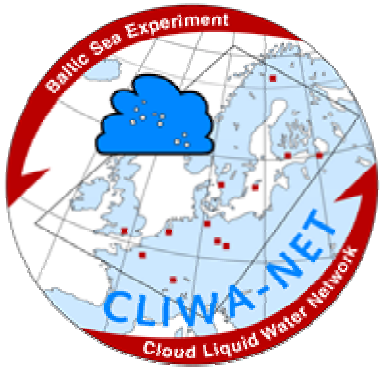


WP4200

Meteorologisches Institut

Universität Bonn

Simulations with the DWD Lokal-Modell at different horizontal resolutions

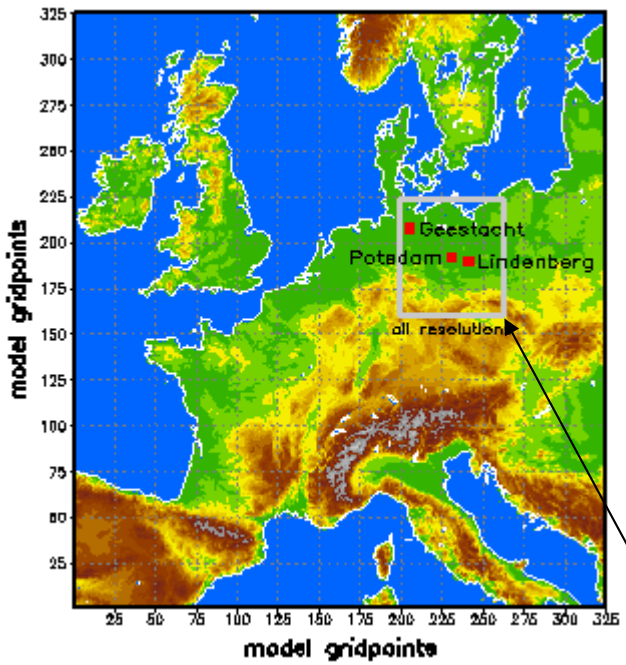
Case studies during CNN2 and BCC

Felix Ament, Susanne Crewell (University of Bonn)

Model domains and selected cases of WP4200

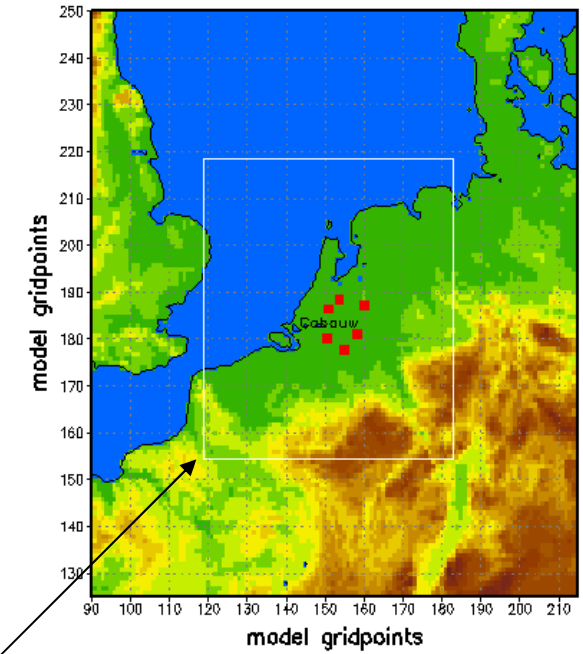
a) CNN1:

