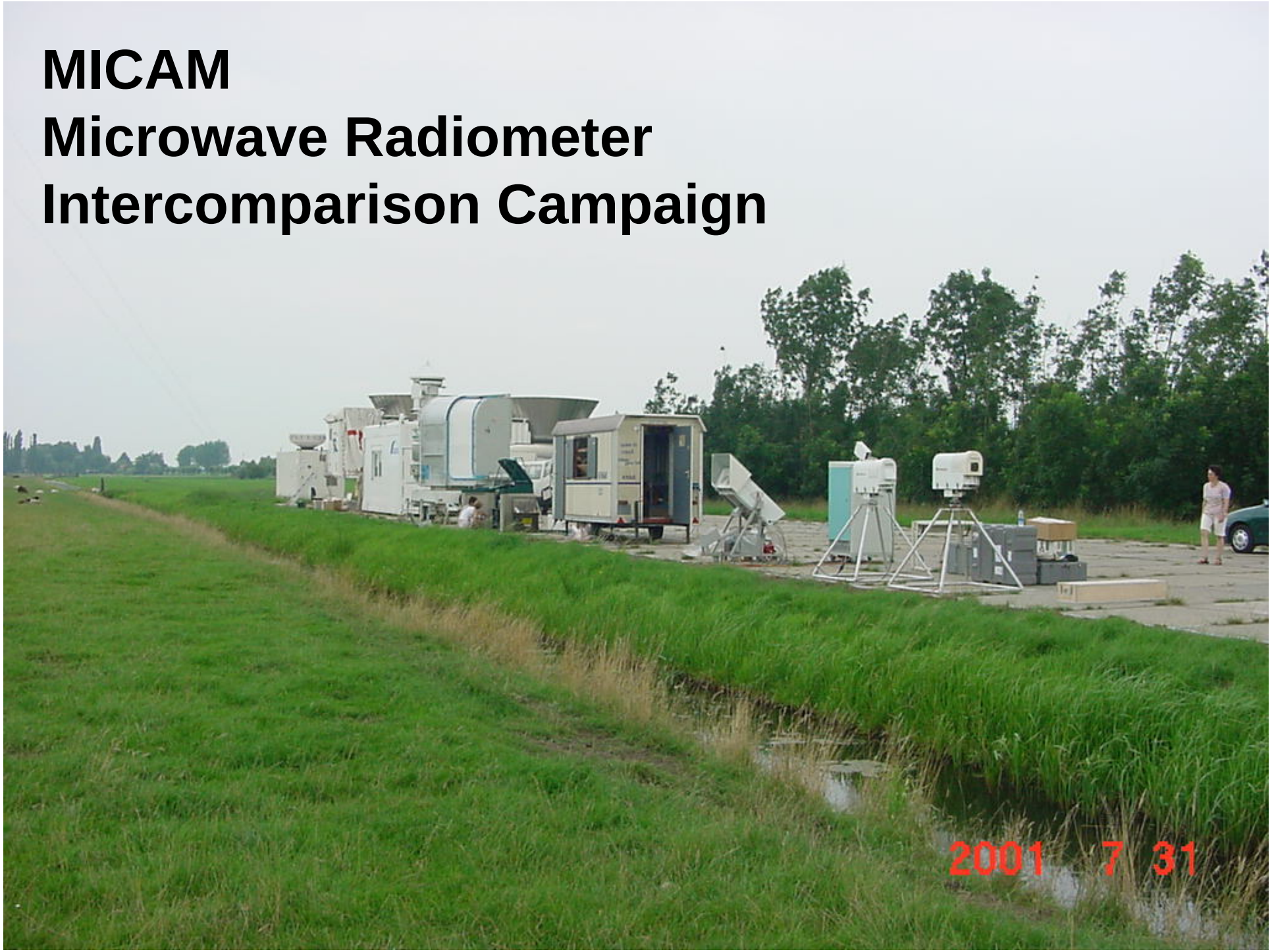

What happened after CLIWA-NET 2000-2003?
Baltic Sea Experiment
CLIWA-NET
Cloud Liquid Water Network
Prof. Susanne Crewell
University of Cologne

First visit to Cabauw...

Designing the BBC campaign!

MICAM
Microwave Radiometer
Intercomparison Campaign




MICCY
Microwave Radiometer
for Cloud Carthography
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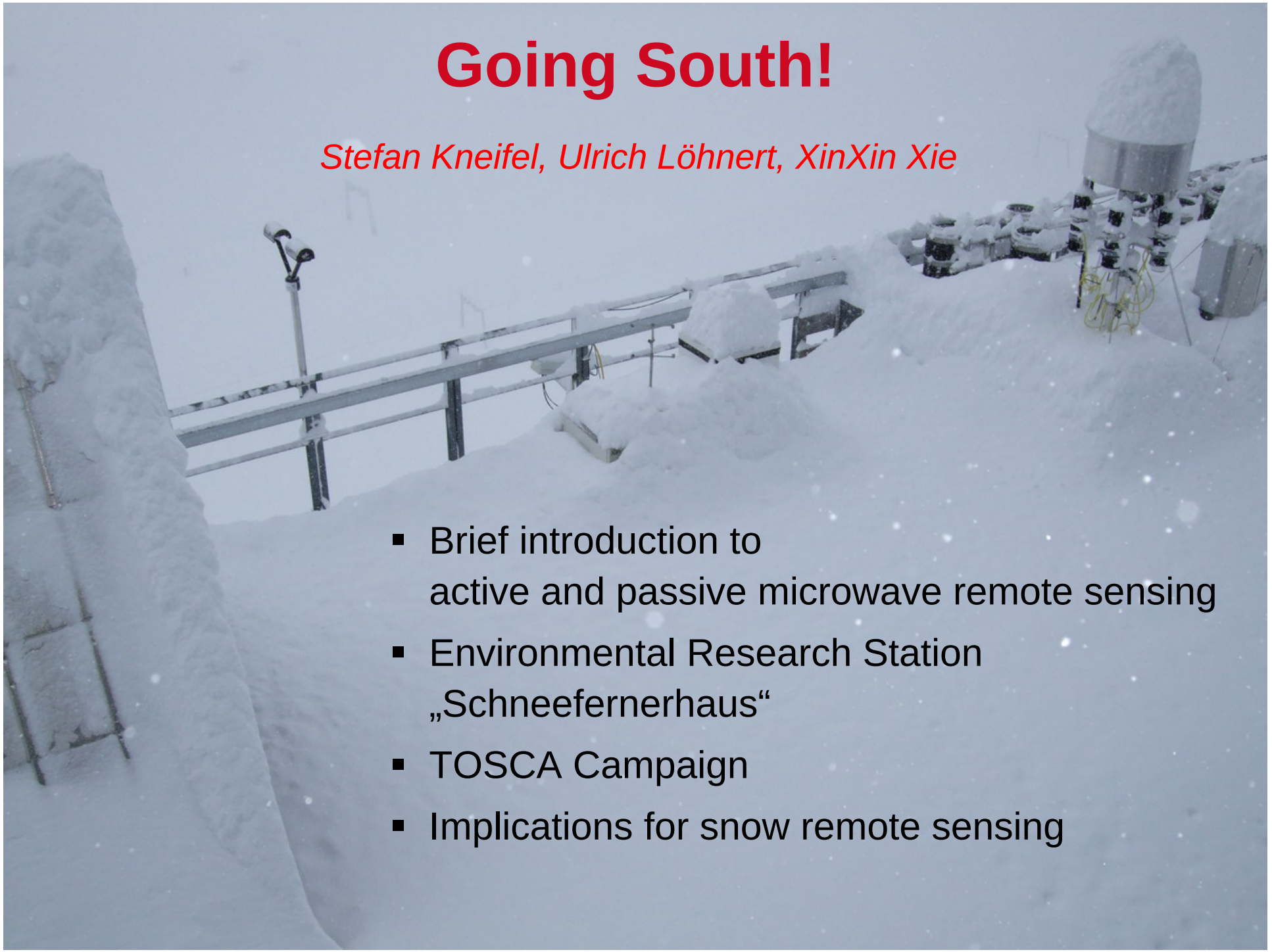
Going South!

