Improved predictions of supercooled liquid water and atmospheric icing in the HARMONIE-AROME weather prediction model

Photo: Ole Gustav Berg

Norwegian Meteorological Institute

Bjørg Jenny Kokkvoll Engdahl

Photo: Ole Gustav Berg

Thesis goal:

Improve the representation of supercooled liquid water in the HARMONIE-AROME weather forecast model, and downstream forecasts of atmospheric icing

Objective

WRF
Thompson

AROME
ICE3

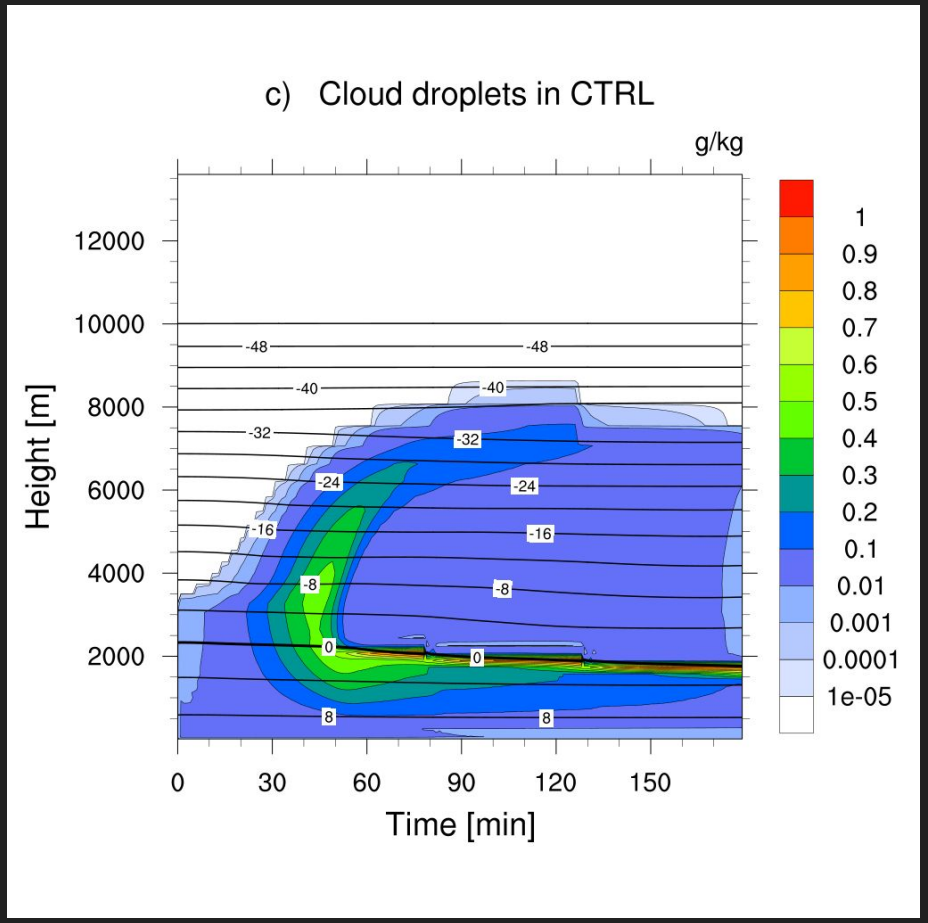
Objective

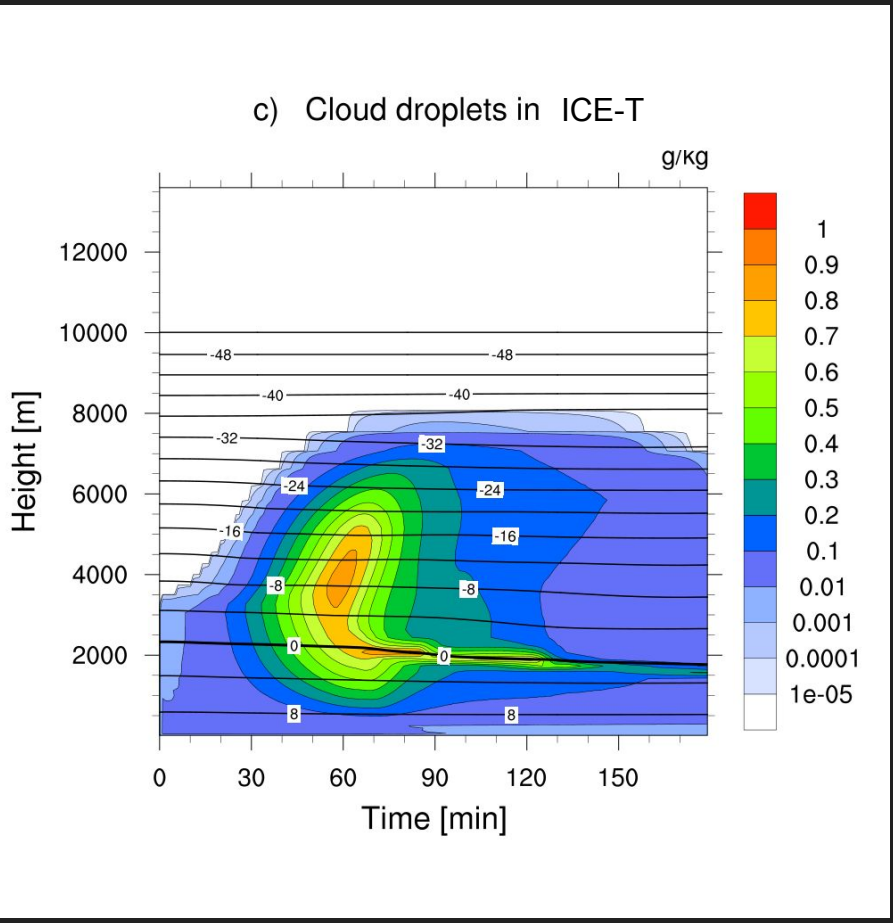
WRF
Thompson

AROME
ICE3

= ICE-T

Change in supercooled liquid water





Part II: Reality check

Real case simulations

3 month 3D simulations with CTRL and ICE-T

2.5 km, 65 levels

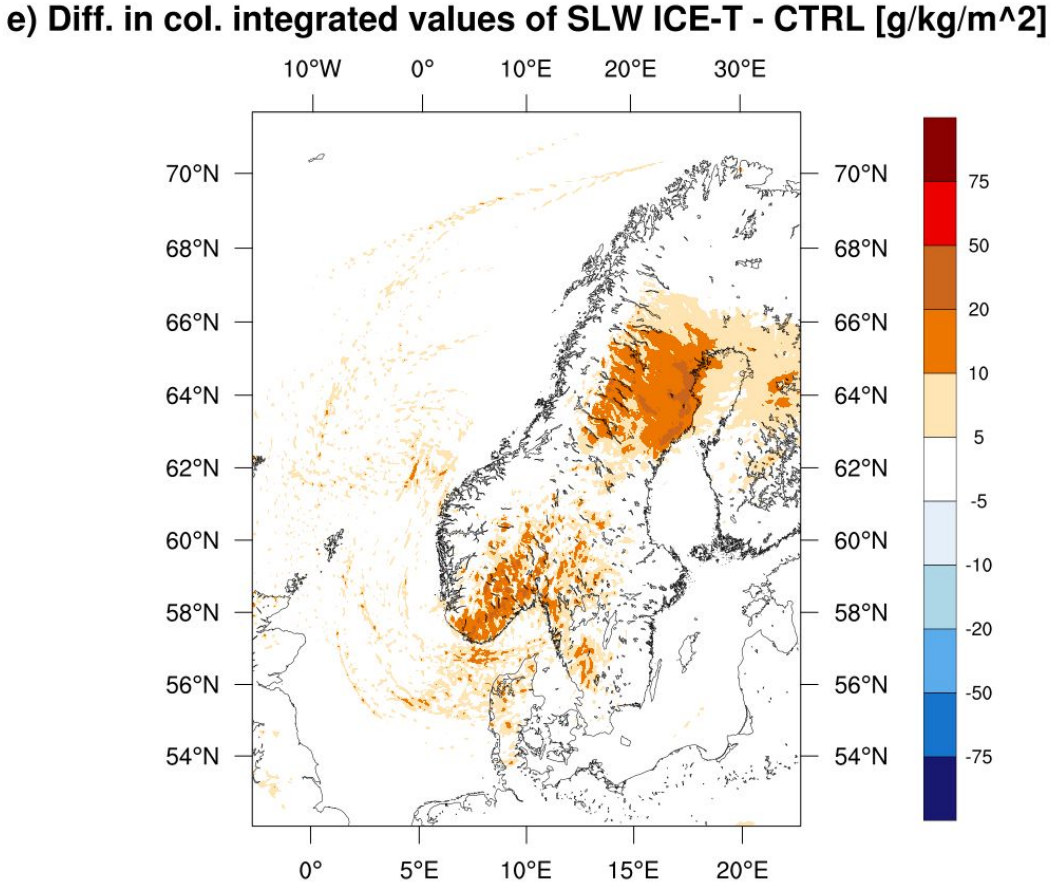
Ice loads on Hardingnuten, and Ålvikfjellet

