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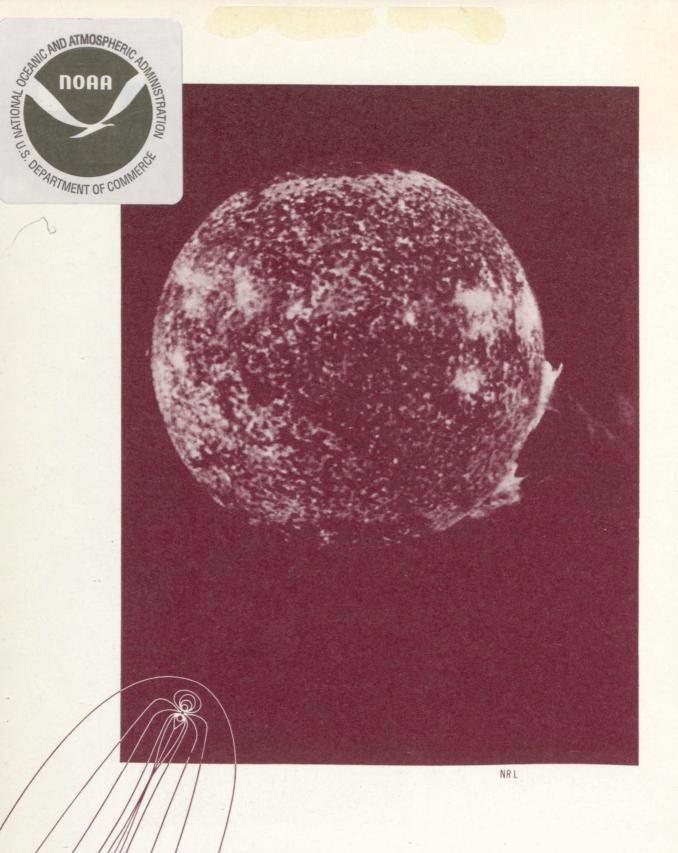
NOAA Technical Report ERL 357-SEL 37

SELDADS;

An Operational Real-Time Solar-Terrestrial Environment Monitoring System

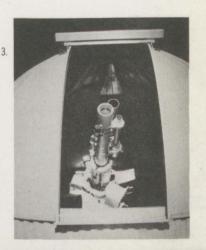
D.J. Williams March 1976

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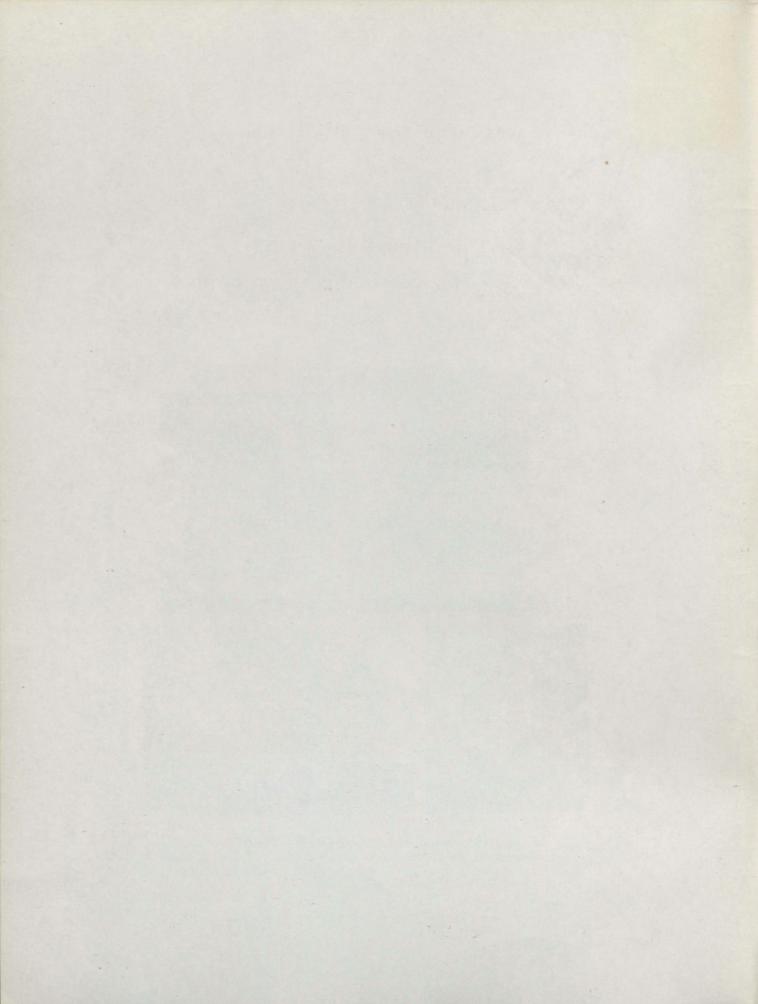








NOAA/GOES satellites measure solar radiation and the geomagnetic field.
 Real-time reception of GOES data at SEL Table Mountain facility, Boulder, Colorado.
 Solar patrol optical telescopes contribute real-time solar flare information.
 SELDADS computers and disk storage.
 Forecast console in the Space Environment Services Center.



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SELDADS;



An Operational Real-Time Solar-Terrestrial Environment Monitoring System

D. J. Williams

Space Environment Laboratory Boulder, Colorado

March 1976

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CONTENTS

		Pag
FOREWA	RD 2021 To may be the seed of	viii
LIST 0	F ACRONYMS	ix
ABSTRA	CT (2112H2) dieptay listing SHS/SOES saddifferds (2112H2)	×
1.0	INTRODUCTION	1
2.	THE REAL-TIME DATA ACQUISITION AND DISPLAY SYSTEM	1
	2.1 General Description 2.2 SELDADS Hardware	1 4
3.	DATA CURRENTLY AVAILABLE	6
	3.1 Solar X-Rays 3.2 Solar Wind 3.3 Charged Particles Measured at Satellite Altitudes 3.4 Magnetic Field at Geostationary Satellite Altitudes 3.5 Total Electron Content 3.6 H-Alpha Solar Events, Features, and Patrol 3.7 Discrete Frequency Solar Radio Flux and Bursts 3.8 Spectrographic Solar Radio Events 3.9 Solar Calcium Plage Observations 3.10 Coronal Intensities 3.11 White-Light Sunspot Observations 3.12 Optical Auroral Observations 3.13 Auroral Radar Backscatter 3.14 Ionosonde Observations 3.15 High Frequency Radio Path Signal Strengths 3.16 Sudden Ionospheric Disturbances 3.17 High-Latitude Riometer Data 3.18 Ground-Based Magnetometer Observations 3.19 Stations Contributing Data to SELDADS	8 11 12 16 18 20 24 26 27 28 29 31 32 34 38 40 41 43 46
4.	DATA TO BE AVAILABLE	49
	4.1 SOLRAD HI Data 4.2 US-IMS Ground Magnetometer Network Data 4.3 TIROS N Data 4.4 Solar Optical Observation Network (SOON) 4.5 Radio Solar Telescope Network (RSTN)	49 49 54 56 56
5.	SUMMARY OF DATA AVAILABLE AND TO BE AVAILABLE	58
6.	ACCESS TO SELDADS	61
7.	KEY PERSONNEL	63
8.	ACKNOWLEDGMENTS	64
9.	REFERENCES	65

FIGURES

			Page
Figure	1.	Schematic diagram of SELDADS	2
	2.	Block diagram of SELDADS	4
	3.	(SMSLIS) display listing SMS/GOES satellite data.	9
	4.	(XRAPLT) display of X-ray data.	10
	5.	(XREV) display listing possible X-ray events from SMS/GOES satellites.	10
	6.	(SWLOG) display summarizing solar wind reports	11
	7.	(CALCA) display: daily summary of predicted polar cap absorption.	14
	8.	(EPSPLT) display summarizing any two particle channels in the SMS/GOES SEM.	14
	9.	(QITOS) display of data from the low-altitude polar orbiting NOAA-4 satellite.	15
	10.	(MAGPLT) display of magnetic data from SMS/GOES satellites.	17
	11.	(SELOG) display: daily summary of equivalent vertical total electron content.	19
	12.	(LDLOG) display: daily summary of disk features and activity in the H-alpha line.	22
	13.	(EVLOG) display: daily summary of solar-geophysical events.	23
	14.	(RLOG) display listing solar radio fluxes from selected observatories at selected frequencies.	25
	15.	(SSP) display of sunspot reports by all observations.	30
	16.	(PREG) display listing history of a solar region's transit across the disk.	30
	17.	(RADAR) display listing 15-min values of auroral radar.	32
	18.	(PRADAR) display plotting auroral radar at ten distance intervals.	33
	19.	(PLTRFOF) display plotting rounded Northern Hemis- phere FOF2's geographically.	35
	20.	(LFOF) display listing FOF2 data from all reporting stations.	36
	21.	(IONOS) display listing hourly ionospheric values from all reporting stations.	37

			Page
	22.	(PHF) display: daily summary of deviations from quiet-day conditions.	39
	23.	(ALOG) display listing polar cap absorption measured along chain of riometers monitored at Anchorage.	42
	24.	(PRIO) display of daily plots of the Anchorage riometer chain in a logarithmic graphical format.	42
	25.	(MAGPLT) display listing A- and three-hourly K- indices from a given station for a requested period of time.	44
	26.	(MLOG) display listing daily A- and three-hourly K-indices from reporting stations.	44
	27.	(THZ) display plotting daily Thule-Z trace.	45
	28.	(PINDEX) display plotting long-range variations of selected magnetometers vs. Carrington longitude, to indicate recurring magnetic disturbances.	45
	29.	North American high-latitude magnetometer network for IMS.	52
	30.	IMS midlatitude magnetometer network.	53
	31.	Sample three-component magnetogram.	54
	32.	Sample "stacked" magnetogram.	55
	33.	Orbits of dedicated real-time satellites illus- trating spatial coverage obtained.	58
		TABLES	
Table	1.	SOLRAD HI Data To Be Incorporated into the SELDADS Data Base.	50
	2.	TIROS N Data To Be Incorporated into the SELDADS Data Base.	57
	3.	SELDADS Dedicated Real-Time Satellite Data Inputs.	59
	4.	SELDADS Real-Time Ground Station Data Inputs.	60

FOREWORD

This report is a general description of the real-time solar-terrestrial environment data system operated by the National Oceanic and Atmospheric Administration, Environmental Research Laboratories, Space Environment Laboratory. The system is known as SELDADS (Space Environment Laboratory Data Acquisition and Display System). Although SELDADS is perhaps a unique operational system in the solar-terrestrial field, it is by no means perfect. We solicit suggestions, from current and potential users, on ways to improve data collection, handling, storage, formats, displays, dissemination, and real-time availability.

ACRONYMS

AC Aerospace Corporation

AFB Air Force Base

AFCRL Air Force Cambridge Research Laboratories
ATN Astrogeophysical Telecommunications Network

AWS Air Weather Service

CDAS Command and Data Acquisition Stations

CRT Cathode-Ray Tube
DIG HIWAY Digital Highway

DP

DPSS Data Processing and Services Subsystem

EDS Environmental Data Service

Data Phone

ERL Environmental Research Laboratories

GSFP Global Solar Flare Patrol
GWC Global Weather Center

HLMS High Latitude Monitoring Station

IMS International Magnetospheric Studies
ITOS Improved TIROS Operational Satellite
IUWDS International Ursigram World Days Service

MCA Multiprocessor Communications Adapter
MIT Massachusetts Institute of Technology

NASA National Aeronautics and Space Administration

NELC Naval Electronics Laboratory Center

NOAA National Oceanic and Atmospheric Administration

NRL Naval Research Laboratory
NSF National Science Foundation

NESS National Environmental Satellite Service

RSTN Radio Solar Telescope Network

SEL Space Environment Laboratory

SELDADS Space Environment Laboratory Data Acquisition and Display

System

SEMS Space Environment Monitor System
SESC Space Environment Services Center

SMS/GOES Synchronous Meteorological Satellite/Geostationary

Operational Environmental Satellite

SOLRAD Solar Radiation

SOON Solar Optical Observing Network STR Satellite Transmission Relay

TEC Total Electron Content

TIROS Television InfraRed Observation Satellite

USAF United States Air Force
USN United States Navy

ABSTRACT

This report describes the real-time solar-terrestrial environment monitoring system operated by the Space Environment Laboratory of the National Oceanic and Atmospheric Administration. Information provided includes sources of data, computer systems employed, kinds of data now available and soon to be available, methods of accessing data, and names and addresses of key personnel to contact for access. A description of each type of data available is given which includes satellites or observatories reporting, parameters reported, frequency of report, medium of report, retention period for on-line availability, list of display formats, and sample displays.

SELDADS

AN OPERATIONAL REAL-TIME SOLAR-TERRESTRIAL ENVIRONMENT MONITORING SYSTEM

D. J. Williams

1. INTRODUCTION

The Space Environment Laboratory (SEL) of the Environmental Research Laboratories (ERL) of the National Oceanic and Atmospheric Administration (NOAA) operates, in conjunction with the United States Air Force (USAF) Air Weather Service (AWS), a real-time solar-terrestrial environment monitoring system and forecasting service. The implementation of real-time data collection, reduction, preparation, and display systems, the maintenance of the real-time solar-terrestrial environment data base, and the provision of the interface for users of the data base, is the responsibility of the Real-Time Data Systems Program Area (C. E. Hornback, Head) of SEL. The assessment and interpretation of conditions in the solar-terrestrial environment, the preparation and issuance of monitoring reports, alerts, and forecasts, and the interface with users of the warning and forecast service is the responsibility of the Space Environment Services Center (G. Heckman, Acting Head) of SEL. For a description of Space Environment Services Center (SESC) activities, see Mangis (1975).

The purpose of this report is to describe the operational real-time data collection and monitoring system, the data and formats now available, the data and formats to be added in the very near future, and methods of obtaining routine and special access to this data system and its data base.

2. THE REAL-TIME DATA ACQUISITION AND DISPLAY SYSTEM

2.1 General Description

The SEL Data Acquisition and Display System (SELDADS) is shown schematically in Figure 1. A variety of ground-based and satellite sensors furnish data to SELDADS. Three inputs to the system, those of the U.S. Navy's (USN) SOLRAD HI Satellite Program, the National Science Foundation (NSF) magnetometers being implemented as part of the U.S. International Magnetospheric Studies (IMS) Program, and the NOAA TIROS-N Satellite Program, are not yet operational, but are expected to be implemented, respectively, in the first quarter of 1976, the first quarter of 1977, and the first quarter of 1978.

