V Workshop "Solar influence on the magnetosphere, ionosphere and atmosphere"

Comparison of global distribution of precipitation zones during storms connected with high-speed streams and with magnetic clouds

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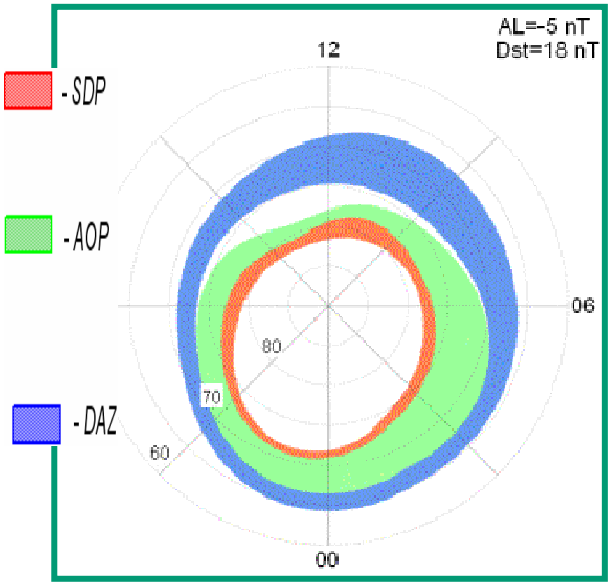
Abstract

Dynamics of the electron precipitation boundaries during magnetic storms on 19-22 February, 2006 were investigated. The magnetic storm with a minimum in Dst of -40 nT was driven by solar wind high-speed recurrent stream. The locations of auroral precipitation boundaries from DMSP spacecraft observations were compared to those obtained by an empirical model (http://apm.pgia.ru/). In this model the locations of different auroral precipitation regions depend on geomagnetic activity level expressed by the AL- and Dst indices. It is shown a good agreement between the observed with DMSP spacecraft and calculated data for different MLT sectors. This allows us to use the model to examine the dynamics of auroral precipitation during the different intensity magnetic storms. The significant latitudinal displacements of the diffuse auroral zone (DAZ) and the auroral oval precipitation (AOP) along with an increase in magnetic activity were observed. The broadening of zones was more significant in the night sector (21-24 MLT). It has been shown a noon-midnight symmetry, which is controlled by an AL index. On the contrary, any differences in dawn-dusk widening (i.e., asymmetry) of the DAZ and AOP zones were not observed which were demonstrated during magnetic storms associated with solar wind magnetic clouds.

Aim of this study: To investigate how solar wind recurrent streams affect the different auroral presipitations zones (namely, auroral oval)



Three zones of auroral electron precipitation were determined:

1) DAZ - diffuse auroral zone, coinciding with the diffuse aurora;

