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A consistently derived set of empirical models for high-latitude electrodynamics

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The ionosphere-thermosphere research community has clearly expressed a need for improved, observation-based estimates of key ionosphere-thermosphere parameters such as Joule dissipation, Poynting flux, and ionospheric conductances. While global estimates of these key parameters can be obtained by combining existing empirical models, one often encounters some frustrating sources of uncertainty: the models to be combined often use different input parameters, different assumptions about hemispheric symmetry, and/or different coordinate systems. We eliminate these sources of uncertainty by deriving a new model of high-latitude ionospheric potential that can be combined with the Average Magnetic Field and Polar Current System (AMPS) model to obtain empirical estimates of Joule dissipation, Poynting flux, and ionospheric conductances. These models treat the two hemispheres independently, are derived in a mutually consistent fashion, and are based entirely on electric and magnetic field measurements made by the Swarm satellites.