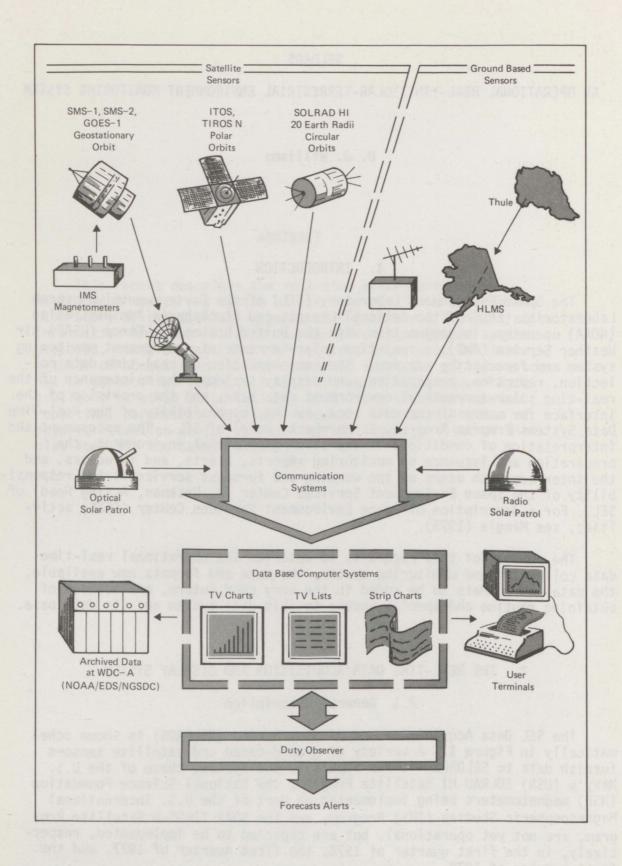


Figure 1. Schematic of SELDADS.

The communications system is made up of the USAF Astrogeophysical Telecommunications Network (ATN), a USN commercial line, direct telemetry to SEL, dedicated commercial communication lines, a dedicated meteorological line to Moscow, and the International Ursigram World Days Service (IUWDS) network. The ATN is used for the bulk of the ground-based data received by the real-time data base, whereas the bulk of the satellite data at this time is obtained by direct satellite telemetry to SEL.

Solar activity and event reports from a solar patrol network operated by USAF/AWS and NOAA/SEL are transmitted through the ATN to SELDADS as they occur.

Real-time X-ray, proton, and vector geomagnetic field measurements are available from the NASA-NOAA SMS/GOES geostationary weather satellite series (Grubb, 1969, 1975a). Data from two satellites of this series are simultaneously received by direct satellite telemetry at SEL and immediately converted, processed, recorded on magnetic tape, and inserted into the real-time data system. Data in the data base are kept as 1-minute averages for the most recent four days, and as 5-minute averages for 32 days.

Near real-time data of polar cap solar proton fluxes are received from a Solar Proton Monitor (Cashion and Gary, 1969; Brown, 1975) carried aboard the NOAA low-altitude polar-orbiting weather satellite series (NOAA/ITOS). These data arrive at SEL through the ATN and are inserted directly into the real-time data base. Plots of solar proton fluxes across the polar caps are maintained for the most recent 8 days, with polar cap averages being maintained for 1 calendar month.

Ground station data from the High Latitude Monitoring Station (HLMS) in Anchorage, Alaska, are transmitted to SEL through the ATN and incorporated directly into the real-time data system. Vector ground-based magnetometer information is relayed from Thule, Greenland, by teletype link to the HLMS and then in turn to SEL. These magnetic field data are transmitted once every 15 minutes. Data from a chain of 8 riometers are collected by the HLMS and transmitted to SEL once every 15 minutes. These data rates reflect the line capacity of the portion of the ATN that is being used.

The incoming data are received and processed by two mini-computers, each of which is capable of maintaining the real-time data base as well as performing a variety of specialized operations on the data. The real-time data base consists of the previous 32 days' worth of data and is maintained in two 58-megabyte discs. In many cases, time resolution will vary throughout the 32-day period of the data base, with finer time resolution existing for the most recent data.

Display capabilities for data residing in the real-time system include interactive and call-up CRT displays, strip charts, word messages, and printer output.

Normal data dissemination procedures include direct computer-to-computer links with the real-time data system, user terminals, telephones, teletype reports and forecasts, a weekly summary of solar-terrestrial environment activity issued by SESC, and special requests.

2.2 SELDADS Hardware

The heart of SELDADS is a mini-computer system shown in block diagram form in Figure 2. The systems in Figure 2 are those identified in Figure 1 as "Data Base Computer Systems." Existing equipments are shown as solidline blocks. Equipments that are being purchased are shown as dotted-line blocks and are expected to be operational by mid-1976.

The present system consists of two Data General NOVA 1200 computers, each having a 32-kiloword core, a 58-megabyte disc, and a 9-track NRZ magnetic tape recorder. The computers are connected by a multiprocessor communications adapter (MCA) and can transfer data to and from each other at a 75-kilobit rate.

Computer (1) has input/output interfaces for: 1) simultaneously acquiring space-environment data from two SMS/GOES satellites; 2) acquiring data from the Air Force ATN line; 3) servicing a 2400-baud data link between SELDADS and AF/AWS computers at the Global Weather Center (GWC), Offutt AFB,

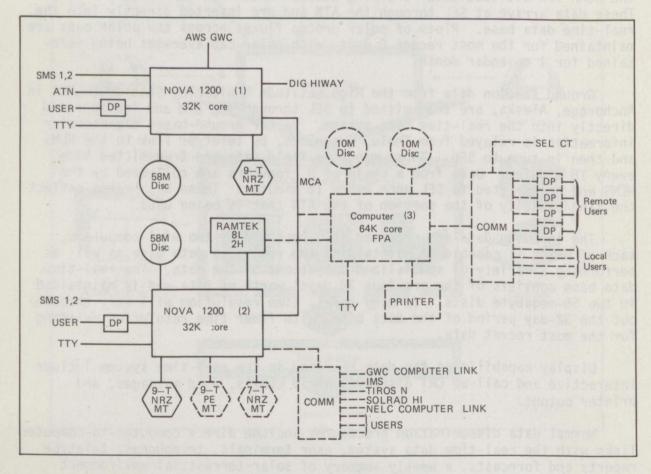


Figure 2. Block diagram of SELDADS.

and 4) interfacing with a communications link called a digital highway (DIG HIWAY), which is used to acquire data from or send data to the SESC data displays.

Computer (2) has input/output interfaces for: 1) simultaneously acquiring space environment data from two SMS/GOES satellites, and 2) sending data to a CRT display device (RAMTEK), which is capable of generating eight low-resolution (256 bit by 240 line) and two high-resolution (512 bit by 480 line) alpha-numeric and graphic displays.

Both NOVA computers have a data phone (DP) terminal and can be used for remote teletype user entry when the computer program system is running the BASIC language software. Data from all sources are incorporated in the real-time data base that is maintained in the 58-megabyte discs. The data base can be accessed by users to generate listing displays. Computer (2) can also be used to generate CRT data displays. A video copying device is available for converting the CRT displays to hard copy.

SELDADS is being expanded to accommodate data from the NSF-IMS magnetometer chains and to provide additional and improved user service. Hardware for the expanded system should be installed by mid-1976, and operational software for the system should be available before the end of 1976. A communications device (COMM) connected to Computer (2) will be used to acquire data from the IMS, SOLRAD HI, and TIROS N sources and to service data links for the AWS/GWC and the Naval Electronics Laboratory Center (NELC). Two magnetic tape units, one a 7-track NRZ and the other a 9-track phase encoded unit, will be connected to Computer (2) to complement the present 9-track NRZ unit and provide the capability of handling most types of magnetic tapes normally used in computer systems.

Computer (3), which must be compatible with the NOVA 1200 computers, will have at least a 64-kiloword core memory and floating point arithmetic hardware. Two 10-megabyte disc units, a 70-character-per-line, 5-line-per-second printer, and a communications device will be added to Computer (3). Computer (3) will be connected to Computers (1) and (2) by an MCA. The CRT (RAMTEK) device will be disconnected from Computer (2) and connected to Computer (3). Computer (3) will be the User Service computer in SELDADS; Computers (1) and (2) will be used primarily to collect data for the data base and to disseminate data to users with computer terminals. Present plans are to have the communications device on Computer (3) service up to eight BASIC language users who will have access to the data base through the MCA. Four remote users will have access to the computer through data phone terminals. Four terminals will be available for local use and will have access to the CRT displays as well as to the printer.

Also shown in Figure 2 is a line to the SEL Computer Terminal (CT) which will allow access to a high-speed printer, additional terminals, and the ERL CDC-6600 computation system.

3. DATA CURRENTLY AVAILABLE

For each type of available data, the following information is given in this report:

Description
Satellites (or observatories) reporting
Parameters reported
Frequency of report
Medium of report
Retention period in SELDADS
List of display formats

Samples of display formats with calling program identified in parentheses

The samples of display formats are representative of the type of output available. Details of all available displays may be obtained from Mr. D. Schroeder (see Key Personnel).

Types of data available include:

Solar X-rays Solar wind Charged particles measured at satellite altitudes Magnetic field at geostationary satellite altitudes Total electron content H-alpha solar events, features, and patrol Discrete frequency solar radio flux and bursts Spectrographic solar radio events Solar calcium plage observations Coronal intensities White-light sunspot observations Optical auroral observations Auroral radar backscatter Ionosonde observations High-frequency radio path signal strengths Sudden ionospheric disturbances High-latitude riometer data Ground-based magnetic field observations

Data are received from a number of systems. Delay times in receiving data depend on the system used for transmission of the data. X-ray, particle, and magnetic-field data measured by the SMS/GOES satellites are received continuously by satellite telemetry at the Table Mountain facility of SEL near Boulder, Colorado, are processed, and entered in real time into the SELDADS data base.

ATN carries messages of current observations of the Sun, solar wind, magnetosphere, and ionosphere encoded in standard formats from a variety of domestic and international observatories and satellite monitors. SELDADS continuously monitors the ATN drop at Boulder and enters most of the ATN data into the data base.

Another data collection system is a dedicated weather wire between Moscow and Washington along with teletype links to Washington from Boulder. By provision of a special U.S./U.S.S.R. agreement, satellite and ground-based data from the U.S.S.R. are received at Boulder three times per day through this system and entered into the data base.

An additional system, collecting data from the widest geographical distribution but operating with the most time delay, is the IUWDS network. As the designated World Warning Agency, SESC receives daily messages from regional warning centers in Asia, Europe, and Australia that collect available real-time geophysical data from their continents. These are sorted and redistributed back to the various regional warning centers and into SELDADS, becoming a part of the data base.

Section 3.19 presents a list of stations contributing data to SELDADS.

3.1 Solar X-rays

Solar X-ray flux levels are available in real-time from several satellites. Ion chamber detectors in the Space Environment Monitor System (SEMS) on the SMS/GOES weather satellites provide whole sun fluxes for the $0.5-4\mbox{\ensuremath{A}}$ and $1-8\mbox{\ensuremath{A}}$ wavelength bands. The satellites are in geostationary orbits, and coverage is continuous from two satellites simultaneously except for brief eclipse periods near the equinoxes. SOLRAD-10 X-ray reports are received also but with less comprehensive coverage. The wavelength bands monitored are $0.5-3\mbox{\ensuremath{A}}$, $1-8\mbox{\ensuremath{A}}$ and $8-20\mbox{\ensuremath{A}}$. SOLRAD-10 is in a low-altitude circular orbit.

3.1.1 Satellites reporting

SMS-1: Currently (1976) in standby mode.

SMS-2: 135° West Longitude.
GOES-1: 75° West Longitude.

SOLRAD-10: Low-altitude circular orbit.

3.1.2 Parameters reported

SMS/GOES: Continuous 1-min-average fluxes and event reports.

SOLRAD-10: Average flux for each approximately 10-min pass.

3.1.3 Frequency of report

SMS/GOES: Every minute.

SOLRAD-10: After each real-time pass.

3.1.4 Medium of report

SMS/GOES: Direct telemetry.

SOLRAD-10: Coded teletype message (ATN).

3.1.5 Retention period in SELDADS

SMS/GOES: 1-min averages for 4 days; 5-min averages

and standard deviations for 32 days.

SOLRAD-10: One calendar month.

3.1.6 Display formats

One CRT graph.

Two printed lists.

3.1.7 Sample displays

Figures 3, 4, and 5 present lists and displays for solar X-ray data.

SMS	5-2	DATA LI	STING					
1 1	NINU	TE AVER	RAGES					
MO	DA	TIME	XL	P1	P2	HE	HN	A 4
	-		SM/W	C/3	C/S	GAMMAS	GAMMAS	C/S
1	27	0900	0.0E+00	1.5E+02	0. 0E+00	1.4E+01	1.4E+01	0.0E+00
1	27	0901	0. UE+00	1.6E+02	0.0E+00	1.4E+01	1.4E+01	0.0E+00
1	27	0902	0. UE+00	1.5E+02	0.0E+30	1.4E+01	1.3E+01	0.0E+00
1	27	0903	0.0E+00	1.5E+02	0.02+00	1.3E+Ø1	1.3E+01	0.0E+00
1	27	0904	0.0E+00	1.5E+02	0.0E+00	1.3E+01	1.3E+01	0.0E+00
1	27	2905	Ø. 0E+00	1.6E+02	0.0E+00	1.3E+01	1.3E+Ø1	0.0E+00
1	27	0906	Ø. 3E+00	1.7E+02	0.0E+00	1.3E+01	1.3E+01	Ø.0E+00
1	27	0907	0.0E+00	1.7E+02	0.0E+00	1.3E+01	1.4E+01	0.0E+00
1.	27	0903	0.0E+00	1.8E+02	0.0E+00	1.3E+01	1.4E+01	0.0E+00
1	27	0909	0.0E+00	1.3E+02	0.0E+00	1.3E+01	1.4E+01	0.0E+00
1	27	0910	2.0E+00	1.9E+02	0.0E+00	1.3E+01	1.4E+01	0.0E+00
1	27	0911	0.0E+00	1.3E+02	0.0E+00	1.3E+01	1.4E+01	0.0E+00
1	27	0912	0.0E+00	1.9E+02	2.3E-01	1.3E+01	1.4E+01	0.0E+00
1	27	0913	0.0E+00	1.9E+02	0.0E+00	1.3E+01	1.4E+01	0.0E+00
1	27	0914	0.0E+00	2.0E+02	0.0E+00	1.3E+01	1.4E+01	0.0E+00
1	27	0915	0.0E+00	2.0E+02	0. DE+00	1.2E+01	1.4E+01	0.0E+08

Figure 3. (SMSLIS) display. This display will list any of the data collected by the SMS/GOES satellites. Data column titles are:

XS	0.5 - 4Å X-rays	P6	85 to 150 MeV protons
XL	1 - 8Å X-rays	P7	150 to 500 MeV protons
HP	Parallel magnetic component	E1	≥2.0 MeV electrons
HN	Normal magnetic component	A1	4 to 10 MeV alpha particles
HE	Earthward magnetic component	A2	10 to 16 MeV alpha particles
P1	0.8 to 4 MeV protons	A3	18 to 56 MeV alpha particles
P2	4 to 6 MeV protons	A4	71 to 150 MeV alpha particles
P3	6 to 10 MeV protons	A5	167 to 245 MeV alpha particles
P4	18 to 28 MeV protons	A6	340 to 392 MeV alpha particles
P5	40 to 500 MeV protons		

Reporting units are:

 $\mbox{W/M2-Watts per meter}^2$ for X-rays; GAMMAS-For magnetic data; C/S-counts per second for particle data.

