

# TROWARA & ASMUWARA

## *Convective and Orographically-Induced Precipitation Study – IAP instrumentation –*

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# Outline

- Institute of Applied Physics (IAP)
  - Geographical location
- TROWARA
  - Frequencies and bandwidths
  - Examples of products
- ASMUWARA
  - Frequencies and bandwidths
  - Examples of Products
- Ongoing work

# University of Bern – Institute of Applied Physics



## TROWARA

Exakte Wissenschaften (ExWi)

46° 50' N , 7° 25' E

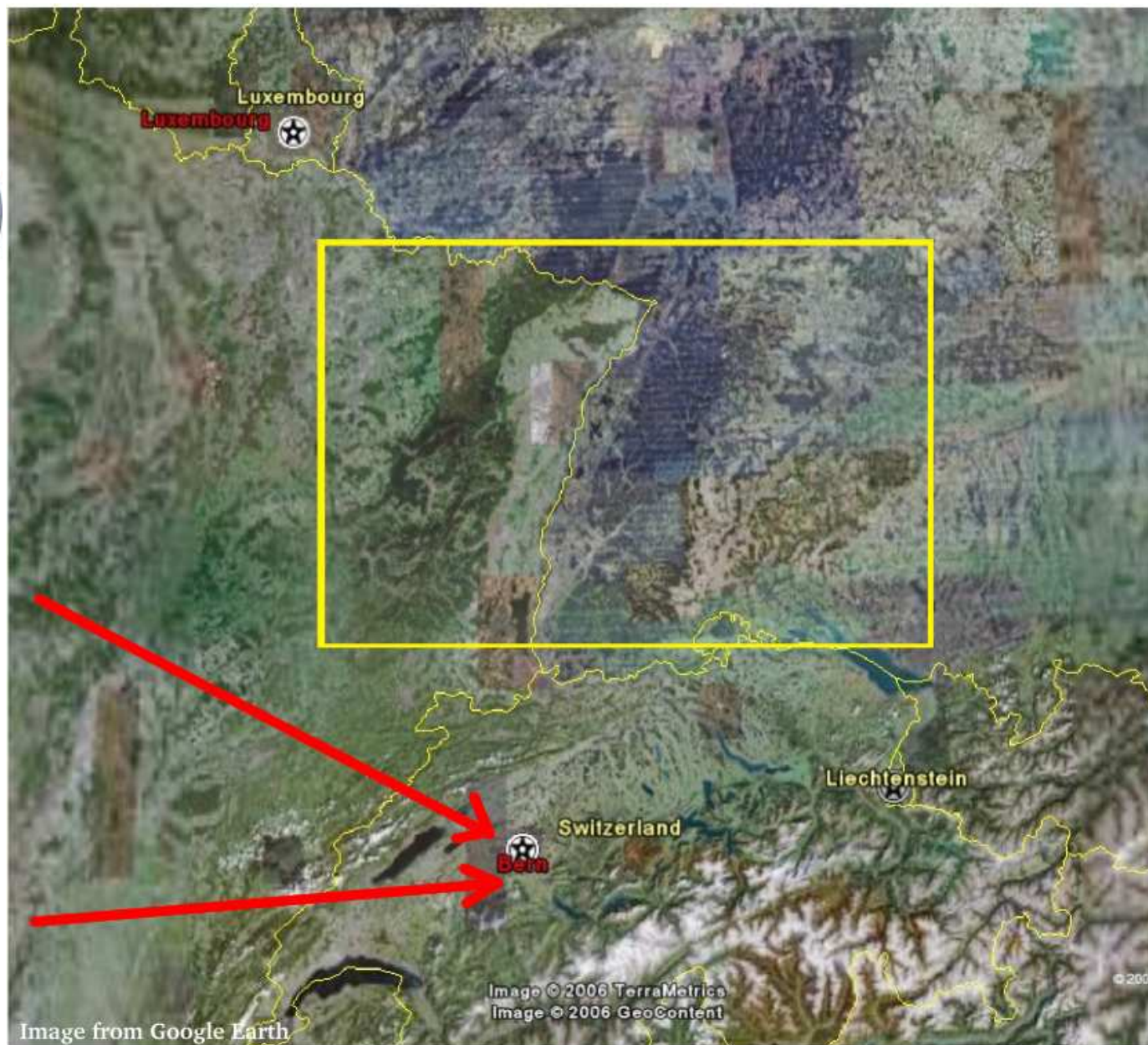
Alt. 575 m asl

## ASMUWARA

Zimmerwald Observatory

10 km South of Bern

Alt. 890 m asl





# TROWARA

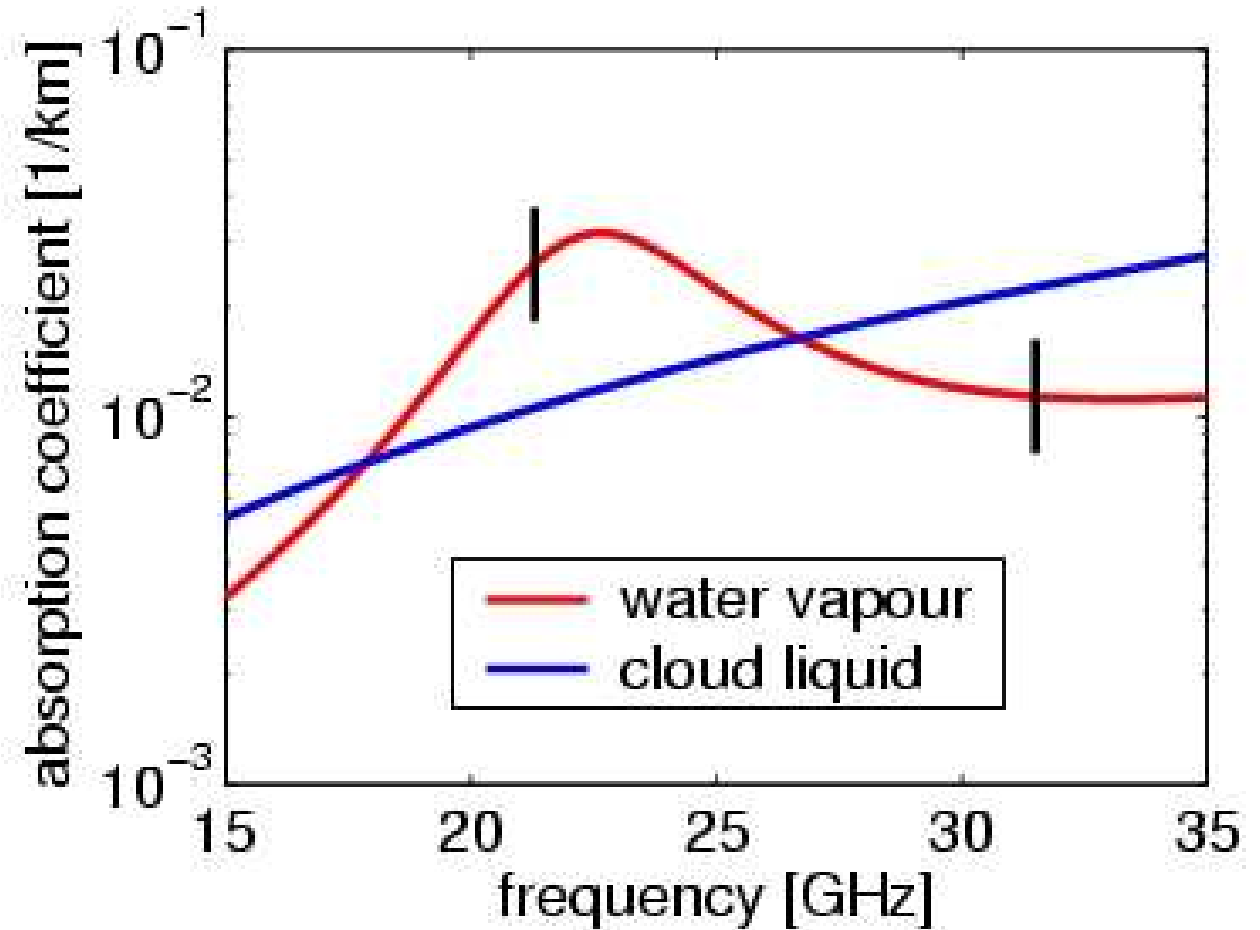
## TROPOSPHERIC-WATER VAPOR RADIOMETER

- Tropospheric observations
- 2 radiometers in MW
  - 21.3 GHz ( $\pm 100$  MHz)
  - 31.5 GHz ( $\pm 50$  MHz)
- Observation
  - Operates on roof of IAP, Bern since 1994
  - Measurement angle of  $40^\circ$ , facing South East
- Products
  - Integrated water vapor
  - Integrated liquid water

