



Usability of COSMO-EU Model Liquid Water Output for In-Flight Icing Warnings

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Motivation

- Aircraft icing is one of the most dangerous hazards to aviation.
- Especially smaller aircrafts are more affected.
- Only a reliable diagnosis and forecast can help pilots to avoid hazardous icing conditions.
- **ADWICE**



Outline

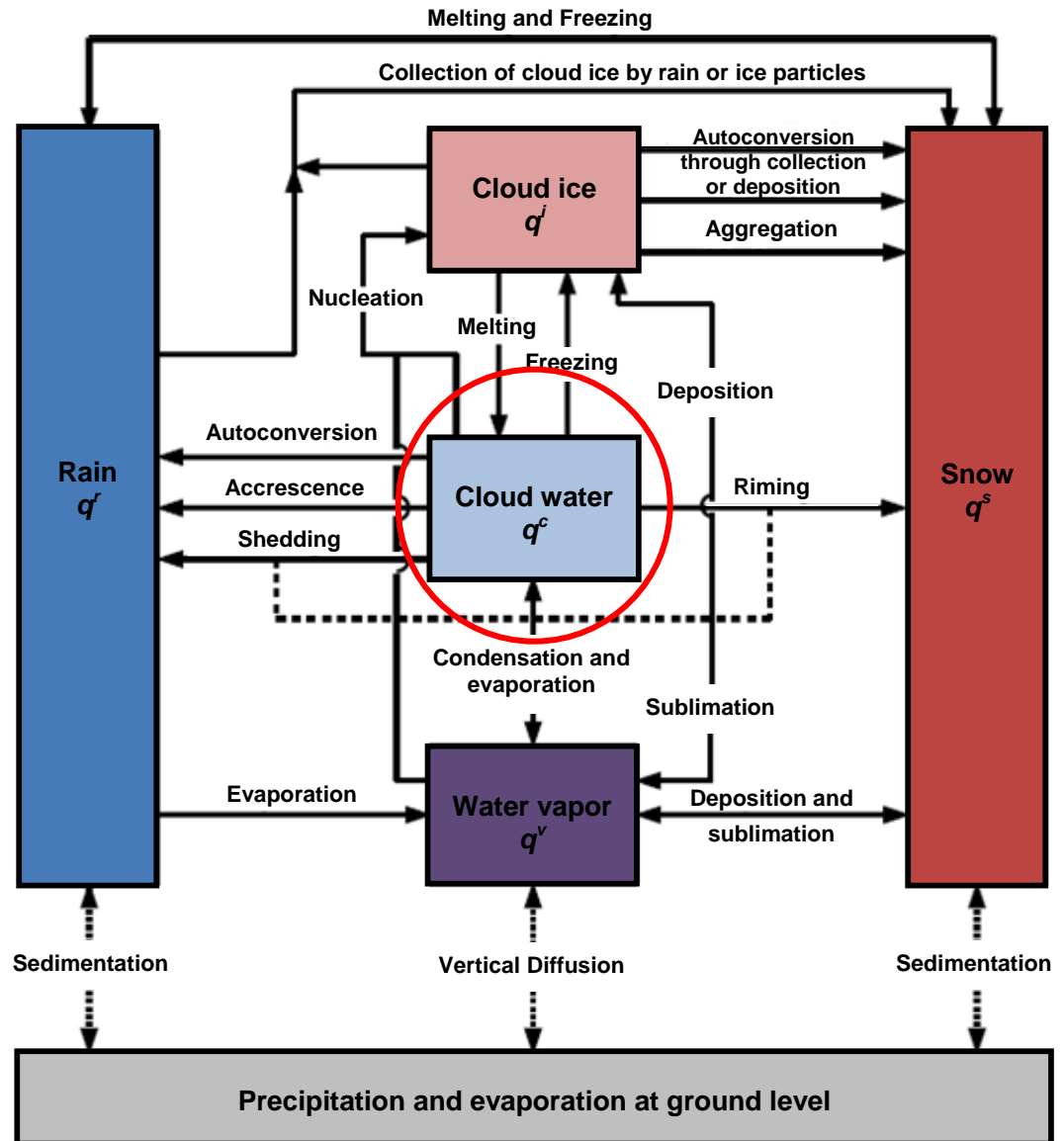
- Meteorological conditions leading to aircraft icing
- COSMO-EU liquid water output
- Weisman and Klemp test case
- Recent experiments

