



## An anomalous bite out of the Boreal Winter Tropical tropopause layer over the Eastern Pacific: A study using COSMIC Radio Occultation measurements

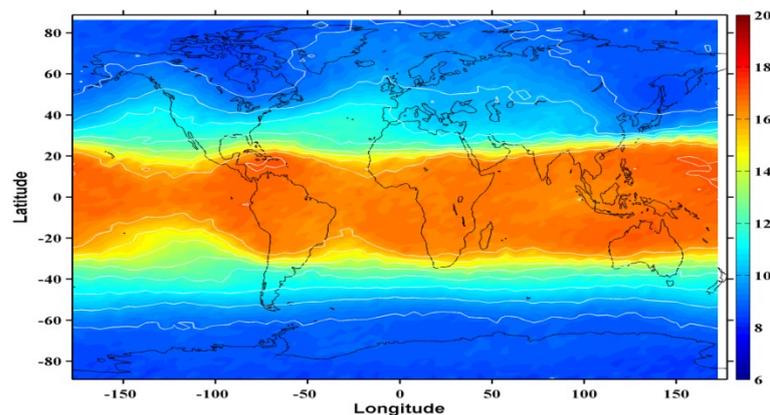
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Tropopause is one of the most significant features of the thermal structure of the Earth's lower atmosphere. Over the tropics the tropopause can reach as high as 16 to 18 km as compared to 12 km over mid-latitudes and 8 km over the high /polar latitudes. The tropical tropopause acts as a lid to the troposphere and limits the deep convective clouds from entering into the stratosphere. It has been reported that the structure and dynamics of tropical tropopause play a vital role in the stratosphere-troposphere interaction process especially in exchanging particulate constituents as well as chemical species such as ozone and water vapour. The latitudinal distribution of tropical tropopause shows a sharp decrease at the boundaries of tropics. In this regard, the latitudinal distribution of tropical tropopause height has been employed as a metric to identify the edges of tropics which more or less coincide with Hadley cell boundaries.

In the present study, we investigate an anomalous structure of tropical tropopause over the East Pacific (EP) Ocean using radio occultation measurements of temperature profiles from Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC) satellite. The COSMIC is a system of six low earth orbiting satellites measuring high resolution (~100m) profiles of temperature and humidity starting near the surface and extending up to as high as 40km in the atmosphere. For the present study, COSMIC measurements of temperature profiles during 2007-2015 are employed. The temperature profiles are gridded into  $5 \times 10^\circ$  grids and the lapse rate tropopause (LRT) altitude is estimated across the globe. The global distribution of tropopause height revealed an anomalous bite out feature over the East Pacific region ( $150^\circ$ - $100^\circ$ W) in terms of lower tropical tropopause height during boreal winter months. This feature of the tropical tropopause is discussed in the study for the first time in details.



**Figure 1:** Global Distribution of LRT estimated using COSMIC measurements during boreal winter depicting anomalous bite out over the EP

Figure 1 shows the global distribution of LRT altitude for the boreal winter months (December-January-February), which readily reveals the bite out structure of tropical tropopause over the EP region. The LRT height over the EP region is approximately 2-3 km lower as compared to adjacent longitudes of the same latitude. It is noted that temperature profiles over the EP region during boreal winter show sharp inversion near the tropical tropopause altitude. This has profound implications in the transport of constituents through stratosphere-troposphere exchange. Also, this is reflected in the tropical belt width (Hadley cell extent) computed from tropopause based metric in terms of a squeeze in HC width over EP region during this season. A detailed analysis is carried out to identify the potential mechanisms responsible for the observed tropical tropopause bite out structure over the EP in the study in terms of distribution of sea surface temperature, vertical winds and potential vorticity for the first time.