Royal Netherlands
Meteorological Institute
*Ministry of Infrastructure and the Environment*

# Operational HARMONIE-AROME issues (clouds and precipitation and some surface)

Sander Tijm
Hylke de Vries

# I want to guide you through:

- Lost soil water
- Lost showers
- Interesting long term precipitation bias developments
- Impact of physics choices on convection
- (Too) Dense fog
- (partly) lost cities
- Plans with HARMONIE-AROME at KNMI

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# Back to Lisbon presentation

- Too much evaporation due to too large LAI in Spring and too much evaporation under normal conditions in Summer (LAI OK).

- Further developments:
  - Experiments with lower LAI give much smaller impact of data assimilation
  - Mechanism behind dry patches developing in model are understood better

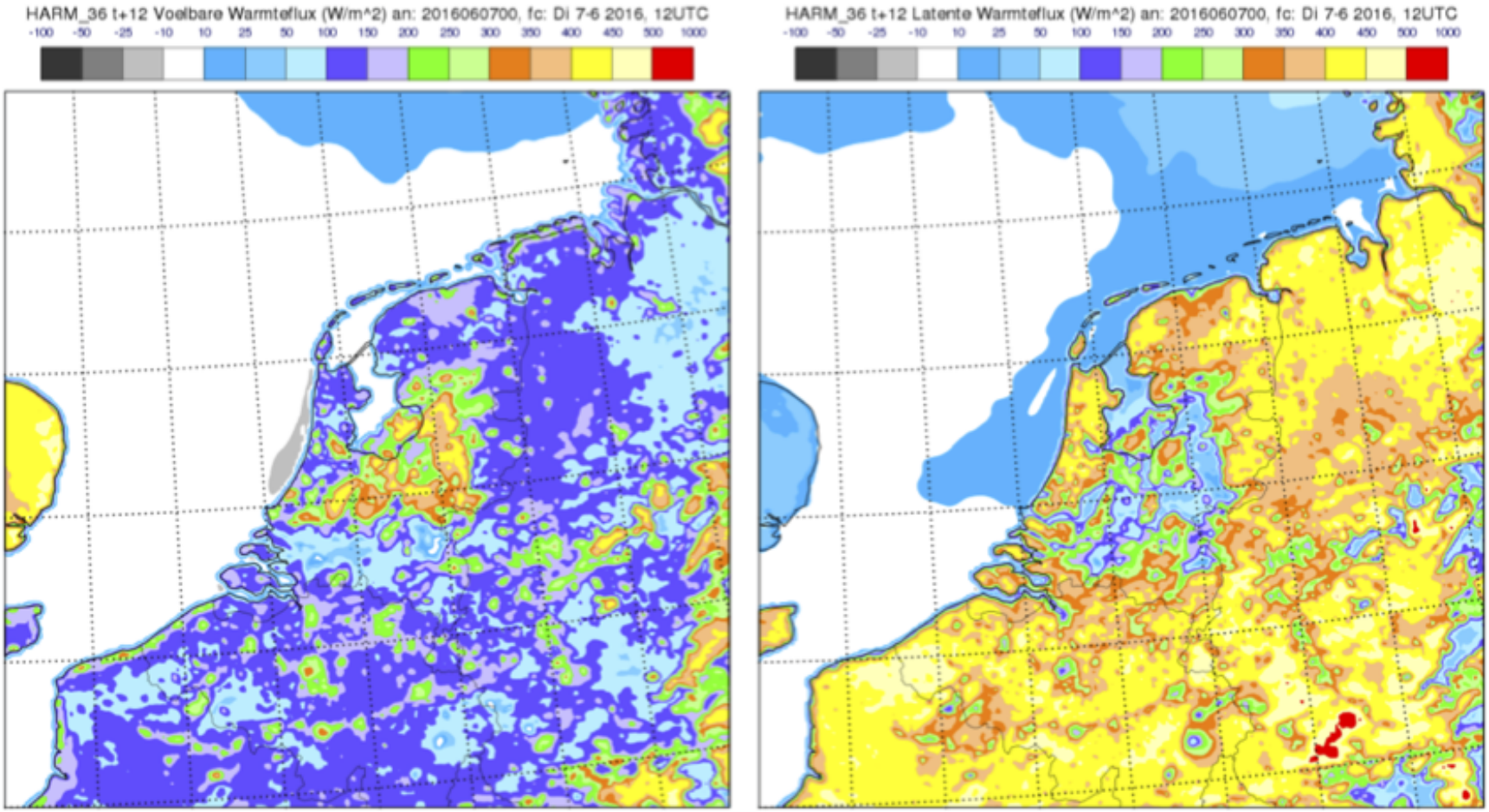
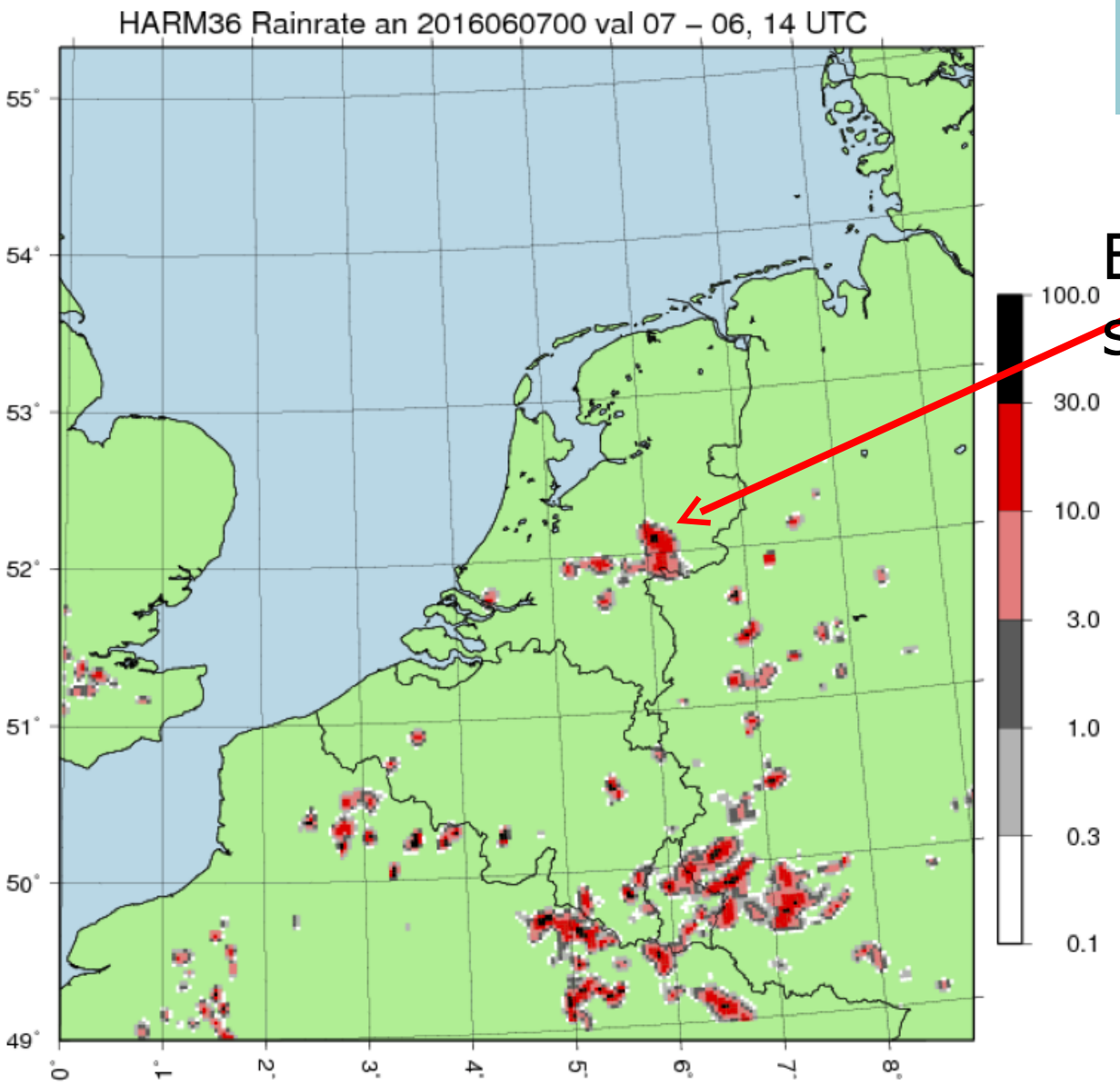
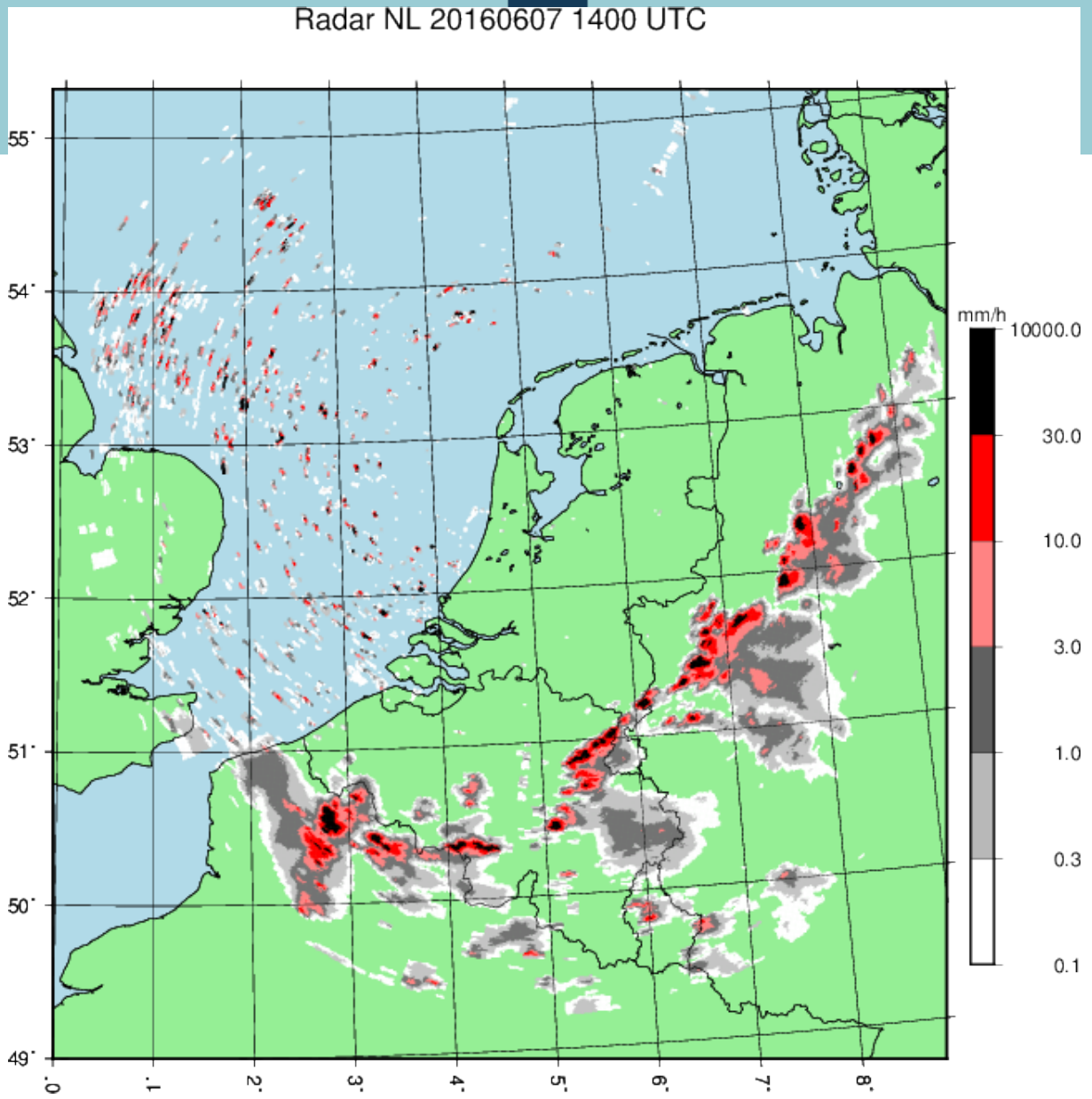



