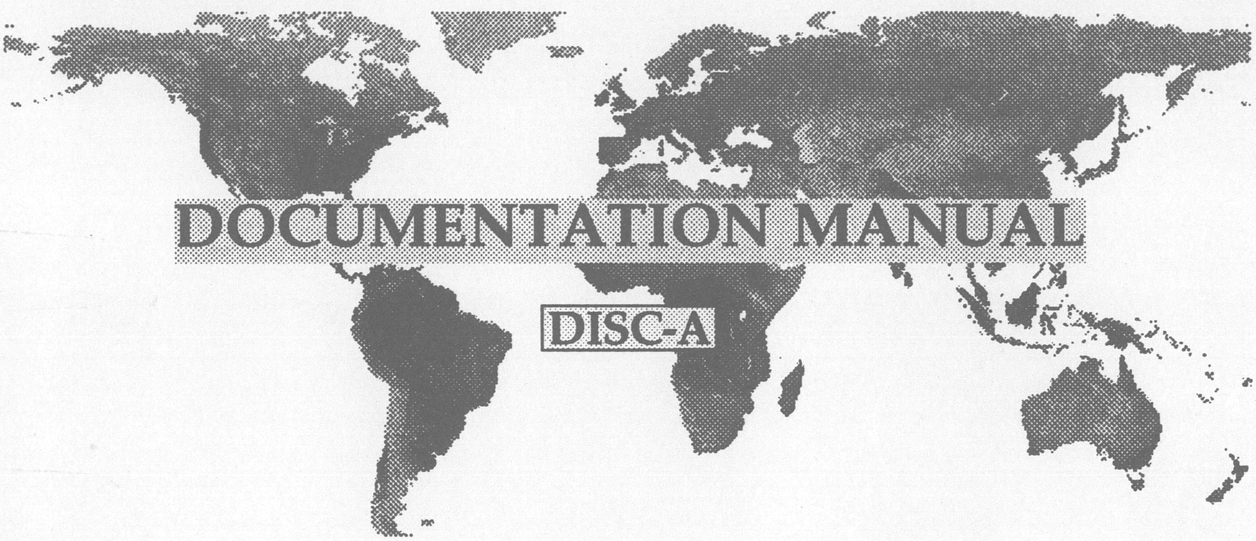
GLOBAL ECOSYSTEMS DATABASE

Version 1.0 (on CD-ROM)

EPA Global Climate Research Program
NOAA/NGDC Global Change Database Program



EPA/600/R-92/194b
NGDC Key to Geophysical Records Documentation No. 27
Incorporated in: *Global Change Database - Volume 1*

U.S. Environmental Protection Agency
Environmental Research Laboratory
Corvallis, Oregon

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Geophysical Data Center and
World Data Center A for Solid Earth Geophysics
Boulder, Colorado

GLOBAL ECOSYSTEMS DATABASE
Version 1.0 (on CD-ROM)

EPA Global Climate Research Program
NOAA/NGDC Global Change Database Program

DOCUMENTATION MANUAL
DISC-A

EPA/600/R-92/194b
NGDC Key to Geophysical Records Documentation No. 27
Incorporated in: *Global Change Database, Volume 1*

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and
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(with contributions as noted)

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(with corrections through September, 1992)

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Disclaimer

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GED Materials Checklist

Please confirm that you have a complete set of materials that comprise the Global Ecosystems Database. These are:

1. User's Guide (June 1992)
2. GED Version 1.0, CD-ROM Disc A (June, 1992)
3. Disc-A Documentation Manual (June, 1992)
4. DOS Access and Exploration Software (floppy disk), Version 1.0
5. IDRISI-Explorer Technical Reference Manual, Version 1.0

Also available on request:

1. IDRISI 3.0 Headers (supplemental floppy disk)
2. GRASS 4.0 Headers (supplemental floppy disk)
3. Project 3-ring binder

As of this printing, Disc B of GED Version 1.0 was in preparation for pre-release review, and scheduled for public availability December, 1992. Please contact NGDC for information on the content and availability of Disc B or subsequent additions.

Technical memoranda about the database may be issued on occasion. In addition there is an electronic bulletin board for communications about the Global Ecosystems Database Project and peer-review. Contact NGDC for information about electronic bulletin-board and on-line data services.

Citing These Materials

This database and documentation may be cited as a complete set as follows:

NOAA-EPA Global Ecosystems Database Project. 1992. *Global Ecosystems Database Version 1.0.* User's Guide, Documentation, Reprints, and Digital Data on CD-ROM. USDOC/NOAA National Geophysical Data Center, Boulder, CO.

The manuals may be cited individually, as follows:

Kineman, J.J. 1992. *Global Ecosystems Database Version 1.0, User's Guide. Key to Geophysical Records Documentation No. 26.* USDOC/NOAA National Geophysical Data Center, Boulder, CO. 121p.

Kineman, J.J., M.A. Ohrenschall, et al. 1992. *Global Ecosystems Database Version 1.0: Disc A, Documentation Manual. Key to Geophysical Records Documentation No. 27.* USDOC/NOAA National Geophysical Data Center, Boulder, CO. 240p.

You may also cite the individual data-sets themselves. The recommended citation for each data-set is given in the DATA-SET DESCRIPTION section of each chapter in the appropriate *Documentation Manual* for a given CD-ROM disc. Literature citations are also provided in that section.

System Requirements

The Global Ecosystems Database was designed for maximum platform independence using a standard ISO 9660 CD-ROM format and relatively generic file formats. All data files use common data types that are accessible at the operating system level. Nevertheless, there is no universal standard for all systems.

Version 1.0 of the database is structured for compatibility with the IBM-PC/DOS environment. DOS executable software is provided with the CD-ROM on an accompanying floppy disk (but is not required to access the data files). The software provides many convenient exploration functions for DOS users, plus export capabilities for UNIX systems. Direct access from other operating systems is possible, but may require conversion of data storage types for correct numerical interpretation.

The software provided on floppy disk requires an IBM-PC compatible computer running IBM-DOS, MS-DOS, or DR-DOS, with at least 256K of memory and EGA, VGA, or 8514A graphics (IBM 8514A compatible graphics is required for 256 color display). For optimal performance, an Intel 80286, 80386, 80486 or compatible processor with 640K of memory and a graphics accelerator card is recommended. A CD-ROM reader is required to access the disc. Since data access is slow from CD-ROM readers, adequate disk space to download portions of the database is desirable. Various printers are supported.

Technical Support

NGDC staff are available to assist with inquiries about data and software availability, and with any technical problems concerning data obtained directly from NGDC. While project resources do not allow extensive user support for the implementation and use of this database or software systems, NGDC staff are always willing to share their knowledge. Where more extensive services are needed, NGDC staff may be able to refer your inquiry to an appropriate source. Please use the following address for contact regarding this project and it's products:

Global Ecosystems Database Project
National Geophysical Data Center
325 Broadway E/GC1
Boulder, Colorado 80303
Phone: (303) 497-6125
Fax: (303) 497-6513
EMAIL: info@mail.ngdc.noaa.gov

Preface

The US Environmental Protection Agency (EPA), Environmental Research Laboratory - Corvallis, Oregon (ERL-C), established an Interagency Agreement with the US National Oceanic and Atmospheric Administration (NOAA), National Geophysical Data Center (NGDC) in September 1990. This agreement began a five year cooperative effort to develop a geographic database for modeling terrestrial climate-biosphere interactions in support of EPA's Global Climate Research Program. Although performing specific tasks under contract to the US EPA, NGDC independently operates a Global Change Database Program (GCDP) as part of its NOAA mission. Considerable synergism therefore exists between the tasks performed for the EPA under the "Global Ecosystems Database Project," and other activities supporting NOAA Climate and Global Change Program.

Within this contract the following cooperative goals have been established:

- Assemble and distribute periodic updates of the database in answer to EPA needs assessments, incorporating existing data and priority data developments, compiling appropriate and complete documentation, providing quality assurance and quality control, and ensuring adequate scientific review.

- Assess the data needs for global change modeling and research, and determine future directions for database and software systems developments.

- Pursue cooperative linkages and exchanges with parallel national and international global change database activities.

Because this database was constructed from many pre-existing data sources of varying quality; errors and omissions can be expected. All data are provided for experimental use, and to initiate a process of evaluation and improvement. Caution is advised when applying these data and computer programs. Users should make special note of limitations mentioned in the *Documentation Manual* and peer-reviews published in the *User's Guide*. For example, problems are endemic in the use of uncorrected Normalized Difference Vegetation Index (NDVI), such as the NOAA Global Vegetation Index (GVI), for time-series analysis, and suitable corrections are still being researched. This and similar issues associated with the various data-sets should be the focus of initial study, along with consideration of potential methods for intercomparison (referring here to comparisons between different data-sets), validation, and empirical calibration using Geographic Information System (GIS) tools and multi-thematic analysis.

INTRODUCTION

This *Documentation Manual* contains descriptive information about each data-set and exact file descriptions for each element in the data-set. The data-set descriptions are structured according to a precise template that is described in detail below (DOCUMENTATION TEMPLATE DEFINITIONS). The Data-Set Description provides an in-depth identification and tracking of the data-set and its technical properties, and gives key references for the data-set. At the end of this description is a summary of any Data Integration and Quality work associated with the project. Such work may range from simple format conversion to complicated re-structuring, interpolation, and testing.

A *User's Guide* is provided as a separate document, giving a complete description of the overall project, including management, research, development, and review procedures that support the integration and improvement of this database, details of the Database Structure, Organization of the CD-ROM, information on use with Geographic Information Systems (GIS), as well as information on links between the database and global change characterization and modeling.

In addition to their printed versions, the *User's Guide* and *Documentation Manuals* are provided in computer-readable form (bit-mapped image format) on the CD-ROMs. ***Reprints*** of the Primary References, including published journal articles, if applicable, are provided separately from the *Documentation Manual* as scanned image files on the CD-ROM. Reprints are assembled from available reports and publications, with permission from the authors and publishers. Only materials that are directly relevant to documenting the data-sets are reproduced. (see User's Guide).

The user should be aware that documentation provided with the source data (i.e., the data-set received for use in this project), and reproduced in the Reprints, may contain references to other formats and media, such as tape formats, which are not relevant to this version of the data-set. In all cases, the user should refer to the formatted Data-set Description and Data File Description sections for each data-set of the *Documentation Manual* (at the beginning of each data-set chapter), and the Database Structure section of the *User's Guide*, for information on data structure and format.

The quality of reproduction of the scanned articles cannot match that of the rest of the manual. The on-line (digital) scanned images are scaled at a low resolution for convenient screen display, and are not intended for duplication in printed form. Higher resolution scanned images are provided for those pages that may be hard to read due to small print or a poor quality original (see the Access and Exploration section in the *User's Guide* for software instructions).

Finally there is also an ***IDRIX Technical Reference Manual*** that accompanies the distribution software developed by Clark University. The IDRIX software provides basic access and exploration capabilities with the database using GIS structures and concepts, and serves as a link with the broader GIS and Global Change community. The IDRIX manual is provided in bit-mapped image format (in addition to it's printed form) on the software floppy disk. It provides detailed descriptions of the software functions and operations available in IDRIX, many of which are extracts from IDRISI.

This database is meant to evolve with the help of its users. Thus, it is important that we obtain feedback for the next revision. Response forms are provided separately for this purpose. Information about user requirements for data of unknown availability may factor into future data development or acquisition plans. An application form is available for those who wish to be reviewers for the database during the lifetime of the project (through 1995). Selection is based on representing an overall balance of disciplines and applications, as well as prominence in global change research. Reviewers receive all project materials and updates at no cost, and review comments are summarized in the *User's Guide*. The number of reviewers will be limited to approximately 100 for each year's review cycle.

The price of this database, as distributed from NGDC, is determined by U.S. Government policy and requirements for cost recovery. Some organizations may qualify for no-cost distribution. Also, NGDC maintains a policy of data exchange, whereby no-cost distribution may be approved in exchange for useful data contributions or other collaborative agreements. All data and materials (with the exception of scanned journal articles and third-party software) are in the public domain, in accordance with government policy.

DATA-SET DESCRIPTION

Each data-set has its own chapter in the documentation. These chapters include relevant information provided by the contributor or other information sources. At the beginning of each chapter there is a structured Data-Set Description that provides a **Data-Set Name**, and summary information about the **Source, Original Design, Integrated Data-Set, Primary References,** and **Additional References**; and lists of the **Data-Set Files, Reprint Files,** and **Source File Examples** (if provided), for each data-set, exactly as the files appear on the CD-ROM. The purpose of this section is to describe everything that comprises the complete data-set as provided here, including key documentation references; and to give technical and statistical information about the data structure.

The information categories in the **DATA-SET DESCRIPTIONs** are defined as follows:

Data-Set Name: Name of the data-set as provided and documented in the GED. The same name appears in the Table of Contents and data-set chapter title, although preceded by the Principal Investigator and Analyst (if appropriate). The format of the chapter titles is {PI} and {data-set name} in italics, preceded by the analysts' names, if the data have been significantly reworked.

Principal Investigator(s): The principal scientist(s) responsible for the actual numerical or classed data values represented in the data-set, and/or the principal institution, if relevant.

SOURCE

This section refers to the source data-set acquired for this project, documentation references, and the full lineage prior to integration into the GED. This information clearly identifies the version of the data used and gives proper citation of the actual numerical data (regardless of format, media, etc.) and its principal investigators.

Source Data Citation: Citation of the particular data-set used as a source in the GED. This is not a literature reference, but a citation of the source version of the digital data-set. The format of this citation is: {Principal Investigator}. {Availability date}. {Data-set description or name, including geographic and temporal coverage}. {"Digital" or "Analog"} {type, e.g., "Raster," "Vector," "Map," etc.} Data on a {cell size, if standard} {projection, e.g., "Geographic (lat/long)"} {grid dimension} grid. {City, State}: {Institution /publisher}. {number of files} on {media}, {size}. For example:

NCDC Satellite Data Services Division. 1985-1988.

Weekly Plate Carreé (uncalibrated) Global Vegetation Index Product from NOAA-9 (APR 1985 - DEC 1988). Digital Raster Data on a Geographic (lat/long) 904x2500 grid. Washington DC: NOAA National Climatic Data Center. 199 files on five 9-track tapes, 425MB.

Contributor(s): Person(s) or institution responsible for disposition of the data, and for releasing the data into the public domain. In most cases this will be the PI, however in some cases data have corporate or institutional ownership prior to release, or are released through an indirect route. This field also provides contact information, if available.

Distributor(s): Data or research center(s) with official responsibility for distributing earlier versions of the data-set, up to and including the source used for the GED. To work cooperatively with other distribution centers, NGDC will refer requests for source data to these official distribution points. Information for each of the institution abbreviations referenced in this field follows this section.

Vintage: The approximate date(s) of the project (digitizing work) creating the data-set represented in the current release. This will precede the publication date and may be later than the period of the data. Also notes continuing projects.

Lineage: Chronological list of the previous versions of the data-set from the original data up to the source version used for the GED (i.e., does not include integration into the GED, which is described in the next section). Sufficient information should be given to identify the previous versions and their source.

ORIGINAL DESIGN

This section refers to the nature of the data before integration into the global database structure. This is important information when considering the reliability and potential application of the data-set to new problems, perhaps not foreseen by the original investigators. It is also useful for those who wish to track back to the original data for quality control or verification purposes, or to compare with the integrated form of the data, which may bear changes that are important for a given application.

Variables: The specific environmental/thematic measurements included in the data-set, the units used, and the numerical or class precision (class precision is a qualitative or descriptive indicator, e.g., "species", "major types", "primary/secondary classes", etc.)

Origin: Description of instrument, data sources, and/or method of original investigation or observation.

Geographic Reference: The coordinate system or projection, and projection parameters (i.e., grid orientation, origin, central meridian, zone, etc.), for the original data-set.

Geographic Coverage: The geographical limits covered by the data-set.

Geographic Sampling: The original spatial interval or sampling resolution of the data, the type of spatial object, and the numerical statistic (i.e. Vector point, line, or polygon unit with various attributes; or Grid point sample, cell average, mode, etc.).

Time Period: The time period represented in the data-set. In the case of time series, this indicates the beginning and ending of the data series. In the case of long-term averages, this field indicates the period from which data were combined.

Temporal Sampling: The original time interval or sampling resolution of the data and the type of statistic (i.e. discrete sample, peak values, running average, typical or average period, etc.).

INTEGRATED DATA-SET

This section describes the integrated version of the data-set, as provided by this project on CD-ROM. While every attempt has been made to preserve the full content and nature of the original data, some alterations may have been necessary to achieve a common structure and geographic registration. For raster data, this may involve interpolation to one of the conventional "nested" grids, or various forms of re-registration of the grid, or perhaps both. To aid in assessing the appropriateness or accuracy of interpolation methods, all interpolated data-sets have corresponding examples of the original form of the data in the SOURCE directory. The original grid representation is clearly documented in the preceding section (Original Design), and interpolation methods are indicated in this section (Data Integration). The user must understand that values represented on a new grid still retain the statistical meaning from their original grid. The information provided here is thus important for proper interpretation and use of the data-sets.

Data-Set Citation: The recommended way of referring to the integrated data-set as published in the GED. This is not a literature reference, but a unique citation for the digital data-set that distinguishes it from other versions, including the source. The format is: {Principal Investigator}. {current publication date}. {*data-set name*, including geographic and temporal coverage}. "Digital {type, e.g., "Raster," or "Vector"} Data on a {cell size, if standard} {projection, e.g., "Geographic (lat/long)"} {grid dimension} grid. In: *Global Ecosystems Database Version 1.0: Disc {disc number}*, Boulder CO: NOAA National Geophysical Data Center. {number of independent spatial layers and attributes} on {media}, {size}. [first published in ...] For example:

> NGDC. 1992. *Monthly Generalized Global Vegetation Index from NESDIS NOAA-9 weekly GVI Data (APR 1985 - DEC 1988).* Digital Raster Data on a 10-minute Geographic (lat/long) 1080x2160 grid. In: *Global Ecosystems Database Version 1.0: Disc A.* Boulder, CO: NOAA National Geophysical Data Center. 45 independent and 24 derived single-attribute spatial layers on CD-ROM. 190MB. [first published in 1989]

Analyst(s): Individual(s) responsible for the data processing and integration methods resulting in the integrated form of the data-set provided here.

Projection: The coordinate system or projection, and projection parameters (i.e., grid orientation, origin, central meridian, zone, etc.), for the integrated data-set.

Spatial Representation: The spatial interval (between grid or vector values) and other spatial characteristics of the integrated version of the data-set, including the type of spatial object, and the numerical statistic (i.e. vector point, line, or polygon unit with various attributes; or Grid point sample, cell average, mode, etc.). This may differ from the original sampling design due to registration differences or aggregation from finer resolution into a standard grid dimension. If re-sampling was performed, this field indicates the method used.

Temporal Representation: The time step and other temporal characteristics of the integrated version of the data-set. This may differ from the original sampling design due to phase differences or aggregation from finer intervals into standard time sequences. If temporal re-sampling was performed, this field indicates the method used.

Data Representation: The form of representing the data values in the integrated data-set, including any numerical type conversion or re-classification that was performed. Usually this will involve only type conversions, although occasionally actual numerical changes may have been necessary. The units and precision are also indicated (e.g., "Real numbers expressed to .001 inches/month," or "Byte integers representing units of 0.1 degree," or "Two-byte integers representing units of meters above sea-level, rounded to the nearest 30 meters").

Layers and Attributes: Spatial Layers and Attributes. The number of geographically different data layers (i.e., independently distributed spatial data layers) represented, and the number of associated attributes, regardless of file structure. For example, multiple data mapped on political units may in reality have only one geographic distribution but many attributes.

Compressed Data Volume: The volume in bytes of a compressed version of the data files. This gives a more accurate estimate of scientific information content than actual file sizes that are format dependent and may reflect inefficient storage methods for the sake of access. The volume estimate is obtained using PKZIP (option -es), Version 1.1, a commonly available data compression program.

PRIMARY REFERENCES

This section lists references that are intended to be the primary literature reference for documentation of the data-set. These may include unpublished documents and published articles. The references may be divided into sub-categories relating to the various data-set elements. One of the goals of this compilation is to provide reprints of all Primary References in addition to this manual. Due to availability and copyright restrictions, however, some documents may not have been available at the time of publication. Articles that are labeled with an asterisk (*) are reproduced as scanned image-files (in PCX format) on the CD-ROM.

[sub-categories] The primary published or unpublished document(s) associated with the production or release of the data. If a literature publication, the article is one that was intended as documentation, and which may or may not describe related research. A copy of the primary reference is provided with this manual. Published articles are provided in scanned (bit-mapped) digital image format, to ensure accurate reproduction.

ADDITIONAL REFERENCES

This section lists key references to the nature and/or application of the database, or other information that may be especially useful to the user. The references may be divided into sub-categories relating to the various data-set elements.

[sub-categories] References to key publications that are relevant to the nature or use of the data-set.

DATA-SET FILES

This section lists the location, names, number, and sizes of all the digital files that comprise the complete data-set, as provided on the CD-ROM. This information is divided into the following file categories:

Spatial Data:	spatially distributed data files (*.IMG and *.VEC)
Attribute Data:	tabular ("values") files (*.VAL)
Headers:	ascii header ("document") files (*.DOC, *.DVC, and *.DVL)
Palettes:	Color palette assignment files (*.PAL)
Time Series:	Time series files (*.TS)
Disk Volume:	Total size of all data-set files on disk, in bytes.

REPRINT FILES

A complete listing of all bit-mapped (scanned) image files of previously published documentation articles. These files are provided in PCX format for users who have appropriate software to display them. They are the full-resolution digital versions of the documentation articles that appear in the individual Data-Set chapters in the printed and digital versions of the *Documentation Manual*. Each file contains one page of the scanned article.

SOURCE EXAMPLE FILES

Listing of all source data files provided as examples for comparison and experimentation. Some data-sets required changes, such as re-gridding, to fully integrate them with the database. Although the integration methods are described, these example source files can be used to verify the results, or to test other methods. The location, names, number, and sizes of all files is given.

DATA FILE DESCRIPTION

The **Data File Description** section refers to the actual data files (after processing) that are included in the database, providing technical information contained in the ASCII header files stored under the META sub-directory on the CD-ROM. Each element of the database (i.e., unique spatial-temporal variable or theme) contains data file-pairs, or a series of file-pairs, each consisting of a spatial data file and its corresponding header file. For *Raster* (i.e., 'image') data, these have the file extensions ".IMG" and ".DOC" respectively. *Vector* data and header file extensions are ".VEC" and ".DVC" respectively. A data element may include *Attribute* data for re-classing or re-labeling the data file. Attribute data files and their corresponding header file extensions are ".VAL" and ".DVL" respectively. A data element may also contain color palette (".PAL") files, and time-series (".TS") files.

Version 1.0 of the database employs the Idrisi 4.0 file structure that was jointly developed with Clark University (described in section IV of the *User's Guide,* in the section titled *Database Structure*). Other formats can be produced from these files using the accompanying conversion software or user-developed programs.

The file descriptions are organized as indicated below. To avoid redundancy in the file descriptions, only the first header of a series is shown, followed by a table of "series parameters" that show only what changes through the series.

DATA ELEMENT: The variable or theme represented in this part of the data-set, and the units used.

STRUCTURE: Raster or Vector topology (e.g., nested grid-cell or grid-point, arc/node vector-line, etc.)

SERIES: Number and type of data series (e.g., "45 month time-series", etc.)

SPATIAL DATA FILES: Description of the raster or vector data files, as provided in the raster or vector header file, or first header file from a series, exactly as it appears in the META directory on the CD-ROM, including legends. If a series, the header file example will be followed by a table of Series Parameters, showing all parameters that change in the multiple header files of a data file series (e.g., titles, min/max values, etc.).

ATTRIBUTE DATA FILES: Description of attribute data files, as provided in the header file associated with an attribute (i.e., tabular 'values') file, as represented on the CD-ROM, including legends. As above, multiple files may be represented with a table showing only those parameters that are different from the example file.

NOTES: Any notes or additional information for the data element, for example notes about any color "palette" files or time-series files included with the data-set.

DATA INTEGRATION AND QUALITY

This section provides a narrative description of methods and significant procedures used in the integration process, such as re-gridding, re-projecting, registration changes, temporal compositing, etc. In general, as little change as possible is made from the original data; however, to achieve comparable data structures from source data with unstandardized formats, changes are necessary for some data-sets. The philosophy of long-term development, as conventions become established, is that major changes should be performed by the original investigators, if possible. This section also includes any information on data quality issues as a result of quality assessment work.

DEFINITION OF TERMS

Accuracy	The difference between an indicated value and its true value in nature. In practice, accuracy must be estimated through some empirical method; however, it is poorly known for most of the global data-sets. Accuracy should not be confused with precision, which may far exceed accuracy in many cases.
Attribute	Used here to denote a numerical or descriptive variable used to re-classify or label the geographical objects in an existing spatial data layer. Attributes can be linked to spatial objects in either raster or vector data structures, using a value or a record number in the spatial data layer as the unique link.
Attribute Layer	The portion of a data-set that represents a geographically dependent data layer, as would be produced by assigning new attributes to their corresponding spatial layer. For reasons of convenience in implementing and using the database, attribute layers may be stored as spatial data files (e.g., raster data files) rather than as attribute values files. Nevertheless, the data-set description will refer to independent spatial layers and dependent attributes for the purposes of documentation.
Bit	Refers to a "binary digit", stored as a 0 or 1 in a computer data file.
Byte	A sequence of 8 bits, which are read as a unit.
Cell	Used synonymously with "pixel" and "raster" to denote the spatial unit of assigned values in a regularly spaced (systematic) spatial grid. See "Raster."
Characterization	Used to denote the process of data integration, derivation, and synthesis with appropriate statistical design, for the purpose of constructing numerical descriptions of environmental or ecological factors that have been identified as key variables for modeling. The database and software system that provides these capabilities may be referred to as an "adaptive characterization database." (See Appendix A of the *User's Guide*)
Database	Used here to denote an integrated assemblage of data-sets, in a common structure and format which can be uniformly accessed by a single system, and which employs common conventions for interpreting geographic objects and data values.
Data Layer	Used here to denote spatially distributed digital (computer) data representing uniquely defined geographical features (i.e., geographical objects), or a continuous distribution (such as a

temperature field) in either raster or vector form as commonly implemented in Geographic Information Systems. GIS layers may be geographically independent, or may represent various attribute assignments on a fixed spatial distribution. For documentation purposes, this term is divided into independent and dependent layers by the terms 'Spatial Layer,' and 'Attribute Layer,' respectively.

Data-set	Used here to denote a single compilation of data by a given Principal Investigator or Institution, usually as a definable project, program, or research output. A data-set may contain many variables, and may extend over may years, but it is defined by theme and investigator.
Element	Data-set Element refers to a portion of a data-set that has a uniquely defined spatial-temporal theme. For example, a data-set element of the monthly GVI data may contain 45 spatial arrays (and header files) representing one variable over time, whereas a vector polygon file (a single spatial distribution) and its corresponding attribute table containing many variables, may also be a single data-set element.
Geographic	Aside from the common usage, 'Geographic' is also the specific name for the Latitude/Longitude coordinate system (i.e., map projection), sometimes referred to as 'unprojected.' It is also the same as plate carreé, although plate carreé may be used to refer to a specific grid.
Grid	Used to denote the entire assemblage of raster/cell/pixel values within a data-set. The "edges" of the grid correspond to the edges of the outermost cells.
Gridding	Used to denote the process of producing a uniform raster "grid" from another grid or randomly spaced distribution using appropriate interpolation methods (see interpolation).
Interpolation	A process of deriving an estimated value from surrounding known or indicated values that are at a different spatial or temporal location. Many interpolation methods exist, including multi-directional linear and other forms of averaging, various mathematical curve fitting, statistical surfaces, etc. The appropriate method of interpolation must be determined for each data-set and application, considering experimental design.
Lat/Long	A Latitude/Longitude coordinate system, or 'projection,' defined in degrees, minutes, and seconds of arc along polar meridians of longitude and equatorial parallels of latitude. Latitude increments are equi-distance intervals (1 minute of latitude = 1 nautical mile),

whereas the true distance between longitude meridians varies from equator to pole due to the convergence of the meridians at the pole.

Layer	(1) A logical separation of map information according to theme. See 'Data Layer.' (2) Used in context most often to refer to 'Spatial Data Layer," in contrast to 'Attributes' or 'Attribute Data Layers.'
Line	Used here to denote a series of points theoretically connected by the spatial vectors between them, and stored in a vector data structure.
Map	Commonly used to refer to a hand-drawn or printed geographical display, but also used to refer to a GIS data layer and digital cartographic files. Because of its varied meanings, which go beyond simple data representation, the term is avoided here, using instead the term "Data layer" to refer to the digital 'maps' in the database.
Modeling	See appendix A of the *User's Guide*.
Nested Grid	A convention adopted for this project whereby all raster data are represented on grids that are commonly edge-matched and are integer multiples of each other. This convention allows the following raster cell sizes in a latitude/longitude coordinate system: 2-degree, 1-degree, .5-degree, 10-minute, 5-minute, 1-minute, 30-second.
Pixel	Used synonymously with "cell" and "raster" to denote the spatial unit of assigned values in a regularly spaced (systematic) spatial grid. See "Raster."
Plate Carreé	A map projection in Latitude/Longitude (i.e., 'Geographic') coordinates. Sometimes used to refer to a specific grid (as in the case of the NOAA GVI source data).
Point	Used here to denote a data value located by geographic coordinates and stored in a vector data structure.
Polygon	Used here to denote a series of points theoretically connected by the spatial vectors between them, and enclosing a single geographic region that is labeled with a data value and may also be linked by that value to a table of other "attribute" values.
Precision	Usage in this document is "numerical" precision as opposed to "experimental" precision. It is the degree of significance to which numerical values are expressed in the data-set, and is contrasted with accuracy. In reference to class definitions, it is taken to mean the level of detail to which classes are divided (in qualitative terms), e.g., species, communities, major ecosystems, etc. It is reported as the smallest significant unit expressed in the actual numerical or

class values of the data-set. "Experimental" precision, on the other hand, would be the expressed as the standard deviation of a set of measurements taken during the original data collection experiment (generally not well documented for most data-sets). Without better documentation, one must assume that the numerical precision chosen by the original investigator in some way represents the experimental precision, but often this is not the case.

Quality Assessment — This term is used to refer to specific tests performed on the data-sets in the project, to determine their quality. It is part of Quality Assurance plan (see User's Guide for definitions). It is distinguished from Quality Control (see User's Guide for definition) because it is a parallel activity to the core work of integrating existing data-sets. Results of quality assessment on specific data-sets is reported in the DATA INTEGRATION AND QUALITY section of the data-set documentation chapter, to the extent that information is available. In addition to results of studies within the project itself, significant information from users and reviewers may also be included.

Raster — Used synonymously with "pixel" and "cell" to denote the spatial unit of assigned values in a regularly spaced (systematic) spatial grid. A Raster data structure may also be used to represent regularly spaced point values, in which case it is assumed that the points are located at the centroid of the raster cell.

Spatial Layer — Also, 'Spatial Data Layer.' Used here to refer to the portion of a data-set that represents an <u>independent</u> spatial distribution of data. For example, remote-sensing images will contain independently distributed data by their nature, whereas a classified raster or vector array may be accompanied with multiple class definitions (attributes values) for a single distribution of geographical objects (e.g., as in choropleth mapping with multiple attributes). Note that when used in the restrictive sense of independent data layers, this refers to the character of the data, not necessarily the way files are actually organized.

Spatial Data File — Used here to refer to a numerical (computer) data file that contains spatially distributed data in the documented GED data structure. These are not necessarily geographically independent data layers, but refer to data files as specifically stored in the database (in some cases multiple attributes may be stored as multiple spatial data files for convenience only, even though they are merely re-classifications of a single spatial layer).

Resolution — Used to denote the instrumental resolution, or actual sample spacing of a data-set. The term resolution is potentially confused with "ground resolution," which is the minimum size of a spatially isolated object that can be accurately resolved in a given data-set (generally 3 to 4 pixels in a satellite image). Another kind of resolution can be described as "detectibility" or "acuity," for example the ability to detect a road or high emission rate in a satellite image can sometimes be at a sub-pixel level, owing to spatial association or anomalously high signal strength.

Vector

Used to denote a spatial object type that is commonly defined in Geographic Information Systems to include point locations, lines represented by a series of points connected by the vectors between them, and the perimeter of areas, also represented by a series of points connected by their spatial vectors. Vector data may also include topological assumptions about the relationship between various spatial objects. It is common to associate a vector data layer with multiple attributes (values and descriptors) in a separate attribute file. Combined vector types such as "arc-node," where line or polygon data are combined with intersection, or "node" points, are also common because of their topological usefulness.

ABBREVIATIONS AND ACRONYMS

DATA CENTERS

The following abbreviations are used in this volume to identify centers from which source data may be obtained. These abbreviations are defined below:

CDIAC	Carbon Dioxide Information Analysis Center Oak Ridge National Laboratory P.O. Box 2008 Oak Ridge, TN 37831-6335, USA
EDC	EROS Data Center US Geological Survey Sioux Falls, South Dakota 57198, USA
GISS	Goddard Institute of Space Studies NASA Goddard Space Flight Center 2880 Broadway New York, NY 10025, USA
GRID/Geneva	Global Resource Information Database Global Environment Monitoring System United Nations Environment Program 6 Rue de la Gabelle CH-1227 Carouge, Switzerland
GRID/Nairobi	Global Resource Information Database Global Environment Monitoring System United Nations Environment Program P.O. Box 30552 Nairobi, Kenya
IIASA	International Institute for Applied Systems Analysis A-2361 Laxenburg, Austria
NCAR	National Center for Atmospheric Research P.O. Box 3000 Boulder, Colorado 80307, USA
NCDC	National Climatic Data Center/NESDIS National Oceanic and Atmospheric Administration Federal Building Asheville, NC 28801, USA

NGDC	National Geophysical Data Center National Oceanic and Atmospheric Administration 325 Broadway E/GC Boulder, Colorado 80303, USA
RIVM	RIjksinstituut voor Vouksgezondheid en Milieuhygiene National Institute of Public Health and Environmental Protection P.O. Box 1 3720 Bilthoven, The Netherlands
SDSD	Satellite Data Services Division, National Climatic Data Center/NESDIS National Oceanic and Atmospheric Administration Code E/CC6 Washington, DC 20233, USA
WDC	World Data Centers International Council of Scientific Unions (see associated national data centers) For information, contact: Chairman, ICSU Panel on World Data Centers University Corporation for Atmospheric Research P.O. Box 3000 Boulder, CO 80307-3000, USA

OTHER ACRONYMS

CIA	Central Intelligence Agency, USA
DMA	Defense Mapping Agency, USA
ESRI	Environmental Systems Research Institute, Inc., Redlands, California, USA
FAO	United Nations Food and Agriculture Organization
NESDIS	National Environmental Satellite Data and Information Service, USA
NOAA	National Oceanic and Atmospheric Administration, USA
UNEP	United Nations Environment Programme
UNESCO	United Nations Education Scientific and Cultural Organization
USAF	United States Air Force
USN/FNOC	United States Navy, Fleet Numeric Oceanographic Center
USNOO	United States Naval Oceanographic Office

A01

NGDC *Monthly Generalized Global Vegetation Index from NESDIS NOAA-9 Weekly GVI Data (APR 1985--DEC 1988)*

DATA-SET DESCRIPTION

DATA-SET NAME: ***Monthly Generalized Global Vegetation Index from NESDIS NOAA-9 Weekly GVI Data (April 1985 - December 1988)***

PRINCIPAL INVESTIGATOR(s): **NOAA National Environmental Satellite, Data, and Information Service (NESDIS)**

SOURCE

SOURCE DATA CITATION: NCDC Satellite Data Services Division. 1985-1988. Weekly Plate Carreé (uncalibrated) Global Vegetation Index Product from NOAA-9 (APR 1985 - DEC 1988). Digital Raster Data on a Geographic (lat/long) 904x2500 grid. Washington DC: NOAA National Climatic Data Center. 199 files on five 9-track tapes, 425MB.

CONTRIBUTOR(s):

National Climatic Data Center (NCDC)
Satellite Data Services Division (SDSD)
National Environmental Satellite, Data, and Information Service
SDSD, World Weather Building, Rm. 100
Washington, DC 20233, USA
(301) 763-8400

DISTRIBUTOR(s): SDSD (see Data Center Codes for address)

VINTAGE: 1985-1988 (switched to NOAA-11 in 1989, continuous operational products)

LINEAGE:

(1) NOAA-9 Satellite, AVHRR sensor array and on-board storage
(2) Global Plate Carreé weekly GVI product
NOAA/NESDIS/NCDC Satellite Data Services Division
Washington, DC

ORIGINAL DESIGN

VARIABLES: Scaled, Uncalibrated Weekly Maximum Normalized Difference Vegetation Index (cloud effects screened by 7-day maximizing procedure, but no other corrections for atmospheric effects or pixel-to-pixel variation in look and sun angles).

ORIGIN: NOAA-9 Polar Orbiting Satellite, Advanced Very High Resolution Radiometer "Global Area Coverage" (AVHRR/GAC) (see Primary Documentation)

GEOGRAPHIC REFERENCE: Plate Carreé (Latitude/Longitude)

GEOGRAPHIC COVERAGE: Global

Maximum Latitude : +75 degrees (N)
Minimum Latitude : -55 degrees (S)
Maximum Longitude : +180 degrees (E)
Minimum Longitude : -180 degrees (W)

GEOGRAPHIC SAMPLING: Last ("random") element of each 4x4 array of GAC (4km) values, mapped onto a 904x2500 Global Plate Carreé (lat/long) grid. GAC values are 1x4km averages (along scan-line) of sampled values within each 4x4 array of 1km cells. Look-angle varies between pixels due to temporal compositing.

TIME PERIOD: April 1985 - December 1988

TEMPORAL SAMPLING: 7-day weekly maximum of daily values. Time of day varies between pixels.

INTEGRATED DATA-SET

DATA-SET CITATION: NGDC. 1992. Monthly Generalized Global Vegetation Index from NESDIS NOAA-9 Weekly GVI Data (APR 1985 - DEC 1988). Digital Raster Data on a 10-minute Geographic (lat/long) 1080x2160 grid. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 45 independent and 24 derived single-attribute spatial layers on CD-ROM, 190MB.

ANALYST(s): John J. Kineman and David A. Hastings

PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).

SPATIAL REPRESENTATION: 10-minute grid aggregating 2-4 (weekly) GVI Plate Carreé values (see original sampling), and interpolating from 8.6 minute to 10-minute grid cells by area-weighted average.

TEMPORAL REPRESENTATION: Monthly RMS averages of 2-4 weekly samples

DATA REPRESENTATION: Uncalibrated single-byte integer (0 to 255) values, representing an RMS average of median weekly GVI values, with spatial smoothing (high=>vegetation). The averaging procedure screens random "noise" and reduces environmental and instrumental variations inherent in the GVI data. It also provides uniform coverage (i.e., no masking), but does not eliminate consistent environmental phenomena (such as persistent clouds).

LAYERS AND ATTRIBUTES: 45 independent and 24 derived single-attribute spatial layers.

COMPRESSED DATA VOLUME: 47,445,363 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

GVI SOURCE DATA:

* Kidwell, K.B (ed.). 1990. *Global Vegetation Index User's Guide.* Washington: USDOC/NOAA National Climatic Data Center, Satellite Data Services Division. 45p.

  NOTE: This paper refers to source tapes of weekly GVI used to produce the data represented in the GED database. It also refers to other forms of the data and other products available from SDSD, which are not represented in the current database. The document is reproduced in its entirety, for completeness.

PRINCIPAL COMPONENTS ANALYSIS:

* Eastman, J.R. 1992. Time series map analysis using standardized principal components. Proceedings, ASPRS/ACSM/RT'92 Convention: Mapping and Monitoring Global Change. Bethesda: ASPRS/ACSM.

  NOTE: The examples in this paper refer to GVI data-sets for Africa that were distributed as part of the IGBP Global Change Database Pilot Project for Africa. These data are identical to the data described here except for their geographic coverage.

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DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	MGV8504.IMG to MGV8812.IMG	45 files	104,976,000
	MGV0001.IMG to MGV0012.IMG	12 files	27,993,600
	MGVC186.IMG to MGVC188.IMG	3 files	13,996,800
	MGVC286.IMG to MGVC288.IMG	3 files	13,996,800
	MGVC386.IMG to MGVC388.IMG	3 files	13,996,800
	MGVC486.IMG to MGVC488.IMG	3 files	13,996,800
Headers:			
\GLGEO\META\	MGV8504.DOC to MGV8812.DOC	45 files	23,091
	MGV0001.DOC to MGV0012.DOC	12 files	7,432
	MGVC186.DOC to MGVC188.DOC	3 files	1,494
	MGVC286.DOC to MGVC288.DOC	3 files	1,491
	MGVC386.DOC to MGVC388.DOC	3 files	1,491
	MGVC486.DOC to MGVC488.DOC	3 files	1,491
Palettes:			
\GLGEO\META\	MGV8.PAL	1 file	4,352
	MGV4.PAL	1 file	272
	MGVC8.PAL	1 file	4,352
Time Series:			
\GLGEO\META\	MGV.TS	1 file	411
	MGV00.TS	1 file	114
Volume on Disk:		143 files	189,002,791

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A01\	MGV1_01.PCX to MGV1_53.PCX	53 files	1,253,256
	MGV1_17X.PCX	1 files	93,708
	MGV2_01.PCX to MGV2_10.PCX	10 files	517,211
	MGV2_##X.PCX	5 files	778,338
Volume on Disk:		69 files	2,642,513

SOURCE EXAMPLE FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\SOURCE\RASTER\	GVI8827.IMG to GVI8831.IMG	5 files	11,300,000
Headers:			
\SOURCE\META\	GVI8827.DOC to GVI8831.DOC	5 files	2,593
Volume on Disk:		10 files	11,302,593

DATA ELEMENT: Monthly Generalized GVI (April 1985 - Dec. 1988)

STRUCTURE: Raster Data Files: 10-minute 1080x2160 GED grid (see *User's Guide*)
SERIES: 45 month time-series
SPATIAL DATA FILES:

MGV8504.DOC

```
file title   : April 1985 Generalized Global Vegetation Index
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : 0
max. value   : 192
value units  : uncalibrated
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

File Series Parameters:

File	Month	Year	Minimum	Maximum
MGV8504	April	1985	0	192
MGV8505	May	1985	0	209
MGV8506	June	1985	0	216
MGV8507	July	1985	0	226
MGV8508	August	1985	0	209
MGV8509	September	1985	0	189
MGV8510	October	1985	0	197
MGV8511	November	1985	0	197
MGV8512	December	1985	0	195
MGV8601	January	1986	0	190
MGV8602	February	1986	0	191
MGV8603	March	1986	0	194
MGV8604	April	1986	0	178
MGV8605	May	1986	0	203
MGV8606	June	1986	0	219
MGV8607	July	1986	0	211
MGV8608	August	1986	0	205
MGV8609	September	1986	0	201
MGV8610	October	1986	0	194
MGV8611	November	1986	0	197

MGV8612	December	1986	0	195
MGV8701	January	1987	0	189
MGV8702	February	1987	0	200
MGV8703	March	1987	0	180
MGV8704	April	1987	0	184
MGV8705	May	1987	0	205
MGV8706	June	1987	0	211
MGV8707	July	1987	0	211
MGV8708	August	1987	0	200
MGV8709	September	1987	0	184
MGV8710	October	1987	0	181
MGV8711	November	1987	0	194
MGV8712	December	1987	0	191
MGV8801	January	1988	0	196
MGV8802	February	1988	0	200
MGV8803	March	1988	0	184
MGV8804	April	1988	0	187
MGV8805	May	1988	0	190
MGV8806	June	1988	0	211
MGV8807	July	1988	0	215
MGV8808	August.	1988	0	189
MGV8809	September	1988	0	174
MGV8810	October	1988	0	166
MGV8811	November	1988	0	213
MGV8812	December	1988	0	218

NOTES:

1. Color palette files are provided for display only. Color assignments are arbitrary.
2. The time-series file (MGV.TS) contains a list of the 45 files for sequential display.
3. See comments in the DATA INTEGRATION section about calibration, variability due to orbital wander, and effects of long-term sensor drift.

DATA ELEMENT: **Characteristic Month Averages from the Monthly Generalized GVI (1986-1988)**

STRUCTURE: Raster Data Files: 10 minute 1080x2160 GED grid (see *User's Guide*)
SERIES: 12 characteristic month time-series
SPATIAL DATA FILES:

MGV0001.DOC

```
file title   : Average January Generalized Global Vegetation Index
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : 0
max. value   : 183
value units  : uncalibrated
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
lineage      : Produced from the following 3 files:
lineage      : GVI8601.IMG, GVI8701.IMG, GVI8801.IMG
```

File Series Parameters:

File	Characteristic Month	Minimum	Maximum
MGV0001	January	0	183
MGV0002	February	0	184
MGV0003	March	0	172
MGV0004	April	0	176
MGV0005	May	0	199
MGV0006	June	0	207
MGV0007	July	0	211
MGV0008	August	0	188
MGV0009	September	0	177
MGV0010	October	0	171
MGV0011	November	0	193
MGV0012	December	0	193

NOTES:

1. Produced by taking the mean of three years for each month

DATA ELEMENT: **Annual Principal Components of the Monthly Generalized GVI for 1986, 1987, and 1988**

STRUCTURE: Raster Data Files: 10 minute 1080x2160 GED grid (see *User's Guide*)
SERIES: 3 year time-series, series of 4 Principal Components for each year
SPATIAL DATA FILES:

MGVC186.DOC

```
file title   : 1986 MGV PCA Component 1
data type    : integer
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/lon
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : -331
max. value   : 1341
value units  : uncalibrated
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

File Series Parameters:

File	Component	Year	Minimum	Maximum
MGVC186	1	1986	-331	1341
MGVC187	1	1987	-495	1404
MGVC188	1	1988	-589	1363
MGVC286	2	1986	-591	554
MGVC287	2	1987	-639	618
MGVC288	2	1988	-700	669
MGVC386	3	1986	-433	345
MGVC387	3	1987	-540	414
MGVC388	3	1988	-605	663
MGVC486	4	1986	-332	400
MGVC487	4	1987	-419	458
MGVC488	4	1988	-513	360

NOTES:

1. Produced using IDRISI's Standardized Principal Components Analysis, on a circum-global window between 55 deg. South and 75 deg. North Latitude.

