Harmonie suite at KNMI and future plans

ALADIN-HIRLAM meeting
7-10 May, Marrakesh, Morocco

Jan Barkmeijer
KNMI

Thanks to many WEER colleagues

Overview

- Harmonie suite configuration
- status
- fog
- radar
- conclusion+plans

Domain: 800x800 and 60 levels

Configuratie since 12 January 2012

- 800x800x Meteo-France 60 level definition
- nesting model Hirlam (soon ECMWF)
- 8x/day 3dvar analyses at 0,3,6,9,12,15,18, and 21 UTC (window is -1.5h/+1h)
- 8x/day T+24u forecast
- hourly post-processing (300x300 at 2,5km and 800x800 at 5km)
- monitoring:

  + DMI site: https://hirlam.org/portal/oprint/WebgraF/ObsVer/HAAA/index.html?choice_ind=Surface
  + KNMI tools: observation usage, o-b/o-a statistics, selected 2D-plots, time series.

Observation Data

- Conventional data: temp, synops, ships, aireps
- ModeS
  - experimental since 18 April 2012, time window=[-10min,10min]
- GPS and RADAR (radial wind and reflectivity)
  - technically working and planned in near future (VarQC)
- MSG cloud cover: in progress
- ASCAT: in progress

Other settings

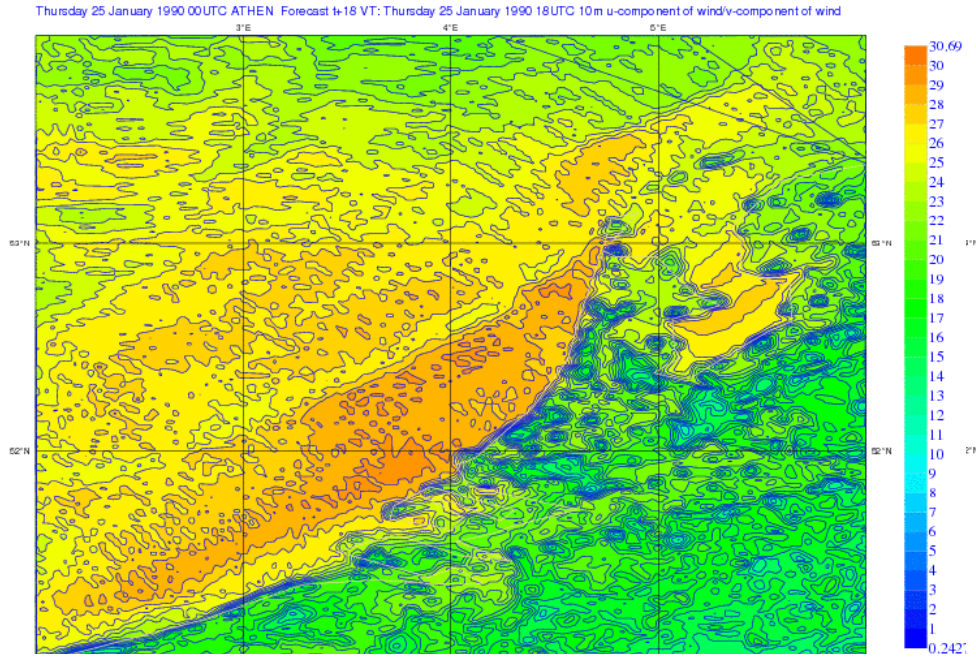
- standard Harmonie set-up, e.g.,

  - EDMFM=true
  - REDNMC=0.9

- ECUME is switched off.

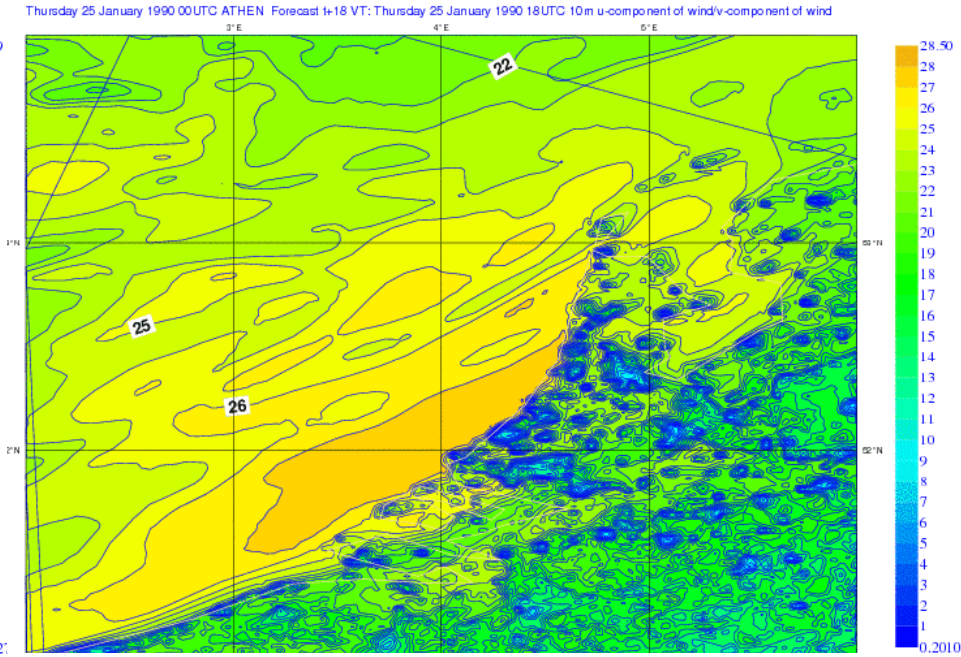
  - Instabilities at sea were observed during episodes of high windspeeds.

