

Effect of Stratosphere Sudden Warmings on the mesosphere structure and dynamics over Antarctica: An overview

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A minor stratospheric warming (SSW) event was noticed in the southern hemisphere (SH) during September (day 259) 2010 along with two episodic warmings in early August (day 212) and late October (day 300) 2010. The signature of mesosphere response was detected using the simultaneous observations from both meteor radar and MF radar located at King Sejong Station (62.22°S, 58.78°W) and Rothera (68°S, 68°W), Antarctica, respectively. The zonal winds in the mesosphere reversed approximately a week before the September SSW occurrence, as has been observed in the 2002 major SSW. The mesospheric wind field was found to differ significantly from normal years probably due to enhanced planetary wave (PW) activity before the SSW. We have also analyzed mesospheric tides using both the radars and noticed strong enhancement of tides during SSW years, 2002 and 2010 in the SH. We also investigated the variability of Antarctic ozone and water vapor from MLS (Microwave Limb Sounder) data during winter periods of both SSW and non-SSW years, and discussed their possible connection to the mesospheric tides. The semi-diurnal tidal enhancement is noticed during the days 270-310, irrespective of the day of peak warming occurred in 2002 and 2010 and this feature is not apparent in non-SSW years (2011, 2012 and 2013). The occurrence timing of the tidal enhancement is consistent with the recovery timing of ozone expected in the stratosphere based on the MLS data. The tidal amplitude enhancement is greater for the year 2010 than 2002: in 2002 both diurnal and semi-diurnal zonal components are enhanced up to 30 m/s from the normal amplitude of 15 m/s, whereas during 2010 the semi-diurnal tidal zonal amplitudes reach up to 40 m/s and 50 m/s at the altitudes of 80 and 90 km. The reduction in ozone destruction and its effect on mesosphere tides has been noticed. Further from the wavelet analysis of wind data of both the stations, we find that strong 14-16 day PWs prevailed prior to the 2010 minor SSW and disappeared suddenly after the SSW in the mesosphere. Our investigations suggest that the minor SSWs in SH can also cause significant effects on the mesospheric dynamics as in the northern hemisphere.