The Polar Sudden Stratospheric Warming (SSW) and It's Possible Manifestations in the Equatorial Mesosphere-thermosphere-ionosphere

Tarun Kumar Pant, C.Vineeth, Sumod S. G., and R.Sridharan
Space Physics Laboratory, Vikram Sarabhai Space Center, Trivandrum-695022, India

In this study, the variations in daytime mesopause temperature and the Equatorial Electrojet over equator during Sudden Stratospheric Warming (SSW) events over high latitudes have been investigated. To reflect upon the stratospheric conditions NCEP-NCAR reanalysis data have also been used. This study indicates a possible dynamical coupling between the two regions through the planetary wave activity. The amplified wave signatures of quasi-16 day period are seen in the equatorial mesopause temperature and zonal mean polar stratospheric temperature (at 10 hPa) during the course of SSW. The possibility that the planetary waves over the polar stratosphere, which play an important role in the generation of SSW, could also have contribution from the tropics has been indicated through numerical simulations in the past [Dunkerton, 1981], but due to the paucity of global measurements it could not be established unequivocally. These simulations also indicated the presence of a zero-wind line whose real counterparts were not observed in the atmosphere. The NCEP-NCAR reanalysis of stratospheric wind and temperatures clearly shows that (i) a dynamical feature similar to the zero-wind line appears over the tropics ~ 60 days prior to the major warming and progresses poleward and, (ii) enhanced PW activity is seen almost simultaneously. This study shows that the recent SSW events had tropical associations. Further, favored occurrences of Equatorial Counter Electrojets (CEJs) with a quasi 16-day periodicity over Trivandrum (8.5oN, 76.5oE, 0.5oN diplat.) in association with the polar Stratospheric Sudden Warming (SSW) events are presented. It is seen that, the stratospheric temperature at ~30 km over Trivandrum showed a sudden cooling prior to the SSW and the first bunch of CEJs occurred around this time. Stratospheric zonal mean zonal wind at ~30 km exhibited a distinctly different pattern during the SSW period. These circulation changes are proposed to be conducive for the upward propagation of the westward waves (both gravity and planetary) over the equatorial latitudes. The interaction of such waves with the tidal components at the upper mesosphere and its subsequent modification are suggested to be responsible for the occurrence of CEJs having planetary wave periods. This result is significant as it presents a new perspective for understanding the mechanism that causes the SSW and its subsequent global manifestations.