The Thompson scheme in HARMONIE-AROME

A freezing drizzle case

Photo: Greg Thompson

Results from implementing elements from the Thompson microphysics scheme into HARMONIE-AROME

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Part of the WISLINE project lead by MET-Norway

Why?

Main goal: Improve the representation of supercooled liquid water in HARMONIE-AROME

How?

How?

Cy40h1

OCND2 active + bug fix

Experiment	Process Altered	Previous	New
CTRL	Heterogeneous ice nucleation	Code mistake	Bug fix
BR74	Autoconversion (cloud to rain)	Khairoutdinov and Kogan (2000)	Berry and Reinhardt (1974)
ACC	Rain accreting cloud water	Variable efficiency (OCND2)	Variable efficiency (Thompson)
C86	Heterogeneous ice nucleation	Modified Meyers (1992)	Cooper (1986)
Bigg	Freezing of water drops	None	Bigg (1954)
GCW	Graupel collecting cloud water	Ferrier (1994) for dry growth; Musil (1970) and Nelson (1983) for wet growth	Cober and List (1992)
SCW	Snow collecting cloud water	Farley et al (1989)	Wang and Ji (2000)
RCS	Rain collecting snow	Ferrier (1994); Eff=1.0	New variable collection efficiency
RCG	Rain collecting graupel	Ferrier (1994); Eff=1.0	New variable collection efficiency
HP	Hydrometeor properties	Locatelli and Hobbs (1974)	Thompson et al. (2008)
Y-int	Rain inverse exponential Y-intercept parameter	8 x 10^6 m^{-4} (Marshal-Palmer)	Variable intercept parameter (Thompson et al 2004)

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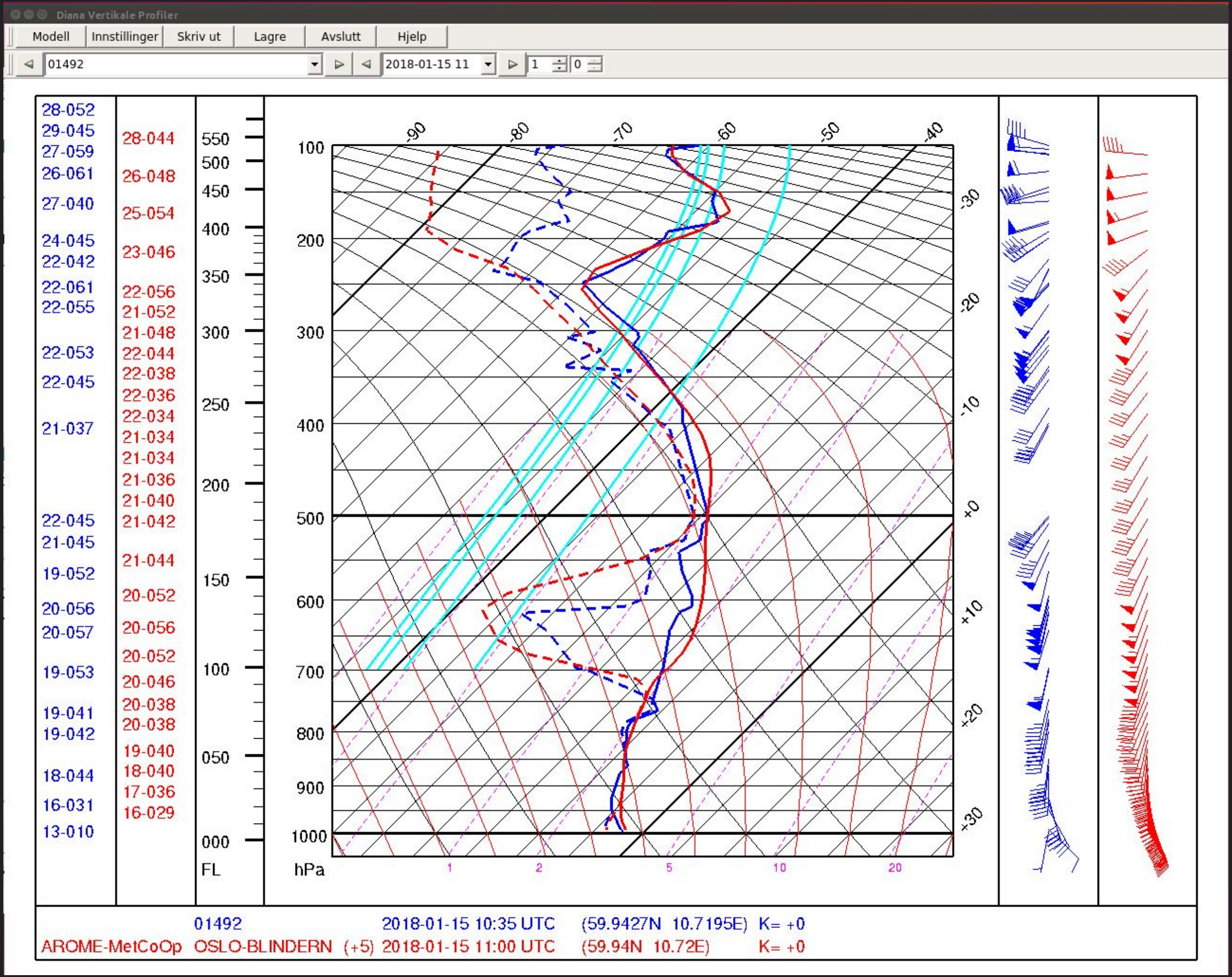
Case study: Oslo Jan 15 2018



