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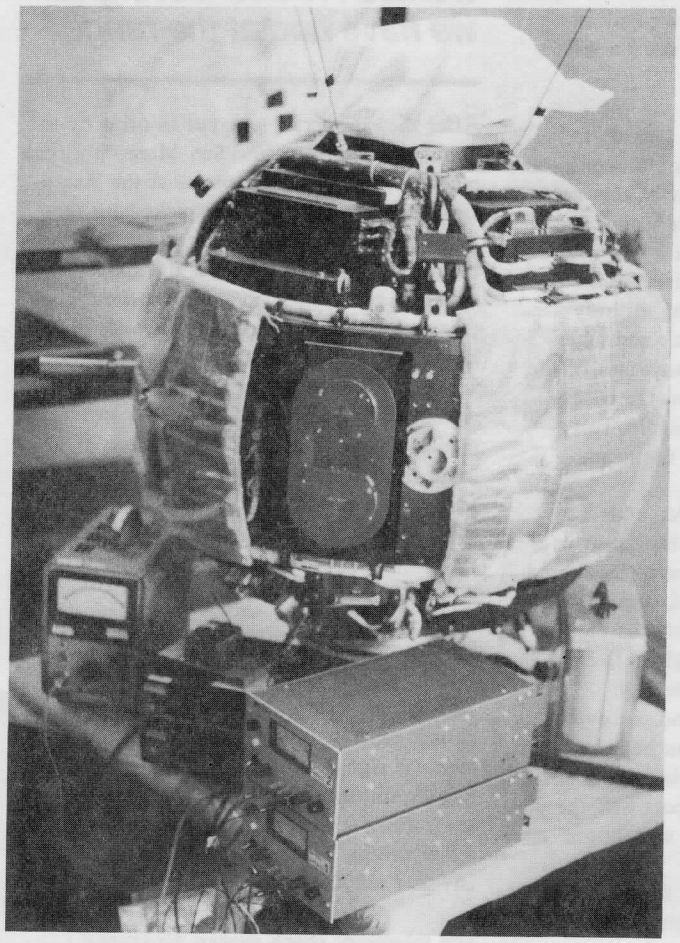
U.S. and Italy Cooperate to Launch San Marco Satellite

Data Center Plays Significant Role in International Program



The San Marco satellite calmly awaits its launch.

The Italian San Marco D satellite roared off the San Marco launching platform in Kenya at 1950:46 UT on March 25. NSSDC personnel had been awaiting the launch with anticipation, as NSSDC's role in this venture with Italy had been significantly broader than any preflight support the Data Center had given to satellite launches in the past.

This cooperative program with Italy is NASA's oldest international one. It was formalized in May 1962 and has resulted in the successful launching of San Marcos A, B, C, C2, and D. The Centro Ricerche Aerospaziali (CRA) of the University of Rome is the responsible Italian agency, and NASA's project activities are carried out by Goddard Space Flight Center (GSFC) personnel.

The San Marco platform, from which San Marco D was launched into a low-altitude, near-equatorial orbit, is located about three miles off the coast of Kenya, near Ungwana Bay. The Santa Rita platform, which serves as the launch control center and blockhouse, is 600 yards northwest of the San Marco platform. The San Marco Equatorial Range (SMER) consists of these two platforms and a base camp located next to the village of Ngomeni, about 18 miles north of the city of Malindi.

San Marco D carries a three-nation payload to continue the study of equatorial aeronomy begun by San Marco B. The payload consists of an Airlow and Solar Spectrometer Instrument (ASSI), supplied by the Federal Republic of Germany's space agency (principal investigator: G. Schmidtke, Institut fuer Physikalische Weltraumforschung); a Drag Balance Instrument (DBI), provided by CRA (principal investigator: L. Broglio, University of Rome); an Ion Velocity Instrument (IVI; principal investigator: W. Hansen, University of Texas at Dallas); an Electric Field Experiment (EFI;

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Message from the Director

On the Launch of San Marco

Jambo, from Kenya. San Marco D was successfully launched on Friday, March 25, at 10:50:46 PM (19:50:46 UT). For me, this launch was particularly special from two perspectives. Three NASA experiments were on board, and it has been a long time since GSFC scientists and their colleagues have received data from a new spacecraft. Also, NSSDC has been involved with the mission for over two and one-half years.

Kenya is a country of contrasts, with many poor villages for the Kenyans and superb hotels for the visitors. I am told that, overall, Kenya is one of the most prosperous countries within Africa, but, still, the difference is staggering.

Kenya had just entered into the rainy season, and the afternoon I arrived, Thursday, March 24, it had rained fairly hard in the morning. There are three main streets in Malindi, where we all were staying, that are paved but have no curb and have dirt parking areas in front of the shops and houses. The many side streets are all dirt, and the rains produced many mud pools. The launch personnel were worried that the weather was turning worse, so the launch was delayed from its Friday, 10:45 AM, launch time until the next launch window, 12 hours later.

In the midafternoon on Friday, Jim Vette took me to the base camp, some 30 km away on a road composed of dirt over a coral bed. The road is quite notable, since you could thoroughly shake test an experiment on the way to camp. It takes an hour to stop shaking after you arrive from the bone-jarring, 40-minute ride.

On that Friday afternoon, the sky was partly cloudy, the humidity was sweltering, and the temperature was high. The San Marco ground camp sits right on the beach, looking at the two platforms just three miles away in the Indian Ocean. One platform is where the spacecraft was launched, while the other housed the launch team and equipment. The tracking antennas were at the San Marco base camp on the coast. During that Friday afternoon, the many calls to GSFC over the dedicated NASCOM voice circuit continued to confirm that the weather during the next launch window, from 10:00 to 12:00 AM, would be acceptable for launch.

About 7:30 PM, four buses arrived with 160 to 180 Italians, Germans, Kenyans, and Americans to see the liftoff. They were mostly family members of personnel involved in the launch. By 8:30 PM, the buffet serving lines were open, and everyone lined up to partake of the plentiful food. After eating, they relaxed on the beach and waited.

About 20 minutes before the launch, I walked in front of the tracking antenna and telemetry shack. Sections of this area were roped off, and I was careful not to cross over the ropes. Within a few minutes, a guard walked over and requested that I move from the area, keeping entirely away from the telemetry shack and antenna. I moved to the far northern part of the camp and set up my tripod on the beach, leaning my camera against an old, rusty metal dock laying broken in the sand.

The launch came at 10:50 PM, with the countdown from 10 seconds broadcast over the loudspeaker at the base camp. Scattered clouds were moving overhead, and at the time of the Scout rocket liftoff the clouds provided a tremendously bright reflecting surface, lighting up the whole sky. Against the bright background, an even brighter inverted candle flame began to move upward, clearing the platform in about seconds. I did not expect half the sky to light up—everything was bright white, with a tint of orange. I took several shots, moving the camera for each one, while the Scout streaked through the frame.

The total length of time the rocket was visible was about 30 seconds. About 15 seconds after launch, the Scout began to make a large arch in the sky as it shot over the water. Finally, the sound of the takeoff came over us and, in a few more seconds, the Scout disappeared behind the clouds, but the sound kept coming.

Returning to the NASA support office in the only two-story building on the base camp, I picked up the NASCOM phone to listen in to the conversations between the Santa Rita platform (San Marco MOM) and the Goddard operators in Greenbelt (called "Goddard voice control"). The Goddard operators would patch calls into the link from tracking stations all over the world and key NASA centers such as GSFC/Wallops and Langley.

"It's great, everything worked . . . cleanest signal we have had at the range."

After the spacecraft was put in orbit by the Scout, Ron Adkins (the San Marco project manager) talked to personnel at the Ascension tracking station, who picked up the San Marco signal as it orbited overhead of them. Ron needed to know the spacecraft spin period. Ascension personnel said that they observed small variations, or knolls, in the amplitude of the incoming signal. The Ascension station lost the signal at 21:24:30 UT. With the loss of signal at Ascension, the San Marco antenna at the launch site moved rapidly. Within 10 minutes (21:33: UT), it had acquired the San Marco spacecraft signal. From the signal, all indications were that the orbit was "nominal" (what was expected).

Returning from the platform, Ron Adkins said to all on the NASCOM teleconference, "It's great, everything worked, inertia booms extended, spin rate is 30 rpms, cleanest signal we have had at the range." Ron continued, "After the first pass, we are putting it to bed and going to town for a few drinks." San Marco was in a 614 by 267 km orbit.

The telemetry shack picked up several minutes of housekeeping data (no instruments were turned on yet) on that first pass. The data were transmitted by microwave and ground communication lines to Rome, where the processing programs that we were involved in took over. From the Rome processing center, the processed

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Vette Plays Two Roles for NSSDC

For the past few years, Dr. James I. Vette, NSSDC chief scientist, has been playing dual roles.

In one role, Dr. Vette has led a small NSSDC effort to provide major support to the recently launched San Marco spacecraft. An accompanying article details the support provided in the areas of distributed science operations planning, orbit generation programs, sun sensor directionality analysis, star mapping and attitude determination, telecommunications, and data processing and data management. Some of these areas were extensions of earlier NSSDC activities, but others were entirely new responsibilities. The accomplishments of the NSSDC team has contributed in a major way to the success of the San Marco mission.

Dr. Vette's other key role in recent years has been as head of the NASA delegation to Panel 2 of the Consultative Committee for Space Data Systems. Under his leadership, the Panel 2 activities have yielded an increasingly accepted and used Standard Formatted Data Unit (SFDU). This tricky task has involved arbitrating a course simultaneously flexible and realistic.

During almost 20 years as NSSDC director, from the mid-1960s through the mid-1980s, Dr. Vette brought NSSDC from its infancy to maturity. As a scientist, he imbued NSSDC with the spirit of being part of the NASA team dedicated to extracting maximal scientific understanding from NASA spaceflight (and some other) data. With encouragement from George Pieper, his longtime supervisor, and with the support of workers such as Leo Davis and others, he defined NSSDC policies and procedures. This effort led to the building of a multidiscipline archive of 100,000 tapes and many miles of film, and an activity level of approximately 2,500 data and information requests annually.

