COMPRESSIONAL ULF WAVES IN THE DAWN PLASMA SHEET OBSERVED BY THE INTERBALL-TAIL

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Introduction

Coupled variations of the magnetic field and plasma density with periods greater than 2 min (about 10 - 30 min) at low geomagnetic latitudes, namely compressional Pc5 waves (hereafter cPc5 waves) [1], [2] are studied.

We undertake the analysis of plasma and magnetic field measurements in the middle tail of the Earth magnetosphere for selected time intervals in order to study properties of cPc5 wave events in the dawn plasma sheet. We are interested in reliable identification of the anti-phase variations of the plasma and magnetic field pressures and spectrum structure. Furthermore, we study possible association of wave activity with vortex flows in the same region.

Data analysis

The Interball Tail probe (hereafter Interball-1) was situated in the low-latitude dawn flank of the magnetosphere in October 1995. We analyze data obtained by the magnetometer **MIF-M** [3] and the plasma analyzer instrument **CORALL** [4]. This study is mainly based on the experimental data with 2-minute resolution.

The spatial boundaries of the regions under study are limited by the conditions $X \leq -5$ and $Z \leq 10$, where coordinates are taken in the GSM-system in the Earth's radii. We exclude from the study the lobe region crossings and consider data obtained in plasma sheet and boundary layers.

Under the first stage of the study, it is natural to seek sub-intervals with anti-phase variations of pressure data to identify the cPc5 wave events. These variations manifest themselves as dissimilarities in behavior of pressures during selected time intervals. This is a

typical property of the mentioned waves which are measured in the flanks. In the case of homogeneous plasma, this behavior is typical for the magnetosonic-type and mirror disturbances. Example of these events is shown in the **Fig.1.** For this purpose, a special method and the respective software were developed, which make possible to find the sub-intervals with definite probability of false alarms. Such a method is based partly on some approaches used for searching of local similarities in DNA strings [5], [6]. The cross-correlation coefficient for the above time series is about 0.1-0.5. However, cross-correlation coefficient for selected sub-intervals reaches 0.7-0.99.

We studied the wave structure respectively the background field line and obtained the power spectra. Magnetic field variations along and transversely to the background magnetic field are of the same order of magnitude.

Plasma velocities are processed for each time period during which the local dissimilarity in the pressure time series is found. Velocity disturbances take place mainly in the orthogonal direction to the local fieldline (see **Fig.2**). The data show clear rotations of the velocity vector during the sub-intervals studied. Data examples for several intervals are shown in the **Fig. 3**. Considering that, we assume that the vortical flows are connected with the cPc5 wave process. Vortices and vortex tubes are typical features of nonlinear drift waves. We note that these vortices are localized in the regions of anti-phase variations of the magnetic field and plasma pressures.

From the results obtained several conclusions can be made:

- Compressional Pc5 waves are detected in the dawn flank of the middle tail during period of strong geomagnetic disturbances. Preliminary results show that these events are absent in the dusk flank.
- The fundamental frequencies corresponding to the maxima in the power spectra are $\nu \sim$ -0.6-2 mHz (10-30 min).
- The vortical fluxes were found at the time intervals under study. This fact can be compared with measurements onboard ISEE-1 and their association with the Pc5 wave activity.
- The wave excitation mechanism is possibly dealt with particle fluxes or local plasma heating in active geomagnetic periods. Theoretical model of the above processes is under study.

