

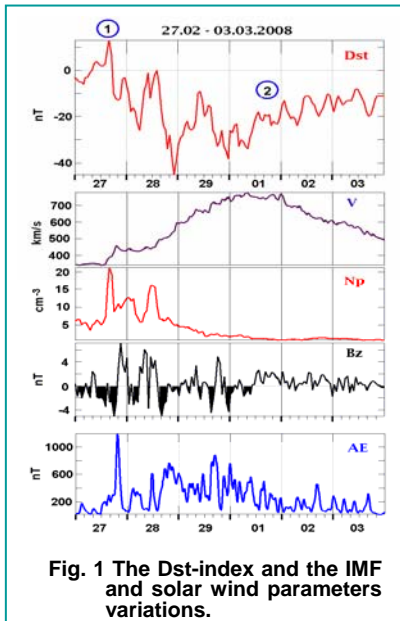
# Simultaneous occurrence of the night and daytime VLF chorus based of the Finland ground and Demeter satellite data: case study 01 March 2008

J. Manninen<sup>1</sup>, M. Parrot<sup>2</sup>, N.G. Kleimenova<sup>3</sup>, O.V. Kozyreva<sup>3</sup>, T. Raita<sup>1</sup> and T. Turunen<sup>1</sup>

<sup>1</sup> Sodankylä Geophysical Observatory, University of Oulu, Sodankylä, Finland

<sup>2</sup> LPC2E/CNRS, Orleans, France

<sup>3</sup> Institute of the Earth Physics, RAS, Moscow, Russia



## INTRODUCTION

A VLF campaign was carried out on 25 Feb-04 Mar 2008 at Kannuslehto (L=5.46) temporal station near Sodankylä (Finland). In this time the recurrent magnetic storm (CIR-storm) was caused by the high-speed solar wind (Fig. 1). Small negative Dst value (-45 nT) is typical for the solar minimum.

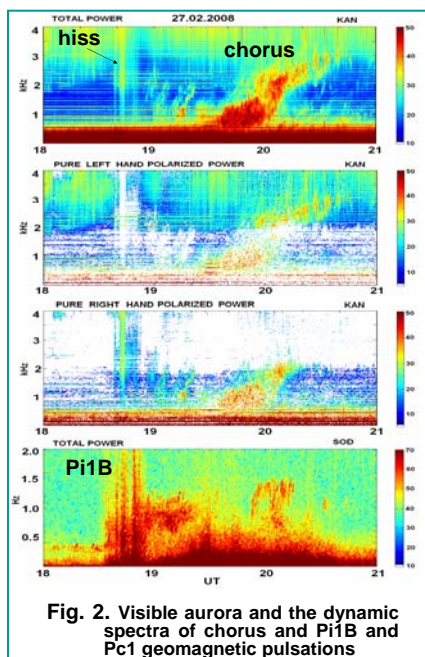
Two night-time VLF chorus events were recorded during this storm.

The aim of the present work is to study these choruses and compare them with simultaneous DEMETER observations

## ① 27 Feb 2008

In the initial phase of the storm (27 Feb 2008), the chorus burst with the frequencies of ~1.3-2.8 kHz was observed near the local magnetic midnight at ~22-23 MLT (Fig. 2).

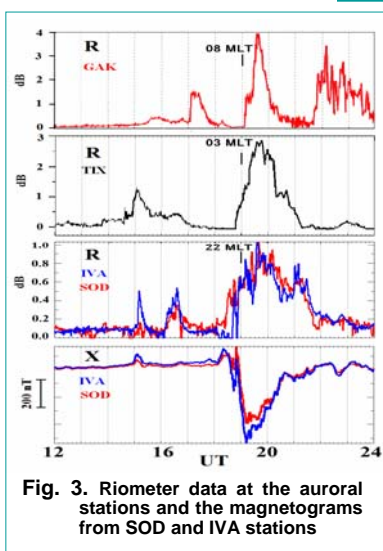
Contrary to the auroral hiss with the right-hand polarization, the chorus demonstrated the presence of both the right-hand and the left-hand polarization. It could be interpreted as the chorus emissions came from different distances, and there was superposition of many ionosphere exit points of energy, not only overhead.



The substorm onset accompanied by the auroral hiss, the Pi1B geomagnetic pulsations and the riometer absorption was preceded the chorus (Fig. 3).

