# Task Team 5 (Ancillary Measurements) Report

*Thierry Leblanc (JPL)*

*Tony Reale (NOAA)*

# Outline

Intro

Lidar Guide (presented earlier)

MWR and FTIR Guides

NPROVS/GPROVS

SASBE

# Intro

## Refresher: TT-AM Terms of Reference

1. *Interface with other expert teams (such as NDACC, EMERGE, etc.)*
2. *Evaluate the data products (uncertainty budget etc.) and bring in missing knowledge*
3. *Inventory potential instruments (and interface with other GRUAN-Task Teams if needed)*
4. *Establish campaign rationales for the validation of data from multiple platforms*
5. *Establish a system for the routine collection and display of data from multiple platforms*
6. *Guidance on the type and amount of data and associated metadata needed to be stored from the instruments, as needed*
7. *Draw conclusions on the suitability of the deployed equipment and advise accordingly to GRUAN Task Team on Site Assessment*
8. *Report to WG-ARO on all above duties*

# Intro

**Refresher: TT-AM Members**

*T. Leblanc (JPL, Lidar) and T. Reale (NOAA, Satellites): Co Chairs*

*M. Schneider (IMK-ASF, FTIR)*

*J. Hannigan (NCAR, FTIR)*

*N. Cimini (Potenza, Microwave)*

*N. Kämpfer (Bern, Microwave)*

*A. Haefele (Payerne, Microwave, Lidar)*

*A. Apituley (Cabauw, Lidar)*

*D. Whiteman (GSFC, Lidar)*

*M. Schröder (DWD, Satellites)*

*D. Tobin (U. Wisc., SASBE)*

**Thierry's suggestion to add a new member (for FTIR)**

*Martine de Mazières, Institut d'Aéronomie Spatiale de Belgique (IASB/BIRA)*

# Lidar

**Lidar Guide, including uncertainty estimates:**
**covered in earlier presentation**

# Microwave

## Task 8: Validation Strategies and Results

*Validation statistics are available for some GRUAN sites (Lindenberg, Payerne, ) and are reported on GRUAN microwave radiometer guidelines*

***Completed (other sites may be added)***

## Task 11: Meta Data

*MWR data from most common units have been collected to start the activities on data and metadata format harmonization*

***Pending new lymph (e.g. EU COST Action TOPROF)***

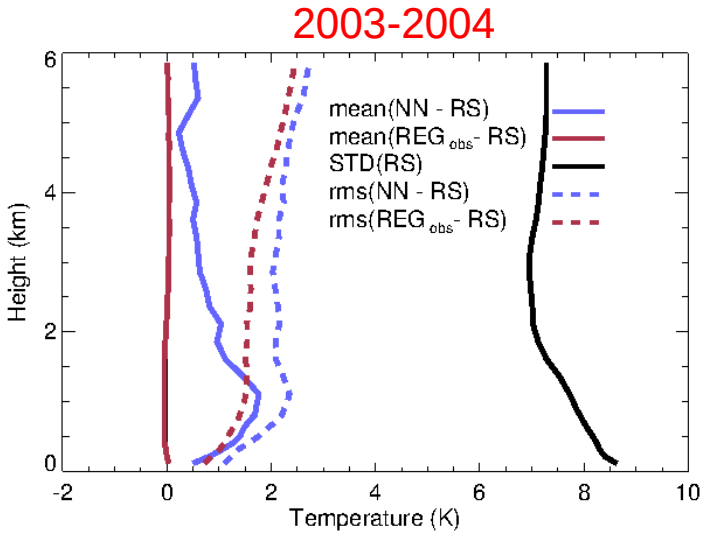
## MWR retrieval performances at Lindenberg

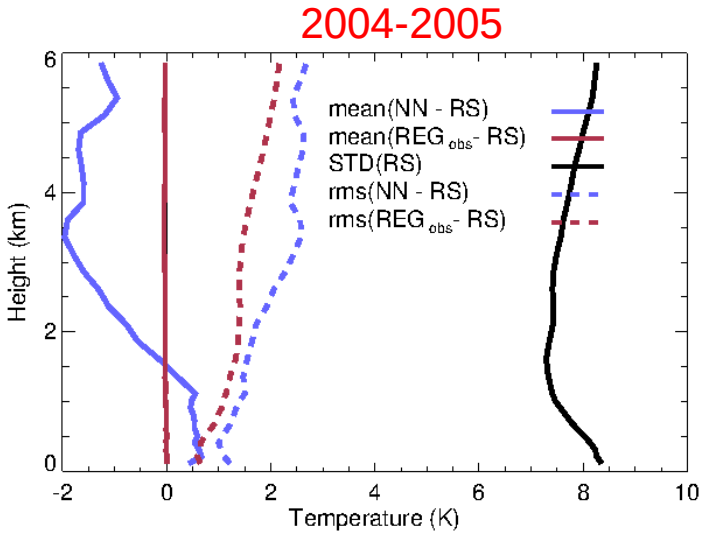
*Courtesy of Güldner Jürgen DWD*

# Microwave (cont.)

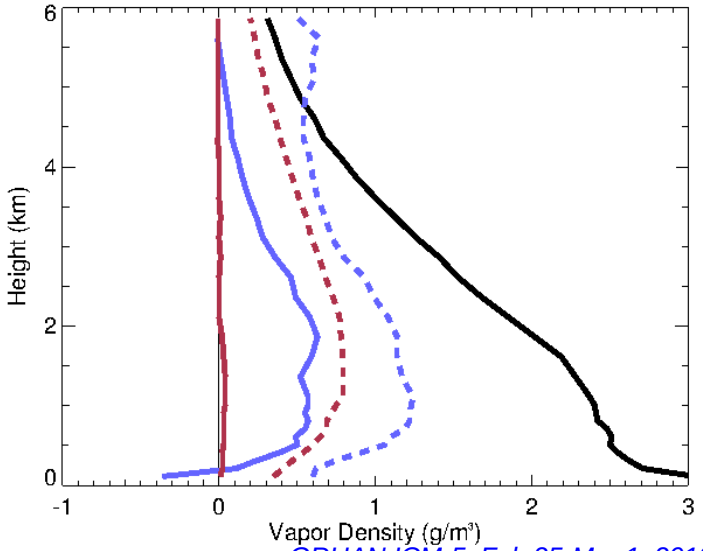
## MWR retrieval performances at Lindenberg (*Courtesy of Güldner Jürgen DWD*)

