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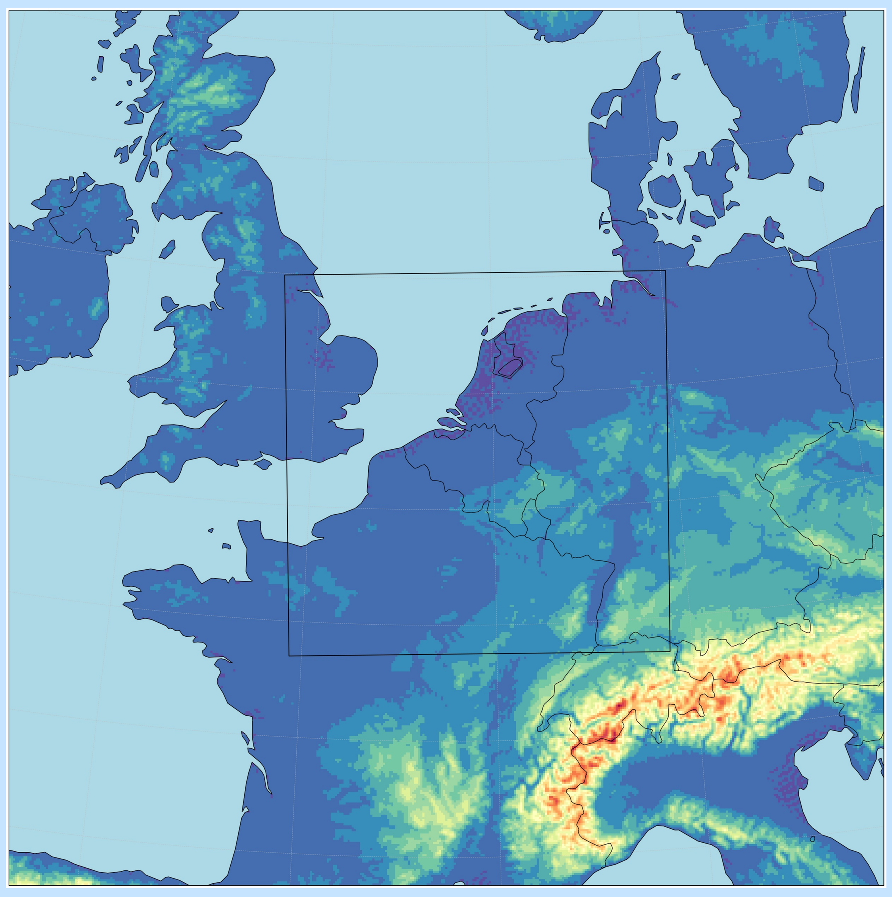
The operational ALADIN-Belgium model