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Innstillinger
Skriv ut
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Avslutt
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hPa
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AROME-MetCoOp
OSLO-BLINDERN
(+5)
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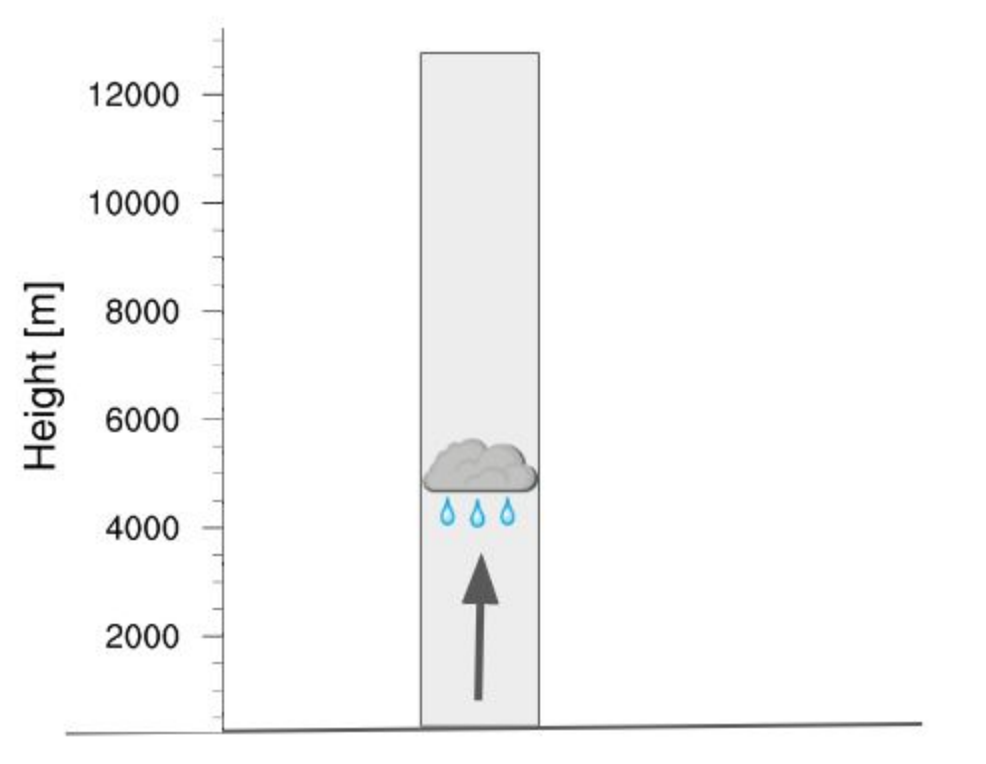
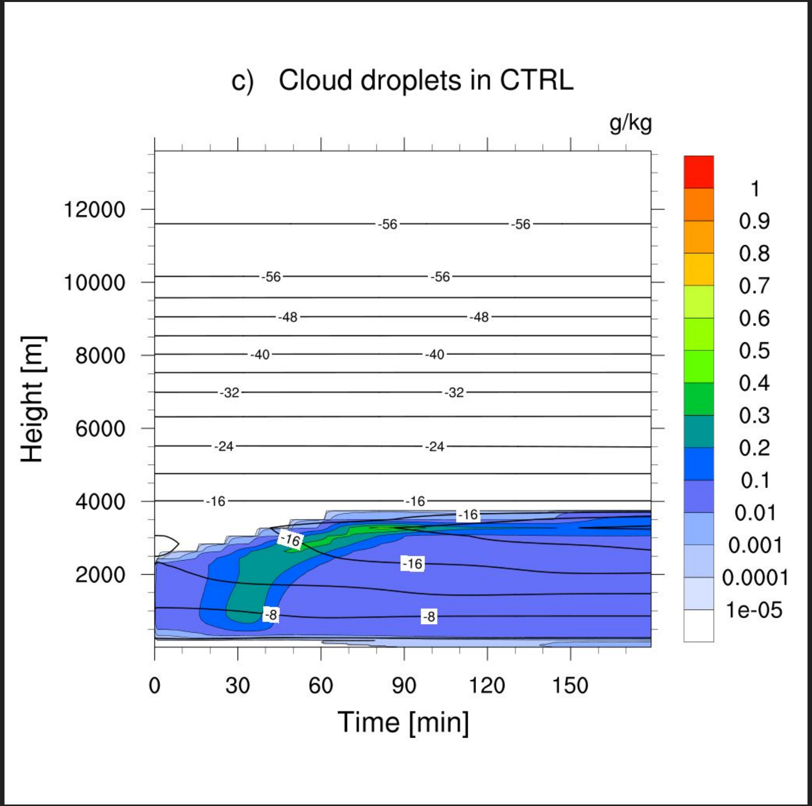
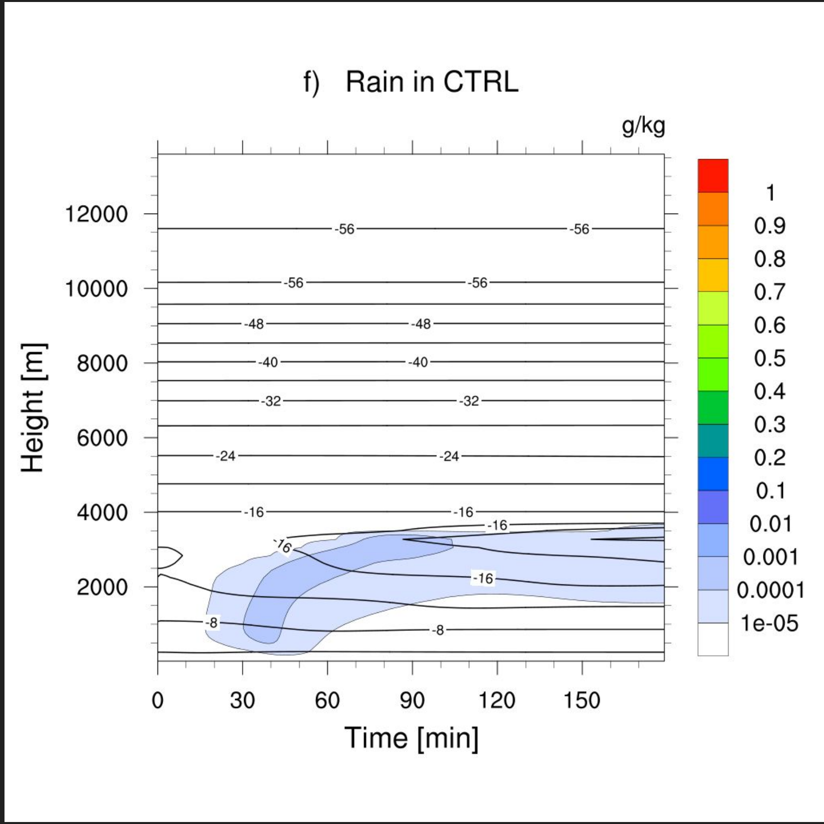
MUSC: idealised case



Cloud droplets



Rain



f) Rain in CTRL
g/kg
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Height [m]
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Time [min]
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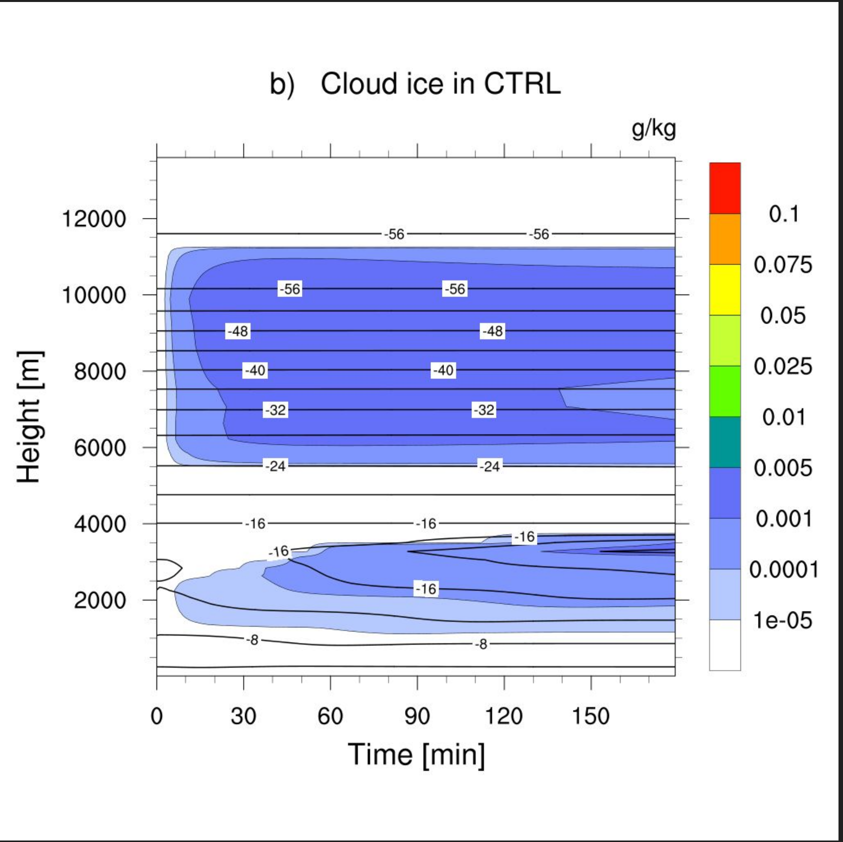
0.001
0.0001
1e-05

