Ionospheric Ion Outflow in the Context of Ionosphere-Plasmasphere, Ionosphere-Thermosphere, and Ionosphere-Magnetosphere Coupling

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Satellite and ground based observations over the past few decades have demonstrated that ionospheric ion outflows represent a significant component of the magnetospheric plasma – and therefore an important part of ionosphere-magnetosphere mass transfer. However, the role of ion outflows in ionosphere-plasmasphere coupling is less well understood, as is its role in ionosphere-thermosphere coupling and in the dynamics of the magnetosphere particularly at the time of storm or substorm onset. We discuss relevant recent observational evidences showing (a) the transport and subsequent acceleration of cold plasmaspheric ions into low-energy ion outflows; (b) solar-cycle variations in ion outflow and up-flow flux, mass composition and energy due to corresponding variations in ion-neutral collisions in the topside ionosphere-thermosphere; and (c) low-energy "in-transit" ion outflows at quiet times that may serve as an important pipeline of heavy ions. Together, these observations strongly suggest an important and direct role of ion outflows in ionosphere-plasmasphere and ionosphere-thermosphere coupling as well as in storm and substorm-time magnetospheric dynamics.