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)

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IcePolCKa:
Introduction

Analyzing convective cloud and precipitation microphysics in radar observation and numerical model

Motivation: Microphysical processes a main source of uncertainty

- Uncertainty coming from model microphysics not well quantified
- Not fully understood which physical processes are responsible for the uncertainties
- Early detection of convection to better understand life-cycle

Goals and methods

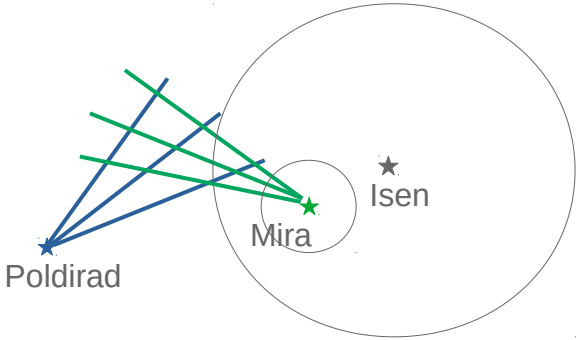
- Targeted observations and coordinated scan patterns with two polarimetric radars
- Tracking of convective clouds over their life-time
- Numerical modeling using different microphysical schemes
- Analyze performance of microphysical schemes

IcePolCKa:
Measurement overview

Recap 2019

- Targeted dual-frequency observations of convective cells
  - ➢ Poldirad (C-Band) and Mira (Ka-Band)
- In total: **149** targeted RHI-scans over **10** days of **36** different convective cells

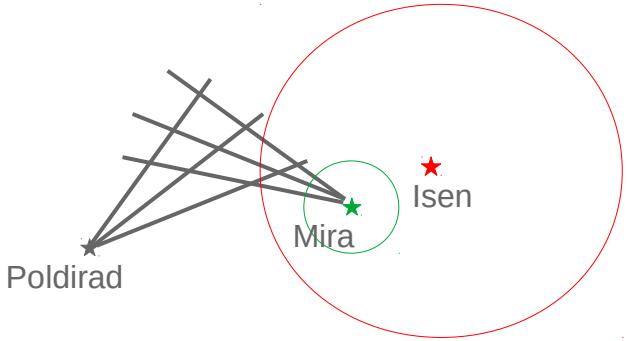
RHI scans at varying azimuth angles



New strategy since 2020, because Poldirad stuck on Barbados

- Now: C-Band data from DWD network
- Operational volume scans every 5 min
- Observations not targeted anymore

PPI scans at varying elevation angles



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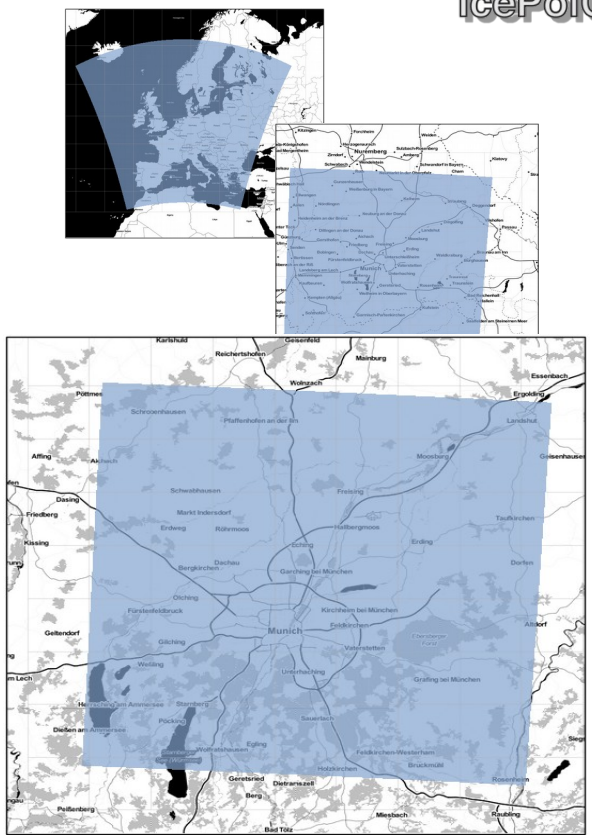
WRF simulations:

Numerical model setup: WRF v.4.2

- Three domains: Europe, Germany, **Munich**
- Global model: **GFS**
- Different **MP**-schemes:
  - **Bulk** (Kessler 1-moment, Morrison 2-moment, Thompson 2-moment)
  - **Spectral Bin** (Khain et al. 2010)
  - **P3** (Morrison and Milbrandt 2015)
- Simulation of all measurement days
- Forward simulation with CRSIM