SOURCE EXAMPLE: NOAA/NCDC Weekly Plate Carreé Global Vegetation Index from NOAA-9 (Samples for July 1988)

STRUCTURE: Raster Data Files: 8.6 minute Plate Carreé 904x2500 grid (non-nested, see *User's Guide*)

SERIES: 5 week time-series for July

SPATIAL DATA FILES:

GVI8827.DOC

```
file title   : June 27 - July 3, 1988 Weekly Global Vegetation Index
data type    : byte
file type    : binary
columns      : 2500
rows         : 904
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -55.0000000
max. Y       : 75.0000000
pos'n error  : unknown
resolution   : 0.1440000
min. value   : 0
max. value   : 255
value units  : uncalibrated
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

File Series Parameters:

File	Year	Week	Minimum	Maximum
GVI8827	1988	27	0	255
GVI8828	1988	28	0	255
GVI8829	1988	29	0	255
GVI8830	1988	30	0	255
GVI8831	1988	31	0	255

NOTES:

1. These source files show data artifacts and minor registration problems that were removed in the monthly compositing (see Integration Methods).

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MONTHLY GENERALIZED GLOBAL VEGETATION INDEX (APRIL 1985 - DECEMBER 1988)

Advanced Very High Resolution Radiometer (AVHRR) data from NOAA Polar Orbiting Environmental Satellites were obtained from the National Environmental Satellite, Data and Information's (NESDIS) Satellite Data Services Division. The data were acquired in NOAA's operational Normalized Difference Vegetation Index (NDVI) "Plate Carreé" (latitude/longitude) weekly image format, and were subsequently converted at the National Geophysical Data Center into 10-minute grids, composited monthly. This new data-set is called the Monthly Generalized Global Vegetation Index (MG-GVI).

The AVHRR spectral bands used for vegetation monitoring are Channel 1, a visible band (0.58 to 0.68m) and Channel 2, a near infrared band (0.73 to 1.0m). Since the spectral reflectance of vegetation is more than three times greater in the reflected infrared than in the visible portion of the spectrum due to leaf structure and chlorophyll absorption in the visible red (CH 1). The difference between the value for Channel 2 and Channel 1 is an indication of the degree to which the sensor "footprint" includes green vegetation. Various mathematical combinations of Channel 1 and 2 data have been found to be sensitive indicators of the presence of green vegetation and are referred to as vegetation indices. Because of the high dependence of these indices on the differential scattering and absorption of red and nearIR bands, they are also dependent on leaf, plant, and canopy structure to a significant degree. Stratified analysis using ancillary land-cover data (along with other empirical calibrations) may thus improve interpretation. It is also known that changes of local time of observation (caused by variation in the satellite orbits), and thus solar azimuth and zenith, cause significant in-homogeneities in the vegetation index, which may be compounded by the weekly compositing procedure (see literature by Gutman, and by Tateishi and Kajiwara, in references above). This phenomena may be somewhat reduced by the averaging process employed for these generalized monthly images, but the resulting variability has not been quantified.

The basic index used by NOAA is the Unscaled Normalized Difference Vegetation Index (XVI), defined by the equation:

$$XVI = (CH2 - Ch1) / (Ch2 + Ch1)$$

For vegetation, the NDVIs range from 0.1m to 0.6m, the higher values being associated with greater density and greenness of the plant canopy. Atmospheric effects, such a scattering and sub-pixel- sized clouds, all act to increase the value of Ch1 with respect to Ch2 and reduce the values of the computed vegetation indices. Maximum values compositing can thus be used as a method for cloud screening over a suitable series of observations.

The normalized index has another advantage for global vegetation monitoring, for it partially compensates for changing illumination conditions, surface slope, and viewing aspect. Clouds, water, and snow have greater reflectance in the visible than in the near infrared, so for these features NDVI values are negative. Rock and bare soil have similar reflectances in the visible and near infrared and this results in vegetation indices near zero.

The data provided by SDSD were scaled as integer values from 0 to 255 according to the formula NDVI = 240-(XVI+0.05)*350 (see Global Vegetation Index User's Guide). In processing, however, the scale was inverted by subtraction from 255, so that high values in the data correspond more intuitively to high vegetation signals (it also avoids mistaking it for other GVI products). Thus the values used in averaging and re-gridding are described by the formula:

$$NDVI = (XVI+0.05)*350 + 15$$

The satellite images were re-sampled from weekly to monthly averages in a series of steps. Two procedures were used to control the quality of these composite images. First, registration accuracy was ensured by alignment of recognizable geographic locations. Second, each weekly composite image was visually inspected for artifacts (i.e., scan lines, orbital swaths, and other noise). If artifacts were visible approximately at the same location in two or more images, only one of those images was used. The remaining artifacts were removed during the monthly composite procedure, which combined all weeks which overlapped the calendar month (thus providing up to one week overlap between months). In this procedure, the high and low weekly values for a given month, for each cell, were eliminated and a root-mean-square average of the remaining weekly "median" cell values was calculated. This technique eliminated random artifacts evident in the weekly data and biased the result toward higher (and presumably more reliable) median values, without forcing the monthly value to its maximum. The images were then re-gridded to a 10-minute grid using a spatially weighted average. The result is therefore a statistic that is presumed to be generally representative of the month's vegetation activity over a partially "smoothed" 10-minute pixel; however, as with any such index, it must be calibrated or classified using additional information. The values were not corrected for orbital parameters or sensor drift.

PROCEDURE FOR DEVELOPING NVI MONTHLY COMPOSITE IMAGES:

Data Source: Weekly Composite Images of 7-day peak values on Global 8.6 minute grids

1. Process weekly images: 2500 cols. x 904 rows (covering 75°N-55°S latitude)
    a. Identify images for each month
    b. Visually inspect images for artifacts
    c. Choose between images in the same month if artifacts overlap
    d. Calculate registration offset (fractional cell offsets)
2. Produce composite monthly images: 2500 cols. x 904 rows
    a. Produce root-mean-square average of selected weekly images for each month, removing high and low values to eliminate remaining artifacts, and applying fractional registration offsets.
3. Re-grid to 10-minute cell size: 2160 cols. x 1080 (Covering 90°N to 90°S latitude)
    a. Resample using a cell-overlap area-weighted linear average
    b. Pad with zeros to the poles

CALIBRATION "DRIFT"

GVI is known to 'drift' over time due to orbital changes (time of passage) and sensor aging. Investigation of the monthly data-set over this time period shows the trend to be increasing linearly with time in low vegetation areas, but is not so evident in the higher vegetation signals (see above). Thus, the desert areas appear (incorrectly) to be increasing in greenness by about 3% per year, whereas highly vegetated areas show little overall change, or perhaps a slight decreasing trend (also an artifact of the drift). If one considers the calibration drift characteristics of the two channels of AVHRR data used to compute the GVI (e.g., Holben, 1990), it can be shown that the NDVI calculation results in a logarithmic curve which, due to the parameters of the linear drift in each sensor, can be closely approximated with a line. The observed drift in these monthly generalized values (plotted over the 45-month time series as an average over Bare Desert regions identified in the Olson data-set - see Chapter A05) agrees well with such prediction based on Holben's calibration drift corrections. This means that empirical correction of this drift in the GVI can be performed after production of the index as well as before, with only a slight loss of accuracy (due to the non-linearity of the NDVI drift, which can be shown to be negligible in this case).

Figure 1, below, shows a time profile of MG-GVI values as described above, comparing spatial averages for the Nile Delta with those for Olson's Bare and Blowing Sand Desert. The regression line for the nile delta is flat, whereas the long-term calibration drift is evident in the desert curve.

Also evident in the 45-month desert profile of the MG-GVI, is an annual dip in these low GVI values. Preliminary research (Dr. Alex Faizoun at LERTS in Toulouse, France) indicates that this dip may be explainable by the annual cycle of atmospheric water content over desert regions, which becomes significant for low GVI values. Both phase and amplitude seem to agree with these preliminary findings for the African Sahel. Atmospheric water vapor may vary differently in different regions, however, and will not have as significant an effect on higher GVI values (simply due to the signal-to-noise ratio).

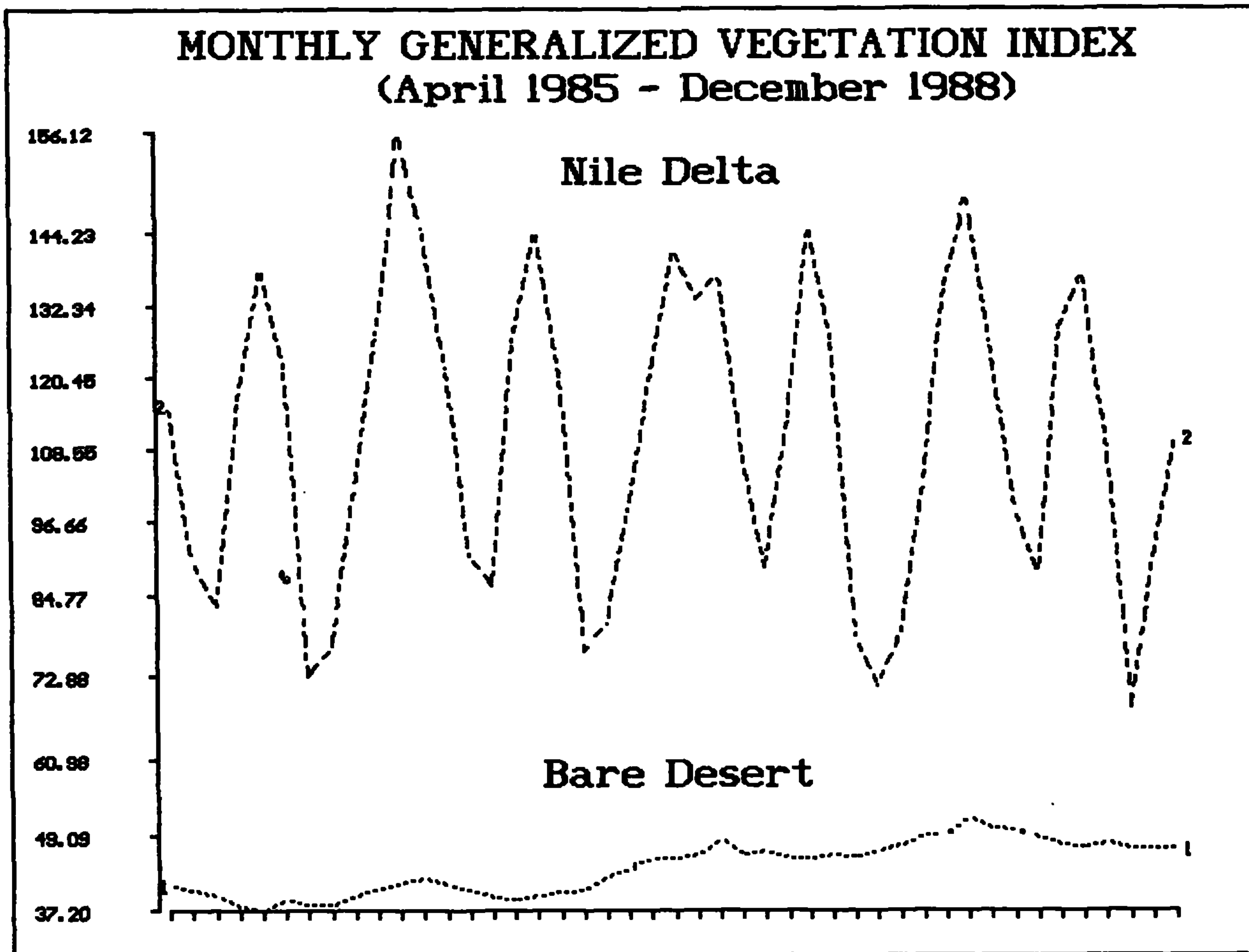

Figure 5 45-month time profile of the Monthly Generalize Global Vegetation Index, averaged over two areas; the Nile Delta and Bare or Blowing Sand Desert (from Olson World Ecosystems version 1.4D)

Similar analysis performed on the Monthly Experimental GVI (ME-GVI, Chapter A02) produced by Kevin Gallo indicates a similar drift in those data for the NOAA-9 series. NOAA-11 data, which became operational in 1989, exhibit a different drift trend (decreasing), which is evident in the Gallo data, even after application of pre-launch corrections. Regression analyses between the Gallo data and the MG-GVI described here indicate reasonable correlation (r=.89 for a sample month, July 1986), but emphasizes that these two data-sets represent different parameters, MG-GVI being a generalized average and ME-GVI being peak values.

CHARACTERISTIC MONTH AVERAGES:

Twelve "characteristic" month data files were produced by averaging the three generalized monthly data files from 1986, 1987, and 1988. 1985 data were omitted because it was an incomplete year of data. The resulting data files should reveal average phenomena for the year (including calibration drift, which may be corrected empirically). These averages are provided as a convenience to users, since they can be readily compared to the climate data from Legates and Willmott and from Leemans and Cramer, which are also characteristic months rather than true time series. Seasonal phenomena should be well represented, however the user is cautioned to evaluate the effect of known annual trends in the calibration of these data for any intended study.

Estimates from plotting profiles of various control areas indicate that a calibration "drift" exists in the GVI data, and appears as an increasing trend throughout the time series in low GVI regions. It is also inversely proportional to the indicated GVI (i.e., less for more vegetated areas). This drift is primarily the result of the gradual delay in time of passage of the satellite overhead, thus affecting the sun angle. Physical structure of the land cover with respect to sun angle may therefore explain the greater effect at low GVI values. The drift was found to be less than 3% of the maximum values in the data-set per year.

The averaged data may reduce atypical cloud effects, however it will certainly incorporate characteristic cloudiness effects in affected regions (e.g., the tropics). It is possible that generalized data on cloudiness can be applied empirically to improve the values in cloud-prone regions, but this idea has not been tested.

ANNUAL PRINCIPAL COMPONENTS OF THE MONTHLY GENERALIZED GLOBAL VEGETATION INDEX FOR 1986, 1987, AND 1988

Principal components analysis (PCA) was used to produce 12 derived digital data files of the Global Vegetation Index using the NGDC monthly generalized data as inputs. The PCA implementation in IDRISI 4.0 was used, choosing standardized variables and the correlation matrix (IDRISI 4.0, Clark University). The results of such analysis require interpretation, and research is being done. The technique was discussed by Eastman (1992), who experimented with the NGDC data for the Africa continent. Tateishi and Kajiwara (1992) have also experimented with this use of PCA along with cluster analysis to produce land-surface classifications based on GVI. Tateishi produced a data-set of monthly-maximum calibrated GVI and land-cover classifications derived from this technique (Odajima, Kajiware, and Tateishi, 1990). The Tateishi, Kajiware, and Odajima data have been contributed for the Global Ecosystems Database, Version 1.0, Disc B.

Derived annual global raster arrays were produced as follows:

Input	Output	File Names
12 files: Jan.-Dec. 1986	PCA #1,2,3,4 for 1986	MGVC186, MGVC286, etc.
12 files: Jan.-Dec. 1987	PCA #1,2,3,4 for 1987	MGVC187, MGVC386, etc.
12 files: Jan.-Dec. 1988	PCA #1,2,3,4 for 1988	MGVC188, MGVC486, etc.

The above analysis results in principal components for each year, using 12 monthly inputs. Because of the nature of PCA, the particular parameters selected for this analysis (standardized components computed on the correlation matrix), and the performance of the analysis on a full global window (excluding the "no-data" regions above 75-degrees N. and below 55-degrees South), the resulting outputs are optimized to reveal specific phenomena. The first component represents an axis of strongest combined GVI signal, essentially equal to the annual average. A comparison of the first component with a 12-month mean for 1986, re-scaled to match offset and gain, showed a maximum difference of +/- 1, probably due to rounding. In the "standardized" PCA analysis, each month's spatial variation is given equal weight.

The next component represents an orthogonal axis, which, by definition, is the strongest annual anomaly. Since the analysis is performed globally, the phase of this anomaly is primarily driven by the summer/winter variation. This phase alignment is reinforced by the seasonal polar "noise" in the GVI data that varies with the solar zenith angle and is easily distinguished over the oceans (un-masked images were used in the analysis). The third component, being also an orthogonal axis, becomes phased with the spring/fall variation; and the fourth component then becomes aligned with the strongest bi-modal variation. A discussion of these results in relation to seasonal patterns for the African continent is given by Eastman (1992).

To the extent that the inter-annual drift effect noted above is a linear function of GVI, without spatial significance (i.e., purely a linear offset and gain difference), it will be removed by the PCA calculation (PCA will thus also remove any such trend that is genuine, but this is an extremely unlikely occurrence for any natural phenomena within a global window). The non-linear portion of the drift curve, which is probably due to annual variation in the atmospheric water content as noted above, will affect the PCA calculation, showing a slight increase in the Spring-Autumn signal, i.e., component #3. Since component #3 already isolates an annual cycle with similar phase and period to fluctuations in atmospheric water (according to preliminary research in the Sahel region of Africa conducted by LERTS in Toulouse, France), even this effect may be corrected empirically.

The integer values in the PCA data files are as produced by the IDRISI software, and have not been re-scaled for inter-annual comparison. In practice, empirical calibration and re-scaling of these images may be necessary using suitable control areas, after which inter-annual comparisons may be more meaningful, taking into account that there are still atmospheric and cloud effects represented in the data.

COLOR PALETTES

A color palette has been developed based on intensity levels of the scaled MG-GVI. Although such palettes are arbitrary, and do not represent detailed studies of land-cover classifications, the NGDC palette has become popular among some users (it was used, for example, by the IGBP, along with an annual average of the data-set, on the cover of IGBP Report #15: Global Change System for Analysis, Research and Training (START). Boulder, CO: UCAR Office for Interdisciplinary Earth Studies). These palettes are provided with the database in both 4 bit-plane (16-color) and 8 bit-plane (256-color) form (MGV4.PAL and MGV8.PAL, respectively).

These palettes also provide the capability to visually compare the MG-GVI documented here with the Monthly Experimental GVI (ME-GVI) developed by Kevin Gallo (see Chapter A02), since corresponding palettes were developed for the ME-GVI data, with identical color-slicing according to the respective offset and gain characteristics. The table below provides the color-slicing criteria for the 256-color palettes, for both data-sets.

% GVI	MG-GVI	ME-GVI	COLOR	RED	GREEN	BLUE
		0	Blue	0	0	20
		1	White	63	63	63
		2	White	63	63	63
	0	3	Blue	0	0	20
0	32.5	100	Brown	17	0	0
20	68	117	Yellow	63	51	0
40	104	134	Olive	20	30	0
50	122	142	Green	0	30	0
75	166	163	Br.Green	0	63	0
100	211	184	Green/White	32	63	32
	255	255	White	63	63	63

The color-slicing levels and color definitions, which result from simple Red-Green-Blue intensity levels (0-63) using IBM-PC conventions, are shown in the table above. "% GVI" refers to the percent of the GVI range represented in the data-set, between XVI=0 (32.5 in the MG-GVI data and 100 in the ME-GVI data) and the mean monthly maximum for July.

The 16-color palette mimics the above color scheme, assuming a linear stretch to 16 classes from 0 to the Maximum data value in the file. Since the monthly maxima vary between files, comparable displays require re-setting the maxima to a standard value for the series. This will involve different procedures for each software package.

Since the Characteristic Month Averages retain similar scaling to the monthly data, the same color palettes can be used. A separate palette (MGVC8.PAL) is provided for the principal components images, which must be re-scaled from minimum to maximum to 256 levels for display (e.g., using autoscaling during display with the provided software). The MGV4.PAL palette may be used with the PCA images when re-scaling to 16 levels.

NOTES

1. These data are uncalibrated values, meaning that they are based on the NOAA Weekly GVI product which used digital counts rather than albedos in the calculation of the NDVI. A new calibrated product has been introduced by NOAA starting with NOAA-11 data (1990). Applying pre-launch calibrations and converting to albedos should make it easier to combine data from different sensors, but does not correct for drift problems noted above. The data in this data-set are all from one sensor (NOAA-9), thus minimizing the importance of calibration within the data-set. However, uncalibrated values may also be difficult to compare with other GVI values in the research literature. Possibilities for empirical calibration and intercomparison exist, as noted above.
2. Although averaging produces a "generalized" data-set with relatively clean, continuous coverage that is suited for use in spatial analysis systems, it also averages many other effects, such as persistent clouds, most notably along the tropical coasts. Future work may include developing separate quality masks based on cloud data.
3. The Principal Components images are provided for experimentation. Their interpretation is a matter of research at present. Some of the un-desirable effects of PCA analysis is avoided by working at a global scale, however users should be aware that PCA analysis is highly sensitive to the geographic window (and scale) of analysis.

REFERENCES

(see "Additional References," Pg. A01-3)

A02

EDC-NESDIS *Monthly Global Vegetation Index from Gallo Bi-Weekly Experimental Calibrated GVI (April 1985 - December 1990)*

DATA-SET DESCRIPTION

DATA-SET NAME: **Monthly Global Vegetation Index from Gallo Bi-Weekly Experimental Calibrated GVI (April 1985 - December 1990)**

PRINCIPAL INVESTIGATOR(s): **Kevin P. Gallo**
USGS EROS Data Center and the NOAA National Environmental Satellite, Data, and Information Service

SOURCE

SOURCE DATA CITATION: Gallo, Kevin P. 1992. Bi-Weekly Global Vegetation Index computed from the NOAA weekly mercator AVHRR product with experimental calibrations. Digital Raster Data on a Mercator 1038x2048 grid. In: *Experimental Calibrated Global Vegetation Index from NOAA AVHRR, 1985-1991*. Boulder Co: National Geophysical Data Center. 175 independent single-attribute spatial layers on CD-ROM, 372MB.

CONTRIBUTOR(s):

Kevin P. Gallo
National Climatic Data Center (NCDC)
Satellite Data Services Division (SDSD)
National Environmental Satellite, Data, and Information Service
SDSD, World Weather Building, Rm. 100
Washington, DC 20233
(301) 763-8400

DISTRIBUTOR(s): (1) EDC (2) NGDC

VINTAGE: 1989-1991

LINEAGE:

(1) NOAA AVHRR weekly Mercator product (produced from Plate Carreé)
NOAA/NESDIS/NCDC/Satellite Data Services Division
Washington, DC

(2) Bi-weekly experimental calculation:
Kevin P. Gallo, NOAA/NESDIS/ORA
EROS Data Center
Sioux Falls, South Dakota

(3) Monthly composite and re-projection to lat/lon:
Douglas C. Binnie, USGS
EROS Data Center
Sioux Falls, South Dakota

ORIGINAL DESIGN

VARIABLES:
Normalized difference vegetation index

ORIGIN: AVHRR sensor on NOAA-9 and NOAA-11 satellites (see Primary Documentation)

GEOGRAPHIC REFERENCE: Mercator

GEOGRAPHIC COVERAGE: Global

Maximum Latitude	:	+75 degrees (N)
Minimum Latitude	:	-55 degrees (S)
Maximum Longitude	:	+180 degrees (E)
Minimum Longitude	:	-180 degrees (W)

GEOGRAPHIC SAMPLING: Last ("random") element of each 4x4 array of GAC (4km) values, mapped onto a 904x2500 Global Plate Carreé (lat/long) grid and resampled to a 1038x2048 global Mercator grid. GAC values are 1x4km averages (along scan-line) of sampled values within each 4x4 array of 1km cells. Look-angle varies between pixels due to temporal sampling.

TIME PERIOD: April 1985 - December 1991

TEMPORAL SAMPLING: Bi-Weekly maximum of daily values (time of day varies between pixels). Because of the bi-weekly maximizing procedure, individual pixels in the bi-weekly image may be from different daily images; thus, look angle and sun-angle (time of day) parameters vary considerably between pixels.

INTEGRATED DATA-SET

DATA-SET CITATION: EDC-NESDIS. 1992. *Monthly Global Vegetation Index from Gallo Bi-Weekly Experimental Calibrated GVI (April 1985 - December 1990).* Digital Raster Data on a 10-minute Geographic (lat/long) 1080x2160 grid. In: *Global Ecosystems Database Version 1.0: Disc A.* Boulder, CO: NOAA National Geophysical Data Center. 69 independent single-attribute data layers on CD-ROM, 161MB.

ANALYST(s): Douglas C. Binnie (USGS), David A. Hastings (NOAA), Jeffrey D. Colby (NOAA)

PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).

SPATIAL REPRESENTATION: 10-minute grid sample from a 10.5 degree (longitude) Mercator grid .

TEMPORAL REPRESENTATION: Maximum daily value occuring in the month.

DATA REPRESENTATION: Single-byte integers scaled between 0 and 255, representing maximum monthly calibrated Normalized Difference Vegetation Index, with cloud and quality masking.
LAYERS AND ATTRIBUTES: 69 independent single-attribute spatial layers attributes
COMPRESSED DATA VOLUME: 27,100,227 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Kidwell, K.B (ed.). 1990. *Global Vegetation Index User's Guide.* Washington: USDOC/NOAA National Climatic Data Center, Satellite Data Services Division. 45p. .

NOTE: This paper refers to source tapes of weekly GVI used to produce the data represented in the GED database. It also refers to other forms of the data and other products available from SDSD, which are not represented in the current database. The document is reproduced in its entirety, for completeness.

ADDITIONAL REFERENCES

See bibliography for NGDC Monthly Generalized Vegetation Index (Chapter A01)

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	MEV8504.IMG to MEV9012.IMG	69 files	160,963,200
Headers:			
\GLGEO\META\	MEV8504.DOC to MEV8812.DOC	69 files	40,032
Palettes:			
\GLGEO\META\	MEV4.PAL	1 file	272
\GLGEO\META\	MEV8.PAL	1 file	4,352
Time Series:			
\GLGEO\META\	MEV.TS	1 file	627
Volume on Disk:		132 files	161,008,483

REPRINT FILES

(see documentation for A01: NGDC Monthly Generalized GVI)

SOURCE EXAMPLE FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\SOURCE\RASTER\	BEV8827.IMG, BEV8829.IMG	2 files	4,251,648
Headers:			
\SOURCE\META\	BEV8827.DOC, BEV8829.DOC	2 files	1,055
Volume on Disk:		4 files	4,252,703

DATA ELEMENT: Monthly Experimental Calibrated GVI

STRUCTURE: Raster Data Files: 10-minute 1080x2160 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

MEV8504.DOC

```
file title   : April 1985 Experimental Vegetation Index
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : 0
max. value   : 181
value units  : calibrated
value error  : unknown
flag value   : 0
flag def'n   : none
legend cats  : 0
comment      : Data flags are 0, 1, and 2 for cloud, data drop, and solar
```

File Series Parameters:

File	Month	Year	Minimum	Maximum
MEV8504:	April	1985	0	181
MEV8505:	May	1985	0	184
MEV8506:	June	1985	0	182
MEV8507:	July	1985	0	185
MEV8508:	August	1985	0	185
MEV8509:	September	1985	0	193
MEV8510:	October	1985	0	183
MEV8511:	November	1985	0	183
MEV8512:	December	1985	0	180
MEV8601:	January	1986	0	180
MEV8602:	February	1986	0	184
MEV8603:	March	1986	0	184
MEV8604:	April	1986	0	186
MEV8605:	May	1986	0	187
MEV8606:	June	1986	0	185
MEV8607:	July	1986	0	186
MEV8608:	August	1986	0	184
MEV8609:	September	1986	0	185
MEV8610:	October	1986	0	184
MEV8611:	November	1986	0	186

MEV8612:	December	1986	0	193
MEV8701:	January	1987	0	191
MEV8702:	February	1987	0	182
MEV8703:	March	1987	0	182
MEV8704:	April	1987	0	180
MEV8705:	May	1987	0	183
MEV8706:	June	1987	0	179
MEV8707:	July	1987	0	184
MEV8708:	August	1987	0	182
MEV8709:	September	1987	0	183
MEV8710:	October	1987	0	175
MEV8711:	November	1987	0	174
MEV8712:	December	1987	0	175
MEV8801:	January	1988	0	178
MEV8802:	February	1988	0	172
MEV8803:	March	1988	0	177
MEV8804:	April	1988	0	173
MEV8805:	May	1988	0	172
MEV8806:	June	1988	0	184
MEV8807:	July	1988	0	179
MEV8808:	August	1988	0	180
MEV8809:	September	1988	0	192
MEV8810:	October	1988	0	179
MEV8811:	November	1988	0	184
MEV8812:	December	1988	0	186
MEV8901:	January	1989	0	181
MEV8902:	February	1989	0	183
MEV8903:	March	1989	0	185
MEV8904:	April	1989	0	183
MEV8905:	May	1989	0	190
MEV8906:	June	1989	0	187
MEV8907:	July	1989	0	184
MEV8908:	August	1989	0	187
MEV8909:	September	1989	0	184
MEV8910:	October	1989	0	183
MEV8911:	November	1989	0	182
MEV8912:	December	1989	0	182
MEV9001:	January	1990	0	182
MEV9002:	February	1990	0	187
MEV9003:	March	1990	0	178
MEV9004:	April	1990	0	186
MEV9005:	May	1990	0	181
MEV9006:	June	1990	0	188
MEV9007:	July	1990	0	186
MEV9008:	August	1990	0	187
MEV9009:	September	1990	0	182
MEV9010:	October	1990	0	184
MEV9011:	November	1990	0	184
MEV9012:	December	1990	0	188

NOTES:

SOURCE EXAMPLE: Gallo Bi-weekly (Mercator) Experimental Global Vegetation Index from NOAA-9 and NOAA-11 (Samples: July 1988)

STRUCTURE: Raster Data Files: non-GED 1038x2048 mercator grid
SERIES: 5 week time-series for July
SPATIAL DATA FILES:

BEV8527.DOC

```
file title   : July 4-17, 1988 Bi-weekly Experimental Vegetation Index
type         : byte
file type    : binary
columns      : 2048
rows         : 1038
ref. system  : mercator
ref. units   : deg
unit dist.   : -999.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -55.0000000
max. Y       : 75.0000000
pos'n error  : unknown
resolution   : unknown
min. value   : 1
max. value   : 185
value units  : calibrated
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

File Series Parameters:

File	Week	Year	Minimum	Maximum
BEV8827	July 4-17	1988	1	185
BEV8829	July 18-31	1988	1	184

NOTES:

DATA INTEGRATION AND QUALITY

Kevin P. Gallo, NOAA/NESDIS
EROS Data Center
Sioux Falls, SD, USA

David A. Hastings and John J. Kineman, NOAA/NESDIS
National Geophysical Data Center
Boulder, CO, USA

INTRODUCTION

The experimental GVI (EGVI) contained on this CD-ROM was developed by Kevin Gallo to investigate the benefits of using pre-launch calibration information to improve the usefulness of the GVI. In addition, screening the data for low sun angle and clouds makes the data more useful for some studies (though use of such masked data in spatial analysis systems should be conducted with care).

The original NOAA operational GVI, available from the Satellite Data Services Division (see above) have been widely accessible, and have been used by many scientists for qualitative and semi-quantitative analysis. One of the major comments about the operational GVI is that the lack of calibration of the data degrades the use of the GVI. Different AVHRR instruments on different satellites have different calibration characteristics, and these characteristics change with time.

The Gallo experimental data-set was an investigation into the use of simple pre-launch calibration information in producing a GVI.

This data-set contains monthly maxima derived from Gallo's original biweekly computations. The data were reprojected by the U. S. Geological Survey's Earth Resources Observation Systems Data Center to a 10-minute latitude-longitude projection. They were then re-registered at the NOAA National Geophysical Data Center.

DEVELOPMENT OF THE DATA

An experimental normalized difference vegetation index (NDVI) was developed and produced during 1988 through 1990, from weekly visible and near-infrared AVHRR channel data for 1985-1990, obtained from NOAA's Global Vegetation Index product (Kidwell, 1991) distributed by the NOAA/NESDIS National Climatic Data Center (NCDC), Satellite Data Services Division (SDSD). NOAA's Mercator-projected product was used. The data are produced for the region between 75 degrees North latitude and 55 degrees South latitude. Data resolution in the Mercator projection varies from 19.6 km pixel size at the equator to 15 km at 40 degrees (North or South). The reflectance values of the visible and near-IR data were computed from pre-launch calibration coefficients. The NDVI was computed as:

NDVI = (nearIR - visible)/(nearIR + visible).

The calibrated visible and near-IR data, and solar zenith angle data included on the NOAA GVI product were used to screen the NDVI data for cloud contamination and low (less than 15 degrees) solar elevation at the time of data acquisition. Data were also screened for data drops. Two successive weeks of the screened NDVI data were then composited based on the maximum NDVI value of the two weeks. The biweekly data were processed for April 1985 through 1990. The start date of the biweekly composite intervals was 099 (9 April) in 1985. The start dates in 1986, 1987, 1988 were 001 (1 January). Processing intervals changed in 1988 on 11 April to a Monday through Sunday weekly cycle. The start date in 1989 was 002 (2 January), in 1990 was 001 (1 January) and for 1991 was 007 (7 January).

The biweekly NDVI data have been scaled to a byte format from the original ND value (a real number with a range from -1.00 to 1.00) computed with the above equation, using the following conversion:

byteNDVI = (realNDVI x 100) + 100.

Thus, a byte NDVI value of 151 in the data set is equivalent to a computed real NDVI value of 0.51. A byte NDVI value of 100 is equivalent to a computed real NDVI of 0.0. Data tagged by the cloud, data drop, or solar elevation algorithms will include values of 0 through 2, respectively.

A FORTRAN program that computes line and sample location from latitude and longitude is appended to this documentation.

More information can be provided by Kevin Gallo, NOAA/NESDIS, National Climatic Data Center, Federal Building, Asheville, North Carolina 28801, USA (704) 259-0878, or from the NGDC Global Change Data Base help line at (303) 497-6125.

DEVELOPMENT OF MONTHLY DATA FROM BI-WEEKLY DATA

The monthly data-set provided in the GED was computed from Kevin Gallo's Biweekly Experimental Calibrated GVI data-set, distributed separately. This data-set was produced for the ISY Global Change Encyclopedia ("GeoScope" from the Canada Centre for Remote Sensing), and in compatible format to the GED (i.e., 10-minute, lat/long grid) to provide a more convenient version of the bi-weekly data.

The monthly maxima of the Gallo experimental GVIs were computed by taking the maximum values of biweekly GVIs for each month, then reprojecting the original mercator-projected data to latitude-longitude projection. The compilation was produced from Gallo's data by the U. S. Geological Survey's EROS Data Center.

Inspection of these data at NOAA's National Geophysical Data Center showed that the computed data were internally consistent to within one grid cell (the locational accuracy usually attributed to the NOAA Polar Orbiting Environmental Satellites that house the AVHRR sensor). However, the data were misregistered to the Earth by approximately 1 grid cell (to the south). In coordination with the Canada Centre for Remote Sensing (CCRS), the data were identically reregistered at NGDC and CCRS by removing the northernmost row of data, and inserting a new row at the bottom of each data file. As these rows contained no GVI values, no data were lost in the process.

COLOR PALETTES

A color palette has been developed based on intensity levels of the scaled ME-GVI (Monthly Experimental GVI). Although such palettes are arbitrary, and do not represent detailed studies of land-cover classifications, the NGDC palette used with the Monthly Generalized GVI (MG-GVI) has become popular among some users. These palettes are provided with the database in both 4 bit-plane (16-color) and 8 bit-plane (256-color) form (MEV4.PAL and MEV8.PAL, respectively).

These palettes also provide the capability to visually compare the ME-GVI documented here with the Monthly Generalized GVI (MG-GVI) developed at NGDC (see Chapter A01), since identical color-slicing was used for both data-sets, according to their respective offset and gain characteristics. The table below provides the color-slicing criteria for the 256-color palette, for both data-sets.

% GVI	MG-GVI	ME-GVI	COLOR	RED	GREEN	BLUE
		0	Blue	0	0	20
		1	White	63	63	63
		2	White	63	63	63
	0	3	Blue	0	0	20
0	32.5	100	Brown	17	0	0
20	68	117	Yellow	63	51	0
40	104	134	Olive	20	30	0
50	122	142	Green	0	30	0
75	166	163	Br.Green	0	63	0
100	211	184	Green/White	32	63	32
	255	255	White	63	63	63

The color-slicing levels and color definitions, which result from simple Red-Green-Blue intensity levels (0-63) using IBM-PC conventions, are shown in the table above. "% GVI" refers to the percent of the GVI range represented in the data-set, between XVI=0 (32.5 in the MG-GVI data and 100 in the ME-GVI data) and the mean monthly maximum for July.

The 16-color palette mimics the above color scheme, assuming a linear re-scaling (i.e., "stretch" or "binning") to 16 classes from 0 to the Maximum data value in the file. Since the monthly maxima vary between files, comparable displays require re-setting the maxima to a standard value for the series. This will involve different procedures for each software package.

NOTES

1. Maximizing over a full month reduces variable cloud effects, preserves the original calibrations, and reduces temporal aliasing (i.e., the likelihood of missing the significant event of the month); but it drastically increases temporal variability between pixels (i.e., values may be from any day of the month), effects due to variable look and sun angles, and the tendency toward temporal bias (e.g., data may be only one day apart if maxima occur at the end of one month and the beginning of the next).
2. Due to the large offset in the integer scaling, these data have a reduced dynamic range with respect to GVI (the lower end of the NDVI range is offset to 100 in the data-set).
3. Quality masking complicates spatial analysis (it has been recommended that future versions provide masks separate from the primary data so that error analysis can be performed independently).
4. Although the calibration procedure was successful in matching the NOAA-9 and NOAA-11 data, it does not remove the calibration "drift" noted for low values of the GVI data (see Chapter A01). Furthermore, this drift, increasing throughout the NOAA-9 data, shifts to a decreasing trend in the NOAA-11 data.
5. There is also an obvious shift in the amount of masking, increasing sharply at the transition between NOAA-9 and NOAA-11 data.
6. The monthly data may have lost some definition in resampling from lat/long at 360 degrees = 2500 pixels (plate carreé) to Mercator at 360 degrees = 2048, and then back to a 10-minutes, with 360 degrees = 2160 pixels.

PROGRAM TO CONVERT LATITUDES & LONGITUDES INTO MERCATOR *MI* AND *MJ* COORDINATES

```
c-------------------------------------------------------------
c
c This program converts input latitude and longitude values into
c MI and MJ coordinates associated with the NOAA Vegetation
c Index products with Mercator projections described in Kidwell
c (1991).  Written by K. P. Gallo, 11 November 1987.
c
c---------------------------------------------------------------
c
c
      real lat,long, mi, mj, in,lonc, x,y,i,j,reply
      data pi/3.1416/,in/2500.0/,lonc/o.o/
c
  20  write(*,701) ' enter latitude and longitude in degrees '
      read(*,'(BN,2f7.2)') lat, long
      write(*,*) lat, long
  701 format(a\)
c
      x=in*(long-lonc)/360.
      y=in*(lat)/360.
c
      i=x+1250.0
      j=-y+522.0
c
      mi=(i*.8192)
      mj=662.0-(log(tan(-0.00126*j+1.44136))*325.95)
c
      write(*,2001) ' mj(line#)= ', mj, ' mi(sample#)= ', mi
 2001 format(a,f7.2,a,f7.2)
      write(*,701) ' enter a "1" for another lat,long '
      read(*,'(BN,f1.0)') reply
      if (reply .eq. 1) goto 20
      end
```

A03

Leemans and Cramer *IIASA Mean Monthly Temperature, Precipitation, and Cloudiness*

DATA-SET DESCRIPTION

DATA-SET NAME: **IIASA Mean Monthly Temperature, Precipitation, and Cloudiness**

PRINCIPAL INVESTIGATOR(s): **Rik Leemans and Wolfgang P. Cramer**
International Institute for Applied Systems Analysis

SOURCE

SOURCE DATA CITATION: Leemans, R., and W.P. Cramer. 1991. *The IIASA Database for Mean Monthly Values of Temperature, Precipitation, and Cloudiness on a Global Terrestrial Grid.* Digital Raster Data on a 30 minute Geographic (lat/long) 360x720 grid. Laxenburg, Austria: IIASA. 9-track tape, 10.3 MB

CONTRIBUTOR(s):

Dr. Rik Leemans
National Institute of Public Health and Environmental Protection, RIVM
P.O. Box 1
NL-3720 BA Bilthoven, The Netherlands
(31)30-749111

DISTRIBUTOR(s): IIASA and RIVM

VINTAGE: circa 1990

LINEAGE:

(1) Published records from 1931 to 1960 (see ORIGIN)
(2) Data integrated from multiple sources at IIASA (Leemans and Cramer)

ORIGINAL DESIGN

VARIABLES:

(1) Average Monthly Surface Temperature, converted to °C (precision=.1°C)
(2) Monthly Average Precipitation (interpolation of measured values), uncorrected for rain-guage bias.
(3) "Cloudiness," expressed as percentage sunshine hours of potential hours per month at the land surface.

ORIGIN: Weather records from the following sources (see Primary Documentation):

1) World Weather Records, U.S. Weather Burear.
2) The Climate Atlas of Walter and Lieth
3) Müller: Selected Climatic Data for Vegetation Science, based on:
    a) UK Meteorological Office records
    b) World Survey of Climatology (Landsberg)

4) Bradley: Precipitation and Temperature Data for the Northern Hemisphere
5) Selected weather data for Europe from the UK Meteorological Office
6) Thornthwait and Mather's Temperature and Precipitation data.
7) Soviet Temperature and Precipitation data (Siberia)
8) Chinese Temperature and Precipitation data (NE China)

GEOGRAPHIC REFERENCE: latitude/longitude
GEOGRAPHIC COVERAGE: Global

Maximum Latitude	:	+90 degrees (N)
Minimum Latitude	:	-90 degrees (S)
Maximum Longitude	:	+180 degrees (E)
Minimum Longitude	:	-180 degrees (W)

GEOGRAPHIC SAMPLING: 30-minute cell values interpolated from station observations using spatial model (see Leemans and Cramer, 1992; pgs. 13-14).
TIME PERIOD: "current climate" (or "normal climate") as characterized from 1931-1960
TEMPORAL SAMPLING: long-term means for each month composited from available records.