Cloud ice



b) Cloud ice in CTRL
g/kg
Height [m]
Time [min]
12000
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0.1
0.075
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0.025
0.01
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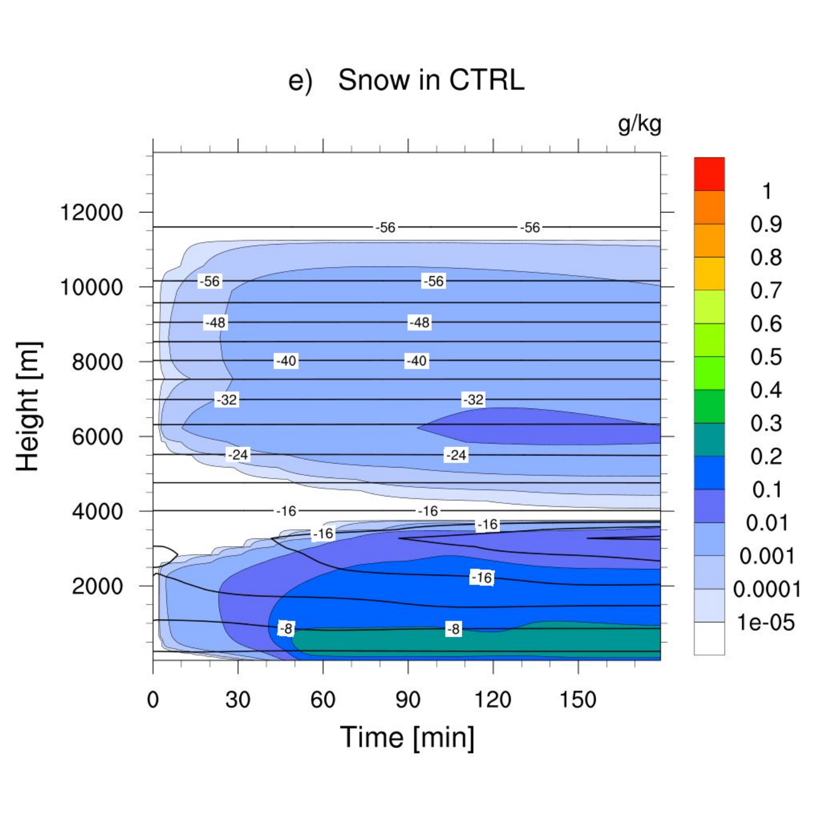
0.001
0.0001
1e-05

Snow



e) Snow in CTRL
g/kg
Height [m]
Time [min]
0
30
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-56
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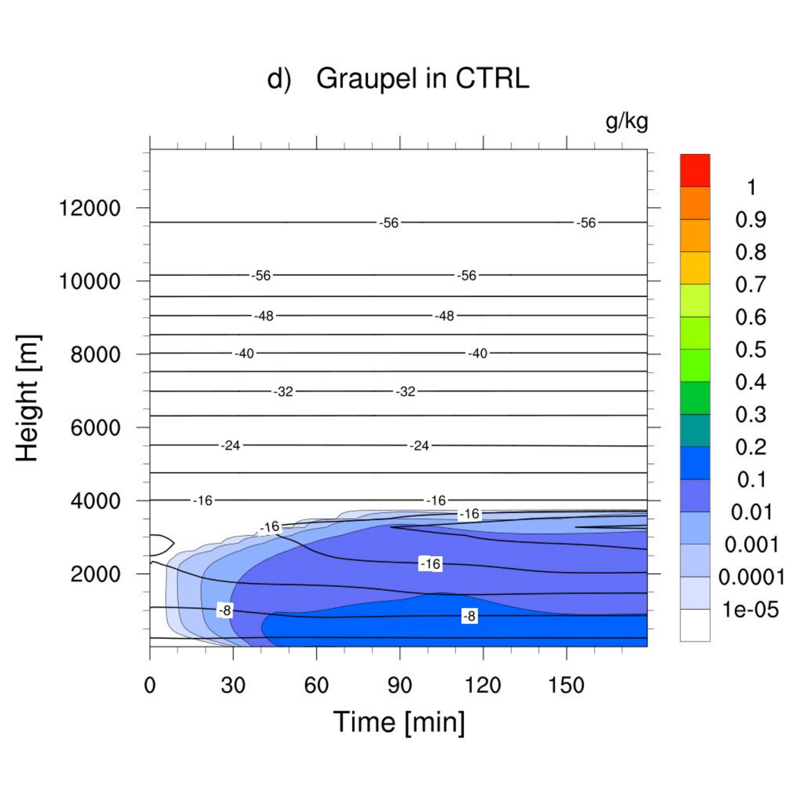
0.001
0.0001
1e-05