NOTE: This display will be referenced by later data descriptions.

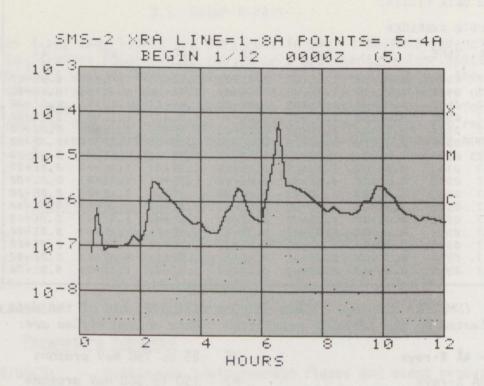


Figure 4. (XRAPLT) display. This display presents a graphical summary of any 12 hours of X-ray data in the data base. The 5-min average flux (watts per meter²) is plotted versus time with the beginning time identified at the top of the graph. Satellite identification is shown. X-ray event classification levels are shown on the right.

THIS IS SMS-2 DATA POSSIBLE EVENT 1/26 0310 2.6E-06 0313 9.3E-06 C Ø SXR/LXR 0.0000 1/26 1/2 P 1/26 0315 5.3E-06 POSSIBLE EVENT BEGIN 1/26 0333 7.0E-06 MAX 1/26 0341 2.5E-05 C 0 SXR/LXR 0.0000 1/2 P 1/26 0344 1.5E-05 1/26 0400 1/26 0500

Figure 5. (XREV) display. This display lists possible X-ray events from SMS/GOES, beginning with a specified time and continuing through the latest data available. Begin, maximum, and ½ maximum (½P) times are given. Flux values are in ergs per cm² per second. X-ray event classification is given along with the flux ratio of the short (0.5 - 4Å) to long (1 - 8Å) wavelength channels. Summaries of events that meet significant criteria are included in (EVLOG) which follows in section 3.6.7.

3.2 Solar Wind

Solar wind velocities are obtained from USAF/AWS using data from electrostatic analyzers on the Vela satellites. Solar wind velocities of 135 km/sec to 930 km/sec in 12 discrete steps are assigned according to the energy channel having the maximum counting rate in five of seven samples. If no channel meets the five-of-seven criterion, no velocity is assigned.

3.2.1 Satellites reporting

Vela numbers 6909 and 6911.

3.2.2 Parameter reported

Solar wind velocity (km/sec).

3.2.3 Frequency of report

Intermittent (zero to several reports per day).

3.2.4 Medium of report

Coded teletype messages (ATN).

3.2.5 Retention period in SELDADS

One calendar month.

3.2.6 Display format

One printed list.

3.2.7 Sample display

Figure 6 presents a display of solar wind data.

Figure 6.	(SWLOG)	display.	This	display
summari	zes solar	wind repo	orts r	eceived
for one	GMT day.	The obse	ervation	on time,
reportin	ng satell	ite, and s	solar i	wind
velociti	in km/s	ec are lis	sted.	

1/23	3/76			
SA		D 111		100
VELA	SULF	ik wi	ואט	LUG
TIME	033	909	91	1
0205			738	3
0427			788	3
0520			789	3
0545			65	3
0615			738	3
0938			788	
0942			656	
1012			780	7
1141			650	3

3.3 Charged Particles Measured at Satellite Altitudes

Energetic proton, electron, and alpha particle fluxes are monitored continuously at geostationary altitudes (6.67 Earth radii) by the SMS/GOES Space Environment Monitor System. In addition, energetic protons in three integral energy ranges and electrons in a single range are reported from the low-altitude polar-orbiting NOAA-4 Solar Proton Monitor. Polar cap proton fluxes are also received three times per day from the Russian METEOR satellite over the U.S./U.S.S.R. dedicated weather line. These data are less than 1 day old by the time they are entered into the data base.

3.3.1 Satellites reporting

SMS-1: Currently (1976) in standby mode.

SMS-2: 135° West Longitude.

GOES-1: 75° West Longitude.

NOAA-4: Low-altitude polar orbit.
METEOR: Low-altitude polar orbit.

3.3.2 Parameters reported

SMS/GOES: Data from two satellites, received simultaneously, giving continuous particle flux values:

Protons: P1 0.8-4 MeV

P2 4-6 MeV

P3 6-10 MeV

P4 18-38 MeV

P5 40-500 MeV

P6 84-150 MeV

P7 150-500 MeV

Alphas: Al 4-10 MeV

A2 10-16 MeV

A3 18-56 MeV

A4 71-150 MeV

A5 167-245 MeV

A6 340-392 MeV

Electrons: E1 ≥ 2.0 MeV

NOAA-4: Particle fluxes for each polar pass.

Protons: >10 MeV Electrons: >140 keV

>30 MeV >60 MeV

METEOR: Particle flux in polar cap.

Protons: >15 MeV >40 MeV

>25 MeV >90 MeV

3.3.3 Frequency of report

SMS/GOES: Every minute.

NOAA-4: 24 passes per day.

METEOR: 3 times per day.

3.3.4 Medium of report

SMS/GOES: Direct telemetry and entry to data base.

NOAA-4: Coded teletype messages (ATN).

METEOR: Coded teletype messages (U.S./U.S.S.R. meteorological

data line).

3.3.5 Retention period in SELDADS

SMS/GOES: Four days of 1-min averages; 32 days of 5- min averages

and standard deviations.

NOAA-4: Plots of each polar cap pass for 6 days; polar cap

averages for 1 calendar month.

METEOR: Polar cap data for 1 calendar month.

3.3.6 Display formats

SMS/GOES: One CRT graph.

One list (See SMS listing under Solar X-Rays, Fig. 3)

NOAA-4: One printed graph.
METEOR: One printed list.

3.3.7 Sample displays

Figures 7, 8, and 9 present displays and lists of charged-particle data.

			_		,
NOAA - 4	PROT	ON /PCA	C	ALCULATION	V
		1/19/	76	Die file	
TIME	HEM	CALC		OBS	
0300	N	10EQ 0		0.0	
0100	S	1 DEQ D		0.0	
3200	N	1DEQ 0		0.0	
1230	S	IVEQØ		0.0	
1330	N	10EQ Ø	-	0.0	
1430				0.0	
1500	N	1DEQ 0	-	0.0	
1600	S	10EQ 2		0.0	
1700	N	1 DEQ D		0.0	
1800		10EQ 3	-	0.0	
1900	N	1 DEQ D	-	0.1	
2000		10EQ0		0.0	
2100	N	10EQ 0	-	0.0	
2230	S	1DEQ 0		0.0	
2300	N	10EQ 0	-	0.0	

Figure 7. (CALCA) display. This display presents a daily summary of predicted Polar Cap Absorption (PCA) derived from the NOAA-4 observations of >10-MeV and >30-MeV protons. Included are the NOAA-4 pass time, the hemisphere (N or S), the calculated absorption in decibels (10EQD indicates that the >10-MeV proton flux was zero, and hence no calculation was possible), and the observed PCA in decibels as observed by the Thule 30-MHz riometer. The calculation algorithm is summarized by Gardner (1975).

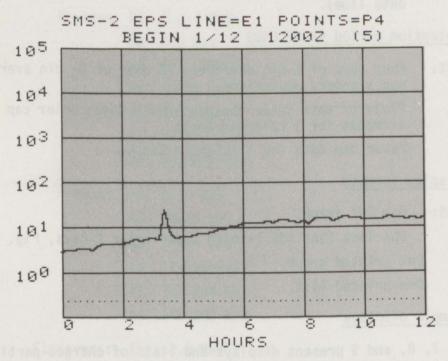


Figure 8. (EPSPLT) display. This display presents a graphical summary of any two of the 14 particle channels in the SMS/GOES SEM. Satellite identification, begin time, and channel ID are shown at the top of the graph. Intensities are given as 5-min counts/second averages versus time. In this example are plotted P4 (18-38 MeV protons) and E1 (≥2 MeV electrons).

```
1/16/76 NOAA
                     2004
                                    SOLAR PROTON COUNTS*1/64
 GEO
                MAG
                                 1 4
                                          16 64 256 1024 4095 16334
 LAT
        LONG
                LAT
                       TIME + ..
               55.3
                                           CA
51.3
        -6.5
                       2004.
                                                         D
53.7
        -3.2
               57.9
                       2005.
                                       BC
                                           A
                                                       D
       -10.0
56.1
               60.5
                       2006.
                                           A
58.6
       -11.9
               63.2
                       2006.
                                                D
61.0
                                  *0
       -14.1
               65.9
                       2007.
       -16.5
63.3
               68.5
                       2008.*
65.6
       -20.0
               71.1
                       2009.*
67.9
       -23.7
               73.9
                       2010.*
                       2011.*
70.0
       -23.0
               76.5
72.0
       -32.9
               79.0
                       2011.*
73.9
       -39.4
               31.7
                       2012.*
       -47.1
75.5
               84.3
                       2013.*
76.9
      -56.9
               37.3
                       2014.*
77.3
      -63.0
                       2015.*
              39.3
73.3
      -30.7
               87.6
                       2016.*
     -94.0
73.2
              85.0
                       2016.*
              32.4
77.5 -106.1
                       2017.*
76.4 -116.3
              79.3
                       2018.*
74.3 -125.3
73.2 -132.5
              77.0
                       2019.*
              74.5
                       2020.*
71.1 -133.7
              71.7
                       2021.*
69.0 -143.2
66.8 -147.1
              69.1
                      2021.*
                       2022.*
2023.A
              66.5
64.7 -150.4
              63.9
                                D
61.9 -153.6
                       2024.
              60.9
59.5 -156.4
                       2025.
                                                    D
```

Figure 9. (QITOS) display. This display plots data from the low-altitude polar orbiting NOAA-4 satellite. Data are plotted as counts per second (horizontal) versus time. The satellite position for each time is listed in geographic latitude and longitude and magnetic latitude. Positive latitudes are Northern Hemisphere, negative are Southern; positive longitudes are Western Hemisphere, negative are Eastern. Letters plotted represent the following:

A > 140 KeV electrons;

B > 60 MeV electrons;

C > 30 MeV protons

D > 10 MeV protons.

Two sensors with the same value are plotted as an asterisk.

Note: The 60-MeV sensor is not functional on NOAA-4.

3.4 Magnetic Field at Geostationary Satellite Altitudes

Real-time magnetometer reports are received from the Space Environment Monitoring System on the SMS/GOES satellites. Each satellite carries a twin fluxgate spinning sensor that makes possible reconstruction of the geostationary magnetic field in three components. Data are received continuously from two satellites simultaneously.

3.4.1 Satellites reporting

SMS-1: Currently (1976) in standby mode.

SMS-2: 135° West Longitude.

GOES-1: 75° West Longitude.

3.4.2 Parameters reported

Three field components (1-min or 5-min averages)

- HP Field parallel to the satellite spin axis (which is perpendicular to the orbital plane).
- HE Field perpendicular to the satellite spin axis and parallel to the satellite-Earth center line.
- HN Field perpendicular to the satellite spin axis and perpendicular to the satellite-Earth center line.

3.4.3 <u>Frequency of report</u>

Every minute.

3.4.4 Medium of report

Direct telemetry.

3.4.5 Retention period in SELDADS

One-minute averages for 4 days.

Five-minute averages and standard deviations for 32 days.

3.4.6 Display format

One CRT plot.

One listing (see Solar X-rays, sec. 3.1.7).

3.4.7 Sample displays

Figure 10 presents a display of magnetic field data.

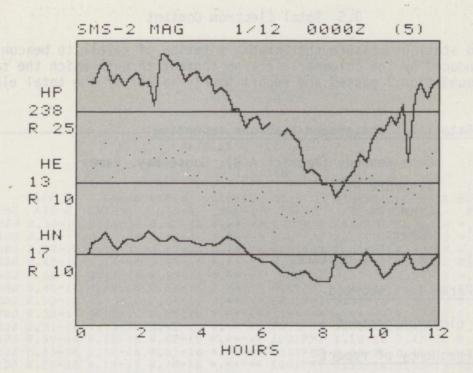


Figure 10. (MAGPLT) display. This display graphically presents magnetic data from the SMS/GOES satellites. The three components are plotted versus time. The straight solid line represents the mean of the data for all three channels for the period (numerically displayed at the left of the line). The Rxxx indicates the range in gammas above and below the mean to the next solid straight line. Satellite identification and begin time are at the top of the display.

3.5 Total Electron Content

Ground stations measure the Faraday rotation of satellite beacon transmissions induced by the columnar electron content through which the satellite-to-ground signal passes and report hourly values of the total electron content.

3.5.1 Satellites and ground stations reporting

ATS-3: Cape Kennedy (Patrick AFB), Goose Bay, Ramey

SMS-1: Sagamore Hill

ISF-2: Osan

ATS-6: Athens

SMS-2: La Posta, Boulder

3.5.2 Parameter reported

Total electron content.

3.5.3 Frequency of report

Hourly

3.5.4 Medium of report

Coded teletype messages (ATN).

3.5.5 Retention period in SELDADS

One calendar month.

3.5.6 Display format

One printed list.

3.5.7 Sample display

Figure 11 presents a display of total electron content data.