Stefan Kneifel, Ulrich Löhnert, XinXin Xie

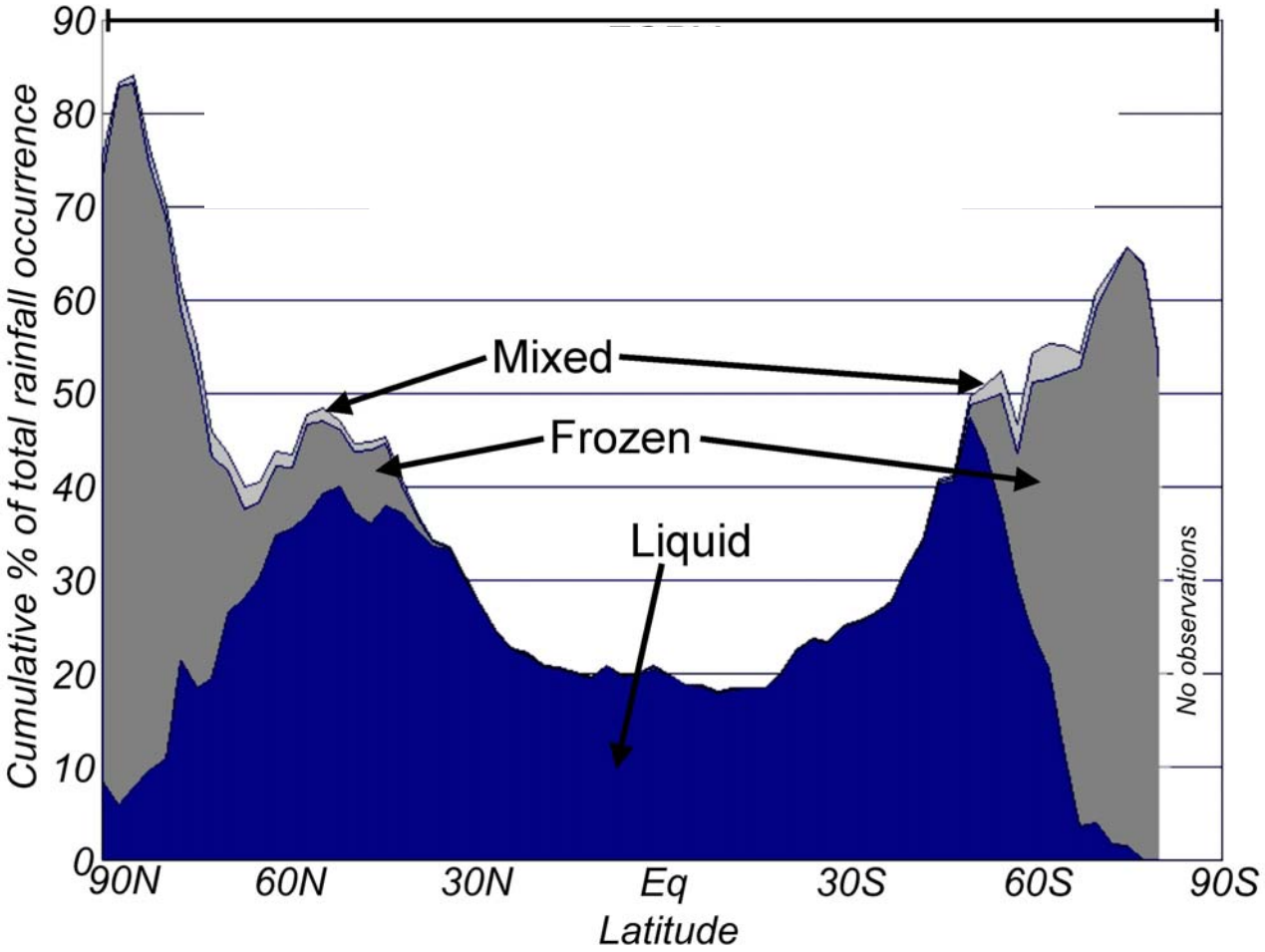


- Brief introduction to
  active and passive microwave remote sensing
- Environmental Research Station
  „Schneefernerhaus“
- TOSCA Campaign
- Implications for snow remote sensing

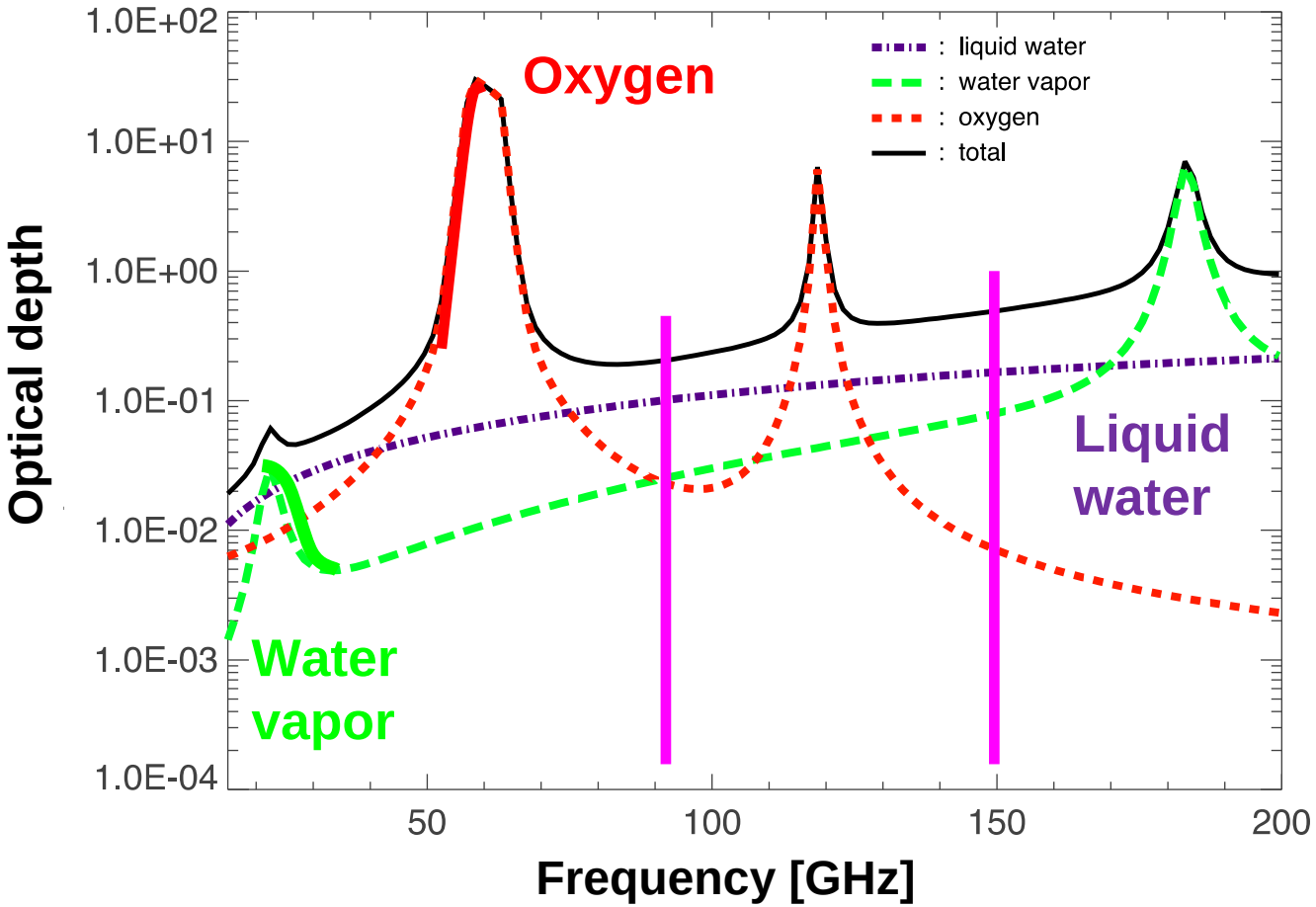
Motivation

How does precipitation change in a changing climate?

