Current and future operational ALARO use in Belgium

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Content

- ALARO setups in Belgium
- Monthly scores
- Case studies
- Conclusions

From the Stone Age to the 21st century at the IRM

- previous HPC machine (2007): 184 Itanium2 cores, 576GB Ram
- new HPC machine (2015): 2688 Haswell cores, 11.8TB Ram
- Paves the way to operational km-scale forecasts.

Overview of the different ALARO configurations used during the last months at RMI

ALO-7 BE

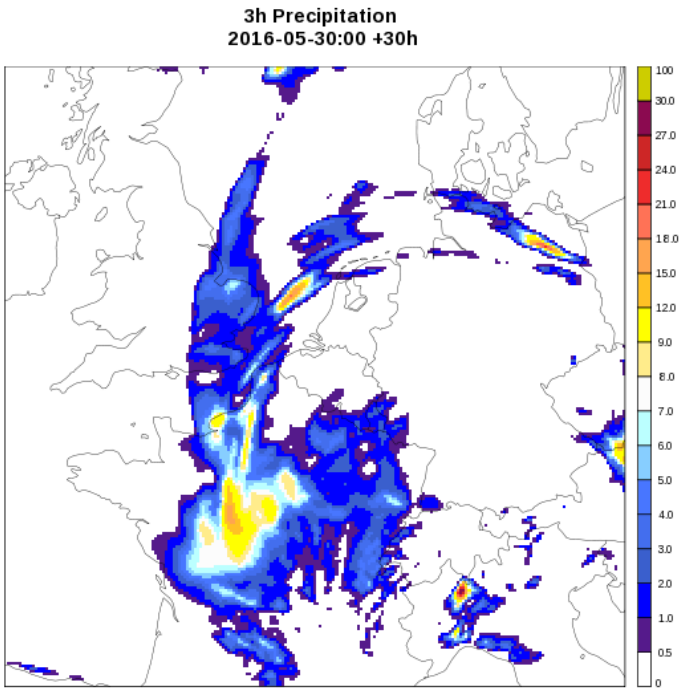
7 km resolution over large domain
46 levels
3 hr coupling to ARPEGE
hydrostatic
Cy38t1 – Alaro0-baseline

ALO-4 be

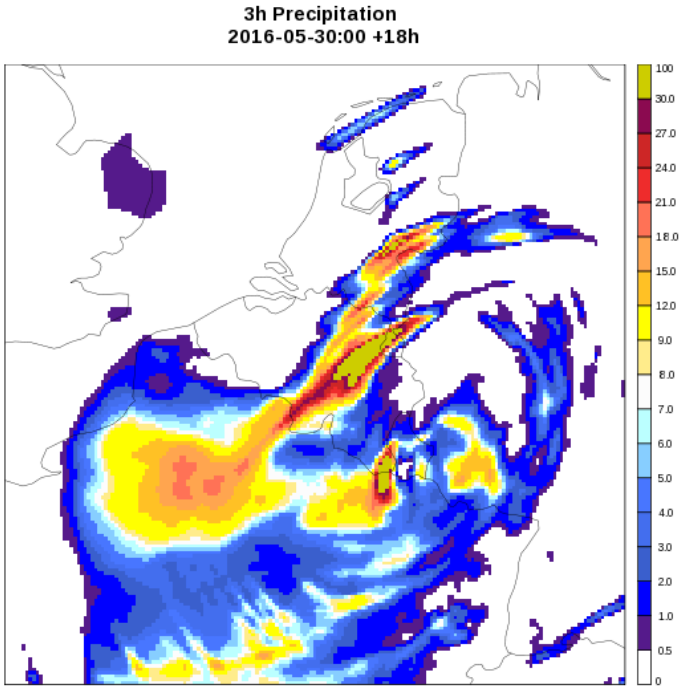
4 km resolution over small domain
46 levels
3 hr coupling to ARPEGE
hydrostatic
Cy38t1 – Alaro0-baseline

current configurations

increasing resolution



Alaro 7km



Alaro 4km

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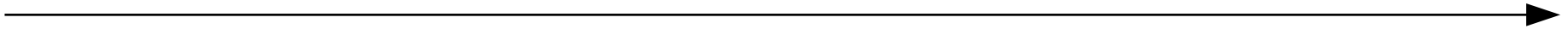

targeted configurations

ALO-4 BE

4 km resolution over large domain
87 levels
3 hr coupling to ARPEGE
hydrostatic
Cy38t1 – Alaro1-proto
(TOUCANS+ACRANEB2+NS-Downdraught)

Overview of the different ALARO configurations used during the last months at RMI

ALO-7 BE

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ALO-4 be

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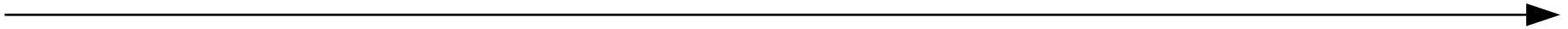
current configurations

increasing resolution



targeted configurations

ALO-4 BE

4 km resolution over large domain
87 levels
3 hr coupling to ARPEGE
hydrostatic
Cy38t1 – Alaro1-proto
(TOUCANS+ACRANEB2+NS-Downdraught)

ALO-1 be

1.3 km resolution over small domain
87 levels
1 hr coupling to ALO-4 BE
Non-hydrostatic
Cy40t1 – Alaro1-baseline
(TOUCANS+ACRANEB2+NS-Downdraught+Shallow Convection + CSD)

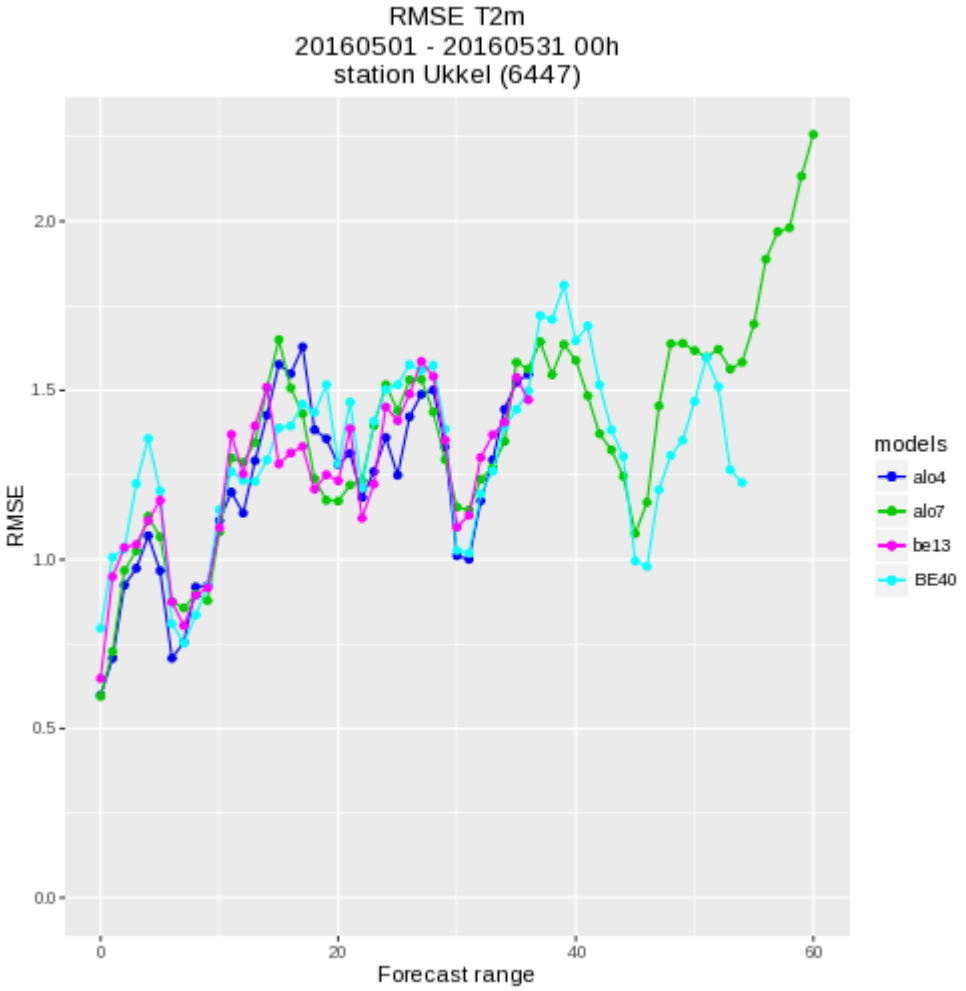
Limitations

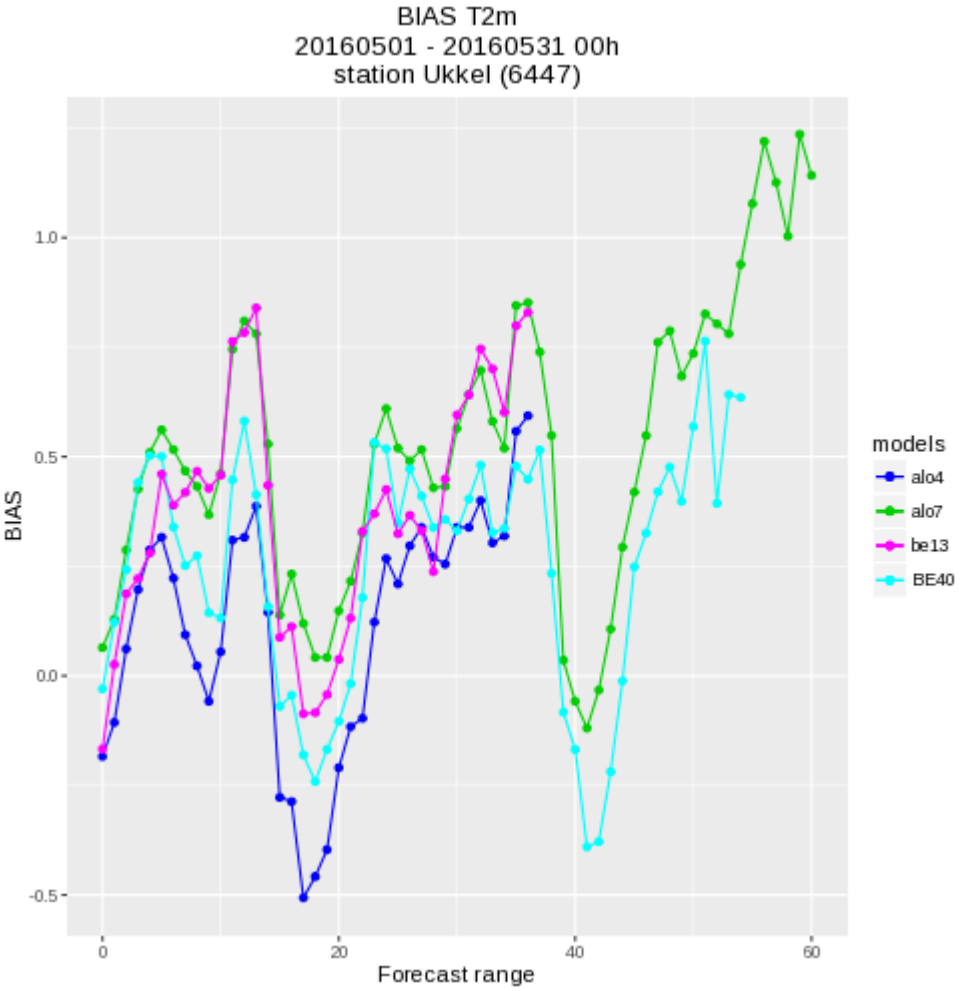
No clean scientific comparison:

- Cycles
- Horizontal resolution
- Vertical resolution
- Coupling
- Domain size

Scores

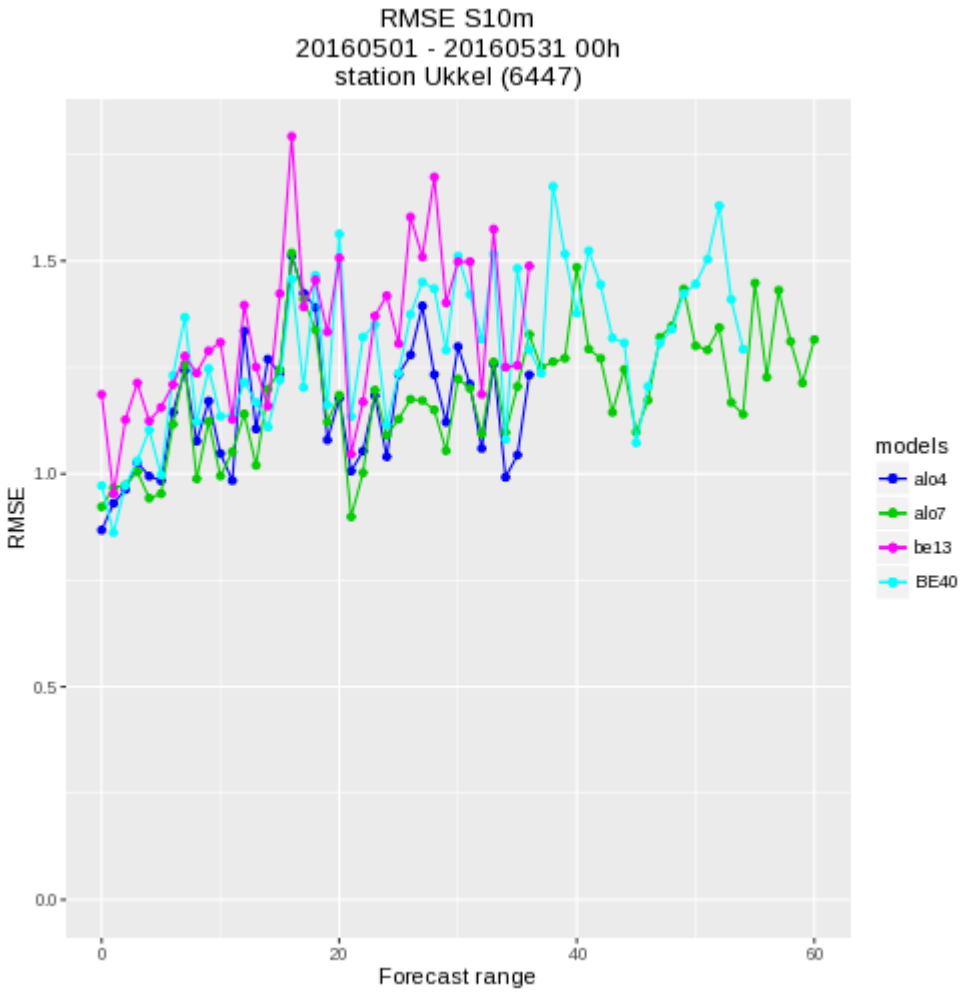
- RMS & bias 2m temperature in Uccle roughly similar