- 02 Aug. 2000
- 25 Aug. 2000
- 04 Sep. 2000



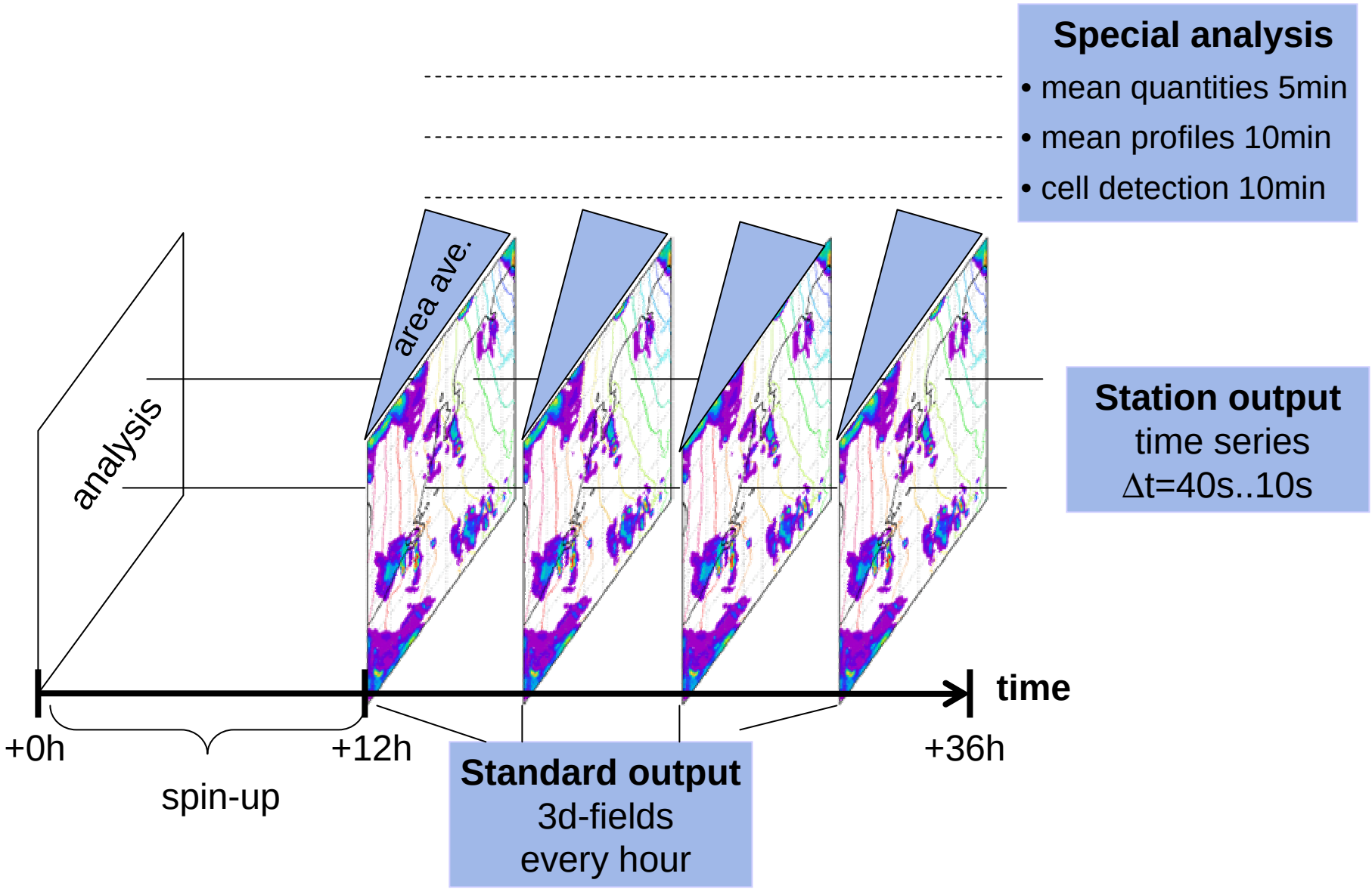
b) CNN2, BBC:

- 13 April 2001
- 02 Aug. 2001
- 23 Sep. 2001



- size of model domain: 400x400km
- horizontal grid spacing: 7.0, (5.5), 2.8, (2.2), 1.1 km
- no additional information at small scales

