Final discussion

Moist Processes in Future High Resolution NWP Models

Norrkoping workshop

Lisa Bengtsson, SMHI
Sander Tijm, KNMI

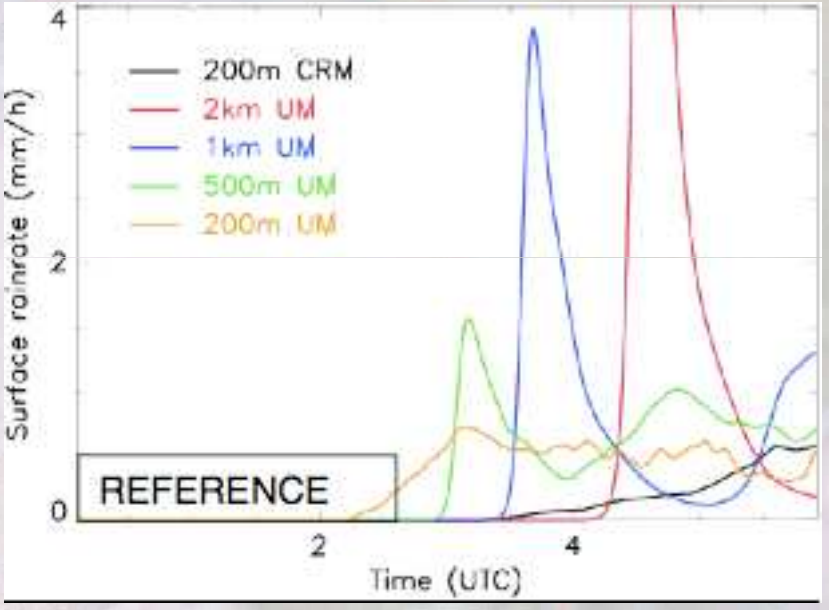
SRNWP sports activity (2)

Football match Sweden – International team
Organization: Lisa Bengtsson
Very motivational speech at half time from Coach
International team won 5-6 (2-1)

Discussion on “challenges in high resolution modeling”

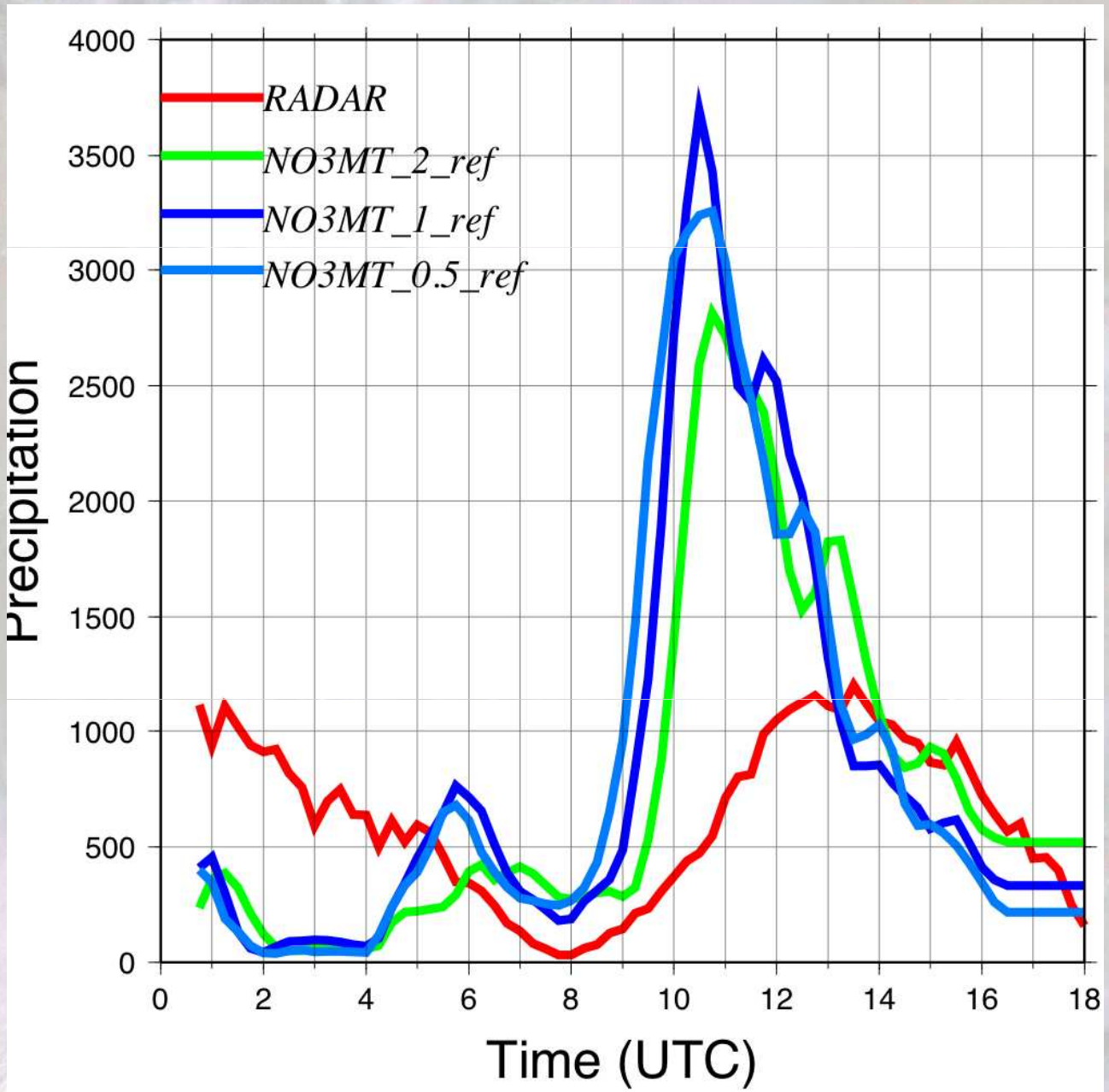
- Are we seeing similar problems in our models?
  - Size of convective structures
  - Intensity of precipitation
  - Onset of precipitation
  - Timing and location
  - Are there systematic errors in our models?
- Governed by domain size
- One way forward is to look at an idealized case of mid-latitude open cell convection... More on that later.