The riometer enhancement was observed simultaneously in the large longitudinal area from the night side (at SOD and IVA) to the late morning side - at TIX (~04 MLT) and GAK (~10 MLT). The riometer absorption is a result of the energetic particle precipitation due to a cyclotron resonance between electrons and chorus waves.

That was non-direct evidence of the simultaneous chorus emission generation in the global scale.

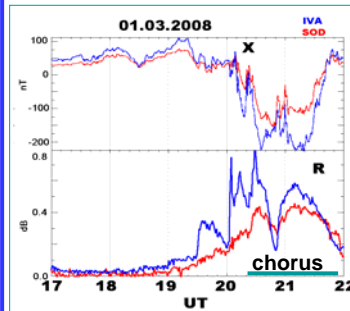


②

## 1 Mar 2008

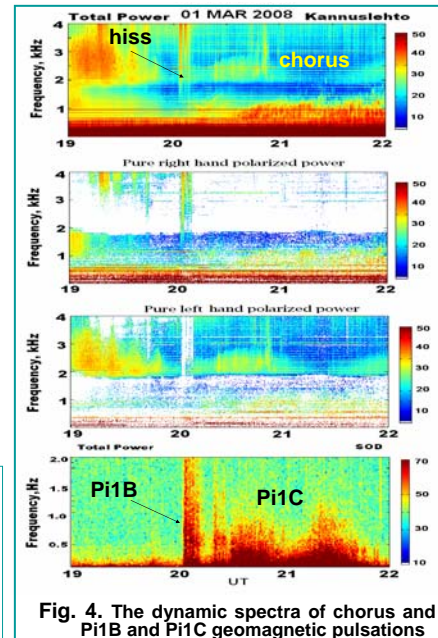
The night-time chorus with the frequencies lower ~1.2 kHz was observed in the recovery phase (1 Mar 2008) of the magnetic storm before local magnetic midnight (Fig. 4).

As in the previous event, the substorm onset with the burst of the auroral hiss and Pi1B pulsations was preceded the chorus (Fig. 5). The chorus was accompanied by riometer absorption enhancement in the global scale at SOD, TIX and GAK (not shown here), i.e. from the evening to the late morning.



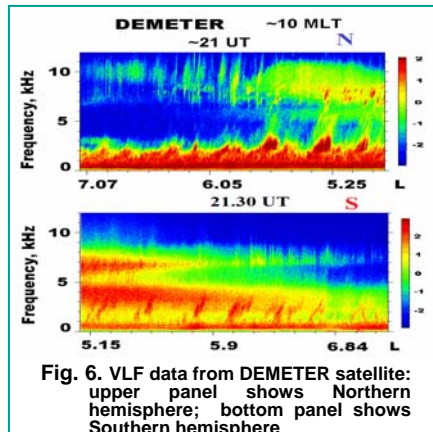
This data was compared with the simultaneous VLF observations on the Demeter satellite (Fig. 6), which was located in the late morning (~10 MLT). There were chorus recorded in both Northern and Southern hemispheres.

It is important to note, that during the both considered chorus bursts (27 Feb and 1 Mar), the chorus emissions were also observed simultaneously at the TIX meridian (not shown here), located at ~05-06 MLT, which is between the Scandinavian meridian (22-23 MLT) and the DEMETER satellite



The wave polarization of the VLF hiss and chorus in this event was the same as in the initial phase.

As classical dawn chorus, the considered night-time chorus was accompanied by the Pi1C geomagnetic pulsations (bottom panel in Fig. 4), which usually associated with energetic electron precipitation.



## SUMMARY

The analysis of the VLF emissions, measured on the ground at auroral latitudes (L=5.3) and DEMETER satellite during the magnetic storm, showed that contrary to the classical VLF chorus in the initial and recovery phases of the analyzed storm, the chorus emission occurred simultaneously in the very large longitude area - from the late evening to the late morning. These chorus are accompanied by the riometer absorption enhancement caused by the energetic electron precipitation.

The negative values of IMF Bz before the considered magnetic storm and during its main phase provided a significant population of the trapped energetic electron in the magnetosphere. The substorm development produced the additional fresh injection of electrons from the magnetosphere tail. That supported the conditions for the electron-cyclotron instability simultaneously in whole evening-morning sector of the magnetosphere resulting VLF chorus generation and riometer absorption.