Responses of lower thermospheric temperature and NO to the 2013 St. Patrick's Day geomagnetic storm

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The altitude and latitude dependent responses of neutral temperature and NO volume mixing ratio (VMR) in the lower thermosphere to the 2013 St. Patrick's Day (17th March) geomagnetic storm are studied. The neutral temperature is measured by both the Solar Occultation For Ice Experiment (SOFIE) instrument onboard the AIM satellite and the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument on the TIMED satellite. The SABER temperature enhancement increases with increasing latitude (e.g., ~15 K at 35°N/S, ~25 K at 50°N and 80°N) above 102 km in both hemispheres. Below 102 km, the SABER temperature enhancement occurs only at latitudes high than 50°N and 80°S, respectively. The SABER temperature enhancement in the northern hemisphere (NH) and southern hemisphere (SH) occurs about half day and 1 day later than the time of geomagnetic storm main phase. The SOFIE temperature enhancement increases with increasing height (e.g, ~15 K at 94 km, ~20 K at 96 and 98 km, and 20-25 K above 100 km) during 18th -19th in the NH. In the SH, the SOFIE temperature enhancement is mainly above 98 km. The enhancement of SOFIE NO VMR is 2-3 times larger relative to the prestorm condition on 18th -19th and extends downward to ~94 km. Moreover, the SOFIE NO VMR enhancement is consistent well with the SOFIE temperature enhancement. By comparing the aurora intensity, which is indicated by the brightness of the N_2 Lyman-Birge-Hopfield short (LBHS) band imaged by the DMSP Special Sensor Ultraviolet Spectrographic Imager (SSUSI) instrument, we fond that the NO VMR and temperature enhancements occur after the time of aurora intensity peak. The different time delay of temperature enhancement at different latitude might be related to the relative location between the temperature enhancement and the aurora oval.

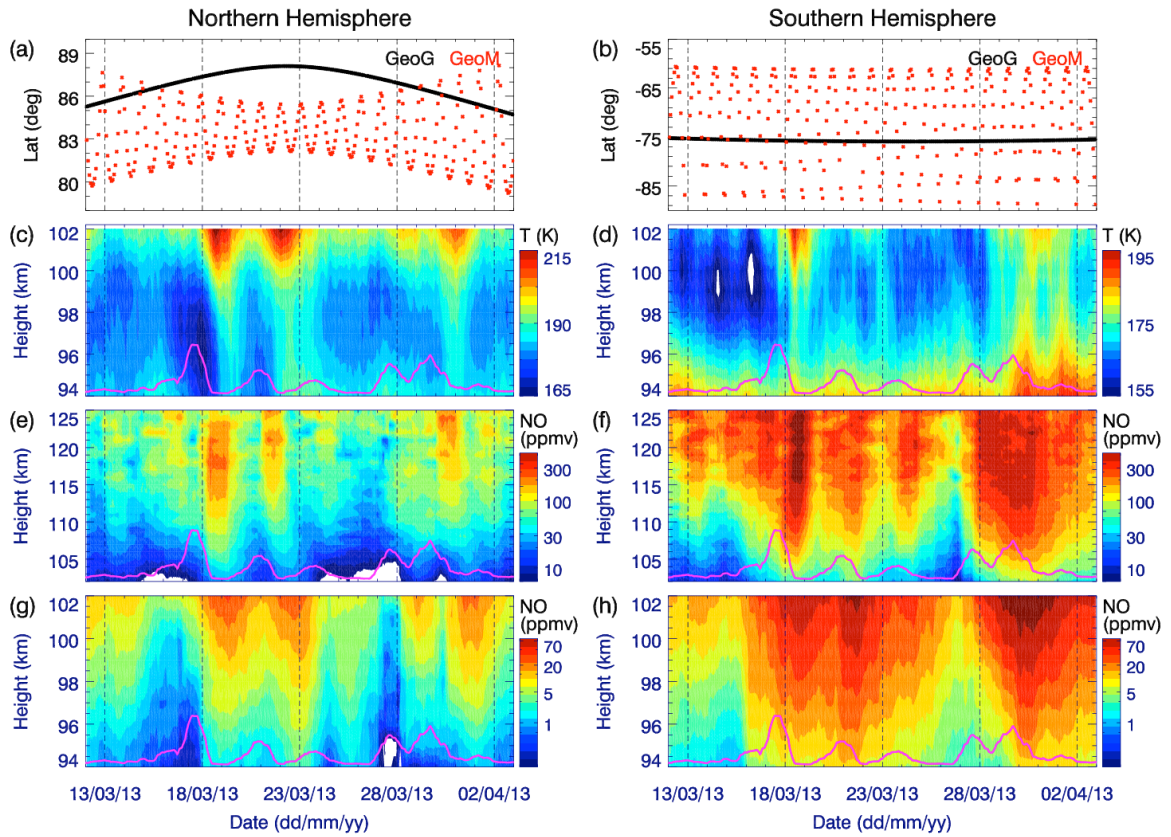

Figure 1. Geographic (black) and geomagnetic (red) latitudes of SOFIE sampling and daily running mean SOFIE NO volume mixing ratio (VMR) and temperature in the Northern (left column) and Southern (right column) Hemispheres. (a) and (b): sampling latitudes of SOFIE measurement (black: geographic latitude; red: geomagnetic latitude); (c) and (d): temperature from 102 km to 94 km; (e) and (f): NO VMR from 125 km to 102 km; (g) and (h): NO VMR from 102 km to 94 km. Since the NO VMR varies with height sharply and to make the NO VMR contour plots more readable, we separate the NO VMR in the height range of 94-125 km into two height ranges (102-125 km and 94-102 km) with different color scales. For the convenience of comparing to the AE index, we over-plot the daily running mean AE index.