- GCSS deep convection working group case 4
- Increasing delay of rain onset with decreasing resolution
- 3D turbulence reduces overshoot and difference in time of onset precipitation



Peter Clark

Impact resolution



Lisa Bengtsson
Sander Tijm

Discussion on “challenges in high resolution modeling”

- How should we use more computer power?

- Higher resolution, when satisfied?
- Ensemble forecast?
- Larger domain size?
- Longer forecast time (48 hours)?

- Domain size – very much governed by “shape of country” (also placement of boundaries).
- How large do our models need to be?

Predictability

- Predictability convection very much dependent on situation
- Convection initiates when CIN zero
- Very unpredictable if CIN is eroded over large area and homogeneous surface forcing, when dependent on history of cold pool formation, large impact small disturbances
- Remarkably predictable when CIN is small over small area (and correctly predicted location of low CIN)

Discussion on “challenges in high resolution modeling”

- Has the gray zone shifted towards smaller scales?
- There will always be processes that act on scales smaller than the horizontal resolution
- Gaps in energy spectra caused by model resolution and diffusion applied to model, dependent on parameterization(s)
- Possibility to reduce gap with stochastic physics, perturbation on smallest scales

Discussion on “challenges in high resolution modeling”

- Scheme that works correct on e.g 100 m resolution will not automatically work correct on 1 km
- Perfect academic physics may not work with-out retuning at operational NWP resolution
- Caused by spectral gaps introduced by diffusion and diffusive methods

