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The Role of Superthermal Electrons in Ionospheric Outflow

Alex Glocer and George Khazanov
NASA/GSFC,Greenbelt, MD, USA

Superthermal Electrons (SEs), play an important role in the outflow of ions from the Earth's ionosphere through two physical mechanisms: the development of a self-consistent parallel electric field as well as Coulomb collisions with thermal electrons that raises the electron temperature and hence the scale height of the ions. The sources of these electrons are photoionization of the neutral atmosphere (photoelectrons), precipitating electrons of magnetospheric origin (primary electrons), or by the resulting impact ionization (secondary electrons). We explore the role of Superthermal Electrons (SEs) in the ionospheric outflow solution using two theoretical modeling techniques: A field-aligned multi-fluid model that solves the gyrotropic transport equations, and a Fokker-Planck Kinetic Model of the SE populations. First, we present the results of our recent study describing the effect of photoelectrons in the geomagnetically quiet polar wind, comparing with statistical data from Akebono and ESR. We find that photoelectrons play an important role in explaining the observed solar zenith angle dependence. Second, we present results our other recent study describing how SEs regulate the energy interplay between the ionosphere and plasmasphere and how this process controls ionospheric outflow on closed field-lines, i.e. plasmaspheric refilling.