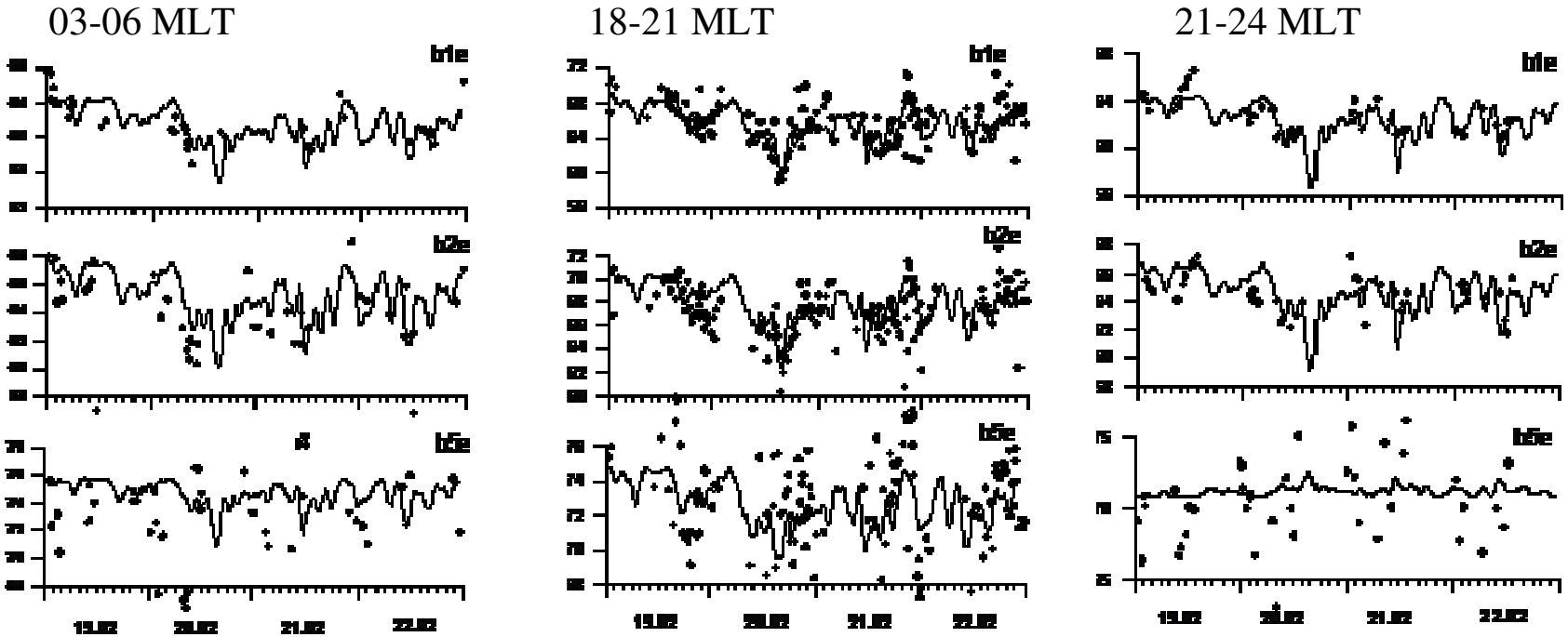
2) AOP - auroral oval precipitation, coinciding with the statical discrete auroral oval;

3) SDP - soft diffuse precipitation

In this work, the mean position of the different precipitation zones boundaries were determined, depending on the level of the magnetic activity in 03-06 MLT, 21-24 MLT and 18-21 MLT sectors for one case of observed solar wind recurrent stream: on **February 19-23, 2006**.

To investigate the planetary distribution of auroral precipitation during the magnetic storms with a minimum in Dst - 40 nT on 19-22 February, 2006 the DMSP F13,15,16 observation data , the AL- and Dst- indices and the empirical model (Vorobjev and Yagodkina, 2005; Vorobjev and Yagodkina, 2007) were used. The solar wind and interplanetary magnetic field parameters were taken from the WIND satellite.

Comparison of the model and observed with DMSP satellites precipitation boundaries



This Figure illustrates the precipitation characteristics in morning-evening-night sectors (**03-06 MLT** on the left panels, **18-21 MLT** on the middle panels and **21-24 MLT** on the right panels).