ECUME active

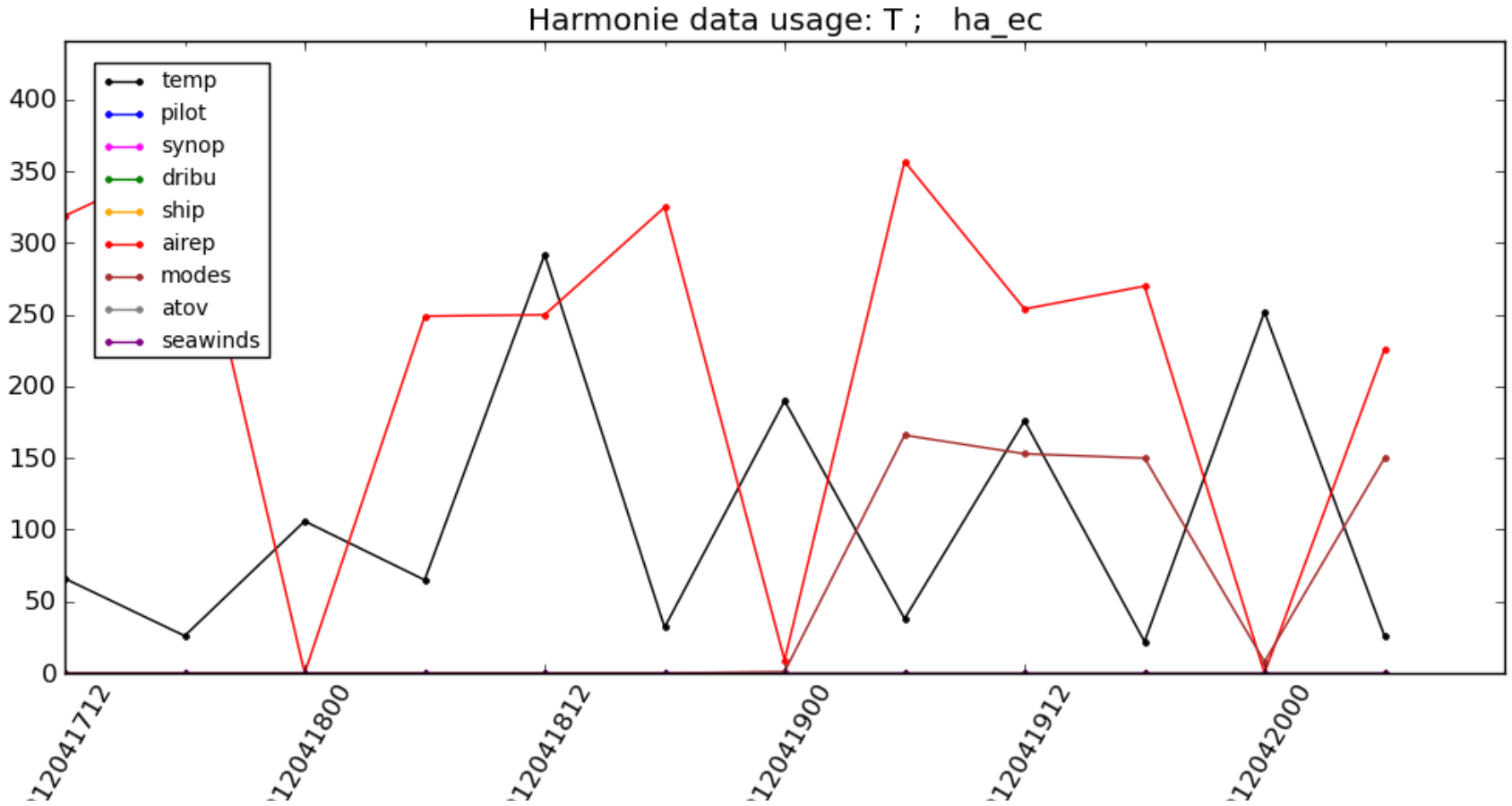


ECUME switched off

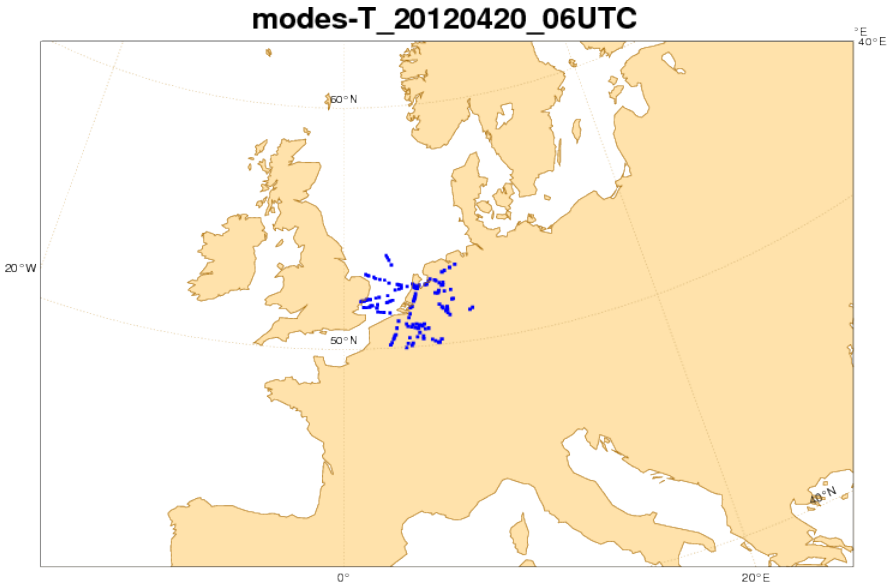
(LSEA_SBL=.false.)