Conventional observations

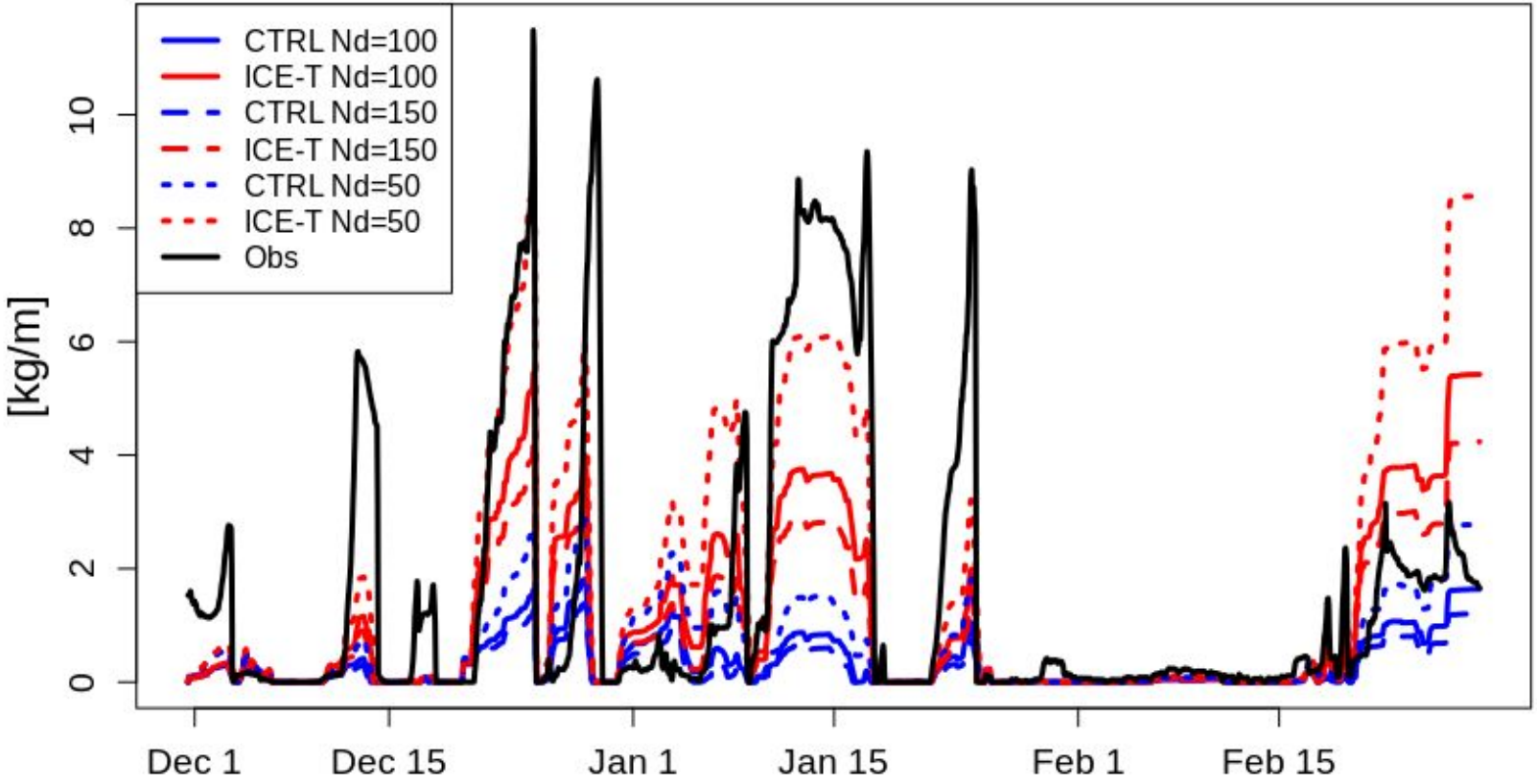
Photo: Kjeller vindteknikk

More supercooled liquid water

Difference in supercooled liquid water between ICE-T and CTRL