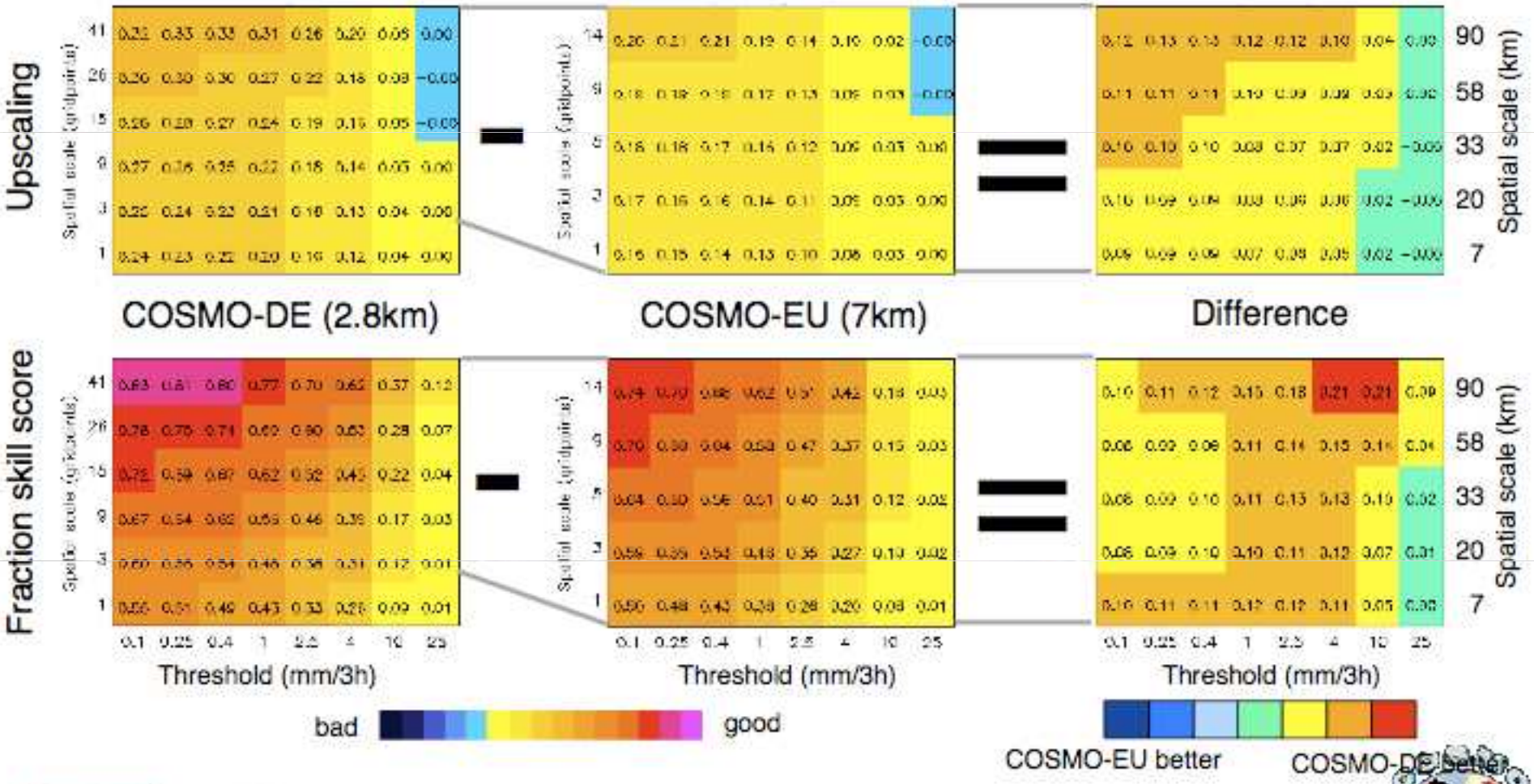
Evaluation/Verification/Application

- There are now methods that can show the added value of high resolution forecasts compared to 10 km scale models
- Still many possibilities to make more use of high resolution forecasts

Fuzzy Verification: COSMODE – COSMOEU

JJA 2007, Verification against Swiss Radar Composite, 3 hourly accumulations

Federico Grazzini



arpa SIM Servizio Idro Meteo

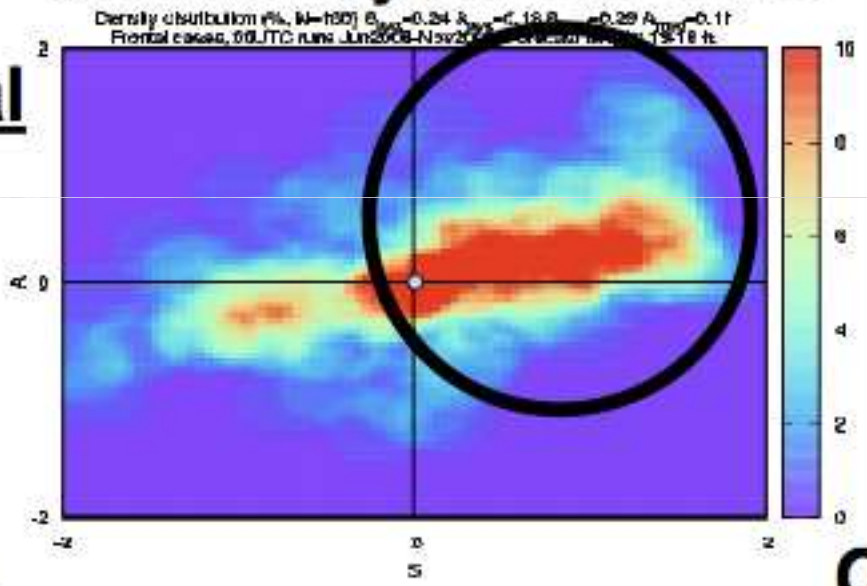
Moist Processes in Future High Resolution NWP Models June 15-17, 2009 Norrköping, Sweden

