IcePolCKa

Investigation of the initiation of convection and the evolution of precipitation using simulations and polarimetric radar observations at C- and Ka-band

Contribution to Priority Programme SPP 2115: Polarimetric Radar Observations meet Atmospheric Modelling (PROM)

Gregor Möller[2] and Eleni Tetoni[1]

Florian Ewald[1], Silke Groß[1], Martin Hagen[1], Christoph Knote[2], Qiang Li[1], Tobias Zinner[2]

1: Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt, Oberpfaffenhofen (DLR)
2: Meteorologisches Institut, Ludwig-Maximilians-Universität München (LMU)

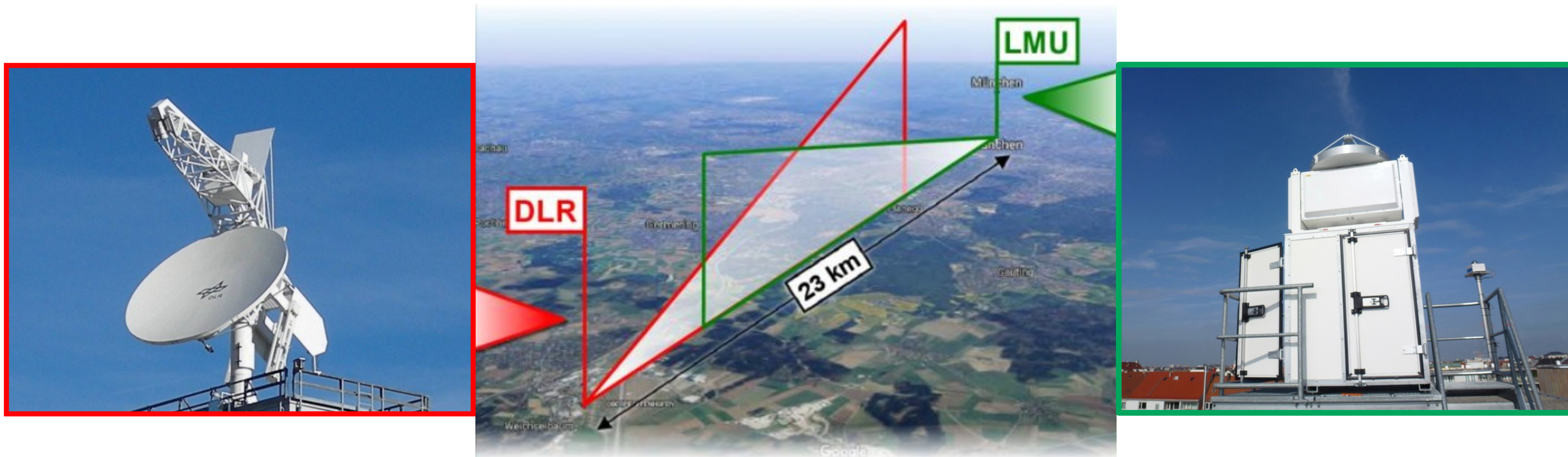
LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN DLR

IcePolCKa:
My role in the project

The life-cycle of cloud and precipitation microphysics in radar observation and numerical model

Motivation	Goals	Planned Methods
Early detection of thunderstorms	Tracking convective clouds over their lifetime	Targeted observations and coordinated scan patterns with two radars
Microphysical processes are a main source of uncertainty	Analyze performance of microphysics parameterizations	Observations aided by data from DWD network
		Numerical modeling using a nested WRF