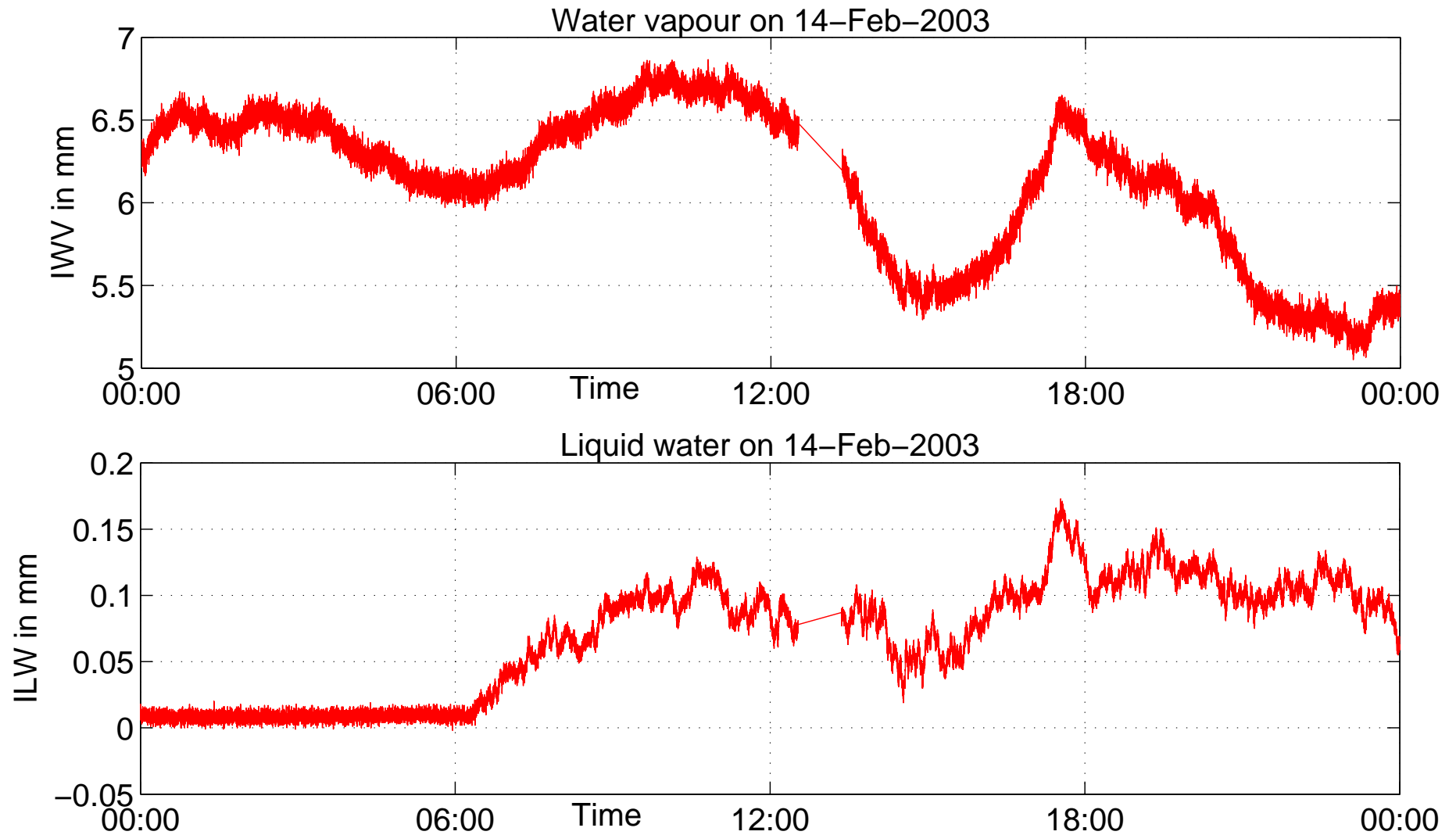


# TROWARA - Frequencies & Bandwidths

Rm.	$f$ [GHz]	$\Delta f$ [MHz]
1.	21.3	100
2.	31.50	50
IR	$10.5 \mu\text{m}$	$1.9 \mu\text{m}$