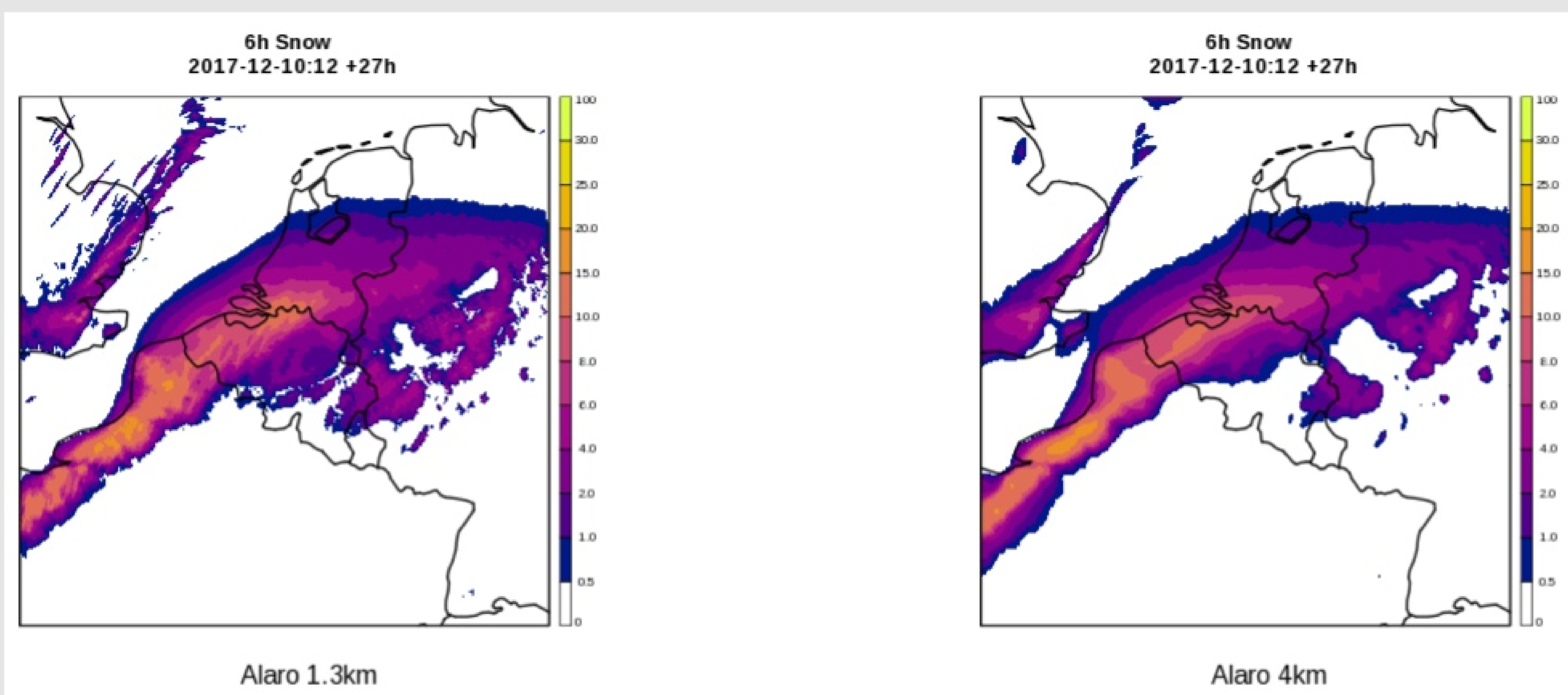
1. The computer system

- SGI Rackable cluster
- 2x56 compute nodes with each 2 Xeon E5-2680V3 processors.
- 24 cores per node, 2x1344 cores in total



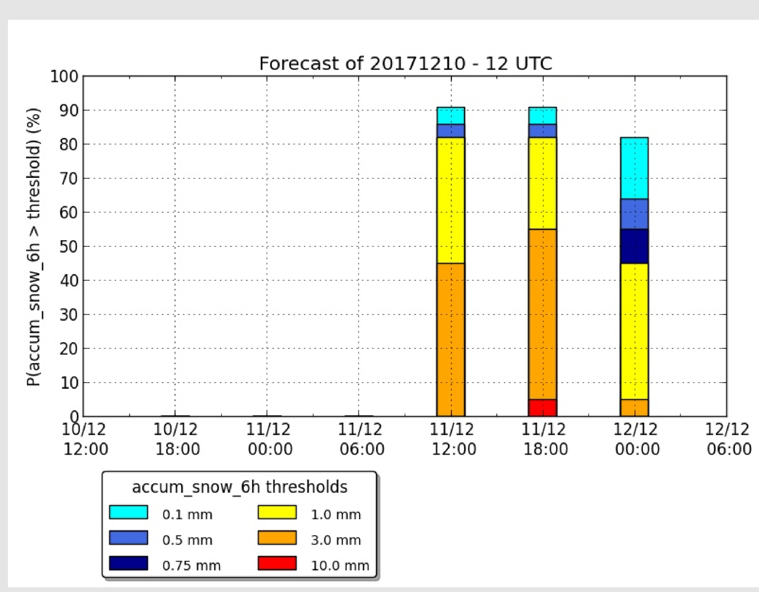
2. Model versions

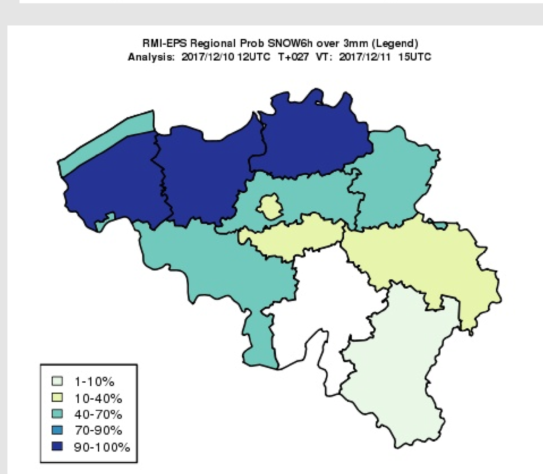
- 4 km resolution 432x432x87L to +60h
  3-hourly coupling to Arpège
  cy38t1 + ALARO-0 + non-saturated downdraft + TOUCANS + ACRANEB2
- 1.3 km resolution 600x600x87L to +36h
  hourly coupling to 4km run
  cy40t1 + ALARO-1, non-hydrostatic
- E-suite: cy43t2
- model runs use 720 cores.



