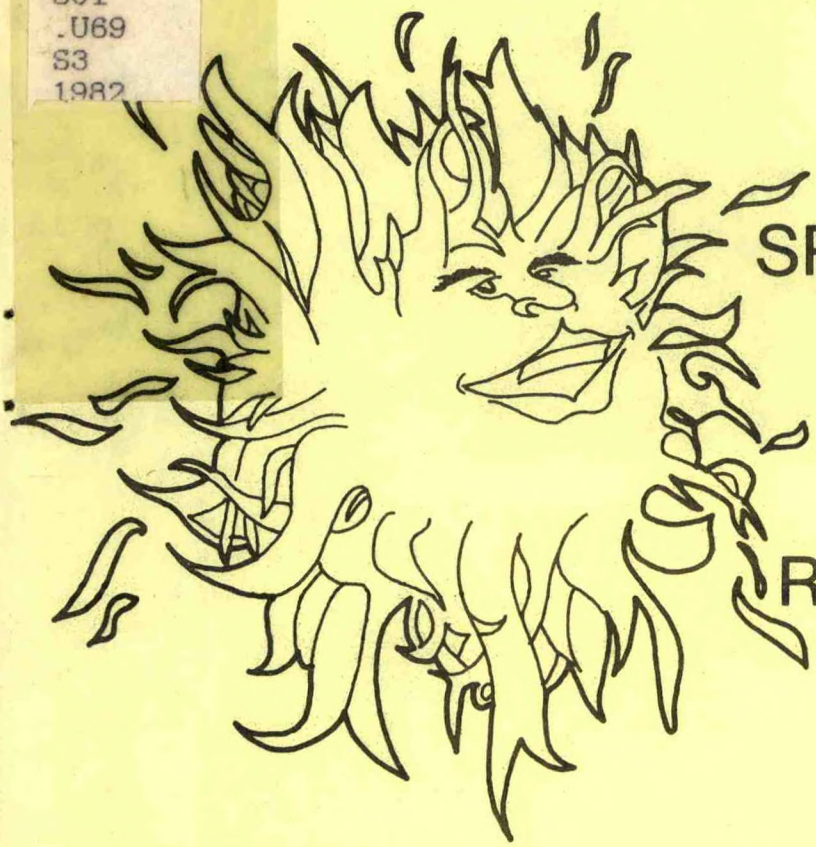

SPACE ENVIRONMENT LABORATORY

Environmental Research Laboratories

ANNUAL REPORT 1982

Dr. Harold Leinbach
Acting Director

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INTRODUCTION

The Space Environment Laboratory provides real-time monitoring and forecasting services, develops techniques necessary for forecasting of solar-terrestrial disturbances and their subsequent effects on the near-Earth environment and conducts research in solar-terrestrial physics in support of the service mission.

The focal point for the nation's present solar-terrestrial services is in the Space Environment Laboratory at Boulder where, with the cooperation of the Air Weather Service, the monitoring and forecasting services are carried out to meet a wide variety of civilian, military, commercial and federal agency requirements. The scope of the services ranges from the real-time collection of solar-terrestrial data to issuance of forecasts, alerts and warnings of adverse solar-terrestrial conditions, to the archiving and processing of solar-terrestrial data from all over the world, to the development of an understanding of the behavior of the solar-terrestrial environment to yield significant service improvements.

Fiscal year 1982 was marked by significant changes within SEL: a change in laboratory directorship was made; a reduction in funds for SEL was proposed in the President's FY 1983 budget; Ionospheric Research was terminated; the Solar UV Research was transferred from SEL to the Geophysical Monitoring for Climatic Change Laboratory in the Air Resources Laboratories; and the laboratory's research and development were being redirected at the end of the year.

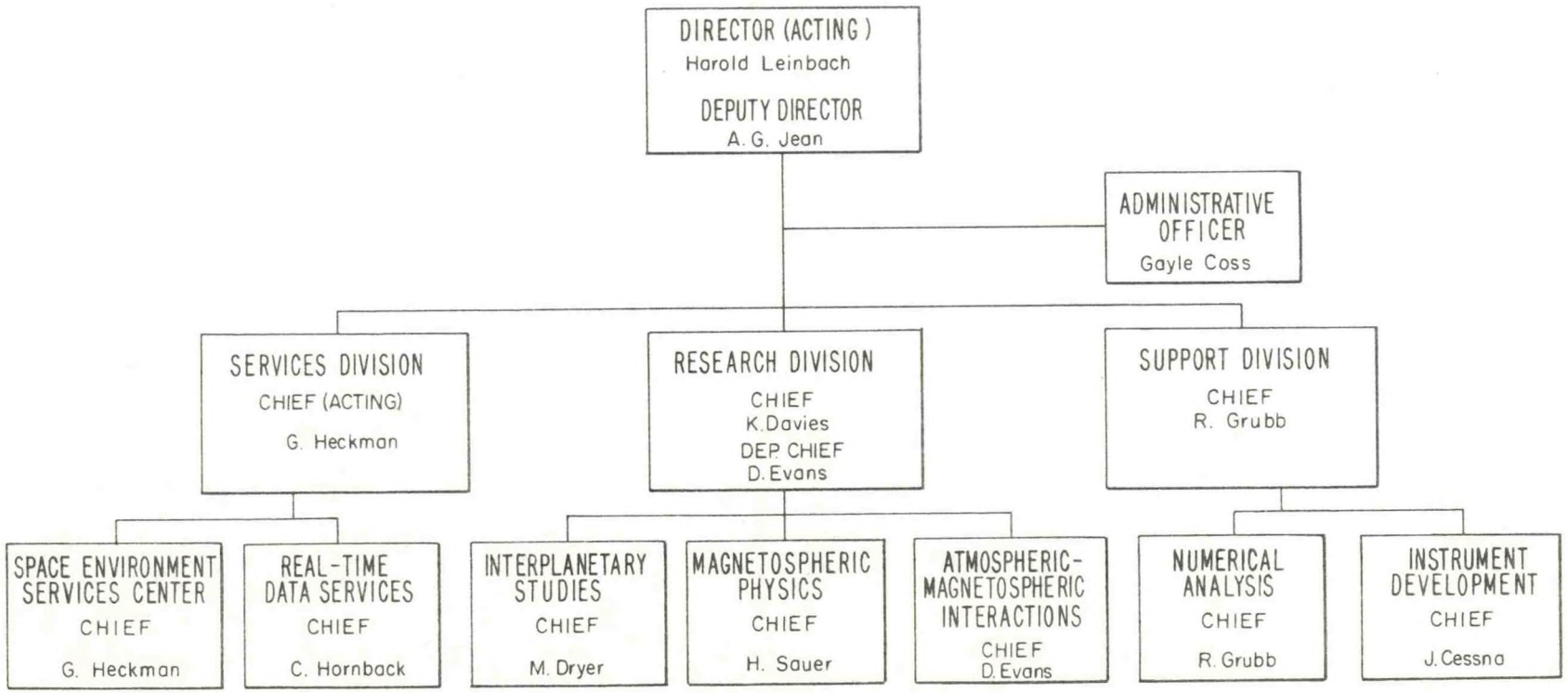
The potential reduction of budget for FY 1983 resulted in many studies of the future of the Laboratory, including a reassessment of Laboratory priorities. It was concluded that the first priority for the Laboratory was to continue to provide the highest-quality, space environment services to other government agencies, and the nation at large. Careful analysis showed that the proposed reduction in budget would not permit the Laboratory to continue to improve its space environment services into the future. In particular, the proposed NOAA funds would not be able to provide continued research in support of services, nor the procurement of the next generation computer-based data acquisition and display system (SELDADS II), so vital to assuring a continuing real-time data base.

SEL has submitted a plan for directed research in FY 1983, which has been given preliminary approval by ERL. This plan directs all SEL research towards supporting and improving space environment services. The plan calls for identifying new techniques and testing their application towards improved forecasts and warnings of significant solar-terrestrial disturbances. The plan also includes a strong effort for scientific support of the real-time data systems, particularly the NOAA/TIROS and GOES satellite space environment monitoring systems. The implementation of this plan is contingent on the final budget for SEL in FY 1983. For this reason, "Future Plans" for the Research Division are omitted from this report.

SPACE ENVIRONMENT LABORATORY

ORGANIZATIONAL CHART

(End of Year 9/30/82)



Realizing the potential impact of a reduction on other agencies, such as NASA, DOD, DOT, etc., the Interagency Subcommittee on Space Environment Forecasting, of the Office of the Federal Coordinator for Meteorological Services and Supporting Research was reconvened to study the situation and recommend possible courses of action to NOAA and the other agencies. As of September 30, 1982, there was no final resolution of the FY 1983 budget, and the Laboratory was proceeding into FY 1983 on a continuing resolution.

ORGANIZATION

The organization arrangement through FY 1982 is shown in the accompanying diagram. SEL has three Divisions:

- Research Division:

  Consisting of Solar-Interplanetary Physics, Magnetospheric Physics, and Atmospheric-Magnetospheric Interactions.

- Support Division:

  Consisting of Numerical Analysis and Instrument Development Branches.

- Services Division:

  Consisting of the Space Environment Services Center and the Real-Time Data Services.

RESEARCH DIVISION

K. Davies

The aim of the Research Division is to conduct research into phenomena that affect the solar-terrestrial environment. This involves understanding emission of radiation from the Sun, the propagation of energy through the solar wind, the interactions between the solar wind and the Earth's magnetosphere, the ionosphere, and the upper neutral atmosphere.