# TROWARA products: Int. water vapour - Int. liquid water



Temporal resolution = 2–3 s

# ASMUWARA

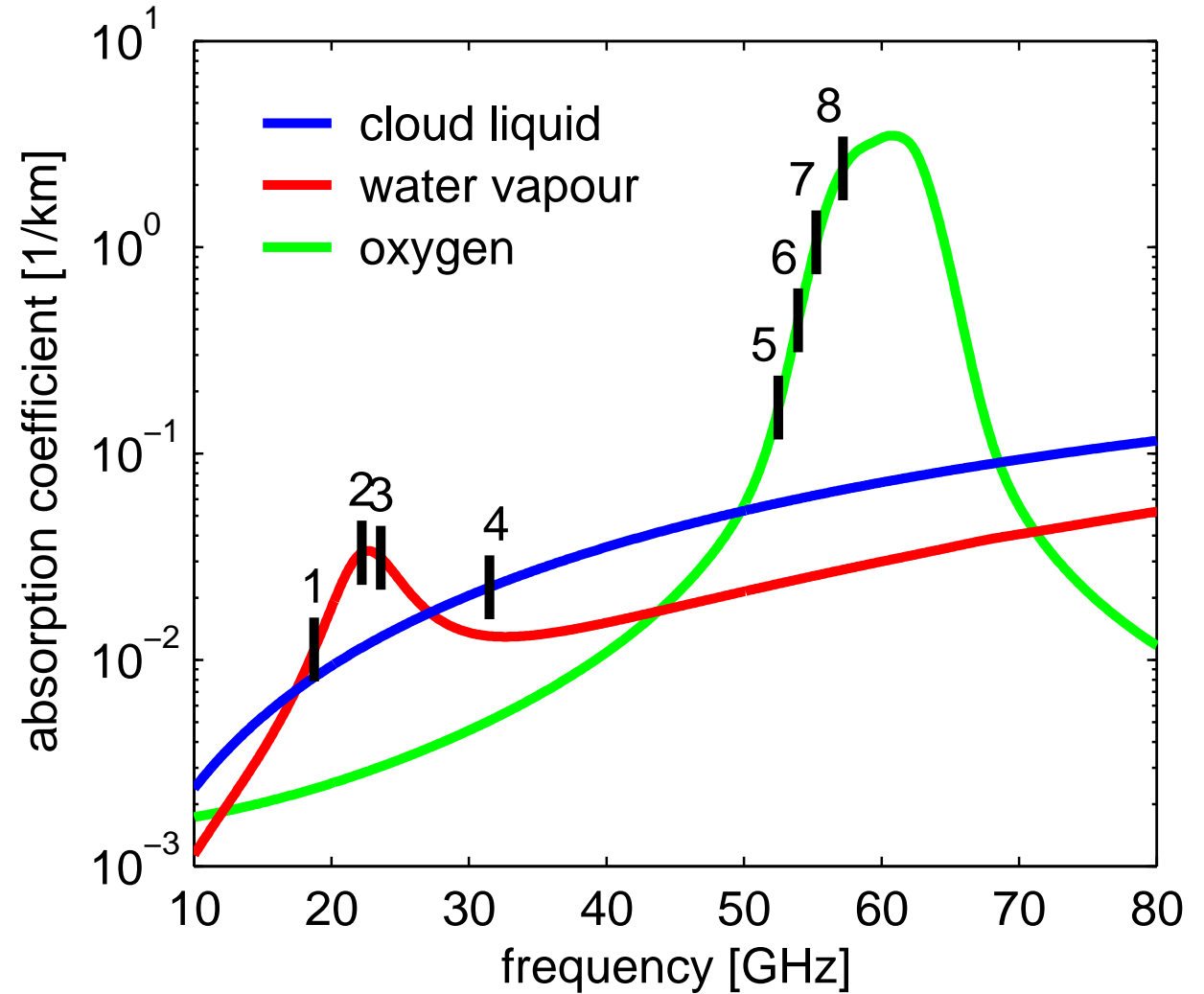
## ALL-SKY MULTI WAVELENGTH RADIOMETER

- Tropospheric observations
- 6 radiometers in MW and IR range
  - MW: 4 radiometers (21,31,50,151GHz)  
Monitoring of trop. water vapor, liquid water, temp/humidity profiles
  - IR: 2 radiometers  
Monitoring of cloud-base temperature
- 1 vis. camera
  - Monitoring of cloud coverage (day)
- 2 axis of observation  
Full hemispheric scan possible  
Versatile observation mode



