N O T I C E

CONTINUATION OF DATA ANALYSIS FROM THE ION MASS SPECTROMETER ON THE ISIS-II SPACECRAFT

SEMI-ANNUAL STATUS REPORT

FOR

September 1980-February 1981

John H. Hoffman

The University of Texas at Dallas

P. O. Box 688

Richardson, Texas 75080

TO

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

(NASA-CR-164204) CONTINUATION OF DATA ANALYSIS FROM THE ION MASS SPECTROMETER ON THE ISIS-2 SPACECRAFT Semiannual Status Report, Sep. 1980 - Feb. 1981 (Texas Univ. at Dallas, Richardson.) 6 p HC A02/MF A01 G3/46 N81-22636 Unclas 42118

NASA GRANT NSG 5087

UTD Account E1369-07

MAY 1981

1.0 PRESENT STATUS AND RECENT PROGRESS

On April 1, 1971, 10 years ago, the ISIS-II spacecraft was launched from the western test range. During that period the spacecraft has performed very well producing a vast amount of data on the composition and dynamics of the ionosphere, particularly in the polar regions, that has lead to the development of models of the interaction between the ionosphere and magnetosphere. The spacecraft is still operational and present plans call for its continued operation for 1 or 2 more years.

The Ion Mass Spectrometer measures the composition and number density of the positive ion species in the ionosphere as well as the ion flux normal to the spacecraft trajectory. Owing to the circular orbit, this flux is in the vertical direction and in the polar regions also lies along the magnetic field lines. The ISIS program is controlled by a working group comprised of the experiment Principal Investigators, satellite controller and representatives from many countries which participate in the program through operation of ground stations or ground based experiments. A sub-set of the Working Group, the Experimenters' Team, meets periodically to plan the future operations of the spacecraft, the type of ionospheric investigations the group will conduct and to compare and study results from on-going investigations.

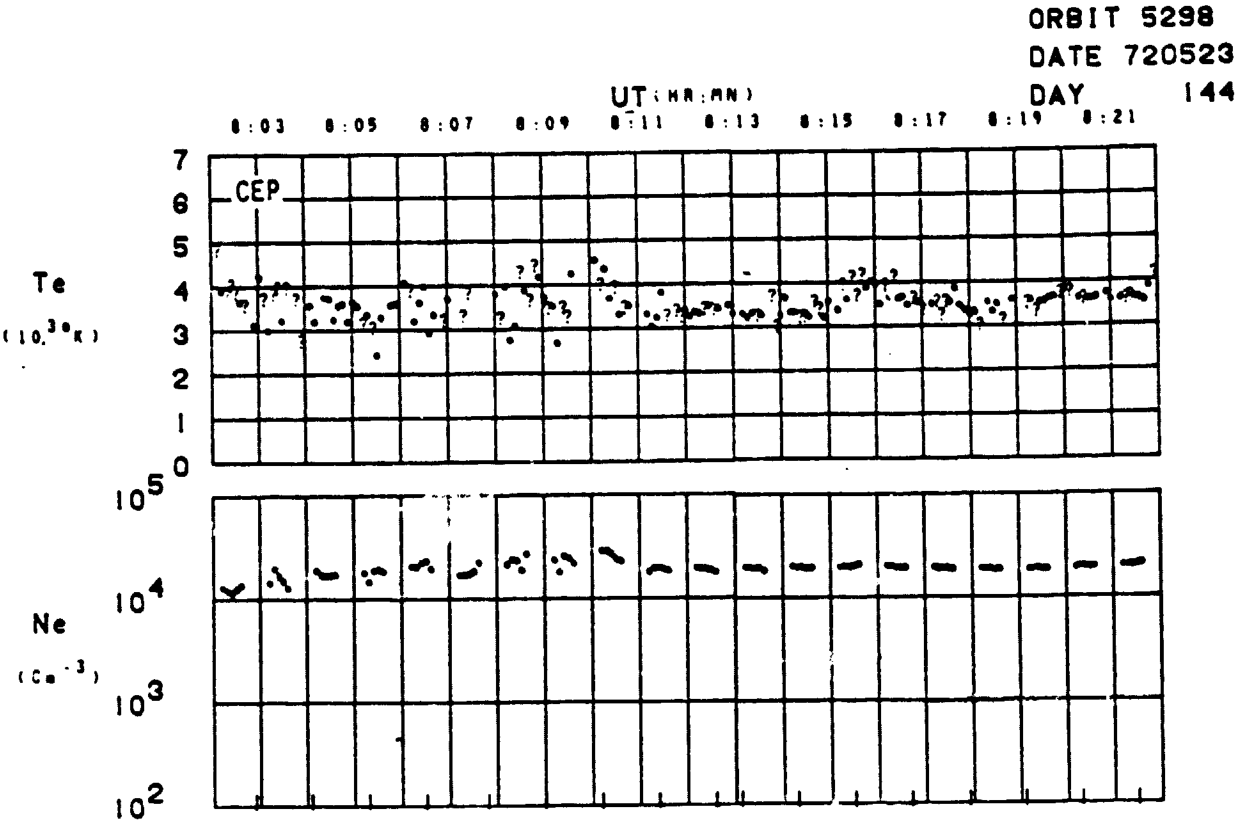
During the past year there were two meetings of the ISIS Experimenters' Team and one meeting of the parent body. A special ISIS symposium was held in Toronto at the American Geophysical Union Spring 1980 meeting at which time the Working Group and Experimenters' Team also met. The symposium was organized to present an overview of ISIS results and accomplishments. It included an invited paper entitled, "High Latitude Ionospheric Dynamics," by Hoffman and Whitteker. (See attached abstract). The paper was assembled and presented by Hoffman with significant inputs from J. Whitteker and R. Sagalyn. It discussed principally motions of ions in the F layer and topside ionosphere. Horizontal drifting affects the distribution of ionization and upward flow of light ions (the polar wind) removes ionization and modifies the composition of the topside ionosphere. These parameters were observed by the topside sounder and ion mass spectrometer on ISIS-II.

