New ARM microwave radiometers

M.P. Cadeddu

New generation MWRs

New 183-GHz radiometer

Microwave radiometry focus group

New MWRs

Radiometrics corporation will build the new radiometers

21 calibrated channels between 20 and 30 GHz + 1 channel 90 GHz

The number of channels for observations can be tuned

Req: Addition of a higher frequency channel (90-GHz) to the two-channel (20-30 GHz) system to improve sensitivity to liquid water and reduce retrieval uncertainties of LWP when the LWP < 100 g/m^2.

21 calibrated channels between 20 and 30 GHz + 1 channel 89 GHz. The actual number of channels for observations can be tuned

Req: Improvements in the spatial resolution of the measurements in the 20-30 GHz frequency range. This implies a reduction of the radiometer field of view to about half of the current specifications (from 5-6 to 3.5 degree).

FOV ~ 3^o

Req: Matching (as much as possible) field of view for all channels.

85 mm lens for 89 GHz and a 280 mm lens for K band. All radiometers and IRT FOVs ~ 2.8^{o} to 3.5^{o}

Req: Temporally coincident (or near-coincident) measurements for all channels.

Measurements synchronized to ~ 1s

Req: Increased temporal resolution of the measurements (data rate 0.5-1 Hz is desirable).

Configurable 3 channel observation cycle times down to < 4 seconds

Req. Improved rain detection and rain mitigation technique that will allow the instrument to provide accurate brightness temperature measurements during rain conditions.

Latest Vaisala rain detection system and new design proposed for rain mitigation

Modular design

1. Separate receivers for K-band and W-band

1. Possibility of adding V-band receiver

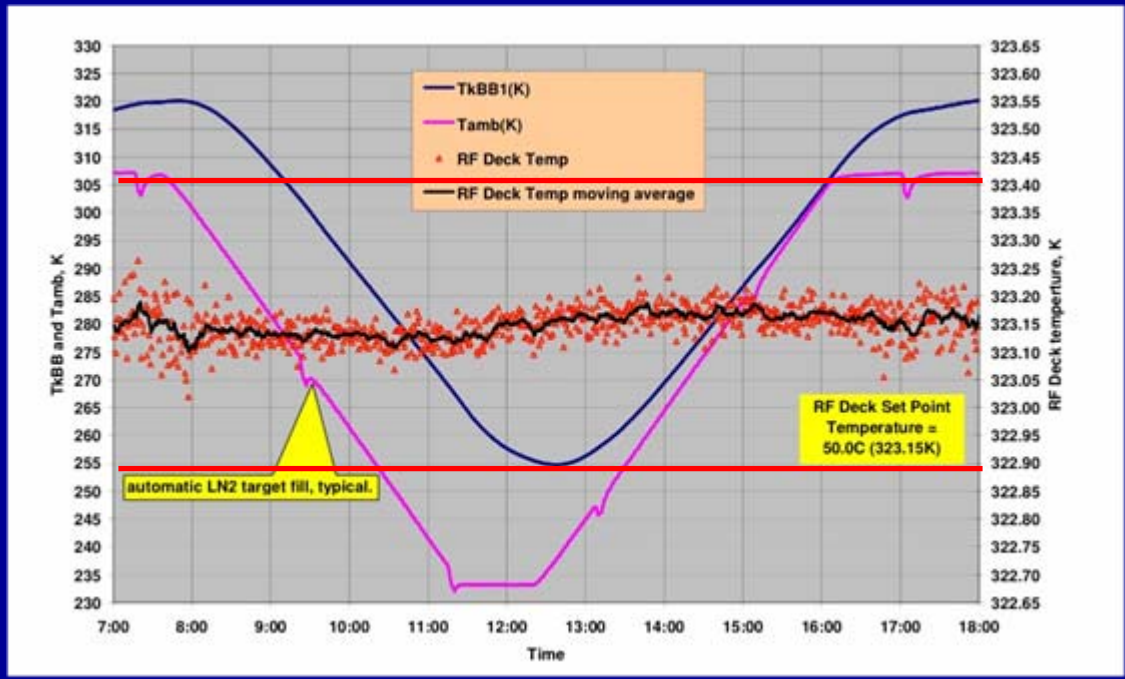
2. Minimal disruption in case of failure