Among his proudest accomplishments have been the Satellite Situation Center (SSC) and the Coordinated Data Analysis Workshop (CDAW) system. The SSC was established as a key element of the 1976-79 International Magnetospheric Study (IMS) to manage spacecraft orbit information in a way that, for instance, times of spacecraft conjunctions on magnetic field lines could be predicted. SSC use continues today. The CDAW system was introduced ten years ago as part of the IMS data analysis phase. It enables groups of scientists to gather and address complex space physics problems requiring online data from many sources throughout, below, and beyond the earth's magnetosphere. As with the SSC, the CDAW system has evolved with time and continues to be very important today. Most of the early vision on these efforts, both the "forests" and the "trees," were Dr. Vette's.

Dr. Vette has played a major role in the San Marco project for many years. Here, he poses alongside the satellite.

Another of Dr. Vette's main accomplishments, spanning most of his career, has been the creation of a series of quantitative, empirical models of energetic protons and electrons trapped in the earth's geomagnetic field. This activity, begun with NASA support even before he came to Goddard in January 1967, has been pursued with a series of colleagues. The models have been vital elements in predicting damage to people and things (e.g., microelectronics) in space during the planning for all U.S. spaceflights and many foreign agency missions.

Before coming to Goddard to head the new data center (then called the NASA Data Center), Dr. Vette worked at the Aerospace Corporation and at Convair in southern California. In addition to initiating his environmental modeling at Aerospace, he also was an active experimental scientist, having built and flown particle, X-ray, and gamma ray instruments on the ERS spacecraft series as part of the Vela satellite program. Among his early achievements were ERS measurements of the cosmic gamma ray background, revealing a bump of cosmologic origin; development of a balloon launching capability; and some of the first observations, from balloons, of high-energy solar X-rays.

Dr. Vette has a B.S. from Rice University and finished work for his Caltech Ph.D. just after the first Sputnik was launched. The doctoral work involved the production of mesons by 1 GeV photons generated by the Caltech synchrotron, which he helped to rebuild to go to the higher energies. His early years also included a three-year stint in the Air Force, where he taught radar electronics.

Dr. Vette and his wife, Zoe, have two sons and two daughters. They also have two grandchildren. They both have roots in the South and are longtime residents of Silver Spring, Maryland.

Joe King

San Marco, *from page 1*

principal investigator: N. Maynard, formerly GSFC, now Air Force Geophysics Laboratory); and a Wind and Temperature Instrument (WATI; principal investigator: N. Spencer, formerly GSFC, now University of Maryland).

NSSDC personnel participated strongly in the areas of science operations planning (SOP); sun sensor calibration, analysis, and data processing; Star Mapper validation and analysis; telecommunication system establishment; and data processing and data management. This came about because the whole concept of SOP had originated and become a reality, telecommunication had improved dramatically, and data processing concepts had changed radically during the extended length of the project. CRA did not have enough staff with expertise in these areas to keep the project capabilities up to date, so it solicited expertise available to NASA. NSSDC was selected for the job.

The most challenging part of the whole endeavor, according to Dr. James I. Vette, who led the NSSDC San Marco support, was to use '80s technologies while maintaining the spirit of the '60s and staying within budget limitations. Consequently new, small-scale approaches were developed to avoid the cost of operating large, general purpose systems. Additionally, the need for a consensus in operations decisions (not uncommon on international cooperative missions) added to the challenge, Vette said.

Science Operations Planning

Science operations planning activities have been growing in sophistication since the mid '70s. They reached an apex on an international scale during the International Magnetospheric Study (IMS), through the endeavors of the IMS Steering Committee and the NSSDC Satellite Situation Center. On a single satellite basis, the Solar Maximum Mission (SMM) is probably the pinnacle, with the International Ultraviolet Explorer (IUE) a close second. The Hubble Space Telescope operation will certainly exceed these in complexity.

The forward step made by San Marco was to provide for distributed SOP: The inputs percolated from the individual principal investigators (PIs), through the U.S. project scientist, to the spacecraft mission (operations) manager at the Rome Operations Control Center (OCC). Nelson Spencer, formerly at GSFC and now at the University of Maryland, has served as the U.S. project scientist since that role was established in the early '60s.

Orbit programs developed by NSSDC that could be run on either personal computers, LSI-11s, the IBM 4331, or the VAX computer family were a key contributing factor to the achievement of distributed science operations planning. As part of these programs, the appropriate parameters derived from the satellite position could be computed The unique part of the orbit work was the development of a simple orbit generator, with appropriate input elements that could be computed by a complex orbit program, such as GTDS, that was capable of producing orbital positions with an accuracy rivaling that of GTDS.

The program OPRMAV was issued about two years ago for operation on PCs and was used by the U.S. project scientist to develop his SOP procedures. A more accurate program, OPRMJ2, which was written in Fortran and utilized more orbit theory than OPRMAV, was released in February 1988. A revision that allows the code to be more transportable to the non-VAX portion of the San Marco community was issued in March 1988.

Sun Sensor

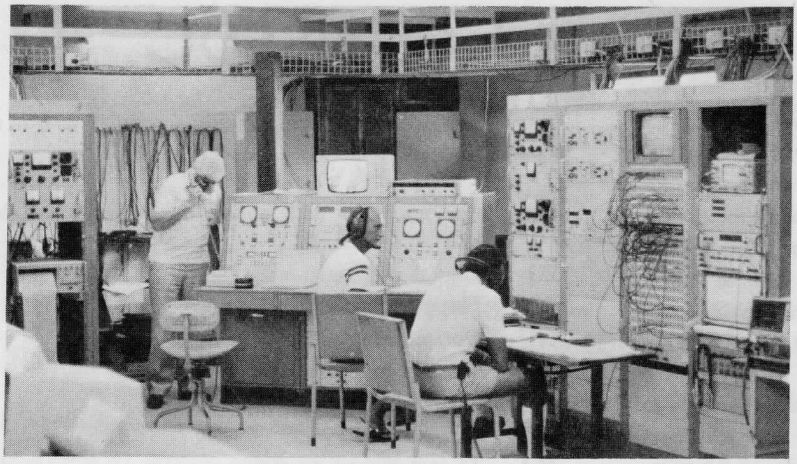
As was the case for many San Marco D sensors, the sun sensors had been mounted on the spacecraft many years before the launch, and it was not possible to validate their operating characteristics during the final solar-vac test. Therefore, a decision was made to confirm the bore sight positioning of the sensors on the spacecraft and the optical alignments within the sensors themselves as part of a spacecraft sun calibration test at Rome. NSSDC personnel directed the establishment of an accurate north-south direction at CRA by using stellar observations with a theodolite. They provided the elevation and azimuth angles of the sun at CRA as a function of time so the spacecraft could be properly positioned for each test.

During the analysis of the data, NSSDC personnel established that the algorithm supplied by the manufacturer for combining fine angle sensor and coarse angle sensor data was erroneous; they developed the proper algorithm. In addition, NSSDC staff members demonstrated that the data proved the "SIN" output of the electronics was wired backward, giving "- SIN" instead. Introducing these features into the analysis made it possible to conclude that the sensors were aligned to better than 0.005°. Unless there are unexpected thermal gradients in the on-orbit spacecraft, the sun sensors should provide the solar aspect to better than 0.01°. The data were sensitive enough to show the differences in the fine angle aperture masks to 0.001°. Without this calibration and the resulting analysis, the solar aspect could not be known to better than 0.5-1°.

Star Mapper

NSSDC personnel were requested to review the Star Mapper instrument and the attitude determination software about 15 months before launch. A study conducted by GSFC spacecraft dynamics personnel had shown that the minimum energy point of the spinning system would be far away from the planned spin vector position in San Marco D with the EFI antennas properly deployed. The planned position was with the angular momentum vector pointing northward, perpendicular to the orbit plane. Such a position would result in a rapid precession of the spin vector, which would require frequent attitude maneuvers to maintain the desired position. The recommendation by the dynamics personnel was to have the spin vector point southward instead of northward.

This brought about the NSSDC study and the use of the star simulator, which had been built years ago for San Marco by GSFC, to test the Star Mapper. In the northward pointing position the Star Mapper would see brighter stars (viewing negative declinations) than in the southward pointing position (viewing positive declinations). Since the gain of the Star Mapper photomultiplier tube could not be measured directly and its voltage could not be adjusted, it was difficult, but not impossible, to infer from the star simulator data that the upper limit of the photomultiplier



The control center for the San Marco project is located on the Santa Rita platform, off the Kenyan coast.

gain change had to be less than 25 percent. It is probable that no gain degradation occurred. This result was essential for southward pointing.

The review of the Star Mapper attitude determination software showed there were no deficiencies in the software except the impossibility of determining any spin misalignment. A program to handle the general case was begun by NSSDC personnel but was put on low priority when it was learned the long EFI antennas, if properly deployed, would damp out any initial misalignment. As a result of the NSSDC study and the recommendation of GSFC dynamics people, the Italians decided on a southward pointing spin vector.

Telecommunications

It might be thought that with the advanced technologies of the '80s it would be easy to establish a telecommunication system for San Marco. However, difficulties were encountered that were not technical in nature but rather were caused by existing regulations, political factors, and a heterogeneous computer environment (with some obsolescences).

Only synchronous modems can be used with the telephone systems in Europe–by regulation. Furthermore, in Italy the attenuation of the phones is such that it is very difficult to have a modem operate reliably. Except with some IBM systems, there are no synchronous modems used in the U.S.; certainly there are none within the U.S. San Marco community. NSSDC was given the responsibility to recommend the final system and to work with ESRIN (the European Space Agency's facility at Frascati, Italy) to establish the San Marco SPAN node at Frascati.

Quick Look Data

To obtain quick look data efficiently, the incoming pass files needed to be broken up into subfiles of approximately 82 seconds, with the pass file header inserted as the header for each subfile. A directory-like mechanism needed to be established so the PIs would know which subfiles were available for request. NSSDC personnel developed this program and made it operational. NSSDC is also in charge of managing the quick look disk files.

