

Ground Based Lidar and Microwave Radiometry Synergy for High Vertical Resolution Thermodynamic Profiling

Meteorological Technology World Expo

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Universität zu Köln, Cologne, Germany,





Why synergies?

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Each instrument has advantages and drawbacks.

Different instruments present different point of view of our scenario.

Want the most optimal atmospheric estimate.

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Why lidar and microwave (MWR)?

Instruments synergy

LIDAR	MWR
+ Very high vertical resolution	- Limited vertical resolution
- No observations in and above clouds. Noisy during daylight. No full vertical profile	+ All weather conditions except for rain
- No automated operation	+ Continuous data acquisition
- Instability of the laser. No internal calibration	+ Calibration with internal references

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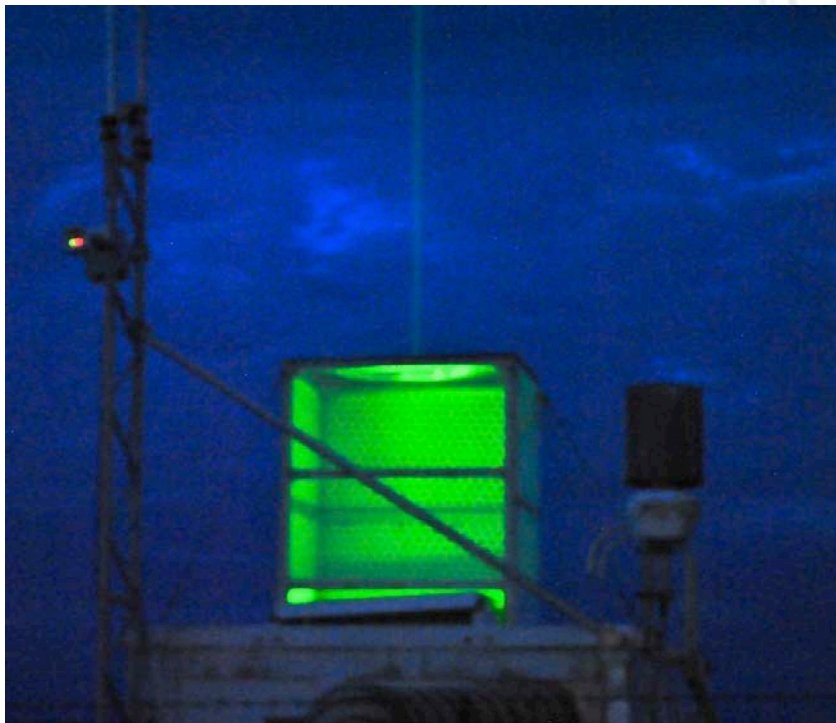
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Main idea

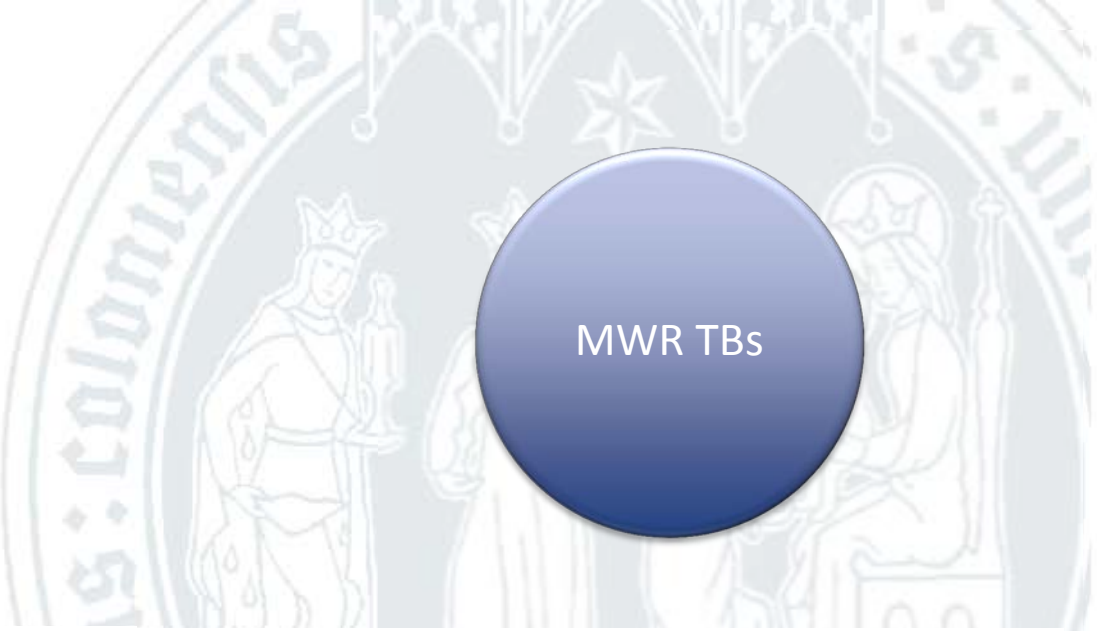
RL mixing
ratio and
temperature
profiles

