HIRLAM
Physics developments 2009/2010

Sander Tijm

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Jan Barkmeijer, Hans de Leeuw, Wim de Rooy,
Lisa Bengtsson-Sedlar

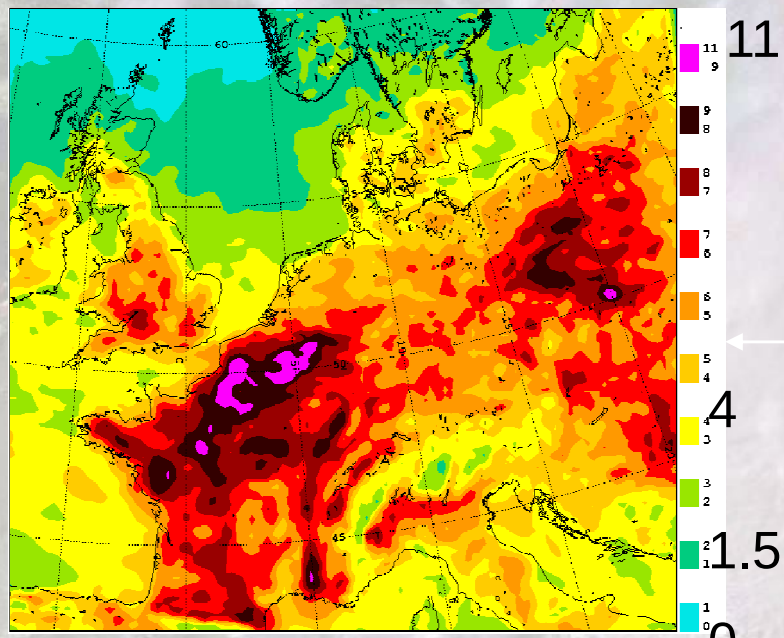
Contents

- HIRLAM physics work
  - Developments Rasch-Kristjansson condensation scheme
  - Chemistry branch
  - Solar radiation in tilted columns
- HARMONIE physics work
  - Impact of SLHD on convection
  - Impact microphysics on convection
  - Sensitivity of outflow to microphysics
  - Inclusion of Rasch-Kristjansson in ALARO
  - EDMF developments (see presentation Valery Masson)

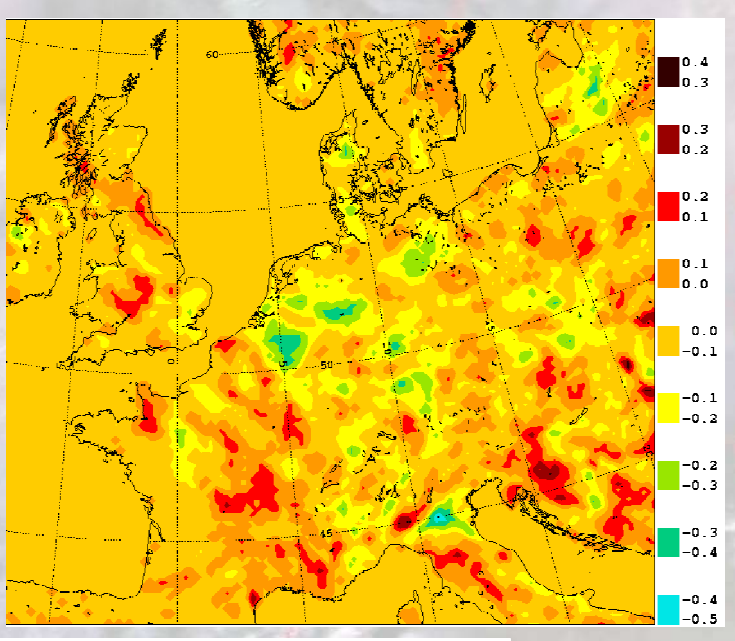
Chemistry branch

- HIRLAM chemistry branch set up
- Chemistry included, no direct aerosol effects yet, but extended chemistry and indirect aerosol effects through clouds
- Impact tested during month long run

Impact indirect aerosol effect



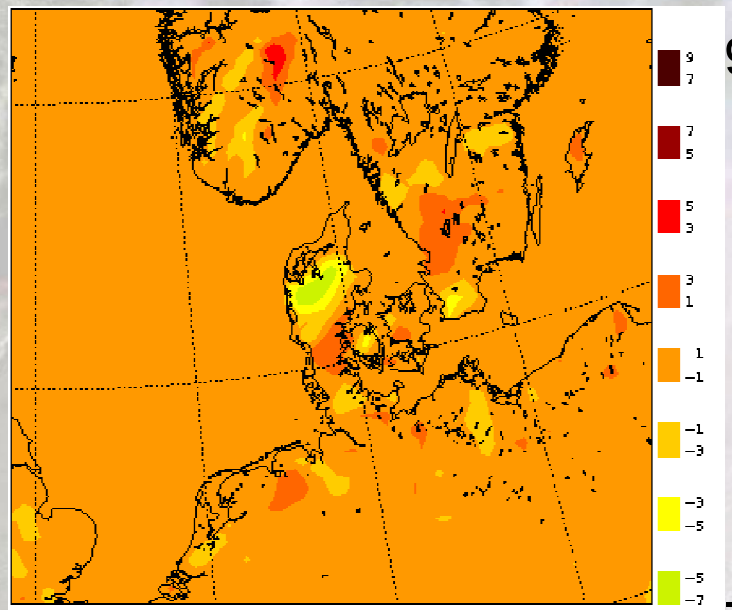
Monthly averaged CCN number concentration ($x10^7$ m^{-3}) at 850 hPa.