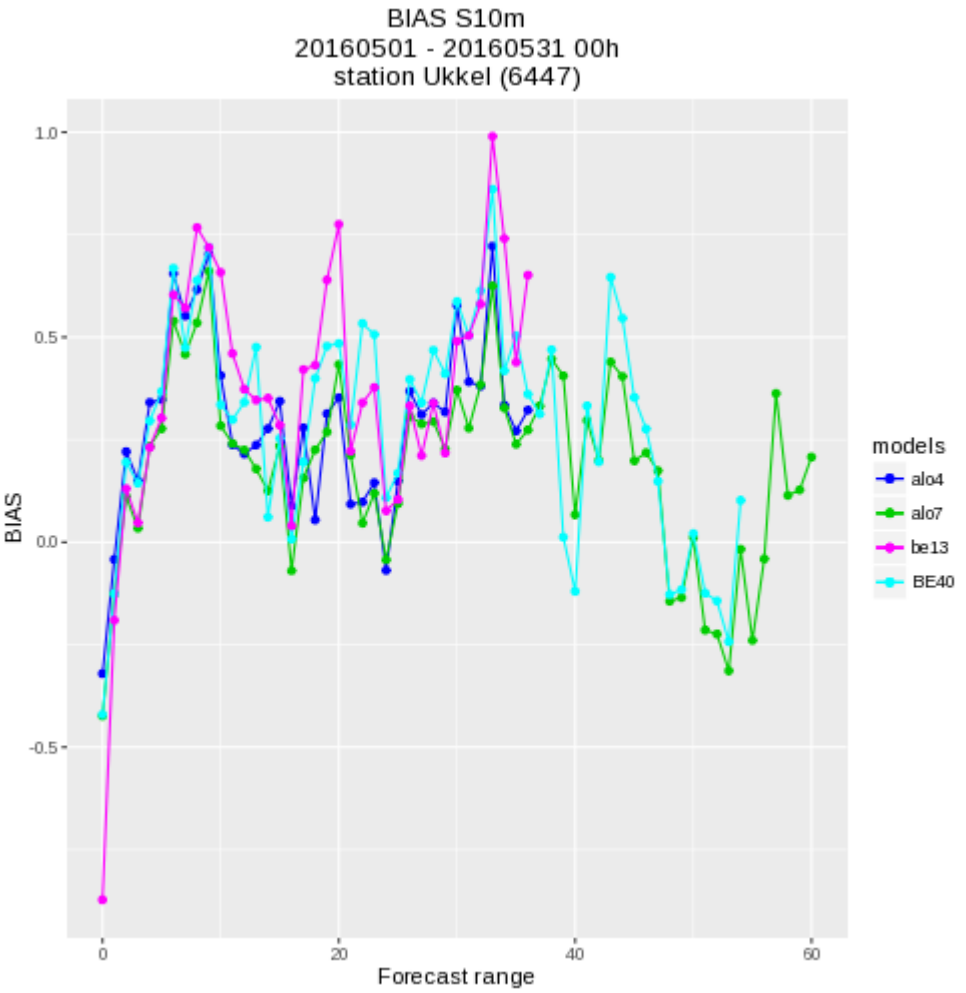




Scores

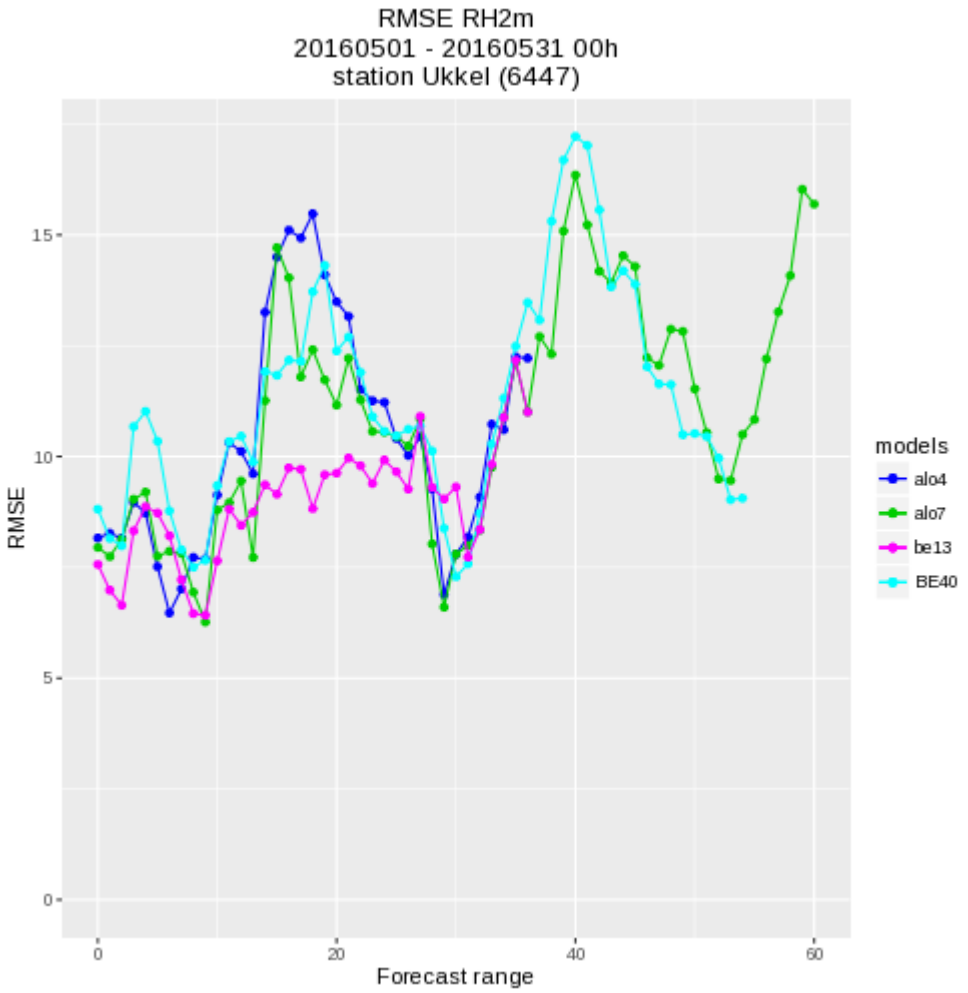
- RMS & bias 10m wind in Uccle roughly similar

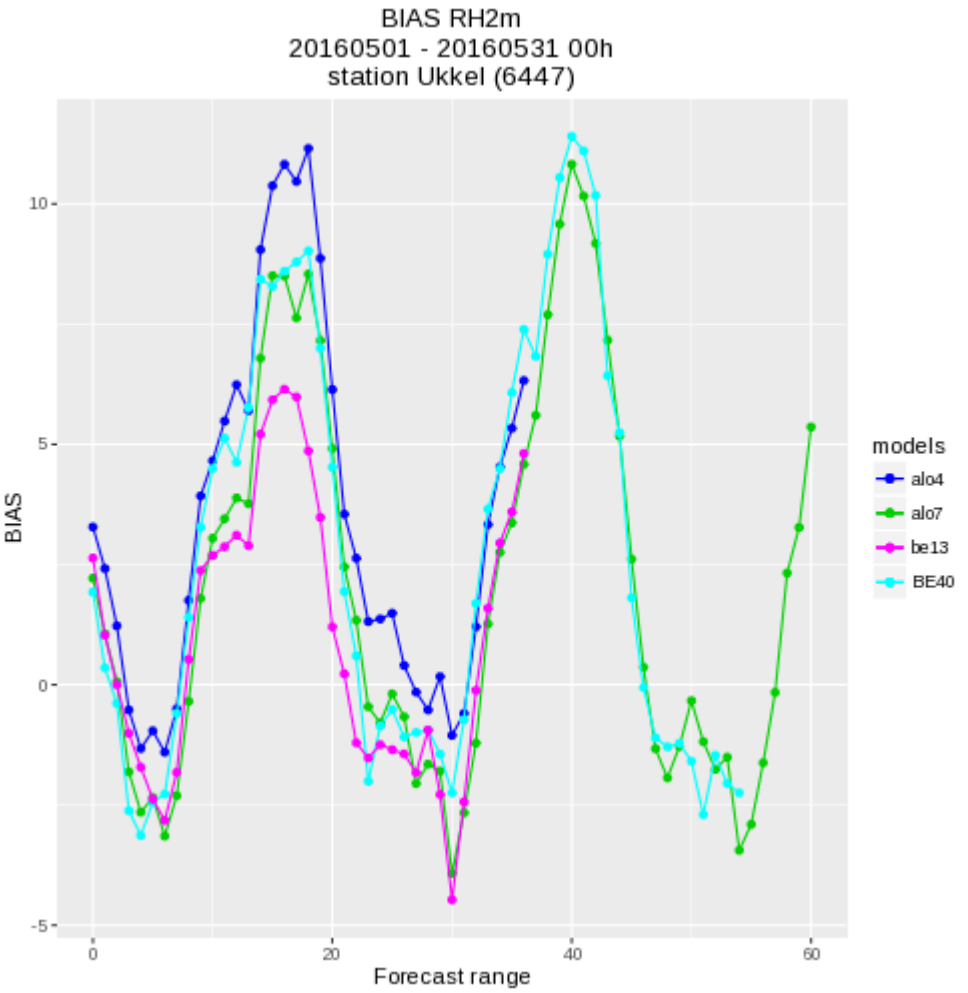




Scores

- RMS & bias 2m relative humidity in Uccle roughly similar





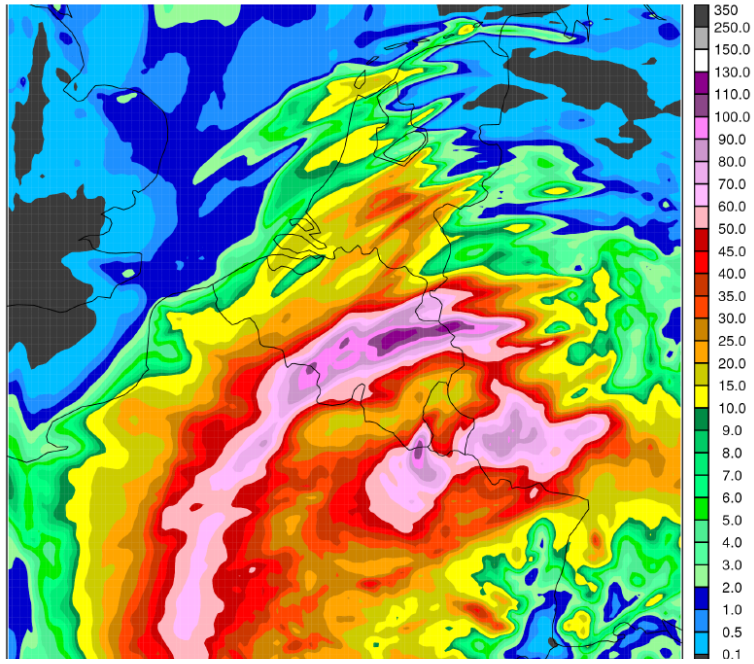
Intense convective precipitation causes floodings in Belgium 30/05/16

www,deredactie.be

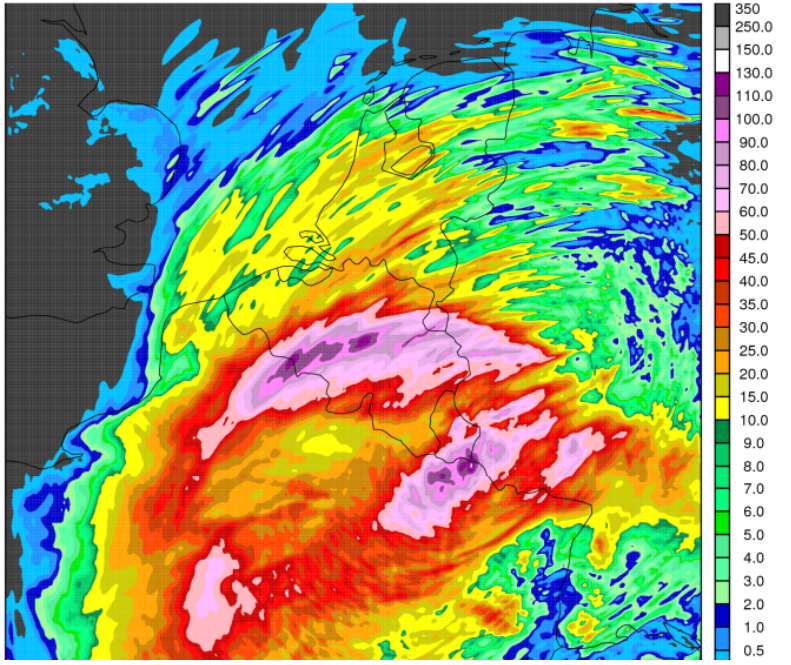
Radar loop: http://www.meteo.be/meteo/view/nl/26935890-De+overvloedige+neerslag+van+de+voorbije+dagen.html

How did the different ALARO configurations perform?