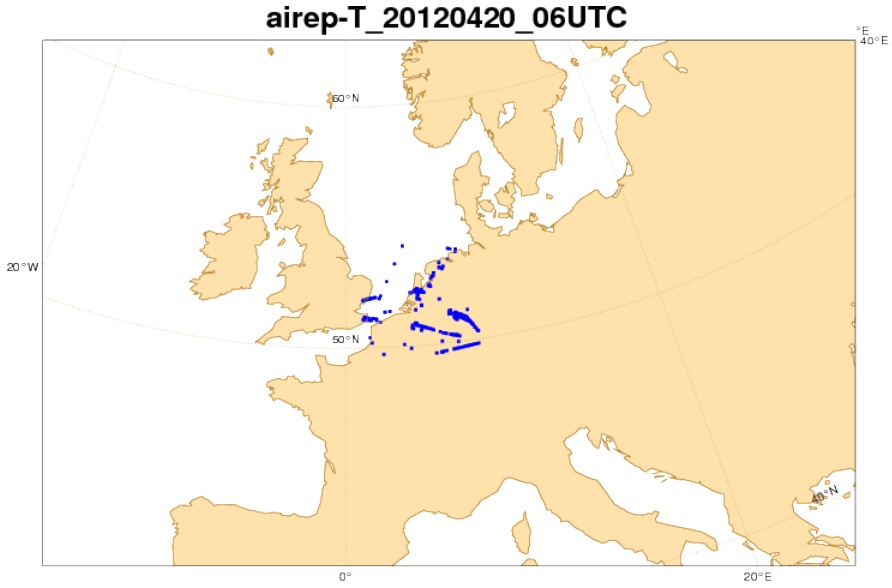


Data usage: ModeS from 2012041906

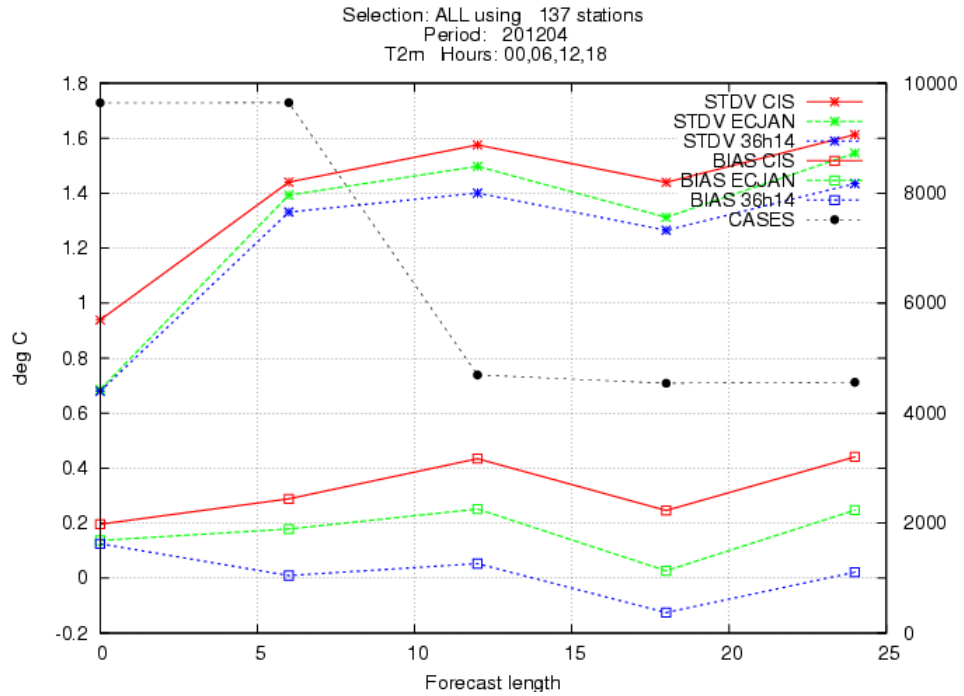


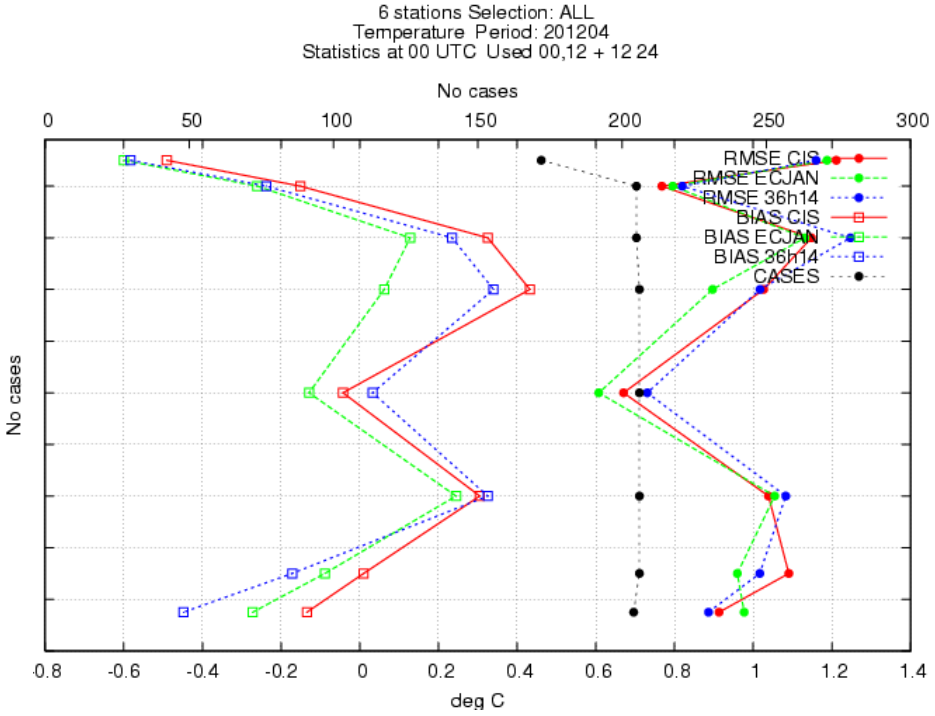
Coverage of ModeS and airep





Verification

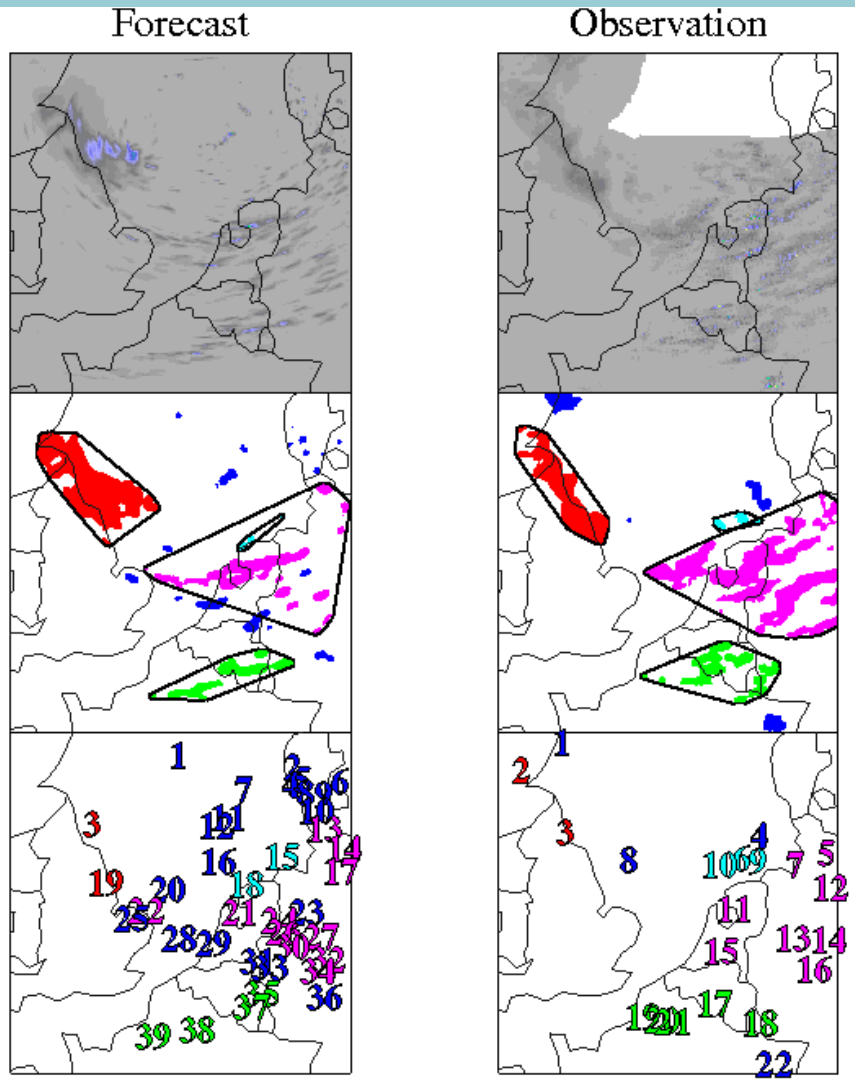




Thanks to Xiaohua Yang

METool

- standard verification
- feature tracking



Fcst	Obs	Interest
3	3	0.9745
37	17	0.9702
21	11	0.9524
37	18	0.9216
14	5	0.9060
34	16	0.8896
35	17	0.8840
30	13	0.8801
24	11	0.8705
17	5	0.8528
26	13	0.7866
27	13	0.7686
27	14	0.7573
39	19	0.7312
18	6	0.7087
39	20	0.7011
17	12	0.6999
18	10	0.6939
15	9	0.6782
32	14	0.6635
32	16	0.6433
13	5	0.6324
36	16	0.6308
23	13	0.6116
35	18	0.6031
27	16	0.6025
18	9	0.5935
38	20	0.5926
18	11	0.5845

Fog in Harmonie

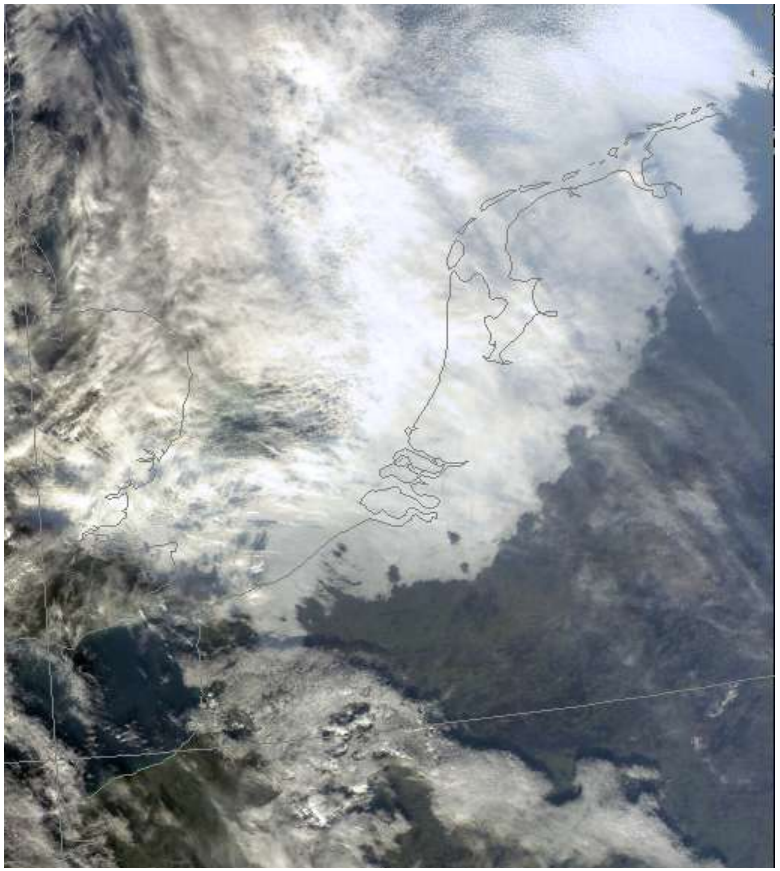
- Representation of fog in Harmonie runs does not always match reality (but, also excellent cases!). Too many low level clouds.

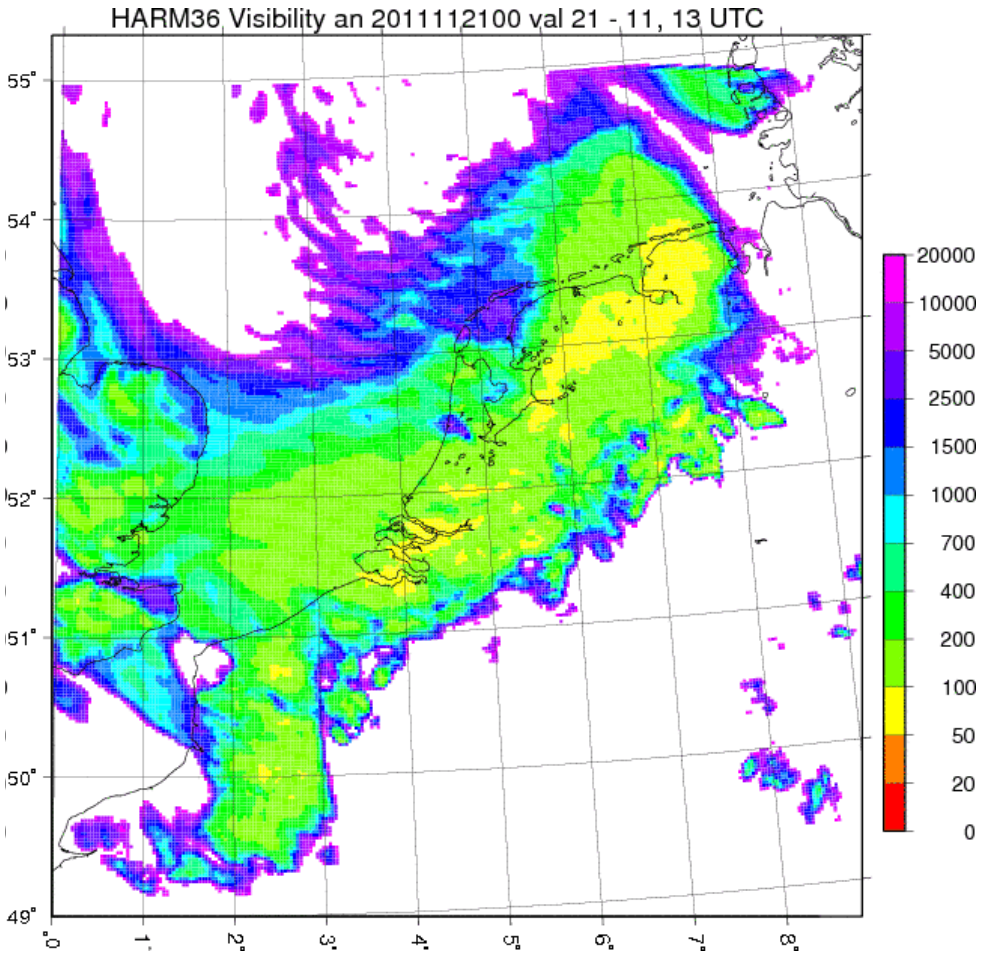
- two approaches are considered to tackle this

  - modify mixing length scale (e.g., x2 and x10) in the turbulence scheme, in order to increase (top) entrainment

  - use MSG cloud information to alter the model IC (q and t profile) (very recently implemented in Harmonie)