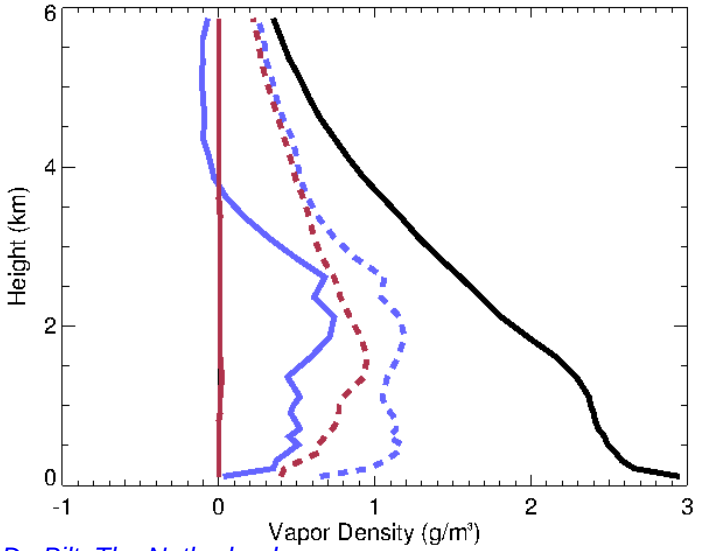
T(z)




WV(z)



# Temperature measurements from the ground to the stratopause by microwave radiometry

Oliver Stähli
Axel Murk, Niklaus Kämpfer

Institute of Applied Physics
University of Bern

Feb. 2013

# Temperature profiling using oxygen line

## Waters 1973, Nature

# Ground-based Measurement of Millimetre-wavelength Emission by Upper Stratospheric $O_2$

J. W. WATERS

Research Laboratory of Electronics and Department of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139

**Measurements from ground level of 53 GHz radiation from molecular oxygen in the stratosphere, using a very precise radiometer, can be used to give stratospheric temperatures.**

THIS article reports measurements at sea level of upper stratospheric thermal emission from five high-rotational, millimetre-wavelength, magnetic dipole transitions of molecular oxygen, and discusses use of the emission lines for remote sensing of upper stratospheric temperatures. One of the lines, the 27−,

Molecular oxygen has a band of spectral lines near 60 GHz (5 mm wavelength) and a single line at 118 GHz produced by changes in orientation of its electronic spin relative to its rotation. The individual spin-rotation lines are designated $N_+$ or $N_-$, where $N$ is the rotation quantum number which must be odd for $^{16}O_2$ in the $^3\Sigma_g^-$ electronic ground state, and where the subscript indicates whether the change in total angular momentum of the molecule during an emission transition is $+1$ or $-1$. Each $N_\pm$ line has $3(2N\pm1)$ Zeeman components spread over $\sim\pm1$ MHz by the terrestrial magnetic field. Near the centre of the 60 GHz band the terrestrial atmosphere is quite opaque, but on the band edges thermal emission, originating in the upper stratosphere where the lines are relatively narrow, can penetrate the lower atmosphere and can be measured at the ground.