*Figure 4: HARMONIE36 model output of LHF (left panel) and SHF on 7 June 2016 00:00 UTC, valid for 7 June 12:00 UTC. From the HARMONIE36 database.*




Erroneous showers


Radar NL 20160607 1400 UTC
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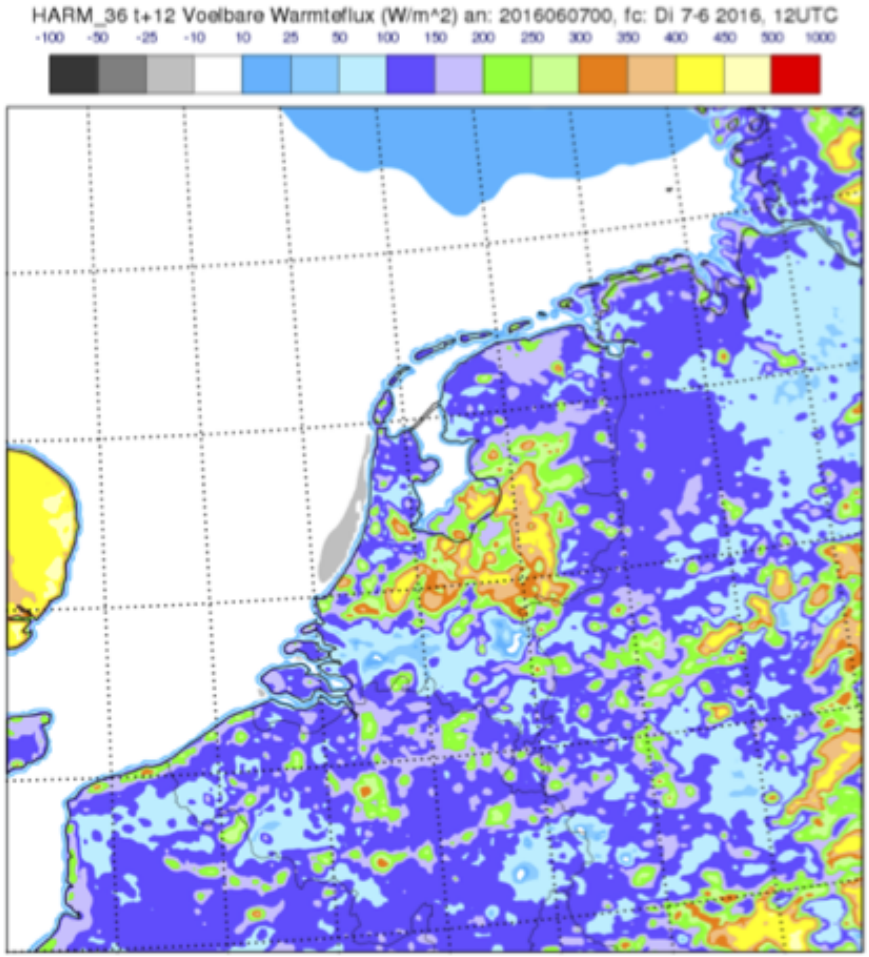
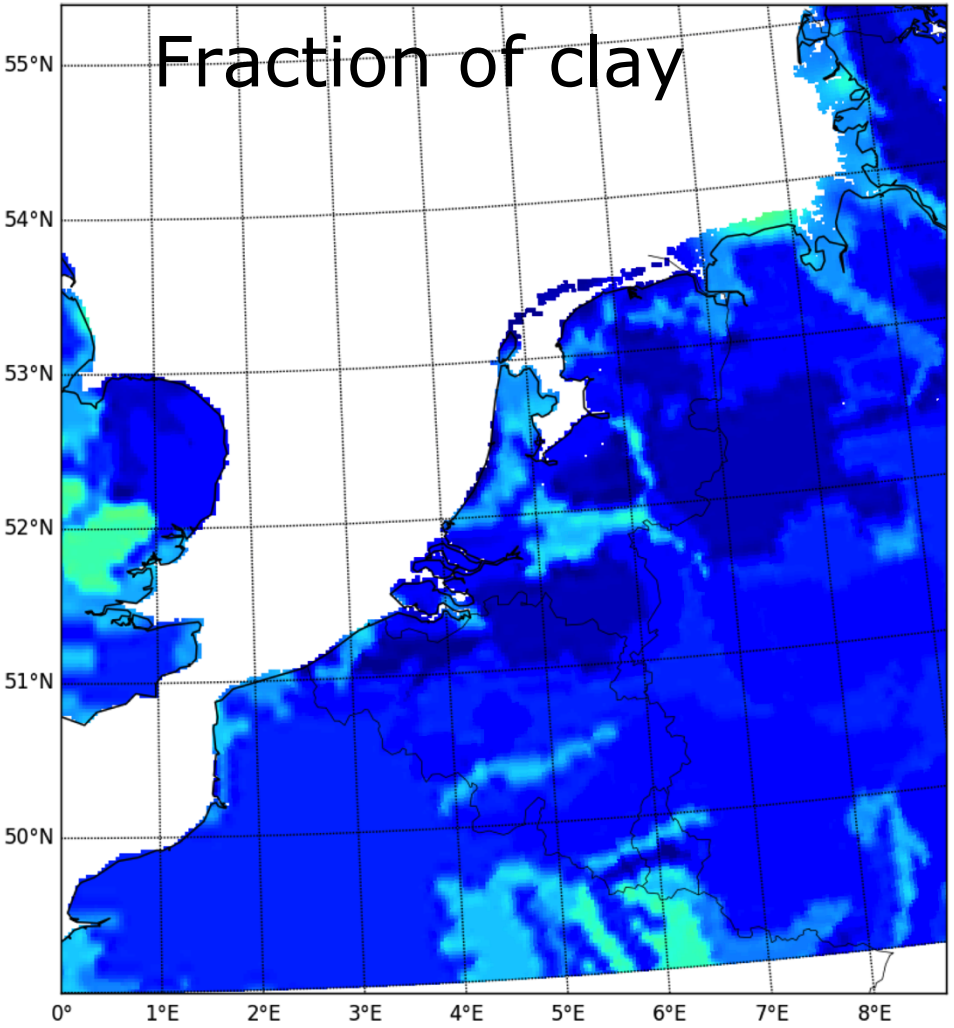

HARM_36 t+12 Voelbare Warmteflux (W/m^2) an: 2016060700, fc: Di 7-6 2016, 12UTC
-100 -50 -25 -10 10 25 50 100 150 200 250 300 350 400 450 500 1000


Fraction of clay
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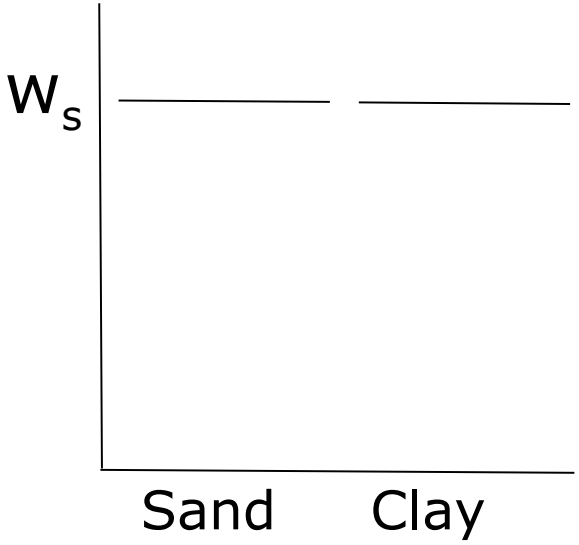
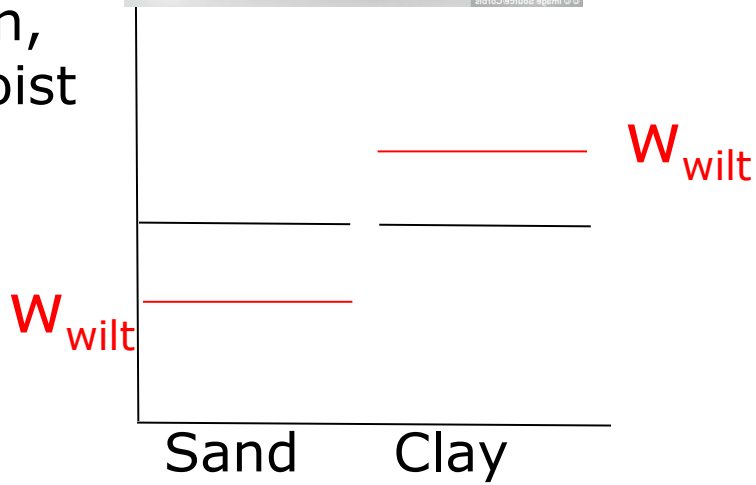
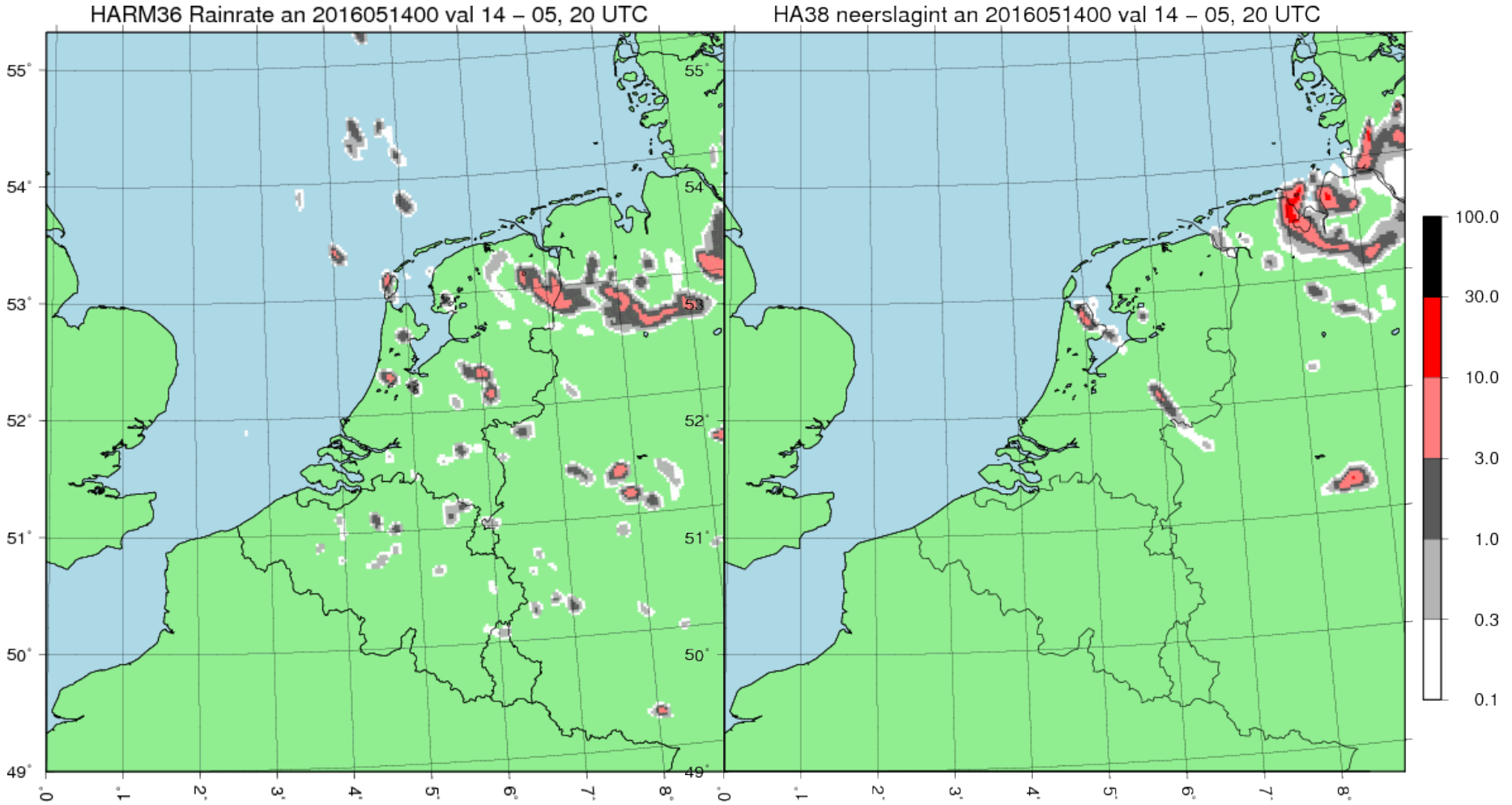



Data assimilation,
Too cold, too moist
LAI/evaporation
Problem (Lisbon
Presentation)



# Lost showers

- Significant number of cases with showers that were missed by HA38
- Showers forecasted by HA36
- Reason?