Positioner

Receivers mounted on a Pan Tilt Unit (PTU)
Manufacturer: Directed Perception

Thermal stability: 30 mK

Current thermal stability: 0.25 K



Rain detection system

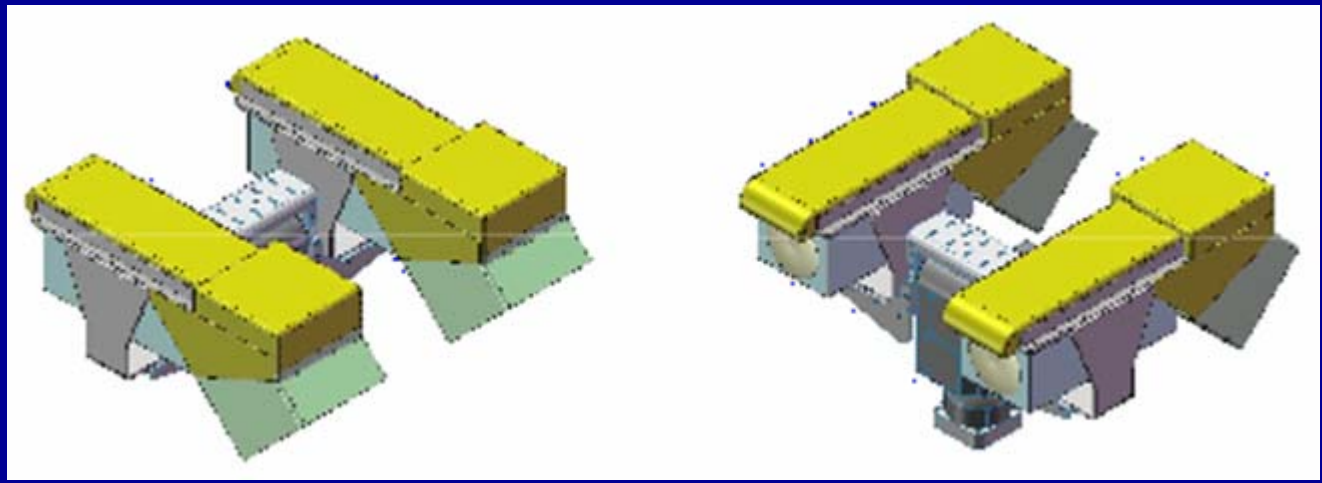
Vaisala Weather Transmitter WXT510 (or 520) based on detection of individual rain drops.

Real-time measurements of accumulated rainfall, rain intensity and duration. Wind speed and direction.