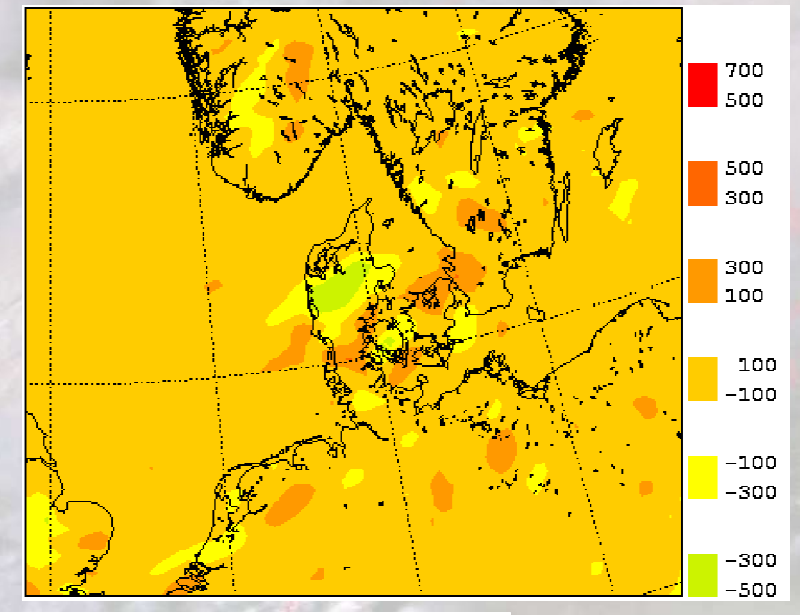
Monthly averaged difference in T_s (° C) (RUN - BASELINE)

Research

Impact indirect aerosol effect



Change in T_s (° C) over Denmark on 8 June 2009 at 12 UTC (RUN - BASELINE)



Change in net SW radiation at the surface (W m^{-2}) on 8 June 2009 at 12 UTC (RUN - BASELINE)

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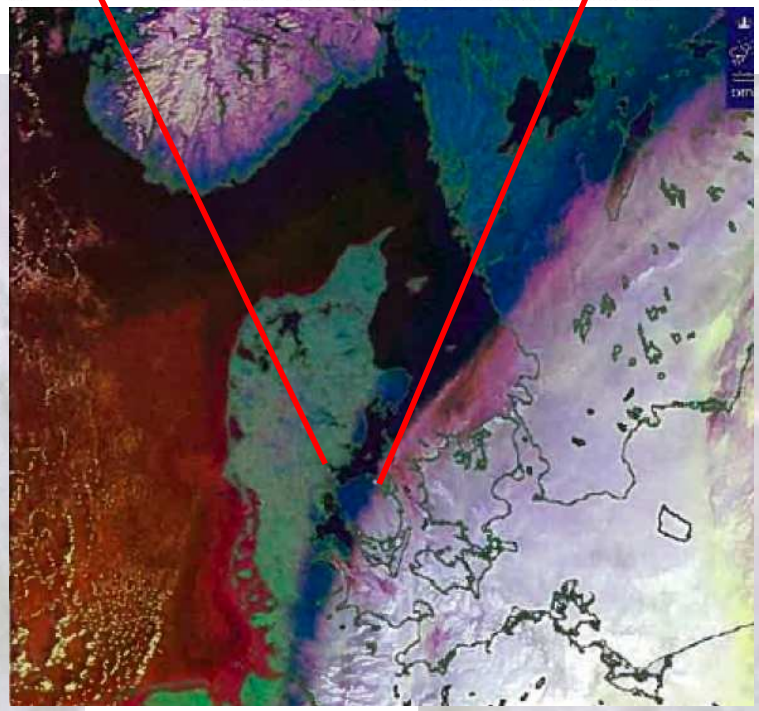
Tilted array modelling: Introduction

Til venstre et termogram fra Horsens. Til højre et termogram fra Beldringe ved Odense.



