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Warming trends in the tropical tropopause layer estimated from GPS radio occultation in 2001-2010

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This study investigated the long term changes in the tropical tropopause layer (TTL) temperature using GPS radio occultation (RO) data form the German CHAMP satellite mission for the period May 2001-December 2007 and US?Taiwanese COSMIC six satellite mission for the period May 2006 - December 2010 in the latitude belt 15 S-15 N. Although continuous GPS RO data is only available for about 10 years, yet it has emerged as potential data to study the interannual changes of the TTL. The radiosonde data for period 1980-2010 in in the latitude belt 15S-15N is also used to compare the result. The TTL is the layer in the tropics between the level of main convective outflow level and the cold point tropopause (CPT), about 12-19 km. However, we use temperatures between altitudes 8-30 km which account both tropospheric (below the TTL) and stratospheric (above the TTL) processes besides TTL. The linear regression analysis was applied to the deseasonalized monthly mean temperature time series for each 1-km altitude bin for the periods 1980-2000 and 2001-2010 separately. The regression analysis included the components representing quasi-biennial oscillation (QBO), El Nino Sothern Oscillation (ENSO) and 11-year solar cycle for the period 2001-2010 as well as volcanic aerosols for the period 1980-2000. The analysis reveals dominance of the QBO (1-3 K/QBO index) in the upper part and above the TTL with maxima at the equator, particularly for the period during Northern Hemispheric (NH) autumn and winter during 2010-2010. The dominance of the ENSO is also seen within the TTL and below it (˜ 0.5-1.0 K/ENSO index) with maxima at the equator, particularly during NH spring and summer during 2001-2010. Solar cycle effect was found to be negligible during 2001-2010.The troposphere below the TTL show warming trend (0.1-0.3 K/decade), while the TTL and above it shows cooling trend (0.2-1.2 K/decade) during 1980-2000. The TTL shows slow warming trend (0.5-1.0 K/decade) during 2001-2010 in contrast to period 1980-2000. The warming in the TTL could be possibly attributed due to increasing greenhouse gases.

キーワード: Tropical Tropopause Layer, GPS Radio Occultation, Temperature Trend, Global Warming
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