International Council of Scientific Unions

SPECIAL COMMITTEE
ON
SOLAR-TERRESTRIAL PHYSICS

77-5

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# IMS NEWSLETTER



IMS Newsletter 77-5 is intentionally a week late. The days since GEOS launch, April 20, have been overfull for everyone concerned with it. Long hours have been required to model radiation effects, compute possible alternative orbits, monitor the spacecraft status from moment to moment and attempt to work out the most acceptable orbit for experimenters, satellite and ground alike. We offered to delay publication so that all could have the latest information once decisions were made. Still, it was necessary to prepare some pages of this NL in advance without knowing when another announcement or new information would come in or how much space to save. Hopefully, the currency of information will offset the roughness of presentation. JHA

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PROGRAM PLANS FOR May 1977 - July 1977

SPECIAL IMS SATELLITE PERIODS

A complete table of satellite conjunction intervals for Jan-Jun 1977 was published in NL 77-4, pg 5. The table will be extended to cover the final half of 1977 and published in these NLs when made available by the IMS Satellite Situation center (probably by the end of May). SSC-designated special intervals for the months covered in detail by this Newsletter are:

May 25, 2200 UT to May 26, 1800 UT  May 30, 0100 UT to Jun 3, 1000 UT

GBR Campaigns: (numbers refer to program details in IMS Bulletin No 2 or in references in these NLs)

----------Phenomena-related Campaigns----------

May 1 to May 31; #0139; Berthellier; Pretoria; BALLOONS (2) - long flights, E-field experiments
Jun 1 to Jun 30; A-32; Smith; Wallops Isl; ROCKETS (2) - 14.533UE and 14.534UE; upper E-region
Jun 27 to Jul 15; A-18; Wooliscroft; South Uist;ROCKETS (2) - positive ion mass spectrometer
Jun 27 to Jul 15; A-19; Williams; South Uist; ROCKETS (2) - Lyman alpha, electron density
Jun 27 to Jul 15; #0085; Dickinson; South Uist; ROCKET - neutral atomic oxygen, electron density
Jul 25 to Aug 5; #0328; Christensen; White Sands; ROCKET - 18.1009 UE, e- accel for EUV emissions

------Quasi-synoptic Observations involving Balloons, Rockets, Aircraft, Selected Surface Campaigns------

May 17-19; Jun 14-16; July 19-21; Bauer (0004), Evans (0171); IISN; SURFACE incoherent scatter radar net

----------Observing Plans for Temporary Surface Stations----------

------ to May 31; #0304; Stuart; Multiple Sites; SURFACE- "Pulsations" program of magnetometers, NL 76-12
June 1, 77 to July 31, 78; #0252; Munch (Proj. Sci. is Wilhelm); Various Sites; SURFACE - induc magnet.
Jun 1 to Sep 30; #0011, #0429; Perrault, Hirosawa; Conjugate Points; SURFACE - note in NL 77-3, pg 4

Regional GBR IMS Program Details, May - Jul 1977

Past NL's have given detailed programs descriptions for some of the 1-line references above. These will not be repeated below unless the IMSCIE Office has received new information.

ANDOYA

B-7; Matthews rocket 18.211 UE postponed to Jan-Feb 1978. Details on program in NL 76-12.

WALLOPS ISLAND

A-32; Smith rockets 14.533 UE & 14.534 UE postponed to June 1977. Details in NL 76-11.

KWAJALEIN

#0400; Fitz (Fremouw) "Equatorial Wideband" program of studies with Wideband satellite postponed to Aug

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#0252; Wilhelm is project scientist for "HIGH LATITUDE MAGNETOMETER NETWORK" described in CCOG Handbook, pgs. 21-27, Munch is co-experimenter. Compensation-type pulsation magnetometers are to be installed at 6 sites listed below. Pulsations in the period range 1 - 300 sec will be recorded on paper strip charts and digitally on magnetic tape. The stations on Iceland and Greenland will begin operation in June and the others in July 1977. Observations will be coordinated with GEOS and with balloon flights in summer 1978. Special coordination with other programs is possible with 1-month advance notice. Sites are: Iceland - Thingeyri (65.9N, 336.5W) and Fagurholsmyri (63.9N, 343.4W); Greenland - Angmagssalik (65.6N, 322.4W); Spitzbergen - Ny Alesund (78.9N, 11.9W); Bjornoya (74.5N, 19.2W); Sweden - Abisko (68.4N, 18.9W).

ENGLAND (Halstead, Kent)

#0474; D. Rees will conduct ground based studies of airglow and atmospheric winds with Fabry-Perot interferometer from April 77 through 1978.

WHITE SANDS

Ferret-3; Christensen will launch 18.1009 UE to study dayglow EUV from 575 - 1375 A and measure EUV emissions of the atmosphere excited by on-board electron source. Dr. E. Zipf, Univ. of Pittsburgh, will provide the source for 15 - 100 eV electrons. Experimenters will try to coordinate with Atmospheric Explorer satellite observations.

ACTUALITIES

MULTIPLE SITES - CANADA

#0205, Vallance Jones successfully completed an auroral photometry campaign of observations at Ft Churchill, Thompson and Broadview during the periods 13 - 26 January and 8 - 22 February 1977. Map and program details given in NL 76-12, pg 7.

FORT CHURCHILL

B-10; Gentieu/Mentall successfullly launched rocket 18.1013 GA on 8 April.

EGLIN AFB

#0400; Fitz, "STRESS", five 48 kg Barium releases and 6 diagnostic rockets with Langmuir probes and plasma frequency probes were successfully lanuched. Several clouds were penetrated successfully. The releases took place on 26 Feb and 2, 7, 13, and 14 March at a solar depression angle of 96 deg. The releases yielded 2 hours of Ba striation photography. Ion cloud motions at 180 km height were observed to be between 65 and 20 m/sec.

ANDOYA

#0308; Theile, "Polar High Atmosphere", successful launch of A1/2IR(Q) on 20 Feb and of A1/2IR on 16 March.

ANTARCTICA

Upper Atmospheric Research at Syowa and Mizuho-1976

IMS programs at Syowa and Mizuho have been announced in these NL's as supplied by Obayashi and Nishida. In particular, NL's 76-8 (pg 5), 76-9 (pg 4) and 76-11 (pg 6) gave extensive tables of scheduled Japanese IMS programs at these and other locations. The following information from Nishida and Fukunishi gives information about times and types of observations from these Antarctic programs.

I. Ground-based observations at Syowa and Mizuho:

Mizuho station is located about 270 km poleward from Syowa station along the geomagnetic meridian through Syowa. Mizuho, closed over a year, was reopened in May 1976 for setting-up facilities for IMS projects. Routine observations began in June. Facilities at Syowa were improved during the austral summer and routine IMS observations there

(Continued on pg 3)

(Continued from pg 2)
began in April. Auroral observations at both stations terminated at the end of September but other observations continued through the year.