Meteorological conditions

- Flight through super-cooled liquid water
- Temperature range: normally $-12^{\circ}\text{C} < T < 0^{\circ}\text{C}$
in updrafts $-40^{\circ}\text{C} < T < 0^{\circ}\text{C}$
- Super-cooled liquid water occurs: in convective systems
in stratiform clouds
in “clean” air with a small number of ice nuclei
- Three influencing factors to icing intensity: temperature
droplet size
liquid water content (LWC)

COSMO-EU Microphysics

- Five microphysical classes
- Class is defined by its mass concentration q^ψ
- Bulk parameterization to describe the conversion terms
- Most interesting:
cloud water



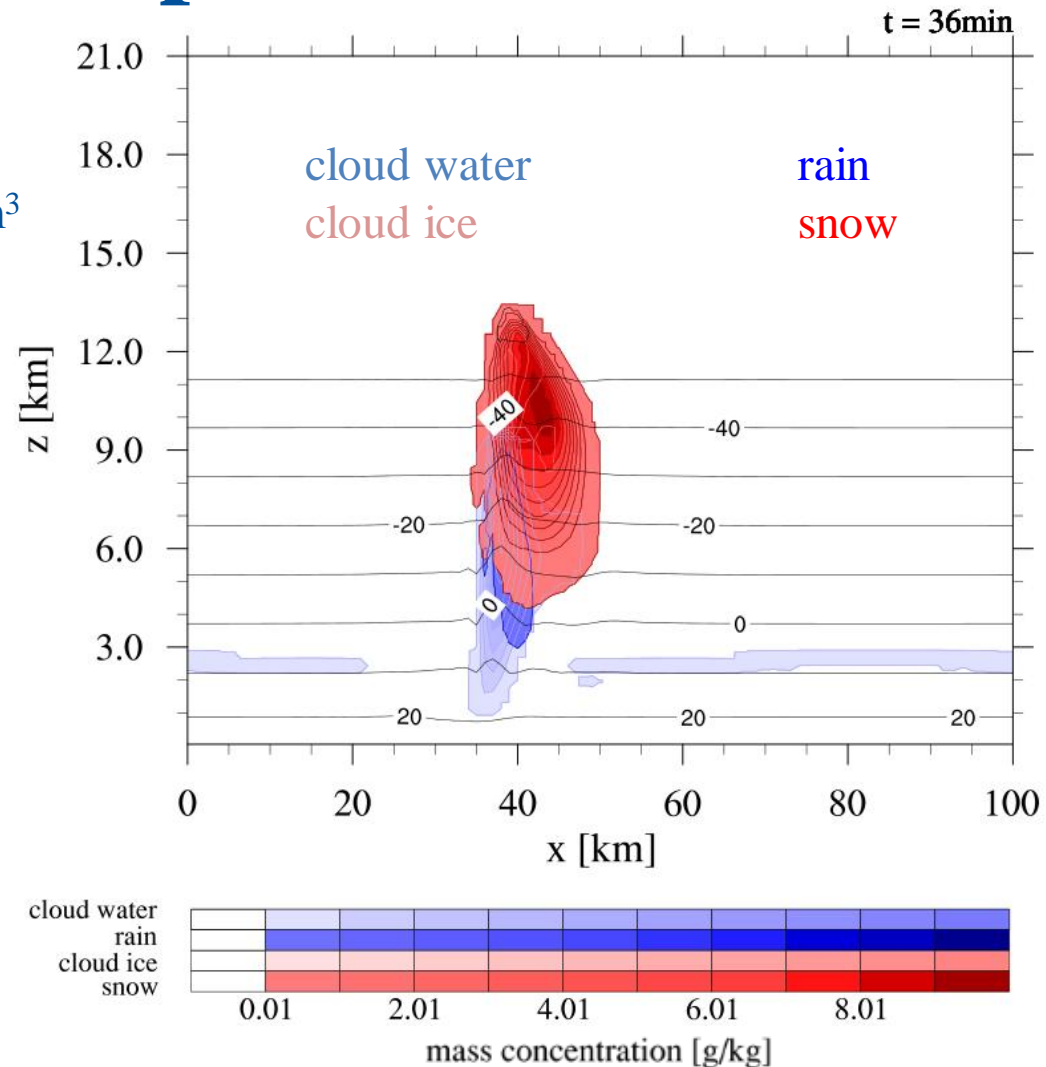
Forecast quality of COSMO LWC

- COSMO-US Experiment: COSMO-EU over the Eastern US in winter 2009/2010
- Comparison of COSMO-US cloud water forecasts to pilot reports concerning aircraft icing
- Results:
 1. COSMO-EU forecasts too small amounts of LWC in the vicinity of icing PIREP observations.
 2. The predicted spatial distribution of LWC shows unacceptable deficiencies in comparison to icing PIREPs.