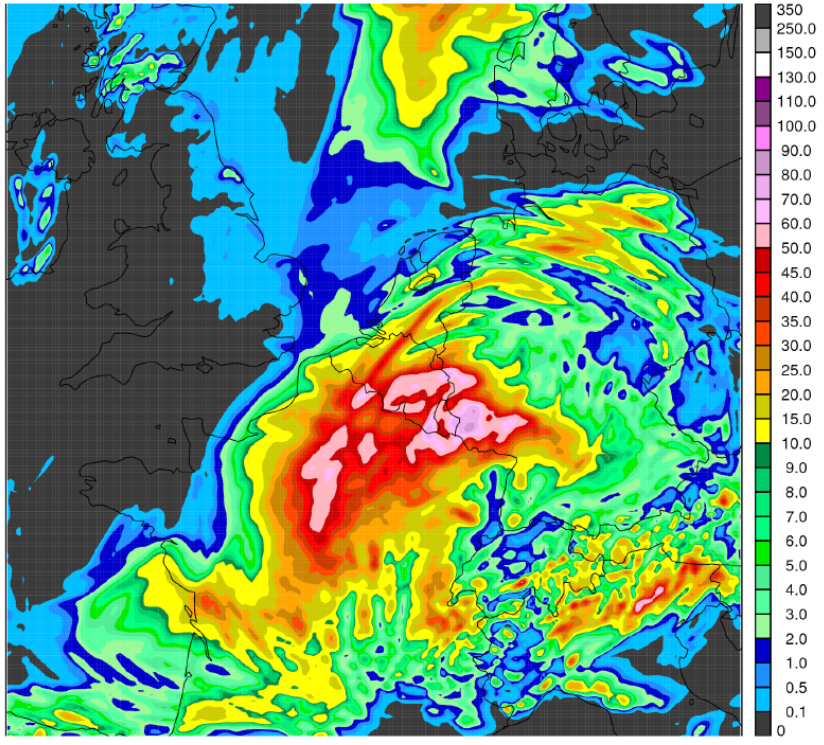
ALO4 30 05 2016 [00h]
24–HR PRECIP



ALO1 30 05 2016 [00h]
24–HR PRECIP

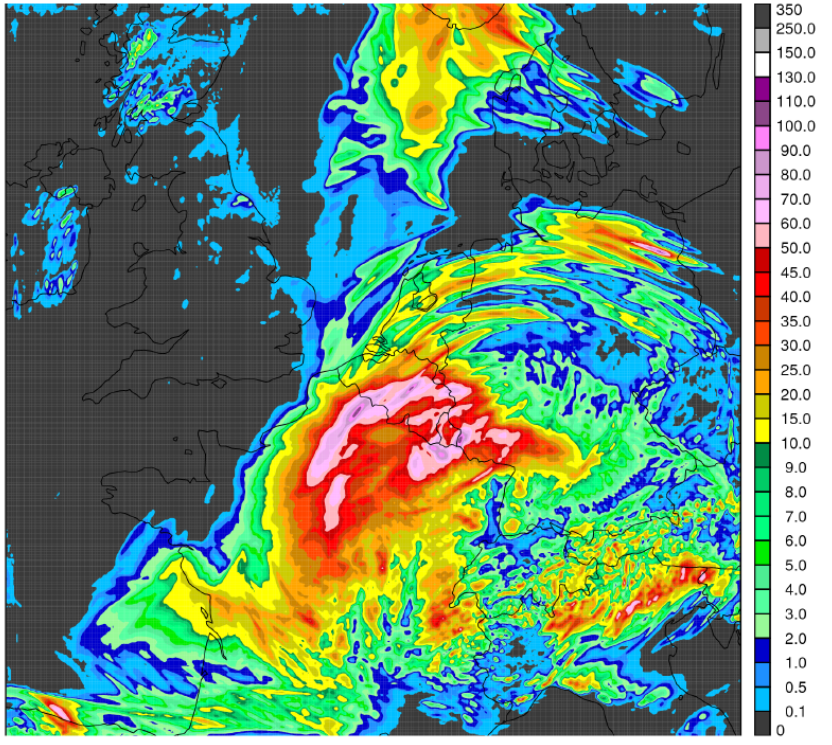


ALO7 30 05 2016 [00h]
24–HR PRECIP



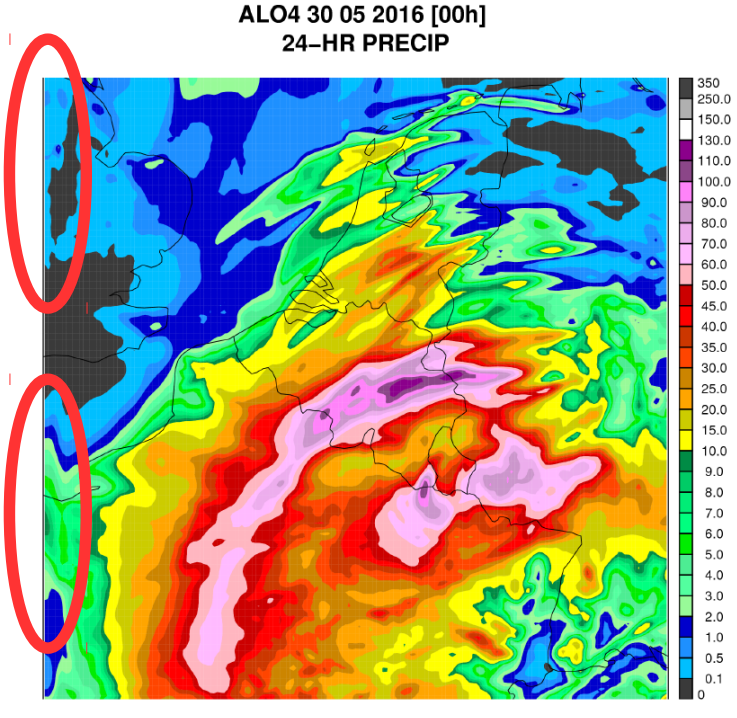
24 hr precipitation

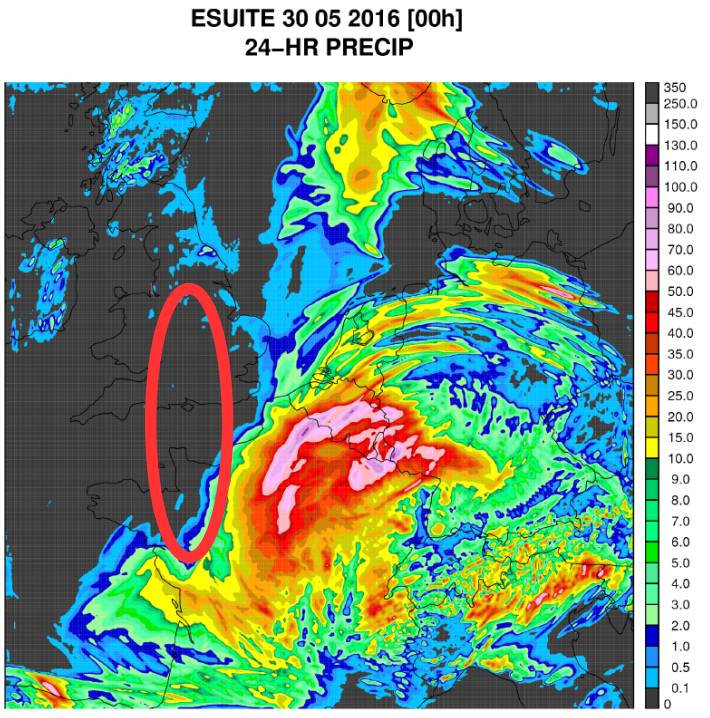
ESUITE 30 05 2016 [00h]
24–HR PRECIP

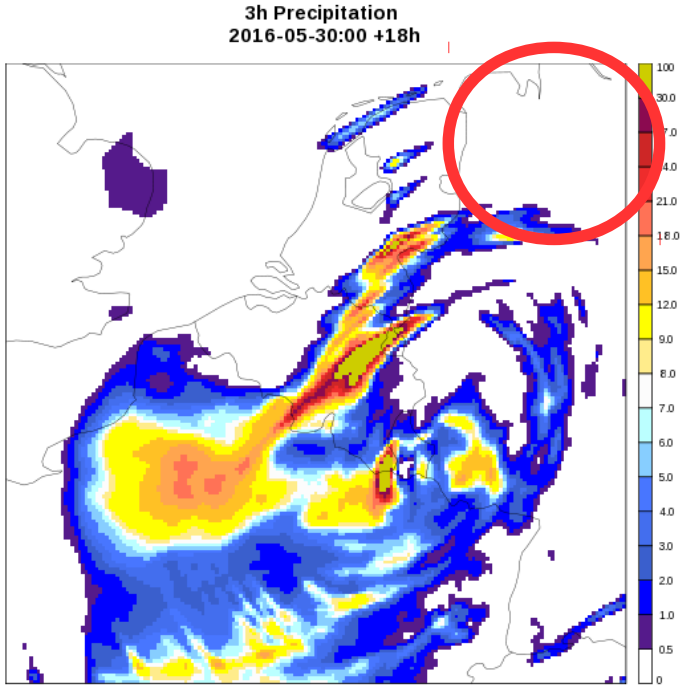


Some conclusions

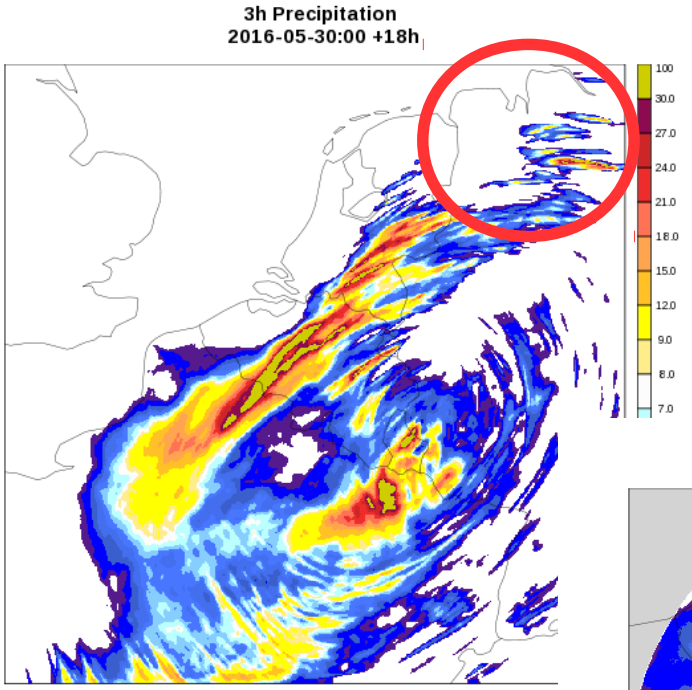
- All runs give very large amounts of rain over Belgium. The rain totals are smallest in the ALO-7 run and largest in ALO-4 and ALO-1. In the end observations up to 93 mm/24 hr were measured.
- The largest accumulations were 4 times expected over the south. This is not related to the resolution but to the global model we are coupling to. In reality the largest sums were measured over Flanders. Higher resolution will not solve such a problem
- Remark some strange precipitation behaviour close to the border of the ALO-4 run. This is something we have seen more and it seems to point to a poor coupling.



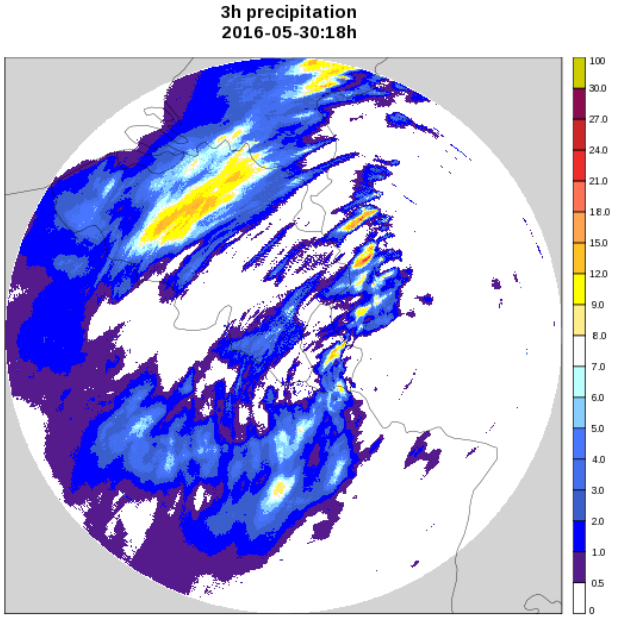




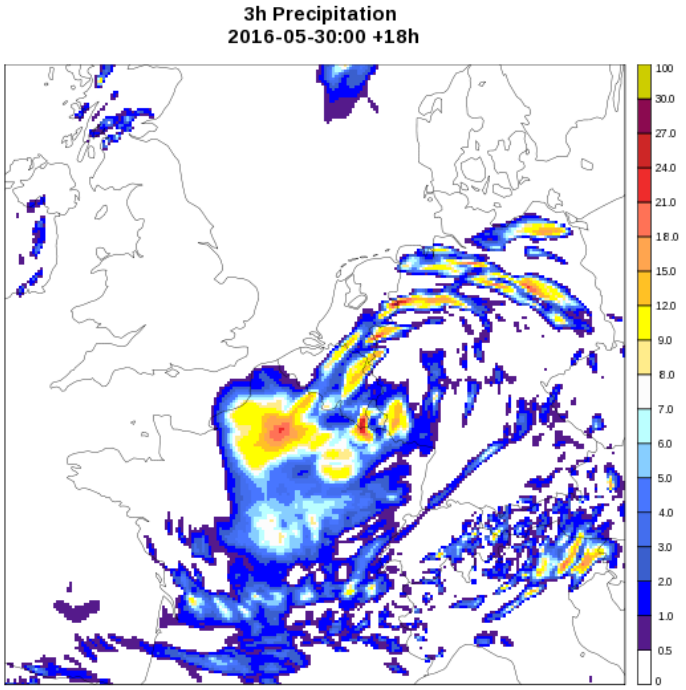
Alaro 4km



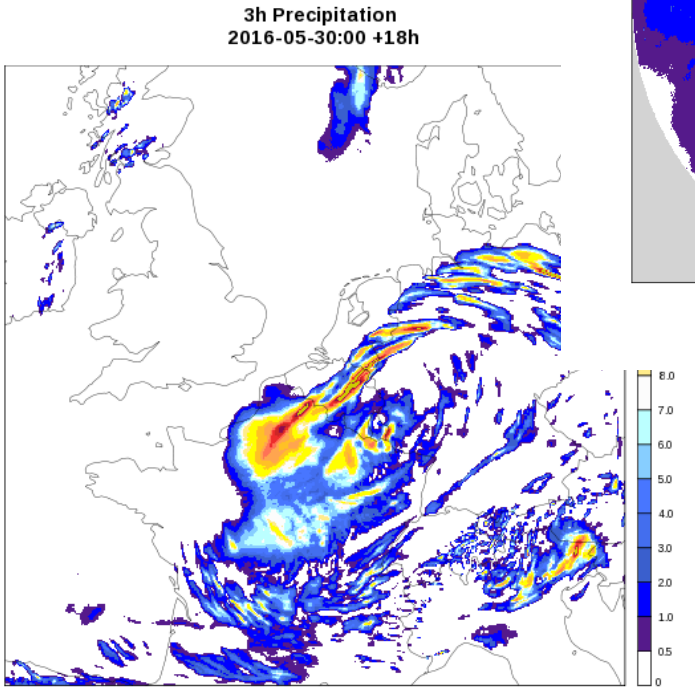
Alaro 1.3km



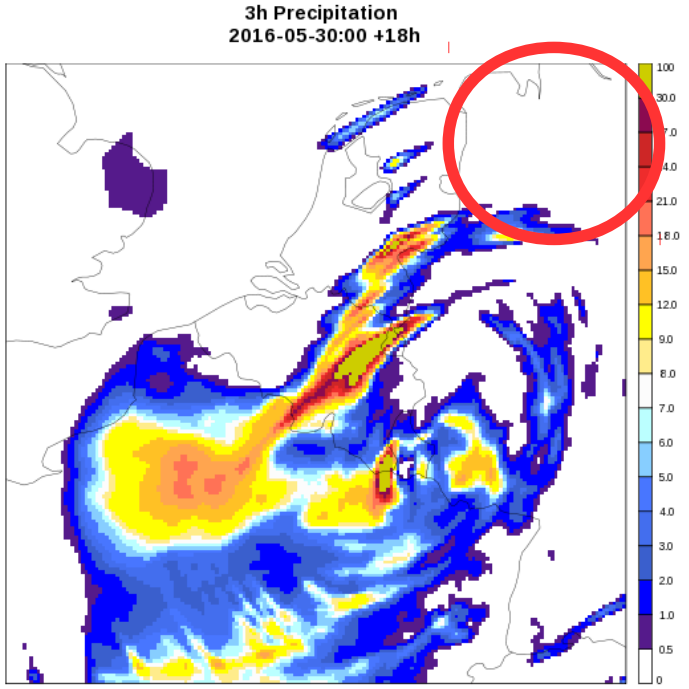
radar wideumont



Alaro 7km



E-Suite 4km



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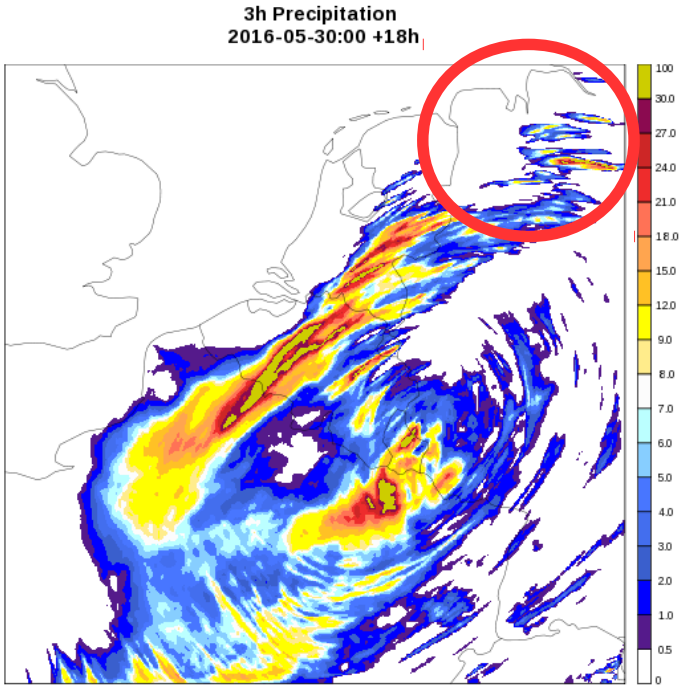