Graupel


d) Graupel in CTRL
g/kg
Height [m]
Time [min]
12000
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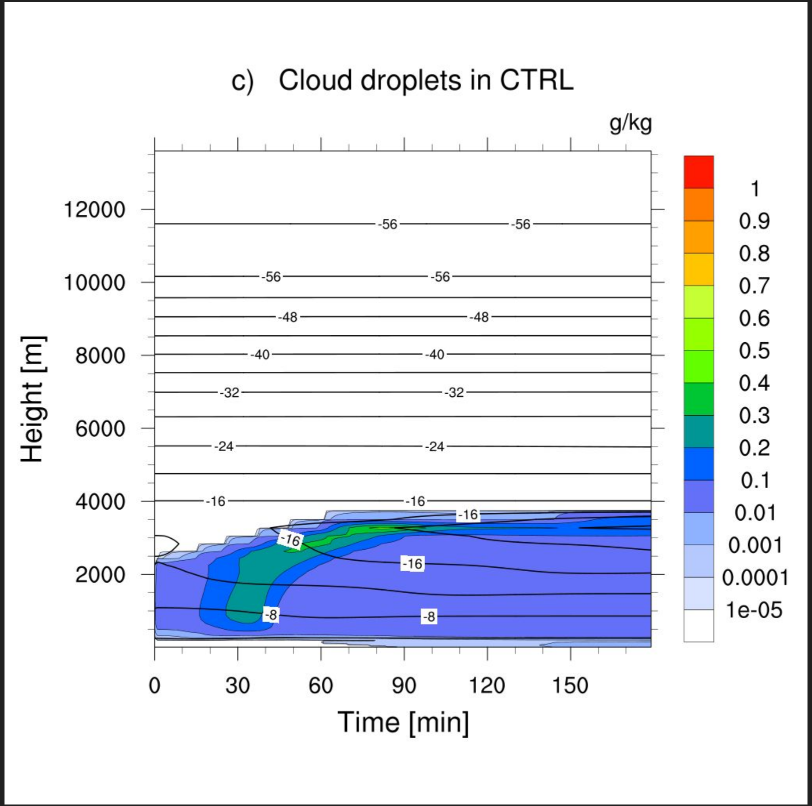
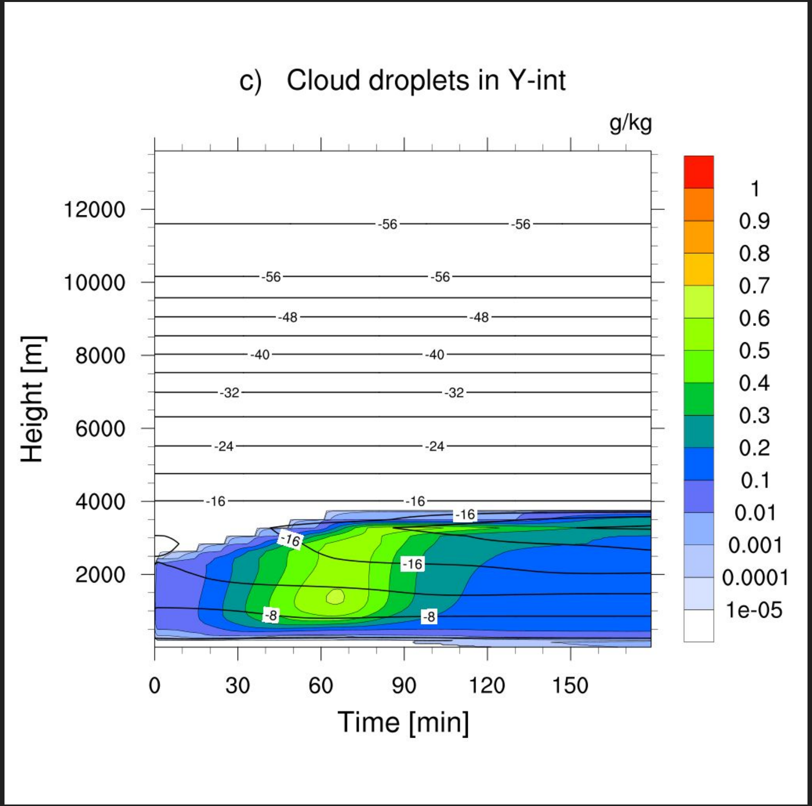
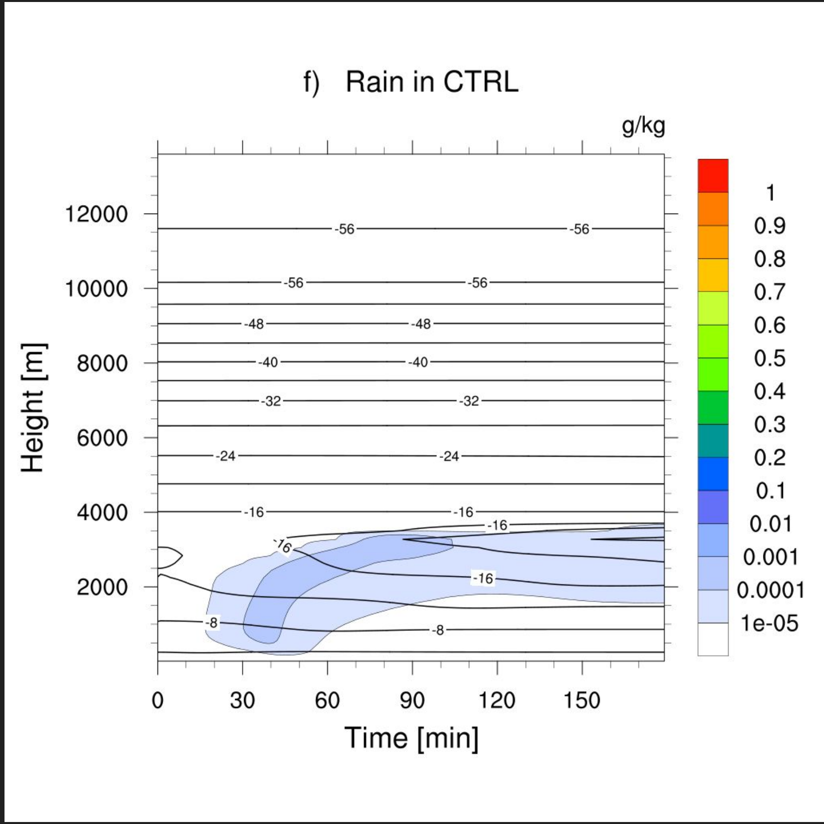
Cloud droplets





Rain



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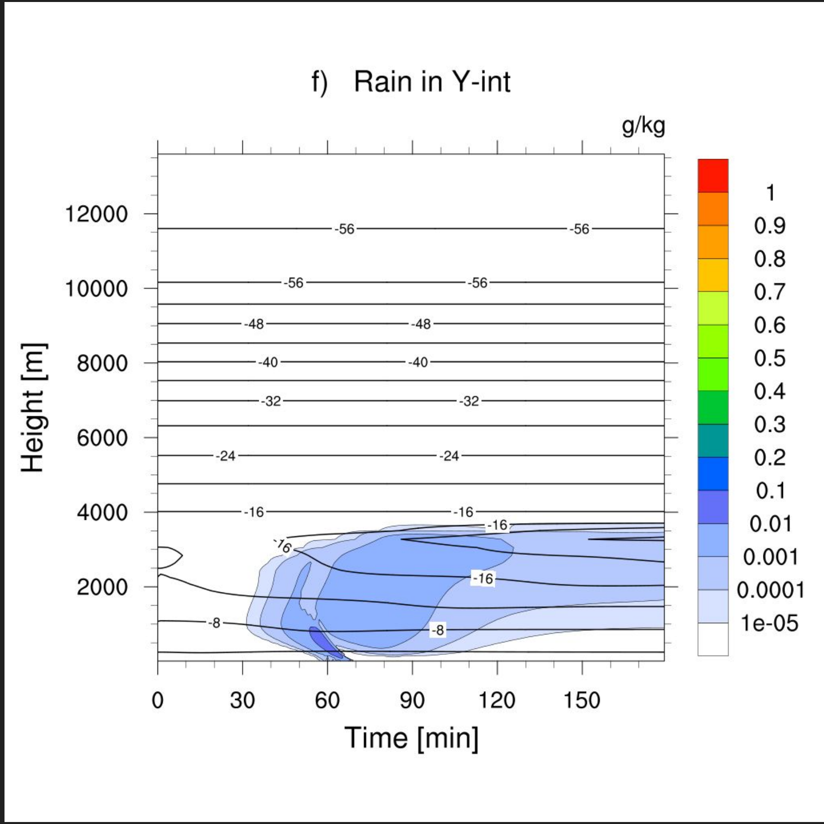