SATELLITE TEC LOG 1/21/76 CAPE KY GOOSE B RAMEY SAGHILL OSAN ATHENS LAPOSTA BOULDER TIME ATS-3 ATS-3 ATS-3 SMS-1 ISF-2 ATS-6 SMS-2 SMS-2 0000 0.34-16 0.21-16 0.62-16 *.**-** EQUIPMT EQUIPMT 0.79-16 *.**-** 0100 0.33-16 0.17-16 0.62-16 *.**-** EQUIPMT EQUIPMT C.54-16 *.**-** 0200 0.37-16 0.14-16 0.61-16 *.**-** EQUIPMT EQUIPMT 0.40-16 *.**-** 0300 0.42-16 0.11-16 0.69-16 *.**-** *.**-** EQUIPMT 0.36-16 0.24-16 0400 0.46-16 0.11-16 0.69-16 *.**-** EQUIPMT 0.32-16 0.37-16 *.**-** 0500 0.45-16 0.10-16 0.66-16 *.**-** EQUIPMT 0.33-16 0.33-16 0.24-16 0600 0.59-16 0.13-16 0.67-16 *.**-** EQUIPMT 0.59-16 0.39-16 0.26-16 0700 0.59-16 0.13-16 0.66-16 *.**-** *.**-** 0.40-16 0.27-16 2300 0.51-16 0.13-16 0.62-16 *.**-** EQUIPMT 1.32-16 0.40-16 0.31-15 3930 0.39-16 0.12-16 0.62-16 *.**-** EQUIPMI 1.33-16 0.41-16 0.36-16 1000 0.33-16 0.12-16 0.65-16 *.**-** EQUIPMT 0.96-16 0.41-16 0.40-16 1100 0.29-16 0.14-16 0.76-16 *.**-** EQUIPMT 0.92-16 0.33-16 0.44-16 1200 0.44-16 0.26-16 1.10-16 *.**-** *.**-** 1.01-16 0.35-16 0.41-16 1300 0.69-16 0.47-16 1.31-16 0.56-16 EQUIPMT 0.96-16 0.30-16 0.31-16 1400 0.39-16 0.66-16 1.55-16 *.**-** *.**-** 0.90-16 0.30-16 0.31-16 1500 0.93-16 0.57-16 1.67-16 0.85-16 EQUIPMT 0.75-16 0.50-16 0.65-16 1603 1.22-16 0.53-16 1.63-16 1.05-16 EQUIPMT 0.53-16 0.96-16 0.68-16 1700 1.33-16 0.74-16 1.50-16 1.24-16 EQUIPMT 0.45-16 0.00-16 0.83-16 1800 1.55-16 0.69-16 1.50-16 1.17-16 *.**-** 0.41-16 1.42-16 1.03-16 1900 1.40-16 0.49-16 1.56-16 1.03-16 EQUIPMT 0.42-16 0.00-16 1.53-16 2000 1.43-16 0.65-16 1.72-16 0.37-16 *.**-** 0.33-16 1.97-16 1.40-16 2100 1.03-16 0.57-16 1.62-16 0.71-16 EQUIPMT 0.40-16 0.00-16 0.95-16 2200 0.72-16 0.45-16 1.02-16 0.54-16 *.**-** 0.33-16 0.00-16 0.85-16 2300 0.59-16 0.26-16 0.73-16 0.43-16 *.**-** 0.38-16 0.00-16 0.65-16

Figure 11. (SELOG) display. This display provides a daily summary of the equivalent vertical total electron content (TEC) in electrons/meter² from eight stations monitoring the five satellites listed above. Data are represented as X.XX-YY indicating X.XX times 10^{YY} electrons per meter².

3.6 H-Alpha Solar Events, Features, and Patrol

Solar events and features observed in the 6563Å line of hydrogen are reported from observatories in the Global Solar Flare Patrol (GSFP) System operated by NOAA and the USAF/AWS. These data are supplemented by a number of observatories reporting through IUWDS. The GSFP System is standardized with telescopes equipped with 0.5Å bandpass (optional 1.0Å) birefringent filters tunable to \pm 1Å from line center. Parameters are measured by visual estimation or by scaling from film records.

3.6.1 Observatories reporting

Global Solar Flare Patrol:

Other IUWDS Observatories:

Boulder Palehua Culgoora Manila Teheran Athens Ramey

McMath Tokyo Moscow Wendelstein Irkutsk Pic-du-midi

3.6.2 Parameters reported

Begin-, maximum-, and end-time of event.

Location on the solar disk.

Event importance (zero to 4; 4 the most important). For flares, brightness normal, faint, or bright is also reported.

Quality of observation.

Report status.

Solar active-region number (assigned at Boulder) in or near which the activity or feature is located.

Objects reported include:

Туре	Description
FLA	Solar flare
ASR	Active surge region
APR	Active prominence region
MDP	Mound prominence
BSL	Bright surge on the limb
LPS	Loop prominence system
EPL	Eruptive prominence on the limb
SPY	Spray
AFS	Arch filament system

ADF	Active dark filament
DSF	Disappearing filament
DSD	Dark surge on the disk
BSD	Bright surge on the disk
SSB	Solar sector boundary
CRN	Coronal rain

Solar patrol times are reported by the GSFP stations. These reports include the beginning and ending times of patrol and include causative factors affecting the patrol such as sunrise, cloud cover, equipment outage, and sunset.

3.6.3 Frequency of report

From GSFP observations, events are reported as they occur. From all observatories, summaries are reported at 4-, 6-, 8- or 24-hour intervals.

3.6.4 Medium of report

Coded teletype messages (ATN, IUWDS).

3.6.5 Retention period at SELDADS

At least 1 calendar month.

3.6.6 <u>Display formats</u>

Two printed lists.

3.6.7 Sample displays

Figures 12 and 13 present displays of data relating to H-alpha solar events, features, and patrol.

		BEGIN -0000 -0100	MAX	END	LOC/	FRQ	IMP	TYPE	MEAS	MIS	C
26204	DSD	30114			SII	W25		FR		R 67	6
17201	ADF	31208 1308 1400		X1408						R	0
17201	APR	1500 B1522 1600 1700 1300 1900		A1727							0
17201 17201 17201	DSD ADF ADF	2036 B2045 X2045 2100 2200 2300		2054 A 2203 A 2203	S11 S11	W35	7	RT FR		RG R6	76 76

Figure 12. (LDLOG) display. This display presents a daily summary of disk features and activity in the H-alpha line. Begin- and end-times, end points of filaments, report status (RT=real time, FR=final report) and SESC-assigned region numbers are included.

		EVENT 1							
		BEGIN 0000	MAX	END	LOC/FRQ	IMP	TYPE	MEAS	MISC
		0100							
		3200							
90002		0205	3220	0240	1-3A	1340	1	.0-3	BYTTE
42101		B 2216			512 W11			80M	
42101	FLA	80216			S12 W11				R676
42101		BØ216 BØ216			S12 W11	SF SF	FR	80M	R676
		0236	0210	HU213	312 WII	31			11010
		0300							
		0400							
		0500					The Wall Street	1 10 to 10 - 10 To	
		0600 0700							
		0300							
90002		0322	0838	0347				.0-3	
		0900							
		1000							
		1100							
		1200			210				
17401		1214	2005	2135		NS	RT FR	64F	
17401		1214	2005	2135	210	NS		641	
		1300							
17401		1306	1307	1309	210	MIN	RI		FU
		1306	1307	1309	210	MIN	FR	1101	FU
17401		1307	1745	1333	25- 63		III	100	11008
17401		1345	1348	1350	210	MIN	FR	1001	U
17401		1414		1416	25- 45	2	II		
		1500							
		1600							
17431	SID	1615	1632	0000	99	1	SWF	1.3DB	99999
17401	SID	1615	1630	0004	00	,	CHE	1 200	00000
17401	210	1013	1632	משמט	99	1	SWF	1.308	99999
17401	SID	1615	1632	0000	99	1	SWF	1.808	0
			1630	2000			5.1		
30503	MAG	1651					BAY		
		1700							
					210				
17401					210	MIN	CC	4 6F	U
17401	RHR	1350	1851	1352	210	MIN	FR	1505	11
17401	RSP	1350			25- 35	1	II	1,001	
17401	RER	1350	1351		213			150F	U
		1900							
17431		1952		1953	25- 53	1	III		
		2000							
		2200							
		-2300							
		-2400							

Figure 13. (EVLOG) display. This display is a daily summary of solar-geo-physical events. Included are flares, X-ray events, radio bursts, spectral radio events, sudden ionospheric disturbances, and magnetic events. Each report includes begin-, maximum-, and end-times; unique parameters for each type of report are also included. This display is referred to in several following sections.

3.7 Discrete Frequency Solar Radio Flux and Bursts

Background solar radio fluxes and events are reported for a number of frequencies from several observatories.

3.7.1 Observatories reporting

In real time:

Boulder (1415, 2695, 4995 MHz)
Sagamore Hill (210, 410, 610, 1415, 2695, 4995, 8800, 15400 MHz)
Athens (1415, 2695, 4995, 8800 MHz)
La Posta (2695, 8800 MHz)
Palehua (1415, 8800 MHz)
Manila (606, 1415, 2695, 4995, 8800 MHz)
Ottawa (2800 MHz)

On a daily basis:

Sydney

Moscow

Voroshilov

Tokyo

Culgoora

Hiraiso

3.7.2 Parameters reported

Background flux: Frequency, flux, time of observation.

Events:

Begin-, maximum-, and end-times.

Types:

NS Noise storm
RBL Rise in base level
MIN Minor burst

GR Group of bursts

CX Complex (major) burst

PBI Post-burst increase

MA+ "Plus" part of "major-plus" burst or microwave post-burst increase

Importance (in flux units or percentage increase). Secondary maxima, importances.

3.7.3 Frequency of report

Background fluxes on a daily schedule. Events as they occur from some observatories.

3.7.4 Medium of report

Coded teletype reports (ATN, IUWDS).

3.7.5 Retention period in SELDADS

One calendar month.

3.7.6 Display format

One printed listing.
Also, see item labeled RBR in Figure 13 (EVLOG).

3.7.7 Sample display

Figure 14 presents a display of solar radio flux data.

			R	OIGA	FLUX	LOG					
	TTC	SAG	SAG	SAG	SAG	SAG	SAG	SAG	SAG	PAL	PAL
DATE	2300	210	415	606	1415	2695	4995	8300	15K	1415	3300
1/15	33	11	24	37	53	79	127	232	532	45	
1/15	31	9	23	35	53	7.3	126	231	530	43	
1/17	79	11	23	37	49	76	123	279	531		
1/13	79	10	25	33	52	76	122	232	526	43	
1/19	73	16	26	39	50	75	122	235	523	42	

Figure 14 (RLOG) display. This display lists solar radio fluxes from selected observatories at selected frequencies.

3.8 Spectrographic Solar Radio Events

Times and intensities of solar sweep frequency events are reported by four observatories.

3.8.1 Observatories reporting

Boulder Manila Sagamore Hill

Culgoora

3.8.2 Parameters reported

Begin-, end-times; status of events. Frequency extent of the event Type of event.

I Noise storm

II Slow drift burst

III Fast drift burst

IV Broad-band continuum

V Brief continuum associated with type III burst

CTM Continuum associated with storms of type III

STM Storm of type III bursts

MWB Short (minutes) microwave continuum, usually of

impulsive start

SDF Decimeter slow drift burst, or type I chain, or gradual change in type III starting frequencies

Importance: 1 to 3+

3.8.3 Frequency of report

As events occur.

3.8.4 Medium of report

Coded teletype messages (ATN, IUWDS).

3.8.5 Retention period in SELDADS

One calendar month.

3.8.6 Display format

See item labeled RSP in Figure 13. Note: For description of types I-V, see Mangis, 1975, p. 32-33.

3.9 Solar Calcium Plage Observations

Plages observed in the K line of calcium (3934Å) are reported from a limited number of observatories.

3.9.1 Observatories reporting

McMath

Manila

3.9.2 Parameters reported

Time, quality, status of observation, and for each plage area:

Observatory-assigned serial number

Location

Longitudinal extent

Area

Compactness

Brightness

Filament description

Age (in solar rotations)

3.9.3 Frequency of report

Once daily from each observatory, weather permitting.

3.9.4 Medium of report

Coded teletype messages (ATN).

3.9.5 Retention period in SELDADS

One calendar month.

3.9.6 Display format

These data are stored and processed in the data base and associated with sunspot observations. See display under White Light Sunspot Observations (Sec. 3.11.7).

3.10 Coronal Intensities

3.10.1 Observatories reporting

Norikura

Pic-du-midi

Wendelstein

3.10.2 Parameters reported

The intensity of solar coronal line emission as a function of heliographic latitude is reported for four lines:

green (5303Å) red (6374Å) red (6702Å) vellow (5694Å)

3.10.3 Frequency of Report

Once daily, if observed.

3.10.4 Medium of Report

Coded teletype messages (IUWDS network).

3.10.5 Retention Period in SELDADS

One calendar month.

3.10.6 Display format

Data are stored and processed in the data base and redistributed as part of the IUWDS data interchange.

3.11 White-Light Sunspot Observations

Sunspot information recorded from observations made in the solar visible continuum is reported from observatories in the Global Solar Flare Patrol System.

3.11.1 Observatories reporting

Boulder Ramey Palehua Teheran Manila Culgoora

Athens

3.11.2 Parameters reported

Time and quality of observation, status of the report, and for each sunspot group:

Observatory serial number

Location

Longitudinal extent

Area

Umbral area

Number of individual spots constituting group
Modified Zurich classification (see Mangis, 1975, p. 9)
Penumbral classification (see Mangis, 1975, p. 9)
Compactness classification (see Mangis, 1975, p. 9)
Inferred magnetic classification (see Mangis, 1975, p. 9)

3.11.3 Frequency of report

Daily if weather conditions allow.

3.11.4 Medium of report

Coded teletype messages (ATN, IUWDS).

3.11.5 Retention period in SELDADS

One calendar month.

3.11.6 Display format

Two listings.

3.11.7 Sample displays

Figures 15 and 16 present displays of white-light sunspot data.