HARM36 Rainrate an 2016051400 val 14 – 05, 20 UTC
HA38 neerslagint an 2016051400 val 14 – 05, 20 UTC
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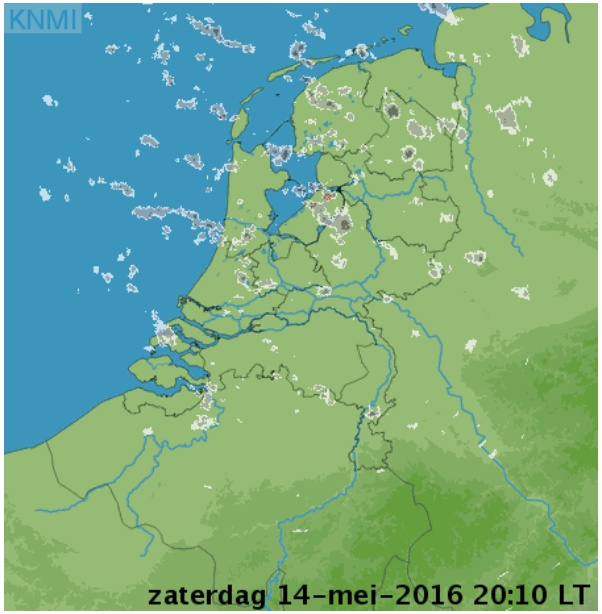
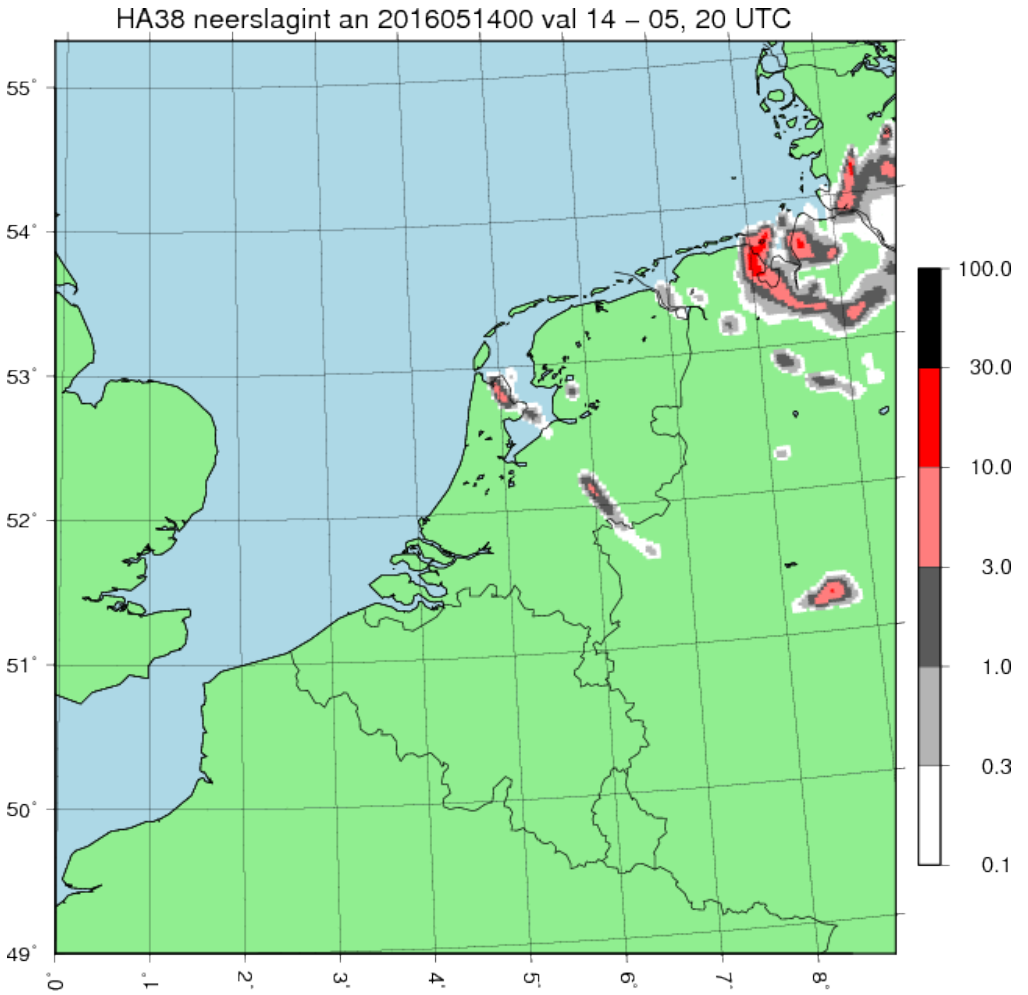

KNMI
zaterdag 14-mei-2016 20:10 LT


HA38 neerslagint an 2016051400 val 14 – 05, 20 UTC
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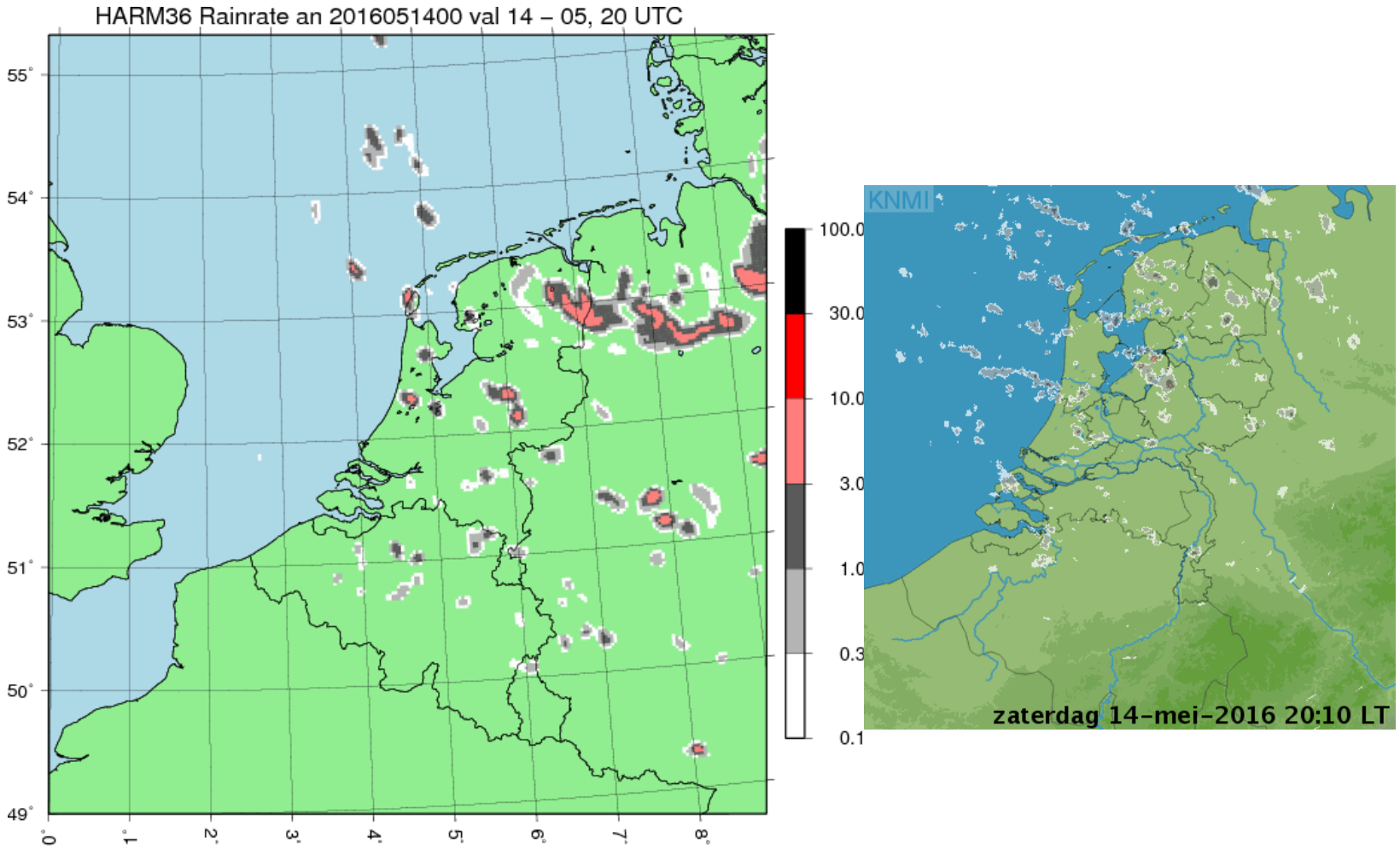



HA36 better, but not capable of representing open cell convection very well

# During summer 2016 many more cases:

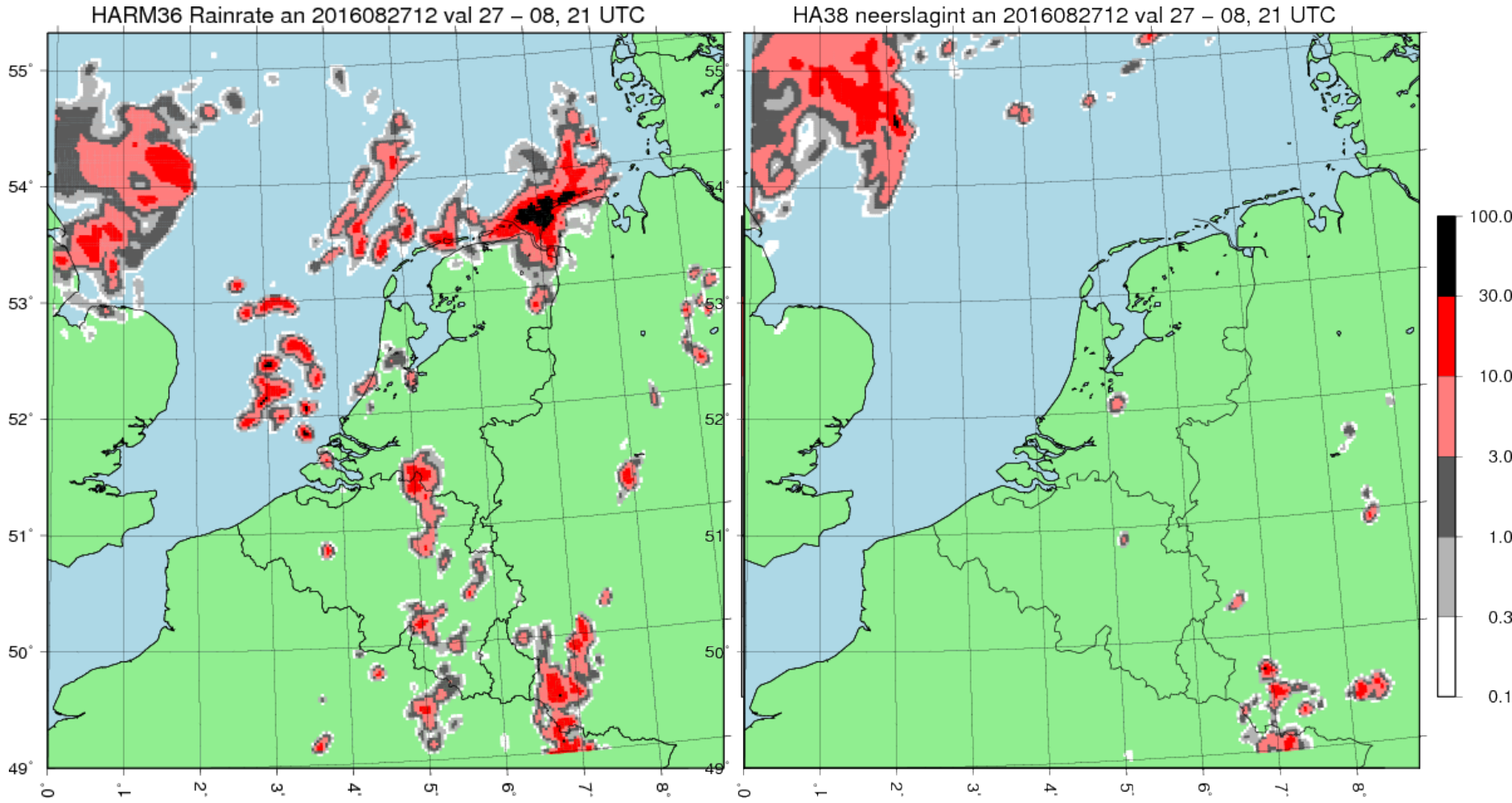
20160705: underestimation showers in HA38

2016071006: HA36 has showers in the evening in Northeast NL, HA38 nothing

2016080403: small showers between 10-15 UTC missed in HA38

2016080506: significant showers developing over NL missed

2016082709: HA38 misses heavy showers in evening, correct signal for SE NL. HA36 gives showers from 19 UTC, not in right place. Some runs of 26-08 gave significant showers in HA38, impact of DA?