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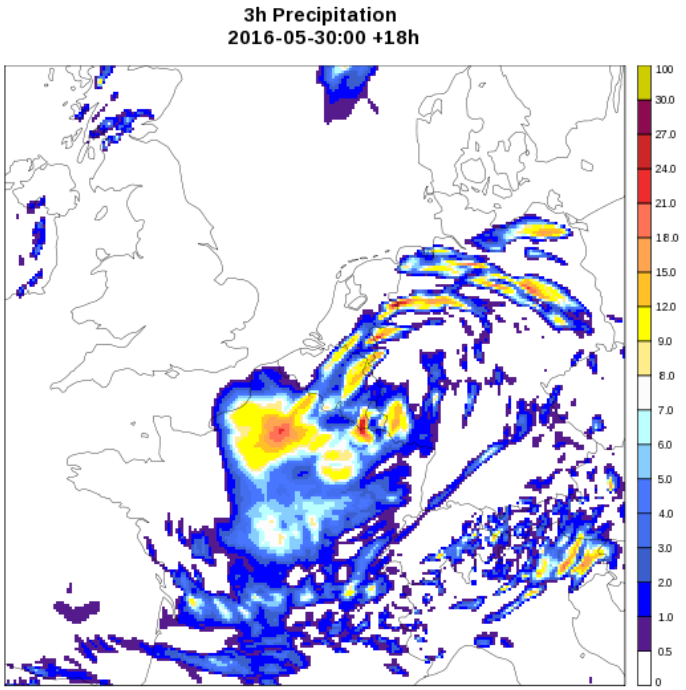

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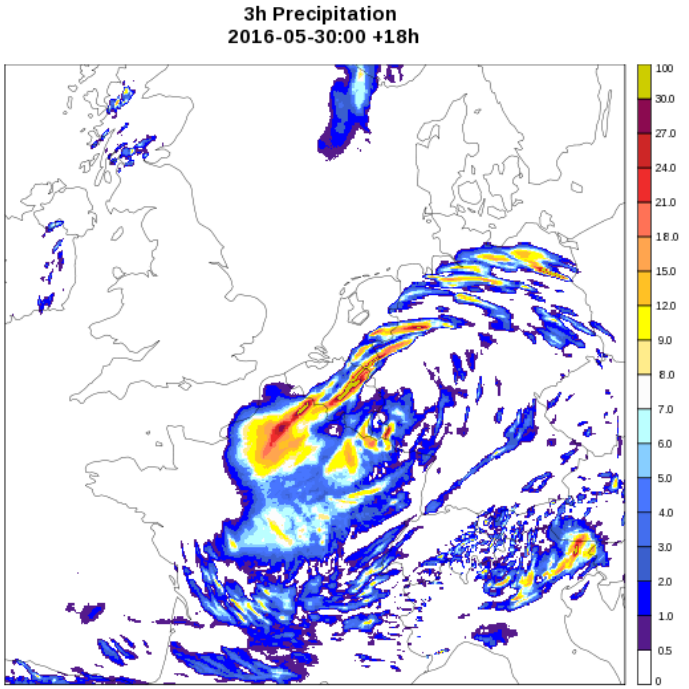
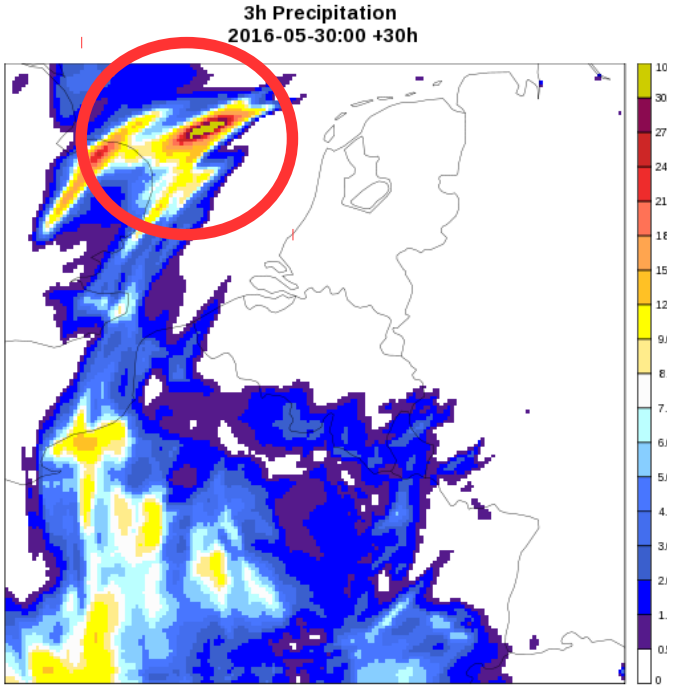


E-Suite 4km

Conclusions

Similar patterns but differences in the details. More realism in the higher resolution runs.

LBC related problems in the ALO-4 run which can lead to problems later in the forecast. ALO-1 with a 1-hr LBC coupling does not have this problem.



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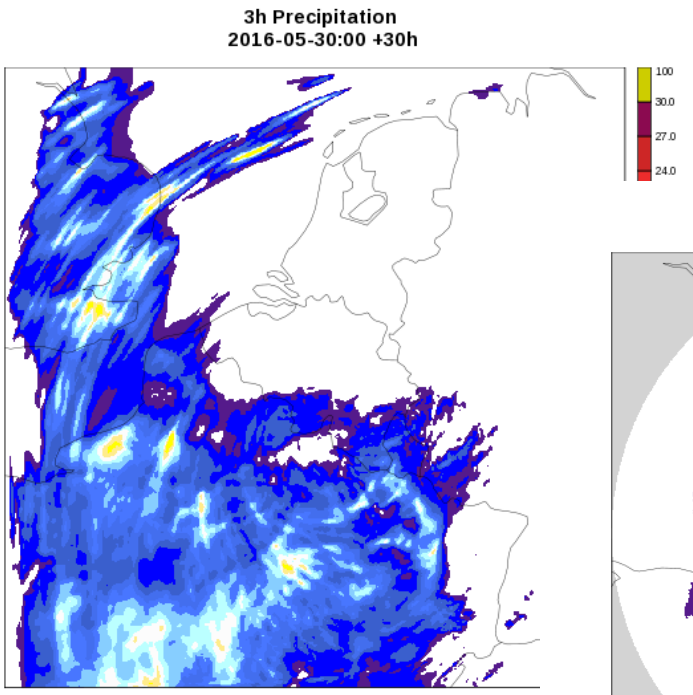

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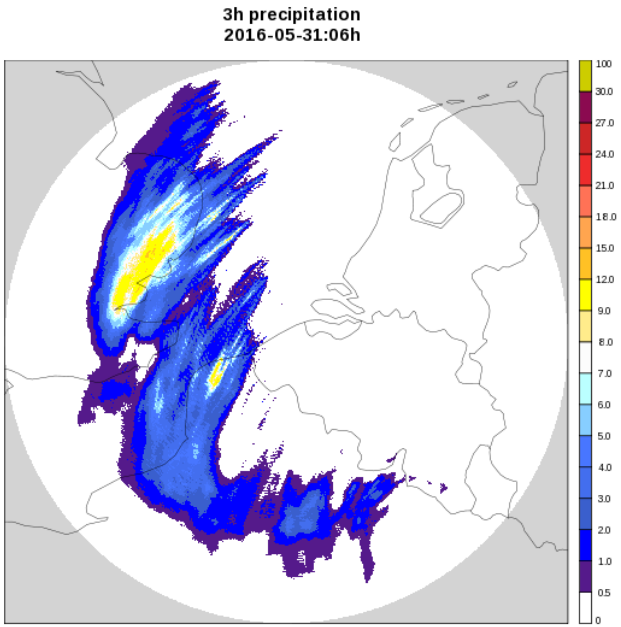
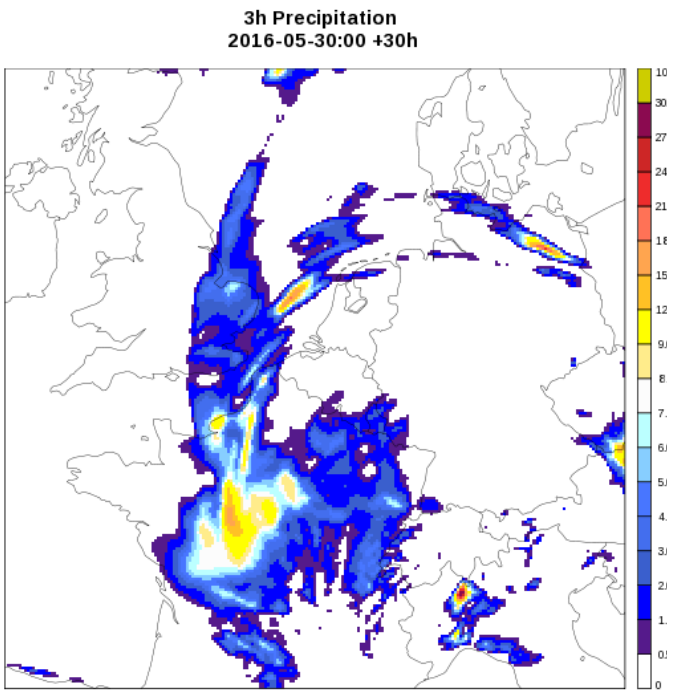


radar jabbeke



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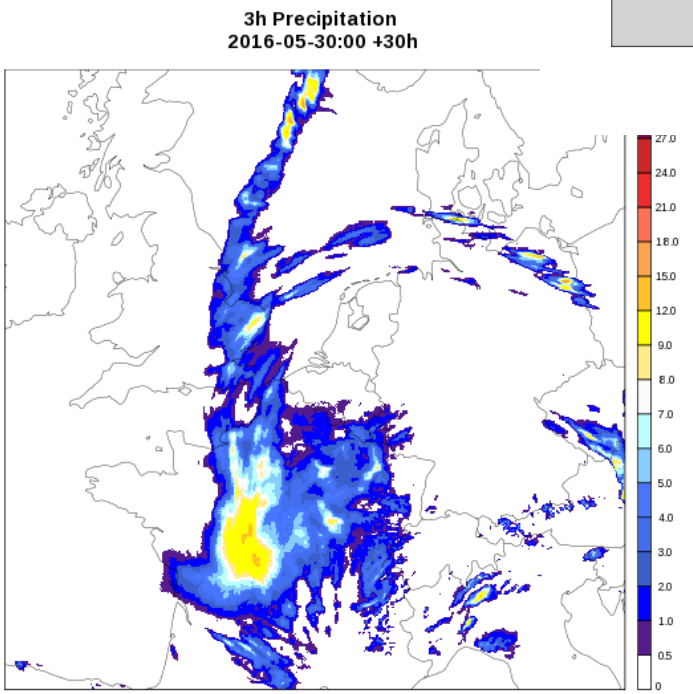
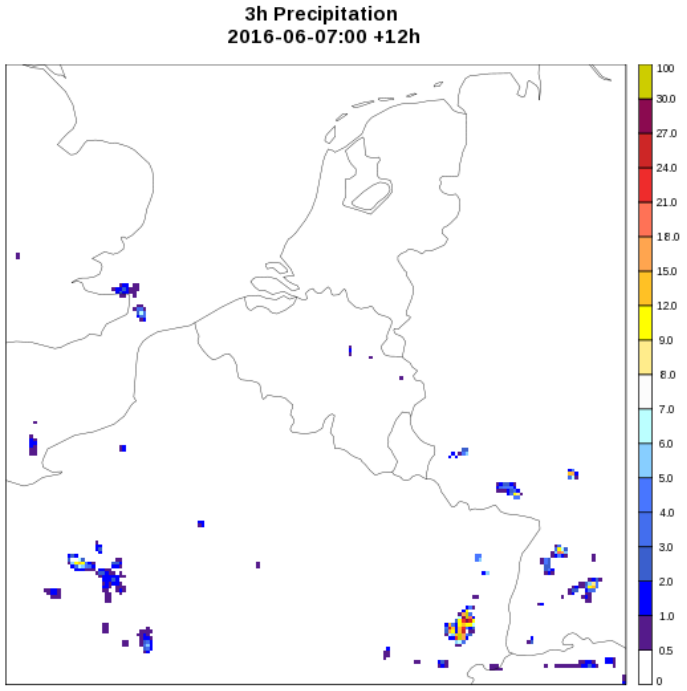


E-Suite 4km

Example: initiation convection 07/06/16



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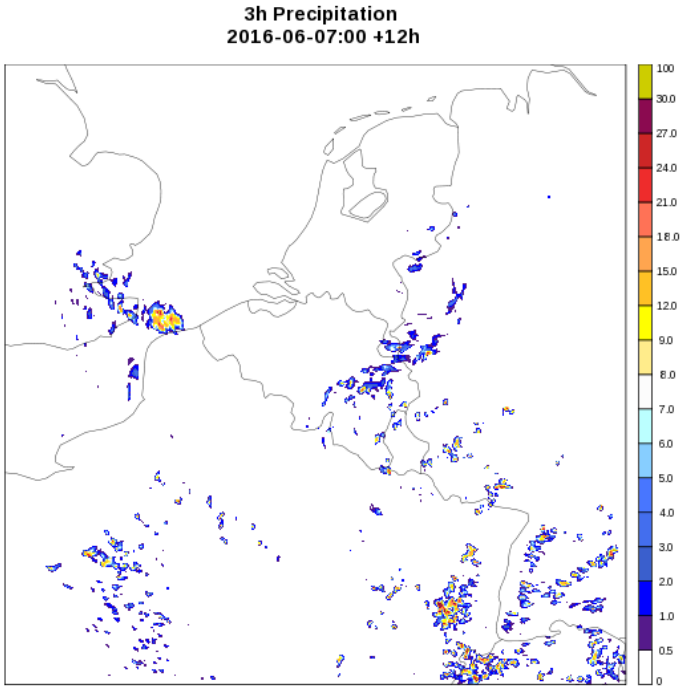

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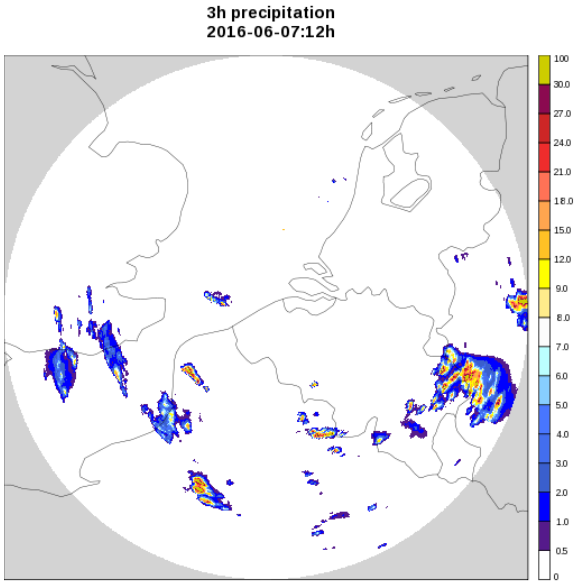