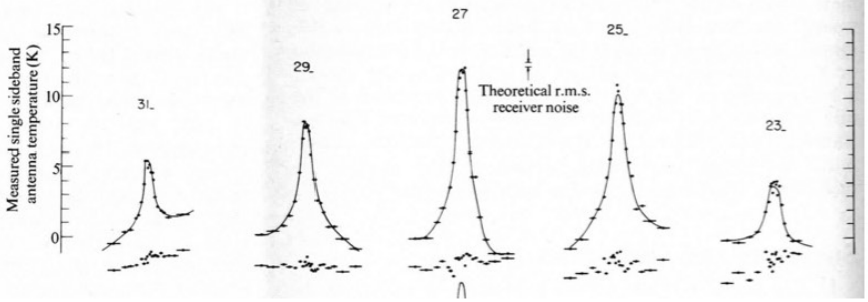
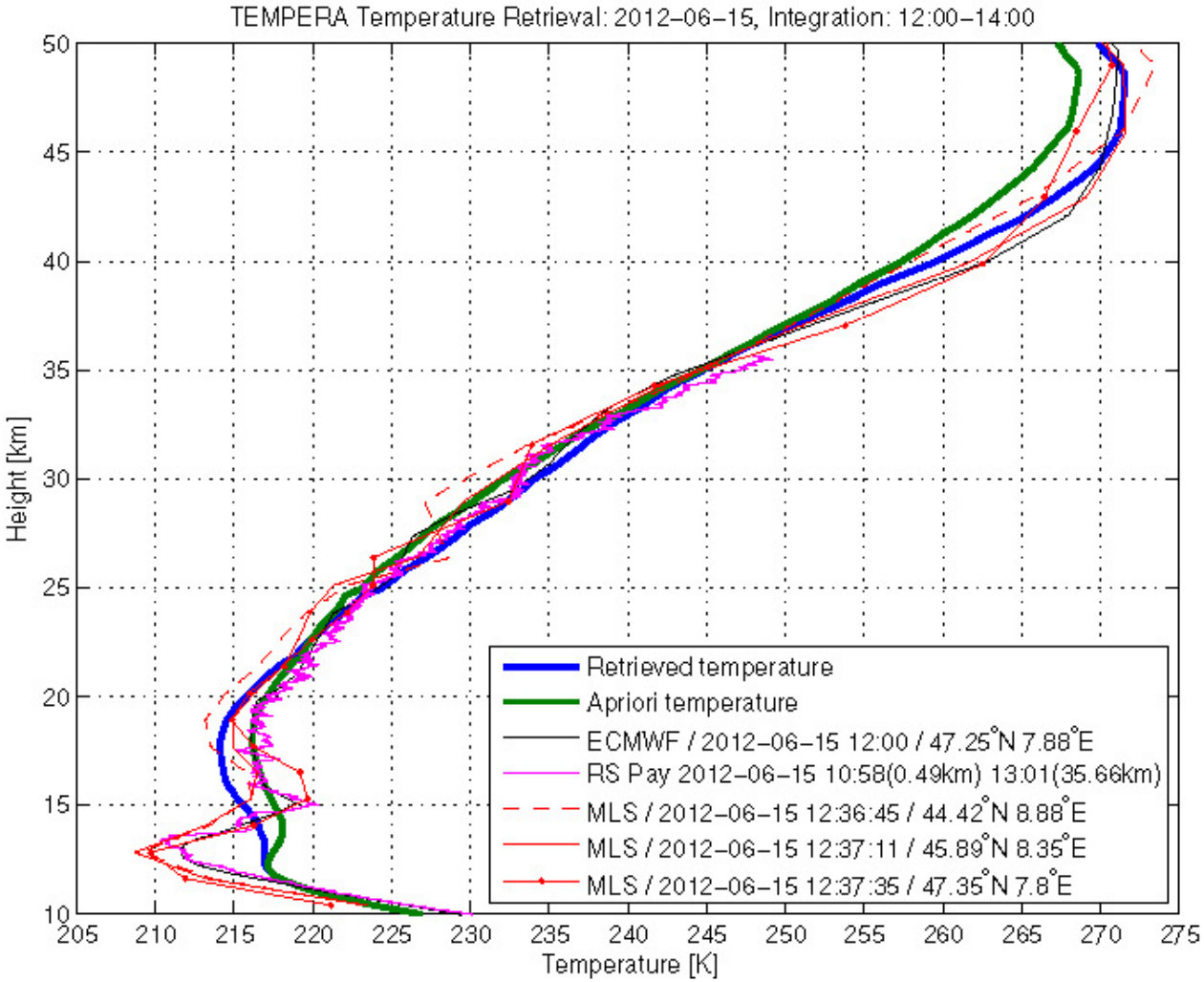
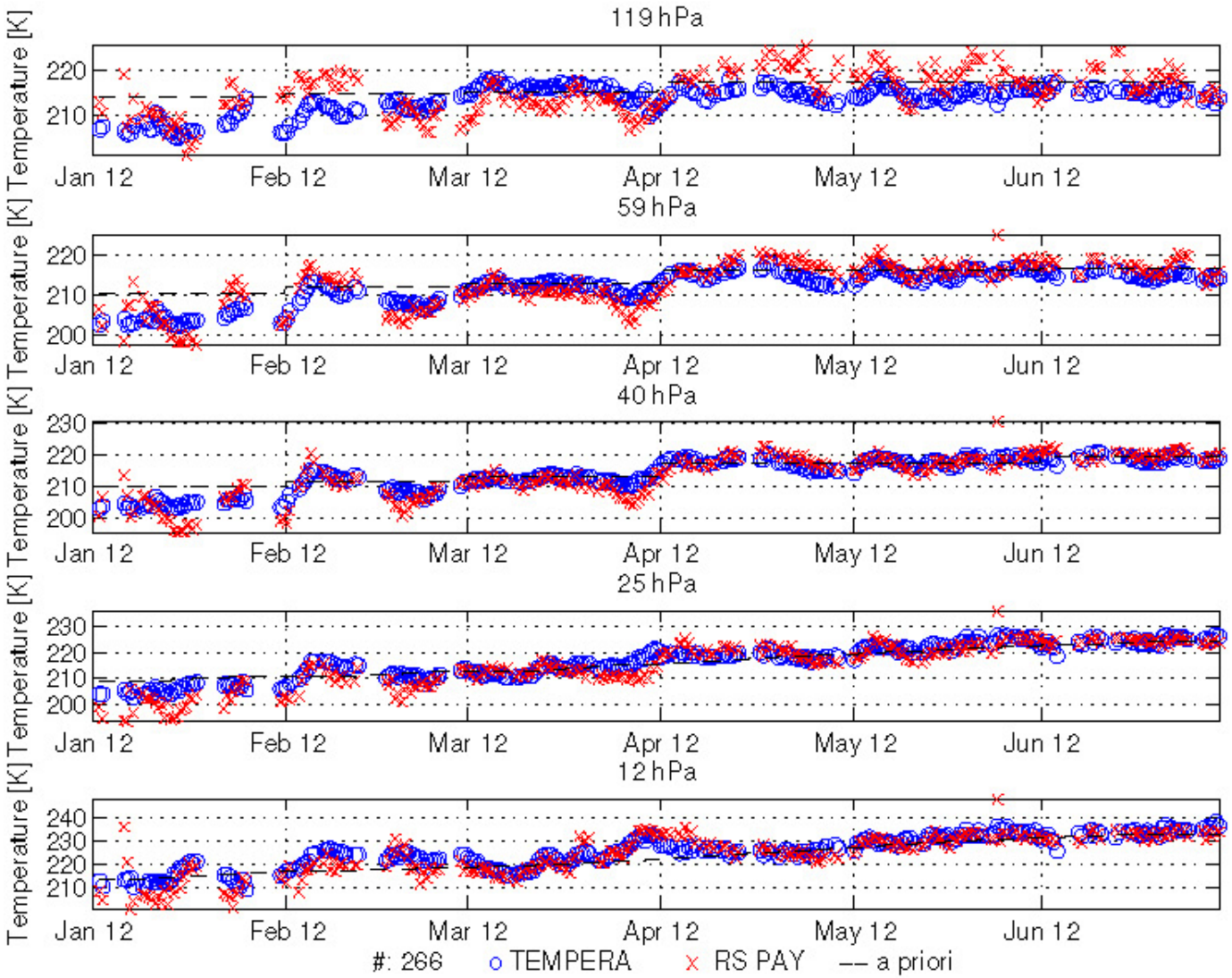