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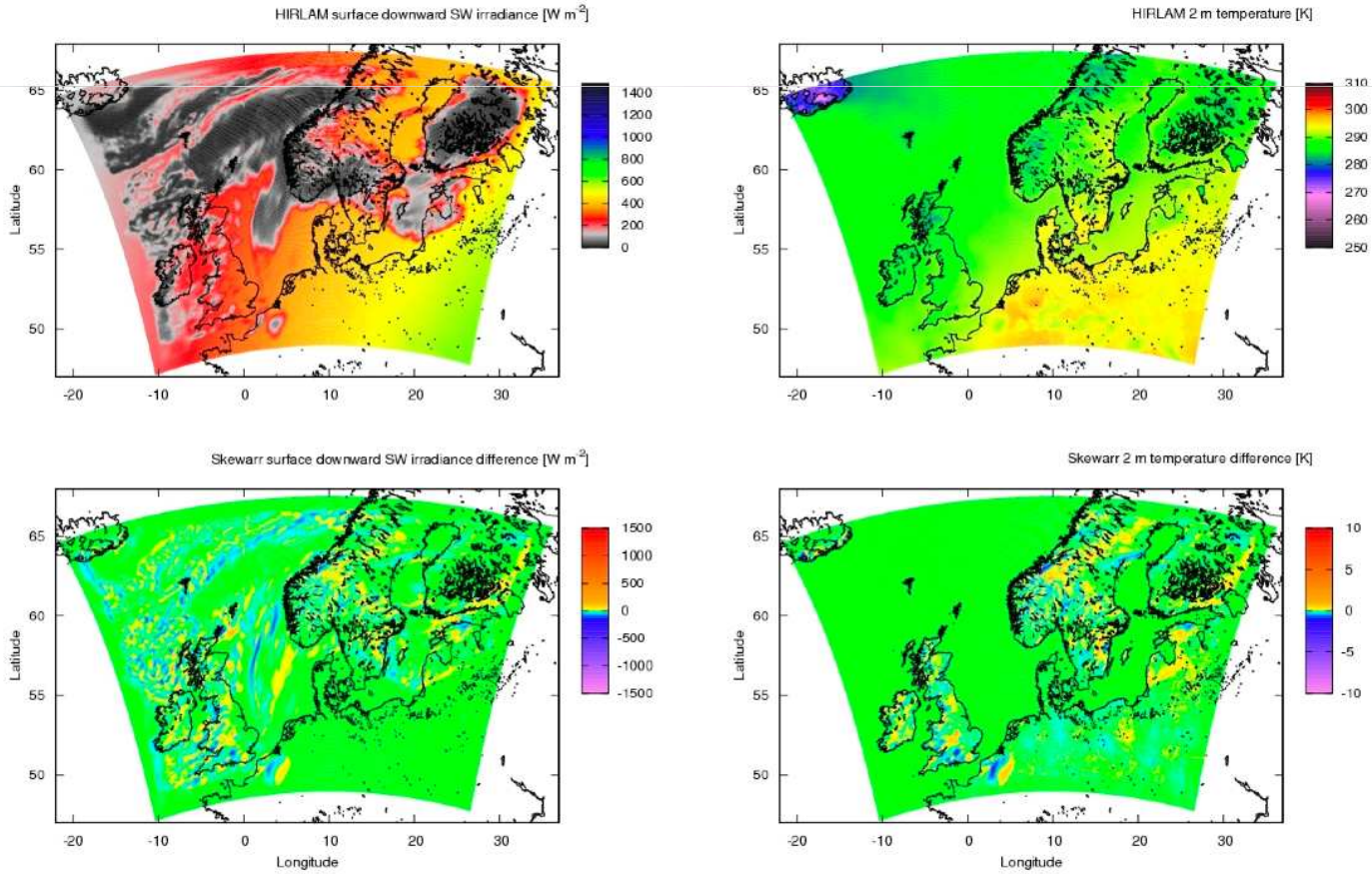
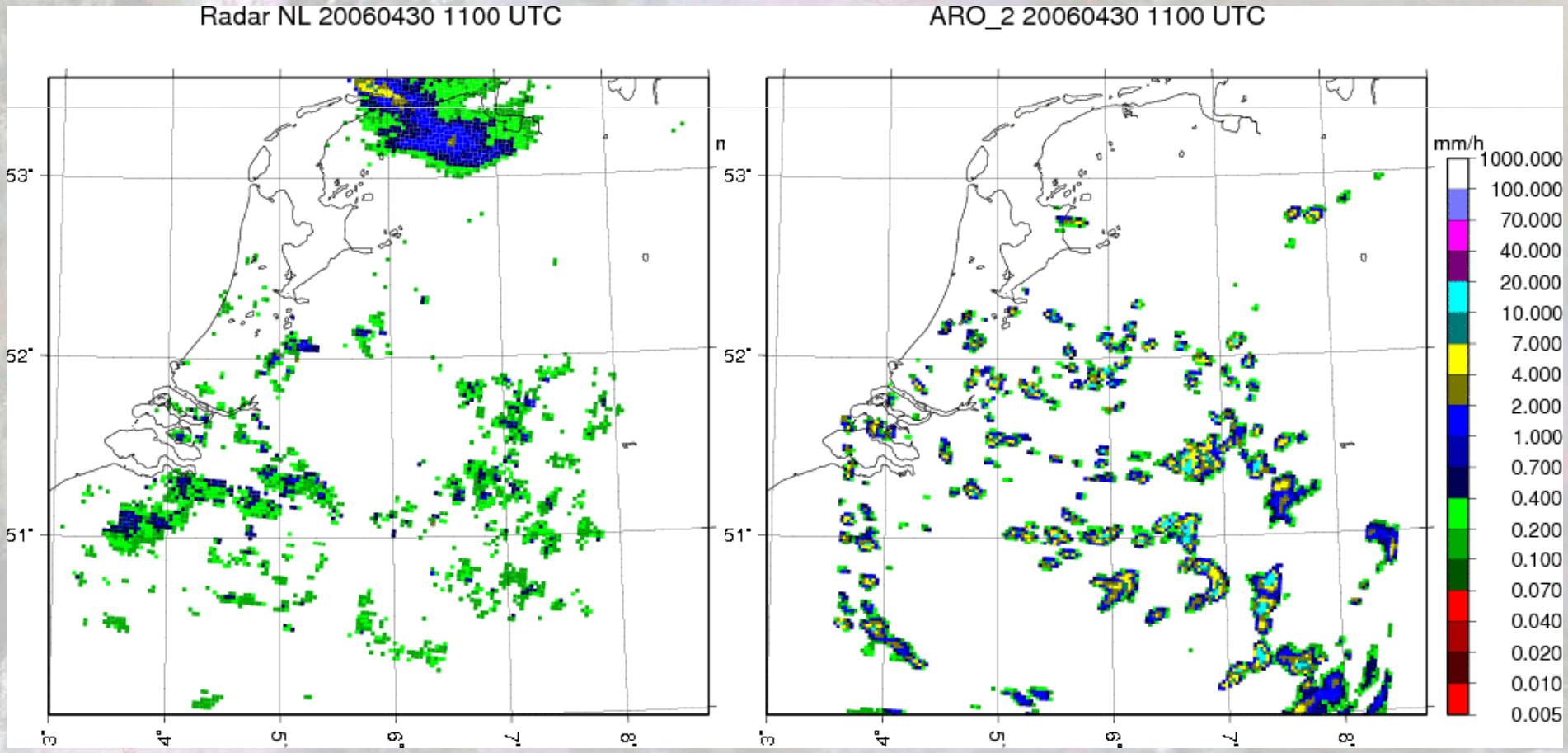
Tilted array modelling - First results (2009-09-01)