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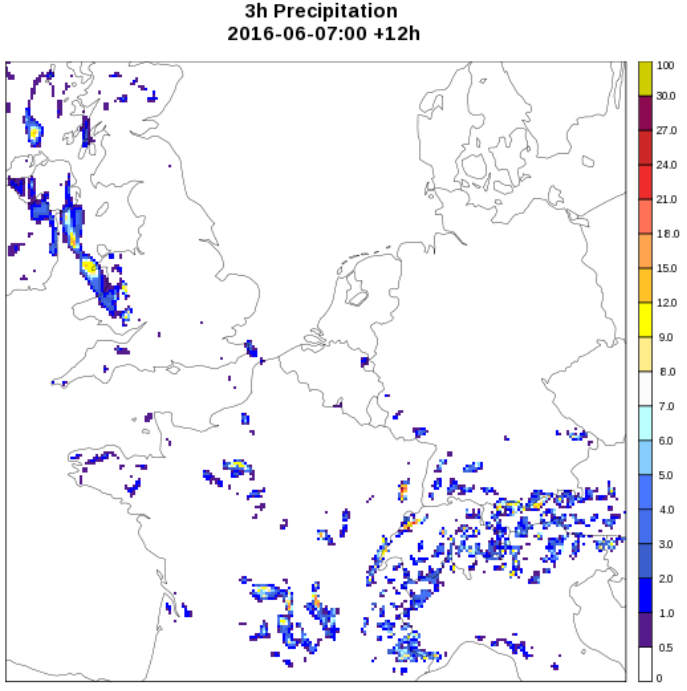

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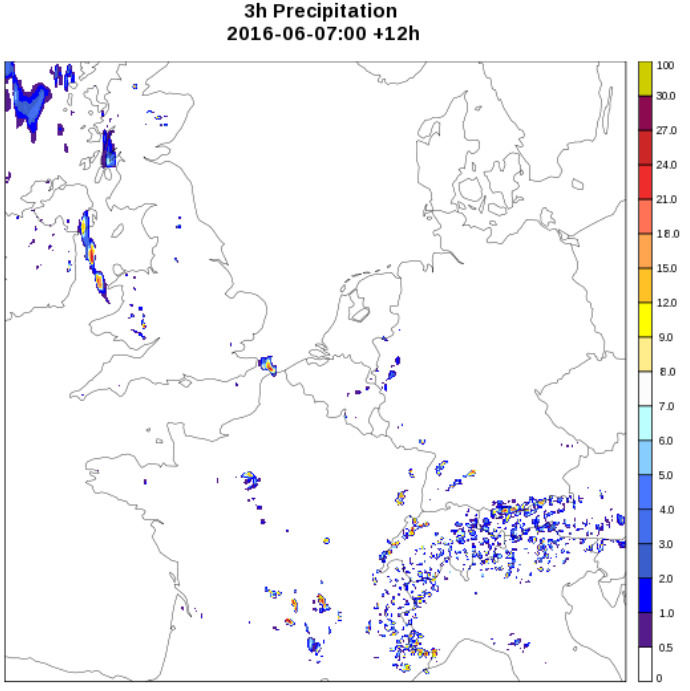
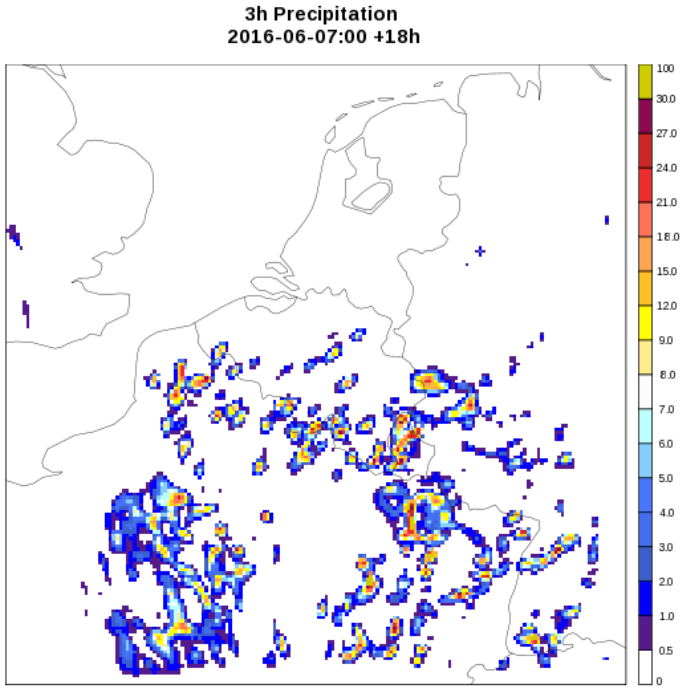
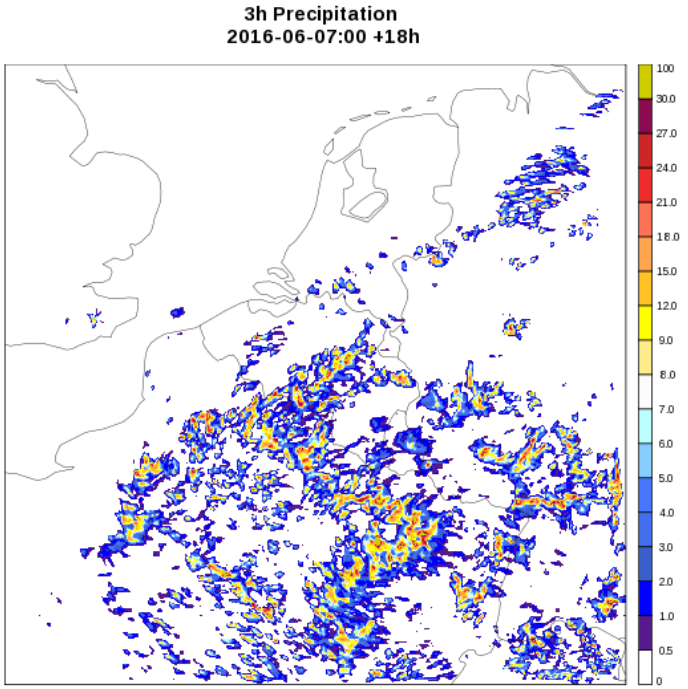


E-Suite 4km

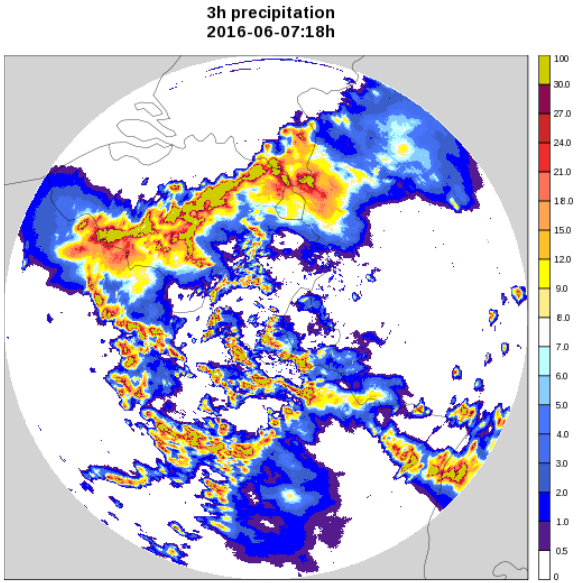
Example: mature convection 07/06/16



Alaro 4km



Alaro 1.3km



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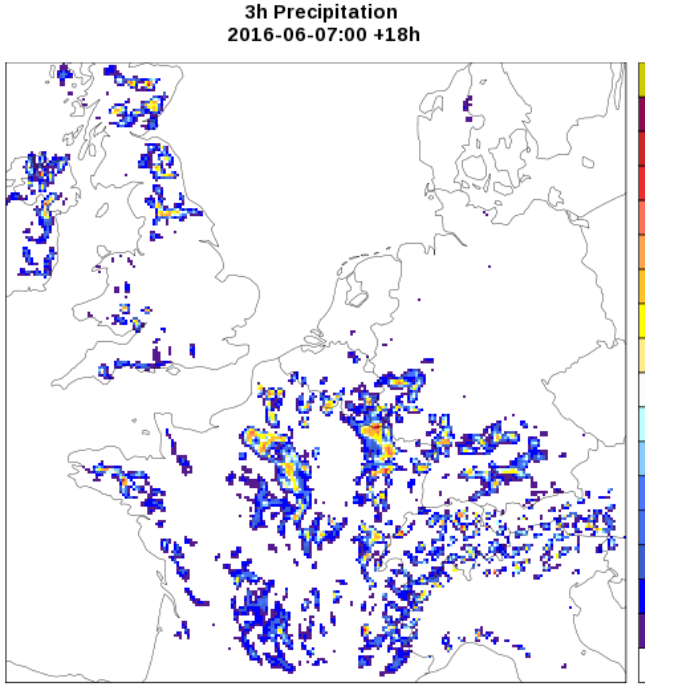
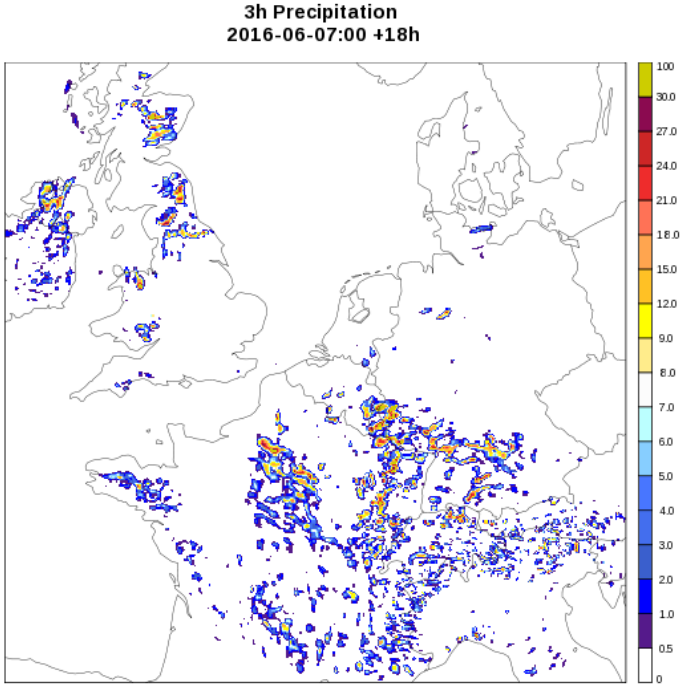
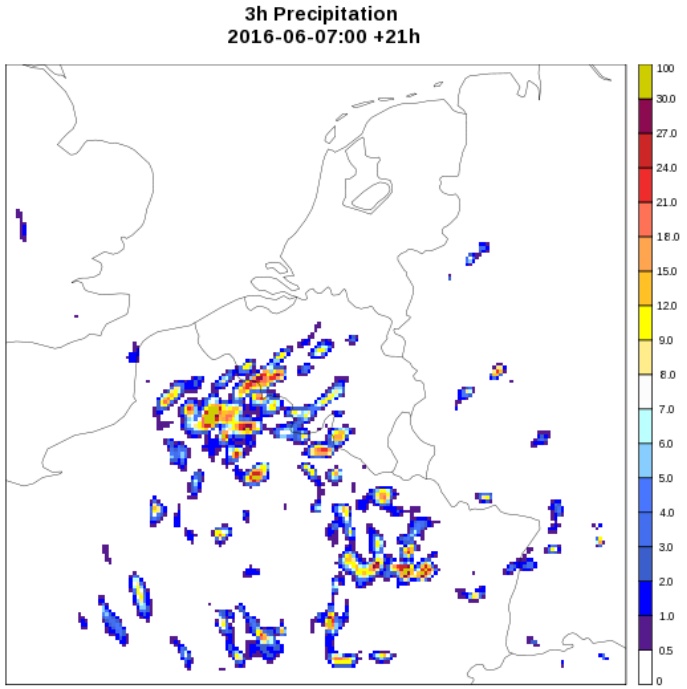


Alaro 7km

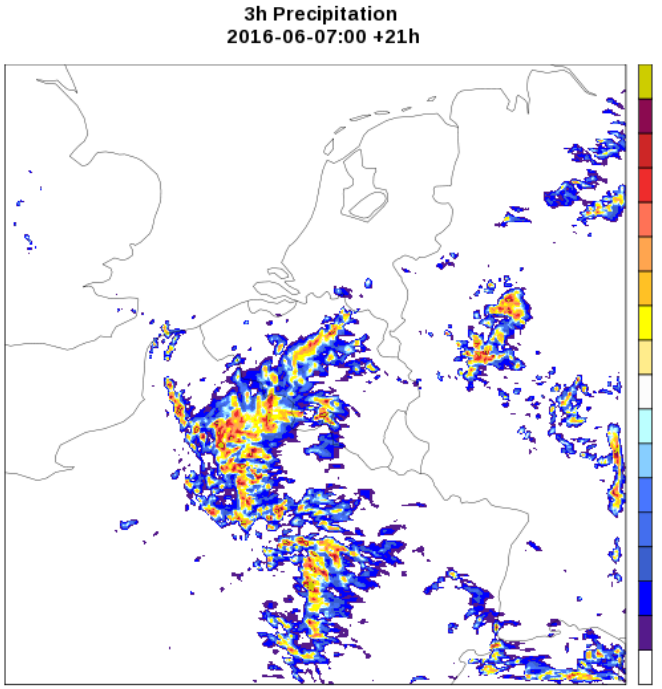


E-Suite 4km

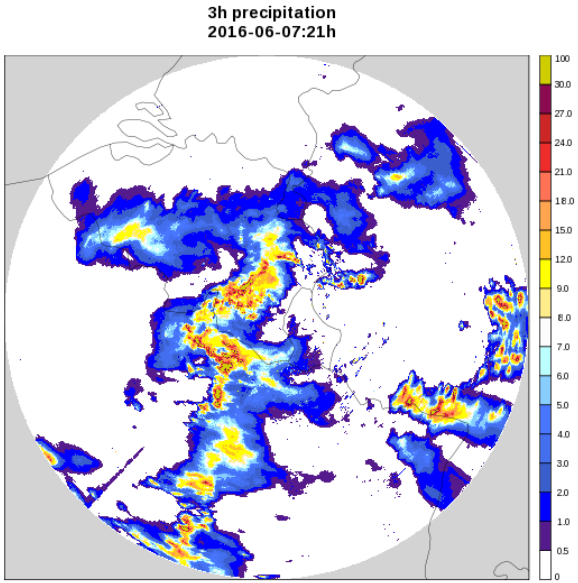
Example: dissipating convection 07/06/16