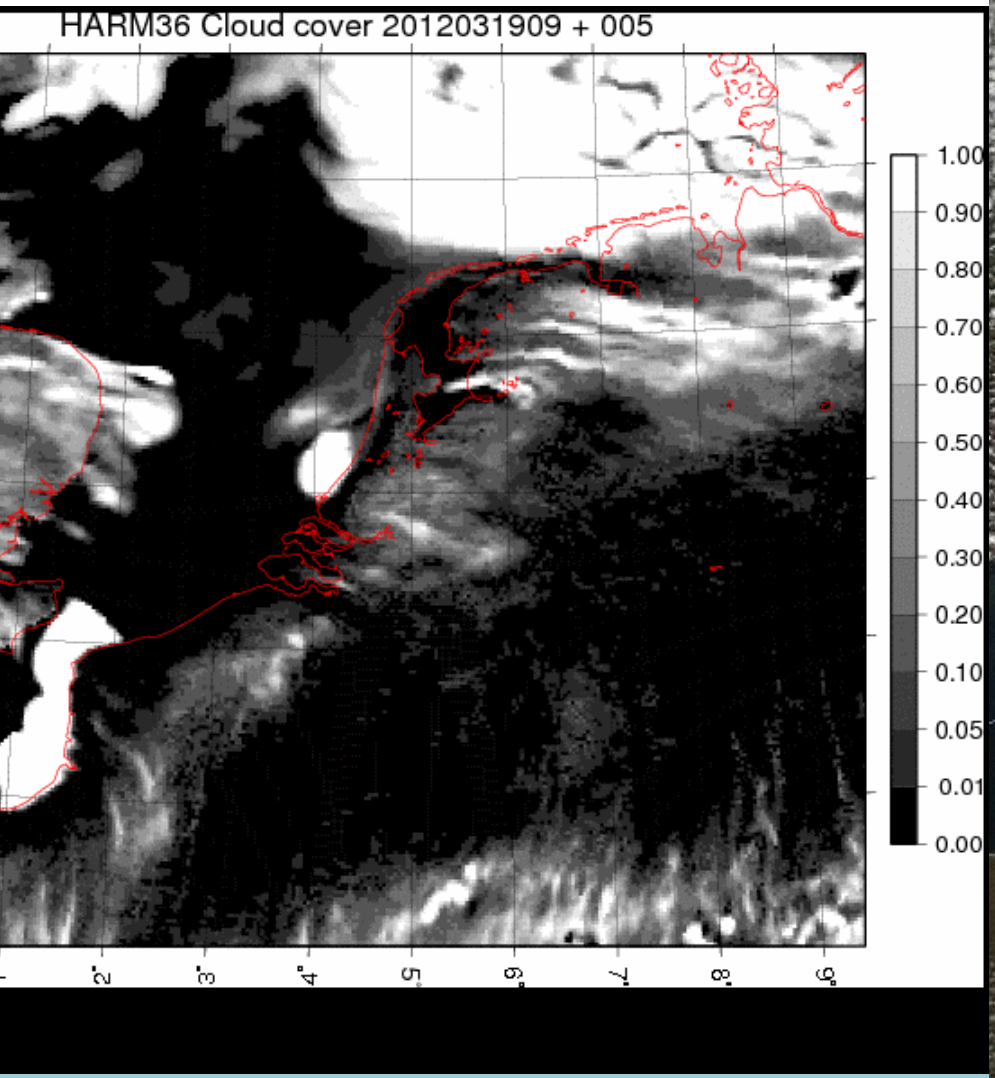
November 21, 2011, 13:21UTC

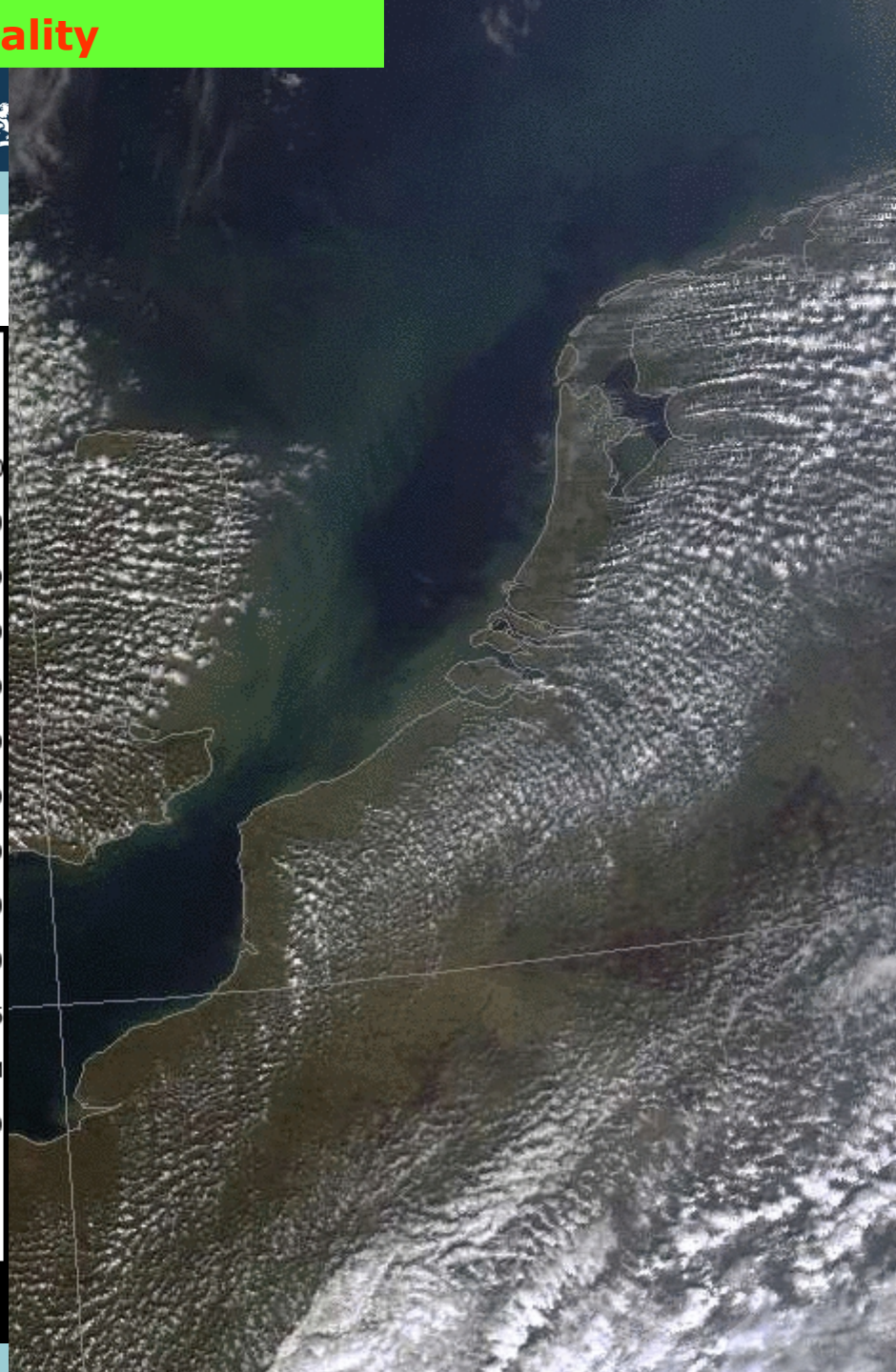




but not in reality

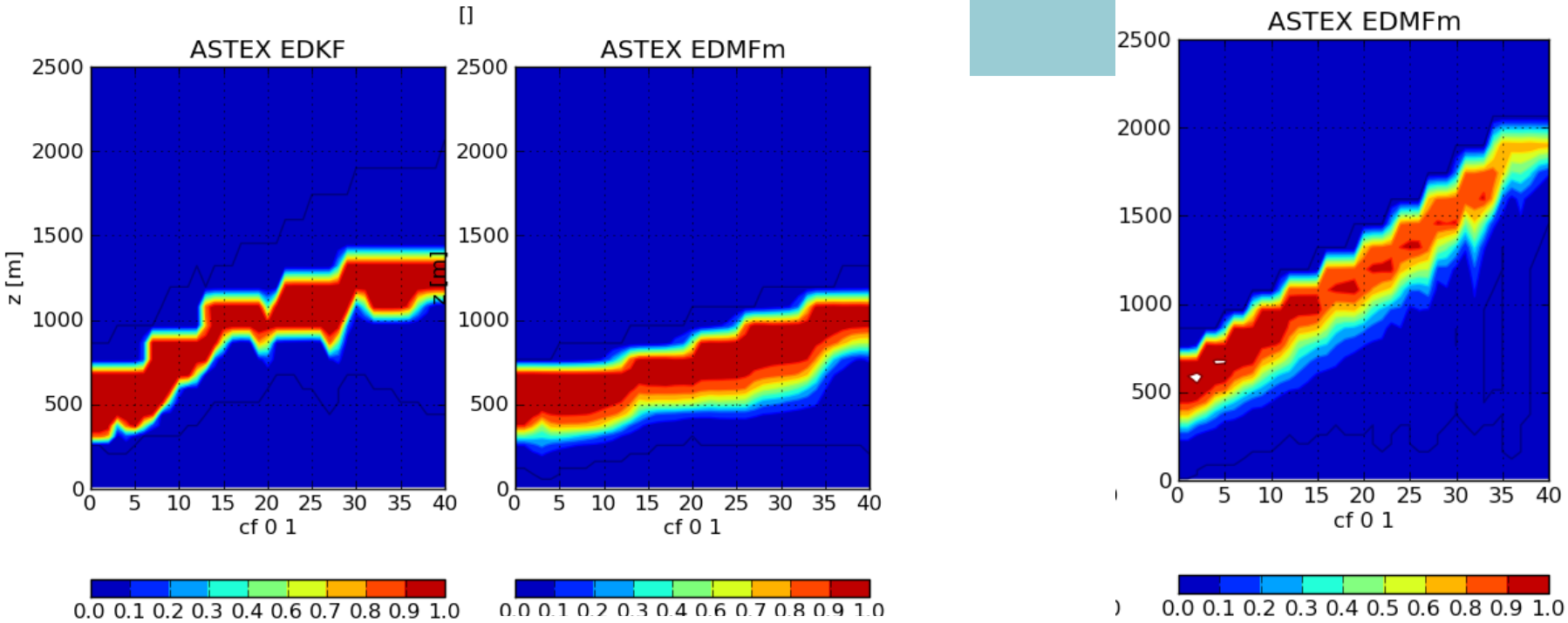
Persistent fog over North Sea



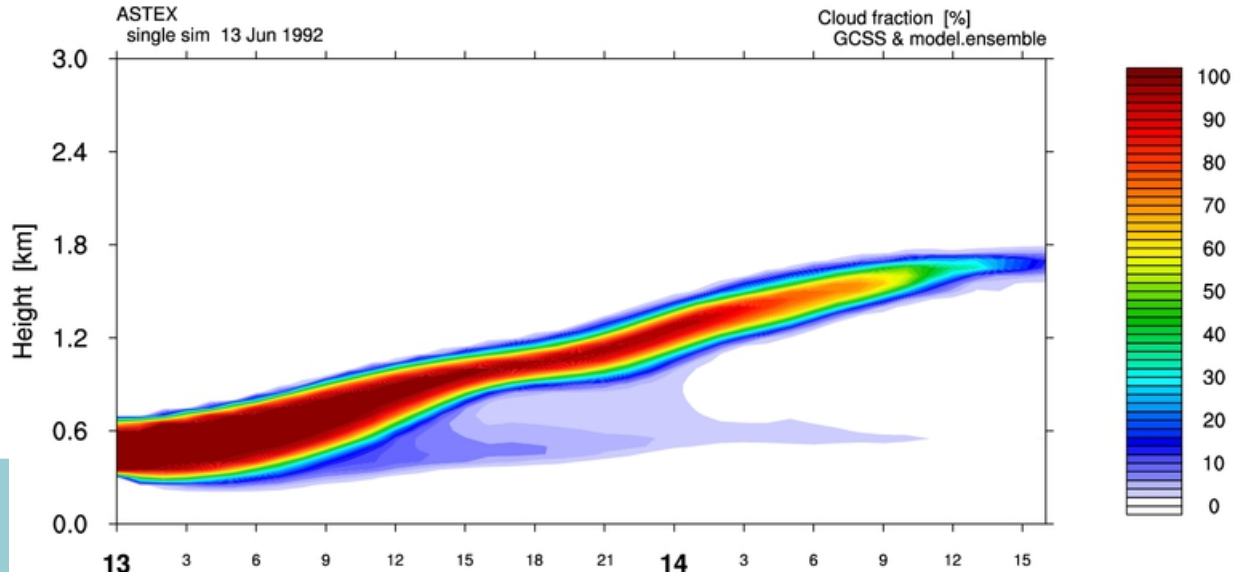


default

length scale *10



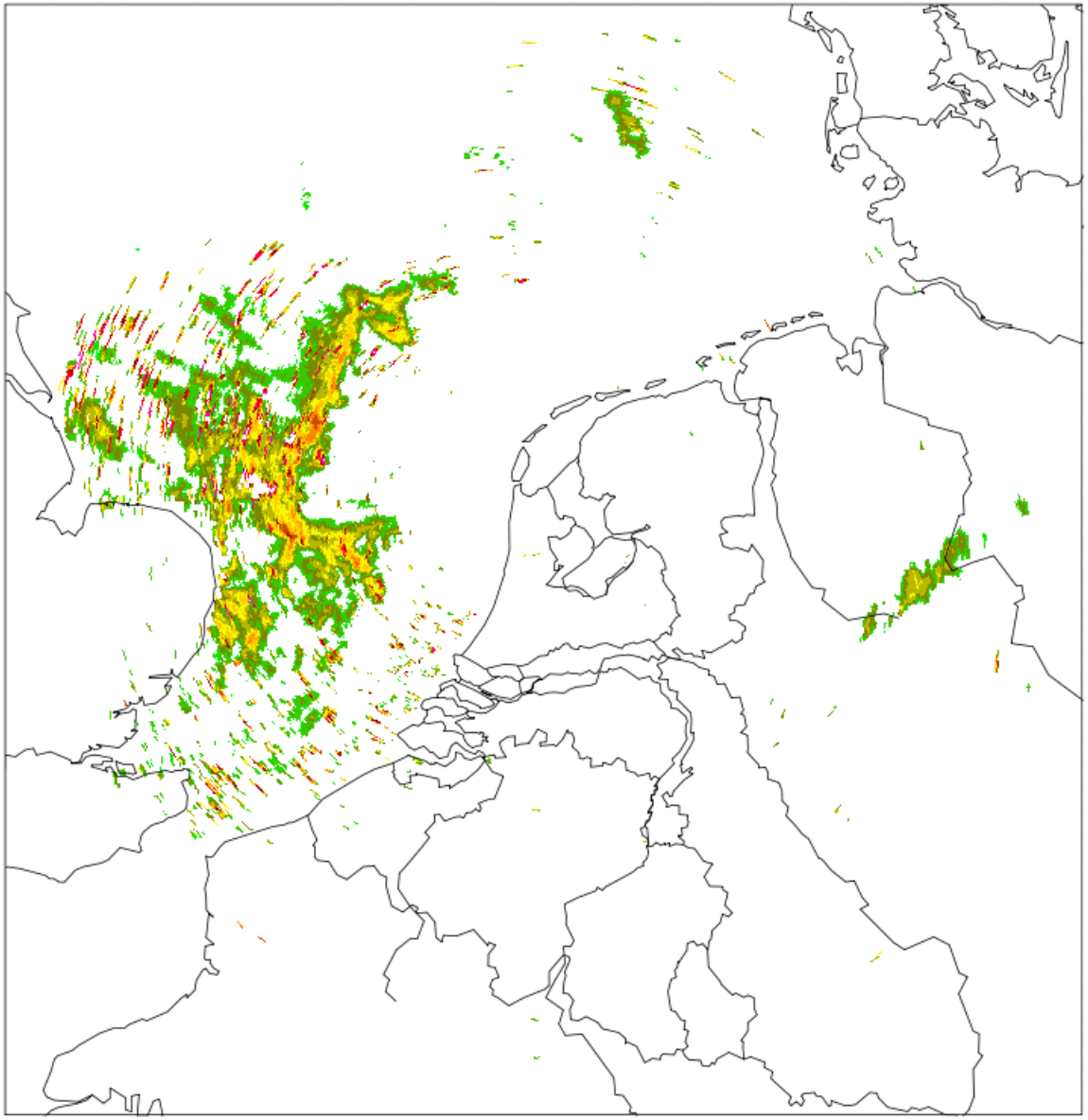
LES →



radar