IcePolCKa:
The instruments



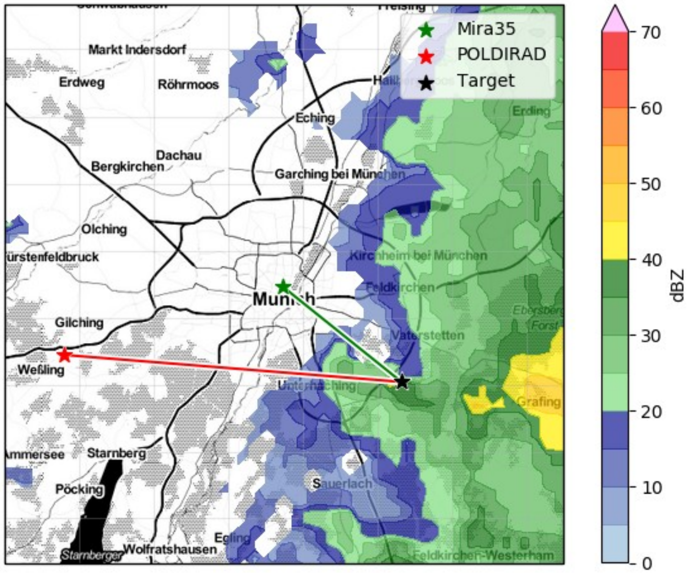
POLDIRAD
C-Band Weather Radar (5.5 GHz, 250 kW)
DLR, Oberpfaffenhofen
Range res: 150 m, Range max: 125 km
4.5 m antenna with 1° beam width
Full polarimetric (ZDR, KDP etc.)

Mira35
Milimeter Cloud Radar (35 GHz, 30 kW)
LMU, Munich
Range res: 30 m, Range max: 30 km
1 m antenna with 0.6° beam width
Linear Depolarization ratio (LDR)

Measurements:
Scan strategies

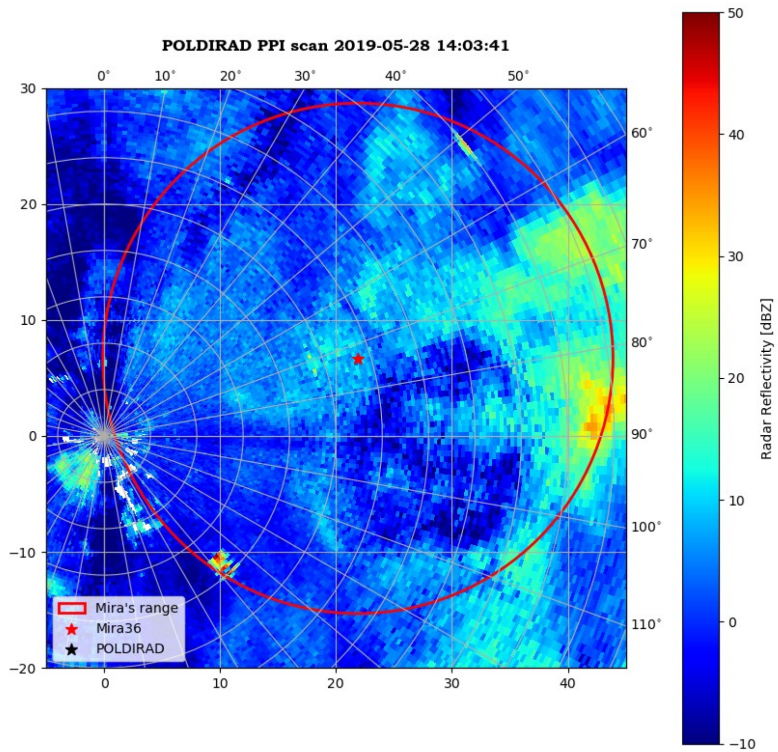
Goal: Tracking of complete convective life-cycle

On-axis scans	Off-axis scans
Intersection along 2D plane	Intersection along 1D profile
Easy setup	Difficult to coordinate, cells must be tracked and followed
Convective cells rarely exactly on-axis	Allows following cells over their life-cycle



Off-axis profiles:
Measurement procedure

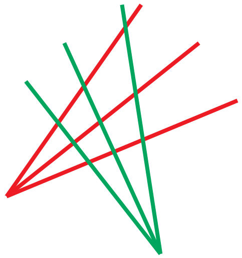
- Plot of the latest POLDIRAD PPI
- User can pick target by mouse click
- Both radars run RHIs into target direction
- Precipitation movement is tracked automatically
- Radar azimuth direction is automatically adjusted