**Fig. 1** Measured (upper) and calculated (lower) atmospheric zenith emission. Each measured line and the instrumental baseline shown beneath it represent integration for 16 min. The measurements were made during the week of August 30

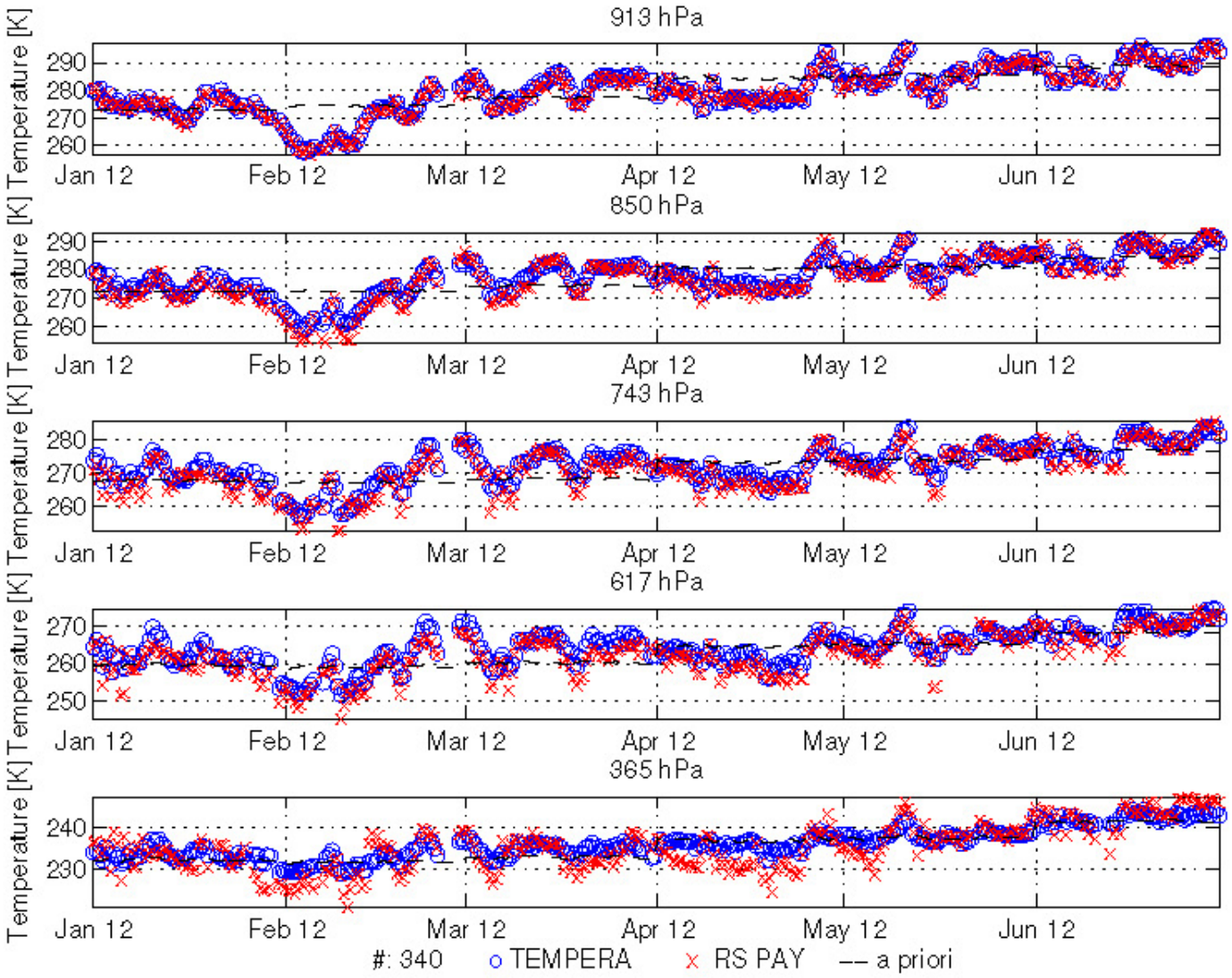
# Retrieved temperature profile in the stratosphere