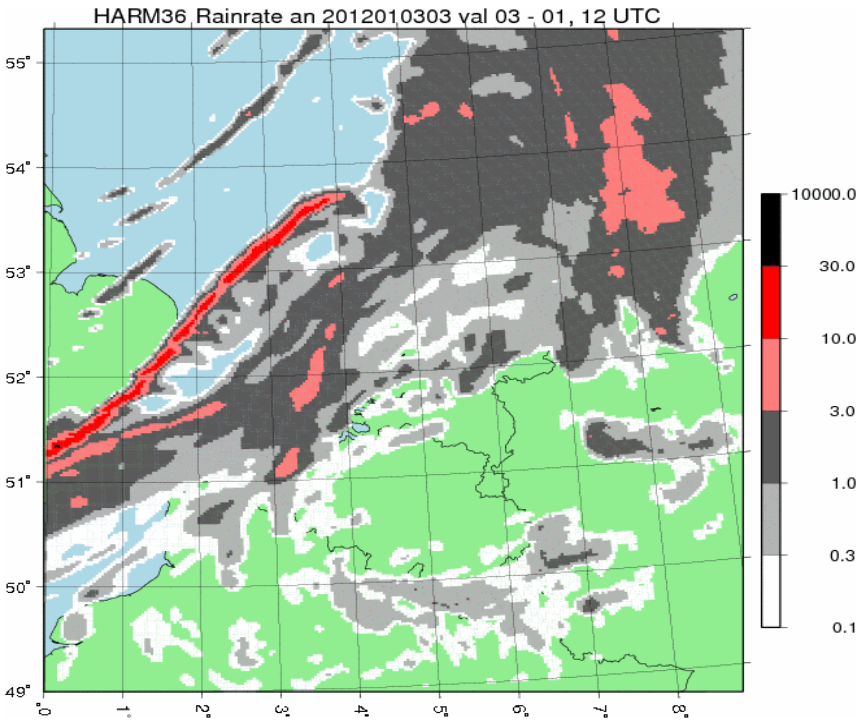
- assimilation technically works for the 2 radars in the Netherlands
- both for radial winds and reflectivity
- radial wind and reflectivity increments lead to quite similar forecast differences (radar - control) at T+6h.
- further research on increment evolution and observation algorithm (reflectivity) and quality control (clutter)

