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

Meteorological Technology World Expo

13th – 15th October 2015

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ITaRS Initial Training for atmospheric Remote Sensing

SEVENTH FRAMEWORK PROGRAMME

MARIE CURIE ACTIONS

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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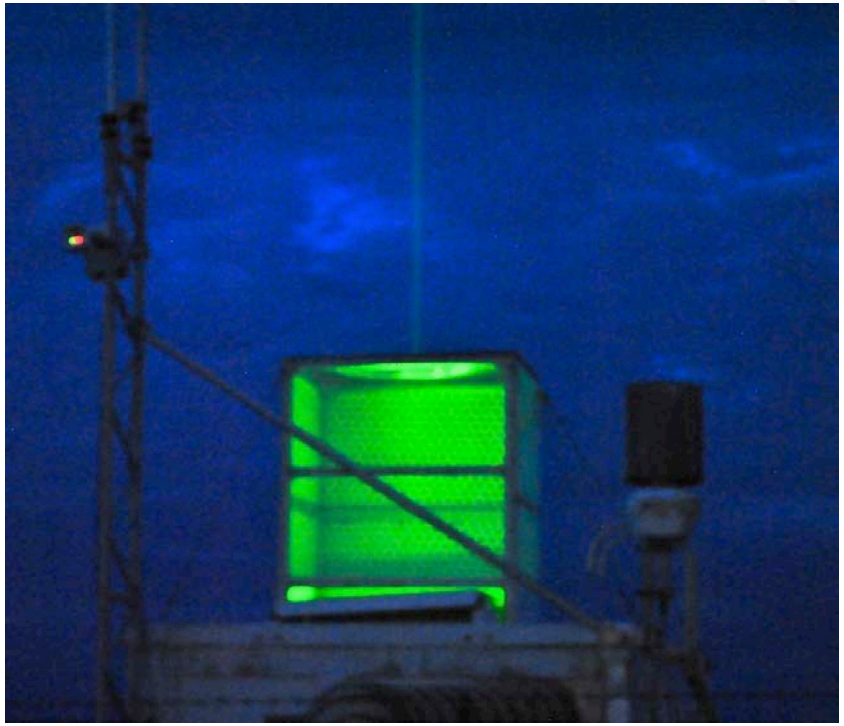
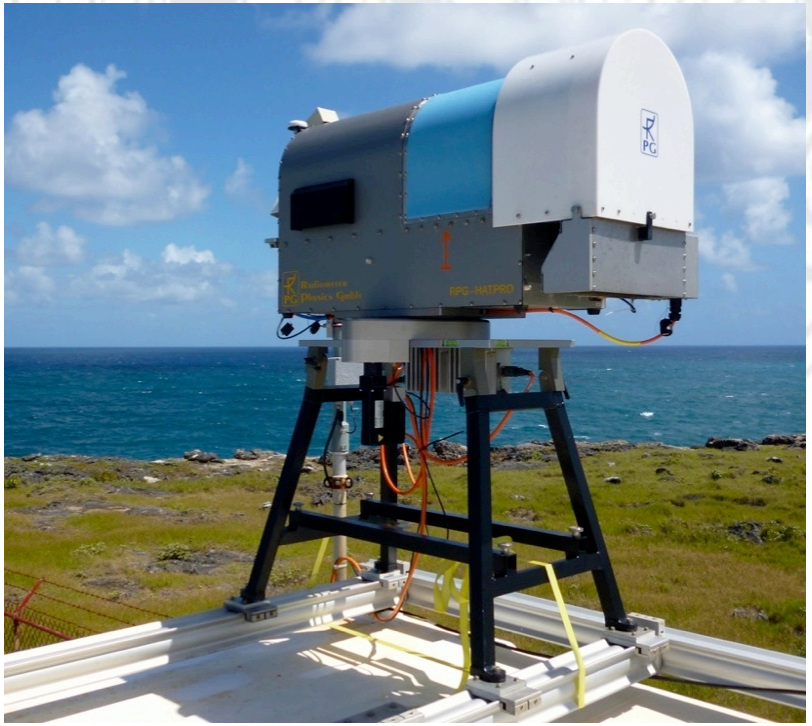
Main idea