Available model data

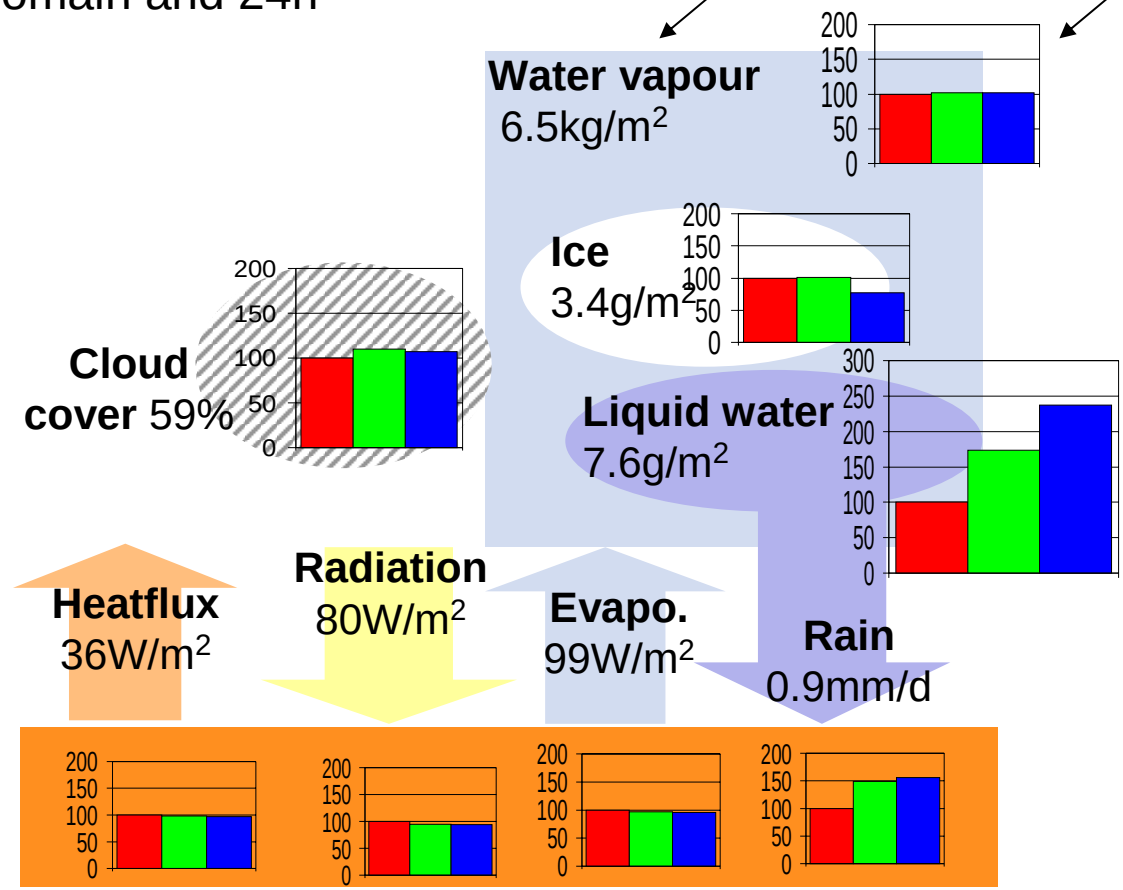


Budgets and fluxes I

Example: 13. April 2001
average over model domain and 24h

Reference values:
7km run without convection scheme

relative deviations
runs with **7**, **2.8** and **1.1** km grid spacings

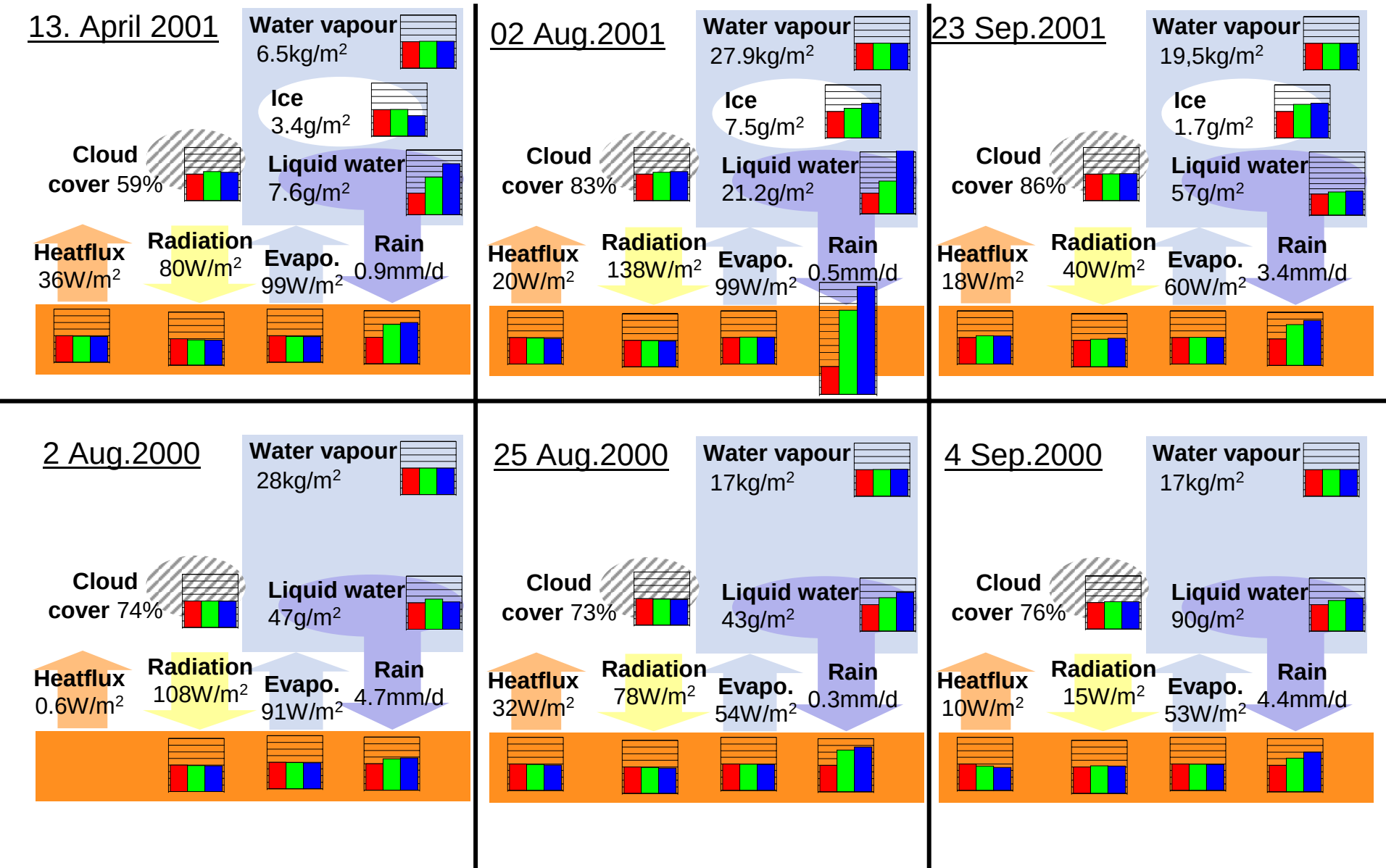


Results:

- water vapour, cloud cover and surface fluxes remain unchanged
- LWP and rain rate increase due to refinement