During the year the Ionospheric Research was terminated in the Laboratory and arrangements were made for the transfer of the digital ionosondes to other research laboratories where the ionospheric investigation will be continued. The Solar UV Research in SEL was transferred at the end of the year to the Air Resources Laboratories in ERL.

INTERPLANETARY PHYSICS

M. Dryer

The principal activity is the development of time-dependent, multi-dimensional, models of the solar wind and interplanetary magnetic field. The near-term goal is to use these models with available real-time solar data as input and to make verifiable predictions of geomagnetic occurrence, severity and duration.

ACCOMPLISHMENTS - FY 1982

SOLAR WIND PHYSICS RESEARCH

As part of an extension of the MHD model to incorporate additional plasma physics, higher moments equations were formulated on the effects of nonzero relative flow velocities and skewing of velocity distribution functions of various species (protons, electrons, helium, etc.) in the solar wind. These effects are believed to be important, in the presence of strong temporal and spatial gradients in the interplanetary medium. A paper was also prepared that explicitly provides equations, based on the closure of the moment equations, for the transport properties (viscosity and thermal conduction) of the solar wind.

The non-planar, two-dimensional, MHD solar wind model was successfully put into production on the NOAA CYBER 750 computer. Additional work was done to provide the full description of solar-flare-generated interplanetary shocks under simulated conditions of variable flare power output. It is now possible to predict the solar wind energy flux at Earth's location, given a reasonable set of near-sun observations.

The 2-D MHD model of coronal transients was used, together with observational X-ray inputs provided for the SMY/STIP event of 1980 June 29 (1821 UT) by NASA's Solar Maximum Mission, to simulate major features of the ensuing coronal transient observations. Nearly the full gamut of SMM instruments (HXIS, XRP, UVSP) were used to assess the flare pulse's temperature, density, and velocity for our mass ejection pulse. The model's temporal output was compared with Fort Davis' Type II sweep frequency

record and the Mauna Loa K-coronameter's white light observations. The comparison provided valuable insight for future flare ejection simulations that ultimately must be coupled with our interplanetary MHD model.

Solar, Spacecraft, and interplanetary scintillation data were accumulated for the very active period of 1979 August when solar activity was characterized by a well-observed series of solar flares and coronal holes. These data will be used as a case history for testing the capabilities of the MHD models to predict solar wind and geomagnetic variations.

Fundamental work was also done to elucidate the hydromagnetic forces which act on a flux tube immersed in the solar atmosphere. The new theory developed will shed some light on the mechanism for filament disappearance, which is a class of important occurrence in the experience of SEL/SESC and is empirically used to alert the possibility of geomagnetic disturbances.

A new method of solving MHD equations (using Shrodinger equation formalism) was applied to models of sunspots, prominences, coronal transients, coronal loops, and the global structure of magnetic fields in the solar system. The most important physical results appear as relations between the magnetic structure and thermodynamical parameters such as temperature, gas pressure and density. For transients, self-similar, time-dependent MHD solutions are obtained.

The global steady coronal structure was successfully modeled with a new numerical simulation allowing a considerably more flexible survey of the parametric dependences than ever before. This work shows the way to incorporate a realistic description of energy transfer in the corona. Utilizing this analysis, the model was then used to study the damping effects of energy transfer on coronal motions.

The laboratory has arranged with the Stanford Solar Observatory to transmit raw solar magnetic field data by telephone daily and to plot these data in formats of potential use for real-time operations. For example, false color plots have been made showing the global distribution of magnetic fields on the sun.

About 200 ISEE-3 Data Pool tapes were compressed onto 7 archive tapes in order to make them available for verification of model forecasts ("hindcasts") of solar wind conditions at the earth. These tapes will also be used in comparative studies of sudden commencement occurrence versus shock observations in front of the earth, and to analyze the most useful energy input parameter derived from the solar wind for the purposes of SESC Users.

A program in connection with the proposed X-ray Imager instrument has been developed to construct synthetic images using the diode array point response function that has been measured in the laboratory. This will permit an analysis of observational limits for coronal holes and other features during flares and erupting filaments.

SOLAR SOFT X-RAY AND UV RADIATION RESEARCH S. Suess

An analysis of nearly five years (1977-1981) of soft x-ray data indicates that daily background x-ray flux is an excellent index for intermediate and long-term solar variability (i.e., 3-6 months and 11 years).

Work to corroborate the UV enhancement observed by Nimbus-7 in late 1979 has centered on acquisition and processing of ground-based, UV measurements since the study began in July 1982. To date, data from the South Pole (ARL-GMCC measurements at Amundsen-Scott Station), and from five New York sites (New York Dept. of Environmental Conservation sites at Poughkeepsie, Whiteface Mountain, Rochester, Scottsville, Eisenhower Park, Schenectady, and Mamoronek) have been obtained for the period of interest, and are in the process of being analyzed.

A model of the solar spectral irradiance, which used ground-based observations of the CaII K chromospheric emission, has been developed for the ultraviolet wavelengths between 140 and 200 nm and for the Lyman alpha emission at 121.6 nm. In this model, the active regions which are bright in CaII K emission (plage) are assumed to be also regions of enhanced ultraviolet emission. Recently, the model has been extended to the middle ultraviolet wavelengths between 200 and 300 nm. The SBUV experiment on the Nimbus-7 satellite has observed a definite 27-day variability at these wavelengths and the model has been used to predict, from these short-term data, the variability over the 11-year solar cycle.

MAGNETOSPHERIC PHYSICS

H. Sauer

Studies in magnetospheric physics include experimental and theoretical investigations of the geomagnetic field and the several particle populations within the magnetosphere and the dynamics of the complex electromagnetic processes by which the particles interact. This involves the analyses of satellite data sets obtained both from research and operational satellites.

ACCOMPLISHMENTS - FY 1982

Multi-satellite studies of magnetospheric processes continue with initial efforts directed toward an exploitation of particle data from the NOAA/TIROS series of low-altitude, polar-orbiting operational satellites. Preliminary studies have shown that polar cap precipitation events are closely associated with the arrival near the Earth of interplanetary shocks propagated from the sun. These shocks are responsible for producing geomagnetic disturbances at the Earth. This association of polar cap precipitation and consequent geomagnetic storm raises an exciting potential for monitoring and possibly forecasting of impending geomagnetic disturbance from the TIROS platform. This potential will be evaluated. Further, while the present solar cycle has not produced major Solar Cosmic Ray events, there are a sufficient number of events that have occurred during the last several years of data acquisition that initial studies of the latitude dependence of geomagnetic cutoffs have been able to be made. The magnetic field of the Earth serves to shield the lower latitudes of the Earth and its atmosphere from the total impact of energetic particle radiation produced sporadically in solar active regions. The importance of determining cosmic ray cutoffs rests in their defining the latitude range and extent of radiation hazard to satellite instrumentation and to manned space activity during larger solar cosmic ray events.

Effort has also been initiated toward better organizing and addressing the issue of quality control and verification of the operational data provided the Space Environment Services Center of this Laboratory. A task group has been formed with the responsibility to systematize and document procedures to enhance and certify the quality of the GOES satellite particle, X-ray and magnetic field data that comprise an important part of the SESC evaluative data base and output.

Theoretical supporting research on magnetospheric dynamics had continued to be aggresively pursued. One of the principal questions addressed is that of energy transfer from the solar wind into the magnetospheric system. Through imaginative modeling, laboratory scientists have determined for the first time a process by which solar wind energy is electrodynamically transferred to particle populations in the interior of the magnetosphere. This process appears to extract about 2% to 10% of the energy of the solar wind impinging on the magnetosphere which is of the order of magnitude of the energy required to maintain the magnetospheric system, and may therefore represent the principal means of energy transport into the system. The resulting energized particle population may then also form the primary source of the ring current, which is responsible for global geomagnetic variability.

Other studies have concerned themselves with defining the morphology and composition of resident magnetospheric populations, to help establish a baseline or reference magnetosphere in order to provide a context or reference within which to better recognize disturbances and departures from "normalcy" and understand the geophysical consequences of these departures.

The Laboratory is presently undergoing a program of re-evaluation and re-direction through which several significant changes have been made. Among them are that the Laboratory will not be further involved with the NASA-sponsored OPEN (Origin of Plasmas in the Earth's Neighborhood) multi-satellite program, and the branch's involvement has been transferred out of NOAA. Consistent with that same de-emphasis of scientific satellite research, there has been a concommitment reduction in the research associated with the highly successful ISEE (International Sun-Earth Explorer) program. Previous reports had elaborated some of the substantial scientific achievements resulting from that program. Two years of reduced, high-quality ISEE magnetospheric particle data will remain the the Laboratory as a companion resource to current acquired operational data.

ATMOSPHERIC-IONOSPHERIC-MAGNETOSPHERIC INTERACTIONS

D. Evans

The objectives of the research in the Atmospheric-Ionospheric-Magnetospheric Interactions area are to understand the transfer of energy (both in the form of electrical and mechanical energy) from the Earth's magnetosphere into the upper atmosphere and to understand and characterize the various consequences that may arise in the Earth's ionosphere, atmosphere, and sea level environment because of this energy input.

ACCOMPLISHMENTS - FY 1982

A major effort during 1982 continued to be the analysis of the total energy flux observations made by the Space Environment Monitor (SEM) flown onboard the TIROS/NOAA series of polar-orbiting spacecraft. The Total Energy Detector (TED) on the SEM monitors on a regular basis the energy flux carried into the polar atmosphere by incident auroral particles (both electrons and protons) over the energy range up to 20 keV.

