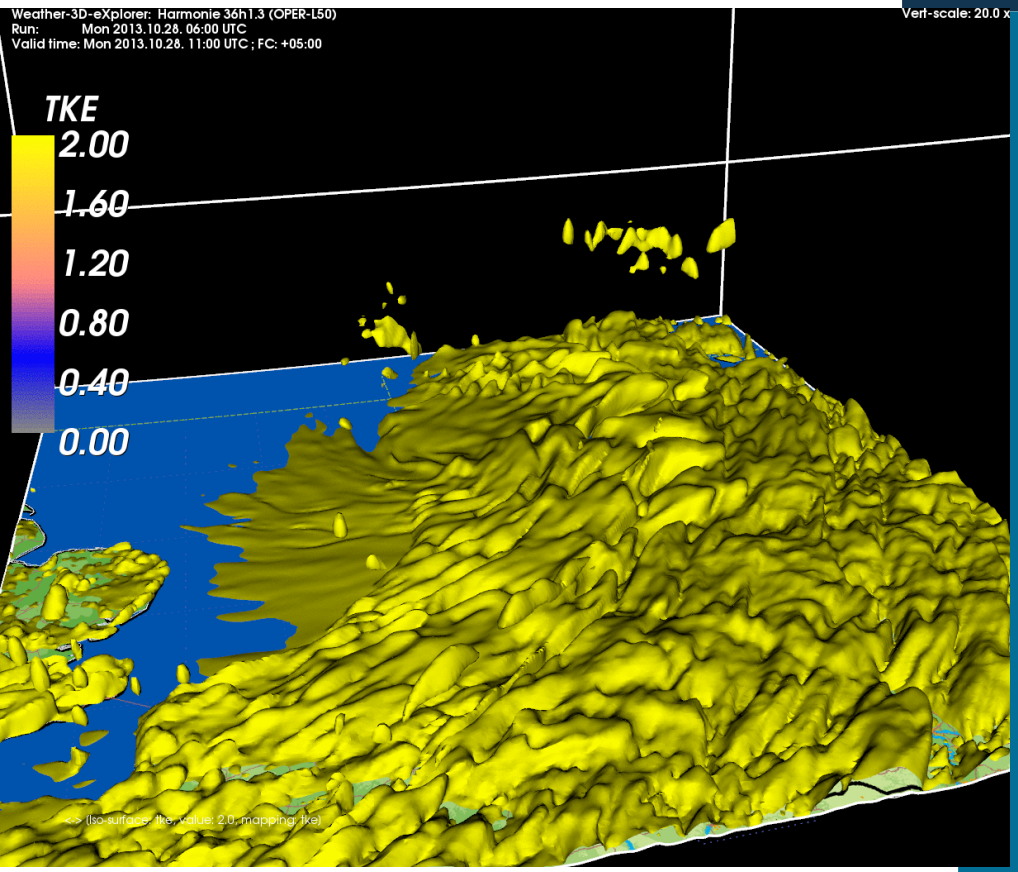


Royal Netherlands
Meteorological Institute (KNMI)
Ministry of Infrastructure and the Environment

HARMONIE validation (and some GLAMEPS)