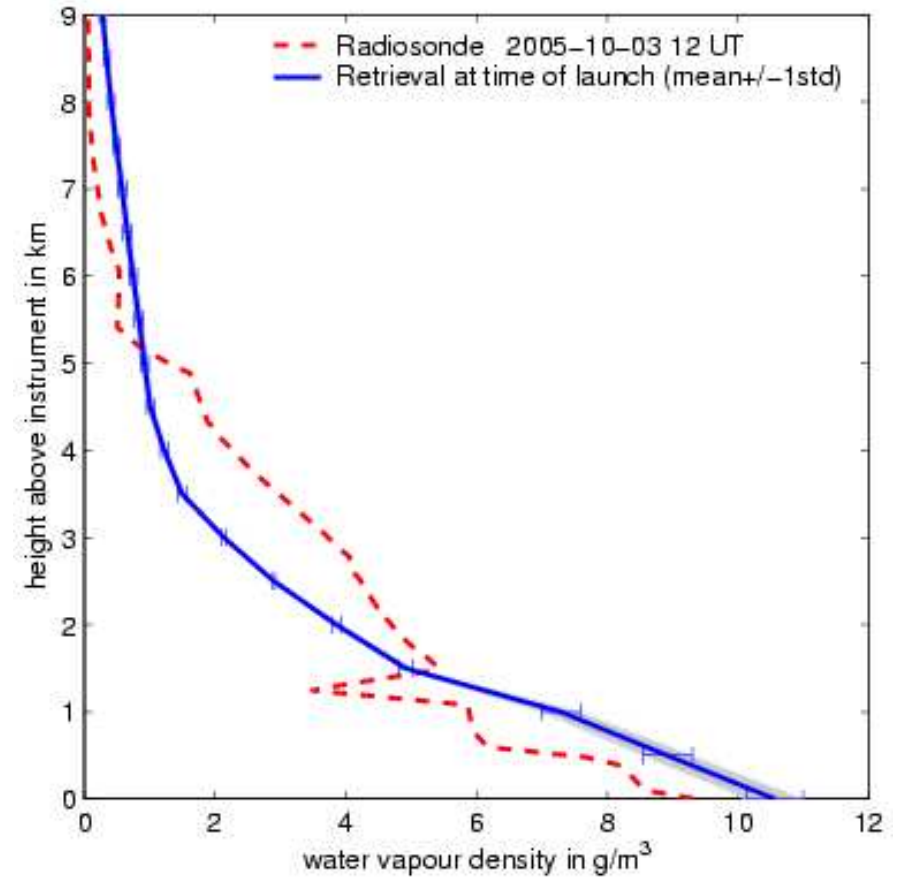
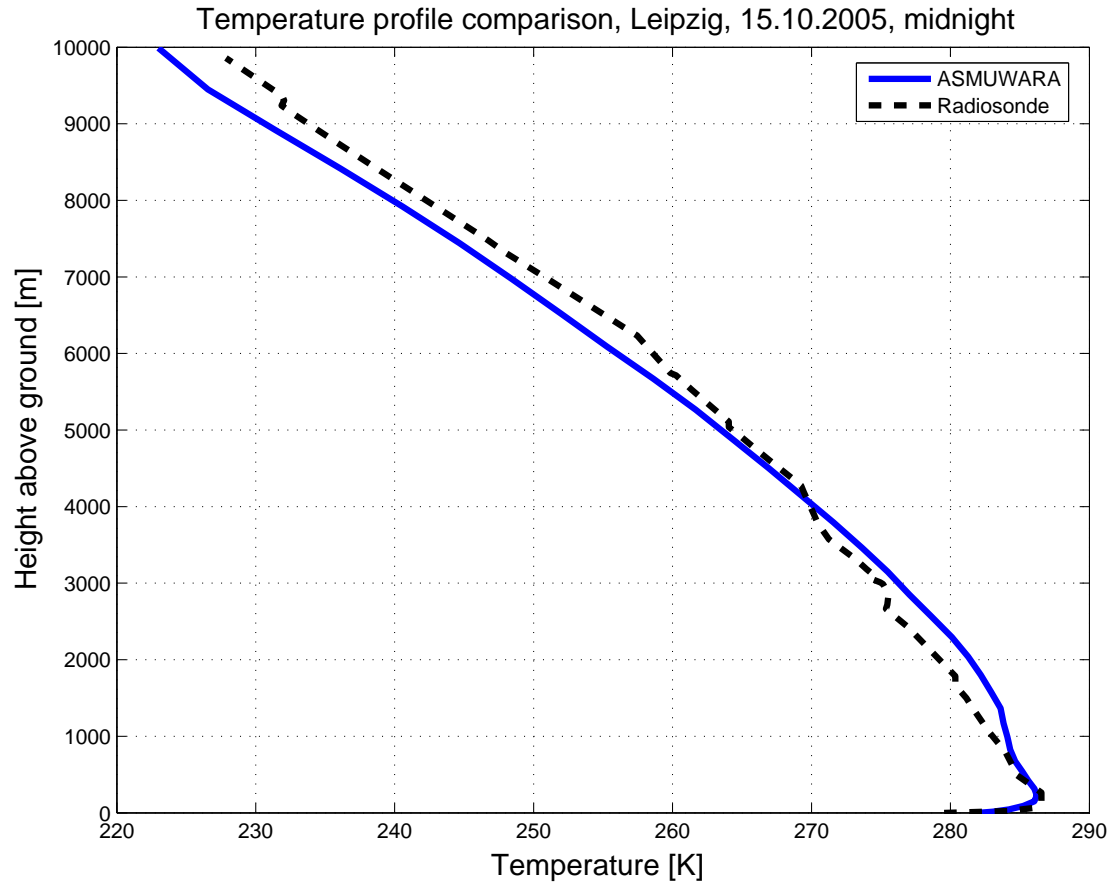
# ASMUWARA - Frequencies & Bandwidths

Rm.	Ch.	$f$ [GHz]	$\Delta f$ [MHz]
1.	1	18.75	300
	2	22.20	760
	3	23.60	900
2.	4	31.50	1100
3.	5	52.50	590
	6	53.94	120
	7	55.26	520
	8	57.20	1300
4.	9	151.00	4000
5.	IR1	11 $\mu\text{m}$	6 $\mu\text{m}$
	IR2	10.5 $\mu\text{m}$	1.9 $\mu\text{m}$