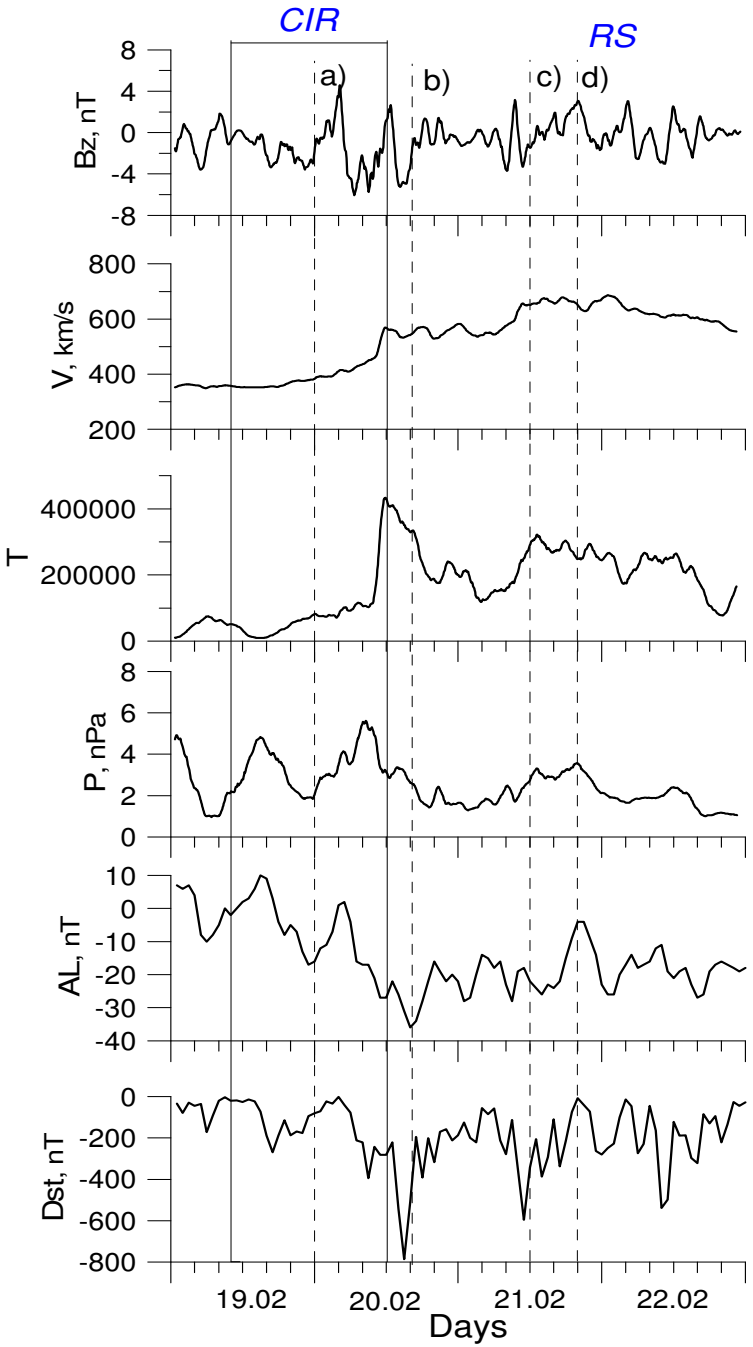
From top to bottom the variations in the position of the **b1e** boundary - the equatorward boundaries of the zone of diffuse auroral precipitation (**DAZ**);

of the **b2e** boundary - the equatorward boundary of auroral oval precipitation (**AOP eq**);

of the **b5e** boundary- the poleward boundary of auroral oval precipitation (**AOP p**) are shown.

The lines show the calculated values of the boundary position, points show the satellite data from DMSP. We can see that the calculated boundaries coincide well enough with measured on the satellite.