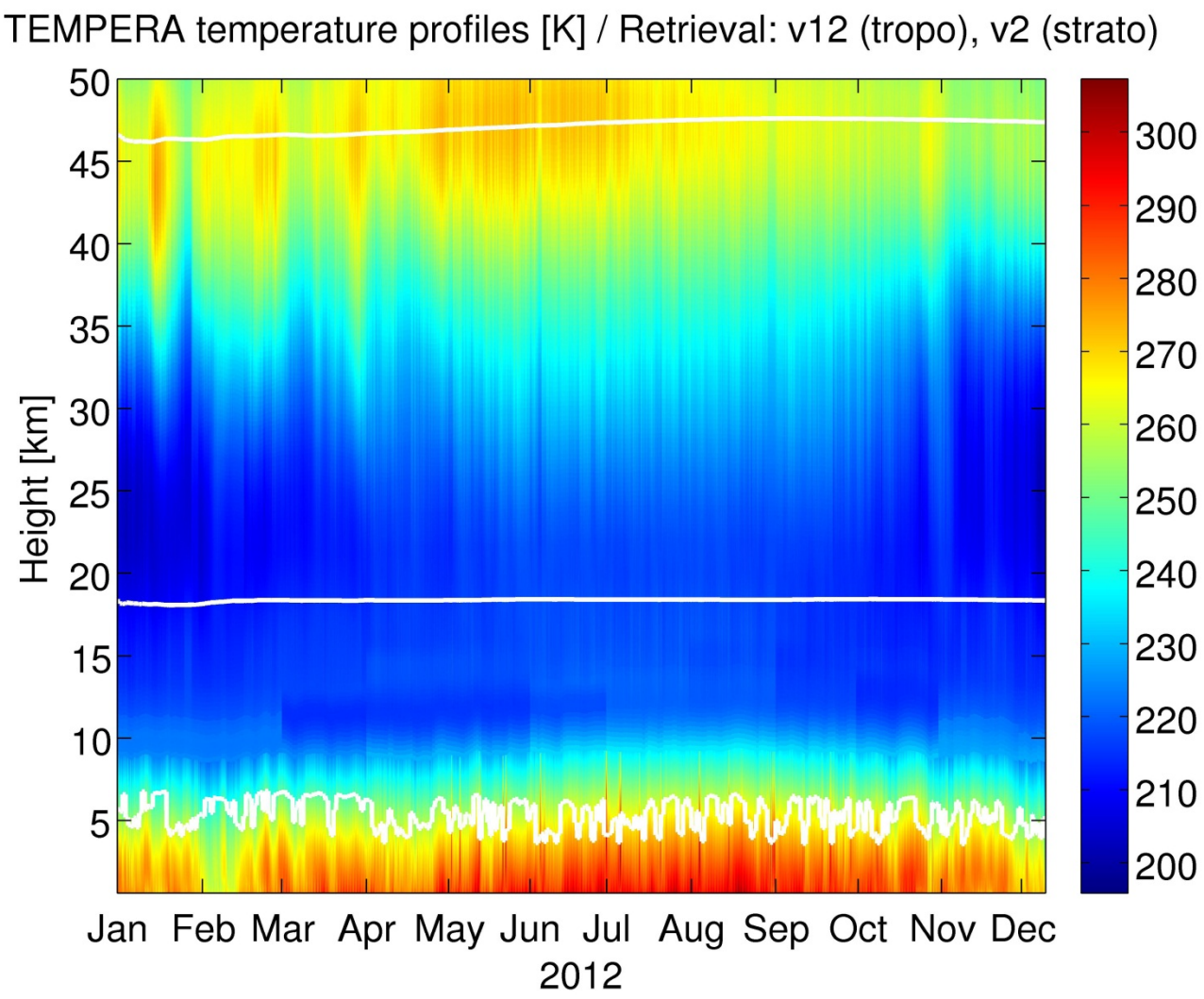
# Comparison of TEMPERA with sondes at Payerne