Data Processing and Data Management

Data processing and management is an area in which NSSDC does have interaction with most flight projects prior to launch. In the San Marco case, there were several additional aspects involved. Along with the San Marco Science Working Team, NSSDC developed the Distributed Data Format (DDF) for distribution of all data, starting with the zero-level processed data that are produced by Kenya. As the data are processed at the Rome OCC and NSSDC, this pass file maintains the same format. A pass file is initialized by setting each bit of the file to a binary zero. Then Kenya writes the zero-level data with appropriate header information in the proper fields.

The pass file header starts with two 20-byte labels that conform to the Consultative Committee for Space Data Systems (CCSDS) Standard Formatted Data Unit (SFDU) recommendation that was approved by all the agency members of CCSDS recently. This makes San Marco D the first orbiting satellite to use an SFDU for the transfer of space-related digital data; this transfer starts with the zero-level data. NSSDC personnel have been active for the past 2 1/2 years in CCSDS Panel 2, where the SFDU work is being done. It is a major milestone to have SFDUs in use on a flight program in its operational phase.

There are a number of projects in their data analysis and archiving phases that are about to use SFDUs and others in their preflight phase that are planning to use SFDUs. However, San Marco is the first project to formally use SFDUs, and this is primarily due to the unique involvement of NSSDC with San Marco D. The documentation of the DDF was completed before launch and is available from NSSDC, which serves as the NASA Control Authority within CCSDS for this information.

Upon completion of processing, the data will be available to the San Marco investigators through SPAN, and a tape will be sent to each requesting principal investigator or coinvestigator in the form most suitable for that requester's computer environment. A Project Data Management Plan, which is a formal agreement for transfer of data into the NSSDC archives, was completed in February. Sections remain to be filled in as the Science Working Team completes certain parts of the plan.

Discussions have been held to establish that the main archival product to be deposited at NSSDC will be reduced and analyzed data with a logical record determined by the spin period. The data will be submitted on optical disk(s) as an SFDU.

Besides Dr. Vette, NSSDC chief scientist, Helen Wu and Howard Leckner of SAR participated in this project, with the latter supplying nearly all of the computer programs. A somewhat more complete report on the San Marco mission and NSSDC's participation is available from the NSSDC Request Coordination Office or from Dr. James Vette.

James Vette and Karen Satin

New Data Sets Archived at NSSDC

The accompanying list gives a one-line description for each data set archived at NSSDC for which data were received between Jan. 1, 1987, and June 15, 1988. In some cases the received data were the first for the data set, and in some cases the data were for additional time periods. To keep the list brief, several types of data sets were omitted from this listing: routine ephemeris data sets, project data pool data sets, and data provided solely for the very limited time periods studied in CDAW.

The quantity of data entered in the list is the total quantity after addition of the new data received. Similarly, the time period given is the total time period covered after addition of the new data. Where the time interval is absent, it is either not appropriate for that data set or it has not yet been verified during processing after receipt of the data at NSSDC. For each data set, there is a preceding one-line descriptive name of the experiment that produced it, and for each experiment there is a preceding line for the spacecraft on which it was flown. For the spacecraft entries, the "Contact" field gives the country and/or agency responsible for the launch.

The "Form" codes for data storage medium are as follows:

DD	Digital magnetic tapes
DF	Floppy disks
DK	Optical disk
FR	4 x 6 inch microfiche, b/w, cards
HI	8 x 10 inch pages
HT	Unbound hard copy
MO	35 mm microfilm reels
MP	16 mm microfilm reels
RO	35 mm color slides
UI	8 x 10 inch b/w positive film, frames
VI	8 x 10 inch color positive film, frames
YI	8 x 10 inch b/w negatives, frames
YV	5 x 5 inch b/w negatives, frames

SATELLITE NAME	NSSDC ID	IDENTIFICATION		CONTACT	FORM	QNTY	TIME SPAN OF DATA
AMPTE/CCE	84-088A	AMPTE/CCE	08/16/84	GSFC			
	84-088A-01	AMPTE/CCE,HOT PLASMA COMPOSITION		SHELLEY			
	84-088A-01A	COLOR SPECTROGRAMS,SLIDES		NYLUND	RO	8650	081784 010186
	84-088A-01B	6.4-MIN, MASS-ENERGY SPECTRA,POOL		NYLUND	DD	3	081684 123184
	84-088A-02	AMPTE/CCE,MED. ENERGY PART ANALYZ		MCENTIRE			
	84-088A-02A	COLOR SPECTROGRAMS,SLIDES		NYLUND	RO	8650	081784 010186
	84-088A-02B	6.4-MIN,MASS-ENERGY SPECTRA, POOL		NYLUND	DD	3	081684 123184
	84-088A-03	AMPTE/CCE,CHARGE-E-MASS SPECTROM		GLOECKLER			
	84-088A-03A	COLOR SPECTROGRAMS,SLIDES		NYLUND	RO	8650	081784 010186
	84-088A-03B	CHARGE-ENERGY-MASS SPECTRUM SFDU		NYLUND	DD	2	082884 123184
	84-088A-04	AMPTE/CCE,PLASMA WAVE EXPERIMENT		SCARF			
	84-088A-04A	SURVEY PLOTS, MICROFICHE		NYLUND	FR	65	082784 123185
	84-088A-04B	62-S AVERAGE & PEAK VALUES, SFDU		NYLUND	DD	1	081784 123184
	84-088A-05	AMPTE/CCE,CCE MAGNETOMETER		POTEMRA			
	84-088A-05A	SURVEY PLOTS, MICROFICHE		NYLUND	FR	65	082784 123185
	84-088A-05B	MAGNETIC FIELD VECTOR SFDU		NYLUND	DD	1	081884 123184
AMPTE/IRM	84-088B	AMPTE/IRM	08/16/84	DFVLR			
	84-088B-02	IRM, MAGNETOMETER		LUEHR			
	84-088B-02B	5-S AVER MAG.FIELD VECTORS, TAPE		PASCHMANN	DD	23	032185 110985
	84-088B-03	IRM, PLASMA INSTRUMENT		PASCHMANN			
	84-088B-03B	5-S AVER PLASMA PARAMETERS, TAPE		PASCHMANN	DD	23	032185 110985
	84-088B-04	IRM, PLASMA WAVE INSTRUMENT		HAUSLER			
	84-088B-04B	5-S AVER PLASMAWAVE AMPLITUDES,TP		PASCHMANN	DD	23	032185 110985
	84-088B-06	IRM,SUPRATHERMAL IONIC CHARG ANAL		HOVESTADT			
	84-088B-06A	5-S AVER SUPRATHRMAL IONS, TAPE		PASCHMANN	DD	23	032185 110985
DYNAMICS EXPLORER 1	81-070A	DYNAMICS EXPLORER 1	08/03/81	NASA			
	81-070A-00G	OPER. TIMES--OVERLAY ON AE PLOTS		HOFFMAN	UI	26	080481 021883
DYNAMICS EXPLORER 2	81-070B	DYNAMICS EXPLORER 2	08/03/81	NASA-OSS			
	81-070B-00F	OPER. TIMES--OVERLAY ON AE PLOTS		HOFFMAN	UI	26	080481 021883
	81-070B-00G	DATA ACQUISITION TIMES, FICHE		HOFFMAN	FR	2	080181 021883
ERBS	84-108B	ERBS	10/05/84	NASA-GSFC			
	84-108B-01	ERBS,EARTH RADN BUDGET EXP/ERBE		BARKSTROM			
	84-108B-01A	RAW ARCHIVAL TAPE (RAT)		KIBLER	DD	149	110484 020186
	84 108B-01C	PROC ARCH TP(PAT) IMAGES ON OP DK		KIBLER	DK	2	