..but how to measure snow globally



Thermal Emission of the Atmosphere



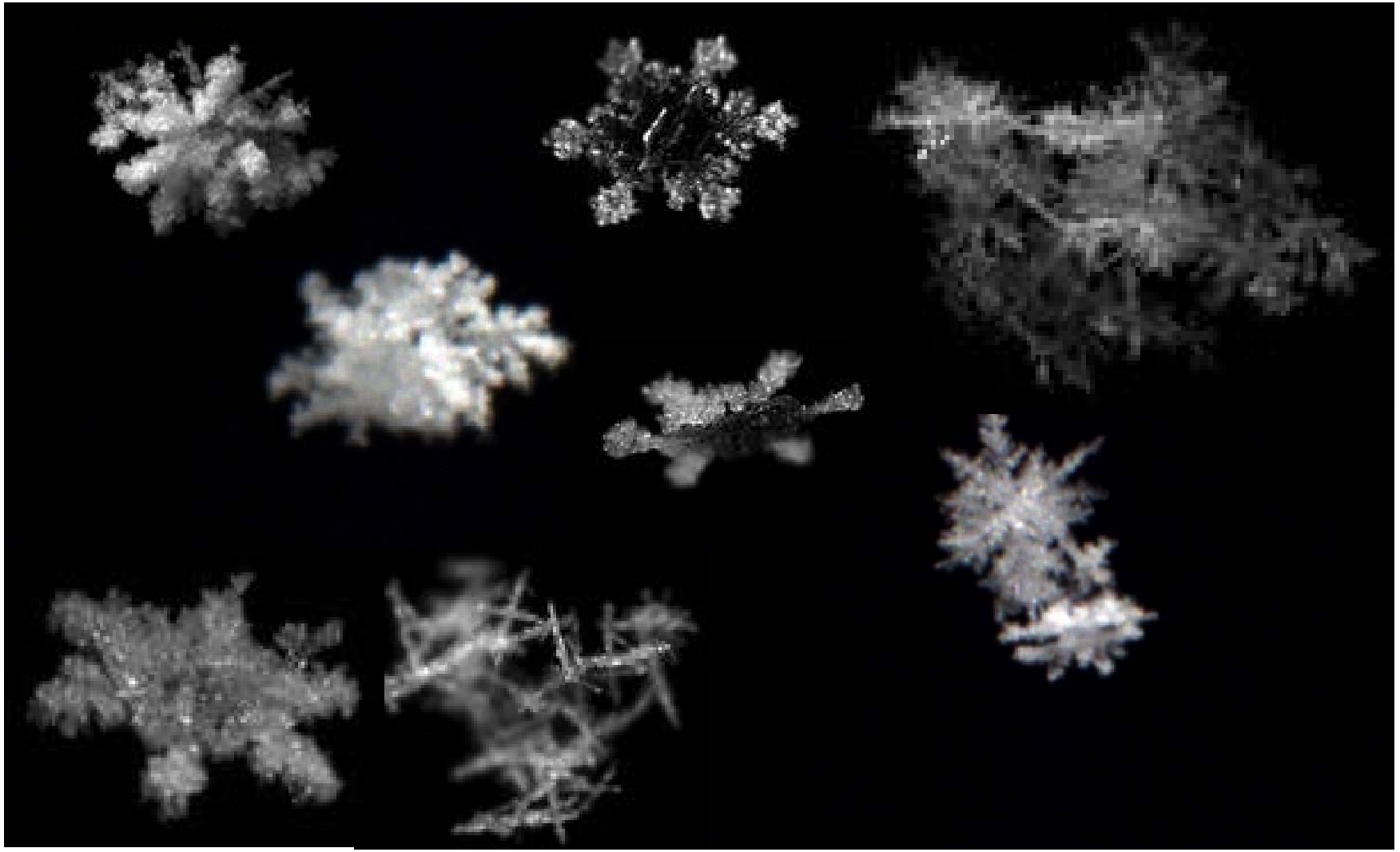
Simulation for a 3 km thick cloud:

Liquid water: 0.1 kg/m²

What happens in case of snow?

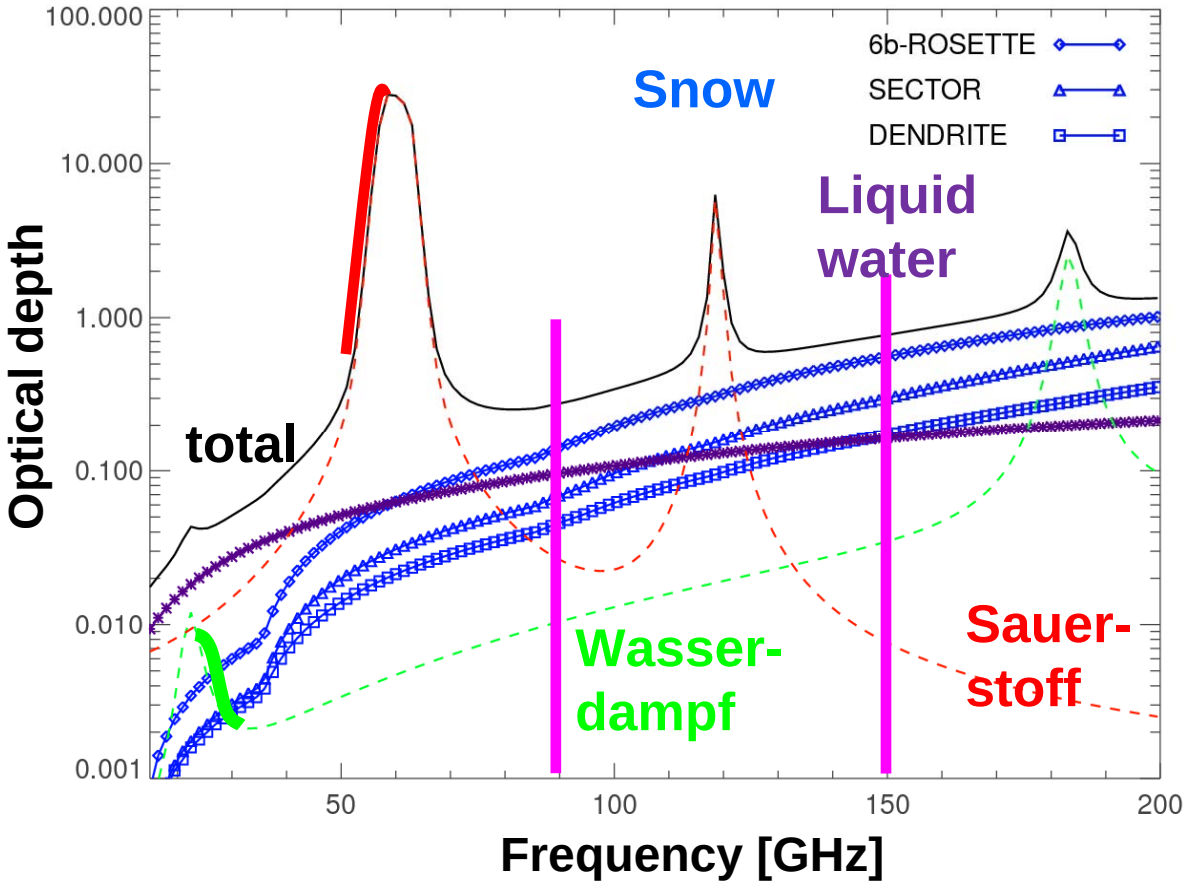
HATPRO: **7 Channels 22.235 – 31.4 GHz**
7 Channels 50.8 – 58.8 GHz
DPR: **90 GHZ and 150 GHz** (vertical/horizontal)

