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Seasonal and Diurnal variations of Kelvin–Helmholtz waves at Earth's Magnetopause

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We survey one solar cycle of in situ data from the NASA THEMIS (Time History of Events and Macro scale Interactions during Substorms) and MMS (Magnetospheric Multiscale) missions to identify Kelvin–Helmholtz Instability (KHI) along Earth's magnetopause flank. We found that KHI occurrence rates exhibit semiannual and diurnal variations; the rate maximizes at the equinoxes and minimizes at the solstices. The rate varies for different IMF By polarities; it is maximum around fall equinox for negative IMF By, while is maximum around spring equinox for positive IMF By. The rate is directly related to the dipole tilt angle. Therefore, the equinoctial hypothesis explains most part of the seasonal and diurnal variation of KHI, while the angle of the Earth's dipole in the plane perpendicular to the Earth□Sun line explains the difference between KHI occurrence rates with positive/negative IMF By. These results reveal the key role of Sun-Earth geometry on modulating the KHI and thus the importance of Earth's dipole tilt and Sun solar declination angle as a function of time for plasma transport across the magnetopause.