Rain mitigation

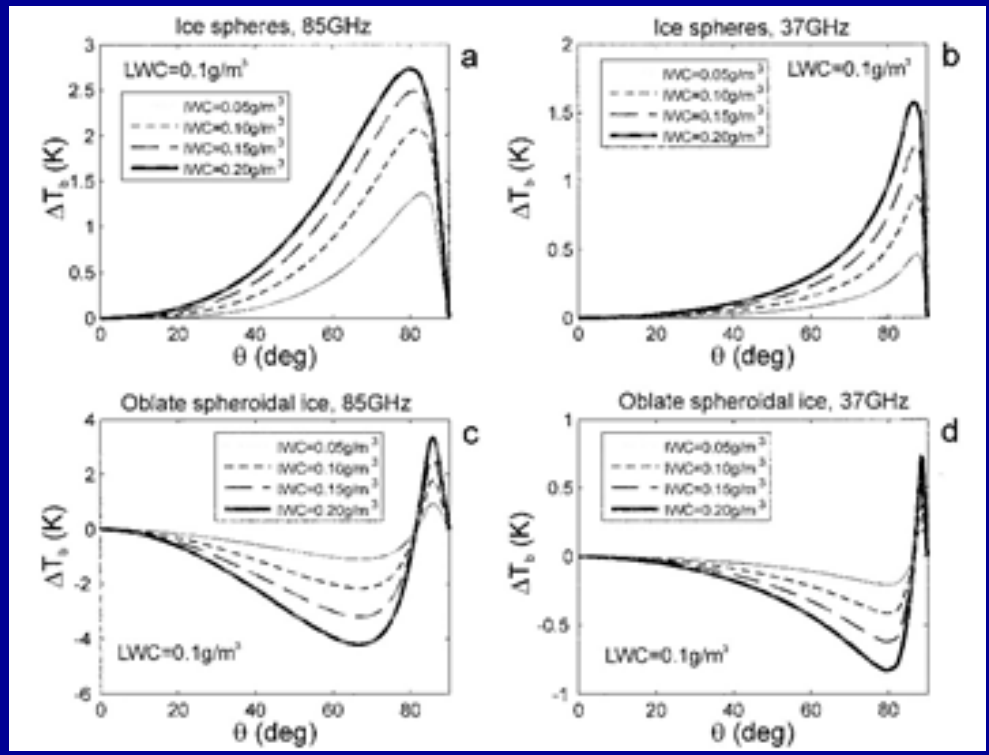
1. Highly effective in light to moderate rain
2. Easily transportable total system
3. Compact and low power for use with pointed radiometers
4. Reasonably low cost...affordable and…
5. Schedule compatible; ready to test by early next year

Radiometrics is working on possible solutions…



Initial delivery and testing probably ~ Jan 2009

Possibility to add polarization to 89-GHz channel



The dependence of the thermal radiation polarization difference *Tb* as a function of zenith angle for a mixed-phase cloud having differing IWC values but constant LWC=0.1 g/m^3 , and an average ice particle size *D*=500 μm.

A.V. Troitsky, A. M. Osharin, A. V. Korolev, J. W. Strapp, *J. Atmos. Sci.*, vol. 60, pp. 1608-1620, 2003