Snow case 11/12/17

On 11 december 2017 a small low pressure system moving from France over the Ardennes towards Germany caused significant snowfall over parts of Belgium. Especially the northwestern part of the country was hit by intense snowfall with local accumulations up to 15 cm (quite rare for this region). The snow event resulted in chaos with near-record traffic jams on the roads and more than 300 cancelled flights at the national airport. The snow event was predicted well by the different products that are used operationally at the RMI as illustrated below.

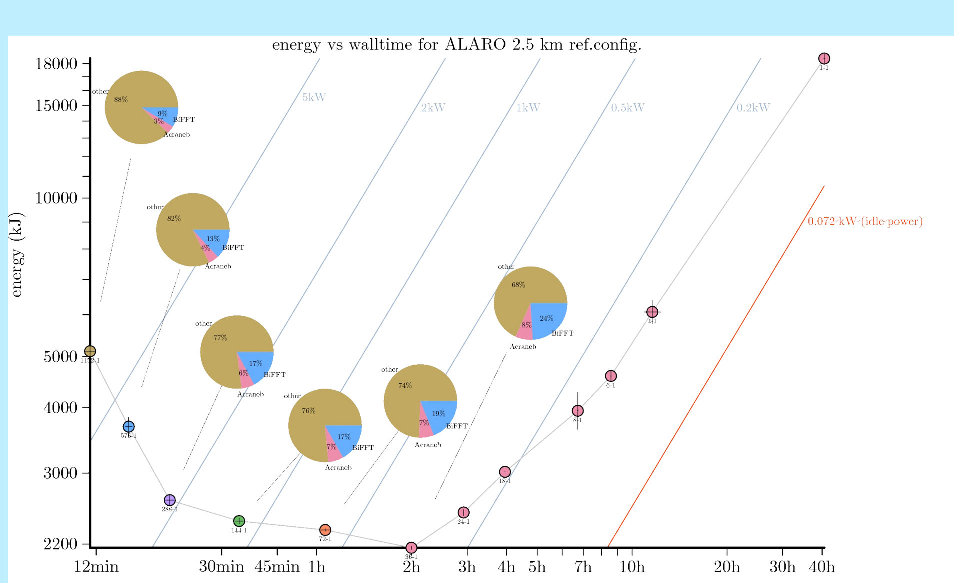




H2020 ESCAPE : energy consumption of weather models

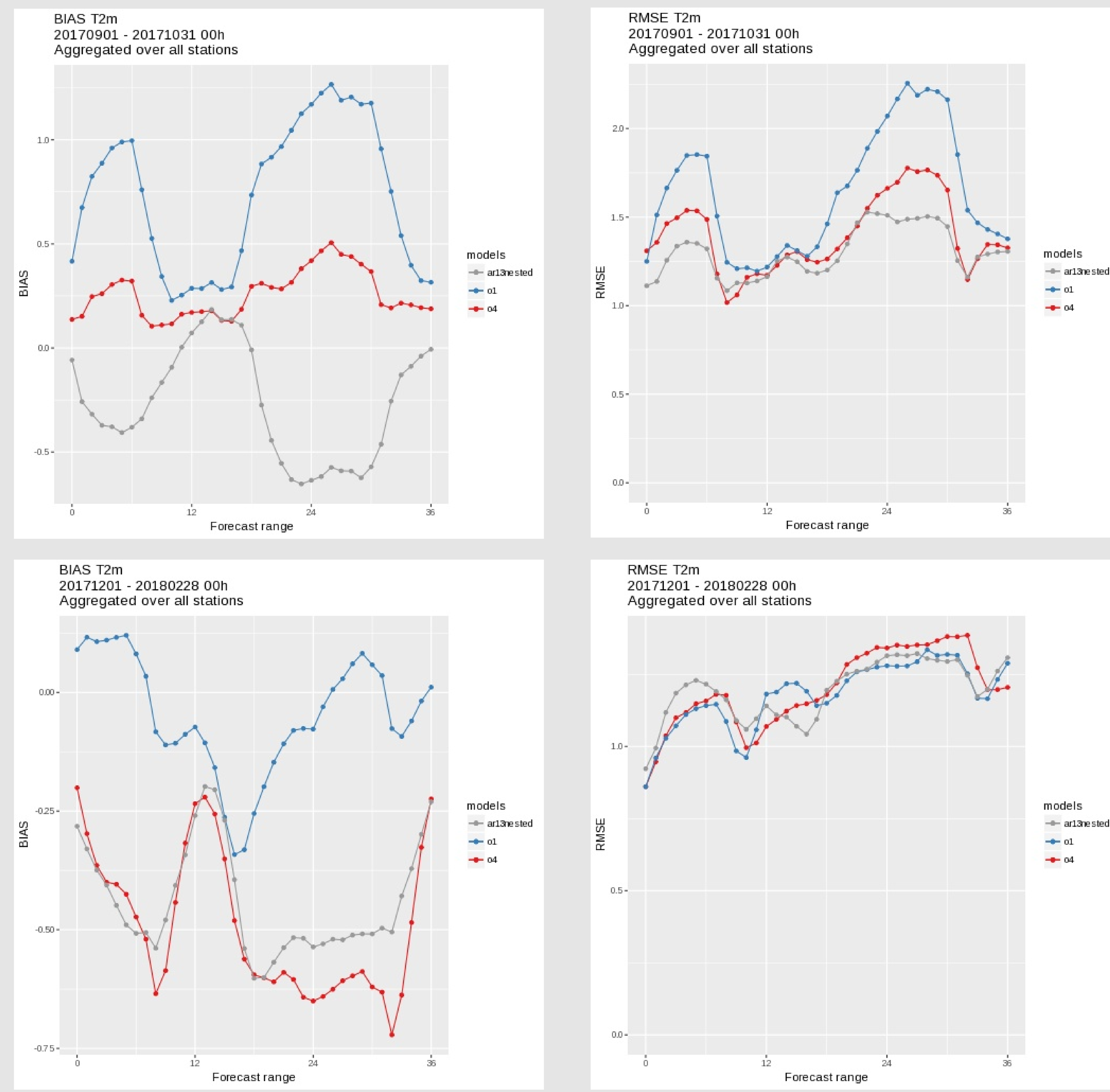
The figure shows the results of energy measurement runs performed with the ALARO 2.5km reference configuration *cca* at the ECMWF. These are pure MPI runs (i.e no OMP threads) of a 12h forecast on a 540 x 450 grid with 65 vertical levels. Each data point is the result of averaging the outcome of 2 separate runs and the black crosses represent error bars.