The objectives for performing these measurements were two-fold. First, measurements of the magnitude, location, and extent of the auroral particle energy influxes provide an excellent guide to the general level of geophysical activity which is of immediate use to the Space Environment Services Center (SESC). These measurements may also be used as inputs to calculations of parameters, such as atmospheric densities, which may be of direct use to the customers of SESC's services. Secondly, because the energy input to the atmosphere above 90 km by auroral particles is a major source of energy to that region, and, thus, dominates the dynamics of the polar upper atmosphere, it is believed that long-term, continuous measurements of this parameter would be of great value in the study of the response of the upper atmosphere to this energy input.

At the present time, some six years of energy flux measurements obtained from three satellites have been assembled into a condensed and easily accessible data base. This data base has been used both in statistical studies of the pattern of the auroral energy input and in the development of techniques and algorithms for use in SESC.

Using this data base, maps of the local energy flux into the atmosphere as a function of magnetic latitude and magnetic local time have been prepared for four levels of magnetic activity (quiet, unsettled, active, and storm conditions). These maps, each of which contain data from as many as 15,000 individual satellite passes, confirm and quantify the increasing magnitudes and physical extent of the energy input as well as the systematic equatorward shift of the boundary of the energy input with increasing magnetic activity. The TIROS/NOAA satellites sample the auroral regions differently during the course of the universal day so that the energy observations display a daily variation even during periods of a constant level of magnetic activity. The existence of these statistical maps, which cover virtually the entire polar region, have allowed the determination of empirical normalizing factors which

can be used to remove (on a statistical basis) the universal time and inter-hermispherical dependences in the total energy flux observations.

In particular, this technique removes these dependences from the calculation of the estimated hemispherical power input to the atmosphere which has been proposed as a polar activity index to be calculated by SESC as the observational data arrives in near real time. Preliminary work by SESC personnel has shown that the hemispherical power input index correlates extremely well on a daily basis with the AE index which has hitherto been accepted as the best available polar activity index. If the correlation is equally good on a short time scale, it will be possible for SESC to provide an AE-like activity index in near real-time rather than the two-three year delay that now exists in the compilation of that index.

The data base was also used to develop an algorithm which identified the location of the equatorward boundary of auroral precipitation and, through a look-up table, inferred a Q-activity index from that location. SESC has adapted the algorithm to operation on TIROS/NOAA data as they are received at SELDADS to compute the Q-activity index which is then forwarded to the Air Force (Global Weather Central) for use as an input for their ionospheric model.

A-I-M personnel participated in the Satellite Drag Workshop which was held in Boulder. This meeting brought together scientists in the atmospheric community, SESC personnel, and those responsible for the day-to-day operation of satellites which are sensitive to variable atmospheric drag. This meeting led to preliminary work directed toward an algorithm which would manipulate the TIROS/NOAA TED data in such a fashion as to give a better characterization of satellite drag effects during periods of magnetic activity than do the K and A magnetic indices currently used. The results of the preliminary work were encouraging.

In addition to the above research, which to a large extent was driven by a desire to ensure the TIROS/NOAA data was made useful to the Services Division of SEL, a number of collaborative research projects were pursued with scientists from other institutions which involved these data. Throughout the first six months of FY 1982, TIROS/NOAA data was routinely extracted and sent to Stanford Research International in order to facilitate comparisons with data obtained by their incoherent scatter radar at Chatanika, Alaska. This radar was closed down in March and transferred to a site at Sondre Stromfjord, Greenland. When the radar becomes operational at the new site, routine extraction of the satellite data will begin anew.

Other scientific collaborations involved the study of specific events or short periods of time. TIROS/NOAA data were exchanged with groups at the University of Munster, Germany (analysis of the results of the energy budget rocket program conducted in Scandinavia in 1980), the University of Bergen, Norway (who were researching the origin of stable auroral red arcs), the University of Alaska (modeling the effects upon the atmosphere of the great magnetic storm of 12 April 1981), Lockheed Research Laboratory (a specific intercomparison with data from other

spacecraft), NCAR (modeling the effects in the atmosphere of auroral energy deposition), Utah State University (a collaborative researching of the data to extract characterizations of auroral activity of use to SESC) Goddard Space Flight Center (comparisons with data obtained from a series of rocket flights), and many others including the Aeronomy Laboratory of ERL. One of the more interesting results of such collaborations came about from a correlation between TIROS/NOAA total energy flux observations and atmospheric observations made by the Laboratory for Atmospheric and Space Physics (University of Colorado) using the solar mesospheric explorer satellite. These comparisons showed that on a daily basis there was a one-to-one correspondence between the observed density of nitric oxide (NO) at high altitude in the polar regions and the amount of energy deposited into the atmosphere as measured by the TIROS/NOAA SEM. Because NO enters into a catalytic chemical reaction which results in the destruction of ozone, the correlation is potentially important in understanding the interplay between ozone concentration and atmospheric behavior.

During the past year several new results were obtained from an analysis of ground-based magnetometer observations. A new mathematical formalism was developed for determining the spatial patterns of geomagnetic variations based upon measurements from arrays of magnetometer stations. This formalism not only permits maps of the geomagnetic disturbance to be drawn by computer, but also allows the separation of the magnetic disturbance vector into two components: one associated with the electrical current system in the ionosphere, the other associated with induced currents flowing in the solid earth. Unlike any previous technique, this method gives quantitative error estimates for the results, and, furthermore, minimizes the magnitude of these errors.

This formalism is being applied to data gathered by a magnetometer chain in Scandinavia (in collaboration with German scientists) to obtain the detailed, time-dependent pattern of the ionospheric current system and its connection to the dynamo region located in the magnetosphere. The work is being extended to study the pattern of earth currents induced during periods of magnetic activity as well.

Other studies have been conducted using data from magnetometers distributed over the entire northern hemisphere in order to obtain a global pattern of ionospheric current flow and the connection with the outer magnetosphere. Analysis of these patterns is yielding estimates of the ionospheric electric fields at high latitudes and of the electrical experience gained from these studies is being put to use in a project designed to improve magnetic activity monitoring and forecasting in the Space Environment Services Center.

Fig. 1. This figure displays maps of the energy input to the polar atmosphere for two levels of geophysical activity (very low and very high). The energy flux values are color encoded and plotted as a function of magnetic latitude and magnetic local time. The large increases in the local magnitudes of the energy input and the area over which energy is input in progressing from quiet to very active conditions are clearly displayed.

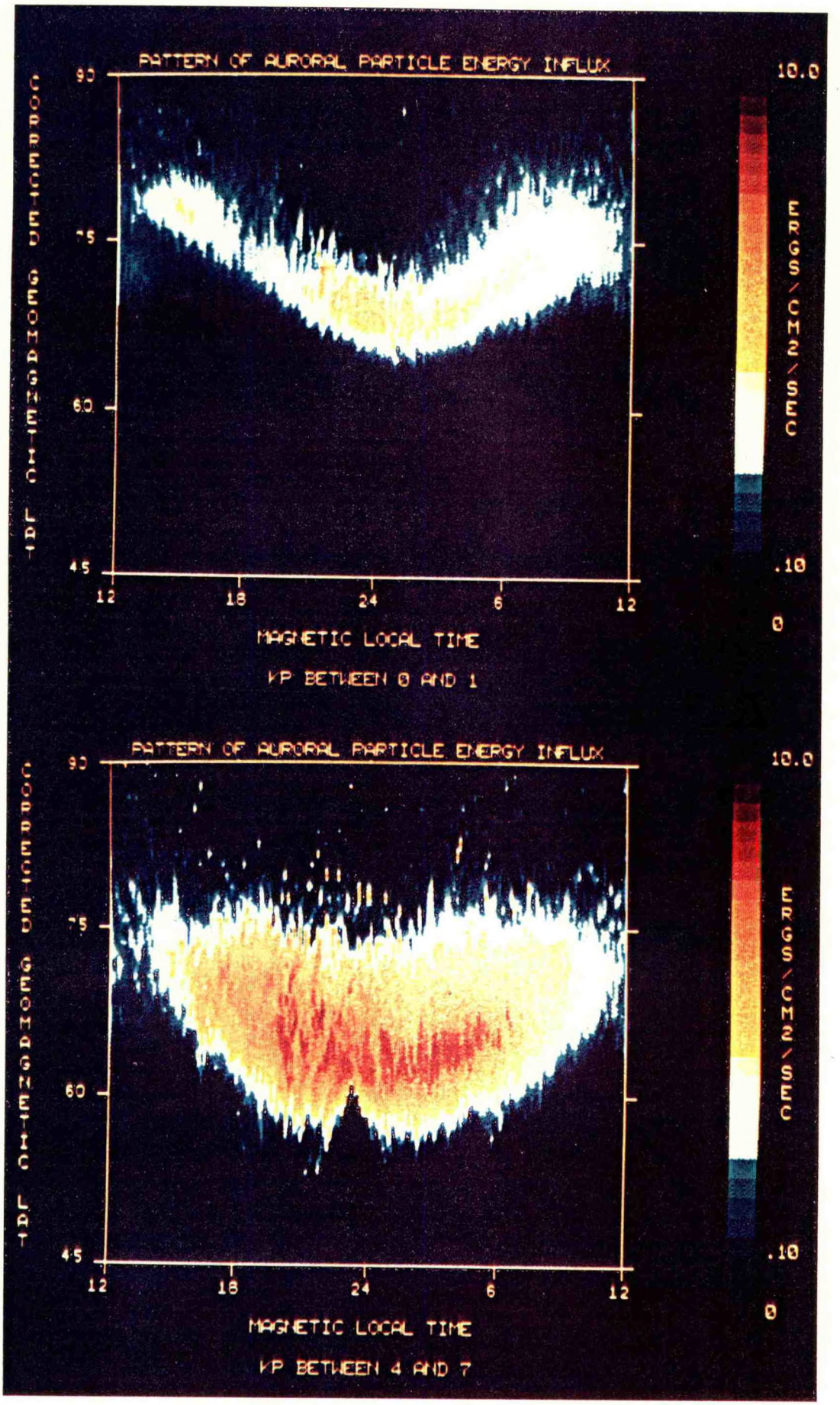

PATTERN OF AURORAL PARTICLE ENERGY INFLUX
90
75
60
45
12
18
24
6
12
MAGNETIC LOCAL TIME
KP BETWEEN 0 AND 1
10.0
ERGS/CM2/SEC
.10
0
PATTERN OF AURORAL PARTICLE ENERGY INFLUX
90
75
60
45
12
18
24
6
12
MAGNETIC LOCAL TIME
KP BETWEEN 4 AND 7
10.0
ERGS/CM2/SEC
.10
0