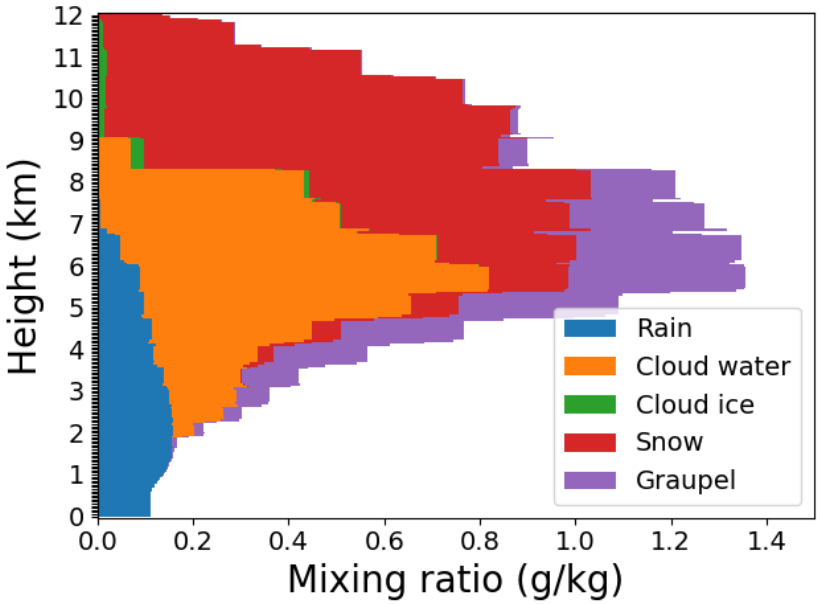


Munich domain with resolution of 400 m

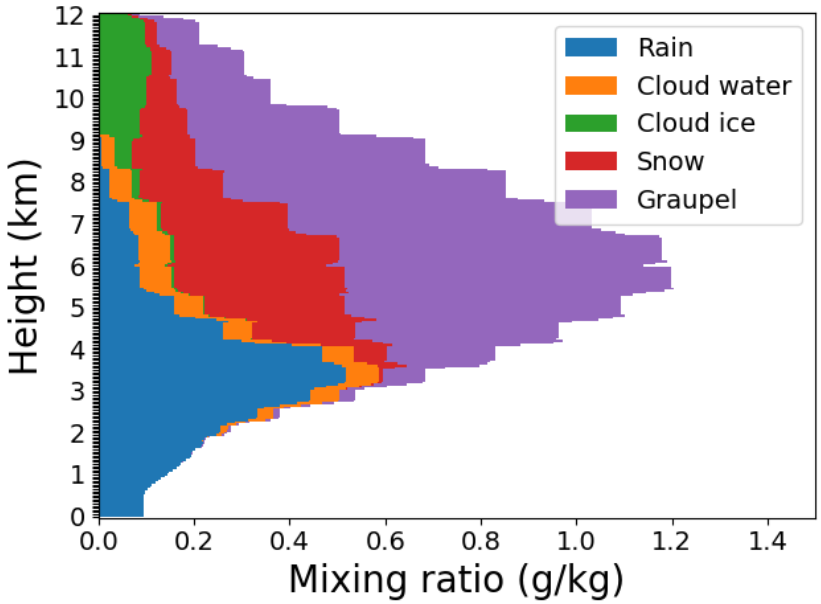
WRF simulations:
Differences between MP schemes