Acknowledgments

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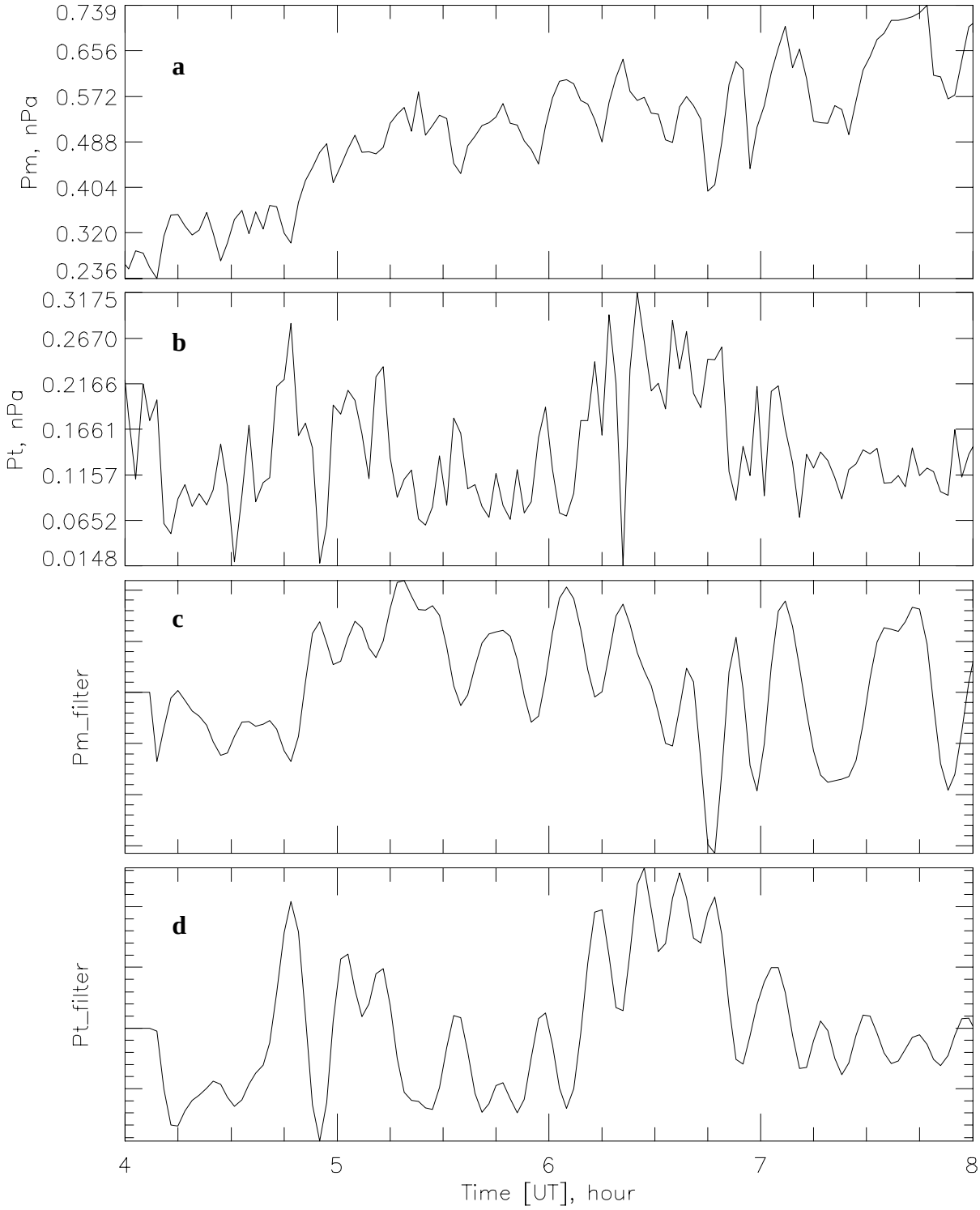

Fig. 1. Magnetic pressure (a) and plasma pressure (b) for time interval from 4:00UT to 8:00UT of 25 October. The pressure data after excluding the linear trend and processing with a non-recursive digital low-pass filter are shown in (c) and (d).