INTEGRATED DATA-SET

DATA-SET CITATION: Leemans, R., and W.P. Cramer. 1992. *IIASA Database for Mean Monthly Values of Temperature, Precipitation, and Cloudiness on a Global Terrestrial Grid*. Digital Raster Data on a 30 minute Geographic (lat/long) 360x720 grid. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 36 independent single-attribute spatial layers on CD-ROM, 15.6MB. [first published in 1991]
ANALYST(s): Rik Leemans and Wolfgang P. Cramer, IIASA, Laxenburg, Austria
PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).
SPATIAL REPRESENTATION: Characteristic values for 30-minute cells, from a spatial model based on irregularly located station data.
TEMPORAL REPRESENTATION: Characteristic months of average climate for 1931-1960 (a relatively stable period).
DATA REPRESENTATION:

Temperature:	2-byte integers, representing surface air temperature in 1/10th degrees Celsius (or degrees x 10).
Precipitation:	2-byte integers, representing average monthly precipitation in milimeters (uncorrected)
Cloudiness:	1-byte integers, representing percentage sunshine hours of potential hours per month (0-100).

LAYERS AND ATTRIBUTES: 36 independent single-attribute spatial layers
COMPRESSED DATA VOLUME: 2,260,638 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Leemans, R. and W.P. Cramer, 1991. The IIASA database for mean monthly values of temperature, precipitation and cloudiness of a global terrestrial grid. Research Report RR-91-18 November 1991, International Institute of Applied Systems Analyses, Laxenburg. 61pp.

ADDITIONAL REFERENCES

Solomon, A.M. and R. Leemans. 1990. Climatic change and landscape-ecological response: Issues and analyses. In: Boer, M.M. and de Groot, R.S. (eds.), Landscape *Landscape Ecological Impact of Climatic Change*. IOS Press, Amsterdam. pp. 293-316 (ISBN 90 5199 023 5).

Prentice, I.C., Cramer, W., Harrison, S.P, Leemans, R., Monserud, R.A. & Solomon, A.M. 1992. A global biome model based on plant physiology and dominance, soil properties and climate. *J. Biogeography* (in press).

Monserud, R.A. and Leemans, R. 1992. The comparison of global vegetation maps. *Ecol. Modelling* (in press).

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	LCCLD01.IMG to LCCLD12.IMG	12 files	3,110,400
	LCPRC01.IMG to LCPRC12.IMG	12 files	6,220,800
	LCTMP01.IMG to LCTMP12.IMG	12 files	6,220,800
Headers:			
\GLGEO\META\	LCCLD01.DOC to LCCLD12.DOC	12 files	6,976
	LCPRC01.DOC to LCPRC12.DOC	12 files	6,619
	LCTMP01.DOC to LCTMP12.DOC	12 files	6,536
Palettes:			
\GLGEO\META\	LCCLD8.PAL	1 file	4,352
Time Series:			
\GLGEO\META\	LCCLD.TS	1 file	114
	LCPRC.TS	1 file	114
	LCTMP.TS	1 file	114
Volume on Disk:		76 files	15,576,825

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A03\	LC1_01.PCX to LC1_28.PCX	28 files	1,011,402
	LC1_##X.PCX	3 files	240,738
	LC2_01.PCX to LC2_27.PCX	27 files	1,556,067
	LC2_##X.PCX	5 files	530,152
Volume on Disk:		63 files	2,338,359

SOURCE EXAMPLE FILES

none

DATA ELEMENT: Average Month Surface Air Temperature

STRUCTURE: Raster Data Files: .5-degree 360x720 GED grid (see *User's Guide*)
SERIES: series of 12 characteristic months
SPATIAL DATA FILES:

LCTMP01.DOC

```
file title   : Leemans and Cramer January Temperature (0.1°C)
data type    : integer
file type    : binary
columns      : 720
rows         : 360
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.5000000
min. value   : -583
max. value   : 406
value units  : 0.1 degrees Celsius
value error  : unknown
flag value   : -999
flag def'n   : flag value -999 indicates no data
legend cats  : 0
```

File Series Parameters:

File	Month	Minimum	Maximum
LCTMP01:	January	-583	406
LCTMP02:	February	-546	413
LCTMP03:	March	-512	423
LCTMP04:	April	-430	432
LCTMP05:	May	-284	434
LCTMP06:	June	-223	429
LCTMP07:	July	-222	441
LCTMP08:	August	-214	423
LCTMP09:	September	-272	426
LCTMP10:	October	-371	423
LCTMP11:	November	-445	420
LCTMP12:	December	-533	417

(units are in 1/10th degrees Celsius, or degrees x 10)

NOTES:

DATA ELEMENT: Average Month Precipitation (uncorrected)

STRUCTURE: Raster Data File: .5-degree 360x720 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

LCPRC01.DOC

```
file title   : Leemans and Cramer January Precipitation (mm/month)
data type    : integer
file type    : binary
columns      : 720
rows         : 360
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.5000000
min. value   : 0
max. value   : 942
value units  : millimeters/month
value error  : unknown
flag value   : -999
flag def'n   : flag value -999 indicates no data
legend cats  : 0
```

File Series Parameters:

File	Month	Minimum	Maximum
LCPRC01:	January	0	942
LCPRC02:	February	0	652
LCPRC03:	March	0	830
LCPRC04:	April	0	676
LCPRC05:	May	0	1280
LCPRC06:	June	0	2695
LCPRC07:	July	0	2774
LCPRC08:	August	0	1950
LCPRC09:	September	0	1106
LCPRC10:	October	0	863
LCPRC11:	November	0	914
LCPRC12:	December	0	743

NOTES:

DATA ELEMENT: Average Month "Cloudiness" (% sunshine)

STRUCTURE: Raster Data File: .5-degree 360x720 GED grid (see *User's Guide*)
SERIES: series of 12 characteristic months
SPATIAL DATA FILES:

LCCLD01.DOC

```
file title   : Leemans and Cramer January Cloudiness (% sunshine)
data type    : byte
file type    : binary
columns      : 720
rows         : 360
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.5000000
min. value   : 0
max. value   : 95
value units  : percentage sunshine hours of potential hours per month
value error  : unknown
flag value   : 254
flag def'n   : flag value 254 indicates no data
legend cats  : 0
```

File Series Parameters:

File	Month	Minimum	Maximum
LCCLD01:	January	0	95
LCCLD02:	February	4	94
LCCLD03:	March	9	88
LCCLD04:	April	2	92
LCCLD05:	May	2	95
LCCLD06:	June	0	98
LCCLD07:	July	0	100
LCCLD08:	August	0	98
LCCLD09:	September	0	98
LCCLD10:	October	0	99
LCCLD11:	November	0	96
LCCLD12:	December	0	100

NOTES:

1. Regional discrepancies with the FAO climatic database have been noted (e.g., Vietnam).

DATA INTEGRATION AND QUALITY

Mark A. Ohrenschall
NOAA National Geophysical Data Center
Boulder, Colorado

The source data were in lat/long projection at 0.5-degree resolution. The source files were in a ASCII record format, with ocean cells omitted. Each data file had a header line containing two different fortran format statements, followed by fixed-length data records containing latitude and longitude in tenths of degrees, referencing the south-west corner of the grid cell, followed by that cell's twelve monthly values.

A raster data file was created for each month for each parameter, setting the background to a no-data flag and a program was written to read in grid values from the source files. Results were checked by spot-checking individual grid points.

The original data structure was compatible with the GED grid conventions, and no changes were made in the original data values, numerical type, or precision.

The data were inspected to verify that there were no obvious artifacts and to spot check the final integrated data against the original source. Some comparisons were made with other data-sets in the database, e.g., the Legates and Willmott data, finding some discrepancies. In particular, comparison with local patterns (e.g., near Mexico) indicated potentially large differences due to variable surface conditions. Otherwise, the data appear to be representative of broad-scale patterns, and reviewers noted that it may provide better resolution than the Legates and Willmot data.

A04

Legates and Willmott *Monthly Average Surface Air Temperature and Precipitation (re-gridded)*

DATA-SET DESCRIPTION

DATA-SET NAME: **Monthly Average Surface Air Temperature and Precipitation (re-gridded)**

PRINCIPAL INVESTIGATOR(s): **David R. Legates and Cort J. Willmott**

SOURCE

SOURCE DATA CITATION: Legates, D.R. and C.J. Willmott, 1989. *Monthly Average Surface Air Temperature and Precipitation*. Digital Raster Data on a .5-degree Geographic (lat/long) 361x721 grid (centroid-registered on .5 degree meridians). Boulder CO: National Center for Atmospheric Research. 4 files on 9-track tape. 83MB.

CONTRIBUTOR(s):

Dr. David R. Legates and Dr. Cort J. Willmott

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(405) 325-6547

Dr. Cort J. Willmott
Center for Climatic Research
Department of Geography
University of Delaware
Newark, DE 19716 USA
(302) 451-8998

DISTRIBUTOR(s): NCAR

VINTAGE: circa 1980's

LINEAGE:

(1) Principal Investigators: David R. Legates and Cort J. Willmott
(2) Archived and Distributed by:
Roy Jenne
National Center for Atmosphereic Research
Boulder, CO

ORIGINAL DESIGN

VARIABLES:

VARIABLE	UNITS	PRECISION
Measured precipitation	mm/month	1mm
Guage corrected precipitation	mm/month	1mm
Standard error of corrected precipitation	mm/month	1mm
Surface Air temperature	degrees Celsius	.1 °C

ORIGIN: 24,941 independent surface air temperature and 26,858 independent precipitation stations, and oceanic grid point estimates from a variety of sources (see Primary Documentation).

GEOGRAPHIC REFERENCE: latitude/longitude

Centroid-registered grid cells on 30-minute lat/long meridians. Original grid (361x721) extends from pole to pole and originates at the International Date Line.

GEOGRAPHIC COVERAGE: Global

Maximum Latitude	:	+90 degrees (N)
Minimum Latitude	:	-90 degrees (S)
Maximum Longitude	:	+180 degrees (E)
Minimum Longitude	:	-180 degrees (W)

GEOGRAPHIC SAMPLING: Weighted (using a spherically-based interpolation algorithm) 30-minute cell averages of station data and oceanic trackline samples, on a centroid-registered 30-minute grid.

TIME PERIOD: Modern "average" climate, from records mostly between 1920 and 1980.

TEMPORAL SAMPLING: 12 characteristic months and characteristic years for each variable, representing long-term (approx. 60 year) monthly and annual means.

INTEGRATED DATA-SET

DATA-SET CITATION: Legates, D.R. and C.J. Willmott. 1992. Monthly Average Surface Air Temperature and Precipitation. Digital Raster Data on a 30 minute Geographic (lat/long) 360x720 grid. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 48 independent and 4 derived single-attribute spatial layers on CD-ROM, 47.2MB. [first published in 1989]

ANALYST(s): John Kineman and Mark Ohrenschall

PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).

SPATIAL REPRESENTATION: 30-minute cell values interpolated from the 4 overlapping quadrant values of the original grid, which contained values interpolated from irregularly spaced point observations.

TEMPORAL REPRESENTATION: 12 characteristic months and characteristic years for each variable, representing long-term (approx. 60 year) means.

DATA REPRESENTATION: 2-byte integers, representing:

VARIABLE	UNITS	PRECISION
1. Measured precipitation	mm/month	1mm
2. Guage corrected precipitation	mm/month	1mm
3. Surface Air temperature	°C x 10	.1 °C

4. Standard deviation (expressed in the same units and precision as above) of the interpolated cell values for each measurement (precipitation, corrected precipitation, and temperature) are provided as separate layers as an estimate of uncertainty introduced by the re-gridding process -- **these three standard deviation ("SD") files were not part of the orignial data-set**.

5. RMS Std. error of corrected precip.	mm/month	1mm

Note that this variable was re-gridded by a different method than the first three: The re-gridding method employed a root-mean-square average to combine the 4 quadrant values into the newly registered grid cell for the GED.

LAYERS AND ATTRIBUTES: 52 independent and 39 derived single-attribute spatial layers

COMPRESSED DATA VOLUME: 15,707,536 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

- * Legates, David R. 1989. "A high-resolution climatology of gage-corrected global precipitation." In: *Precipitation Measurement*, B. Sevruk (ed.), *Proceedings of the WMO/IAHS/ETH International Workshop on Precipitation Measurement, St. Moritz, Switzerland, Dec. 3-7, 1989*. Zurich: Swiss Federal Institute of Technology, pp. 519-526.
- * Legates, David R. and Cort J. Willmott. 1990. "Mean seasonal and spatial variability in global surface air temperature." *Theoretical and Applied Climatology*, vol. 41, pp. 11-21.
- * Legates, David R. and Cort J. Willmott. 1990. "Mean seasonal and spatial variability in gauge-corrected global precipitation." *International Journal of Climatology*, vol. 10. pp. 111-127.

ADDITIONAL REFERENCES

Sevruk, B. 1989. "Reliability of precipitation measurement." In: *Precipitation Measurement*, B. Sevruk (ed.), *Proceedings of the WMO/IAHS/ETH International Workshop on Precipitation Measurement, St. Moritz, Switzerland, Dec. 3-7, 1989*. Zurich: Swiss Federal Institute of Technology, pp. 519-526

Shepard, D. 1968. "A two-dimensioinal interpolation function for irregularly-spaded data." In: *Proceedings of 23rd National Conference of the Association for Computing Machinery*. ACM Pub. P-68. Princeton, NJ: Brandon/Systems Press, Inc.

Legates, David R. 1987. A Climatology of Global Precipitation. *Pub. Climatol.*, 40(1): 103 p.

Willmott, ~~C.J.,~~ C.M. Rowe, and W.D. Philpot. 1985. "Small-scale climate maps: a sensitivity analysis of some common assumptions associated with grid-point interpolation and contouring. *The American Cartographer*, 12(1): 5-16.

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	LWCPR00.IMG to LWCPR12.IMG	13 files	6,739,200
	LWCSD00.IMG to LWCSD12.IMG	13 files	6,739,200
	LWERR00.IMG to LWERR12.IMG	13 files	6,739,200
	LWMPR00.IMG to LWMPR12.IMG	13 files	6,739,200
	LWMSD00.IMG to LWMSD12.IMG	13 files	6,739,200
	LWTMP00.IMG to LWTMP12.IMG	13 files	6,739,200
	LWTSD00.IMG to LWTSD12.IMG	13 files	6,739,200
Headers:			
\GLGEO\META\	LWCPR00.DOC to LWCPR12.DOC	13 files	6,921
	LWCSD00.DOC to LWCSD12.DOC	13 files	6,799
	LWERR00.DOC to LWERR12.DOC	13 files	6,908
	LWMPR00.DOC to LWMPR12.DOC	13 files	6,775
	LWMSD00.DOC to LWMSD12.DOC	13 files	6,944
	LWTMP00.DOC to LWTMP12.DOC	13 files	6,931
	LWTSD00.DOC to LWTSD12.DOC	13 files	6,814
Palettes:	none		
Time Series:			
\GLGEO\META\	LWCPR.TS	1 file	123
\GLGEO\META\	LWMPR.TS	1 file	123
\GLGEO\META\	LWTMP.TS	1 file	123
Volume on Disk:		185 files	47,222,861

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A04\	LW1_01.PCX to LC1_17.PCX	17 files	864,882
	LW1_##X.PCX	16 files	2,871,460
	LW2_1.PCX to LC1_8.PCX	8 files	695,424
	LW2_#X.PCX	6 files	921,810
	LW3_01.PCX to LC1_11.PCX	11 files	577,957
	LW3_##X.PCX	7 files	1,263,135
Volume on Disk:		65 files	7,194,668

SOURCE EXAMPLE FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\SOURCE\RASTER\	LWSCP07.IMG	1 file	520,562
	LWSER07.IMG	1 file	520,562
	LWSMP07.IMG	1 file	520,562
	LWSTM07.IMG	1 file	520,562
Headers:			
\SOURCE\RASTER\	LWSCP07.DOC	1 file	538
	LWSER07.DOC	1 file	528
	LWSMP07.DOC	1 file	537
	LWSTM07.DOC	1 file	531
Volume on Disk:		8 files	2,084,382

DATA ELEMENT: Guage Corrected Precipitation (re-gridded)

STRUCTURE: Raster Data Files: .5-degree 360x720 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

LWCPR00.DOC

```
file title   : Legates & Willmott Annual Corrected Precipitation (mm/year)
data type    : integer
file type    : binary
columns      : 720
rows         : 360
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.5000000
min. value   : 0
max. value   : 6626
value units  : millimeters/year
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

File Series Parameters:

File	Month	Minimum	Maximum
LWCPR00	year cum.	0	6434
LWCPR01	January	0	1048
LWCPR02	February	0	612
LWCPR03	March	0	616
LWCPR04	April	0	545
LWCPR05	May	0	646
LWCPR06	June	0	1129
LWCPR07	July	0	1378
LWCPR08	August	0	1327
LWCPR09	September	0	833
LWCPR10	October	0	739
LWCPR11	November	0	848
LWCPR12	December	0	876
Standard Deviation:			
LWCSD00	year cum.	0	2410
LWCSD01	January	0	255
LWCSD02	February	0	176
LWCSD03	March	0	261
LWCSD04	April	0	215
LWCSD05	May	0	264
LWCSD06	June	0	335
LWCSD07	July	0	506

LWCSD08	August	0	364
LWCSD09	September	0	261
LWCSD10	October	0	328
LWCSD11	November	0	258
LWCSD12	December	0	239

ATTRIBUTE DATA FILES none

NOTES:

1. Mean and standard deviation derived from 2x2 quadrant average of the source grid, resulting in an interpolated .5-degree (GED) grid with 1-deg. smoothing.

DATA ELEMENT: **Standard Error for Guage Corrected Precipitation (re-gridded)**

STRUCTURE: Raster Data Files: .5-degree 360x720 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

LWERR00.DOC

```
file title   : Legates & Willmott Annual Standard Error (mm/year)
data type    : integer
file type    : binary
columns      : 720
rows         : 360
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.5000000
min. value   : 0
max. value   : 344
value units  : millimeters/year
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

File Series Parameters:

File	Month	Minimum	Maximum
LWERR00	year cum.	0	344
LWERR01	January	0	401
LWERR02	February	0	571
LWERR03	March	0	558
LWERR04	April	0	550
LWERR05	May	0	319
LWERR06	June	0	275
LWERR07	July	0	354
LWERR08	August	0	492
LWERR09	September	0	400
LWERR10	October	0	599
LWERR11	November	0	969
LWERR12	December	0	720

ATTRIBUTE DATA FILES none

NOTES:

1. Mean and standard deviation derived from 2x2 quadrant average of the source grid, resulting in an interpolated .5-degree (GED) grid with 1-deg. smoothing.
2. The corrected precipitation error data were interpolated by a 2x2 r.m.s. filter.

DATA ELEMENT: Measured Precipitation (re-gridded)

STRUCTURE: Raster Data Files: 0.5-degree 360x720 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

LWMPR00.DOC

```
file title    : Legates & Willmott Annual Measured Precipitation (mm/year)
data type     : integer
file type     : binary
columns       : 720
rows          : 360
ref. system   : lat/long
ref. units    : deg
unit dist.    : 1.0000000
min. X        : -180.0000000
max. X        : 180.0000000
min. Y        : -90.0000000
max. Y        : 90.0000000
pos'n error   : unknown
resolution    : 0.5000000
min. value    : 0
max. value    : 6434
value units   : millimeters/year
value error   : unknown
flag value    : none
flag def'n    : none
legend cats   : 0
```

File Series Parameters:

File	Month	Minimum	Maximum
LWMPR00	year cum.	0	6434
LWMPR01	January	0	1048
LWMPR02	February	0	612
LWMPR03	March	0	616
LWMPR04	April	0	545
LWMPR05	May	0	646
LWMPR06	June	0	1129
LWMPR07	July	0	1378
LWMPR08	August	0	1327
LWMPR09	September	0	833
LWMPR10	October	0	739
LWMPR11	November	0	848
LWMPR12	December	0	876
Standard Deviation:			
LWMSD00	year cum.	0	2362
LWMSD01	January	0	251
LWMSD02	February	0	172
LWMSD03	March	0	253
LWMSD04	April	0	210
LWMSD05	May	0	259
LWMSD06	June	0	330
LWMSD07	July	0	496
LWMSD08	August	0	357
LWMSD09	September	0	253
LWMSD10	October	0	321

LWMSD11	November	0	252
LWMSD12	December	0	233

ATTRIBUTE DATA FILES none

NOTES:

1. Mean and standard deviation derived from 2x2 quadrant average of the source grid, resulting in an interpolated .5-degree (GED) grid with 1-deg. smoothing.

DATA ELEMENT: Surface Air Temperature (re-gridded)

STRUCTURE: Raster Data Files: .5-degree 360x720 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

LWTMP00.DOC

```
file title   : Legates & Willmott Annual Temperature (0.1C)
data type    : integer
file type    : binary
columns      : 720
rows         : 360
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.5000000
min. value   : -569
max. value   : 299
value units  : 0.1 degrees celsius
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

File Series Parameters:

File	Month	Minimum	Maximum
LWTMP00	year cum.	-569	299
LWTMP01	January	-540	328
LWTMP02	February	-503	323
LWTMP03	March	-584	330
LWTMP04	April	-666	339
LWTMP05	May	-674	358
LWTMP06	June	-702	399
LWTMP07	July	-690	418
LWTMP08	August	-718	395
LWTMP09	September	-669	363
LWTMP10	October	-596	319
LWTMP11	November	-441	324
LWTMP12	December	-468	336

Standard Deviation:

LWTSD00	year cum.	0	152
LWTSD01	January	0	146
LWTSD02	February	0	156
LWTSD03	March	0	182
LWTSD04	April	0	173
LWTSD05	May	0	161
LWTSD06	June	0	169
LWTSD07	July	0	155
LWTSD08	August	0	149
LWTSD09	September	0	156
LWTSD10	October	0	150
LWTSD11	November	0	147
LWTSD12	December	0	158

ATTRIBUTE DATA FILES none

NOTES:

1. Mean and standard deviation derived from 2x2 quadrant average of the source grid, resulting in an interpolated .5-degree (GED) grid with 1-deg. smoothing.

SOURCE EXAMPLE: *Average Monthly Air Temperature and Precipitation (Source Examples)*

STRUCTURE: Raster Data File: .5-degree, 361x721 centroid-registered grid (non-GED registration convention – see *User's Guide*)
SERIES: Sample file for July
SPATIAL DATA FILES:

LWSCP07.DOC

```
file title   : Legates & Willmott July Corrected Precipitation (source)
data type    : integer
file type    : binary
columns      : 721
rows         : 361
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.5000000
min. value   : 0
max. value   : 1540
value units  : millimeters/month
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

File Series Parameters:

File	Variable	Units	Minimum	Maximum
LWSCP07	Corr. Precip.	mm/month	0	1540
LWSER07	Guage error	mm/month	0	376
LWSMP07	Meas. Precip.	mm/month	0	1492
LWSTM07	Temperature	°C x 10	-693	442

NOTES:

1. Source files are provided for the user to assess the appropriateness of the GED integration method in cases where re-gridding, or other significant alteration of the data values was necessary to achieve intercomparability with the other data-sets. **See Integration Methods (below).**

DATA INTEGRATION AND QUALITY

John Kineman and Mark Ohrenschall
National Geophysical Data Center
Boulder, Colorado

OVERVIEW

The Legates and Willmott data are referenced to a latitude/longitude grid with the data values located at intersections of the .5-degree latitude and longitude meridians, globally. This can be seen as a grid of half-degree cells with the cell centers located at the .5 degree meridian intersections. Note also that the "cell" boundaries of this type of grid extend beyond the "edges" of the global lat/long grid extending between +/- 180 degrees longitude and +/- 90 degrees latitude. This differs from the convention adopted for the GED, of edge alignment with a nested set of GED "conventional" latitude and longitude meridians, one of which is .5-degrees (i.e., the GED "nested" grids - see *User's Guide*). In the GED convention, the cell boundaries are aligned with the edges of the global window and with each "nested" meridian. The difference between these two grid conventions is cell registration, but it poses a problem for integration or intercomparison with other data in the database since differently registered grid cells do not occupy the same location, and thus must be either interpolated or accepted with a spatial offset of 1/2 the diagonal of a cell (e.g., systems that would automatically grid-sample to obtain the edge-registered grid values from a centroid-registered grid).

In a raster GIS, each number in a digital image file is referenced to a "cell," which covers some area on the surface of the earth. Given data values spaced a half-degree apart on a latitude/longitude grid, each value is considered to refer to a half-degree "cell" on the surface of the earth (although with true "point" data sets the value more properly refers to the centroid of the cell). In practice, the spatial meaning of cell values may vary considerably between data-sets, depending on design criteria of the original investigators. The Legates and Willmott data are carefully interpolated from irregularly spaced point observations to values that have a spatial resolution approximately equal to the cell size (i.e., .5-degree). It is therefore not correct to assume a spatial uncertainty of .5-degrees, as commonly used "nearest-neighbor" resampling would. Unfortunately, owing to the complex nature of rainfall data and the spatial interpolation techniques that were applied (see references), any method of re-gridding introduces problems.

In resampling from the Legates and Willmott grid to the Global Ecosystems Database grid two methods were tested: (2) combining resampling and interpolation to represent the data on a GED-compatible 10-minute grid, and (2) regridding (interpolation) to the GED conventional half-degree grid using a simple 2x2 quadrant average for each cell in the new grid. The first of these products was distributed on the 1991 Prototype CD-

ROM of the GED Database (Version 0.1 - Beta Test). Partly based on the 1991 review, the decision was made to include the second product on the current release of the GED database (Version 1.0). Both of these solutions are considered inferior to re-producing the data from source material, however this will require more time and resources.

METHOD USED IN THE PROTOTYPE

The method used for the prototype was to expand (by pixel replication) the Legates and Willmott grid by a factor of six in both row and column dimensions, window on the inner 2160 rows and 4320 columns (excluding the outer-most three rows and columns), and then contract (with cell averaging) by a factor of two. The result was a 10-minute grid that can nest with other gridded images in the Global Ecosystems Database. While the new 10-minute grid was to some degree interpolated from the original grid, the advantage of this method was that the original grid values are preserved amongst interpolated values, and the original data-set can be recovered from the new grid by sampling. Its disadvantage was that it was unclear how to use this mixed grid in normal processing, and the artificially fine grids (10-minutes) require a lot of storage space and may mislead users into assuming greater regional resolution than actually exists. In other words, the expanded grid would have to be aggregated to a coarser grid to have proper meaning anyway.

METHOD USED IN THE CURRENT VERSION

The method used for the current release was a simple grid interpolation, averaging 4 cell values to obtain a 1/2 cell offset data-set on a .5-degree grid that is compatible with the GED convention. This, unfortunately, also smooths the original data, thus reducing its variability and changing its spatial meaning. Statistically, the new grid represents averages of four 1/2-degree "quadrant" cells covering a 1x1 degree region, taken at 1/2-degree grid increments. The data should be interpreted with this in mind, as it is a questionable procedure for many uses to interpolate variables such as precipitation in this way (although the original values are themselves interpolated and spatially general). It may be more appropriate to use this interpolated GED grid for coarser studies, at 1-degree or greater resolution.

To assess the uncertainty in the re-gridding process, companion data files are provided for each variable giving the standard deviation (sample s.d., i.e., 1/n-1) for each cell's 4 source values. This may serve as a reliability indicator for the interpolated values.

According to the NCAR documentation, the gauge-error data (for the gauge-corrected precipitation estimates) is expressed as a standard error, however the literature references discuss gauge-errors in percent. It was decided to interpolate the gauge-error file as standard error estimates, using a simple root-mean-square algorithm.

Further investigation of these methods is warranted.

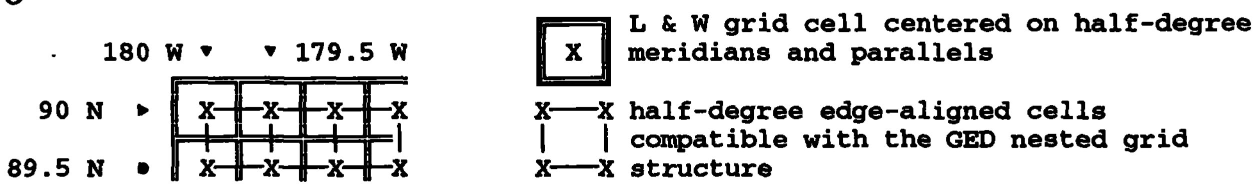
SOURCE FILE FORMATTING

The Legates and Willmott data came as four files on tape, one file for each parameter, with an 80-character fixed-record format containing latitude, longitude, and 13 data fields for the twelve monthly averages and the annual average. Since each record did have geo-referencing, a cell sequencing was unnecessary, nonetheless the data files had cell sequencing north to south within longitude columns, with column sequencing from west to east, beginning at 90 degrees north and 180 degrees west. Each data value was referenced by half-degree multiples, including 90 degrees north, 90 degrees south, 180 degrees west, and 180 degrees east.

DATA PROCESSING

In processing the data, the first task was running a custom-written program to resequence the cells and extract the data fields to produce an Idrisi image for each parameter for each monthly and annual image. Next, a program was written to average a moving window of 4 original cell values, writing the averages and standard deviations of the 2x2 average to the new grid.

In the following figure, the double-line represents the original grid before regridding. The single-line represents the half-degree meridians and parallels, as well as the new, interpolated grid. The new values are located at the intersection of 4 original .5 degree cells. An "X" indicates the location of data points in the original Legates and Willmott grid.



CONCLUSION

The representation of the Legates and Willmott data is a compromise to achieve integration with multi-thematic data. As with any data-set, the user must assess its value for the purpose at hand. These "re-gridded" data will loose regional variability information due to the smoothing effect of the interpolation. The amount of loss may be estimated by the standard deviation values provided with the re-gridded data, and by experimenting with the sample source file provided with the database. Nevertheless, an obvious future improvement would be to re-calculate the data-set on the desired grid from station observations, using the original (or improved) interpolation methods.

A05

Olson *World Ecosystems*

DATA-SET DESCRIPTION

DATA-SET NAME: **World Ecosystems**

PRINCIPAL INVESTIGATOR(s): **Jerry S. Olson**
Global Patterns Company

SOURCE

SOURCE DATA CITATION: Olson, J.S., 1989-91. *World Ecosystems (WE1.3 and WE1.4).* Digital Raster data on global Geographic (lat/long) 180x360 and 1080x2160 grids. NOAA National Geophysical Data Center. Boulder, Colorado. Various working files from GPC on floppy disk.

CONTRIBUTOR(s):
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37771-9424, USA
(615) 376-2250
(Fax (615) 690-3906 c/o Business Computer Associates)

DISTRIBUTOR(s): NGDC/WDC-A

VINTAGE: circa 1970's and 1980's (continuing updates)

LINEAGE:
(1) Principal Investigator:
Jerry S. Olson
Global Patterns Company
(2) Reprocessed and updated by:
Jerry S. Olson, Lee Stanley, Jeff Colby, and Mark Ohrenschall
NOAA/NGDC, Boulder, CO 80303

ORIGINAL DESIGN

VARIABLES: Characteristic (actual) ecosystem classes with respect to carbon content.

WE1.3A	Major Groups at 30-minute resolution
WE1.4D	Detailed Categories at mixed 30-minute and 10-minute resolution
WE1.4DR	Resolution codes for WE1.4D

ORIGIN: Numerous collected maps, references, and observations (see Primary Documentation).

GEOGRAPHIC REFERENCE: latitude/longitude

GEOGRAPHIC COVERAGE: Global

Maximum Latitude : +90 degrees (N)
Minimum Latitude : -90 degrees (S)

Maximum Longitude : +180 degrees (E)
Minimum Longitude : -180 degrees (W)

GEOGRAPHIC SAMPLING: Characteristic classes for 30-minute cells with 10-minute updates for selected classes in Africa

TIME PERIOD: Modern

TEMPORAL SAMPLING: Modern composite

INTEGRATED DATA-SET

DATA-SET CITATION: Olson, J.S. 1992. *World Ecosystems (WE1.4)*. Digital Raster Data on a 10-minute Geographic 1080x2160 grid. In: *Global Ecosystems Database, Version 1.0: Disc A*. Boulder, CO: National Geophysical Data Center. 3 independent single-attribute spatial layers on CD-ROM, 5 MB.

ANALYST(s): Jerry S. Olson and Lee Stanley, NGDC, Boulder, Colorado

PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).

SPATIAL REPRESENTATION:

WE1.3A: 30-minute characteristic classes on a 30-minute grid
WE1.4D: mixed 30-minute and 10-minute characteristic classes on a 10-minute grid
WE1.4DR: 10-minute cell labels

TEMPORAL REPRESENTATION: Modern composite

DATA REPRESENTATION:

WE1.3A: single-byte integer codes for 29 major ecosystem/landscape groups.
WE1.4D: single-byte integer codes for 73 detailed ecosystem/landscape types.
WE1.4DR: single-byte integer cell labels for WE1.4D resolution.

LAYERS AND ATTRIBUTES: 3 independent single-attribute spatial layers

COMPRESSED DATA VOLUME: 215,231 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Olson, J.S., J.A. Watts, and L.J. Allison. 1985. Major World Ecosystem Complexes Ranked by Carbon in Live Vegetation: A Database. NDP-017. Carbon Dioxide Information Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee.
* Olson, J.S., J.A. Watts, and L.J. Allison, 1983. Carbon in Live Vegetation of Major World Ecosystems, Report ORNL-5862, Oak Ridge Laboratory, Oak Ridge, Tennessee. (Incorporated in NDP-017, cited above)

ADDITIONAL REFERENCES (Also see references on page A05-36)

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*Olson, J.S., 1982. "Earth's Vegetation and Atmospheric Carbon Dioxide," in Carbon Dioxide Review: 1982. Ed. by W.C. Clark, Oxford University Press, New York, pp. 388-398. (Incorporated in NDP-017, cited above)
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DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	OWE13A.IMG	1 file	259,200
\GLGEO\RASTER\	OWE14D.IMG	1 file	2,332,800
\GLGEO\RASTER\	OWE14DR.IMG	1 file	2,332,800
Headers:			
\GLGEO\META\	OWE13A.DOC	1 file	2,611
\GLGEO\META\	OWE14D.DOC	1 file	7,341
\GLGEO\META\	OWE14DR.DOC	1 file	621
Palettes:			
\GLGEO\META\	OWE13A.PAL	1 file	1,947
Time Series:	none		
Volume on Disk:		7 files	4,935,645

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A05\	OW_001.PCX to OW_179.PCX	179 files	5,672,998
	OW_###X.PCX	21 files	1,133,902
Volume on Disk:		200 files	6,806,900

SOURCE EXAMPLE FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\SOURCE\RASTER\	OWE14.IMG	1 file	2,332,800
Headers:			
\SOURCE\META\	OWE14.DOC	1 file	4,947
Volume on Disk:		2 files	2,337,747

DATA ELEMENT: World Ecosystems (WE1.3A)

STRUCTURE: Raster Data File: 30-minute 720x360 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

OWE13A.DOC

```
file title   : Olson World Ecosystems Version 1.3A
data type    : byte
file type    : binary
columns      : 720
rows         : 360
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.5000000
min. value   : 0
max. value   : 29
value units  : classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 30
```

Legend:

```
category  0 :  0 OCEAN/SEA Oceans, Seas (including Black Sea)
category  1 :  1 CONIFOR  Conifer Forest
category  2 :  2 BRODLFOR Broadleaf Forest: temperate, subtropical drought
category  3 :  3 MIXEDFOR Mixed Forest: conifer/broadleaf; so. Boreal
category  4 :  4 GRASSHRB Grassland +/- Shrub or Tree
category  5 :  5 TROPICFR Tropical/subtr. Forest: montane, seasonal,
                 rainforest
category  6 :  6 SCRUBWDS Scrub +/- Woodland &/or fields
                 (evergreen/decid.)
category  7 :  7 SEMIDTUN Semidesert shrub/steppe; Tundra (polar, alpine)
category  8 :  8 FLDWDSAV Field/Woods complex &/or Savanna, tallgrass
category  9 :  9 NORTAIGA Northern Boreal Taiga woodland/tundra
category 10 : 10 FORFDREV Forest/Field; Dry Evergreen broadleaf woods
category 11 : 11 WETLAND  Wetlands: mires (bog/fen); marsh/swamp +/-
                 mangrove
category 12 : 12 DESERTS  Desert: bare/alpine; sandy; salt/soda
category 13 : 13 SHRBTRST Shrub/Tree: succulent/thorn
category 14 : 14 CROPSETL Crop/Settlement (irrigated or not)
category 15 : 15 CONIFRFC Conifer snowy Rainforest, coastal
category 16 : 16          not used
category 17 : 17          not used
category 18 : 18          not used
```

```
category 19 : 19 MANGROVE Mangrove/wet forest/thicket + tidal flat
category 20 : 20 WALANCST Water (~51-90%) & Land, Coast/hinterland
                 complexes
category 21 : 21          not used
category 22 : 22          not used
category 23 : 23 ISLFRING Island or Fringe land (91-99% water)
category 24 : 24 LANDWATR Land/Water (~21-50%) complexes
category 25 : 25 ICE      Ice: Glaciers & emerging rocks near fringe
category 26 : 26 POLARDES Polar Desert
category 27 : 27 WTNDMHTH Wooded Tundra Margin; Heath/moorland
category 28 : 28          not used
category 29 : 29 INLDWATR Inland Water bodies (including Caspian Sea)
```

Notes:

(1) Comment: 14 Major Ecosystem classes and 8 fringe classes, plus Ocean

(2) Lineage: Derived from WE1.4D by editing, aggregating classes, and modal filtering to .5-degree. Also used FNOC % water for fringe classes (FNOCWAT in Chapter A13).

(3) Completeness: .5-degree coverage complete for land areas, based on WE1.4D

(4) Consistency : All values represent spatial dominance at .5-degree

DATA ELEMENT: World Ecosystems (WE1.4D)

STRUCTURE: Raster Data File: 10-minute 1024x2160 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

OWE14D.DOC

```
file title   : Olson World Ecosystem Classes Version 1.4D
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : mixed .167|.5
min. value   : 0
max. value   : 73
value units  : classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 74
```

Legend:

```
category  0 : Waters, including Ocean and Inland Waters
category  1 :  1   CCX    City complexes--being added for MM4 type cat.1
category  2 :  2   SSG    Short or Sparse Grass/shrub of semiarid climates
category  3 :  3 Not used
category  4 :  4 Not used
category  5 :  5 Not used
category  6 :  6   TBE       Temperate/Tropical-montane Broadleaf
                             Evergreen covers warm temperate or montane
                             broadleaf evergreen forest [Africa only]
category  7 :  7 Not used
category  8 :  8   DMB    Desert, mostly bare stone, clay or sand
category  9 :  9 Not used
category 10 : 10 Not used
category 11 : 11 Not used
category 12 : 12 Not used
category 13 : 13 Not used
category 14 : 14 Not used
category 15 : 15 Not used
category 16 : 16  {BES}      Broadleaf Evergreen Scrub, commonly with #46
                             and #47
category 17 : 17   ICE    Antarctic ice cap
category 18 : 18 Not used
category 19 : 19 Not used
category 20 : 20   SRC    Snowy, rainy coastal conifer
category 21 : 21   MBC    Main Boreal conifer forest, closed or open
```

category 22 : 22	SNB	Snowy non-Boreal conifer forest
category 23 : 23	CDF	Conifer/deciduous, snow persisting in winter
category 24 : 24	TBC	Temperate Broadleaf/Conifer forest: with deciduous and/or evergreen hardwood trees
category 25 : 25	SDF	Snowy Deciduous Forest, i.e. summergreen (=cold-deciduous) types
category 26 : 26	TBF	Temperate broad-leaf forest: deciduous, semideciduous, and some temperate-subtropical broadleaf evergreen types that are least active in winter.
category 27 : 27	NSC	Non-snowy conifer forest
category 28 : 28	TMC	Tropical montane complexes, typically evergreen, including dwarfed ("elfin") forest, opening to grass, or tall or short forbs (puna, paramo)
category 29 : 29	TBS	Tropical Broadleaf Seasonal, with dry or cool season
category 30 : 30	CFS	Cool Farmland & Settlements, more or less snowy
category 31 : 31	MFS	Mild/hot farmland & settlements
category 32 : 32	RGD	Rain-green (drought-deciduous) or very seasonal dry evergreen forests to open woodlands, very frequently burned.
category 33 : 33	TRF	Tropical RainForest
category 34 : 34	Not used	
category 35 : 35	Not used	
category 36 : 36	PRA	Paddy rice and associated land mosaics
category 37 : 37	WCI	Warm/hot cropland, Irrigated extensively
category 38 : 38	CCI	Cool cropland with Irrigation of variable extent
category 39 : 39	CCP	Cold cropland and pasture, irrigated locally
category 40 : 40	CGS	Cool grass/shrub, showy in most years
category 41 : 41	MGS	Mild/warm/hot grass/shrub
category 42 : 42	CSM	Cold steppe/meadow +/- larch woods (in Siberia), scrub (Bering sea) or tundra (Tibetan highland)
category 43 : 43	SGW	Savanna/Grass, seasonal woods: Trees or shrubs above grass groundcover may be interspersed on many scales in savana belts of varying drought duration and high fire frequency
category 44 : 44	MBF	Mires include peaty Bogs and Fens (mostly in high latitudes)
category 45 : 45	MOS	Marsh or other swampy wetlands include various transitionsto or mixtures with trees
category 46 : 46	MES	Mediterranean-type Evergreen (mostly) broadleaved Scrub and forest relics
category 47 : 47	DHS	Dry or highland scrub, or open woodland
category 48 : 48	DEW	Dry Evergreen Woodland or low forest, mapped mostly in interior Australia and South America
category 49 : 49	HVI	Hot-mild volcanic "islands" (Galapogos), with local denser forest on some older lava flows but wide areas of sparse cover on recent lavas)
category 50 : 50	SDB	Sand Desert, partly Blowing dunes
category 51 : 51	SDS	SemiDesert/Desert Scrub/succulent/sparse grass
category 52 : 52	CSS	Cool/cold shrub semidesert/steppe
category 53 : 53	TUN	Tundra (polar, alpine)

category 54 : 54	TER	Temperate Evergreen Rainforest (e.g., in Chile)
category 55 : 55	SFW	Snowy Field/Woods complex
category 56 : 56	FFR	Forest/Field complex with Regrowth after disturbances, mixed with crops and/or other non-wooded lands
category 57 : 57	SFF	Snowy Forest/Field, commonly openings are pasture and/or mires
category 58 : 58	FWG	Field/Woods with Grass and/or Cropland
category 59 : 59	STW	Succulent and Thorn Woods or scrub is widespread
category 60 : 60	SDT	Southern Dry Taiga or similar aspen/birch with northern and/or mountain conifers
category 61 : 61	LT	Larch Taiga with deciduous conifer
category 62 : 62	NMT	Northern or maritime taiga typifies a wide latitude belt or a narrow altitude belt above denser forest or woodland
category 63 : 63	WTM	Wooded tundra margin or mountain scrub/meadow)
category 64 : 64	HMW	Heath and Moorland, Wild or artificially managed, as by burning and/or grazing. Can include wetland (#44-45) interspersed with drier heath, with dwarfed or taller, commonly dense scrub on peat or sand
category 65 : 65	CNW	Coastal: NorthWest quadrant near most land
category 66 : 66	CNE	Coastal: NorthEast quadrant near most land
category 67 : 67	CSE	Coastal: SouthEast quadrant near most land
category 68 : 68	CSW	Coastal: SouthWest quadrant near most land
category 69 : 69	PDL	Polar desert with rock Lichens, locally abundant or productive (even between mineral grains) but provide little food. Animals import residues for localized humus
category 70 : 70	GLA	Glaciers in polar or alpine complex, with rock fringes
category 71 : 71	SSF	Salt/soda flats desert playas, occasionally with intermittent lakes
category 72 : 72	MSM	Mangrove and non-saline swamps and tidal Mudflats [Africa only]
category 73 : 73	ISL	Islands and shore waters in oceans and/or lakes [Elba Island]

Notes:

(1) Data represent mixed 0.5-degree and 10-minute classes (see WE1.4DR)

(2) In refining low vegetation classes (desert, etc.) an average of the monthly MG-GVI data over 3 years was used. The actual multi-year average is not provided for intercomparison, however it can easily be reproduced from the Characteristic Month Averages in Chapter A01.