Fig. 1

SUPPORT DIVISION

R. Grubb

The Support Division assists all Laboratory projects in using computers for acquiring and analyzing data through the Analysis Branch and in developing instrument hardware, engineering software, and data systems design through the Instrument Development Branch.

Typical contributions to laboratory services are the development of satellite and ground-based instrumentation for SESC data collection and in the analysis of data for Service products and operational research.

During the year the division completed its withdrawal from the NOAA Digital Sounder (HF Radar) program. This was negotiated with the National Science Foundation following the laboratory's decision to terminate its scientific participation in the program. The lead role in continuing the hardware and software has largely been taken over by the Los Alamos National Laboratory. The division provided a course on software and hardware in the system at Los Alamos in 1982. The division also generally continued to support the Brighton/Bootlake field site which was again used to train operating scientists for the two instruments now in the Antarctic. One of these is operated by Utah State University at Siple, and the other by the British Antarctic Survey at Halley Bay in the Antarctic. Both systems are reported to have operated well. As noted below the Analysis group completed the "Phase II" software for the system and its documentation and the Instrumentation group completed an extension of the remote control capability of the system. Our withdrawal from this program is now essentially complete.

A new area for the division during the year was the support of the solar flux and UV radiation research program. Computer programming and analysis were performed for data from the Nimbus spacecraft series. Instrument design support was provided to analyze the requirements for the electronics needed for a proposed, precision, solar spectroradiometer rocket mission. This is intended to improve the calibration of the longer term spacecraft experiments. This program has been transferred out of SEL and into the Air Resources Laboratories.

A highlight of the division's work was the completion of the feasibility demonstration program for the proposed GOES solar X-ray imager instrument. This was a joint program with NASA Marshall Space Flight Center (MSFC). MSFC designed and fabricated an X-ray optical system and SEL built a CCD detector and digital image handling system. Tests were made of the overall system resolution in white light and X-rays. A CCD image despinning mode which would be vital to the use of the instrument on a spinning spacecraft was successfully demonstrated. Figures 2, 3 and 4 show the prototype GOES X-ray mirror and some of the more interesting data obtained. A final report will be published in the near future.

ANALYSIS BRANCH

The Analysis Branch provides computer programming to support the Laboratory. Members of the branch combine experience and training in physics, engineering, and mathematics with expertise in the use of computer systems. They provide assistance and advice in these areas to all other laboratory programs.

ACCOMPLISHMENTS - FY 1982

The Analysis Branch supported the solar flux and UV radiation research projects by providing computer access to Nimbus-4 and Numbus-7 solar flux data, and ground-based solar flux broadband data. The Nimbus-7 data is being analyzed for solar cycle and solar rotation dependencies. Because of missing data a technique using auto-correlation after quadratic detrending has been developed which has so far proved very successful. It is now being applied to a larger data set.

Archive production began on the NOAA Geostationary Operational Satellite (GOES) soft burst X-ray project. Production finished for the solar X-ray summary and continues for the IMS satellite.

The archiving of International Sun-Earth Explorer 2 satellite, charged-particle data has been continued through 1981, Day 339, with copies of the archive tapes being sent to co-investigators in Lindau and Kiel, Germany. A full set of ISEE-1 pitch angle plots were generated on microfilm. Various color displays of ISEE data were made on request. Copies of the ISEE-1 archive tapes; pitch angle plots; flux, magnetic, and spectral plots (both microfilm and hardcopy); and the documentation were provided to other cooperating groups. The archiving of IMP-J data has continued into data for February 22, 1982.

The general purpose "compositor" (text formatting) program originally written in Snobol has been converted to Fortran 77 for the Cyber system and several new features and improvements incorporated. A new manual has been completed. The program has been used by SEL to complete the documentation on the new HF radar software and is used by several other groups in ERL for text formatting. The Fortran Concordance program was supplied to NCAR where it was used successfully to increase the efficiency of a large climate model program.

Assistance was provided to the Glaciology World Data Center in converting their data base from the OUTFOL (SEL) system on the Cyber to System 2000 on the Rockville Univac. General assistance continues to be provided to the ERL Central Computer Facility. SEL staff routinely assist with the calibration and adjustment of the FR80 microfilm system and with problems associated with tape systems. An Electronic mail program was written for the Cyber and made available for general use.

The terminal equipment available to Support Division staff was upgraded during the year by the addition of six, 132-column CRT terminals, three of which also support Plot 10 Graphics. Three of the systems have local dot matrix printers, making it possible to obtain small amounts of

hardcopy conveniently. These systems have proved very successful and have substantially improved our efficiency.

The support of the SEL HF Radar system has been completed. The phase 2 software and documentation package will be distributed to all users in October 1982.

The Branch supported the FY 82 computer procurement by assembling, testing, and distributing benchmark software tapes. It has also supported the Space Environment Laboratory Data Acquisition and Display System (SELDADS) II, RFP preparation by participation in the Technical Review Committee and Source Evaluation Board Activities.

PLANS - FY 1983

The Branch plans to increase its direct participation in the operational spacecraft SESC Space Environment Monitoring data analysis and archiving. It will continue to support the main SELDADS II RFP and will provide programming assistance to RTDS for the SELDADS preprocessor system.

INSTRUMENT DEVELOPMENT BRANCH

The Instrument Development Branch (IDB) provides general support to the Laboratory with instrument hardware, engineering software, and data system design. This support includes involvement throughout the lifetime of a laboratory program, often beginning with system conceptual development and proposal writing, continuing through design, fabrication, and test phases, to support in-field deployment or launch operations and often involving continuing evaluation and consultation during data reduction and analysis. Program management and technical supervision of contractors are provided for larger programs.

ACCOMPLISHMENTS - FY 1982

OPERATIONAL SPACE ENVIRONMENT MONITORS (SEM)

In July NASA approved the SEL proposal to fabricate an additional High Energy Proton and Alpha Detector (HEPAD) instrument for the GOES program. Although the group does not normally fabricate instruments for the operational program, in this case there is a substantial, government-owned inventory of parts from a previous contract fabrication program. SEL assembly and test of one instrument represents a substantial cost savings over the alternative approaches examined by NASA. The HEPAD instrument is used to provide radiation hazard warnings for high altitude aircraft during very large, high-energy, solar events.

No new launches of GOES or TIROS satellites occurred during the year. Instrument repair facilities have been maintained and one instrument was repaired during the year.

Support has been provided to SEL, NESS and GSFC on the GOES NEXT specifications for Space Environment Monitors systems. These will be the systems which will support the Space Environment Services Center in the period after the present generation of spacecraft are phased out.

SOLAR X-RAY IMAGER FEASIBILITY DEMONSTRATION

A study has been made of the critical features of a new instrument for GOES NEXT which would provide important new information for the Space Environment Services Center on the structure of solar activity.

The practical work on this program was completed with the overall optical and X-ray testing of the combined mirror and CCD detector system in SEL and at MSFC X-ray test facility. In general, the results confirm the design study predictions. The final report is written and will be ready for publication in early FY 1983.

HF RADAR

A small amount of general support was provided to the Brighton/ Bootlake facility. The major contribution was the completion of the serial data interface system. This allows the radar computer to switch antenna relays or control other devices at distances up to 1 Km. The technical manual is also complete. Negatives are available for all PC boards to permit other groups to copy the system if they wish.

GALILEO ENERGETIC PARTICLE DETECTOR

The flight "Time of Flight" (TOF) electronics were completed and supplied to Johns Hopkins University, Applied Physics Laboratory on schedule. In response to SEL program changes and changes of staff, the branch has withdrawn from any further participation in this program. The delivery of the TOF unit completes our obligations.

SOLAR UV SPECTRORADIOMETER

The branch provided outline performance analysis and specifications for the electronics of a proposed rocket UV spectroradiometer experiment for the Solar UV program.

SEL MICROPROCESSOR SUPPORT SYSTEM

During the year the branch wrote specifications for a set of general purpose microprocessor systems which will be used in the laboratory for general purpose scientific and administrative support. These are expected to be delivered in early FY 1983.