SATELLITE NAME	NSSDC ID	IDENTIFICATION	CONTACT	FORM	QNTY	TIME SPAN OF DATA
	84-108B-01D	RAW ARCH TP(RAT) IMAGES ON OP DSK	KIBLER	DK	3	
	84-108B-02	ERBS,STRATO AROSOL & GAS EXP/SAGE	MCCORMICK			
	84-108B-02A	MET,EPHEM,RAW ARCHIV TAPE (MERDAT	MCMASTER	DD	51	110184 113086
	84-108B-02B	SAGE II OZONE PROFILE ARCH. TAPE	MCMASTER	DD	2	110184 113087
	84-108B-02C	SAGE II AEROSOL PROFIL ARCH. TAPE	MCMASTER	DD	2	100584 113087
EXOSAT	83-051A	EXOSAT 05/26/83	ESA			
	83-051A-00D	EXOSAT OBSERVATION LOG (1987)	WARREN	DD	1	061983 040886
GIOTTO	85-056A	GIOTTO 07/02/85	ESA/ESTEC			
	85-056A-03	GIOTTO, ION MASS SPECTROMTR(IMS)	BALSIGER			
	85-056A-03A	PROTON AND LIGHT ION MOMENTS	FUSELIER	DD	1	031386 031486
	85-056A-03B	MODEL PROTON & LIGHT ION MOMENTS	FUSELIER	DD	1	031386 031486
GOES 1	75-100A	GOES 1 10/16/75	NOAA-NESS			
	75-100A-01	GOES 1,V/IR SPIN-SCAN RAD (VISSR)	NESS STAF			
	75-100A-01D	VISSR IR/VIS AOIPS IMAGE TAPES	PUCCINELL	DD	4602	071975 061178
HEAO 2	78-103A	HEAO 2 11/13/78	NASA-MSFC			
	78-103A-03	HEAO 2, CRYSTAL XRAY SPECTROMETER	GIACCONI			
	78-103A-03C	FPCS REDUCED DATA TAPES	MARKERT	DD	17	
HEAO 3	79-082A	HEAO 3 09/20/79	NASA-MSFC			
	79-082A-03	HEAO 3, HEAVY NUCLEI	ISRAEL			
	79-082A-03A	HEAVY NUCLEI REDUCED DATA-GOLD	GARRARD	DD	21	
	79-082A-03B	HEAVY NUCLEI REDUCED DATA-COBALT	GARRARD	DD	11	
	79-082A-03C	HEAO C-3 VERIFY PROGRAM	GARRARD	DD	1	
IMP-H	72-073A	IMP-H 09/23/72	NASA-GSFC			
	72-073A-00H	TRAJECTORY PLOTS, MFICHE	MILLIGAN	FR	7	092672 092578
	72-073A-01	IMP-H,TRI-AXIS MAGNETOMETER	NESS			
	72-073A-01D	320 MSEC MAGNETIC FIELD VECTORS	KING	DD	49	
IMP-J	73-078A	IMP-J, EXPLORER 50 10/26/73	US			
	73-078A-00E	TRAJECTORY PLOTS, MFICHE	SULLIVAN	FR	16	103073 011188
	73-078A-01	IMP-J,TRI-AXIS MAGNETOMETER	NESS			
	73-078A-01A	15 SEC AVGD MAGNETIC VECTORS,TAPE	LEPPING	DD	45	103073 052786
	73-078A-01C	15 SEC AVGD MAG FLD PLOTS, MFILM	LEPPING	MP	23	103073 121386
	73-078A-01E	24-HR MAG FLD SUMMARY PLOTS,FICHE	RUSSELL	FR	33	102277 042283
	73-078A-02	IMP-J,SOLAR PLASMA,FARA.CUP	BRIDGE			
	73-078A-02A	INTERPLANETARY HOURLY AVERAGES	BRIDGE	DD	5	010176 080787
	73-078A-02G	1-2 MINUTE RESOLUTION PLASMA PARA	LAZARUS	DD	5	103173 111486
	73-078A-03	IMP-J,SOL.IONS+ELECT,100KEV	GLOECKLER			
	73-078A-03C	SUMMARY DATA ON MAG TAPE	GLOECKLER	DD	33	103073 090787
	73-078A-04	IMP-J,ELEC+PROT,25EV-50KEV	FRANK			
	73-078A-04C	COLOR E-T SPECTROGRAMS, SLIDES	FRANK	RO	2947	111573 070186
	73-078A-07	IMP-J,COSMIC RAY NUCLEAR COMP	SIMPSON			
	73-078A-07A	RATE AND PHA DATA TAPES	MURPHY	DD	493	103073 091185
	73-078A-07B	5.46-MIN AVG COUNT RATES ON TAPE	MURPHY	DD	16	103073 092985
	73-078A-07C	SOL. ROT. COUNT-RATE PLOTS, MFILM	MURPHY	MO	12	103073 082285
	73-078A-09	IMP-J,COSMIC RAYS(E VS DE/DX)	MCDONALD			
	73-078A-09A	1-HR AVGD,20-40 MEV PROTON FLUX	KING	DD	3	080175 123184
	73-078A-09B	1-HR AVGD,40-80 MEV PROTON FLUX	KING	DD	3	090175 123184
IRAS	83-004A	IR ASTRON. SAT., NETH. 01/25/83	NIVR-JPL			
	83-004A-01	IRAS, IR TELESCOPE	BEICHMAN			
	83-004A-01K	SKY PLATE (HCON 3) DATA ON TAPE	CHESTER	DD	24	
	83-004A-01c	ASTEROID AND COMET SURVEY	TEDESCO	DD	1	
	83-004A-01d	SERENDIPITOUS SURVEY CAT.	BEICHMAN	FR	10	
	83-004A-01e	SERENDIPITOUS SURVEY CATALOG	KLEINMANN	DD	1	
	83-004A-01f	SURF BRIGHT MAPS OF LARGE OPT GAL	CHESTER	DD	1	
ISEE 1	77-102A	ISEE 1 10/22/77	NASA-GSFC			
	77-102A----	DATA POOL TAPE,MULTIPLE EXPERMNTS	SCHMIDT	DD	21	102277 092687
	77-102A-00E	MULTI-COORD PLOTS, MFICHE	RUSSELL	FR	172	102277 092687
	77-102A-00G	ATTITUDE-ORBIT LISTINGS, MFICHE	RUSSELL	FR	701	102277 122086
	77-102A-00I	GND MAG FLD LINE INTERCEPT PLOTS	SAUNDERS	FR	22	102477 091487

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	77-102A-03	ISEE 1,HOT PLASMA	FRANK			
	77-102A-03D	E-T SPECTGMS,CHAN 1P,1E&6P,SLIDES	FRANK	RO	3206	010182 092687
	77-102A-04	ISEE 1,FLUXGATE MAGNETOMETER	RUSSELL			
	77-102A-04G	24-HR MAG FLD SUMMARY PLOTS,FICHE	RUSSELL	FR	125	102277 122785
	77-102A-04Q	ONE-MINUTE AVERAGED MAGNETIC FLD	RUSSELL	DD	61	011380 011084
	77-102A-04R	24-HR DETRENDED SUMMARY PLOTS,FCH	RUSSELL	FR	23	011280 121783
	77-102A-10	ISEE 1,ELECTRONS AND PROTONS	ANDERSON			
	77-102A-10F	32 SEC AVG SURVEY PLOTS ON MFICHE	PARKS	FR	84	010279 063080
	77-102A-12	ISEE 1,ION COMPOSITION	SHARP			
	77-102A-12F	SUMMARY: R-FILES (FORMAT4)	LENNARTSS	DD	13	123077 123079
ISEE 2	77-102B	ISEE 2 10/22/77	ESA			
	77-102B-00E	ATTITUDE-ORBIT LISTINGS, MFICHE	RUSSELL	FR	700	102277 122086
	77-102B-00G	GND MAG FLD LINE INTERCEPT PLOTS	SAUNDERS	FR	23	102477 091487
	77-102B-00I	MULTI-COORDINATE EPHEMERIS, TAPE	PALMER	DD	145	
	77-102B-04	ISEE 2,FLUXGATE MAGNETOMETER	RUSSELL			
	77-102B-04K	4-SEC AVGD MAG FIELD PLOTS,MFICHE	RUSSELL	FR	615	102277 062986
	77-102B-04N	24-HR DETRENDED SUMMARY PLOTS,FCH	RUSSELL	FR	17	102277 011380
	77-102B-08	ISEE 2,ELECTRONS AND PROTONS	ANDERSON			
	77-102B-08D	32 SEC AVG SURVEY PLOTS ON MFICHE	PARKS	FR	109	010279 123180
ISEE 3	78-079A	ISEE 3 08/12/78	NASA-GSFC			
	78-079A----	DATA POOL TAPE,MULTIPLE EXPERMNTS	SCHMIDT	DD	10	081278 011087
	78-079A-00E	JPL TRAJ COMET G-Z ENCOUNTER	WOLF	DD	1	091085 091285
	78-079A-02	ISEE 3,MAGNETIC FIELDS	SMITH			
	78-079A-02D	1-MIN,1-H &1-D AVGD MAGNETOM DATA	WOLF	DD	40	081378 123185
	78-079A-07	ISEE 3,PLASMA WAVES	SCARF			
	78-079A-07A	24-H PLASMA WAVE SUMRY PLTS,FICH	SCARF	FR	57	081278 123186
	78-079A-10	ISEE 3,RADIO MAPPING	STEINBERG			
	78-079A-10C	90-MIN + 24-HR SURVEY PLOTS,FICHE	STONE	FR	2902	081378 020787
	78-079A-14	ISEE 3, X- AND GAMMA-RAY BURSTS	ANDERSON			
	78-079A-14A	32-SEC AVGD WEEKLY PLOTS,MFICHE	ANDERSON	FR	407	081278 020787
	78-079A-14B	32-SEC AVGD WEEKLY LISTING,MFICHE	ANDERSON	FR	2080	081278 020787
ISS-B	78-018A	ISS-B 02/16/78	NASD-RRL			
	78-018A-01	ISS-B,SWEPT-FREQ TOPSDE SOUNDER	AIKYO			
	78-018A-01A	FOF2 MODELS FOR 6 4-MONTHS PERIOD	MATUURA	DD	1	081178 121379
	78-018A-01B	TOPSIDE IONOGRAMS, MICROFICHE	MATUURA	FR	392	032478 070281
	78-018A-01C	SUMMARY PLOTS ON MICROFICHE	MATUURA	FR	18	061878 033180
	78-018A-02	ISS-B,RADIO NOISE RECEIVER	KATOH			
	78-018A-02A	RADIO NOISE DATA ON MICROFICHE	MATUURA	FR	375	022578 051082
	78-018A-02B	MAPS OF THUNDERSTORM ACTIVITY FIC	KOTAKI	FR	2	060178 053180
	78-018A-03	ISS-B,SPHERICAL RET POTENT TRAP	SAGAWA			
	78-018A-03A	ELEC DEN+TE,ION TE+COMP+MASS FICH	BILITZA	FR	2	081178 043080
	78-018A-04	ISS-B,BENNETT ION MASS SPECTROM	IWAMOTO			
	78-018A-04B	ELEC DEN+TE,ION TE+COMP+MASS FICH	IWAMOTO	FR	2	081178 040380
	78-018A-04C	SUMMARY PLOTS ON MICROFICHE	MATUURA	FR	18	081678 033180
IUE	78-012A	IUE, INT. UV EXPLORER 01/26/78	NASA-ESA			
	78-012A-01	IUE, ULTRAVIOLET SPECTROGRAPH	NASA GSFC			
	78-012A-01A	IUE SPECTROSCOPIC IMAGE DATA, FLM	WARREN	YI	49674	062078 032588
	78-012A-01B	SPECTROSCOPIC IMAGE DATA ON TAPE	WARREN	DD	665	040178 063087
	78-012A-01C	EUROPEAN SPECT. IMAGE DATA	WARREN	DD	262	040178 063087
	78-012A-01D	EXTRACTED SPECTRA ON TAPE	WARREN	DD	258	040178 063087
	78-012A-01E	IUE (NASA/VILSPA) MERGED OBS LOG	WARREN	FR	21	040178 033185
	78-012A-01J	ATLAS O-TYPE SPECTRA (1987)	WARREN	DD	1	
MAGSAT	79-094A	MAGSAT 10/30/79	NASA-GSFC			
	79-094A-01	MAGSAT, SCALAR MAGNETOMETER	LANGEL			
	79-094A-01P	EQUIV SOURCE DIPOL SOL, SCAL, TAP	LANGEL	DD	1	
	79-094A-02	MAGSAT, VECTOR MAGNETOMETER	LANGEL			
	79-094A-02T	65S-65N VECTOR ANOMALY COMPS, TP	LANGEL	DD	1	
	79-094A-02U	EQUIV SOURCE DIPOL SOL, VECTOR TP	LANGEL	DD	1	