(3) In refining coastal values, an "ocean mask" was used, which was derived from the FNOC elevation data-set. Since this mask itself may have errors, the mask is provided with the FNOC data-set for intercomparison (see Chapter A13).

(4) comment: not all classes are used.

(5) comment: This version is a refinement of WE1.4. Changes include:
  (1) Trimmed desert and bare ground using AVHRR/GVI data
  (2) Trimmed coastline areas using elevation data
  (3) Added Elba Island
  (4) Corrected mis-located tropical montane classes
  (5) Other miscellaneous corrections

(6) The data file named OWE14R provides an overlay to determine which cells contain 10-minute and 30-minute data.

(7) Derived from Olson World Ecosystems Version 1.4 (prototype)

(8) Version 1.4 was an extension of Version 1.2, previously distributed by CDIAC, Oak Ridge National Laboratory

(9) 10-minute updates are incomplete. Complete coverage of land areas is achieved by a mix of 10-min and 30-min classes.

DATA ELEMENT: World Ecosystems (WE1.4DR)

STRUCTURE: Raster Data File: 10-minute 1024x2160 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

OWE14DR.DOC

```
file title   : Resolution codes for OWE1.4D
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : 0
max. value   : 2
value units  : classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 3
```

Legend:

```
category  0 : 30' data
category  1 : 10' edits
category  2 : 10' residuals from edited regions
```

Notes:

(1) Produced from edits of WE1.4D

(2) This layer is provided as an index or overlay to determine which values in the WE1.4D have 10-minute spatial meaning and which have 30-minute spatial meaning. It can be used to divide the 10-minute and 30-minute data into separate data layers, if desired.

(3) "Residuals" are 10-minute cells within a 30-minute major ecosystem type cell that were "orphaned" when other cells in the 30-minute region were edited. They are coded as having 10-minute spatial interpretation only if they cover less than 1/2 the 30-minute cell (i.e., "non-modal")

SOURCE ELEMENT: World Ecosystems (WE1.4)

STRUCTURE: Raster Data File: 10-minute 1024x2160 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

OWE14.DOC

```
file title   : Olson Ecosystem Classes Version 1.4
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : 0
max. value   : 72
value units  : classed
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 73
```

Legend:

```
category  0 :  0          Waters,  including Ocean and Inland Waters
category  1 :  1   CCX    City complexes--being added for MM4 type cat.1
category  2 :  2   SPV    Shortgrass prairie variant of 40 or 41
category  3 :  3 Not used
category  4 :  4 Not used
category  5 :  5 Not used
category  6 :  6   TMT    Temperate to montane tropical (major forest and
                          woodland)
category  7 :  7 Not used
category  8 :  8   DMB    Desert, mostly bare
category  9 :  9 Not used
category 10 : 10 Not used
category 11 : 11 Not used
category 12 : 12 Not used
category 13 : 13 Not used
category 14 : 14 Not used
category 15 : 15 Not used
category 16 : 16 Not used
category 17 : 17   ICE    Antarctic ice, land or grounded shore ice
category 18 : 18 Not used
category 19 : 19 Not used
category 20 : 20   SRC    Snowy, rainy coastal conifer (with alder etc.)
category 21 : 21   MBC    Main Boreal conifers
category 22 : 22   SNB    Snowy non-Boreal conifer forest
category 23 : 23   CDS    Conifer/deciduous, snow persisting in winter
category 24 : 24   SED    (semi) Evergreen/deciduous, little/no snow
```

category 25 : 25	SDF	Similar to 26, snow persisting in winter
category 26 : 26	TDF	Temperate ~deciduous forest, little or no snow
category 27 : 27	NSC	Non-snowy conifer forest
category 28 : 28	TMC	Tropical montane complexes (tree & other)
category 29 : 29	TSF	Tropical seasonal forest (~evergreen...) (major forest/woodland)
category 30 : 30	CFS	Cool farmland & settlements (~snowy)
category 31 : 31	MFS	Mild/hot farmland & settlements
category 32 : 32	RGD	Rain-green (drought-deciduous) (major forest and woodland)
category 33 : 33	TRM	Tropical rainforest (major forest and woodland)
category 34 : 34	Not used	
category 35 : 35	Not used	
category 36 : 36	PRA	Paddy rice and associated lands (part anaerobic)
category 37 : 37	WCI	Warm/hot crops with extensive irrigation
category 38 : 38	CCI	Cool crops with irrigation (variable extent)
category 39 : 39	CCP	Cold crops, pasture, irrigation ~local
category 40 : 40	CGS	Cool (snowy) grass/shrub (including much 2)
category 41 : 41	MGS	Mild/warm/hot grass/shrub
category 42 : 42	CSM	Cold steppe/meadow +/- larch, scrub
category 43 : 43	STB	Savanna, mostly tallgrass + bush fallow/woods
category 44 : 44	MAG	Mire (acid bog &/or groundwater-fed fen), ~cold peatland (or muck): sphagnum, grass-like, and/or dwarf shrub or mire tree vegetation
category 45 : 45	MOS	Marsh or other swamp (warm-hot) salty/freshwater marsh, thicket, ~flooded woods
category 46 : 46	MET	Mediterranean evergreen tree/scrub (winter rain)
category 47 : 47	ODH	Other dry or highland scrub/tree (juniper, etc.)
category 48 : 48	EAQ	Eucalyptus or Acacia, quebracho, saxaul
category 49 : 49	HVI	Hot-mild volcanic "islands" (variable veg.)
category 50 : 50	SDB	Sand desert, partly blowing
category 51 : 51	ODS	Other desert and semidesert
category 52 : 52	CSS	Cool/cold shrub semidesert/steppe (sagebrush...)
category 53 : 53	TUN	Tundra (polar, alpine)
category 54 : 54	TRC	Temperate rainforest (+/- conifer) (major forest and woodland)
category 55 : 55	SCW	Similar to 58: cool-cold (~persistent snow)
category 56 : 56	RWC	Regrowing woods + crop/grass
category 57 : 57	SWC	Similar to 56: cool-cold (~persistent snow)
category 58 : 58	GCW	Grass/crop + <40% woods: warm, hot
category 59 : 59	STW	Succulent and thorn woods
category 60 : 60	SDT	Southern dry taiga (and other aspen/birch, etc.)
category 61 : 61	SLT	Siberian larch taiga [partly other taiga 21]
category 62 : 62	NMT	Northern or maritime taiga/tundra
category 63 : 63	WTM	~Wooded tundra margin (or mt. scrub, meadow)
category 64 : 64	HMW	Heath and moorland, wild or artificial (~grazed)
category 65 : 65	NW	NW quadrant near most land (...mainland, large island, ...)
category 66 : 66	NE	NE quadrant near most land (peninsula, small islands, ...)
category 67 : 67	SE	SE quadrant near most land (...or isthmus)
category 68 : 68	SW	SW quadrant near most land
category 69 : 69	PDL	Polar desert (rock lichens)
category 70 : 70	GLA	Glaciers (other polar and alpine)
category 71 : 71	SSF	Salt/soda flats (playas, lake flats rarely ~wet)
category 72 : 72	MSM	Mangrove swamp/mudflat [Africa only]

NOTES:

(1) Data represent mixed 0.5-degree and 10-minute classes

(2) This data set is the one that was contributed for the 1992 International Space Year (ISY) Global Change Encyclopedia (GlobeScope). It is included here for comparison to the subsequent versions produced by Jerry Olson and incorporated into GED Version 1.0, but also to provide a link between these newer versions and the ISY discs. Both data and legends have changed in the newer versions.

DATA INTEGRATION AND QUALITY

Jerry Olson
Global Patterns Company
Lenoir City, Tennessee

John J. Kineman, Mark A. Ohrenschall, and Jeffrey D. Colby
NOAA Natioinal Geophysical Data Center
Boulder, Colorado

PREFACE (Jerry Olson, April 22, 1992)

Several years spent before and after my 1985 early retirement from Oak Ridge National Laboratory (ORNL) in Tennessee brought together ideas and data on global patterns of ecological systems (ecosystems). Patterns previously mapped by large computers (Olson et al. 1983, 1985) are now made available, with improvements, for personal computers (PCs).

Parts of 3 years in Europe (1985-88) and in Western States and the Pacific (1988-91) helped improve my World Ecosystems database. It was licensed for the National Center for Atmospheric Research (NCAR), in Boulder, Colorado, to help set the parameters for calculating air-landscape interaction in a new Community Climate Model (CCM2, in NCAR's Climate and Global Dynamics Division, CGD). Soon NCAR's Atmospheric Chemistry Division (ACD) started using the 1989 version for estimating chemical contributions from plants or fires to air (Müller 1992).

In Boulder, I also started refining the half-degree resolution of my previous worldwide grid (WE1.2: 720 columns x 360 rows of picture elements or pixels to 10-minute resolution, initially for a pilot project chosen for Africa by the World Data Center-A). WDC-A's host, the National Geophysical Data Center of the National Oceanic and Atmospheric Administration (NGDC/NOAA), meanwhile was distributing other data, using the larger capacity of compact disks.

During the beta test (outside checking) of NOAA's Global Ecosystem Database (GED) in late 1991 I compared my mapping with the index of greenness estimated from NOAA's meteorological satellites and with GIS layers contributed by others. The combined features WE1.4D show more than any data layer could alone about global patterns. But they also emphasize a problem we face repeatedly--striving for breadth of global coverage while working toward depth of data layers, and eventually of understanding, and of actions to improve our world. The grouping of types in WE1.3A (section 2 below) is a step toward handling such breadth and depth together.

Acknowledgement: I thank Lee Stanley of GPC and Mark Ohrenschall, John Kineman, and David Hastings of NGDC/NOAA and WDC-A. We used Idrisi Geographic Information System (GIS) software version 3.0 from Ron Eastman, Clark University, Worcester, Massachusetts, 01610; version 4.0 was not available during this work.

INTRODUCTION

This report explains how the World Ecosystem data-set version 1.4D (WE1.4D), and version 1.3A (WE1.3A) were produced from previous versions, and how they describe land parts of Earth's sphere of life, or Biosphere.

Detailed ecosystem types (0-73) in WE1.4D, at both 10-minute and 30-minute resolution, are related to the broader Main Groups of ecosystem types (0-29) in WE1.3A, at 30-minute resolution. The land Groups include forests of conifer, broadleaved, mixed, and mostly tropical moist broadleaved (mostly evergreen) types. Other mixtures include: grass-shrub, shrub-tree, semidesert and tundra, field/woods and savanna, northern taiga, forest/field and dry evergreen woods, wetlands, desert, succulent/thorn woods, crop and settlements, and other (ice and fringe) types.

Since WE1.4D incorporates data at mixed resolutions (10 and 30 minutes lat/long), a separate data element (OWE14DR) is provided with resolution codes for the main file (OWE14D). A special palette file (OWE13A.PAL) is provided for the WE1.3A data, mostly for convenience in recognition of some conventional color assignments.

HISTORY OF THE OLSON DATA SET

The original version (1.0) of the Olson Ecosystems data set was produced for the DOE Carbon Dioxide Information and Analysis Center in Oak Ridge Tennessee by Jerry S. Olson, Julia A. Watts, and Linda J. Allison. Reprints of the Primary Documentation from this work are included on disc (see Reprint Files, above), and should be consulted for detailed information on the creation of these data and their use of estimating carbon content.

DATA UPDATING PROCEDURES FOR THE 1991 PROTOTYPE (WE1.4)

During the summer of 1989, Jerry Olson, Lee Stanley and research assistants from the National Geophysical Data Center updated the data set, "Major World Ecosystem Complexes Ranked by Carbon in Live Vegetation: A Database." The results of this update have been incorporated into Olson World Ecosystem WE1.4.

Data were revised at both 30 and 10 minute grid cells. Changes were first made for the 30 minute data between 20 degrees West and 70 degrees East. In addition, modifications were made to limited portions of the United States data. Revisions were made in the following ecological classes:

(1) tropical forest (type 33)
(2) polar deserts (type 69)
(3) ice (type 70)
(4) a few areas of mangrove/tropical swamp forest (type 72)

Updates for the United States were quite limited and affected mostly the islands and coastlines of Alaska. To a lesser extent changes were made along the western and eastern coastlines of the lower 48 states.

Modifications at 10 minute resolution were numerous, but were confined to the African continent and some coastlines. They included changes in tropical montane complexes (type 28), boradleaved evergreen forest types at high altitudes with cool climates despite tropical latitudes (type 6), for example Cameroon, Ethiopia, and other areas of East Africa and some in the Atlas Mountains; mangrove tropical swamp forests (type 72), and coastlines. Salt/soda flats (type 71) were not systematically reviewed but received sample editing.

SUBSEQUENT EDITING FOR WE1.3A AND WE1.4D

Greenness indices from Advanced Very High Resolution Radiometer (AVHRR) satellite data were used in certain desert and coastal ecosystems. WE1.4D is a first step toward global resolution at 10 arc-minutes, replacing a test version called GOLSON in GED Prototype (Version 0.1). Most of the main land cover complexes are still effectively mapped at 30′ (half-degree) scale in WE1.4D. Ten arc-minute (10′) improvements are mostly limited to areas with low greenness indices from NOAA satellites and, in Africa, to mangrove (type #72) and mountain complexes (#6, 28). Conditions of high and intermediate greenness are important, but have quite different meanings in different parts of the biosphere.

The quality of basic geographic data is very uneven from various parts of the world. The computer media becoming available from the NOAA National Geophysical Data Center/World Data Center-A (WDC-A) and from Global Patterns Company (GPC) provide worldwide coverage of many features that can be quantified for interpreting changes of climate and atmospheric chemistry and many feedbacks on life.

Ten-minute mapping of certain landscape types was donated in 1989 for NGDC's Africa Pilot Project for the IGBP, as one testing step of GPC. Yet comparable refinement to 10′ has not yet been done evenly on any continent. The main patterns of the Olson World Database for the NOAA CD-ROM in 1992 (GED) still have the same half-degree resolution as the 1982 printed map of Olson and Watts (~75 x 150 cm: enclosed with and documented by Olson et al. 1983, and the 1985 re-release of the same report with computer-readable data by Oak Ridge National Laboratory, ORNL). ORNL's Carbon Dioxide Information and Analysis Center (CDIAC contact: Tom Boden) will continue to distribute such maps, and the Olson et al. (1985) Numeric Data Set 017, which is called WE1.2 in the Global Patterns numbering series.

MAIN LANDSCAPE GROUPS AND ECOSYSTEM TYPES

The documentation file OWE14D.DOC gives the detailed category legend for WE1.4D, modified slightly from that of the test version (GOLSON) prepared in 1989 for testing in 1990-91. Closely related types from WE1.4D are put in GROUPS, with Group numbers, in the two sections below (A-main types, and B-selected "fringe" types). These MAJOR GROUPS and numbers were used to create a new 30-minute data file (WE1.3A).

The narrower type numbers of WE1.4D are listed below each Major Group description. Brackets [] enclose those legend numbers that are still applied very unevenly. Braces {} foretell more subdivisions, not yet used or even explained here. This list is expanded slightly from previous ORNL reports (Olson et al. 1983, 1985), with additions between 0 and 19, and above 71. Readers should consult GPC and references just cited for more explanation. Readers should be forewarned that the Canadian Centre for Remote Sensing (CCRS) compact disk will use an intermediate version, renumbered to omit certain numbers that were deliberately skipped here. Despite potential confusion in numbering sequence between CCRS and other releases, the three-LETTER mnemonic codes given below between old (ORNL/GPC/NOAA) numbers and titles should clarify the match with the ISY Global Change Encyclopedia (GeoScope).

The Group sequence below is arranged to take advantage of a standard IBM color palette for either the Enhanced Graphic Adapter (EGA), or Video Graphics Adapter (VGA). Thus, some color conventions (e.g. purple for tropical moist forest) follow the UNESCO vegetation committee suggestions or our older ORNL printed map (Olson and Watts 1982). In most printing, black on the video screen (0) is replaced with pale background for the ocean (e.g. pale cyan). A 16-color IDRISI color palette is provided that retains the IBM color scheme with this minor change to the background (OWE13A.PAL).

MAJOR GROUP (OWE13A)		DESCRIPTION

A. Main LAND GROUPS of Ecosystem Complexes (1-14):

(0) SEAS — Oceans, Mediterranean Sea, Black Sea

FORESTS:

(1) CONIFOR — CONIfer FORest here stands for all complexes dominated by coniferous trees (evergreen or deciduous, in snowy climate or not), except for the coastal fringe below (i.e. group 15 type 20 in section 2B):

WE1.4D classes grouped here:

#21	MBC	Main Boreal Conifer forest, closed or open;
#22	SNB	Snowy Non-Boreal conifer forest;
#27	NSC	Non-Snowy Conifer forest.

(2) BRODLFOR — BROADLEAF FORest of temperate and seasonally dry ~subtropical (rain-green or partly drought-deciduous) groups (#32 for the latter).

WE1.4D classes grouped here:

#25	SDF	Snowy Deciduous Forest, i.e. summergreen (= cold-deciduous) types;
#26	TBF	Temperate Broadleaf Forest: deciduous, semideciduous, and some temperate-subtropical broadleaf evergreen types that are least active in winter. (The latter could be shifted to type #6 and perhaps to group 5 later, in order to get more broadleaf evergreen types together.)
[#6]	TBE	Temperate/Tropical-montane Broadleaf Evergreen covers warm temperate or montane broadleaf evergreen forest, so far mostly in Africa where our pilot test for 10' started.
#32	RGD	Rain-green (Drought-deciduous) or very seasonal dry evergreen forests to open woodlands, very frequently burned.

(3) MIXEDFOR — MIXED FORest here includes not only deciduous-conifer mixtures, within stands and as mosaics over the landscape, but many gradations toward broadleaved evergreen. Conifers are common, but often uneven; native and/or planted.

WE1.4D classes grouped here:

#23	CDF	Conifer/Deciduous Forest: snow persisting in winter;

#24	TBC	Temperate Broadleaf/Conifer forest: with deciduous and/or evergreen hardwood trees;
[#54]	TER	Temperate Evergreen Rainforests, e.g. in Chile.

For simplicity, southern Boreal (= taiga in Russian) deciduous mixtures with aspen, birch, and/or larch as well as evergreen conifers are included here:

#60	SDT	Southern Dry Taiga, or similar aspen/birch with northern and/or mountain conifers;
#61	LT	Larch Taiga with deciduous conifer.

(4) GRASSHRB GRASS-SHRUB-HERB complexes vary widely in structure, precipitation and temperature. Few trees (mostly sparse, planted, or streamside/ravine patches, if any) break the open horizon. Cropland, especially dryland cereal grains or local irrigation, can be important economically, but is a minor fraction of total land cover/use in most years.

WE1.4D classes grouped here:

[#2]	SSG	Short or Sparse Grass/shrub of semiarid climates;
#40	CGS	Cool Grass/Shrub, snowy in most years
#41	MGS	Mild/warm/hot Grass/Shrub,
#42	CSM	Cold Steppe/Meadow, +/- larch woods (in Siberia), scrub (Bering sea) or tundra (Tibetan highland). (This class might be regrouped with the tundra margin group, especially when better defined at 10′ resolution.)

(5) TROPICFR = TROPICAL/subtropical moist or Broadleaf Humid FORest. Most are evergreen but deciduous forms increase in the subtropics, especially with extreme monsoon droughts.

WE1.4D classes grouped here:

#28	TMC	Tropical Montane Complex, typically evergreen, including dwarfed ("elfin") forest, opening to grass, or tall or short forbs (puna, paramo) above timberline;
#29	TBS	Tropical Broadleaf Seasonal, with dry or cool season;
#33	TRF	Tropical RainForest.

(6) SCRUBWDS SCRUB-WOODS Complexes, often with grass or crops locally, tend to have a dry season and/or pronounced fire. Trees are not always rare, but may be short or open-grown. The bigger ones tend to cluster on favorable substrate or terrain, or near places where fire starts or spreads less often.

WE1.4D classes grouped here:

{#16}	BES	Broadleaf Evergreen Scrub, commonly with the following
#46	MES	Mediterranean-type Evergreen (mostly) broadleaved Scrub and forest relics;
#47	DHS	Dry or Highland Scrub or open woodland.

(7) SEMIDTUN — SEMIDesert or TUNdra. Open shrub or shrub-steppe (low grass) of very dry regions may grade into the preceding groups 5 and 6. Dwarf-shrub or grass-like (graminoid) tundra tends to occur above the altitudes or latitudes of local tree line (see groups 9 and 27 below).

WE1.4D classes grouped here:

#51	SDS	SemiDesert/Desert Scrub/succulent/sparse grass;
#52	CSS	Cool/cold Shrub Semidesert/steppe;
#53	TUN	Tundra (polar, alpine).

(8) FLDWDSAV — FIELD/WOODS mosaic or SAVANNA. Tall grass or crops together often cover more area than forest or woodland in Field/woods:

WE1.4D classes grouped here:

#55	SFW	Snowy Field/Woods complex;
#58	FWG	Field/Woods with Grass and/or Cropland;
#43	SGW	Savanna/Grass, Seasonal Woods: Trees or shrubs above grass groundcover may be interspersed on many scales in savanna belts of varying drought duration and high fire frequency.

(9) NORTAIGA — NORThern TAIGA or SUBALPINE narrow-crowned sparse conifer and/or dwarf deciduous tree/scrub/meadow/wetland mosaics

WE1.4D classes grouped here:

#62	NMT	Northern or Maritime Tiaga typifies a wide latitude belt or a narrow altitude belt above denser forest or woodland.
{#62a}		or a new number might distinguish the subalpine mosaics at lower latitudes.

(10) FORFDREV — FOREst/FIELD or DRy EVergreen mixtures commonly have much broadleaf tree and tall shrub, but conifers pure or mixed (as in group 3) may be important. Nonwooded land is also interspersed, especially where low forest or open woodland is cleared and burned for crops or grazing, and where drought or seasonally wet soil limits establishment or the mature height and density of trees.

WE1.4D classes grouped here:

#56	FFR	Forest/Field complex with Regrowth after disturbances, mixed with crops and/or other non-wooded lands;
#57	SFF	Snowy Forest/Field, commonly openings are pasture and/or mires;
#48	DEW	Dry Evergreen Woodland or low forest, mapped mostly in interior Australia and South America.

(11) WETLAND Mires, Marshes, or Swamps.

WE1.4D classes grouped here:

#44	MBF	Mires include peaty Bogs and Fens (mostly in high latitudes;
#45	MOS	Marsh or Other Swampy wetlands include various transitions to or mixtures with trees.

(Also see group 19 below for #72 mangrove, digitized first for Africa in GED.)

(12) DESERTS ~Mostly Bare, Sandy, or Salt-Soda deserts grade into semideserts (group 7); both have patches interspersed within the other and within dry grassland.

WE1.4D classes grouped here:

#8	DMB	Desert, Mostly Bare stone, clay or sand;
#50	SDB	Sand Deserts, partly Blowing Dunes;
#71	SSF	Salt/Soda Flats: desert playas, occasionally with intermittent lakes.

(13) SHRBTRST SHRUB-TRee, Succulent or Thorn thickets are alternatives to the tree/grass life form strategy response to tropical droughts. Two droughts per year may occur near the equator as rain belts shift north or south; or droughts may persist with little or no relief as in eastern-most Brazil.

WE1.4D classes grouped here:

#59	STW	Succulent and Thorn Woods or scrub is widespread;
#49	HVI	Hot Volcanic Islands presently is used in the Galapogos Islands, which have local denser forest on some older lava flows but wide areas of sparse cover on recent lavas.

(14) CROPSETL CROP/SETTLement/Commercial Complexes include rice and other irrigated cropland (#36; 37-39) and other cropland, with interspersed villages, cities, or industrial areas (#30, 31).

WE1.4D classes grouped here:

#30	CFS	Cool Farmland and Settlements, more or less snowy;
#31	MFS	Mild-hot Farmland and Settlements;
#36	PRA	Paddy Rice and Associated land mosaics;
#37	WCI	Warm-hot Cropland, Irrigated extensively;
#38	CCI	Cool Cropland with Irrigation of variable extent;
#39	CCP	Cold Cropland and Pasture, irrigated locally.

B. Ice, Land-water and Other FRINGES (15-29):

Glacier ice and the following mostly narrow fringe types can be distinguished on a separate video display (pagedown image with Idrisi software using the same color palette as for 0-14). Or a palette with more colors can be defined by the user.

(15) CONIFERFC — CONIFER RAINForest FRinge Coast is here applied to snowy conifer rainforest in a narrow band from the southern Alaska to coastal Washington and Oregon:

WE1.4D classes grouped here:

#20	SRC	Snowy, Rainy Coastal Conifer

(16-18) — temporarily reserved for later uses.

(19) MANGROVE — is separately digitized only for Africa.

WE1.4D classes grouped here:

#72	MSM	Mangrove and non-saline Swamps and tidal Mudflats; may also be common within group 5, 7 or 10.

(20) WALANCST — WAter/LANd mixtures & COASTal SYSTems. Previously mapped mostly as Coast/hinterland complexes:

WE1.4D classes grouped here:

#65	CNW	Coastal: NorthWest quadrant near most land;
#66	CNE	Coastal: NorthEast quadrant near most land;
#67	CSE	Coastal: Southeast quadrant near most land;
#68	CSW	Coastal: Southwest quadrant near most land;
{80}	CWL	Coastal Water/Land (~51-90% water) besides those oriented per #65-68: beach and various dunes, cliff/rock/fjord, and delta complexes as well as inland types are common. Locating such kinds of coastal ecosystems and landscapes are refinements for the future.

(21-22) reserved for later use.

(23) ISLFRING ISLand-shore water FRINGes really just mean >90% water. But in practice this applies mostly to small islands. Edges of islands or mainland may occur, with near-shore ocean or inland water bodies:

WE1.4D classes grouped here:
#73 ISL Islands and shore waters in oceans and/or lakes.

(24) LANDWATR LAND-WATER combinations, with water ~31-50%, include not only additional coastal pixels with more land but also many 10′ land pixels with small lakes or wide rivers or reservoirs.

WE1.4D classes grouped here:
{#74-76} in GPC's extended legend are expected to include complexes with lake and wetland mixtures, alluvial wildlands, floodplain and/or shoreline farms and settlements or ports.

(25) ICE is mostly in Antarctica (#17, or new #12 when the long legend is revised) or Greenland, or in smaller glaciers (#70).

WE1.4D classes grouped here:
#17 ICE Antarctic glacial cap [may be #12 in future versions];
#70 GLA Glaciers in polar or alpine complex, with rock fringes.

(26) POLARDES POLAR "DESert" spans small but somewhat diverse areas where precipitation is low and/or rarely melted as water.

WE1.4D classes grouped here:
#69 PDL Polar "Desert" with rock Lichens, locally abundant or productive (even between mineral grains) but provide little food. Animals depend on nearby waters, and import some residues from their food chains for localized humus.

(27) WTNDMHTH Wooded TUNDra or Moorland-HEATH types

WE1.4D classes grouped here:
#63 WTM Wooded Tundra Margin or mountain scrub/meadow
#64 HMW Heath and Moorland, Wild or artificially managed, as by burning and/or grazing. Moorland conventionally includes wetland (#44-45) interspersed with drier heath, with dwarfed or taller, commonly dense scrub on peat or sand.

(28) reserved for later use.

(29) INLDWATR INLAND WATER here refers to specific lake body pixels in which land is negligible. Otherwise not distinguished from #0 in long legend.

SOURCES

Improved mapping of the main ecosystem groups described above, depends mainly on sources noted in this report and Olson et al. (1983, 1985). Data from these sources helped to improve and sometimes combine current information about global patterns in ecological and landscape systems. WE1.3A and WE1.4D represent examples of doing that using the sources and history outlined below.

A. Maps and Source Data for Numeric Data Package-17 (NDP-017 = WE1.2)

1) Hummel-Reck Database (1978-79).

To aid studies of carbon cycling and climate at ORNL, Hummel and Reck (1979) contributed a computer-readable data-set from General Motors Laboratory. They had digitized a land-use map from Oxford Economic Atlas (Jones 1972; also Cohen 1973). Their main refinement was to add snow duration in one or two quarters of the year (respectively "cool" and "cold") because it strongly affected albedo, or reflectivity of the regional surface affecting their climate models.

2) ORNL Map and Database (1978-85)

The Olson and Watts (1982) map resampled the modified Gall projection of the Oxford Economic Atlas maps to half-degrees in both latitude and longitude. Fig. 1 of Olson et al. (1983) shows our splitting of several categories, especially "grazing lands" and certain forests--especially Boreal (= taiga in Russian) and mosaics of wooded/non-wooded types (see below). The Russian-language Physical-Geographic Atlas of the World was cited by Olson et al. (1983) after Gerasimov, Committee Chairman; Fillipov, the operational Editor is cited as author of the same atlas in NCAR's library in Boulder. Global vegetation map plates were used previously;continental and USSR maps in some of the revisions. Unpublished maps of the former Soviet Union from Natalia Bazilivich are being digitized for NOAA databases by Dmitri Varlyguin at Clark University.

Tropical/subtropical broadleaf humid forest includes extreme "rainforest" and other somewhat seasonal (but not necessarily deciduous) forms. In printing Olson and Watts (1982), blue stipples were inserted over the purple to separate the former type (#33) from the latter (#29). Hand-controlled (red line) printing for mangroves on Olson and Watts (1972) used information from any source. Yet half-degree pixels seem too coarse for digitizing such a "fringe" type of the tropical/subtropical land-saltwater margin. Its type (#72) was added for the ICSU/UNEP project in 1989 when finer 10′ pixels were first incorporated.

B. Early revisions by Olson (Global Patterns Company)

1) Europe (1985-88)

In October-November 1985, visits to the European Space Agency (ESA) found much remote sensing information at laboratories in Frascati and Ispra, Italy that was useful for ecosystem mapping. From late May 1986 to 1987, cross-checking of maps in Sweden, Belgium, Netherlands, Germany, Denmark, Norway, and Iceland showed more possible refinements than have been used so far. In July 1987, botanical fieldwork included Greece.

In April and June-July, 1988, two trips to Austria were added to different routes in Sweden and Germany. At the International Institute for Applied Systems Analysis (IIASA, at Laxenburg, near Vienna), a data-set organized for analysis of acid deposition quantified percentages of forest and total land, but for grid cells of 0.5 degrees latitude x 1 degree longitude.

2) USA and Pacific (especially 1987-91)

Browsing in libraries and research laboratories in Asia, Australia and New Zealand and the USA as well as Europe, showed many more maps or articles than can be cited. Observations were recorded on diverse base maps, many of which have schematic overlays of green showing forest or tree cover. Some provide much finer resolution than maps at a national to global level and also suggest mosaic combinations: Forest/field has most continuity between the main wooded parts of a patchwork. Field/woods has more continuity between croplands, grasslands or other non-wooded land categories than between forest/woodland patches (woodlots, plantations, regrowing forests--commonly degraded by thinning, grazing, or fire).

The triangle diagram shown below as Figure 1 (from Olson et al. 1983) ideally suggests 60 per cent nonwoods component for separating Field/woods (above) from more evenly divided Forest/field (40-60% nonwoods parts of the mosaic). Below that level Olson divides broadleaved (or more concisely broadleaf) forest or woodland (>75% of the woods stand area), from broadleaf/conifer mixed woods (25-50% conifer), and a wider band called conifer (>50% conifer).

Broadleaf gradations above or below 25% may be recognized but are less commonly mapped. This tradition reflects common attribution of more economic value to "softwood" forest products or of more ecological/biophysical indicator value to percent conifer than "hardwood" when in mixtures.

Where trees are sparse and/or dwarfed by cold, drought or other stress, tall or dense scrub may be included in green overlay: e.g. my groups 6 and 13. Olson's use of the term "woods," like "the bush" in Australia, is a broad grouping, ranging from such shrubby low growth to closed or open forest, of tall, medium, or low stature.

The Cairns and Brisbane-Cooloola areas of Queensland, were visited in September, 1990, and southeastern New South Wales in October-December. As in Australia, New Zealand broadleaf woods are mostly evergreens (southern beech, Nothofagus, and many others). These could be separated in new types when the Olson legend is being extended instead of being simplified as in this report. {Type #77 will be for southern conifers (Podocarpus, etc.) and/or planted Pinus alternating with broadleaved forest, fjords, and glaciated peaks; #78 for forest that is tall (>30 m) and/or dense (>70% foliage cover); #79 for other Eucalyptus forest (30-70%.}

In Japan, several agencies are active in developing imagery for sample localities. The Institute of Agro-environmental Research in the science city Tsukuba (northeast of Tokyo) has data files directly relevant to grazing and some tree crops as well as to farming. Forestry records also have potential, and a national land digital database (of land use and elevation) for planning may be even more helpful, with pixels at a level of 10 km.

Much finer resolution is available in most countries of the world but many questions remain about how to shift from "thinking locally" to mapping and thinking globally.

METHODS

Showing just one land type or group for all nine 10′ subcells in one half-degree cell is commonly a simplification of the real world. Yet heterogeneous regions may have one main category taken as representative: a "winner" among competing nominee types. The "runner-up" candidates may be winners in other cells or blocks. The hope is that suitable proportions of all types used in modeling the environment of a wider surrounding area, or the whole planet, will average out. But wetland, mountain summit and some other types often occur only in minor proportions. These may be under-represented by weighting schemes in which "winner takes all."

Shifts toward finer resolution (e.g. from the 30′ grid called WE1.3A to 10′ pixels of WE1.4D) are partly justified to overcome or avoid such bias, as well as to refine boundary shapes. An attempt was made to compensate by including "representatives-at-large" among the mapped pixels--located in places where the minority type is relatively important but not necessarily the single commonest type or group.

During processing, a 30′ cell may be temporarily flagged with a minor type instead of losing the latter's identity and approximate location completely. Later editing ought to

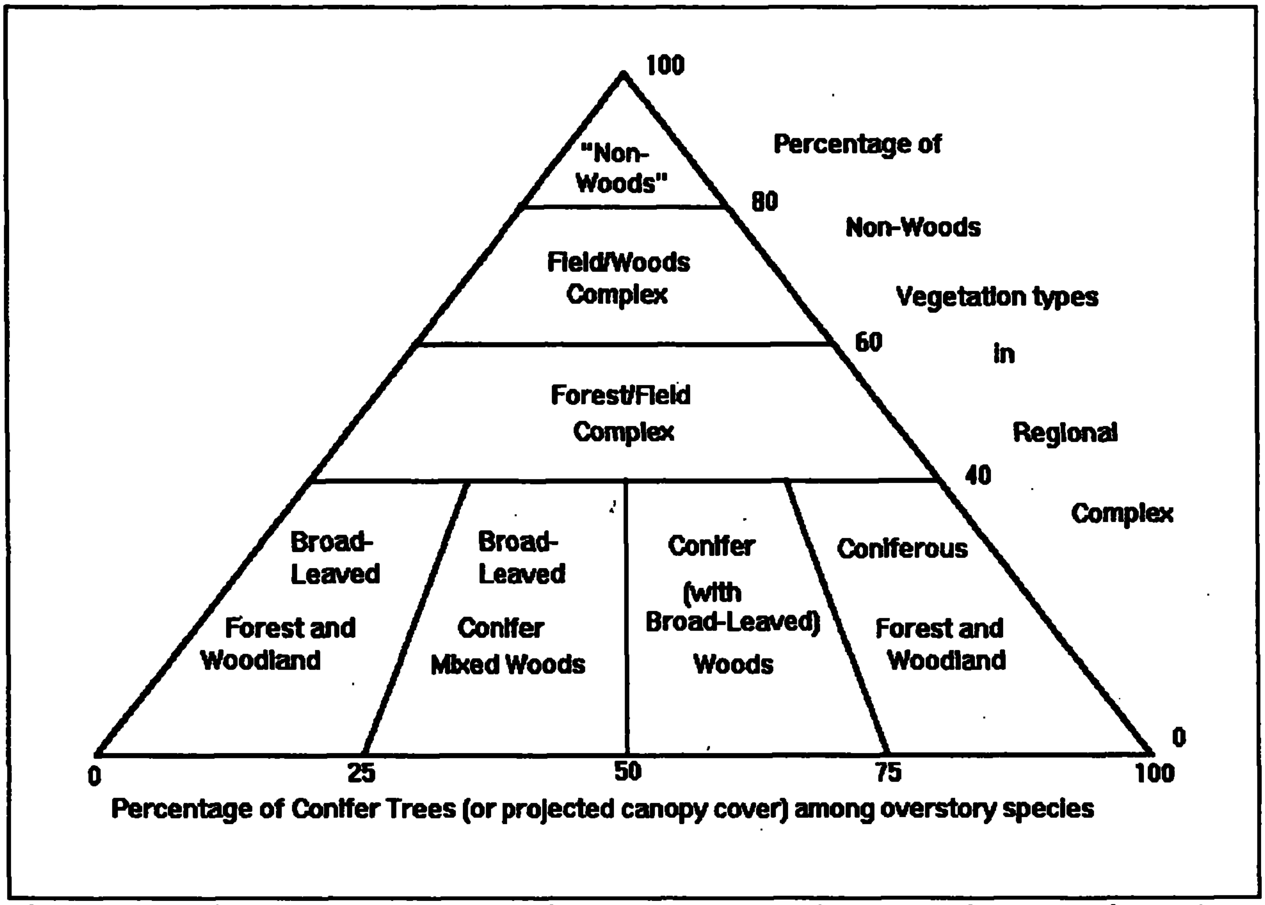

Figure 6 Approximate relations of tree cover, regional percent of non-tree formations, and major kinds of forest, interrupted woods, and non-woods systems. (from ORNL-DWG-81-9450, Oak Ridge National Laboratory)

show which 10′ subcell(s) deserve the less common labels when most become reassigned like their commoner neighbors.

Techniques of map or database improvement include digitizing from paper map sources or adapting global database information that is already computer-readable. Both approaches are essential, but the emphasis may shift as work progresses. Early editing of data has used only a fairly small fraction of the possible refinements. WE1.4D illustrates using data already digitized from satellites.

In 1989 the new digitizing of shore types (especially mangrove, #72) and montane tropical complexes (#28 and/or #6) used the ocean mask and altitude files from the FNOC Terrain data-set [Chapter A13 in this volume], as improved by Roy Jenne and Dennis Joseph of NCAR and John Kineman of NOAA. For Africa, the proper elevation for montane rainforest was found to be only adjacent to where it had been marked on Olson and Watts (1982). Altitude data, first at 30′ and then 10′ resolution also clarified where the Olson data had correctly included the peak or where it had originally lacked enough location control to do so. The real refinements at 10′ are mostly limited to the few types just mentioned and others which happen to have low greenness.

A. Editing from previous maps and diverse sources

For Africa, earlier 30′ type locations were first refined manually where available maps or references allowed. Then the 30′ grid was expanded 3-fold in both coordinates. That meant fewer 10′ pixels needed to be fixed along the edges or within a 3x3 array of identical values--compared with editing all 9 values independently. However, pending such follow-up checking at 10′, mountain labels may be left temporarily pinned on some pixels in a valley or on a plain or plateau below altitudes defining the real peak(s).

Much of the 1989 editing was done with Wordstar-2000, convenient (though tedious) for dealing with single cells or data strings in large files. Within Idrisi, substituting of new values for old ones was also applied not only to points, rows, or columns, but to rectangular arrays (commonly 3, 6, or 9 10′ pixels wide, e.g. in case 1, 2, or 3 of the half-minute pixels required large-area correction).

However, the difficulty of mislocating points or boundaries, relative to a sparse printed latitude-longitude net or landmarks, had to be diminished first. This was accomplished by using reference data already digitized in the GED Prototype disk.

B. Associating vegetation and greenness indexes

Indices of vegetation greenness from weather satellites of NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) could be used in several ways. At NASA's Goddard Space Flight Center (GSFC) and the University of Maryland, Koomanoff (1988) used the old Olson et al. (1985: WE1.2) database to show almost normally distributed variations of greenness for some type groups (e.g. her Figs. 4.1 and 4.3). Skewness for other groups (her Figs. 4.2-4.6) and more diversity for others (even distinct peaks of greenness for her Figs. 4.7-4.16) indicated that the lumped groups were heterogeneous, and individual cover types (as originally mapped or refined later) may be significantly more homogeneous.

Those and other Maryland analyses used early AVHRR indices averaged over one whole year. Ignoring medium- and long- infrared channels (#3-5), channel signals 1 and 2 *(0.58-0.68 μm visible; 0.73-1.10 μm near-infrared) are commonly expressed as ratios of* difference/sum of reflectances Ch1 and Ch2: i.e.

$$XVI = (Ch2 - Ch1)/(Ch2 + Ch1) \quad (1)$$

This unscaled index ranges from -0.1 for water, cloud or ice or+/- 0.1 for nearly bare rock or soil to ~0.6 or 0.7 for dense, vigorous vegetation. NOAA then derives integer values rescaled to

NDVI = (XVI+0.05)*350 + 15. (2)

Composite sampling and regridding discards values that are low artificially (due to clouds, haze or dust). Extra bias toward exceptionally green values by this procedure was decreased by saving the last physically acceptable weekly value.

Second generation NOAA products include a weekly summary of equal latitude - longitude grid cells (~16 km at the equator) for latitudes 75N to 55S. Further NOAA quality control in developing the NGDC monthly GED grids used here included (1) checking registration accuracy against prominent geographic features and (2) inspection for artifacts (e.g. bad scan lines and system noise) and selection of images without co-located artifacts. Then (3), both the low and high values were discarded from the remaining weekly pixel values within each month, to eliminate random noise evident in the weekly files. (4) A root-mean-square average of the remaining "median" weekly values within each month was computed for each pixel. (5) The images were then re-gridded to a 10-minute grid using a spatially weighted average. (6) The images used to process the World Ecosystems data-set were multi-year averages of these monthly "generalized" images [provided in Chapter A01 of this volume].

The GED compact disk also has corrections from Kevin Gallo for pre-launch calibration, drift of the satellite or instrument, and refinements related to solar zenith declination angles. Gallo's file of weekly data masked the unusually low values of NDVI that may be clouds in some places but glaciers or bare desert in others. Monthly summary files from Gallo were not ready when the work took place from December 1985 through November 1988 average 10' NDVI and GVI intervals.

Another kind of monthly AVHRR summary from Japan [Tateishi and Kajiwara - see reference in Chapter A01 of this volume] deliberately selects the greenest values for each month, and therefore has least risk of cloud contamination of the image. However, that advantage is traded off against highest exaggeration of locally high selection (e.g. irrigated cropland; dense, tall forest) or of seasonal trend favoring the summer end of spring (or monsoon) season or autumn transition months. Neither the Gallo or Japanese file is yet likely to be as representative as Kineman's 3 year average used here.

After exploring data for particular months, annually averaged 3-month seasonal images (December-February, March-May, June-August, September-November) and a 3-year average for all 12 months were produced. Another simplification was to establish categories for the Monthly Generalized Global Vegetation Index (MGV), each step matching 11 levels of the scaled MGV values (which range from 0 to about 211). Our first questions concerned lower intervals, i.e.,

low GVI Levels 0, 1, 2, 3: for MGV = 0-11, 12-22, 23-33, 34-44, respectively

Briefer inspection and analysis included:

medium GVI Levels 4, 5, 6: for MGV = 45-55, 56-66, 67-77; and

high GVI Levels 7-11: for MGV > 77.