How does an ice particle look like?



http://alta.com/pages/snowflakeshowcase.php

Thermal Emission of the Atmosphere



Simulation for a 3 km thick cloud:

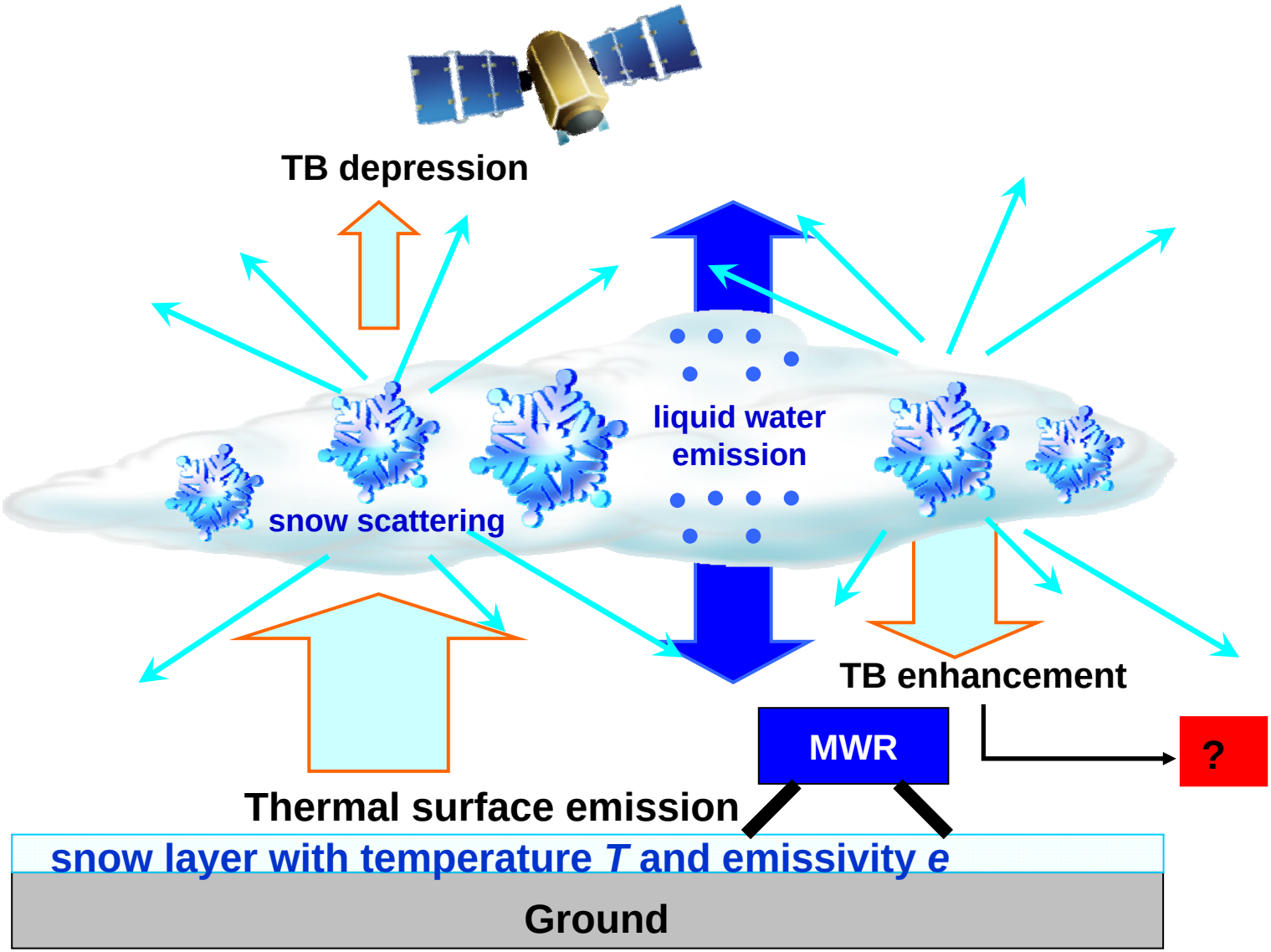
Liquid water: 0.1 kg/m²

Snow 0.3 kg/m²

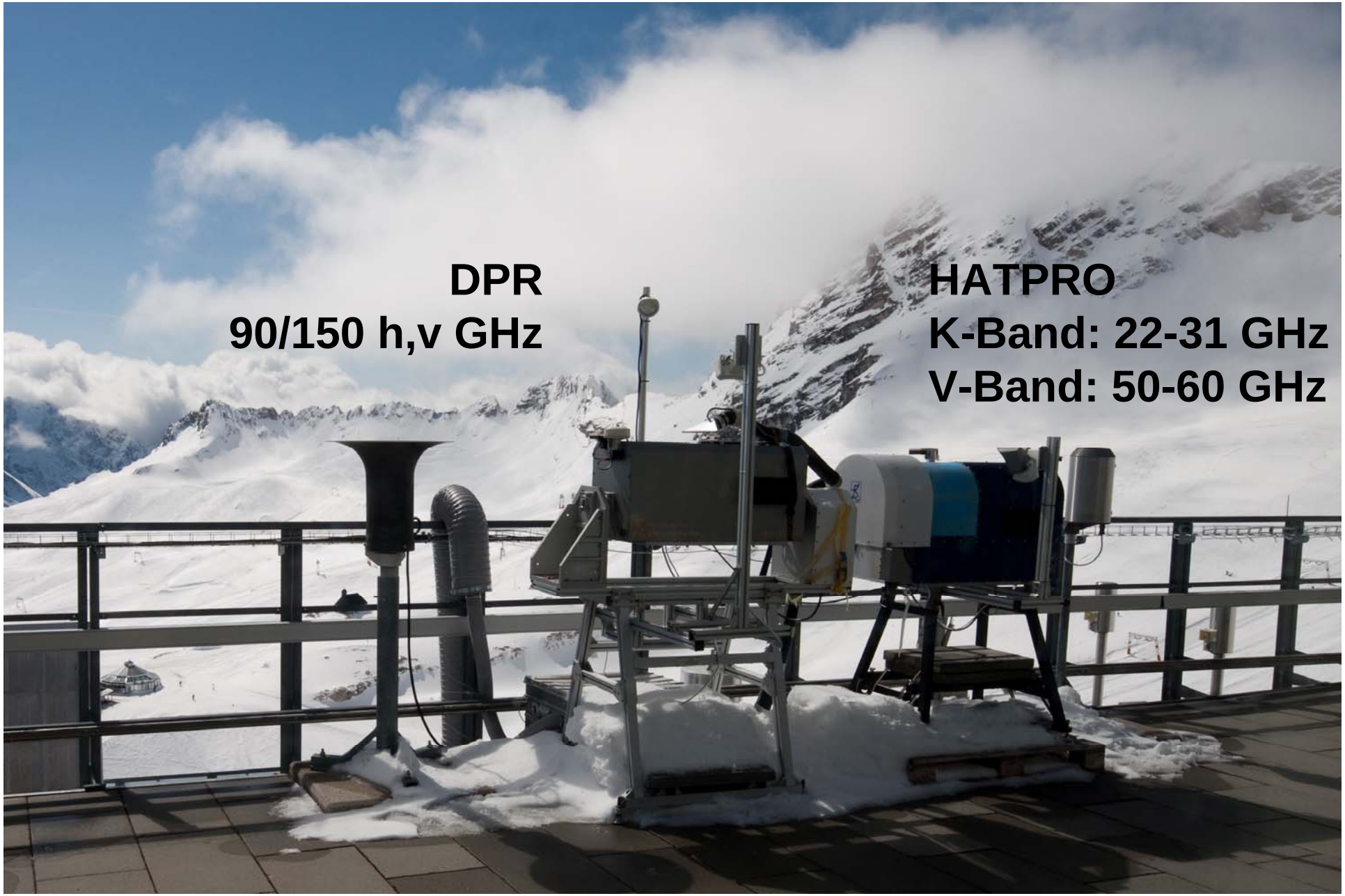
Snow Scattering for 3 different crystal types (*Liu-Database, BAMS, 2008*)