# TEMPERA also measures tropospheric temp



# Retrieved T- profiles in 2012




white lines indicate masurement response of higher than 60%

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

**Federal Department of Home Affairs FDHA**
**Federal Office of Meteorology and Climatology MeteoSwiss**

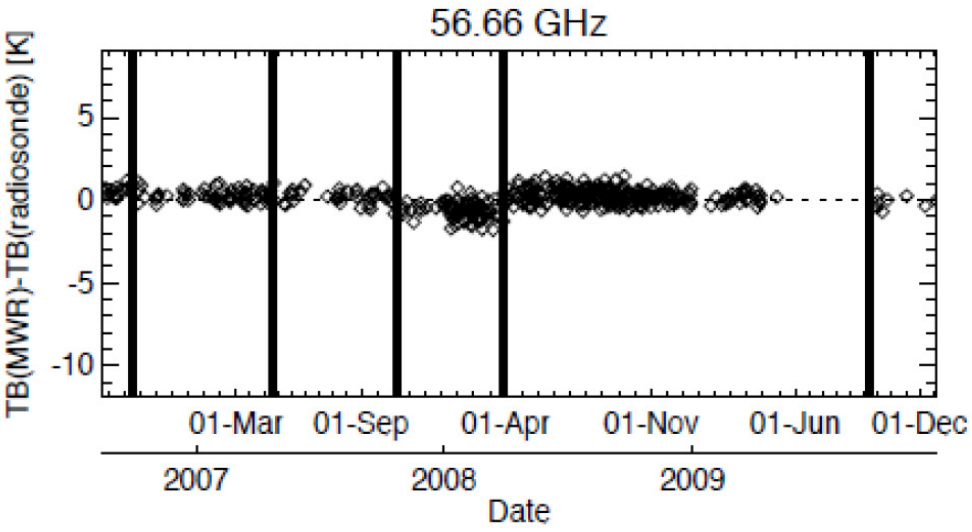
# MWR activities at MeteoSwiss/Payerne

A. Haefele*, E. Maillard-Barras*, O. Maier*, E. Brocard*, D. Ruffieux*, and N. Kämpfer**

**Federal Office of Meteorology and Climatology MeteoSwiss, Ch. de l'Aérologie, 1530 Payerne, Switzerland*

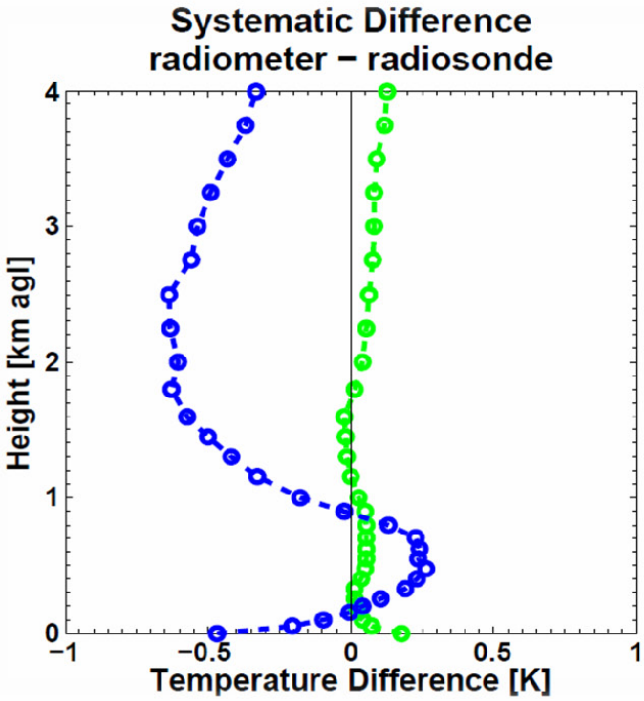
***Institute of Applied Physics, University of Berne, Sidlerstrasse 5, 3012 Bern, Switzerland*

# Monitoring and correction of bias in *Tb*




Comparison MWR-RS in terms of *Tb*

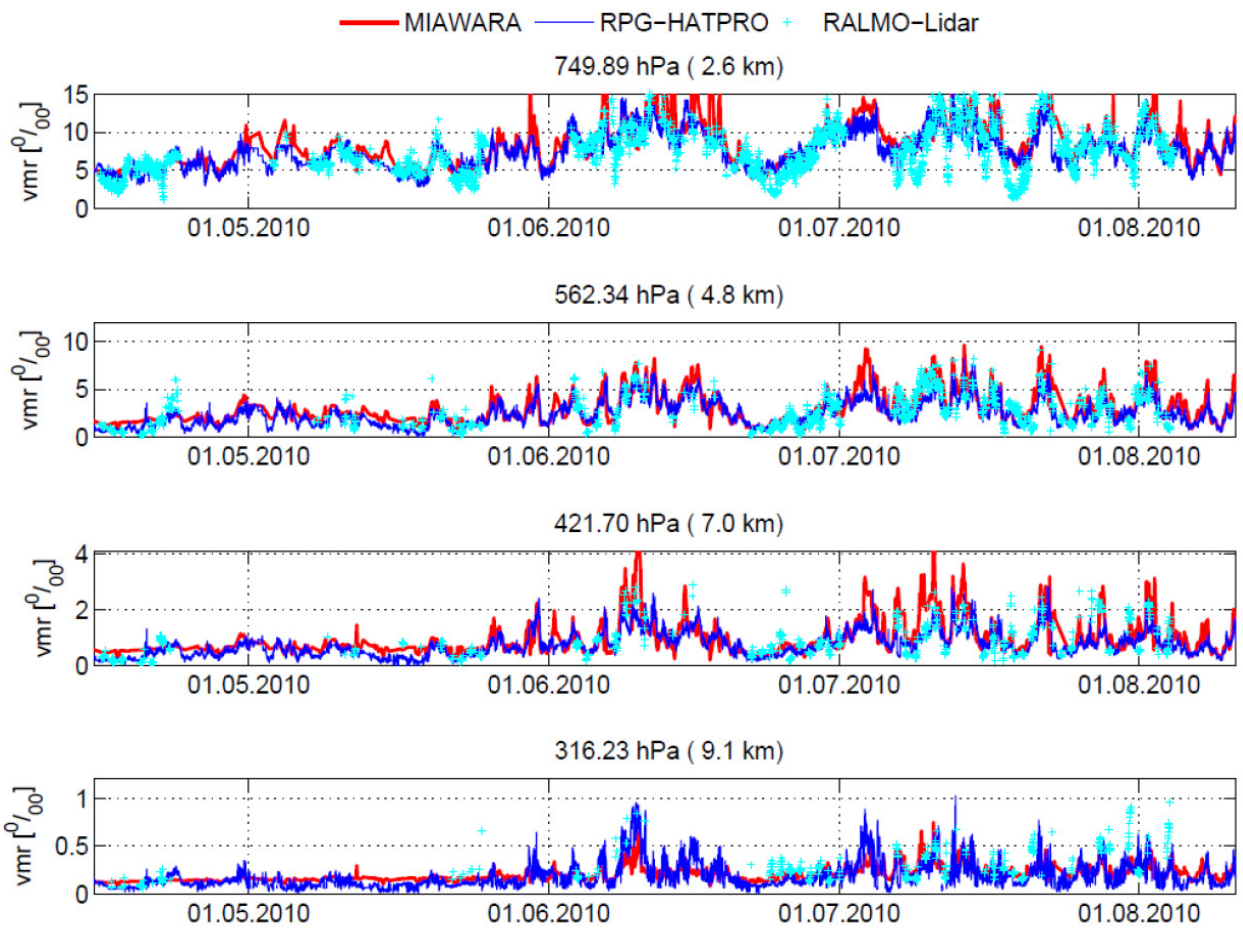
[Löhnert and Maier, AMT, 2012]




Unbiased *T* profiles after offset correction.