Impact SLHD on convection



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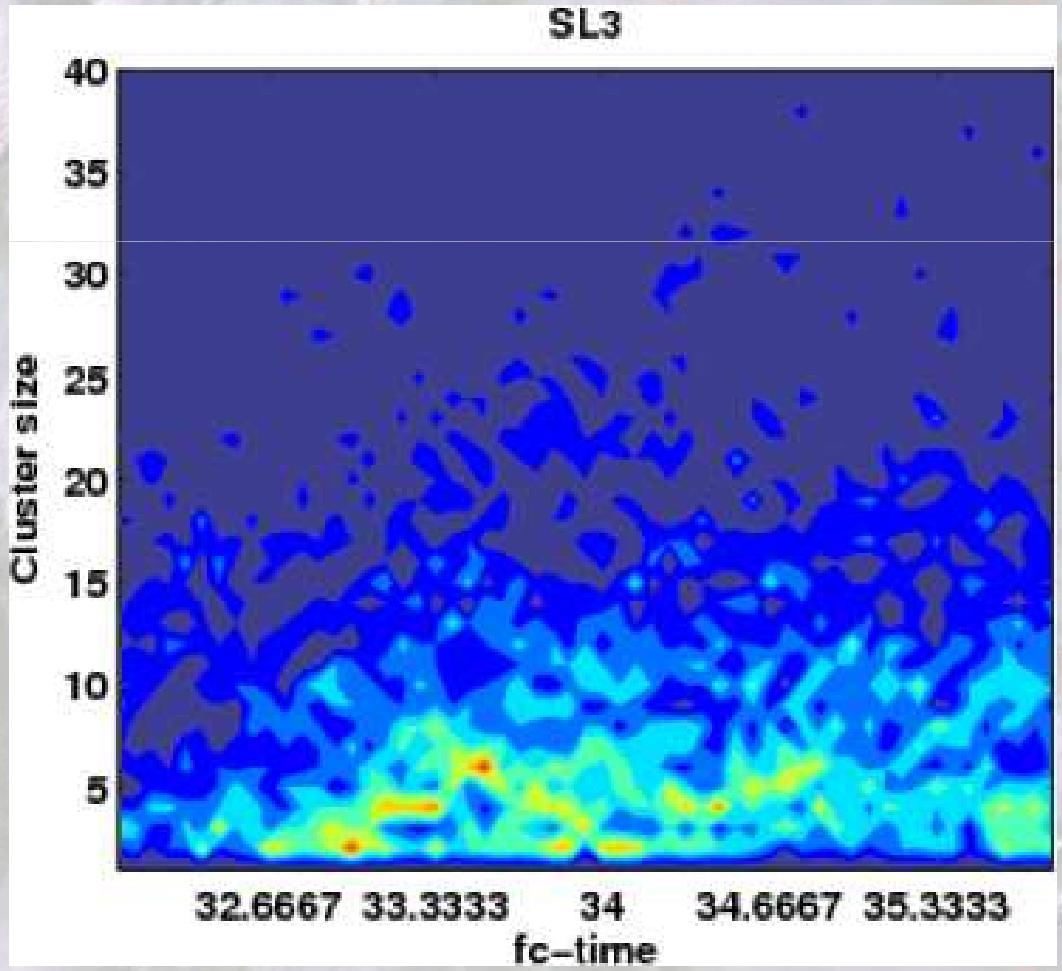
Impact SLHD on convection



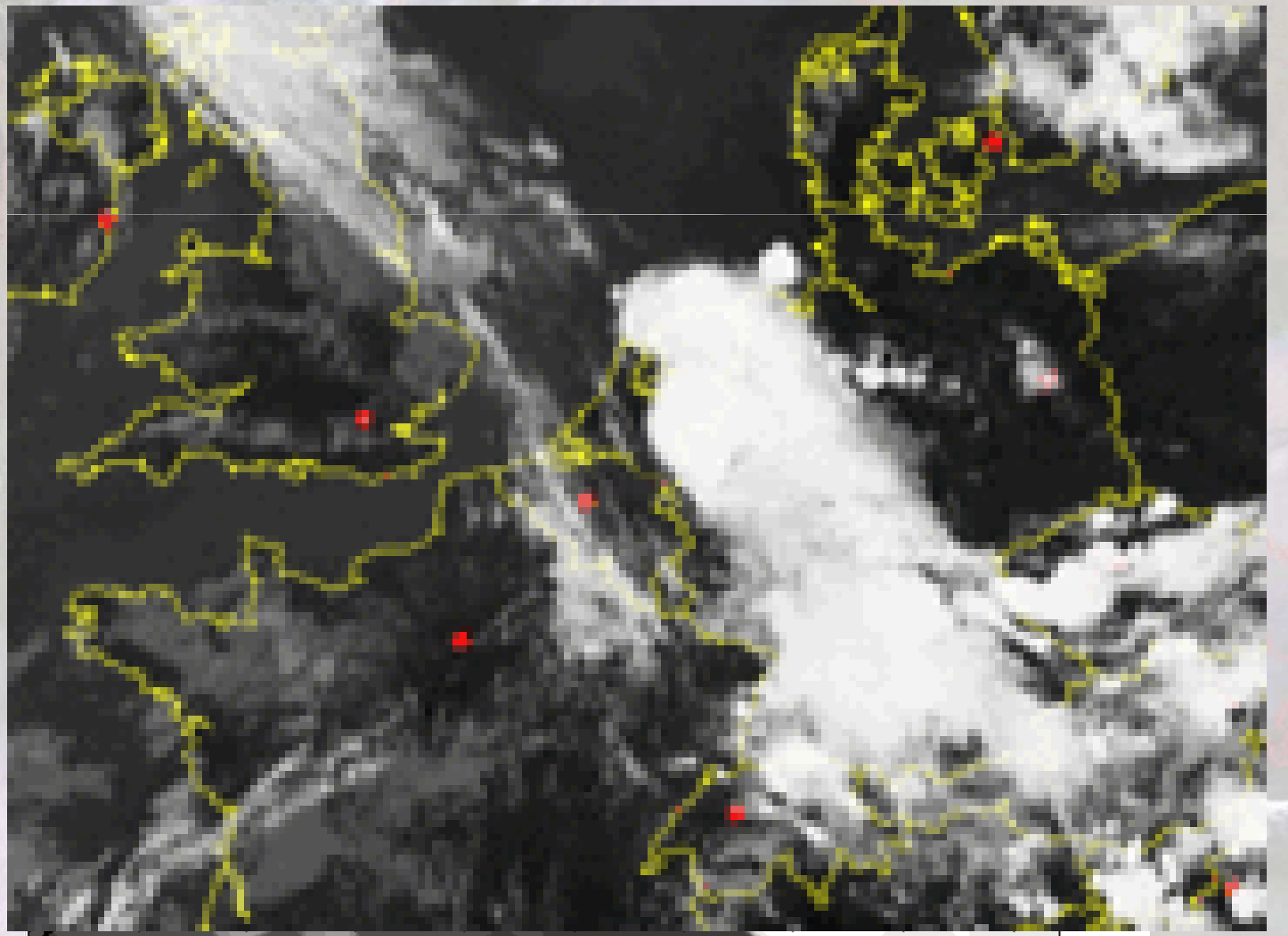
Microphysics impact AROME

- Convection too active for certain cases
- Link with outflow? Objective tests to see if outflow is overestimated
- Studies on removal of processes for graupel, snow and graupel, reduction of graupel production, reduction of evaporation, impact of fall speed hydrometeors