Average mixing ratio of all cells over ~5 simulation hours

Thompson et al. 2008



Morrison et al. 2009

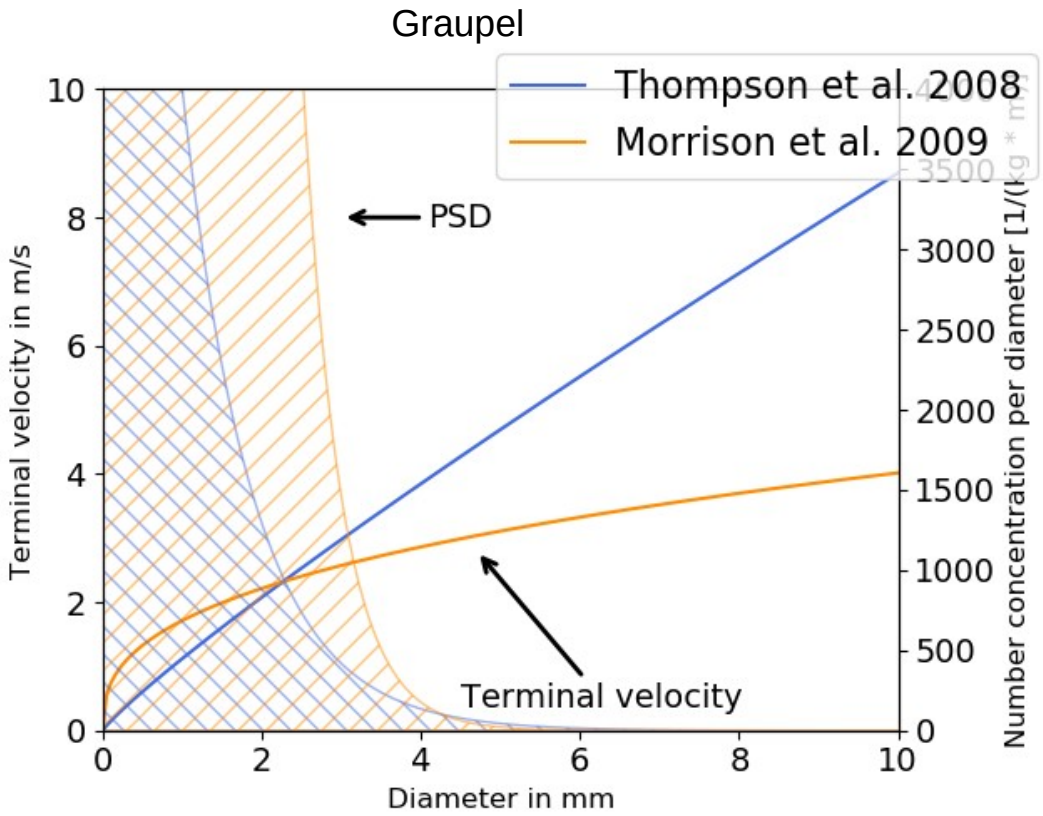


1) Reason for differences?

2) Which one is closer to reality?

Microphysic schemes:
The physics behind

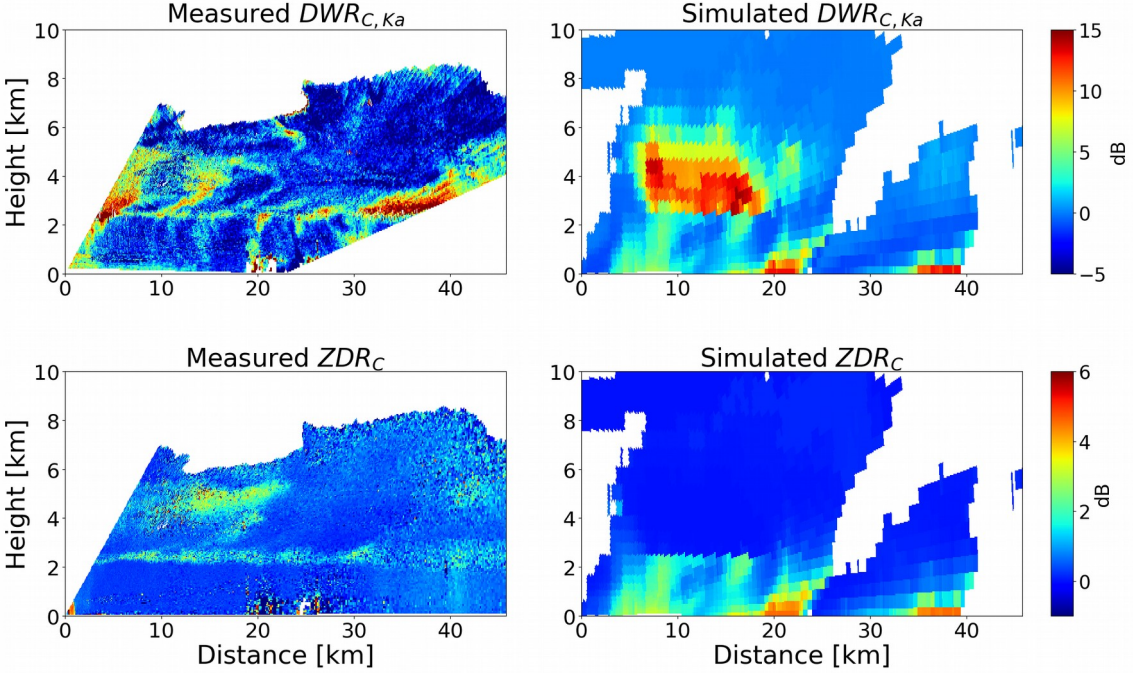
Average terminal velocity and PSD at melting height over ~ 5 hours



- Thompson terminal velocity higher for Graupel > 2 mm
- Some Graupel > 2 mm present
  - ➢ This could point towards Thompson Graupel falling further below the melting height
  - ➢ Comparison to measured Doppler Spectra could give an idea about fall speeds in reality

WRF simulations:
Statistical comparison to observations

Example observables of a simulated RHI scan



- Capable of producing the same observables from simulation and observation
- Comparison in radar space
  - Reflectivity Z
  - Differential reflectivity ZDR
  - Dual-wavelength ratio DWR

Summary:
and next steps

- Two dual-frequency measurement strategies: Targeted RHI scans and operational volume scans
- Model setup: WRF, CR-SIM and TINT
- Comparison of MP-schemes: Differences in hydrometeor abundance and physics behind
- Comparison to observations: Producing the same observables (RHI of DWR, ZDR, ...)

Coming up next

- Track down reasons for MP-differences
- Compare model and observations on a statistical basis