MWR TBs



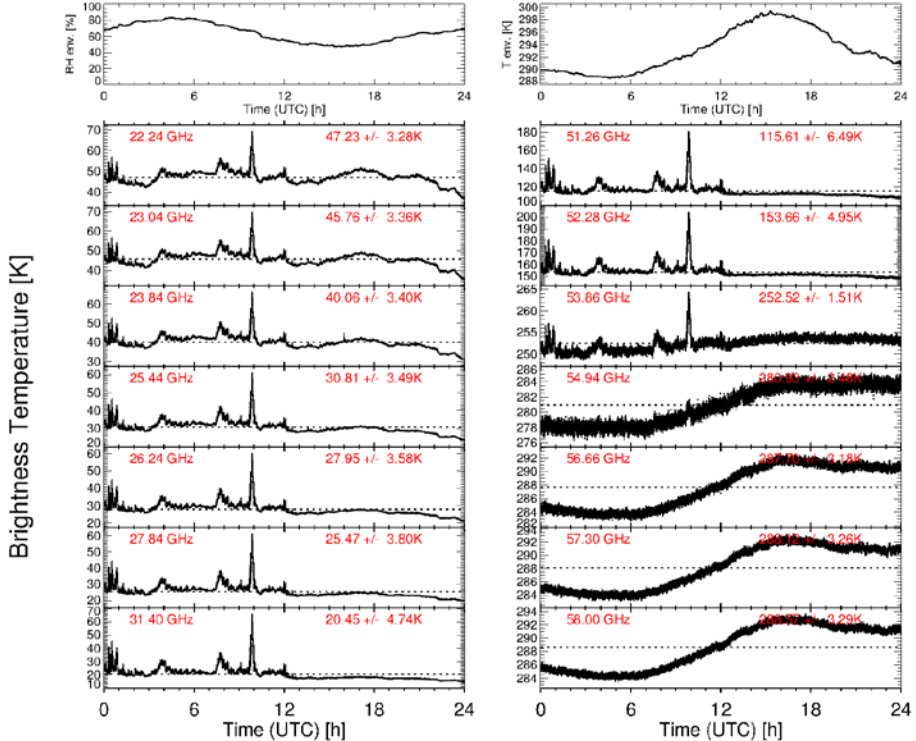
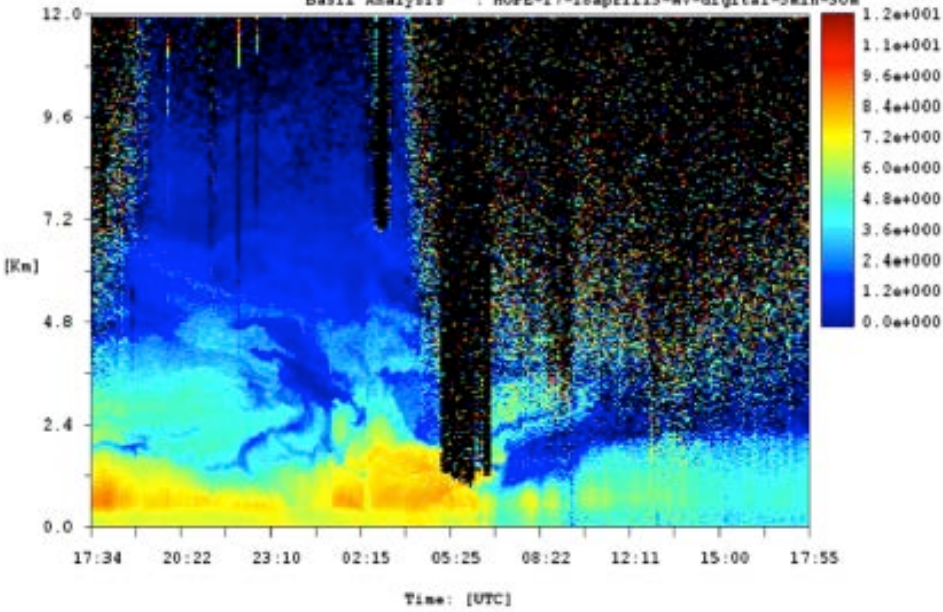
RL mixing ratio and temperature profiles