PLANS - FY 1983

OPERATIONAL SPACE ENVIRONMENT MONITOR

The branch expects to complete most of the fabrication of the HEPAD instrument during FY 1983. Instrument repair and integration support

will be continued for the present GOES and TIROS programs. Support will also be provided as required for the GOES NEXT program.

SOLAR X-RAY IMAGER, SEL SPECTROHELIOGRAPH, SESC IMAGING

Support will be provided as required to the proposals for flight of the x-ray imager. The experience gained with digital image display and CCD technology will be applied to providing a digital image output from the SEL Spectroheliograph to make it more useful as an operational tool and also to a general study of SESC image handling.

SEL MICROPROCESSOR SYSTEM SUPPORT

The branch will provide assistance with program installation and customization. It is planned to automate some laboratory administrative accounting and recordkeeping functions using DBMS software. If resources are available the system will be interconnected to a central hard-disk file system.

Fig. 2 Finished GOES X-ray mirrors. The paraboloidal element is on top in this view, and the hyperboloidal element on the bottom. Holes in the central mounting ring are for weight reduction. In actual operation, the entrance aperture is covered with a slotted stop plate.

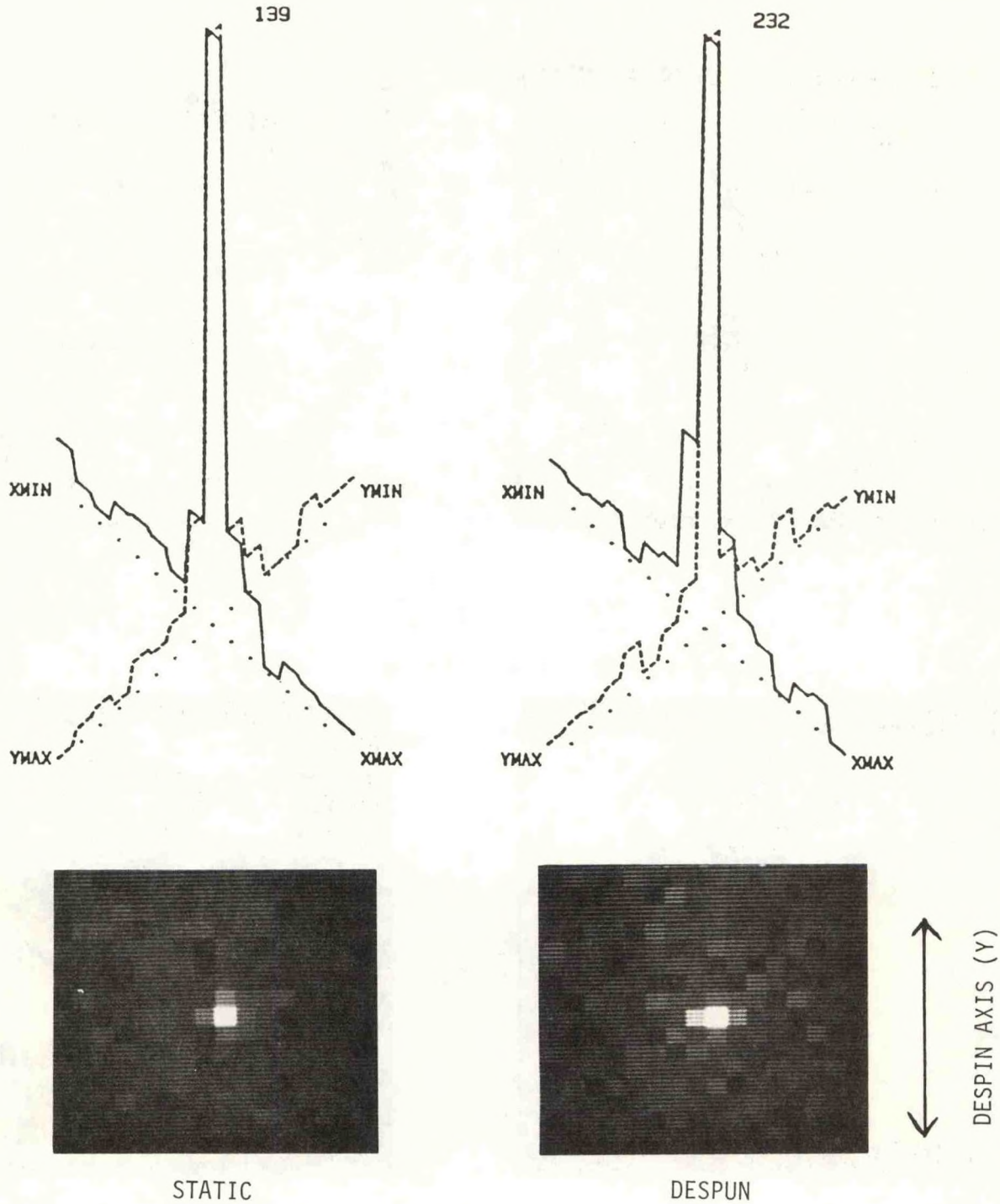


Fig. 3 Brightness contours (point spread functions) and corresponding images are for a 1 arc minute pinhole white light source. For the left-hand image, source was static (non-spinning); while on the right, source was spinning with an image velocity at focal plane of 4.65K pixels per second. Lens used was 25 mm focal length, giving image size of 1/4 pixel at focal plane.

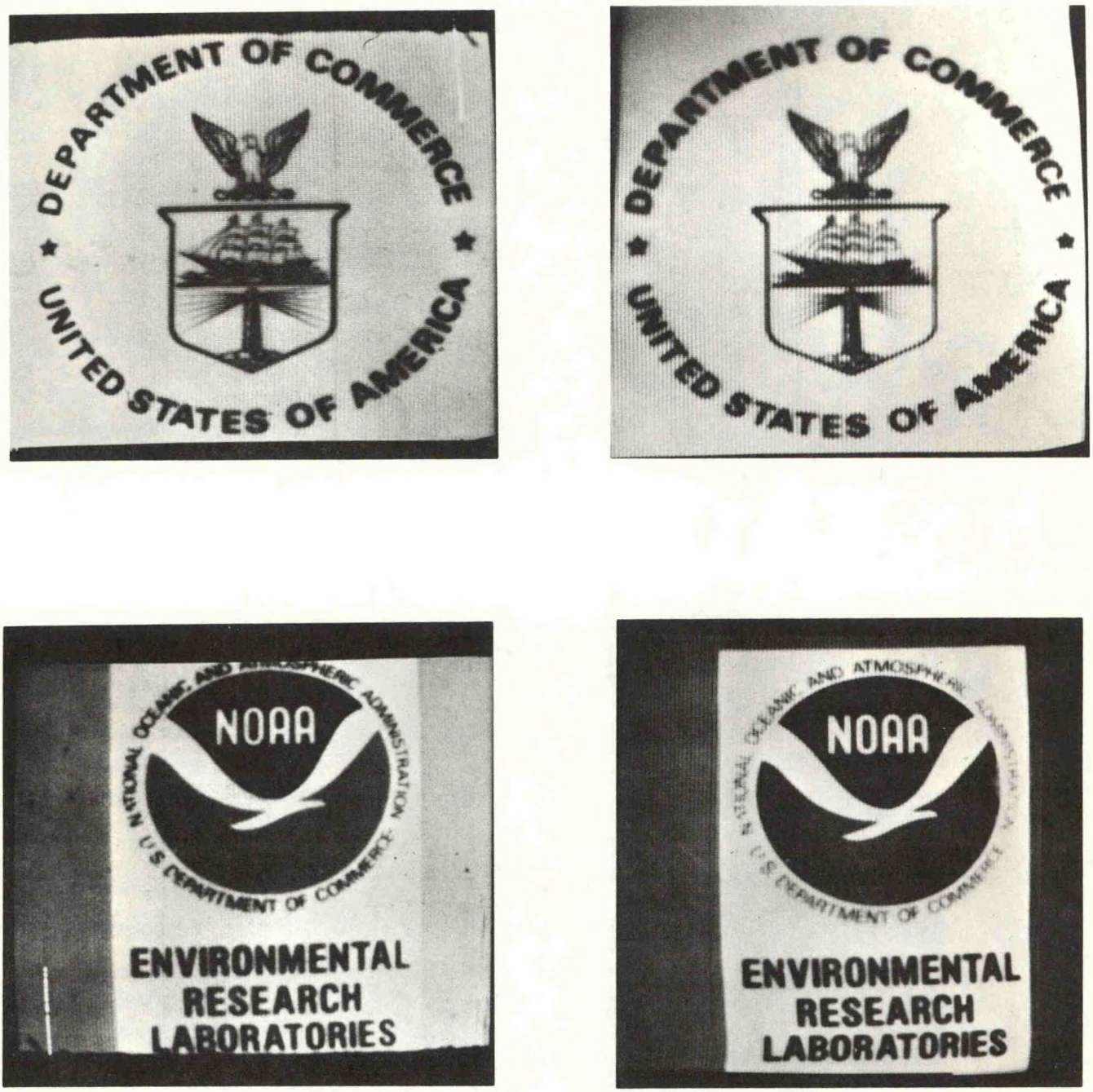


Fig. 4 Static and despun pairs for DOC and NOAA emblems in white light. In both cases, the picture on the left is with static target, while picture on the right is with spinning target. A 500 mm lens was used, producing an image velocity at the focal plane of 159.5 K pixels per second. Despin smearing appears to be no more than one pixel.