- Monitoring and validation of *Tb* is important
- Best practices need to be established for calibration
- Correction of offset in *Tb* allows to remove bias in *T* profile

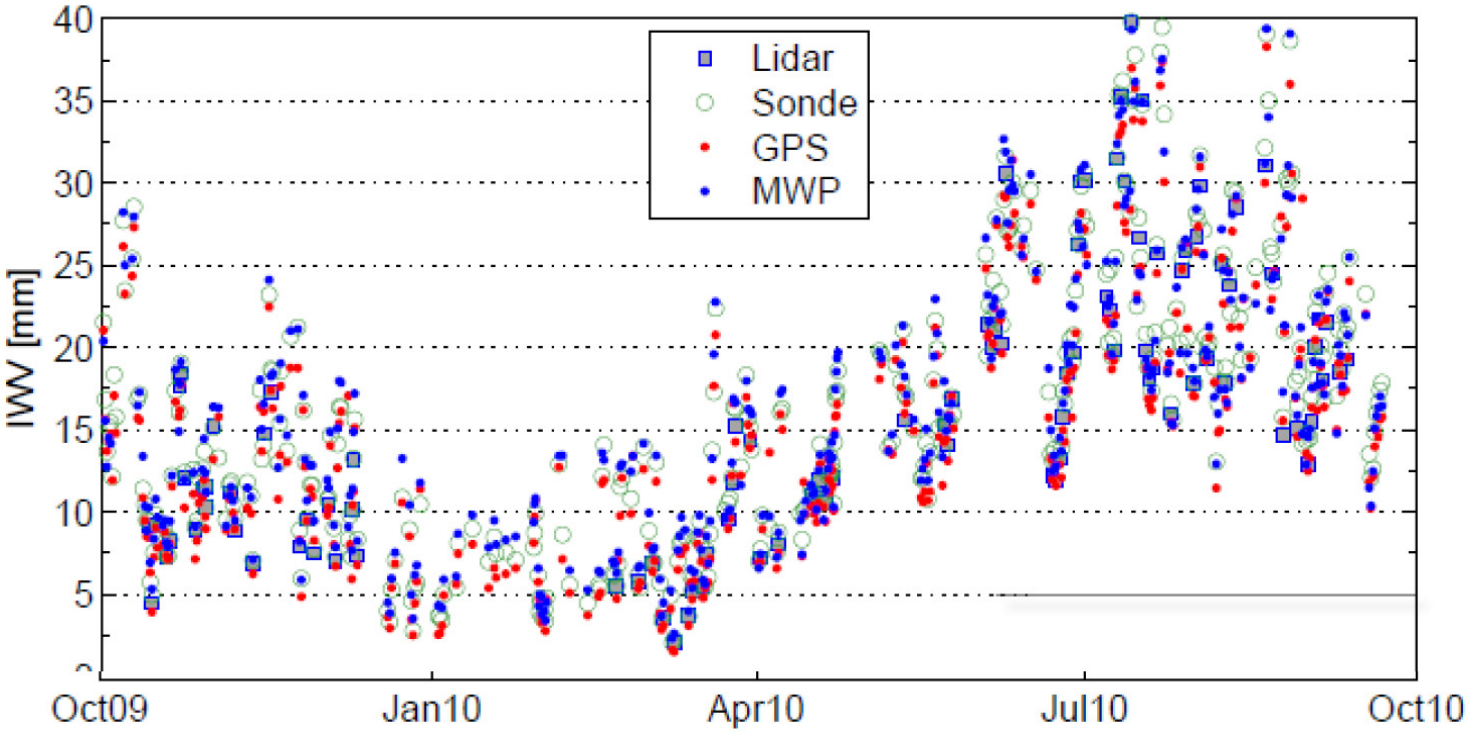
# MWR - LIDAR comparisons at PAY/Bern




[Bleisch et al., AMT, 2011]

- Continuous monitoring of water vapor by MWR and lidar
- Good correlation between MWR and lidar in the whole troposphere.