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NIMBUS 4	70-025A	NIMBUS 4 04/08/70	NASA-GSFC			
	70-025A-05	NIMBUS 4,BACKSCATTER UV SPEC(BUV)	HEATH			
	70-025A-05Q	TOTAL + PROFILE O3 TP (HDBUV)	HEATH	DD	15	041070 050677
NIMBUS 6	75-052A	NIMBUS 6 06/12/75	NASA-GSFC			
	75-052A-02	NIMBUS 6, HIGH RES IR SNDER(HIRS)	SMITH			
	75-052A-02B	HIRS/SCAMS RADN, TMP+HUMIDITY TP	REPH	DD	268	081775 030476
	75-052A-10	NIMBUS 6,SCANNING MICROWAVE SPECT	STAELIN			
	75-052A-10C	HIRS/SCAMS RADN,TMP+HUMIDITY TP	REPH	DD	268	081775 030476
NIMBUS 7	78-098A	NIMBUS 7 10/24/78	NASA-GSFC			
	78-098A-06	NIMBUS 7,SAM-11,STRAT AEROSOL MEA	MCCORMICK			
	78-098A-06B	BETA-AEROSOL NO DEN ARCH (BANAT)	MCCORMICK	DD	99	110178 013087
	78-098A-07	NIMBUS 7,ERB-EARTH RADIATN BUDGET	JACOBOWIT			
	78-098A-07A	RADN BUDGET MASTER ARCH TP,MAT	JOCOBOWIT	DD	1086	111678 102986
	78-098A-07B	SOLAR + EARTH FLUX DATA TP(SEFDT)	STOWE	DD	96	110178 103186
	78-098A-07C	MAPPED RADN DATA MATRIX TP	STOWE	DD	94	111678 103186
	78-098A-07H	POST MAT CALIBRATION TP (DELMAT)	STOWE	DD	76	110586 050587
	78-098A-07I	SEASONAL AVG RADN BUDGET(SAVER)	STOWE	DD	29	120278 030186
	78-098A-08	NIMBUS 7,SMMR-SCNNG MICROWAVE RAD	GLOERSEN			
	78-098A-08A	ANTENNA TEMPERATURE TAPE (TAT)	GLOERSON	DD	713	102578 040988
	78-098A-08B	HOR+VER POLRTZ BRGH TMP(CELL-ALL)	GLOERSON	DD	528	102978 082587
	78-098A-08C	SEA ICE,PARM 37-GHZ CHAN(PARM-30)	GLOERSON	DD	394	102978 102986
	78-098A-08D	PARAM OF LAND AND OCEAN (PARM-LO)	GLOERSON	DD	243	102978 102986
	78-098A-08E	PARAM SEA ICE,SNOW+ICE (PARM-SS)	GLOERSON	DD	243	102978 102986
	78-098A-08W	CALIBRATED TEMPERATURE TAPE (TCT)	GLOERSON	DD	535	102578 082087
	78-098A-08Y	0.5-DEG CAL. TEMP MAP (TCT) TAPE	HWANG	DD	129	102578 050287
	78-098A-08Z	0.25-DEG CAL. TEMP MAP (TCT) TAPE	HWANG	DD	36	102578 082087
	78-098A-08a	SMMR PARMAP DATA ON TAPE	GLOERSEN	DD	6	110383 103185
	78-098A-08c	COLORADO R SNOW PARM ATLAS DISK	HAN	DF	15	120578 042186
	78-098A-09	NIMBUS 7,BUV/TOMS-BACKSC UV/OZONE	HEATH			
	78-098A-09C	HDTOMS TOTAL OZONE DATA TAPE	KRUEGER	DD	162	103178 051688
	78-098A-09D	SBUV TOTAL+PROFIL OZON TP(HDSBUV)	FLEIG	DD	51	103178 021287
	78-098A-09E	RAW UNITS TAPE-TOMS (RUT-T)	KRUEGER	DD	779	103178 042488
	78-098A-09F	RAW UNITS TAPE-SBUV DATA (RUT-S)	HEATH	DD	494	103178 042488
	78-098A-09K	SBUV ZONAL MEANS OZONE TP(ZMT-S)	HEATH	DD	7	103178 092985
	78-098A-09Q	SBUV CMPRES PROFIL OZONE TP(CPOZ)	FLEIG	DD	10	103178 021287
	78-098A-09R	DAILY GRID TOMS O3 TP(GRIDTOMS)	KRUEGER	DD	15	103178 063087
	78-098A-09U	SBUV CONT SCAN EARTH RAD TP,EARTH	HEATH	DD	7	110478 101585
	78-098A-09V	SBUV CONT SCAN SOLAR FLUX TP,SUNC	HEATH	DD	7	110478 101585
	78-098A-09W	SBUV 1-DAY O3+PROFIL CONTR(PSC)TP	MILLER	DD	7	110778 093086
	78-098A-10	NIMBUS 7,TEMP-HUMID IR RAD (THIR)	STOWE			
	78-098A-10D	CLOUD DATA ERB FORMAT (NCLE)	SISSALA	DD	1036	103078 033185
	78-098A-10F	CLOUD DATA (C-MATRIX)	SISSALA	DD	7	040179 103184
NOAA 9	84-123A	NOAA 9 12/12/84	NOAA-NASA			
	84-123A-05	EARTH RADN BUDGET EXP (ERBE)	BARKSTROM			
	84-123A-05A	RAW ARCHIVAL TAPE (RAT)	KIBLER	DD	120	040185 020186
	84-123A-05C	RAW ARCH TP(RAT) IMAGES ON OP DSK	KIBLER	DK	1	
OAO 3	72-065A	OAO 3, COPERNICUS 08/21/72	NASA-GSFC			
	72-065A-01	OAO 3, REFL. TELESCOPE,800-3000A	SPITZER			
	72-065A-01J	UV EXPERIMENT OBSERVING HISTORY	JENKINS	HI	145	
	72-065A-01K	GAMMA PEGASI UV ATLAS	ROGERSON	DD	1	
	72-065A-01L	COPERNICUS UV ATLAS OF SIRIUS	ROGERSON	DD	1	
PIONEER 10	72-012A	PIONEER 10, PIONEER F 03/03/72	NASA-ARC			
	72-012A-00G	ATTITUDE + HEC TRAJECTORY (VAX VR	KAYSER	DD	1	041872 082887
	72-012A-02	PIONEER 10,CHARGED PARTICLE COMP	SIMPSON			
	72-012A-02B	PULSE HEIGHT ANALYSIS DATA, TAPES	SCHROEDER	DD	58	030372 123185
	72-012A-02C	5-MIN AVG. COUNT RATE TAPES	SCHROEDER	DD	25	030372 123185
	72-012A-04	PIONEER 10,METEOROID DETECTOR	KINARD			
	72-012A-04B	COMPLETE EVENT TIMES,CHN.0+1,FICH	HUMES	FR	1	060972 083080