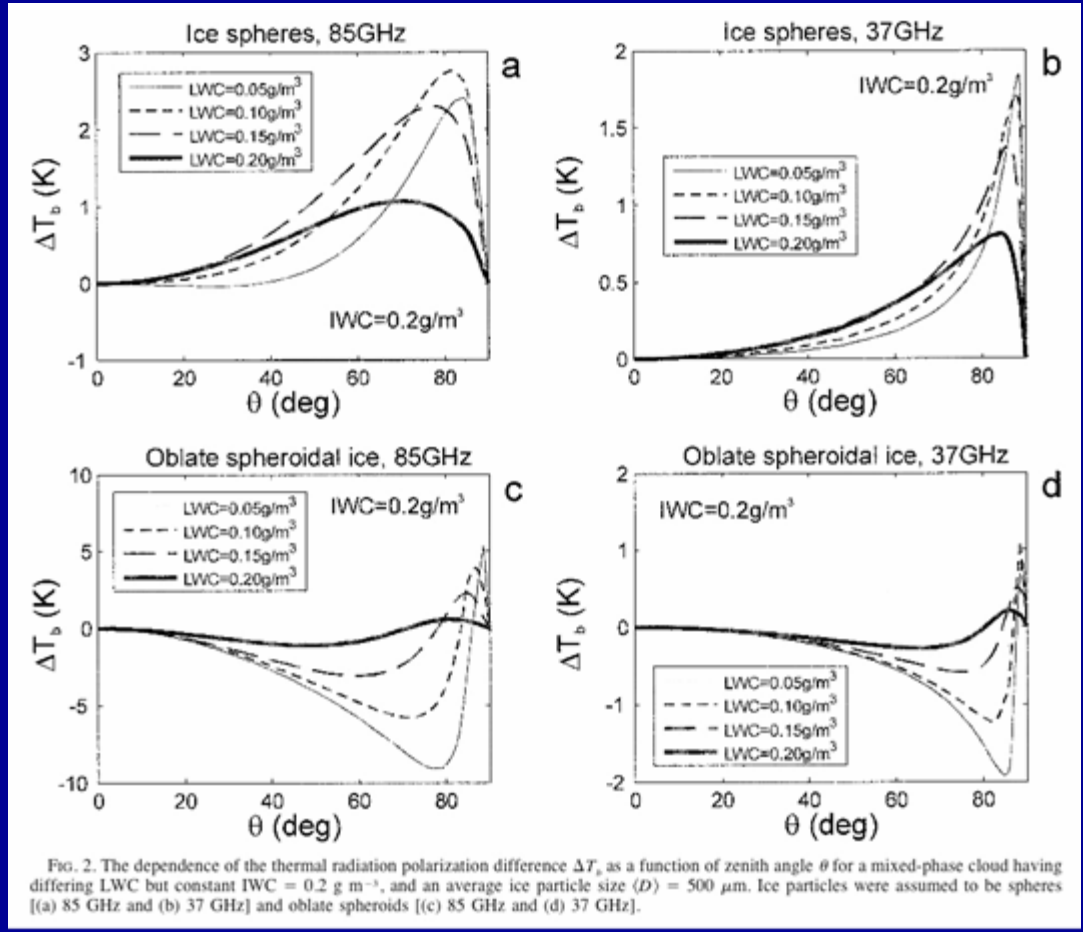


FIG. 2. The dependence of the thermal radiation polarization difference ΔT_b as a function of zenith angle θ for a mixed-phase cloud having differing LWC but constant IWC = 0.2 g m^{-3}, and an average ice particle size $\langle D \rangle$ = 500 μm. Ice particles were assumed to be spheres [(a) 85 GHz and (b) 37 GHz] and oblate spheroids [(c) 85 GHz and (d) 37 GHz].

The dependence of the thermal radiation polarization difference *Tb* as a function of zenith angle for a mixed-phase cloud having differing LWC but constant IWC =0.2 g/m^3 , and an average ice particle size *D*=500 μm.

