REPORT UAG-90

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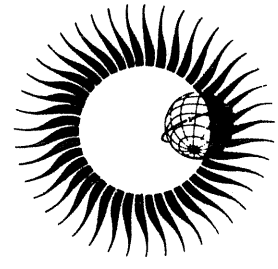
for
Solar-Terrestrial Physics

EXPERIENCE WITH PROPOSED IMPROVEMENTS OF THE INTERNATIONAL REFERENCE IONOSPHERE (IRI)



MAY 1984

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Solar-Terrestrial Physics

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EXPERIENCE WITH PROPOSED IMPROVEMENTS OF THE INTERNATIONAL REFERENCE IONOSPHERE (IRI)

Contributed papers, mainly from the URSI-COSPAR workshop held in Budapest in 1980

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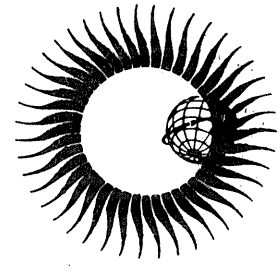

May 1984

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service
National Geophysical Data Center
Boulder, Colorado

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2.2.3 Comparison of the IRI with Ion Temperature and Ion Density as Measured during Very Quiet Geomagnetic Conditions on board the Geophysical Rocket "Vertical-6"

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Abstract: During a magnetically quiet time ion temperature and ion density up to 1500 km were measured on 25 Oct. 1977 during the flight of the geophysical rocket "Vertical-6" by means of a group of five retarding potential analyzers, looking into different directions of space. The results when compared with the International Reference Ionosphere 1978 show that both the ion temperature and the ion density are lower than the values predicted by the Reference Ionosphere, the difference decreasing with increasing alitude.

1, Introduction

The geophysical rocket "Vertical-6" was launched on 25th October 1977 at 1515 LMT, at middle latitude in the European part of the USSR in the framework of the complex investigation of the upper atmosphere organized by Inter osmos. The trajectory of the rocket was very close to the vertical, the deviation being not greater than about 3°. The rocket was stabilized along three axes with an accuracy of ±3° and reached an altitude of 1500 km. The measurements, discussed here, were carried out by means of a group of five retarding potential analyzers (RPA) looking into different directions in space.

The experiment is particularly interesting for two reasons: on the one hand, rocket experiments reaching an altitude of 1500 km are rare, and on the other hand the date in the minimum of the solar cycle during a period of very low activity. At the launch day the relative sunspot number was 28, Covington's solar radio flux index was 88.1. Geomagnetically the conditions were extremely quiet (Kp = 0). We thus had the exceptional situation of completely undisturbed conditions.

2, Methods of Analysis

The ion temperature and ion density where determined, by multi-parameter curve fitting partly from the characteristic curves of the analyzer looking upwards and partly from the data given by one of the RPAs looking in the horizontal direction /Knudsen, 1966; Hoss and Hyman, 1968; Hanson et al., 1970/. The model values have been computed using the procedures given in the International Reference Ionosphere 1978 /Rawer et al., 1978a/, however, when calculating the ion temperature, the smoothing procedure designed to keep it less than the electron temperature has been not used, as it was clear in advance that the ion temperature would satisfy this condition. As regards the determination of the total ion density in the height range between HmF2 and 1000km, for the harmonized Bent-model the maximum electron density has been computed by means of the subroutine IONDEM, i.e. after the simplified equations of Chiu.

3, Results and Proposed Improvements

The ion temperatures obtained from the measurements were compared with the model values computed for the time of the apogee of the trajectory in Figure 1; the neutral temperature, computed on the basis of CIRA /1972/ is also plotted. Below about 550 km the computed values of ion temperature differ considerably from the measured ion temperature which approaches the neutral temperature. Above this altitude the measured data show a steep gradient and the model approaches the observed ion temperature at about 700 km. Then the model deviates more and more from the measured data with increasing height showing the largest difference at about 800 km. Above this height the computed values again approach gradually the observed values. The difference between the measurements and the average model may be due to the quiet conditions.

In figure 2 the computed values of electron density and the measured total ion density are shown. It can be seen that the computed electron density is greater than the observed value along the whole profile, the difference decreasing somewhat with increasing height. However, the shapes of the two profiles are practically identical. The difference between both profiles may be due largely to the Chiu value of foF2 being too great.