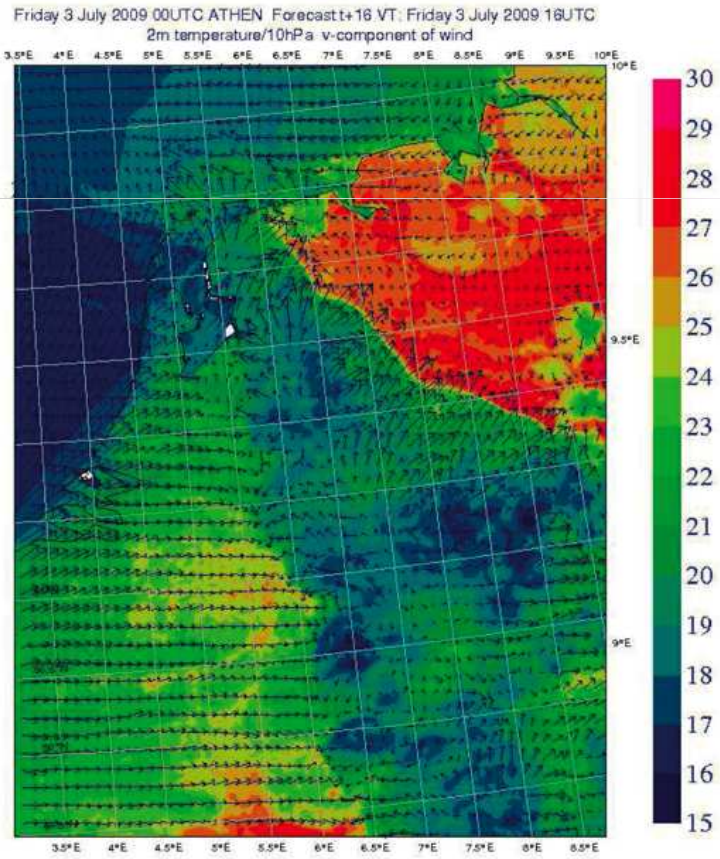
Impact graupel & snow

- Graupel very important for intensity of convection
- Snow large impact on outflow, low fall speed, transport of hydrometeor to unsaturated environment
- Correct balance between graupel, snow, cloud water, cloud ice?

Removal of snow



Outflow, impact hydromet.



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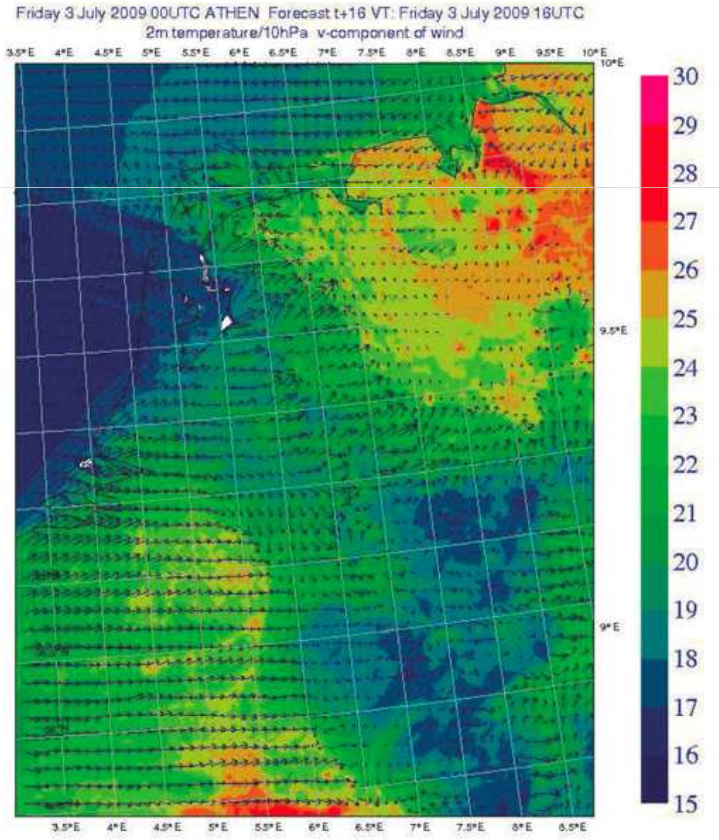