f) Rain in Y-int
g/kg
Height [m]
Time [min]
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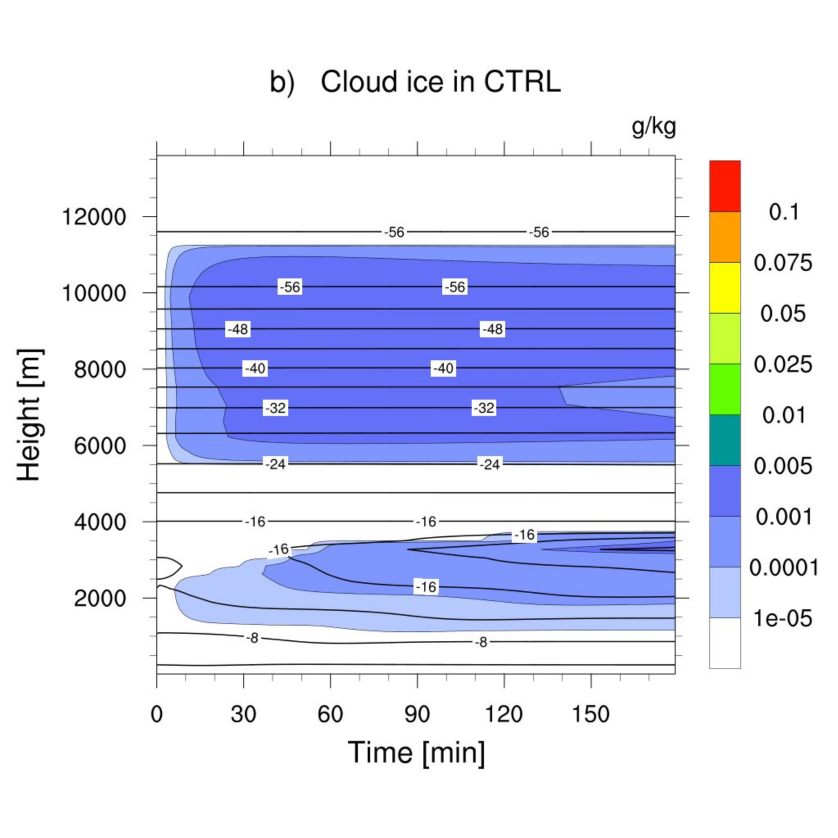
Cloud ice



b) Cloud ice in CTRL
g/kg
Height [m]
Time [min]
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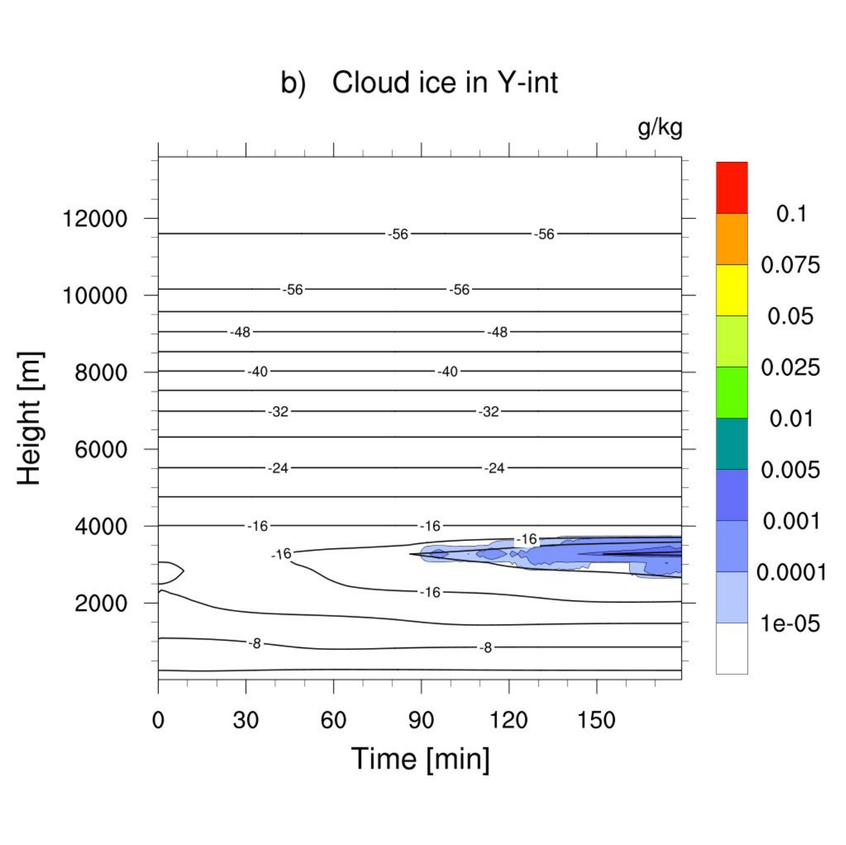

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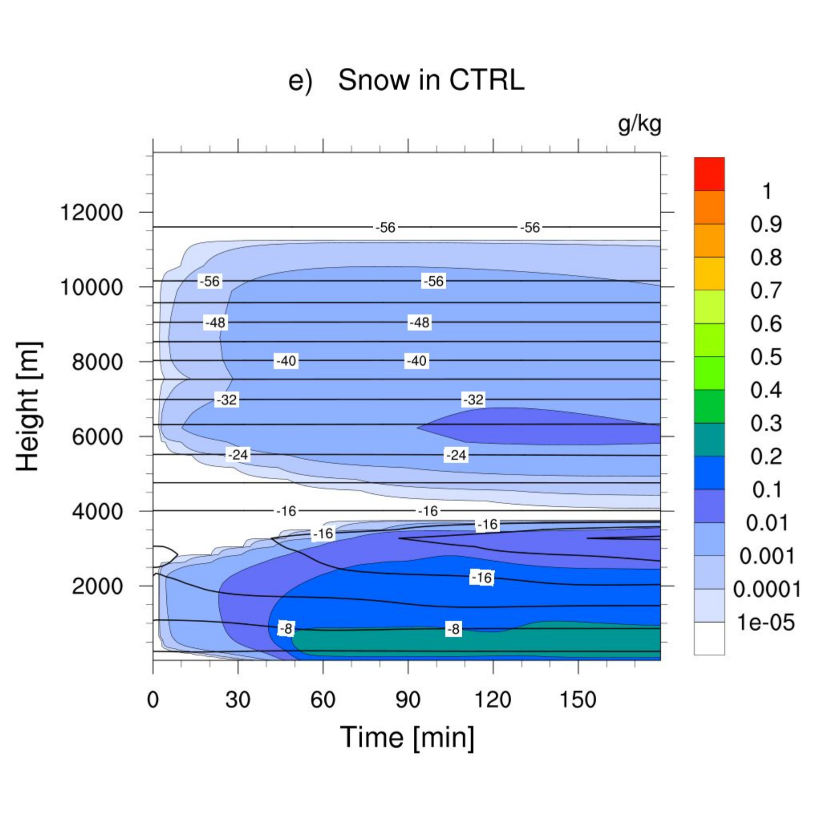
Snow