Sander Tijm, Hans de Vries,
Peter Baas, meteorologists
KNMI

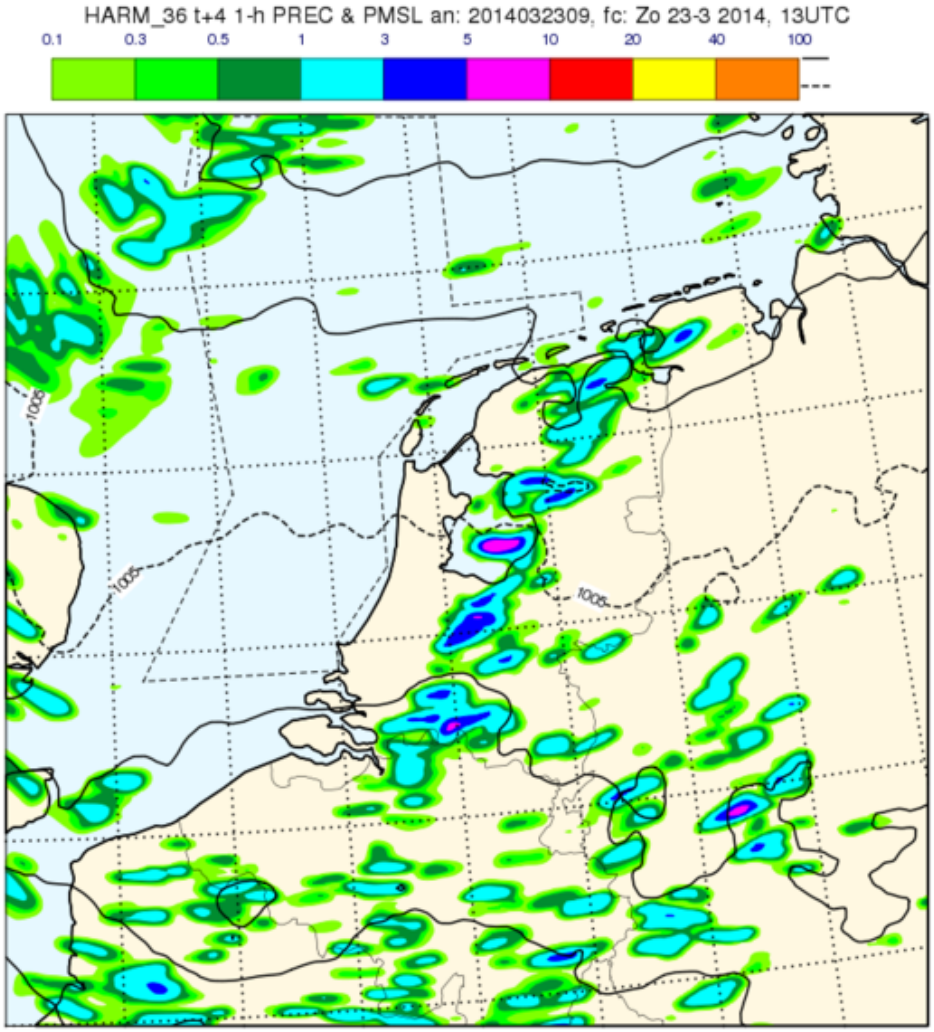
Zweers Burgers de Vries Makin

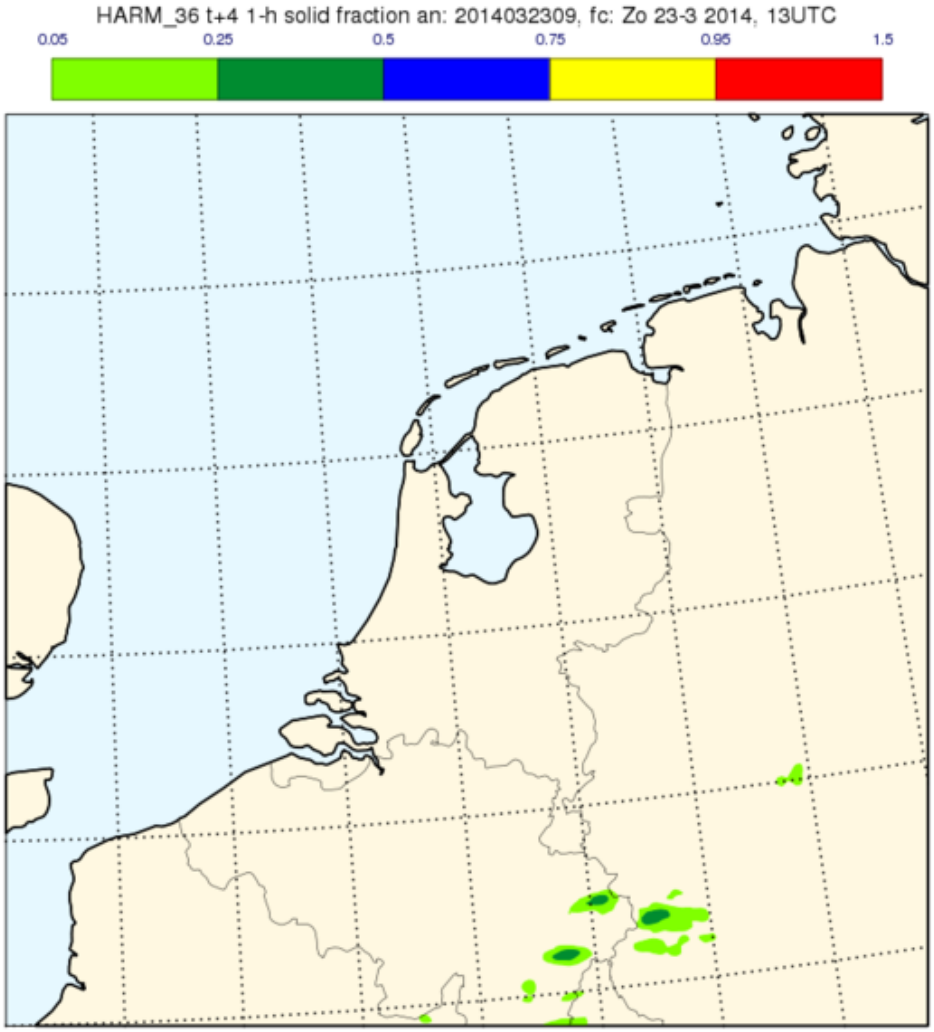
Overview

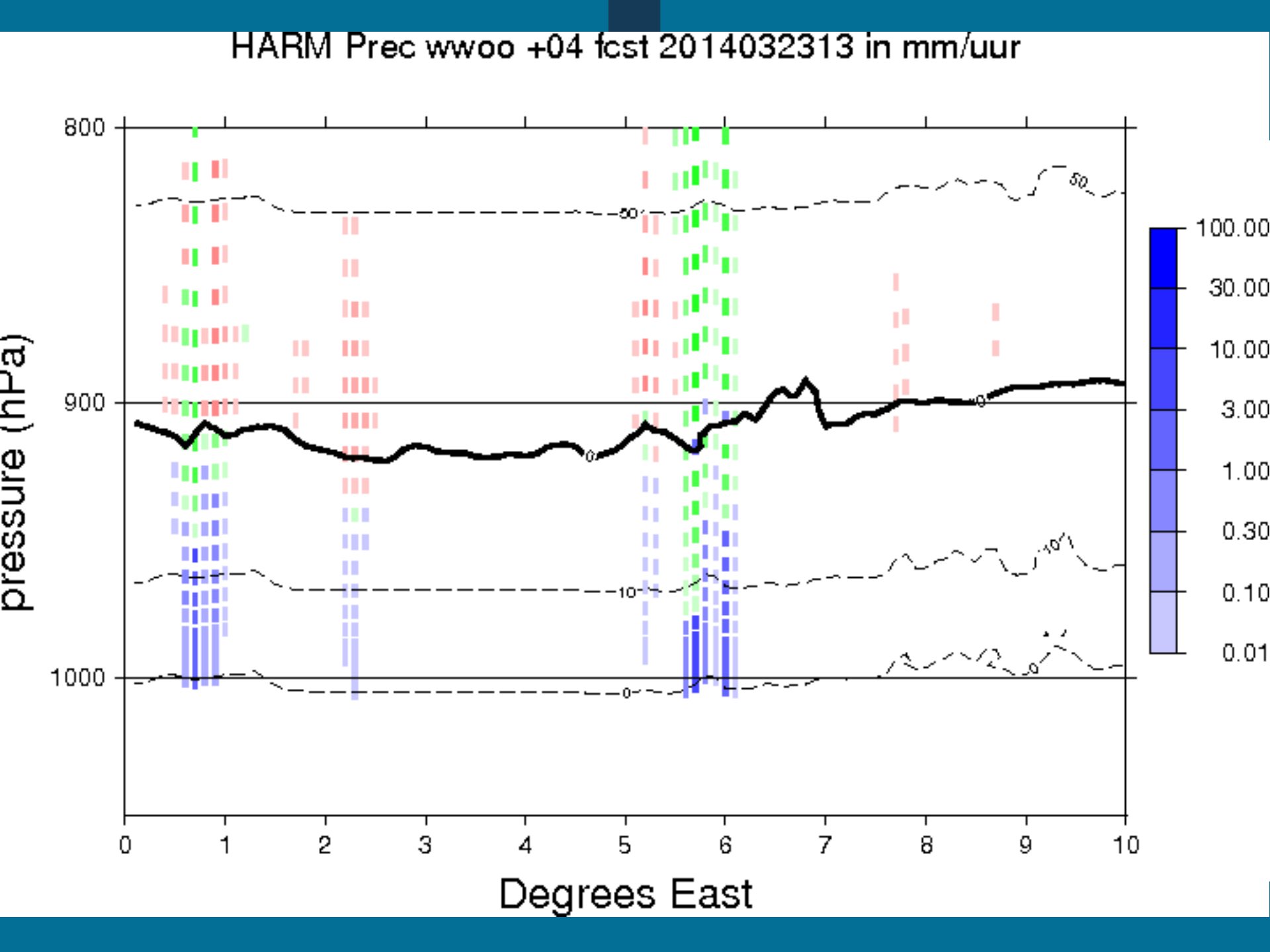
- Microphysics
- Fog and low clouds
- Wind gusts
- Some more wind gusts
- Some other stuff

Microphysics issues

- From all sorts of forecast characteristics HARMONIE-AROME seems to have wrong balance in different parts of microphysics scheme:
  - No solid precip in case of winter/spring hail storms -> example hail showers 23-03-2014
  - Too intense and local precip in case of snow showers
  - Missing mixed phase clouds
  - Too quick and numerous warm rain showers
  - No precip reaching surface with dry lower atmosphere
- Tuning of conversion factors and thresholds may improve forecasts?


HARM_36 t+4 1-h PREC & PMSL an: 2014032309, fc: Zo 23-3 2014, 13UTC
0.1
0.3
0.5
1
3
5
10
20
40
100
1005
1005
1005

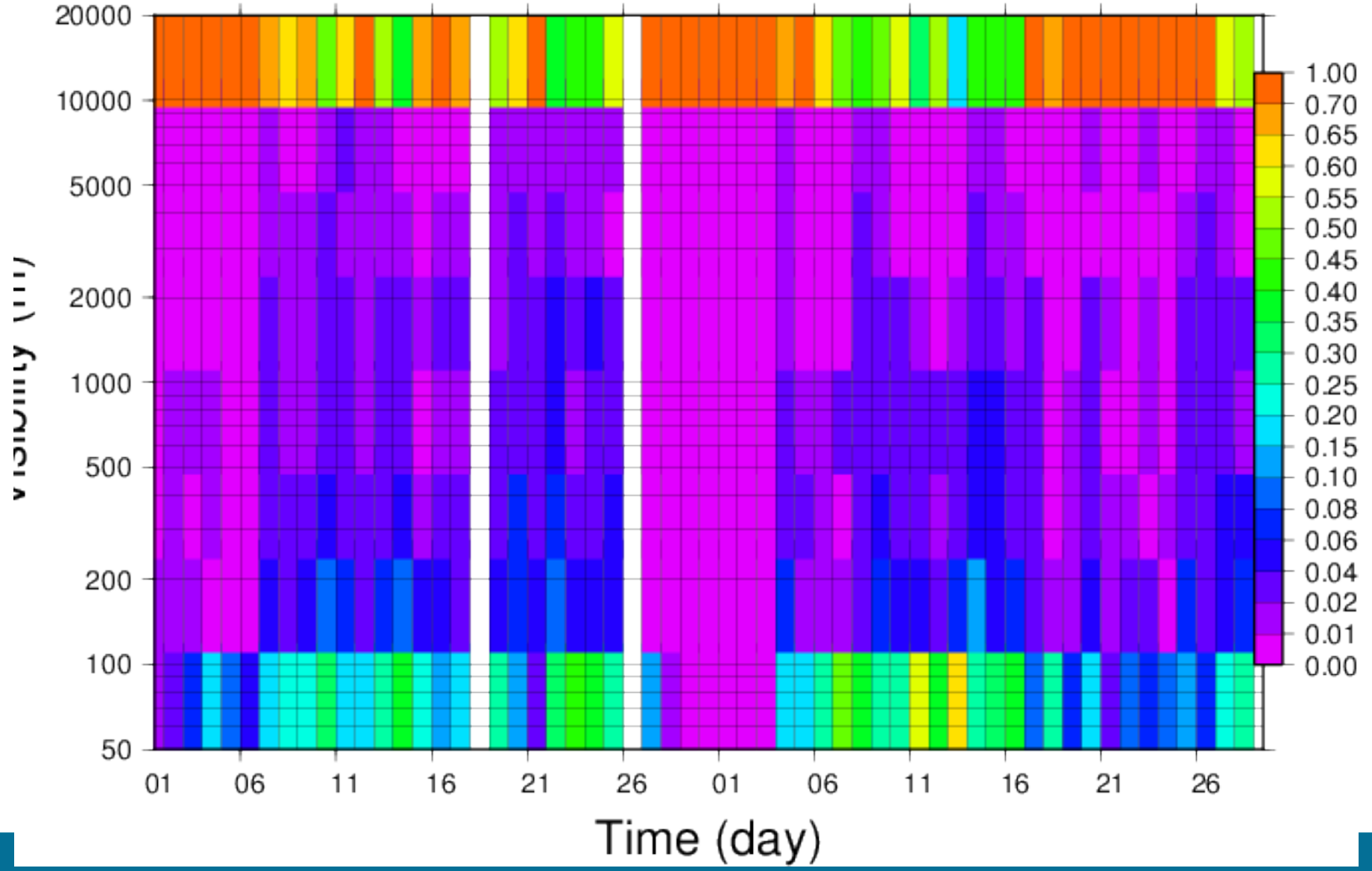

HARM_36 t+4 1-h solid fraction an: 2014032309, fc: Zo 23-3 2014, 13UTC
0.05
0.25
0.5
0.75
0.95
1.5


HARM Prec wwoo +04 fcst 2014032313 in mm/uur
800
900
1000
pressure (hPa)
0
1
2
3
4
5
6
7
8
9
10
Degrees East
50
50
0
10
10
0
0
100.00
30.00
10.00
3.00
1.00
0.30
0.10
0.01

