Prediction of the midlatitude geomagnetically induced currents

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Morphologically, the midlatitude GICs are well correlated with the y-component magnetic field (By) on both the day and nightsides, while those are poorly correlated with the Bx [Watari et al., 2009]. The GIC is found to be a current induced by the By propagating into the ground as a diffusion mode. The daytime GIC is also found to be well correlated with the equatorial electrojet (EEJ), suggesting that the By is transmitted from high latitudes by the TM0 mode waves in the Earth-ionosphere waveguide [Kikuchi and Araki, 1979]. The TM0 mode waves take a major role in transmitting electromagnetic energy consumed in the GIC at low latitude, while the TE mode with the Bx is an evanescent mode not contributing to the transport of energy [Kikuchi and Araki, 1979]. The By can be predicted by predicting the ionospheric Pedersen currents and field-aligned currents (FACs). The midlatitude daytime Pedersen currents complete a circuit between the polar and equatorial ionosphere [Kikuchi et al., 1996], which are driven by magnetospheric dynamos created by the magnetospheric compression [Fujita et al., 2003] and southward IMF [Tanaka, 1995]. The FACs on the night are the substorm R1 FACs driven by the near-Earth tail and lobe mantle dynamos [Tanaka et al., 2010; Ebihara and Tanaka, 2015]. We now propose a prediction scheme of the midlatitude GIC, where the global MHD simulation with the potential solver provides the ionospheric Pedersen currents on the dayside and the substorm FACs on the nightside and the solution of the diffusion equation for the By provides the GIC.

Keywords: Geomagnetically induced current, Mid latitude ground surface current, Global ionospheric current, Magnetosphere-ionosphere field-aligned current, Ionosphere-ground transmission line