SUNSP	OT 3	SUMMAR	Y FO	OR 1	/13	3/76	5		ogen e		nester
LOCAT	IONS	ROTA	ATED	TO	1/1	14/	75 1	00002	4		
NMLR	LOCA	NCIT	LON	AREA	Z	LL	NN	MAG	OBS	2	TIME
1 2 675	503 503	W56	34 34 33	10 10 10	A B A	3	3 2	A B	35431 32401 17201 20401 26234	4 3 1	0712 1236 1640
2 3	S13 S10	E52	285 233	440	EE	12	13	BG		4 3	.0712
3	514	E66	271	20	В	4	5	3	32401	4	0712
676	S11	E57	279	270	E	14	7	BG	20401	1	1642

Figure 15. (SSP) display. This display presents sunspot reports by all observatories on a daily basis, grouping individual reports of the same sunspot group.

						REC	GION	667								
03	S	REC	NOIS	SI	INS	SPOT	Г	CAL	CIL	JM		FLA	RES			
MO	DA		TION	AREA	Z	NR	MAG	AREA	OB	BRT	M	X	0	1	2	3
11	14	307	E79	Ø	H	1	A	800	MC	2.0	Ø	0	0	0	Ø	0
11	15	503	E63	60	D	3	В	5100	MA	4.0	Ø	Ø	1	0	0	0
11	16	SØ3	E50	140	H	4	В	4500	MA	3.0	Ø	Ø	3	Ø	Ø	0
11	17	507	E38	260	B	28	BG	2000	MC	3.5	1	Ø	7	Ø	Ø	0
11	13	506	E25	420	D	30	BG	2000	MC	3.5	Ø	3	3	0	Ø	0
11	19	506	E11	320	D	23	B	2300	MC	4.5	Ø	3	3	Ø	Ø	0
11	20	SØ 6	WUD	420	D	21	BG				Ø	Ø	2	0	0	2
11	21	507	W15	270	D	14	В	2300	MC	3.0	Ø	Ø	1	Ø	Ø	0
11	22	507	W28	240	D	13	В	2200	MC	3.0	1	Ø	0	1	0	8
11	23	507	W40	400	C	15	В	2500	MC	3.0	Ø	Ø		0	Ø	8
11	24	507	W53	200	H	4	A	4000	MA	3.0	Ø	Ø	Ø	0	Ø	6
11	25	507	W64	220	H	2	A	2300	MC	3.0	0	0	0	0	Ø	2
11.	26	507	W31	110	Н	1	Α				0	Ø	0	0	3	8
L :	= 3	43 MG	CMATH	REGIO	ON	12	937	FLARE	TO	TALS	2	Ø	20	1	Ø	0
				CPO	cci	ED 1	WEST	LIMB								

Figure 16. (PREG) display. This display lists the history of a solar region's transit across the disk. Information includes sunspot and calcium parameters, energetic events, and flare activity.

3.12 Optical Auroral Observations

Reports of visible auroral forms, locations, and colors are received from cooperating observatories or observers.

3.12.1 Observatories reporting

Kergulen Island Kiruna

3.12.2 Parameters reported

Time of observation
Weather conditions
Color, form, and motion characteristics

3.12.3 Frequency of report

As observed.

3.12.4 Medium of report

Coded teletype message (IUWDS),

3.12.5 Retention period in SELDADS

One calendar month.

3.12.6 Display format

These data are stored and processed in the data base for redistribution in the IUWDS data interchange.

3.13 Auroral Radar Backscatter

A 50-MHz fixed-frequency radar system located at the SEL High Latitude Monitoring Station measures signals backscattered from ionospheric heights along a track north from Anchorage, Alaska (Gray and Ecklund, 1974). Measurements are taken every 20 seconds in 10 successive ranges between 225 and 975 km; 15-minute averages are transmitted to SELDADS.

3.13.1 Stations reporting

Anchorage

3.13.2 Parameters reported

Backscattered intensity (in a relative scale from 1 to 999).

3.13.3 Frequency of report

Every 15 minutes.

3.13.4 Medium of report

Coded teletype message (ATN).

3.13.5 Retention period in SELDADS

One calendar month.

3.13.6 Display format

One printed list.

One CRT graph.

3.13.7 Sample displays

Figures 17 and 18 present displays of auroral radar data.

		AUR	ORAL	RADAR	1/2	0/76				
TIME	225	300	375	450	525	600	675	750	825	900
ð	124	109	105	120	99	91	89	34	76	70
15	101	105	102	99	98	91	87	30	77	72
30	98	103	102	102	94	85	87	80	72	67
45	101	100	98	98	90	85	86	77	68	66
100	94	97	95	94	93	85	83	76	71	68
115	96	100	97	96	90	90	32	73	69	67
130	93	96	93	91	93	82	80	74	70	64
145	89	87	89	35	81	77	74	67	65	61
200	33	89	37	38	83	77	73	69	65	59
215	37	84	67	35	81	79	70	65	64	60

Figure 17. (RADAR) display. This display lists the 15-minute values of the auroral radar at each range from 225-975 km.

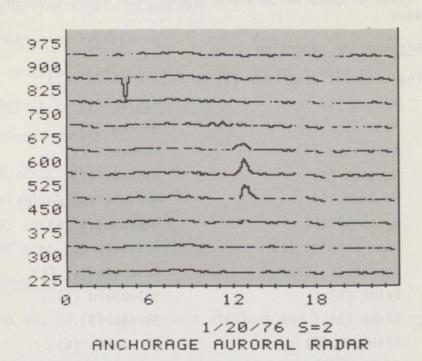


Figure 18. (PRADAR) display. This display plots auroral radar at the ten distance intervals. A scale factor (S) may be chosen so that extremely disturbed periods do not overlap.

3.14 Ionosonde Observations

Several types of observations are scaled from swept frequency ionospheric sounders.

3.14.1 Observatories reporting

(Reporting interval each hour (1) or each 6 hours (6))

Alborg (1) Manila (1)
Alma Ata (6) Moscow (6)
Ashkhabad (1) Murmansk (1)

Bangkok (1) Nicosia (1)
Boulder (1) Norfolk Island (6)

Brisbane (6) Ougadougou (6)
Cape Schmidt (1) Poitiers (1)
Churchill (1) Resolute Bay (1)

Dakar (6)
Salekhard (1)
Dixon (1)
Slough (1)
Djibouti (6)
St. Johns (6)

Eielson (1) Taoyuan (1)
Irkutsk (6) Tokyo (6)

Irkutsk (6) Tokyo (6)
Keawakapu (1) Townsville (6)
Khabarovsh (1) Tromsoe (1)

Kiruna (1) Vandenberg (1)

Lindau (1) Vanimo (6)

Magadan (1) Wallops Island (1)

3.14.2 Parameters reported

Critical frequency of the F2 layer in tenths of MHz (F0F2).

Maximum usable frequency at 3000-km distance (M3000).

Minimum frequency observed (FMIN).

Lowest frequency at which the spread E layer becomes transparent (FES).

Or a descriptive letter symbol (Piggott and Rawer, 1961):

A Blanketing sporadic E F Spread echoes

Complete absorption $G F0F2 \leq F0F1$

Equipment trouble I Interpolated value

Frequency higher than equipment R Attenuation

E Frequency lower than equipment

3.14.3 Frequency of report

Variable from hourly to weekly.

3.14.4 Medium of report

Coded teletype messages (ATN, IUWDS, US/USSR data link).

3.14.5 Retention period in SELDADS

One calendar month.

3.14.6 Display format

One printed list.

One CRT list.

One CRT plot.

3.14.7 Sample displays

Figures 19, 20, and 21 present displays and lists of ionosonde observations.

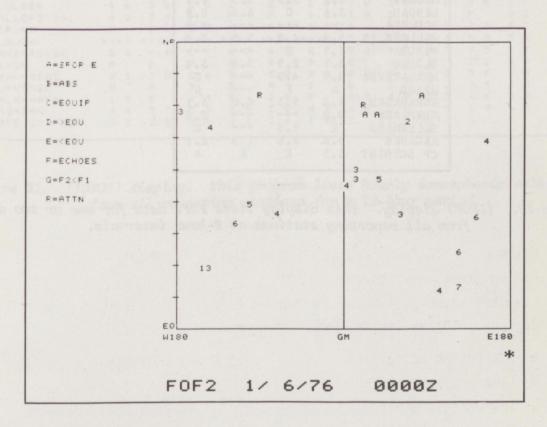


Figure 19. (PLTRFOF) display. This display plots rounded Northern Hemisphere FOF2's geographically. The asterisk represents the longitude of the Sun at the time plotted.

FOF2 SUMMARY	Y			
STATION Ø	1/3 000Z	1/3 0600Z	1/3 1200Z	1/3 1800Z
TAIWAN BANGKOK ALBORG CYPRUS MANILA EIELSON CHURCHILL VANDENBERG HAWAII RESOLUTEBY TROMSOE BRISBANE NORFOLK VANIMO TOWNSVILLE AHMEDABAD	5.3 3.9 3.0 6.0 3.3 6.0 7.1 3.3 7.4 6.1 7.0 3.4 4.6 C 2.4 3.0 3.1 3.3 1.7 3.3 1.7 3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5	12.2 6.5 2.7 7.5 R R 6.3 6.6 9.4 2.6 4.0 5.4 3.5 C	1200Z 4.7 6.7 5.6 7.0 7.0 6.7 7.0 6.7 7.9 F 3.3 A 5.5 6.4 3.5 6.4 3.5 6.4 3.5 6.4	4.0 4.2 3.0 R.9 G.3 R.9 G.3 R.9 G.3 F.9 F.9 F.9 F.9 F.9 F.9 F.9 F.9 F.9 F.9

Figure 20. (LFOF) display. This display lists FOF2 data for one or two days from all reporting stations at 6-hour intervals.

		::F1	TATA	6 :	·e							
STATION	002	012	011	012	242	052	062	272	012	090	102	112
TAIWAN.	5 5		- 6	8 0	11 5	13 4	11 9	11 1	11 0	7 9	5 4	5
EANGROP	4.2	5 9	6 3	6 5	6 0	5.8	8.0	6 5	6 8	7 2	7 3	9 1
ALEGRG	3.3	3 3	3 3	3 0	2.6	2.5	2.2	2 4	4 4	= 1	5 2	5
CYPPUS	****		****	* * * *	+++*	****	****	****	* * + +	****	****	***
MANILA	7 3	9 0	8.5	7 5	6.5	6.5	7.2	7 9	8.5	9.0	9.0	7 .
EIELSON	3.5	1.8	P	1 5	1.5	R	P	F	F	R	P	P
CHURCHILL	****	****	****	****	****	****	****	****	* * * *	****	****	***
VANDENBERG	6.3	4 4	2.6	P	2.4	2.5	2.6	2.9	3.1	3.0	3.0	3.5
HAWAII	13.4	7.3	5.3	5.7	4.2	2.5	2.9	A	****	****	****	***
RESOLUTE BAY	P	3.5	A	P	P	R	P	3.5	R	A	P	P
TROMSOE	P	P	P	P	A	A	R	R	R	3.4	R	P
BRISBANE	6.9	****	****	****	****	****	8.6	****	****	****	****	***
NORFOLK ISL	7 3	****	****	****	****	****	7.7	****	****	****	****	***
VANIMO	6.1	****	****	****	****	****	8.4	****	****	****	****	***
TOWNSVILLE	7.1	****	****	****	****	****	11.0	* * * *	****	****	****	***
DUGADOUGOU	****	****	****	****	****	****	****	****	****	****	****	***
DJIBOUTI	****	****	****	****	****	****	****	****	****	****	****	****
DAKAR	****	****	****	****	****	****	****	****	****	****	****	***
POITIERS	3.5	3.3	3.4	3.5	3.2	3.0	2.9	3.0	5.1	5.8	5.9	5 5
ТОКУО	5.7	****	****	****	****	****	A	****	****	****	****	***
ST JOHNS	****	****	****	****	****	****	****	****	****	****	****	ak ak ak a
ALMA ATA	****	****	****	****	****	****	****	****	****	****	****	****
IRKUTSK	****	****	****	****	****	****	****	****	****	****	****	ale ale ale a
MOSCOW	****	****	****	****	****	****	****	****	****	****	****	****
INDAU	3.3	3.1	3.1	2.5	2.3	2.1	1.9	3.2	4.7	5.4	C	5.3
BOULDER	4.6	3.6	2.6	2.7	2.4	2.4	3.0	3.5	3.6	3.6	3.7	3.2
MALLOPS ISL	4.2	3.4	F	F	F	1.8	1.9	2.1	F	F	3.2	2.3
CIRUNA	A	1.8	0.0	A	A	В	A	B	2.1	3.1	4.2	4.6
SLOUGH	****	****	****	****	****	****	2.0	1.9	3.3	5.0	5.3	4.9
HABAROVSK	5.4	6.0	С	6:7	6.5	6.7	5.3	4.7	4.7	3.5	3.1	3.1
DIXON	A	A	A	A	P	B	E	3.7	o ciol	2.2	2.0	A
ASHKHABAD	3.1	2.8	2.6	3.2	5.0	4.4	6.0	6	6.8	5.6	4.9	5.5
MURMANSK	A	A	E	E	A	E	В	2 0	3.2	3.5	4.3	3.8
SALENHAPD	1.8	E	1.4	E	1 8	F	4.3	4 5	5.5	4 6	3 9	3.2
MAGADAN	4 4	5 7	5 9	5 9	5 0	4 5	4 0	3 0	2.5	1.9	1 8	1 5
THE SCHMILT	3 3	3 6	3 5	3 2	: 6	1 8	c	-	-	ċ	c ·	ċ

Figure 21. (IONOS) display. This program lists hourly ionospheric values from all reporting stations for a 12-hour period.

3.15 High Frequency Radio Path Signal Strengths

Fixed frequency, continuous wave radio transmitters are monitored by receivers at the NOAA-AWS High Latitude Monitoring Station. Signal strengths are measured every 10 seconds; 15-minute averages are transmitted to SELDADS.

3.15.1 Stations reporting

Thule (12 MHz)
Adak (10 MHz)
WWV (Ft. Collins) (15 MHz)
WWV (Ft. Collins) (10 MHz)

3.15.2 Parameters reported

Deviation from a quiet day curve.

3.15.3 <u>Frequency of report</u>

Every 15 minutes.

3.15.4 Medium of report

Coded teletype messages (ATN).

3.15.5 Retention period in SELDADS

One calendar month.

3.15.6 Display format

One CRT plot.

3.15.7 Sample display

Figure 22 presents a display of radio path data.