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HOPE CAMPAIGN: University of Basilicata - Potenza Italy
 Basil Analysis : HOPE-17-18aprill13-MV-digital-5min-30m

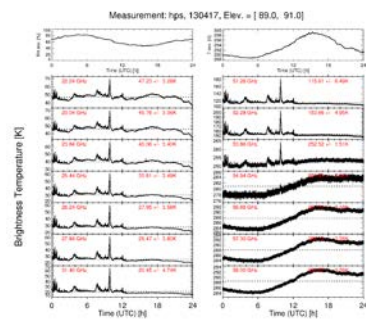
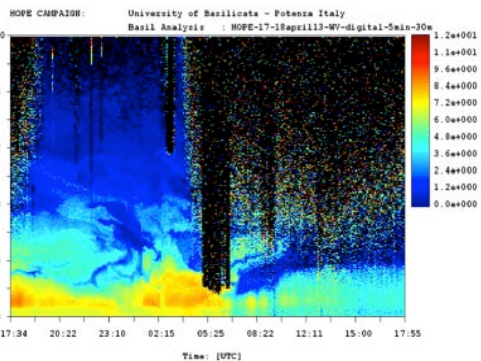
Measurement: hps, 130417, Elev. = [89.0, 91.0]



RL mixing ratio and temperature profiles



MWR TBs



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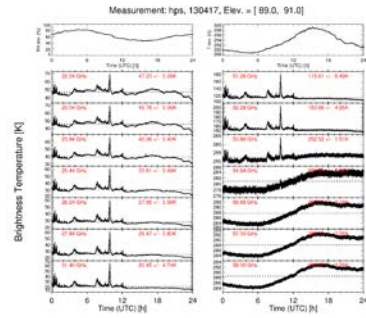
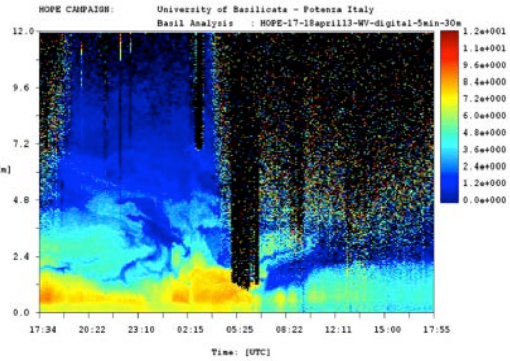