SERVICES DIVISION

G. Heckman

The Services Division provides a variety of services to a growing national and international community of users concerned with the effects of solar activity on the environment. The Real-Time Data Services (RTDS) Branch and the Space Environment Services Center (SESC) jointly constitute the major activity of the United States in solar-terrestrial monitoring, forecasting, and real-time data collection and dissemination. Many of the services are joint activities of NOAA and the U.S. Air Force.

ACCOMPLISHMENTS - FY 1982

The theme of the year in the Division was maintenance of a high level of service to a growing number of users while making major changes to improve efficiency in the use of personnel, to increase the utility and reliability of equipment used in the services operation and to continue to prioritize services to meet user requirements.

Work on the planning and procurement for a new Space Environment Laboratory Data Acquisition and Display System (SELDADS II) was a major activity. Both RTDS and SESC personnel developed requirements, served on (and chaired) the Technical Review Committee to draft the major RFP (Request for Proposal) for the system, established benchmarks for system requirements and defined and procured a preprocessor system that will improve the data going into SELDADS in terms of volume, reliability and data quality. A major problem that has had to be addressed is that the current SELDADS was developed primarily as a data collection and storage system. Significant display capability was added only after-the-fact and little user planning or analysis of user requirements went into the current user software. A major effort in planning SELDADS II has been in establishing user requirements and providing for them in a systematic way.

The definition of SELDADS II user requirements has been complicated by the fact that the Space Environment Services Center is a relatively new operation that has grown rapidly in terms of users, data sources and products. Until this year, no system had been established for documenting or standardizing the operation. Much of the basis for the operation was passed from forecaster to forecaster as a kind of folklore. Planning begun the previous year culminated in 1982 in adoption of a product review process as a management tool to gradually, but systematically, impose order on the present operation. The process, adapted from developments in the data processing world, prescribes an orderly review process where users, providers (e.g., scientists developing improved services) and management agree on a service objective and the associated requirements for technical development, documentation, testing and implementation in the services operation. The review process identifies the resources necessary to complete a project and assists management in controlling the allocation of those resources. Products are the outcome of the review process and are defined in broadest terms, e.g., new data sources, displays, indices and improved techniques for solar flare forecasting

are examples of products. One of the first products in the review process has been a set of documentation guidelines for services operation.

SPACE ENVIRONMENT SERVICES CENTER

G. Heckman

The Space Environment Services Center (a joint operation of NOAA and the USAF Air Weather Service) continued to provide predictions, alerts, and data for a variety of users whose systems are affected by disturbances in the space environment or who are conducting scientific experiments to improve understanding of that environment. Predictions and summaries of activity are distributed daily to users throughout the United States and the world. Customers using the services included DOD, NASA, DOT, DOE, universities and research foundations, and industrial and commercial users.

ACCOMPLISHMENTS - FY 1982

Increased emphasis was placed on surveys of users, their priorities for services and the importance of the services to those users. Lists of products and the results of these immediate user surveys were made available to the Office of the Federal Coordinator for Meteorological Services and Supporting Research and to the Subcommittee for Space Environment Forecasting (SC/SEF). Other agency representatives to the SC/SEF established priorities for the products according to their own uses. In addition to being used by the Office of the Federal Coordinator to develop options for long-term planning of space environment services, the priorities have been used by the SESC as a basis for internal allocation of resources.

Personnel assignments in the SESC were redefined in response to evolving operational requirements. Teletype communications were once the mainstay of data collection and product distribution of the center and the staff included 4.5 teletype operators. SELDADS as an automated data handling and distribution system was established later and did not become fully integrated into the operation until about 1978. In 1983, the last teletype machine will be phased out while the care and feeding of the real-time data base has expanded to a 24-hour task.

A reorganization in progress effectively converts the teletype operators to technicians responsible for the real-time data flow into and out of SELDADS. Some of the senior professional forecaster staff that had been increasingly diverted to the SELDADS task will be assigned responsibilities in the SELDADS II effort or for development of improved analysis and forecasting techniques. A core of professional forecasters will be retained to provide the analysis and forecasts produced by the SESC.

FORECAST CENTER

In the Forecast Center in Boulder, data are collected within and supplementary to the SELDADS. Real-time quality control is performed on the data. Analyses and summaries are compiled and indices extracted as

the observations flow in. Predictions for a standard set of parameters are made and alerts are issued for major disturbances.

In addition to standard users, special projects using support during the year included the Space Transportation System, the International Upper Atmospheric Energy Budget Campaign and approximately 15 rocket launches. Increasing numbers of requests were received from users concerned with the effects of geomagnetic field variation on biological and technological systems.

COMMUNICATIONS CENTER

Though many of its functions are automated, the Communications Center has continued to function. A contractor provides telegraphic service to the Boulder Laboratories on a cost-reimsursable basis.

OBSERVATORIES

The Air Force Solar Electronic Observing Network (SEON) provides a basic solar optical flare and radio patrol. These data are supplemented by synoptic observations from Kitt Peak Observatory, Marshall Space Flight Center, Culgoora, Mt. Wilson, Ottawa, and other solar observatories.

The Boulder Observatory provided basic solar images for use in forecasting. Inadequate regular staff was a continuing problem in the local observatory this year.

Satellite Observations came from Space Environment Monitors on the GOES and TIROS/NOAA Satellites and from the International Sun-Earth Explorer (ISEE) 3 Satellite.

Geomagnetic data are provided by NOAA, USAF, USGS and NSF observatories.

The Space Environment Services Center functions as the World Warning Agency for the International Ursigram and World Days Service. In this role, it exchanges solar, geomagnetic and ionospheric data with regional warning centers throughout the world and issues a consensus international forecast for disturbances.

TECHNIQUE DEVELOPMENT

Technique development work aimed at improved services were concentrated in a few areas where current services are weakest and potential payoff to users are high.

Studies of techniques for predicting the terrestrial effects of eruptive solar filaments continued. Geomagnetic forecasts one to three days in advance are one of the highest priority services to users and among the most inaccurate forecasts made by the SESC. The sources of the largest geomagnetic disturbances during the present 11-year cycle

have been from erupting solar filaments that were not associated with big, energetic flares.

Another especially weak area in the services is the prediction of overall levels of solar activity 3 to 27 days in advance. Techniques for monitoring and evaluating large-scale, mass motions on the sun, based on identification of these features in solar synoptic maps, continued. These studies have promise for predicting the appearance and growth of solar- active regions before they are identified by current techniques.

Development of the use of magnetograms that measure the shear within solar-active regions was carried out in cooperation with the Air Force. The work is aimed at identifying the storage of energy in the few hours to a day or so before solar flares occur.

After NASA announced reduction of their program to predict solar cycles several years in advance, a number of satellite programs, which use the predictions to plan launch dates and orbital parameters, were referred to SESC. A review of the prediction techniques that could be used to predict the next 11-year cycle was made and a combined prediction was issued.

Work to improve the geomagnetic field indices and related services to make them more useful, especially to geophysical users, was carried out.

As part of an on-going program to bring users and service providers together, a workshop on measuring and predicting the solar variables that affect the level of atmospheric drag on satellites was organized by the Division. Where an earlier workshop in 1979 had covered the entire range of solar-terrestrial predictions, the 1982 drag workshop concentrated on a few users and a narrow range of problems. The narrow, focused approach was successful and will be used again in the future.

PLANS - FY 1983

Maintenance of services, as prioritized from user surveys, will be continued to the extent provided by 1983 allocations. Planning and implementation of user requirements for the SELDADS will continue. Requirements for application software will have to be developed for the new system.

A centralized documentation system is planned for the Division to maintain the growing documentation for the various aspects of SELDADS I and II.

The forecaster staff will be involved in the implementation of a new laboratory research plan, including direct participation in some of the research, liaison to assist in defining research to meet service requirements, and providing a "user" viewpoint for research product reviews.

REAL-TIME DATA SERVICES BRANCH

C. Hornback

Real-Time Data Services (RTDS) operates systems that provide data from various solar and geophysical sensors for supporting the Space Environment Services (SESC) operations. RTDS has three operational components: (1) the Data Display System (DDS) in the Radio Building at Boulder, Colorado; (2) the Table Mountain Observatory (TMO) near Boulder, Colorado; and (3) the High-Latitude Monitoring Station (HLMS) at Anchorage, Alaska. Systems at the three sites operate 24-hours per day, 7 days per week. The sites are staffed during normal working hours; at other times personnel are on call for problems.

The efforts of RTDS fall into three primary types of activities: (1) operating the system to provide solar geophysical data, (2) dealing with frequent contingencies that arise in a far-flung, diverse system with so many disparate components, and (3) planning, designing, and implementing upgrades and replacements to the components before they suffer catastrophic failure.

ACCOMPLISHMENTS - FY 1982

The Space Environment Laboratory Data Acquisition and Display System (SELDADS) consists of facilities to acquire, process and display a wide range of solar geophysical data for use by the SESC forecaster. The data are also used by a number of industrial, governmental and scientific groups who dial up the system from their own terminals. Data are provided over dedicated lines to the USAF Air Weather Service at Offutt Air Force Base, Nebraska, and to the Naval Ocean Systems Laboratory, San Diego. The following systems provided data to SELDADS during the year.

Communications Networks operated by the Defense Communications Agency provided worldwide data from the International Ursigram and World Days Service network from Regional Warning Centers operated by major countries in Europe, Asia and Australia.

The Astrogeophysical Teletype Network (ATN), operated by the Air Weather Service, supplies data from observatories around the world, including the High-Latitude Monitoring Station (HLMS) in Anchorage, Alaska. These data are decoded in SELDADS and stored for retrieval and display in SESC.