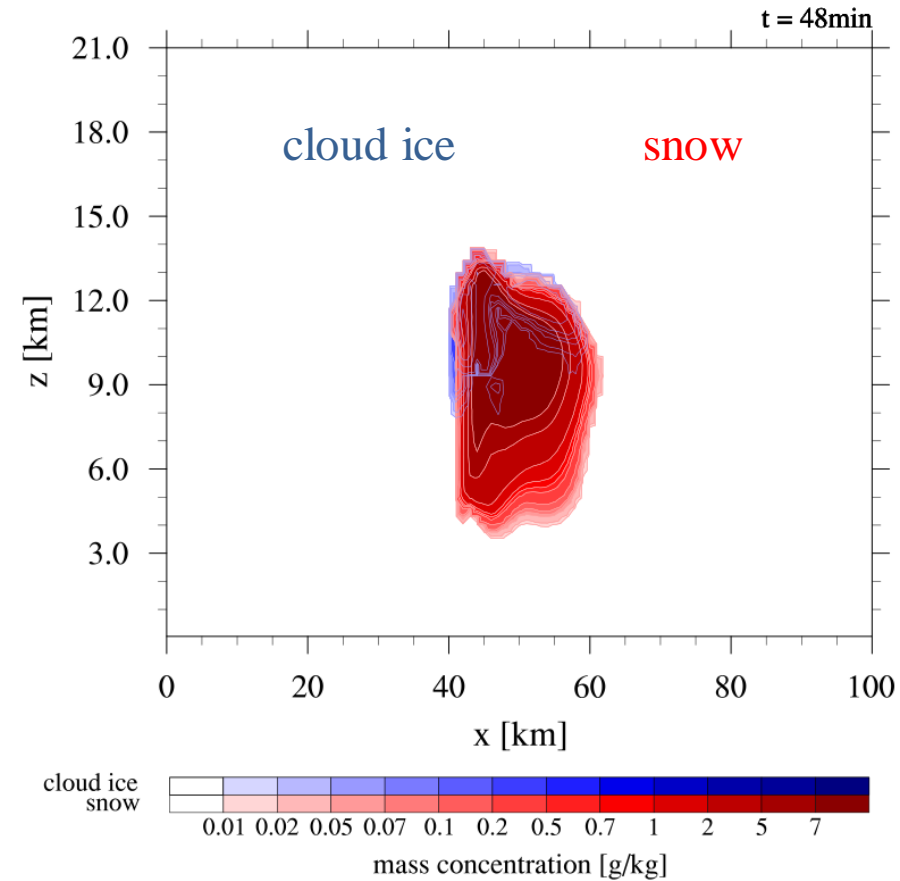
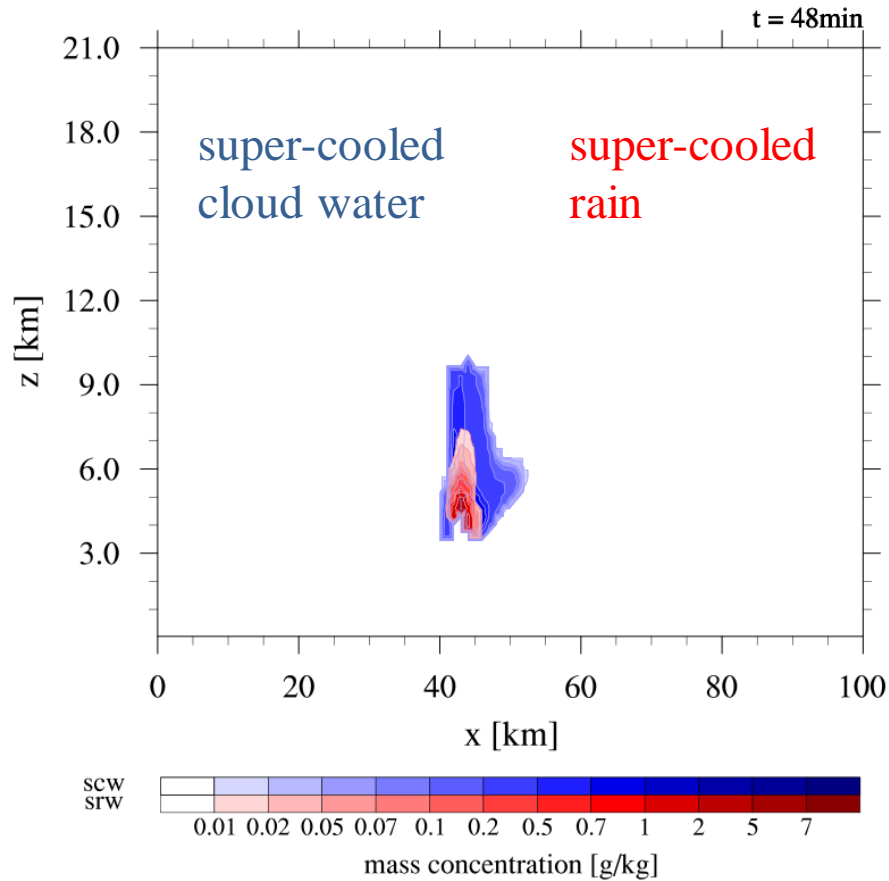
K.Roloff, 2012: Untersuchung zur Eignung wolkenmikrophysikalischer Parameter des numerischen Wettervorhersagemodells COSMO-EU zur Vereisungsprognose in ADWICE. Master thesis. Leibniz Universität Hannover. 141pp.

