World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Long-Term Variabilities and Tendencies in the Zonally Averaged TIMED-SABER Ozone and Temperature in the Middle Atmosphere over 10°N-15°N

Authors : Oindrila Nath, S. Sridharan

Abstract : Long-term (2002-2012) temperature and ozone measurements by Sounding of Atmosphere by Broadband Emission Radiometry (SABER) instrument onboard Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED) satellite zonally averaged over 10°N-15°N are used to study their long-term changes and their responses to solar cycle, quasi-biennial oscillation and El Nino Southern Oscillation. The region is selected to provide more accurate long-term trends and variabilities, which were not possible earlier with lidar measurements over Gadanki (13.5°N, 79.2°E), which are limited to cloud-free nights, whereas continuous data sets of SABER temperature and ozone are available. Regression analysis of temperature shows a cooling trend of 0.5K/decade in the stratosphere and that of 3K/decade in the mesosphere. Ozone shows a statistically significant decreasing trend of 1.3 ppmv per decade in the mesosphere although there is a small positive trend in stratosphere at 25 km. Other than this no significant ozone trend is observed in stratosphere. Negative ozone-QBO response (0.02ppmv/QBO), positive ozone-solar cycle (0.91ppmv/100SFU) and negative response to ENSO (0.51ppmv/SOI) have been found more in mesosphere whereas positive ozone response to ENSO (0.23ppmv/SOI) is pronounced in stratosphere (20-30 km). The temperature response to solar cycle is more positive (3.74K/100SFU) in the upper mesosphere and its response to ENSO is negative around 80 km and positive around 90-100 km and its response to QBO is insignificant at most of the heights. Composite monthly mean of ozone volume mixing ratio shows maximum values during pre-monsoon and post-monsoon season in middle stratosphere (25-30 km) and in upper mesosphere (85-95 km) around 10 ppmv. Composite monthly mean of temperature shows semi-annual variation with large values (~250-260 K) in equinox months and less values in solstice months in upper stratosphere and lower mesosphere (40-55 km) whereas the SAO becomes weaker above 55 km. The semi-annual variation again appears at 80-90 km, with large values in spring equinox and winter months. In the upper mesosphere (90-100 km), less temperature (~170-190 K) prevails in all the months except during September, when the temperature is slightly more. The height profiles of amplitudes of semi-annual and annual oscillations in ozone show maximum values of 6 ppmv and 2.5 ppmv respectively in upper mesosphere (80-100 km), whereas SAO and AO in temperature show maximum values of 5.8 K and 4.6 K in lower and middle mesosphere around 60-85 km. The phase profiles of both SAO and AO show downward progressions. These results are being compared with long-term lidar temperature measurements over Gadanki (13.5°N, 79.2°E) and the results obtained will be presented during the meeting.

Keywords : trends, QBO, solar cycle, ENSO, ozone, temperature
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020