

# Temperature trends and long term variations in the UTLS region and its association with Convection over Indian and adjacent region

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In order to achieve the insights of the temperature fluctuations and trends over Indian and adjacent regions including Darwin station, radiosonde data for temperature have been extensively utilized at major stations such as Delhi and Kolkata in India in the past 2-3 decades. The analysis of temperature is focused at 100 hPa, which is a standard pressure level, to represent UTLS features. Recent results based on COSMIC is also utilized to show ENSO signal in the troposphere and QBO in the lower stratosphere.

Combined analysis of radiosonde and COSMIC helped us to bring salient features of the temperature characteristics and trends in the upper and middle troposphere. A decreasing trend in temperature is found over Kolkata (~22.3° N, 82.2°E), station facing Bay of Bengal - a region of high convective activity, suggesting increasing convection with time starting from 1990. This is also confirmed with the increasing trend in temperature in the middle troposphere due to larger latent heat release caused by increased convection over a period of time. Large scale components mainly ENSO and quasi-biennial oscillation (QBO) that contributed to the 100-hPa temperature variability were also analyzed, which showed that ENSO variance is larger by a factor of two in comparison to QBO over Indian region. ENSO warm conditions cause warming at 100-hPa over Delhi and Darwin. However, due to strong QBO and solar signals in the equatorial region, ENSO signal seems less effective. QBO, ENSO, and solar cycle contribution in temperature are found location-dependent (latitudinal variability) responding in consonance with shifting in convective activity regime during El Niño, seasonal variability in the tropical easterly jet, and the solar irradiance.

Key words: Convection, QBO, ENSO, Solar cycle