Programs carried out at both stations are:
(1) Syowa (69.00S, 39.58E). Aurora: all-sky camera (35mm fisheye lens, 6 frames per minute), zenith photometer (4278A), meridian scanning photometer (5577A, $H_\beta$), highly sensitive TV camera, VHF auroral radar (50, 60, 80, 112 MHz). Geomagnetism: fluxgate magnetometer, induction magnetometer. Ionosphere: ionosonde, riometer (20, 30, 50 MHz). VLF Emission: narrow-band intensity recorder (0.5, 0.7, 0.75, 0.9, 1, 1.25, 2, 3.6, 8, 20, 32, 64, 128 KHz), wide-band tape recorder (0.2 - 5 KHz or 0.2 - 10 KHz), direction finder.
(2) Mizuho (70.70S, 44.44.30E). Aurora: highly sensitive TV camera. Geomagnetism: fluxgate magnetometer, induction magnetometer. Ionosphere: riometer (30 MHz). VLF Emission: narrow-band intensity recorder (0.75, 1, 2, 8, 20 KHz), wide-band tape recorder (0.2-5 KHz or 0.2-10 KHz)

II. Reception of telemetry signals from polar orbiting satellites:
Satellite data receiving facilities were constructed at Syowa during Jan and Feb 1976. Routine reception of telemetry signals from ISIS satellites began on 5 April. The total number of orbits from which data reception has been accomplished from start through 31 Jan 1977, is: ISIS 1 - topside sounder, 44; VLF, 77. ISIS 2 - topside sounder, 140; VLF, 97.

III. Rocket experiments:

7 sounding rockets were successfully launched at Syowa in 1976. Times and dates of firing are given below with information on experiments. No names of experimenters were given for these launches, we suggest that interested persons contact the Japanese IMS Office for details.

| Rocket | Launching Time | Date | Apogee Ht (km) | Experiments |
|---|---|---|---|---|
| S210JA 22 | 2320UT | 25 Jan | 119 | $\alpha$(1.0)band in NO-emissions; e-spectra;ambient plasma densities |
| S310JA 1 | 0945UT | 13 Feb | 215 | VLF,HF waves; e-spectra;ambient plasma densities |
| S210JA 20 | 2340UT | 24 June | 118 | " |
| S210JA 21 | 0023UT | 26 July | 116 | " |
| S210JA 24 | 2354UT | 16 Aug | 118 | E-, B-fields, amb. plasma densities |
| S210JA 25 | 0000UT | 1 Sept | 125 | " |
| S210JA 23 | 0431UT | 13 Sept | 120 | Same as JA 22 |

Rockets S210JA 20, 21, 24 and 25 were launched into aurora. S210JA 20, 21 and 23 were launched when ISIS satellites were passing overhead near Syowa.

IV. Balloon experiment:
A balloon of capacity 5,000 $m^3$ was launched from Syowa at 1138UT on 12 Dec 1976. Instruments on board were an X-ray counter and an electric field detector. Telemetry signals were received until 2325UT on 12 Dec.

Syowa Rockets - 1977

| Rocket | Launching Time | Date | Apogee Ht (km) | Experiments |
|---|---|---|---|---|
| S310JA 2 | 0022UT | 10 Feb | 212 | VLF, HF waves; e- spectra;ambient plasma densities |
| S210JA 28 | 0355UT | 27 March | 106 | NO; O3; ambient plasma densities |
| S210JA 26 | 0500UT | 11 April | 105 | " |

## EASTERN TEST RANGE (CAPE CANAVERAL) - GEOS LAUNCH

At 1015 UT, 20 April 1977, GEOS was launched by a Delta vehicle. Probably due to premature spin-up (simultaneously with 2nd stage firing), the satellite/rocket only achieved an unstable 1 rpm spin rate before firing of the 3rd stage. The transfer orbit achieved after 3rd stage firing had an apogee only about 1/3 the intended altitude (11,710 km achieved apogee vs. 35,956 km planned). Consequently the apogee burn motor could not be used to attain the geostationary orbit planned for GEOS and the satellite had to be left in transfer orbit while alternatives were evaluated. Almost continuous meetings between staff of ESA and NASA, GEOS experimenters, and personnel of the IMS Satellite Situation Center were necessary over several days to monitor the stability of the achieved transfer orbit, model the probable radiation exposure damage to the solar power supply as a result of the unplanned prolonged passage through the inner radiation belts, and model the possible orbits that could still be achieved. In part because of concern about decreasing power output from the solar panels, the ABM was activated on 24 April to boost GEOS into an orbit permitting at least partial recovery of the original mission. Final orbit parameters are given on page _ of this NL as relayed by the SSC. Also given are maps that display the satellite orbit subtrack and magnetic footprint with annotations in the accompanying table tied to points along the orbital track.

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The following is the text of a telex dated 29 April 1977 from K. Knott about the status of GEOS and plans for remaining changes.

"Rescue action with aim to recover at least part of original GEOS mission is continuing. The following steps have been carried out successfully since the spacecraft was placed into incorrect transfer orbit with minimal spin:
1. Spin-up maneuvre to 12 rpm
2. Spin axis reorientation into standby position.
3. Spin axis reorientation for ABM firing
4. Spin-up to 95 rpm
5. ABM firing into 12 hour orbit
6. Spin down to 60 rpm
7. antenna deployment
8. S-band data acquisition
9. Cable boom release

Forthcoming activities:
10. Release of radial boom pair
11. Release of 4 axial booms
12. Payload switch-on (to be complete 2 May)

Technical behaviour of spacecraft has been excellent so far. Initial degradation of solar array power output in low apogee transfer orbit has stopped. Degradation in present orbit is such that payload can be operated without time sharing for at least one year. Radiation damage to CMOS components in experiments difficult to asses but this may be limiting factor of mission duration.

Present local time of apogee is about 80 degrees, drifting at rate of 4.2 degrees per day toward the west. Drift will be stopped at around 0 deg or slightly west of 0 deg. In this position, conjugated observations from Iceland and Syowa Base can be carried out during four hours per day.

Coverage will Be 8-10 hours per day around apogee from Darmstadt. Steps are being taken to get S-band receiving station in Alaska to obtain second daily observation slot which would allow conjugated operation with Alaska magnetometer network."

## CCOG HANDBOOK FOR THE IMS-GEOS (PERIOD 1976-79)

The Committee for Coordination of Observations Associated with GEOS has just distributed its Circular Letter Nr. 7, dated December 1976. This excellent collection of material (some 200 pages) has been compiled due to the great efforts of Dr. W. Stoffregen, Chairman of CCOG, and has been published and distributed by the Space Science Department of the European Space Agency. So long
(Continued on pg 4)

(Continued from pg 3)

as copies are available, they may be obtained by writing to: GEOS Project Scientist, Karl Knott, Space Science Department of ESA, ESTEC, Noordwijk, The Netherlands. Distribution outside Scandinavia and Western Europe is through the following persons: 1. USA and Canada - Dr. J. Vette, WDC-A for R&S, NASA, Code 601, Goddard Space Flight Center, Greenbelt, Maryland 20771, USA; 2. European Socialist Countries - Dr. C.U. Wagner, Zentralinstitut fur Solar Terr. Physics, DDR - 15 Potsdam, Telegrafenberg A 50, German Democratic Republic; 3. Japan - Prof. T. Obayashi, Inst. for Space and Aeronautical Science, University of Tokyo, Kanaba, Meguro-Ku, Tokyo, JAPAN; and 4. USSR - Prof. V.V. Migulin, Chairman of Soviet IMS Commission, IZMIRAN, P/O Akademgorodok, Moscow Region, USSR.