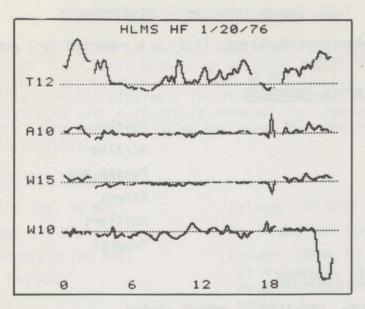


Figure 22. (PHF) display. This display presents a daily summary of deviations from quiet-day conditions (the dotted lines) for the four high-frequency paths monitored at Anchorage.

3.16 Sudden Ionospheric Disturbances

Sudden Ionospheric Disturbances (SID) are reported by a number of stations.

3.16.1 Observatories reporting

Sagamore Hill Sydney

Luchow

Ramey La Posta

McMath

Palehua

Hiraiso

Panska Ves

Athens

Poitiers

Teheran

3.16.2 Parameters reported

Begin-, maximum-, end-times; report status,

Type:

SFD Sudden frequency deviation

SWF Short wave fadeout

SEA Sudden enhancement of atmospherics

SPA Sudden phase anomaly

SCNA Sudden cosmic noise absorption

SES Sudden enhancement of signal

Importance: 1- to 3+

Frequency monitored

Transmitter site

Intensity of the measured phenomena (decibels for SWF, degrees of SPA) Secondary maxima

3.16.3 Frequency of report

As events occur.

3.16.4 Medium of report

Coded teletype messages (ATN, IUWDS).

3.16.5 Retention period in SELDADS

One calendar month.

3.16.6 Display format

See item labeled SID in Figure 13 (EVLOG).

3.17 High-Latitude Riometer Data

Riometers (Little and Leinbach, 1959) are receivers operated continuously to measure ionospheric absorption of radio noise from the cosmic background. The receivers operate at or near 30 MHz and are fed by either quaddipoles or folded double-dipoles. The receiver outputs are sampled every 10 seconds and averaged over a 15-minute interval for transmission to Boulder. The values are compared with a quiet day curve to compute the ionospheric absorption in decibels.

ments.

3.17.1 Stations reporting

Thule (26 MHz, 30 MHz)
Anchorage (30 MHz)
Sheep Mountain (30 MHz)
Paxson (30 MHz)

College (30 MHz)

Ft. Yukon (30 MHz)

Chivers (30MHz); a test riometer at Anchorage, it has faster response than the other instru-

3.17.2 Parameters reported

Absorption in decibels and solar zenith angle.

3.17.3 Frequency of report

Every 15 minutes.

3.17.4 Medium of report

Coded teletype messages (ATN).

3.17.5 Retention period in SELDADS

One calendar month.

3.17.6 Display format

One printed list.
One CRT graph.

3.17.7 Sample displays

Figure 23 and 24 present displays of high-latitude riometer data.

		1/2	20/76					
TIME	126	T30	ANC	CHV	SHP	PAX	COL	FTY
0000	. ON	1N	ØD	20	. 2D	-1.20	7D	9T
2215	.1N	ØN	ØD	2D	.2D	-1.3D	ST	GT
0030	.ON	1N	. ØD	10	.30	-1.3D	5T	6T
0045	· ØN	.ØN	ØD	10	.3D	-1.4T	5T	7T
0100	. ON	ØN	1D	40	.3T	-1.3T	5T	-1.3T
0115	. ON	1N	.ØT	ØT	.3T	-1.3T	3T	-2.8T
3130	: 21	ØN	TG.	0T	.3T	-1.2T	4T	9T
0145	. DN	1 N	. OT	ØT	.3T	-1.1T	3T	1.01
0200	. ON	DN	.ØT	TG.	.3T	-1.1T	- OT	3T

Figure 23. (ALOG) display. This display lists polar cap absorption measured along the chain of riometers monitored at Anchorage. Absorption is listed in decibels, followed by a letter indicating whether the station is in daylight (D), twilight (T), or night (N).

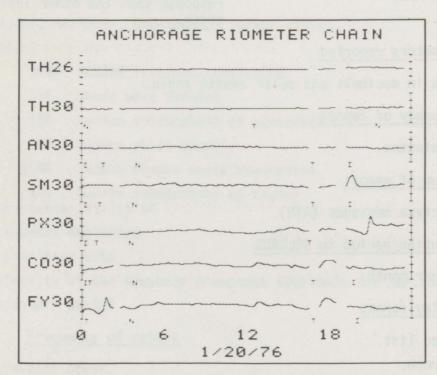


Figure 24. (PRIO) display. This display presents daily plots of the Anchorage riometer chain in a logarithmic graphical format. Absorption is plotted as deviations from zero. Changes from day to twilight to night are listed below each station.

3.18 Ground-Based Magnetometer Observations

Magnetic field observations from a variety of magnetometer stations are entered into the data base.

3.18.1 Observatories reporting (reporting frequency included)

Anchorage (every 15 minutes)
Boulder (every 3 hours, visual observation continuous)
Chambon-la-foret (daily)
Eielson (every 90 minutes)
Fredericksburg (daily)
Ft. Yukon (every 15 minutes)
Goose Bay (every 90 minutes)
Irkutsk (daily)
Kakioka (daily)

Kergulen Island (daily)
Loring (every 90 minutes)
Magadan (daily)
Moscow (daily)
Murmansk (daily)
Novosibirsk (daily)
Thule (every 15 minutes)
Tucson (daily)
Vostok (hourly field values)
Wingst (daily)

3.18.2 Parameters reported

U.S. Air Force stations use fluxgate magnetometers and measure field components x,y,z. The remaining stations generally measure field components H,D,Z.

3.18.3 Frequency of report

See Sec. 3.18.1.

3.18.4 Medium of report

Coded teletype messages (ATN, IUWDS, US/USSR data link)

3.18.5 Retention period in SELDADS

One calendar month.

3.18.6 Display format

Two printed listings
Two CRT plots.

3.18.7 Sample displays

Figures 25 through 28 present lists and displays of ground-based magnetometer data.

```
FREDERICKSBURG MAGNETOMETER DATA

A K-INDICES

MO DA 1 2 3 4 5 6 7 8

1/14 3 2 2 3 3 2 1 1 2

1/15 4 1 0 0 1 2 2 2 2

1/16 5 2 1 2 1 0 1 2 3

1/17 *** 2 3 3 2 * * * *

1/18 *** * * * * 1 1 2 1

1/19 5 2 2 1 2 1 1 2 2
```

Figure 25. (MAGPLT) display. This display lists daily A- and three-hourly K-indices for a given station for a requested period of time.

1/19/76	MAGNE	TIC	SUN	1MA F	RY				
STATION	A	K1	K2	K3	K 4	K5	K 6	K7	KS
A NCH WINGST MOSCO W FREDBG TUCSON KAKIOKA BOULDER MAGADAN MURMANSK NOVSBRSK	9 11 6 4 6 3 9	22 - 2202 - 21	2 2 2 3 0 2 - 1 2	2 1 2 1 1 1 0 - 1 1	3 2 2 2 2 2 2 - 1 2	2 3 3 1 2 1 1 - 1 2	3 3 1 - 2 2 - 3 3	2 3 3 2 - 2 2 - 3 3	2 3 3 2 - 2 2 - 3 3
ANCH RT IRKUTSK KERGLN CHAMBON EIELSON IHULE LORING GOOSE BY	9 12 6 7 7 7 9 7 2	2 1 2 1 2 1 1	2 1 0 1 1 1 1 1 1 1	2 2 0 1 1 1 0 0	3 2 1 2 4 3 2 0	2 3 2 1 1 3 1 0	3 4 3 3 2 3 1 1	2 1 2 1 2 1	2 3 3 2 1 2 4 1

Figure 26. (MLOG) display. This display lists daily A- and three-hourly K-indices from reporting stations.

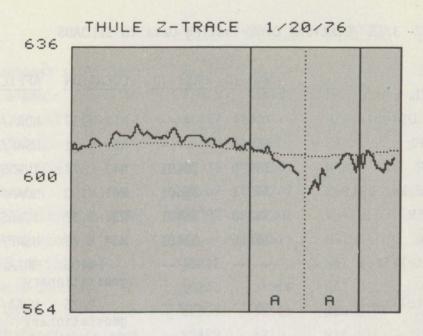


Figure 27. (THZ) display. This display is a plot of the daily Thule Z-trace. A normal daily trace (sine curve, dotted) is fitted to the trace, and deviations at critical periods are used to infer the direction of the interplanetary magnetic field.

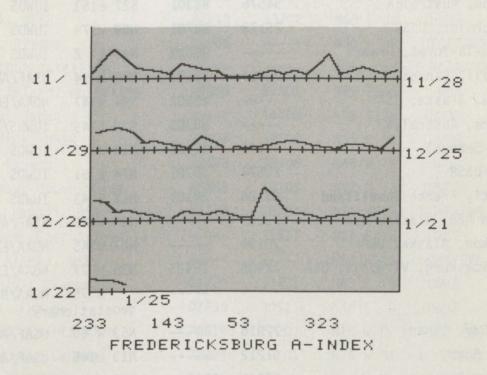


Figure 28. (PINDEX) display. This display plots long-range variations of selected magnetometers versus Carrington longitude (along the bottom of the plot) to indicate recurring magnetic disturbances.

3.19 Stations Contributing Data to SELDADS

STATION	WMO ID	URSI ID	LOCATION	AFFILIATION
Adak, Alaska, USA	70454		N52 W177	NOAA/ERL
Alborg, Denmark	06067		N57 E 11	USAF/AWS
Alma Ata, USSR	36870	38401	N43 E 77	IUWDS
Anchorage, Alaska, USA	70273	25601	N61 W150	NOAA/ERL
Ashkhabad, USSR	38880	36401	N37 E 58	IUWDS
Athens, Greece	16716	32401	N38 E 23	USAF/AWS
ATS-3 (USA satellite)			W105 geostation	NOAA/NASA nary
ATS-6 (USA satellite)			E 25 geostation	NOAA/NASA nary
Bangkok, Thailand	48455		N14 E100	USAF/AWS
Boulder, Colorado, USA	72469	20401	N40 W105	NOAA/ERL
Univ. of Colo., Boulder		20402	N40 W105	IUWDS
Brisbane, Australia	94576	85301	S27 E153	IUWDS
Cape Schmidt, USSR	25173	28701	N69 W179	IUWDS
Chambon-la-foret, France		30503	N48 E 2	IUWDS
Churchill, Canada	72913	19601	N58 W 94	USAF/AWS
College, Alaska, USA		25602	N64 W147	NOAA/ERL
Culgoora, Australia		85303	S30 E149	IUWDS/NOAA/ERL
Dakar, Senegal	61641	12101	N15 W 17	IUWDS
Dixon, USSR	20674	38701	N74 E 81	IUWDS
Djibouti, French Somaliland	63125	34101	N12 E 43	IUWDS
Eielson AFB, Alaska, USA	70265		N65 W147	NSAF/AWS
Ft. Yukon, Alaska, USA	70194		N67 W145	NOAA/ERL
Fredericksburg, Virginia, USA	72405	18403	N38 W 77	NOAA/ERL
GOES-1			W 75 geostation	NOAA/NESS nary
Goose Bay, Canada	72816		N53 W 60	USAF/AWS
Agana, Guam	91212		N13 E145	USAF/AWS
Exmouth, Australia	94301		S22 E114	USAF/AWS
Hiraiso, Japan		44401	N36 E141	IUWDS
Irkutsk, USSR	30710	40501	N52 E104	IUWDS

STATION	WMO ID	URSI ID	LOCATION	AFFILIATION
ISF-2 (European satellite)				USAF/AWS
Kakioka, Japan	47628	44402	N36 E140	IUWDS
Keawakapu, Hawaii, USA	91191		N21 W156	USAF/AWS
Kergulen Island		77501	S49 E 70	IUWDS
Khabarovsk, USSR	31735	43501	N48 E 35	IUWDS
Kiruna, Sweden	02102	32702	N68 E 20	IUWDS
La Posta, California, USA	72287	22301	N34 W118	USN/USAF/AWS
Lindau, West Germany		31511	N51 E 10	IUWDS
Loring AFB, Maine, USA	72712		N47 W 68	USAF/AWS
Luchow, West Germany	10253	31514	N53 E 11	IUWDS
Magadan, USSR	25913	45601	N60 E151	IUWDS
Manila, Philippine Islands	98429	42101	N14 E121	USAF/AWS/IUWDS
McMath Obs, Pontiac, Mich., USA	72537	18404	N42 W 83	IUWDS
METEOR (USSR satellite)			Polar orbi	t IUWDS
Moscow, USSR	27612	34502	N55 E 37	IUWDS
Murmansk, USSR	22113	33702	N68 E 33	IUWDS
Nicosia, Cyprus	17606		N35 E 33	USAF/AWS
NOAA-4 (USA satellite)			Polar orbi	t NOAA/NESS
Norfolk Island, Australia	94996	87301	S29 E168	IUWDS
Norikura, Japan		44405	N36 E138	IUWDS
Novosibirsk, USSR	29634	38500	N55 E 83	IUWDS
Ottawa, Canada	72628	18406	N45 W 76	IUWDS
Ougadougou, Upper Volta	65503	10101	N12 W 2	IUWDS
Palehau, Hawaii, USA	91178	26204	N21 W158	USAF/AWS
Panska Ves, Czechoslovakia		31517	N51 E 15	IUWDS
Paxson, Alaska, USA			N63 W146	NOAA/ERL
Pic-du-midi, France	07720	30401	N43 E 0	IUWDS
Poitiers, France	07335	30511	N46 E 0	IUWDS
Ramey AFB, Puerto Rico	78514	17201	N18 W 67	USAF/AWS
Resolute Bay, Canada	72924	19701	N74 W 94	USAF/AWS
Sagamore Hill, Mass., USA	72509	17401	N42 W 70	USAF/AWS
St. Johns, Nfld, Canada	72801	15501	N47 W 52	IUWDS
Salekhard, USSR	23330	37701	N66 E 66	IUWDS
Sheep Mountain, Alaska, USA	70269		N62 W148	NOAA/ERL

STATION	WMO ID	URSI ID	LOCATION	AFFILIATION
Slough, England	03778	10504	N51 W 1	IUWDS
SMS-1 (USA satellite)		19110	W105 geostation	NOAA/NESS ary
SMS-2 (USA satellite)	TUTO DO		W135 geostation	NOAA/NESS ary
SOLRAD-10	50500	SOESON	large Earth orbit	USN/NRL
Sydney, Australia	94768	85304	S34 E151	IUWDS
Taoruan, Taiwan	46697		N25 E121	USAF/AWS
Teheran, Iran	40754	35401	N36 E 52	USAF/AWS
Thule, Greenland	04202	17801	N76 W 68	USAF/AWS
Tokyo, Japan	47662	44406	N36 E140	IUWDS
Townsville, Australia	94294	85201	S19 E147	IUWDS
Tromsoe, Norway	01025	32703	N70 E 19	USAF/AWS
Tucson, Arizona, USA	72274	21302	N32 W110	IUWDS
Vandenberg AFB, California, USA	72393		N35 W121	USAF/AWS
Vanimo, Australia	94022	84001	S 3 E141	IUWDS
Voroshilov, USSR	34523	43401	N43 E132	IUWDS
Vostok, Antarctica	89606	81801	S78 E105	IUWDS
Wallops Island, Va., USA	72402	17402	N37 W 75	IUWDS
Wendelstein, West Germany	10980	31522	N47 E 12	IUWDS
Wingst, West Germany		31523	N54 E 9	IUWDS
Yokosuka AB, Japan	47696		N35 E140	USAF/AWS

4. DATA TO BE AVAILABLE

In this section we present data that are planned to be available in real-time to SELDADS within the next two years. Five new planned and funded data inputs are the USN SOLRAD HI satellite program, the US IMS ground-based magnetometer program, the NOAA TIROS-N advanced low-altitude polar orbit weather satellite program, the USAF/AWS Solar Optical Observing Network (SOON), and the USAF/AWS Radio Solar Telescope Network (RSTN).