HARM36 Rainrate an 2016082712 val 27 – 08, 21 UTC
HA38 neerslagint an 2016082712 val 27 – 08, 21 UTC
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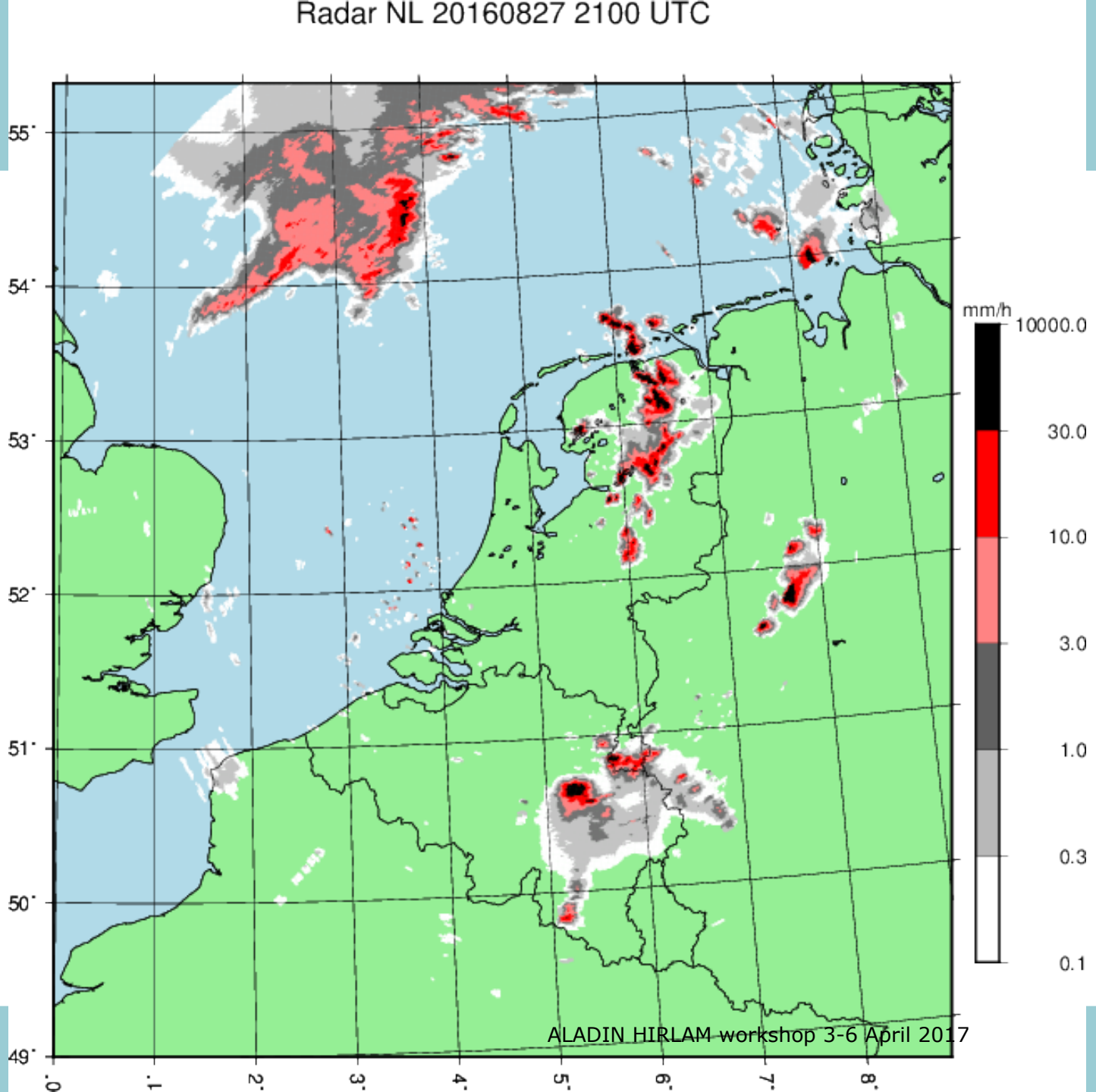
Radar NL 20160827 2100 UTC
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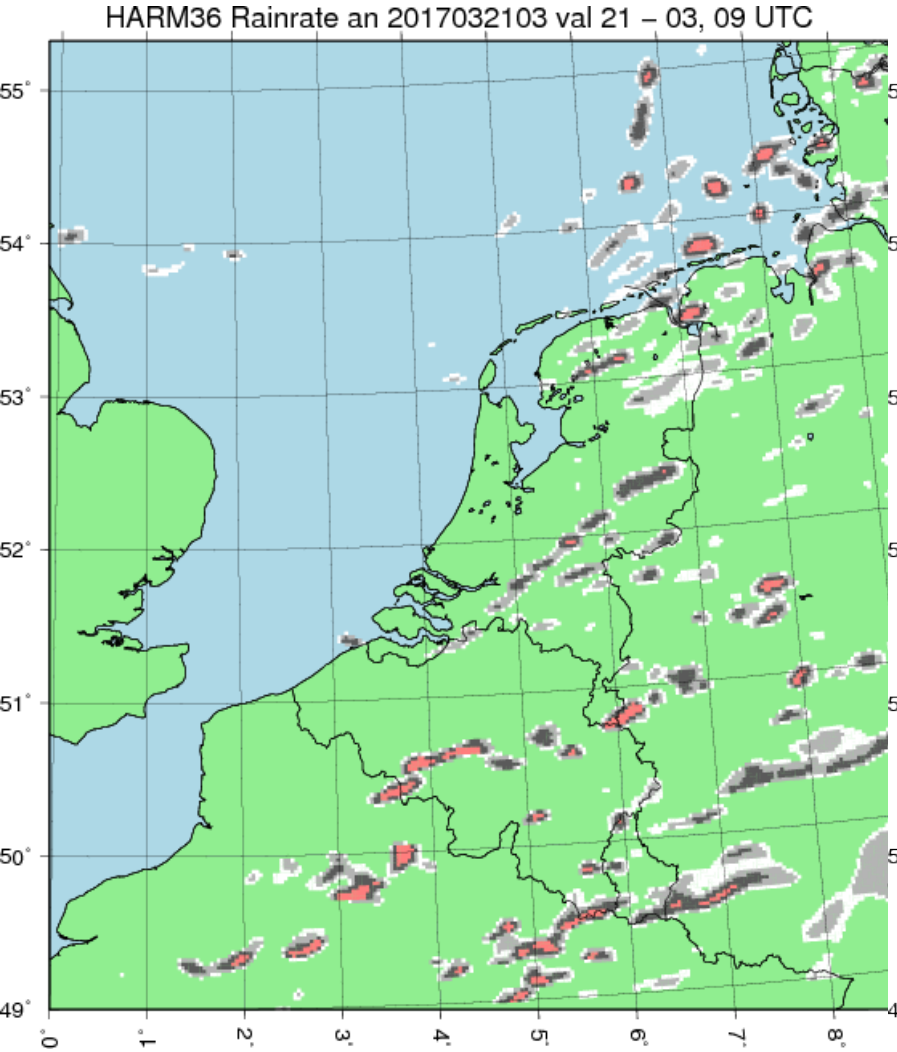
HARM36 Rainrate an 2017032103 val 21 – 03, 09 UTC
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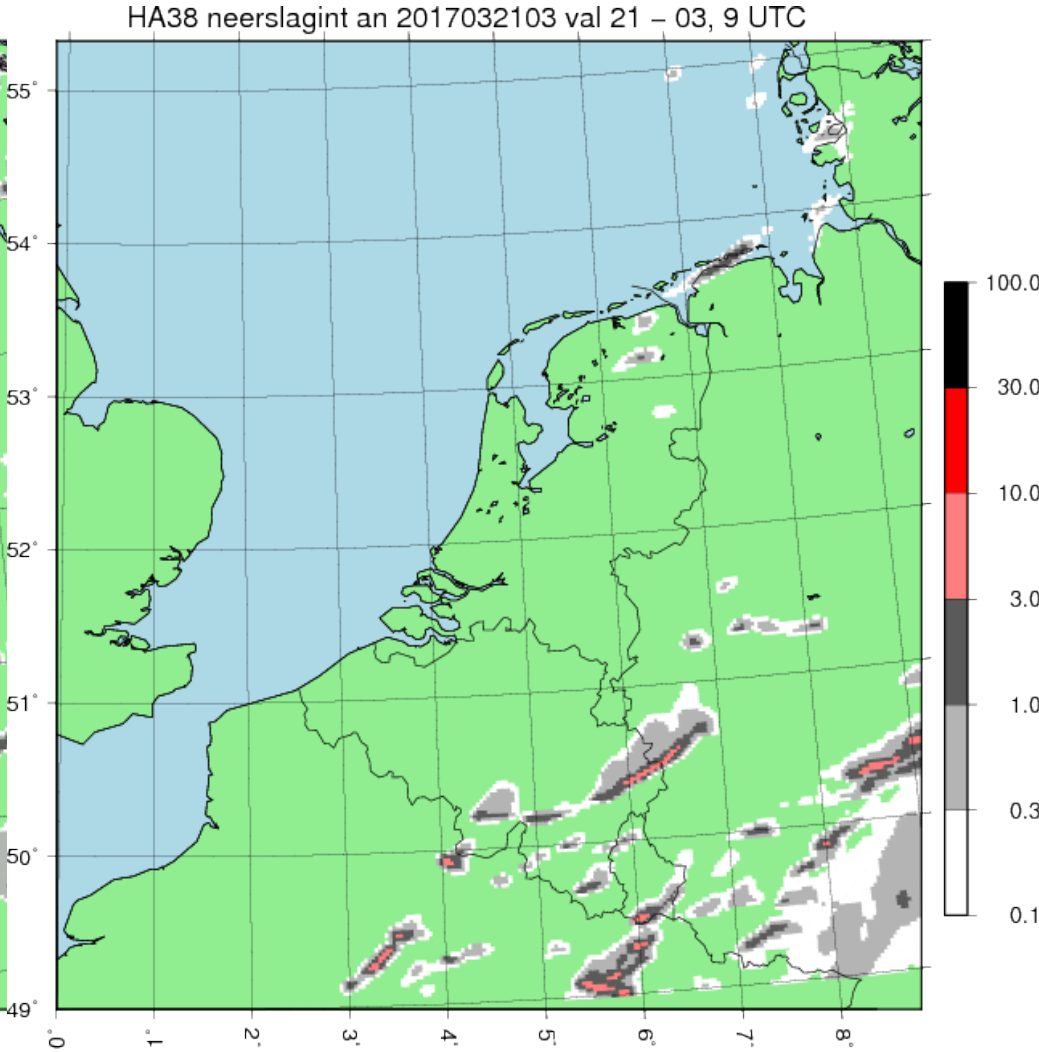
HA38 neerslagint an 2017032103 val 21 – 03, 9 UTC
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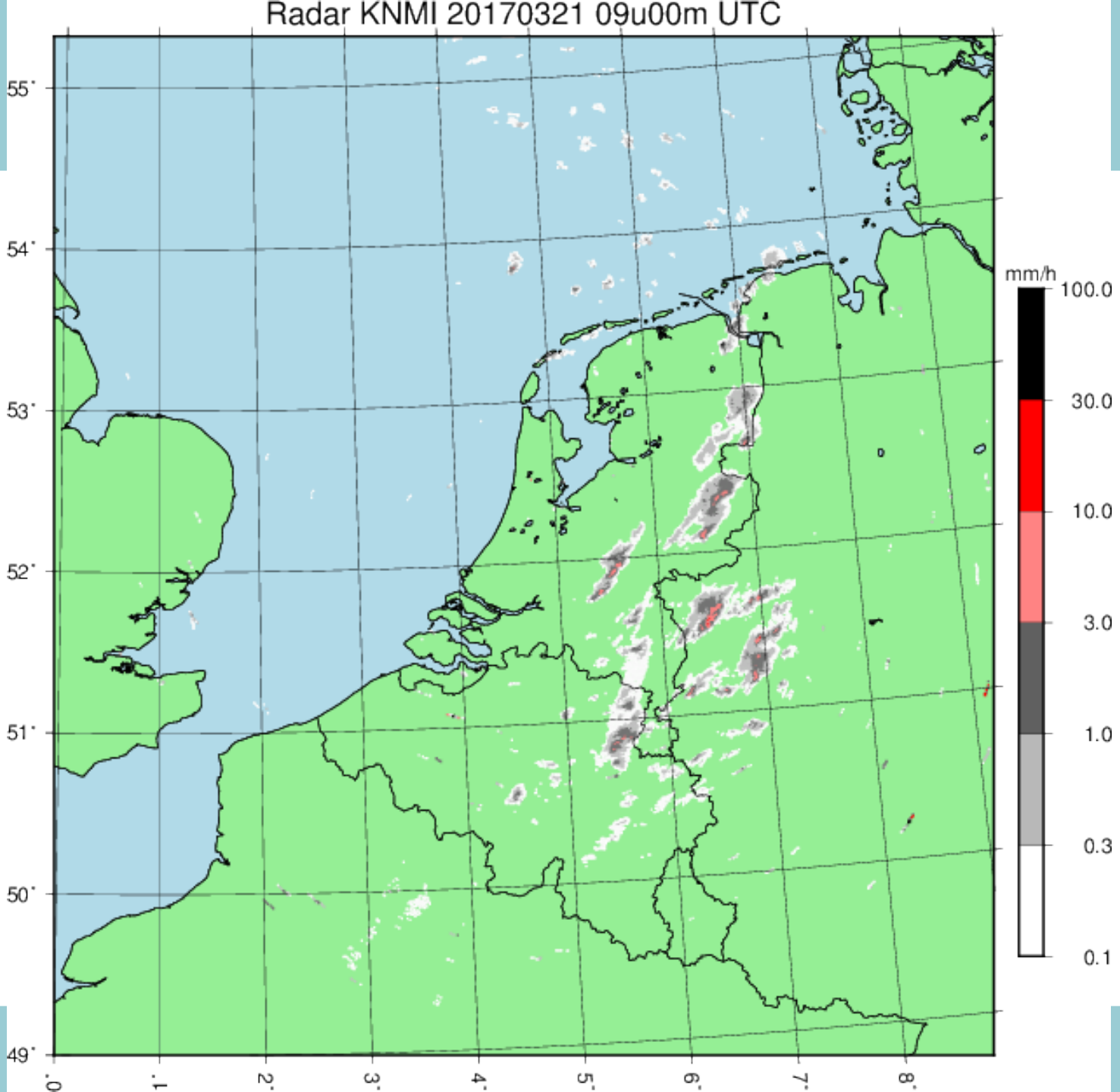
Radar KNMI 20170321 09u00m UTC
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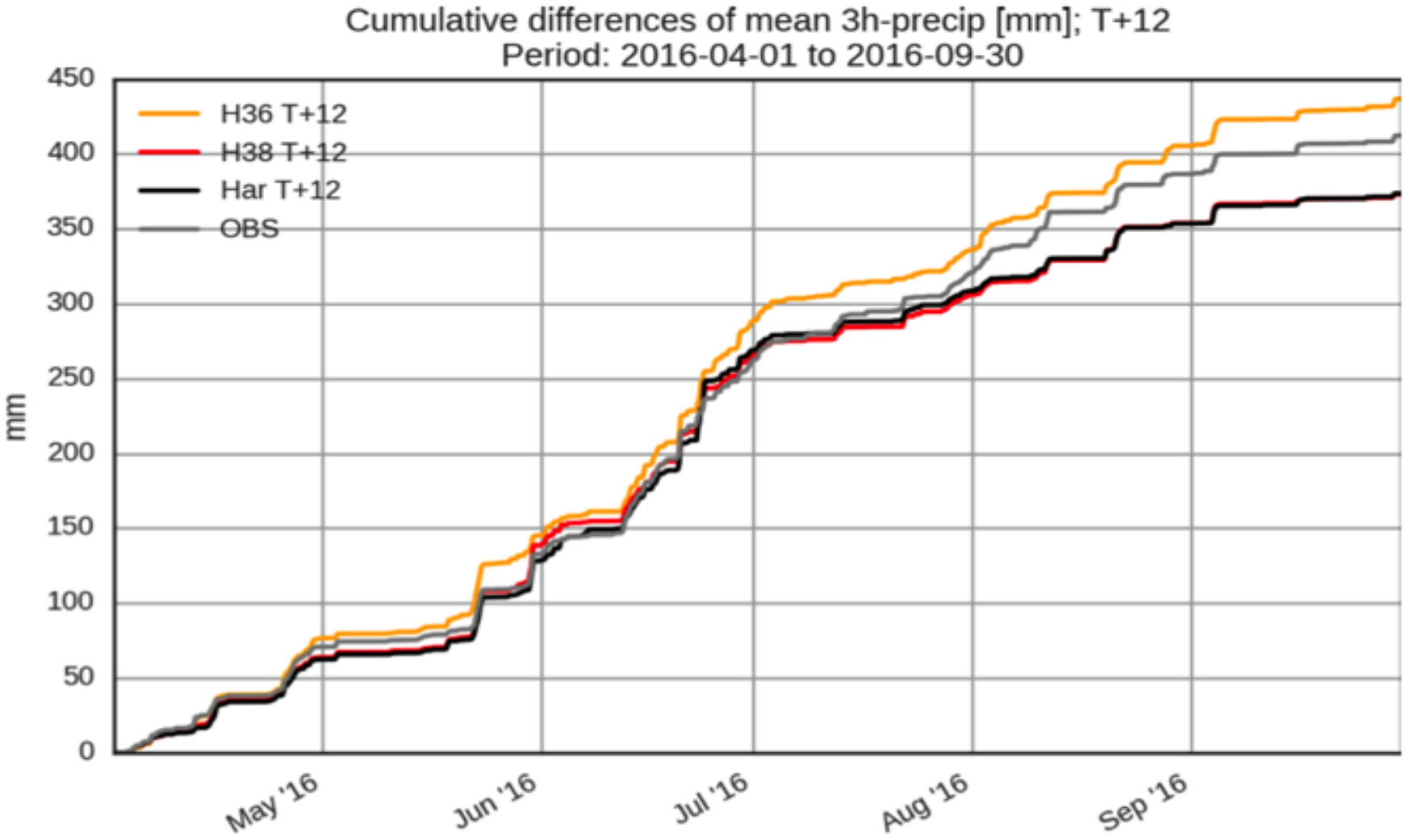
Missed showers are very detrimental for faith of forecasters in model. Forecasters prefer model with higher FAR and POD over model with lower FAR and POD.