IMSCIE Office Staff feel that this newsletter (77-5) and many future issues can usefully include extracts of summarized articles and maps from the CCOG Handbook. Because we expect to frequently refer readers of these NL's to the complete articles in the CCOG Handbook, we hope that it will receive the widest possible distribution among those interested in IMS. Also, this publication gives us many helpful new ideas, to match its material, as we go about our task of informing about IMS programs.

In the next Newsletter (77-6), we will include A. Konradi's summarization of Durney's article on ISEE A, B and C satellites from the CCOG Handbook. The following is a condensed table of contents and list of maps contained in the Handbook (authors are given in parentheses).

Preface (Knott, Bostrom); CCOG-Committee Report and Acknowledgements (Stoffregen); Networks of Instruments: Map of L-values, Quick-Look Table of Instruments, The Magnetometer Network (Bostrom), The Pulsation-Magnetometer Network (Ashour-Abdalla, Gendrin and Perraut), High Latitude Magnetometer Network (Wilhelm), The Riometer Network (Oksman), The Ionosonde Network (Rawer, Piggott), The VHF-Backscatter Sonde Network (Lange-Hesse), The STARE Project (Greenwald), The HF-Backscatter Network (Moller), The ELF-VLF Observation Network (Holtet), The All-Sky Camera Network (Lassen), The Auroral Spectrum Observation Network (Henriksen, Harang), Southern Hemisphere and Conjugate Point Experiments (Perraut), Norwegian Arctic Stations (Brekke) and Electric Field Measurements from Satellites, rockets and balloons (Fahleson); Rocket Ranges (Installations and Programs): ESRANGE, Launch Programmes (1976-79) ESRANGE and ANDOYA, Andoya, Sondre Stromfjord, Data Link ESOC-ESRANGE-ANDOYA: Scientific Projects: GEOS (Knott), GEOS II (Haerendel, Pedersen and Young), ISEE A-B-C (Durney), SSC-Satellite Situation Center, Incoherent Scatter - EISCAT (Giraud, Westerlund), and Partial Reflection Experiment, PRE (Brekke, Haug); Review of GEOS-IMS Associated Projects in the Northern European Area (response to CCOG-Circular Letters): Finland, Sweden, Norway, Iceland, Denmark, United Kingdom, Germany (FRG), France, Belgium, Netherland, and Austria; Other Information: The Regional Warning Center at Meudon (Simon), Data from Ground Based Observations (Pedersen), Special Note on ISEE (Durney), and Regional IMS Workshop Finland May 1977.

MAPS: L-values, Magnetometer network, German Magnetometer Net, Pulsation magnetometer net, High latitude magnetometer net, Riometer net, Ionospheric sounding net, VLF backscatter net, STARE project, VLF meridian net, Northern hemisphere All-Sky Camera net, All-sky camera net, Spectral observatory net, Antarktic stations, ESRANGE map, ANDOYA map, Greenland map, World map ISEE project, and Map of EISCAT site and PRE.

## NOTES FROM IMS INFORMATION/COORDINATION CENTRES

European Regional Office - P. Simon visited the IMSCIE Office dring April in conjunction with a Flare Forecasting Workshop of the Solar Optical Observatory Network (SOON). Principal topics for our discussion were the possible utility of a condensed directory giving the addresses of all those receiving the IMS Newsletter and the maintenance of a common program information and actuality file at each IMS Information Centre. IMSCIE Office staff have already completed a computer program to prepare a simple 1-line listing taken from our mailing label files. We are working to solve minor problems ("Secretary Assistant" is out of alphabetical order) and correct many of the addresses based on recent information from several national contacts. We expect to have the final copy ready for distribution as a supplement with the July IMS Newsletter (77-7). It will consist of some 20 pages of NL-size text. This first attempt will be preliminary to possible annual updating and will be accompanied by a reply form to be returned by all wishing to continue receiving the IMS Newsletter. The common report file will permit each information centre to provide a prompt response to spacecraft or GBR experimenters wanting to know who has completed or who plans observations during a specific time period. Such information will continue to be published on a monthly schedule in these NL's but often the job of searching out details for a particular program is difficult because of program rescheduling or numerous changes and the elapsed time between announcements and actualities. At present, both announcements and actualities are available on the IMSCIE Office time-share computer and can be interrogated upon request for any time or set of key words. However, our newest staff member, T. Kamei, is now investigating use of alternate systems to permit computer storage of standardized common file information with multiple opportunities for useful accession of this information.

New USSR IMS Coordination and Information Office - Recent letters from Dr. N.V. Pushkov, President "Sun-Earth Council", and Prof. V.V. Migulin, Chairman Soviet IMS Committee, announce the designation of the "Sun-Earth" Council of the USSR Academy of Sciences to assume responsibility for duties of operational information and coordination centre of the Soviet IMS Committee. They will assist in coordination of IMS satellite observations with those carried out by ground-based stations (USSR satellites with GBR programs of other countries and USSR GBR programs with satellites of other nations), provide information about IMS program progress in the USSR, exchange of observational data, organization of joint discussions, notification through IMS Nl's and Centre circular letters of changes in dates or programmes and the completion of experiments, collection and circulation of solar-geophysical information for IMS retrospective intervals, and the compilation of brief annual reports about progress of USSR IMS programs.

The USSR IMS Centre will be guided by Dr. I.A. Zhulin, address: "Sun-Earth" Council, IZMIRAN, 142092, P/O Akademgorodok, Moscow region, USSR. Telex: 7523 SOLTER SU; Cable address: Moscow 112265 NIZMIR.

## NOTES FROM NATIONAL IMS COORDINATORS

CANADA - Dr. Currie has forwarded to IMSCIE Office a copy of his Canadian IMS Newsletter for April 1977. This is a very full document from which we will extract information of general interest for these IMS NLs. Such items are the surveys of data collection intervals, record quality and scientific activity using 1976 magnetometer recordings from the Churchill and Alberta meridian chains. Because of the NL publication delay for this issue in order to present the latest information on GEOS, we have not been able to fully exploit this information packed source in this NL. Contents of the Canadian newsletter are: 1. Distribution of GEOS Daily Summaries; 2. Pc 1 & Pc 2 Events (Gupta); 3. Magnetic pulsations, aurorae and VLF emissions (Watanabe, Oguti, Tsuruda, Hayashi and Horita); 4. Churchill Magnetometer Array (1976) and TRIAD Satellite Magnetometer Data (Walker); 5. Edmonton

(Continued on pg 5)

(Continued from pg 4)

Magnetometer Array (Rostoker); 6. Auroral Campaign at Cambridge Bay, Dec 76 - Jan 77 (Shepherd); 7. Proton Aurora Campaign Jan 13-26 and Feb 8-22, 1977(Jones, Gattinger, Creutzberg, and Harris); 8. Churchill Rocket Flight ADD-VA-45 Summary (McEwen); 9. Polar Ionosphere Study (Forsyth, et al.); 10. Proposed Meridian Scanning Photometer Observations at Island Lake, Churchill and Rankin Inlet (Eather); 11. Ft Churchill Rocket Launches (Canadian participants); and 12. La Ronge and Lucky Lake Observations during Jan and Feb 1977 (Paulson).