HATPRO: **7 Channels 22.235 – 31.4 GHz**
7 Channels 50.8 – 58.8 GHz
DPR: **90 GHZ and 150 GHz** (vertical/horizontal)

Scattering in the Microwaves Range



Radiometer at Schneefernerhaus



Schneefernerhaus

Sensor Synergy at Schneefernerhaus

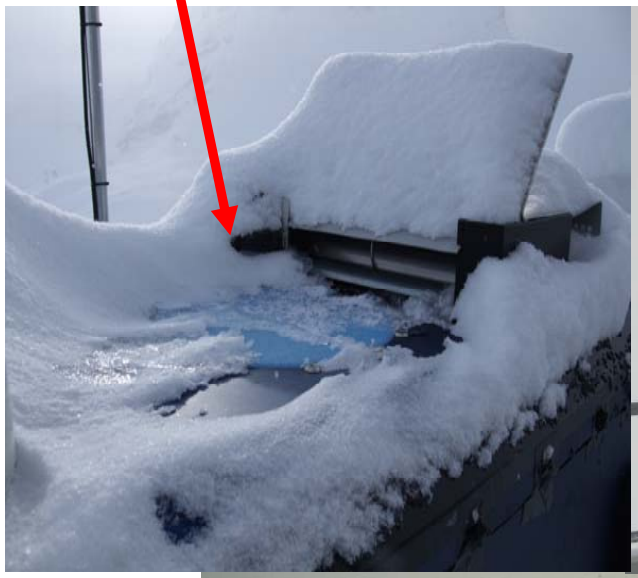
Löhnert et al., 2011

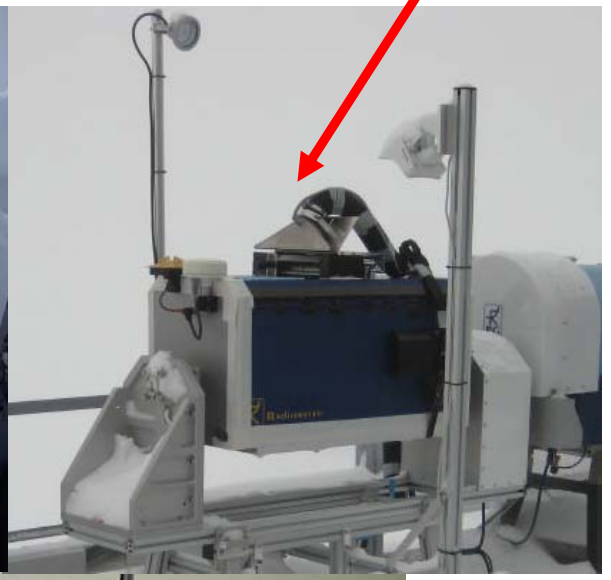
http://gop.meteo.uni-koeln.de/tosca

Challenges for observations

Old Blower

New Blower



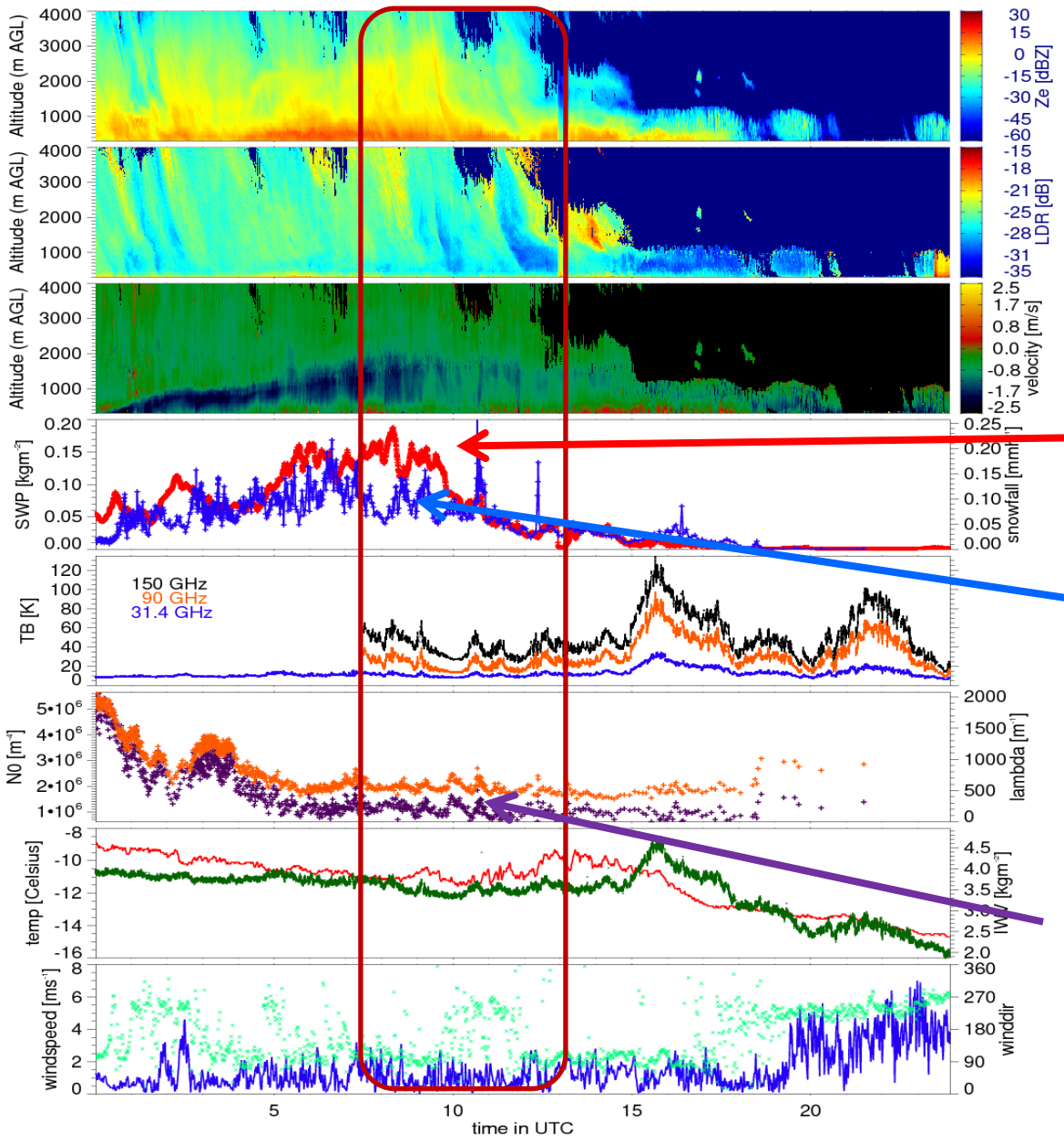


Monitoring!