RL mixing ratio and temperature profiles

MWR TBs





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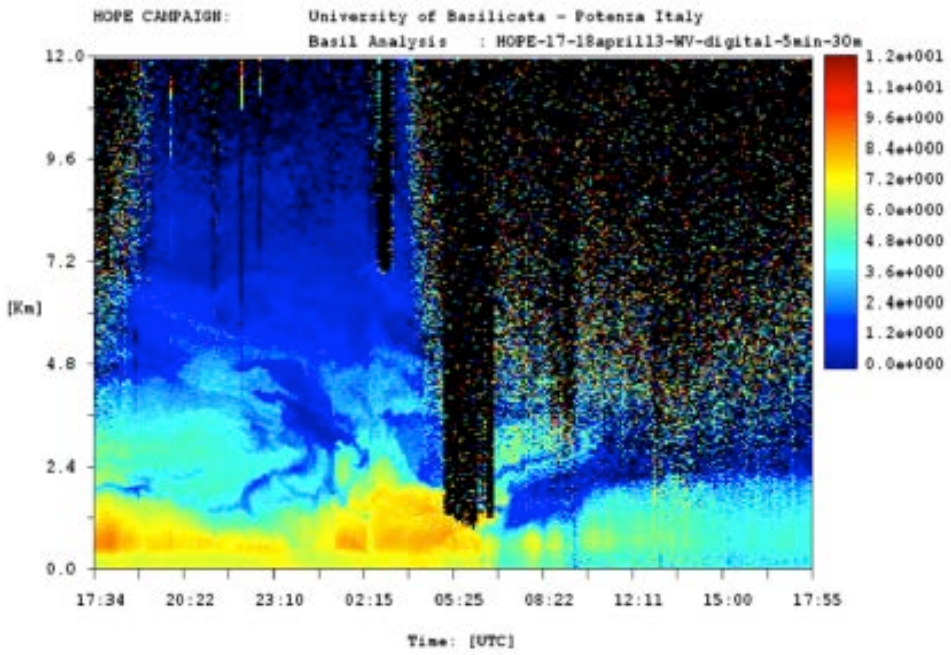

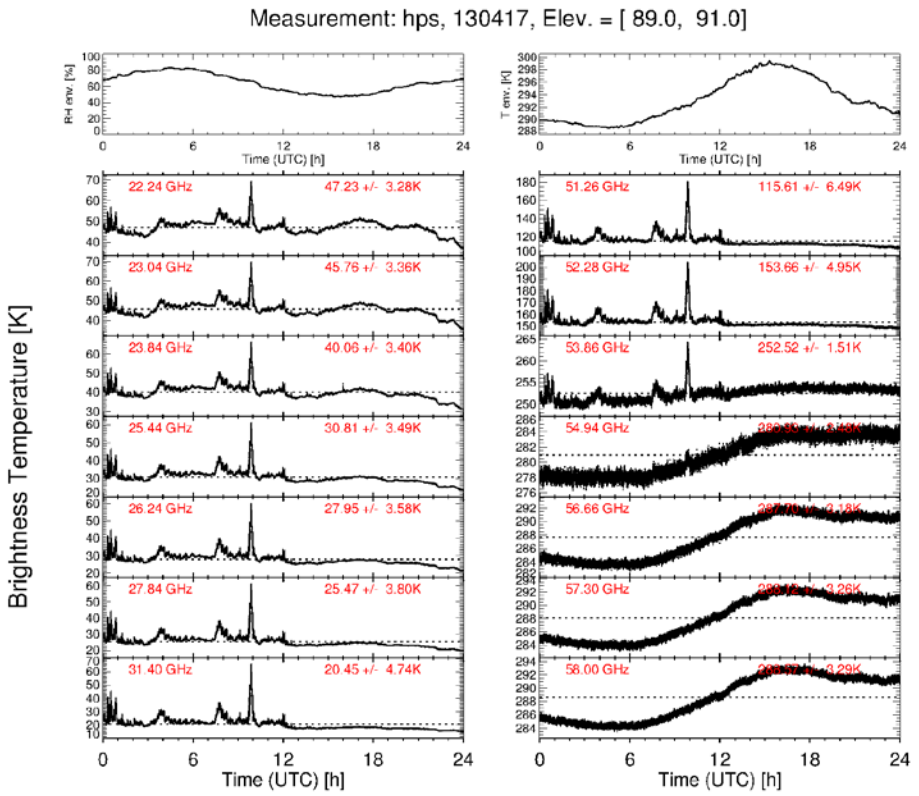

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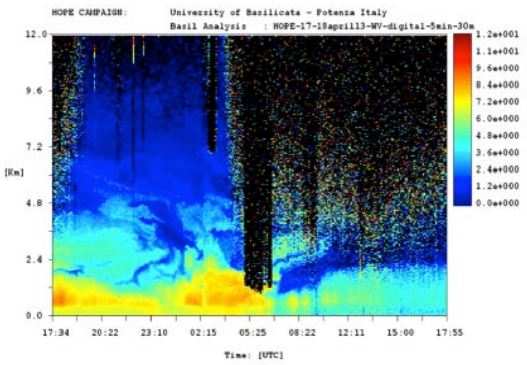