Budgets and fluxes II

7, 2.8, 1.1km



Convection scheme on/off - influence on averaged quantities

No effect:

- water vapour
- cloud cover
- radiative fluxes

Small deviations:

- sensible heat flux
- latent heat flux

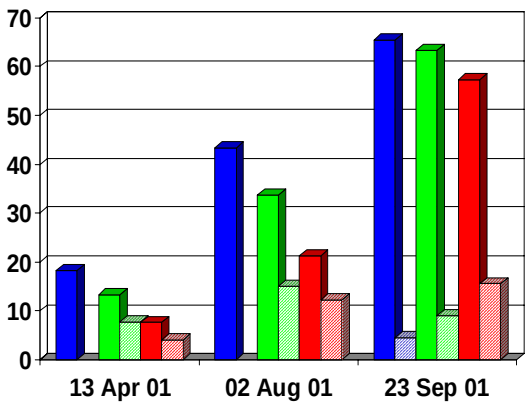
Differences:

7, **2.8**, **1.1**km

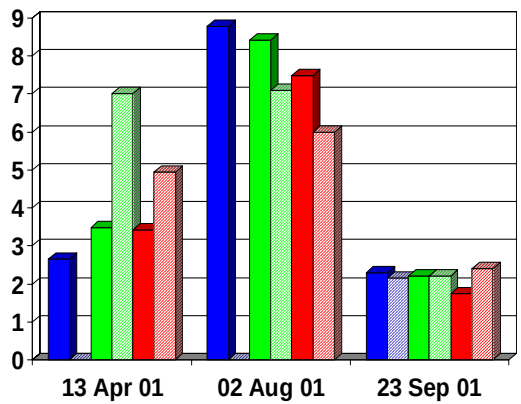
no convection

convection

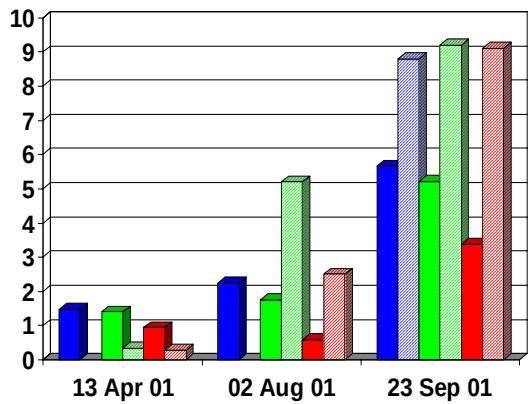
LWP [g/m^2]



IWP [g/m^2]