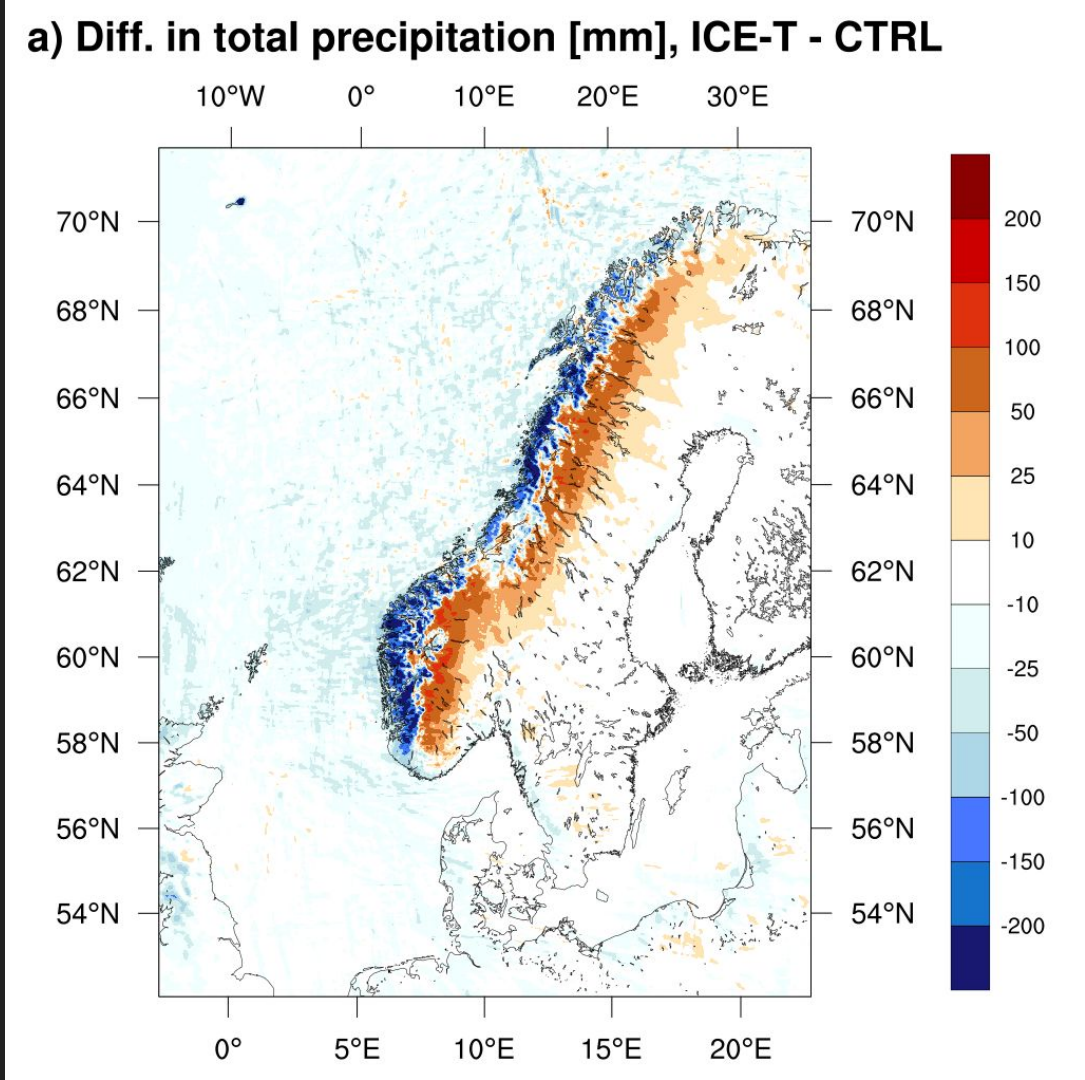


a) Iceloads Ålvikfjellet Dec 1 2016 - March 1 2017



Changed precipitation pattern

Difference in precipitation between ICE-T and CTRL



Part III: Take-off!