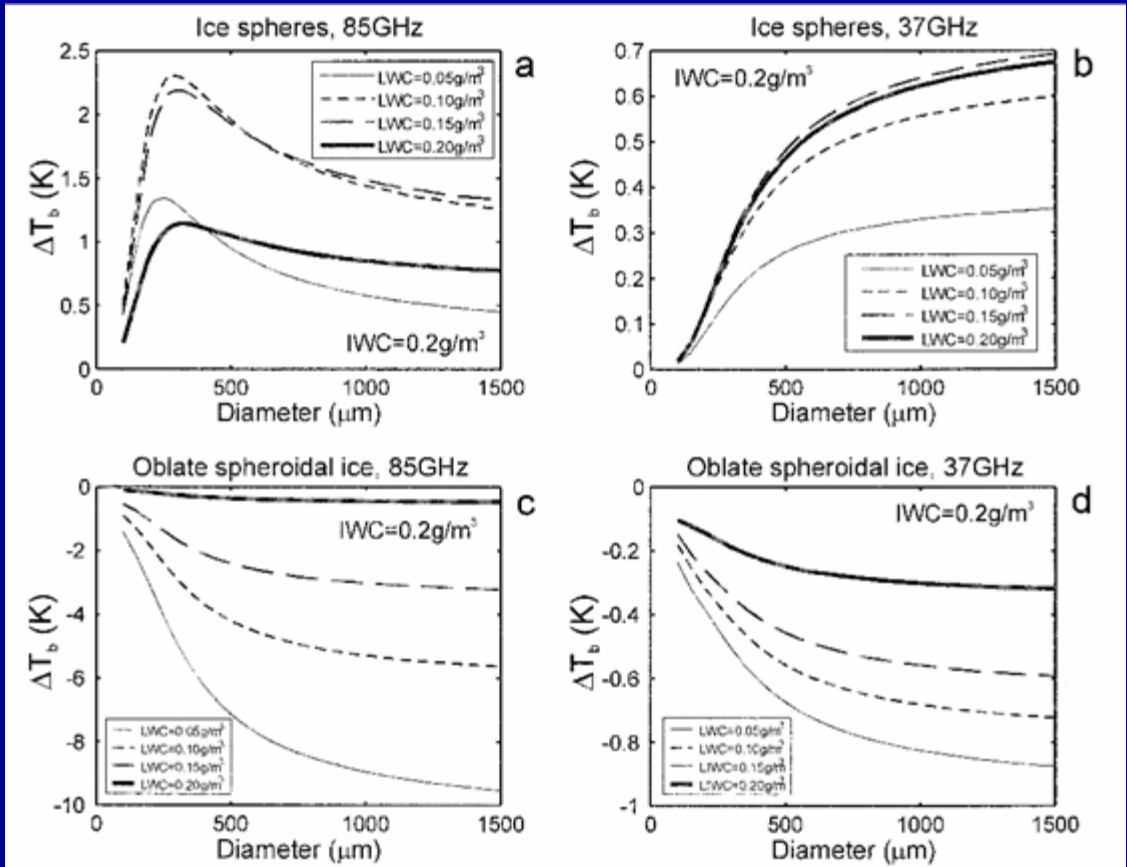


FIG. 3. The dependence of the thermal radiation polarization difference ΔT_b as a function of average ice particles size $\langle D \rangle$, for a mixed-phase cloud having differing LWC but constant IWC = 0.2 g m^{-3}. The zenith angle was set at $\theta = 66°$C. Ice particles are the same as in Figs. 1 and 2.

The dependence of the thermal radiation polarization difference *Tb* as a function of average ice particles size *D* , for a mixed- phase cloud having differing LWC but constant IWC 0.2 g/m^3. The zenith angle was set at 66C. Ice particles are the same as in Figs. 1 and 2.

