Adv. Space Res. Vol. 8, No. 8, pp. (8)155–(8)158, 1988
Printed in Great Britain.

0273–1177/88 $0.00 + .50

CORRELATED COSMOS-900 AND INTERCOSMOS-17 OBSERVATIONS OF SPATIAL–TEMPORAL VARIATIONS OF IONOSPHERIC PARAMETERS AND RING CURRENT ION PRECIPITATIONS

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ABSTRACT

The data of simultaneous Cosmos-900, Intercosmos-17 measurements of 100-keV ions and cold plasma density and electron temperature are analyzed. The dynamics and the mutual position of the ionospheric trough and the ring-current ion precipitation regions during a strong magnetic storm in the dusk-dawn sector of the magnetosphere are studied.

The 500-km altitude circular orbiting satellites Cosmos-900 and Intercosmos-17 with 83° and 84° inclinations of their orbits measured the ions with E = 200-300 keV using a differential crystal spectrometer (Cosmos-900) and the ions with E = 150-350 keV using proportional gas-discharge counters (Intercosmos-17). Use is made of the data from the detectors measuring the particles whose mirror points are located at the satellite orbit altitude. The thermal plasma density measurements were carried out by a three-electrode ion trap and the electron temperature was measured by a radiofrequency probe.

Figure 1 shows an example of simultaneous measurements of the following parameters on board the two satellites: the cold plasma density and electron temperature and the counting rate of ions with E = 200-300 keV (the Cosmos-900 measurements); the cold plasma electron temperature and the counting rate of ions with E = 150-300 keV (the Intercosmos-17 measurements). The times of the satellite passes were very close to each other, namely, 0642-0649 UT and 0637-0646 UT October 28, 1977. The local times were very different, namely, 2100 MLT and 0200 MLT. A trough in the ionospheric plasma density profile is clearly seen. The electron temperature maximum is observed in the region of minimum density /1/. Henceforth, the position of the trough will be defined using just the electron temperature because the latter was measured on board twq satellites. The electron temperature was peaking

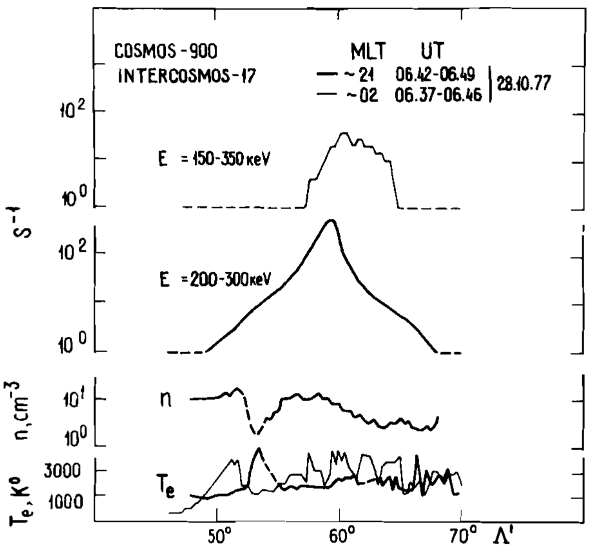

Fig. 1. The data of the simultaneous Cosmos-900 and Intercosmos-17 measurements of ions and the cold plasma density and temperature on October 28, 1977.

on 53.5° at 2100 MLT and on 51° at 0200 MLT. The difference arises from the LT asymmetry of the position on the ionospheric trough. It is seen that the dusk-side trough is located in the ion precipitation region, whereas the dawn-side ion precipitation boundary is shifted polewards from the trough.

The upper part of Figure 2 shows the intensity variations in the ion precipitation maximum on board the two satellites during the magnetic storm of October 27-28, 1977. The ion injection is clearly seen in the dusk-midnight sector of the magnetosphere during a weak individual substorm at ≈ 0100 UT. Within the period from 0700 to 1100 UT, data are absent and we can only see an intensity decrease on both satellites after particle injection during the first strong substorm. The particle injection during the second substorm (with the maximum at ≈ 1500 UT) was recorded as simultaneous intensity maxima on board the two satellites. The local times of the satellites during that period were 2200 LT (Cosmos-900) and 0030 LT (Intercosmos-17). After that, the ion intensity curve shapes on the two satellites got very different because of the differents between the local times of the satellites. Cosmos-900 traversed the dusk sector with its favourable conditions for observations of particle injection. Intercosmos-17 entered the aftermidnight sector where the intensity was formed mainly by the drift from the injection region located in the dusk sector of the magnetosphere. During the storm recovery phase from 0600 UT on October 28, 1977, an ion intensity decrease was observed on both satellites. At ≈ 1230 UT in the dusk sector Cosmos-900 detected an ion intensity increase resulting from the development of another substorm. The middle part of Figure 2 shows the latitudinal positions of the ion precipitation regions inferred from the Cosmos-900 and Intercosmos-17 data as well as of the ionospheric trough. The position of the trough varies slowly throughout the storm and follows approximately the D_{st}-variation behaviour on both dusk and dawn