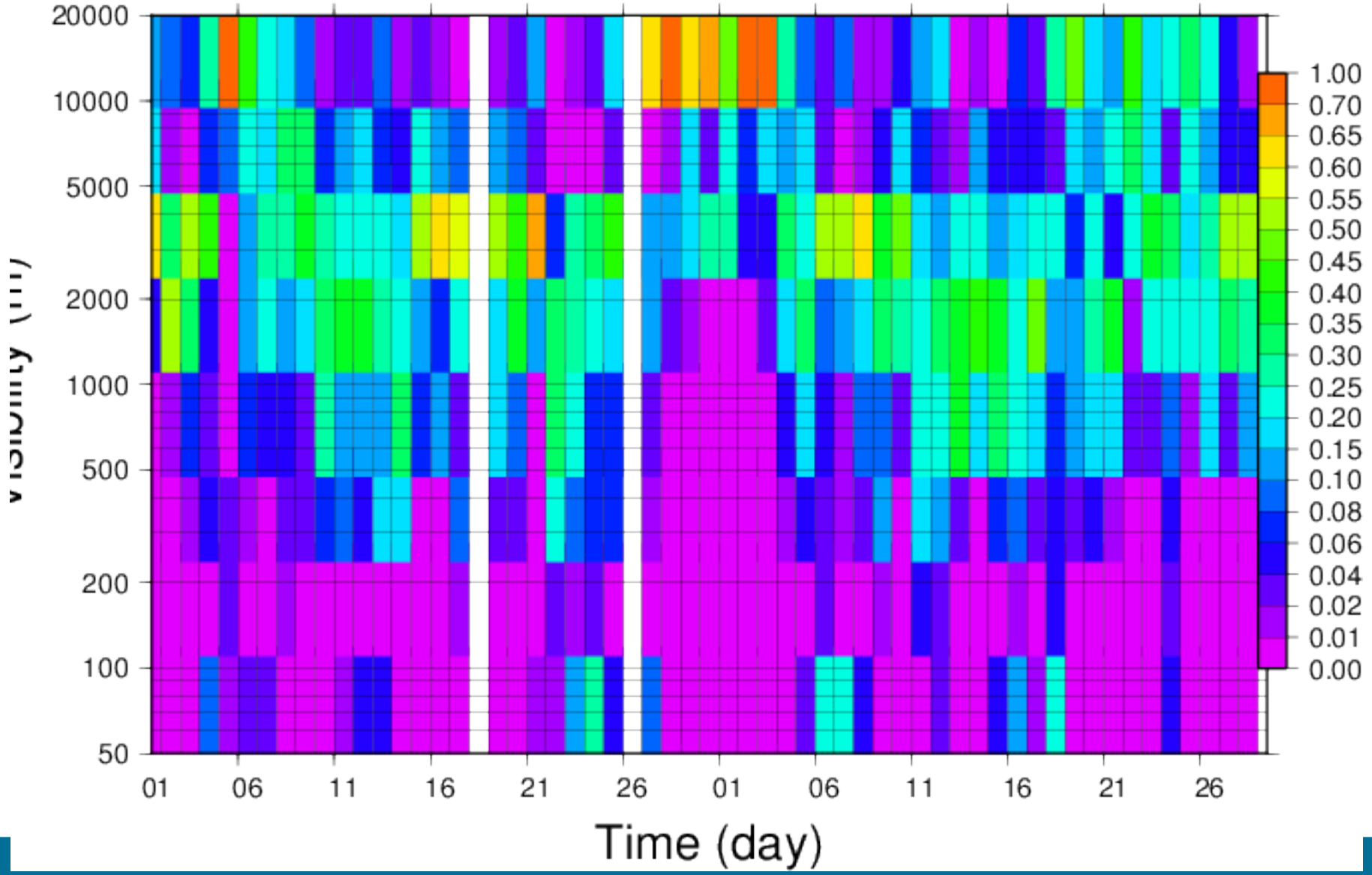
Missing clouds and overestimation fog

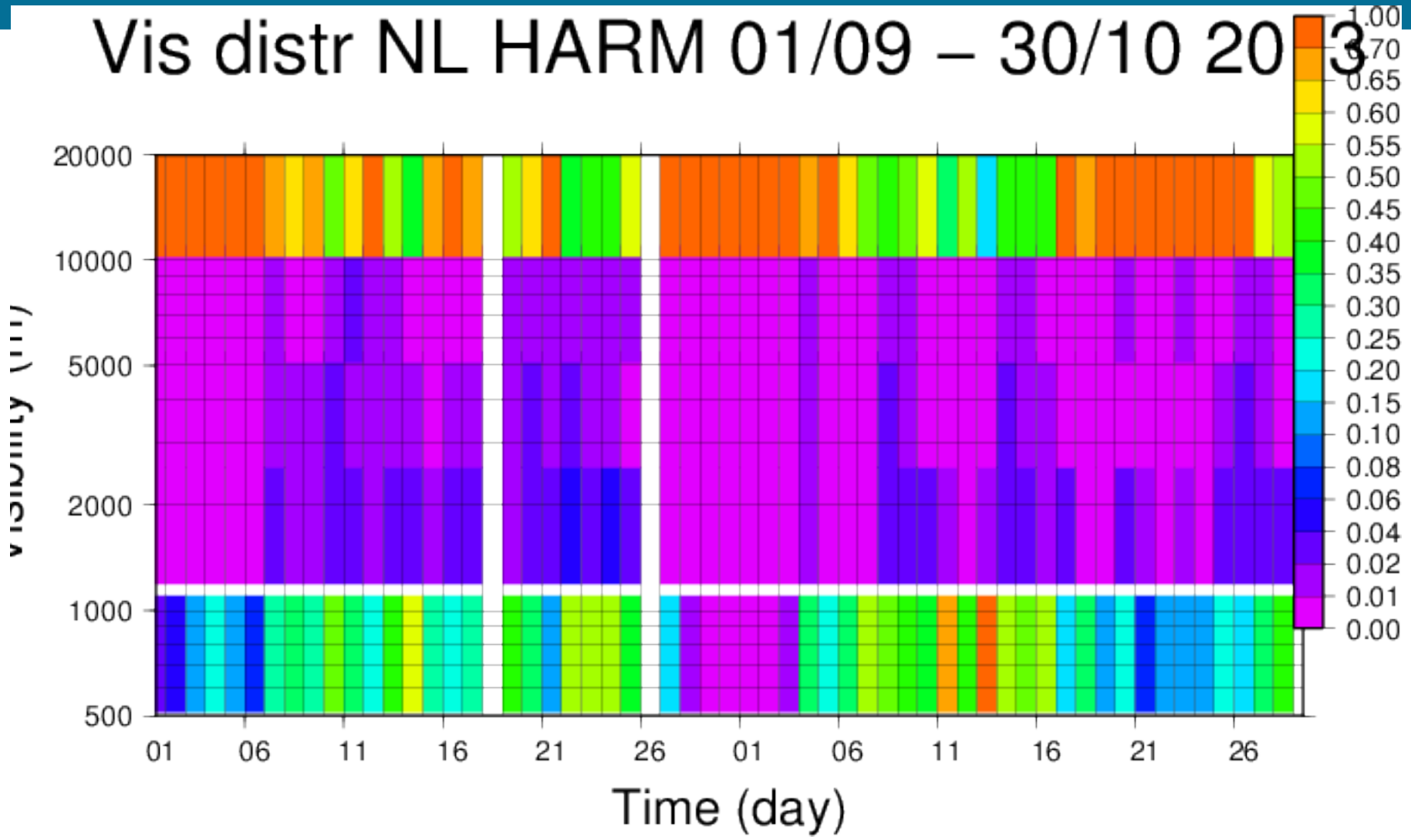
- Time series of visibility and cloud base at observation stations used to check climatology of model
- Distribution of cloud base and visibility made based on 00 UTC runs and for all observation stations during 24 hours

Vis distr NL HARM 01/09 – 30/10 2013



Vis distr NL OBS 01/09 – 30/10 2013




Vis distr NL HARM 01/09 – 30/10 20
20000
10000
5000
2000
1000
500
01
06
11
16
21
26
01
06
11
16
21
26
Time (day)
1.00
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
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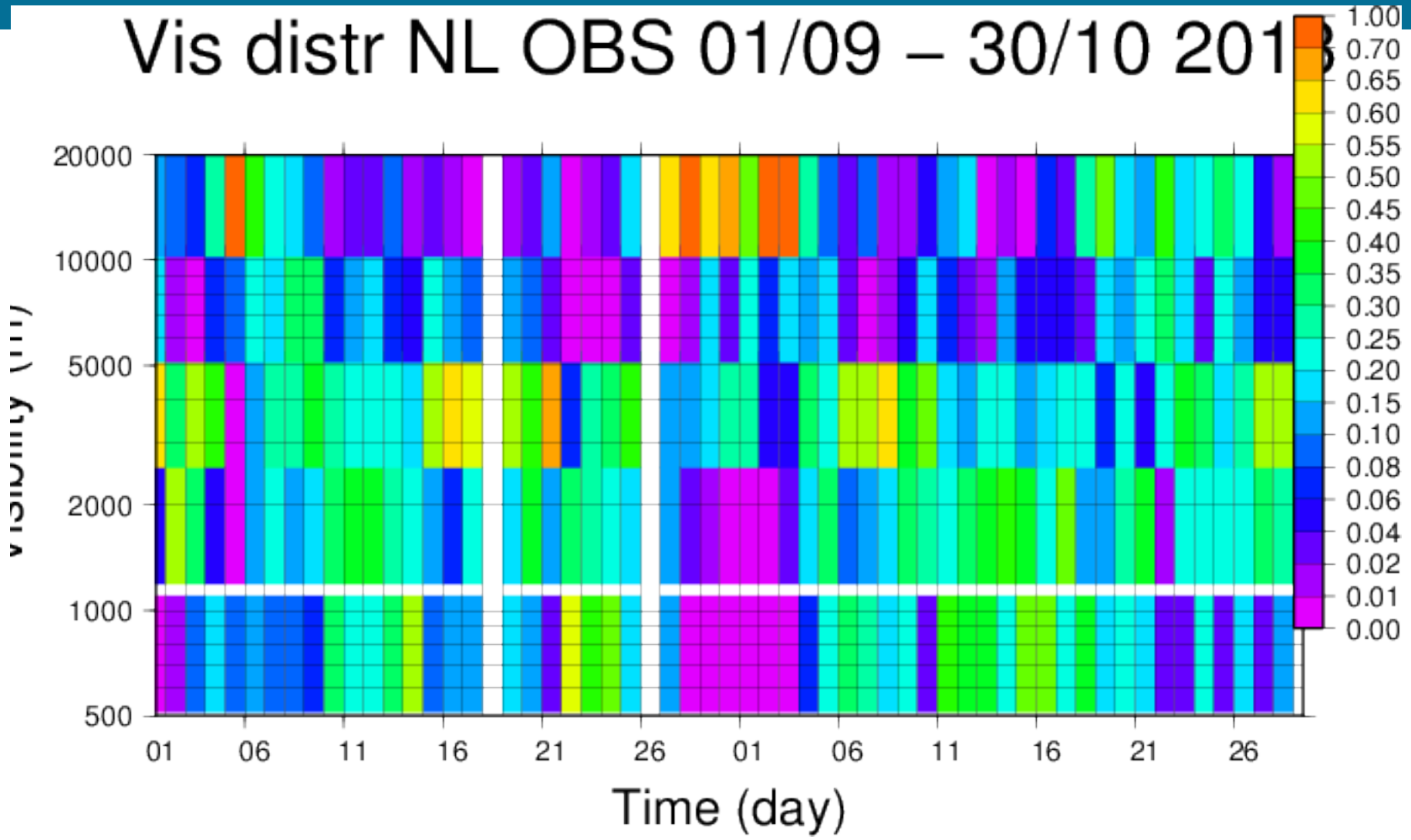
Vis distr NL OBS 01/09 – 30/10 201
20000
10000
5000
2000
1000
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01
06
11
16
21
26
01
06
11
16
21
26
Time (day)
1.00
0.70
0.65
0.60
0.55
0.50
0.45
0.40
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0.25
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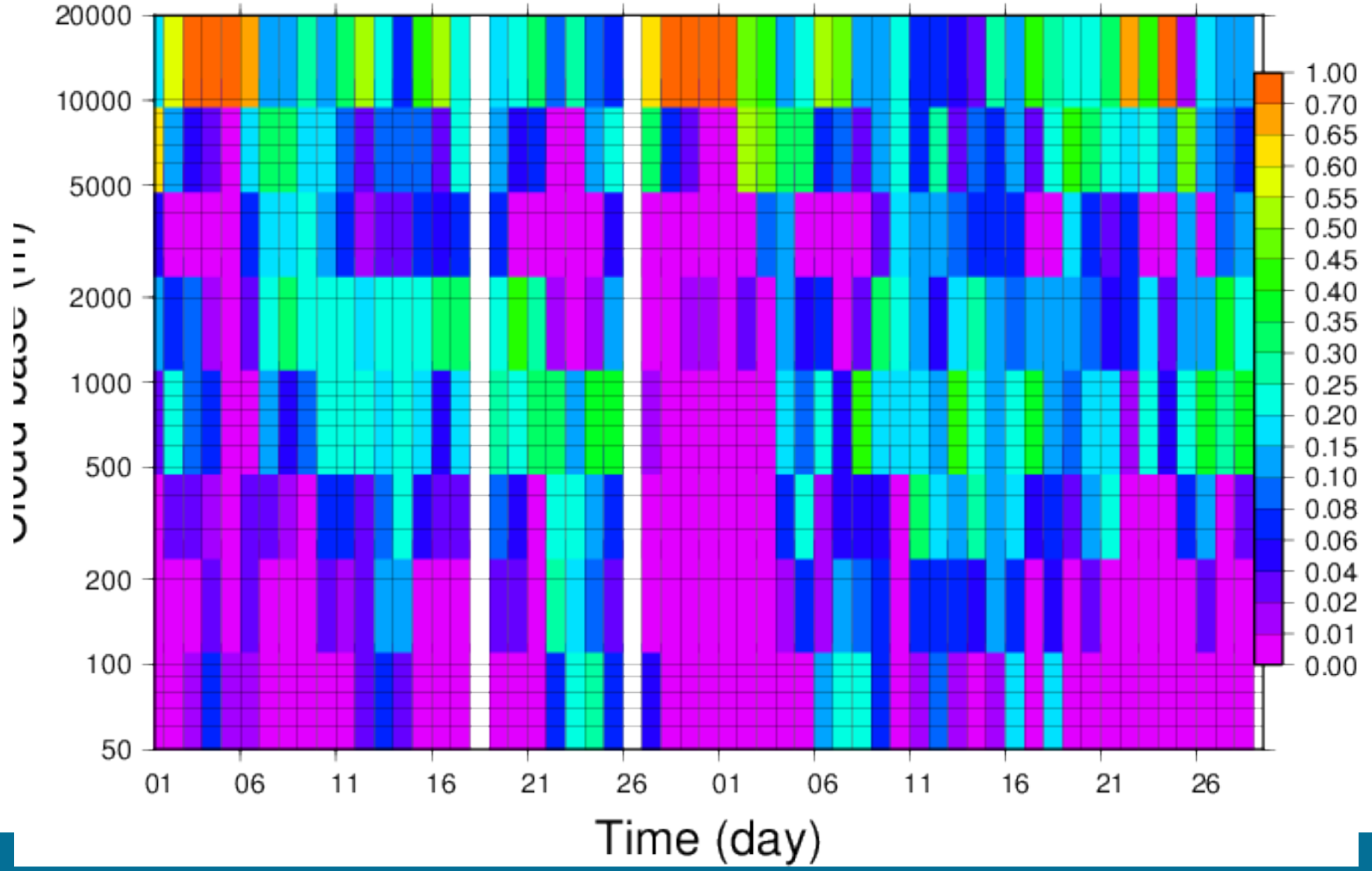
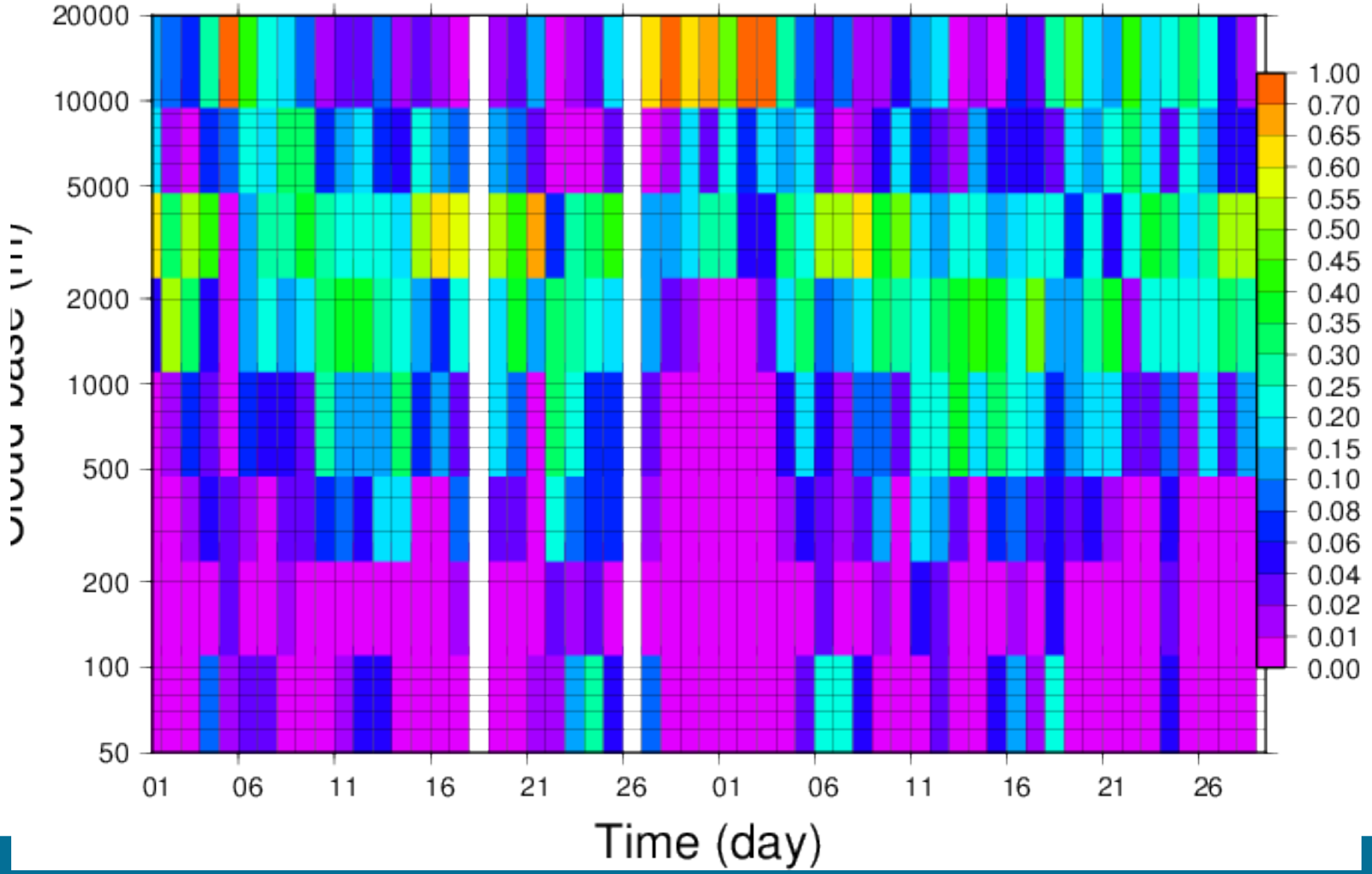
0.00