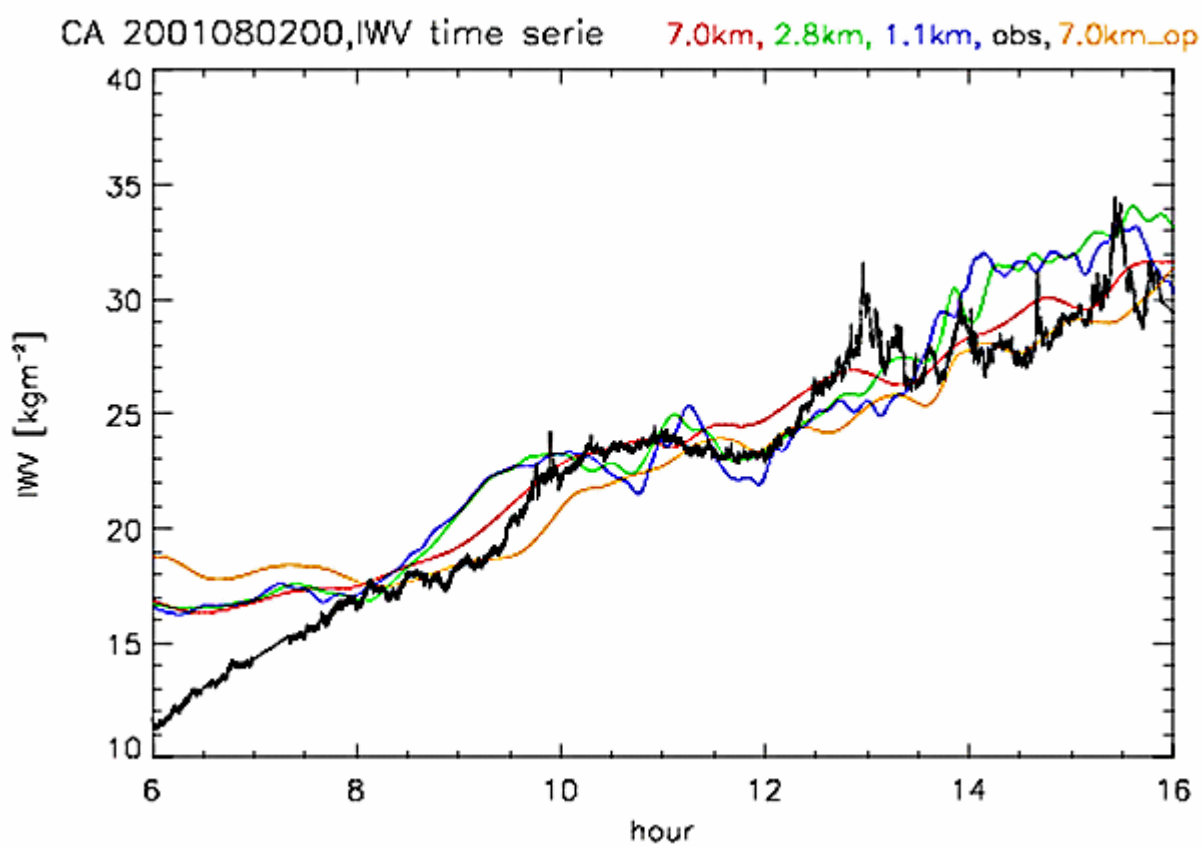


RR [mm/d]



IWV - measurement and simulation

Example: 02 August 2001, Station Cabauw



Extreme wet air is advected during the afternoon from the south to Cabauw.