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	72-012A-13	PIONEER 10,2 QUAD'SPHERE ANALYZRS	WOLFE			
	72-012A-13I	FULL HISTORY SOLAR WIND (VAX VER)	KAYSER	DD	1	041872 121586
	72-012A-13J	HR AVG SOLAR WIND PRO+MNT(VAX VER	KAYSER	DD	1	041872 121386
	72-012A-13K	DAILY AVG SOLAR WIND PRO+MNT (VAX	KAYSER	DD	1	041872 110486
PIONEER 11	73-019A	PIONEER 11 04/06/73	NASA-ARC			
	73-019A-00F	ATTITUDE + HEC TRAJECTORY (VAX VR	KAYSER	DD	1	042173 102287
	73-019A-02	PIONEER 11,CHARGED PARTICLE COMP	SIMPSON			
	73-019A-02A	15-MIN PULSE HEIGHT TAPES	SCHROEDER	DD	51	040773 123185
	73-019A-02B	5-MIN SECTORED COUNT-RATE TAPES	SCHROEDER	DD	24	040773 123185
	73-019A-04	PIONEER 11, METEOROID DETECTOR	KINARD			
	73-019A-04C	COMPLETE EVENT TIMES,CHN.0+1,FICH	HUMES	FR	1	040673 030384
	73-019A-13	PIONEER 11,2 QUAD'SPHERE ANALYZRS	WOLFE			
	73-019A-13H	FULL HISORY SOLAR WIND (VAX VER)	KAYSER	DD	1	042173 050886
	73-019A-13I	DAILY AVG SOLAR WIND PRO+MNT(VAX	KAYSER	DD	1	042173 050486
	73-019A-13J	HR AVG SOLAR WIND PRO+MNT(VAX VER	KAYSER	DD	1	042173 041786
	73-019A-14	PIONEER 11, FLUXGATE MAGNETOMETER	ACUNA			
	73-019A-14C	JOVIAN ENCOUNTER,36-S AVGS, TAPE	OTTENS	DD	1	120374 120374
	73-019A-14D	SATURN ENCOUNTER,1+2-MIN AVS,TAPE	OTTENS	DD	1	090179 090179
PIONEER VENUS 1	78-051A	PIONEER VENUS ORBITER 05/20/78	NASA-ARC			
	78-051A-00D	ORBIT PLOTS, MFICHE	RUSSELL	FR	102	120578 072287
	78-051A-00E	ATTITUDE-ORBIT LISTINGS, MFICHE	RUSSELL	FR	607	120578 112987
	78-051A-00H	EPHEMERIS, TAKEN FROM SEDR, TAPE	CRAIG	DD	36	120578 122478
	78-051A-06	PIO780R, CLOUD PHOTOPOLARIMETER	TRAVIS			
	78-051A-06B	DIGITAL MAP IMAGES ON MAG TAPE	TRAVIS	DD	64	120878 111983
	78-051A-12	PIO780R-TRIAX FLUXG MAGNETOMETER	RUSSELL			
	78-051A-12E	HI-RES, 12-S, & 2-MIN B & E PLOTS	RUSSELL	FR	1512	120578 090584
	78-051A-13	PIO780R-ELECTRIC FIELD DET.	SCARF			
	78-051A-13C	HI-RES, 12 S, & 2 MIN B & E PLOTS	RUSSELL	FR	1512	120578 090584
	78-051A-13E	12-S B & E FIELD PERIAPSIS (OEFD)	RUSSELL	DD	4	120578 052883
	78-051A-17	PIO780R, ION MAS SPECT.(1-60 AMU)	TAYLOR			
	78-051A-17B	12-SEC ION DENSITIES(REPLACES17A)	TAYLOR	DD	3	120578 021887
	78-051A-17C	OIMS HI-RES DATA BASE	TAYLOR	DD	8	120578 022587
PROGNOZ 6	77-093A	PROGNOZ 6 09/22/77	IKI			
	77-093A-01	PROGNOZ 6,3-AXIS FLUX MAGNETOMETR	EROSHENKO			
	77-093A-01A	5-MIN AVER B-FIELD VECTOR,TAPE	DOLGINOV	DD	1	092677 012478
PROGNOZ 7	78-101A	PROGNOZ 7 10/30/78	USSR			
	78-101A-01	PROGNOZ 7, PLASMA SPECTROMETER	VAISBERG			
	78-101A-01A	H+ & HE++ FLUX, V, T, & DEN, TAPE	FELDSTEIN	DD	1	110378 061279
	78-101A-04	PROGNOZ 7,THREE-AXIS FLUX MAG	DOLGINOV			
	78-101A-04A	5-MIN AVERAGED MAG FIELD VECTOR	FELDSTEIN	DD	1	111078 060279
PROGNOZ 10	85-033A	PROGNOZ 10 04/26/85	USSR			
	85-033A-02	PR10,ENERG PARTCLS/SHOCKS, ECHNUV	LUTSENKO			
	85-033A-02A	HR-AVG ENERGETIC E-,H+,HE++,&B	LUTSENKO	DD	1	042685 110585
	85-033A-03	PR10,TRIAXIAL FLUXGATE MAG, SG-76	EROSHENKO			
	85-033A-03A	10-MIN AVER B-FIELD VECTOR	EROSHENKO	DD	2	042785 110485
	85-033A-03B	HR-AVG B & ENERGETIC E-,H+,HE++	FELDSTEIN	DD	1	042685 110585
SME	81-100A	SME 10/06/81	NASA-OSS			
	81-100A-01	LIMB VIEWING UV OZONE SPECTROMETR	BARTH			
	81-100A-01A	DAILY AVG OZONE MIX RATIO PFL,TP	THOMAS	DD	3	123081 093085
	81-100A-01B	OZONE RADIANCE DATA, TAPE	THOMAS	DD	17	121681 121886
	81-100A-01C	DAILY ORBITAL OZONE PROFILE, TAPE	THOMAS	DD	4	
	81-100A-01D	MONTHLY AVG OZON MIX RATIO PFL,TP	THOMAS	DD	2	
	81-100A-02	SME, INFRARED RADIOMETER	BARTH			
	81-100A-02A	IRR, LIMB RAD PROF. 6.8 & 9.6 MIC	THOMAS	DD	8	
	81-100A-03	NEAR IR(1.27-MICRON) SPECTROMETER	BARTH			
	81-100A-03A	DAILY AVG OZONE MIX RATIO PFL,TP	BARTH	DD	3	123081 093085
	81 100A-03B	RADIANCE DATA, TAPE	THOMAS	DD	52	121681 093086
	81-100A-03C	DAILY ORBITAL OZONE PROFILE, TAPE	THOMAS	DD	4	

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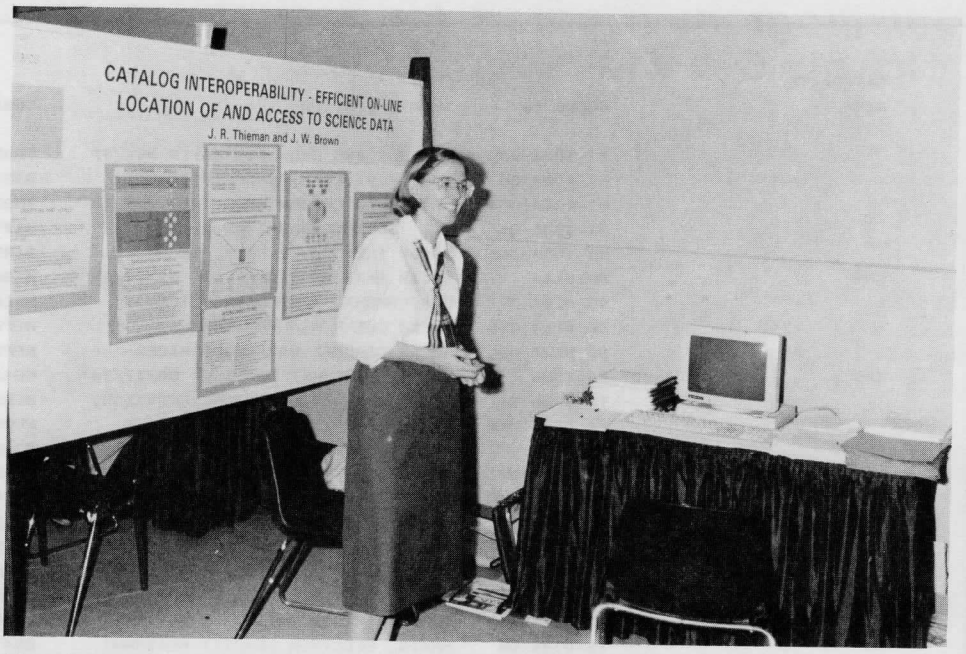
	81-100A-03D	MONTHLY AVG OZON MIX RATIO PFL,TP		THOMAS	DD	2	
	81-100A-04	SME, VISIBLE NITROGEN DIOXIDE		BARTH			
	81-100A-04A	DAILY AVG COLUMN NO2, TAPE		THOMAS	DD	25	010182
	81-100A-05	SME, SOLAR UV MONITOR		BARTH			
	81-100A-05A	SOLAR IRRADIANCE DATA, TAPE		BARTH	DD	1	010182 093085
SMM	80-014A	SOLAR MAX. MISSION	02/14/80	NASA-GSFC			
	80-014A-01	SMM CORONAGRAPH/POLARIMETER		MACQUEEN			
	80-014A-01B	GREEN CLEAR H-ALPHA IMAGES		REPPERT	MO	13	031180 092380
	80-014A-01C	SOLAR CORONAL POLAROID IMAGES		REPPERT	MO	14	030880 092380
SMS 1	74-033A	SMS 1, SYNC MET SAT 1	05/17/74	NOAA-NASA			
	74-033A-01	SMS 1,SPIN-SCAN RADIOMETER(VISSR)		NESS STAF			
	74-033A-01D	AOIPS IR + VISIBLE IMAGE TAPES		PUCCINELL	DD	5472	051774 092675
SMS 2	75-011A	SMS 2, SYNC MET SAT 2	02/06/75	NOAA-NASA			
	75-011A-04	SMS 2,SPIN-SCAN RADIOMETER(VISSR)		NESS STAF			
	75-011A-04D	AOIPS IR + VISIBLE IMAGE TAPES		PUCCINELL	DD	4278	081274 091279
SRATS	75-014A	SRATS	02/24/75	ISAS			
	75-014A-01	SRATS, SOLAR X-RAY MONITOR		MATSUOKA			
	75-014A-01A	SUMMARY PLOTS, MFICHE		OYAMA	FR	7	022575 051976
	75-014A-02	SRATS, HYDROGEN LYMAN ALPHA		OSHIO			
	75-014A-02A	SUMMARY PLOTS, MFICHE		OYAMA	FR	7	022575 051976
	75-014A-04	SRATS, ELECTRON DENSITY MEASRMNT		OYA			
	75-014A-04A	SUMMARY PLOTS, MFICHE		OYAMA	FR	7	022575 051976
	75-014A-05	SRATS, ELECTRON TEMPERATURE		HIRAO			
	75-014A-05A	SUMMARY PLOTS, MFICHE		OYAMA	FR	7	022575 051976
STS-51B/SPACELAB 3	85-034A	STS-51B/SPACELAB 3	04/29/85	NASA-OSTS			
	85-034A-14	SPACELAB 3,ATMOS.TRACE MOLECULES		FARMER			
	85-034A-14A	TRACE+MINR GAS MIX RATIO PROFILES		RAPER	DF	1	040185 053185
STS-51F/SPACELAB 2	85-063A	STS-51F/SPACELAB 2	07/29/85	NASA-OSF			
	85-063A-04	SPACELAB 2, PLASMA DEPLETION		MENDILLO			
	85-063A-04A	DEPLETION EXPER GAS DYNAMICS BOOK		BERNHARDT	HI	25	073085 073085
	85-063A-04B	DEPLETION EXPER PLASMA DATA BOOK		BERNHARDT	HI	25	073085 073085
	85-063A-04C	DEPLET.EXP.MILSTONE.NO1.OMS.6300A		MENDILLO	DD	1	073085 073085
VEGA 1	84-125A	VEGA 1	12/15/84	USSR			
	84-125A-07	HALLEY 1,ION MASS SPEC/ELEC ANLYZ		GRINGAUZ			
	84-125A-07A	PLOTS OF HOURLY N,V,T ON MFICHE		VERIGIN	FR	1	030985 081486
VEGA 2	84-128A	VEGA 2	12/21/84	USSR			
	84-128A-07	HALLEY 2,ION MASS SPEC/ELEC ANLYZ		GRINGAUZ			
	84-128A-07A	PLOTS OF HOURLY N,V,T ON MFICHE		VERIGIN	FR	1	030685 041585
VIKING 1 LANDER	75-075C	VIKING 1 LANDER	08/20/75	NASA-JPL			
	75-075C-06	VIKING 1 LANDER,LANDER IMAGING		MUTCH			
	75-075C-06W	HIGH RESOLUTION LITHO MOSAICS		LIEBES	HT	5	
VIKING 1 ORBITER	75-075A	VIKING 1 ORBITER	08/20/75	NASA-JPL			
	75-075A-01	VIKING 1 ORBITER, IMAGERY		CARR			
	75-075A-01V	B/W PHOTOMOSAICS 1:500 K		CARR	YI	120	
	75-075A-01W	USGS PHOTOMOSAICS 1:2M		CARR	YI	138	
	75-075A-01Y	STEREO IMAGING CATALOG, MFICHE		MARTIN	FR	7	
	75-075A-01Z	COLOR COMPOSITES OF MARS		SWANN	VI	6	
VIKING 2 ORBITER	75-083A	VIKING 2 ORBITER	09/09/75	NASA-JPL			
	75-083A-01	VIKING 2 ORBITER, IMAGERY		CARR			
	75-083A-01V	USGS PHOTOMOSAICS 1:2M		CARR	YI	138	
	75-083A-01X	STEREO IMAGING CATALOG MFICHE		MARTIN	FR	7	
	75-083A-01Y	COLOR COMPOSITES OF MARS		SWANN	VI	6	
VOYAGER 1	77-084A	VOYAGER 1, MARINER 77A	09/05/77	NASA-JPL			
	77-084A-01	VOYAGER 1, IMAGING		SMITH			
	77-084A-01L	FOOTPRINTS+AIRBR MAPS OF JUP SATS		BATSON	YI	38	
VOYAGER 2	77-076A	VOYAGER 2	08/20/77	NASA-JPL			
	77-076A-01	VOYAGER 2, IMAGING		SMITH			
	77-076A-01K	FOOTPRINTS+AIRBR MAPS OF JUP SATS		BATSON	YI	38	

