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GEOMAGNETICALLY VERY QUIET CONDITIONS ON
BOARD OF THE GEOPHYSICAL ROCKET
"VERTICAL-6" WITH THE INTERNATIONAL
REFERENCE IONOSPHERE

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REFERENCE IONOSPHERE

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ABSTRACT

Ion temperature and ion density, measured the 25th October 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, are compared with the International Reference Ionosphere 1978. The measurements were carried out in a geomagnetically very quiet period to a height of 1500 km. The results show that both the ion temperature and the ion density are lower than the values predicted by the Reference Ionosphere, the difference is decreasing with increasing altitude.

АННОТАЦИЯ

На геофизической ракете "Вертикаль-6", запущенной 25 октября 1977 года, были проведены измерения ионной температуры и ионной плотности при помощи пяти анализаторов с тормозным потенциалом, установленных в различные направления космоса. Результаты были сравнены с данными "Международной модели ионосферы 1978". Измерения проводились в спокойном геомагнитном периоде до высоты 1500 км. Результаты показывают отличие от предварительных значений Международной модели как для ионной температуры так и для ионной плотности. Увеличением высоты отличие уменьшается.

KIVONAT

Az 1977. október 25-én felbocsátott "Vertikál-6" geofizikai rakéta repülése során ionhőmérséklet és ionsűrűség méréseket hajtottak végre öt különböző irányba néző fékezőpotenciális sikanalizátor segítségével. Az eredményeket az International Reference Ionosphere 1978 adataival vetették egybe. A méréseket igen nyugodt geomágneses időszakban, 1500 km csúcsmagasságig hajtották végre. Az eredmények azt mutatják, hogy mind az ionhőmérséklet mind az ionsűrűség kisebb, mint a Reference Ionosphere által előrejelzett értékek. A különbség növekvő magassággal csökken.

INTRODUCTION

The geophysical rocket "Vertical-6" was launched the 25th October 1977, 15 15 LMT from the middle latitude area of the European part of the USSR in the framework of the upper atmosphere's complex investigation, organized by Intercosmos. The trajectory of the rocket was very close to the vertical, the deviation being not greater than about 3° . The rocket was three axially stabilized with an accuracy of $\pm 3^{\circ}$ and reached an altitude of 1500 km. The measurements, the results of which will be discussed in this paper, were carried out by means of a group of five retarding potential analyzers /RPA/ looking into different directions in space.

It may be useful to compare the results of these measurements with the International Reference Ionosphere, as on the one hand rocket experiments reaching an altitude of 1500 km are rare, on the other hand the rocket was launched during very quiet geomagnetic conditions. The relative sunspot number and the solar radio flux, measured at 2800 MHz were 28, respectively $88,1/10^{-22} \text{ Wm}^{-2} \text{ Hz}^{-1}$ and the three-hourly geomagnetic index 0. The launch time was preceded and followed by a period of low solar activity. Thus, the state in the upper atmosphere corresponds really to undisturbed conditions.

METHODS OF ANALYSIS

The ion temperature and ion density have been determined from the characteristic curves of the analyzer looking upwards by means of a multi parameter curve fitting [1, 2, 3]. The model values have been computed using the corresponding procedures given in the International Reference Ionosphere 1978 [4]. In case of the calculation of the ion temperature the smoothing

procedure to keep it less, than the electron temperature has been not used, as it was in advance clear that the ion temperature will satisfy this condition. As regards the determination of the total ion density, that is the electron density in the height range between HMF2 and 1000 km, for the harmonized Bent-model the maximum electron density has been computed by means of the subroutine IONDEM corrected according to the program of Chiu.

RESULTS AND PROPOSED IMPROVEMENTS

The ion temperature derived from the measurements on board of the geophysical rocket "Vertical-6" are compared with the model values computed for the time of the apogee of the trajectory in *Fig. 1*. Additionally the neutral temperature, computed on the basis of CIRA 1972 [5], is also plotted. Below about 550 km the computed values of ion temperature differ considerably from the measured ion temperature approaching the neutral temperature. Above this altitude the measured data show a steep gradient and thus the model gives at about 700 km values practically equal to the observed ion temperature. Then the model deviates from the measured data with increasing height more and more showing the largest difference at about 800 km. Above this height the computed values approach gradually the observed values. The difference between the measurements and the model may be due to the quiet conditions and might be explained by the combined effect of charge exchange reactions and diffusion.