Fire and Ice

Risky business ...

Sensor Synergy (08. Feb. 2009):



Cloud radar

- Ze in dBZ
- LDR
- Doppler velocity

Snow water path(SWP) derived by radar

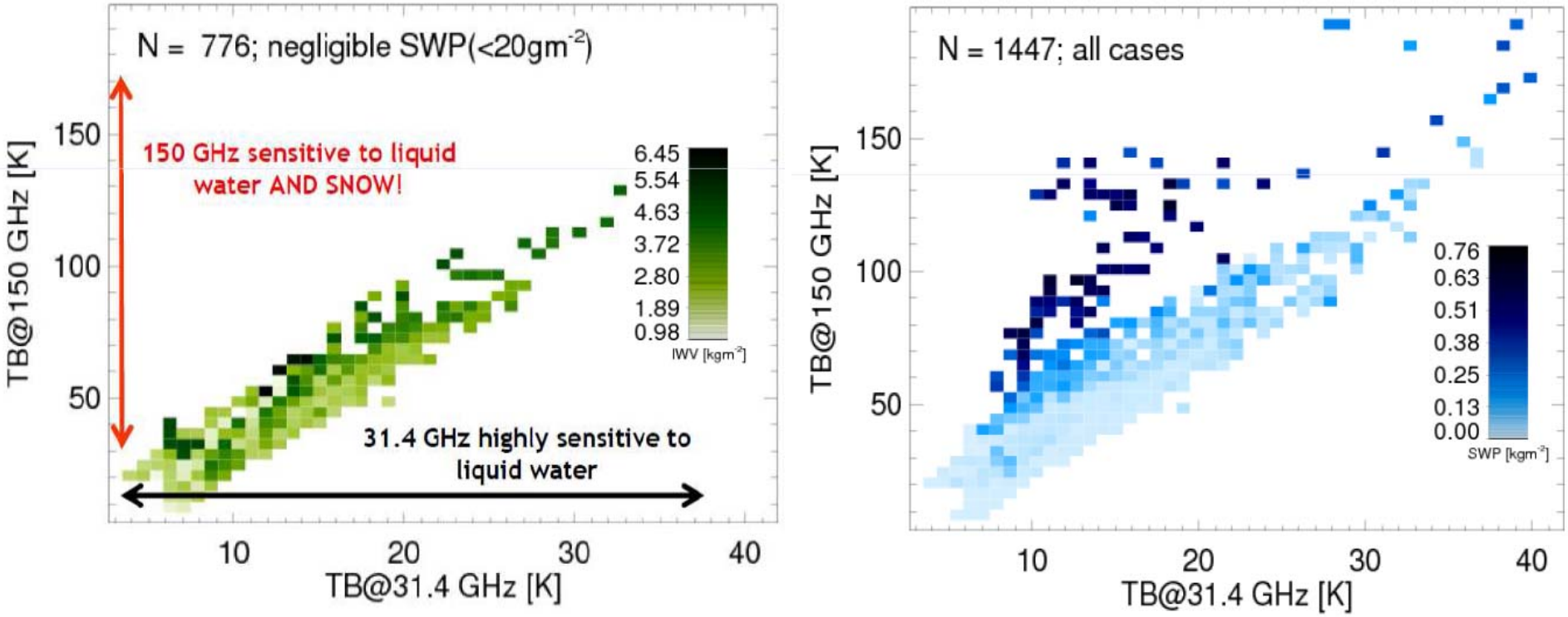
Snow fall rate at the surface

Size distribution at surface

$$N(D) = N_0 \exp(-\Lambda D)$$

(Kneifel et al., 2010)

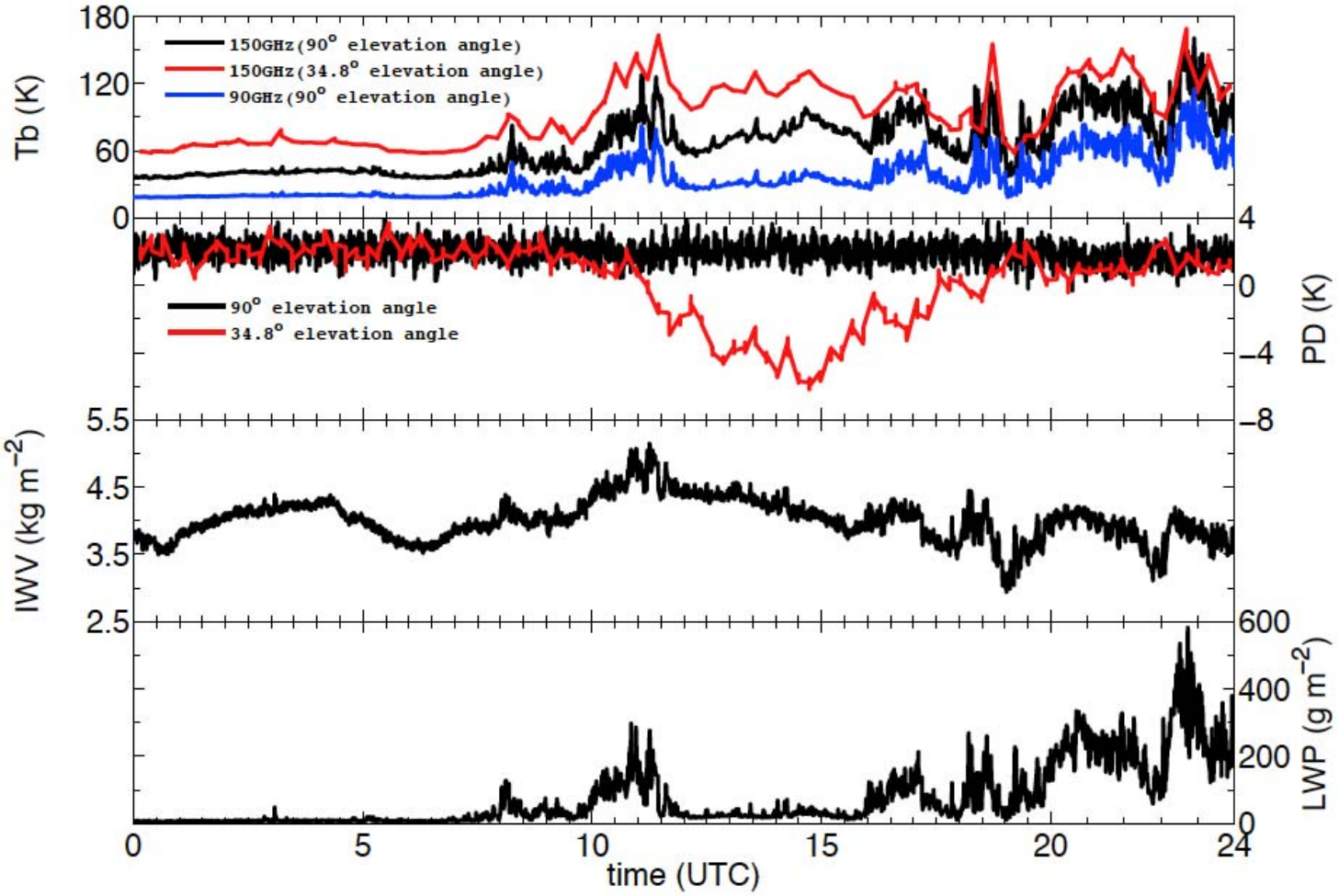
Snow scattering effects



- In case of no snow the microwave signal is dominated by the emission of water vapor and cloud liquid
- During snow fall the additional TB 150 GHz enhancement is correlated with snow water path