Same-colored data points use the same number of nodes. Added are lines of constant power (light blue lines), including the power delivered by a node in the idle state (orange line). Indices below each data point denote the number of MPI tasks (left number). In order to get a better view of the total curve, we also include runs which do not fill an entire node. For the other, multi-node runs we include pie charts showing the relative energy consumption for the BiFFT and Acraneb dwarfs.

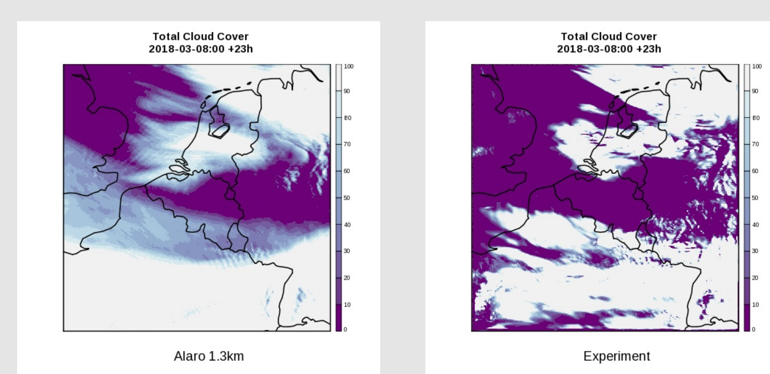


comparing ALARO & AROME at 1.3 km

As an experiment, we have run several months of arome (cy43t2) on the same grid and with exactly the same nesting strategy as the operational ALARO-1.3km run: no data assimilation (downscaling), hourly LBC's from the 4 km run.