fgrazzini@arpa.emr.it

S vs. A – diurnal cycle **00 UTC +13-18h**

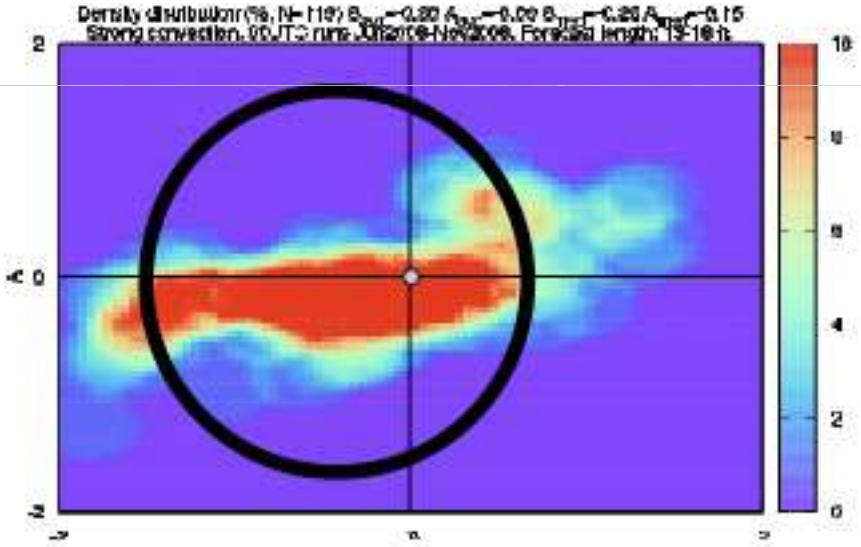
○ = perfect score

Frontal

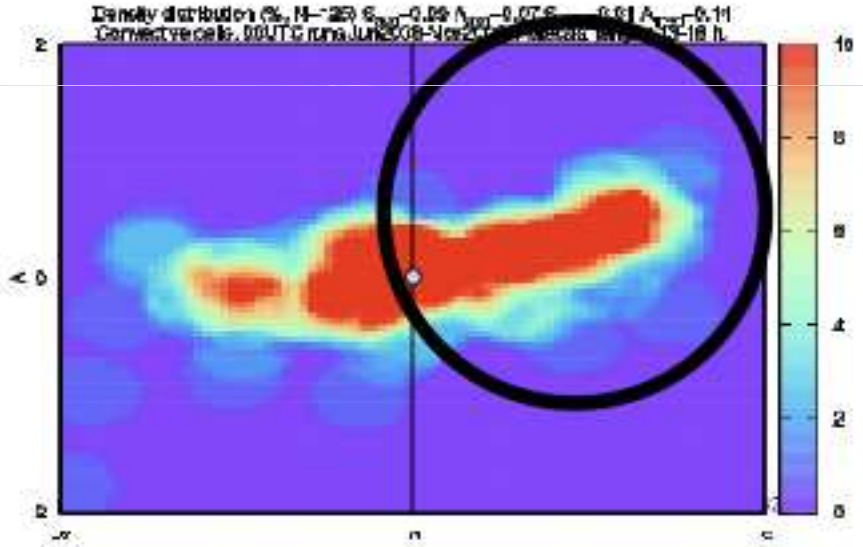


Sami Niemela

Strong conv.



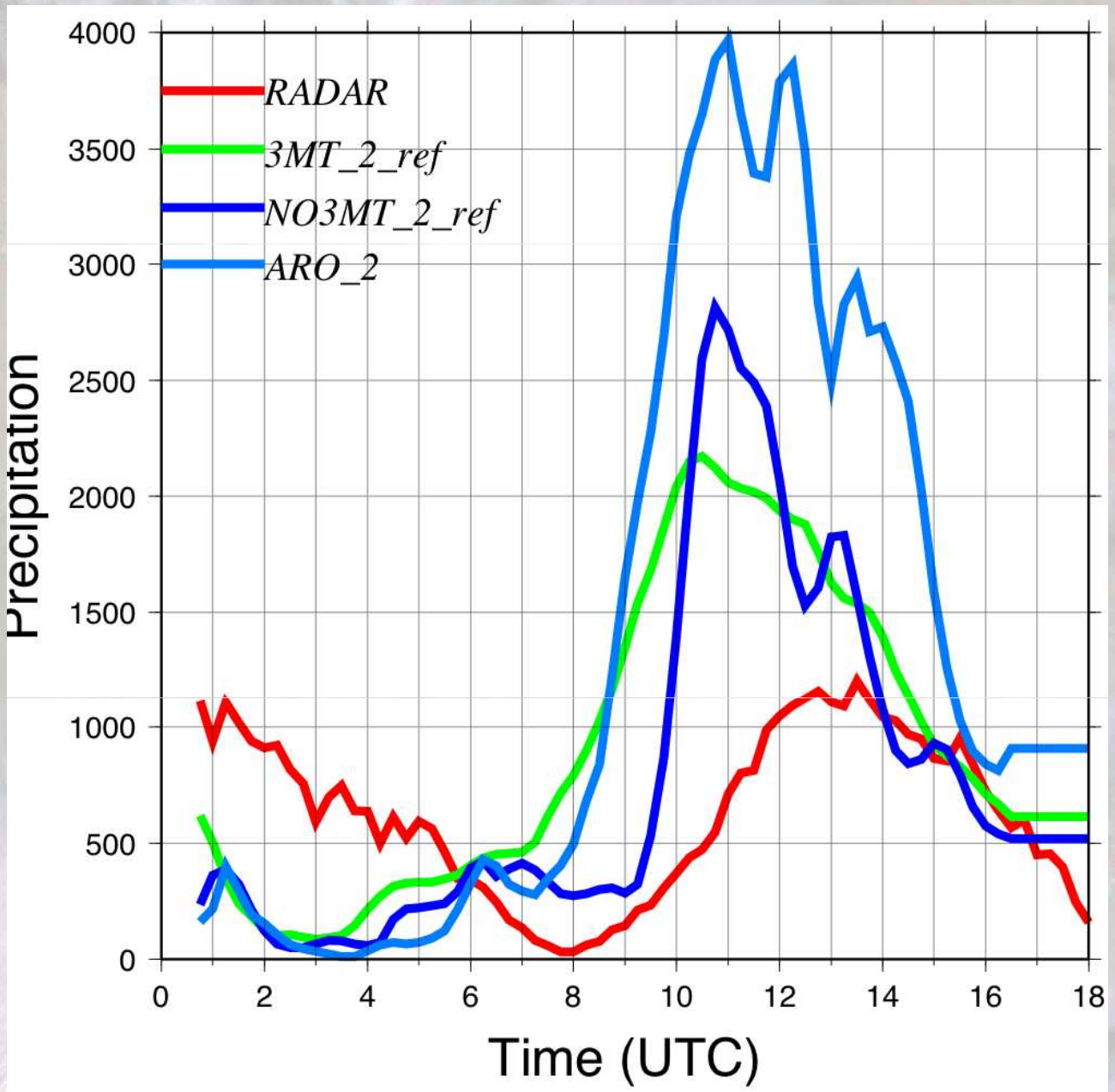
Open cell conv.