Data from the Space Environment Monitors on the GOES satellites were routinely received and sent to SELDADS where they were processed, displayed, and archived.

Data from NOAA-6 and NOAA-7 polar-orbiting satellites are received at Boulder from NESS. The data are stored in a data base, displayed by the SESC, archived, and sent to the Global Weather Center (GWC) at Offutt Air Force Base, Nebraska.

SELDADS receives, processes, displays, and archives magnetometer data from a U.S. magnetometer network via a satellite communications link. Because the data are received at SELDADS, there is a considerable

amount of system monitoring and communication with the USGS, University of Alaska, UCLA, and University of New York, which maintain the magnetometer sites. The real-time magnetometer network is designated as Real-Time Geophysical Observatory Network (RGON).

Data from the ISEE-3 electric field, solar wind, x-ray, and magnetometer sensors are received at Table Mountain. The data are processed, and one-minute summaries are sent to SELDADS and displayed in real time by SESC. A solar wind "shock" alarm was implemented using the electron solar wind velocity.

The SELDADS was operational in excess of 95 percent of the time despite intervals of serious disk storage failures. As a result of the failures, new disk drives were purchased in order to maintain operational capability over the next year or so. Software modifications were made to speed up the operating system in some of the processors; to meet new needs for data displays from users such as NASA (the Shuttle program) and the Air Force; to provide new real-time monitoring displays for the SESC; to handle new GOES Space Environment Monitor data formats; to generate on-line teletype messages in place of those originally produced manually; and to generate new user products from the Total Energy Detector (TED) on the NOAA satellites. Experience has shown that about 20 to 30 percent of the user and data stream software becomes obsolete every year with an approximately 100 percent turnover in five years.

TABLE MOUNTAIN OBSERVATORY

Table Mountain Observatory (TMO), 13 miles north of Boulder, consists of ground stations for direct receipt of GOES Space Environment Monitor data, a magnetometer, total electron content detector, and other sensors and equipment for receiving, processing and relaying the data into the SELDADS. Computer capacity at the TMO is used to supplement the back-up processing done in the primary SELDADS in Boulder. As usual, most of the work at TMO in FY 1982 was concerned with operation and maintenance of the types of equipment used in converting original sensor data into digital streams for computer processing as well as the vagaries of high technology, field site operation in a high wind, wildlife infested area along the front range.

HIGH-LATITUDE MONITORING STATION

The HLMS acquires, processes, displays, and archives geophysical data observed from local and remote ground-based sensors located across Alaska and at Thule, Greenland. The site is jointly operated with the Air Force Air Weather Service. A local HF propagation and magnetic forecast is prepared along with special products for the AF-AWS needs. Data summaries are sent out every 15-minutes on the Astrogeophysical Teletype Network; also, a daily telephone call transfers a synoptic summary to SESC.

HLMS maintained its daily operation during FY 1982. As with Table Mountain, major efforts went into repair and refurbishing of the data collection system and interfaces with the central Boulder location. In

both locations, the high level of continuous operation that is maintained is due to the efforts of a few dedicated personnel who are highly adaptable at solving disparate problems.

SELDADS II

RTDS provided the chairmanship for the Technical Review Committee for the primary SELDADS II upgrade. The initial version of the Request for Proposal (FRP) was completed in March and submitted to the Source Evaluation Board.

The basic functions to be upgraded or replaced in SELDADS II includes: (1) data base management (both automated and technician interface); (2) SESC user display and analysis capability, (3) external user interface and management, (4) incoming data stream decoding, filtering and other initial processing and (5) event detection. Function 4 and portions of functions 2, 3 and 5 will be handled by a series of microprocessors operating individually on each of the incoming data streams. An Invitation for Bid (IFB) was completed, bids solicited and an order issued for the preprocessor portions of SELDADS II.

Alternative plans for various configurations of SELDADS II purchases were derived as a means of planning for various funding contingencies. Some of these are now in their second and third generation.

PLANS - FY 1983

Maintaining the operation of data systems essential to meet the high-priority SESC users will be the first order. Participating in completion of the RFP, planning and initial installation of the preprocessors will also be carried out.

Reprogramming necessary to complete the conversion from the earlier International Magnetospheric Study to the new Real-Time Geophysical Observatory Network (RGON) will be completed. Pending the completion of a new SELDADS, existing software and displays will have to be modified to account for changing data sources such as new energy ranges in replacement sensors, implementation of new user requirements and fixes to yet undiscovered problems.

Solar Origin of 65 Geomagnetic Storms (Ap≥30)

FROM JUNE 1, 1976 - JUNE 30, 1979

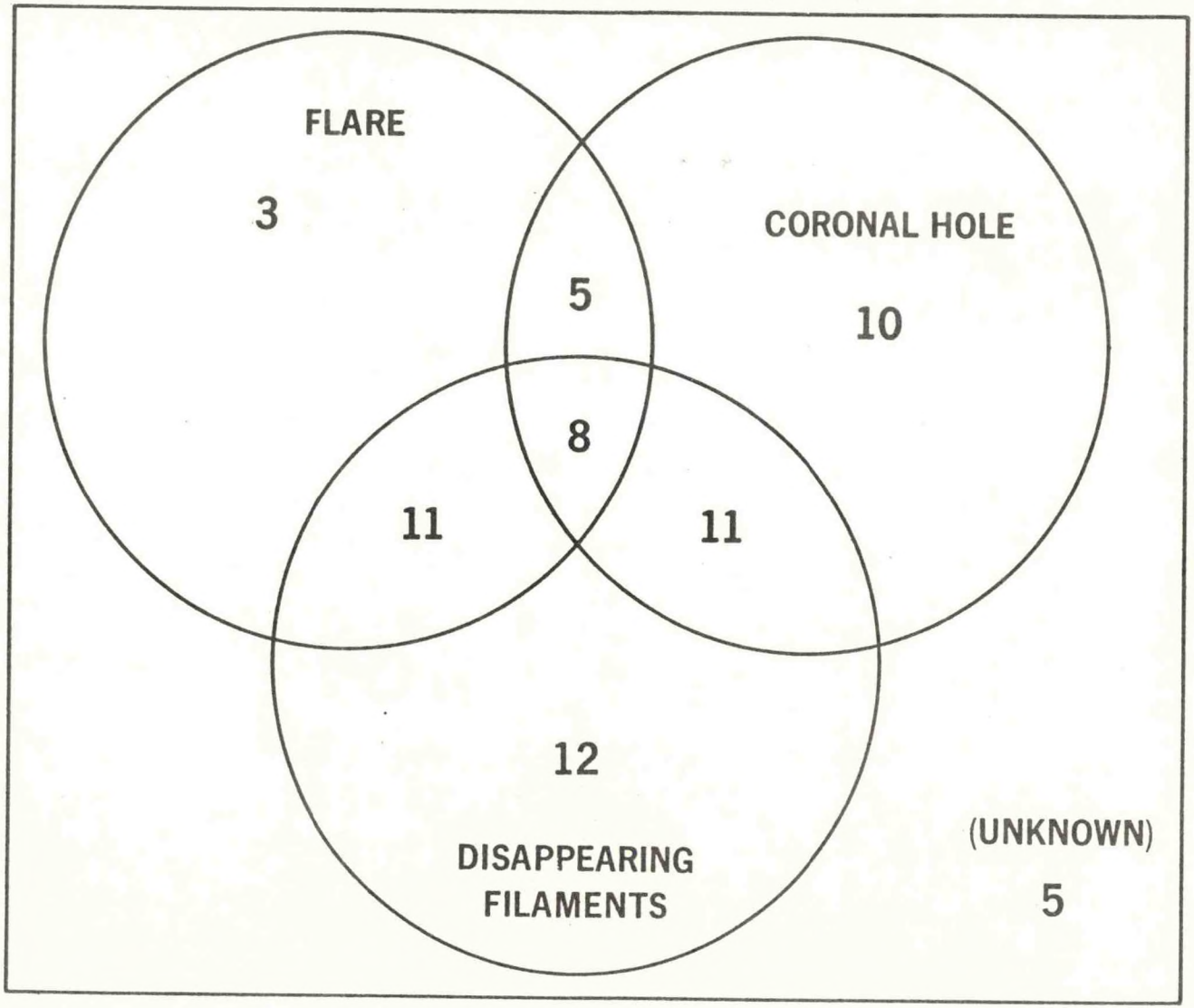


Figure 5

SEL STAFF

OFFICE OF THE DIRECTOR, Harold Leinbach, Acting Director

Ahl, Irene V.	Secretary
Beasley, Sally A.***	Clerk-Typist
Jean, A. Glenn	Deputy Director

***

ADMINISTRATIVE SUPPORT, Mark Lash, Administrative Officer

Garrett, Janet	Secretary
Coss, Gayle	Assistant Administrative Officer

RESEARCH DIVISION, Kenneth Davies, Division Chief

Evans, David S.	Deputy Chief
Wiarda, Marianne	Secretary

Atmosphere-Ionosphere-Magnetosphere, David S. Evans, Chief

Anderson, David N.***	Physicist
Richmond, Arthur D.	Space Scientist

Magnetospheric Physics, Herbert H. Sauer, Chief

Fahnenstiel, Steven C.***	Physicist
Fritz, Theodore A.***	Physicist
Garcia, Howard	Physical Scientist
Hill, V. Viola	Secretary
Lyons, Lawrence R.	Physicist