Variation **SRHI**: Three fast RHIs

1) Into target direction
2) Two degrees left of target
3) Two degrees right of target

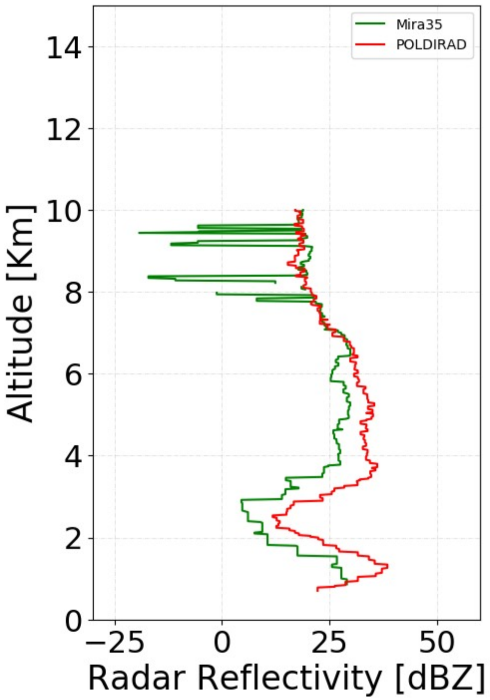
3x3 points of intersection

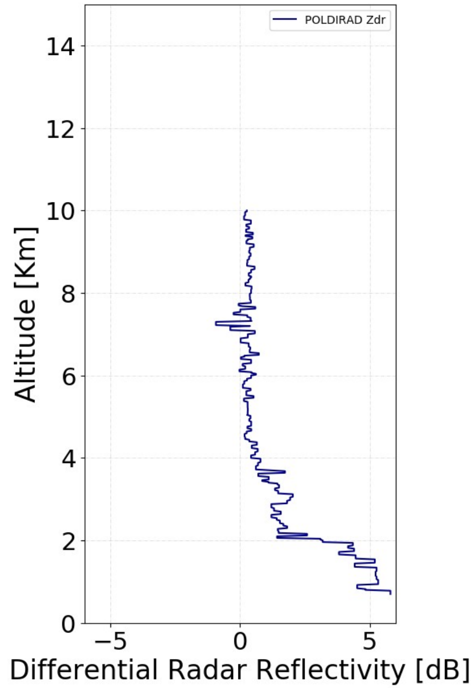


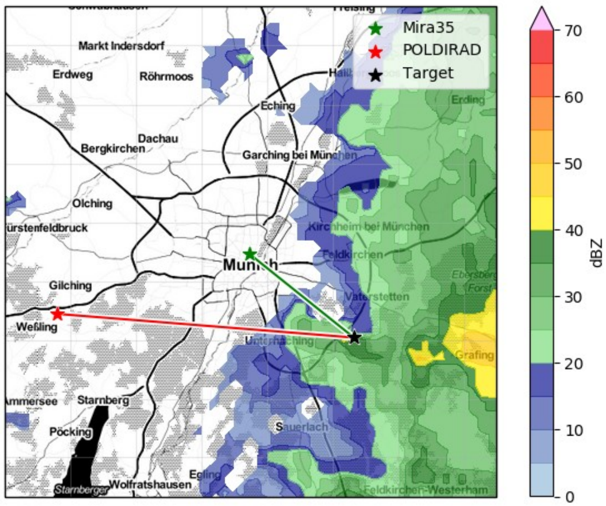
LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN DLR

Off-axis profiles:

