



## **Pre-Storm Ionospheric Oxygen Ions between the Ionosphere and the Inner Magnetosphere**

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The prompt appearance of energetic O<sup>+</sup> ions in the ring current in the growth phase of a magnetic storm raises the interesting question of the possible role of O<sup>+</sup> ions between the ionosphere and the plasma sheet and ring current immediately preceding the main phase of a magnetic storm. We examine oxygen ion transport from the high-altitude polar ionosphere in the quiet-time periods immediately preceding a series of five large magnetic storms (Dst < -100 nT) in Solar Cycle 23, using single-particle trajectory simulations in conjunction with Akebono ion measurements and related IMF and convection electric field data. Observed low-energy O<sup>+</sup> ions on Akebono in the quiet-time high-altitude auroral and polar cap ionosphere (7000 km) are found to have temperatures of about 0.2-0.3 eV and flow velocities of a few km/s, and a portion of the ions undergo centrifugal acceleration at higher altitudes (above about 3 Earth radii (altitude)), resulting in a low but non-negligible O<sup>+</sup> ion flux between the ionosphere and the plasma sheet and ring current that is dependent on IMF as well as K<sub>p</sub>: up 30% of the observed low-energy O<sup>+</sup> ions reach the plasma sheet, and more of the ions reach the dusk than dawn, corresponding to an O<sup>+</sup> mass source rate of ~ 0.14 kg/s and a “plasma sheet filling time” of ~6.7 hr near solar maximum, assuming a plasma sheet oxygen density of 0.1 per cc.