CLB distr NL HARM 01/09 – 30/10 2013



CLB distr NL OBS 01/09 – 30/10 2013



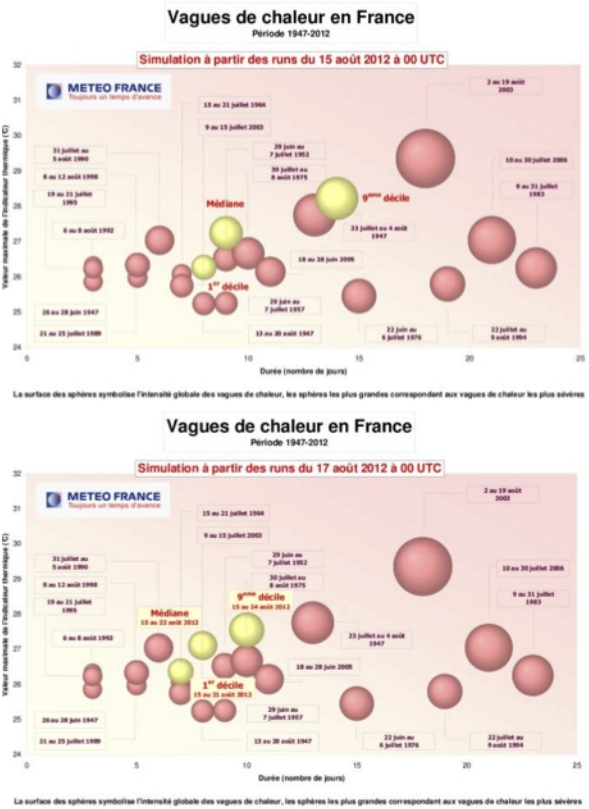
Missing clouds and overestimation fog

- Time series of visibility and cloud base at observation stations used to check climatology of model
- Distribution of cloud base and visibility made based on 00 UTC runs and for all observation stations during 24 hours
- Too many cases with low clouds base and fog, cloud base at 2000-5000 metres seem to be missing, fog too dense and haze missing from model (no aerosols).

Verification/classification wind gusts

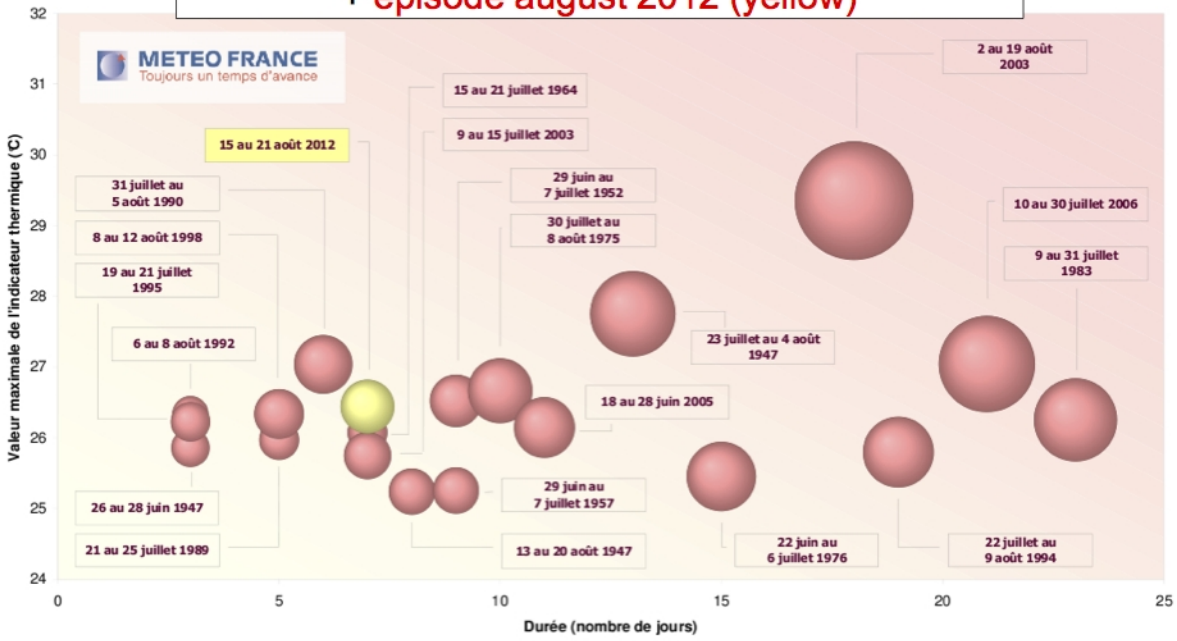
- For forecast of impact of severe storm-force winds classification of forecasts compared to historic observations necessary
- If historic impact known and forecasts unbiased, impact can be estimated -> correct warning issued
- Classify forecasted and observed maximum gusts at observation locations with:
- X=f(G>30) * avg(G)
- Also possible to verify the model forecasts
- Actual position in storm list for communication