Clearly the latter deserve more attention. Lands in the high range have most green foliage generating organic production, nutrient recycling, and evaporation.

RESULTS

ECOSYSTEMS, VEGETATION, AND LANDSCAPES

1) Desert, cold, and water: low GVI landscapes

Investigation was made to determine the match between low greenness index (MG-GVI, Chapter A01) and sand desert areas (type 50 on my legend), e.g. the Ergs of the Sahara. The lowest GVI categories (Categories 1 and 2; MGV = 12-33) were associated with salt flats or intermittent playa lakes (type #71), except for some matches with water that were used to refine shore delineation. Especially at the 10′ pixel resolution, pixels or clusters of pixels showed up in the depressions located from altitude files (some below sea-level) or shown in many atlases.

A few very low index values also appeared on the highest Himalaya Mountains and ranges on or west of the Tibetan Plateau. These may represent glaciers (#70) or other very snowy landscapes that may be missed or mislabelled #71, or else mixed with #8 as bare "alpine" desert, along with the following true desert types.

The next lower level (Level 3; MGV = 34-44) in desert areas was also not mainly in areas where the working database or extra maps showed most dunes. A "mostly bare" desert category, already defined as #8 was only sporadically used before 1991. It includes some sand but commonly also rocky and fine-soil deserts with little or no green cover. Independent cartography confirms many such landscapes, but more checking is required, especially outside Africa. In the Nubian, eastern and western Arabian, and some Iranian deserts, areas originally mapped as grass-shrub (Group 4, type #41, because of their designation as grazing lands on the Oxford Economic Atlas) effectively belong in this bare or true desert category in most years. Nomadic economies depend on distant herd migrations to find the exceptional times and places where grazers can be kept alive, even if not in thriving condition.

2) Gradients (Ecotones) of Intermediate Greenness (GVI Levels 4-6)

In the Sahara and elsewhere, some dune regions showed higher index values for greenness (Levels 4 and 5) than the landscape types of the preceding paragraphs. Seasonal or sporadic variation in the index suggested ephemeral vegetation where occasional rains occur. Alternatively, plants on the inter-dune depressions could be sub-irrigated from rains previously intercepted along the truly bare dune ridges. For part of the Kalahari desert, GVI Level 6 (MGV = 67-77) overlapped areas of Kalahari sand that was mapped as #50. It has not been confirmed whether this and a few other areas represent just the upper range of a pixel variations for sand desert and semidesert type, or if a "sand hill grass/shrub" category should be created (#87 reserved), or if it should be coded with existing shrub-grass types #50 or 51.

Oases (irrigated agriculture #37, Group 14) are likely to occur more often as higher-resolution pixels are provided for. Most seem too localized to show even at 10′—even when associated with persistent marshy vegetation from natural seepage or drainage (#45, Group 11).

In the USA, higher-resolution (~1.1 km) AVHRR imagery has been treated in more detail by Loveland et al. (1991). They map somewhat wider areas of effectively "bare" landscape and infer (pers. com.) that these match deserts with only a few per cent of green cover. Desert pixels of 10′ and especially 30′ typically include mosaics of such nearly bare land plus shrub or shrub-steppe or irrigated cover, and so are less likely to be considered bare in the aggregate.

At high latitudes, the low sun angle, especially in winter, limits use of AVHRR. Data are not even retained above 75 N latitude. Nevertheless, a reasonable distinction between high Arctic tundra (annual mean GVI Level 3) and low Arctic tundra (GVI Level 4 or lower range of 5). The Wooded Tundra fringe (mapped, illustrated and discussed in detail by Larsen 1989, for North America) conversely has GVI mostly 4, less often (or less clearly) 3. It needs to be much better defined at the 10′ resolution than the initial 30′ mapping.

Within the Northern Taiga and other Boreal forest belts, there is also an orderly progression of the GVI (from the MGV data-set), despite numerous inclusions of locally lower GVI. The inclusions of land-water mixtures (see section 4C) accounts for much of the seeming "noise" that is related to lakes and mires but these are not yet provided for in WE1.4D. Analyzing how the whole complex can be resolved, with better resolution from Local Area Coverage (LAC) AVHRR and still finer satellite imagery, will be a major contribution of the planned BOREAS project of NASA and other sponsors.

RESOLUTION CODES AND 10-MINUTE UPDATES FOR WE1.4D

The resolution code overlay (OWE14DR) was produced by first tagging all pixels on the WE1.4D 10-minute grid that differed from their 30-minute mode (for the standard 30-minute grid registration). These cells were coded 1 against a 0 background. Known classes that were edited at 10-minutes were then over-written onto the grid. The resulting map thus provides the following codes:

EXPLANATION OF RESOLUTION CODES

0	unaltered cells representing 30-minute spatial dominance (expanded to a 10-minute grid)
1	edited 10-minute cells
2	residual, or "orphaned" cells from 30-minute regions within which other 10-minute updates were made. These cells are presumed to represent spatial dominance at less than 15-minutes (only coded if such cells cover less than half of the original 30-minute cell), because the other cells in the 30-minute region have been changed.

The following table describes the specific 10-minute updates made to the data-set, on a background of 30-minute values:

TABLE OF 10-MINUTE EDITS IN OWE14D

OLSON14D CLASS	DESCRIPTION
0	Water, coastline edits for Africa and some other coasts
6	Montane forest, edits in Africa only
8	Bare desert, updated globally using average GVI.
28	Tropical montane, edits for Africa only
65-68	Coastline, mostly Africa but other areas as well.
71	Salt/soda flats, updated globally using average GVI.
72	Mangroves, Africa only
73	Island/Coastal (Elba Island only)

REFERENCES

ORIGINAL REFERENCES

Extensive references for the original work are given in Olson et al. (1983) and its excerpt (scanned images of this reference are provided on the CD-ROM -- see Primary Documentation, above). All references related to the present work are listed under Additional References, above.

REFERENCES FOR RECENT UPDATES AND COMPARISONS

Cohen, S. (ed.). 1973. *The Oxford World Atlas.* Oxford University Press, London.

Goward, S. N., C. J. Tucker and D. G. Dye. 1985. North American vegetation patterns observed with the NOAA-7 advanced very high resolution radiometer. *Vegetatio* 64: 3-64.

Henderson-Sellers, A., M. F. Wilson, G. Thomas, and R. E. Dickinson. 1986. Current Global Land-Surface Data Sets for Use in Climate-Related Studies. *NCAR Technical Notes*, NCAR/TN-272+STR, National Center for Atmospheric Research, Boulder, Colorado

Hobbs, R., and H. Mooney (eds.). 1990. Remote Sensing and Biosphere Functioning. *Ecological Studies*. Springer-Verlag, New York.

Hummel, J.R., and R.A. Reck. 1979. A global surface albedo model. *J. Appl. Meteorol.* 18:239-253.

Jones, D.B. (ed.). 1972. *Oxford Economic Atlas of the World, 4th Ed.* Oxford University Press, London.

Koomanoff, V. A. 1988. Analysis of Global Vegetation patterns: A Comparison Between Remotely Sensed Data and a Conventional Map. *Report 890201 of Laboratory for Global Remote Sensing Studies*, Geography, Univ. of Maryland, College Park MD.

Larson, J.A. 1989. The northern forest border in Canada and Alaska: Biotic communities and ecological relationships. *Ecological Studies* 70. Springer-Verlag, New York.

Loveland, T. R., J. W. Merchant, D. O. Ohlen, and J. F. Brown. 1991. Development of a land-cover characteristics database for the conterminous United States. *Photogram. Engineering and Remote Sensing* 57:1453-1463.

Olson, J.S. 1992. Global changes and resource management. *ASPRS/ACSM/RY92 Technical Papers, Volume 1.* P. 32-42.

A06

Leemans *Holdridge Life Zone Classifications*

DATA-SET DESCRIPTION

DATA-SET NAME: **Holdridge Life Zone Classifications**

PRINCIPAL INVESTIGATOR(s): **Rik Leemans**
International Institute for Applied Systems Analysis

SOURCE

SOURCE DATA CITATION: Leemans, R., 1989. Global *Holdridge Life Zone Classifications.* Digital Raster Data on a 0.5-degree Geographic (lat/long) 360x720 grid. Laxenberg, Austria: IIASA. Floppy disk, 0.26 MB.
CONTRIBUTOR(s): Dr. Rik Leemans
RIVM
National Institute of Public Health and Environmental Protection
P.O. Box 1, 3720 BA
Bilthoven, The Netherlands
(31)30-749111
DISTRIBUTOR(s): IIASA and RIVM
VINTAGE: circa 1989
LINEAGE:
(1) Rik Leemans, Principal Investigator
International Institute for Applied Systems Analysis (IIASA)
Laxenberg, Austria

ORIGINAL DESIGN

VARIABLES: Characteristic life zone classes as predicted by climate, according to the Holdridge classification method.

ORIGIN: Classification based on climate parameters (temperature and precipitation) from the IIASA database (see data-set A03). (see Primary Documentation)
GEOGRAPHIC REFERENCE: latitude/longitude
GEOGRAPHIC COVERAGE: Global

Maximum Latitude	:	+90 degrees (N)
Minimum Latitude	:	-90 degrees (S)
Maximum Longitude	:	+180 degrees (E)
Minimum Longitude	:	-180 degrees (W)

GEOGRAPHIC SAMPLING: Characteristic classes for 0.5-degree grid cells.

TIME PERIOD: Modern, 1931 through 1960.
TEMPORAL SAMPLING: Modern estimate, based on average or "normal" climate.

INTEGRATED DATA-SET

DATA-SET CITATION: Leemans, R. 1992. Global Holdridge Life Zone Classifications. Digital Raster Data on a 0.5-degree Geographic (lat/long) 360x720 grid. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 2 independent single-attribute spatial layers on CD-ROM, 0.5MB. [first published in 1989]
ANALYST(s): Rik Leemans
PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).
SPATIAL REPRESENTATION: Characteristic classes for 0.5-degree cells
TEMPORAL REPRESENTATION: Modern estimate
DATA REPRESENTATION: 1-byte integers, representing characteristic classes
LAYERS AND ATTRIBUTES: 2 independent single-attribute spatial layers
COMPRESSED DATA VOLUME: 32,624 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

Leemans, Rik, 1989. "Possible Changes in Natural Vegetation Patterns Due to a Global Warming." In: Hackl, A. (eds.), *Der Treibhauseffekt: das Problem - Mogliche Folgen - Erforderliche MaBnahmen*. Akademie für Umwelt und Energie, Laxenburg, Austria. pp 105-122.

* Leemans, Rik, 1990. "Possible Changes in Natural Vegetation Patterns Due to a Global Warming." IIASA Working Paper WP-90-08 and Publication Number 108 of the Biosphere Dynamics Project. Laxenburg, Austria: International Institute of Applied Systems Analysis. 22 pp.

ADDITIONAL REFERENCES

Solomon, A.M. and R. Leemans. 1990. Climatic change and landscape-ecological response: Issues and analyses. In: Boer, M.M. and de Groot, R.S. (eds.), Landscape *Landscape Ecological Impact of Climatic Change*. IOS Press, Amsterdam. pp. 293-316 (ISBN 90 5199 023 5).

Prentice, I.C., Cramer, W., Harrison, S.P, Leemans, R., Monserud, R.A. & Solomon, A.M. 1992. A global biome model based on plant physiology and dominance, soil properties and climate. J. Biogeography (in press).

Monserud, R.A. and Leemans, R. 1992. The comparison of global vegetation maps. *Ecol. Modelling* (in press).

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	LHOLD.IMG	1 files	259,200
	LHOLDAG.IMG	1 files	259,200
Headers:			
\GLGEO\META\	LHOLD.DOC	1 files	2,459
	LHOLDAG.DOC	1 files	1,146
Palettes:	none		
Time Series:	none		
Volume on Disk:		4 files	522,005

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A06\	LH_01.PCX to LH_17.PCX	17 files	628,049
	LH_##X.PCX	4 files	400,880
Volume on Disk:		21 files	1,028,929

SOURCE EXAMPLE FILES

none

DATA ELEMENT: **Holdridge Life Zones Classification**

STRUCTURE: Raster Data Files: 0.5-degree 360x720 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

LHOLD.DOC

```
file title   : Leemans' Holdridge Life Zones Classification
data type    : byte
file type    : binary
columns      : 720
rows         : 360
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.5000000
min. value   : 0
max. value   : 38
value units  : classed
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 40
```

Legend:

```
category  0 :  0 Oceans
category  1 :  1 Ice        Ice
category  2 :  2 Po Des     Polar Desert
category  3 :  3 Po Dry Tu  Polar Dry Tundra
category  4 :  4 Po Mois T  Polar Moist Tundra
category  5 :  5 Po Wet Tu  Polar Wet Tundra
category  6 :  6 Po Rain T  Polar Rain Tundra
category  7 :  7 Bor Des    Boreal Desert
category  8 :  8 Bor Dry B  Boreal Dry Bush
category  9 :  9 Bor Mois   Boreal Moist Forest
category 10 : 10 Bor Wet F  Boreal Wet Forest
category 11 : 11 Bor Rain   Boreal Rain Forest
category 12 : 12 ClTmp Des  Cool Temperate Desert
category 13 : 13 ClTmp D/B  Cool Temperate Desert Bush
category 14 : 14 ClTmp Ste  Cool Temperate Steppe
category 15 : 15 ClTmp MsF  Cool Temperate Moist Forest
category 16 : 16 ClTmp Wet  Cool Temperate Wet Forest
category 17 : 17 ClTmp RnF  Cool Temperate Rain Forest
category 18 : 18 WmTmp Des  Warm Temperate Desert
category 19 : 19 WmTmp D/B  Warm Temperate Desert Bush
category 20 : 20 WmTmp Thn  Warm Temperate Thorn Steppe
category 21 : 21 WmTmp Dry  Warm Temperate Dry Forest
```

```
category 22 : 22 WmTmp MsF Warm Temperate Moist Forest
category 23 : 23 WmTmp Wet Warm Temperate Wet Forest
category 24 : 24 WmTmp RnF Warm Temperate Rain Forest
category 25 : 25 SbTrp Des Subtropical Desert
category 26 : 26 SbTrp D/B Subtropical Desert Bush
category 27 : 27 SbTrp Thn Subtropical Thorn Steppe
category 28 : 28 SbTrp Dry Subtropical Dry Forest
category 29 : 29 SbTrp MsF Subtropical Moist Forest
category 30 : 30 SbTrp Wet Subtropical Wet Forest
category 31 : 31 SbTrp RnF Subtropical Rain Forest
category 32 : 32 Trop Des  Tropical Desert
category 33 : 33 Trop D/B  Tropical Desert Bush
category 34 : 34 Trop ThnS Tropical Thorn Steppe
category 35 : 35 Trop VDry Tropical Very Dry Forest
category 36 : 36 Trop DryF Tropical Dry Forest
category 37 : 37 Trop MsFo Tropical Moist Forest
category 38 : 38 Trop WetF Tropical Wet Forest
category 39 : 39 Trop RnFo Tropical Rain Forest
```

NOTES:

DATA ELEMENT: Holdridge Life Zones Aggregated Classification

STRUCTURE: Raster Data Files: .5-degree 360x720 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

LHOLDAG.DOC

```
file title   : Leemans' Holdridge Life Zones Aggregated Classification
data type    : byte
file type    : binary
columns      : 720
rows         : 360
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.5000000
min. value   : 0
max. value   : 14
value units  : classed
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 15
```

Legend:

```
category  0 :  0 Oceans
category  1 :  1 Tundra       Tundra
category  2 :  2 Cold Park Cold Parklands
category  3 :  3 Forest Tu Forest Tundra
category  4 :  4 Boreal Fo Boreal Forest
category  5 :  5 Cool Dese Cool Desert
category  6 :  6 Steppe    Steppe
category  7 :  7 Temprt Fo Temperate Forest
category  8 :  8 Hot Deser Hot Desert
category  9 :  9 Chapparal Chapparal
category 10 : 10 WmTmp For Warm Temperate Forest
category 11 : 11 Trop Semi Tropical Semi-Arid
category 12 : 12 Trop DryF Tropical Dry Forest
category 13 : 13 Trop Seas Tropical Seasonal Forest
category 14 : 14 Trop Rain Tropical Rain Forest
```

NOTES:

DATA INTEGRATION AND QUALITY

Mark A. Ohrenschall
NOAA National Geophysical Data Center
Boulder, CO

The Leemans Holdridge Classification source data came as a compressed file containing two variables, "standard" and "aggregated with Olson's ecosystem classes." The data were in a lat/long projection on a half-degree grid bounded by 90 degrees north, 90 degrees south, 180 degrees west, and 180 degrees east. The data are treated as average cell values.

Both data files were in compressed or run-length encoded format. A fortran routine to decode the data files was provided, which was modified to generate the desired output, separating the two numerical values and expanding the run-length encoded grid. This program produced an integer-ASCII Idrisi file, for which an IDRISI header (.DOC) file was created. The data-set was then converted to a byte-binary file type in IDRISI. Legend information was then entered by keyboard.

Although class 39 is documented for the "standard" version, this value did not occur in the data-set. The original structure of the data-set was compatible with the GED conventions, and thus did not require re-working.

A07

Matthews *Vegetation, Land Use, and Seasonal Albedo*

DATA-SET DESCRIPTION

DATA-SET NAME: **Vegetation, Land Use, and Seasonal Albedo**

PRINCIPAL INVESTIGATOR(s): **Elaine Matthews**
Goddard Institute for Space Studies

SOURCE

SOURCE DATA CITATION: Matthews, E., 1983. *Global Vegetation, Land-Use, and Seasonal Albedo* [NASA Goddard Institute for Space Studies]. Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. Boulder, CO: National Center for Atmospheric Research. 9 track tape, 0.8 MB

CONTRIBUTOR(s): Dr. Elaine Matthews
NASA Goddard Space Flight Center,
Institute for Space Studies
2880 Broadway
New York, NY 10025 USA

DISTRIBUTOR(s): NCAR

VINTAGE: circa 1980

LINEAGE: (1) Principal Investigator:
Elaine Matthews
NASA Goddard Institute of Space Studies
(2) Archived and Distributed by:
Roy Jenne
National Center for Atmosphereic Research (NCAR)

ORIGINAL DESIGN

VARIABLES:

1. Vegetation, representing natural (pre-agricultural) vegetation based on the UNESCO (1973) classification system.
2. Cultivation Intensity derived from land use data, representing areal extent of presently cultivated land in the 1-degree cells.
3. Seasonal Albedo, as present integrated surface albedo for January, April, July, October for snow-free conditioins except for permanently snow-covered continental ice, incorporating natural vegetation and cultivation characteristics from the vegetation and cultivation-intensity data sets.

NOTE: Data are included for land areas only, including continental ice (Water, including oceans and lakes, are coded 0).

ORIGIN: digitized from numerous published sources and satellite imagery (see Primary Documentation)

GEOGRAPHIC REFERENCE: latitude/longitude
GEOGRAPHIC COVERAGE: Global

Maximum Latitude :	+90	degrees (N)
Minimum Latitude :	-90	degrees (S)
Maximum Longitude:	+180	degrees (E)
Minimum Longitude:	-180	degrees (W)

GEOGRAPHIC SAMPLING: integrated values for 1 degree grid cells
TIME PERIOD: circa 1950's through 1970's
TEMPORAL SAMPLING: Modern composite of available data

INTEGRATED DATA-SET

DATA-SET CITATION: Matthews, E. 1992. *Global Vegetation, Land-Use, and Seasonal Albedo*. Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 6 independent single-attribute spatial layers on CD-ROM, 1.6 MB. [first published in 1983]
ANALYST(s): Elaine Matthews
PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).
SPATIAL REPRESENTATION: integrated values for 1-degree grid cells
TEMPORAL REPRESENTATION: Modern composite
DATA REPRESENTATION:

Vegetation Type:	1-byte integers: integrated type classes for 1-degree cells.
Cultivation Intensity:	1-byte integers: classes (0-5) of areal extent within 1-degree cells.
Seasonal Albedo:	2-byte integers: percent (x 100) integrated albedo.

LAYERS AND ATTRIBUTES: 6 independent single-attribute spatial layers
COMPRESSED DATA VOLUME: 45,646 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Matthews, E. 1983. "Vegetation, Land-Use and Seasonal Albedo Data Sets: Documentation of Archived Data Tape." *NASA Technical Memorandum #86107*.
* Matthews, E., 1983. "Global vegetation and land use: New high resolution data bases for climate studies." *Journal of Climatology and Applied Meteorology*, vol. 22, pp. 474-487.

ADDITIONAL REFERENCES

Matthews E., 1985. "Atlas of archived vegetation, land-use, and seasonal albedo data sets." *NASA Technical Memorandum #86199*.

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	MAVEG.IMG	1 files	64,800
	MACULT.IMG	1 files	64,800
	MALBFA.IMG	1 files	129,600
	MALBSM.IMG	1 files	129,600
	MALBSP.IMG	1 files	129,600
	MALBWN.IMG	1 files	129,600
Headers:			
\GLGEO\RASTER\	MAVEG.DOC	1 files	2,828
	MACULT.DOC	1 files	650
	MALBFA.DOC	1 files	502
	MALBSM.DOC	1 files	504
	MALBSP.DOC	1 files	499
	MALBWN.DOC	1 files	504
Palettes:	none		
Time Series:	none		
Volume on Disk:		12 files	653,487

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A07\	MA1_01.PCX to MA1_14.PCX	14 files	297,060
	MA1_##X.PCX	3	361,780
	MA2_01.PCX to MA2_14.PCX	14 files	639,909
	MA2_##X.PCX	12 files	1,752,214
Volume on Disk:		43 files	3,050,963

SOURCE EXAMPLE FILES

none

DATA ELEMENT: Vegetation Type

STRUCTURE: Raster Data File: 1-degree 180x360 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

MAVEG.DOC

```
file title   : Matthews Vegetation Types
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 31
value units  : classed
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 33
```

```
category  0 :  0 Water       (including lake and ocean)
category  1 :  1 TER         Tropical evergreen rainforest, mangrove
                             forest
category  2 :  2 TES         Tropical/subtropical evergreen seasonal
                             broadleaved forest
category  3 :  3 SER         Subtropical evergreen rainforest
category  4 :  4 TSP         Temperate/subpolar evergreen rainforest
category  5 :  5 TSB         Temperate evergreen seasonal broadleaved
                             forest, summer rain
category  6 :  6 EBS         Evergreen broadleaved sclerophyllous forest,
                             winter rain
category  7 :  7 TEN         Tropical/subtropical evergreen needleleaved
                             forest
category  8 :  8 TSE         Temperate/subpolar evergreen needleleaved
                             forest
category  9 :  9 TSD         Tropical/subtropical drought-deciduous forest
category 10 : 10 CDE         Cold-deciduous forest, with evergreens
category 11 : 11 CDF         Cold-deciduous forest, without evergreens
category 12 : 12 XFW         Xeromorphic forest/woodland
category 13 : 13 ESW         Evergreen broadleaved sclerophyllous woodland
category 14 : 14 ENW         Evergreen needleleaved woodland
category 15 : 15 TDD         Tropical/subtropical drought-deciduous
                             woodland
```

category 16 : 16 CDW		Cold-deciduous woodland
category 17 : 17 EBT		Evergreen broadleaved shrubland/thicket, evergreen dwarf-shrubland
category 18 : 18 ENM		Evergreen needleleaved or microphyllous shrubland/thicket
category 19 : 19 DDS		Drought-deciduous shrubland/thicket
category 20 : 20 CDS		Cold-deciduous subalpine/subpolar shrubland, cold-deciduous dwarf shrubland
category 21 : 21 XSD		Xeromorphic shrubland/dwarf shrubland
category 22 : 22 ATM		Arctic/alpine tundra, mossy bog
category 23 : 23 TGW		Tall/medium/short grassland with 10-40% woody tree cover
category 24 : 24 TGV		Tall/medium/short grassland with <10% woody tree cover or tuft-plant cover
category 25 : 25 TGS		Tall/medium/short grassland with shrub cover
category 26 : 26 TGN		Tall grassland, no woody cover
category 27 : 27 MGN		Medium grassland, no woody cover
category 28 : 28 MSG		Meadow, short grassland, no woody cover
category 29 : 29 FFO		Forb formations
category 30 : 30 DES		Desert
category 31 : 31 ICE		Ice
category 32 : 32 CUL		Cultivation

NOTES:

DATA ELEMENT: **Cultivation Intensity**

STRUCTURE: Raster Data Files: 1-degree 180x360 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

MACULT.DOC

```
file title   : Matthews Cultivation Intensity
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 5
value units  : classed
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 6
```

Legend:

```
category  0 : 0 Water     (including lake and ocean)
category  1 : 1   0%
category  2 : 2  20%
category  3 : 3  50%
category  4 : 4  75%
category  5 : 5 100%
```

NOTES:

DATA ELEMENT: Seasonal Albedo

STRUCTURE:

SERIES: none

SPATIAL DATA FILES: Raster Data Files: 1-degree 180x360 GED grid (see *User's Guide*)

MALBFA.DOC

```
file title   : Matthews Fall Albedo (% X 100)
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 7500
value units  : percentage X 100
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

File Series:

File	Season	Minimum	Maximum
MALBFA	Fall	0	7500
MALBSM	Summer	0	7500
MALBSP	Spring	0	7500
MALBWN	Winter	0	7500

NOTES:

DATA INTEGRATION AND QUALITY

Mark A. Ohrenschall
NOAA National Geophysical Data Center
Boulder, CO

The Matthews data were in a lat/long projection on a one-degree grid bounded by 90 degrees North, 90 degrees South, 180 degrees West, and 180 degrees East. The data-sets consisted of three files, VEGTYPE, CULTINT, and ALBEDO. All files were in ASCII fixed field format, with cell sequencing scanning left to right, bottom to top in the one-degree grids. The VEGTYPE and CULTINT files consisted of a sequence of two-digit integers and the ALBEDO file consisted of a sequence of four-digit reals (2 decimal places). The four albedo grids were stacked together in the ALBEDO file.

Programs were written to read each file and write the appropriate values into an IDRISI raster data file in ASCII (for inspection), and then converted to binary. All grids were then inverted to place North at the top. The four seasonal albedo files were then windowed from the stacked data file, multiplied by 100 and converted to byte-binary data types.

The original numerical values are thus preserved, except for scaling of the albedos to allow byte storage. All final data files were inspected for agreement with the original data.

A08

Lerner, Matthews and Fung *Methane Emission From Animals*

DATA-SET DESCRIPTION

DATA-SET NAME: **Methane Emission From Animals**

PRINCIPAL INVESTIGATOR(s): **Jean Lerner, Elaine Matthews, and Inez Fung**
Goddard Institute for Space Studies

SOURCE

SOURCE DATA CITATION: Lerner, J., E. Matthews, and I. Fung. 1989. *Methane Emmission From Animals: A Global High Resolution Database* from the NASA Goddard Institute for Space Studies. Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. Boulder, CO: National Center for Atmospheric Research. 1 floppy disk, 1.3 MB.

CONTRIBUTOR(s): Drs. Jean Lerner, Elaine Matthews and Inez Fung
NASA Goddard Space Flight Center,
Institute for Space Studies
2880 Broadway
New York, NY 10025 USA

DISTRIBUTOR(s): NCAR

VINTAGE: circa 1987

LINEAGE:

(1) Data Development:
Jean Lerner, Elaine Matthews and Inez Fung
NASA Goddard Institute of Space Studies
New York, NY

(2) Archived and Distributed by:
Roy Jenne
National Center for Atmosphereic Research
Boulder, CO

ORIGINAL DESIGN

VARIABLES:

Animal Density for various animals, expressed in number of animals per square kilometer.

Annual Methane Emmission, in kilograms per square kilometer

ORIGIN: (see Primary Documentation)

1. Domestic animals: 1984 FAO Production Yearbook
2. Wild and domestic caribou: Anderson, 1978; Nowak and Paradiso, 1983;

Jackson, 1986.

3. Matthews Vegetation and Land Use data (see A07)

GEOGRAPHIC REFERENCE: latitude/longitude

GEOGRAPHIC COVERAGE: Global

Maximum Latitude	:	+90 degrees (N)
Minimum Latitude	:	-90 degrees (S)
Maximum Longitude	:	+180 degrees (E)
Minimum Longitude	:	-180 degrees (W)

GEOGRAPHIC SAMPLING: Averages over 1-degree grid cell areas

TIME PERIOD: Modern statistical compilations, circa 1980's

TEMPORAL SAMPLING: Modern composite of available data

INTEGRATED DATA-SET

DATA-SET CITATION: Lerner, J., E. Matthews, and I. Fung. 1992. *Methane Emmission from Animals: A Global High Resolution Database*. Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 11 independent single-attribute spatial layers on CD-ROM, 2.9 MB. [first published in 1988]

ANALYST(s): Jean Lerner, Elaine Matthews, and Inez Fung

PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).

SPATIAL REPRESENTATION: Averages over 1-degree grid cell areas

TEMPORAL REPRESENTATION: Modern composite

DATA REPRESENTATION:

Animal Density: Number/km^2, with precisions up to 10^{-7}; expressed as 4-byte IEEE real numbers to 10 significant digits

Methane Emmission: Kg/km^2, $^+$/-1 Kg/km^2, expressed as 4-byte IEEE real numbers

LAYERS AND ATTRIBUTES: 11 independent single-attribute spatial layers

COMPRESSED DATA VOLUME: 130,257 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Lerner, J., Matthews, E., and Fung, I. 1988. "Methane emissions from animals:A global high-resolution data base." *Global Biogeochemical Cycles*, vol. 2, no.2, pp. 139-156.

ADDITIONAL REFERENCES

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	LMFCAML.IMG	1 file	259,200
	LMFCARB.IMG	1 file	259,200
	LMFCOW .IMG	1 file	259,200
	LMFDCOW.IMG	1 file	259,200
	LMFGOAT.IMG	1 file	259,200
	LMFHORS.IMG	1 file	259,200
	LMFMETH.IMG	1 file	259,200
	LMFNCOW.IMG	1 file	259,200
	LMFPIG .IMG	1 file	259,200
	LMFSHEP.IMG	1 file	259,200
	LMFWBUF.IMG	1 file	259,200
Headers:			
\GLGEO\META\	LMFCAML.DOC	1 file	611
	LMFCARB.DOC	1 file	612
	LMFCOW .DOC	1 file	633
	LMFDCOW.DOC	1 file	615
	LMFGOAT.DOC	1 file	610
	LMFHORS.DOC	1 file	611
	LMFMETH.DOC	1 file	627
	LMFNCOW.DOC	1 file	623
	LMFPIG .DOC	1 file	610
	LMFSHEP.DOC	1 file	612
	LMFWBUF.DOC	1 file	619
Palettes:	none		
Time Series:	none		
Volume on Disk:		22 files	2,857,983

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A08\	LMF1_01PCX to LC1_18.PCX	18 files	1,180,734
	LMF1_##X.PCX	5 files	656,178
Volume on Disk:		23 files	1,836,912

SOURCE EXAMPLE FILES

none

DATA ELEMENT: Animal Density

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: Animals
SPATIAL DATA FILES:

LMFCAML.DOC

```
file title   : Lerner et al. Camel Density (1/Km^2)
data type    : real
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/lon
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0.0000000
max. value   : 11.3000002
value units  : animals / square kilometer
value error  : unknown
flag value   : -1.0000000
flag def'n   : flag value signifies land with no animals
legend cats  : 0
comment      : ocean has the value -100
```

File Series Parameters:

File	Animal	Minimum	Maximum
LMFCAML	Camels	0.0000000	11.3000002
LMFCARB	Caribou	0.0000000	6.9600000
LMFCOW	Dairy and Non-Dairy Cattle	0.0000000	246.0000000
LMFDCOW	Dairy Cows	0.0000000	77.0000000
LMFGOAT	Goats	0.0000000	91.9000015
LMFHORS	Horses	0.0000000	18.2000008
LMFNCOW	Non-dairy Cattle	0.0000000	218.0000000
LMFPIG	Pigs	0.0000000	361.0000000
LMFSHEP	Sheep	0.0000000	382.0000000
LMFWBUF	Water Buffalo	0.0000000	89.3000031

NOTES:

1. These data are stored as real numbers (IEEE 4-byte floating point reals) to preserve the full range of numerical values in the original data-set.

DATA ELEMENT: Annual Methane Emmission

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

LMFMETH.DOC

```
file title   : Matthews & Fung Annual Methane Emission (Kg/Km^2)
data type    : real
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/lon
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0.0000000
max. value   : 11400.0000000
value units  : kilograms / square kilometer
value error  : unknown
flag value   : -1.0000000
flag def'n   : flag value signifies land with no methane
legend cats  : 0
comment      : ocean has the value -100
```

NOTES:

1. These data are stored as real numbers (IEEE 4-byte floating point reals) to preserve the full range of numerical values in the original data-set.

DATA INTEGRATION AND QUALITY

Mark A. Ohrenschall
National Geophysical Data Center
Boulder, CO

Data were read from floppy disk and converted to the GED format, separating each variable into different GIS files without altering the original numerical values. Legend information was entered from the accompanying documentation. All final data files were inspected for agreement with the original versions.

A09

Matthews & Fung *Global Distribution, Characteristics and Methane Emission of Natural Wetlands*

DATA-SET DESCRIPTION

DATA-SET NAME: **Global Distribution, Characteristics and Methane Emission of Natural Wetlands**

PRINCIPAL INVESTIGATOR(s): **Elaine Matthews and Inez Fung**
Goddard Institute for Space Studies

SOURCE

SOURCE DATA CITATION: Matthews, E., 1989. *Global Data Bases on Distribution, Characteristics and Methane Emission of Natural Wetlands* from the NASA Goddard Institute of Space Studies. Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. Boulder, CO: National Center for Atmospheric Research. Floppy disk, 1.2 MB.

CONTRIBUTOR(s): Dr. Elaine Matthews and Dr. Inez Fung
NASA Goddard Space Flight Center,
Institute for Space Studies
2880 Broadway
New York, NY 10025

DISTRIBUTOR(s): NCAR

VINTAGE: circa 1986

LINEAGE:

(1) Elaine Matthews
NASA Goddard Space Flight Center
Institute of Space Studies
New York, NY

(2) Archived and Distributed by:
Roy Jenne
National Center for Atmosphereic Research
Boulder, CO

ORIGINAL DESIGN

VARIABLES:

Wetland Types:	12 integrated wetland type classes for 1-degree grid cells.
Wetland Data Sources:	combinations (7 codes) of sources used to determine Wetland Type for 1-degree grid cells.
Fractional Inundation:	Inundated proportion of 1-degree grid cells

Vegetation Types: 178 UNESCO vegetation type classes for 1-degree grid cells.

Zobler Soil Types: 106 Zobler soil classes for 1-degree grid cells.

ORIGIN: Integration of 3 independent digital sources:

1. Matthews Vegetation and Land Use data-set (see A07)
2. Zobler FAO soils data-set (see A11)
3. ONC Charts

GEOGRAPHIC REFERENCE: latitude/longitude

GEOGRAPHIC COVERAGE: Global

Maximum Latitude	:	+90 degrees (N)
Minimum Latitude	:	-90 degrees (S)
Maximum Longitude	:	+180 degrees (E)
Minimum Longitude	:	-180 degrees (W)

GEOGRAPHIC SAMPLING:

TIME PERIOD: Modern

TEMPORAL SAMPLING: Composite Modern composite

INTEGRATED DATA-SET

DATA-SET CITATION: Matthews, E. and I. Fung. 1992. *Global Data Bases on Distribution, Characteristics and Methane Emission of Natural Wetlands*. Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 11 independent single-attribute spatial layers on CD-ROM, 1.3 MB. [first published in 1989]

ANALYST(s): Elaine Matthews and Inez Fung, NASA/GISS, New York, New York

PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).

SPATIAL REPRESENTATION: Characteristic classes and averages over 1-degree grid cell areas.

TEMPORAL REPRESENTATION: Modern composite

DATA REPRESENTATION:

Wetland Types	2-byte integer class codes
Wetland Data Sources	2-byte integer source codes
Fractional Inundation	2-byte integers (% of cell)
Vegetation Types	2-byte integer class codes
Zobler Soil Types:	2-byte integer class codes

LAYERS AND ATTRIBUTES: 5 independent single-attribute spatial layers

COMPRESSED DATA VOLUME: 30,914 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Matthews, E. 1989. Global Data Bases on Distribution, Characteristics and Methane Emission of Natural Wetlands: Documentation of Archived Data Tape.

NASA Technical Memorandum 4153.

* Matthews, E. and I. Fung. 1987. Methane emission from natural wetlands: Global area, distribution and environmental characteristics of sources. *Global Biogeochemical Cycles*, 1, 61-86.

ADDITIONAL REFERENCES

FAO. 1971-1981. Soil Map of the World, Vols. 1-10 (1:5M scale maps and accompanying texts), UNESCO, Paris.

Matthews, E. 1983.: Global vegetation and land use: new high-resolution data bases for climate studies. *J. Clim. Appl. Meteorol.*, 22, 474-487.

UNESCO. 1973. International classification and mapping of vegetation. UNESCO,Paris.

Zobler, L. 1986. A world soil file for global climate modeling. *NASA Technical Memorandum 87802.*

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	MFWFRIN.IMG	1 files	129,600
	MFWSOL.IMG	1 files	129,600
	MFWSRC.IMG	1 files	129,600
	MFWVEG.IMG	1 files	129,600
	MFWWET.IMG	1 files	129,600
Headers:			
\GLGEO\META\	MFWFRIN.DOC	1 files	2,572
	MFWSOL.DOC	1 files	5,160
	MFWSRC.DOC	1 files	829
	MFWVEG.DOC	1 files	11,389
	MFWWET.DOC	1 files	1,186
Palettes:	none		
Time Series:	none		
Volume on Disk:		10 files	669,136

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A09\	MFW1_01.PCX to MFW2_21.PCX	21 files	537,013
	MFW2_01.PCX to MFW2_26	26 files	1,376,180
	MFW2_##X.PCX	5 files	428,032
Volume on Disk:		52 files	2,341,225

SOURCE EXAMPLE FILES

none

DATA ELEMENT: Wetland Types

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

MFWWET.DOC

```
file title   : Matthews and Fung Wetland Type
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 12
value units  : characteristic classes
value error  : unknown
flag value   : -1
flag def'n   : flag value signifies water
legend cats  : 13
```

Legend:

```
category  0 :  0 other land (non-wet)
category  1 :  1 frst bog  forested bog
category  2 :  2 nfrst bog nonforested bog
category  3 :  3 frst swmp forested swamp
category  4 :  4 nfst swmp nonforested swamp
category  5 :  5 alvl form alluvial formations
category  6 :  6 trpcl/sub tropical/subtropical forest/woodland
category  7 :  7 temp frst temperate forest/woodland
category  8 :  8 hi-lat tm high-latitude temperate/boreal
                 forest/woodland/shrub
category  9 :  9 shrb/dsrt shrubland; xeromorphic formations; desert
category 10 : 10 wd grass  wooded grassland
category 11 : 11 nwd grass nonwooded grassland
category 12 : 12 tundra    tundra
```

NOTES:

DATA ELEMENT: Wetland Data Sources

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

MFWSRC.DOC

```
file title   : Matthews and Fung Wetland Data Source
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 7
value units  : characteristic classes
value error  : unknown
flag value   : -1
flag def'n   : flag value signifies water
legend cats  : 8
```

Legend:

```
category  0 : 0 other land (non-wet)
category  1 : 1 U+F+O     UNESCO + FAO + ONC
category  2 : 2 U+O       UNESCO + ONC
category  3 : 3 U+F       UNESCO + FAO
category  4 : 4 U         UNESCO
category  5 : 5 O+F       ONC + FAO
category  6 : 6 O         ONC
category  7 : 7 F         FAO
```

NOTES:

DATA ELEMENT: Fractional Inundation

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

MFWFRIN.DOC

```
file title   : Matthews and Fung Fractional Inundation
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 100
value units  : percent inundation
value error  : unknown
flag value   : -1
flag def'n   : flag value signifies water
legend cats  : 101
```

NOTES:

1. Legend not shown (category # = integer percent value)

DATA ELEMENT: Vegetation Type

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

MFWVEG.DOC

```
file title   : Matthews and Fung Vegetation Type
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 178
value units  : characteristic classes
value error  : unknown
flag value   : -1
flag def'n   : flag value signifies water
legend cats  : 179
```

Legend:

