Simultaneous observations of geosynchronous magnetopause crossings and equatorward shift of the HF radar cusp

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The earth's magnetopause sometimes moves across the geosynchronous orbit when the solar wind dynamic pressure (Pd) is extremely enhanced and/or the erosion is highly developed due to the continuous intense southward interplanetary magnetic field (IMF). These events are called Geosynchronous Magnetopause Crossings (GMCs). To examine the dependence of the GMC occurrence on the solar wind conditions, two GMC events are studied with the solar wind parameters, geomagnetic indices, and HF radar echos observed by SuperDARN. First event occurred on March 10, 1998. The IMF Bz turned southward to -15 nT with no enhancement of Pd. It took more than 2 hours from the southward IMF arrival at the magnetopause to the GMC observed by GOES satellites. Equatorward shift of the dayside cusp or open/closed field line boundary (OCB) was observed by SuperDARN simultaneously during the erosion. We call this type of GMCs 'Bz type', which was caused by continuous erosion of the dayside magnetosphere. In this event, 3 GOES satellites were located in the dayside sector. GOES 9 at 9h LT and GOES 10 at 11h LT observed magnetosheath simultaneously, but GOES 8 at 13h LT remained in the magnetosphere. These signatures show dawn-dusk asymmetry of the eroded magnetopause shape. Second event occurred on September 22, 1999. The GOES 10 satellite at 11h LT encountered the magnetopause few minutes after the solar wind Pd was sharply enhanced to about 30 nPa. This first GMC occurred before the SuperDARN radar detected the equatorward shift of the cusp. It means that the dayside magnetopause was highly compressed below the geosynchronous orbit without help of erosion. We call this type of GMCs 'Pd type'. After 25 minutes of the first GMC, the IMF turned southward and kept negative Bz for more than 3 hours. Several GMCs occurred with lower Pd in this period. The cusp latitude detected by SuperDARN radars was linearly correlated with the time integral of the southward IMF. It suggests that time history of the IMF Bz might affect GMC occurrence and equatorward shift of the cusp.