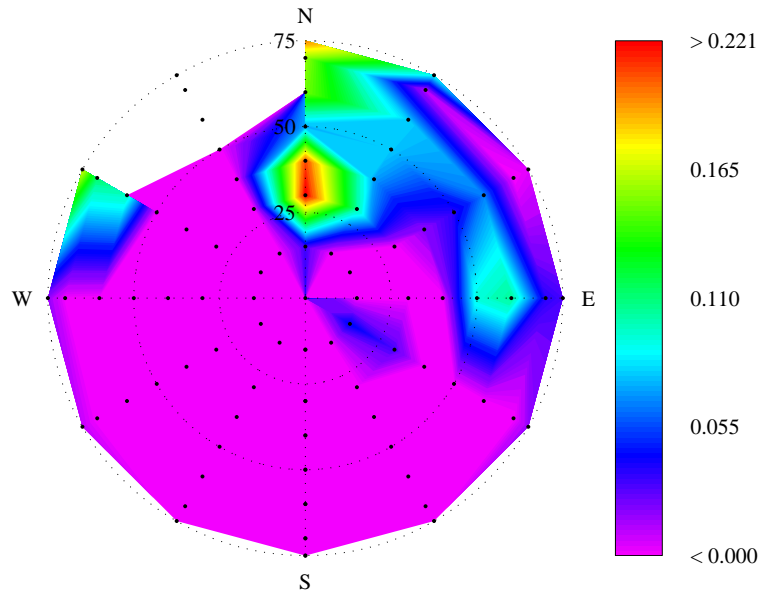




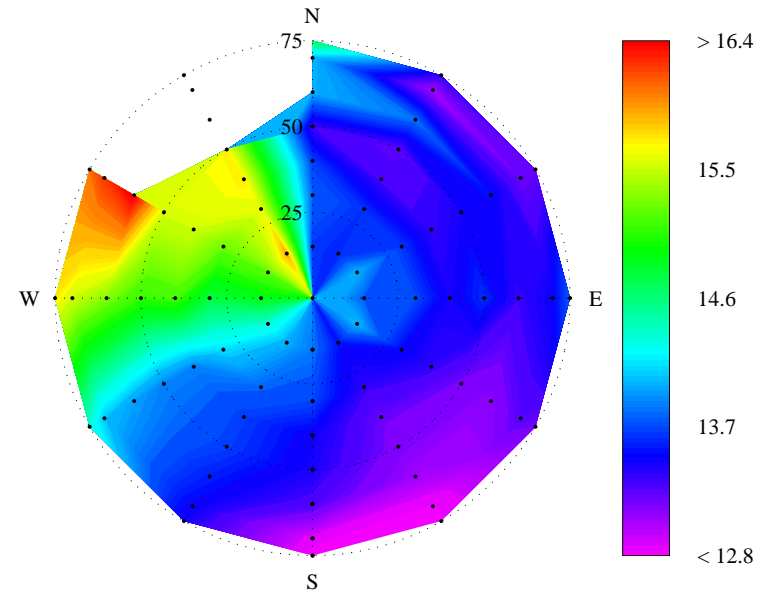
# ASMUWARA products: Temperature - Humidity profiles