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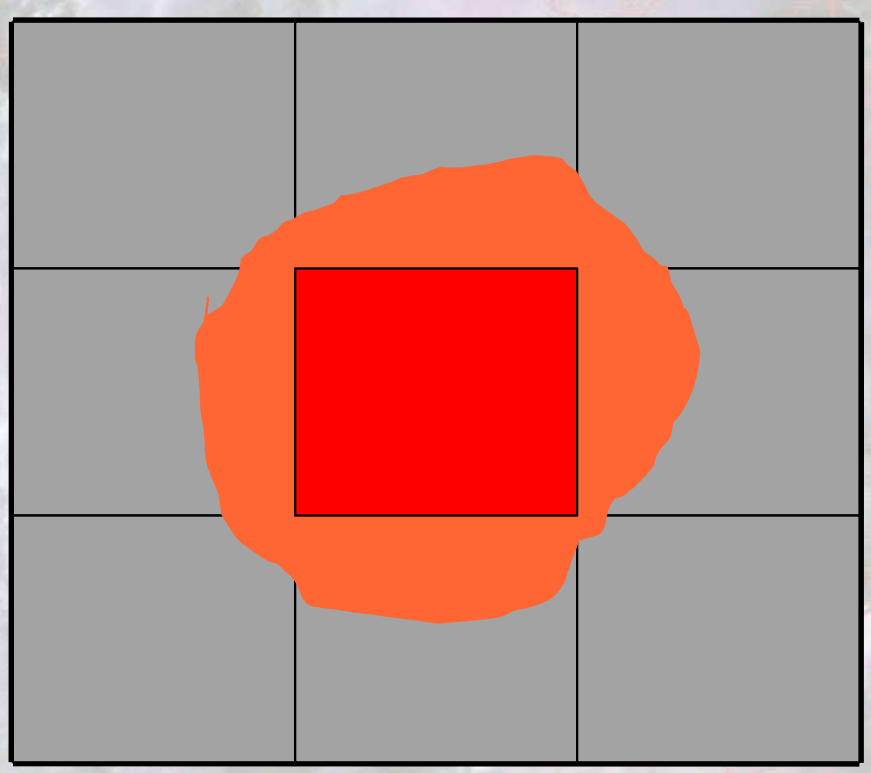
Outflow study

- Cases with and without convection and outflow studied
- Difficult to couple observations directly to model. Look at distributions of obs. & model parameters over longer time (10-22 UTC)
- Parameters wind speed, wind gust (through TKE method), temperature (cold pool), wind direction
- No signal in wind speed and gust

Impact no evaporation

- Evaporation of rain plays a major role, in addition to snow
- Putting evaporation at 30-50% gives best results, subgridscale effect?
- Convection too active due to 2.5 km cells, evaporation same resolution problem?
- Possible solution: Brake on vertical velocity plus reduced evaporation?
- Subgrid scale microphysics

Subgrid microphysics



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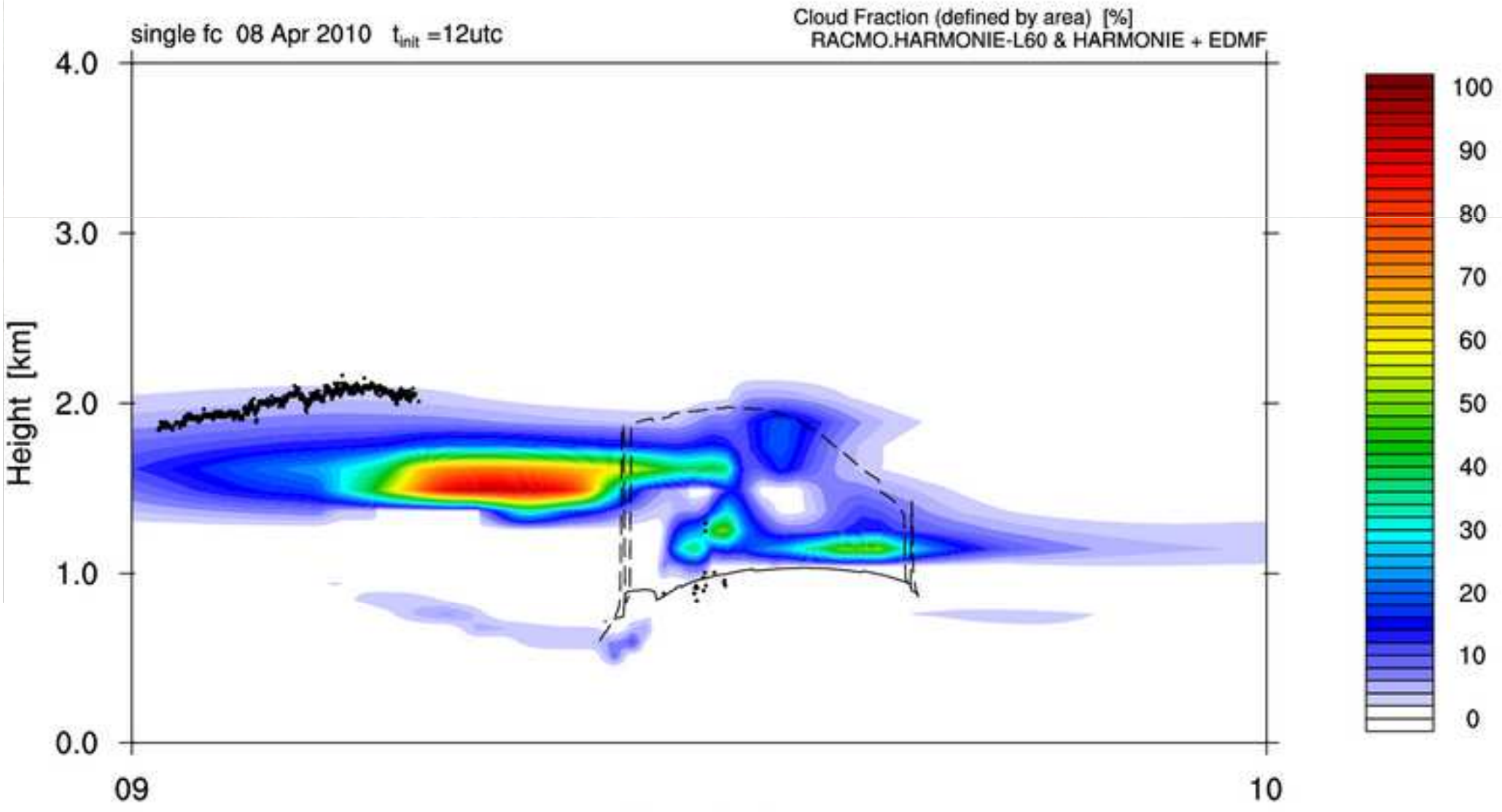
EDMF developments

- Inclusion of MUSC in KPT with EDMF and EDKF daily runs
- Statistical clouds scheme improvement (see presentation Valery Masson)
- KF-problem, too much detrainment of moisture close to cloud base, too strong moistening of air, tendency to produce Sc.
- Second problem of KF: no entrainment in cloud hostile environment, cloud too deep.

