Utah State University (USU) Time Dependent Ionospheric Model (TDIM)

The TDIM was initially developed as a mid-latitude, multi-ion (NO+, O2+, N2+, and O+) model by Schunk and Walker [1973]. The time-dependent ion continuity and momentum equations were solved as a function of altitude for a corotating plasma flux tube, including diurnal variations and all relevant E- and F-region processes. This model was extended to include high-latitude effects due to convection electric fields and particle precipitation by Schunk et al. [1975, 1976]. A simplified ion energy equation was also added, which was based on the assumption that local heating and cooling processes dominate (valid below 500km). Flux tubes of plasma were followed as they moved in response to the convection electric fields. The addition of plasma convection and particle precipitation models is described by Sojka et al, [1981a, b]. Schunk and Sojka [1982] extended the ionospheric model to include ion thermal conduction and diffusion thermal heat flow. Also, the electron energy equation was included by Schunk et al. [1986], and consequently, the electron temperature is now rigorously calculated at all altitudes. The theoretical development of the TDIM is described by Schunk [1988], while comparisons with observations are discussed by Sojka [1989].

The standard form of the TDIM requires inputs for the neutral atmosphere, neutral wind, auroral precipitation, and convection electric field. These are represented by the MSIS-86 [Hedin, 1987], HWM [Hedin et al., 1991], Hardy oval [Hardy et al., 1987], and the Heppner and Maynard convection patterns [Heppner and Maynard, 1987], respectively. These drivers are empirical models that require the geomagnetic three-hourly Kp and Ap indices; the MSIS-86 and HWM models require the solar f10.7 and f10.7A indices as well. For this 240 day study in which the TDIM is being exercised to test if its climatology across a solar minimum equinox and summer are adequate TDIM runs were made in extremely climatological settings. Specifically, the indices of Kp, Ap, F10.7, and F10.7A were selected once and the entire 240 days were simulated. This was repeated for different selections of these driver indices. Hence the TDIM was not responding to specific variability in the indices, which would contain weather information.