First cases





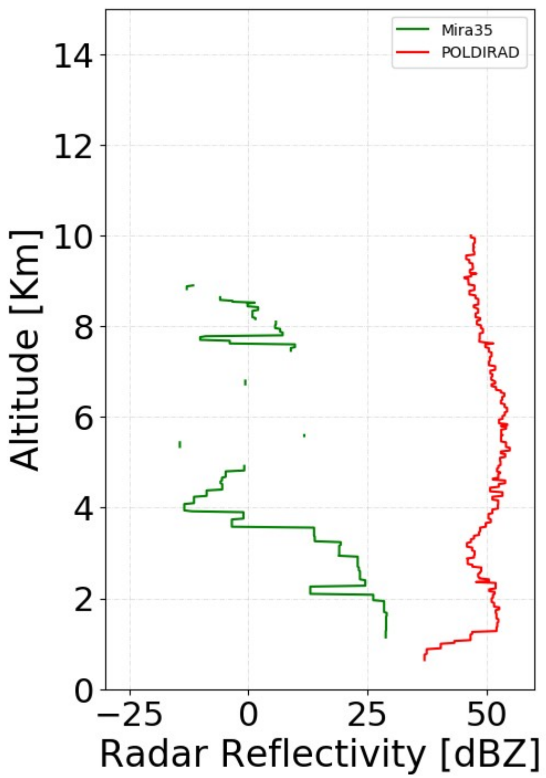


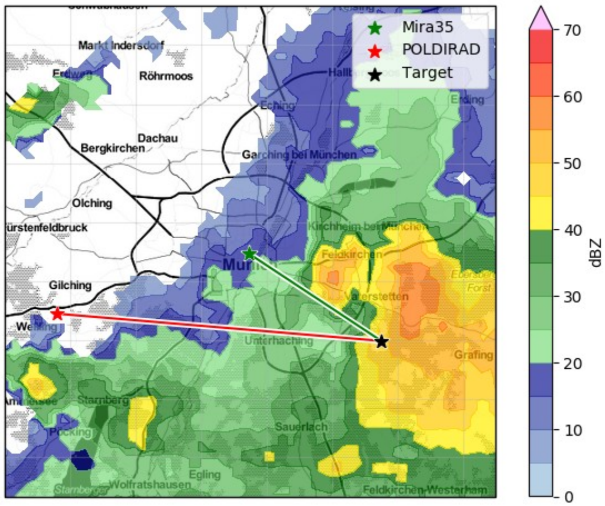
In some cases: good agreement

Polarimetric and dual wavelength parameters available

Microphysical parameters retrievable

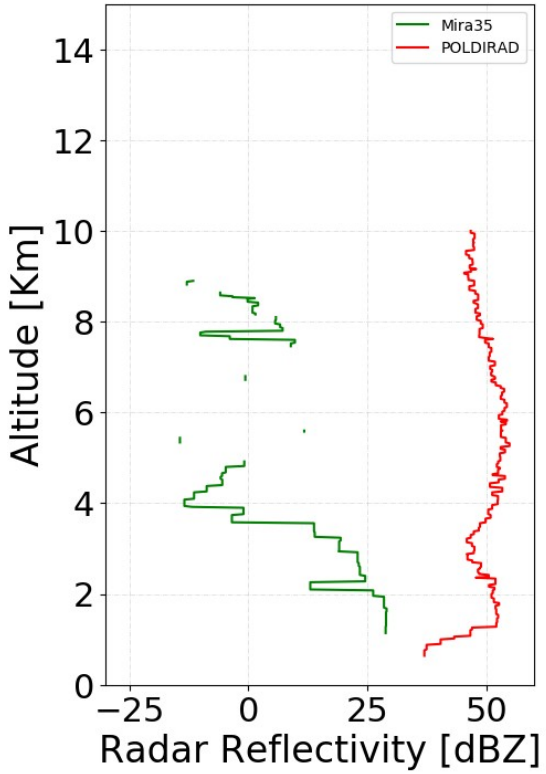
Off-axis profiles:
First cases

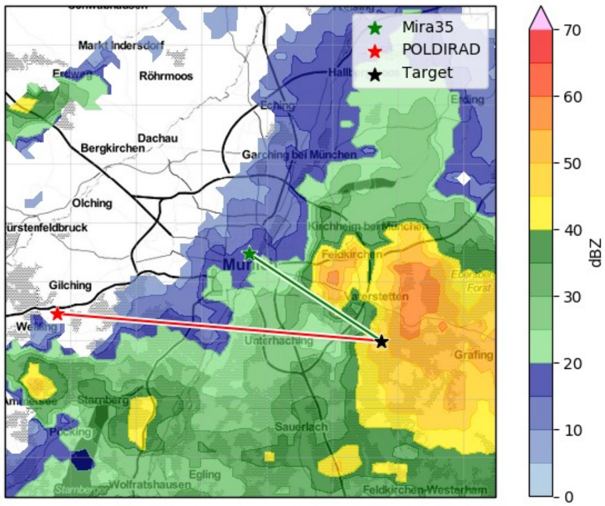