Impact of diffusion

- Worrying that an artificial parameter such as horizontal diffusion has such a strong influence.
- Increase in horizontal mixing delays onset of convection
- Increase in vertical mixing (e.g. non-local scheme) causes earlier onset deep convection
- Not a cure for stability, but rather applied as a physical parameterization

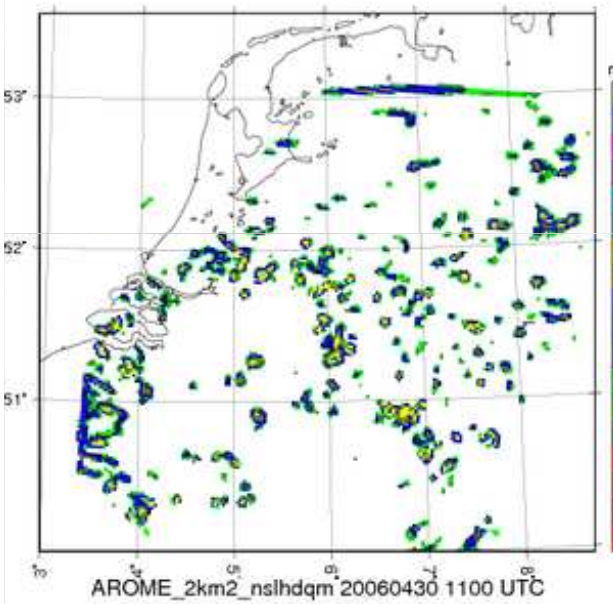
Impact horizontal diffusion



Isa Bengtsson
Sander Tijm

Impact horizontal diffusion

AROME_2km2_T 20060430 1100 UTC



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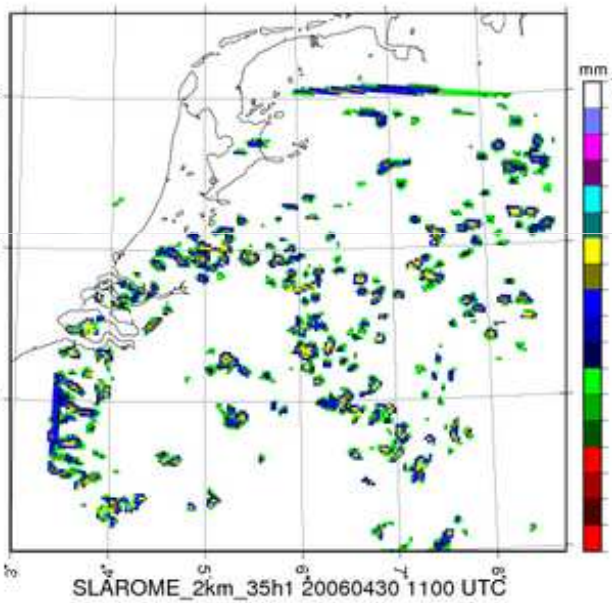

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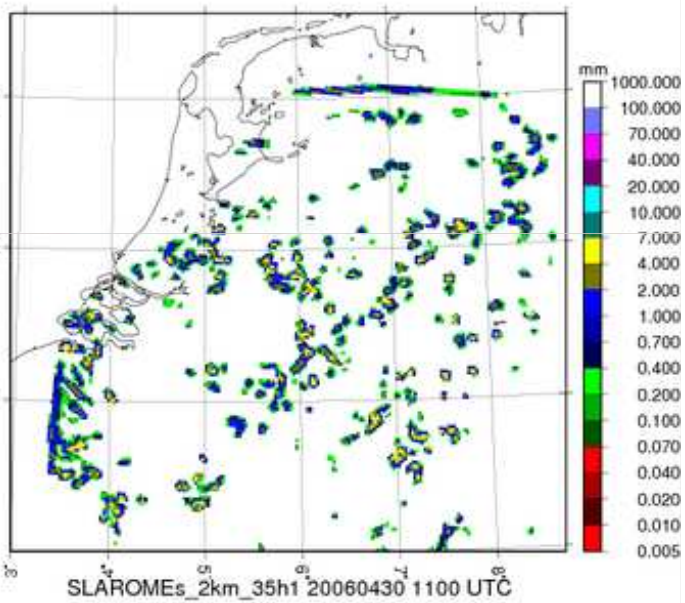