Interplanetary Studies, Murray Dryer, Chief

Donnelly, Richard F.***	Physicist
Smith, Zdenka	Physicist
Suess, Steven T.	Physicist
Puga, Lawrence**	Physical Science Student
Quintana, Annabelle**	Physical Science Student

SUPPORT DIVISION, Richard N. Grubb, Division Chief

Numerical Analysis, R. N. Grubb, Acting Chief

Caldwell, Ginger A.***	Mathematician
Falcon, Janet E.	Mathematician
Lewis, L. David	Physicist
Matheson, Lorne	Physicist
Merrill, R. Greg	Physicist
Retallack, William M.	Physical Science Technician
Stephenson, Judith J.	Mathematician
Starr, Irma J.	Secretary
Walden, David	Computer Specialist
Winkelman, James R.	Mathematician

Instrument Development, James Cessna***, Chief

Dayhoff, Raymond E.	Electronics Technician
Holmes, Carl A.***	Electronics Technician
Jones, John E.	Electronics Engineer
Knapp, Elizabeth	Secretary
Orswell, Prentice L.	Electronics Engineer
Riley, Michael	Engineering Student Trainee
Seale, Richard A.	Electronics Engineer
Taylor, John H.	Electronics Engineer

SERVICES DIVISION,Gary Heckman, Acting Division Chief

Real-Time Data Services, Charles R. Hornback, Chief

Abeyta, James	Computer Specialist
Berger, Earl L.***	Electronics Engineer
Gray, Alvin M.	Electronics Engineer
Hale, Harold D.	Electronics Technician
Hines, Robert G.	Electronics Engineer
Jones, Paul H.	Electronics Technician
Schroeder, Jacob D.	Computer Specialist
Wasmundt, Donald F.	Electronics Engineer

Space Environment Services Center, Gary R. Heckman, Chief

Abbott, E. Ann	Data Center Clerk
Algiene, Thomas E.***	Communications Relay Operator
Carran, Kurt L.	Supvy. Communications Relay Operator
Chilson, I. Gayle	Communications Relay Operator
Cowley, Frank	Mathematician
Cruickshank, Cheryl M.	Computer Assistant
Flowers, William E.	Space Scientist
Goehringer, Bette C.	Communications Relay Operator
Hill, Viola J.	Mathematician
Hirman, Joseph W.	Space Scientist
Joselyn, JoAnn C.	Physicist
Kildahl, Karl	Space Scientist
McIntosh, Patrick S.	Space Scientist
Recely, Frank J.	Space Scientist
Rosales, Abel***	Communications Relay Operator
Sargent, Haward H.	Space Scientist
Smith, Jesse B.	Space Scientist
Snelling, David***	Mathematician
Spear, Kerry A.*	Physical Science Aid
Speich, David H.	Space Scientist
Sutorik, Joseph A.	Space Scientist
Wilvert, Audrey	Secretary

NOAA Corps

Lt. Kent Doggett
Lt. James Gordon
Lt. Walter Latimer
Lt. James O'Clock***
LCDR. Lloyd Thomas
Lt. Steve Tullis

USAF

T/Sgt. Frank Guy
Capt. Thomas Metzger
M/Sgt. Philip Powell
Capt. Bruce Springer

USAF (At Anchorage, Alaska)

Capt. Ghee Frye
S/Sgt. Warrent West
Capt. Thomas Clark
S/Sgt. James Kizer

This list includes all SEL Full-Time and Part-Time Employees onboard during FY 1982, including:

* Intermittent Employees
** COOP Students
*** Personnel no longer employed at SEL

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Donnelly, R. F., "Intercomparison of Daily Measurements of Solar 1-8Å X-Ray Flux and 10.7 cm Radio Flux". AGU Fall Meeting, San Francisco, California, December 7-11, 1981.

Donnelly, R. F., "UV Solar Radiation". ERL Seminar, Boulder, Colorado, March 4, 1982.

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Dryer, M., "Compression of the Venusian Ionopause on 10 May 1979 by the Interplanetary Shock Generated by the Solar Eruption of 8 May 1979". Symposium on Venus, San Francisco, California, November 3-6, 1981.

Dryer, M., "MHD Simulation of 1980 June 29 (1821 UT) Flare and Coronal Transient". Solar Physics Division Meeting, Boulder, Colorado, January 12, 1982.

Dryer, M., "On the Use of Time-Dependent MHD Modeling for Simulation of Solar Wind-Based Geomagnetic Storm Predictive Parameters". SCOSTEP Solar-Terrestrial Physics Symposium, Ottawa, Canada, May 17-22, 1982.

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Evans, D. S., "TIROS-N Total Energy Detector: Where Are We and Where Should We Go?" SEL Seminar, NOAA/ERL, Boulder, Colorado, December 17, 1981.

Gislason, G., "A Numerical Simulation of Solar Flare-Generated Disturbances of the Solar Wind." Math Department, Engineering Wing, Boulder, Colorado, April 13, 1982.

Grimalizzi, O. M., "A Model Study of the Mid-Latitude Ionosphere, with Particular Emphasis on Faraday Content and f_0 F2 Data." SEL Seminar, NOAA/ERL, Boulder, Colorado, December 15, 1981.

Hirman, J. W., "Shuttle - What It Is and What It Will Do." Monthly Meeting of the Boulder Valley Retired Teachers Assocation, Boulder, Colorado, January 11, 1982.

Hirman, J. W., "The Space Shuttle." Rocky Mountain Climbers Club, Boulder, Colorado, April 17, 1982.

Joselyn, J. A., "Geomagnetic Predictions." Workshop on Satellite Drag, Boulder, Colorado, March 19, 1982.

Joselyn, J. A., "Solar Weather - Why Do We Care?" Boulder Lions Club, Boulder, Colorado, April 28, 1982.

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Joselyn, J. A., "Space Environment Services Appropriate to Radio Probing of the High-Latitude Ionosphere." URSI International Symposium, University of Alaska, Fairbanks, Alaska, August 9, 1982.

Kamide, Y., "ISEE Observations and Energetic Particles in the Magnetosphere: Their Structure and Dynamics." Annual Japanese Geophysical Union Meeting, Kobe University, Kobe, Japan, October 12, 1981.

Kamide, Y., "Coordinated Study of an Isolated Substorm Using Multiple Data Sets." AGU Fall Meeting, San Francisco, California, December 10, 1981.

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Kamide, Y., "Inferring Electric Fields and Currents from Ground-Magnetometer Data - A Test with Theoretically Derived Inputs." AGU Spring Meeting, Philadelphia, Pennsylvania, May 30 - June 4, 1982.

Leinbach, H., "A Retrospective Look at Polar Cap Absorption Events -- Were Things Really Better in the Good Old Days?" SEL Seminar, NOAA/ERL, Boulder, Colorado, January 5, 1982.

Maxwell, A., "Confrontation of MHD Computer Models with Observationsl Data on Transients in the Solar Corona." SCOSTEP/COSPAR Solar Terrestrial Physics Symposium, Ottawa, Canada, May 17-27, 1982.

McIntosh, Patrick S., "Meteorology of the Solar Surface." Seminar at Herzberg Institute of Astrophysics, National Research Council of Canada, Ottawa, Canada, May 14, 1982.

Osherovich, V., "Analytical Description of Coronal Magnetic Loops and Transients." SEL Seminar, NOAA/ERL, Boulder, Colorado, January 26, 1982.

Osherovich, V., "The Study of Toroidal Magnetic Configurations in a Spherically Symmetric Gravitational Field with Applications to Coronal Loops & Transients." Boston College, Boston, Massachusetts, May 24, 1982.

Park, Hongwoo, "Temporal Behavior of UV Solar Spectral Irradiance Observed near the Solar Maximum." AGU Meeting, San Francisco, California, December 8, 1981.

Sargant, Howard H. III., "Geomagnetic Implications of Sunspot Cycle 22 Forecasts." Workshop on Satellite Drag, Boulder, Colorado, March 19, 1982.

Smith, J. B., "The Magnetic Structure and Evolution of Selected Flaring and Non-Flaring Active Regions." Space Environment Laboratory Seminar, NOAA/ERL, Boulder, Colorado, March 1, 1982.

Smith, J. B., "Sheared Magnetic Fields and Flare Occurrence." IAU, Patras, Greece, August 20, 1982.

Speer, K. A., "Longitudinal Dependence of Solar Proton Events." AGU Spring Meeting, Philadelphia, Pennsylvania, June 3, 1982.

Speiser, T. W., "Tail Current Sheet Acceleration." AGU Spring Meeting, Philadelphia, Pennsylvania, June 4, 1982.

Suess, S. T., "Conductive Damping of Coronal Motions." SEL Seminar, NOAA/ERL, Boulder, Colorado, January 19, 1982.

Suess, S. T., " 'Coronal Oscillations' Solar Maximum Mission Coronagraph Imaging Team." NCAR Seminar, Boulder, Colorado, January 28, 1982.

Suess, S. T., "Numerical Modeling of Coronal Flow." Astro-Geophysics Department Students Colloquium on Facility Research, Boulder, Colorado, February 1, 1982.

Suess, S. T., "Conductive Damping of Coronal Motions." Lecture at Department of Physics, Univ. of New Hampshire, June 8, 1982.

Suess, S. T., "Predictive Modeling of Solar Corona and Interplanetary Medium." Atmospheric & Environmental Research, Inc., New Hampshire, June 9, 1982.

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Williams, D. J., "Studies of Plasmas in Space: Results and Applications." Rice University Seminars, Houston, Texas, October 8, 1981.

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