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Ionospheric current patterns during the undershielding and overshielding deduced by a global ionospheric potential solve

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Toward the understanding of the magnetosphere-inner magnetosphere-ionosphere coupled system, we have developed a two-dimensional ionospheric global potential solver (GEMSIS-POT). Our model basically follows a methodology of the so-called "thin shell model." The important extension from previous studies is that our model covers the pole-to-pole ionosphere without placing any boundary at the equator. By using the solver, we investigated how the ionosphere changes from under-shielding condition to over-shielding condition as the FAC distribution changes. Calculations are performed by changing j0, R2 / j0, R1 (the ratio of peak current density of R2 and R1-FAC) and moving R2-FAC toward the nightside with dLTR2-R1 (the local time deference between the R1 and R2-FAC peaks) relative to the fixed R1-FAC. In the previous talk, we reported the calculation results focusing on the electric field structure. In the present study, we analyze the ionospheric current and equivalent magnetic field perturbation of the calculation examples representing the undershielding and overshielding.

We separate the ionospheric current into the diagonal and non-diagonal components in terms of the thin shell approximation. In the polar region, where the dip angle of the geomagnetic field is close to zero, the diagonal and non-diagonal components are nearly equivalent to Pederson and Hall currents, respectively. However, in the low latitude region with the finite dip angle, they cannot be simply reduced to Pederson and Hall currents because of the mixture of Pederson, Hall and parallel conductivities in the conductivity tensor arising from the thin shell approximation of Jz=0 (vertical ionospheric current is assumed to be zero).

The calculation results show that the non-diagonal part is the major part of the ionospheric current in the polar region, whereas, in the equatorial region, the diagonal component becomes the major part. In this talk, we discuss how the current circuit from the polar to equatorial region is described by the pair of diagonal and non-diagonal components and also discuss the derived current circuit in relation to the pair of Pederson and Hall currents.