Global distribution of auroral precipitation zones on February 19-22, 2006



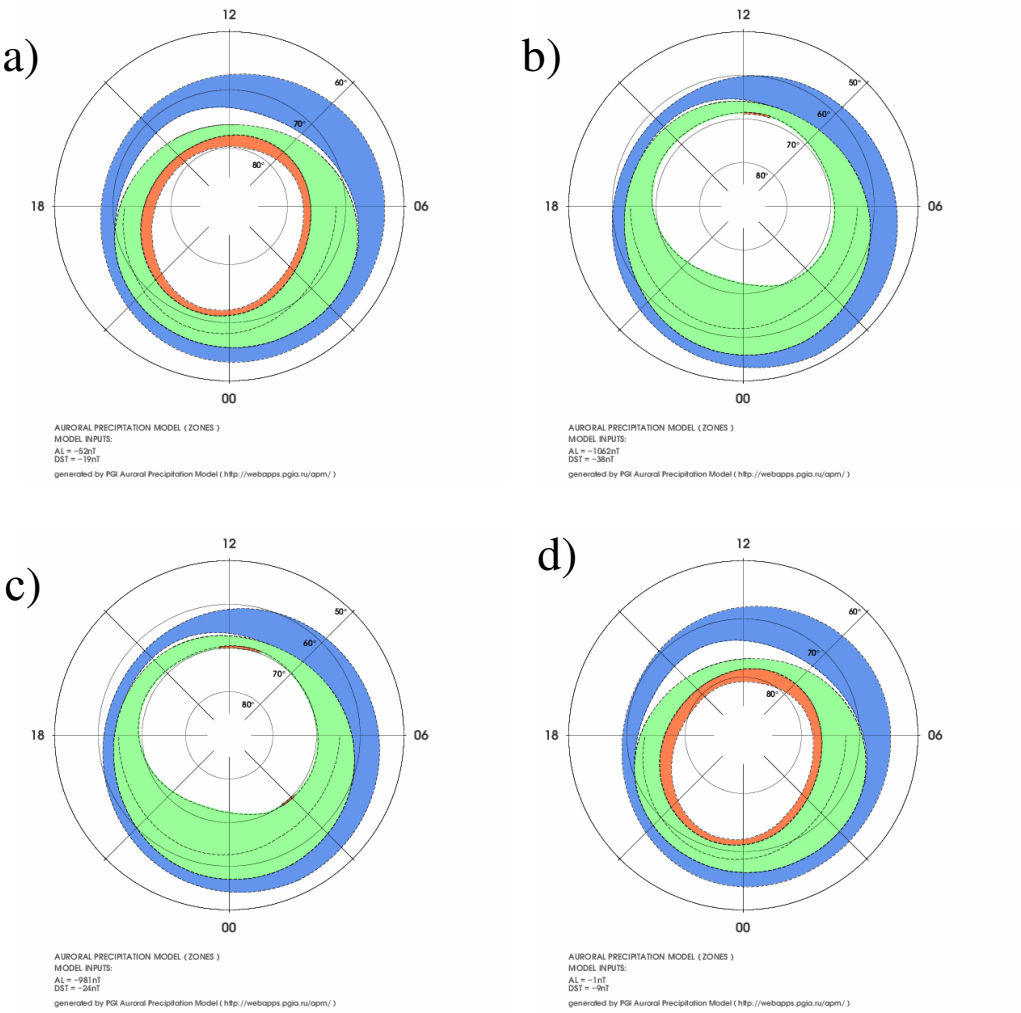


Figure 2. On the left panel - the solar wind conditions and the indices of geomagnetic activity (AL and Dst indices) during the storm on 19-22 February, 2006; on the right panel - the dynamics of the global precipitation for four intervals marked by the dashed black lines ((a), (b), (c), and (d)).