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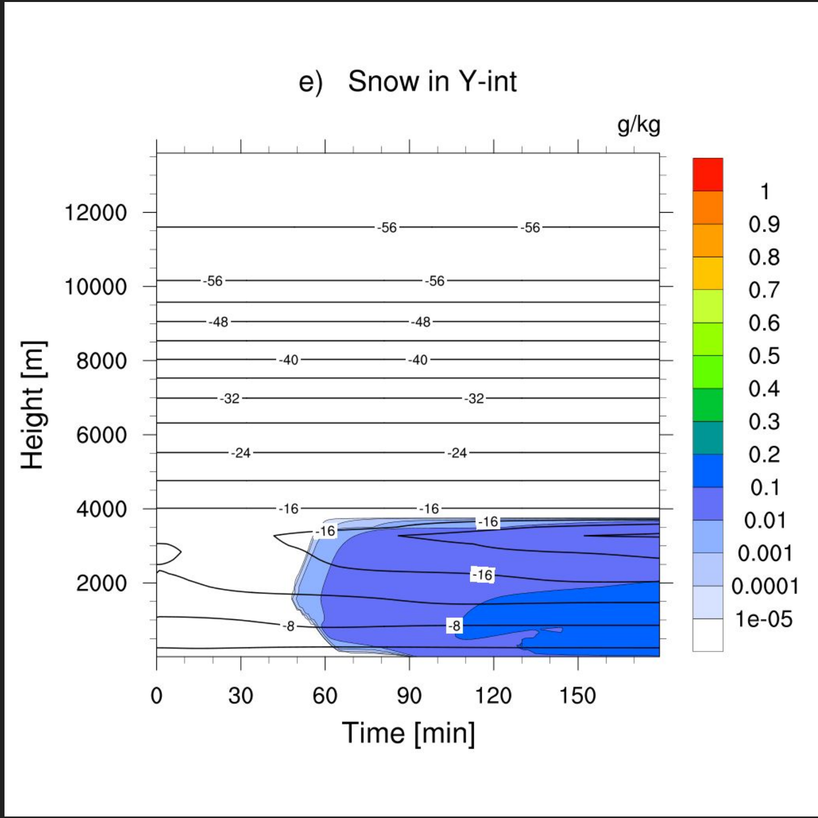

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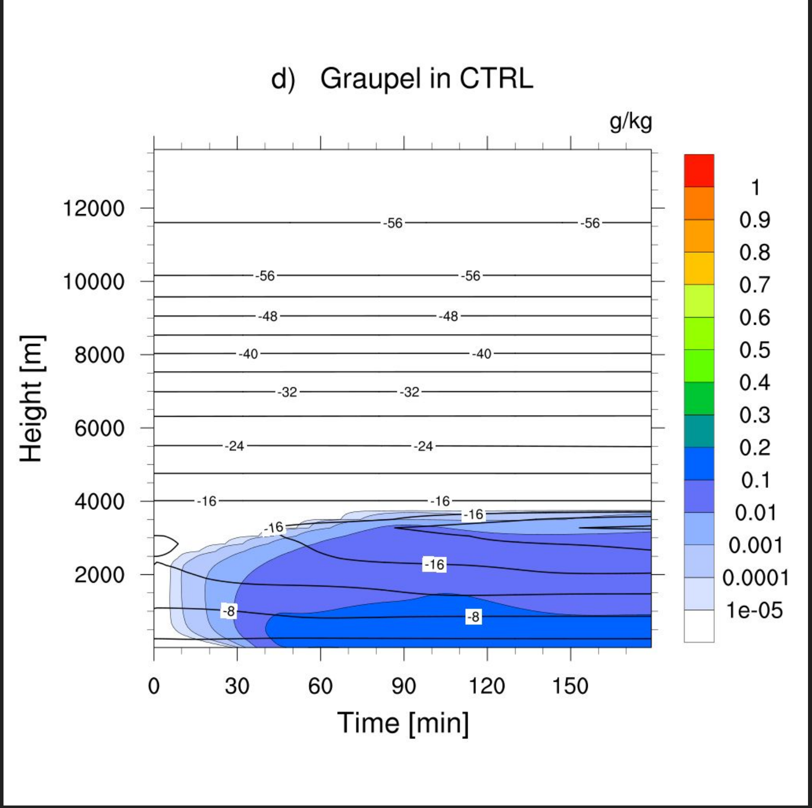
Graupel



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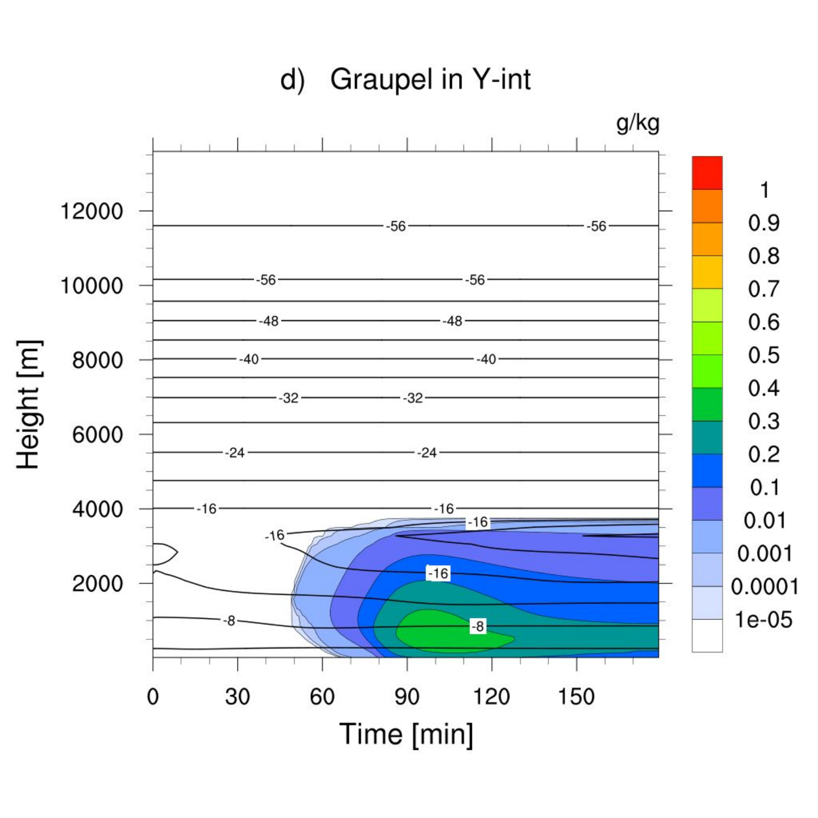