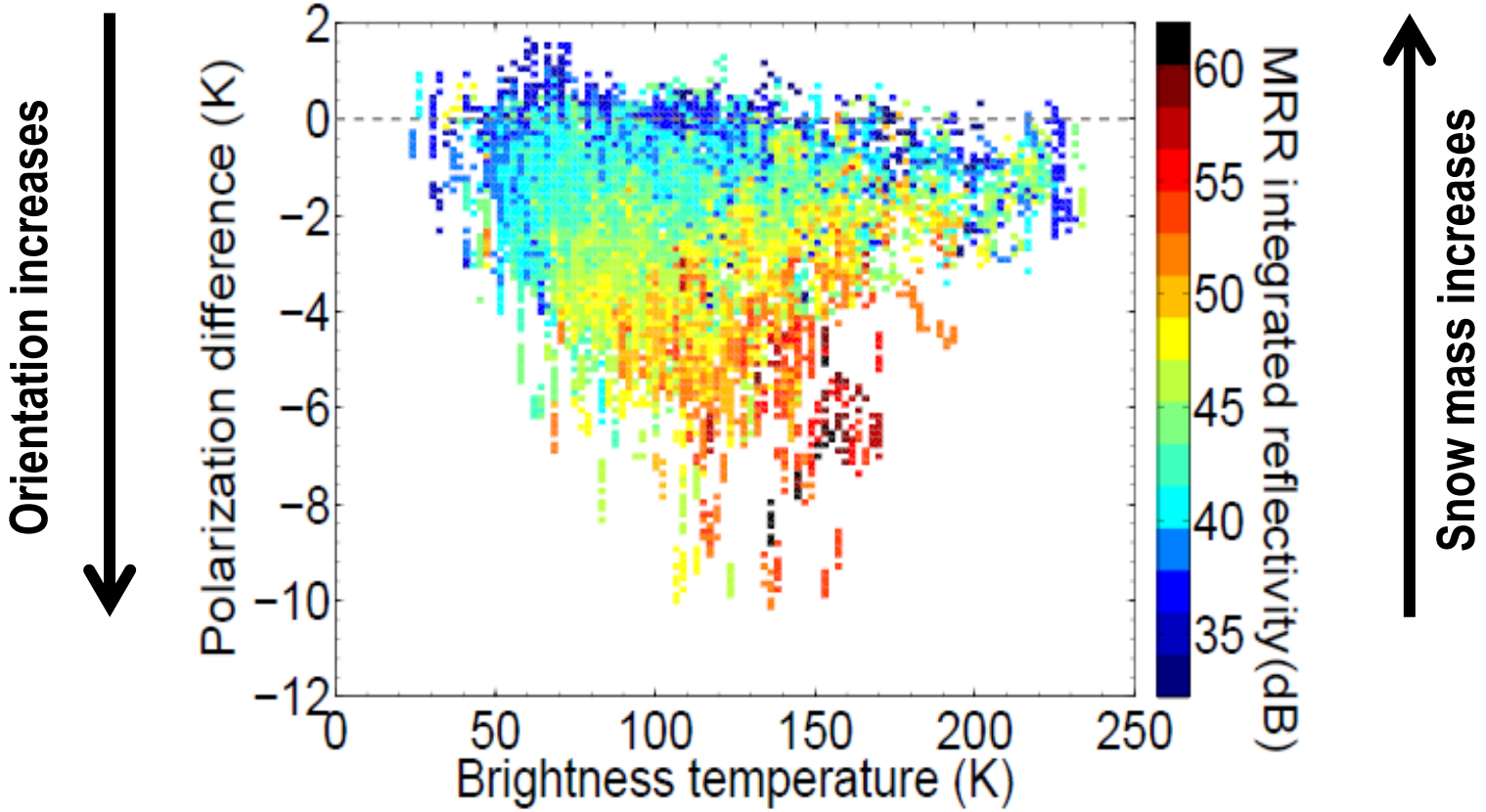
Radiative transfer calculations reveal that TB enhancement is **twice as high** as the TB depression seen from satellite *(Kneifel et al., 2010)*

How does polarization help?



During snowfall negative **Polarization Differences = TB_v - TB_h**
occur which are reduced when liquid water is present *(Xie et al., 2012)*

How does polarization help?

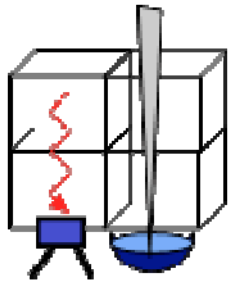


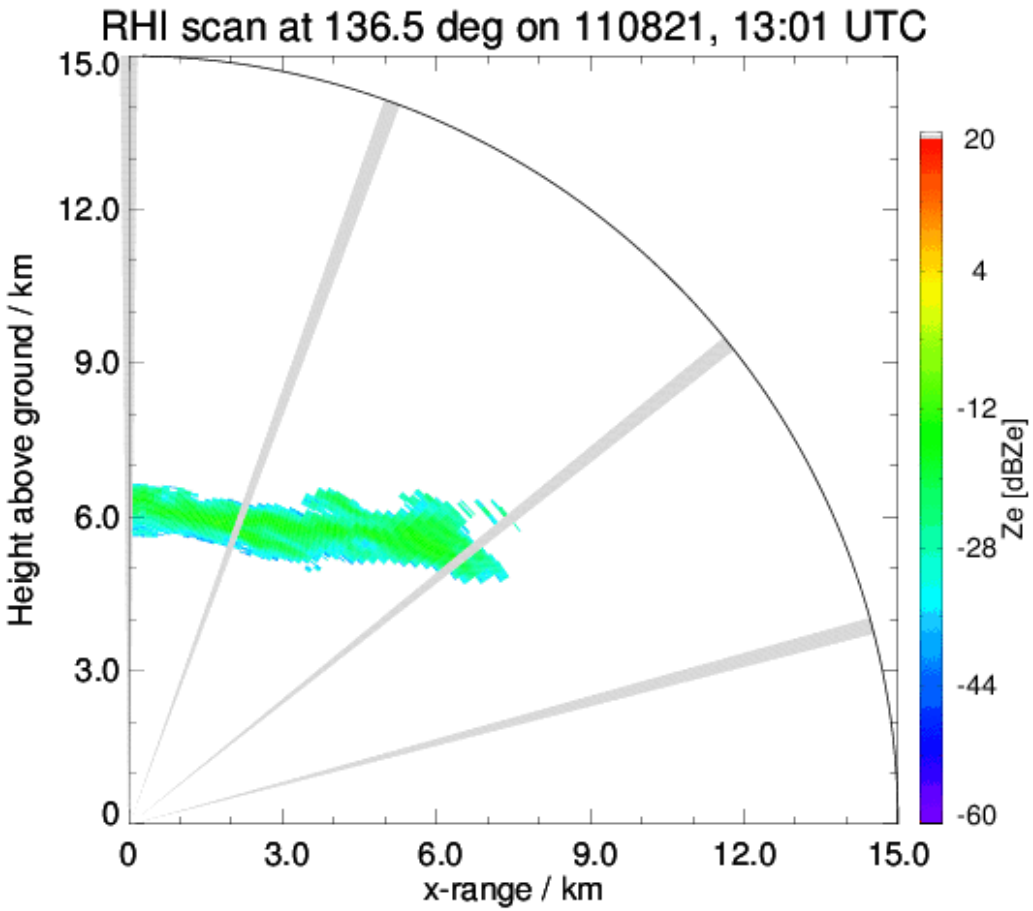
Larger snowflakes tend to fall with their longest axis oriented.