UNITED STATES - Dr. Manka sends word that the sites have been selected that will receive the first 12 magnetometer systems including 3-axis fluxgate sensor package, interface controller and radio/antenna package for satellite telemetry relay of data via SMS-GOES. Also, the two locations having on-site recording capability are to be among the first instrumented. For station locations and operating groups, see IMS NL 77-1, pages 5-7. Site names are: On-site recording - Eureka and Isachsen; STR-sites - Johnson Pt, Ft Yukon, College, Talkeetna, Pelly Bay, Rankin Inlet, Eskimo Pt, Tungsten, Ft Simpson, Lynn Lake, Eusebio, and San Juan. Staff of NOAA's Space Environment Lab have prepared a list of IMS platform locations with information on self-timed channel frequencies, interogated mode channel frequencies, planned satellite for each site's signal relay, geographic and geomagnetic coordinates of sites, azimuth and elevation angles to each satellite (East & West), the starting time sequence, site primary and secondary addresses for interrogation, and the equipment to be supplied each site under the US-NSF program. Rescheduled training classes will be announced directly to investigators and others concerned. We will share this announcement in these NLs. Recent delays in completion of some of the systems has been due to conversion of the interface controllers and radio sets to permit self-timed and/or satellite interrogated modes of operation in order to diminish the periods of data loss due to low power conditions during satellite ecclipse around equinox. A summary/schedule of magnetometer hardware status, calibration and delivery plans has been requested and this information will be shared when available.

FRANCE - Dr. P. Simon sends telex notice that S300 GEOS experimenter R. Gendrin (#0011) is interested in possible cooperative studies with IMS GBR programs in Alaska, particularly in ULF, VLF and induction magnetometer observations. It now appears that the final GEOS orbit will have a nominal 12-hr period passing through geostationary altitudes daily over W. European meridian and over Alaskan meridian with foot-tracks along the L-shells connecting to Scandinavia and Alaska ground observation networks. See further GEOS information under Actualities, pg 3 and on pg 6.

Geomagnetic Meridian Project Circular Letter - The 7th and final circular letter of the GMP Working Group has been distributed for A.N. Zaitzev who is now wintering-over at the South Pole station. This letter contains a summary of the International Symposium on GMP (24-28 May 1976) listing the invited papers presented in each session. Notes of the GMP WG meeting are given with the Draft Resolution to be presented at the IAGA Assembly in Seattle. The resolution confirms termination of the GMP WG and encourages continued operation of the GMP observatories during the period of the IMS. The importance of regular exchange of GMP data through the World Data Centres is emphasized and WDC-A for STP (Boulder) and WDC-B (Moscow) are asked to give attention to more rapid distribution of GMP observation data. Progress with the Soviet-American experiment to transmit digital magnetic variations recordings from 3 ground points via the ATS-6 satellite was reported. Scientists at UCLA and IZMIRAN are working with the combined ground and satellite data and first scientific results are expected in 1977. Some of the ground Data Collection Platform (DCP) - ATS-6 satellite joint observations coincided with 1976 Special IMS Intervals and other periods of general interest. UT-times of common DCP - ATS-6 observations were: March 18, 1600-2100 (IMS); March 20, 23-25, and 27-28 all from 1600-2100, March 30-31, 0000-0315, April 2, 0000-0300, and April 3, 1630-2000 (GBR Program Special Period); April 13, 0000-0315 and 2300 to April 14, 0315, May 18, 0000-0330, May 19, 1630 to May 20, 0030 and May 20, 0700-1200 (Regular World Days on the International Geophysical Calendar); June 23, 0000-0330 and 0700-1200, June 24, 1630-2400, June 25, 0700-1200 (IMS); July 7, 0000-0330 and 0700-1200, July 9-10, 0700-1200, July 10, 1630-2300, July 22, 1630-2400, August 3, 1700 to August 4, 0200 (IMS).

Summaries are given of plans or operational status of magnetometer meridian chains for several countries. In particular, a report is given on Danis observatories, permanent and special temporary ones, in Greenland (see also CCOG Handbook, pg 12). The Scandinavian stations of Untiedt, Kuppers and Baumjohann are also listed and maps are given for most arrays. The complete list of stations along the 145 degree meridian chain are given, including some new sites to become operational during 1977. From this report, it seems assured that the excellent start by the GMP Working Group will be continued as one of the main ground-based programs of the IMS.

SOUTH POLE NEWS - A. Zaitzev informs us by radio/telex that his programme of IMS geomagnetic observations at South Pole is progressing smoothly. He sends: "The quality of the observations of the magnetic variations in the format of standard magnetogrammes is good. Sensitivity is stable around 10 gammas. March 10 missed due to technical failure. The day of beginning regular observations is February 22. Greetings from the South Pole."

FINLAND - IMS WORKSHOP --- The 3rd Circular for the IMS Workshop in Hankasalmi, Finland has been received at IMSCIE. The number of special intervals to be studied has expanded to 25, including several based upon data collected by the SAMBO-76 balloon program completed in December 1976. Events and characteristics are: 1. Pulsation (pc 5) event, 75/03/11, typical large amplitude pc-5 pulsations during morning hours after substorm night. 2. Substorm event, 75/04/06, 2000-2300UT, well isolated typical substorms with strong and abrupt D-variations possibly indicating local field-aligned current. 3. Magnetic storm event, 75/07/07-08, 1700-0700UT, storm with very fast and large amplitude magnetic variations, remarkable saw-tooth shaped Z-variations and rapid changes of jet position, 4. Eastward PEJ event, 75/10/26, 1500-1900UT, current system for most of the time rather 2-dimensional. 5. Substorm event, 75/10/30, 1900-2330UT, some similarity to event 2, above, expected. 6. Substorm event, 75/12/03-04, 2100-0100UT, event selected for correlation with digitizable ASC data. 7. Magnetic storm, 76/03/06-07, 1300-0500UT, correlative studies with S 17 rocket, ATS-6, ISIS-1 and -2, TV and all-sky recordings planned. 8. Eastward PEJ, 76/10/07, 1200-1500UT, it is expected that the current system of this event is rather 2-dimensional and that a meaningful separation of the magnetic field into external and internal parts will be possible. 9. Eastward and westward PEJ, 76/10/07, 1600-2200UT, first event selected for comparison with STARE observations. 10. Eastward PEJ ending with substorm expansion phase, 76/10/27, 1700-2100UT, selected by Greenwald for combined observations of STARE (Trondheim), 3-color panoramic photometer, and narrow beam riometer.

