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Saturn and Earth polar oval position forecast by IMPEx Infrastructure Web Services based on the Paraboloid magnetospheric model

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Abstract

The Saturn and Earth auroral emissions have different generation mechanisms, however, both mechanisms are not understood very well till now (see [1]). Both of these phenomena have a long history of observations. For Saturn these are Hubble images and big onground telescope images, as well as the Cassini ones in recent time. For Earth these are the satellite visible and UV camera images and onground observations. In course of the EU-FP7 Project "Integrated Medium for Planetary Exploration" the Web services based on the paraboloid magnetospheric models were constructed . The model field lines tracing gives us a possibility to distinguish the closed and open field line bundles. Additionally, we can find a boundary between the dipole type field lines and determine a region of the tail-like field lines crossing the equatorial plane tailward from the inner edge of the tail current sheet. Projections of this boundary and of the boundary between open and closed field lines at the ionospheric level mark the terrestrial auroral oval boundaries. The final result depends on the solar wind parameters and the magnetospheric state. In the Earth's case we have the ACE solar wind monitoring data which should be used to determine the magnetospheric state (`http://smdc.sinp.msu.ru/index.py?nav=paraboloid/index` [*Interactive Earth*]). For Saturn we use the three levels of the solar wind dynamic pressure (`http://smdc.sinp.msu.ru/index.py?nav=paraboloid/index` [*Interactive Saturn*]).

1. The Saturn's auroral oval

In the course of the IMPEx project we performce development of the paraboloid model of the planetary magnetospheres. This development is based on the modern observational data. Using the simultaneous data on the solar wind magnetic field measured by Cassini upstream from the noon Saturn's bow shock and UV southern Kronian polar cap Hubble Space Telescope (HST) images, Belenkaya et al. ([1]) refined the paraboloid magnetospheric model and performed the field-aligned mapping of the observable dayside southern auroral oval into the equatorial magnetosphere and/or magnetopause. The authors studied the dependence of the obtained projections on the direction and magnitude of the interplanetary magnetic field (IMF). Calculations in the paraboloid Kronian magnetospheric model allowed Belenkaya et al. ([1]) to determine the preferable mechanisms of the auroral emission generation at the low- and high-latitude boundaries of the southern dayside Saturn's auroral oval. Based on this study Belenkaya et al. ([1]) supported the idea that the poleward boundary of the Saturn's auroral oval is located closely to the open-closed field line boundary [2]. After calculation of this curve we can forecast better the location of the high-latitude edge of the auroral oval.

2. The Earth's auroral oval

One of the most probable location of the equatorward boundary of the Earth aurorae coincides with the ionospheric projecion along the magnetic field lines of the inner edge of the tail current sheet (see [3] and [4]). Another important feature of the auroral zone is that it includes the ionospheric foots of the open field lines bundle. In the course of the Solar events (mainly, after the solar flares) the solar energetic particles can reach the Earth's upper atmosphere along the open field lines. Scobeltsyn Institute of Nuclear Physics web-cite `http://smdc.sinp.msu.ru/index.py?nav=paraboloid/index` [*Interactive Earth*] demonstrates the modelled open field line

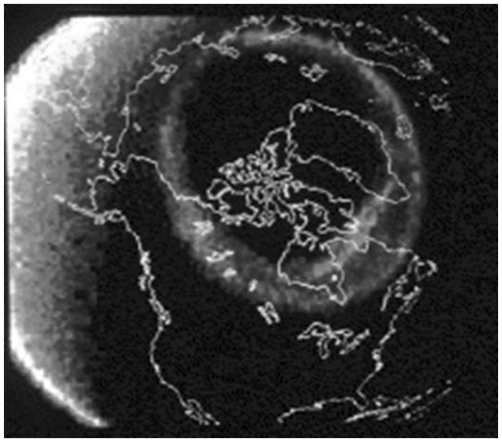

Figure 1: The polar view of northern Earth polar region as it looks by IMAGE UV camera ([4]).

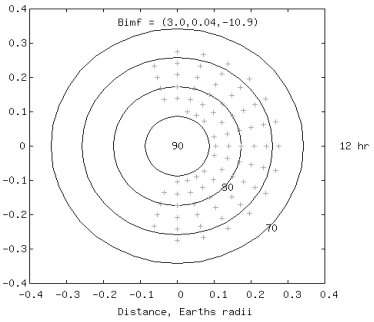

Figure 2: The open field line bundlle at ionospheric level of northern Earth polar region as it can be fixed by paraboloid model field line tracing. This is an example of the web-service calculations results at our web cite.

bundle corresponding to the concrete solar wind and magnetosphere conditions.

3. Summary and Conclusions

In course of currently ongoing research phase of the IMPEx project in the framework of the Work Package 4 several Web services have been established. Part of them are dilling with the forecast of the auroral zone position and area of the polar region which can be bombarded by the solar flare energetic particles. Such services have been constructed for the Earth and Saturn polar regions. Given the fact that for the forecast of the Earth magnetosphere state we can use the data from ACE (solar wind monitor) at the libration point, the users of the described Web-services can receive an instantaneous location of the auroral zone and solar particle penetration area in interactive regime. For Saturn we can forecast the average polarward boundary of the auroral zone position. Additionally, the three levels of the solar wind dynamic pressure can be taken into account.

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