(Xie et al., 2012)

Going back north-west

..and to cloud carthography!





Jülich ObservatorY for Cloud Evolution

JOYCE

Observation platform jointly operated by

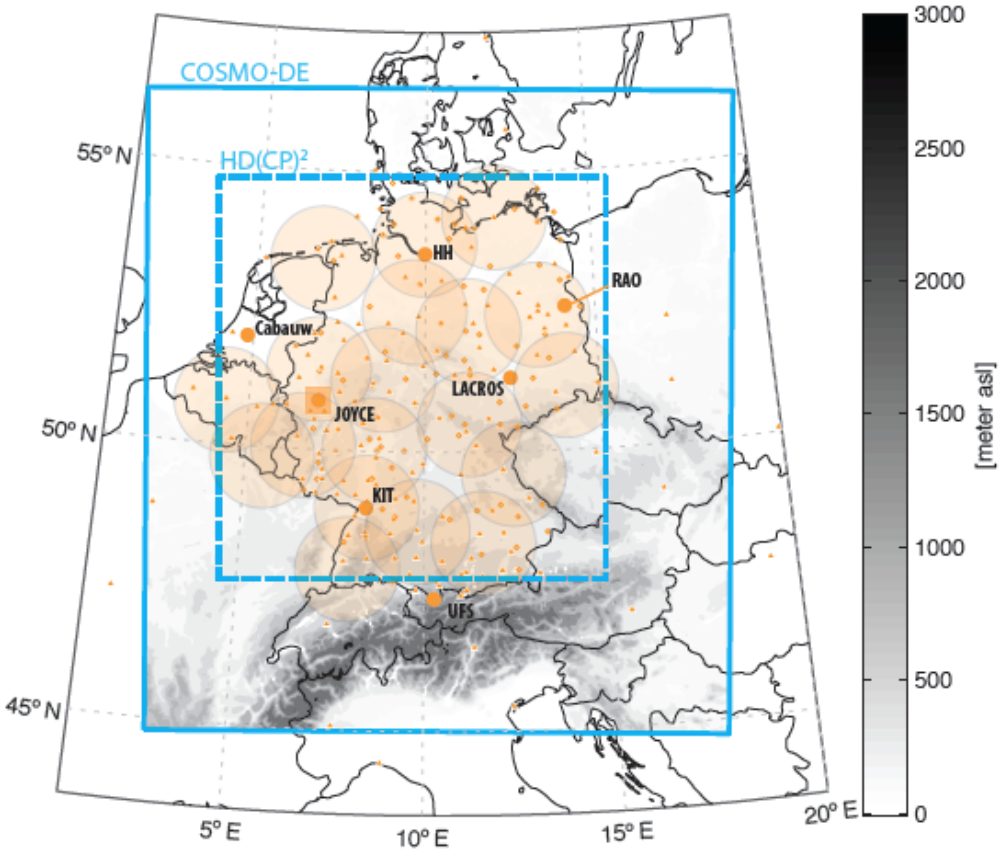
- University of Cologne
- Research Centre Jülich
- SFB/TR 32 „Patterns in Soil-Vegetation-Atmosphere-Systems Monitoring, Modelling and Data Assimilation“

→ continuously monitor **winds, temperature, water vapor, clouds,** and **precipitation** over many years

geomet.uni-koeln.de/joyce

The Future

High definition clouds and precipitation for advancing climate prediction HD(CP)²



- Improve representation of cloud and precipitation in climate simulation
- Perform high spatial (100m) resolution modelling over large domain and whole summer season
- Compile comprehensive observational data set for synthesis

"Supersites" present key component for assessing small scale models

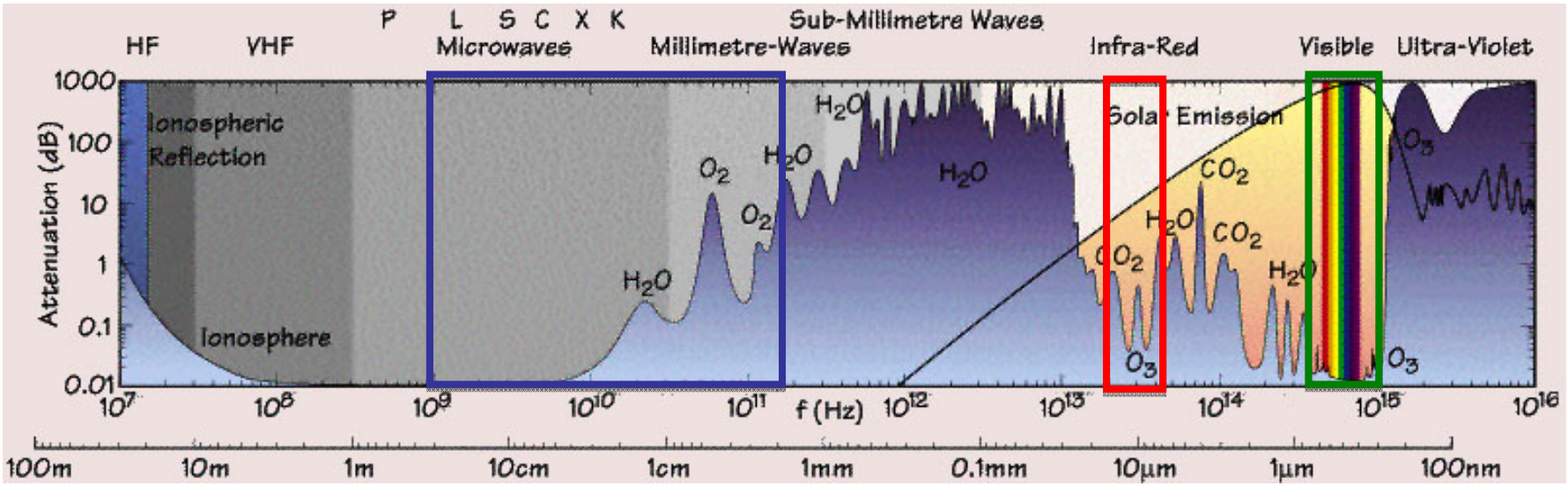

2001 9 13


MEIER


On the run for rain...
2001 9 19

Warum Sensorsynergie?

- In situ Sensoren erlauben keine umfassende räumlich-/zeitliche Abdeckung
- Vielfältige Fernerkundungsmethoden
  - im **sichtbaren**, **terrestrischen** und **Mikrowellenbereich**
  - aktive und passive Sensoren
  - boden- und flugzeuggebundene Sensoren, Satelliten
- Kein einziger Sensor alleine kann die nötigen Informationen liefern für
  - wolkenmakro- und mikrophysikalische Eigenschaften
  - Umgebungsbedingungen



Quelle: W. Mauser LMU