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The Ionospheric Source of the Plasma Sheet During Storm Main Phase

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The ionospheric and solar wind contributions to the magnetosphere can be distinguished by their composition. While both sources contain significant H+, the heavy ion species from the ionospheric source are generally singly ionized, while the solar wind consists of highly ionized ions. Both the solar wind and the ionosphere contribute to the plasma sheet. It has been shown that with both enhanced geomagnetic activity and enhanced solar EUV, the ionospheric contribution, and particularly the ionospheric heavy ions contribution increases. However, the details of this transition from a solar wind dominated to more ionospheric dominated plasma sheet are not well understood. An initial study using AMPTE/CHEM data, a data set that includes the full charge state distributions of the major species, shows that the transition can occur quite sharply during storms, with the ionospheric contribution becoming dominant during the storm main phase. However, during the AMPTE time-period, there were no continuous measurements of the upstream solar wind, and so both the simultaneous solar wind composition and the driving solar wind and IMF parameters were not known. The HPCA instrument on MMS and both the LEPi and MEPi instruments on Arase are able to measure He++. With these data sets, the He++/H+ ratio can be compared to the simultaneous He++/H+ ratios in the solar wind to more definitively identify the solar wind contribution to the plasma sheet. This allows the ionospheric contribution to the H+ population to be determined, so that the full ionospheric population is known. We find that when the IMF turns southward during the storm main phase, the dominant source of the hot plasma sheet becomes ionospheric. This composition change explains why the storm time ring current also has a high ionospheric contribution.