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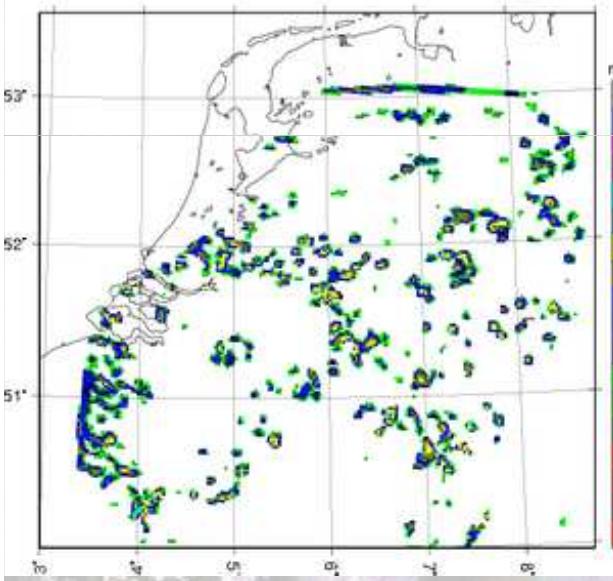
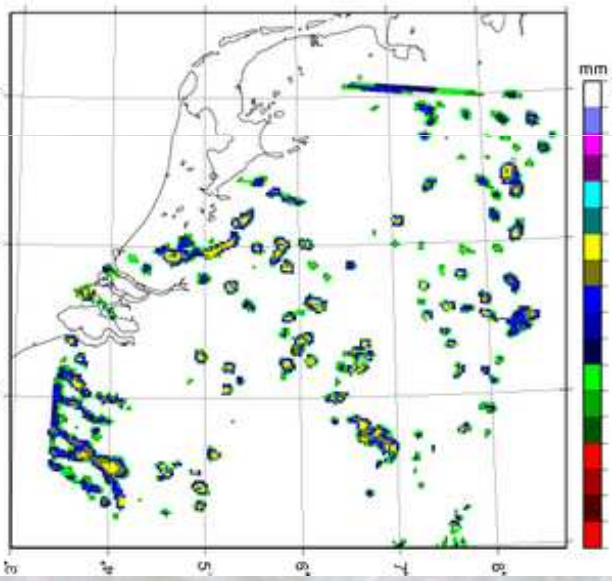
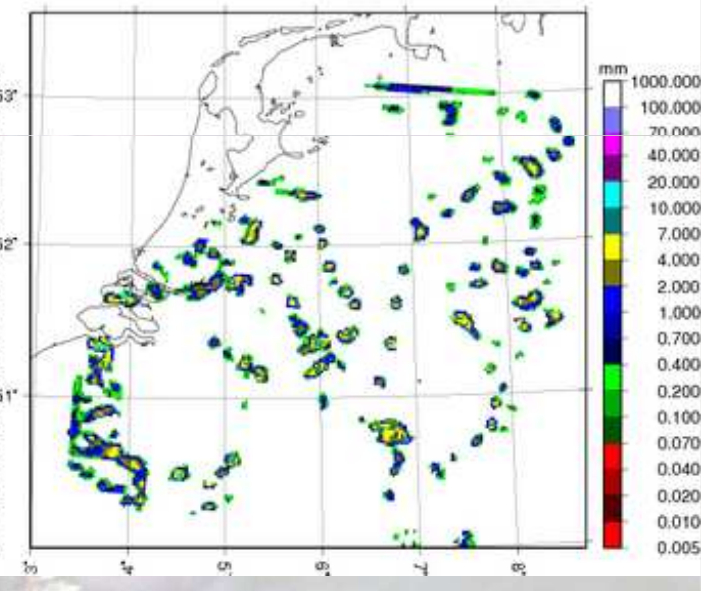


