Ionospheric response to 17 March 2013 geomagnetic storm identified by data assimilation result

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Based on slant total electron content (TEC) observations made by ∼10 satellites and ∼450 ground IGS GNSS stations, we constructed a 4-D ionospheric electron density reanalysis during the March 17, 2013 geomagnetic storm. Four main large-scale ionospheric disturbances are identified from reanalysis: (1) The positive storm during the initial phase; (2) The SED (storm enhanced density) structure in both northern and southern hemisphere; (3) The large positive storm in main phase; (4) The significant negative storm in middle and low latitude during recovery phase. We then run the NCAR-TIEGCM model with Heelis electric potential empirical model as polar input. The TIEGCM can reproduce 3 of 4 large-scale structures (except SED) very well. We then further analyzed the altitudinal variations of these large-scale disturbances and found several interesting things, such as the altitude variation of SED, the rotation of positive/negative storm phase with local time. Those structures could not be identified clearly by traditional used data sources, which either has no global coverage or no vertical resolution. The drivers such as neutral wind/density and electric field from TIEGCM simulations are also analyzed to self-consistently explain the identified disturbance features.