Alaro 4km



Alaro 1.3km



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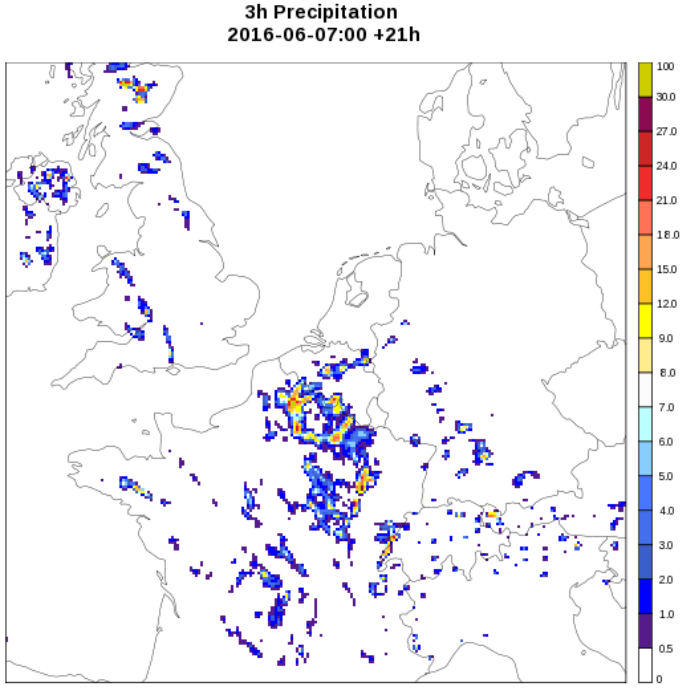
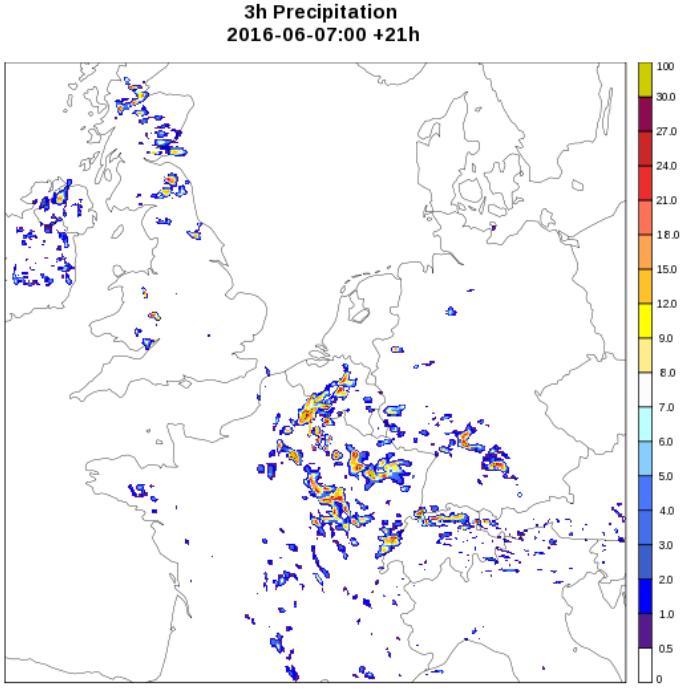
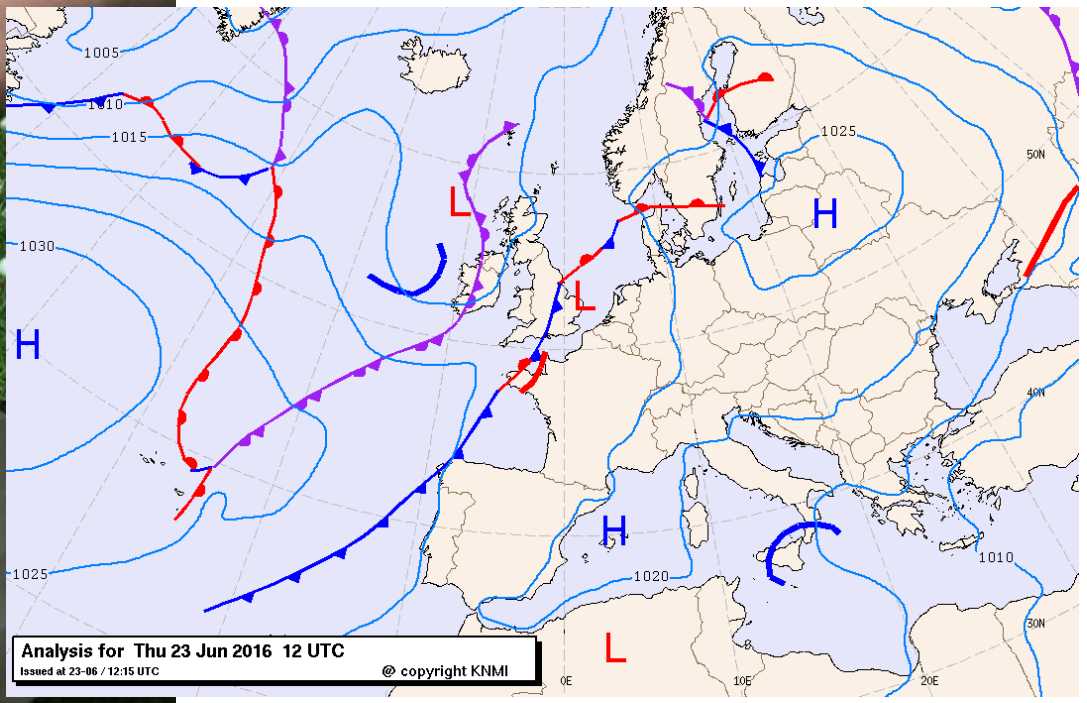


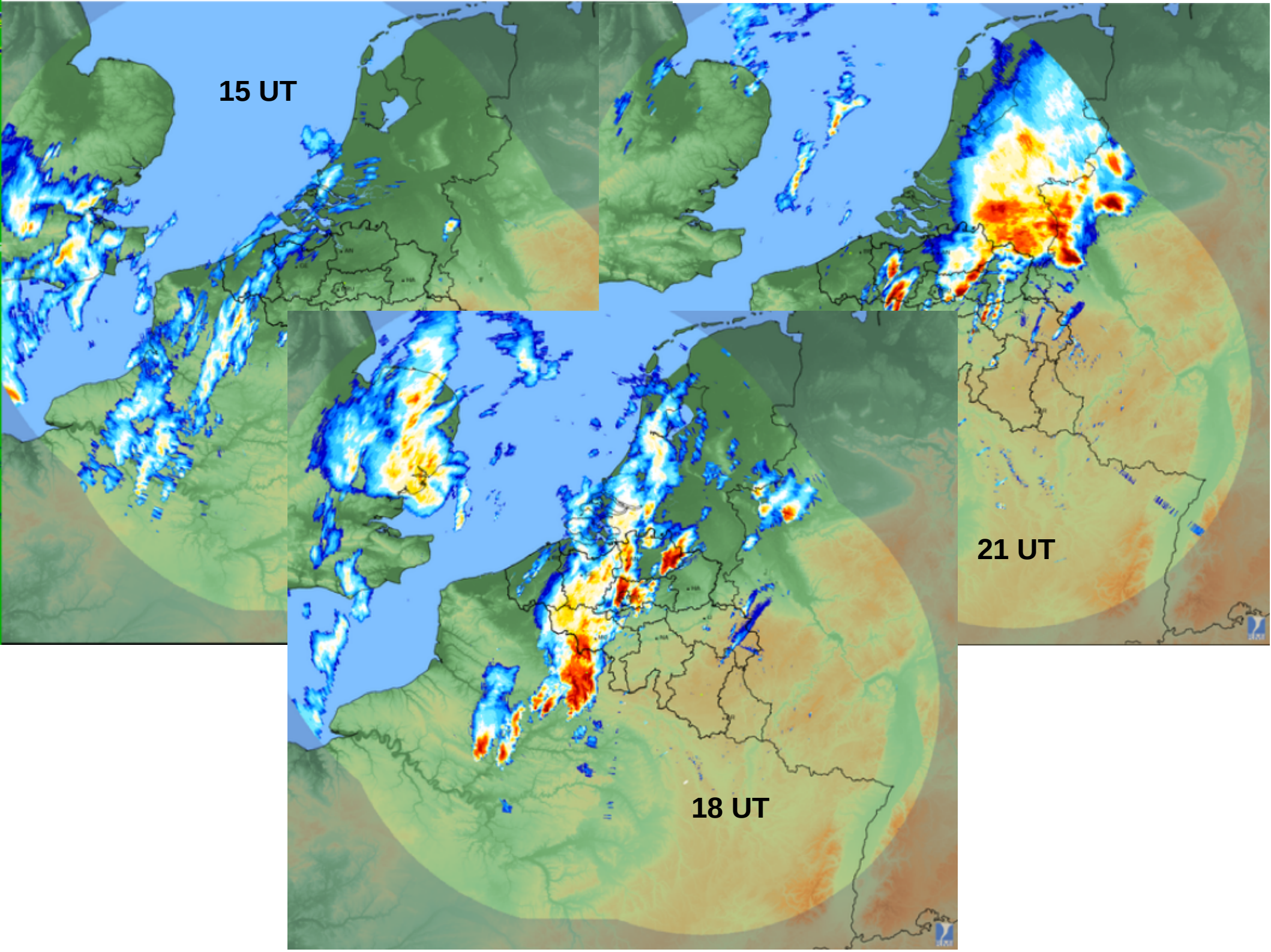
Alaro 7km

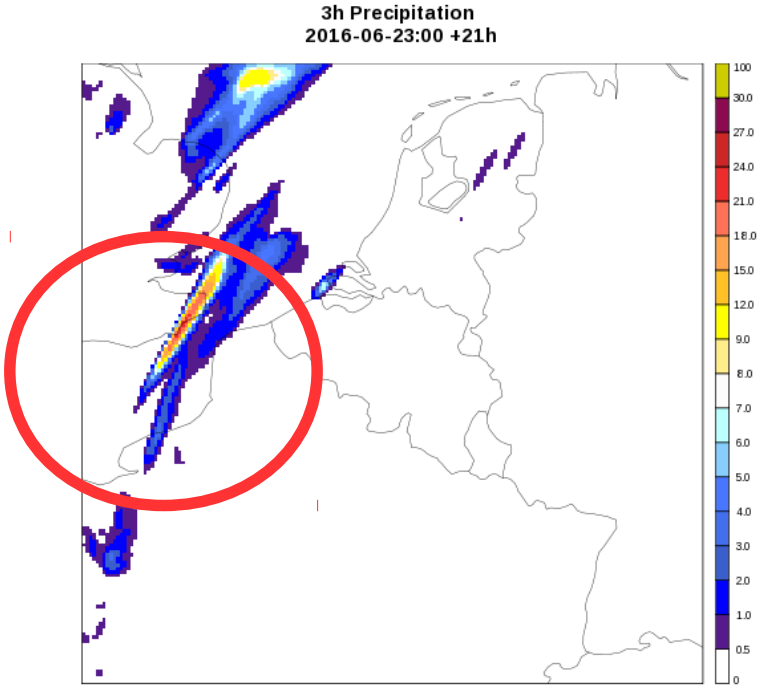


E-Suite 4km

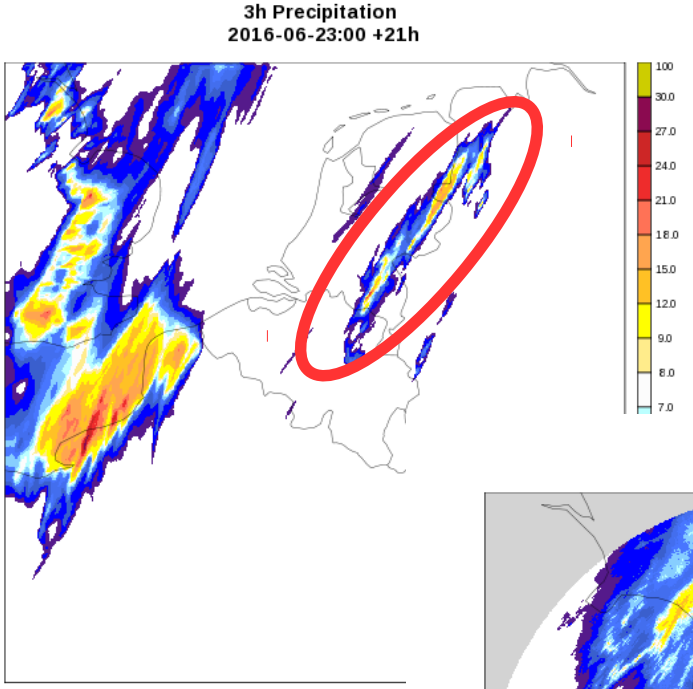
Active thunderstorms over Belgium and the Netherlands on 23/06/16




15 UT
18 UT
21 UT

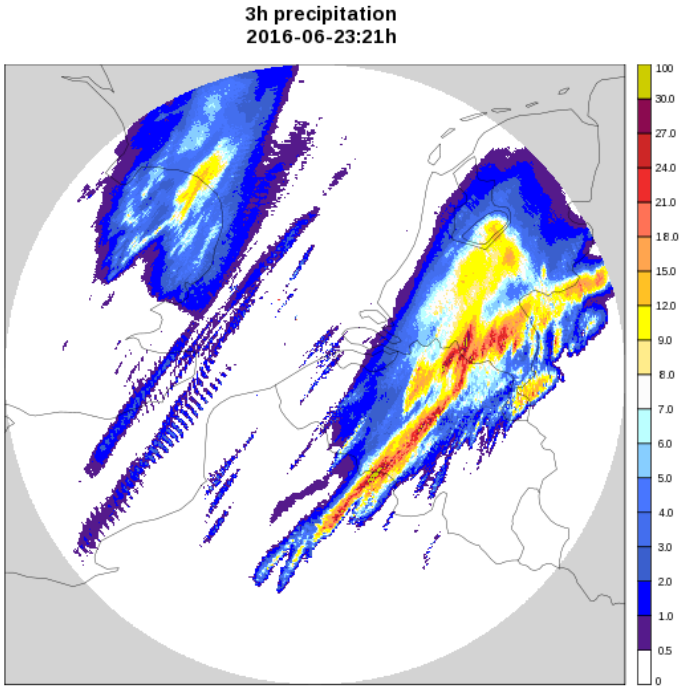


Alaro 4km

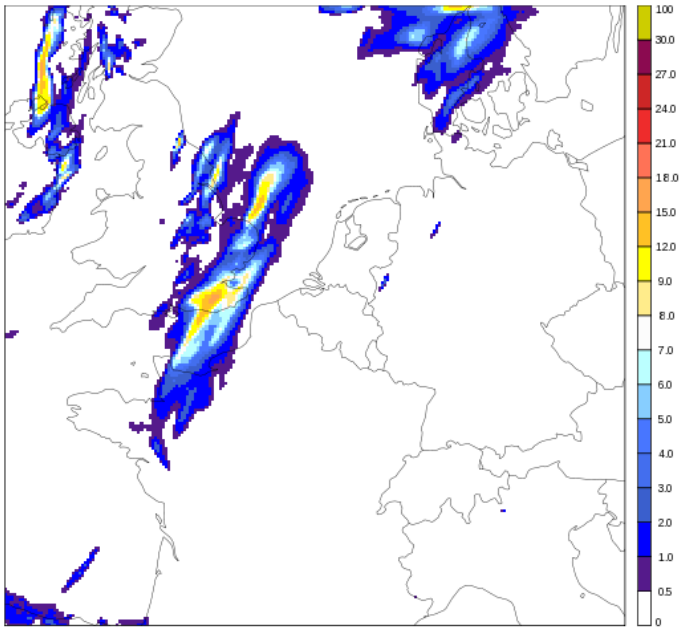


Alaro 1.3km

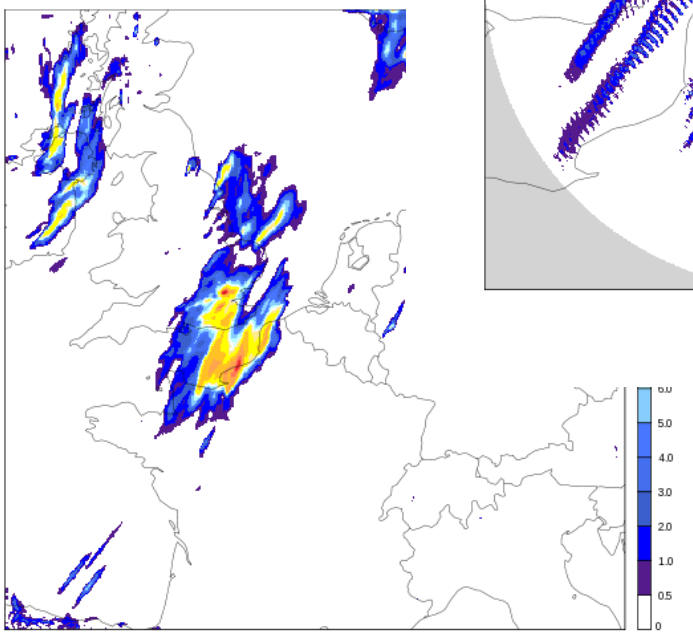
Poor forecast, ALO1 is the only one that gives some convection; due to dynamics or physics?



radar jabbeke



Alaro 7km

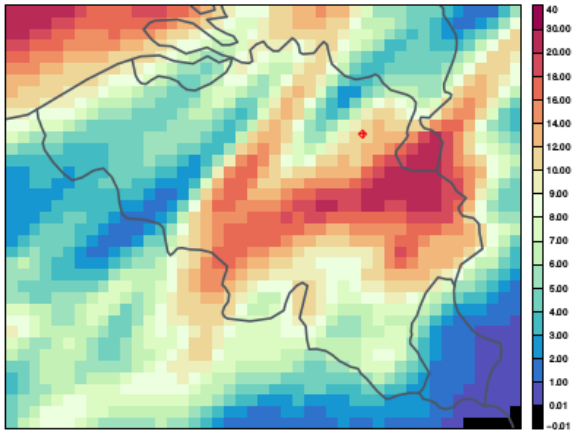


E-Suite 4km

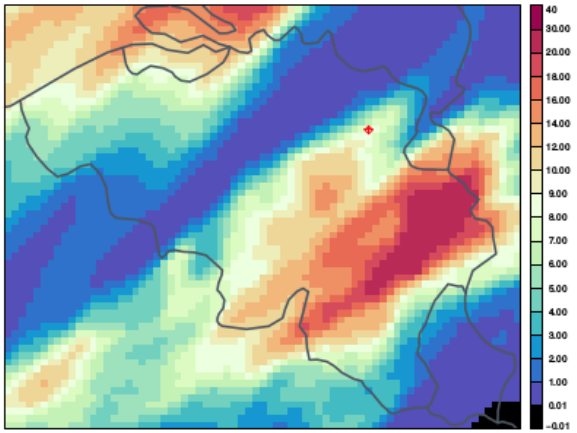
Pukkelpop case: ESUITE and ALO-1 add value to forecast.

