Current circuit connecting the polar and equatorial region deduced by a global ionospheric potential solver (GEMSIS-POT)

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Disturbances in the solar wind-magnetosphere system propagate to the ionosphere in the form of the variations of the field-aligned currents (FACs) connecting these two regions. It is widely accepted from the accumulated observations that the associated electric field disturbance propagates globally deep into the equatorial region. The DP2 variations, SCs, and the overshielding are well-known examples. However it is not still clear how the associated electric field and currents are distributed globally from the polar region to the equatorial region. In this study we numerically investigate this problem by using a global ionospheric potential solver (GEMSIS-POT). The solver is the so-called thin shell model, which solves the Poisson equation with the applied source FACs with a height-integrated ionospheric conductivity model.

We performed the calculation in the following way: (1) The conductivity distribution is fixed. (2) The local-time dependences of the R1 and R2 currents are expressed by the same Gaussian functions, (3) but the peak local times, the local time width of their distributions, and the intensity ratio of R2 and R1-FACs are changed. We analyze the current pattern by dividing the total current into the diagonal and non-diagonal currents in the thin shell model. Here the diagonal current corresponds to the curl-free current, which connects the upward and downward FACs, and the non-diagonal current corresponds to the divergence-free current, which encircles the source FACs. The results are summarized as follows: (a) The equatorial electrojet/counter electrojet (EEJ/CEJ) are closed with the FACs as the diagonal current. (b) The current streamlines of the diagonal current connecting the EEJ/CEJ and FACs align around the dawn/dusk terminators irrespective of the local time distribution of FACs. (c) The diagonal currents that extend to the dayside are closed in the mid latitude region. The diagonal currents that reach the dip equator run close to the dawn/dusk terminators. (d) The non-diagonal currents are basically closed in the mid latitude region, surrounding FACs, but they extend to the equatorial region along the dawn/dusk terminators. In this talk we discuss these results in terms of the background conductivity and FAC distributions.