A numerical simulation of the Pi2 pulsations associated with the substorm current wedge

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Transient behavior of the MHD perturbations in the inner magnetosphere induced from an impulsive localized eastward current is studied as a model of the Pi2 pulsations in the magnetosphere. The current is a current equivalent to the magnetospheric part of the substorm current wedge. Numerical results exhibit 1) the plasmasphere virtual resonance in nighttime, 2) the toroidal wave with largest amplitude in the local time of the east/west edge of the source current, 3) the significant poloidal mode in the middle plasmasphere. These numerical results are essentially consistent with the satellite observations, namely the day-night asymmetry in the Pi2 occurrence and transient toroidal waves.

The present paper deals with transient behavior of the MHD perturbations in the inner magnetosphere induced from an impulsive localized eastward current (the source current) as a model of the Pi2 pulsations in the magnetosphere. The model magnetosphere has the dipole magnetic field, the plasmasphere, the ionosphere with the Pedersen conductivity, and a free outer boundary. The source current is a current equivalent to the magnetospheric part of the substorm current wedge. It is distributed around the equatorial plane of L = 10. It has about 2Re (radial) * 10Re (longitudinal) in size in the equatorial plane and 2Re in length in the field-aligned direction. Numerical results exhibit the local time variation of the Pi2 pulsation signals. The poloidal wave shows the plasmasphere virtual resonance with larger amplitude around midnight and faint one in the dayside. The toroidal wave is excited as a field-line resonance with the amplitude larger than the poloidal wave immediately after passing the wave front of the poloidal wave in the regions where VA gradient is steep. The toroidal wave has largest amplitude in the local time of the east/west edge of the source current. Duration of this wave is about 5 min. In the middle plasmasphere where spatial gradient of the VA is smaller, the poloidal mode wave tends to be significant compared with the toroidal mode wave. These numerical results are essentially consistent with the satellite observations, namely the day-night asymmetry in the Pi2 occurrence and transient toroidal waves.