24h accumulated precipitation
with resp. BE70, be40, BE40, be13 and radar
(detailed info on separate pages)

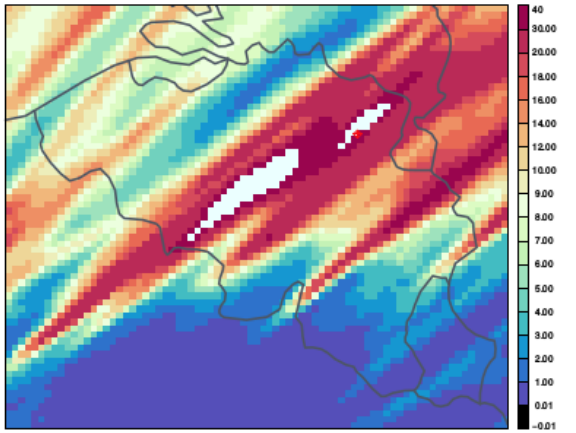
rain rate BE70 06h–30h (mm)



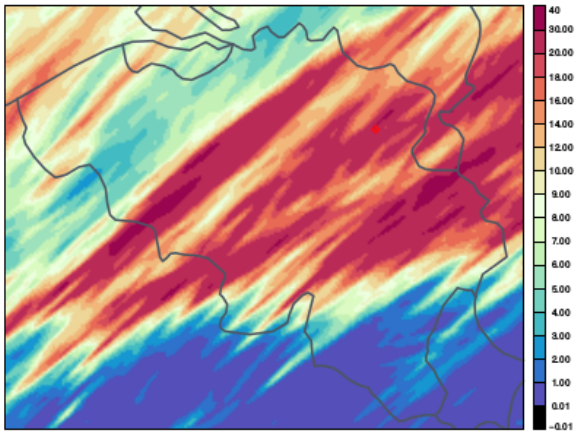
rain rate be40 06h–30h (mm)



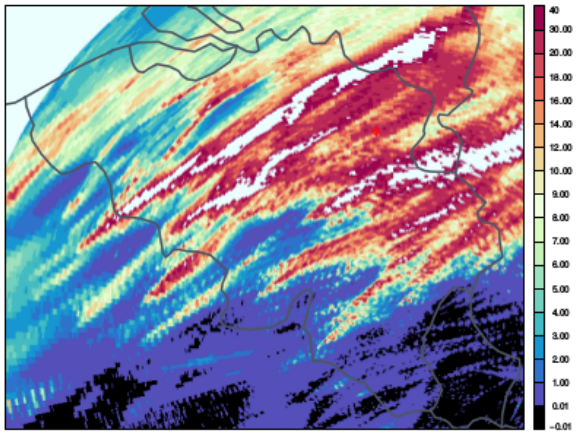
rain rate BE40 06h–30h (mm)



rain rate be13 06h–30h (mm)

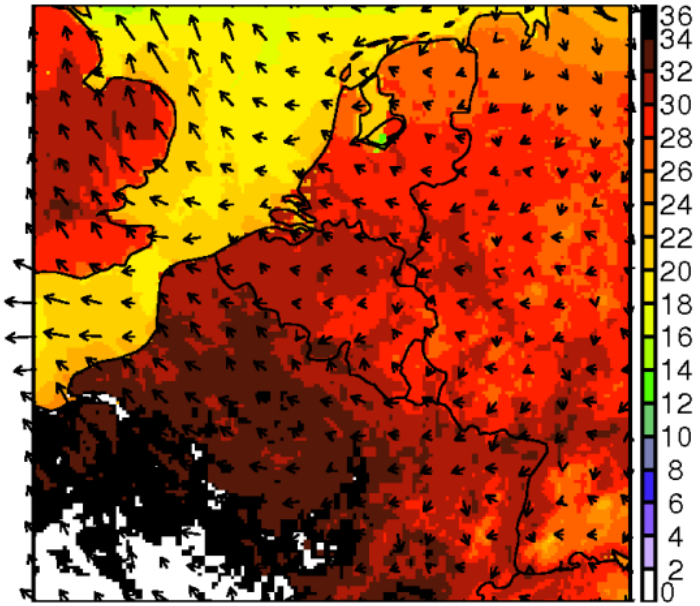


rain rate rad 06h–30h (mm)

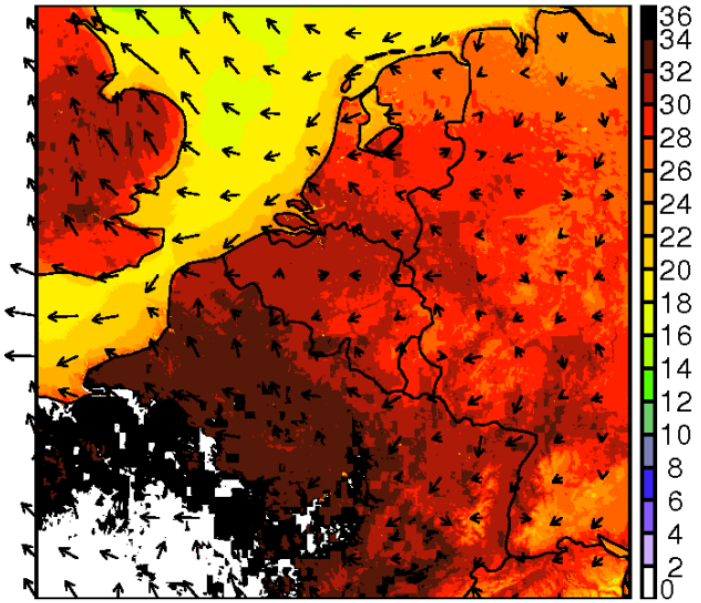


A tropical day in Belgium (19/07/16): no large differences in temp

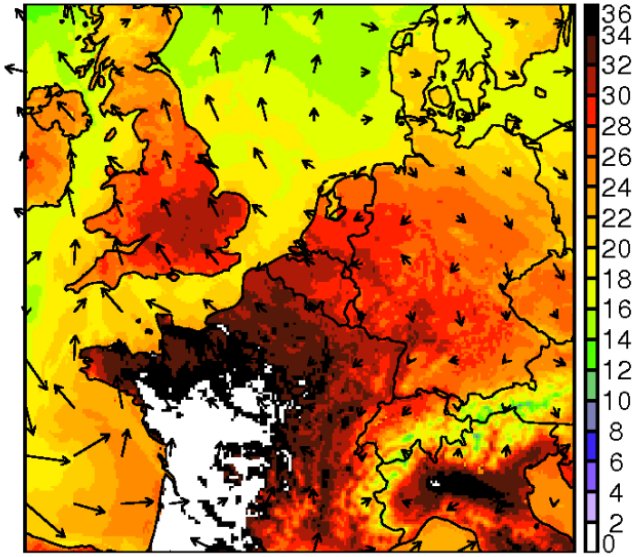
ALO4 19 07 2016 [00h]
SURF TEMP (IN DEGR CELC): +15 h



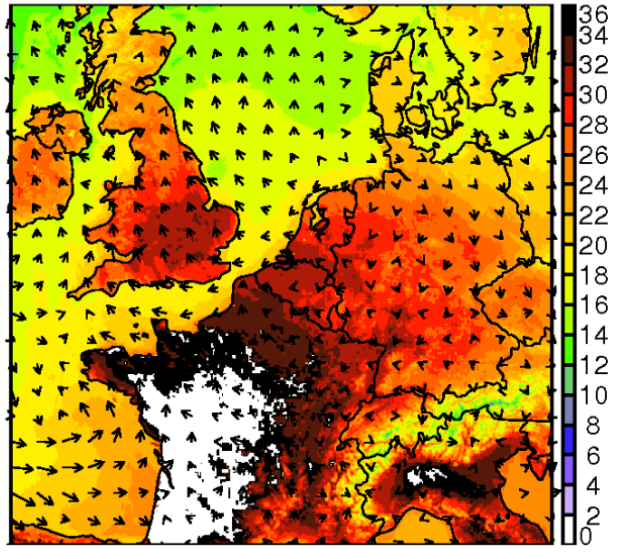
ALO1 19 07 2016 [00h]
SURF TEMP (IN DEGR CELC): +15 h



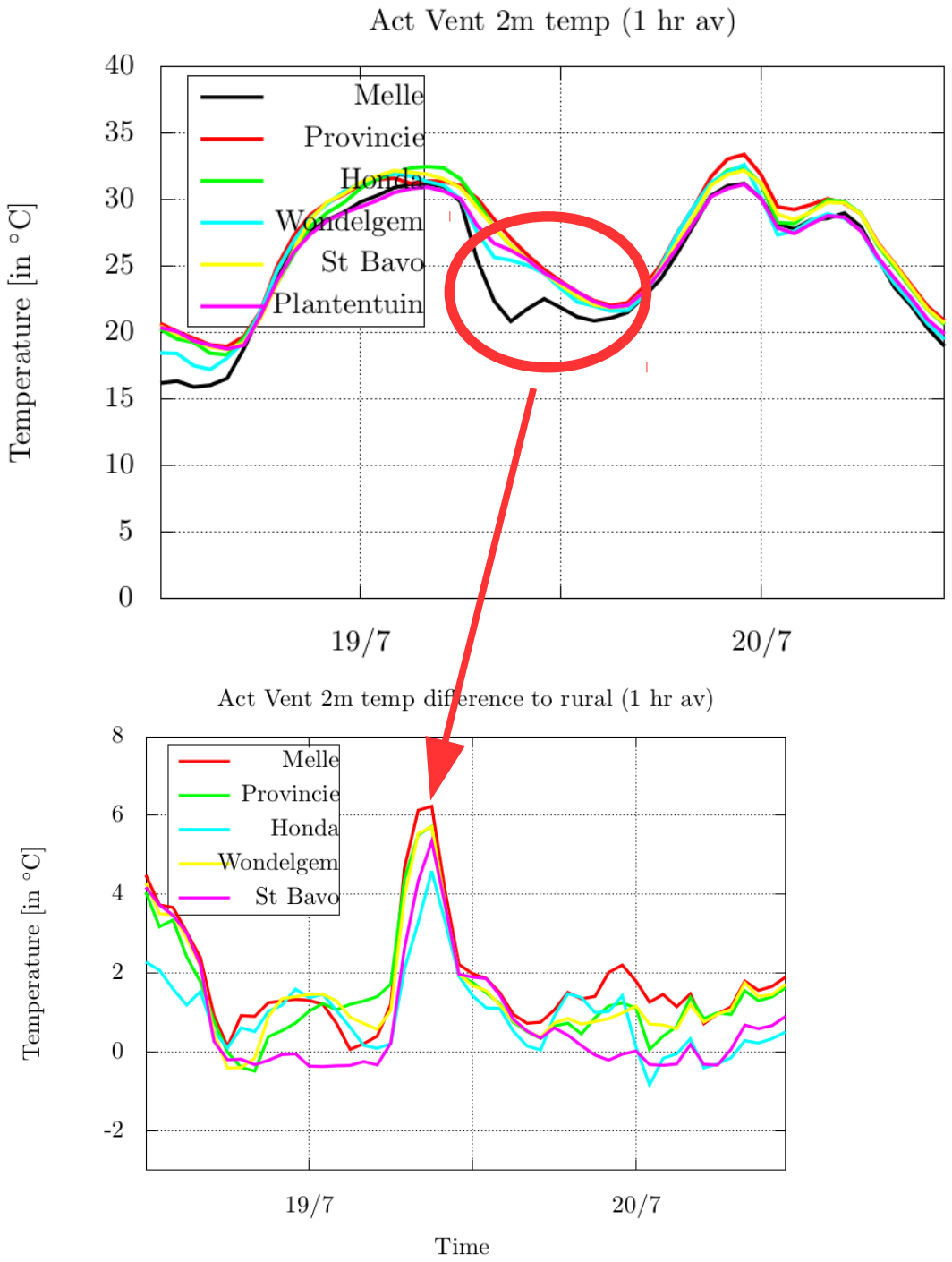
ALO7 19 07 2016 [00h]
SURF TEMP (IN DEGR CELC): +15 h