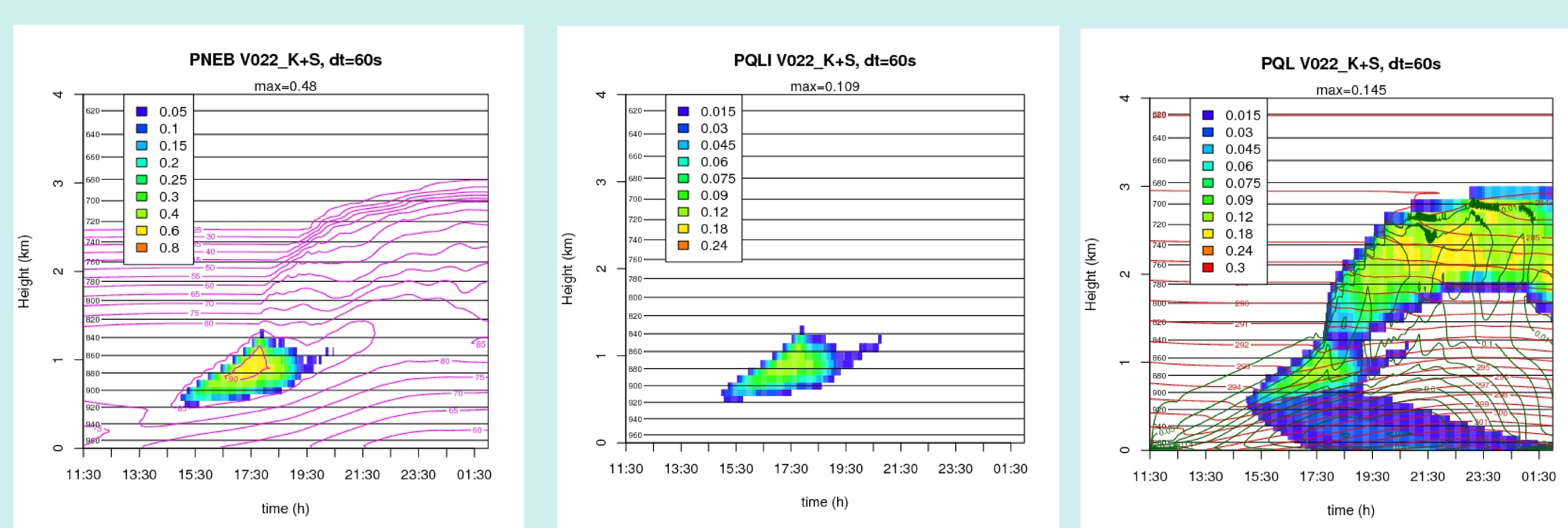
Just as in RMI-EPS, both models show strengths and weaknesses. The T2m bias is very different (alaro-1 run is with old ISBA).



Cloudiness in AROME and ALARO looks very different

Use of MUSC to track an old hidden bug

We made a single column simulation of for the ARM shallow convection, aiming at using the prognostic cloud condensates from microphysics into radiation (unifying cloudiness). However, while the cloud and the radiative condensate (Fig.1, left and center) appear plausible (eventhough a bit too shallow), the microphysical condensates presented the weird behaviour shown on fig. 1 (right).



We could trace that the flowing down of the condensate below the cloud was removed when suppressing cloud water sedimentation (LSEDCL=F), and the strange plume above when we suppressed the turbulent diffusion of the condensates (NDIFNEB=0). Sedimentation for instance is computed in the microphysics; normally the cloud scheme should re-evaporate sedimented condensates at the next time step.

We finally discovered the bug in the two routines of the cloud scheme, `acnebcond` that computes new cloud fraction, and `accdev` that computes the actual condensation. When the new cloud fraction was zero, the old condensate was merely set to zero in the computation of condensation/evaporation. For this reason, condensate transported outside the cloud by sedimentation or turbulent diffusion was forgotten by phase change, and continued to be transported (advected, diffused and sedimented) further away over several time steps.

The solution was to rather set the new condensate to zero outside the cloud, but keep the old one, so that the final tendencies imply the evaporation of the part that got outside the cloud. This bugfix (brought in CY43T2bf?) had some (small) impact on scores in the 3D model.