New intervals suggested in response to 2nd circular: 11. X-ray flare, 76/03/25 2100UT to 03/28 0900UT. 12. X-ray flare, 76/03/31 2100UT to 04/02 2100UT. 13. Cosmic ray flare, 76/04/30 0000UT to 05/02 2400UT, major events, data compilations being prepared by NGSDC. 14. Westward electrojet, 74/10/15, 1800-0400UT. 15. Isolated substorm, 77/01/10, 1800-0200UT, current systems analyzed by H. Maurer. 16.-18. STARE data, 77/01/28; 77/01/30; and 77/02/02, selected

(Continued on page 6)

(Continued from page 5)
events for comparison of current systems with radar echoes, Maurer and Greenwald. 19. Magnetic storm, 75/07/07, 1700-0700UT. 20. Giant pulsations, 75/06/26, 0300-0600UT. 21. PC-3 event, 75/07/29, 0530-1300UT, multistation pulsation observations, see IMS Newsletter 77-3, pg 5, Hillebrand. 22.-24. Balloon data 76/11/10, 1700UT to 11/13 1200UT: 76/12/04, 1700-2400UT; and 76/12/09 1700UT to 12/10 0300UT, periods of SAMBO-76 balloon campaign see IMS Newsletter 77-1, pg 3, Raspopov. 25. Substorms 75/01/06-07, sudden commencement magnetic storm with barium trail in polar cap and auroral breakups photographed in Finland, world-wide current system analysis, Pellinen, Heikkila, Ranta, Kisabeth, et al. Associated meetings held in conjunction with the Workshop are CCOG open business meeting Monday, 23 May 1900-2100,Stoffregen); IMS information and future plans and possibile publication of Workshop contributions will be Thursday afternoon, 26 May (Roederer and Simon); Post-Workshop meeting on joint publications to be at Nurmijarvi Observatory (near Helsinki), Friday afternoon, 27 May beginning 1500 and Saturday at 0930.

We hope that the Finland and other IMS Workshops still in planning for this summer are productive of concrete results and will provide guidance for the remainder of the IMS. As information from these meetings becomes available or if we are able to participate in some of them, we hope to provide news of the progress through these NL's.

## MORE NEWS OF GEOS

This page and the following (pgs 6 & 7) give updated information about GEOS as of 3 and 4 May 1976. Sources are acknowledged with each item. This information will supersede any on earlier pages of this Newsletter and may yet be updated or supplemented by still later information which will be found on the back cover (pg 10). The situation with GEOS is evolving from day-to-day and we have necessarily to complete some parts of this NL for our printer before finishing the last page with the latest information on the day of final printing.

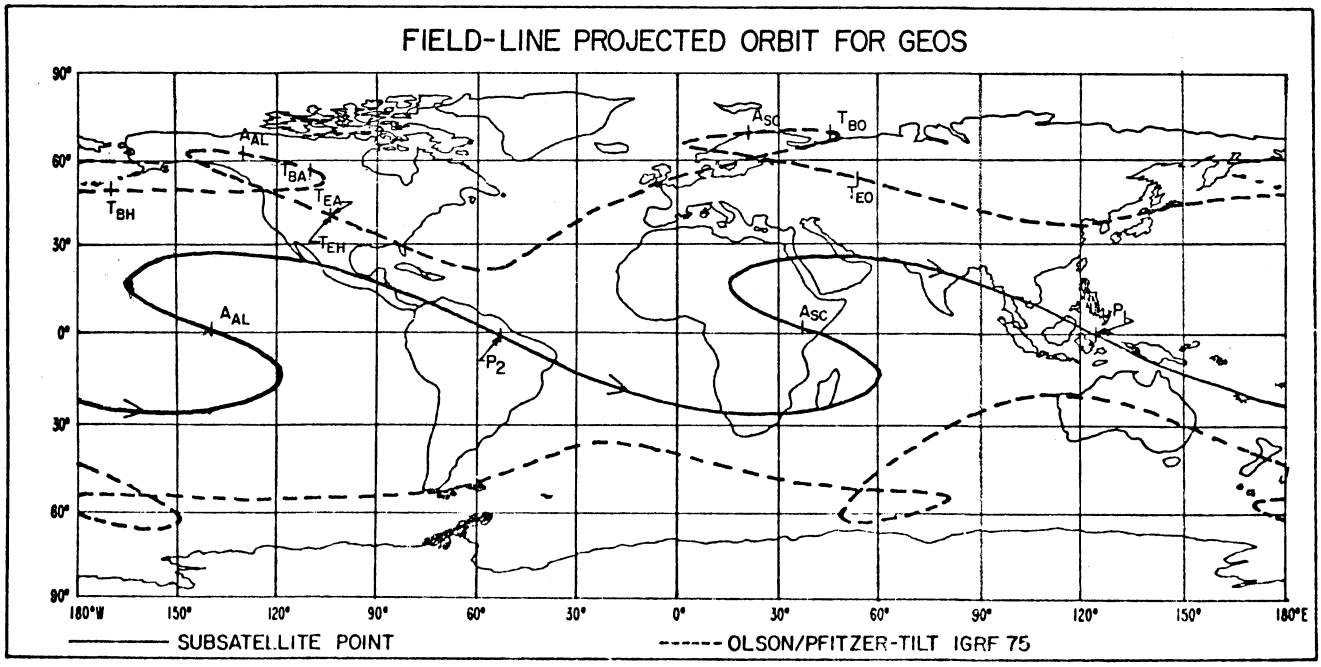
The map below, Field-Line Projected Orbit for GEOS, was produced by the computer of the IMS Satellite Situation Center, NASA, Goddard Space Flight Center (also WDC-A for Rockets & Satellites). It was prepared from orbit parameters which will probably result from adjustments to reduce the orbital drift of GEOS relative to the surface (presently about 4 degrees per day to the west). On the map are shown the ground track of GEOS (solid line) and the N&S hemisphere magnetic footprints (broken lines). For details, see ACTUALITIES (pgs 2&3). GEOS is in an inclined, elliptical orbit extending from apogee at about 6.4 Re to perigee at about 1/3 Re. Its orbital period is nominally 12 hours (actually to be 1/2 of a sidereal day) so that each day there will be two intervals of several hours near apogee when GEOS will be passing through altitudes (L-bands) corresponding to its intended geostationary orbit which could not be achieved due to launch problems.

The Eastern or Scandinavian Apogee (1.45°N, 37.72°E) is indicated on the ground track (subsatellite path) as $A'_{SC}$ and the corresponding foot of the magnetic field line through that location is shown on the upper magnetic foot track as $A_{SC}$ (69.82°N,21.17°E). The point on the foot track labeled $T_{BO}$ marks the beginning of tracking capability from the ESOC facility at Odenwald (near Darmstadt). $T_{EO}$ marks the end of tracking capability (a range of about 11.3 hours per day).

The Western or Alaskan Apogee $A'_{AL}$ (1.52°N, 142.22°W) occurs over a longitude about 180 degrees from the first apogee and is marked $A_{AL}$ (61.27°N, 124.24°W). $T_{BH}$ marks the magnetic footprint location at which tracking could potentially begin from Hawaii and $T_{BA}$ the start of tracking from Alaska. $T_{EH}$ and $T_{EA}$ mark the simultaneous end of tracking potential from both western sites (11.3 hrs from Hawaii and 8.2 hrs per day from Alaska). Indicated times of tracking are hypothetical and may be complicated by technical considerations such as antenna size, rate of data transmission, blockage of some antenna angles by obstructions, etc. If tracking is arranged for the Alaskan Apogee, it may be a combination of coverages to supplement the data that can be collected at Odenwald during the apogee over the main CCOG region.