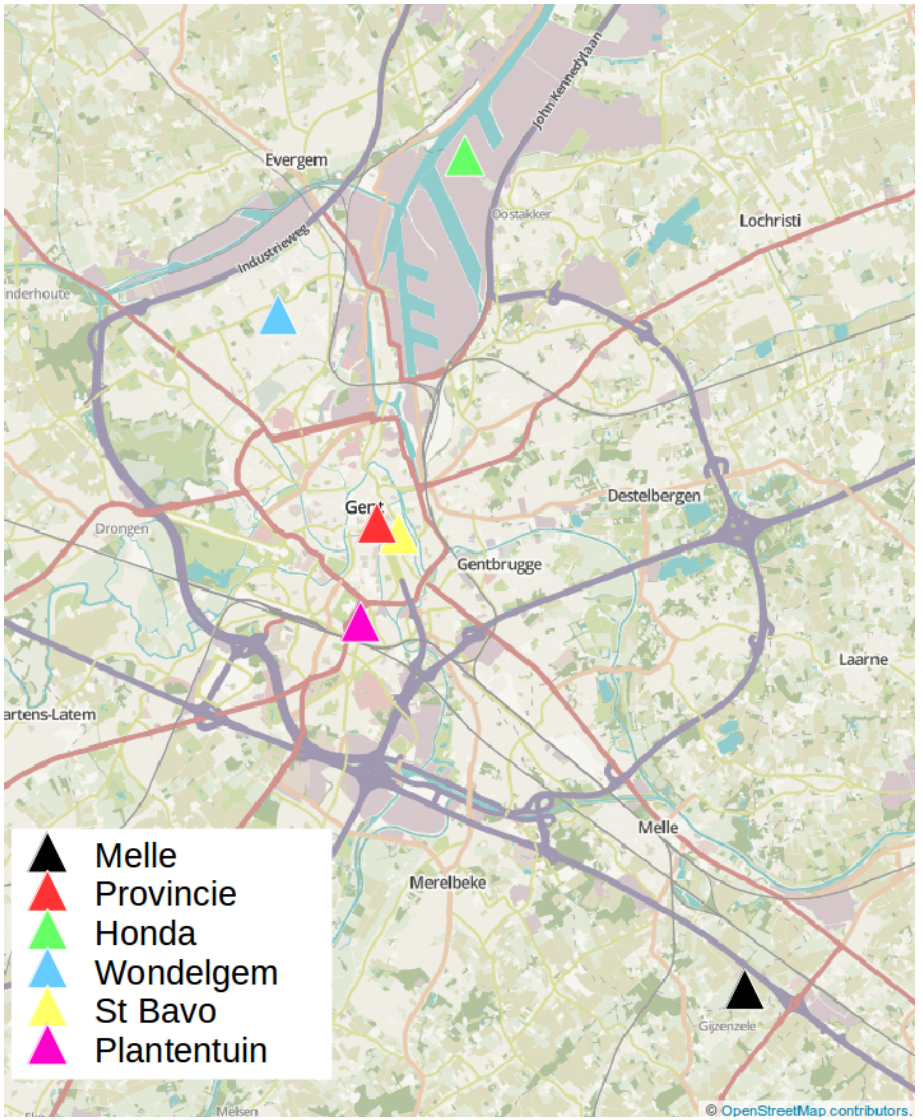


ESUITE 19 07 2016 [00h]
SURF TEMP (IN DEGR CELC): +15 h



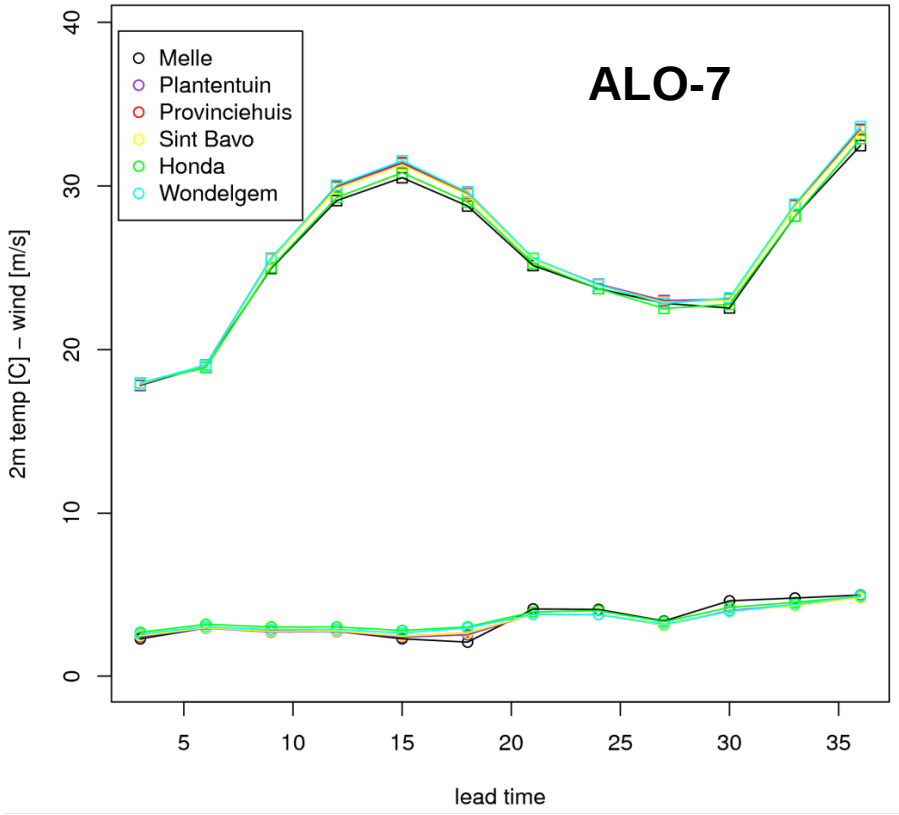
The following evening a large UHI was measured in Gent.

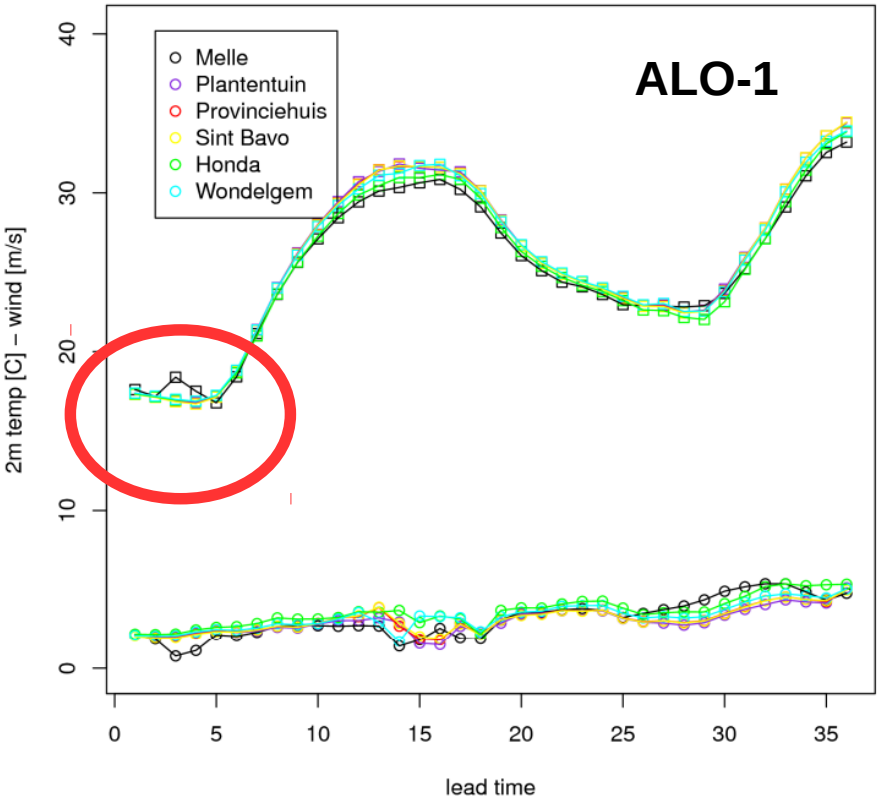


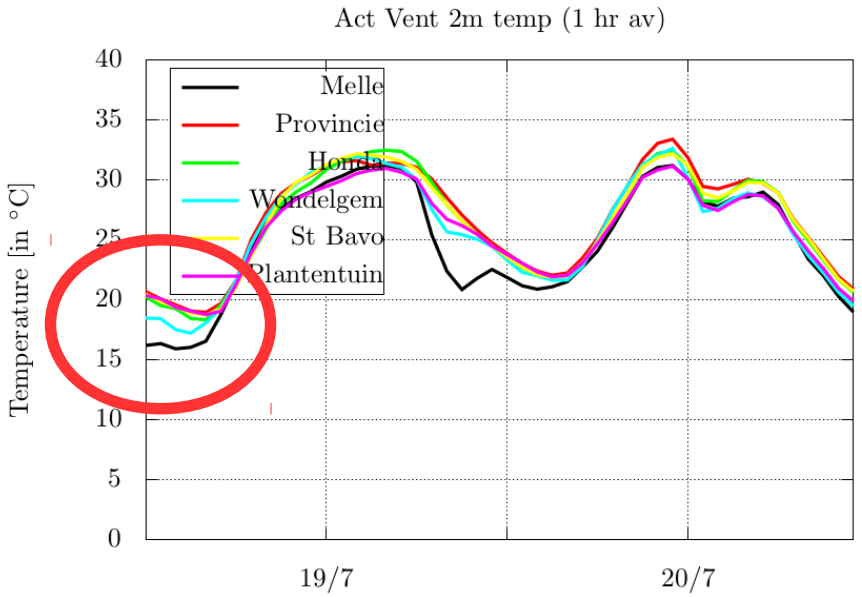


More information + realtime observations:
http://www.observatory.ugent.be/

Is the model able to capture the UHI?

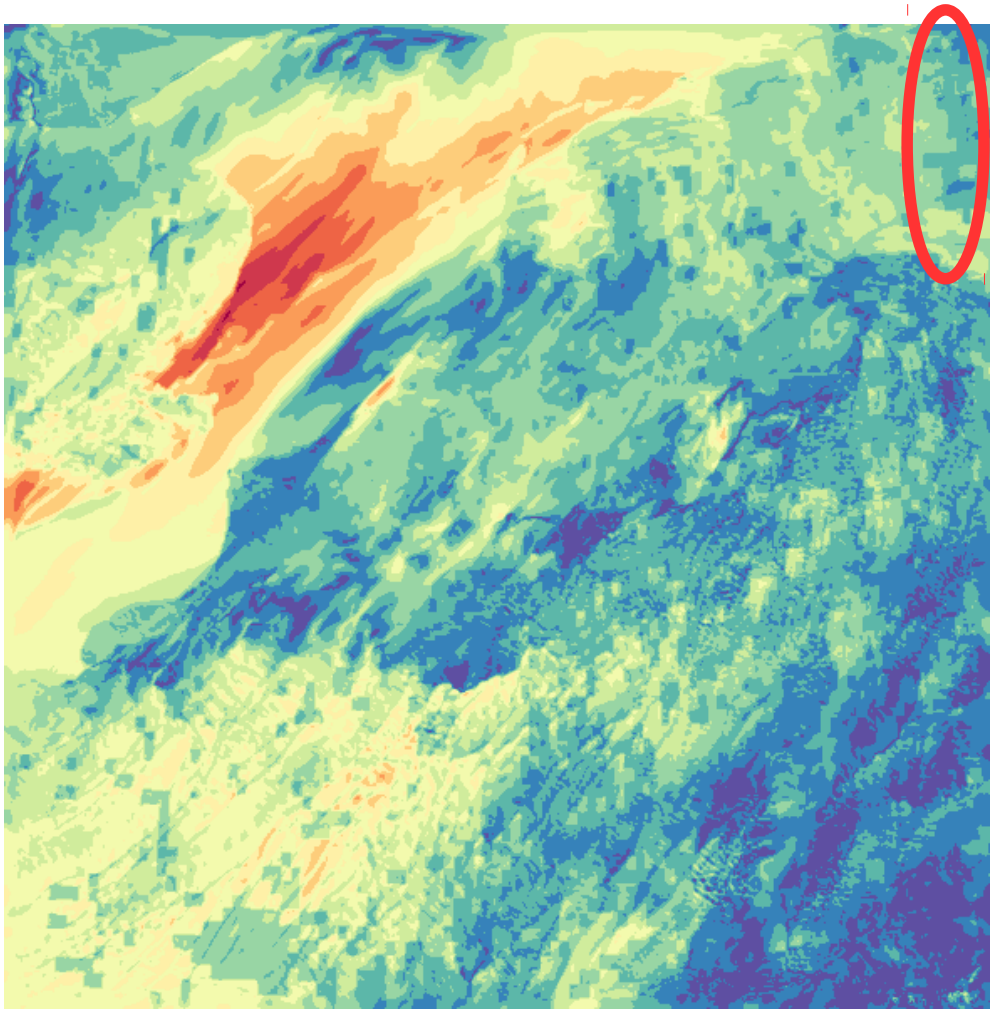


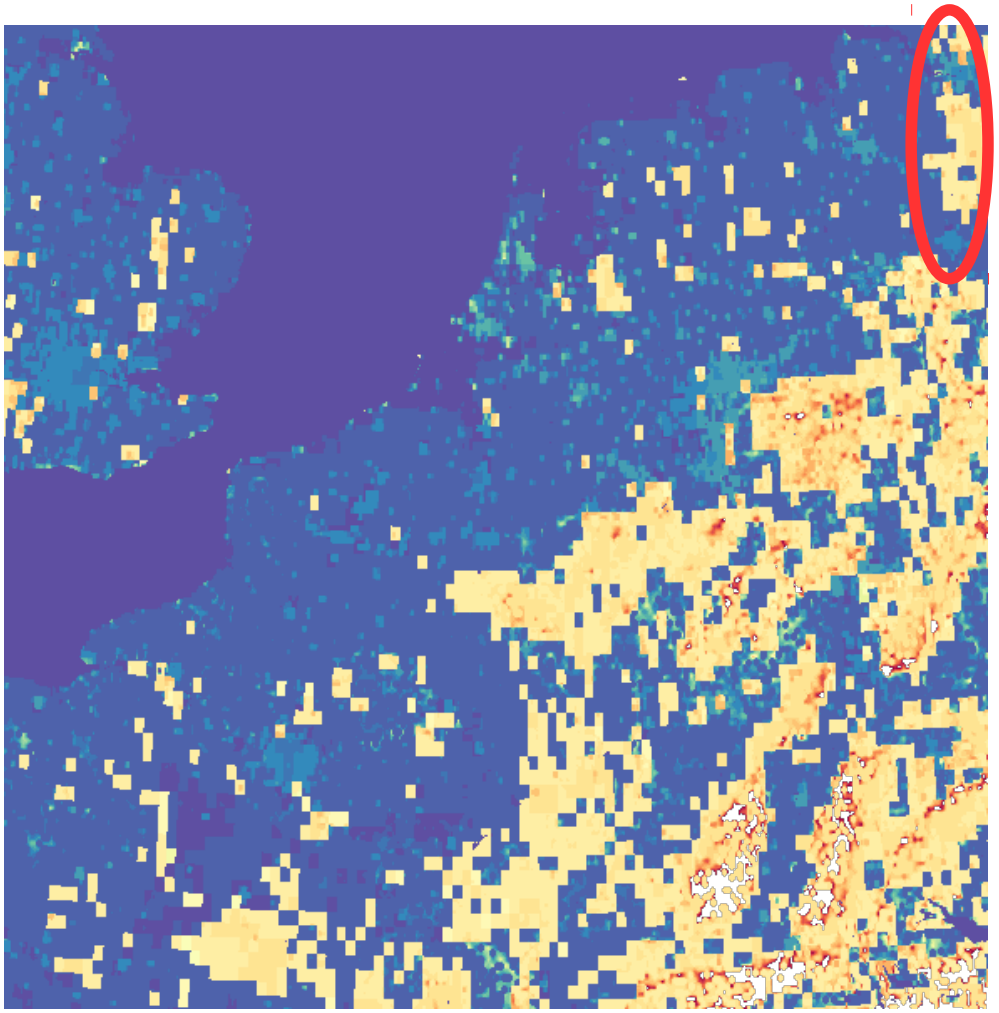




No UHI in the ALARO-runs.
SURFEX will be needed in order to make forecasts sensitive the UHI.

ISBA is no longer sufficient at kilometerscale





Wind at level 87 (of 88 levels) → block pattern does affect fields at model levels
→ another reason to go for SURFEX

Conclusions

- 1.3 km ALARO configuration is successfully tested on new machine
- The scores are similar as the 7km and 4km resolution configurations used at RMI
- The 4km ALARO run shows some artefacts coming from the boundaries
- 1 hr coupling solves this for the 1.3 km runs
- Case studies show the added value of 1.3km (more details, more realism?)
- SURFEX is needed to fully exploit the 1.3 km resolution