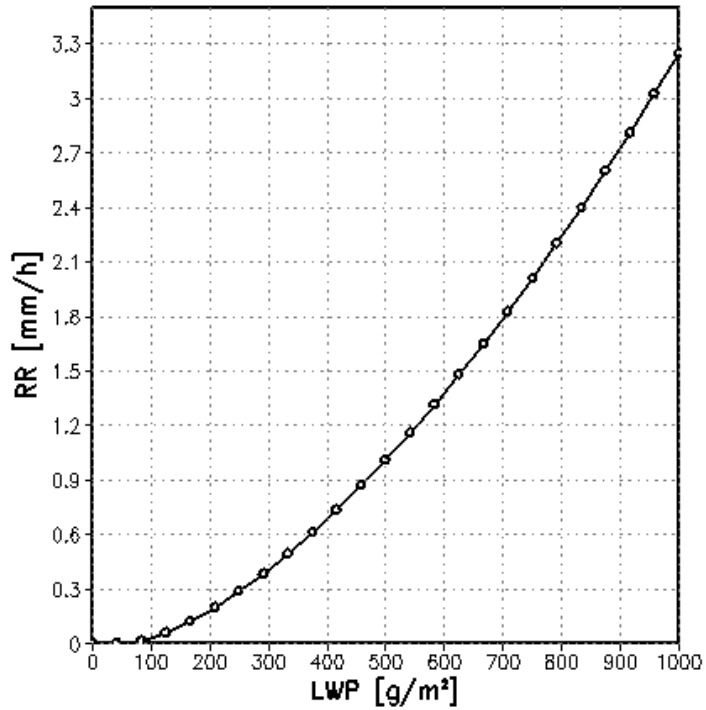
Direct LWP-rain effect

grid refinement

more LWP variations

nonlinear
LWP-RR relation

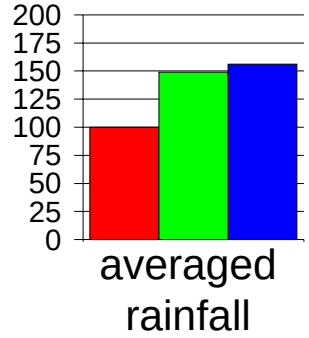
more RAIN !



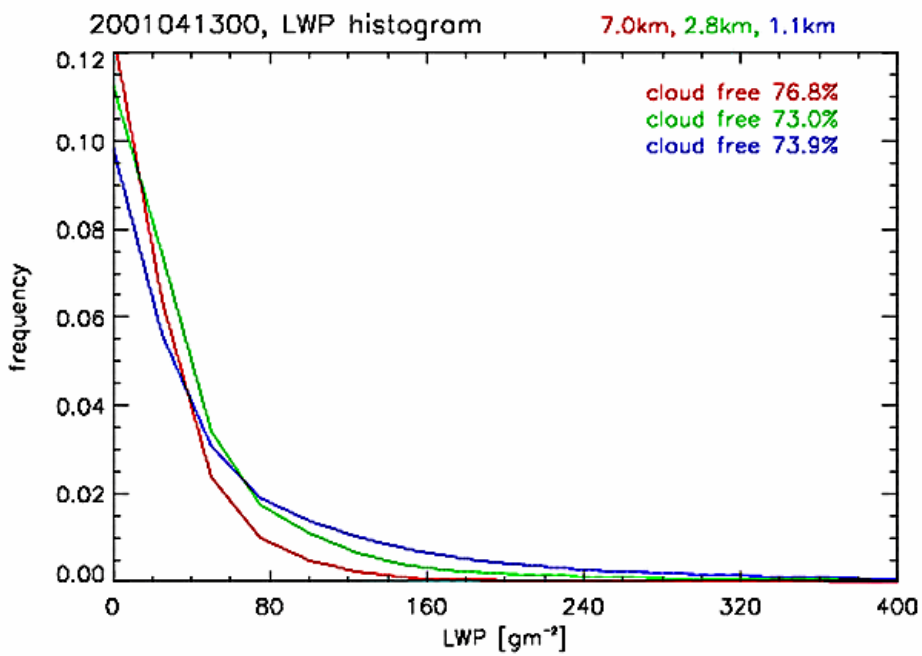
Result of LM cloud scheme
using idealized cloud profiles