MWR TBs



Abs. Humidity + uncertainties

Temperature + uncertainties



RL mixing ratio and temperature profiles



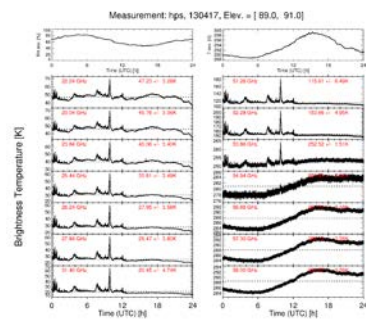
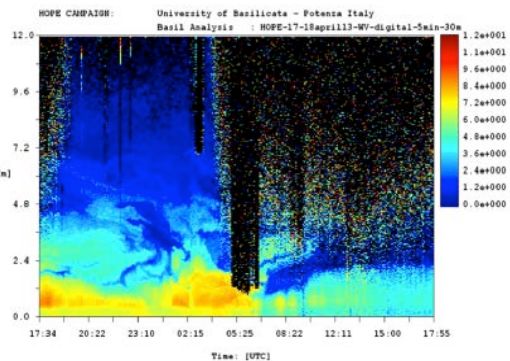
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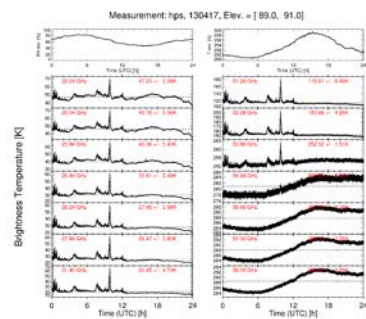
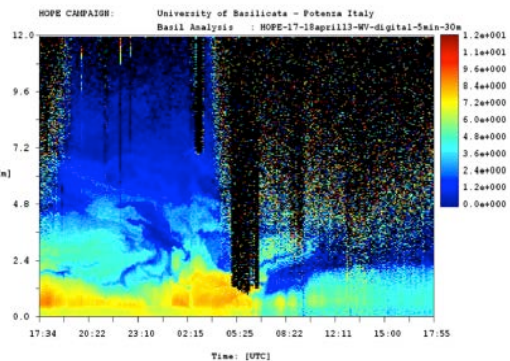
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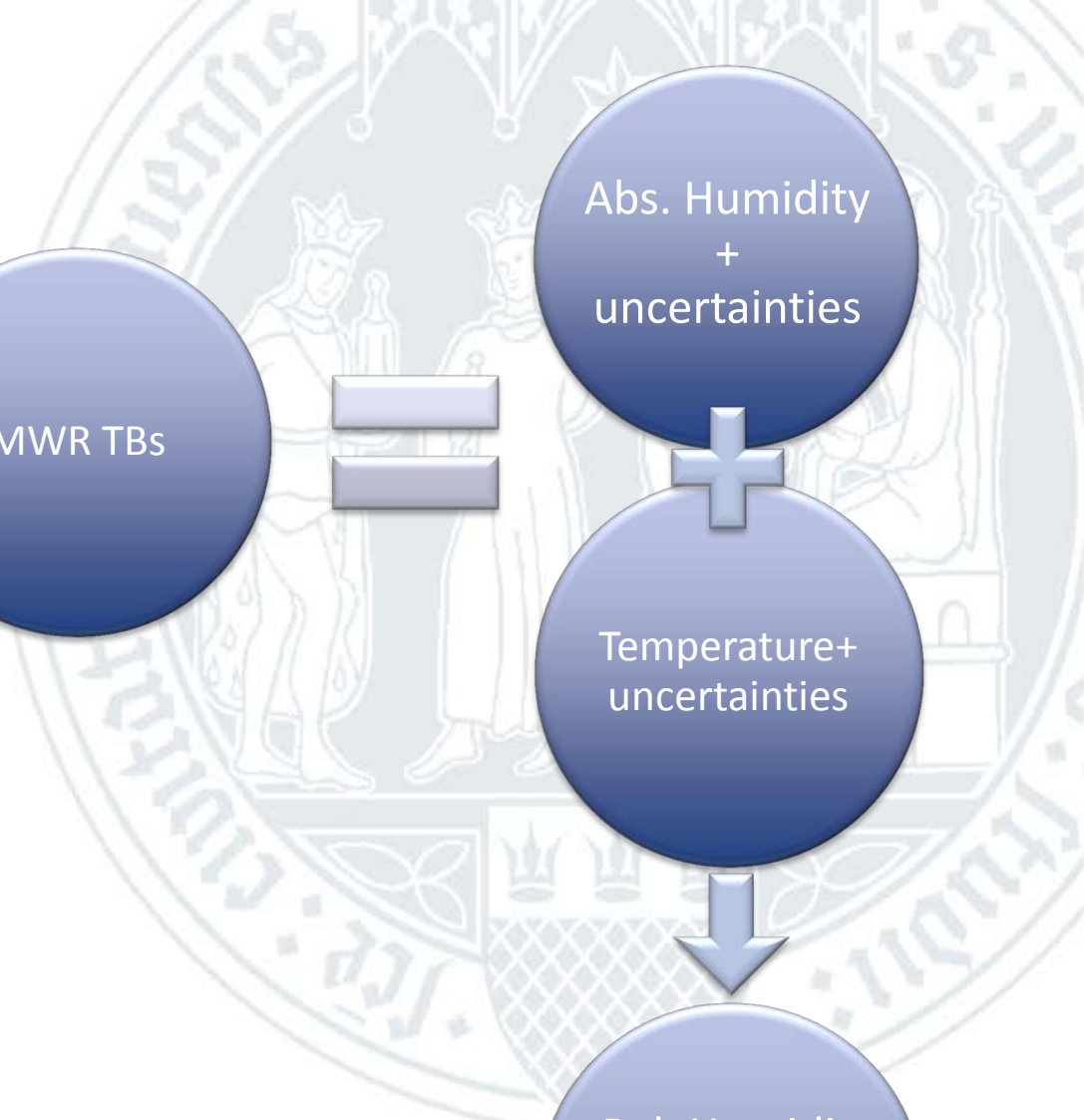
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RL mixing ratio and temperature profiles