I would be not proper to suggest any improvement of the IRI on the basis of only one experiment; therefore the discussion has been confined to the presentation of results.

Editor's remark:

The shape of the observed instantaneous temperature profile might be strongly influenced by atmospheric gravity waves. As for electron density the agreement with an average profile could not be better due to the known large variability.

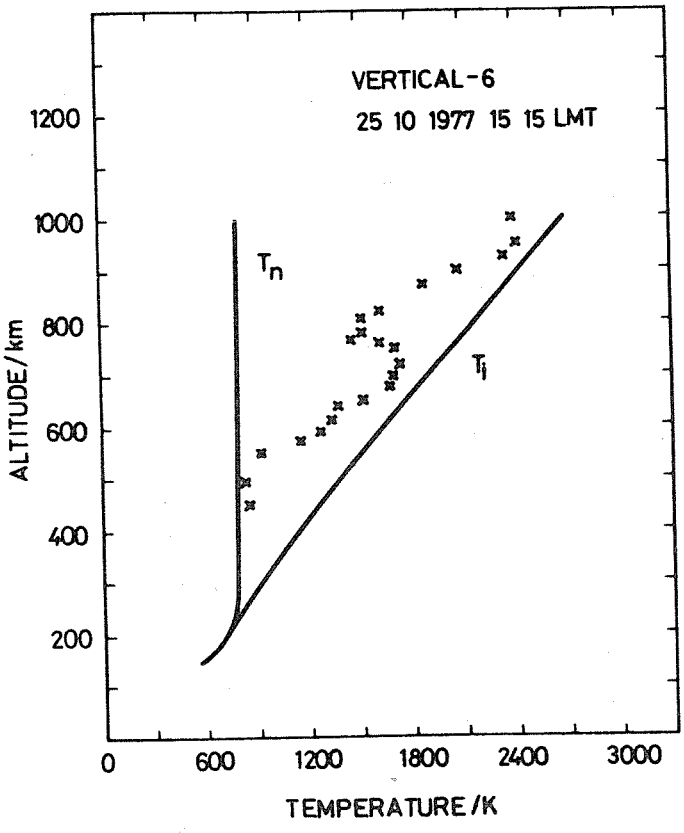

Fig. 1 Variation of the neutral and ion temperatures (Tn, Ti) with altitude computed for the time of apogee with CIRA 1972, and the International Reference Ionosphere 1978, respectively (full lines). The measured ion temperature is denoted by crosses.

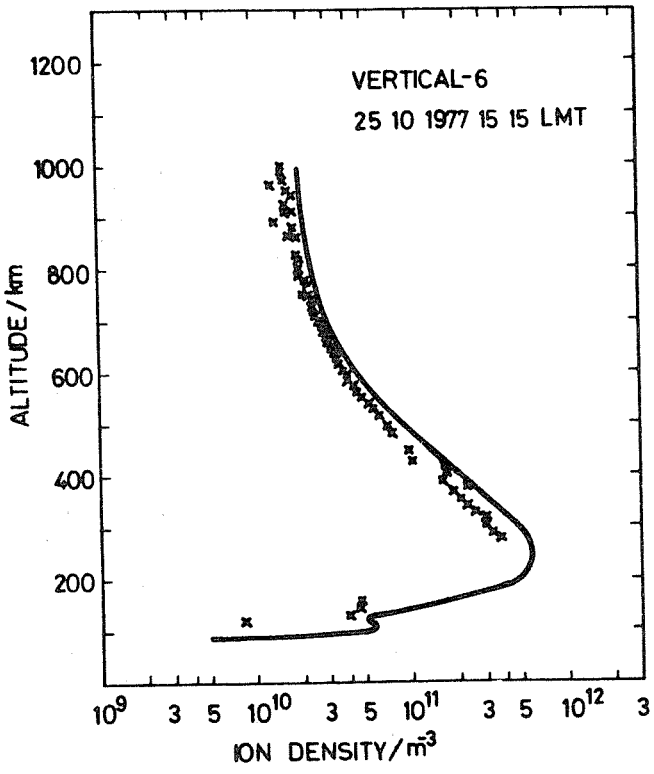

Fig. 2 Electron density profile computed on the basis of the International Reference Ionosphere 1978 for the time of apogee (full line). Measured total ion desities are denoted by crosses.