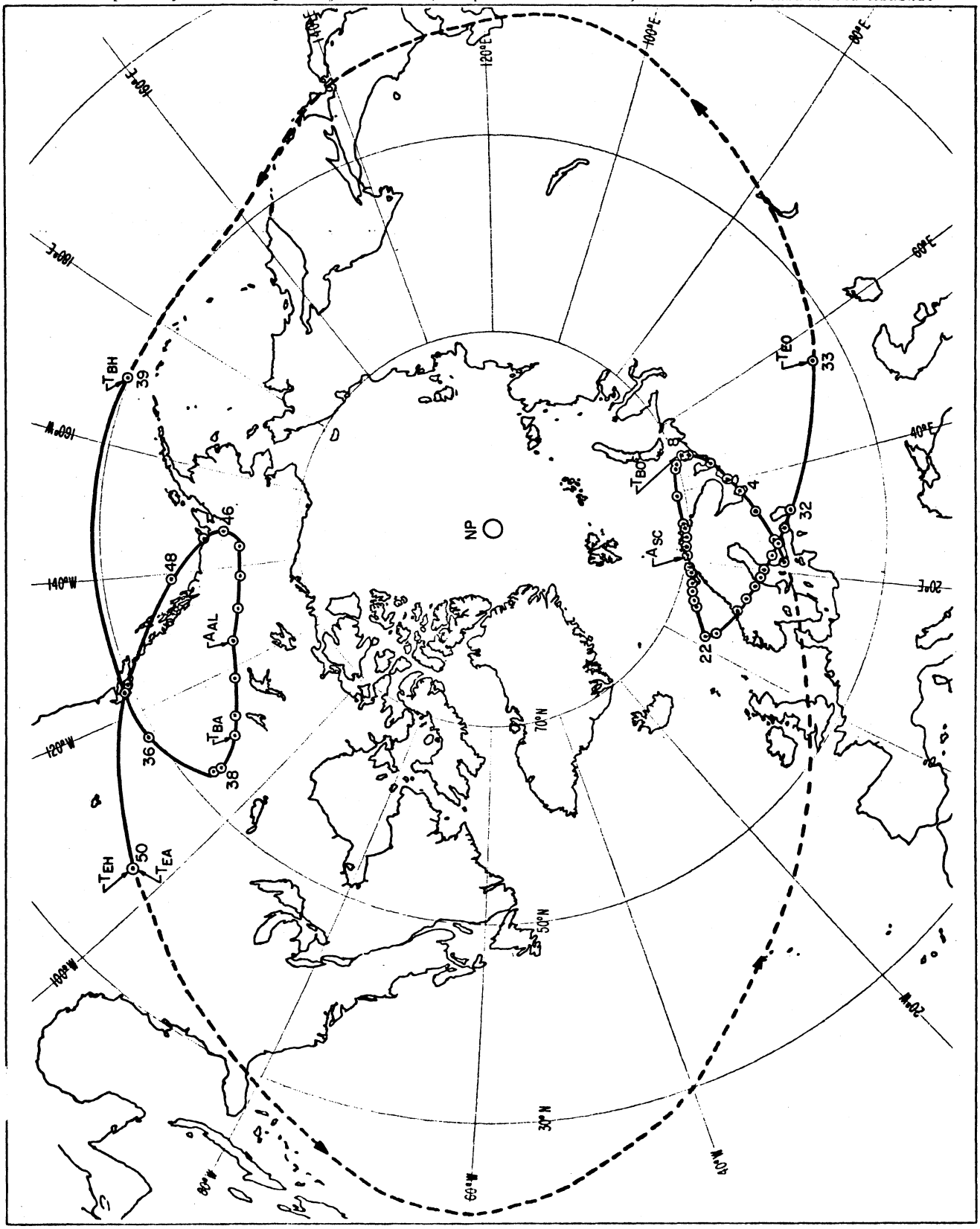
The calculations of magnetic foot tracks for GEOS orbit were made by the SSC using the recent Olson & Pfitzer model which includes a tilted dipole and ring current contributions. This model gives results cimilar to the Mead/Fairfield model for "Super-disturbed" conditions. Internal source contributions to the field are based on the IGRF75. The model is good out to geosynchronous altitudes and is the basis for the tabulated values given.

Parameters expected for the stabilized orbit are: Local Time of Apogee 1900 hours; Inclination 26.38 ; Perigee height 2074 km; Apogee Height 38293 km; Period 718.033 min (12 hr commensurate orbit); Scandinavian Apogee (1.45, 37.72E) parameters -
(Continued on page 8)



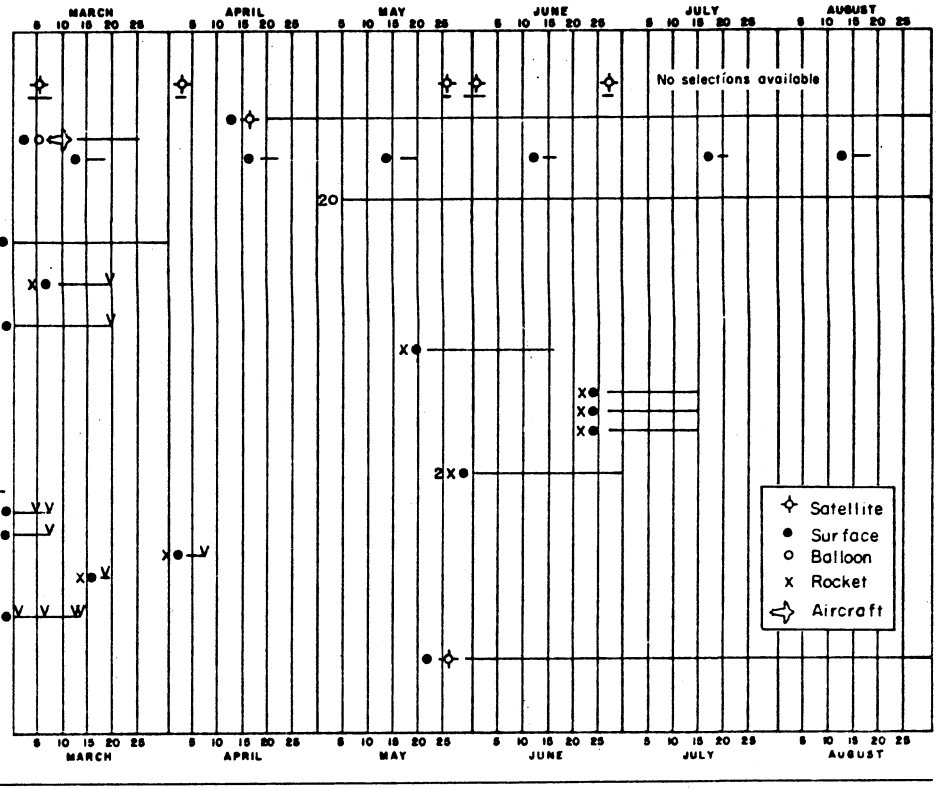
## GEOS MAGNETIC FOOTPRINT MAP (Lambert Equal Area Projection - N. Hemisphere)

The map below shows in some detail the "magnetic footprint" for the most probable final orbit (to be achieved while this NL is in the mail). The numbered and labeled points (1-50) correspond to the table listed on page 6. The points were hand-plotted for coordinates supplied by the IMS Satellite Situation Center. The solid track connects computed points while the broken track (away from apogee) is sketched-in from the later map prepared by the SSC and telecopied to the IMSCIE Office (pg 6). The magnetic footprint point when GOES is at the Scandinavian (Eastern) Apogee is shown as $A_{SC}$ and that for the Alaskan (Western) Apogee is $A_{AL}$. Other labels ($T_B$ and $T_E$) indicate nominal positions along the foot track corresponding to the beginning and ending of potential tracking at Odenwald, Hawaii and Alaska.