SEA CLUTTER 3 October 2011

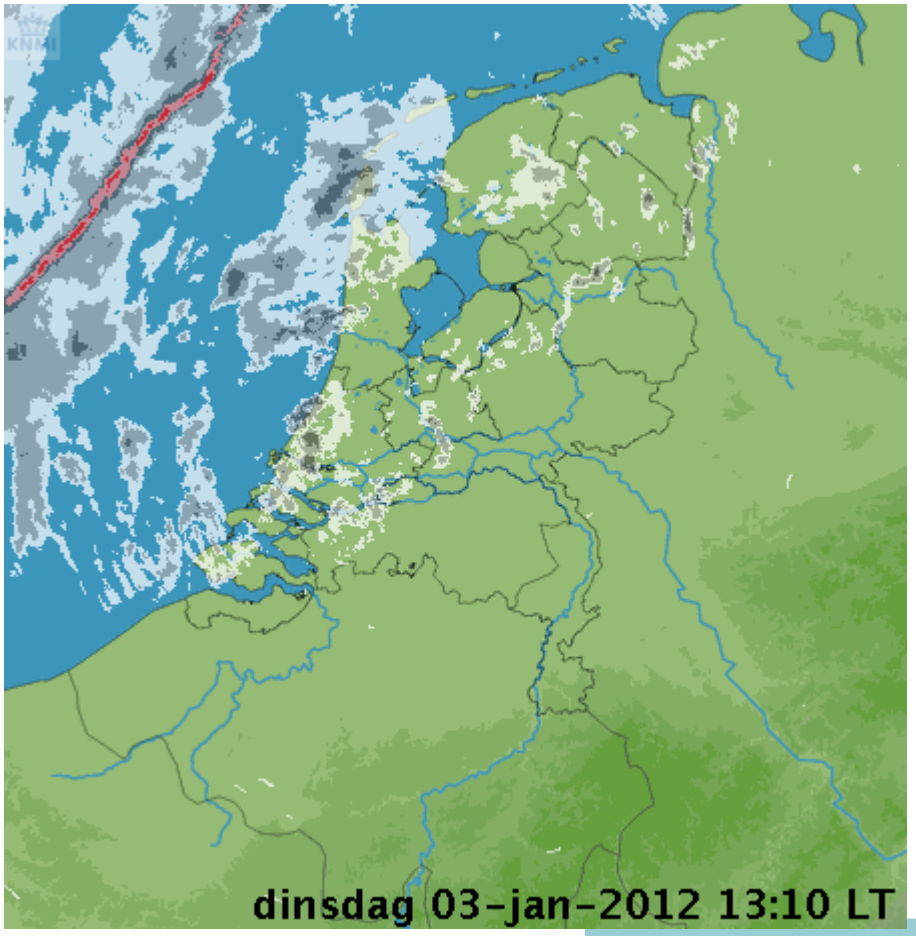


HARMONIE (6h)

LT=UTC+1

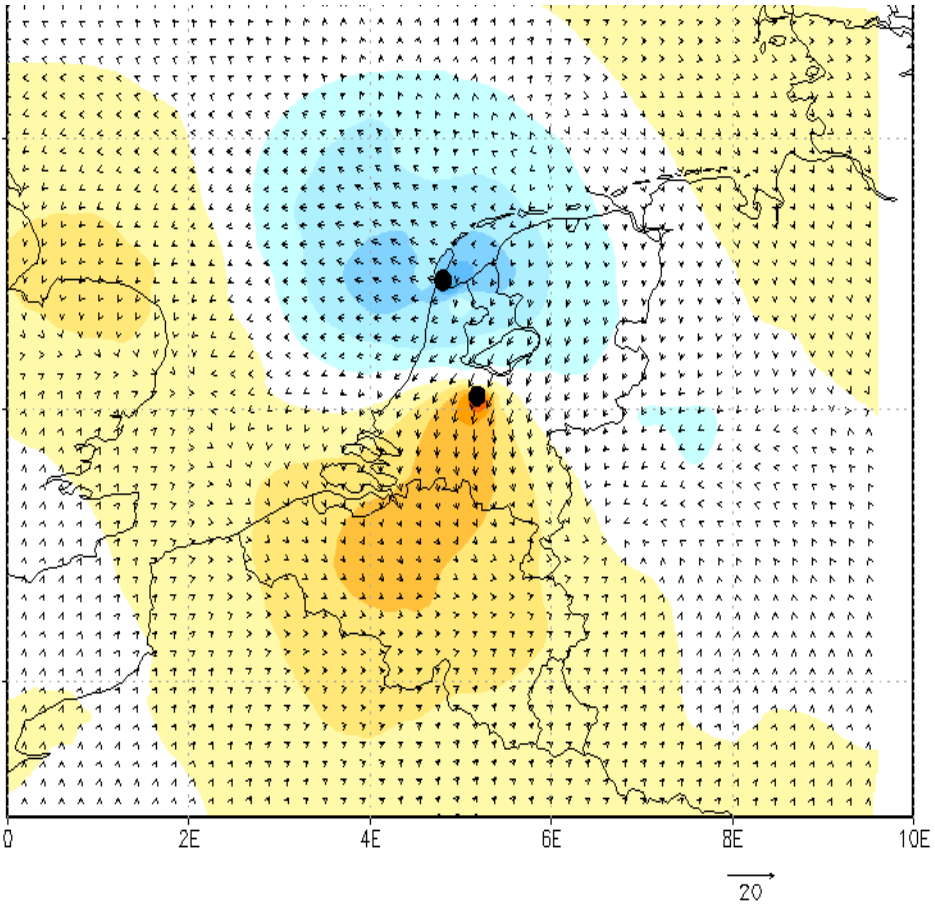


RADAR (2h)

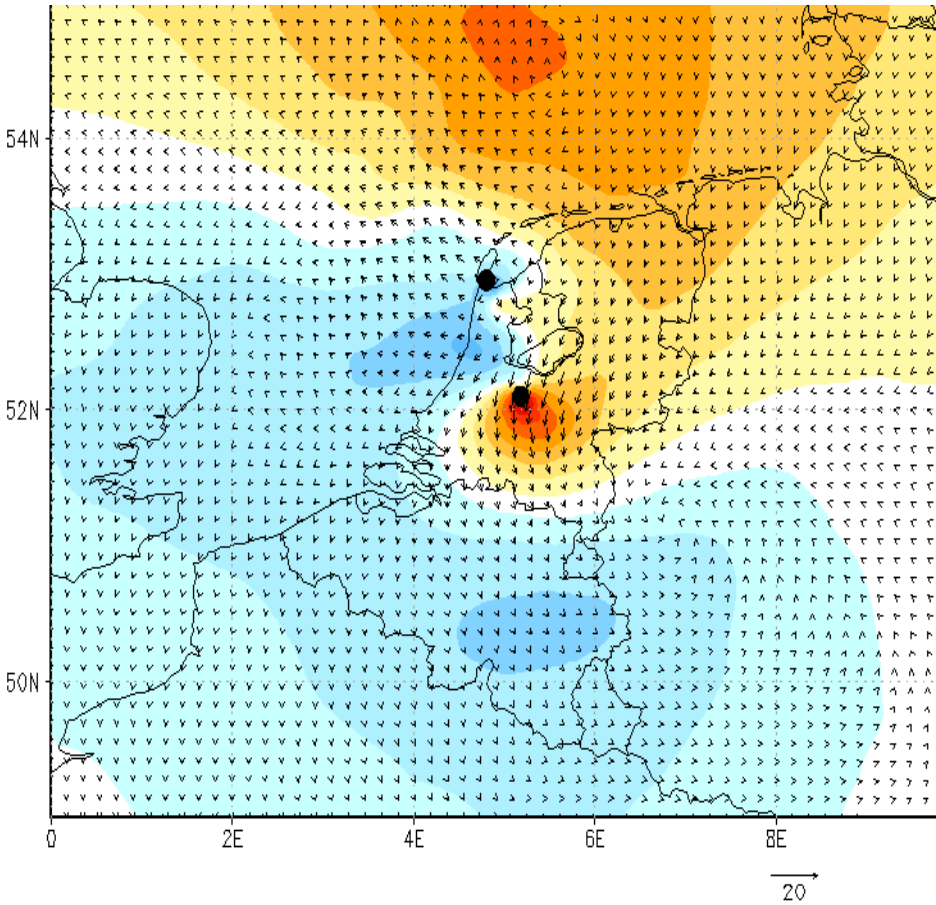


Analysis differences radar-control (T60, c.i.= 0.05K) forecast starting from 20120103 12 UTC