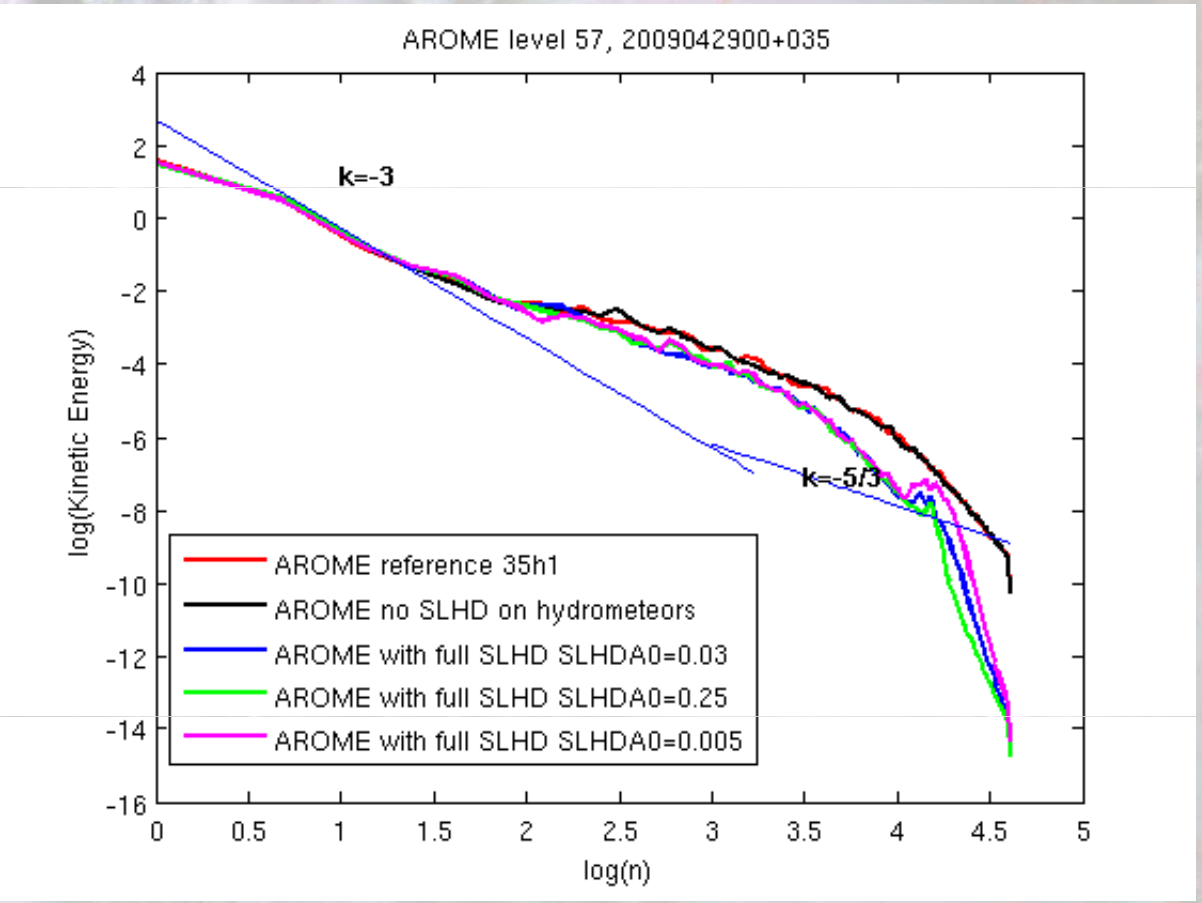
SLAROME_2km_35h1 20060430 1100 UTC



SLAROMEs_2km_35h1 20060430 1100 UTC



Impact horizontal diffusion



Lisa Bengtsson

Discussion on deep convection

- Semi-Lagrangian, Semi-Implicit dynamics
- Lower boundary condition imposes a flux even though vertical velocity should be 0 at surface (warm bubble tests with AROME and IFS).
- Diffusive schemes

Discussion on deep convection

- Data assimilation (only touched very briefly)
- Which technique to use?
- How to best use radar
- Simplified physics?
- Be careful touching the small waves

Discussion on deep convection

- Is it a problem that we treat convection as fully mature, without intermediate stage (no growth of showers, history in parameterizations)?
- What is the “non-mature” stage of convection? Shallow convection?

- How to eliminate spin-up? High resolution models interesting for nowcasting.

