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Transient time scale of poloidal Alfven waves in dipole geometry

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Abstract

Standing poloidal Alfven waves with high azimuthal wave number (m >> 1) are of interest since they can be excited via bounce-drift resonance with ring current particles of the Earth's magnetosphere. However, the temporal behavior of these transient poloidal waves in realistic dipole geometry has not been demonstrated in detail. We have conducted 2.5-D MHD simulations in a dipole coordinate system that are suited to model high-m ULF waves with high grid resolution. To investigate the time-dependent behavior of local wave fields, we impose fundamental and second harmonic standing poloidal Alfven waves with different azimuthal wave number and follow their evolution in time at different locations. Our results show that the wave energy is initially poloidal and asymptotically transferred to the toroidal mode energy. Such transit time is dependent on the azimuthal wave number; the poloidal mode remains for a longer period of time when the wave has larger mode number. Although our results agree with the tendency from previous theoretical studies that the poloidal mode with higher azimuthal wave number has longer lifetime than that with lower wave number, it is shown that the transit time in dipole geometry is much shorter than that from box models. It suggests that the observations of prolonged poloidal mode waves are likely due to the continuous excitation via wave-particle interaction.