MWR TBs



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Abs. Humidity + uncertainties



Temperature + uncertainties



Rel. Humidity + uncertainties



OPTIMAL ESTIMATION

The background of the slide features a large, faint watermark of the University of Cologne seal. The seal is circular and contains a central illustration of the Adoration of the Kings. It depicts the Virgin Mary seated on the right, holding the infant Jesus. Three kings are kneeling before them, offering gifts. Two other kings stand behind them, one holding a scepter. The seal is surrounded by Latin text, including 'S: COLONIENSIS' at the top and 'S: FRUSTR' at the bottom. A shield with a diamond pattern is visible at the bottom center of the seal.

How?

Optimal Estimation Scheme

$$\mathbf{x}_{i+1} = \mathbf{x}_i + \left(\mathbf{K}_i^T \mathbf{S}_e^{-1} \mathbf{K}_i + \mathbf{S}_a^{-1} \right)^{-1} \times \left[\mathbf{K}_i^T \mathbf{S}_e^{-1} (\mathbf{y} - \mathbf{y}_i) + \mathbf{S}_a^{-1} (\mathbf{x}_a - \mathbf{x}_i) \right]$$

- A priori information, \mathbf{x}_a , \mathbf{S}_a
 - Radiosondes climatology
- Measurements, \mathbf{y} , \mathbf{S}_e
 - Lidar temp and humidity profiles
 - TB from MWR
- Atmospheric retrieved parameters, $\mathbf{x}=[T,q]$
 - Temperature and humidity profiles

$$\mathbf{K}_i = \frac{\partial F(\mathbf{x}_i)}{\partial \mathbf{x}_i}$$

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Thanks for your attention