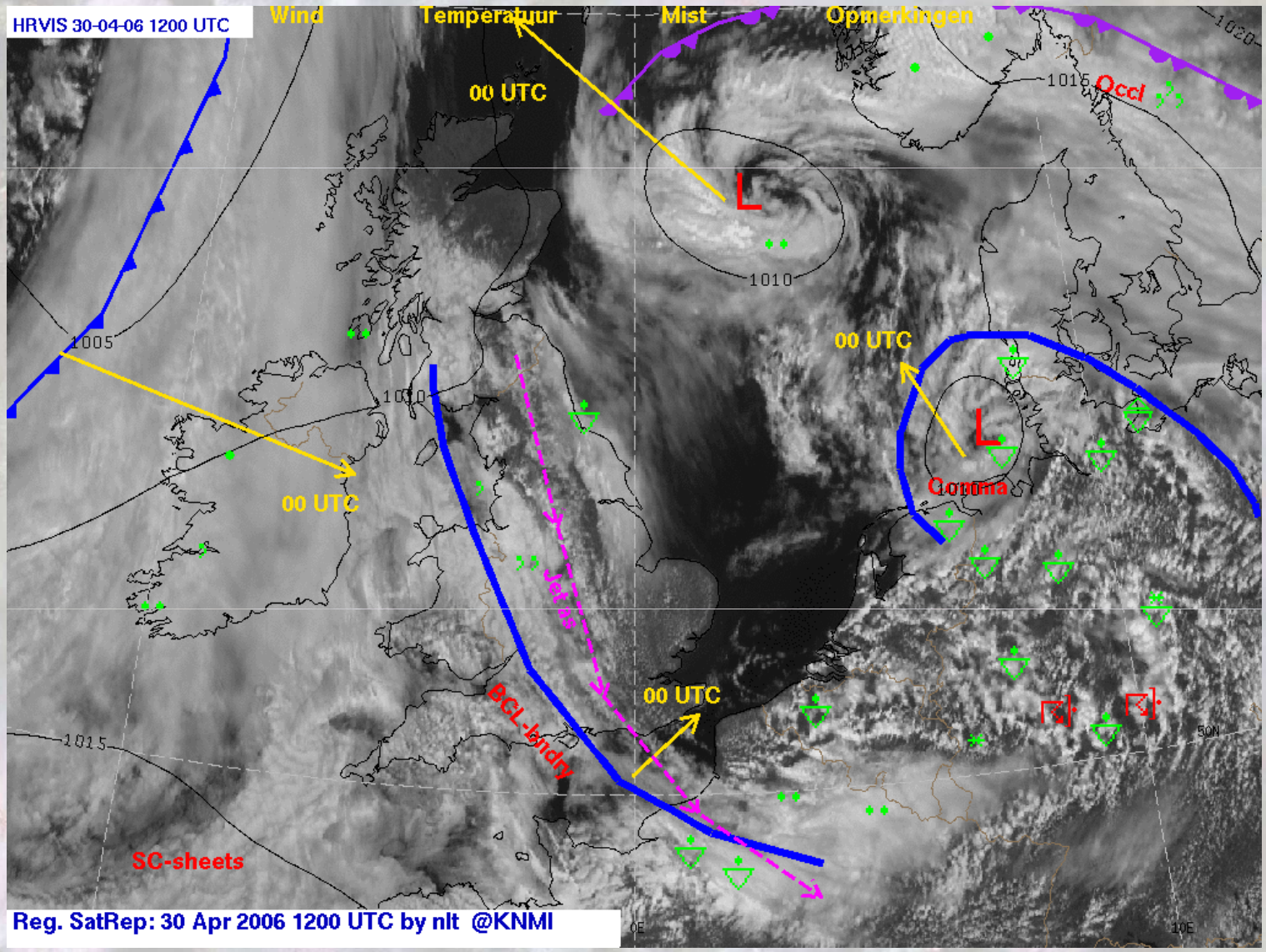
Case 30-04-2006

- Case with daily cycle of moderate deep convection over Netherlands
- Open cell convection (not too deep)
- Limited updraft mass flux
- Weak advection (no big impact of boundaries)
- Cold pool formation and impact on convection

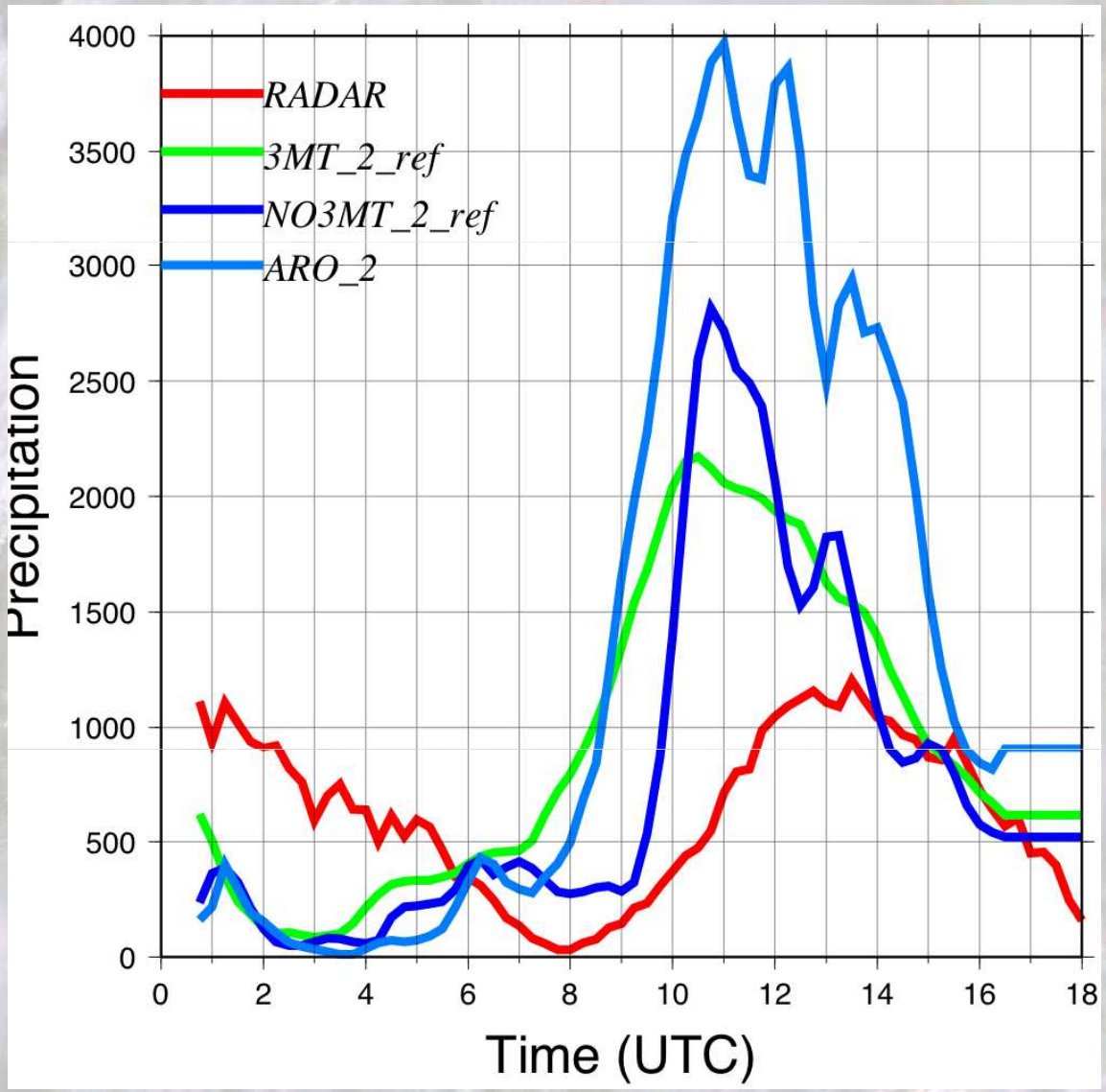
Case 30-04-2006

- Case for model intercomparison
- Try to make homogeneous case with no orography, flat land, equal bowen ratio throughout domain
- SRNWP expert team cooperation

ALARO/AROME case study



Intensity fluctuations



Conclusions[2]

- Lots of talk about dynamics in physics workshop!
- Large impact of advection scheme and diffusion on convection initiation and continuation
- Intercomparison of moderate (difficult) convection case will point to where differences in models are and help in finding improvements
- Case setup in coming months


Questions
@
Lunch