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Dayside ionospheric current system of Pi2 pulsations: Comparison between equivalent currents and numerical simulation

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We present the two-dimensional distribution of equivalent currents of Pi2 pulsations in the dayside middle-to-equatorial latitude regions (|geomagnetic latitude|<60 degrees and sunlit region at 100 km in altitude), using magnetic data from globally distributed magnetometers. Equivalent current vectors of Pi2s are determined by rotating filtered horizontal magnetic field vectors by an angle of 90 degrees clockwise. We found that meridional equivalent currents in the prenoon and postnoon sectors are in antiphase, and they close with an enhanced zonal current near the magnetic equator forming a global equivalent current system oscillating with a period of Pi2s. The current system shows the prenoon-postnoon asymmetry, that is, meridional equivalent currents in the prenoon sector is larger than in the postnoon sector. We also numerically simulated the distribution of ionospheric currents produced by a pair of field-aligned currents (FACs) around midnight under the assumptions that the ionosphere is a thin spherical shell and the electric field can be described as the gradient of an electrostatic potential. The essential features of the simulated ionospheric current on the dayside are consistent with the observed equivalent current system. In the simulation Hall currents and their polarization charges at the terminator contribute essentially to the prenoon-postnoon asymmetry. The east-west magnetic perturbations expected from the FACs and meridional ionospheric currents in the simulation may explain the observed four longitudinal phase reversals of east-west magnetic fields around midnight, noon, dawn and dusk. We thus conclude that the oscillatory ionospheric current system produced by the nightside FACs is the dominant source of dayside Pi2 pulsations.

Keywords: Pi2 pulsation, ionospheric current, current oscillation, equatorial enhancement, global potential solver, solar terminator