# KNMI HIRLAM and HARMONIE research 2010-2011

## Impact of domain size, new computer
### (Emiel van der Plas, Jan Barkmeijer)

- Boundaries have a large impact on convection development in model.
- If you want to represent convection qualitatively OK then convection has to develop inside model domain, well away from boundary
- For Netherlands convection often develops over France/Belgium
- Domain as far south as Pyrenees to represent severe convective cases, examples 25/26 May 2009 and 14 July 2010 (see figure 1 and 2).
- KNMI new supercomputer has arrived, operational December 2011
- BullX B500, 4752 cores, 9.8 Tb memory
- Aim: 800x800x60levels domain for HARMONIE 2.5 km.



Figure 1: Impact of domain size on representation of organized convection. Top: domain of 300x300 points. Bottom: domain of 500x500 points. The plots show the cloud ice (grey), cloud water (yellow) and rain (purple) contours of 0.01 g/kg at 17 UTC on 14 July 2010, together with the observed radar precipitation intensity.
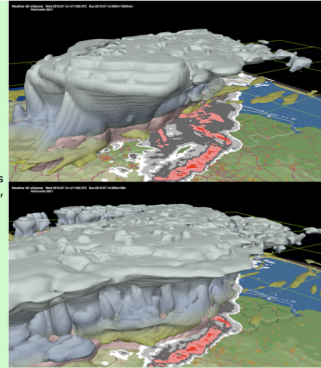
## Interaction microphysics and dynamics (1)

- Reduction of graupel fall speed (fast falling species, ~4 m/s compared to 1 m/s for snow) leaves more hydrometeors suspended in atmosphere. Reference is used for Figure 2 a.
- Case of 17 December produced as much graupel (soft hail) in HARMONIE as snow, most of precipitation was snow further inland!
- Higher concentration of hydrometeors in air parcels (not falling out so quickly) takes away part of buoyancy from parcels, less peaked and intense precipitation.
- Gives larger, weaker and more organized (in larger structures) precipitation, looking more like reality (compare figures 2 a-c).
- Can take away part of overestimation of precipitation for smaller scale convective structures.



Figure 2 a) Reference run

Figure 2 c) Slow graupel run

Figure 2 b) Radar observations
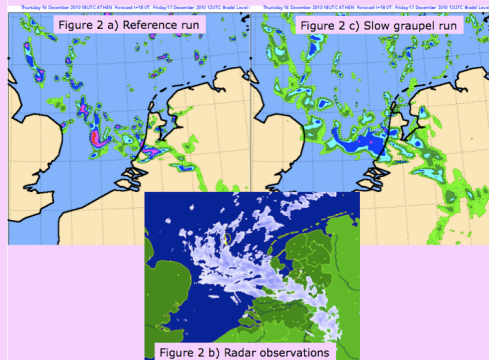
## Interaction microphysics and dynamics (2)

- There is a strong interaction between the microphysics and the dynamics of the mesoscale models.
- Initial versions of HARMONIE had strong horizontal diffusion, causing diffusion of hydrometeors into environment, strong evaporation and formation of downdrafts, 'outflow' problem
- Reduction of horizontal diffusion removed most of problem.
- Still remaining problem of only resolved scales in model for microphysics, while updrafts can be much smaller in scale, depending on the type of organization. In formation of e.g. graupel this should be taken into account.
- Also, in reality not whole grid box will be covered by hydrometeors at cloud boundaries. Evaporation should be dependent on the fraction of the grid box that is covered by hydrometeors, maybe by counting the surrounding grid boxes that have hydrometeors (se figure 3)

## Subgrid microphysics

- Counting the surrounding grid boxes with hydrometeors.
- 8 boxes is 100% evaporation potential
- For the rest $(n/8)^?$ with ? being subject of study?
- Similar thing can be done for the updraft and hydrometeor formation link.
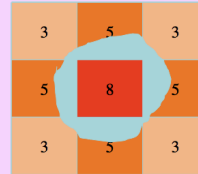


| 3 | 5 | 3 |
| 5 | 8 | 5 |
| 3 | 5 | 3 |

Figure 3: representation of hydrometeors in mesoscale model with the color representative of concentration, together with the shower in reality (light blue).

## Wind power prediction (Gertie Geertsema)

- Wind power climatological predictions often done with synops translated to 100 metres
- Stability not taken into account
- Can give underprediction of wind power potential

- Cabauw tower offers opportunity to compare translation with observations at 80 and 140 metres
- Also comparison with archived HIRLAM forecasts.
- Archived model winds shows normal spread around the diagonal, translated synops show significant underprediction of wind power potential
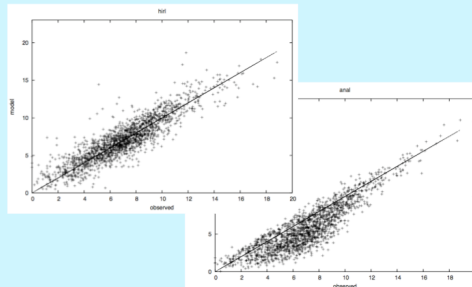


Figure 4: comparison of 100 metres wind with HIRLAM forecasted winds (left) and with the 10m-observations wind translated to 100 metres (right)

## Improved HIRLAM cloud cover forecasts
### (Sibbo van der Veen)

- Nowcasting SAF cloud cover, cloud top temperatures and interpolated synop cloud base maps used to adjust initial specific humidity fields.
- Experiments for 1 week in every season.
- Improves the cloud amount significantly in 80% of cases.
- Improvements can be kept up to 24 hours ahead, especially in Winter, in Summer the positive impact is short lived.
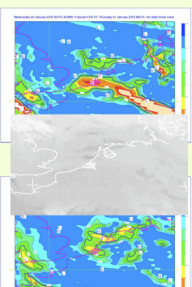- Can have a positive impact on temperature also.



Figure 5: reference cloud cover (top) observed clouds (center) and forecast with MSG initialisation (bottom)



Figure 6: bias (top) and RMS (bottom) for the 00 UTC and 12 UTC runs of HIRLAM with the reference HIRLAM version (REF) and with the MSF initialized humidity (MSG)