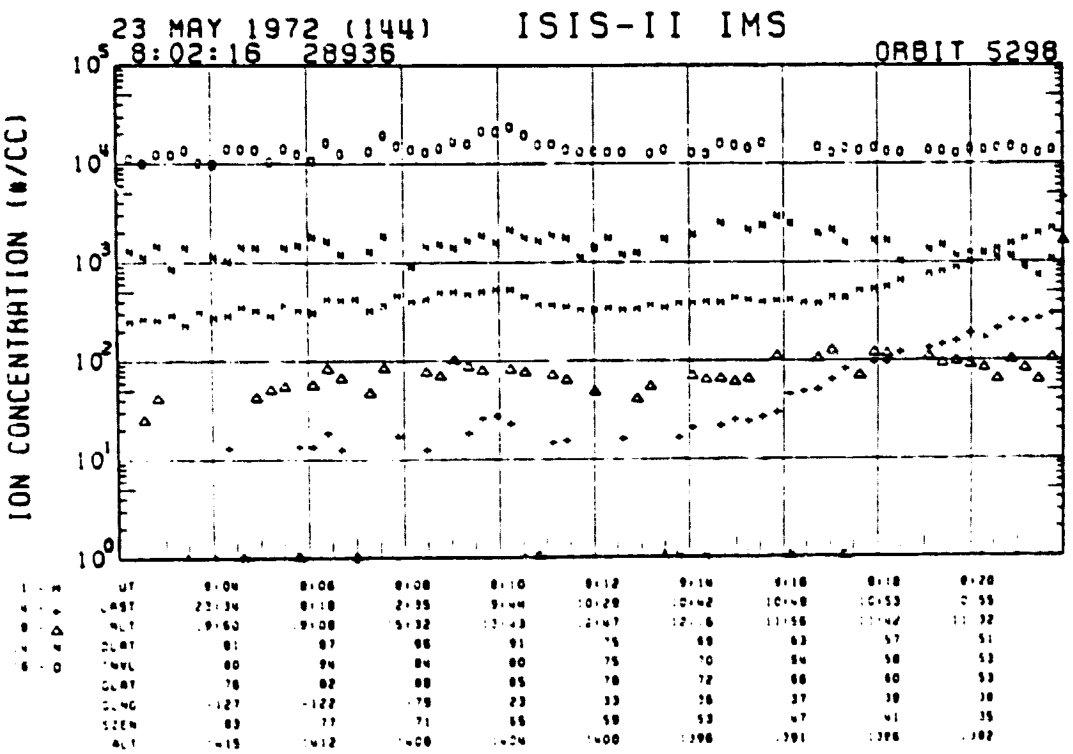
At the Experimenters' Team meetings the planning and organization of a set of 4 ISIS-II data books was accomplished. These are being published by the National Space Science Data Center as pertinent examples of ISIS data to show the types and breadth of ISIS data that are available from the Data Center. Ion composition results appear mainly in Volumes 3 and 4. A special format for the ion mass data was prepared in order to show its correlation with other direct measurements. In particular, the IMS data are presented with the electron temperature data from the Cylindrical Electrostatic Probe. The format shows the data over 20 minute time segments as concentrations of the more dominant ion species, H^+, He^+, O^{++}, N^+ and O^+. Universal time is given in two minute intervals with ephemeris data at the bottom of the page. A sample page is attached.

