Longitudinal Differences in the Low-latitude Ionosphere and in the Ionospheric Variability

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Analysis of longitudinal differences in ionospheric parameters can illuminate variety of mechanisms responsible for ionospheric variability. In this study, we aim to 1) quantitatively describe major features of longitudinal differences in peak electron density in the low-latitude ionosphere; 2) examine differences in ionospheric variability at different longitude sectors, and 3) illustrate longitudinal differences in ionospheric response to a large disturbance event, sudden stratospheric warming of 2016. We examine NmF2 observations by a network of ionosondes in the American (30-80W) and Asian (110-170E) longitudinal sectors. Selected instruments are located in the vicinity of EIA troughs (Jicamarca, Sao Luis, Guam, Kwajalein), northern and southern crests of EIA (Boa Vista, Tucuman, Cachoeira Paulista, Okinawa), and beyond EIA crests (Ramey, Yamagawa, Kokubunji). To examine main ionospheric features at each location, we use long-term datasets collected at each site to construct empirical models that describe variations in NmF2 as a function of local time, season, solar flux, and geomagnetic activity. This set of empirical models can be used to accurately describe background ionospheric behavior and serve as a set of observational benchmarks for global circulation models. It reveals, for example, higher NmF2 in the EIA trough in the Asian sector as compared to the American sector. Further, we quantitatively describe variability in NmF2 as a difference between local observations and local empirical model, and find that American sector's EIA trough has overall higher variability that maximizes for all local times during wintertime, while Asian sector trough variability does not change significantly with season. Additionally, local empirical models are used to isolate ionospheric features resulting from dynamical disturbances of different origin (e.g. geomagnetic storms, convective activity, sudden stratospheric warming events, etc.). We illustrate this approach with the case of sudden stratospheric warming of 2016.

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