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Observations of tropical water vapor using a groundbased microwave sensor

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Introduction

This study presents first results of ground-based measurements in the **inner tropics in Paramaribo/Suriname** (north of South-America) of the tropical water vapor content derived from microwave data. The portable **TRARA** (**tra**gbares **Ra**diometer) of the Institute of Applied Physics is operated at the Meteorological Service of Suriname (MDS) in cooperation with the Anton de Kom University and measures nearly continuously since mid of December 2006. The dual-channel sensor with frequencies near 21 and 35 GHz is capable to observe **integrated water vapor and liquid water** of the troposphere. The tropospheric opacity is derived from tipping curve calibrations [1]. High variability of water vapor has been found and the results are compared to relative humidity data of **ozone sonde** measurements which are launched about every other week at Paramaribo.

The Instrument

Measurements of:
- Integrated Water Vapor (**IWV**)
- Integrated Liquid Water (**ILW**)

Two channels (**20.9 GHz** and **35.0 GHz**)

Intermediate frequency (IF) 10-400 MHz

Dicke switching @ 70 Hz
(to eliminate gain fluctuations)

Location: **Suriname**, Paramaribo,
5.8N; 55.2W (since December 2006)

*Fig.1: The **TRARA** radiometer at Suriname*

Sample measurement

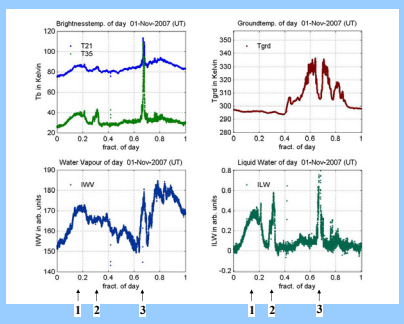


Fig.2: $T_{brightness}$, T_{ground}, IWV, ILW versus time

Water vapor (IWV):
- slow decrease mornings
- sudden rise shortly after noon

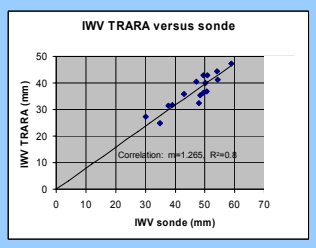
Liquid water (ILW):
- clouds in morning (2) and at noon (3)
- ILW near zero for the rest

Problems:
- dew on window at night (1)
- rain hits window (3)

Improvements (t.b.d.):
- window heating, rain protection
- more frequent calibrations

Comparison with sondes

In a first step, analysis of TRARA IWV is done by a linear statistical retrieval using the coefficients derived for the microwave radiometer MWR [2]. Sonde data are used to adjust the coefficients for this radiometer and this location. Ozone sonde IWV is calculated from relative humidity using the *Magnus formula* specified for T>=0 and T<0.



Sonde data, launch 13-14 UT, (LT=UT– 4) are compared with TRARA (12-24 UT)

Next step: - additionally using radiosondes for improved statistics
- performing sensor specific calibration

Fig.3: Integrated water vapor (IWV median) measured by microwave radiometer versus ozone sondes

Seasonal cycle of water vapor 2007

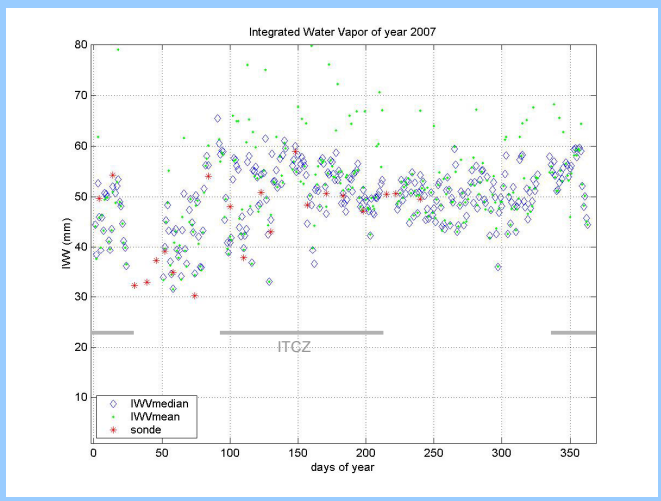


Fig.4: Columns of water vapor by TRARA and ozone sonde data derived from relative humidity profiles. Frequent outliers of the mean values (which are not observed in the median) are due to occasions when rain hits the window.

Results:
- seasonal dependence with high short-term variability observed
- IWV median agrees well with humidity of sondes (course of the year)

Conclusion

Tropical columnar water vapor (IWV) measured by the radiometer TRARA is compared with humidity data derived from ozone sondes at Suriname in 2007. High day-to-day variability is observed and seasonal dependence shows good agreement with sonde data. Preliminary calibration and analysis of the microwave data give promising results and motivates for future investigations at this emphasized location near the equator in the zone of influence of the Inter-Tropical Convergenze Zone (**ITCZ**).

References

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