S-RAMP(STEP-Results, Applications and Modeling Phase)
Database in Japan

Simulation/Modeling (SRAMPDB-J-SM0003)
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KRM Output for the January 10, 1997 Magnetic Storm

This CD-ROM contains 1-min. plots of ionospheric parameters, which represent the KRM output for the January 10, 1997 magnetic storm.

1. Introduction

Magnetic perturbation data are available from, at least, 100 ground-based magnetometers worldwide. Thus, using a model of the ionospheric conductance or global snapshot imaging of the aurora in various wavelengths from polar-orbiting satellites and radar measurements of ionospheric parameters, it is possible, through magnetogram-inversion techniques, to generate a two-dimensional map of:

(1) The equivalent ionospheric current system.
(2) The electric potential and electric fields in the ionosphere.
(3) Field-aligned currents.

(4) Joule heating from the ionospheric currents.
(5) Other related parameters such as the Hall and Pedersen components of the ionospheric currents.

One of the byproducts of this modeling effort is the ability to deduce some of the important planetary parameters, including the cross-polar cap potential, total Joule heating rate, and the total electrojet and field-aligned currents. Adding satellite observations of the solar wind and the magnetosphere leads us to a better, quantitative understanding of solar wind-magnetosphere coupling.

In view of the growing realization of the importance for monitoring Space Weather, this CD-ROM demonstrates that ground magnetic observations are quite useful in estimating two-dimensional maps of electric fields and currents in the polar ionosphere on a near real-time basis. For this purpose, we have chosen the January 10-11, 1997 magnetic storm, particularly of interest to the solar-terrestrial physics community because of the dramatic response of the Earth's magnetosphere to an intense magnetic cloud in the interplanetary medium: see, for example, *Burlaga et al.* [1998]. We used the KRM algorithm [*Kamide et al.*, 1981] to calculate the ionospheric parameters.

2. KRM Algorithm and Procedure

Ground magnetogram records from 105 observatories have been collected: see *Shue and Kamide* [1998] for the distribution of these observatories. The quiet-time variation of January 8, 1997 has been removed from all of the magnetogram data.

To run the KRM algorithm, the *Ahn et al.* [1998] model of the ionospheric conductance has been utilized for simplicity. This model is essentially empirical, based on incoherent scatter radar measurements of electron density and ion drifts from which electric fields and the conductance in the polar ionosphere are deduced. Using a large number of radar data covering various quiet and disturbed conditions, *Ahn et al.* [1998] obtained an empirical formula for the relative strengths of ionospheric electric fields and the conductance, which are parameterized in terms of magnetic disturbances for various geomagnetic latitudes and local times.

3. KRM Output

The KRM plots in this CD-ROM cover the period from 0000 to 2359 UT (except for 0001, 0524, 1104, 1242, 1320, and 1924-1930 UT), January 10, 1997, in terms of the electric potential, ionospheric current vectors, field-aligned currents, superposed X_m component plots, and the corresponding solar wind conditions.

(1) Electric potential: Contours of the electric potential are shown in the upper-left panel. The contour interval is 10 kV. The potential value at the pole is set to zero as a boundary condition in solving the KRM differential equation. The maximum potential, the minimum potential, and the total potential difference are indicated in the lower-right corner of this panel.

(2) Ionospheric current vectors: The upper-right panel shows ionospheric current vectors. Red (or blue) arrows denote the westward (or eastward) currents in the ionosphere. Note that this color differentiation is not very meaningful if the east-west currents are minor or the total current itself is minor.

(3) Field-aligned currents: The lower-left panel shows global patterns of field-aligned currents, using the contour interval of 0.40 μA/m^2. Red (blue) contours represent the upward (downward) field-aligned current. The upward and downward field-aligned currents have been integrated over the area above 50°, corresponding to the total upward and downward currents. The maximum upward and downward current intensities are marked in the lower-right corner of this panel.

(4) The superposed X_m component plots over 60°-75° corrected ge-

omagnetic latitude are superposed in the first row of the lower-right panel. The four subsequent rows are: IMF B_y, B_z, and solar wind number density and speed observed by the WIND spacecraft during the January 10, 1997 magnetic cloud event. The red vertical line corresponds to the period of the KRM output shown in the three plots. Note that the solar wind parameters in this panel have not been shifted according to the propagation time of the solar wind from the WIND to the magnetopause locations.

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S-RAMP Database

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