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Time [min]
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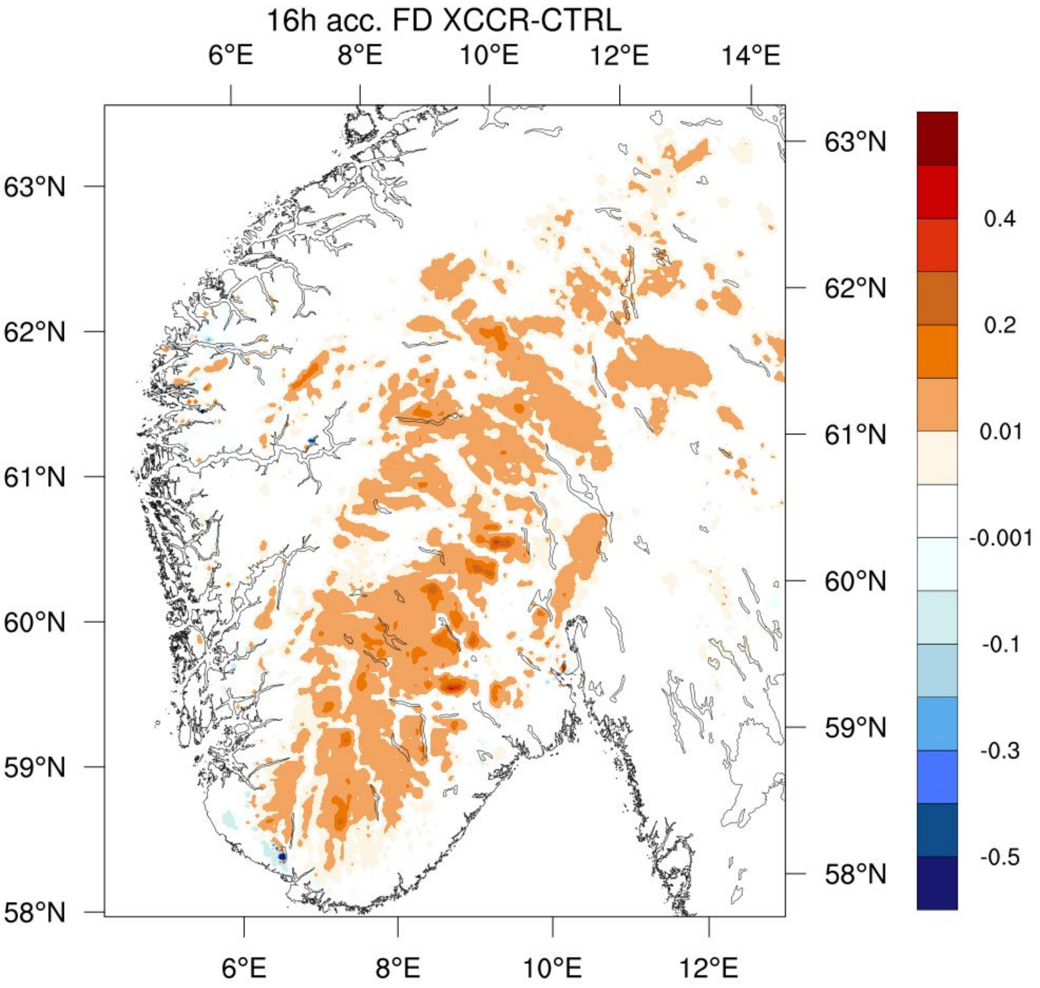
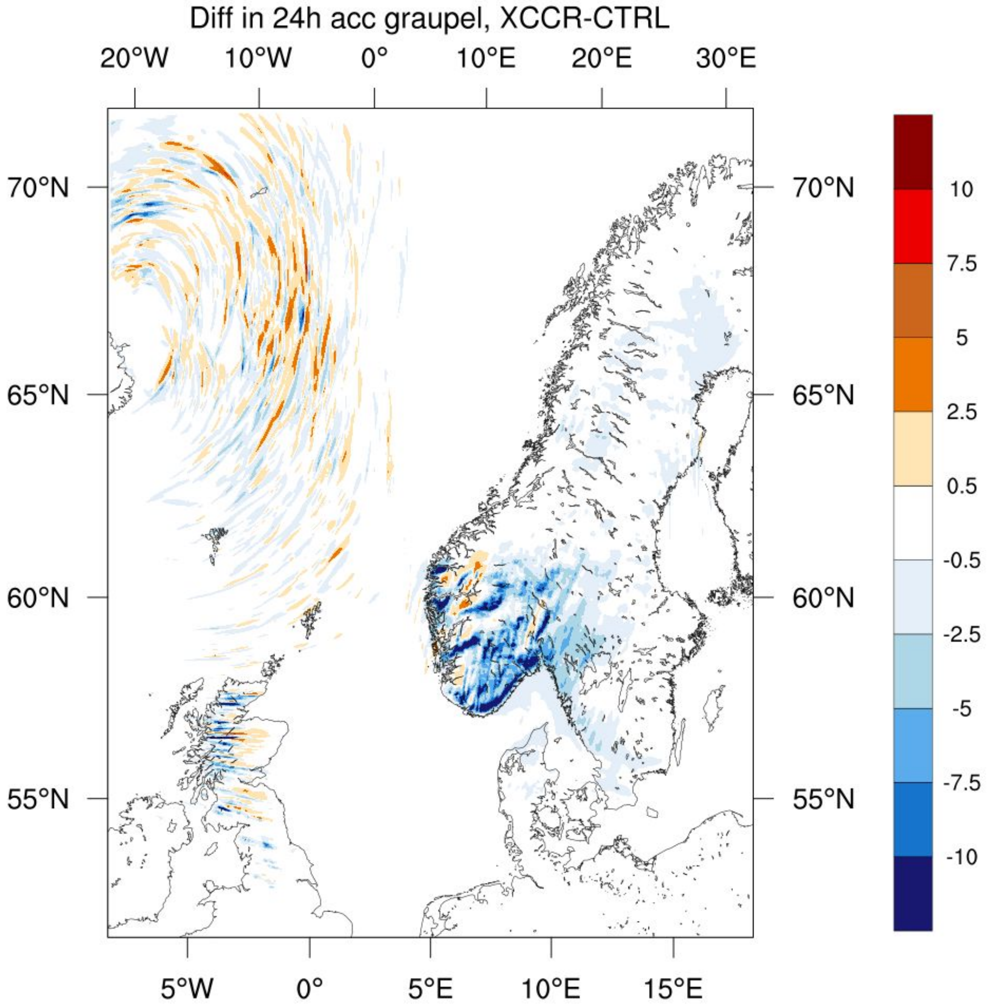
3D