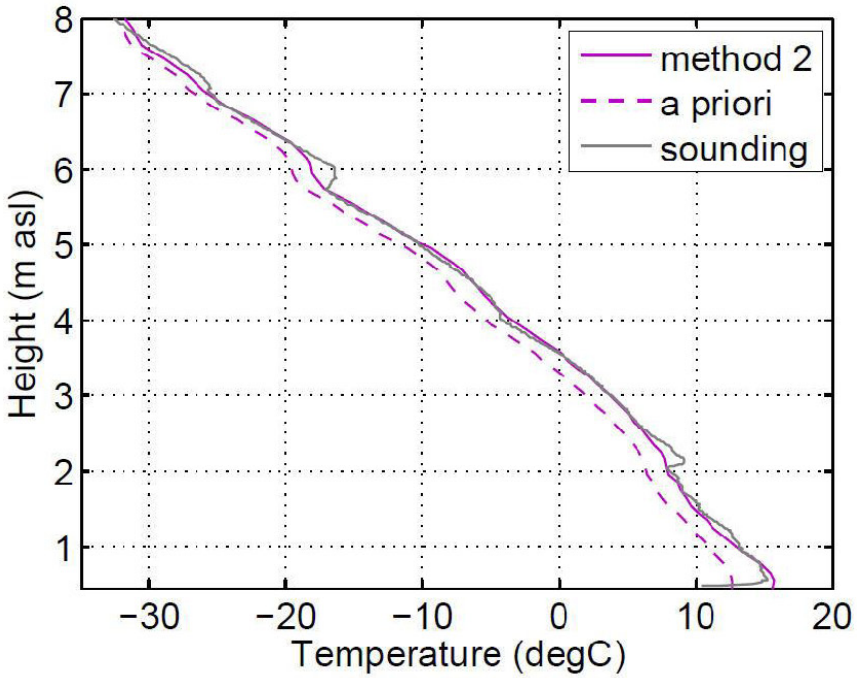
# MWR - LIDAR comparisons at PAY

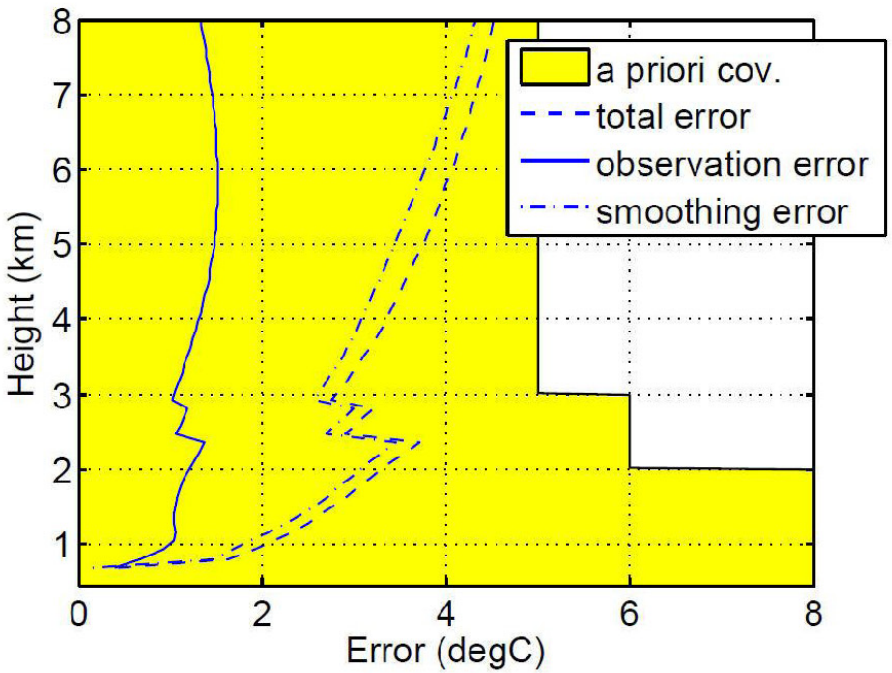



[Brocard et al., AMTD, 2012]

- Intercomparison in terms of IWV
- BIAS:
  - MWR-Sonde: -2 %
  - MWR-Lidar: -6 %

# MWR - LIDAR synergy for *T* profiling




[Haefele et al., ISTP, 2012]

- Optimal Estimation Retrieval of T profile
- Lidar measurement is used as a priori profile
- Good characterization of error possible

# Bringing FTIR measurements into GRUAN

Current FTIR networks:

NDACC and TCCON (research networks)

Mid-infrared and near-infrared, resp.

Data products include O3, H2O and greenhouse gases; columns and vertical profiles

Specific supporting ongoing projects:

MUSICA (ERC grant) for H2O vapour

NORS (EU FP7) demonstration project for bringing NDACC (FTIR, LIDAR, MW, and UV-VIS DOAS) to more operational status in support of Copernicus (GMES) Atmosphere Service

## Ongoing activities

- Harmonisation of the products between sites
  - TCCON is more advanced in harmonisation of operating procedures
  - Publication planned....
- Work on uncertainty budgets: their evaluation and reporting; common tools
- More rapid data delivery
- Documentation of procedures, information content of the data, guide to users
- Establishment of new sites beyond Europe
- Data consistency verifications in case of redundancy between techniques
- Development of data integration methods (e.g., $O_3$ from different techniques at same station)
- Data reporting, metadata,  and traceability (still many questions)
- Support to satellite validation

# FTIR

***From Jim Hannigan (NCAR):***

**AERI:**

*No progress*

*If I were there I would bring it up to the group but this is at your discretion.*
*I did not think it an issue for the FTS talk given by Martine so its not covered there.*
*It is really TT5 general and with the whole group: if they wish to explore the technique for GRUAN*

**CO2:**

*A second similar issue are new smaller CO2 instruments that are being explored ~.1 -.2 the costs of a TCCON CO2 instrument. Again we can discuss probably later. And a long the same lines its for the wider group or TT5 to discuss*

**FTIR Guidelines:**

*-LIDAR effort to be followed*

*-MUSICA's example and IRWG/NORS workshop provide already roadmap (see Martine De Mazieres' presentation tomorrow morning)*

# Interaction with networks and other projects of interest to GRUAN

## GEWEX (marc Schröder)

*- Second workshop on G-VAP carried out on 26-28 Sept. 2012.*
*- Workshop summary was published in a GEWEX Newsletter (November 2012).*
*- Assessment plan and data fact sheet revised ➔ to be distributed in near future*

***Marc Schröder is in this room ➔ do not hesitate to approach him for any inquiry***

## EARLINET

*-First contact w/ G. D'Amico (CNR) made at recent Lidar Conference (July 2012) to discuss EARLINET's single calculus data processing chains (aerosols)*

*-Increase interaction expected in 2013/2014*

## NDACC

*-Collaborative network protocol in place (presented earlier by PT)*

*-Pending action on integrating FP hygrometers into NDACC (role of GRUAN?)*

# Conclusion

**As "predicted" in our the Task Team Report of August 2012, activity within the GRUAN Task team on Ancillary Measurements has significantly increased since the end 2012**

**TT-AM "predicted" deliverables for 2013 include:**

*-Lidar: GRUAN Lidar Guide, first "official" version by first quarter of 2013 (use not "spring")*

*-Lidar: Start development of the GLASS (First products available by end of 2013)*

*-Lidar: ISSI Team on Vertical resolution and Uncertainty AMT publication mid-2013*

*-Microwave: GRUAN Microwave Guide first draft for review by WG-GRUAN: mid 2103*

*-FTIR: GRUAN Microwave Guide first draft review by WG-GRUAN: mid 2013*