# Precipitation bias development summer 2016

HARMONIE precipitation verified against rain gauge calibrated radar observations shows interesting bias development over summer

From April 1 until September 30 overestimation HA36, underestimation HA38.


Cumulative differences of mean 3h-precip [mm]; T+12
Period: 2016-04-01 to 2016-09-30
H36 T+12
H38 T+12
Har T+12
OBS
mm
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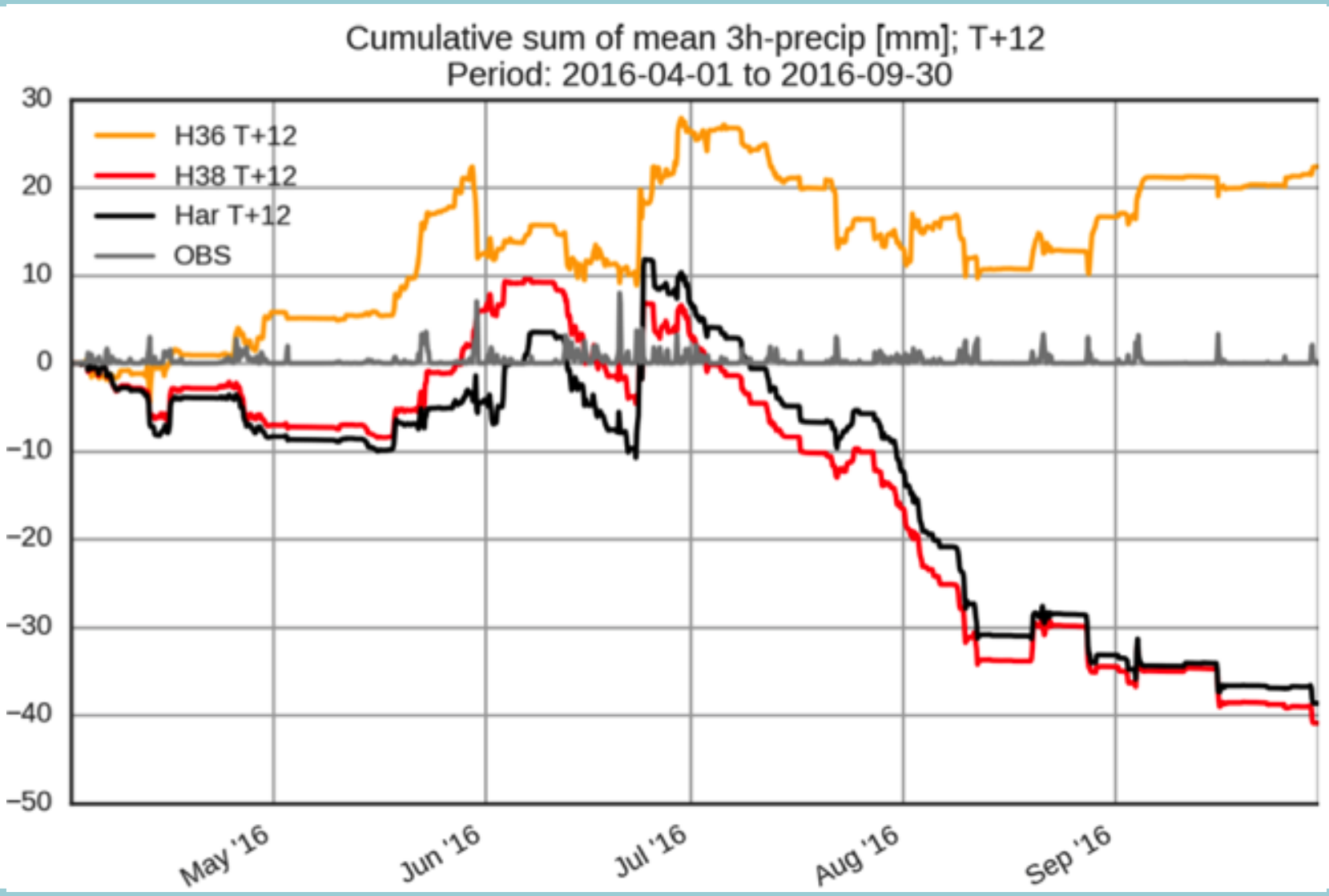
May '16
Jun '16
Jul '16
Aug '16
Sep '16


Cumulative sum of mean 3h-precip [mm]; T+12
Period: 2016-04-01 to 2016-09-30
H36 T+12
H38 T+12
Har T+12
OBS
30
20
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0
−10
−20
−30
−40
−50
May '16
Jun '16
Jul '16
Aug '16
Sep '16

# Impact of physics choices on convection

Missing showers give rise to question where these differences between HA36 and HA38+ (almost HA40) come from

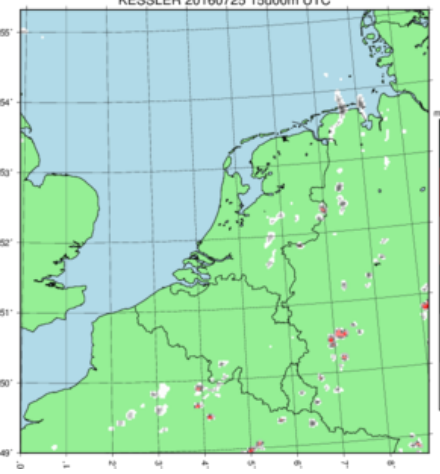
Clean experiments with cold start from ECMWF analysis show impact of physics choices