- In other cases: no agreement
- Possible reasons:
  - Different beam volume
  - Different sensitivity
  - Different attenuation

Off-axis profiles:
First cases



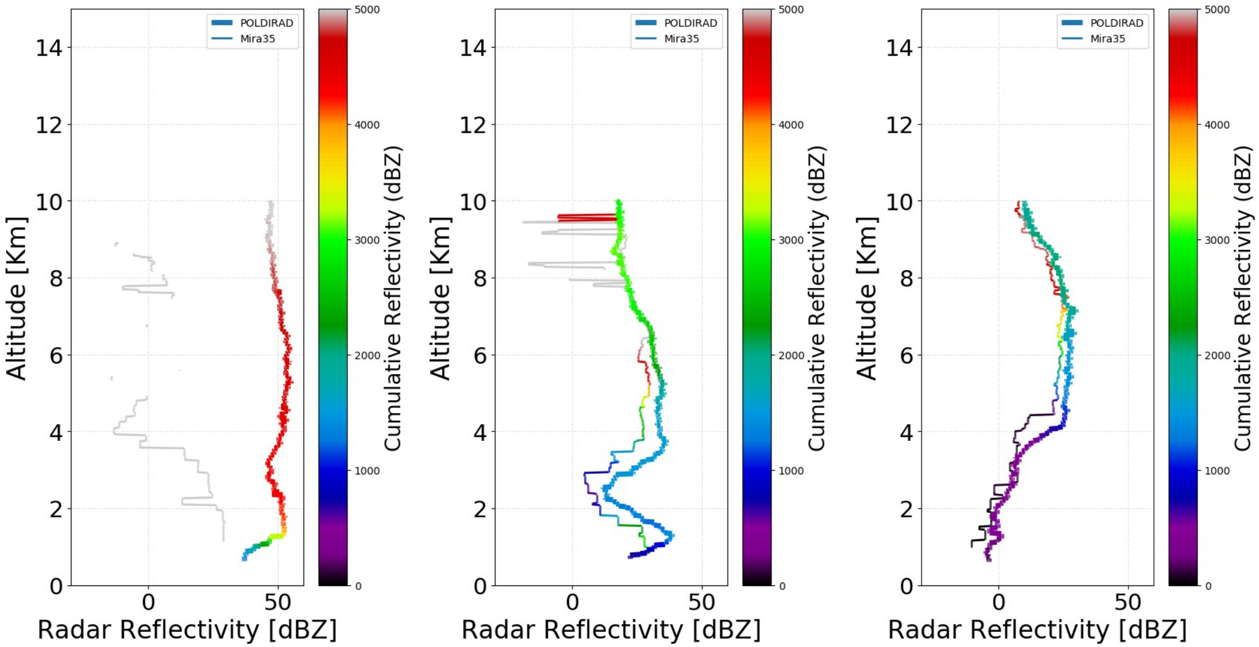


- In other cases: no agreement
- Possible reasons:
  - Different beam volume
  - Different sensitivity
  - Different attenuation