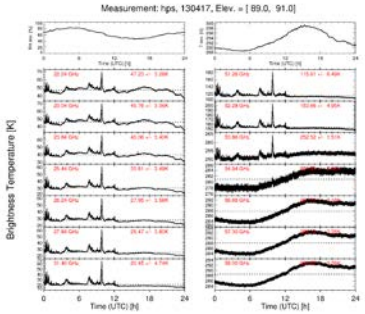

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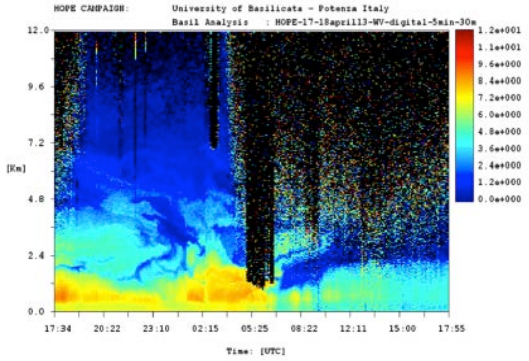

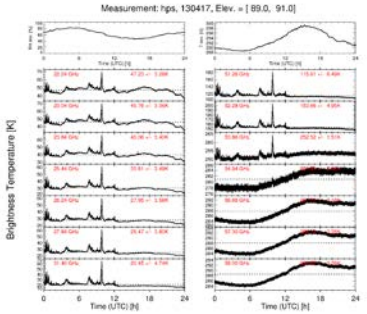

RL mixing ratio and temperature profiles

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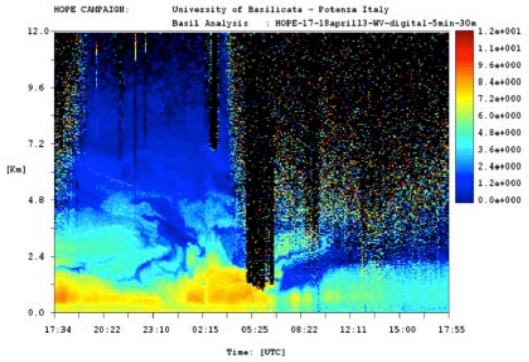
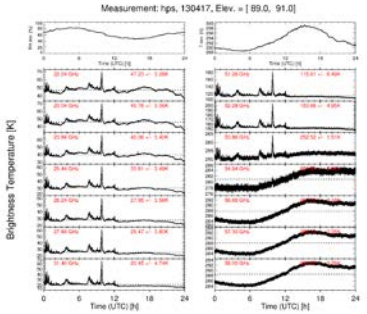
Abs. Humidity + uncertainties

Temperature+ uncertainties





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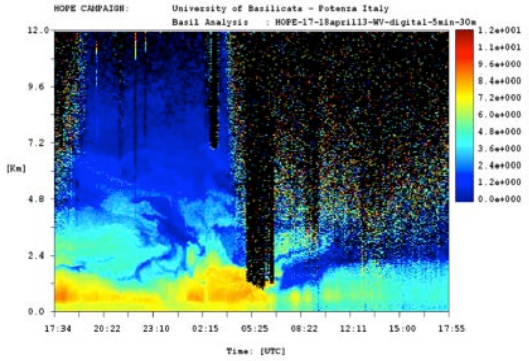

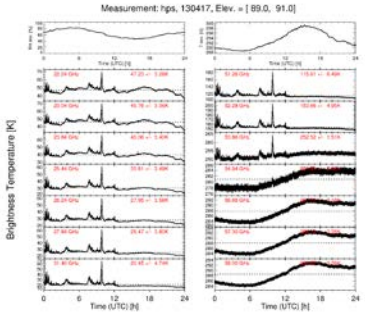

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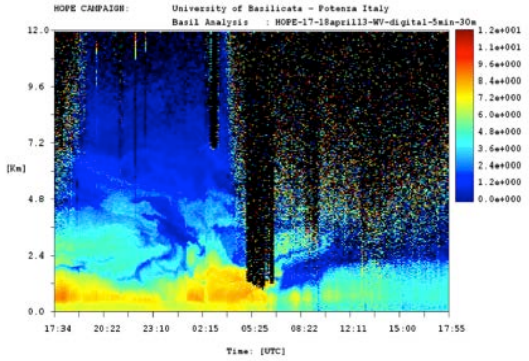