Direct LWP-rain effect

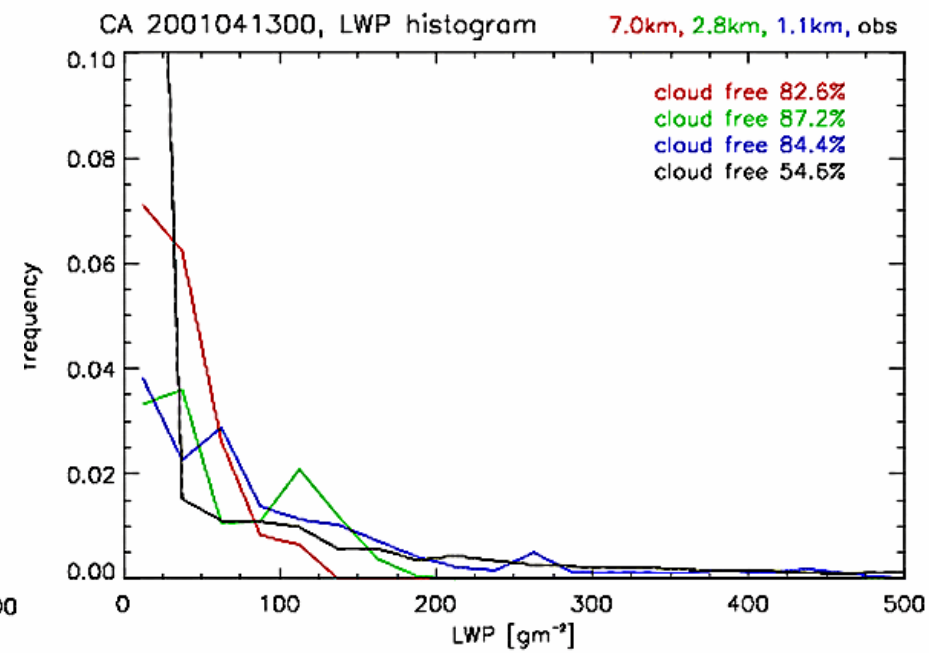
Example 14 April 01



Domain average



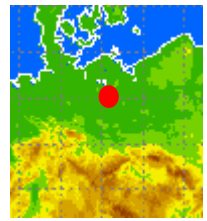
Cabauw



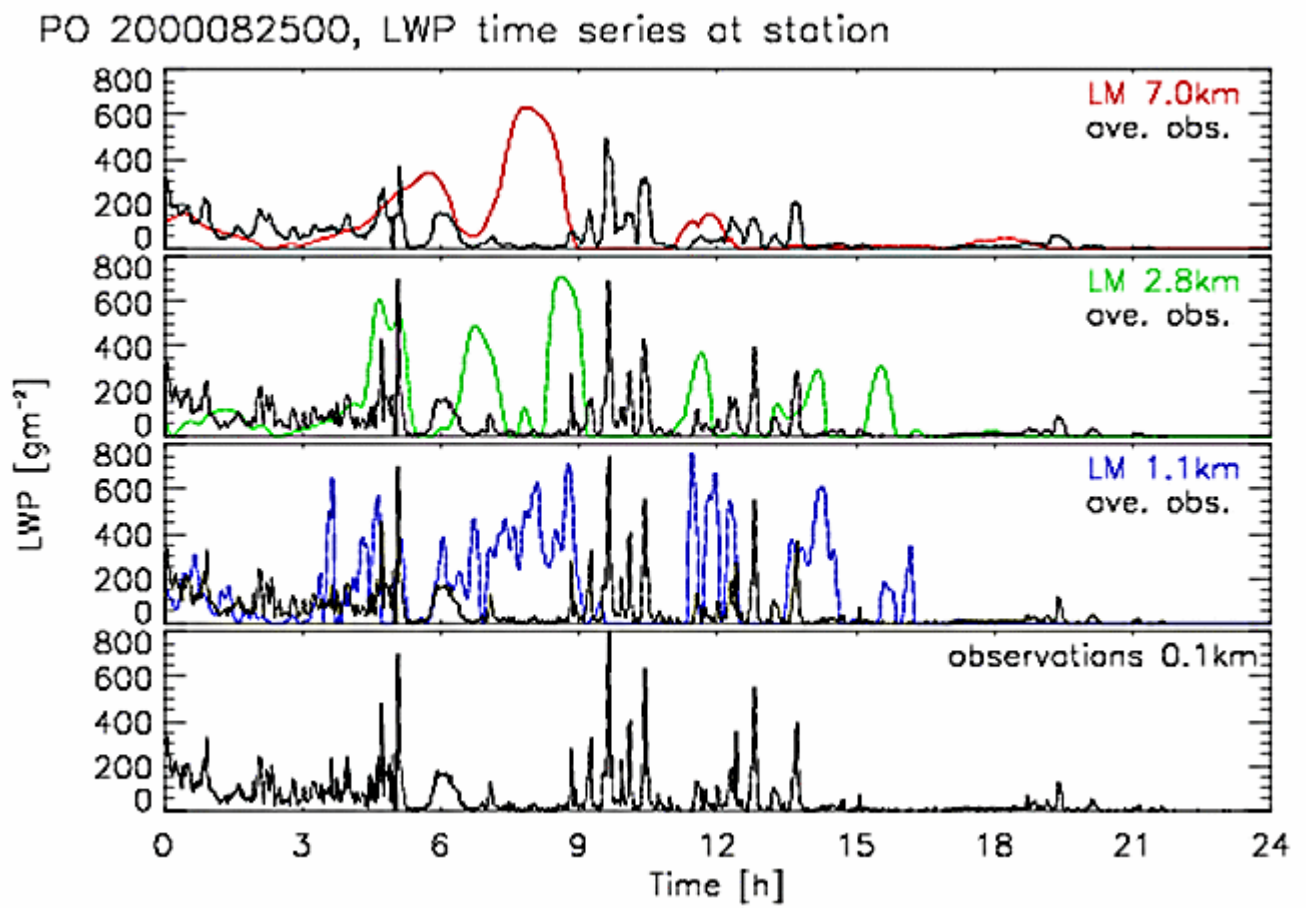
Probably poor statistic!