→ **Influence of attenuation?**

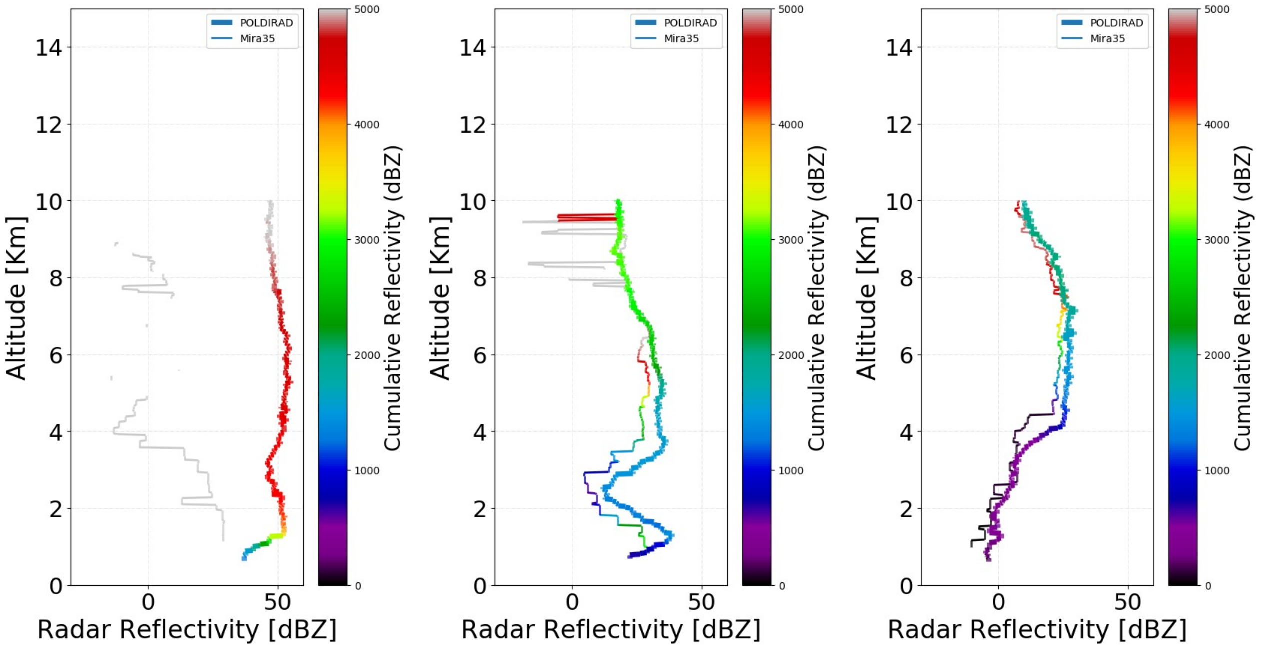
IcePolCKa
LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN
DLR

Off-axis profiles:
First attenuation estimation



- Cumulative reflectivity as first attenuation indicator
- No correlation visible
  - Cumulative reflectivity not a good indicator?
  - Attenuation not the reason for differences?