Forecasts based on
15 and 17 august



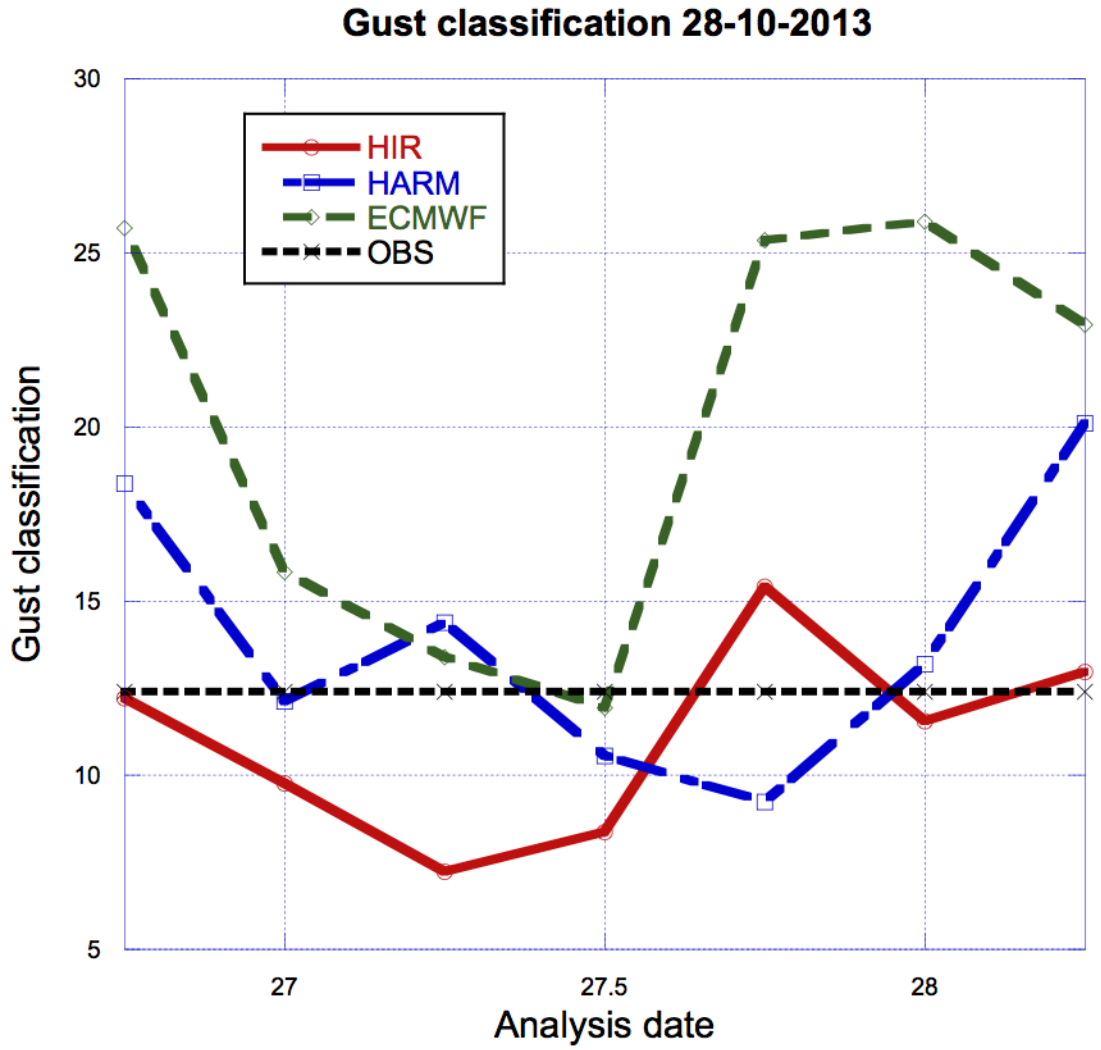
observations

heat waves over France
period 1947-2011
+ episode august 2012 (yellow)

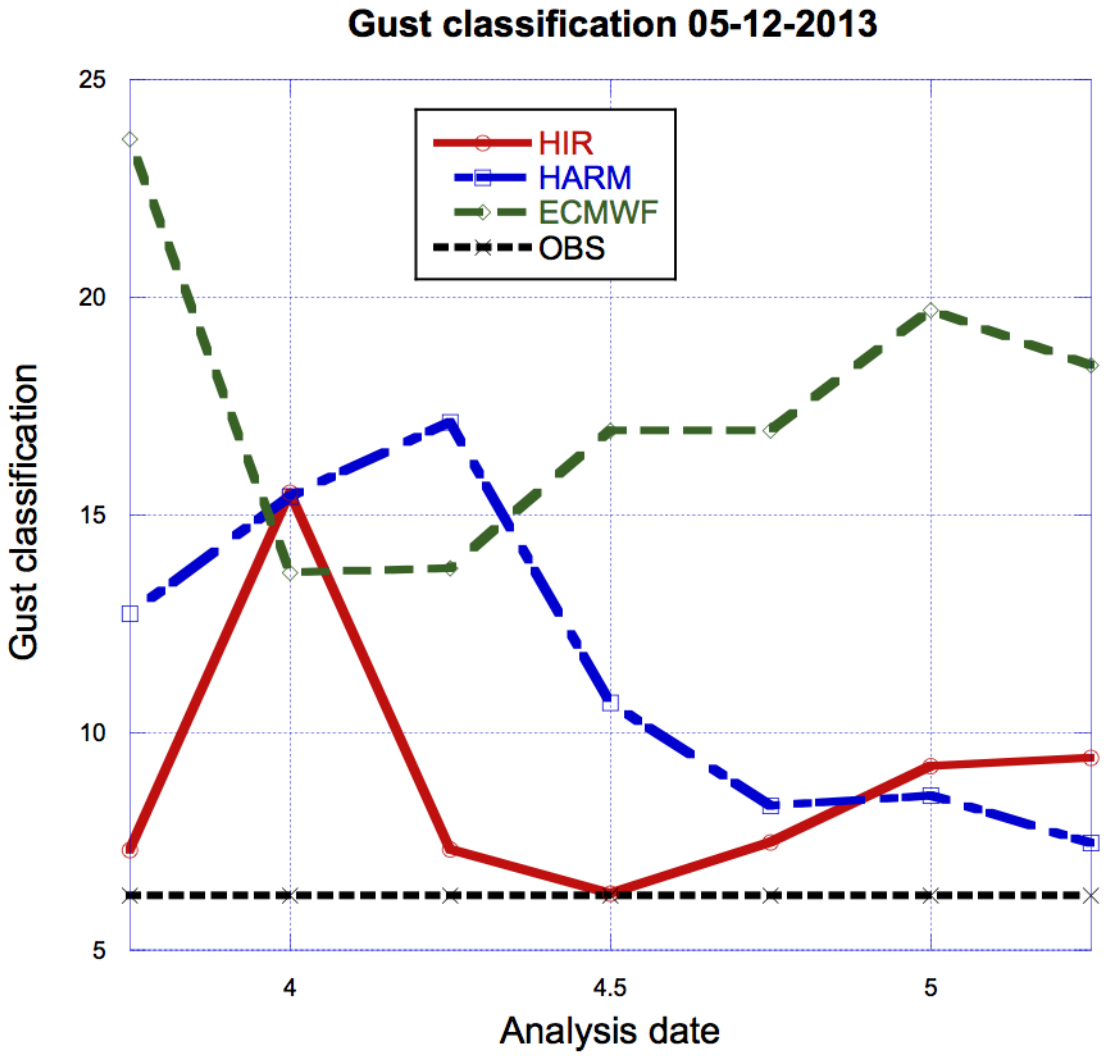


La surface des sphères symbolise l'intensité globale des vagues de chaleur, les sphères les plus grandes correspondant aux vagues de chaleur les plus sévères

METEO FRANCE



- Rank 11 since 1971
- ~100 Meuro damage
- ECMWF too extreme
- HIRLAM and HARMONIE-AROME best forecasts



- Rank 28 since 1971
- 5-10 Meuro damage
- ECMWF too extreme, early HARMONIE forecasts also
- HIRLAM (and HARMONIE-AROME) best forecasts

Storm classification

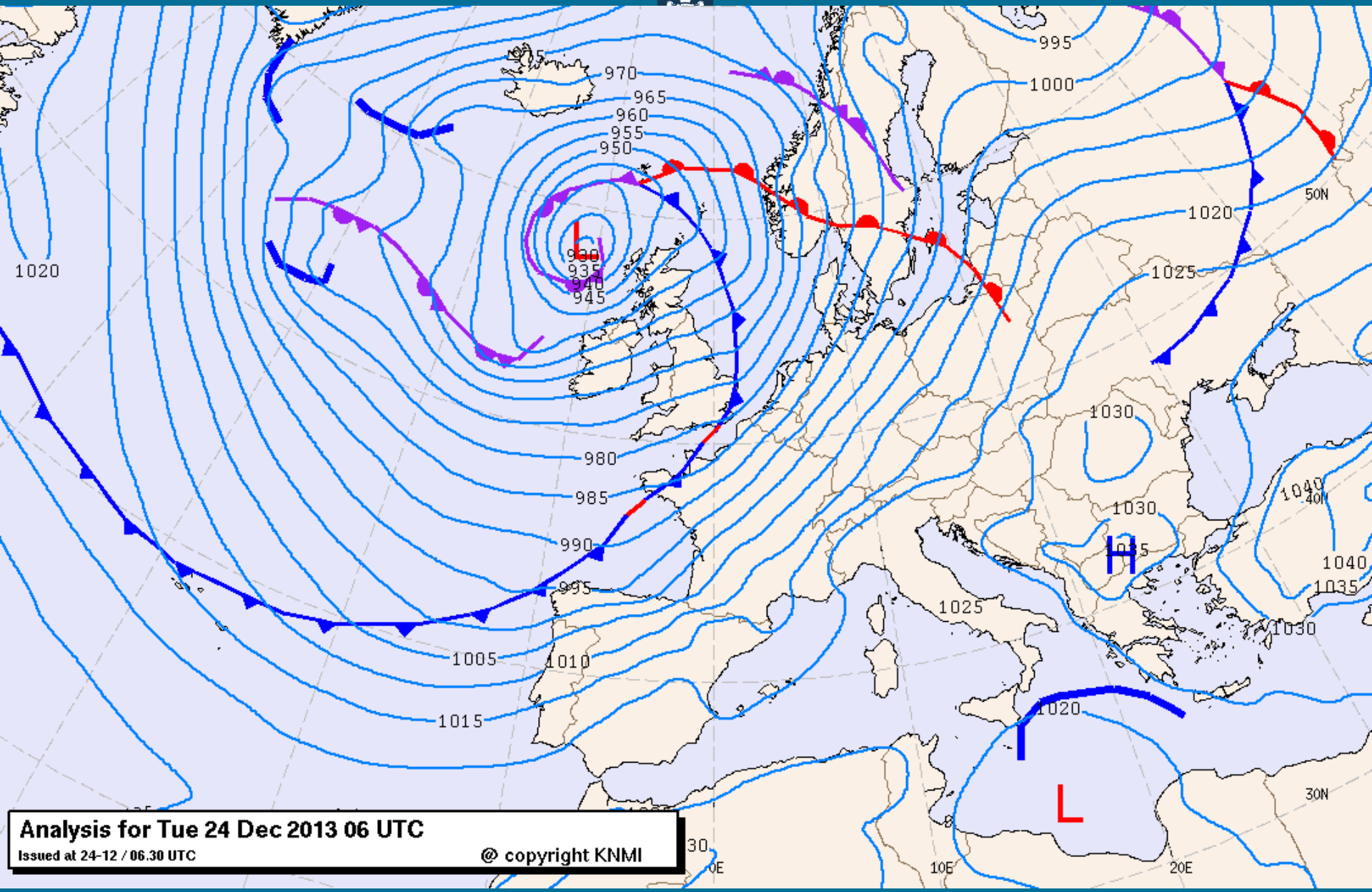
- Using hard limit of 30 m/s unsatisfactory
- Severe storms inland are not taken into account in this way
- Therefore improving storm classification with stations climatology
- X=f(G>C(2y)) * avg(G(G>C(2y))-C(2y))

GLAMEPS, gusts in subensembles

- Warnings in Netherlands issued based on wind gust forecasts
- Accurate and reliable wind gust distribution in GLAMEPS necessary
- Subensembles (HIRLAM, ALADIN or ECMWF) often have own characteristics
- Wind gusts pdf has multiple maxima, sometimes far apart and far from observed values