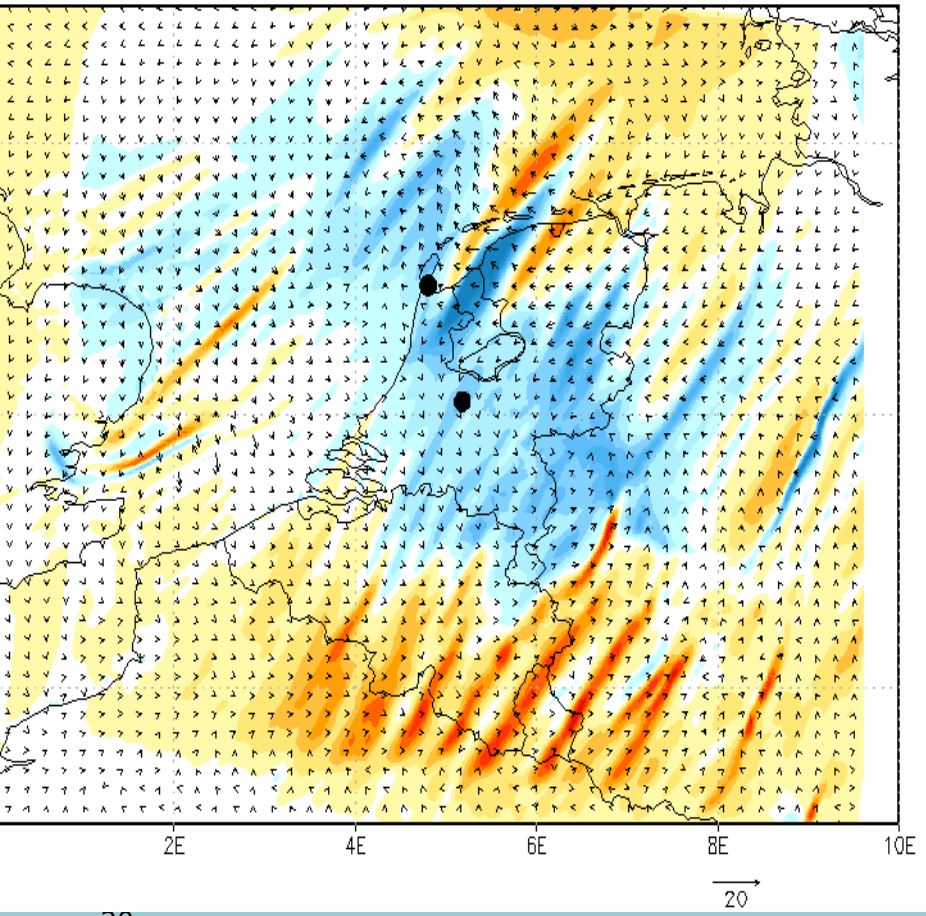
300x300 gp

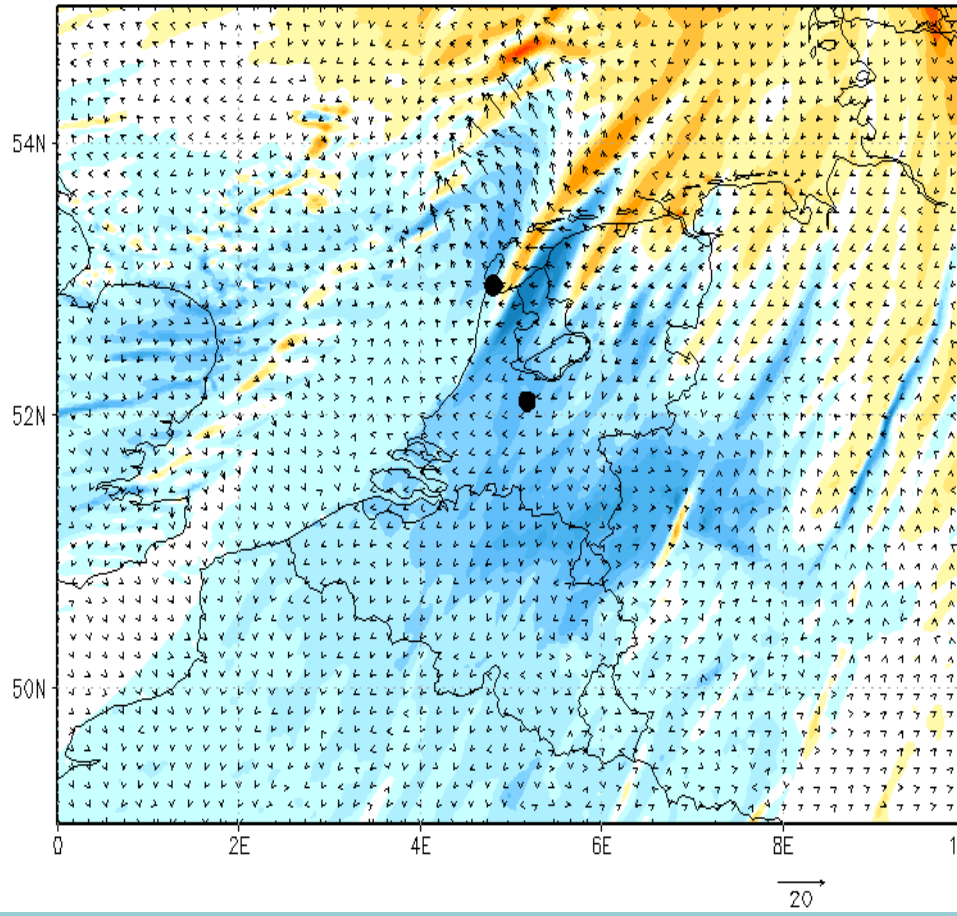


800x800 gp

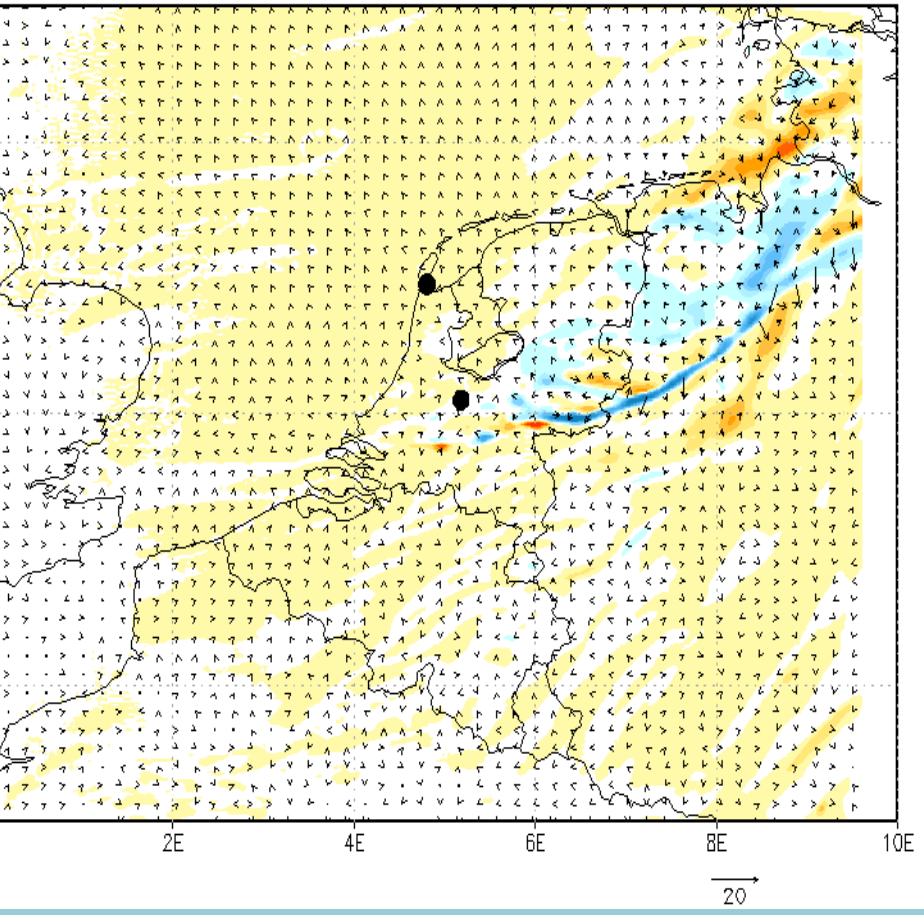


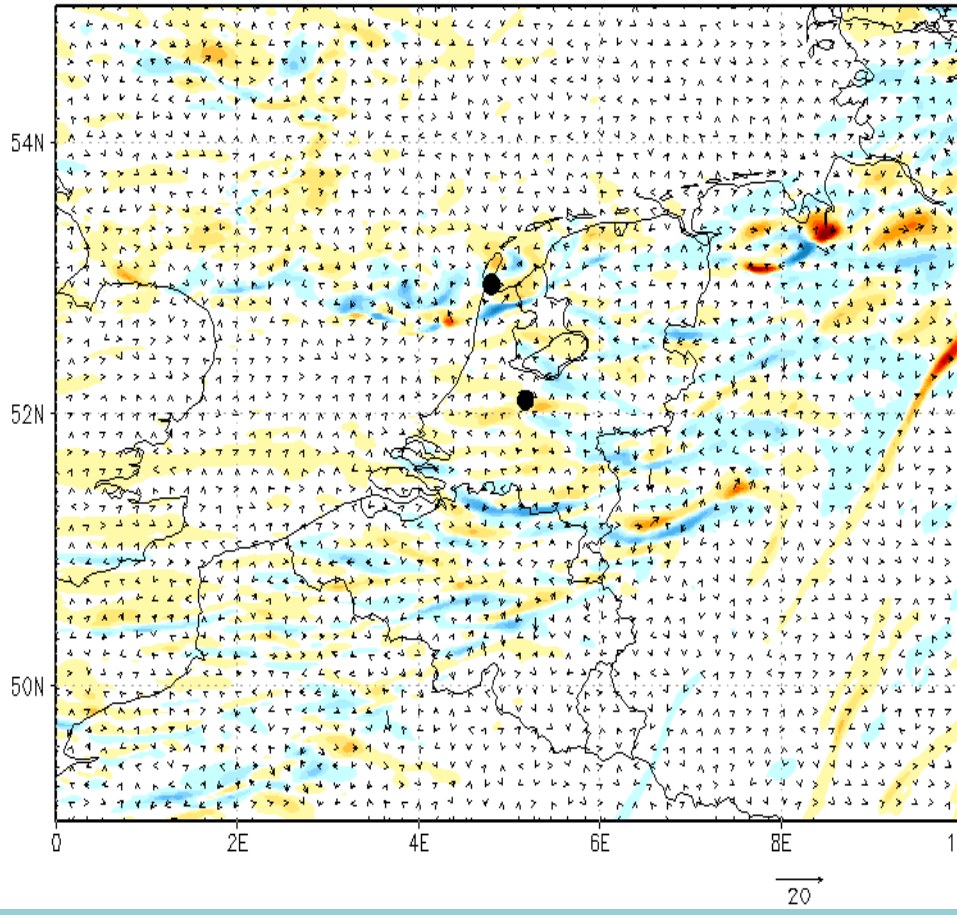
Forecast difference radar-control at T+1h (c.i.=0.1K)





Forecast difference radar-control at T+6h (c.i.=0.2K)





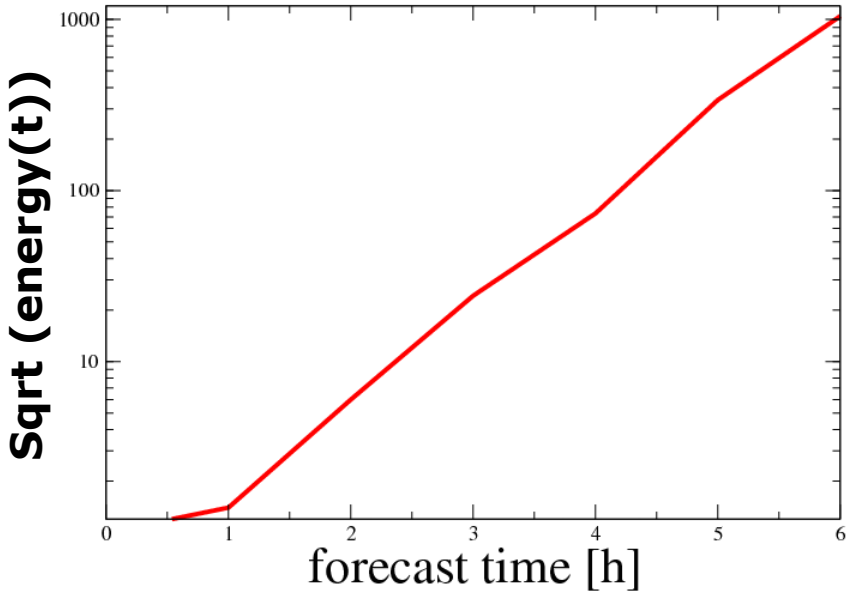
Singular vector as analysis increment

- SVs are defined to produce large amplification for a pre-scribed forecast time (optimization time).