Storage and display formats are being determined. We present here a general discussion of storage and display formats and a detailed summary of measured parameters for these programs.

4.1 SOLRAD HI Data

The Navy's SOLRAD HI satellites will be launched early in 1976. There will be 116 different measurements of particle, X-ray, and ultraviolet parameters available in real-time to the SELDADS data base. Although there will be two SOLRAD HI satellites, present resources allow for the tracking of only one at a time. Highest tracking priority will be given that satellite in the interplanetary medium.

SOLRAD HI data will be sent from NRL (Blossom Point, Maryland) to NELC at La Posta, California, and to SELDADS in Boulder, Colorado.

The basic data format for SOLRAD HI is repeated every 120 seconds and contains 490 values plus system status information. Table 1 is a summary of the SOLRAD HI data that will be stored in the data base of SELDADS. A detailed summary of the SOLRAD HI instruments is available in Horan (1974).

Energy and wavelength ranges given in Table 1 should be considered as guideline values at this time. SEL will update these values as information is available from NRL. For more detailed information concerning SOLRAD HI and instrument status, contact

Dr. R. Kreplin Naval Research Laboratory Washington, D. C. 20390

4.2 US-IMS Ground Magnetometer Network Data

During the period of the IMS, SEL will use the SELDADS computing system to receive data from the US-IMS ground magnetometer network being implemented by the NSF. The data will be available on a real-time basis both for onsite users and for offsite users who have telephone access to SELDADS. The data will subsequently be recorded on microfilm and computer tapes and delivered to the Environmental Data Service (EDS) for archiving and distribution.

Table 1. SOLRAD HI Data to be Incorporated into the SELDADS Data Base. (~20 Earth Radii Circular Orbit)

Experiment Number	Experiment Name		Energy or Wa	
1	High Energy X-Ray Monitor (NR	RL)	15-20 keV 20-30 keV	30-60 keV 60-150 keV
2	X-Ray Proportional Counter (M	IRL)	3-7.5 keV 7.5-15 keV	15-30 keV 30-60 keV
3	Mg XI and Mg XII Monitor (NRL	.)	9.17Å, 8.4 8.8Å cor	2Å lines ntinuum
4	Ionization Counter (NRL)		1-8	BÅ
5	Ionization Counter (NRL)		8-1	6Å
6	Ionization Counter (NRL)		44-6	SoÅ
7	LiF Photosensitive Surface Detectors (NRL)		170- 500Å, 725-1	
8	Ionization Chamber (NRL)		1080-1	1350Å
9	UV Spectrometer (NRL)		Scans 1175-1 in 25 and 3	
10	Thomson X-Ray Polarimeter (NF	RL)	10-22 keV, 2	22-60 keV
11	Bragg X-Ray Polarimeter (NRL))	2.8	BÅ
12	Ionization Chamber (NRL)		0.5-	3Å
13	Ionization Chamber (NRL)		1-3	20Å
14, 23	Solar, Anti-Solar Protons (A	c)	≥2 MeV, ≥10 ≥4.5 MeV al	
15	Solar Wind (MIT)		velocity of	mperature, bulk solar wind ions temperature of electrons.
16	Stellar/Auroral X-Rays (NRL)		1-1	8Å
17	Protons (AC)			
		Protons (MeV) 5-20 10-25 20-40	Alphas (MeV) 20-80 40-100 80-140	Directional Protons (keV) 20-36 36-74 74-150
		50-90 100-160	200-240 400-460	150-280 280-500 ≥500

Table 1. Continued.

xperiment Number	Experiment Name	Energy or Wavelength Intervals Various lines in 200-1400Å band	
18, 19	Geocoronal-Extraterrestrial EUV (NRL)		
20	Proton-Alpha Telescope (AFCRL)	Protons (MeV) (MeV) (MeV) (MeV) (MeV) 1.24-1.35 22-1.35-1.56 32-1.56-2.01 52-1.56-2.01 52-1.56-2.01 52-1.56-2.01 52-1.56-2.01 52-1.50-1.50 8.0-1.3.0 13-25 25-50 50-100	V) 32 52
21	Low Energy Proton Spectrometer (AFCRL)	Protons (MeV) .097137 .137169 .169228 .228320 .320445 .445617 .617854 .854-1.28 1.28-1.77 1.77-2.74 2.74-6.02	
22	Solar Flare Electrons (AC/AFCRL)	Electrons (keV) 11-30 30-60 60-94 94-140 140-220 220-405 405-610 610-830 830-1060 1060-1280 1280-1510	



The US-IMS ground magnetometer networks will consist of 25 stations equipped with fluxgate magnetometers, digital recording, and interface units to transmit data to SEL in real-time by Satellite Transmission Relay (STR), using the NASA/NOAA SMS/GOES geostationary weather satellite data link. The STR stations will be located in three high-latitude chains and one midlatitude chain. The high-latitude chains are:

- 1) The Alaskan Chain along the 260° E magnetic meridian through College, Alaska, extending to the vicinity of the invariant pole.
- 2) The Fort Churchill chain along the 326° E magnetic meridian through Fort Churchill, Manitoba.
- 3) The east-west chain along the auroral oval linking the above two chains.

Figure 29 shows the STR stations that are to be included in the high latitude chains along with other nearby stations collecting magnetometer data during IMS. It is expected that non-STR stations will deliver data directly to EDS for archiving and dissemination.

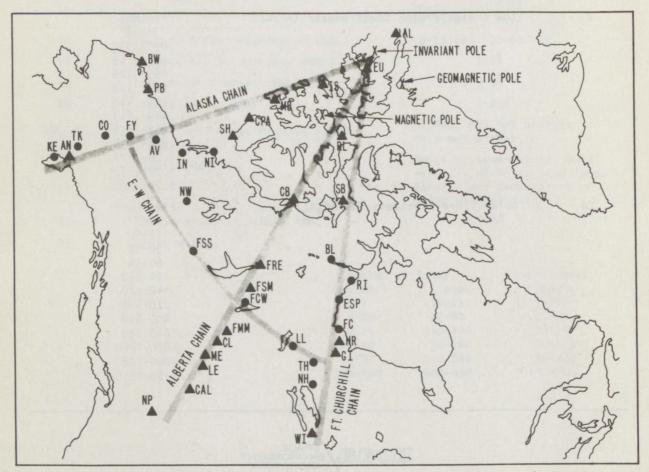


Figure 29. North American high-latitude magnetometer network for IMS.

• = Satellite relay, IMS network; ▲ = On-site recording.

Figure 30 shows the midlatitude STR magnetometer stations and their spatial relation to the high latitude chains.

The IMS magnetometer data files in the SELDADS system will be maintained at original (10 sec) resolution for 4 days and at 1-min resolution for 32 days. Periodically, the magnetometer data files will be dumped to magnetic tapes, microfilmed, and delivered to EDS for archiving and dissemination.

The user will be able to access the IMS magnetometer data files either by use of onsite terminals or by remote telephone linkage. For onsite users, output will be available in a variety of forms; however, the primary output mode will be a number of standard plots on CRT display. Upon request, the system will display for the user any of a variety of plots, as listed below. A microfilm recording system will be coupled to the CRT for permanent graphic recording. The standard plot outputs will be:

a) Individual magnetograms. For any given station in the US-IMS array, the user will be able to plot three-component magnetograms in any of a number of suitable coordinate systems. Scaling and frame interval will be flexible. Nominally, 1-, 6-, and 24-hour frames are planned. A sample plot is shown in Figure 31.

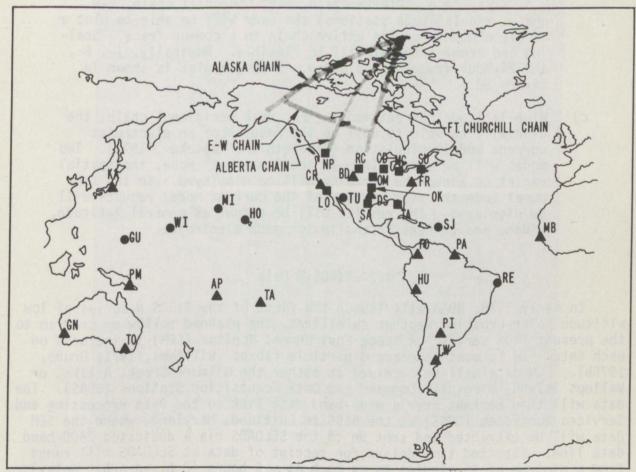


Figure 30. Mid-latitude IMS network.

• = Satellite relay, IMS network; \blacktriangle = On-site recording.

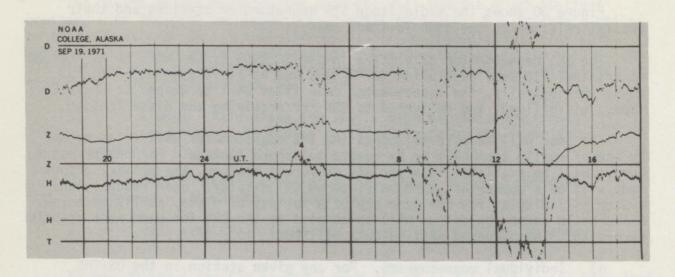


Figure 31. Sample three-component magnetogram.

- b) "Stacked" magnetograms. For any magnetometer chain in the U.S. array (e.g., Alaska chain, Fort Churchill chain, E-W chain, mid-latitude stations) the user will be able to plot a single element for the entire chain in a common frame. Scaling and frame interval will be flexible. Nominally, 1-, 6-, and 24-hour frames are planned. A sample plot is shown in Figure 32.
- c) High-latitude current model. For each meridional chain, the user will be able to call up the results of an electrojet current model calculation (Kisabeth and Rostoker, 1971). Two modes will be available. In the "snapshot" mode, the spatial variation along the meridian will be displayed. In the temporal mode the time history of the current model results will be displayed. The results will be output as central latitude, width, and current intensity for each electrojet.

4.3 TIROS N Data

In early 1978, NOAA will launch the first of the TIROS N series of low altitude polar orbiting weather satellites, the planned follow-on program to the present ITOS series. A Space Environment Monitor (SEM) is included on each satellite to measure charged particle fluxes (Williams, 1971; Grubb, 1975b). SEM data will be received at either the Gilmore Creek, Alaska, or Wallops Island, Virginia, Command and Data Acquisition Stations (CDAS). The data will then be sent over a wide-band data link to the Data Processing and Services Subsystem (DPSS) at the NESS in Suitland, Maryland, where the SEM data will be extracted and sent on to the SELDADS via a dedicated 2400-baud data line. Expected time delays for receipt of data at SELDADS will range from a minimum of 15 minutes to as much as \sim 5 hours (3 blind-orbit delay). Present NOAA plans call for a simultaneous two-satellite operation.

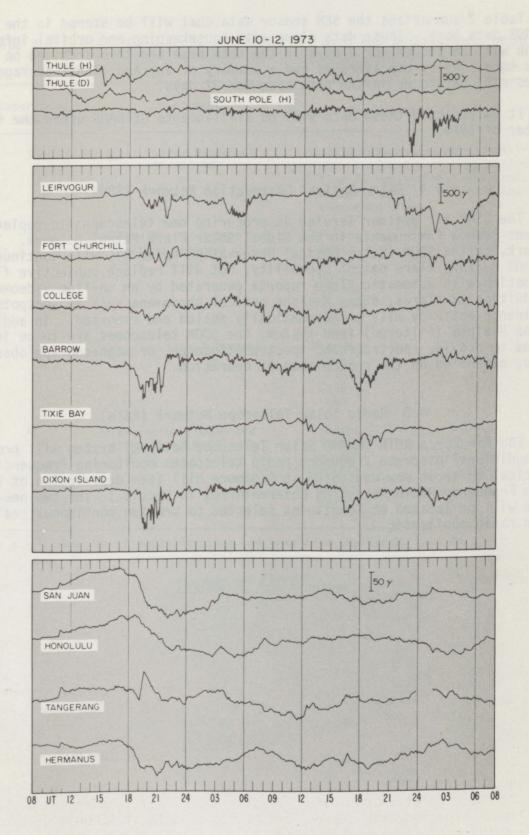


Figure 32. Sample "stacked" magnetogram for chain of magnetometer stations.

Table 2 summarizes the SEM sensor data that will be stored in the SELDADS data base. These data along with housekeeping and orbital information will be stored for 4 days in the data base and then archived on magnetic tape. Polar cap averages and a summary of any additional averaged data values will be stored in the data base for 32 days.

It is expected these data will be available to SELDADS users the first quarter of 1978.

4.4 Solar Optical Observation Network (SOON)

The USAF Air Weather Service is procuring new telescopes to replace the present Razdow instruments in the Global Solar Flare Patrol Network. The new network, called SOON (Solar Optical Observation Network), will continue the present H-alpha flare patrol capability, but will replace subjective flare estimation with automatic flare reports generated by an on-line videometer. In addition to flares, other H-alpha optical phenomena such as sunspots and prominence activity will be automatically scaled and reported. In addition to the H-alpha (filtered) feed system, the SOON telescopes are to be instrumented to provide spectrograph, spectrohelioscope, or magnetograph observations, depending on the chosen mode of operation.