```
category  0 :   0 other land (non-wet)
category  1 :   1  1.A.1     Tropical evergreen rainforest
category  2 :   2  1.A.1a     lowland
category  3 :   3  1.A.1b     submontane
category  4 :   4  1.A.1c     montane
category  5 :   5  1.A.1c2     needleleaved
category  6 :   6  1.A.1e     cloud
category  7 :   7  1.A.1f     alluvial
category  8 :   8  1.A.1f1     frequently flooded
category  9 :   9  1.A.1f3     seasonally water-logged
category 10 :  10  1.A.1g     swamp
category 11 :  11  1.A.1g2     dominated by palms
category 12 :  12  1.A.1h     bog
category 13 :  13  1.A.2     Tropical/subtropical evergreen seasonal
                             forest
category 14 :  14  1.A.2a     lowland
category 15 :  15  1.A.2b     submontane
category 16 :  16  1.A.2b2     needleleaved
category 17 :  17  1.A.2c     montane
category 18 :  18  1.A.3     Tropical/subtropical semi-deciduous forest
category 19 :  19  1.A.4     Subtropical evergreen rainforest
category 20 :  20  1.A.4b     submontane
category 21 :  21  1.A.4c     montane
category 22 :  22  1.A.4c2     needleleaved
category 23 :  23  1.A.4f     alluvial
category 24 :  24  1.A.5     Mangrove forest
```

category 25 :	25	1.A.6	Temperate/subpolar evergreen rainforest
category 26 :	26	1.A.6a	temperate
category 27 :	27	1.A.6a1	broadleaved
category 28 :	28	1.A.6a2	broadleaved with needleleaved trees
category 29 :	29	1.A.7	Temperate evergreen broadleaved seasonal forest
category 30 :	30	1.A.8	Evergreen broadleaved sclerophyllous forest (winter r
category 31 :	31	1.A.8a	lowland/submontane
category 32 :	32	1.A.8b	lowland/submontane, generally less than 50m tall
category 33 :	33	1.A.9	Tropical/subtropical evergreen needleleaved forest
category 34 :	34	1.A.9a	lowland/submontane
category 35 :	35	1.A.9b	lowland/subalpine
category 36 :	36	1.A.10	Temperate/subpolar evergreen needleleaved forest
category 37 :	37	1.A.10c	with conical crowns
category 38 :	38	1.A.10d	with cylindro-conical crowns (boreal)
category 39 :	39	1.A.10e	with cylindro-conical crowns (boreal):water-logge
category 40 :	40	1.B.1	Tropical/subtropical drought-deciduous forest
category 41 :	41	1.B.1a	broadleaved lowland/submontane
category 42 :	42	1.B.1b	montane (and cloud)
category 43 :	43	1.B.2	Cold-deciduous broadleaved forest with evergreen tree
category 44 :	44	1.B.2a	with evergreen broadleaved trees and climbers
category 45 :	45	1.B.2b	with evergreen needleleaved trees
category 46 :	46	1.B.2c	subalpine and subpolar
category 47 :	47	1.B.2d	subalpine/subpolar alluvial
category 48 :	48	1.B.2e	waterlogged
category 49 :	49	1.B.3	Cold-deciduous forest without evergreen trees
category 50 :	50	1.B.3a	temperate lowland/submontane
category 51 :	51	1.B.3b	montane/boreal
category 52 :	52	1.B.3b1	broadleaved
category 53 :	53	1.B.3b2	needleleaved (e.g. Larix)
category 54 :	54	1.B.3c	subalpine/subpolar
category 55 :	55	1.B.3d	alluvial
category 56 :	56	1.B.3d2	regularly flooded with abundant herbaceous underg
category 57 :	57	1.B.3e	swamp or peat
category 58 :	58	1.C.1	Extremely xeromorphic sclerophyllous-dominated forest
category 59 :	59	1.C.2	Extremely xeromorphic thorn forest
category 60 :	60	1.C.2a	mixed deciduous-evergreen
category 61 :	61	1.C.2b	deciduous
category 62 :	62	1.C.2c	evergreen
category 63 :	63	2.A.1	Evergreen broadleaved woodland
category 64 :	64	2.A.2	Evergreen needleleaved woodland
category 65 :	65	2.A.2a	with rounded crowns
category 66 :	66	2.A.2a1	with evergreen sclerophyllous understorey (Medite
category 67 :	67	2.A.2b	with conical crowns (subalpine)
category 68 :	68	2.A.2c	with cylindro-conical crowns (boreal)
category 69 :	69	2.A.2d	waterlogged
category 70 :	70	2.B.1	Tropical/subtropical drought-deciduous

			woodland
category 71 :	71	2.B.1a	lowland/submontane, broadleaved
category 72 :	72	2.B.1b	montane (and cloud)
category 73 :	73	2.B.2	Cold-deciduous woodland with evergreen trees
category 74 :	74	2.B.3a	broadleaved (2.B.3 Cold-deciduous woodland without
category 75 :	75	2.B.3b	needleleaved
category 76 :	76	2.B.3b2	mixed broadleaved-needleleaved
category 77 :	77	2.C	Extremely xeromorphic woodland
category 78 :	78	2.C.1	Extremely xeromorphic schlerophyllous-dominated woodl
category 79 :	79	2.C.2	Extremely xeromorphic thorn woodland
category 80 :	80	2.C.2a	mixed deciduous-evergreen
category 81 :	81	2.C.2c	deciduous
category 82 :	82	2.C.3	Extremely xeromorphic succulent woodland
category 83 :	83	3.A.1	Evergreen broadleaved shrubland or thicket
category 84 :	84	3.A.1a	low bamboo thicket
category 85 :	85	3.A.1d	sclerophyllous shrubland or thicket
category 86 :	86	3.A.2	Evergreen needleleaved or microphyllous shrubland or
category 87 :	87	3.A.2a	needleleaved
category 88 :	88	3.A.3b	microphyllous
category 89 :	89	3.B.1	Drought-deciduous shrubland with evergreens
category 90 :	90	3.B.2	Drought-deciduous shrubland without evergreens
category 91 :	91	3.B.2b	subalpine/subpolar
category 92 :	92	3.B.3b	subalpine/subpolar (3.B.3 Cold-deciduous shrubland)
category 93 :	93	3.B.3b1	dwarf shrubland, with forbs
category 94 :	94	3.B.3b2	dwarf shrubland, with lichens
category 95 :	95	3.b.3c	alluvial
category 96 :	96	3.C	Extremely xeromorphic subdesert shrubland
category 97 :	97	3.C.1	Extremely xeromorphic evergreen subdesert shrubland
category 98 :	98	3.C.1a	evergreen
category 99 :	99	3.C.1a1	broadleaved
category100 :	100	3.C.1a2	microphyllous, or leafless with green stems
category101 :	101	3.C.1a3	succulent
category102 :	102	3.C.1b	semi-deciduous
category103 :	103	3.C.1b1	facultatively deciduous
category104 :	104	3.C.2	Extremely xeromorphic deciduous subdesert shrubland
category105 :	105	3.C.2b	with succulents
category106 :	106	4.A.1	Evergreen dwarf-shrub thicket
category107 :	107	4.A.2	Evergreen dwarf shrubland
category108 :	108	4.A.2a	dense cushion
category109 :	109	4.A.3	Mixed evergreen dwarf shrub/herbaceous formation
category110 :	110	4.C	Extremely xeromorphic subdesert dwarf shrubland
category111 :	111	4.C.1a	evergreen (4.C.1 Extremely xeromorphic subdesert dw
category112 :	112	4.C.2	Extremely xeromorphic deciduous subdesert dwarf shrub
category113 :	113	4.D	Tundra
category114 :	114	4.D.1	Mainly bryophyte tundra
category115 :	115	4.D.2	Mainly lichen tundra

```
category116 : 116  4.D.2a    with caespitose dwarf shrubs and moss
category117 : 117  4.D.2b    with creeping or matted dwarf shrubs and
                            moss
category118 : 118  4.E        Mossy bog formations with dwarf shrubs
category119 : 119  4.E.2b    string bog (4.E.2 Non-raised mossy bog)
category120 : 120  5.A.1     Tall grassland with 10-40% tree cover
category121 : 121  5.A.1a     with evergreen broadleaved tree cover
category122 : 122  5.A.1a1     wet or flooded most of year
category123 : 123  5.A.1c     with deciduous broadleaved tree cover
category124 : 124  5.A.1c1     seasonally flooded
category125 : 125  5.A.1c2     with deciduous broadleaved tree cover
category126 : 126  5.A.2     Tall grassland with < 10% tree cover
category127 : 127  5.A.2c     with deciduous broadleaved tree cover
category128 : 128  5.A.3c     with deciduous broadleaved shrub cover
category129 : 129  5.A.4     Tall grassland with tuft plant cover (usually
                            palms)
category130 : 130  5.A.5     Tall grassland without woody cover
category131 : 131  5.A.5a     tropical grassland
category132 : 132  5.A.5a1     seasonally flooded
category133 : 133  5.A.5a2     wet or flooded most of year
category134 : 134  5.B.1     Medium grassland with 10-40% tree cover
category135 : 135  5.B.1a     with evergreen broadleaved tree cover
category136 : 136  5.B.1a1     wet or flooded most of year
category137 : 137  5.B.1b     with semi-evergreen broadleaved tree cover
category138 : 138  5.B.1c     with deciduous broadleaved tree cover
category139 : 139  5.B.2     Medium grassland with < 10% tree cover
category140 : 140  5.B.3     Medium grassland with shrub cover
category141 : 141  5.B.3c     with deciduous broadleaved shrub cover
category142 : 142  5.B.3e     with deciduous thorny shrub cover
category143 : 143  5.B.4     Medium grassland with open cover of tuft
                            plants (usua
category144 : 144  5.B.4a     subtropical, with open groves of palms
category145 : 145  5.B.5     Medium grassland without woody cover
category146 : 146  5.B.5a1     wet or flooded most of year (5.B.5a mainly
                            sod gr
category147 : 147  5.B.5a2     on sandy soil or dunes
category148 : 148  5.B.5b     mainly bunch grasses
category149 : 149  5.B.5b2     wet or flooded most of year
category150 : 150  5.C.1     Short Grassland with 10-40% tree cover
category151 : 151  5.C.1a     with evergreen broadleaved tree cover
category152 : 152  5.C.1c     with deciduous broadleaved tree cover
category153 : 153  5.C.1d     with evergreen needleleaved tree cover
category154 : 154  5.C.2     Short grassland with < 10% tree cover
category155 : 155  5.C.2a1     seasonally flooded (5.C.2a with evergreen
                            broadle
category156 : 156  5.C.2c     with deciduous broadleaved tree cover
category157 : 157  5.C.3     Short grassland with shrub cover
category158 : 158  5.C.3b     with semi-evergreen broadleaved shrub cover
category159 : 159  5.C.3c     with deciduous broadleaved shrub cover
category160 : 160  5.C.3e     with deciduous thorny shrub cover
category161 : 161  5.C.5     Short grassland without woody cover
category162 : 162  5.C.5a     tropical alpine, open/closed bunch-grasses
                            with tuf
category163 : 163  5.C.5b     tropical alpine, open bunch grasses
category164 : 164  5.C.5d     bunch grasses of varying coverage with dwarf
                            shrubs
category165 : 165  5.C.6     Short grassland without woody cover
```

category166 :	166	5.C.6a	short-grass communities in semi-arid climates
category167 :	167	5.C.6b	bunch-grass communities (tussock)
category168 :	168	5.C.7	Short to medium tall mesophytic grassland (meadow)
category169 :	169	5.C.7a	sodgrass communities, forbs in low altitude, cool h
category170 :	170	5.C.7b	alpine/subalpine meadows, high latitudes
category171 :	171	5.C.7b2	alpine/subalpine meadows, high latitudes, rich in
category172 :	172	5.C.7b3	snow-bed communities in high latitude alpine/suba
category173 :	173	5.C.8	Graminoid tundra
category174 :	174	5.C.8a	bunch-form with mosses and lichens (Eriophorum)
category175 :	175	5.D.2	Low forb communities (< 1m)
category176 :	176	5.D.2a	perennial flowering forbs and ferns
category177 :	177	6	desert
category178 :	178	7	ice

NOTES:

DATA ELEMENT: Soil Types

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

MFWSOL.DOC

```
file title   : FAO Soil Types of Matthews & Fung Wetland Locations
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 107
value units  : characteristic classes
value error  : unknown
flag value   : -1
flag def'n   : flag value signifies water
legend cats  : 108
```

Legend:

```
category  0 :   0 other land (non-wet)
category  1 :   1 AF      Ferric Acrisol
category  2 :   2 AG      Gleyic Acrisol
category  3 :   3 AH      Humic Acrisol
category  4 :   4 AO      Orthic Acrisol
category  5 :   5 AP      Plinthic Acrisol
category  6 :   6 BC      Chromic Cambisol
category  7 :   7 BD      Dystric Cambisol
category  8 :   8 BE      Eutric Cambisol
category  9 :   9 BF      Ferralic Cambisol
category 10 :  10 BG      Gleyic Cambisol
category 11 :  11 BH      Humic Cambisol
category 12 :  12 BK      Calcic Cambisol
category 13 :  13 BV      Vertic Cambisol
category 14 :  14 BX      Gelic Cambisol
category 15 :  15 CG      Glossic Chernozem
category 16 :  16 CH      Haplic Chernozem
category 17 :  17 CK      Calcic Chernozem
category 18 :  18 CL      Luvic Chernozem
category 19 :  19 DD      Dystric Podzoluvisol
category 20 :  20 DE      Eutric Podzoluvisol
category 21 :  21 DG      Gleyic Podzoluvisol
category 22 :  22 E       Rendzina
category 23 :  23 FA      Acric Ferralsol
category 24 :  24 FH      Humic Ferralsol
category 25 :  25 FO      Orthic Ferralsol
```

category 26 :	26 FP	Plinthic Ferralsol
category 27 :	27 FR	Rhodic Ferralsol
category 28 :	28 FX	Xanthic Ferralsol
category 29 :	29 GC	Calcaric Gleysol
category 30 :	30 GD	Dystric Gleysol
category 31 :	31 GE	Eutric Gleysol
category 32 :	32 GH	Humic Gleysol
category 33 :	33 GM	Mollic Gleysol
category 34 :	34 GP	Plinthic Gleysol
category 35 :	35 GX	Gelic Gleysol
category 36 :	36 HC	Calcic Phaeozem
category 37 :	37 HG	Gleyic Phaeozem
category 38 :	38 HH	Haplic Phaeozem
category 39 :	39 HL	Luvic Phaeozem
category 40 :	40 I	Lithosol
category 41 :	41 JC	Calcaric Fluvisol
category 42 :	42 JD	Dystric Fluvisol
category 43 :	43 JE	Eutric Fluvisol
category 44 :	44 JT	Thionic Fluvisol
category 45 :	45 KH	Haplic Kastanozem
category 46 :	46 KK	Calcic Kastanozem
category 47 :	47 KL	Luvic Kastanozem
category 48 :	48 LA	Albic Luvisol
category 49 :	49 LC	Chromic Luvisol
category 50 :	50 LF	Ferric Luvisol
category 51 :	51 LG	Gleyic Luvisol
category 52 :	52 LK	Calcic Luvisol
category 53 :	53 LO	Orthic Luvisol
category 54 :	54 LP	Plinthic Luvisol
category 55 :	55 LV	Vertic Luvisol
category 56 :	56 MG	Gleyic Greyzem
category 57 :	57 MO	Orthic Greyzem
category 58 :	58 ND	Dystric Nitosol
category 59 :	59 NE	Eutric Nitosol
category 60 :	60 NH	Humic Nitosols
category 61 :	61 OD	Dystric Histosol
category 62 :	62 OE	Eutric Histosol
category 63 :	63 OX	Gelic Histosol
category 64 :	64 PF	Ferric Podzol
category 65 :	65 PG	Gleyic Podzol
category 66 :	66 PH	Humic Podzol
category 67 :	67 PL	Leptiv Podzol
category 68 :	68 PO	Orthic Podzol
category 69 :	69 PP	Placic Podzol
category 70 :	70 QA	Albic Arenosol
category 71 :	71 QC	Cambic Arenosol
category 72 :	72 QF	Ferralic Arenosol
category 73 :	73 QL	Luvic Arenosol
category 74 :	74 RC	Calcaric Regosol
category 75 :	75 RD	Dystic Regosol
category 76 :	76 RE	Eutric Regosol
category 77 :	77 RX	Gelic Regosol
category 78 :	78 SG	Gleyic Solonetz
category 79 :	79 SM	Mollic Solonetz
category 80 :	80 SO	Orthic Solonetz
category 81 :	81 TH	Humic Andosol
category 82 :	82 TM	Mollic Andosol

```
category 83 :  83 TO      Ochric Andosol
category 84 :  84 TV      Vitric Andosol
category 85 :  85 U       Ranker
category 86 :  86 VC      Chromic Vertisol
category 87 :  87 VP      Pellic Vertisol
category 88 :  88 WD      Dystric Planosol
category 89 :  89 WE      Eutric Planosol
category 90 :  90 WH      Humic Planosol
category 91 :  91 WM      Mollic Planosol
category 92 :  92 WS      Solodic Planosol
category 93 :  93 WX      Gelic Planosol
category 94 :  94 XH      Haplic Xerosol
category 95 :  95 XK      Calcic Xerosol
category 96 :  96 XL      Luvic Xerosol
category 97 :  97 XY      Gypsic Xerosol
category 98 :  98 YH      Haplic Yermosol
category 99 :  99 YK      Calcic Yermosol
category100 : 100 YL      Luvic Yermosol
category101 : 101 YT      Takyric Yermosol
category102 : 102 YY      Gypsic Yermosol
category103 : 103 ZG      Gleyic Solonchak
category104 : 104 ZM      Mollic Solonchak
category105 : 105 ZO      Orthic Solonchak
category106 : 106 ZT      Takyric Solonchak
category107 : 107 ice
```

NOTES:

DATA INTEGRATION AND QUALITY

Mark A. Ohrenschall
NOAA National Geophysical Data Center
Boulder, CO

Data were read from floppy disk and converted to the GED format, separating each variable into different GIS files without altering the original numerical values. Legend information was entered from the accompanying documentation. All final data files were inspected for agreement with the original data.

A10

Wilson and Henderson-Sellers *Global Land Cover and Soils data for GCMs*

DATA-SET DESCRIPTION

DATA-SET NAME: **Global Land Cover and Soils Data for GCMs**

PRINCIPAL INVESTIGATOR(s): **M.F. Mylne (née Wilson) and Anne Henderson-Sellers**

SOURCE

SOURCE DATA CITATION: Wilson, M.F. and A. Henderson-Sellers, 1985. *A global archive of land cover and soils data for use in general circulation climate models*. Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. NCAR, Boulder, Colorado. 0.3 MB.

CONTRIBUTOR(s): Dr. Anne Henderson-Sellers, Director
Climatic Impacts Centre
Macquarie University
School of Earth Sciences
New South Wales: 2109 : Australia

DISTRIBUTOR(s): NCAR

VINTAGE: circa 1980's

LINEAGE: (1) M.F. Mylne (formerly Wilson) and A. Henderson-Sellers, Principal Investigators
Department of Geography
University of Liverpool (U.K.)

(2) Data archived and distributed by:
Roy Jenne
National Center for Atmospheric Research (NCAR)

ORIGINAL DESIGN

VARIABLES: Characteristic 1x1-degree vegetation, soil and reliability classes

ORIGIN: Integrated data sources including the FAO/UNESCO Soil Map of the World, Oxford Regional Economic Atlas of the USSR and Eastern Europe, and Central Asia and East European map sheets.

GEOGRAPHIC REFERENCE: lat/long

GEOGRAPHIC COVERAGE: Global

Maximum Latitude	:	+90 degrees (N)
Minimum Latitude	:	-90 degrees (S)
Maximum Longitude	:	+180 degrees (E)
Minimum Longitude	:	-180 degrees (W)

GEOGRAPHIC SAMPLING: Characteristic classes for 1-degree grid cell areas

TIME PERIOD: Modern period, circa 1960's and 70's
TEMPORAL SAMPLING: Modern composite

INTEGRATED DATA-SET

DATA-SET CITATION: Wilson, M.F. and A. Henderson-Sellers. 1992. *A global archive of land cover and soils data for use in general circulation climate models*. Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 5 independent single-attribute spatial layers on CD-ROM, 0.3MB. [first published in 1985]
ANALYST(s): M.F. Mylne (née Wilson) and Anne Henderson-Sellers
PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).
SPATIAL REPRESENTATION: Characteristic classes for 1-degree grid cells
TEMPORAL REPRESENTATION: Modern composite
DATA REPRESENTATION: 1-byte integer values representing characteristic classes and reliability codes for 1-degree grid cells.
LAYERS AND ATTRIBUTES: 3 independent single-attrubute spatial layers with 2 attribute layers (represented as raster data files for convenience).
COMPRESSED DATA VOLUME: 29,038 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Wilson, M.F., and A. Henderson-Sellers, 1985. "A Global Archive of Land Cover and Soils Data for Use in General Circulation Climate Models." *Journal of Climatology*, vol. 5, pp. 119 - 143.

ADDITIONAL REFERENCES

* Henderson-Sellers, A., M.F. Wilson, G. Thomas, and R.E. Dickenson. 1986. *Current Global Land-Surface Data Sets for Use in Climate-Related Studies*. NCAR Technical Note TN-272+STR. Boulder, CO: National Center for Atmospheric Research.

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	WHCOV1.IMG	1 files	64,800
	WHCOV2.IMG	1 files	64,800
	WHLREL.IMG	1 files	64,800
	WHSOIL.IMG	1 files	64,800
	WHSREL.IMG	1 files	64,800
Headers:			
\GLGEO\RASTER\	WHCOV1.DOC	1 files	3,988
	WHCOV2.DOC	1 files	3,990
	WHLREL.DOC	1 files	630
	WHSOIL.DOC	1 files	2,203
	WHSREL.DOC	1 files	650
Palettes:	none		
Time Series:	none		
Volume on Disk:		10 files	335,461

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A10\	WH1_01PCX to WH1_25.PCX	25 files	975,479
	WH1_##X.PCX	10 files	966,891
	WH2_001.PCX to WH2_108.PCX	108 files	2,446,005
	WH2_###X.PCX	27 files	2,241,326
Volume on Disk:		170 files	6,629,701

SOURCE EXAMPLE FILES

none

DATA ELEMENT: Primary and Secondary Vegetation Class

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: primary and secondary classes
SPATIAL DATA FILES:

WHCOV1.DOC

```
file title   : Wilson & Henderson-Sellers Primary Land Cover Classes
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 73
value units  : characteristic classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 81
```

File Series Parameters:

File	Description	Minimum	Maximum
WHCOV1	Primary Land-Cover Classes	0	73
WHCOV2	Secondary Land-Cover Classes	0	80

Legend:

```
category  0 :  0 Open Water
category  1 :  1 INW   Inland water
category  2 :  2 BOM   Bog or marsh
category  3 :  3 ICE   Ice
category  4 :  4 PAR   Paddy rice
category  5 :  5 MAN   Mangrove (tree swamp)
category  6 :  6 Not used
category  7 :  7 Not used
category  8 :  8 Not used
category  9 :  9 Not used
category 10 : 10 DNE   Dense needleleaf evergreen forest
category 11 : 11 ONE   Open needleleaf evergreen woodland
category 12 : 12 DMN   Dense mixed needleleaf and broadleaf, evergreen and
                       deciduous forest
```

```
category 13 : 13 OMN   Open mixed needleleaf and broadleaf, evergreen and
                       deciduous woodland
category 14 : 14 EBW   Evergreen broadleaf woodland
category 15 : 15 EBC   Evergreen broadleaf cropland
category 16 : 16 EBS   Evergreen broadleaf shrub
category 17 : 17 ODN   Open deciduous needleleaf woodland
category 18 : 18 DDN   Dense deciduous needleleaf forest
category 19 : 19 DEB   Dense evergreen broadleaf forest
category 20 : 20 DDB   Dense deciduous broadleaf forest
category 21 : 21 ODB   Open deciduous broadleaf woodland
category 22 : 22 DTC   Deciduous tree crops (temperate)
category 23 : 23 OTW   Open tropical woodland
category 24 : 24 WOS   Woodland + shrub
category 25 : 25 DDD   Dense drought deciduous forest
category 26 : 26 ODD   Open drought deciduous woodland
category 27 : 27 DES   Deciduous shrub
category 28 : 28 THS   Thorn shrub
category 29 : 29 Not used
category 30 : 30 TMP   Temperate meadow and permanent pasture
category 31 : 31 TRG   Temperate rough grazing
category 32 : 32 TGS   Tropical grassland + shrub
category 33 : 33 TRP   Tropical pasture
category 34 : 34 RGS   Rough grazing + shrub
category 35 : 35 PAT   Pasture + tree
category 36 : 36 SAR   Semi arid rough grazing
category 37 : 37 TSG   Tropical Savanna (grassland + tree)
category 38 : 38 Not used
category 39 : 39 PAS   Pasture + shrub
category 40 : 40 ARC   Arable cropland
category 41 : 41 DFA   Dry farm arable
category 42 : 42 NMG   Nursery and market gardening
category 43 : 43 CAS   Cane sugar
category 44 : 44 MAI   Maize
category 45 : 45 COT   Cotton
category 46 : 46 COF   Coffee
category 47 : 47 VIN   Vineyard
category 48 : 48 IRG   Irrigated cropland
category 49 : 49 TEA   Tea
category 50 : 50 ERF   Equatorial rain forest
category 51 : 51 ETC   Equatorial tree crop
category 52 : 52 TBF   Tropical broadleaf forest (slight seasonality)
category 53 : 53 Not used
category 54 : 54 Not used
category 55 : 55 Not used
category 56 : 56 Not used
category 57 : 57 Not used
category 58 : 58 Not used
category 59 : 59 Not used
category 60 : 60 Not used
category 61 : 61 TUN   Tundra
category 62 : 62 DWS   Dwarf shrub (tundra transition and high altitude
                       wasteland)
category 63 : 63 Not used
category 64 : 64 Not used
category 65 : 65 Not used
category 66 : 66 Not used
category 67 : 67 Not used
```

```
category 68 : 68 Not used
category 69 : 69 Not used
category 70 : 70 SDB   Sand desert and barren land
category 71 : 71 SDS   Scrub desert and semi desert
category 72 : 72 Not used
category 73 : 73 SDT   Semi desert + scattered trees
category 74 : 74 Not used
category 75 : 75 Not used
category 76 : 76 Not used
category 77 : 77 Not used
category 78 : 78 Not used
category 79 : 79 Not used
category 80 : 80 Urban
```

NOTES:

DATA ELEMENT: Soil Class

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: primary and secondary classes
SPATIAL DATA FILES:

WHSOIL.DOC

```
file title   : Wilson & Henderson-Sellers Code and Properties of Soil
Classes
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 34
value units  : characteristic classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 35
```

Legend:

```
category  0 :  0
category  1 :  1 not used
category  2 :  2 not used
category  3 :  3 not used
category  4 :  4 not used
category  5 :  5 not used
category  6 :  6 not used
category  7 :  7 not used
category  8 :  8 not used
category  9 :  9 not used
category 10 : 10 not used
category 11 : 11 LCF      LIGHT, COARSE, FREE
category 12 : 12 LIF      LIGHT, INTERMEDIATE, FREE
category 13 : 13 LFF      LIGHT, FINE, FREE
category 14 : 14 LCI      LIGHT, COARSE, IMPEDED
category 15 : 15 LII      LIGHT, INTERMEDIATE, IMPEDED
category 16 : 16 LFI      LIGHT, FINE, IMPEDED
category 17 : 17 MCF      MEDIUM, COARSE, FREE
category 18 : 18 MIF      MEDIUM, INTERMEDIATE, FREE
category 19 : 19 MFF      MEDIUM, FINE, FREE
category 20 : 20 MCI      MEDIUM, COARSE, IMPEDED
category 21 : 21 MII      MEDIUM, INTERMEDIATE, IMPEDED
category 22 : 22 MFI      MEDIUM, FINE, IMPEDED
category 23 : 23 DCF      DARK, COARSE, FREE
category 24 : 24 DIF      DARK, INTERMEDIATE, FREE
```

```
category 25 : 25 DFF      DARK, FINE, FREE
category 26 : 26 DCI      DARK, COARSE, IMPEDED
category 27 : 27 DII      DARK, INTERMEDIATE, IMPEDED
category 28 : 28 DFI      DARK, FINE, IMPEDED
category 29 : 29 L-P      LIGHT, --, POOR
category 30 : 30 M-P      MEDIUM, --, POOR
category 31 : 31 D-P      DARK, --, POOR
category 32 : 32 not used
category 33 : 33 not used
category 34 : 34 ICE
```

NOTES:

1. Categories refer to COLOR, TEXTURE, DRAINAGE
2. In the printed documentation Code 32 is listed between 25 and 27 which is taken as a typographical error since Code 26 has nine occurences and Code 32 has zero occurences.

DATA ELEMENT: Vegetation and Soil Class reliability

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: reliability files for each primary variable (vegetation and soils)
SPATIAL DATA FILES:

WHLREL.DOC

```
file title   : Wilson & Henderson-Sellers Land Cover Reliability
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 5
value units  : characteristic classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 6
```

File Series:

File	Description	Minimum	Maximum
WHLREL	Land-Cover Class Reliability	0	5
WHSREL	Soil Class Reliability	0	5

Legends:

WHLREL.DOC

```
category  0 : 0
category  1 : 1 High
category  2 : 2
category  3 : 3
category  4 : 4
category  5 : 5 Low
```

WHSREL.DOC

```
category  0 : 0
category  1 : 1 High
category  2 : 2 Good
category  3 : 3 Moderate
category  4 : 4 Fair
category  5 : 5 Poor
```

NOTES:

DATA INTEGRATION AND QUALITY

Mark A. Ohrenschall
NOAA National Geophysical Data Center
Boulder, CO

Data were read from floppy disk and converted to the GED format, separating each variable into different GIS files without altering the original numerical values. Legend information was entered from the accompanying documentation. All final data files were inspected for agreement with the original data.

A11

Staub and Rosensweig *Zobler Soil Type, Soil Texture, Surface Slope, and Other Properties*

DATA-SET DESCRIPTION

DATA-SET NAME: **Zobler Soil Type, Soil Texture, Surface Slope, and Other Properties**

PRINCIPAL INVESTIGATOR(s): **Leonard Zobler**
NASA Goddard Institute for Space Studies

SOURCE

SOURCE DATA CITATION: Staub, B. and C. Rosenzweig, 1987. *Global Digital Data Sets of Soil Type, Soil Texture, Surface Slope, and Other Properties.* Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. NCAR, Boulder, Colorado. 0.45 MB.

CONTRIBUTOR(s): Dr. Leonard Zobler
Goddard Institute of Space Science
Columbia University
2880 Broadway
New York, NY 10025 USA

DISTRIBUTOR(s): NCAR

VINTAGE: circa 1980's

LINEAGE: (1) Principal Investigator:
Leonard Zobler
Columbia University
NASA Goddard Institute for Space Studies

(2) Reprocessed and edited by:
Brad Staub and Cynthia Rosenzweig
NASA Goddard Institute for Space Studies

ORIGINAL DESIGN

VARIABLES: Dominant FAO soils and related classes: Soil Type, Associated and Included Soils, Near-Surface Texture (upper 30cm), Slope, Phase, Area, Special Codes for missing data and conflicting nominal classification (land, land-ice, water) between Zobler and Matthews.

ORIGIN: Data based on FAO Soils Map of the World (1974), digitized by Zobler (1986); and Matthews' vegetation data-set (see A07), with editorial additions and comparisons by Staub and Rosenzweig.

GEOGRAPHIC REFERENCE: lat/long
GEOGRAPHIC COVERAGE: Global

Maximum Latitude : +90 degrees (N)
Minimum Latitude : -90 degrees (S)
Maximum Longitude : +180 degrees (E)
Minimum Longitude : -180 degrees (W)

GEOGRAPHIC SAMPLING: Characteristic classes for 1-degree grid cell areas
TIME PERIOD: Modern period, circa 1960's and 70's
TEMPORAL SAMPLING: Modern composite

INTEGRATED DATA-SET

DATA-SET CITATION: Staub, B. and C. Rosenzweig. 1992. Global Zobler Soil Type, Soil Texture, Surface Slope, and Other Properties. Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. In: *Global Ecosystems Database Version 1.0: Disc A.* Boulder, CO: NOAA National Geophysical Data Center. 7 independent single-attribute spatial layers on CD-ROM, 0.45 MB. [first published in 1986]
ANALYST(s): Brad Staub and Cynthia Rosenzweig, NASA/GISS, New York, New York
PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).
SPATIAL REPRESENTATION: Characteristic classes for 1-degree grid cell areas
TEMPORAL REPRESENTATION: Modern composite
DATA REPRESENTATION: 1-byte integer codes representing characteristic classes within grid cells; except for Associated and Included Soils, which is stored as 2-byte integer codes.
LAYERS AND ATTRIBUTES: 7 independent single-attribute spatial layers
COMPRESSED DATA VOLUME: 48,226 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Staub, Brad and Cynthia Rosenzweig. 1986. "Global Digital Data Sets of Soil Type, Soil Texture, Surface Slope, and Other Properties: Documentation of Archived Tape Data." *NASA Technical Memorandum* #100685.

Zobler, L. 1986. "A world soil file for global climate modeling." *NASA Technical Memorandum #87802.*

ADDITIONAL REFERENCES

Henderson-Sellers, A., M.F. Wilson, G. Thomas, R.E. Dickinson, 1986. "Current Global Land Surface Data Sets for Use in Climate-Related Studies." *NCAR Technical Note* 272+STR.

Matthews, E., 1983. "Global vegetation and land use: New high resolution databases for climate studies." *Journal of Climatology and Applied Meteorology*, vol. 22, pp. 474-487.

Matthews, E., 1984. "Vegetation, Land-Use and Seasonal Albedo Data Sets: Documentation of Archived Data Tape." *NASA Technical Memorandum #86107*.

Wilson, M.F. and A. Henderson-Sellers, 1985. "A global archive of land cover and soils data for use in general circulation climate models." *Journal of Climatology*, vol. 5, pp. 119-143.

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	SRZAREA.IMG	1 files	64,800
	SRZCODE.IMG	1 files	64,800
	SRZPHAS.IMG	1 files	64,800
	SRZSLOP.IMG	1 files	64,800
	SRZSOIL.IMG	1 files	64,800
	SRZSUBS.IMG	1 files	129,600
	SRZTEXT.IMG	1 files	64,800
Headers:			
\GLGEO\META\	SRZAREA.DOC	1 files	992
	SRZCODE.DOC	1 files	1,578
	SRZPHAS.DOC	1 files	5,067
	SRZSLOP.DOC	1 files	835
	SRZSOIL.DOC	1 files	5,332
	SRZSUBS.DOC	1 files	7,985
	SRZTEXT.DOC	1 files	884
Palettes:	none		
Time Series:	none		
Volume on Disk:		14 files	541,073

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A11\	SR_01.PCX to SR_17.PCX	17 files	327,164
Volume on Disk:		17 files	327,164

SOURCE EXAMPLE FILES

none

DATA ELEMENT: Soil Type

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

SRZSOIL.DOC

```
file title   : Staub and Rosenzweig Zobler Soil Units
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 107
value units  : characteristic classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 108
```

Legend:

```
category  0 :    0 Water
category  1 :    1 99       Land-Ice
category  2 :    2 JE       Eutric Fluvisols
category  3 :    3 JC       Calcaric Fluvisols
category  4 :    4 JD       Dystric Fluvisols
category  5 :    5 JT       Thionic Fluvisols
category  6 :    6 GE       Eutric Gleysols
category  7 :    7 GC       Calcaric Gleysols
category  8 :    8 GD       Dystric Gleysols
category  9 :    9 GM       Mollic Gleysols
category 10 :   10 GH       Humic Gleysols
category 11 :   11 GP       Plinthic Gleysols
category 12 :   12 GX       Gelic Gleysols
category 13 :   13 RE       Eutric Regosols
category 14 :   14 RC       Calcaric Regosols
category 15 :   15 RD       Dystic Regosols
category 16 :   16 RX       Gelic Regosols
category 17 :   17 I        Lithosols
category 18 :   18 KH       Haplic Kastanozems
category 19 :   19 KK       Calcic Kastanozems
category 20 :   20 KL       Luvic Kastanozems
```

category 21 :	21	CH	Haplic Chernozems
category 22 :	22	CK	Calcic Chernozems
category 23 :	23	CL	Luvic Chernozems
category 24 :	24	CG	Glossic Chernozems
category 25 :	25	QC	Cambic Arenosols
category 26 :	26	QL	Luvic Arenosols
category 27 :	27	QF	Ferralic Arenosols
category 28 :	28	QA	Albic Arenosols
category 29 :	29	E	Rendzinas
category 30 :	30	U	Rankers
category 31 :	31	TO	Ochric Andosols
category 32 :	32	TM	Mollic Andosols
category 33 :	33	TH	Humic Andosols
category 34 :	34	TV	Vitric Andosols
category 35 :	35	VP	Pellic Vertisols
category 36 :	36	VC	Chromic Vertisols
category 37 :	37	HH	Haplic Phaeozems
category 38 :	38	HC	Calcic Phaeozems
category 39 :	39	HL	Luvic Phaeozems
category 40 :	40	HG	Gleyic Phaeozems
category 41 :	41	MO	Orthic Greyzems
category 42 :	42	MG	Gleyic Greyzems
category 43 :	43	ZO	Orthic Solonchaks
category 44 :	44	ZM	Mollic Solonchaks
category 45 :	45	ZT	Takyric Solonchaks
category 46 :	46	ZG	Gleyic Solonchaks
category 47 :	47	SO	Orthic Solonetz
category 48 :	48	SM	Mollic Solonetz
category 49 :	49	SG	Gleyic Solonetz
category 50 :	50	YH	Haplic Yermosols
category 51 :	51	YK	Calcic Yermosols
category 52 :	52	YY	Gypsic Yermosols
category 53 :	53	YL	Luvic Yermosols
category 54 :	54	YT	Takyric Yermosols
category 55 :	55	XH	Haplic Xerosols
category 56 :	56	XK	Calcic Xerosols
category 57 :	57	XY	Gypsic Xerosols
category 58 :	58	XL	Luvic Xerosols
category 59 :	59	BE	Eutric Cambisols
category 60 :	60	BD	Dystric Cambisols
category 61 :	61	BH	Humic Cambisols
category 62 :	62	BG	Gleyic Cambisols
category 63 :	63	BX	Gelic Cambisols
category 64 :	64	BK	Calcic Cambisols
category 65 :	65	BC	Chromic Cambisols
category 66 :	66	BV	Vertic Cambisols
category 67 :	67	BF	Ferralic Cambisols
category 68 :	68	LO	Orthic Luvisols
category 69 :	69	LC	Chromic Luvisols
category 70 :	70	LK	Calcic Luvisols
category 71 :	71	LV	Vertic Luvisols
category 72 :	72	LF	Ferric Luvisols
category 73 :	73	LA	Albic Luvisols
category 74 :	74	LP	Plinthic Luvisols
category 75 :	75	LG	Gleyic Luvisols
category 76 :	76	WE	Eutric Planosols
category 77 :	77	WD	Dystric Planosols

```
category 78 :  78 WM     Mollic Planosols
category 79 :  79 WH     Humic Planosols
category 80 :  80 WS     Solodic Planosols
category 81 :  81 WX     Gelic Planosols
category 82 :  82 OE     Eutric Histosols
category 83 :  83 OD     Dystric Histosols
category 84 :  84 OX     Gelic Histosols
category 85 :  85 DE     Eutric Podzoluvisols
category 86 :  86 DD     Dystric Podzoluvisols
category 87 :  87 DG     Gleyic Podzoluvisols
category 88 :  88 PO     Orthic Podzols
category 89 :  89 PL     Leptiv Podzols
category 90 :  90 PF     Ferric Podzols
category 91 :  91 PH     Humic Podzols
category 92 :  92 PP     Placic Podzols
category 93 :  93 PG     Gleyic Podzols
category 94 :  94 FO     Orthic Ferralsols
category 95 :  95 FX     Xanthic Ferralsols
category 96 :  96 FR     Rhodic Ferralsols
category 97 :  97 FH     Humic Ferralsols
category 98 :  98 FA     Acric Ferralsols
category 99 :  99 FP     Plinthic Ferralsols
category100 : 100 AO     Orthic Acrisols
category101 : 101 AF     Ferric Acrisols
category102 : 102 AH     Humic Acrisols
category103 : 103 AP     Plinthic Acrisols
category104 : 104 AG     Gleyic Acrisols
category105 : 105 NE     Eutric Nitosols
category106 : 106 ND     Dystric Nitosols
category107 : 107 NH     Humic Nitosols
```

NOTES:

1. first column is category number, second is soil abbreviation
2. categories 81 and 90 do not occur

DATA ELEMENT: Associated and Included Soils

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

SRZSUBS.DOC

```
file title   : Staub and Rosenzweig Zobler Associated and Included
Subsidiary Soil Units
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 278
value units  : characteristic classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 279
```

Legend:

```
category  0 :   0
category  1 :   1 Blank
category  2 :   2 AF
category  3 :   3 AFBD
category  4 :   4 AGFA
category  5 :   5 AGFO
category  6 :   6 AO
category  7 :   7 AOFO
category  8 :   8 B U
category  9 :   9 BC
category 10 :  10 BCBH
category 11 :  11 BCDD
category 12 :  12 BCL
category 13 :  13 BCLC
category 14 :  14 BCTV
category 15 :  15 BCV
category 16 :  16 BD
category 17 :  17 BDBH
category 18 :  18 BDBXDD
category 19 :  19 BDDD
category 20 :  20 BDDDPH
category 21 :  21 BDLOTO
category 22 :  22 BDRD
category 23 :  23 BDTO
category 24 :  24 BDU
category 25 :  25 BE
```

```
category 26 :  26 BEBH
category 27 :  27 BEC
category 28 :  28 BEE
category 29 :  29 BELC
category 30 :  30 BELO
category 31 :  31 BETO
category 32 :  32 BEU
category 33 :  33 BF
category 34 :  34 BH
category 35 :  35 BH U
category 36 :  36 BHTV
category 37 :  37 BHU
category 38 :  38 BK
category 39 :  39 BKR
category 40 :  40 BKRC
category 41 :  41 BKX
category 42 :  42 BV
category 43 :  43 BVLC
category 44 :  44 BXDD
category 45 :  45 BXDDOD
category 46 :  46 BXRC
category 47 :  47 CH
category 48 :  48 DD
category 49 :  49 DDLOTO
category 50 :  50 DDPH
category 51 :  51 DDPL
category 52 :  52 DDRD
category 53 :  53 E
category 54 :  54 E BC
category 55 :  55 FHNETO
category 56 :  56 FO
category 57 :  57 FOFX
category 58 :  58 FOLF
category 59 :  59 FOND
category 60 :  60 FP
category 61 :  61 GE
category 62 :  62 GX
category 63 :  63 GXRX
category 64 :  64 HH
category 65 :  65 HL
category 66 :  66 HLKL
category 67 :  67 JCXK
category 68 :  68 K E
category 69 :  69 K
category 70 :  70 K U
category 71 :  71 KH
category 72 :  72 KHJ
category 73 :  73 KHU
category 74 :  74 KL
category 75 :  75 L
category 76 :  76 L RE
category 77 :  77 L Q
category 78 :  78 LA
category 79 :  79 LABD
category 80 :  80 LC
category 81 :  81 LCE
category 82 :  82 LCRE
```

```
category 83 :  83 LCX
category 84 :  84 LF
category 85 :  85 LFNE
category 86 :  86 LFRD
category 87 :  87 LFRE
category 88 :  88 LG
category 89 :  89 LGRE
category 90 :  90 LK
category 91 :  91 LO
category 92 :  92 LOBC
category 93 :  93 MO
category 94 :  94 NE
category 95 :  95 OEPH
category 96 :  96 OEPHU
category 97 :  97 PHU
category 98 :  98 PO
category 99 :  99 POBD
category100 : 100 POBX
category101 : 101 POOD
category102 : 102 POOX
category103 : 103 Q
category104 : 104 R B
category105 : 105 R
category106 : 106 RB
category107 : 107 RCX YK
category108 : 108 RCX
category109 : 109 RCXK
category110 : 110 RCYK
category111 : 111 RCZO
category112 : 112 RD
category113 : 113 RDSO
category114 : 114 RE
category115 : 115 REBE
category116 : 116 REQA
category117 : 117 RERX
category118 : 118 REXK
category119 : 119 REYH
category120 : 120 RX
category121 : 121 RXBC
category122 : 122 RXBX
category123 : 123 RXOX
category124 : 124 RXX YH
category125 : 125 TO
category126 : 126 TV
category127 : 127 TVOD
category128 : 128 U
category129 : 129 V
category130 : 130 VHU
category131 : 131 VP
category132 : 132 X
category133 : 133 XH
category134 : 134 XK
category135 : 135 XKE
category136 : 136 XKK E
category137 : 137 XL
category138 : 138 Y
category139 : 139 YH
```

```
category140 : 140 YHRE
category141 : 141 YHSO
category142 : 142 YHYK
category143 : 143 YK
category144 : 144 YY
category145 : 145 ZO
category146 : 146 1
category147 : 147 10
category148 : 148 100
category149 : 149 101
category150 : 150 102
category151 : 151 103
category152 : 152 104
category153 : 153 105
category154 : 154 106
category155 : 155 107
category156 : 156 108
category157 : 157 109
category158 : 158 11
category159 : 159 110
category160 : 160 111
category161 : 161 112
category162 : 162 115
category163 : 163 116
category164 : 164 117
category165 : 165 118
category166 : 166 12
category167 : 167 120
category168 : 168 122
category169 : 169 123
category170 : 170 125
category171 : 171 126
category172 : 172 127
category173 : 173 128
category174 : 174 129
category175 : 175 13
category176 : 176 130
category177 : 177 131
category178 : 178 133
category179 : 179 135
category180 : 180 136
category181 : 181 138
category182 : 182 14
category183 : 183 142
category184 : 184 143
category185 : 185 146
category186 : 186 15
category187 : 187 16
category188 : 188 17
category189 : 189 177
category190 : 190 18
category191 : 191 19
category192 : 192 2
category193 : 193 20
category194 : 194 21
category195 : 195 22
category196 : 196 23
```

```
category197 : 197 24
category198 : 198 25
category199 : 199 26
category200 : 200 27
category201 : 201 28
category202 : 202 29
category203 : 203 3
category204 : 204 30
category205 : 205 31
category206 : 206 32
category207 : 207 33
category208 : 208 34
category209 : 209 35
category210 : 210 36
category211 : 211 37
category212 : 212 38
category213 : 213 39
category214 : 214 4
category215 : 215 40
category216 : 216 41
category217 : 217 42
category218 : 218 43
category219 : 219 44
category220 : 220 45
category221 : 221 46
category222 : 222 47
category223 : 223 48
category224 : 224 49
category225 : 225 5
category226 : 226 50
category227 : 227 51
category228 : 228 52
category229 : 229 53
category230 : 230 54
category231 : 231 55
category232 : 232 56
category233 : 233 57
category234 : 234 58
category235 : 235 59
category236 : 236 6
category237 : 237 60
category238 : 238 61
category239 : 239 62
category240 : 240 63
category241 : 241 64
category242 : 242 65
category243 : 243 66
category244 : 244 67
category245 : 245 68
category246 : 246 69
category247 : 247 7
category248 : 248 70
category249 : 249 71
category250 : 250 72
category251 : 251 73
category252 : 252 74
category253 : 253 75
```