HA40h1.1 reference is Kogan autoconversion

Experiments:

- Kessler autoconversion
- HARATU update of EDMF switched off
- OCND2 put to false

Kessler

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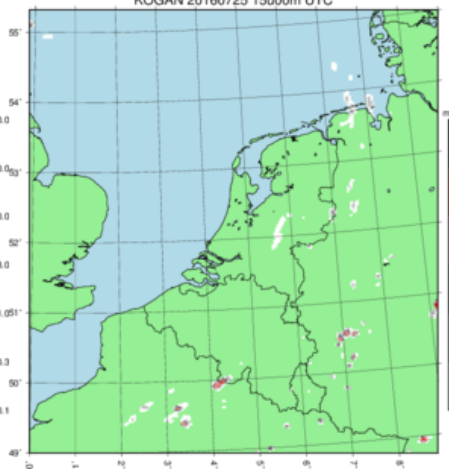
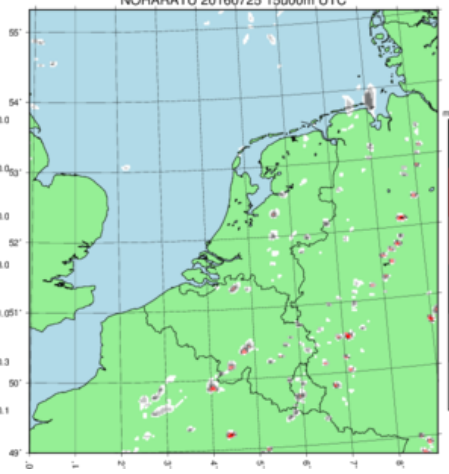
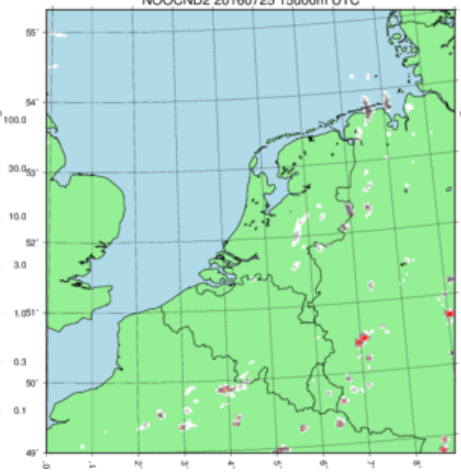


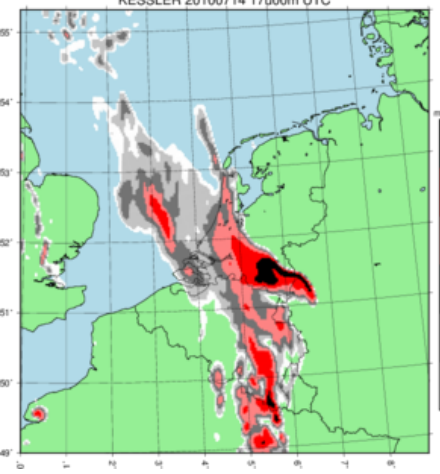

NO HARATU




NO OCND2



Kessler

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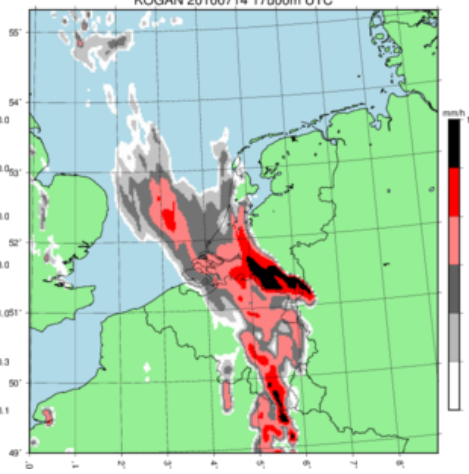
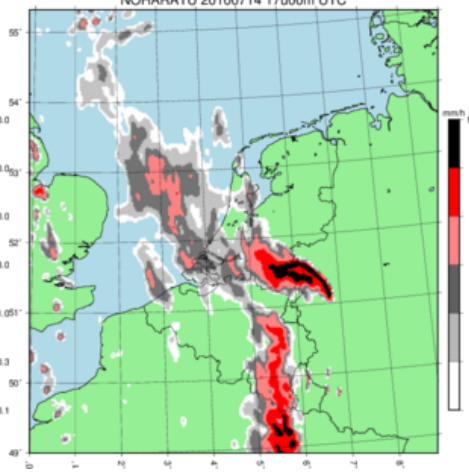



NO HARATU

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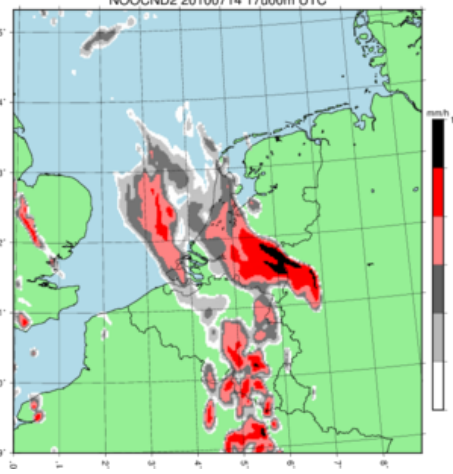
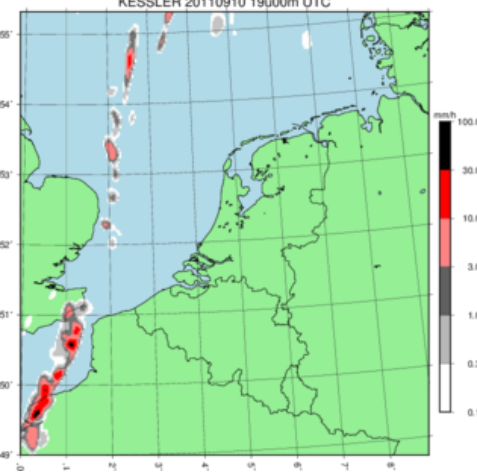


Kessler

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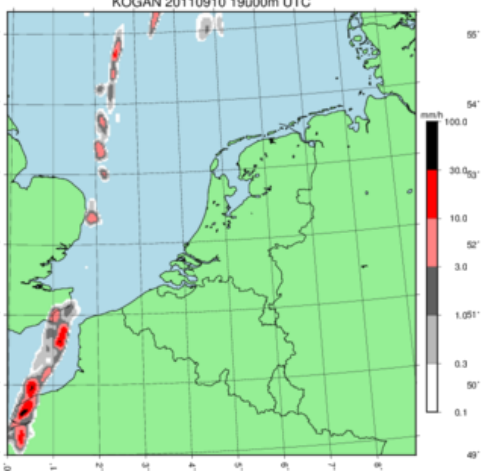


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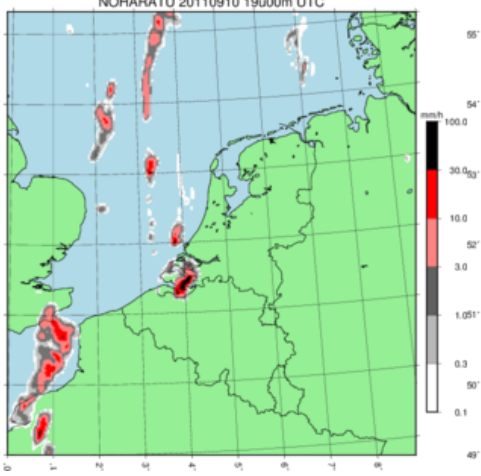


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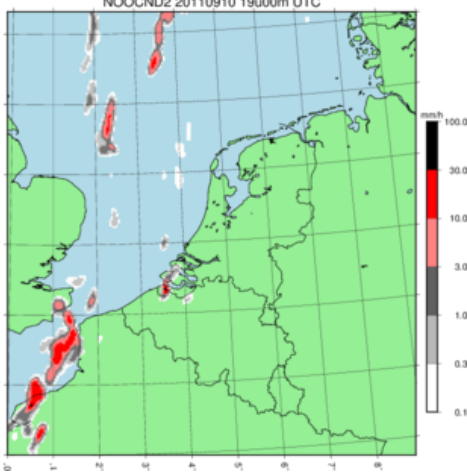
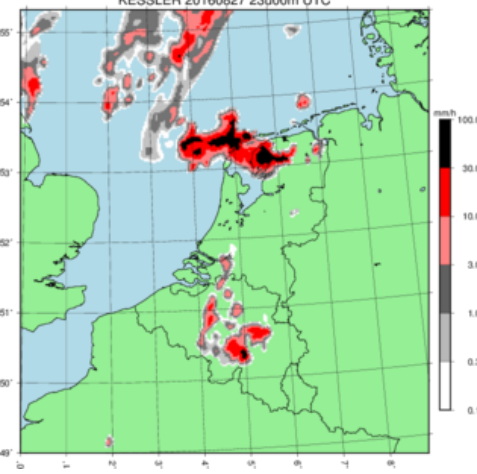


Kessler

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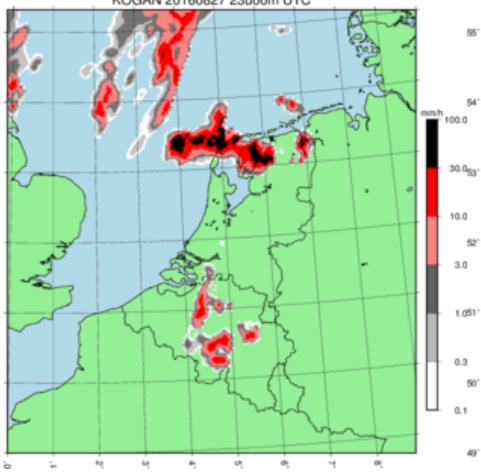
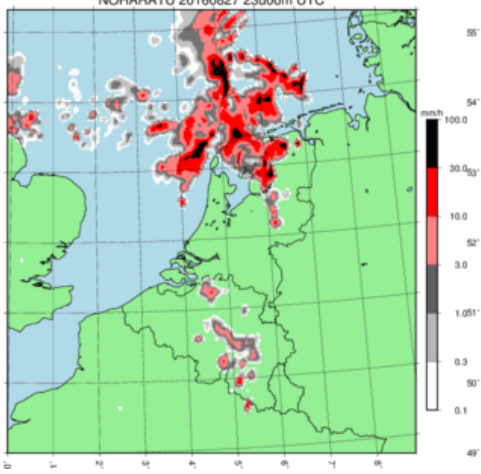