GLAMEPS, gusts in subensembles

- Example storm 24-12-2013
- Deep low west of Scotland, central pressure < 930 hPa
- Stormy weather in large warm sector of low
- Inland wind gusts more severe than 28-10 and 5-12
- In this example gusts > 100 km/hr


970
965
960
955
950
995
1000
1020
50N
1020
1025
930
935
940
945
980
985
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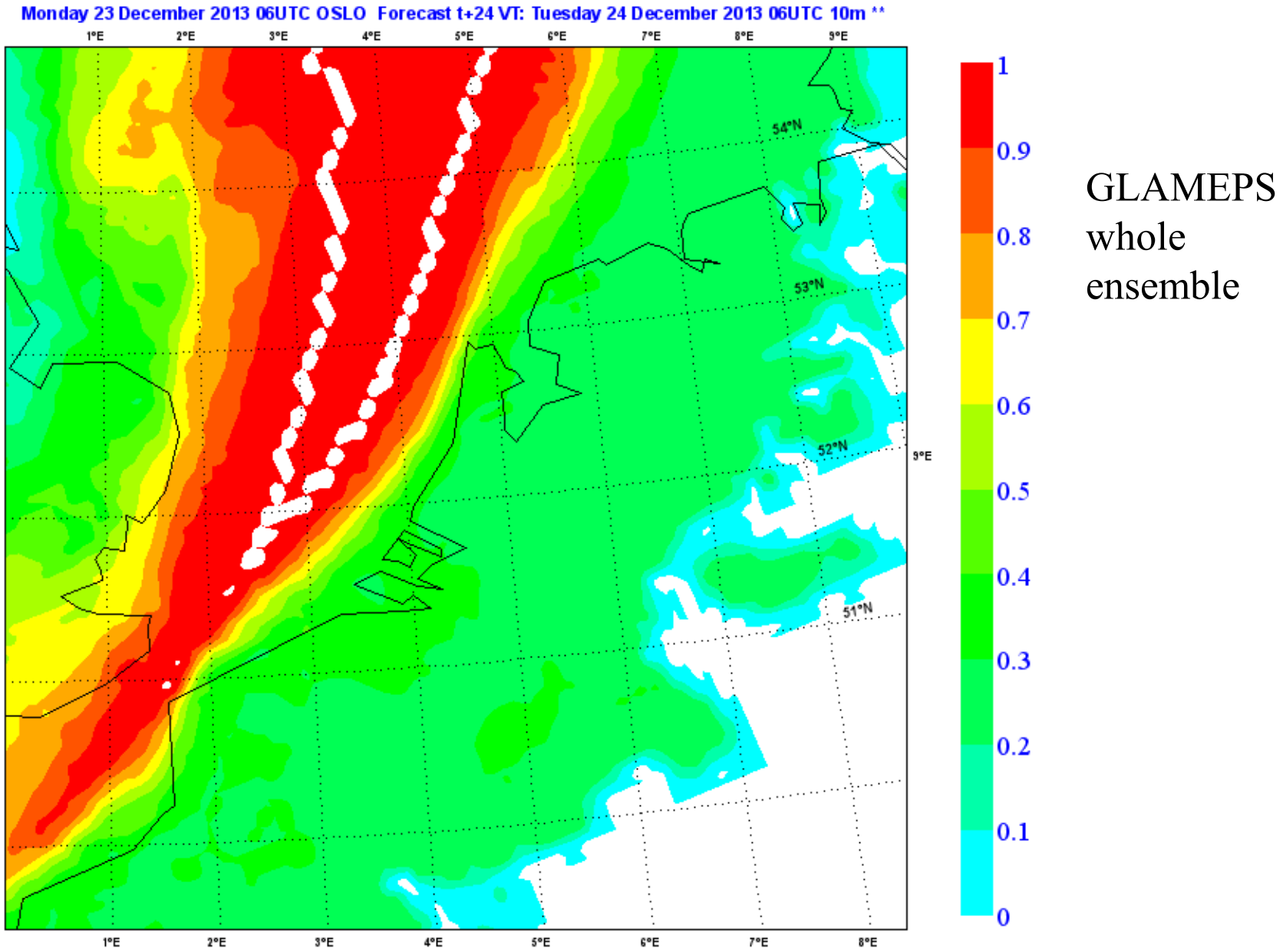
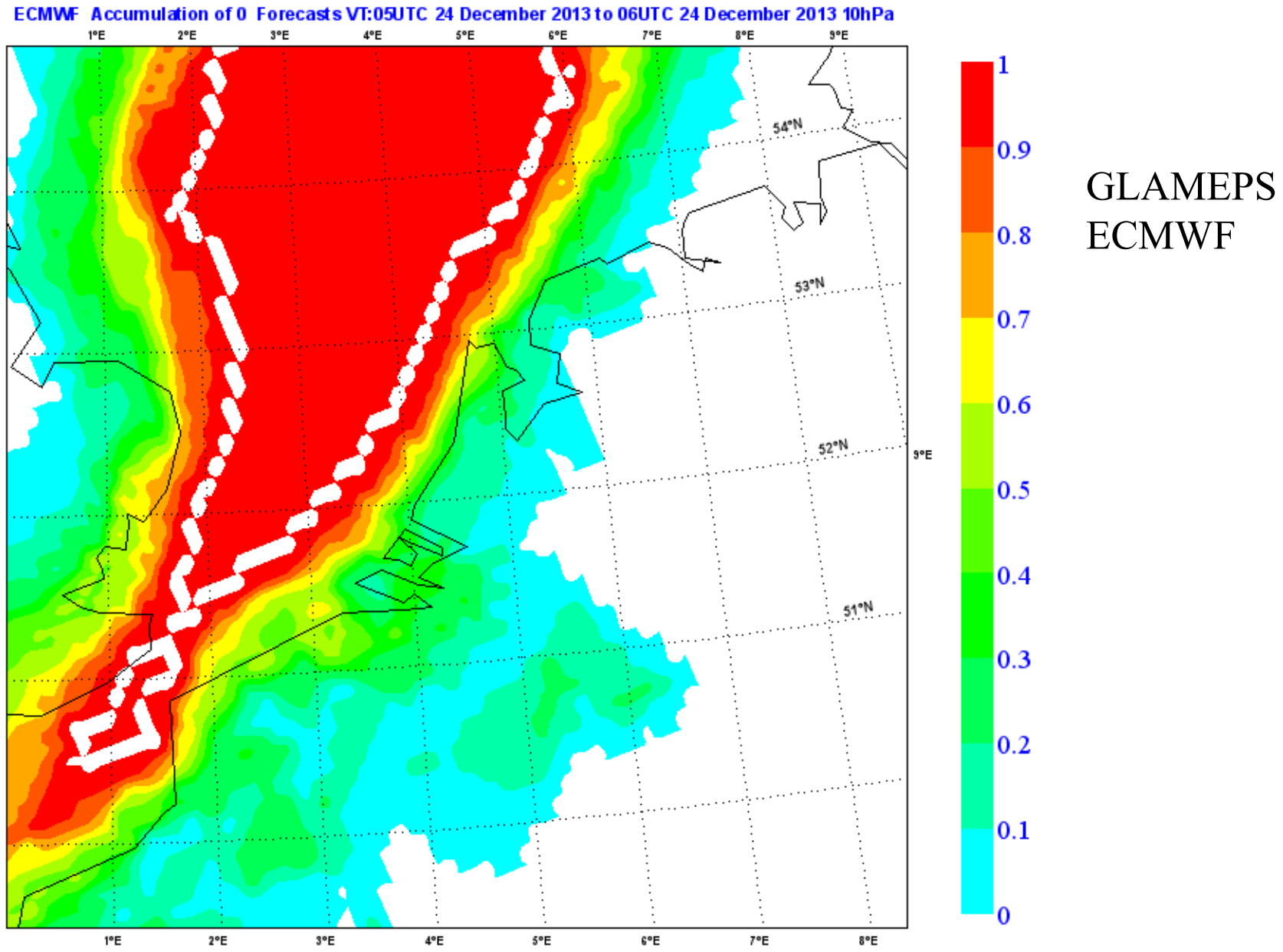
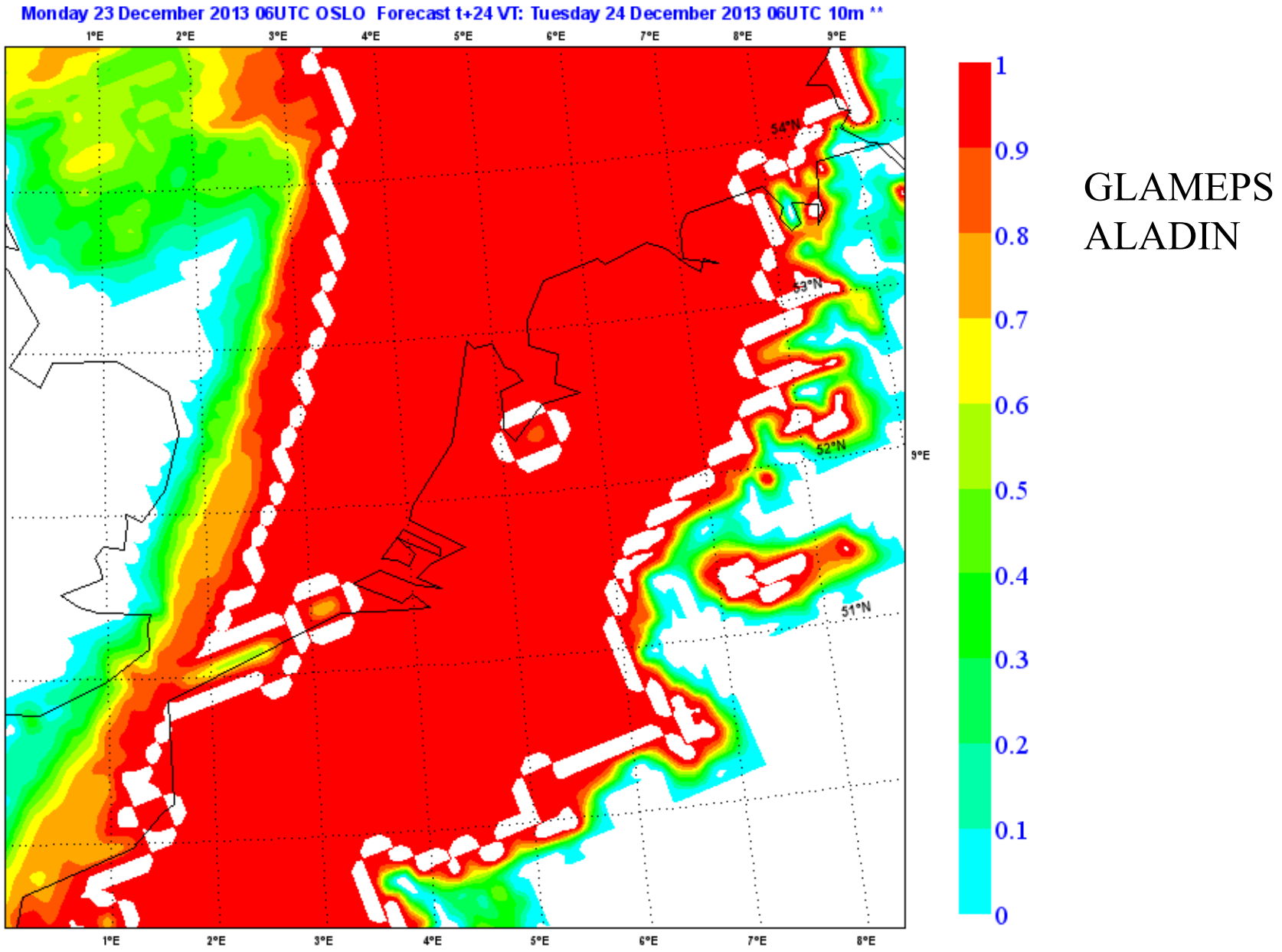
40N
1030
1035
1040
1035
1030
1025
1005
1010
1015
1020
30N
L
30
0E
10E
20E
Analysis for Tue 24 Dec 2013 06 UTC
Issued at 24-12 / 06.30 UTC
@ copyright KNMI