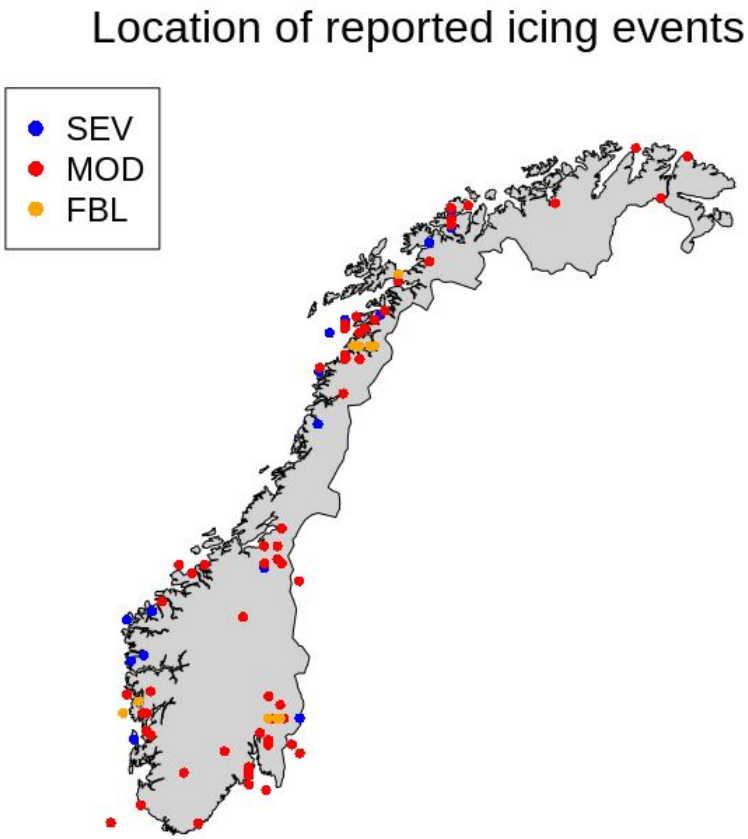
Photo: shutterstock

Method

Same 3 month data set

Pilot reports

Satellite data



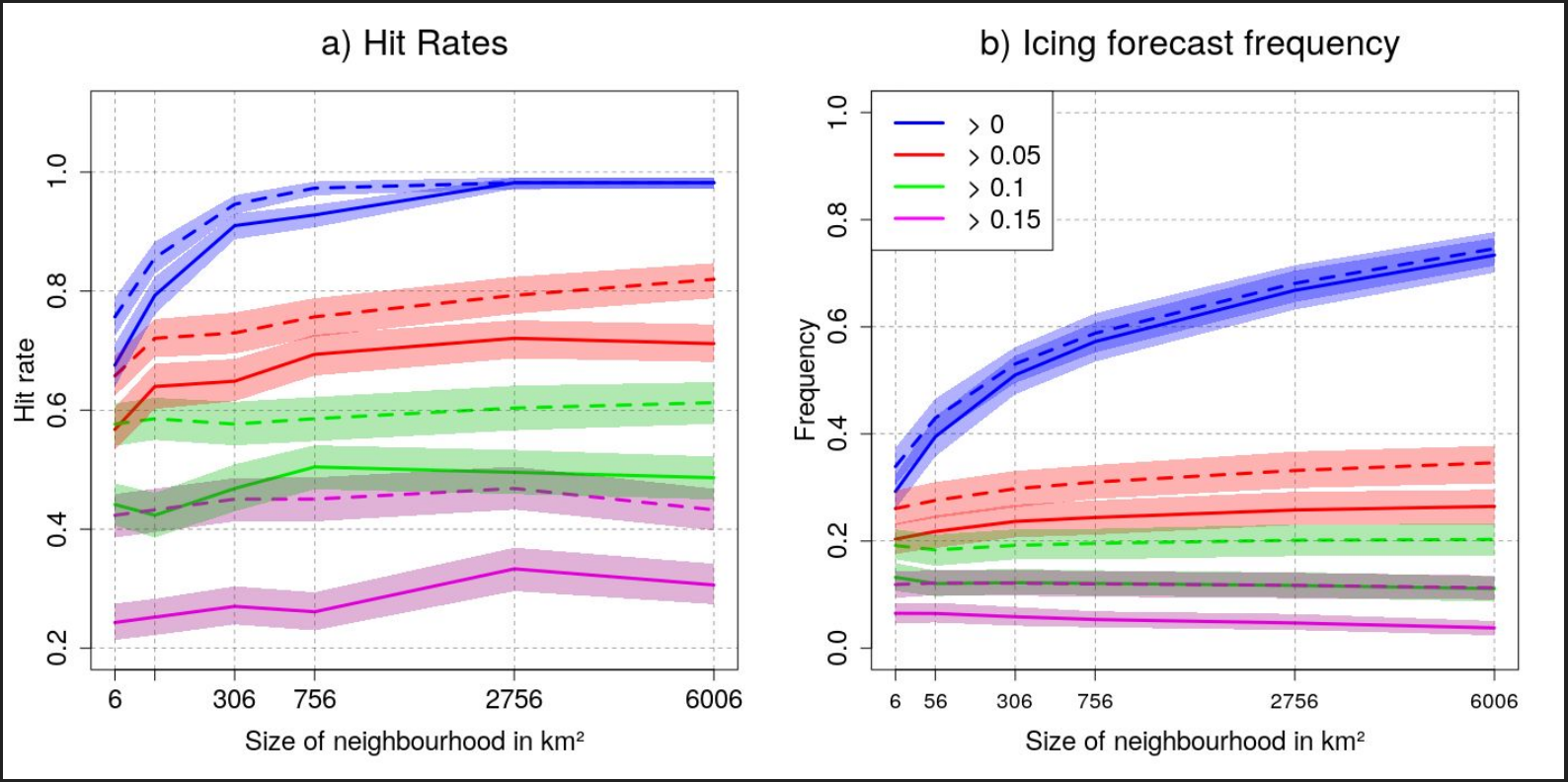
Neighbourhood

neighbourhood areas: 6, 56, 306, 756, 2756, and 6006km^2

Thresholds: > 0% (any icing), 5%, 10% , 15%

Hit rate and icing forecast frequency

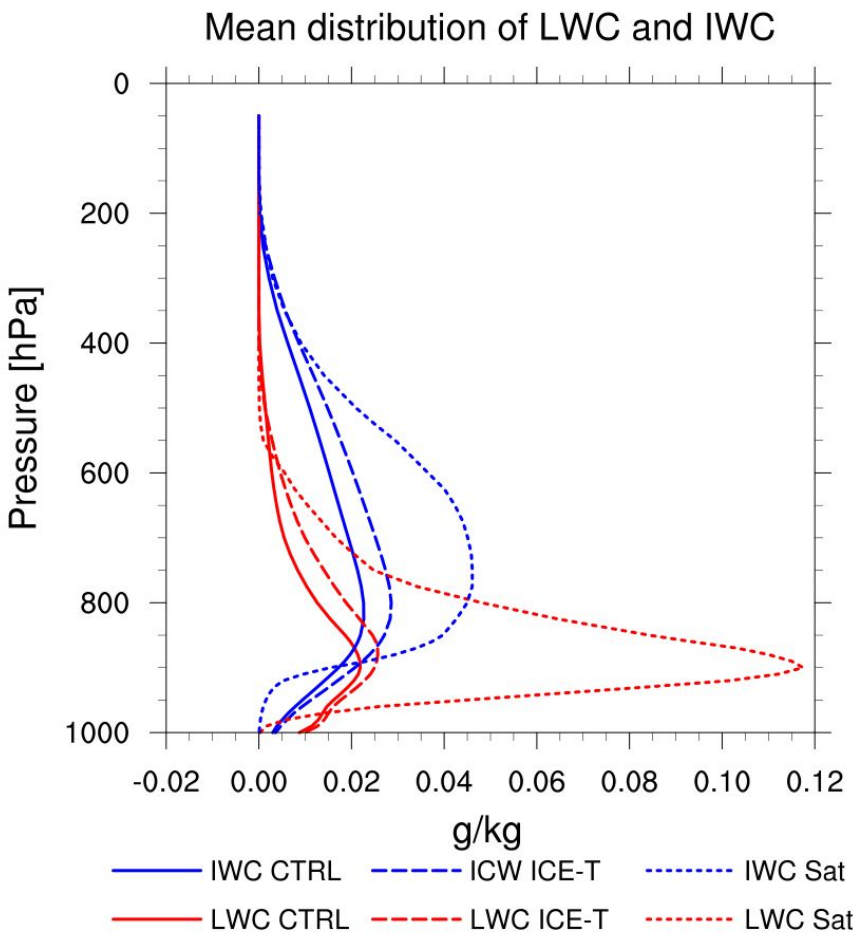
Increased hit rates and Icing forecast frequencies with ICE-T (dashed lines) compared with CTRL (solid lines)



Atmospheric profiles of liquid and ice

Vertical profiles of liquid (red lines) and ice (blue lines)

Satellite profiles from CloudSat-CALIPSO



Thesis conclusions

Modified important processes

Leads to increased

- supercooled liquid water
- ice loads
- forecasts of icing

Better match

- ice loads
- hit rates
- satellite

Supercooled liquid water could still be underestimated

Shift in precipitation pattern

Photo: Greg Thompson

Thank you for your attention!

Photo: Ole Gustav Berg