Off-axis profiles:
First attenuation estimation

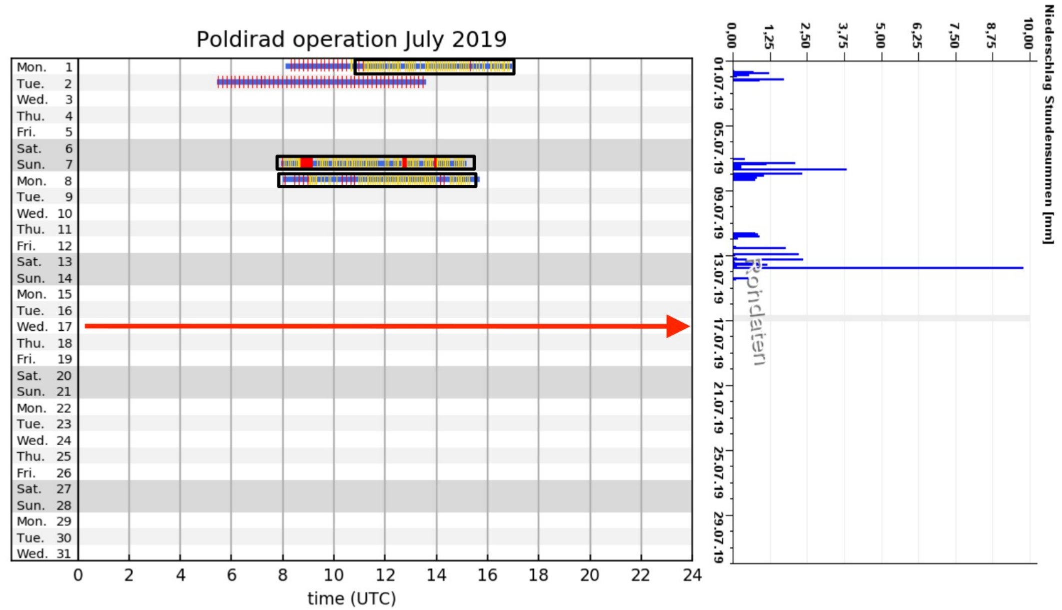


- Cumulative reflectivity as first attenuation indicator
- No correlation visible
  - Cumulative reflectivity not a good indicator?
  - Attenuation not the reason for differences?

Better attenuation estimation needed!

Campaign Recap:
April to July

- Executed many coordinated RHI-scans with Poldirad and Mira35
- Applied two different strategies:
  - On-axis scans
  - Off-axis scans



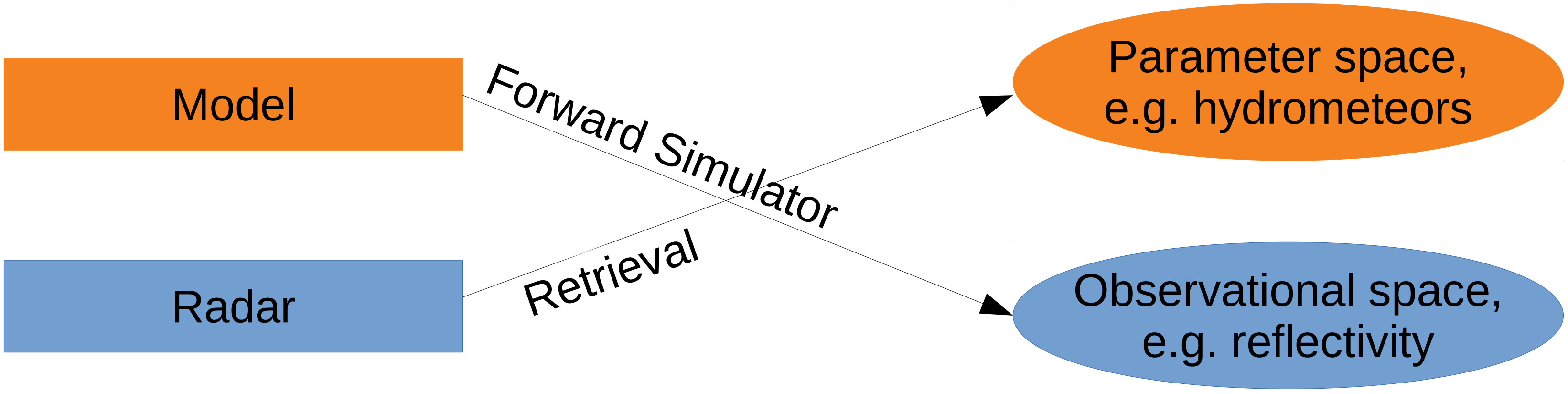
In total: 246 RHI-scans
- On-axis: 97
- Off-axis: 149