Comparison EDMF - EDKF



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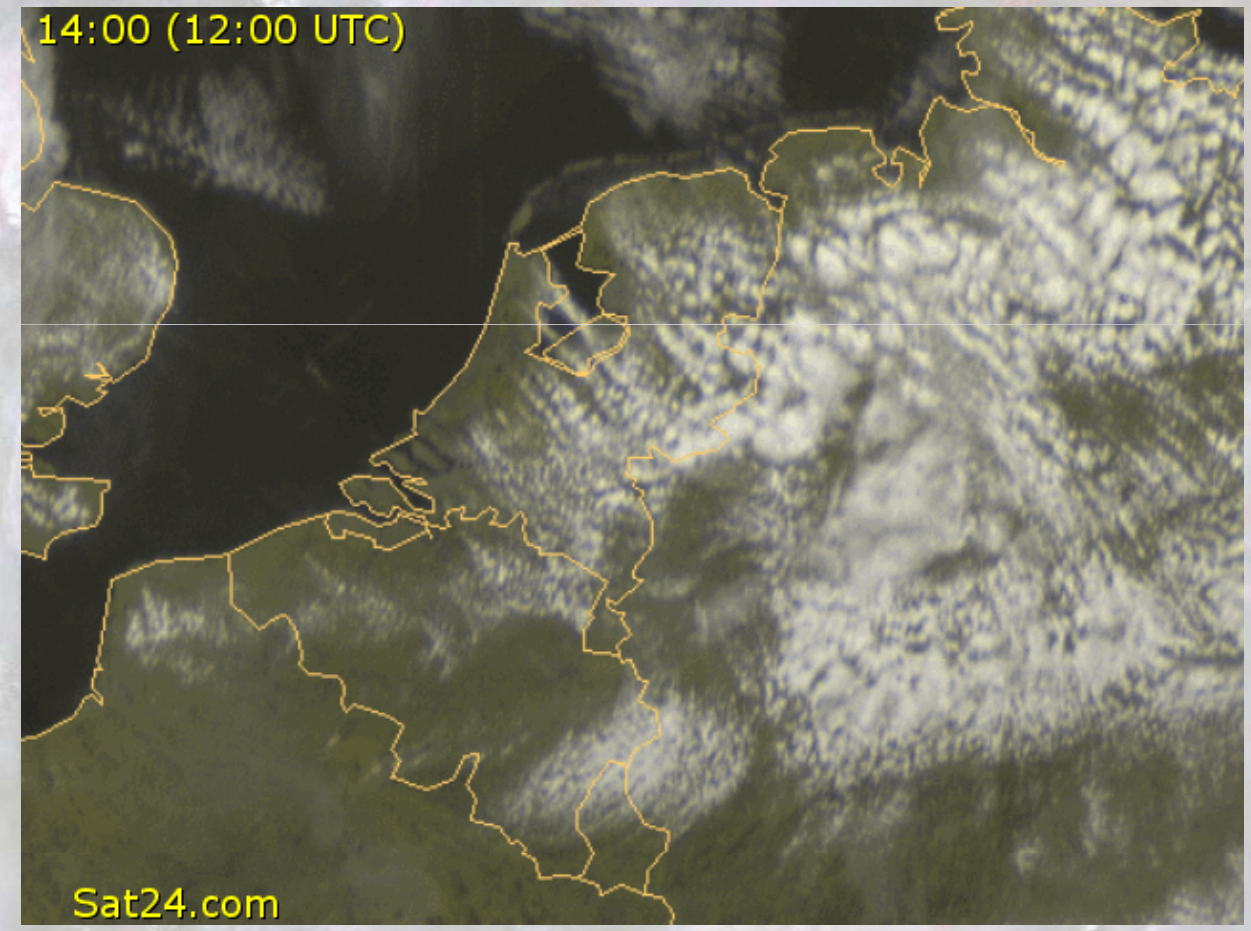
Comparison EDMF - EDKF