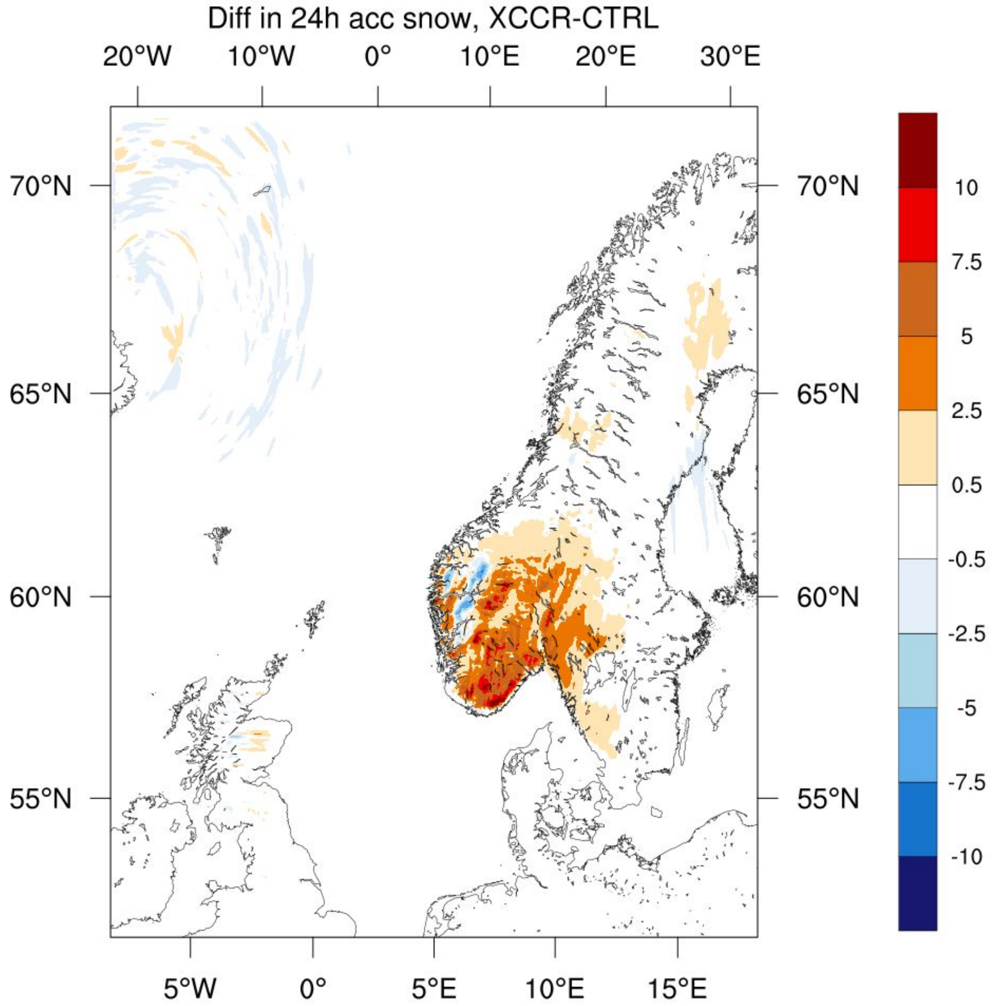
Freezing drizzle at surface: EXP - CTRL



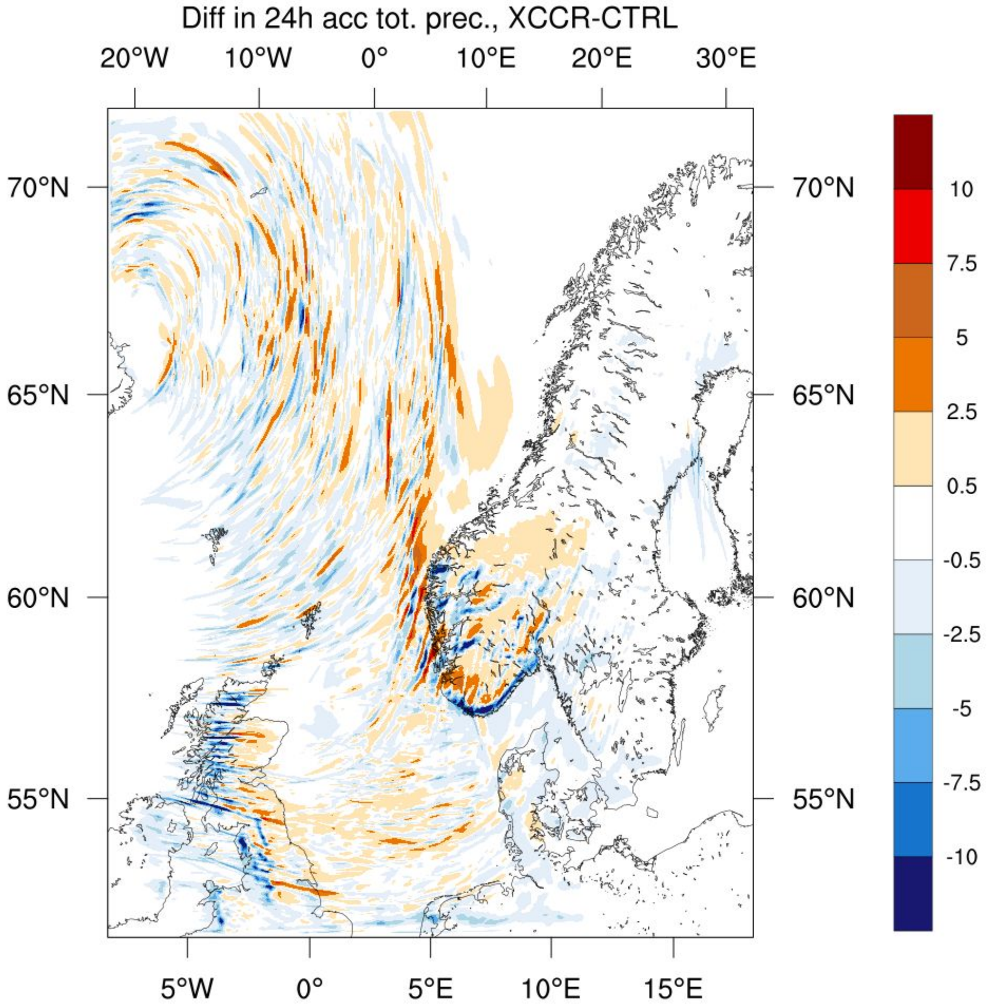
Graupel:
EXP - CTRL



Snow: EXP - CTRL



Total precipitation: EXP - CTRL



Conclusions

- Modified the microphysics scheme in HARMONIE-AROME to resemble the Thompson scheme
- 1D-simulations show clear change towards more supercooled liquid water and less ice
- 3D-simulations show more freezing drizzle, more snow and less graupel
- Hard to know the “truth”, but the microphysics have responded the way we wanted

Future work

- Analyse 3D-cases further, especially further up in the clouds
- Validate against observations
- Run longer simulations to check for false alarms, hit and miss rates

Thank you!

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