```
category254 : 254 76
category255 : 255 77
category256 : 256 78
category257 : 257 79
category258 : 258 8
category259 : 259 80
category260 : 260 81
category261 : 261 82
category262 : 262 83
category263 : 263 84
category264 : 264 85
category265 : 265 86
category266 : 266 87
category267 : 267 88
category268 : 268 89
category269 : 269 9
category270 : 270 90
category271 : 271 91
category272 : 272 92
category273 : 273 93
category274 : 274 94
category275 : 275 95
category276 : 276 96
category277 : 277 97
category278 : 278 98
```

NOTES:

1. no data are provided for water areas or Antarctica
2. first column is category number, remaining are codes
3. categories are unique permutations of codes

DATA ELEMENT: Near-Surface Soil Texture

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

SRZTEX.DOC

```
file title   : Staub and Rosenzweig Zobler Near-Surface Soil Texture
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 9
value units  : characteristic classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 10
```

Legend:

```
category  0 :  0 Water
category  1 :  1 COR       Coarse
category  2 :  2 MED       Medium
category  3 :  3 FIN       Fine
category  4 :  4 CM        Coarse-medium
category  5 :  5 CF        Coarse-fine
category  6 :  6 MF        Medium-fine
category  7 :  7 CMF       Coarse-medium-fine
category  8 :  8 ORG       organic
category  9 :  9 LI        Land Ice
```

NOTES:

DATA ELEMENT: Surface Slope

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

SRZSLOP.DOC

```
file title   : Staub and Rosenzweig Zobler Soil Unit Surface Slope
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 9
value units  : classed
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 10
```

Legend:

```
category  0 : 0 Water
category  1 : Class 1     0-8%
category  2 : Class 2     8-30%
category  3 : Class 3     > 30%
category  4 : Class 4     0-30%
category  5 : Class 5     0-8%  > 30%
category  6 : Class 6     8-30% > 30%
category  7 : Class 7     0-8% 8-30% > 30%
category  8 : 8 Not Used
category  9 : 9 Land-Ice
```

NOTES:

DATA ELEMENT: Soil Phase

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

SRZPHAS.DOC

```
file title   : Staub and Rosenzweig Zobler Soil Phase Codes
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 86
value units  : permutations of phase codes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 87
```

Legend:

```
category  0 :  0
category  1 :  1 Blank
category  2 :  2 St G        stony; glacier (i.e.; land-ice)
category  3 :  3 St Pf       stony; permafrost
category  4 :  4 St So       stony; sodic
category  5 :  5 St IP       stony; intermittent permafrost
category  6 :  6 St Pf G     stony; permafrost glacier (i.e.; land-ice)
category  7 :  7 St Pf Po    stony; permafrost ponded
category  8 :  8 St Po       stony; ponded
category  9 :  9 St L        stony; lithic
category 10 : 10 St Pg       stony; petrogypsic
category 11 : 11 St RD       stony; rock debris
category 12 : 12 St ?        stony; 27
category 13 : 13 St IP G     stony; intermittent permafrost glacier (i.e.;
                             land-ice)
category 14 : 14 St DS       stony; dunes; sand
category 15 : 15 St D        stony; duripan
category 16 : 16 St D Po     stony; duripan ponded
category 17 : 17 St C        stony; cerrado
category 18 : 18 St L Pc     stony; lithic petrocalcic
category 19 : 19 St Sa       stony; saline
category 20 : 20 St Ph       stony; phreactic
category 21 : 21 St Pc       stony; petrocalcic
category 22 : 22 St          stony
category 23 : 23 Ph          phreactic
category 24 : 24 Ph Pf       phreactic; permafrost
```

```
category 25 : 25 Ph Po      phreactic; ponded
category 26 : 26 C          cerrado
category 27 : 27 So Po      sodic; ponded
category 28 : 28 So DS      sodic; dunes, sand
category 29 : 29 So         sodic
category 30 : 30 L So       lithic; sodic
category 31 : 31 L Pf       lithic; petroferric
category 32 : 32 L Pf RD G  lithic; permafrost; rock debris; glacier
                            (i.e., land-ice)
category 33 : 33 L Pf       lithic; permafrost
category 34 : 34 L Pf RD    lithic; permafrost; rock debris
category 35 : 35 L Sa       lithic; saline
category 36 : 36 L Pf Po    lithic; permafrost; ponded
category 37 : 37 L P        lithic; petric
category 38 : 38 L Po       lithic; ponded
category 39 : 39 L IP       lithic; intermittent permafrost
category 40 : 40 L          lithic
category 41 : 41 L RD       lithic; rock debris
category 42 : 42 Pf Po      permafrost; ponded
category 43 : 43 Pf         permafrost
category 44 : 44 Pf G       permafrost; glacier (i.e., land-ice)
category 45 : 45 IP Po      intermittent permafrost; ponded
category 46 : 46 IP         intermittent permafrost
category 47 : 47 IP G         intermittent permafrost; glacier (i.e.,
                            land-ice)
category 48 : 48 G          glacier (i.e., land-ice)
category 49 : 49 G St Pf    glacier (i.e., land-ice); stony; permafrost
category 50 : 50 G Pf       glacier (i.e., land-ice); permafrost
category 51 : 51 G RD L Pf  glacier (i.e., land-ice); rock debris;
                            lithic; permafrost
category 52 : 52 G L Pf     glacier (i.e., land-ice); lithic; permafrost
category 53 : 53 G L RD Pf  glacier (i.e., land-ice); lithic; rock
                            debris; permafrost
category 54 : 54 G RD Pf    glacier (i.e., land-ice); rock debris;
                            permafrost
category 55 : 55 Po DS      ponded; dunes, sand
category 56 : 56 Po         ponded
category 57 : 57 Po RD      ponded; rock debris
category 58 : 58 DS         dunes, sand
category 59 : 59 DS L       dunes, sand; lithic
category 60 : 60 RD St      rock debris; stony
category 61 : 61 RD Pc St   rock debris; petrocalcic; stony
category 62 : 62 RD G       rock debris; glacier (i.e., land-ice)
category 63 : 63 RD St DS   rock debris; stony; dunes, sand
category 64 : 64 RD         rock debris
category 65 : 65 RD DS      rock debris; dunes, sand
category 66 : 66 RD St ?    rock debris; stony; 27
category 67 : 67 RD DS St   rock debris; dunes, sand; stony
category 68 : 68 ?          27
category 69 : 69 P Po       petric; ponded
category 70 : 70 P C        petric; cerrado
category 71 : 71 P          petric
category 72 : 72 Pf Po      petroferric; ponded
category 73 : 73 Pf         petroferric
category 74 : 74 Pc Po      petrocalcic; ponded
category 75 : 75 Pc         petrocalcic
category 76 : 76 Pg         petrogypsic
```

```
category 77 : 77 Pg Po       petrogypsic; ponded
category 78 : 78 F           fragipan
category 79 : 79 D           duripan
category 80 : 80 D Po        duripan; ponded
category 81 : 81 Sa ?        saline; 27
category 82 : 82 Sa DS       saline; dunes, sand
category 83 : 83 Sa          saline
category 84 : 84 Sa Po       saline; ponded
category 85 : 85 Sa So       saline; sodic
category 86 : 86 Sa RD       saline; rock debris
```

NOTES:

1. no data are provided for water areas or Antarctica
2. category 1 indicates records filled with spaces in the source file
3. categories are unique permutations of phase codes (e.g., 63, 67)
4. Code 27 is undocumented

DATA ELEMENT: Special Codes

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

SRZCODE.DOC

```
file title   : Staub and Rosenzweig Zobler Special Codes
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 11
value units  : characteristic classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 12
```

Legend:

```
category  0 :  0
category  1 :  1 Blank
category  2 :  2 33    Land cell not present on FAO map; classified as
                       soil; SU, TEX, and SLP fields filled in
category  3 :  3 44    Land cell not present on FAO map; classified as
                       land-ice
category  4 :  4 55 88
category  5 :  5 55    Cell classified as soil by Zobler, and as land-ice
                       by Matthews
category  6 :  6 66    Cell classified as land-ice by Zobler, and as
                       vegetation (soil implied) by Matthews
category  7 :  7 77 88
category  8 :  8 77    Slope information missing; SLP field filled in
category  9 :  9 88    Texture information missing; TEX field filled in
category 10 : 10 88 77
category 11 : 11 99    No soil information present on the map; SU; TEX,
                       and SLP fields filled in
```

NOTES:

1. no data are provided for water areas or Antarctica
2. category 1 indicates records filled with spaces in the source file
3. categories are unique permutations of codes
4. first column is category number, remaining columns are codes

DATA INTEGRATION AND QUALITY

Mark A. Ohrenschall
NOAA National Geophysical Data Center
Boulder, CO

The Zobler data was in a lat/long projection on a one-degree grid that was compatible with the GED conventions. The source data consisted of four ASCII files, which were read and converted to raster data files in the GED format. The first three of these files (SOIL.USER, TEX.USER, AND SLP.USER) presented no problems in representing the numerical values exactly. The fourth file (SOILWRLD), however, contained character string data rather than numerical codes. In the GED (IDRISI 4.0) data structure, these must be represented as numerical values linked to the character information as a legend or values file. The following method was employed to translate this file:

A program was written to read SOILWRLD and tabulate each unique occurrence of a character string for each parameter field, creating a look-up table. Numerical codes were assigned to each unique string in the look-up tables, which were then used to re-class the SOILWRLD file.

Other than assigning codes to the SOILWRLD data, no other changes were made in the original data values. All final data files were inspected for agreement with the original data.

A12

Webb, Rosensweig, and Levine *Global Soil Particle Size Properties*

DATA-SET DESCRIPTION

DATA-SET NAME: **Global Soil Particle Size Properties**

PRINCIPAL INVESTIGATOR(s): **Robert S. Webb, Cynthia E. Rosenzweig, and Elissa R. Levine**

SOURCE

SOURCE DATA CITATION: Webb, R.S., C.E. Rosenzweig, and E.R. Levine. 1991. *A Global Data Set of Soil Particle Size Properties.* Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. New York: NASA Goddard Institute of Space Studies. 0.51 MB.

CONTRIBUTOR(s): Dr. Robert S. Webb
NOAA Paleoclimatology Program
National Geophysical Data Center
325 Broadway
Boulder, CO 80303 USA

DISTRIBUTOR(s): NASA/GISS

VINTAGE: circa 1980's

LINEAGE:

(1) Principal Investigators: R.S. Webb, C.E. Rosenzweig, and E.R. Levine
NASA Goddard Institute for Space Studies

(2) R.S. Webb
NOAA National Geophysical Data Center

ORIGINAL DESIGN

VARIABLES:

Zobler Soil Classes
Continental Classes
Combined Zobler and Continental Classes (spatial layer for horizon data)
Potential Storage of Water in Soil Profile
Potential Storage of Water in Root Zone
Soil Water Model II
Soil Profile Thickness
Texture-based Potential Storage of Water
Depth of 15 horizons (meters)
Amount of sand, silt, and clay in 15 horizons

ORIGIN: FAO/UNESCO Soil Map of the World (1974) -- see Chapter A16X

GEOGRAPHIC REFERENCE: lat/long

GEOGRAPHIC COVERAGE: Global

Maximum Latitude	:	+90 degrees (N)
Minimum Latitude	:	-90 degrees (S)
Maximum Longitude	:	+180 degrees (E)
Minimum Longitude	:	-180 degrees (W)

GEOGRAPHIC SAMPLING: Characteristic Classes and Values for 1-degree grid cells
TIME PERIOD: Modern, circa 1971-1981
TEMPORAL SAMPLING: Modern composite

INTEGRATED DATA-SET

DATA-SET CITATION: Webb, Robert S., Cynthia E. Rosenzweig, and Elissa R. Levine. 1992. *A Global Data Set of Soil Particle Size Properties.* Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. In: *Global Ecosystems Database Version 1.0: Disc A.* Boulder, CO: NOAA National Geophysical Data Center. 2 independent and one derived spatial layer with 65 attributes, on CD-ROM, 16.5 MB. [first published in 1991]
ANALYST(s): Robert S. Webb
PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).
SPATIAL REPRESENTATION: Characteristic classes and values within 1-degree grid cells.
TEMPORAL REPRESENTATION: Modern composite
DATA REPRESENTATION:

Zobler Soil Classes	1-byte integer class codes
Continental Classes	1-byte integer class codes
Combined Zobler and Continental Classes (spatial layer for horizon data)	2-byte integer class codes
Potential Storage of Water in Soil Profile	2-byte integers (mm)
Potential Storage of Water in Root Zone	2-byte integers (mm)
Soil Water Model II	2-byte integers (mm)
Soil Profile Thickness	2-byte integers (cm)
Texture-based Potential Storage of Water	2-byte integers (mm)
Depth of 15 horizons (meters)	4-byte real (meters +/- .001)
Amount of sand, silt, and clay in 15 horizons	4-byte real (% +/- .001)

LAYERS AND ATTRIBUTES: 2 independent and 1 derived spatial layers with 65 attribute layers (stored as raster data files).
COMPRESSED DATA VOLUME: 602,458 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Webb, Robert S., Cynthia E. Rosenzweig, and Elissa R. Levine, 1991. A Global Data Set of Soil Particle Size Properties. *NASA Technical Memorandum* 4286.

ADDITIONAL REFERENCES

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DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	WRCONT.IMG	1 file	64,800
	WRMODII.IMG	1 file	129,600
	WRPROF.IMG	1 file	129,600
	WRROOT.IMG	1 file	129,600
	WRSOIL.IMG	1 file	129,600
	WRTEXT.IMG	1 file	129,600
	WRZSOIL.IMG	1 file	64,800
	WRCLA01.IMG to WRCLA15.IMG	15 files	259,200
	WRDEP01.IMG to WRDEP15.IMG	15 files	259,200
	WRSAN01.IMG to WRSAN15.IMG	15 files	259,200
	WRSIL01.IMG to WRSIL15.IMG	15 files	259,200
Headers:			
\GLGEO\META\	WRCONT.DOC	1 file	1,026
	WRMODII.DOC	1 file	497
	WRPROF.DOC	1 file	521
	WRROOT.DOC	1 file	518
	WRSOIL.DOC	1 file	500
	WRTEXT.DOC	1 file	519
	WRZSOIL.DOC	1 file	5,703
	WRCLA01.DOC to WRCLA15.DOC	15 files	8,226
	WRDEP01.DOC to WRDEP15.DOC	15 files	8,226
	WRSAN01.DOC to WRSAN15.DOC	15 files	8,226
	WRSIL01.DOC to WRSIL15.DOC	15 files	8,226
Palettes:	none		
Time Series:	none		
Volume on Disk:		134 files	16,371,788

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A12\	WR_01.PCX to LC1_37.PCX	37 files	1,270,334
	WR_##X.PCX	5 files	470,703
Volume on Disk:		42 files	1,741,037

SOURCE EXAMPLE FILES

none

DATA ELEMENT: Continent Codes

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRCONT.DOC

```
file title   :    Webb et al. Continent Codes from the FAO/UNESCO Soil Map
                  of the World
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 10
value units  : classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 11
```

Legend:

```
category  0 : 0 OCEAN
category  1 : 1 not used
category  2 : 2  N (NAM)  NAMERICA
category  3 : 3  C (MCA)  MEXICEAM
category  4 : 4  S (SAM)  SAMERICA
category  5 : 5  E (EUR)  EUROPE
category  6 : 6  A (AFR)  AFRICA
category  7 : 7  I (SCA)  SCASIA
category  8 : 8  U (NCA)  NCASIA
category  9 : 9  E (SEA)  SEASIA
category 10 : 10 T (AUS)  AUSTRALI
```

NOTES:

1. Continent codes correspond to volume numbers of the FAO/UNESCO
2. Soil Map of the World (1971-81).

DATA ELEMENT: Zobler Soil Type

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRZSOIL.DOC

```
file title   : Webb et al Soil Particle Size Properties Zobler Soil Types
data type    : byte
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 107
value units  : classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 108
```

Legend:

```
category  0 :   0 WATER   WATER/OCEAN/LAKE
category  1 :   1 AF      FERRIC ACRISOL
category  2 :   2 AG      GLEYIC ACRISOL
category  3 :   3 AH      HUMIC ACRISOL
category  4 :   4 AO      ORTHIC ACRISOL
category  5 :   5 AP      PLINTHIC ACRISOL
category  6 :   6 BC      CHROMIC CAMBISOL
category  7 :   7 BD      DYSTRIC CAMBISOL
category  8 :   8 BE      EUTRIC CAMBISOL
category  9 :   9 BF      FERRALIC CAMBISOL
category 10 :  10 BG      GLEYIC CAMBISOL
category 11 :  11 BH      HUMIC CAMBISOL
category 12 :  12 BK      CALCIC CAMBISOL
category 13 :  13 BV      VERTIC CAMBISOL
category 14 :  14 BX      GELIC CAMBISOL
category 15 :  15 CG      GLOSSIC CHERNOZEM
category 16 :  16 CH      HAPLIC CHERNOZEM
category 17 :  17 CK      CALCIC CHERNOZEM
category 18 :  18 CL      LUVIC CHERNOZEM
category 19 :  19 DD      DYSTRIC PODZOLUVISOL
category 20 :  20 DE      EUTRIC PODZOLUVISOL
category 21 :  21 DG      GLEYIC PODZOLUVISOL
category 22 :  22 E       RENDZINA
category 23 :  23 FA      ACRIC FERRALSOL
category 24 :  24 FH      HUMIC FERRALSOL
category 25 :  25 FO      ORTHIC FERRALSOL
```

category 26	:	26	FP	PLINTHIC FERRALSOL
category 27	:	27	FR	RHODIC FERRALSOL
category 28	:	28	FX	XANTHIC FERRALSOL
category 29	:	29	GC	CALCARIC GLEYSOL
category 30	:	30	GD	DYSTRIC GLEYSOL
category 31	:	31	GE	EUTRIC GLEYSOL
category 32	:	32	GH	HUMIC GLEYSOL
category 33	:	33	GM	MOLLIC GLEYSOL
category 34	:	34	GP	PLINTHIC GLEYSOL
category 35	:	35	GX	GELIC GLEYSOL
category 36	:	36	HC	CALCARIC PHAEOZEM
category 37	:	37	HG	GLEYIC PHAEOZEM
category 38	:	38	HH	HAPLIC PHAEOZEM
category 39	:	39	HL	LUVIC PHAEOZEM
category 40	:	40	I	LITHOSOL
category 41	:	41	JC	CALCARIC FLUVISOL
category 42	:	42	JD	DYSTRIC FLUVISOL
category 43	:	43	JE	EUTRIC FLUVISOL
category 44	:	44	JT	THIONIC FLUVISOL
category 45	:	45	KH	HAPLIC KASTANOZEM
category 46	:	46	KK	CALCIC KASTANOZEM
category 47	:	47	KL	LUVIC KASTANOZEM
category 48	:	48	LA	ALBIC LUVISOL
category 49	:	49	LC	CHROMIC LUVISOL
category 50	:	50	LF	FERRIC LUVISOL
category 51	:	51	LG	GLEYIC LUVISOL
category 52	:	52	LK	CALCIC LUVISOL
category 53	:	53	LO	ORTHIC LUVISOL
category 54	:	54	LP	PLINTHIC LUVISOL
category 55	:	55	LV	VERTIC LUVISOL
category 56	:	56	MG	GLEYIC GREYZEM
category 57	:	57	MO	ORTHIC GREYZEM
category 58	:	58	ND	DYSTRIC NITOSOL
category 59	:	59	NE	EUTRIC NITOSOL
category 60	:	60	NH	HUMIC NITOSOL
category 61	:	61	OD	DYSTRIC HISTOSOL
category 62	:	62	OE	EUTRIC HISTOSOL
category 63	:	63	OX	GELIC HISTOSOL
category 64	:	64	PF	FERRIC PODZOL
category 65	:	65	PG	GLEYIC PODZOL
category 66	:	66	PH	HUMIC PODZOL
category 67	:	67	PL	LEPTIC PODZOL
category 68	:	68	PO	ORTHIC PODZOL
category 69	:	69	PP	PLACIC PODZOL
category 70	:	70	QA	ALBIC ARENOSOL
category 71	:	71	QC	CAMBIC ARENOSOL
category 72	:	72	QF	FERRALIC ARENOSOL
category 73	:	73	QL	LUVIC ARENOSOL
category 74	:	74	RC	CALCARIC REGOSOL
category 75	:	75	RD	DYSTRIC REGOSOL
category 76	:	76	RE	EUTRIC REGOSOL
category 77	:	77	RX	GELIC REGOSOL
category 78	:	78	SG	GLEYIC SOLONETZ
category 79	:	79	SM	MOLLIC SOLONETZ
category 80	:	80	SO	ORTHIC SOLONETZ
category 81	:	81	TH	HUMIC ANDOSOL
category 82	:	82	TM	MOLLIC ANDOSOL

```
category 83 :  83 TO      OCHRIC ANDOSOL
category 84 :  84 TV      VITRIC ANDOSOL
category 85 :  85 U       RANKER
category 86 :  86 VC      CHROMIC VERTISOL
category 87 :  87 VP      PELLIC VERTISOL
category 88 :  88 WD      DYSTRIC PLANOSOL
category 89 :  89 WE      EUTRIC PLANOSOL
category 90 :  90 WH      HUMIC PLANOSOL
category 91 :  91 WM      MOLLIC PLANOSOL
category 92 :  92 WS      SOLODIC PLANOSOL
category 93 :  93 WX      GELIC PLANOSOL
category 94 :  94 XH      HAPLIC XEROSOL
category 95 :  95 XK      CALCIC XEROSOL
category 96 :  96 XL      LUVIC XEROSOL
category 97 :  97 XY      GYPSIC XEROSOL
category 98 :  98 YH      HAPLIC YERMOSOL
category 99 :  99 YK      CALCIC YERMOSOL
category100 : 100 YL      LUVIC YERMOSOL
category101 : 101 YT      TAKYRIC YERMOSOL
category102 : 102 YY      GYPSIC YERMOSOL
category103 : 103 ZG      GLEYIC SOLONCHAK
category104 : 104 ZM      MOLLIC SOLONCHAK
category105 : 105 ZO      ORTHIC SOLONCHAK
category106 : 106 ZT      TAKYRIC SOLONCHAK
category107 : 107 ICE     GLACIER/ICE
```

NOTES:

DATA ELEMENT: Potential Storage of Water in Soil Profile

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRPROF.DOC

```
file title   : Webb et al Potential Storage of Water in Soil Profile (mm)
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 4432
value units  : millimeters
value error  : unknown
flag value   : 1
flag def'n   : ice
legend cats  : 0
```

NOTES:

DATA ELEMENT: Potential Storage of Water in Root Zone

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRROOT.DOC

```
file title   : Webb et al Potential Storage of Water in Root Zone (mm)
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 1700
value units  : millimeters
value error  : unknown
flag value   : 1
flag def'n   : ice
legend cats  : 0
```

NOTES:

DATA ELEMENT: **Soil Water Model II**

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRMODII.DOC

```
file title   : Webb et al Model II Soil Water (mm)
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 650
value units  : millimeters
value error  : unknown
flag value   : 1
flag def'n   : ice
legend cats  : 0
```

NOTES:

DATA ELEMENT: Soil Profile Thickness

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRSOIL.DOC

```
file title   : Webb et al Soil Profile Thickness (cm)
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 800
value units  : centimeters
value error  : unknown
flag value   : 1
flag def'n   : ice
legend cats  : 0
```

NOTES:

DATA ELEMENT: Texture-based Potential Storage of Water

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRTEXT.DOC

```
file title   : Webb et al Texture-Based Potential Storage of Water (mm)
data type    : integer
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0
max. value   : 2160
value units  : millimeters
value error  : unknown
flag value   : 1
flag def'n   : ice
legend cats  : 0
```

NOTES:

DATA ELEMENT: Depth of Horizon

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRDEP01.DOC

```
file title   :   Webb et al Soil Particle Size Properties: depth for
                 horizon 1
data type    : real
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0.0000000
max. value   : 0.1400000
value units  : meters
value error  : unknown
flag value   : -1.0000000
flag def'n   : end of record for soil type
legend cats  : 0
```

File Series Parameters:

File	Horizon	Minimum	Maximum
WRDEP01	1	0.0000000	0.1400000
WRDEP02	2	0.0000000	3.5999999
WRDEP03	3	0.0000000	1.0500000
WRDEP04	4	0.0000000	3.5999999
WRDEP05	5	0.0000000	3.5999999
WRDEP06	6	0.0000000	5.0000000
WRDEP07	7	0.0000000	8.0000000
WRDEP08	8	0.0000000	7.0000000
WRDEP09	9	0.0000000	3.5999999
WRDEP10	10	0.0000000	3.0230000
WRDEP11	11	0.0000000	3.0480001
WRDEP12	12	0.0000000	3.5309999
WRDEP13	13	0.0000000	2.7000000
WRDEP14	14	0.0000000	2.2300000
WRDEP15	15	0.0000000	2.4600000

NOTES:

DATA ELEMENT: Amount of Clay in Horizon

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRCLA01.DOC

```
file title   : Webb et al Soil Particle Size Properties: clay in horizon 1
data type    : real
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0.0000000
max. value   : 0.7700000
value units  : proportional value
value error  : unknown
flag value   : -1.0000000
flag def'n   : missing soil type
legend cats  : 0
```

File Series Parameters:

File	Horizon	Minimum	Maximum
WRCLA01	1	0.0000000	0.7700000
WRCLA02	2	0.0000000	0.8400000
WRCLA03	3	0.0000000	0.9180000
WRCLA04	4	0.0000000	0.9300000
WRCLA05	5	0.0000000	0.9140000
WRCLA06	6	0.0000000	0.9180000
WRCLA07	7	0.0000000	0.7500000
WRCLA08	8	0.0000000	0.6400000
WRCLA09	9	0.0000000	0.6800000
WRCLA10	10	0.0000000	0.7500000
WRCLA11	11	0.0000000	0.7600000
WRCLA12	12	0.0000000	0.7800000
WRCLA13	13	0.0000000	0.3780000
WRCLA14	14	0.0000000	0.3620000
WRCLA15	15	0.0000000	0.0000000

NOTES:

DATA ELEMENT: Amount of Sand in Horizon

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRSAN01.DOC

```
file title   : Webb et al Soil Particle Size Properties: sand in horizon 1
data type    : real
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0.0000000
max. value   : 0.9800000
value units  : proportional value
value error  : unknown
flag value   : -1.0000000
flag def'n   : missing soil type
legend cats  : 0
```

File Series Parameters:

File	Horizon	Minimum	Maximum
WRSAN01	1	0.0000000	0.9800000
WRSAN02	2	0.0000000	0.9900000
WRSAN03	3	0.0000000	0.9840000
WRSAN04	4	0.0000000	0.9900000
WRSAN05	5	0.0000000	0.9880000
WRSAN06	6	0.0000000	0.9900000
WRSAN07	7	0.0000000	0.9920000
WRSAN08	8	0.0000000	0.9920000
WRSAN09	9	0.0000000	0.9910000
WRSAN10	10	0.0000000	0.9960000
WRSAN11	11	0.0000000	0.4600000
WRSAN12	12	0.0000000	0.5400000
WRSAN13	13	0.0000000	0.3360000
WRSAN14	14	0.0000000	0.3400000
WRSAN15	15	0.0000000	0.0000000

NOTES:

DATA ELEMENT: Amount of Silt in Horizon

STRUCTURE: Raster Data Files: 1-degree GED 180x360 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

WRSIL01.DOC

```
file title   : Webb et al Soil Particle Size Properties: silt in horizon 1
data type    : real
file type    : binary
columns      : 360
rows         : 180
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 1.0000000
min. value   : 0.0000000
max. value   : 0.8670000
value units  : proportional value
value error  : unknown
flag value   : -1.0000000
flag def'n   : missing soil type
legend cats  : 0
```

File Series Parameters:

File	Horizon	Minimum	Maximum
WRSIL01	1	0.0000000	0.8670000
WRSIL02	2	0.0000000	0.8770000
WRSIL03	3	0.0000000	0.8830000
WRSIL04	4	0.0000000	0.8300000
WRSIL05	5	0.0000000	0.8580000
WRSIL06	6	0.0000000	0.7840000
WRSIL07	7	0.0000000	0.8970000
WRSIL08	8	0.0000000	0.7900000
WRSIL09	9	0.0000000	0.7980000
WRSIL10	10	0.0000000	0.8690000
WRSIL11	11	0.0000000	0.6990000
WRSIL12	12	0.0000000	0.7210000
WRSIL13	13	0.0000000	0.7240000
WRSIL14	14	0.0000000	0.7140000
WRSIL15	15	0.0000000	0.0000000

NOTES:

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National Geophysical Data Center
Boulder, CO

The following is an excerpt from documentation provided by Robert S. Webb. This selection refers to a data file containing depth and soil particle size information. Note that references to 106 entries in the data array (corresponding to Zobler soil types) is a typographical error, and the correct figure is 107.

> The data has been organized as four 106x10x15 [sic] dimensioned real*4 arrays: depth, sand, silt, and clay. The first dimension (106) [sic] corresponds to the sequence number of the soil types in Zobler's (1986) World Soil Data File. The second dimension (10) corresponds to the volume numbers of the nine major continental divisions in FAO/UNESCO Soil Map of the World, Vols. 2-10 (1971-81). The third dimension (15) corresponds to the individual horizons with data for each soil type from the Morphological, Chemical and Physical Properties Appendix in each of the nine volumes of the FAO/UNESCO Soil Map of the World (1971-81). The data in the sand, silt, and clay arrays are stored as proportional values for each soil horizon. The arbitrary particle size distribution summing to 100 percent included for Histosols (entries 61-63 in first dimension of each array) should not be used. Instead, values reflecting the physical properties of organic soils and appropriate for specific research objectives should be inserted.
>
> The data in the depth array are scaled in meters with the first value being 0m depth for each soil type and the subsequent values the contact depths of contiguous horizons. By definition the depth array contains one extra value for the third dimension corresponding to the bottom depth of the lowest horizon for each soil type. Within the data set, no soil type had more than 14 soil horizons. In cases when the number of horizons in a soil type was less than 14, we used -1.0 values to flag the end of record of each soil type. For example, a soil type with 10 horizons has 10 data entries in the sand, silt, and clay arrays, 11 data entries for the depth array, and -1.0 values for entries 11 - 15 in each array (entries 12 - 15 for the depth array).

Some technical notes are given regarding the 107x10x15 data array for those interested:

1) A code for océan was added to the group of nine continent codes, thus accounting for the 10 elements of the second dimension of the data array. The data array for all soil horizons for all soil types for this continent code was zero-filled.
2) The data array was an ASCII text file with four columns of numbers, each column corresponding to one of the four variables, namely depth, sand, silt, or clay. Thus each array element was actually a line of text containing four data values for the four variables.
3) The ordering of the array elements into the (one-dimensional) data file was such that the 107 soil types vary slowest, the 10 continent codes vary faster, and the 15 soil horizons vary fastest. In other words, if an element's position in the array is given by the indices (i,j,k) where $1 <= i <= 107$, $1 <= j <=10$, and $1 <= k <= 15$ then the position of that element in the data file is given by $((i - 1) * 15 * 10) + ((j - 1) * 15) + k = ((i - 1) * 10 + j - 1) * 15 + k$.

The first stage in producing the IDRISI format for the data array was to separate the data by variable (depth, sand, silt, and clay) and by horizon number (one through 15) into 60 attribute values files. Each attribute values file would be composed of feature identification codes corresponding to each of the 107 soil types for each of the 10 continent codes (explained below), with each feature i.d. being paired with a data value. The data value for each feature i.d. was read from the appropriate position in the data array (given above). In other words, the first and second dimensions of the data array were merged into a single dimension with $107 * 10 = 1070$ elements, and the third and fourth dimensions (the fourth dimension is the variable) were also merged into a single dimension with $15 * 4 = 60$ elements. Here the elements of the first merged dimension are "continental soil type" (the feature i.d.'s) and data value pairs , and the elements of the second merged dimension are attribute values files, named after variable and soil horizon.

The second stage in producing the IDRISI format was to create the spatial map associated with the attribute values files. This spatial map would be the feature definition file that uses the continental soil types as links between the data values and geographic locations. Since the soil types and the continental divisions are already spatially defined it only remained to produce the map of continental soil types. This was done by overlaying the map of continent codes (WRCONT) multiplied by 1000 with the map of soil types (WRZSOL) via addition[1]. Both the original continent codes and the original soil types can be recovered from this map, the continent code by performing integer division by 1000, and the soil type by taking the continental soil type modulo 1000.

---

[1]This was done by running the IDRISI module SCALAR on WRCONT, choosing the multiply option and specifying 1000, creating a temporary file, for example WRCONTE4. Then the IDRISI module OVERLAY was run on this file and on WRZSOIL, choosing the addition option and thus creating the feature definition file, for example WRCZSOL. An algebraic notation for this series of operations would be:

WRCZSOL = WRCONTE4 + WRZSOIL, where WRCONTE4 = 1000 * WRCONT, or
WRCZSOL = (1000 * WRCONT) + WRZSOIL.

The final stage in producing the IDRISI format was to produce 60 separate raster grids from the 60 attribute values files and the single feature definition file. This was done by running the IDRISI module ASSIGN on the feature definition file and on each of the 60 attribute values files. The ASSIGN module creates an output grid from an input grid and an attribute values file, using the input grid (whose cells take on feature i.d.'s as values) to define the locations of the data values found in the attribute values file. The appropriate data values are taken from the attribute values file according to the feature i.d.'s paired with each data value. Thus if a cell in the input grid has a value p and the attribute values file has a feature i.d. and data value pair (p,z) then the cell with the corresponding position in the output grid will take on the value z. Note that feature i.d.'s in attribute values files must be unique, but feature i.d.'s in the feature definition file may occur multiple times.

A13

FNOC *Elevation, Terrain, and Surface Characteristics*

DATA-SET DESCRIPTION

DATA-SET NAME: **Elevation, Terrain, and Surface Characteristics**

PRINCIPAL INVESTIGATOR(s): **Leo Clarke**
US Navy Fleet Numerical
Oceanographic Center

SOURCE

SOURCE DATA CITATION: Fleet Numeric Oceanographic Center. 1985. 10-minute *Global Elevation, Terrain, and Surface Characteristics* (re-processed by NCAR and NGDC). Digital Raster Data on a 1-degree Geographic (lat/long) 180x360 grid. NOAA National Geophysical Data Center. 9 files on 9-track tape or 2 floppy disks in compressed format, 28 MB. [first published in 1981]

CONTRIBUTOR(s): Leo Clarke
U.S. Navy, Fleet Numerical Oceanographic Center
Monterey, CA 93943 USA

DISTRIBUTOR(s): NGDC/WDC-A

VINTAGE: circa 1960's

LINEAGE:

(1) Principal Investigator (digitizing from maps):
Leo Clarke
US Navy Fleet Numerical Oceanographic Center

(2) Reprocessed with corrections to elevation values:
Dennis Joseph
National Center for Atmospheric Research

(3) Error flags, corrections, and re-structuring (1985):
John J. Kineman
NOAA National Geophysical Data Center
Boulder, CO

ORIGINAL DESIGN

VARIABLES:

(1) Elevation: Maximum, minimum, mode (+/- 30 ft.)
(2) Urban and Water Cover: Percent areal coverage (+/- 1)
(3) Primary, Secondary, and Ocean Types: Characteristic class
(4) Number and direction of ridges: Count +/- 1, direction +/- 10.

ORIGIN: Digitized from ONC charts and other maps as available.

GEOGRAPHIC REFERENCE: lat/long

GEOGRAPHIC COVERAGE: Global

Maximum Latitude	:	+90 degrees (N)
Minimum Latitude	:	-90 degrees (S)
Maximum Longitude	:	+180 degrees (E)
Minimum Longitude	:	-180 degrees (W)

GEOGRAPHIC SAMPLING: Spatial statistics (Mode, Maximum, and Minimum) and characteristic classes for 10-minute grid cells.

TIME PERIOD: Modern composite, circa 1970's

TEMPORAL SAMPLING: Modern Composite

INTEGRATED DATA-SET

DATA-SET CITATION: FNOC. 1992. FNOC/NCAR Global Elevation, Terrain, and Surface Characteristics. Digital Raster Data on a 10-minute Geographic (lat/long) 1080x2160 grid. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 10 independent single-attribute spatial layers on CD-ROM, 28 MB. [first published in 1981]

ANALYST(s): John J. Kineman

PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).

SPATIAL REPRESENTATION: Spatial statistics (Mode, Maximum, Minimum, and percent coverage) and characteristic classes for 10-minute grid cells.

TEMPORAL REPRESENTATION: Modern Composite

DATA REPRESENTATION:

(1) Elevation (Maximum, minimum, mode): 2-byte integers, representing meters above sea level, rounded to nearest 10 meters.

(2) Urban and Water Cover: 1-byte integers, representing percent areal cover (+/- 1%)

(3) Primary, Secondary Types, and Ocean/Land Mask: 1-byte integers representing characteristic classes.

(4) Number of ridges: 1-byte integers representing count +/- 1

(5) Direction of ridges: 1-byte integers representing direction East of True North, rounded to nearest 10 degrees.

LAYERS AND ATTRIBUTES: 9 independent single-attribute spatial layers

COMPRESSED DATA VOLUME: 2,036,120 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

Cuming, Michael J. and Barbara A. Hawkins, 1981. "TERDAT: The FNOC System for Terrain Data Extraction and Processing." Technical report MII Project M-254 (Second Edition). Prepared for Fleet Numerical Oceanography Center (Monterey, CA). Published by Meteorology International Incorporated. (*see excerpt, below).

ADDITIONAL REFERENCES none

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	FNOCAZM.IMG	1 file	2,332,800
	FNOCMAX.IMG	1 file	4,665,600
	FNOCMIN.IMG	1 file	4,665,600
	FNOCMOD.IMG	1 file	4,665,600
	FNOCOCM.IMG	1 file	2,332,800
	FNOCPT.IMG	1 file	2,332,800
	FNOCRDG.IMG	1 file	2,332,800
	FNOCST.IMG	1 file	2,332,800
	FNOCURB.IMG	1 file	2,332,800
	FNOCWAT.IMG	1 file	2,332,800
Headers:			
\GLGEO\META\	FNOCAZM.DOC	1 file	1,026
	FNOCMAX.DOC	1 file	512
	FNOCMIN.DOC	1 file	512
	FNOCMOD.DOC	1 file	510
	FNOCOCM.DOC	1 file	561
	FNOCPT.DOC	1 file	3,532
	FNOCRDG.DOC	1 file	512
	FNOCST.DOC	1 file	3,555
	FNOCURB.DOC	1 file	537
	FNOCWAT.DOC	1 file	538
Palettes:	none		
Time Series:	none		
Volume on Disk:		20 files	30,338,195

REPRINT FILES

none

SOURCE EXAMPLE FILES

none

FILE DESCRIPTION

DATA ELEMENT: Elevation

STRUCTURE: Raster nested-grid: 10 arc-minutes (see *User's Guide*)
SERIES: Elevation statistics
SPATIAL DATA FILES:

FNOCMOD.DOC

```
file title    : Navy Terrain Data--Modal Elevation (meters)
data type     : integer
file type     : binary
columns       : 2160
rows          : 1080
ref. system   : lat/long
ref. units    : deg
unit dist.    : 1.0000000
min. X        : -180.0000000
max. X        : 180.0000000
min. Y        : -90.0000000
max. Y        : 90.0000000
pos'n error   : unknown
resolution    : 0.1666667
min. value    : -120
max. value    : 7830
value units   : meters
value error   : unknown
flag value    : none
flag def'n    : none
legend cats   : 0
```

File Series Parameters:

File	VARIABLE	Minimum	Maximum
FNOCMOD	Modal Elevation	-120	7830
FNOCMAX	Maximum Elevation	-120	8840
FNOCMIN	Minimum Elevation	-240	6100

NOTES:

1. Datum shifts of 20m or more are obvioius in flat areas, especially in Africa and South America.
2. Many artifacts have been noted in various locations

DATA ELEMENT: Primary and Secondary Surface Type

STRUCTURE: Raster Data Files: 10-minutes 1080x2160 GED grid (see *User's Guide*)
SERIES: Primary and Secondary classes
SPATIAL DATA FILES:

FNOCPT.DOC

```
file title   : Navy Terrain Data--Primary Surface Type Codes
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : 0
max. value   : 62
value units  : characteristic classes
value error  : unknown
flag value   : 99
flag def'n   : flag value 99 indicates bad or missing data
legend cats  : 10
```

File Series Parameters:

File	VARIABLE	Minimum	Maximum
FNOCPT	Primary Surface Type	0	62
FNOCST	Secondary Surface Type	0	31

Legend:

```
category  0 :  0 salt/lake   salt or lake bed
category  1 :  1 Flat        flat or relatively flat
category  2 :  2 Desert      desert (or, for high latitudes, glaciers or
                             permanent ice)
category  3 :  3 Marsh       marsh
category  4 :  4 Lake/Atol   lake country or atoll
category  5 :  5 Valley/Be   major valleys or river beds
category  6 :  6 Iso Mount   isolated mountains, ridge or peak
category  7 :  7 Low Mount   low mountains or hills
category  8 :  8 Ave Mount   average mountains
category  9 :  9 Rug Mount   extremely rugged mountains
category 31 : 31 Ocean       Ocean (Primary Type)
category 62 : 62 Ocean       Ocean (Secondary Type)
```

NOTES:

1. Bad or missing data flagged as 99
2. These data are known to have many errors in land values, especially in the southern hemisphere.

DATA ELEMENT: Ocean/Land Mask

STRUCTURE: Raster Data Files: 10-minutes 1080x2160 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

FNOCOCM.DOC

```
file title   : Ocean Mask (produced from Navy Terrain data)
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : 0
max. value   : 1
value units  : characteristic classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 2
```

Legend:

```
category 0 : 0 Ocean
category 1 : 1 Land
```

NOTES:

1. This layer was derived from other variables in the original FNOC data-set to provide a convenient ocean/land mask for display and processing uses. It was also included here as a source data-set for coastline corrections made to the Olson WE1.4D (see Chapter A05).
2. Land appears to have been given priority to ocean values, thus enlarging some land areas and reducing lakes (e.g., the Black Sea).

DATA ELEMENT: Number of Ridges

STRUCTURE: Raster Data Files: 10-minutes 1080x2160 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

FNOCRDG.DOC

```
file title   : Navy Terrain Data--Number of Significant Ridges
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : 0
max. value   : 63
value units  : counts, 0-63
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

NOTES:
(1) These data are known to have many layers.

DATA ELEMENT: Direction of Ridges

STRUCTURE: Raster Data Files: 10-minutes 1080x2160 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

FNOCAZM.DOC

```
file title   : Navy Terrain Data--Direction of Ridges (degrees X 10)
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : 0
max. value   : 18
value units  : degrees X 10
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 19
```

Legend:

```
category  0 :  0 deg.
category  1 :  1  10 deg.
category  2 :  2  20 deg.
category  3 :  3  30 deg.
category  4 :  4  40 deg.
category  5 :  5  50 deg.
category  6 :  6  60 deg.
category  7 :  7  70 deg.
category  8 :  8  80 deg.
category  9 :  9  90 deg.
category 10 : 10 100 deg.
category 11 : 11 110 deg.
category 12 : 12 120 deg.
category 13 : 13 130 deg.
category 14 : 14 140 deg.
category 15 : 15 150 deg.
category 16 : 16 160 deg.
category 17 : 17 170 deg.
category 18 : 18 180 deg.
```

NOTES:

1. These data are known to have many errors

DATA ELEMENT: Water and Urban Cover

STRUCTURE: Raster Data Files: 10-minutes 1080x2160 GED grid (see *User's Guide*)
SERIES: water and urban
SPATIAL DATA FILES:

FNOCWAT.DOC

```
file title   : Navy Terrain Data--Percent Water Cover
data type    : byte
file type    : binary
columns      : 2160
rows         : 1080
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.1666667
min. value   : 0
max. value   : 100
value units  : percent
value error  : unknown
flag value   : 255
flag def'n   : flag value 255 indicates bad or missing data
legend cats  : 0
```

File Series:

File	Variable	Minimum	Maximum
FNOCWAT	Water Cover	0	100
FNOCURB	Urban Cover	0	98

NOTES:

1. These data are known to have many errors

DATA INTEGRATION AND QUALITY

John J. Kineman
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SUMMARY

The Navy Fleet Numerical Oceanography Center (NFNOC) began creating the original 10-minute terrain data set in the mid 1960's. Work extended into the early 1970's. The main sources for the data were the U.S. Department of Defense Operational Navigation Charts (ONC), scale 1:1,000,000. For certain regions ONC charts were not available; for such areas selected charts from the Jet Navigation Charts and World Aeronautical Charts were used. The charts were hand read out to forms by employees, and then read by optical character reader to tape. The values were estimates from contour lines. Isometric graphs were made for quality control, checking terrain features. Later, other errors were corrected by the National Center for Atmospheric Research in Boulder, Colorado.