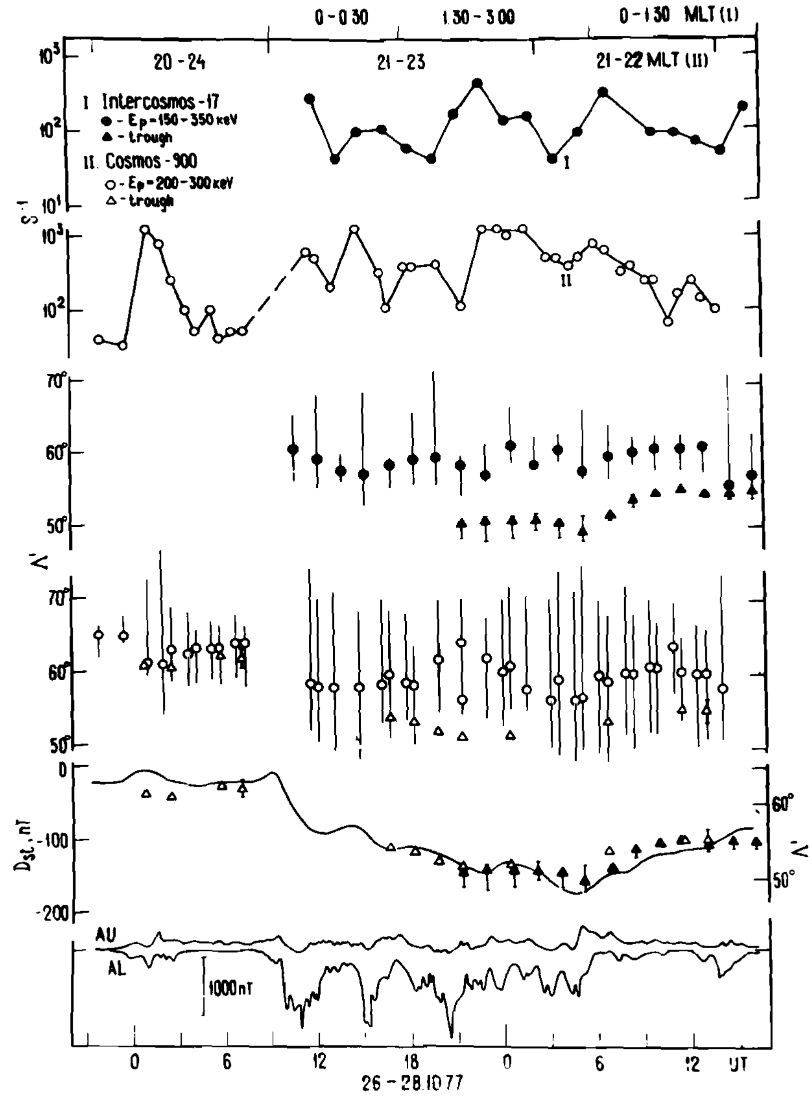

Fig. 2. The temporal behaviour of the ion counting rate in the precipitation maximum (the upper part of the figure) and of the latitudinal positions of the precipitation region and the ionospheric trough (in the middle); the D_{st}-variations, the AU- and AL-indices.

sides. The most asymmetric distribution of cold plasma was observed at 0640 UT on October 28, 1977 when the difference between the positions of the T_e maxima was 2.5°. This occurs during the storm recovery phase when the substorm disturbances were minor. The difference between local times was 5 hours (see Figure 1). The simultaneous data of 1130 UT belong also to a comparatively quiet period; in this case, however, the LT difference was smallerthan 3 hours and the latitudes of the T_e maxima were the same. During the storm expantion phase, the closeness between the latitudes of the trough is probably due to its LT symmetrisation during disturbances. A different pattern was observed for the positions of the ion precipitation regions. As in /2/, we see noticable variations during idividual substorms in the course of the storm are clearly seen in the dusk sector data of Cosmos-900. The variations of the boundary are much less dramatic in the postmidnight magnetospheric sector which was located probably beyond the main dusk zone of particle injection (the Intercosmos-17 data).

The mutual positions of the trough and of the ion precipitation regoins are very different in different LT sectors. According to the Cosmos-900 data, the dusk sector trough was located wuthin the ion precipitation region. The only exclusion is the interval from 1930 UT on October 27, 1977 to 0030 UT on October 28, 1977; for this interval, however, the local time was 2300 i.e. was close to midnight. In the postmidnight sector (the Intercosmos-17 data), the trough was shifted to lower latitudes compared with the ion precipitation region. Thus, the boundary of the ring current precipitation region is formed under interactions with cold plasma /3, 4/ within a rigorously limited sector of the dusk and premidnight hours.

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