Green , Thieman Chair Special Session at Spring AGU Meeting

The Spring National Meeting of the American Geophysical Union in Baltimore was marked by a major NSSDC presence, primarily related to a special session chaired by Drs. James Green and James Thieman entitled "Access to Geophysical Data and Models in Aeronomy and Space Plasma Physics."

In all, there were 23 poster presentations concerning online data, models, information, etc. Seven of them were by NSSDC staff:

- Developing and Populating a NASA Master Directory (M. James, J. King, J. Thieman, C. Hood, and M. Schwaller)
- Catalog Interoperability—Efficient On-line Location of and Access to Science Data (J. Thieman and J. Brown)
- Geophysical Models at the National Space Science Data Center (D. Bilitza)
- A Climate Data Access System (M. Reph, B. Meeson, L. Olsen, and J. Closs)
- The Coordinated Data Analysis Workshop Program (R. McGuire, R. Manka, J. Green, and L. Treinish)
- Online Access to NSSDC Solar Wind and Ozone Data (J. King and P. Bhartia)
- Online Access Using Optical Disks (B. Lowrey and R. Bewtra)



Mary James prepares to answer questions about Catalog Interoperability and to demonstrate the online system.

In addition to the poster presentations, a talk entitled "Advances in the Crustal Dynamics Data Information System" was given by H. Linder, J. Behnke, and C. Noll.

Abstracts of all these presentations are found in the April 19, 1988, issue of *Eos*, the Transactions of the Americal Geophysical Union.

Joe King

Perry's Poster Presentation Explains NSSDC Role in IUE Data Dissemination

The 10 Year International Ultraviolet Explorer (IUE) Celebratory Symposium, held April 12-15 at Goddard Space Flight Center, was attended by more than 250 international participants. Papers and posters covering all aspects of ultraviolet astronomy and IUE were presented.

Charleen Perry of NSSDC/SAR presented a poster entitled "The NSSDC and IUE, 1978-Present." It provided a review of the IUE data available at NSSDC and explained NSSDC's contributions in the dissemination of IUE data to the scientific community.

Over the past ten years, NSSDC has added to its archives all available IUE data. As new observations are taken, they too are added to the NSSDC archives, usually within 30 days of the observation. Having as complete an archive as possible and using modern methods for the archiving of the data makes them more accessible to the scientific community.

With the emphasis on the technological advances of today, which include the ability to request data on line, the ease and rapidity in which a person can request and receive data from NSSDC via the Space Physics Analysis Network (SPAN) was a highlighted item. One participant's use of NSSDC's SPAN online data request service made it possible for her to acquire data quickly and make a poster presentation for this symposium.

Tutorial handouts about SPAN access to IUE data and the accessing of SPAN from a non-SPAN node, available during the poster presentation, were much sought after items. Suggesting a luminous nebulae star field, the poster's "ultraviolet blue" background, speckled with multihued dots, and the color graphics resulted in a highly visible and informative poster presentation.

The symposium was sponsored by the National Aeronautics and Space Administration (NASA), the European Space Agency (ESA), and the United Kingdom Science and Engineering Research Council (SERC). It was cosponsored by the American Astronomical Society (AAS). The papers and posters presented at the symposium are to be published by the Publications Division of ESA.

Charleen M. Perry

Pilot Program Initiated for Restoration of Data on Old Magnetic Tape

NSSDC recently initiated a pilot program for the "restoration" of atmospheric sciences data archived on magnetic tape.

As NASA's long-term archive of space and earth sciences data, NSSDC holds about 80,000 tapes of reduced and raw digital data accumulated over the past two decades. Many of them are over ten years old and are slowly deteriorating. Also, many are written at low densities, using the obsolete 7-track technology. Although some of these tapes are seldom requested, the data they contain may still be of unique scientific (or historic) value in studies, for example, of long-term trends. To guarantee preservation of the most important data, NSSDC has begun a program of copying them to new, higher-density media.

Because resources to actually copy these tapes are limited, one aspect of the effort is to define the relative scientific priorities of different data sets. NSSDC is forming a series of science advisory panels to address the prioritization problem. The initial ("pilot") panel was chosen to focus on the discipline of atmospheric sciences, with some emphasis on the earth remote-sensing data now held at NSSDC. This discipline includes about 40,000 tapes that constitute about 100 data sets—a relatively small number of data sets. Data from spacecraft such as TIROS, Nimbus, and SMS/GOES (representing some of the oldest tapes in the NSSDC archive) fall within this definition.

Based on nominations from NASA Headquarters, the Committee on Data Management and Computing (CODMAC), and representatives from the American Geophysical Union and American Meteorological Society, the members of the initial panel are:

- Dr. Roy Jenne (chairman), NCAR
- Dr. Albert Arking, Goddard Space Flight Center
- Prof. Peter Cornillon, University of Rhode Island
- Greg Hunolt, NOAA/NESDIS
- Prof. Donald Johnson, University of Wisconsin

In preparation for the panel activities, questionnaires were sent to various project scientists, investigators, and data suppliers thought to be most knowledgeable about the contents of the individual data sets under review. Their assessments were solicited regarding the overall archival value of the data sets, including accuracy of calibrations, instrument performance, and resolutions. These materials are now under continuing review by the panel, which held its first full meeting at Goddard on April 13-14. At this meeting, a number of key Goddard personnel made informal presentations to the panel on specific projects with which they have been associated.

The meeting was highly informative, and a preliminary ranking of the data sets under review was generated. There remain specific questions on several data sets and continuing discussion as to the final methodology that should be used in establishing such rankings. Particular and still unresolved concerns are the disposition of VISSR (SMS/GOES) and HCMM imaging data. These digital data sets are quite voluminous, with relatively little current request activity, and are only a subset of the total spacecraft data still held on 14" analog reels. The availability of other versions or archived copies of the data and the issues involved in any possible conversion of the analog-tape-stored data are being researched. It is expected that a more complete and final prioritization can be generated over the next several months with an accompanying summary report of the rationale behind those rankings. These recommendations will then be circulated both within NASA and to the larger atmospheric and earth sciences community for further comments and review.

In parallel with the panel activity, NSSDC has begun tests to define and resolve various technical issues in the copying of large numbers of (possibly) deteriorating magnetic tapes. Tapes from the various data sets under analysis are being sampled to establish typical read error rates and procedures to optimize the data recovery rate with respect to the throughput of "restored" tapes. Ongoing work includes the analysis of given tape formats as to their sensitivity to the loss of specific tape records, improving procedures to best recover important tapes that have become highly deteriorated, and testing the use of alternative Goddard facilities outside of NSSDC itself to improve throughput.

Data are currently being copied to high-density standard (6250-bpi, 9-track) tapes. NSSDC is exploring an expanded use of optical disk and various cartridge tape/helical scan technologies as well. The gradual transition to a full-scale production mode for restoration activities is expected over the next several months.

As data restoration evolves from this pilot phase to a full-scale program, additional science advisory panels in other discipline areas will be formed to review and rank other data sets in NSSDC's archive. With whatever resources are available, NSSDC will restore as many tapes as possible that are identified on review as of reasonable long-term importance. It is intended that as data are ranked and restored, they will become part of a systematic and substantially improved program for archival maintenance and preservation. Restoration of these data to high density media is also expected to help NSSDC improve the ultimate accessibility of these data to the larger NASA and international scientific community.

Carolyn Ng and
Robert E. McGuire

NSSDC Holdings in Atmospheric Sciences

	No. Tapes Currently Archived	Projected 6250 Equivalents
7-Track	11,000	1,300
9-Track	35,000	11,500
Total Tapes	46,000	12,800
> 10 Yr Old	23,000	4,400
< 10 Yr Old (all 9-track)	23,000	8,400

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SMM Solar Irradiance Data Added to Climate System

The NASA Climate Data System has expanded its holdings of solar irradiance data collected by the Active Cavity Radiometer Irradiance Monitor (ACRIM) flown on the Solar Maximum Mission. These data are stored on line in a form that allows researchers to access them with the Climate Data System's data manipulation and graphics tools. These tools include a capability to list data to an ASCII file, which can easily be downloaded to other computer systems for further analysis.