IMS CALENDAR OF GBR CAMPAIGNS MARCH - AUGUST 1977
(As of 20 April 1977)

WORLD-WIDE- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Special SSC-selected satellite periods
GEOS (K. Knott, et al)
ASHAY (Radicella, et al)
IISN (Bauer, et al) (preliminary)
MULTIPLE SITES- - - - - - - - - - - - - - - - - - - - - - - - - - -
#0139 (Berthellier; "Vortex") Pretoria region
HEISS ISLAND- - - - - - - - - - - - - - - - - - - - - - - - - - - -
#0327 (Beghin, et al: "IPOCAMP")
KIRUNA (ESRANGE)- - - - - - - - - - - - - - - - - - - - - - - - - -
#0183 (Haerendel, "Porcupine")
ANDOYA (ANDENES)- - - - - - - - - - - - - - - - - - - - - - - - - -
"Polar High Atmosphere" (#0308; Theile; Skylarks)
B-7 (Matthews; 18.211 UE/IE)
SOUTH UIST- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
A-18 (Woolliscroft: P73H)
A-19 (Williams; P190H)
#0085 (Dickinson; P196H)
WALLOPS ISLAND- - - - - - - - - - - - - - - - - - - - - - - - - - -
A-32 (Smith; 14.533UE, 14.534UE)
FORT CHURCHILL - - - - - - - - - - - - - - - - - - - - - - - - - -
B-14 (Whalen, et al.)
B-9 (Zipf; 31.002UA)
B-10 (Gentieu/Mentall; 18.1013GA)
B-12 (Hays/Sharp; 25.025UE)
EGLIN AFB - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
#0400 (Fitz; "STRESS")
CONJUGATE POINTS- - - - - - - - - - - - - - - - - - - - - - - - - -
#0011, 0429 (Perrault, Hirosawa)




(Continued from page 6)
L=7.08, B/Bo=1.009, Perigee 1 (-1.49,127.8E); Alaskan Apogee (1.52, 142.22W) parameters - L=7.06, B/Bo=1.029; Perigee 2 (-1.56, 52.19W).

The N. hemisphere magnetic foot track is replotted on the NGSDC polar map of page 7. Numbered reference points correspond to those labeled on the SSC map. Point 1 is 5.2 hrs before apogee. The most eastern point reached before retrograde motion (8) is 3.73 hrs before apogee. Tracking from Odenwald can begin at $T_{BA}$ (-3.2 hrs). Point 22, at the end of retrograde motion across Scandinavia, is at +3.4 hrs. Tracking from Odenwald can continue until +5.6 hrs (#33).

For the Alaskan Apogee, tracking might begin as early as -5.65 hrs (34) and continue through the retrograde loop until +5.65 hrs (50). Alaskan tracking could begin at T (-2.6 hrs) and continue until +5.65 hrs (50). The passage across the top of the retrograde loop (through apogee) extends from #38 (-3.8 hrs) to #46 (+4.03 hrs). The parts of the foot track between the referenced apogee segments has been dashed-in from comparison with the SSC map and is not intended to be more than a general indication of the remainder of the foot track.

LATEST NEWS FROM ESOC - DARMSTADT: IMSCIE Office received the following telex from K. Knott --- "Today, 4 May 1977, switch-on of all GEOS experiments completed. Initial assessment is that all work normally. In particular, novel electron beam experiment has acquired signal. Payload operation will enter routine phase today. Spacecraft apogee longitude is still drifting at rate 4 degrees per day toward West. Will be stopped at around 35 degrees East in conjugated position to Scandinavia. J. Vette will advise on optimum position of apogee."

IMSCIE Office received a letter in early April giving samples of the planned GEOS Daily Summary Data and detailed explanations of each display as it relates to the GEOS experiments. We do not know what sort of daily summary data will now be made available fromGEOS but we will provide examples in these NLs at the earliest possible time since routine data collection has started.

## LITERALLY LAST-MINUTE NEWS OF GEOS FROM THE IMS SSC

Following an unfortunate malfunction of the GEOS launch vehicle and a subsequent injection of the spacecraft into a transfer orbit from which the planned GEOS geosynchronous circular equatorial orbit could not be achieved, the SSC was requested by Dr. Knott, GEOS Project Scientist, to assist in the evaluation of three possible commensurate orbits that could be obtained with the apogee: two elliptical twelve hour and one elliptical twenty-four hour period orbits had been selected in order to insure data acquisition from the Odenwald station, which is twenty miles from Darmstadt and was constructed as the sole station for GEOS.

Using the SSC interactive computer system, these orbits were examined from the following points of view: 1. Data coverage from Odenwald and from NASA/STDN stations. 2. Time spent in various regions of B-L space. The charged particle environment in the transfer and three candidate final orbits. Since the charged particle environment in all of these orbits is more severe than the planned GEOS stationary orbit, solar cell degradation and the lifetime of the highly sensitive CMOS integrated circuits used in all the experiments was an important factor. 4. The position of the magnetic field line threading the spacecraft on the Earth's surface in the northern and southern hemispheres. This was an important factor in carrying out the planned correlative measurements with the extensive ground based experiments located in Iceland, Scandinavia and Syowa in Antarctica, conjugate to those in Iceland.

Based on the desired L range coverage for which the experiments were designed and on the magnetic ground tracks, the SSC was able to demonstrate that the twelve hour orbits were far superior to the twenty-four hour orbit to accomplish some of the science which the GEOS mission hoped to achieve. These factors outweighed the radiation environment which was more severe by about a factor of three relative to the twenty-four hour elliptical orbit and a factor of eight relative to the planned GEOS stationary orbit. Consequently, a twelve hour orbit with a shorter expected operational lifetime was chosen because the science which can be accomplished is very similar to that originally planned. Unfortunately, it is difficult to estimate the lifetime of the mission at the present time because the amount of shielding provided for the CMOS devices used in all the experiments is difficult to ascertain. Estimates range from weeks to months depending upon whether the shielding is 2 or 3 mm of aluminum equivalent. Following injection into the final chosen orbit, the spacecraft was given a westward drift of 4.2 degrees/day in order to move the longitude of apogee from about 82 degrees east to the position where data acquisition coverage from Odenwald is improved and correlative ground based measurements can be performed. An SSC representative was sent to the Experimenters Meetings held one day after injection into the final orbit to provide the vast amount of material generated to study the possible orbits. After a subsequent experimenters meeting in which it was decided to stop the westward drift of the spacecraft at the optimum position to place the magnetic ground track over Scandinavia, the SSC was requested to study this ground track in detail and recommend the longitude of apogee. Fortunately, the SSC was aided in this task by the gracious provision of a new 1977 external magnetic field model (or be it a preliminary one) produced by Olsen and Pfitzer which included tilt and ring current. Although this model is not valid beyond 10 earth radii, it was ideal to handle the region around L equal 6-7 where GEOS, with an apogee around L=7, spends most of its time. Although this model is for relatively quiet magnetic conditions, the magnetic ground tracks are very similar to the Mead-Fairfield Super-Distrubed Model because the ring current effects are important in the present GEOS orbit. On the basis of this study the SSC has recommended to the GEOS Project that the longitude of apogee be placed initially at 37.7 degrees East. The information presented in this issue of the Newsletter about the GEOS orbit is based on this position of apogee. Very fortunately, the magnetic ground track at the other apogee provides an interesting pattern for the ground based stations in Alaska and the present position of ATS 6 as illustrated in this issue. Because of this added bonus in the compromised orbit of GEOS, steps are being taken by ESA and the US IMS community to investigate data acquisition of the "Western" apogee of GEOS by the NASA STDN network. For this reason, coverage from some appropriate STDN stations are included in this issue. In order to maintain this optimum magnetic ground track it is necessary to program a westward drift of the GEOS subsatellite track of 0.12 degrees/day to compensate for nodal and apsidal precessions of the orbit due to the non-spherical nature of the earth's gravitational field. The SSC has also recommended this to the GEOS Project on the basis of its study. As the local time of apogee changes (at the rate of about 0.88 degrees/day) the magnetic ground track of GEOS will change somewhat in the important near-polar regions. Once the final orbit maneuvering of the GEOS spacecraft is accomplished, the SSC will issue in the Newsletter the predicted changing of the GEOS magnetic ground track so that the IMS community will be informed. In spite of the failure of GEOS to attain its desired orbit, there are many interesting properties of its present orbit that should prove very useful to the IMS.