23 measurement days
- On-axis: 19
- Off-axis: 10

Towards modelling:
Strategies to compare model and observation

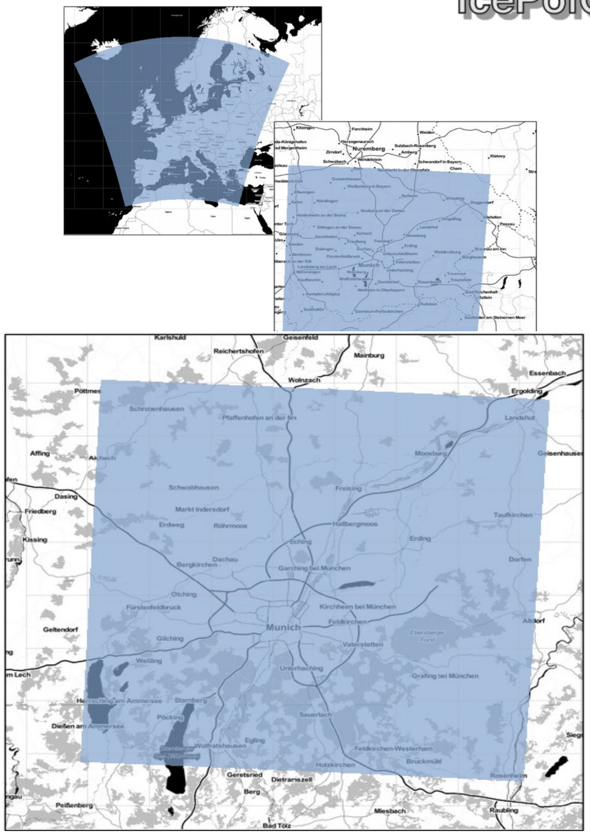
Goal: Improvement of microphysics schemes

- Use polarimetric and dual-wavelength measurements to analyze model performance
- Comparison in parameter space and observational space
- Use as many measurements as possible to get sound statistics



WRF simulations:
Model setup

- Three domains: Europe, Germany, **Munich**
- Global model: **GFS**, **ECMWF**
- Different **MP**-schemes:
  - **Bulk** (Thompson 1-moment, Morrison 2-moment, Milbrandt and Yau 3-moment)
  - **Spectral Bin** (Fan et al. 2012)
  - **P3** (Morrison and Milbrandt 2015)
- Simulation of all measurement days



Munich domain with resolution of 400 m

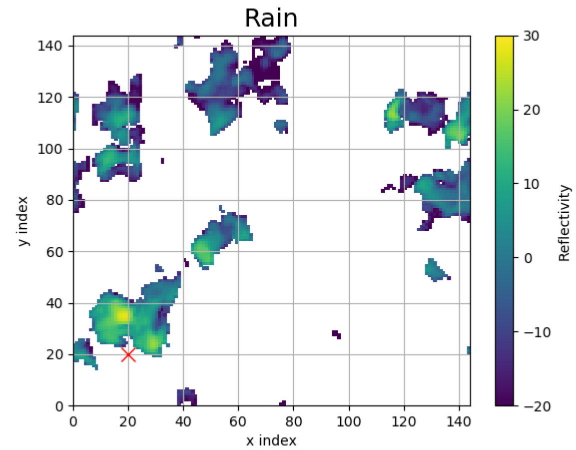
LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN
DLR

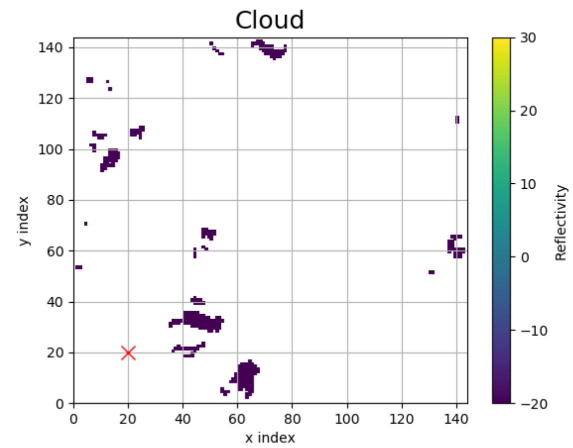
Summary:
and next steps

- Applied two dual-wavelength scan strategies
- Matched Off-axis profiles
- Applied first attenuation estimator
- Started first WRF simulations
- Started first CR-SIM simulations

Coming next

- Better attenuation estimation
- Compare model and observations
- Decide on Forward Simulator





LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN
DLR