Geophysical Research Abstracts, Vol. 9, 09225, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09225

On induction effects of geomagnetic daily variations from EEJ and Sq sources. Model studies and comparison with observations.

A. Kuvshinov (1,2), C. Manoj (3), N. Olsen (4), T. Sabaka (5)

(1) Institute of Geophysics, ETH, CH-8093 Zurich, Switzerland, (2) Institute of Terrestrial Magnetism, Ionosphere and Radiowave Propagation, Russian Academy of Sciences, 142190, Troitsk, Moscow region, Russia, (3) National Geophysical Research Institute, Uppal Road, Hyderabad - 500007, India, (4) Danish National Space Center, Juliane Maries Vej 30, DK-2100 Copenhagen, Denmark, (5) Terence Sabaka, Geodynamics Branch, NASA GSFC, Greenbelt/MD, USA (kuvshinov@erdw.ethz.ch/ +41 044 63 33619)

We investigate the spatio-temporal behaviour of the magnetic vertical field of the daily ionospheric current systems: the Equatorial Electrojet (EEJ) and Solar-quiet (Sq) regular variations, considering induction in the mantle and oceans. The three-dimensional (3-D) conductivity model of the Earth includes nonuniform oceans of laterally variable conductance and a spherical conductor (1-D) underneath. The inducing EEJ and Sq current systems are provided by the Comprehensive Model (CM4) of Sabaka et al. (2002). Our model studies demonstrate that induction effect in Z due to the EEJ is negligible (comprising only 1 % of the external signal) everywhere inland for all local times. Contrary to Sq, no coastal anomalous induction is generated by the EEJ. However, in the open ocean, the induction from EEJ is significant at pre- and afternoon hours. At CHAMP altitude (400 km) the magnetic signals induced by EEJ above the oceans does not exceed 2-5 % of the external field during local noon. This, in particular, means that one can avoid considering the induction effects when modelling the EEJ current strength from inland surface magnetic measurements (including coastal regions) or/and satellite data around local noon. As expected, induction in the oceans strongly affects the Sq field in coastal regions. The intensity and sign of the Sq coastal anomalies vary with local time and show different behaviour in different regions of the world. The model studies also show that anomalous induction effect (defined as the difference between results obtained with 1-D and 3-D conductvity models of the

Earth) of Sq is substantional at CHAMP altitude and reaches 15 nT around local noon over the oceans comprising more than 50 % of the total field. It is therefore necessary to include induction in the oceans when modeling Sq variations for both ground-based and satellite data. It is interesting that induction in the oceans by Sq source generates small-scale anomalies of 7-9 nT on the ground even during local midnight in many coastal regions of the world (for e.g., in Indonesia, South India, South-West Africa, etc). At CHAMP altitude these anomalies have amplitudes of 2-3 nT. These results are relevant for lithospheric field determination where it is common practice to assume negligible non-polar ionospheric currents during the night. Finally we demonstrate that the well known anomalous behaviour of the daily variations in Z component at South Indian sites - namely a large positive prenoon peak - can be explained by the 3-D induction of the large-scale Sq variations, with the EEJ playing no part in it. This result also implies that there is no need to invoke a deep conductor or current channeling effect in South India that has been suggested in order to explain the observed anomaly.