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A new parametrized model of the global horizontal and vertical ionospheric current system

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We present a newly developed global empirical model of the ionospheric magnetic disturbance field, and the associated horizontal and vertical currents. The field is represented in terms of spherical harmonics, parametrized in terms of solar wind drivers, dipole tilt angle, and the F10.7 index. The model parameters are estimated by using magnetic field measurements from ESA's CHAMP and Swarm missions. The model represents an improvement compared to other empirical models of ionospheric currents by the following three characteristics: 1) Distortions due to Earth's main magnetic field are taken into account and essentially corrected for by use of magnetic apex coordinates. This allows us to interpret resulting currents independently of longitudinal, hemispheric, and temporal variations in the Earth's magnetic field. 2) We do not impose any symmetry between hemispheres, so that inter-hemispheric differences can be investigated. 3) We estimate both the Birkeland currents (and its closure) and the horizontal divergence-free currents (the equivalent current) simultaneously. They can be combined to calculate the true height-integrated horizontal current. This is only possible, without additional data or assumptions, because we use magnetic field measurements from low Earth orbit. In this presentation we compare modeled magnetic field perturbations at ground and in space with independent observations. We find that the total field aligned currents in the model are very well correlated with the total currents measured by AMPERE. We also show that, on time scales of > 1h, the model is well correlated with measured ground magnetic field perturbations. Neither AMPERE nor any ground magnetometers were used to estimate model coefficients.