The Climate Data System also provides researchers with access to solar irradiance data from the Nimbus 7 Earth Radiation Budget (ERB) instrument (as provided on the ERB Solar Analysis Tapes) and the Earth Radiation Budget Experiment (ERBE) solar monitor flown on the Earth Radiation Budget Satellite (ERBS) and NOAA 9 and 10. The ACRIM data holdings cover February 1980 through March 1986 and will be expanded as more data are released by the principal investigator, Dr. Richard Willson of JPL. The ERB data holdings currently cover November 1978 through March 1986. The ERBE data holdings (nearly instantaneous measurements, obtained every two weeks) currently cover November 1984 through 1987. More information about these and other data sets held by the Climate Data System is available via the system's online catalog.

Mary Reph, Lola Olsen, and James Closs

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Catalog Interoperability Workshop Held at JPL

The Second Catalog Interoperability (CI) Workshop was held at JPL January 12-14. Representatives from the major NASA discipline-oriented data systems; the user community in various science disciplines; NOAA, USGS, and NCAR data service organizations; and NASA Headquarters discussed their progress in creating interconnected directories, catalogs, and inventories that would permit a user to efficiently locate, learn about, and order data of interest regardless of archive location.

The CI effort has already resulted in a potential standard for a data structure to use in sending, receiving, and loading directory information—the Directory Interchange Format (DIF). The overall structure of the DIF was evaluated and problems with the planned contents of several of its fields were discussed. Not all the problems were resolved, but guidance was obtained.

The first version of the NASA Master Directory was demonstrated. This version is viewed as a testing prototype, but no major objections to it were voiced. It has been useful in the development of methods of keyword searching and in determining the exact nature of what kinds of groups of "data sets" should be described in the directory and what information about them should be displayed.

The next steps toward establishing interoperability among existing and future data systems were discussed. Interconnections already exist between the Master Directory and the major discipline data systems. Near-term plans call for passing information across these connections to assist the user in finding data of interest and to allow data set information to be kept up-to-date in a more automated manner. Various methods of achieving these goals were debated. The data system representatives will be working together to refine the suggested solutions and to implement these solutions in a coordinated manner.

The group also recommended the creation of a document specifying underlying concepts and needed capabilities for interoperable data systems. This plan differs from earlier ones specifying standards for the data systems. The document is intended to provide guidance, yet allow leeway in modifying existing data systems and creating new ones. It should bring a more uniform, coherent whole to the data system environment without retarding use of improved technology.

James Theiman

SPAN Broadens Role in Ozone Hole Investigation

The Space Physics Analysis Network (SPAN) played a larger role in the ozone hole investigation than had originally been planned.

Initially, the primary function for SPAN had been the network transmission of analog data; 400 maps from the European Center for Midrange Weather Forecasting and the United Kingdom Meteorological Office were to be sent via facsimile from Europe to Punta Arenas each day. MicroVAXs were configured in Punta Arenas, Great Britain, and Goddard Space Flight Center (GSFC) to access SPAN, thereby providing a backup digital communications capability for the investigation. The installation of a temporary 9.6-kbps link from Punta Arenas to Goddard helped facilitate the access.

SPAN was found to be exceedingly useful once the actual ozone hole investigation got started, according to Richard Winkler from NOAA in Boulder, CO. Raw Total Ozone Mapping Spectrometer (TOMS) image data were downloaded from Goddard to Punta Arenas; software was pulled in by the Ames Research Center group (from their home facility) to process the airplane data; 50 megabytes of data from the aircraft flights were sent from Punta Arenas to GSFC; and electronic mail was used extensively for communication between Punta Arenas, GSFC, and Ames.

In addition, SPAN was used to access NASAMAIL, thus allowing mail to be sent from the Antarctic to Ames, GSFC, and NASA Headquarters. This was the only way for scientists to get hard copy from the Antarctic.

SPAN worked so well for the ozone hole investigation that when Winkler returned to Boulder, his boss asked him to find out how NOAA could get a permanent connection to it. By the way, this was Winkler's first experience with networking.

Valerie Thomas

EFS-NEWSBRIEFS-NEW

Joe King Named Chairman of Lexicon Working Group

Joe King of NSSDC has been named chairman of the new Earth Science and Applications Data System (ESADS) Data System Lexicon Working Group (DSLWG), which held its first meeting at the Jet Propulsion Laboratory in January.

This activity is an outgrowth of the February 1987 ESADS workshop, where it was recognized that one of the significant impediments to interdisciplinary research, within and beyond NASA, was the inconsistent terminology being used in various disciplines, projects, and agencies. The DSLWG contains primarily NASA earth scientists, with representation from other NASA disciplines and from other agencies (NOAA, USGS, NSF/NCAR) involved in earth science and applications.

Before the DSLWG meeting, draft lexicon versions were iteratively developed. The draft lexicon is intended to be a fairly high-level lexicon. It defines about four dozen terms, many of which are closely related, including "data sets" and "data set granule," "data directory" and "data catalog," "data center" and "archive," "levels of data processing," etc.

During the meeting, the intent and scope of the lexicon, the procedures for establishing, maintaining, and modifying it, and some steps to promote lexicon usage were discussed. The eventual use of the lexicon as the basis for exchange of computer-readable/usable metadata on data tapes and disks, and with electronic data exchanges, was also discussed. Definitions of some of the words in the draft lexicon were discussed and refined. Followup teleconferences among the DSLWG members are planned.

When accepted by the DSLWG members, the draft lexicon will be circulated for comment among a wider community.

Joe King

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Glasnost Comes to NSSDC

The World Data Center-A for Rockets and Satellites, located at NSSDC, recently hosted two distinguished Soviet scientists from Moscow's Institute of Earth Physics. Prof. Michael Borisovich (Misha) Gohkberg, vice director of the institute, and Dr. Vyacheslav (Slava) Anatol'Yevich Pilipenko, staff scientist, traveled here to conduct joint research on electromagnetic precursors to earthquakes, with special emphasis on acoustical disturbances from earthquakes as an origin of inner-zone proton diffusion.

Dr. James Vette and Epaminondas Stassinopoulos are the key NSSDC collaborators in this research. Discussions and preparation for meetings with representatives from the World Data Center-A/NSSDC, the World Data Center-A/NOAA (Boulder, CO), and the World Data Center-B/Moscow were held with Dr. James Green and Dr. Joseph King during the Soviets' visit.

While visiting NSSDC, Prof. Gohkberg gave a talk on "Acoustic Active Experiments: Atmospheric Electromagnetic Phenomena related to Earthquakes," and Dr. Pilipenko spoke on "Terrogenic Effects in the Ionosphere."

James Green and George Abid

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Reph Takes Part in Remote Sensing Synthesis Panel

Mary Reph recently participated in a Remote Sensing Synthesis Panel sponsored by the U.S. Army Strategic Defense Command in Huntsville, Alabama. The panel considered the application of remotely sensed data to planning and siting for U.S. Army ground-based strategic defense facilities.

Reph was invited because of her experience with the Climate Data System, which incorported data bases similar to those needed for this project. She presented an overview of the system and described techniques used by the Climate Data System to handle many different data sets in many different formats, stored at varying resolutions. System developers from Teledyne-Brown showed an interest in learning more about the design of the Climate Data System's data bases and similar data systems, such as the Pilot Land Data System.

Mary Reph

1988 Edition of Data Listing Available

The January 1988 publication *NSSDC Data Listing*, the sixth volume in this series started in 1979, is now available from NSSDC. The document identifies, in a highly summarized way, data available from NSSDC. For the first time since the Data Center was reorganized in 1984, the data holdings for each one of its elements are shown together in one document.

More than 3,000 spacecraft/instrument data sets held by NSSDC on magnetic tape or as film/print products of various sizes, as well as several ground-based data sets, models, and computer routines, are identified. In addition, the data holdings of the NASA Climate Data System, Astronomical Data Center, Crustal Dynamics Data Information Center, and Pilot Land Data System, as well as special online data sets, are described.

The *NSSDC Data Listing* provides a high-level index to all NSSDC holdings, while the various paper catalogs issued by NSSDC and online information files developed by various Data Center elements are more descriptive of the different groups of data sets. The *NSSDC Data Listing* has been widely distributed; copies are available from the NSSDC addresses given on the last page of this newsletter.

Richard Horowitz

Above: Personnel board the motor launch that will take them to the control center on the Santa Rita platform.
Below: Visitors to the launch site enjoyed Kenyan-style accommodations.

Director, *from page 2*

Rome processing center, the processed data were networked to Frascati, Italy, to the San Marco MicroVAX at the ESRIN data center. Within minutes, Bob Powers of the University of Texas at Dallas networked several minutes of housekeeping data back to Texas over SPAN. This complete processing and data transfer back to the States worked well, and I have a wonderful feeling of accomplishment, since all the NSSDC efforts were demonstrated and were clearly paying off.

The spacecraft continued on for seven or eight orbits while the ground crews slept. The ground crew returned in the morning and began to check out the finer details of the orbit and spacecraft attitude, with the eventual turn on of all the instruments scheduled for about ten days after all the spacecraft verification tests.

A few days later, I returned home. A fantastic trip ending with the successful launch. We will continue to work to help the U.S. investigators in any way we can to facilitate the science and make San Marco a successful mission. Good luck to the science teams!

James L. Green

Data Inquiries

For information on submitting data to the Data Center or inquiries regarding availability, cost, and ordering procedures, researchers *within the United States* should contact:

Submissions:

Dr. H. K. Hills
National Space Science Data Center
Code 633.8
Goddard Space Flight Center
Greenbelt, Maryland 20771
Telephone: (301) 286-4106
SPAN: NSSDCA::HILLS

Requests:

National Space Science Data Center
Code 633.4
Goddard Space Flight Center
Greenbelt, Maryland 20771
Telephone: (301) 286-6695
Telex: 89675 NASCOM GBLT
TWX: 7108289716
SPAN: NSSDC::REQUEST

Individuals residing *outside the United States* should contact Dr. James I. Vette for information on submissions. Inquiries to Dr. Vette and requests from outside the United States must be directed to:

World Data Center A for Rockets and Satellites
Code 630.2
Goddard Space Flight Center
Greenbelt, Maryland 20771 USA
Telephone: (301) 286-6695
Telex: 89675 NASCOM GBLT
TWX: 7108289716
SPAN: NSSDC::REQUEST

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Editor: Karen W. Satin