Comparison of LWP time series

microwave radiometer - model output



CNN1

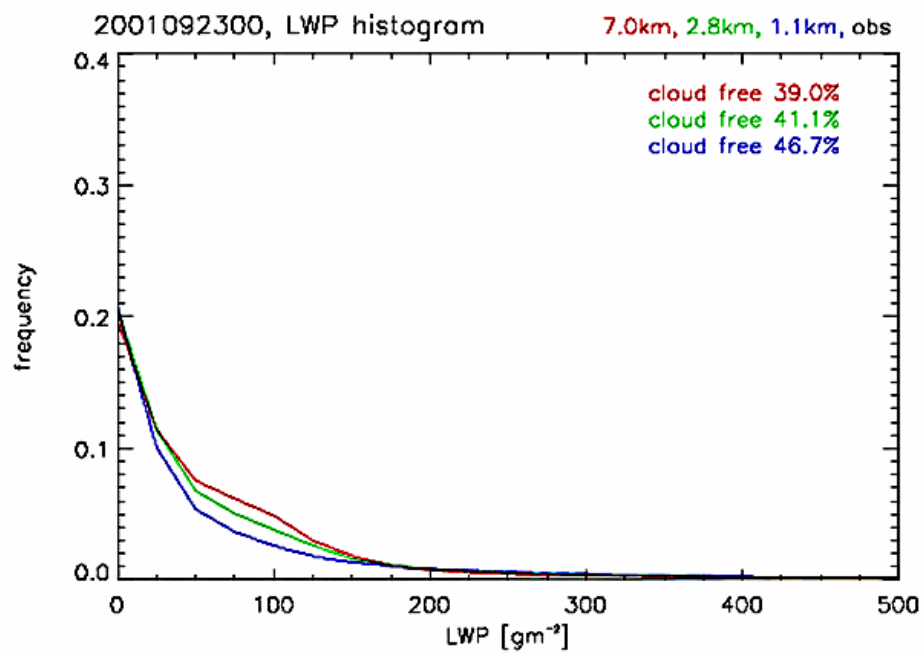


$\Rightarrow$ no better match, <u>but</u> statistic is improved!

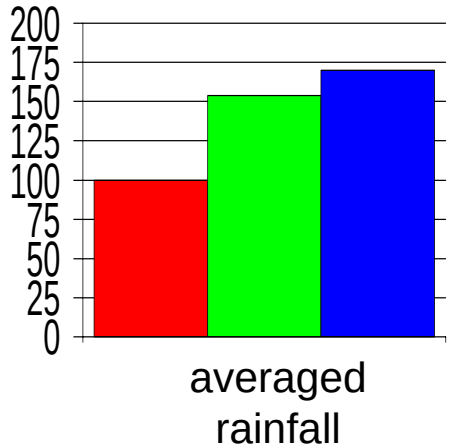
No rule without exception :-)

Example: 23 Sep 01

Domain average



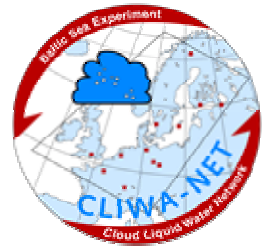
but



==> additional mechanism:

- vertical cloud structure, humidity below cloud
- ???

Results of WP4200 - so far ...



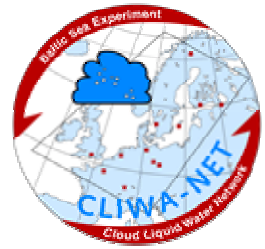
- boundary effects can be larger than refinement effect
==> use the same boundary conditions at all resolutions!

- Average *cloud water content* and *rain rates* are the only mean quantities affected by refinement

- LM simulations without convection scheme produce quite realistic *LWP* values

- The size of resolved convective cells depends on the grid spacing at scales larger than 1km.

Interesting issues



Increase of LWP and rain

- understanding of mechanisms
- (validation with measurements)

Convection scheme

- Partitioning of resolved and parameterized convection at different grid spacings
- vertical transport

Cloud cover

- Is there really no refinement effect?

Cell shrinking

- Which parameters control the cell size? Horizontal diffusion?