

Observations of Extremely low tropopause temperatures over the Arabian Sea region during ARMEX campaign (summer monsoon season)

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Background:

Spatial distribution of the temperature of the tropical tropopause region is important for the stratosphere-troposphere exchange of minor constituents. Observations over the eastern coastal station of India and over the Bay of Bengal have shown that tropopause temperature $\leq 191\text{K}$ do occur over this region during the monsoon months (Jain et al., 2006). This result motivates us to look into the variation of tropopause temperature over the Arabian Sea region using radiosonde data collected in ARMEX campaign (summer monsoon season).

Objective:

In the present study radiosonde observations carried out during the Arabian Sea Monsoon Experiment (ARMEX) campaign (June – August 2002) and that from CHAMP satellite are examined to determine whether, on day to day basis, extreme cold tropopause temperature ($\leq 191\text{K}$) do occur over the Arabian sea region and adjoining area during the summer monsoon months.

Data Base:

Radiosonde observations carried out in campaign mode during ARMEX period (i.e. 20 June – 16 August 2002) on board ORV Sagar Kanya (Figure.1) are used (Bhat, 2005,2008). CHAMP Satellite provides a broader spatial coverage (Schmidt et al., 2004). Hence, in addition to ARMEX data, available CHAMP satellite observations for the summer monsoon months (i.e. May – September) for the years 2002-2006 are used to examine the occurrence of low tropopause temperature (LTT) i.e. CPT $\leq 191\text{K}$, over the Bay of Bengal, Arabian sea and adjoining areas.

Results and Discussion:

(A) ARMEX Period Observations

These observations show that LTT with CPT $\leq 191\text{K}$ do occur over the Arabian sea on number of days. A clear modulation by wave activity of the period of about 14 days is observed (Figure 2,3).

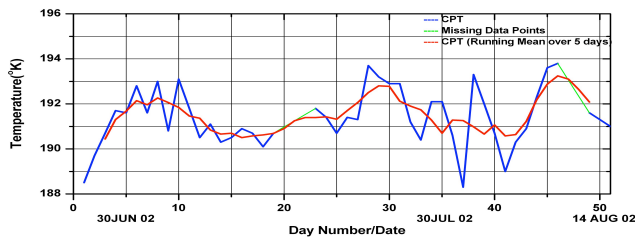


Figure 2. Time series of CPT and CPT after running mean over five days over Arabian Sea at Sagarkanya location (Fig. 1) at 00GMT during ARMEX campaign.

(B) CHAMP Satellite Observations

Observations of atmospheric temperature for the months of May – August for the year 2002-2006 have given a broader spatial coverage of LTT. Highlights of these observations are as follows:

- LTT do appear over the Arabian sea and adjoining coastal areas on number of days specially during the early period of the monsoon months (May – June).
- Areas of LTT are also seen to extend on some occasions to the African horn region indicating wider spatial coverage by such areas.
- Large year to year variability is also observed in the area of observation of LTT.

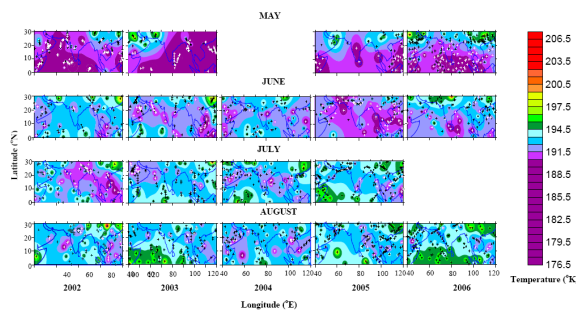


Figure 4. Contour maps of cold point temperature (CPT) drawn using CHAMP satellite observations during summer monsoon months. Crosses show CPT for each pass. White crosses indicate CPT $\leq 191\text{K}$ and the black crosses correspond to CPT $> 191\text{K}$.

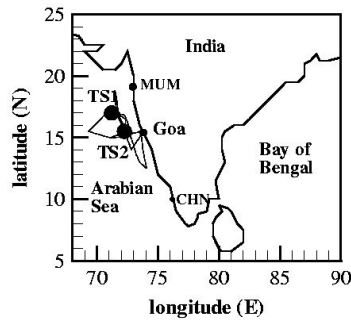


Figure 1. Cruise track and time series positions of ORV Sagar Kanya. The time series positions are: TS1 at 71.2°E & 16.9°N from 30 June – 10 July, TS2 at 72.2°E & 15.5°N from 22 July – 5 August 2002 (after Bhat 2008).

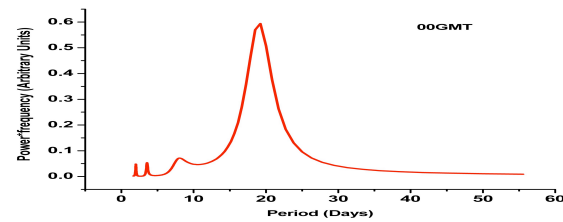


Figure 3. Power spectrum of the CPT time series, after 5 days running mean (as shown in fig.2), using MEM technique. Dominant period is about 14 days.

Summary:

Present observations show that, on day to day basis, CPT $\leq 191\text{K}$ do occur frequently over the Arabian sea region during the early part of the monsoon season. Observations of such cold temperature in tropopause region over the Arabian sea have not been reported so far.

The CHAMP satellite observations, which gives a broader spatial coverage, indicate that extreme cold temperature ($\leq 191\text{K}$) extends to the African horn region showing wider spatial coverage by this phenomena.

The observations of LTT do indicate that on day to day basis, low tropopause temperatures occur over Arabian Sea region also in addition to North-East and Bay of Bengal. This implies that a wider area which includes Arabian sea region is contributing to Stratosphere-Troposphere exchange of minor constituents, such as water vapor.

References:

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Acknowledgement

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