Weisman and Klemp Test Case I

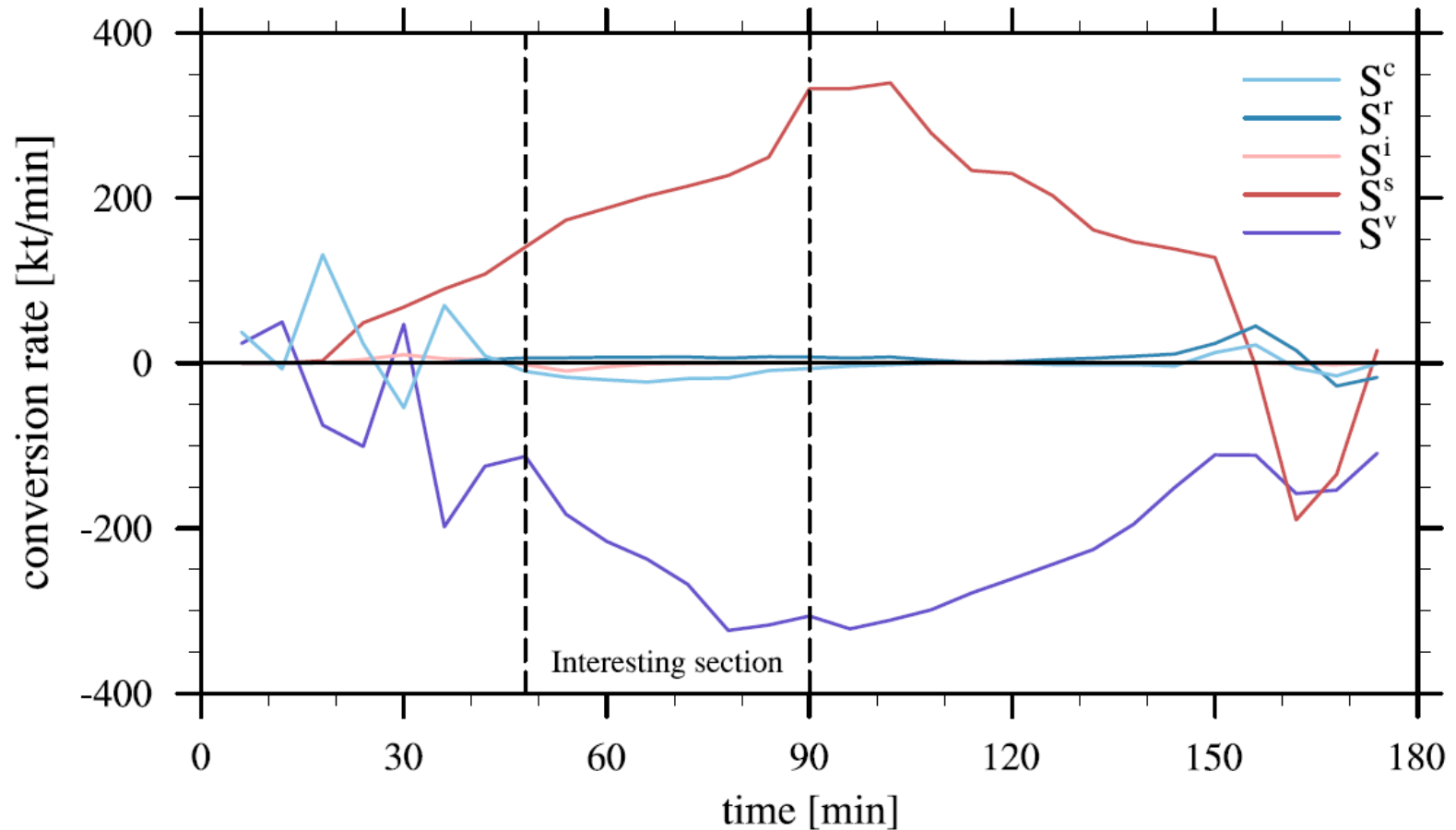
- Model domain: 100 x 100 x 20 km³ without orology
- Horizontal resolution: 1 km
- Vertical resolution: 64 layers
- Horizontal homogenous, vertical profiles for T , rH , u , v
- Constant inflow in x -direction
- Initialization of a warm bubble



Weisman and Klemp Test Case II



Weisman and Klemp Test Case III



Time series of the conversion terms S^ψ .

Conclusion



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- COSMO-EU predicts too small amounts of LWC in a wrong spatial distribution.
- Freezing processes are simulated too fast in its microphysical scheme.
- Potential reasons are identified and improvements are planned.
- For now, it is not advisable to use this field for aircraft icing forecasts additionally.

Thank you for your kind attention!

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