NO HARATU

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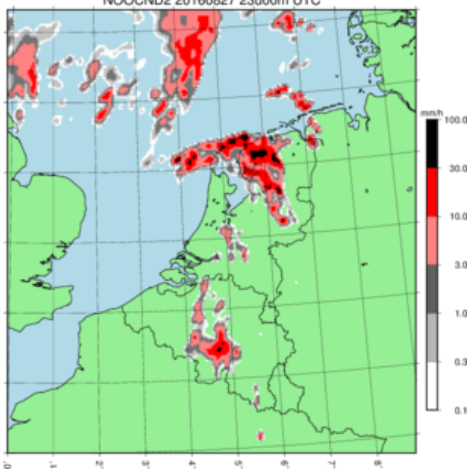
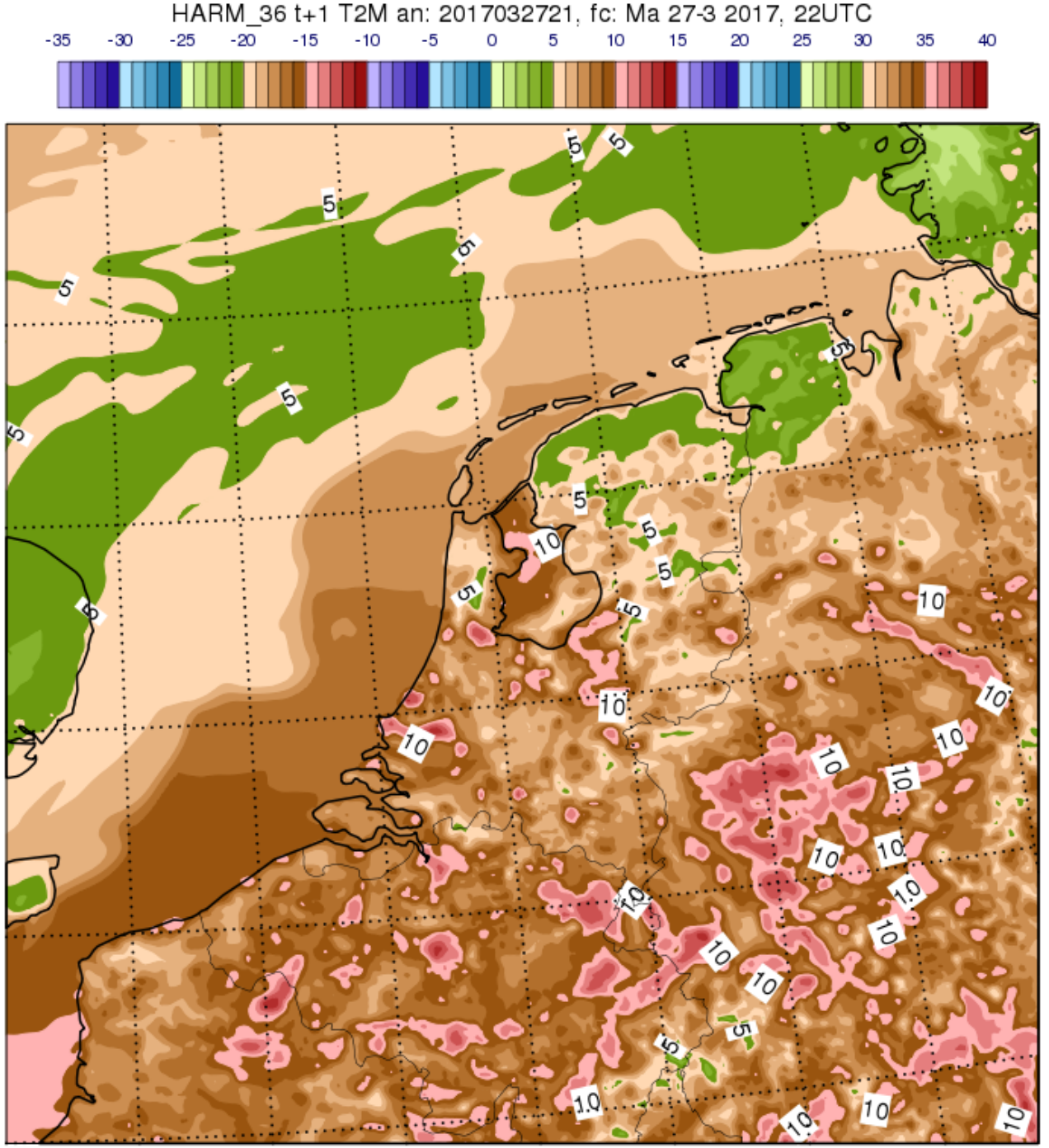


# Lost cities

- In the Netherlands and surrounding areas the effect of cities on temperature (heat island) is much less in HA38 than HA36
- Similarly, the impact of the cities on wind is much smaller in HA38 than HA36
- So far no solution has been found for this behaviour, but suspect is translation of land use database to surface characteristics in SURFEX and the classification of temperate cities (too low city fraction?)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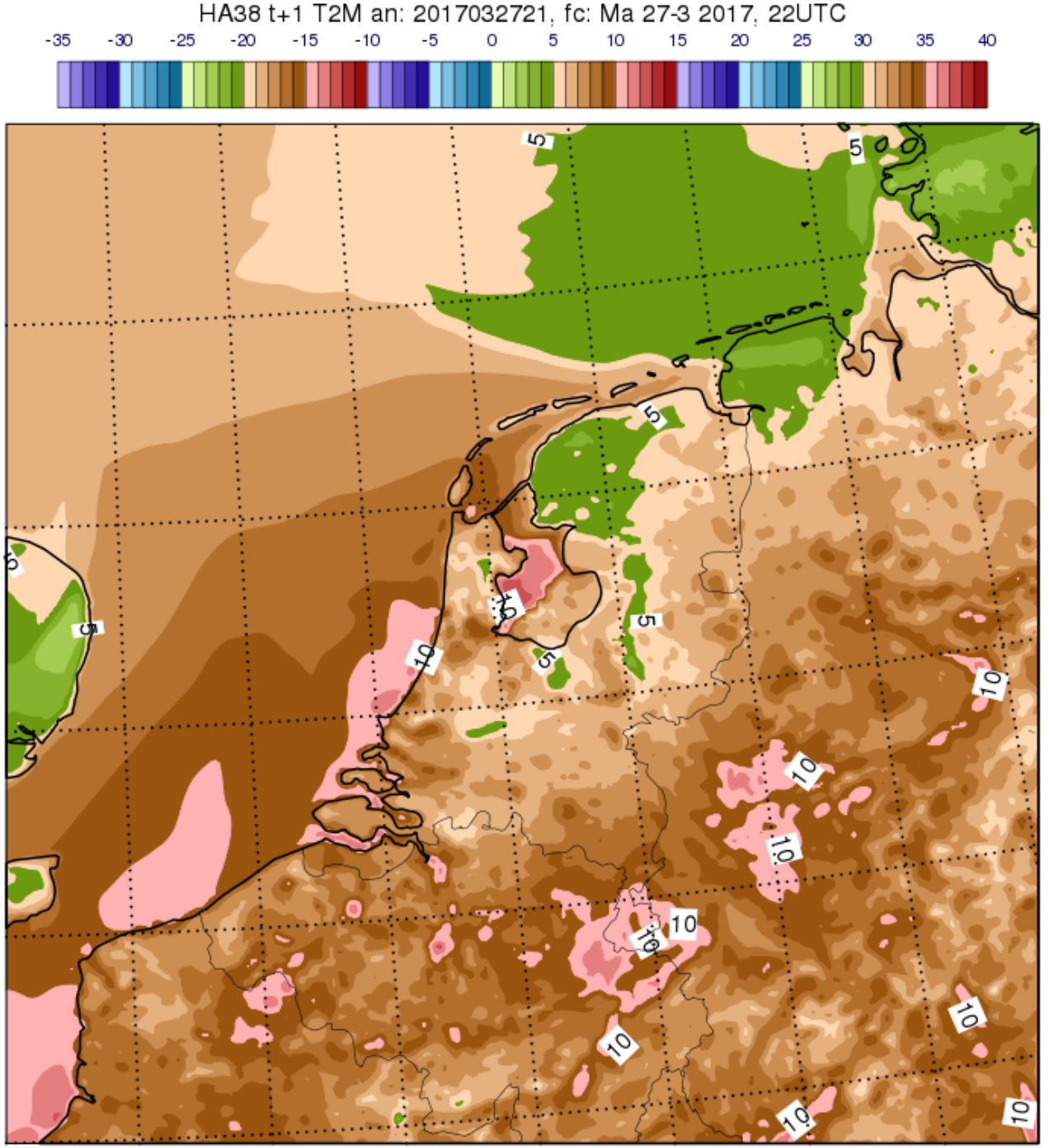
-35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40


HA38 t+1 T2M an: 2017032721, fc: Ma 27-3 2017, 22UTC
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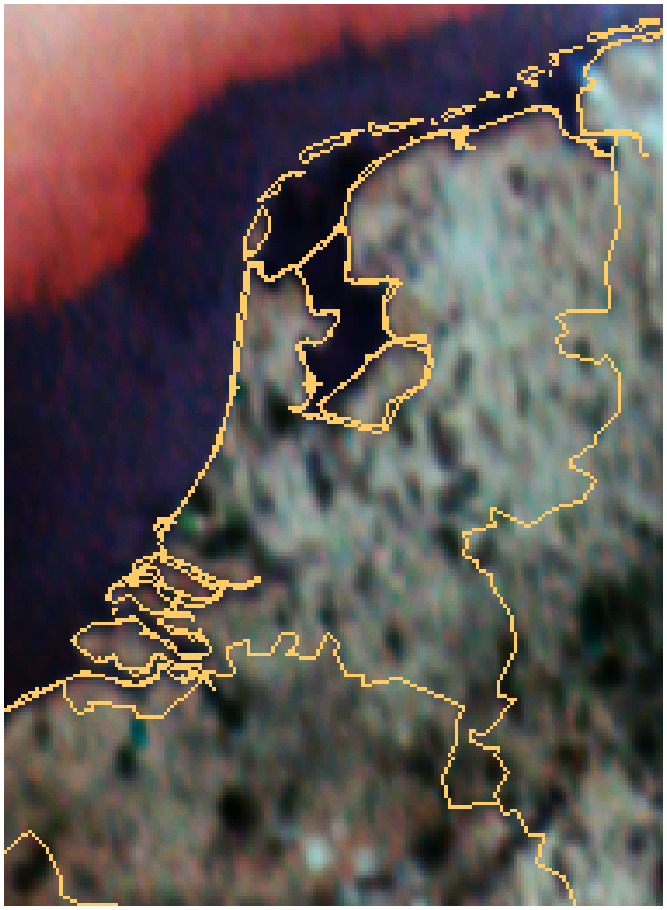
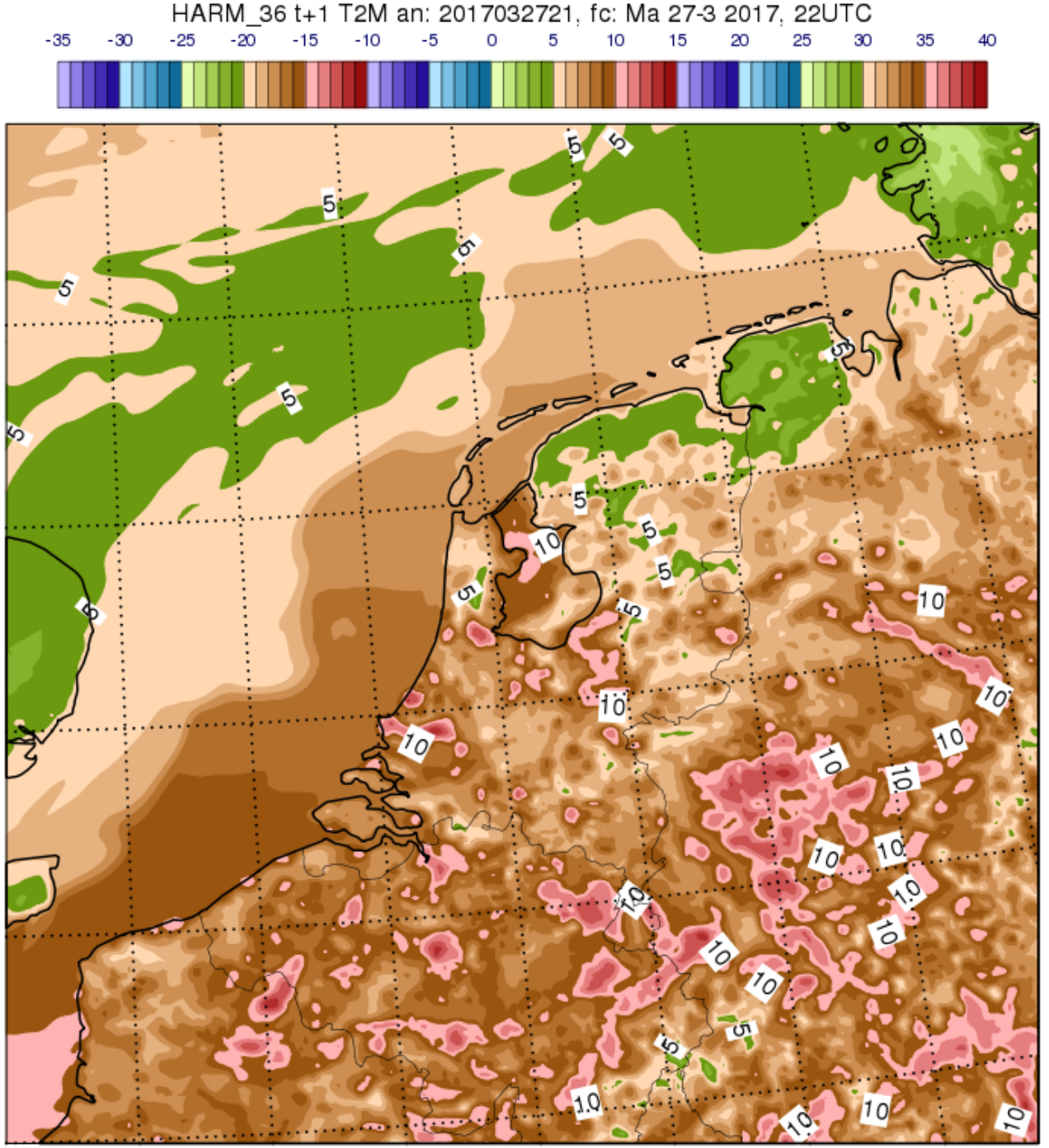