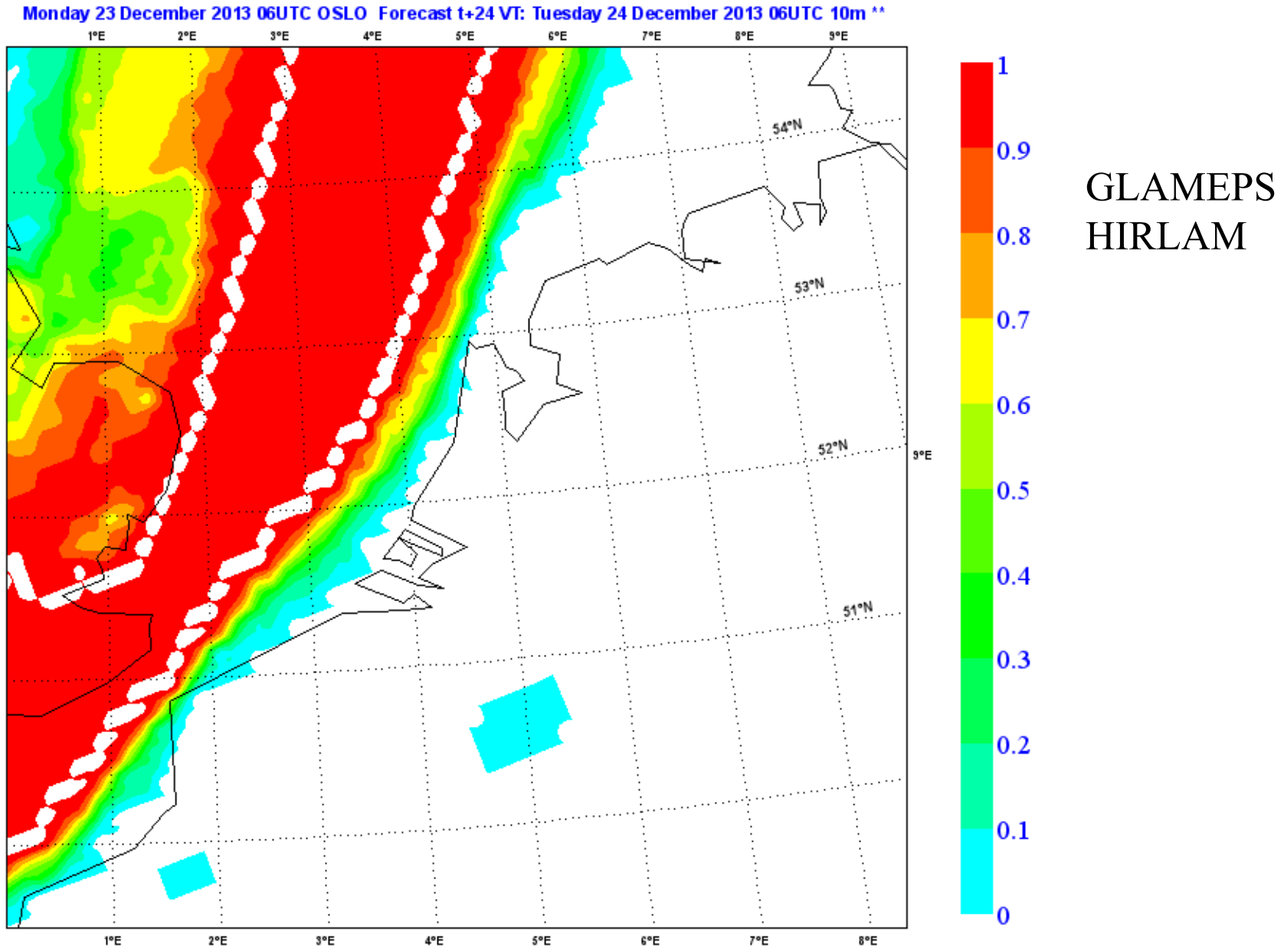
GLAMEPS whole ensemble



GLAMEPS
ECMWF



GLAMEPS
ALADIN



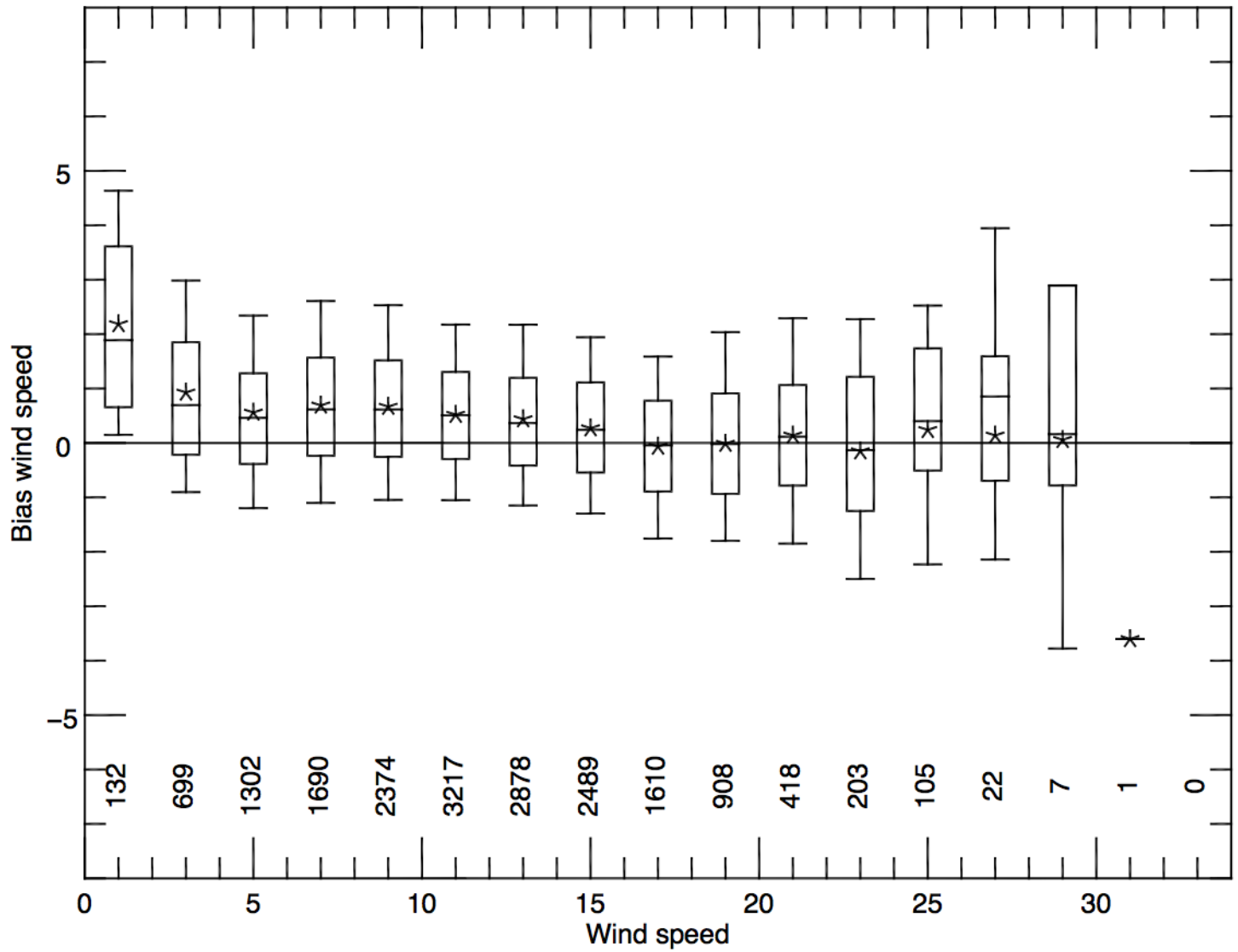
GLAMEPS
HIRLAM

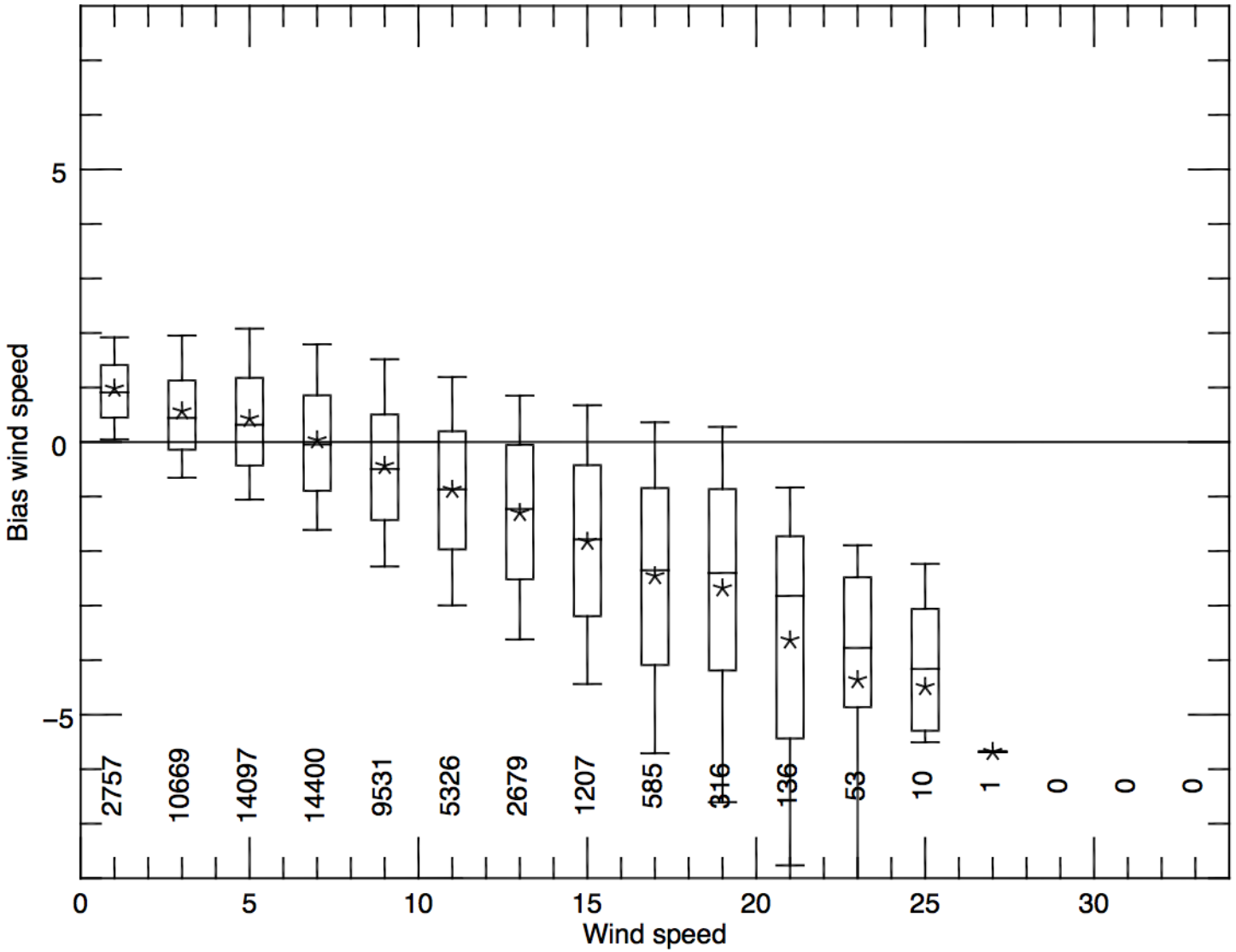
GLAMEPS summary

- Strong overestimation of wind gusts from ALADIN (warm sector, stable conditions)
- Some underestimation of wind gusts by HIRLAM
- Spread should not come from multi model aspect too much, seems to be the case in GLAMEPS
- (Wind) gusts should be calibrated -> different behaviour under different conditions!
- Similar things visible in extreme (convective) precipitation

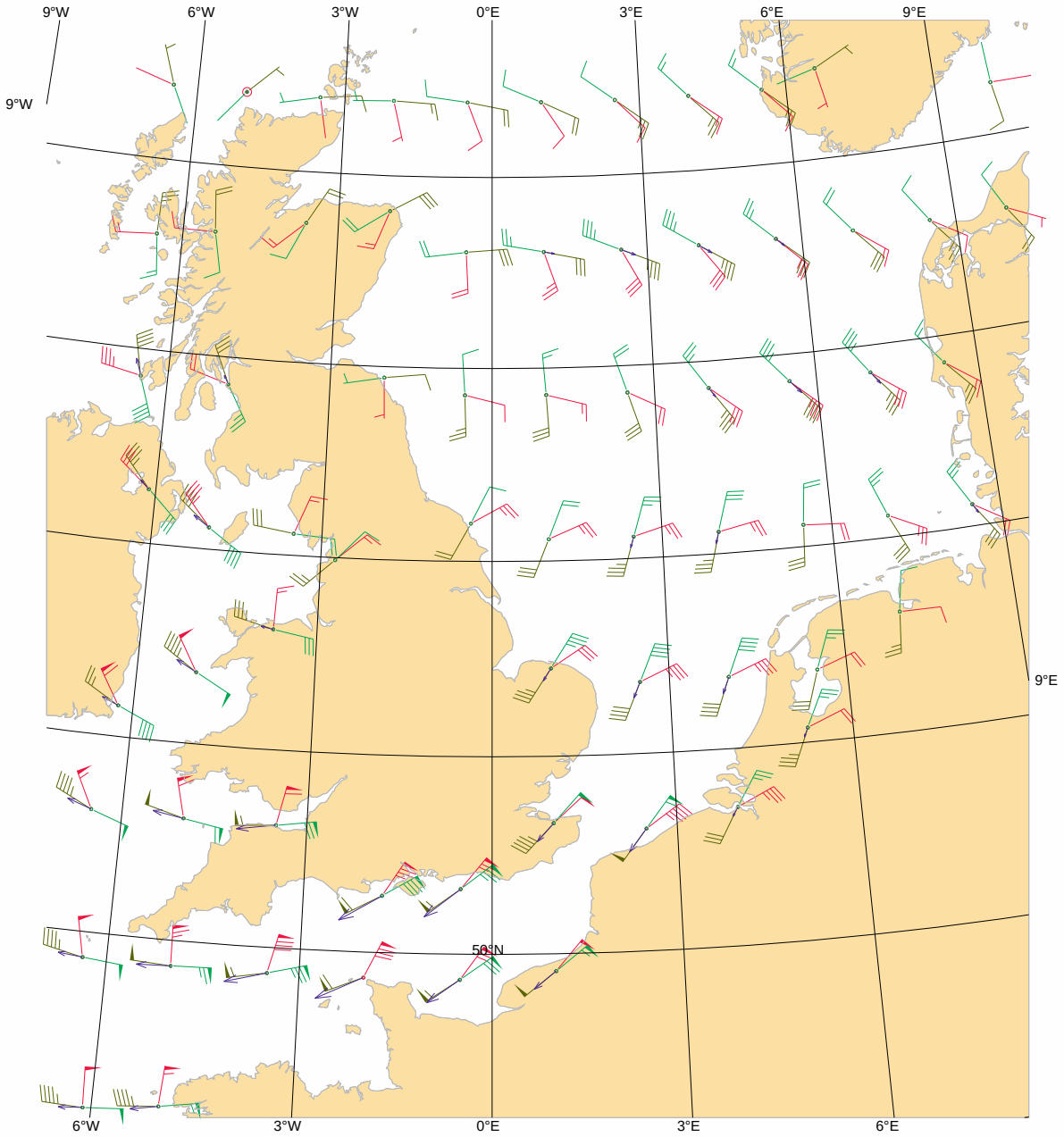
Miscellaneous

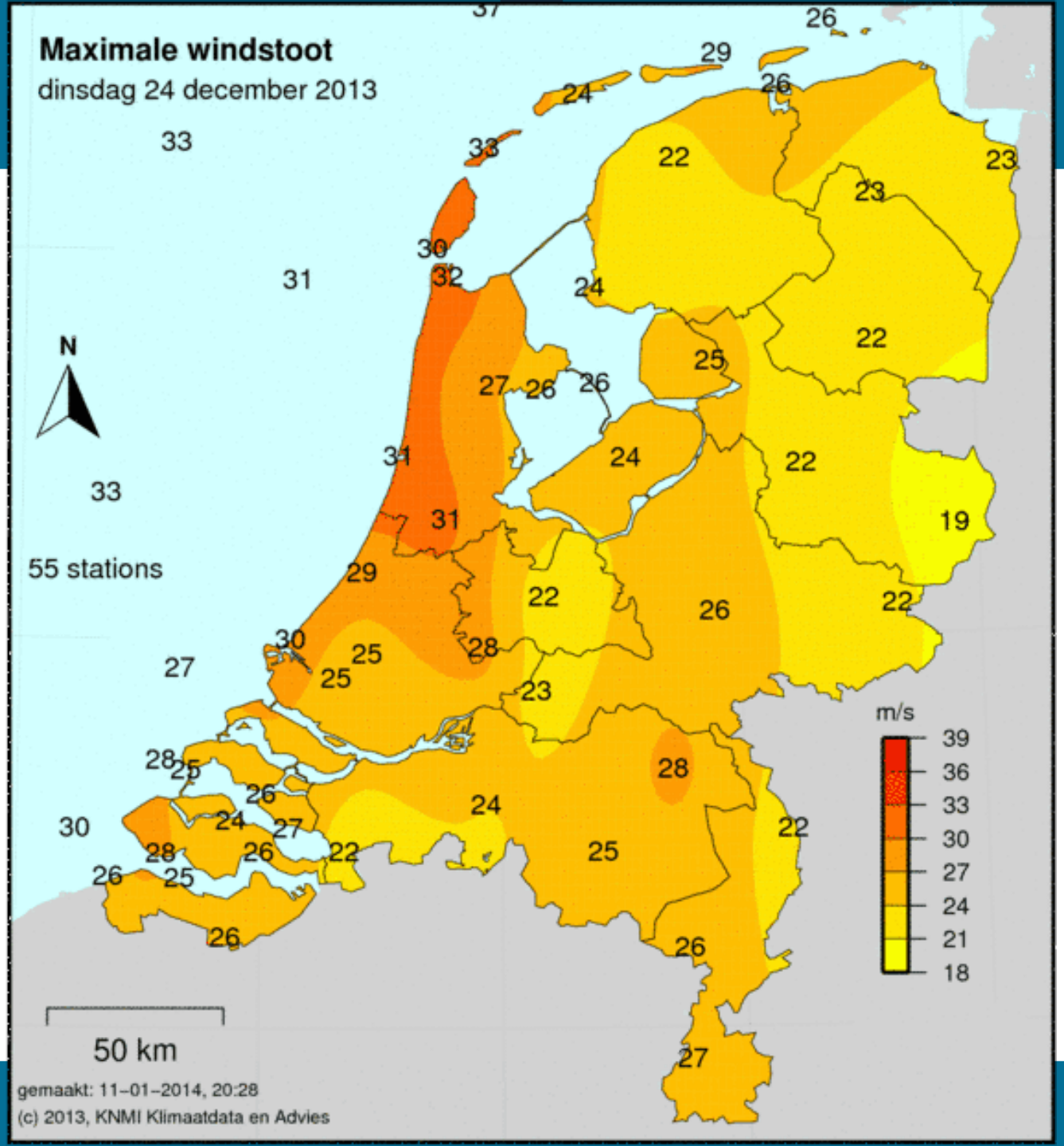
- Bias wind speed over sea OK as function of wind speed (up to 30 m/s), over land bias increasing with increasing wind speed
- Instantaneous surface drag compares well with wind in model, accumulated fluxes show large directional differences.