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GEOS Recommended Orbit --- If the GEOS longitude of apogee is stoped at 37.7E and a westward drift is maintained of 0.12 degrees/day, the times shown on the detailed orbit plots for the Scandinavian and Alaskan regions are hours before (- values) or after (+ values) apogee. In the next IMS Newsletter, we will publish more complete tables giving corresponding L values and the ration of magnetic field at the satellite location to the equatorial field, B/Bo. The approximate L coverages for planned or potential tracking stations in hours is: Odenwald - L/HRS = >7/2.0, 7-6/4.1, 6-5/1.0, 5-4/0.7, 4-3/0.5, 3-2/0.4, <2/0.1, total time 8.8 hrs; Hawaii/Alaska (combined coverage) - >7/1.4, 7-6/4.2, 6-5/2.0, 5-4/1.6, 4-3/0.9, 3-2/0.3, <2/0, total time 10.5 hrs. Coverage at Odenwald begins about -3.2 hrs from apogee and ends at +5.6 hrs. Local time of apogee is 19.0 hrs. The magnetic ground track of ATS 6 at 140W intersects Alaska ground track of GEOS at about 121.5W.

Nodal and apsidal precession of orbit calculations for 120 sidereal days with westward drift of 0.12 degrees/day gives the following points on the Scandinavian magnetic footprint track. Hrs from apogee/lat,E long --- -1.0/72.0,33.7; 0/72.0,24.6; +1.0/71.5,16.8; +3.8/67.8,14.2; +4.6/64.4,20.9; +5.0/60.8,33.4. Local time of apogee for this case is 12.3 hours.

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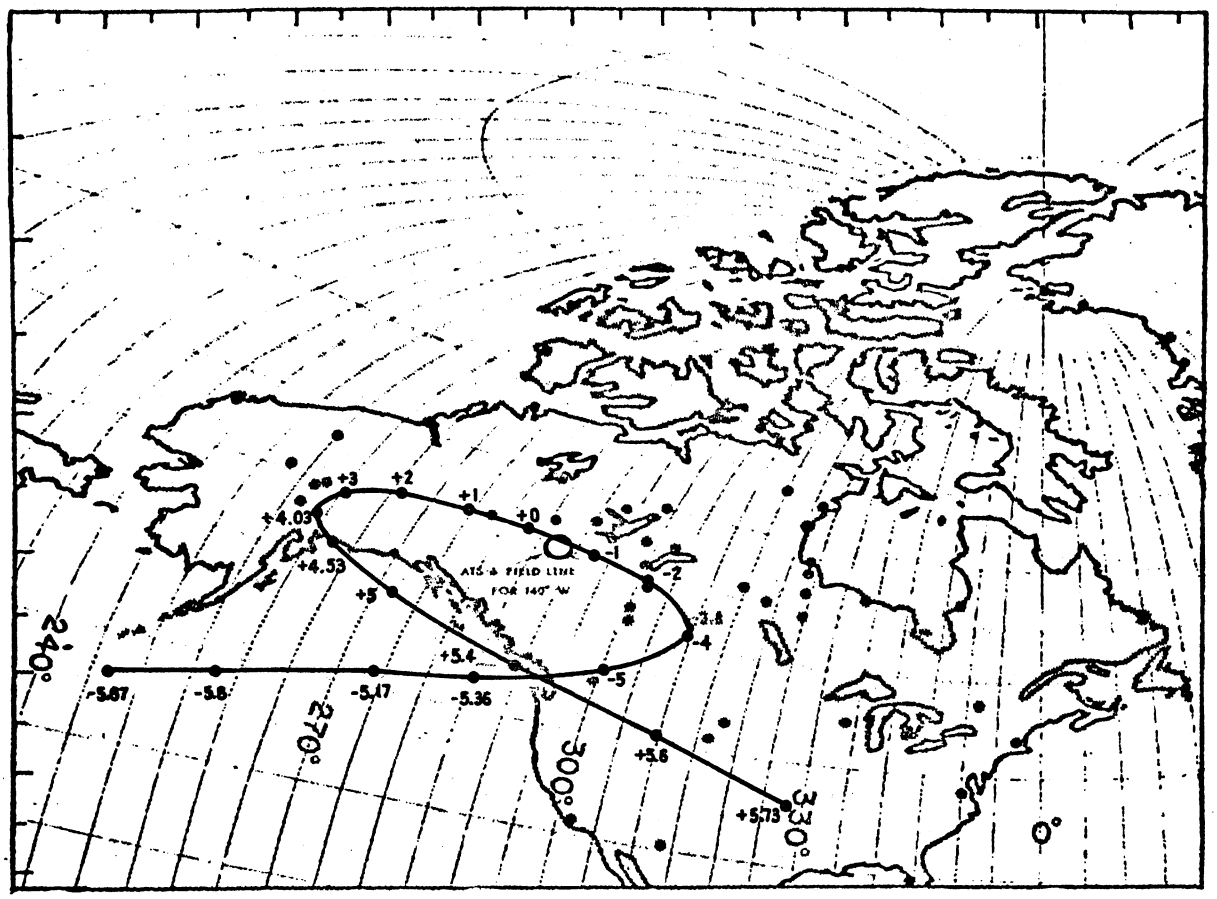
Request from US IMS Coordinator --- Dr. Manka asked that all experimenters on ATS-6 and those having ground-based programs in N. America near the GEOS magnetic foot track consider beginning data collection now or planning for data collection programs in conjunction with GEOS observations as it sweeps the Canadian and U.S. areas. Immediate planning may be important because of the uncertainty about the GEOS operational lifetime under the higher radiation conditions. It is hoped that NASA will soon begin data acquisition from GEOS when it is near the Western Apogee.

# GEOS ALASKAN APOGEE
(ATS-6 INTERSECT)




# GEOS SCANDINAVIAN APOGEE