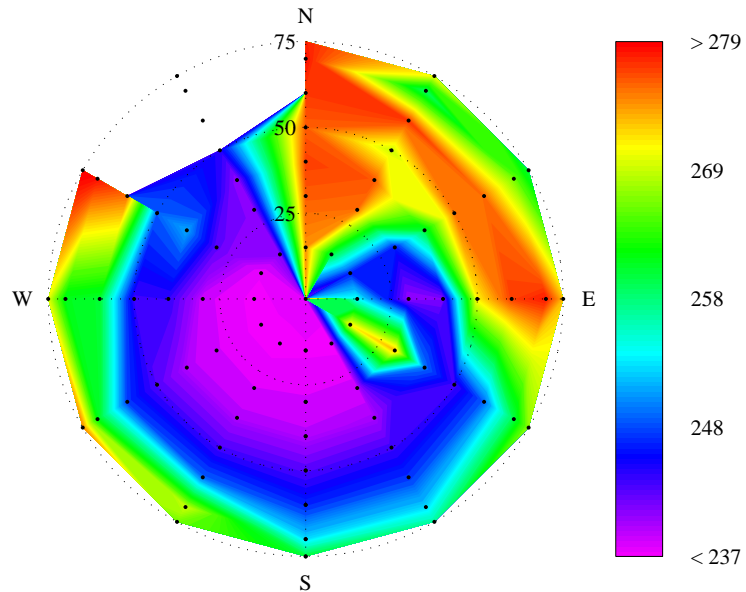
# ASMUWARA products: IWV ILW IR



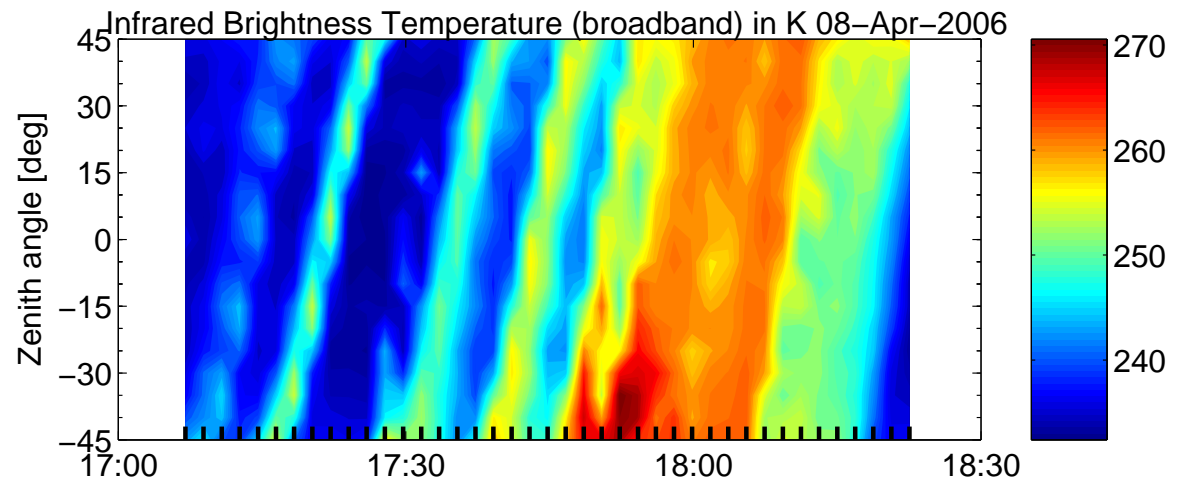
Integrated Cloud Liquid Water in  $\text{kg/m}^2$  2005-09-29, 16:17:29 UT



Integrated Water Vapour in  $\text{kg/m}^2$  2005-09-29, 16:17:29 UT



Infrared Brightness Temp. in K (Broadband) 2005-09-29, 16:17:29 UT



# Ongoing work – Plans for COPS

- Further develop the retrieval of atmospheric structure information (wind)
- Further develop retrieval of humidity and temperature profiles
- Involve the 2 IR channels to retrieve more information on cloud properties
- Use new Ceilometer:

Commercial instrument: Vaisala CT25K

Location: Zimmerwald

# References

- Websites:

<http://www.iapmw.unibe.ch/research/projects/ASMUWARA/>

<http://www.iapmw.unibe.ch/research/projects/TROWARA/>

- Publications:

L. Martin, M. Schneebeli, C. Mätzler, *ASMUWARA, a ground-based radiometer system for tropospheric monitoring*, Meteorologische Zeitschrift, vol.: 15, no.: 1, pp.: 11-17, 2006.

L. Martin, M. Schneebeli, C. Mätzler, *Tropospheric water and temperature retrieval for ASMUWARA*, Meteorologische Zeitschrift, vol.: 15, no.: 1, pp.: 37-44, 2006.

J. Morland, *TROWARA - Tropospheric Water Vapour Radiometer. Radiometer review and new calibration model*, IAP Research Report, No. 2002-15, Institut für angewandte Physik, Universität Bern, 2002.