In *Fig. 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 data along the whole profile the difference decreasing somewhat with increasing height. However, the model electron density profile has practically a shape identical with the measured total ion density profile. Thus, the difference between the computed and measured profiles may be due largely to the value of FOF2 being too much.

Finally it would be not proper to suggest any improvement of the IRI on the basis of only one experiment, therefore the discussion is confined to the presentation of results.

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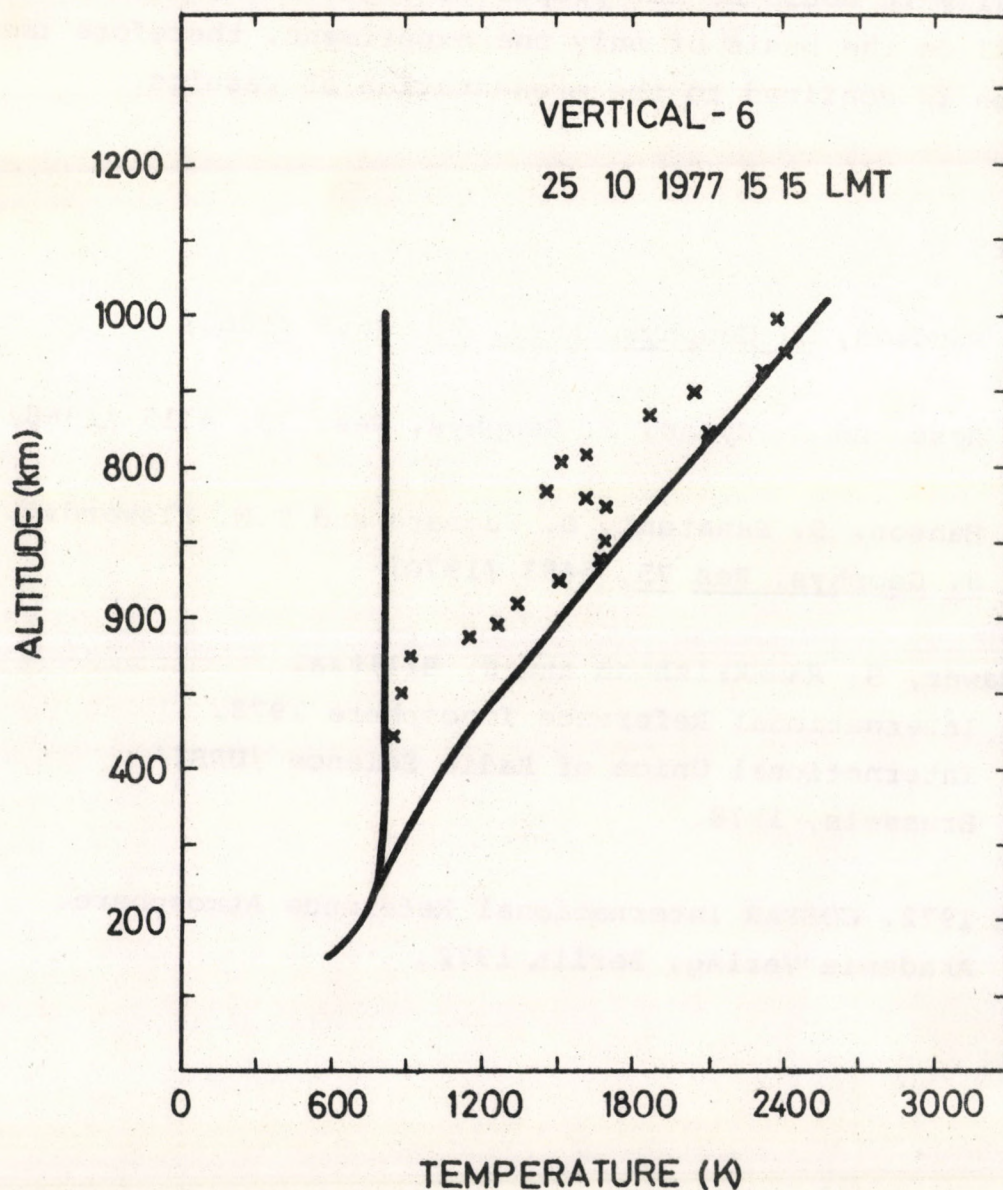


Fig. 1 Variation of the neutral, ion and electron temperature with altitude at the time of apogee of the geophysical rocket "Vertical-6" computed on the basis of CIRA 1972, resp. the International Reference Ionosphere 1978. The measured ion temperature is denoted by crosses.

