6.5 RESULTS OF ROCKET MEASUREMENTS OF D-REGION IONIZATION OVER THUMBA IN MAP

D. K. Chakrabarty, G. Beig
Physical Research Laboratory
Navrangpura, Ahmedabad 380 009, India

S. C. Garg, P. Subrahmanyam, K. S. Zalpuri, Y. V. Somayajulu, M. N. M. Rao, C. B. Tandel, and T. R. Murlikrishna

National Physical Laboratory
New Delhi 110012, India

Under MAP, two rockets were launched from Thumba (8.5°N, 76.8°E) around 1030 hrs Lt with identical payloads on 7 and 10 March 1986 for D-region studies. Positive ion densities were measured by spherical probe and Gerdien condenser and electron densities were measured by Langmuir probe and propagation experiments. In both flights a valley in ionization height profile was noticed around 83 km. The density of ionization at this altitude was about 4×10^2 cm^{-3}. A detailed positive ion-chemical scheme was used to reproduce the measured ionization height profiles. The density of NO needed to reproduce the valley in ionization at 83 km came around 5×10^5 cm^{-3}. A photochemical treatment without diffusion process was found inadequate to explain this value of NO. Calculations showed that the value of vertical eddy diffusion needed to reproduce the value of NO was around 10^6 cm^2 s^{-1}. Interestingly, the same value of eddy diffusion coefficient was obtained when derived in the manner described by Thrane and his coworkers using only the positive ion current data of spherical probes.
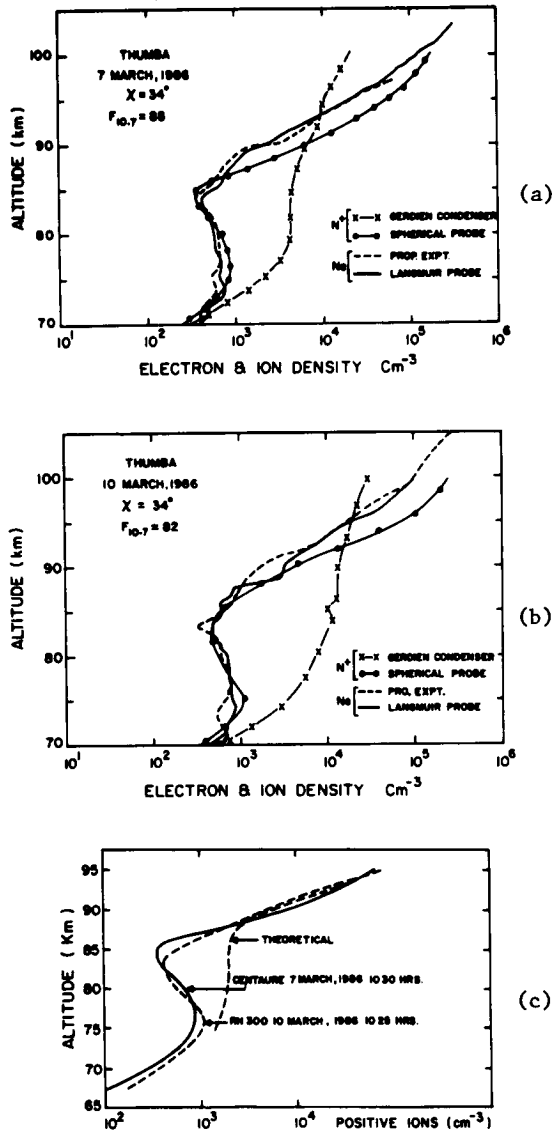
Figure 1. (a) and (b) show the plot of rocket measurements of electron and ion density profiles made at Thumba on 7 and 10 March 1986, respectively. On both days, the rocket carried identical payloads, viz., Langmuir probe, propagation experiment, Gerdien condenser and spherical probe. The Gerdien condenser gives an over estimation of the values of positive ion density below about 90 km and an underestimation above this altitude. Profiles obtained by all other techniques show a ledge preceded by a valley around 83 km. In general, the shapes of electron and ion density profiles on two days are identical but they differ in detail. (c) shows the plot of positive ion density profiles obtained on two days by spherical probe. A day-to-day variability is discernible. The theoretical profile in (c) has been obtained using the measured NO density profile of Torker et al. [1985] at Thumba.
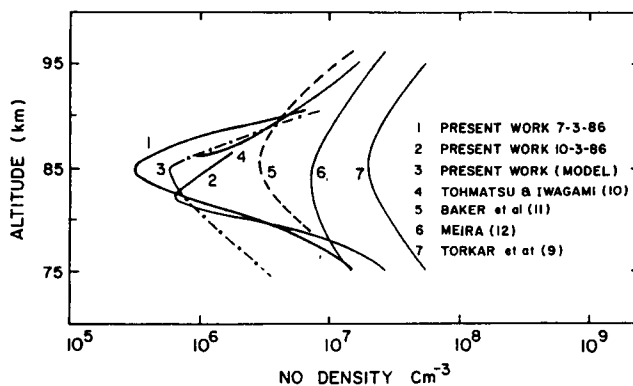
Figure 2. Height distributions of NO density obtained theoretically and experimentally by different workers. Here profile number 1 and number 2 represent the NO density required to reproduce the observed positive ion density profiles of 7 and 10 March 1986. It is to be noted that both the profiles have a valley around 80 - 85 km altitude. Also they differ considerably among themselves and are about an order of magnitude less than that of Baker et al. at this region. Profile number 3 was obtained by an 1D NO program using the eddy diffusion coefficient values derived by the current data of the spherical probe of 7 March 1986 in the manner described by Thrane et al. It is to be noted that we are able to reproduce the NO density above ~ 83 km, but below this altitude the NO values are underestimated.
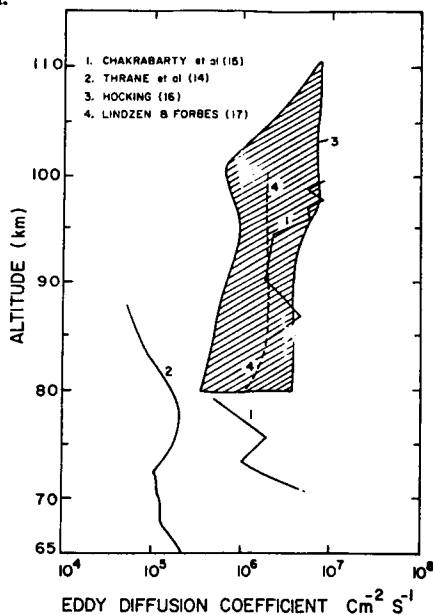

Figure 3. Height distribution of eddy diffusion coefficient given by some authors. Here profile number 1 is derived from the current data of the spherical probe obtained on 7 March 1986 in the manner described by Thrane et al. The profile of the eddy diffusion coefficient has been used in an 1D NO program. The profile of NO thus obtained matches the NO profiles required to reproduce the observed ion density profiles of 7 and 10 March 1986 above ~ 83 km; below this altitude, the NO values are underestimated.