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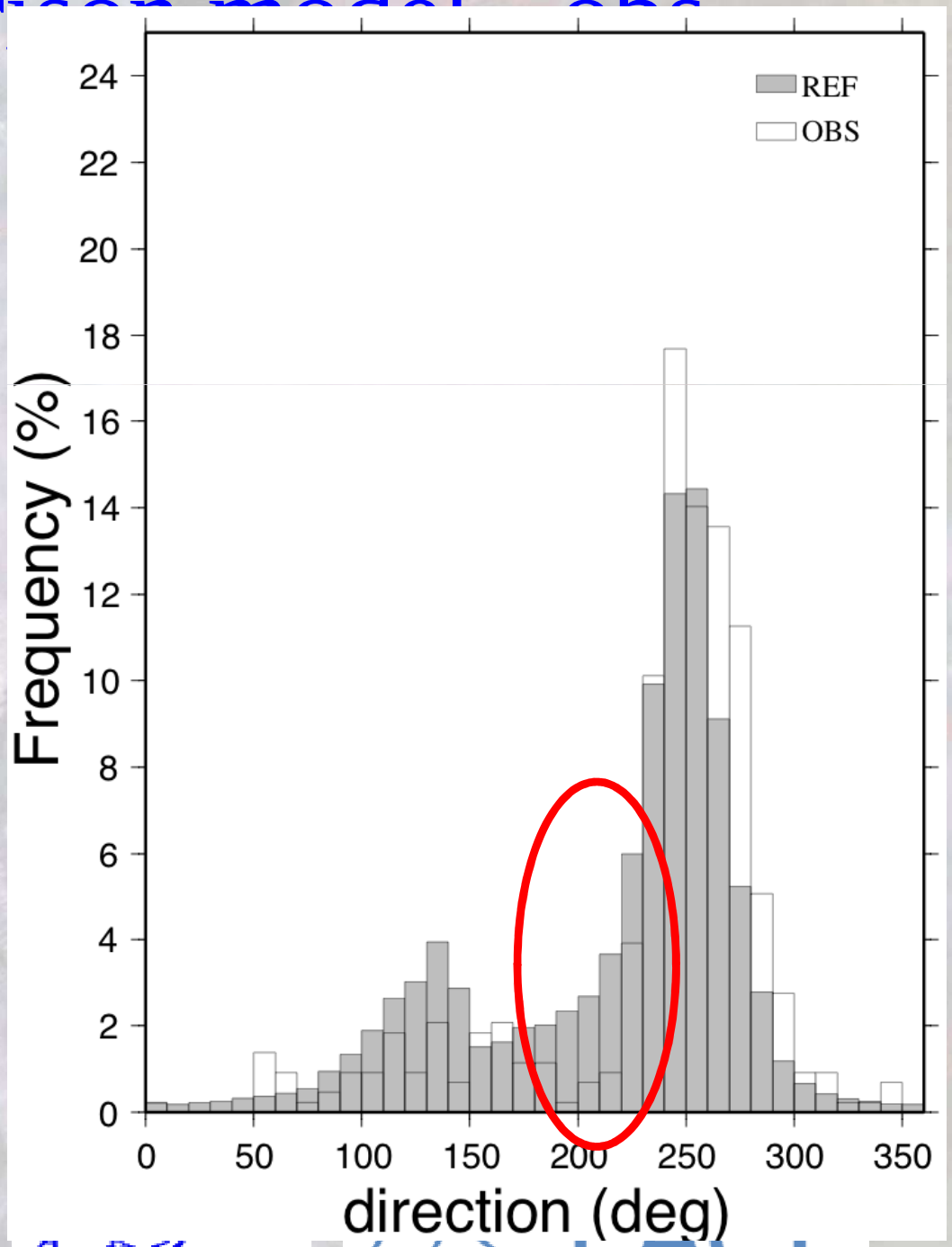
- Questions?

Comparison model - obs

- More spread in model wind direction distribution than observed



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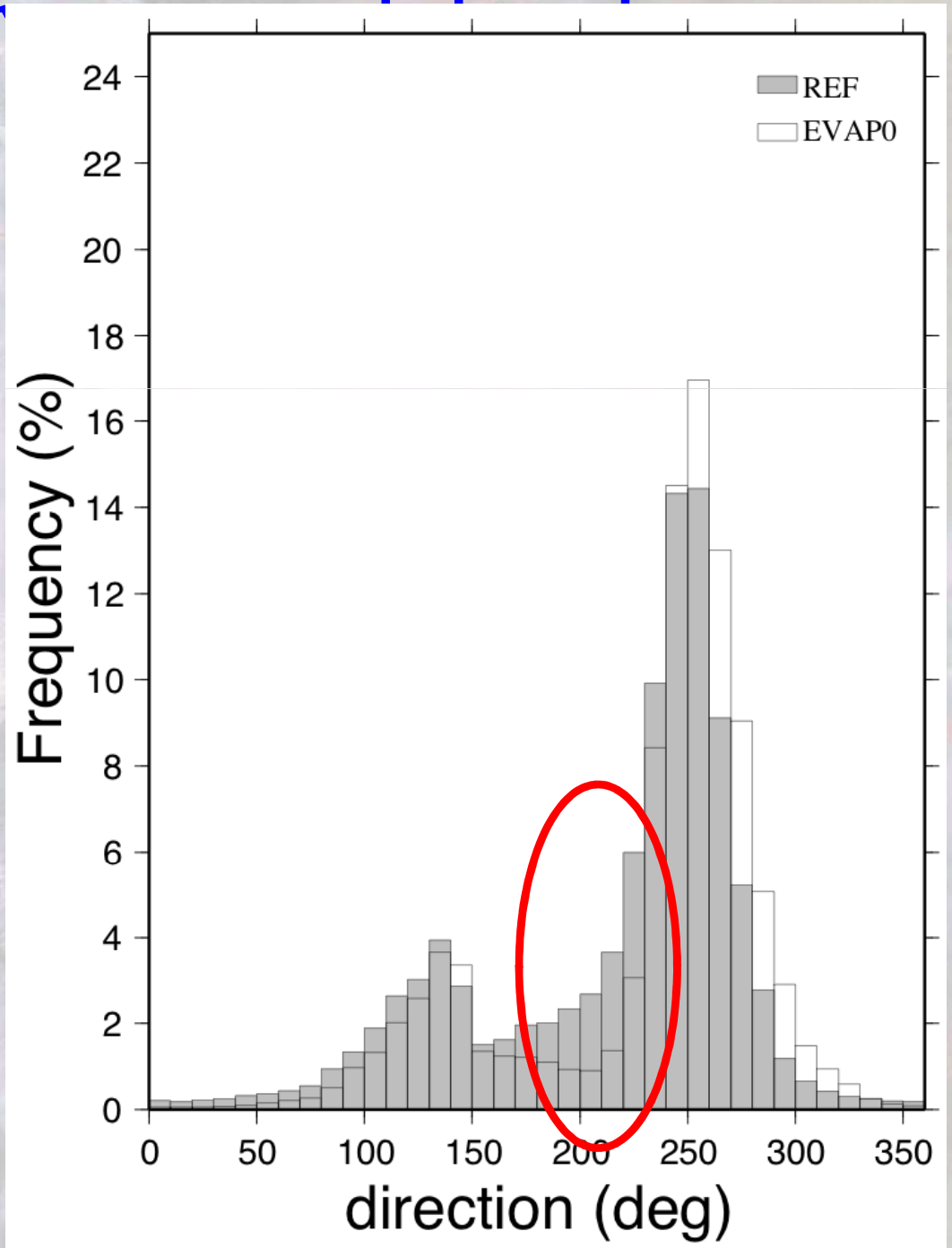
Compar

- No (!) evaporation of rain comes close to observed distribution
- Optimum 30-50%



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