Separation of Sq current system into Cowling-Electrojet current channel using Hall conjugate current analysis

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The Hall Conjugate Current (HCC) analysis, which enable to separate the ionospheric polarization electric field into Hall current divergence origin and Pedersen current divergence origin is adopted to the simulation data of Sq current system derived from the quasi-3D dynamo equation with 3-D neutral wind model produced by Kyushu University General Circulation Model (GCM).

In our previous study, we submitted a new interpretation model for global vortex structure of Sq current system that will be formed by superposition of spiral Pedersen and Hall current system. The spiral current structure is composed by a rotational and irrotational part of ionospheric current, accordingly, to satisfy 2-dimensional closure of total Sq-current, irrotational part of Pedersen and Hall current spiral are need to be mutually cancelled out and rotational part of Pedersen and Hall current spiral form Sq current in a coordinated manner. This means that process of Sq vortex current formation is including a Cowling effect. In our theoretical model, the above context was explained by using qualitative separation of Sq current system into Electrojet and Cowling current channel and polarization electric field into Pedersen current divergence origin and Hall current divergence origin.

To concretely make such separation from the simulation data, we develop a newly method for extraction of Cowling effect from the ionospheric current system, so-called "Hall conjugate current analysis" . The Hall conjugate current is a virtual current system of which Hall effect direction is defined in the opposite for real current system. Once, we construct this virtual current system with same boundary condition for real current system, we can extract the Electrojet-current channel by summation of real and virtual current system and the Cowling current channel current from the subtraction between real and virtual current system.

In this paper, will show the results of the HCC analysis to the Sq simulation data, and will give both quantitative and qualitative discussions for separated current and polarization electric fields.