Source data from NCAR were stored in binary compressed format. This was converted at NGDC to an ASCII format for products distributed on tape with latitude/longitude encoding, grouped in 5-degree squares. A series of quality checks were performed on the data in 1985 to test for internal consistency between the various parameters. Numerous errors were noted, especially in the southern hemisphere. Some of the errors could be corrected by comparison between data layers. Others were flagged with a bad-data code. Errors that could not be detected by comparing the fields were not tested for.

These data were later converted to a raster data file by mapping the lat/long coordinates into the corresponding 10-minute grid and separating the variables into individual spatial layers. The resulting files are provided here, with the addition of an "ocean mask" file produced from a combination of variables in the FNOC data-set. This land/ocean mask is provided for convenience in masking other data for display, but also for use in evaluating results of ocean masking in the Olson data-sets (Chapter A05).

Users should take special caution in using these data, as many errors have been noted. The most commonly used portion of the data-set is the elevation values, and there has been progress in improving the other values. New source tapes were obtained in the hopes that some of the errors were introduced during it's long lineage and could be removed by comparison with the originals; however this approach has not proven to be feasible due to uncertainties in the source tapes.

Several efforts are underway to obtain improved topography and to derive corrections from other data. An improved version of the 10-minute data is expected for the next CD-ROM (Disc B).

COMPILATION OF EXISTING DOCUMENTATION

BACKGROUND

The 10-minute Terrain data set distributed by NGDC was originally produced by the U.S. Navy, Fleet Numerical Oceanography Center in Monterey, CA. The data were then transferred to the National Center for Atmospheric Research (NCAR) in Boulder, CO (Dennis Josephs), where some corrections were made in the elevation values. NCAR was then the source of NGDC's version. Various quality checks were run on the data at NGDC in 1986, revealing numerous errors (about 16,000), mostly in the Southern Hemisphere and mostly in the attribute fields. A second version of the data set was then sent from NCAR. The new version had fewer errors (about 9,000), still mostly in the attribute values for the Southern Hemisphere. These errors resulted from 10 automated tests, as listed below:

1) Range (from max and min) excludes mode
2) Sea height and type mismatch (between elevation and primary or secondary type code)
3) Ridge azimuth out of limit (i.e. < 0 or > 18)
4) Number of Ridges out of limits
5) Secondary type undefined
6) Primary type undefined
7) % water out of limits
8) % urban out of limits
9) Max/min out of limit (exceeds lowest and highest known elevations on earth).
10) Sea type-code discrepancy (between primary and secondary type codes).

* summaries of these error checks are available from NGDC

In the case of elevation data, corrections were made based on other data sources, but in the case of the attribute fields, data errors that had no obvious correction were flagged (all bits on = nine's in the NGDC ASCII format, or 255 in the current one-byte integer format) to indicate bad data.

Attempts were made to retrieve original or near-original copies of the data set to see if errors may have been introduced during processing at one or more locations. After several years, an "original" tape emerged from Mr. Leo Clark at the Navy FNOC. Other copies were also obtained from varioius sources. NGDC will continue to evaluate the various versions, and plans to produce an up-dated version the 10-minute data set using all the latest information and reference to other data. Meanwhile, we are convinced that the data represented here, although known to have numerous errors, is the "best available" version for now.

The appendices (A and B) contain information from existing documentation of the previous (source) versions of the data set, eliminating tape and other format descriptions that are irrelevant to the current data structure and format (described elsewhere in this manual).

DESCRIPTION OF VARIABLES:

Significant Ridges:

Subjective estimate of number of ridges and their orientation in tens of degrees (00-18).

Terrain Elevation:

Elevation in meters (converted from original elevation in 100's of feet, rounded to the nearest 30 meters). Ocean are coded as zero elevation, however not all zero values indicate ocean. Refer to the Primary or Secondary terrain characteristics (or the special Ocean mask, which was created from the Primary terrain characteristics code 62). Inland water bodies are coded with the elevation of the water surface (except in minimum field where it is always zero), except when the water body is below sea level, in which case the surface elevation is used (another exception to this is the Caspian Sea, which is coded as zero).

Characteristics of the Terrain (Primary and Secondary):

0	:	salt or lake bed.
1	:	flat or relatively flat.
2	:	desert (or, for latitudes greater than 70N, glaciers or permanent ice).
3	:	marsh.
4	:	lake country or atoll.
5	:	major valleys or river beds.
6	:	isolated mountains, ridge or peak.
7	:	low mountains or hills.
8	:	average mountains.
9	:	extremely rugged mountains.
[31]	:	Ocean (used in Secondary type only)
[62]	:	Ocean (used in Primary type only)

Percentage of Water:

For ocean areas at sea level the value is 100, for all other areas the range is 00 to 99 (large lakes or inland seas will not be coded as 100).

Percentage of Urban Development:

Not updated (reflects highly subjective judgements from the maps used).

APPENDIX A

EXCERPTS FROM NCAR DOCUMENTATION PACKAGE:

"Data Format for Global 10-Minute Elevation Data from the U.S. Navy"

Dennis Joseph
NCAR, Data Support Section
April 1982, update Dec 1984

Global elevation data at a resolution of 10-minutes were prepared by the Navy Fleet Numerical Oceanography Center at Monterey. For each 10X10 minute area, the set includes modal elevation, minimum elevation, maximum elevation, orientation of ridges, terrain characteristics, and urban development. This is archived by the NCAR Data Support Section (DSS) in a packed binary format. Parameters available are identical to those described in documents by Meteorological International, Inc. and the Fleet Numerical Oceanography Center, but the DSS has made some [format] changes to the set. The information content of the original set has been preserved entirely. Each 64 bit group [in the NCAR/DSS data set] has the following format:

Bits	Code	Description
1-6	RR	Estimate of the number of significant ridges
7-12	DD	General direction of ridges
13-21	HMO	Terrain elevation - Modal height.
22-30	HHI	Terrain elevation - Maximum height.
31-39	NLO [HLO]	Terrain elevation - Minimum height.
40-45	C1	Primary characteristics of terrain.
46-50	C2	Secondary characteristics of the terrain.
51-57	WWW	Percentage of water surface.
58-64	URB	Percentage of urban development.

<u>General Information</u>:

The modal terrain height has been contoured at NCAR, and major problems identified in these plots have been corrected by the Navy. Distribution summaries of all parameters indicate that there are still some invalid elevation values and unexplained code values, especially in the terrain characteristics field. As of this data no further information is available on these problems. Occasional occurrences of full range values (all bits on) are assumed to indicate missing data.

The data distribution summaries showed a strong tendency for elevation values to cluster around multiples of 500 feet. This is probably due to the contour intervals in the original

The data distribution summaries showed a strong tendency for elevation values to cluster around multiples of 500 feet. This is probably due to the contour intervals in the original maps or to some other characteristic in the method of reading map values.

The true resolution of the data is reduced to 20 minutes poleward of 70 degrees latitude, but data values are still present for each 10 minute [cell]. More information on the original data format, the sources of the data, the methods of reading the data, and the routines designed for the Navy to read the original format is available in documentation by the Fleet Numerical Oceanography Center and Meteorology International Inc.

General Information Update - DEC 1984:

Various users have noted a large number of bad data points in the minimum elevations. A few bad points in the modal and maximum elevations have also been identified. An attempt has been made to remove these bad points and replace them with estimated values. The minimum values from a previous edition of the data were found to have many fewer problems and these values were used for all minimum elevations north of 30 South. Checks for unreasonable values and gradients were run and comparisons of min, mode, and max were made. The results of these tests were manually inspected and were estimates seemed better than the original values, they were inserted in the set. Checks were run on the minimum, modal, and maximum elevation only. No checks were run on the other parameters.

There are most likely still some erroneous values in the set, but most of the totally unreasonable values have been removed. Note that the minimum elevations are coded as zero for all water surfaces regardless of the true elevation of the water surface (even when this surface is below sea level). In some areas the elevation values are constant over one degree areas indicating that the resolution is not truly 10 minutes in those areas. In general, the modal elevations seem to be more reliable than the minimum or maximum.

This corrected set will be the primary archive set, and the uncorrected earlier versions are available on request.

Roughness computations:

Stephano Tibaldi, European Center for Medium Range Weather Forecasting, has used these elevations to compute estimates of surface roughness. His method for computing roughness length (Z) over a user-defined area containing multiple 10′ [cells] is given on the following page. Note that his relative maxima are determined by examining the 8 surrounding [cells]. When looking at data which are poleward of 70 degrees, use every other point to compensate for true resolution of 20′.

Formula to compute the roughness length Z_o :

$$Z_o = \sqrt{\frac{N}{F}\left(\sum p_i \overline{h}_i^2 - \left(\sum p_i h_i\right)^2\right)} + \sum \sqrt{\frac{n_i}{f_i} p_i \frac{\left(\overline{h}_i - h_i^{\min}\right)\left(h_i^{\max} - \overline{h}_i\right)}{4}}$$

where:

N	=	number of relative $\overline{h}_i$ maxima in the user-defined grid square
F	=	surface area of the user-defined grid square
n_i	=	number of significant ridges in the 10′ grid square
$\overline{h}_i$	=	mean height in the 10′ grid square
$h_i^{\max}$	=	maximum height in the 10" grid square
$h_i^{\min}$	=	minimum height in the 10" grid square
f_i	=	surface area of the 10′ grid square
p_i	=	proportion of the user-defined grid square occupied by the i^{th} 10′ grid square

APPENDIX B

EXCERPT FROM NAVY/FNOC DOCUMENTATION:

Cuming, Michael J. and Barbara A. Hawkins, 1981. "TERDAT: The FNOC System for Terrain Data Extraction and Processing." Technical report MII Project M-254 (Second Edition). Prepared for Fleet Numerical Oceanography Center (Monterey, CA). Published by Meteorology International Incorporated. (*see excerpt, below).

THE FNOC TERRAIN DATA SET

The terrain Parameters:

Terrain parameters, listed below, have been extracted from charts and recorded for all 10-minute latitude by 10-minute longitude areas covering the globe. (This work was begun by FNOC in the mid-1960's.) The basic charts used were the U.S. Department of Defense Operational Navigation Charts (ONC), scale 1:10^6. For certain regions ONC charts were not available; for such areas selected charts from the Jet Navigation charts (JN) and World Aeronautical Charts were used.

The following terrain parameters are available for each 10'x10' area:

Code	Description
RR	The estimated number of significant ridges.
DD	General orientation of ridges in tens of degrees (0->18).
HMO	Terrain elevation -- modal height (see NOTE 1).
HHI	Terrain elevation -- maximum height (see NOTE 1).
HLO	Terrain elevation -- minimum height (see NOTE 1)
C1	Primary characteristics of the terrain (see NOTE 2).
C2	Secondary characteristics of the terrain (see NOTE 2).
WWW	Percentage of water surface.
URB	Percentage of urban development (see NOTE 4).

NOTES:

1. The most frequently occurring height (HMO) was estimated from contour lines. Elevations are coded as positive numbers in hundreds of feet. For example, 1000 ft. is coded as 010; the maximum value of HHI (Mount Everest, 29028 ft.) is coded as 290. To avoid negative codings, elevations below sea-

minimum value of HLO (Dead Sea, -1299 ft) is coded as 413.

2. The code for c1 and c2 is:

0	--	salt or lake bed.
1	--	flat or relatively flat.
2	--	desert (or, for latitudes greater than 70N, glaciers or permanent ice).
3	--	marsh.
4	--	lake country or atoll.
5	--	major valleys or river beds.
6	--	isolated mountains, ridge or peak.
7	--	low mountains or hills.
8	--	average mountains.
9	--	extremely rugged mountains.

3. For open sea points, all terrain parameters are set to zero.

4. The Terrain Data Set has not been updated to reflect changes in the percentage of urban development. in addition the determination of certain terrain parameters--e.g., RR and DD--is highly subjective.

A14

Pospeschil *Micro World Data Bank II*

DATA-SET DESCRIPTION

DATA-SET NAME: **Micro World Data Bank II**

PRINCIPAL INVESTIGATOR(s): **U.S. Central Intelligence Agency**

SOURCE

SOURCE DATA CITATION: Pospeschil, F (analyst). 1988. *Micro World Databank II (MWDB-II): Coastlines, Country Boundaries, Islands, Lakes, and Rivers.* Digital vector data at 1-minute resolution. Bellevue, NB: MicroDoc, Inc. Compressed format on 1 floppy disk, 2.5 MB.

CONTRIBUTOR(s): WDB-II: U.S. National Technical Information Service (NTIS)
MWDB-II Fred Pospeschil

DISTRIBUTOR(s): WDB-II: U.S. National Technical Information Service (NTIS)
Washington D.C. USA
MWDB-II Fred Pospeschil
MicroDoc Inc.
3108 Jackson Street
Bellevue, Nebraska 68005 USA

VINTAGE: unknown

LINEAGE:

(1) CIA World Data Bank II
(2) Generalized to 1-minute by US Air Force
(3) Distributed as "Share-ware" by:
Fred Pospeschil
MicroDoc, Inc.
3108 Jackson Street
Bellevue, Nebraska 68005 USA

ORIGINAL DESIGN

VARIABLES: Un-labeled vector boundaries, representing: Coastlines, Islands, National (Country) borders, State borders (USA), Rivers, and Lakes at 1-minute resolution.

ORIGIN: Originally digitized from maps, primarily ONC Charts.

GEOGRAPHIC REFERENCE: lat/long

GEOGRAPHIC COVERAGE: Global

Maximum Latitude : +90 degrees (N)
Minimum Latitude : -90 degrees (S)
Maximum Longitude : +180 degrees (E)
Minimum Longitude : -180 degrees (W)

GEOGRAPHIC SAMPLING: 1-minute point locations
TIME PERIOD: circa 1970's and 80's
TEMPORAL SAMPLING: Composite of modern map data

INTEGRATED DATA-SET

DATA-SET CITATION: Pospeschil, F. 1992. *Micro World Databank II (MWDB-II): Coastlines, Country Boundaries, Islands, Lakes, and Rivers.* Digital vector data at 1-minute resolution. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 6 independent single-attribute spatial layers on CD-ROM, 2.5 MB. [first published in 1988]
ANALYST(s): Fred Pospeschil, MicroDoc Inc.
PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).
SPATIAL REPRESENTATION: point locations for boundaries, rounded to 1-minute in latitude and longitude.
TEMPORAL REPRESENTATION: Composite of modern data
DATA REPRESENTATION: Point locations represented in minutes of latitude and longitude, originating from the Greenwich Meridian and Equator. Values east of Greenwich are positive, West are negative. Values North of the Equator are positive, South are negative.
LAYERS AND ATTRIBUTES: 6 independent single-attribute spatial layers attributes
COMPRESSED DATA VOLUME: 772,786 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Pospeschil, F. ----. Micro World Data Bank II (MWDB-II). Unpublished documentation. Bellvue, WA: Micro Doc. 8p.

ADDITIONAL REFERENCES

none

DATA-SET FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\GLGEO\RASTER\	MWCOAST.VEC	1 files	857,929
	MWISLAND.VEC	1 files	404,436
	MWLAKE.VEC	1 files	172,371
	MWNATION.VEC	1 files	243,608
	MWRIVER.VEC	1 files	315,677
	MWSTATE.VEC	1 files	27,680
Headers:			
\GLGEO\META\	MWCOAST.DVC	1 files	402
	MWISLAND.DVC	1 files	403
	MWLAKE.DVC	1 files	401
	MWNATION.DVC	1 files	405
	MWRIVER.DVC	1 files	402
	MWSTATE.DVC	1 files	402
Palettes:	none		
Time Series:	none		
Volume on Disk:		12 files	2,024,116

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A14\	MW_01.PCX to MW_08.PCX	8 files	242,478
Volume on Disk:		8 files	242,478

SOURCE EXAMPLE FILES

none

DATA ELEMENT: Vector Boundaries

STRUCTURE: Vector data file: 1-minute resolution (see *User's Guide*)
SERIES: Feature files
SPATIAL DATA FILES:

MWCOAST.DVC

```
file title   : Micro World Data Bank II Coasts
id type      : integer
file type    : ascii
object type  : line
ref. system  : lat/long
ref. units   : deg
unit dist.   : 0.0166667
min. X       : -10800.0000000
max. X       : 10800.0000000
min. Y       : -5400.0000000
max. Y       : 5400.0000000
pos'n error  : unknown
resolution   : 0.0166667
comment      : rounded to 1-minute from World Data Bank II
```

File Series Parameters:

File	Description
MWCOAST	Coastlines
MWISLAND	Island boundaries
MWNATION	National (Country) borders
MWSTATE	State borders (USA)
MWRIVER	Rivers
MWLAKE	Lake boundaries

NOTES:

(1) Coastline artifacts have been noted in various locations
(2) Political boundaries have not been up-dated since the original compilation

DATA INTEGRATION AND QUALITY

Fred Pospeschil
MicroDoc Inc.

John J. Kineman (ed.)
NOAA National Geophysical Data Center
Boulder, CO

INTRODUCTION

The full WDB-II is a digitial map data base produced by the Central Intelligence Agency (CIA) and distributed by the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA, 22161. In it's original form, Micro WDB-II is a highly compressed version of WDB-II which is suitable for use on micro computers and was put in this configuration by Micro Doc. Before describing Micro WDB-II a few words should be said about the source file - WDB-II. The following paragraphs are paraphrased from the NTIS overview of WDB-II.

> WDB-II is a digitial representation of the world coastlines and boundaries suitable for use in automated mapping systems. It contains approximately six million discrete geographic points and was digitized using all available sources of information. Map scales used range from 1:750,000 to 1:4,000,000 with a nominal scale of 1:3,000,000. These points are grouped by and identified as describing (1) coast lines, (2) country boundaries, (3) state boundaries (USA only), (4) islands, (5) lakes, and (6) rivers. Each of these groupings is further broken down into features and subordinate classifications/ranks. These ranks are hierarchically structured, and are also used for plotting symbol definition.
>
> WDB-II, as provided by NTIS, is in a 20 character format on five 9 track EBCDIC one-half inch magnetic tapes. This data base consists of two types of records, one for the line segment identifier data, and the other for the latitude and longitude values of each discrete point making up the line segment. In this format latitude and longitude values are recorded only as integers in degrees, minutes, and seconds. WDB-II is available for $660.00 (Order Number PB-271 874 SET/HBG).

Clearly, WDB-II is an excellent data source when making large (4 x 6 foot) plots on a mainframe or minicomputer. It is, however, somewhat large (150 - 200 megabytes) for use on microcomputers. Even on the larger commercial online graphics systems, many points have to be filtered out before generating displays. For this reason many people have spent considerable time over the past to filter and compress this data into a form which could be used in desktop computers. To these people we wish to express our appreciation - particularly Antonio Riveria who provided Micro Doc with the latest download of the file.

BACKGROUND

The present version began as a three megabyte ASCII text file which contained some 179,000 points selected from all six of the line types described above. This file was then converted into a sixteen bit integer format which reduced the size to just over one megabyte. Since this was still a little large for most five inch disk formats the file was divided into six files - one for each of the six line types. The coast line file was further divided into two files as it was over 400 KB. With this processing completed the file was configured such that it could be readily moved to most desk top microcomputers using the MSDOS disk format.

The MWDB-II distributed by Micro Doc allows the user to extract 5 levels of detail from the database for each line type. Each level of detail retains the same number of line segments, but generalized to a different number of points per segment.

INTEGRATION

For use in the Global Ecosystems Database, the most detailed level of MWDB-II was chosen and is represented in the six vector data-sets included on the CD-ROM. These files were created by first extracting the highest level of detail from MWDB-II using the Micro Doc software, then reformatting the resulting vector files for use in the GED. The Geographic Information Structure of the GED eliminates the need for imbedded line type codes (each type becomes a separate overlay) and detail level selection (most GIS have functions for generalizing lines). Without generalizing or windowing the vector files, however, some plots may be slow (e.g., the coastline file, MWCOAST).

The following table shows the number of points which are in each file and for the full level of detail (i.e., all points in MWDB-II) used in the GED. It also shows the number of line segments in each file. File sizes were given in the File Description section, earlier in this Chapter.

Micro WDB-II File Composition - detail level 1 (all points)
==========================

Detail	COAST	COUNTRY	STATE	ISLAND	LAKE	RIVER	Total
Points	75175	22359	2259	35171	15118	28194	179331
Lines	208	301	111	344	103	196	1263

"This product contains/uses data and/or code placed in the public domain by Fred Pospeschil and Antonio Riveria. Original coordinate data was created by the Central Intelligence Agency."

A15X

Edwards *Global Gridded Elevation and Bathymetry*

DATA-SET DESCRIPTION

DATA-SET NAME: **Global Gridded Elevation and Bathymetry**

PRINCIPAL INVESTIGATOR(s): **Margaret Edwards**

SOURCE

SOURCE DATA CITATION: Edwards, M.O. 1989. Global Gridded Elevation and Bathymetry (*ETOPO5*). Digital raster data on a 5-minute Geographic (lat/long) 2160x4320 (centroid-registered) grid. 9-track tape. Boulder, CO: NOAA National Geophysical Data Center. 18.6 MB.

CONTRIBUTOR(s): Dr. Margaret Edwards
Department of Earth and Planetary Sciences
Washington University, Campus Box 1169
One Brookings Drive
Saint, Louis, Missouri 63130-4899

DISTRIBUTOR(s): NGDC/Marine Geology and Geophysics Division

VINTAGE: circa 1960's

LINEAGE:

(1) 5-minute dataset Integrated from best available 5 and 10-minute digital sources:
Margaret Edwards
Washington University
Earth and Planetary Remote Sensing Laboratory
St. Louis, MO

(2) Corrections, distributed as "ETOPO5"
Peter W. Sloss
NOAA National Geophysical Data Center
Boulder, CO

ORIGINAL DESIGN

VARIABLES: Elevation and bathymetry (meters). 10-minute data were expressed to nearest 30 feet, 5-minute data expressed to nearest meter.

ORIGIN: Integrated from best available 5- and 10- minute digital sources: (1) US Navy Fleet Numeric Oceanographic Center Montery, CA (10-minute), (2) US Defense Mapping Agency (5-minute for USA, Europe, Japan, and Korea), (3) US Naval Oceanographic Observatory (4) Bureau of Mineral Resources of Australia, and Department of Scientific and Industrial Research of New Zealand (5-,minute).

GEOGRAPHIC REFERENCE: lat/long, with origin at the Greenwich Meridian

GEOGRAPHIC COVERAGE: Global

Maximum Latitude	:	+90 degrees (N)
Minimum Latitude	:	-90 degrees (S)
Maximum Longitude	:	+360 degrees (E)
Minimum Longitude	:	0 degrees (E)

GEOGRAPHIC SAMPLING: 10-minute (modal elevation) and 5-minute (average elevation) grid cell values integrated into one 5-minute grid. 5-minute data are used for land data in Europe, Japan, Korea, United States, and Australia. 10-minute data are used for land data elsewhere. 5-minute data were used for all ocean areas.

TIME PERIOD: Modern composite, circa 1950's-1970's

TEMPORAL SAMPLING: Composite of available information.

INTEGRATED DATA-SET

DATA-SET CITATION: NOAA/NGDC. 1992. *Integrated Global Elevation and Bathymetry*. Digital Data. NOAA/NGDC/WDC-A, Boulder, Colorado. Digital raster data on a 5-minute Geographic (lat/long) 2160x4320 grid. In: *Global Ecosystems Database Version 1.0: Disc A*. Boulder, CO: NOAA National Geophysical Data Center. 1 independent single-attribute spatial layer on CD-ROM. 18.6 MB. [first published in 1989]

ANALYST(s): Peter Sloss, NGDC

PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).

SPATIAL REPRESENTATION: 10-minute (modal elevation) and 5-minute (average elevation) grid cell values integrated onto a 5-minute grid.

TEMPORAL REPRESENTATION: Modern Composite

DATA REPRESENTATION: 2-byte integers representing elevation and bathymetry in meters above or below sea-level. Expressed to nearest meter.

LAYERS AND ATTRIBUTES: 1 independent single-attribute spatial layer.

COMPRESSED DATA VOLUME: 17,359,125 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Edwards, Margaret Helen, 1986. "Digital Image Processing of Local and Global Bathymetric Data." Master's Thesis. Washington University, Department of Earth and Planetary Sciences, St. Louis, Missouri, 106p.

Haxby, W. F., et al, 1983. "Digital Images of Combined Oceanic and Continental Data Sets and Their Use in Tectonic Studies." EOS Transactions of the American Geophysical Union, vol. 64, no. 52, pp. 995-1004.

ADDITIONAL REFERENCES

none

DATA-SET FILES (experimental)

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\SOURCE\RASTER\	ETOPO5.IMG	1 files	18,662,400
Headers:			
\SOURCE\META\	ETOPO5.DOC	1 files	509
Palettes:	none		
Time Series:	none		
Volume on Disk:		2 files	18,662,909

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A15X\	ETOP_01.PCX to ETOP_24.PCX	24 files	586,087
	ETOP_##X.PCX	5 files	313,996
Volume on Disk:		29 files	900,083

SOURCE EXAMPLE FILES

none

DATA ELEMENT (experimental): Elevation and Bathymetry

STRUCTURE: Raster Data File: 5-minute 2160x4320 GED grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

ETOPO5.DOC

```
file title   : Global Elevation and Bathymetry (meters)
data type    : integer
file type    : binary
columns      : 4320
rows         : 2160
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.0833333
min. value   : -10376
max. value   : 7833
value units  : meters
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 0
```

NOTES:

(1) The bathymetry data conform to a centroid-registered grid with upper-left cell centered on 90 degrees (N) and -180 degrees (W). The last row (90 degrees South) is missing and there is no redundant column at 180 degrees (E).

(2) Land data are shifted generally to the West by 5 to 10 minutes (e.g., 5-minutes in Hawaii and Japan, 10-minutes in Africa), however shorelines are governed by the bathymetric data, which seems to be given priority.

(3) Data come from mixed sources.

(4) There is an erroneous line in the Antarctic region at about 81 degree S. beginning at the Greenwich Meridian and continuing East.

(5) Effective resolution in some areas is a poor as 1-degree (e.g., China and Mongolia) due to sparse data on the original maps that were digitized.

(6) Many discontinuities appear in the land data over South America, Asia, and Africa, originating with the FNOC terrain data.

DATA INTEGRATION AND QUALITY

Peter W. Sloss and John J. Kineman
NOAA National Geophysical Data Center
Boulder, CO

ETOPO5 combines the data-set DBDB5 (5-minute grid of worldwide bathymetry) and additional data which constitute a 5-minute grid of worldwide topography. These data were provided as a 5-minute centroid-registered grid with last row (-90 degrees) missing and no replication of the column at the Greenwich Meridian at the eastern edge of the grid. Processing involved separating the grid into two halves at Greenwich, and then re-assembling a grid originating at the International Date Line. Conversion to Idrisi format was trivial, requiring only the creation of a header (.DOC) file.

No interpolation was done to register the grid to the GED convention (i.e., to correct for the 2.5 minute offset of the centroid-registered grid) because of non-uniform registration in the original data-set itself, between the bathymetric data and land. While the bathymetric data appear to conform to the stated centroid-registered convention, with the north-most row centered on +90 degrees and the west-most column centered on -180 degrees, the land data show mis-registrations of from one to two pixels (i.e., from 5 to 10 minutes).

All ocean depth data are -1 meter or deeper, and these bathymetric data were apparently given priority over land data (shorelines are thus indicated by the -1 meter contour). This, plus the 1 to 2 pixel internal mis-registration of land data, may create abrupt transitions on western coasts compared to eastern coasts, which may pick up zero values from the ocean areas in the underlying terrain data-sets. This can be observed especially in islands or coasts with sharp relief, such as the Hawaiian Islands (Mauna Loa is offset by at least 5-minutes to the West).

CAUTION: These data should not be used for overlay with other data at full resolution without first correcting the registration errors for the region of interest (especially distinguishing between land and bathymetry). However, since this represents the best publicly available land and bathymetric data-set, it has been popular for use with coarser scale models, or for regional studies where the registration shifts can be corrected.

An improved version of this data-set is being produced at NGDC. The current data are provided for experimental use (e.g., registration corrections and aggregation to coarser scale), and to provide a link with prior uses of ETOPO5.

A16X

UNEP/GRID *Gridded FAO/UNESCO Soil Units*

DATA-SET DESCRIPTION

DATA-SET NAME: **Gridded FAO/UNESCO Soil Units**

PRINCIPAL INVESTIGATOR(s): **FAO/UNESCO**

SOURCE

SOURCE DATA CITATION: UNEP/GRID. 1986. FAO Soil Map of the World in digital form. Digital Raster Data on a 2-minute Geographic (lat/long) 5400x10800 grid. Carouge, Switzerland: UNEP/GRID. 1 file on 9-track tape, 58.3 MB.
CONTRIBUTOR(s): FAO/UNESCO
DISTRIBUTOR(s): GRID/Geneva
VINTAGE: circa 1970's
LINEAGE:
(1) Original investigation: FAO/UNESCO
(2) Digitizing: ESRI (FAO contract)
380 New York Street
Redlands, CA 92373
(3) Reprocessed: UNEP/GRID
6 rue de la Gabelle
1227 Carouge Switzerland

ORIGINAL DESIGN

VARIABLES:
soil classes
ORIGIN:
GEOGRAPHIC REFERENCE: lat/long
GEOGRAPHIC COVERAGE: Global
Maximum Latitude : +90 degrees (N)
Minimum Latitude : -90 degrees (S)
Maximum Longitude : +180 degrees (E)
Minimum Longitude : -180 degrees (W)
GEOGRAPHIC SAMPLING: 1:5,000,000 printed map 2-min raster grid sampled from vector polygon data
TIME PERIOD: prior to 1974
TEMPORAL SAMPLING: none Muli-year composite

INTEGRATED DATA-SET

DATA-SET CITATION: UNEP/GRID. 1992. *Global Gridded FAO/UNESCO Soil Units.* Digital Raster Data on a 2-minute Geographic (lat/long) 10800x5400 grid. In: *Global Ecosystems Database Version 1.0: Disc A.* Boulder, CO: NOAA National Geophysical Data Center. 1 single-attribute spatial layer on CD-ROM, 58.3 MB. [first published in 1984]
ANALYST(s): Lloyd MacGregor, UNEP/GRID
PROJECTION: Geographic (lat/long), GED window (see *User's Guide*).
SPATIAL REPRESENTATION: Dominant classes within 2-minute grid cells
TEMPORAL REPRESENTATION: Composite of most recent data.
DATA REPRESENTATION: 1-byte integers representing characteristic classes
LAYERS AND ATTRIBUTES: 1 single-attribute spatial layer
COMPRESSED DATA VOLUME: 1,298,699 bytes

PRIMARY REFERENCES (* reprint on CD-ROM)

* Unpublished documentation from GRID/Geneva.

FAO/UNESCO. 1974. *Soil Map of the World, 1:5,000,000: 10 volumes.* UNESCO, Paris.

ADDITIONAL REFERENCES

ESRI. 1984. *UNEP/FAO World and Africa GIS Data Base: Final Report.* Redlands, CA: Environmental Systems Research Institute Inc. 500+pp.

Also see Chapters A06, A07, A08, A10, A11, and A12

DATA-SET FILES (experimental)

LOCATION	NAME	NUMBER	TOTAL SIZE
Spatial Data:			
\SOURCE\RASTER\	FAOSOIL.IMG	1 files	58,320,000
Headers:			
\SOURCE\META\	FAOSOIL.DOC	1 files	6,254
Palettes:			
\SOURCE\META\	FAOSOIL8.PAL	1 file	4,352
Time Series:	none		
Volume on Disk:		3 files	58,330,606

REPRINT FILES

LOCATION	NAME	NUMBER	TOTAL SIZE
\DOCUMENT\A16X\	FAO_01.PCX to FAO_02.PCX	2 files	95,172
Volume on Disk:		2 files	95,172

SOURCE EXAMPLE FILES

none

DATA ELEMENT (experimental): GRIDDED FAO/UNESCO SOIL UNITS

STRUCTURE: Raster Data File: 2-minute 10800x5400 grid (see *User's Guide*)
SERIES: none
SPATIAL DATA FILES:

FAOSOIL.DOC

```
file title   : UNEP/GRID Gridded FAO/UNESCO Soil Units
data type    : byte
file type    : binary
columns      : 10800
rows         : 5400
ref. system  : lat/long
ref. units   : deg
unit dist.   : 1.0000000
min. X       : -180.0000000
max. X       : 180.0000000
min. Y       : -90.0000000
max. Y       : 90.0000000
pos'n error  : unknown
resolution   : 0.0333333
min. value   : 0
max. value   : 133
value units  : characteristic classes
value error  : unknown
flag value   : none
flag def'n   : none
legend cats  : 134
```

Legend:

```
category  0 :   0 Ocean
category  1 :   1   A     Acrisols
category  2 :   2   Af    Ferric Acrisols
category  3 :   3   Ag    Gleyic Acrisols
category  4 :   4   Ah    Humic Acrisols
category  5 :   5   Ao    Orthic Acrisols
category  6 :   6   Ap    Plinthic Acrisols
category  7 :   7   B     Cambisols
category  8 :   8   Bc    Chromic Cambisols
category  9 :   9   Bd    Dystric Cambisols
category 10 :  10   Be    Eutric Cambisols
category 11 :  11   Bf    Ferralic Cambisols
category 12 :  12   Bg    Gleyic Cambisols
category 13 :  13   Bh    Humic Cambisols
category 14 :  14   Bk    Calcic Cambisols
category 15 :  15   Bv    Vertic Cambisols
category 16 :  16   Bx    Gelic Cambisols
category 17 :  17   C     Chernozems
category 18 :  18   Cg    Glossic Chernozems
category 19 :  19   Ch    Haplic Chernozems
category 20 :  20   Ck    Calcic Chernozems
category 21 :  21   Cl    Luvic Chernozems
```

category 22 :	22	D	Podzoluvisols
category 23 :	23	Dd	Dystric Podzoluvisols
category 24 :	24	De	Eutric Podzoluvisols
category 25 :	25	Dg	Gleyic Podzoluvisols
category 26 :	26	E	Rendzinas
category 27 :	27	F	Ferralsols
category 28 :	28	Fa	Acric Ferralsols
category 29 :	29	Fh	Humic Ferralsols
category 30 :	30	Fo	Orthic Ferralsols
category 31 :	31	Fp	Plinthic Ferralsols
category 32 :	32	Fr	Rhodic Ferralsols
category 33 :	33	Fx	Xanthic Ferralsols
category 34 :	34	G	Gleysols
category 35 :	35	Gc	Calcaric Gleysols
category 36 :	36	Gd	Dystric Gleysols
category 37 :	37	Ge	Eutric Gleysols
category 38 :	38	Gh	Humic Gleysols
category 39 :	39	Gm	Mollic Gleysols
category 40 :	40	Gp	Plinthic Gleysols
category 41 :	41	Gx	Gelic Gleysols
category 42 :	42	H	Phaeozems
category 43 :	43	Hc	Calcaric Phaeozems
category 44 :	44	Hg	Gleyic Phaeozems
category 45 :	45	Hh	Haplic Phaeozems
category 46 :	46	Hl	Luvic Phaeozems
category 47 :	47	I	Lithosols
category 48 :	48	J	Fluvisols
category 49 :	49	Jc	Calcaric Fluvisols
category 50 :	50	Jd	Dystric Fluvisols
category 51 :	51	Je	Eutric Fluvisols
category 52 :	52	Jt	Thionic Fluvisols
category 53 :	53	K	Kastanozems
category 54 :	54	Kh	Haplic Kastanozems
category 55 :	55	Kk	Calcic Kastanozems
category 56 :	56	Kl	Luvic Kastanozems
category 57 :	57	L	Luvisols
category 58 :	58	La	Albic Luvisols
category 59 :	59	Lc	Chromic Luvisols
category 60 :	60	Lf	Ferric Luvisols
category 61 :	61	Lg	Gleyic Luvisols
category 62 :	62	Lk	Calcic Luvisols
category 63 :	63	Lo	Orthic Luvisols
category 64 :	64	Lp	Plinthic Luvisols
category 65 :	65	Lv	Vertic Luvisols
category 66 :	66	M	Greyzems
category 67 :	67	Mg	Gleyic Greyzems
category 68 :	68	Mo	Orthic Gleyzems
category 69 :	69	N	Nitosols
category 70 :	70	Nd	Dystric Nitosols
category 71 :	71	Ne	Eutric Nitosols
category 72 :	72	Nh	Humic Nitosols
category 73 :	73	O	Histosols
category 74 :	74	Od	Dystric Histosols
category 75 :	75	Oe	Eutric Histosols
category 76 :	76	Ox	Gelic Histosols
category 77 :	77	P	Podzols
category 78 :	78	Pf	Ferric Podzols

```
category 79 :  79   Pg    Gleyic Podzols
category 80 :  80   Ph    Humic Podzols
category 81 :  81   Pl    Leptic Podzols
category 82 :  82   Po    Orthic Podzols
category 83 :  83   Pp    Placic Podzols
category 84 :  84   Q     Arenosols
category 85 :  85   Qa    Albic Arenosols
category 86 :  86   Qc    Cambic Arenosols
category 87 :  87   Qf    Ferralic Arenosols
category 88 :  88   Ql    Luvic Arenosols
category 89 :  89   R     Regosols
category 90 :  90   Rc    Calcaric Regosols
category 91 :  91   Rd    Dystric Regosols
category 92 :  92   Re    Eutric Regosols
category 93 :  93   Rx    Gelic Regosols
category 94 :  94   S     Solonetz
category 95 :  95   Sg    Gleyic Solonetz
category 96 :  96   Sm    Mollic Solonetz
category 97 :  97   So    Orthic Solonetz
category 98 :  98   T     Andosols
category 99 :  99   Th    Humic Andosols
category100 : 100   Tm    Mollic Andosols
category101 : 101   To    Ochric Andosols
category102 : 102   Tv    Vitric Andosols
category103 : 103   U     Rankers
category104 : 104   V     Vertisols
category105 : 105   Vc    Chromic Vertisols
category106 : 106   Vp    Pellic Vertisols
category107 : 107   W     Planosols
category108 : 108   Wd    Dystric Planosols
category109 : 109   We    Eutric Planosols
category110 : 110   Wh    Humic Planosols
category111 : 111   Wm    Mollic Planosols
category112 : 112   Ws    Solodic Planosols
category113 : 113   Wx    Gelic Planosols
category114 : 114   X     Xerosols
category115 : 115   Xh    Haplic Xerosols
category116 : 116   Xk    Calcic Xerosols
category117 : 117   Xl    Luvic Xerosols
category118 : 118   Xy    Gypsic Xerosols
category119 : 119   Y     Yermosols
category120 : 120   Yh    Haplic Yermosols
category121 : 121   Yk    Calcic Yermosols
category122 : 122   Yl    Luvic Yermosols
category123 : 123   Yt    Takyric Yermosols
category124 : 124   Yy    Gypsic Yermosols
category125 : 125   Z     Solonchaks
category126 : 126   Zg    Gleyic Solonchaks
category127 : 127   Zm    Mollic Solonchaks
category128 : 128   Zo    Orthic Solonchaks
category129 : 129   Zt    Takyric Solonchaks
category130 : 130   RO    Rock
category131 : 131   SA    Salt
category132 : 132   WA    Water
category133 : 133   --    no name
```

NOTES:

1. This data-set was created at UNEP/GRID by rasterizing a vector version of the FAO/UNESCO soils. The UNFAO is in the process of revising the data, and an updated version of the vector data will be released when available.
2. This 2-minute data-set does not easily match the GED convention of "nested-grids." For this reason, and because it is a provisional data-set, it is placed in the "SOURCE" directory on the GED CD-ROM. The FAO/UNESCO soils data have been used as a basis for many of the other data-sets in the GED, however, this version of the FAO soils is provided only for intercomparison -- the other data were not derived from this data-set.
3. A revised classification has been produced (FAO, 1988 revised legend for the Soil Map of the World) but was not available for this report. A revised version of this data-set may be available from the International Soil Reference and Information Center (ISRIC), The Netherlands; from FAO, Rome; or through the WISE project (World Inventory on Soil Emissions).

DATA INTEGRATION AND QUALITY

John J. Kineman (ed.)
NOAA National Geophysical Data Center
Boulder, CO

BACKGROUND

This data-set was produced at UNEP/GRID (Geneva) by rasterizing on a 2-minute grid from a vector GIS (Arc/Info) version of the 1973 FAO/UNESCO Soil Map of the World at 1:5,000,000 scale, produced by ESRI of Redlands CA. This work was completed in 1984 as part of an FAO/UNEP Desertification and Mapping Project (ESRI, 1984). The Arc/Info version of the FAO Soil Map of the World was used as the base map for this project. The original FAO Soil Map was produced on 18 map sheets with varying projections. The digitized (vector) version was thus broken into regions with different projections. One of these projections did not have an inverse transformation (Miller Oblate Stereographic Projection for Africa), so it has been difficult to assemble a digital version of this data-set onto a uniform (i.e., lat/long) global grid.

Some modifications were made to the original data in the production of this version at UNEP/GRID, including conversion from a 106 category legend to 133 categories. Although the documentation provided with the data refers only to Africa, it is assumed to be relevant to the global data-set. For more information on content of the data-set, see the scanned documentation on the CD-ROM (DOCUMENT/A16X).

PROCESSING

Projection transformations were performed at UNEP/GRID (Geneva) to produce a global data-set in lat/long projection, which was then rasterized. The exact methods used have not been published, except for the informal documentation sent from GRID, which appears in the scanned documentation on disc (DOCUMENT/A16X/FAO_#.PCX). Nevertheless, it is likely that a revised version of this data-set will be produced in the near future, through various cooperative efforts. FAO (Rome) has developed a revised classification for the map, and recommends that the older version (the one supplied here) be abandoned in favor of the newer classification (which, reportedly, does not change the underlying spatial units). Meanwhile, however, versions of the ESRI digital version have been disseminated to many research groups and individuals, and the information has worked its way into the literature in significant ways. Many of the soils and vegetation data-sets included in the Global Ecosystems Database were based on the current version of the FAO Soils Map of the World (see Additional References for specific Chapters).

Because documentation is limited for this version of the data-set, and because the 2-minute grid-cell size is not compatible with the adopted GED "nested-grid" convention, it is listed here as an experimental data-set in transition. On the other hand, the extensive use of the FAO Soils Map (vector version) and the future need for comparison with revised versions, indicates the need for distribution at this stage, in a form that can be easily compared to it's derivative data-sets, other data-sets, and subsequent versions. This UNEP raster version meets this need, since it is in a convenient form for intercomparison (except for the grid size), although there are questions of how representative it may be of the original data.

No attempt was made to further process the data except to bring it into the GED format for experimental use, and to create a color palette conforming to the information contained in the UNEP/GRID documentation. It conforms to the GED window and registration convention (i.e., edge-registered cells windowed between poles and with the International Date Line at the eastern and western edges of the grid). The 2-minute grid cell is an even multiple of 10-minutes and 30-minutes and 1-degree, thus affording easy comparison with the other data-sets in the GED that are based on the FAO Soils data. It is not directly comparable with 5-minute grids, however, which will likely be the preferred alternative in the "nested-grid" structure (see *User's Guide*).

*U.S. GOVERNMENT PRINTING OFFICE:1995-673-018/00077