Latitudinal sizes of **DAZ** and **AOP**

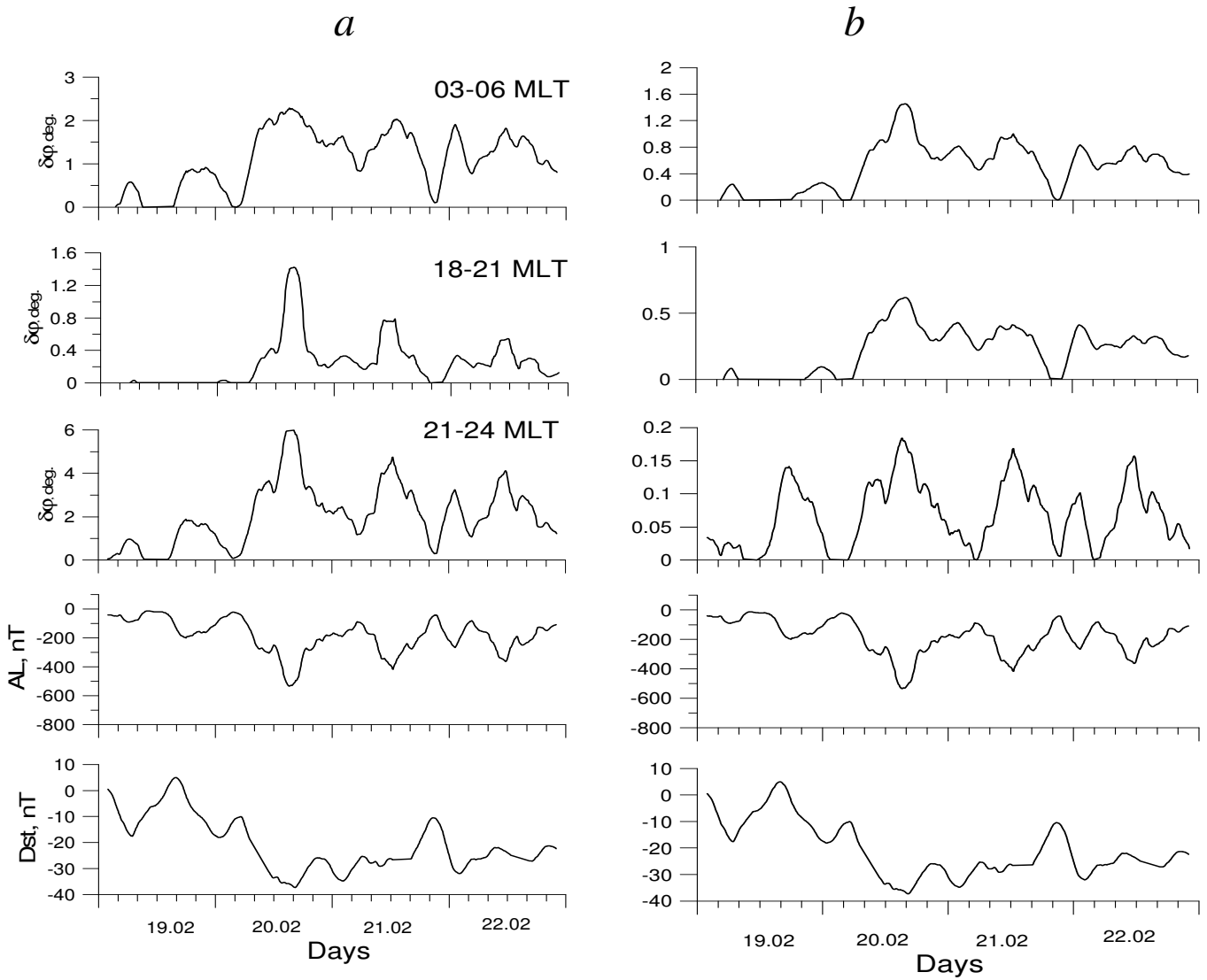
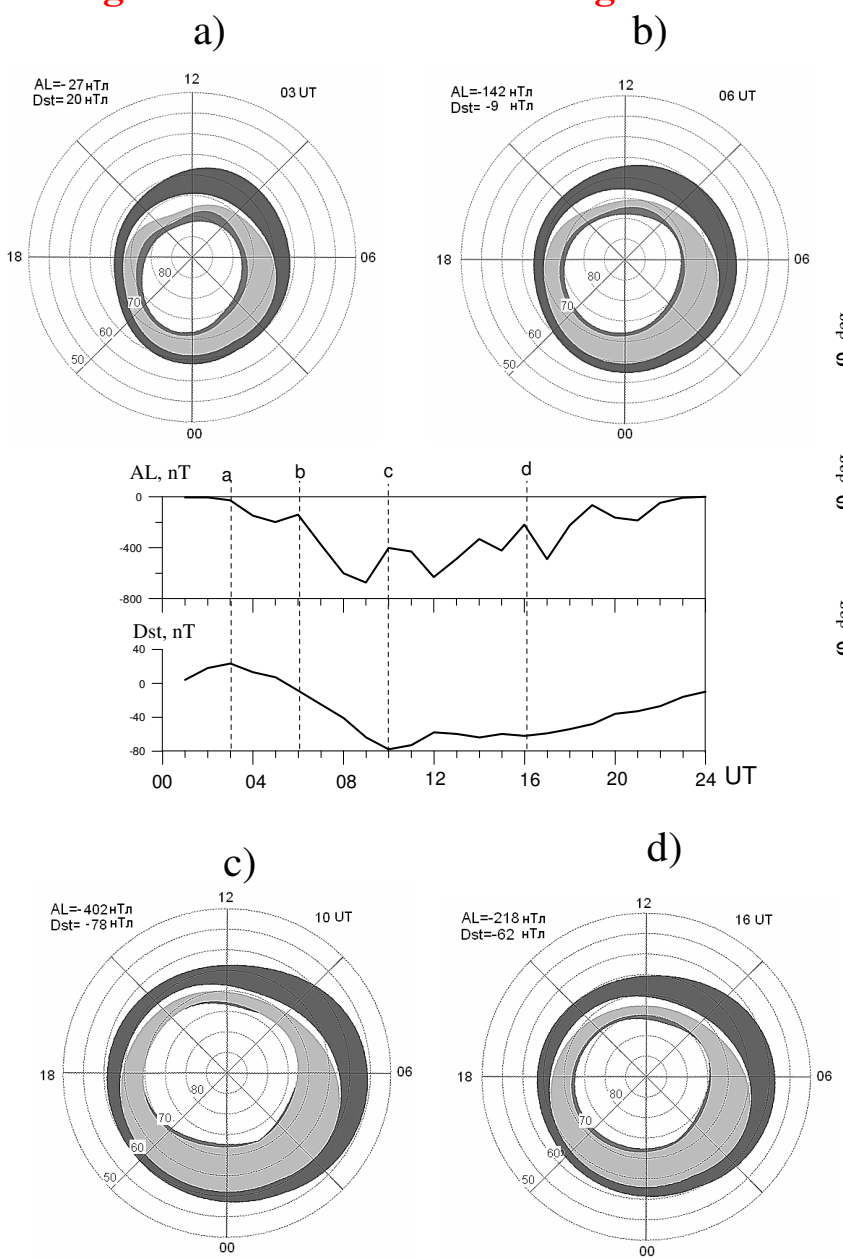
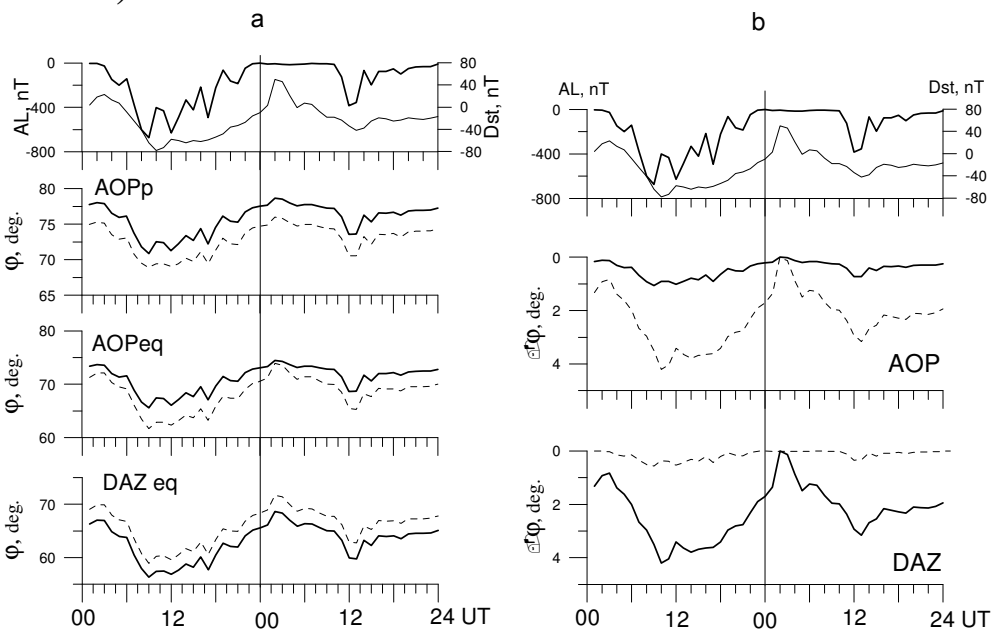