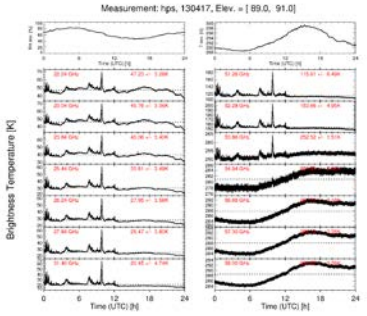

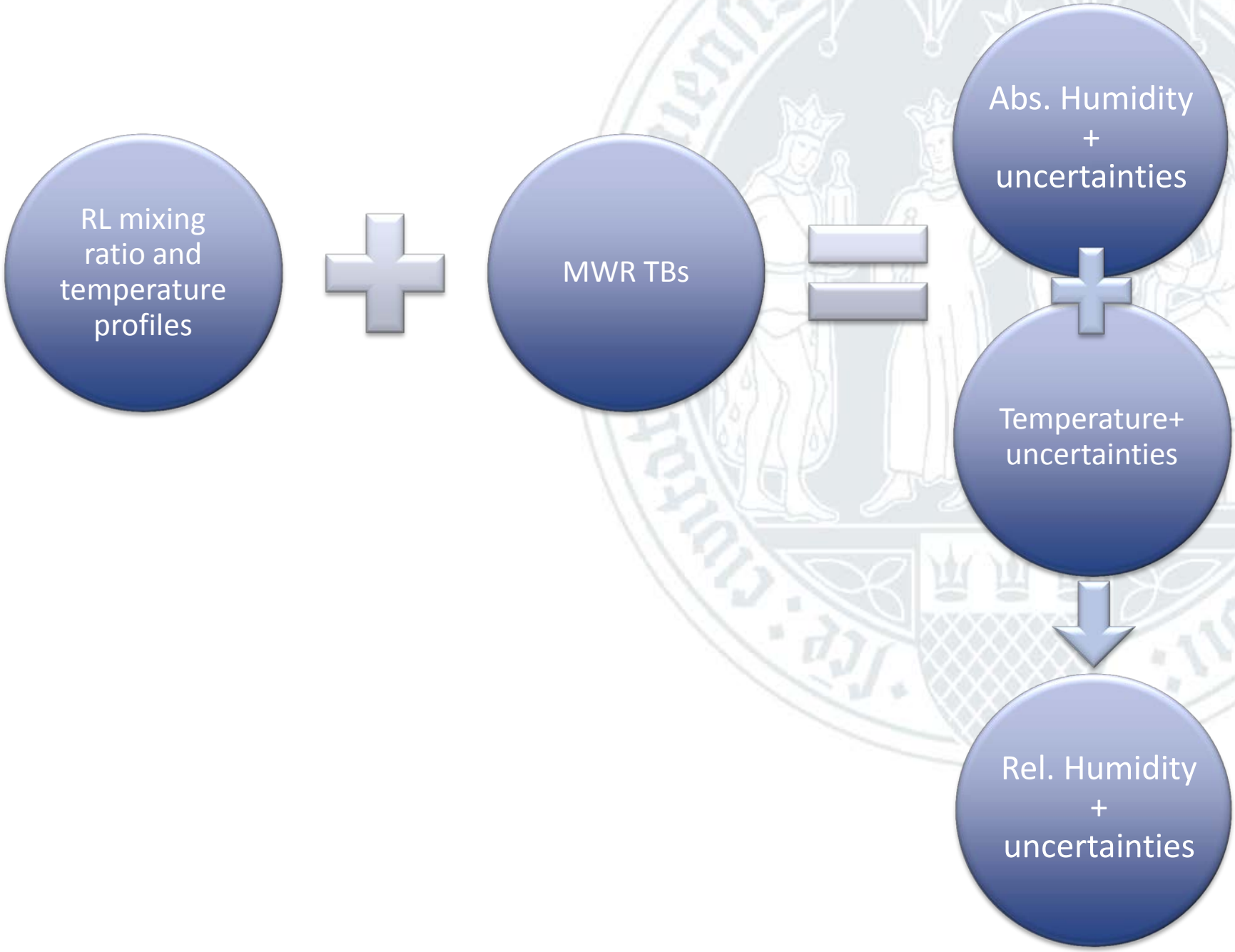
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OPTIMAL ESTIMATION

How?

Optimal Estimation Scheme

$$x_{i+1} = x_i + \left(K_i^T S_e^{-1} K_i + S_a^{-1}\right)^{-1} \times \left[K_i^T S_e^{-1}\left(y - y_i\right) + S_a^{-1}\left(x_a - x_i\right)\right]$$

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

$$K_i = \frac{\partial F(x_i)}{\partial x_i}$$

Rodgers 2000

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$$x_{i+1} = x_i + \left(K_i^T S_e^{-1} K_i + S_a^{-1}\right)^{-1} \times \left[K_i^T S_e^{-1}(y - y_i) - S_a^{-1}(x_a - x_i)\right]$$

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Thanks for your attention