4.5 Radio Solar Telescope Network (RSTN)

The Air Force RSTN (Radio Solar Telescope Network) system will provide two additional discrete frequency radio telescopes monitoring frequencies identical to those now monitored at Sagamore Hill (see description of Discrete Frequency Radio Reporting Observatories in Sec. 5.) The two new instruments will be located at longitudes selected to provide continuous real-time solar radio monitoring.

Table 2. TIROS N Data To Be Incorporated into the SELDADS Data Base (Low-Altitude Polar Orbit, Sun-Synchronous)

Experiment Number	Experiment Name Total Energy Detector $\phi *=0^\circ$ and 30°	O.3-20 keV; total energy, maximum flux, and energy of maximum flux in the interval measured. Spectral scan obtained at low time resolution.		
1				
2	Medium Energy Proton and Electron Detector ϕ = 0° and 90°	Protons (keV) 30-80 80-250 250-800 800-2500 ≥2500	Electrons (keV) ≥30 ≥100 ≥300	
3	Omnidirectional Protons	Protons (MeV) ≥16 ≥36 ≥80		
4	High Energy Proton and Alpha Detector $\phi = 0^{\circ}$	Protons (MeV) 370-480 480-640 640-850 ≥850	Alphas (MeV) 640-850 ≥850	

 $^{* \}phi = 0$ along Earth-satellite line and away from the Earth.



5. SUMMARY OF DATA AVAILABLE AND TO BE AVAILABLE

The following tables and figures provide quick reference to available and soon-to-be available SELDADS data. Note that planned data comments, energy ranges, and frequency ranges are subject to change.

Figure 33 is a schematic showing dedicated real-time satellite orbits and thus the corresponding spatial coverage for real-time data collection. Table 3 summarizes the data received from these satellites, their tracking, and their orbits. Figure 33 and Table 3 list only dedicated real-time satellite programs. Other satellite programs (notably the ATS, Pioneer, VELA, and USSR/METEOR programs) do on occasion submit data to SELDADS on a near real-time basis when tracking, data, and resources are available.

Table 4 summarizes data received from ground based observatories and stations located throughout the world.

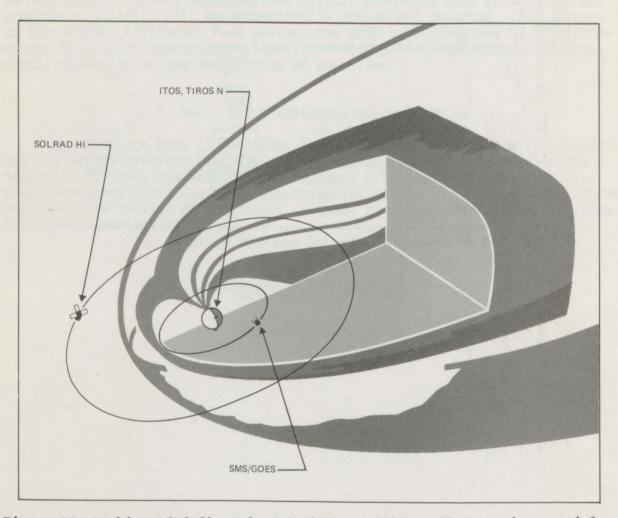


Figure 33. Orbits of dedicated real-time satellites, illustrating spatial coverage obtained.

Table 3. SELDADS Dedicated Real-Time Satellite Data Inputs

	Existing				
			Planned		
	to do A liner an	cent line l'opera	1978	1976	
Satellites	SMS/GOES	ITOS	TIROS N (NASA/NOAA)	SOLRAD HI (USN)	
Data Reception	2 satellites simultaneously	1 satellite of the series	2 satellites simultaneously	1 of 2 satellites	
Orbit	Geostationary	Low-altitude polar Sun-synchronous	Low-altitude polar Sun-synchronous	Circular, ∿ 20 Earth radii	
X-Rays	0.5-4Å 1-8Å			3-150 keV (6 intervals) 0.5-1350Å (8 intervals)	
Solar Wind	Designation	7 Sunsport clos	and Javeston Const	Density, Velocity, Temperature	
Protons	0.8-500 MeV (7 intervals)	≥10 MeV ≥30 MeV ≥60 MeV	0.3-2500 KeV (6 intervals) ≥10 MeV ≥30 MeV ≥60 MeV 370-≥805 MeV (4 intervals)	20 keV-160 MeV (>16 intervals)	
Alpha Particles	4-392 MeV (6 intervals)	Mid (<u>202</u>) maleke kal Jevera I parke etar	640- >850 MeV (2 intervals)	20-460 MeV (5 intervals)	
Electrons	≥2 MeV	≥140 keV	0.3-20 keV ≥ 30 keV ≥100 keV ≥140 keV ≥300 KeV	11-1510 keV (11.intervals)	
Magnetic Field	3 components			and a selection	

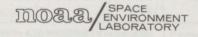


Table 4. SELDADS Real-Time Ground Station Data Inputs.

Parameters	tations	Comments
E	existing	
Total Electron Content	8	Obtained in conjunction with ATS-3, ATS-6 SMS-1, 2, GOES-1, and ISF-2 satellites.
Hα Solar Patrol	7	In addition, six IUWDS observatories report on non-dedicated basis. Event description and begin-, maximum-, and end-times.
Solar Radio Patrol Discrete Frequency	6	Six additional observatories report, on non-dedicated basis, background flux, event description and begin-, maximum-, and end-times.
Swept Frequency	4	Event description and begin- and end-time
Coronal Intensities	3	Intensity as function of heliographic latitude.
White Light Sunspot Observations	5 7	Sunspot classifications.
Solar Calcium Plage	2	Plage areas and intensities.
Auroral Optical	2	Event descriptions
Auroral Radar	1	Event descriptions
Ionosonde Observations	36	Characteristic propagation frequencies and event descriptions.
Sudden Ionospheric Disturbances	13	Event begin-, maximum-, and end-times. Event descriptions.
High Frequency Radio Path Monito	or 1	Signal strength deviation from quiet day value.
Riometer Observations	7	Absorption (dB) and solar zenith angle.
Magnetometer Observations	19	Three-hourly and daily indices; geomagnetic disturbance descriptions.
	Planned	
Magnetometer Observations (NSF/NOAA)	25	3 components every 10 sec; magnetograms available on 1-, 6-, 24-hour and monthly basis.
Solar Optical Observing Network (USAF)	5	Replacement of $H\alpha$ Solar Patrol equipment with research quality telescopes. Event descriptions and begin-, maximum-, and end-times.
Radio Solar Telescope Network (USAF)	3	Supplement existing discrete and swept frequency solar radio patrol. Background flux, event description and begin-, maximum-, and end-times.



6. ACCESS TO SELDADS

Direct Access to Data Base

Direct teletype access to the SELDADS data base is available through either commercial or FTS telephone lines. Necessary equipment is a standard coupler which operates in the originate mode and is compatible with Bell 103 data sets. The NOVA user access lines operate at 110 Baud (10 characters per second in ASCII code). Since the NOVAs presently have the capability of handling only two remote users at one time, we request that interested users contact Mr. C. E. Hornback (see Section 7) to obtain the SELDADS phone number and approriate direct-access information.

Use of the SELDADS data retrieval and display programs is straightforward. Necessary instructions and program operation information are forwarded to SELDADS users following registration (through Mr. Hornback). Generally all that is required is to log on the system, give an account number, type program name desired, list parameters desired, receive data and/or display, and log off the system.

Indirect Access to Data Base

In lieu of direct access to the data base, some users may wish to use other methods of obtaining real-time data. Descriptions of several alternatives follow. (Appropriate phone numbers and addresses are listed in Section 7.)

- 1) The user may call the duty forecaster at SESC and receive a verbal report. Several parameters from the data base are displayed continuously in real-time at SESC. At present they include:
 - 1 8A X-ray flux from SMS/GOES
 - 6 10 and 18 39 MeV proton fluxes from SMS/GOES

Optical H-alpha images (during local daylight hours)

- 1425, 2695, and 4995 MHz solar radio flux (during local daylight hours)
- 8 80 MHz radio spectroheliograph (from University of Colorado)

H and D components of the magnetic field at Boulder Three components of the magnetic field at SMS/GOES.

Any data in the data base may be called up by the duty forecaster. There will be some delay while displays are reconfigured and the computer accessed.

2) Descriptive summaries of major events are included in the forecasts and are issued at 2200 UT each day (primary report) and 0600 UT and 1500 UT each day (secondary reports). These are available by teletype with the user responsible for communications cost.

- 3) Weekly forecasts and more comprehensive tabulated event summaries along with plots of selected X-ray, particle, and magnetic events from SMS/GOES are available in the free weekly publication "Preliminary Report and Forecast of Solar Geophysical Data" available upon request from SESC.
- 4) For specific events or time periods, users may request CRT graphs (such as SMS/GOES data) or printed listings, to be transmitted by telecopier over the telephone. This option requires a telecopy receiver compatible with SESC's Xerox 4001 equipment.
- 5) It may be possible to arrange to receive hard copies of CRT plots or printed listings on an intermittent or regular basis by mail. This is not a standard practice at the present time, but users may discuss the possibilities with the SESC forecast representative listed in Section 7.

7. KEY PERSONNEL

The following personnel will aid interested users in all aspects of SELDADS, from obtaining access to the system, to obtaining SESC support for their real-time needs.

The address for all Key Personnel is:

NOAA/ERL/SEL - R43 325 South Broadway Boulder, Colo. 80302

The SEL commercial phone number is 303-499-1000. Appropriate extensions are indicated below

	Phone		
Contact	Commercial	FTS	Contact for:
Mr. C. E. Hornback Head, Real-time Data Systems Program Area	X3780	323-3780	System information and plans; SELDADS phone number and to register as a SELDADS user; user hardware interface;
Mr. J. D. Schroeder	X3780	323-3780	Details and use of SELDADS data handling and display programs; data base contents, storage formats, and usage; user software interface;
Mr. G. Heckman (Acting Head, SESC)	X3204	323-3204	Arranging for support of real- time needs; arranging for spe- cialized experiment campaign and system support and ser- vices; consideration of re- ceipt of hard copy display and print out; general and spec- ific requests for SESC support and service.
Duty Forecaster	X3171	323-3171	Indirect access (verbal reports, descriptive summaries, special event graphics, etc); support for real-time needs; specialized experiment campaign or system support and service; receipt of SESC weekly summary and forecast report.

8. ACKNOWLEDGMENTS

It is a pleasure to acknowledge the following for their invaluable contributions: J. N. Barfield, G. Heckman, C. Hornback, and D. Schroeder for assembling the data-base information for this report, and T. Gray and the Analysis Group of SEL for the development of the SELDADS software. The SEL real-time system, which has made possible the present SELDADS system, has been maintained for the past 5 years by C. Hornback, R. Grubb, A. G. Jean, and the staffs of the SEL Real-Time Data Systems Program Area and Space Environment Services Center, the USAF/AWS, and the NOAA/NESS.

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The mission of the Environmental Research Laboratories is to study the oceans, inland waters, the lower and upper atmosphere, the space environment, and the Earth, in search of the understanding needed to provide more useful services in improving man's prospects for survival as influenced by the physical environment. The following laboratories contribute to this mission.

Marine EcoSystems Analysis Program Office.

estuarine, coastal, and near-shore marine processes (Seattle, Washington).

MESA

GLERL Great Lakes Environmental Research

MESA	Plans and coordinates regional programs of basic and applied research directed toward the solution of environmental problems which involve the functioning, health and restoration of marine ecosystems.	CLIL	Laboratory. Research areas include: physical, chemical, and biological limnology; lake-air interactions, lake hydrology, lake level forecasting, and lake ice studies (Ann Arbor, Michigan).
OCSEA	Outer Continental Shelf Environmental Assessment Program Office. Plans and directs assessments of the primary environmental impact of energy development along broad areas of the outer continental shelf of the United States; coordinates related research activities of federal, state and private	GFDL	Geophysical Fluid Dynamics Laboratory. Research areas include: dynamics and physics of geophysical fluid systems; development of a theoretical basis, through mathematical modeling and computer simulation, for the behavior and properties of the atmosphere and the oceans (Princeton, New Jersey).
W/M	institutions. Weather Modification Program Office. Plans and directs ERL weather modification research for precipitation enhancement and severe storms mitigation; operates ERL's research aircraft.	APCL	Atmospheric Physics and Chemistry Laboratory. Research areas include: processes of cloud and precipitation physics; chemical composition and nucleating substances in the lower atmosphere; laboratory and field experiments toward developing feasible methods of weather modification.
NHEML	Meteorology Laboratory. Develops techniques for more effective understanding and forecasting of tropical weather. Research areas include: hurricanes and tropical cumulus systems; experimental methods for their	NSSL	National Severe Storms Laboratory. Research is directed toward improved methods of predicting and detecting tornadoes, squall lines, thunderstorms, and other severe local convective phenomena (Norman, Oklahoma).
RFC	and related instrumentation for environmental research programs. Maintains liaison with user and provides required operations or	WPL	Wave Propagation Laboratory. Research areas include: theoretical research on radio waves, optical waves, and acoustic gravity waves; experimental research and development on new forms of remote sensing.
measurement tools, lo	measurement tools, logged data, and related information for airborne or selected surface research programs.	ARL	Air Resources Laboratories. Research areas include: diffusion, transport, and dissipation of atmospheric contaminants; development of
(CIRES)	participation in the Cooperative Institute for Research in Environmental Sciences (CIRES), a joint activity with the University of Colorado. Conducts cooperative research studies of a theoretical nature on environmental problems. AOML Atlantic Oceanographic and Meteorological Laboratories. Research areas include: geology and geophysics of ocean basins and borders, oceanic processes, sea-air interactions and remote sensing of ocean processes and characteristics (Miami, Florida).		methods for prediction and control of atmospheric pollution; geophysical monitoring for climatic change (Silver Spring, Maryland).
		AL	Aeronomy Laboratory. Research areas include: theoretical, laboratory, rocket, and satellite studies of the physical and chemical processes
AOML			controlling the ionosphere and exosphere of the Earth and other planets, and of the dynamics of their interactions with high-altitude meteorology.
		SEL	Space Environment Laboratory. Research areas include: solar-terrestial physics, service
PMEL	Pacific Marine Environmental Laboratory. Research areas include: environmental processes with emphasis on monitoring and		and technique development in the areas of environmental monitoring and forecasting.
processes with em predicting the effe	predicting the effects of man's activities on		

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION