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Spatial and temporal extent of ionospheric anomalies during sudden stratospheric warmings in the daytime ionosphere

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Recent studies have demonstrated large variations in the daytime ionosphere during sudden stratospheric warmings (SSW) and a debate has started about the relative importance of solar and lunar tides in these ionospheric variations. In this study we use GPS TEC data from the MIT Haystack Observatory Madrigal database along 75^{o}W collected in 2000-2014 as well as several digisondes to examine the magnitude and spatio-temporal extent of ionospheric anomalies related to SSW. To separate ionospheric anomalies during SSW from regular ionospheric behavior, we develop empirical models of ionospheric parameters (TEC, NmF2) using available long-term records. The models describe variations in parameters for each lon/lat bin (or digisonde location) as a function of solar activity, geomagnetic activity, day of year, and local time. Ionospheric anomalies are obtained as difference between observations and empirical model. Analysis of anomalies shows that they are observed for both major and minor SSW events, reaching 50-100% variation from expected seasonal behavior for major SSW events and 30-60% variation for minor SSW events. SSW-associated variations are pronounced more strongly in NmF2 than in TEC. The largest variations in TEC in the daytime are observed both in the crests of equatorial ionization anomaly and at 40-60^{o}S (geodetic). Variations in TEC and NmF2 are even discernable up to high latitudes (70^{o}S) in the Southern Hemisphere and mid-latitudes (42^{o}N) in the Northern Hemisphere. We discuss several possible mechanisms contributing to these anomalies, focusing on solar and lunar semidiurnal tides and interhemispheric coupling.

キーワード: sudden stratospheric warming, atmospheric coupling, ionosphere
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