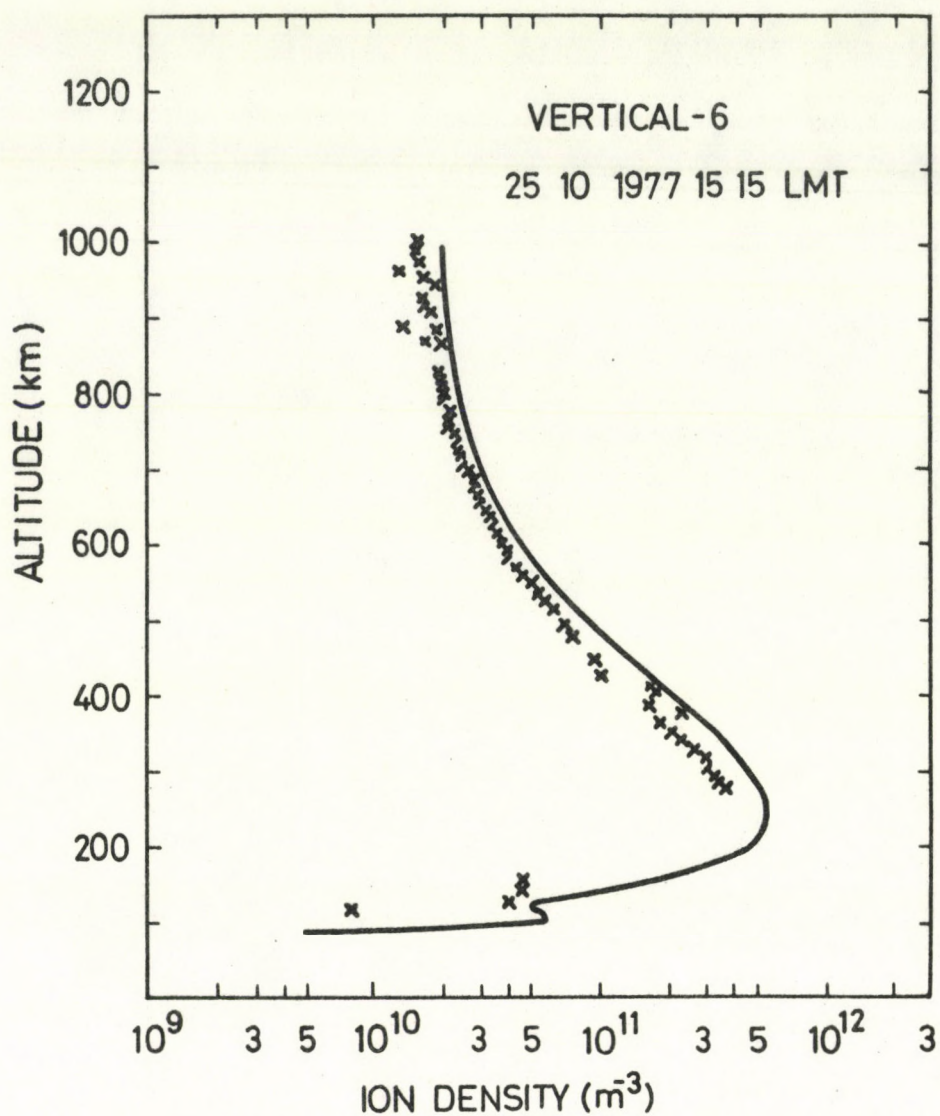


Fig. 2 Electron density profile computed on the basis of the International Reference ionosphere 1978 for the time of apogee of the geophysical rocket "Vertical-6". Measured total ion densities are denoted by crosses.



Fig. 2. A graph showing the relationship between the density of the polymer and the density of the solvent. The curve starts at approximately (0.00, 0.00), rises to a peak of about 0.05 at x=0.05, then falls to a minimum of about 0.01 at x=0.10, and finally rises again to about 0.05 at x=0.15.

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