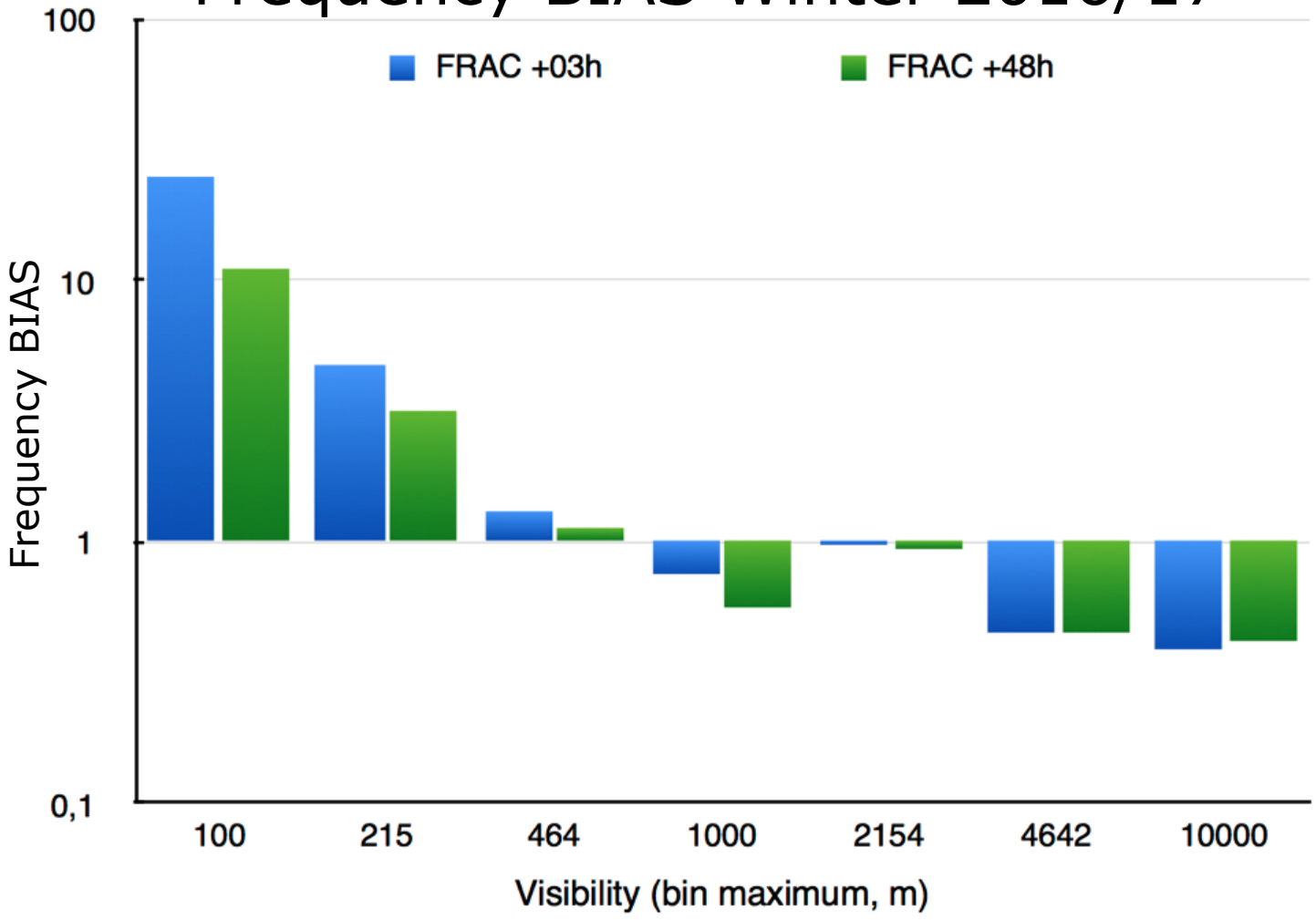

HARM_36 t+1 T2M an: 2017032721, fc: Ma 27-3 2017, 22UTC
-35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40

# Dense fog

- When HARMONIE-AROME forecasts fog, it often is very dense (50-200 metres)
- Observed visibility often forecasted visibility x 2

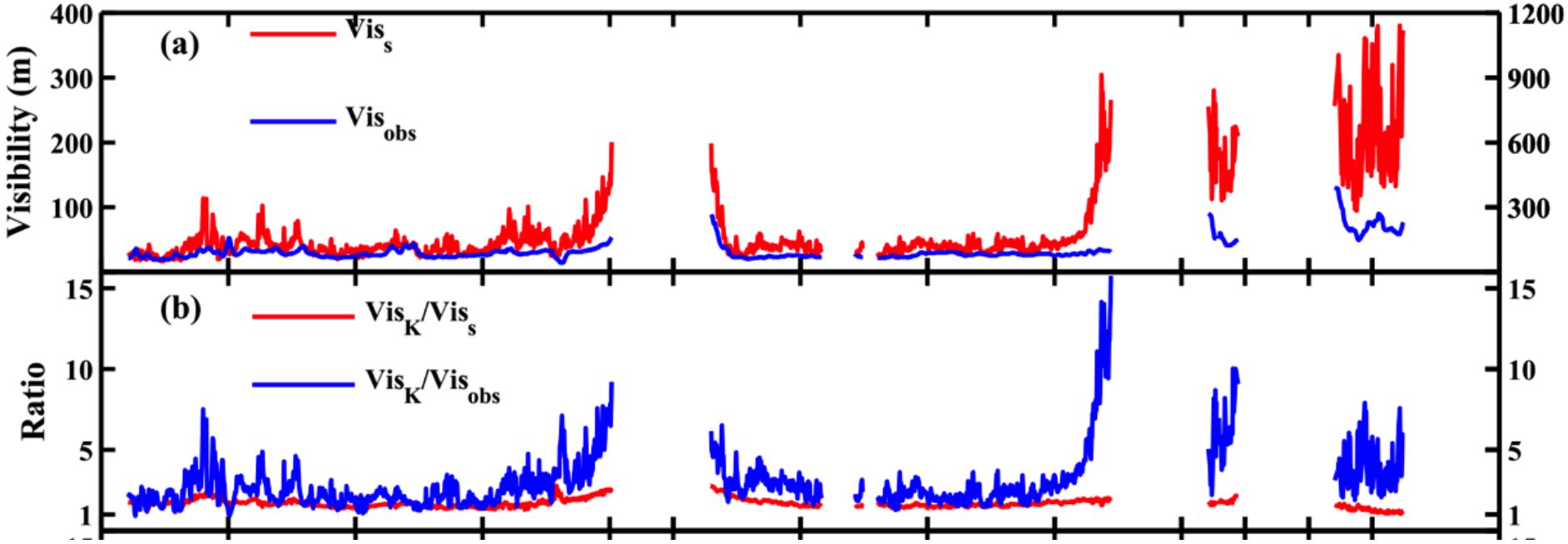
- Verification of visibility, based only on hydrometeors (effect of relative humidity and aerosols as currently used in HA38 excluded) shows erroneous distribution for fog cases
- Results solely based on relations of Kunkel (1984), derived around 1980 in NE-USA

# Frequency BIAS Winter 2016/17



# Dense fog

- Use of Kunkel relation in China leads to too high visibility




- Zhang et al, 2014, Atmospheric Environment

# Dense fog

- Use of Kunkel relations leads to too high visibility in China (very dirty air), too low visibility in HARMONIE (relatively clean air in Europe)
- Relations of Kunkel were derived around 1980
- Air quality has improved considerably since then
- Improve visibility through inclusion of aerosol concentration observations and forecasts in postprocessing of model output

or

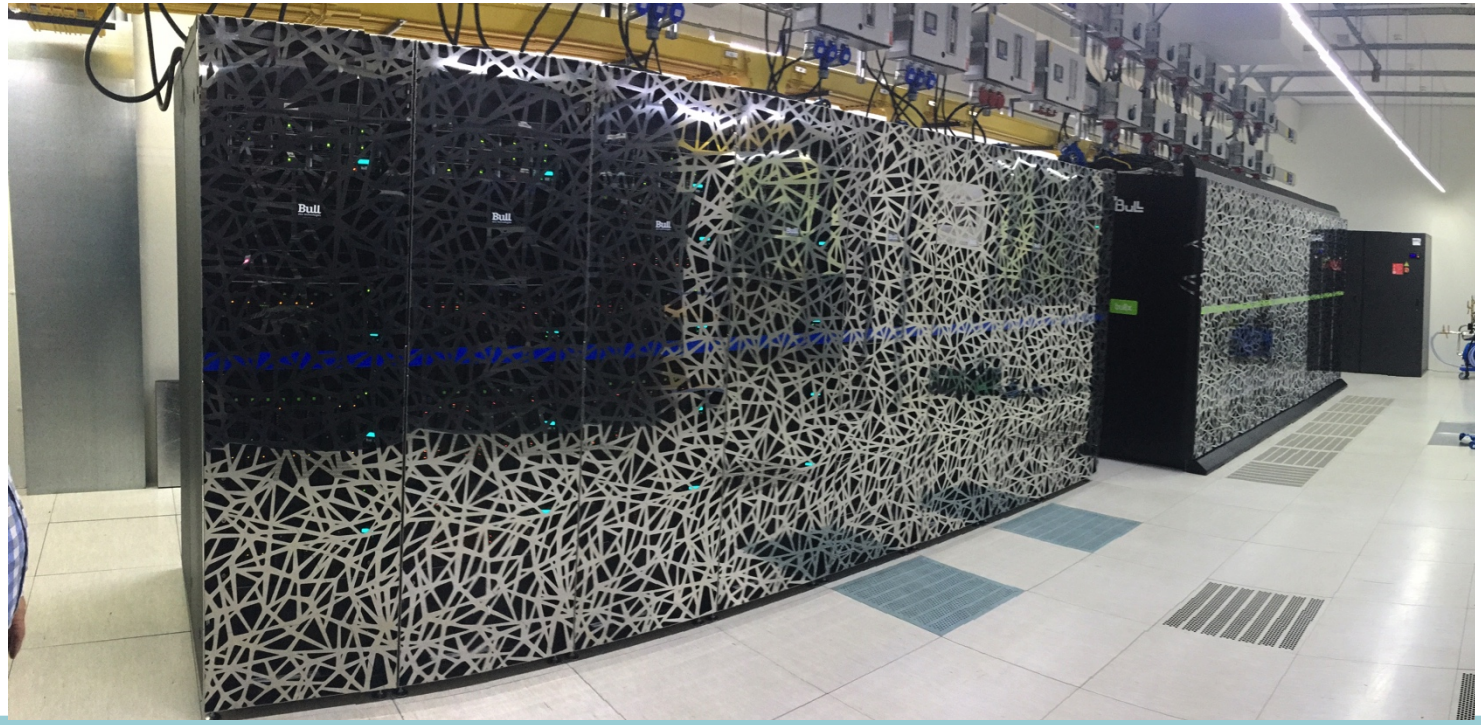
- derive new relations between cloud water and visibility under current air quality conditions

# KNMI plans

New supercomputer (Bull):

Operations: 250 nodes, 224 Tflop

Research: 180 nodes, 161 Tflop



# KNMI plans

First porting of operational HIRLAM and HARMONIE-AROME runs to new computer (April, May)

Then setup of ensemble, 15-20 members on 800x800, 2.5 km grid in 1.5 hours, every 3 hours?

Room for O- and E-suite

Operational rhythm 8 hours, 3 shifts. Not sensible to run 4 or 8 runs per day but 3 or 6?