Dr. Eichii Sagawa from the Radio Research Laboratory in Japan, an ISIS member organization, is spending a year in our laboratory working on principally ISIS data and its correlation with the MIMS ion concentration data from AE C and D spacecrafts. He is supported by a grant from the Japanese government. He is looking at polar wind type ion flows from the AE data and is investigating the correlation with the ISIS results.

Dr. Sagawa is also involved in the study of the location of the latitudinal position of the minimum in the light ion trough. This is referred to as the knee. There is a knee in both the H^+ and the He^+ densities. Preliminary indications show the He^+ knee lie poleward of the H^+ knee during quiet times, but the two tend to become coincident as the Kp index increases.

An emperical composition model of the polar ionosphere at 1400 km altitude (the ISIS-II altitude) consisting of maps of the major constituent, H^+, He^+ and O^+, concentrations on a dip-latitude-local time coordinate base for solstice and equinox times is being developed. This model shows the variations in ion composition and flow velocities at 1400 km altitude and displays its behavior in the auroral and polar cap regions. The data are taken at reasonably magnetically quiet times. Separate models will be developed for solstice and equinox seasons. All of the data from the first two years of ISIS-II operation are used and as much as possible after that time will be used to fill in the local time coordinate.


ORBIT 5298
DATE 720523
DAY 144
UT(HR:MN)
8:03 8:05 8:07 8:09 8:11 8:13 8:15 8:17 8:19 8:21
CEP
Te
(10^3 °K)
Ne
(Cm^-3)


23 MAY 1972 (144) ISIS-II IMS
8:02:16 28936
ORBIT 5298
ION CONCENTRATION (#/CC)

HIGH LATITUDE IONOSPHERIC DYNAMICS

J. H. Hoffman (The University of Texas at Dallas P. O. Box 688, Richardson, Tx 75080)
J. H. Whitteker (Communications Research Centre Shirley Bay, P.O. Box 11490, Station "H", Ottawa, Ontario K2H 8S2 Canada)

The high-latitude ionosphere is almost always in a state of motion, both horizontally and vertically. Many of the properties of the F layer and topside arise from this fact. Horizontal drifting affects the distribution of ionization, and the upward flow of light ions (the polar wind) removes ionization and modifies drastically the ion composition in the topside. In the ISIS program, the results of the redistribution of ionization, both horizontally and vertically, have been observed in topside-sounder measurements of electron density, and the upward flow of light ions has been measured directly by directional ion mass spectrometers. The most obvious example of horizontal drifting is a 'tongue' of ionization extending from the sunlit side of the solar terminator into the polar cap. An example of ionospheric dynamics involving both horizontal and vertical motion is the heating, expansion, cooling, and collapse of the topside ionosphere as it drifts beneath the magnetospheric cleft. The polar wind, particularly in winter can cause a severe depletion of light ions in the topside, which implies a low scale height, which in turn results in very low electron densities at high altitudes. The distribution of polar wind velocity and flux in the polar regions is wide spread and exists at all times. H^+ fluxes are lower in winter than in summer, whereas He^+ fluxes are a factor of 10 higher in winter and tend to follow the neutral helium concentration near the F_2 maximum. The latter agree well with model calculations of flux in the winter but lie above the model values by a factor of 2 in summer. H^+ fluxes also agree well with ion flow models.