- Operational model aborted due to difference in time between SURFEX and Atmospheric model. Only solution so far commenting out abort. How to remove the time difference?


Bias wind speed
5
0
−5
132
699
1302
1690
2374
3217
2878
2489
1610
908
418
203
105
22
7
1
0
0
5
10
15
20
25
30
Wind speed


Bias wind speed
5
0
-5
0
5
10
15
20
25
30
Wind speed
2757
10669
14097
14400
9531
5326
2679
1207
585
316
136
53
10
1
0
0
0

Thursday 25 January 1990 12 UTC 99 t+1 VT:Thursday 25 January 1990 13 UTC surface Momentum flux, u-component/Momentum flux, v-component
Thursday 25 January 1990 12 UTC 99 t+1 VT:Thursday 25 January 1990 13 UTC 10 m 10 metre U wind component/10 metre V wind component
99 Base Time: Thursday 25 January 1990 12 UTC 10 metre U wind component/10 metre V wind component
Thursday 25 January 1990 12 UTC 99 t+1 VT:Thursday 25 January 1990 13 UTC 10 m 10 metre U wind component/10 metre V wind component




Maximale windstoot
dinsdag 24 december 2013
55 stations
N
m/s
39
36
33
30
27
24
21
18
50 km
gemaakt: 11-01-2014, 20:28
(c) 2013, KNMI Klimaatdata en Advies