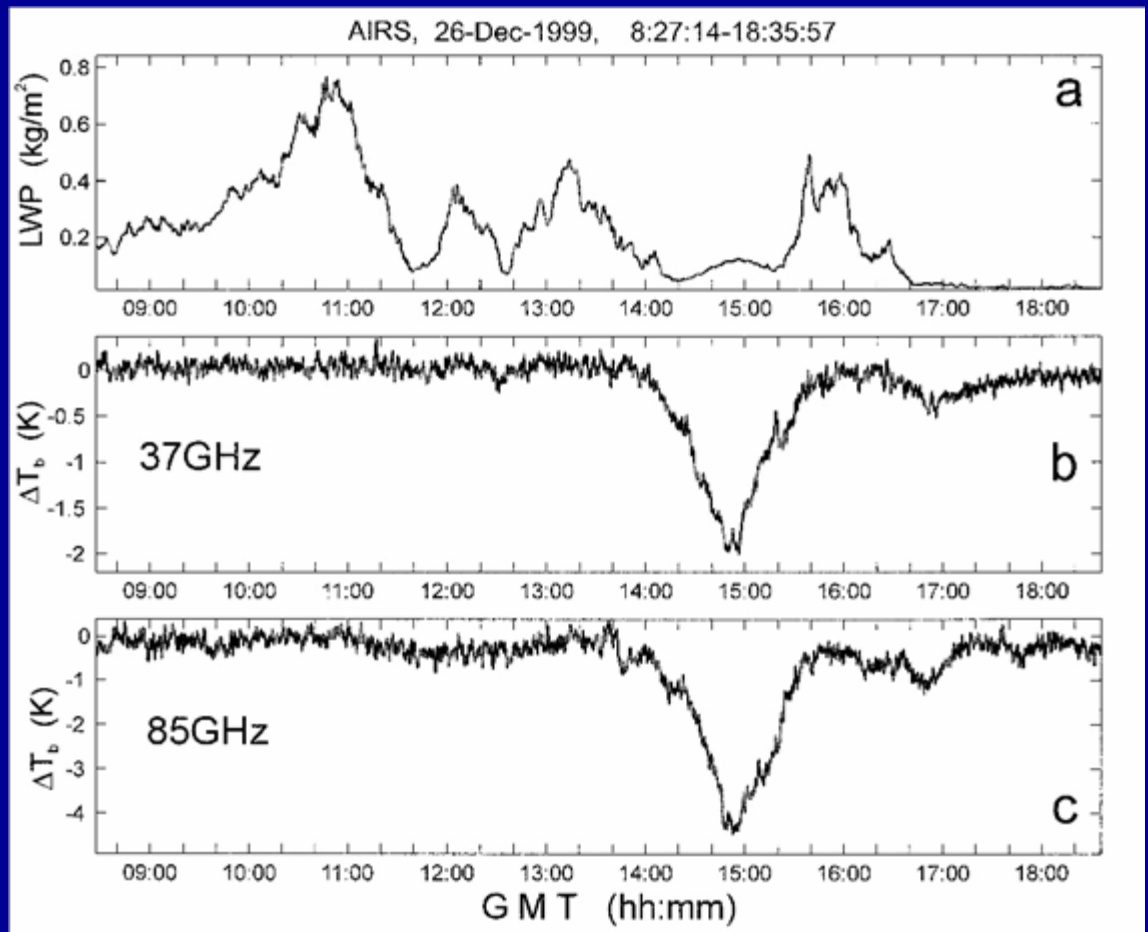


FIG. 4. Time history of (a) LWP, (b) $\Delta T_b(37)$, and (c) $\Delta T_b(85)$ measured during AIRS on 26 Dec 1999 in Ottawa.

Time history of (a) LWP, (b) $\Delta T(37)$, and (c) $\Delta T(85)$ measured during AIRS on 26 Dec 1999 in Ottawa.

New G-Band Vapor Profiler radiometer in Barrow

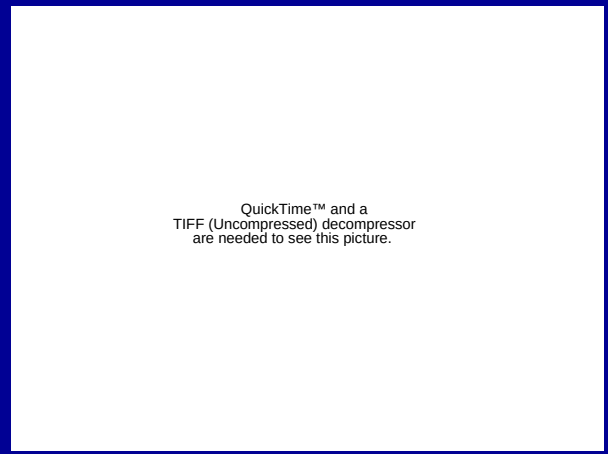
GVRP: 15 channels between 170 and 183.31 GHz

Retrievals: PWV, LWP. The same retrieval of PWV and LWP will be applied to both instruments

Data available from April to August 2008

GVRP to Chile for RHUBIC II in 2009

GVR



GVRP

GVRP currently on the Ron Brown participating in the VAMOS Ocean-Cloud-Atmosphere-Land Study Regional Experiment (VOCALS-REX) in the South-East Pacific.

Supplement 2-channel retrievals of LWP from U. of Miami MWR and NOAA 90-GHz radiometer

ARM GVRP

U. Of Miami 2- channel MWR

Microwave radiometry focus group

Wednesday, November 12 15:45 to 17:30

15:45 to 16:00 Introduction and overview

16:00 to 16:45 Focus on instruments and products: A comparison of different methodology to retrieve LWC from microwave data

- Review of current limitations of ARM LWC retrievals from microwave radiometers
- Development of a strategy to improve the retrievals and review of available integrated retrievals
- Combination of active and passive sensors -- Discussion
- *Contributions from Zhanquing Li group and Dave Turner*

Review of 90-150 GHz data

16:45 to 17:30 Focus on model comparison and improvement

- Revised Microwave Water Vapor Continuum Values Based on MWR and MWRHF measurements

- Modifications to the Water Vapor Continuum in the Microwave Suggested by 150 GHz Observations

- *Contributions by Vivienne Payne, Eli Mlawer, and Dave Turner*

17:30 Summary and suggestions