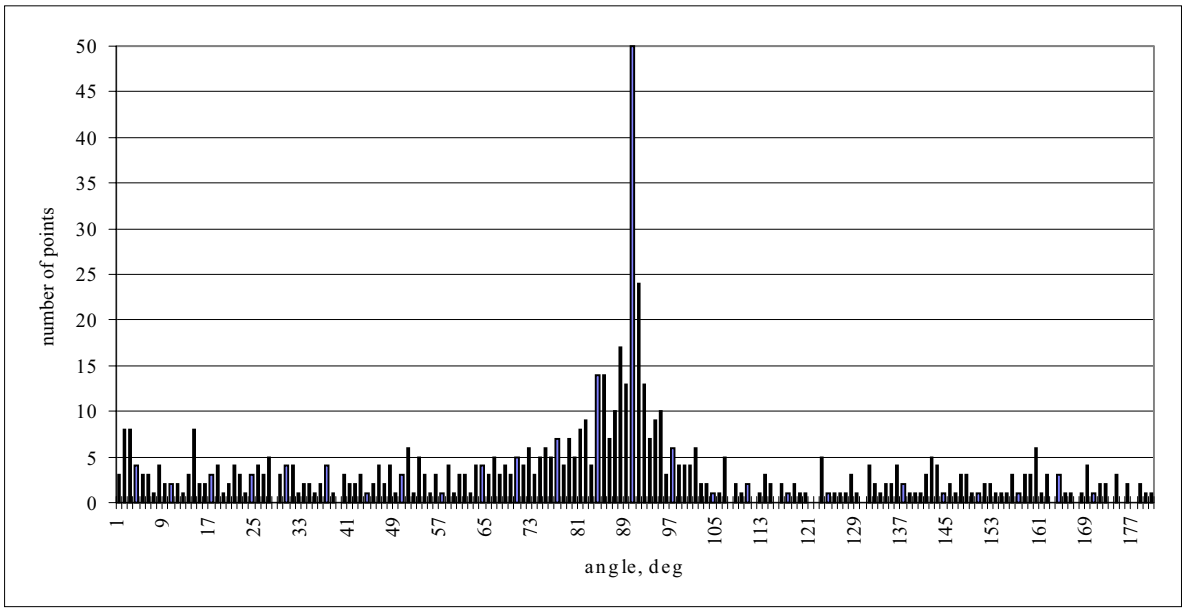

Fig. 2. Distribution of the measurements versus angle between the local magnetic field line and the flow velocity vector.

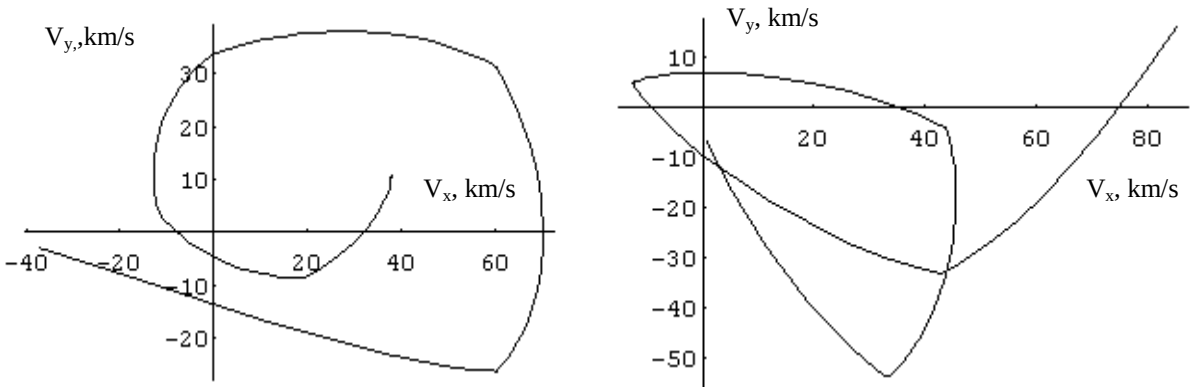

Fig. 3. Hodograph of the plasma flow velocity (km/s) in the GSM coordinates for the selected time intervals of 2 October, during which the dissimilarities in pressure time series were found.

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