Figure 3. Latitudinal sizes of AOP (a) and DAZ (b) in the three MLT sectors; two bottom panels show the variations of AL and Dst indices.

Global distribution of precipitation zones during storm connected with magnetic clouds



The displacement of the boundaries (a) and changes in the size of the precipitation zones(b) in the morning (06–09 – solid lines) and evening (18–21— dashed lines) MLT sectors



The planetary pattern of auroral precipitation indicates different dawn-dusk widening of the DAZ and AOP zone (asymmetry) during both the main and the recovery phases of the magnetic storm: (1) the width of the DAZ did not change in the evening sector and it extended up to 71 in the morning sector during the strong storm; (2) the AOP region expands differently in two sectors for the storms of different intensity. For the moderate and strong storms, the AOP region expansion was observed in both sectors, and for theweak storma significant expansion occurred only in the evening sector.

Conclusions

An empirical model has been used to study the auroral precipitation during **RS**. The following conclusions were made:

• Model calculations describe well the dynamics of precipitation boundaries observed by **DMSP** satellite. This makes it possible to describe the situation of recurrent streams in model calculations

• The planetary distribution indicated the equatorward displacement of electron precipitation zones. The broadening of the regions observed in the equatorial region (**DAZ**), and in the **AOP** region. An equatorward displacement of precipitation up to 50° CGL (for **DAZ**) and up to 60° CGL (for **AOP**) is observed. The broadening is more significant in the night sector (**21-24 MLT**).

• It is shown a symmetry noon-midnight, which is controlled by an **AL** index . On the contrary, is no dawn-dusk asymmetry (controlled by an **Dst** index) was observed during storms associated with magnetic clouds.