Upper Tropospheric Humidity data set from operational microwave sounders

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This presentation covers the following topics:

- UTH from microwave radiances \( (T_B^{18}) \)
- Cloud issues
- Climatology
- Inter-satellite differences
- IR – Microwave comparison
Motivation

• Water vapour in the upper troposphere (UT) is an important climate variable (Held and Soden, 2000)

• Good quality measurements are lacking (Foster and Collins, 2004)

  - radiosonde data quality is not good in UT (lots, 19xx - 200x)

• IR (HIRS) measurements of UT water vapour available, but there is clear-sky bias in the data set (Lanzante and Ghars, 2000)

• Microwave data (SSM/T2, AMSU-B, MHS) can be used except in the presence of precipitating clouds (Greenwald and Cristopher, 2002)
UTH from $T_B^{18}$

- 183.31 +/- 1.00 GHz
- UTH: Jacobian weighted relative humidity in the “upper troposphere”
- A simple relation between radiance and UTH exists for IR 6.7 $T_B$s \cite{Soden1993}.
- This is also applicable to AMSU $T_B^{18}$ \cite{Buehler2005}.
UTH from $T_B^{18}$

- $\ln(UTH) = a + b T_B^{18}$
- Similar coefficients from independent data sets
- Retrieval precision is 2 %RH for low humidity and 7 %RH for high humidity
- Coefficients are calculated for all viewing angles
UTH is limb corrected
Cloud Filter

- Clear sky: $T_B^{20} > T_B^{18}$
- Cloudy: $T_B^{18} > T_B^{20}$
- $T_B^{18} >$ Threshold
Cloud Filter

NOAA–16, Lat 45–50

ECMWF(RTTOV), Lat 45–50
Cloud Impact
UTH Climatology
Seasonal Cycle
Diurnal Cycle
Diurnal Cycle
Inter-satellite difference

- NOAA-15 UTH is ~3% drier than NOAA-16 UTH, but no clear time evolution.
- NOAA-17 UTH shows a time varying bias compared to NOAA-16 UTH.
AMSU – HIRS comparison

- HIRS has 7-9%RH dry bias compared to AMSU

Data Set

- Available at: [http://www.sat.ltu.se/projects/uth-clim/](http://www.sat.ltu.se/projects/uth-clim/)
- Contains:
  - mean, variance, # of pixels, median
  - ascending and descending separated
  - cloud filtered and unfiltered
  - daily and monthly (2.5 x 2.5 grid)
- Also contains deep convective cloud fraction (*Hong et al.*, 2005)
Summary and outlook

- Gridded daily and monthly UTH data set available from operational microwave sounders
- Cloud impact is not significant
- Shows large-scale features of atmospheric general circulation
- Seasonal and diurnal cycles
- HIRS UTH is drier than AMSU UTH
- Plan to extend the data set by combining similar instruments (SSM/T2 and MHS)
Questions and answers