- SV computation performed with Aladin at 5km and domain size 100x100 or 200x200 gp (TSTEP=120s)
- standard setting of tangent linear and adjoint models
- to reduce memory use TSTEP_TRAJ=600s (every 600s the nonlinear trajectory is updated)

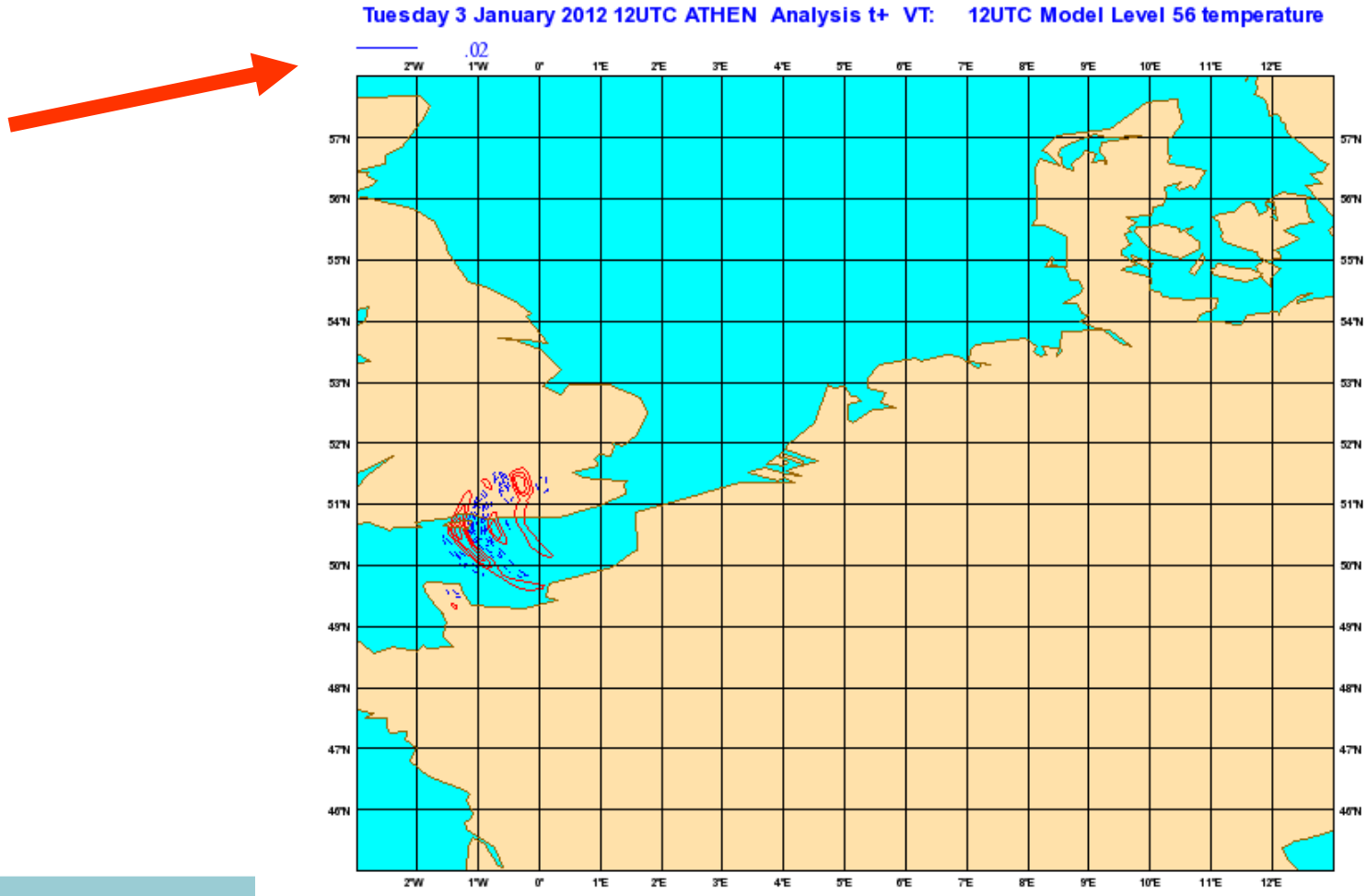
SV amplification: sqrt(total energy) at time=OT

OT[h]	100x100	200x200
3	16.8	52.3
6	1.7	**1063.5**
9	0.9	21.4
12	0.6	2.4

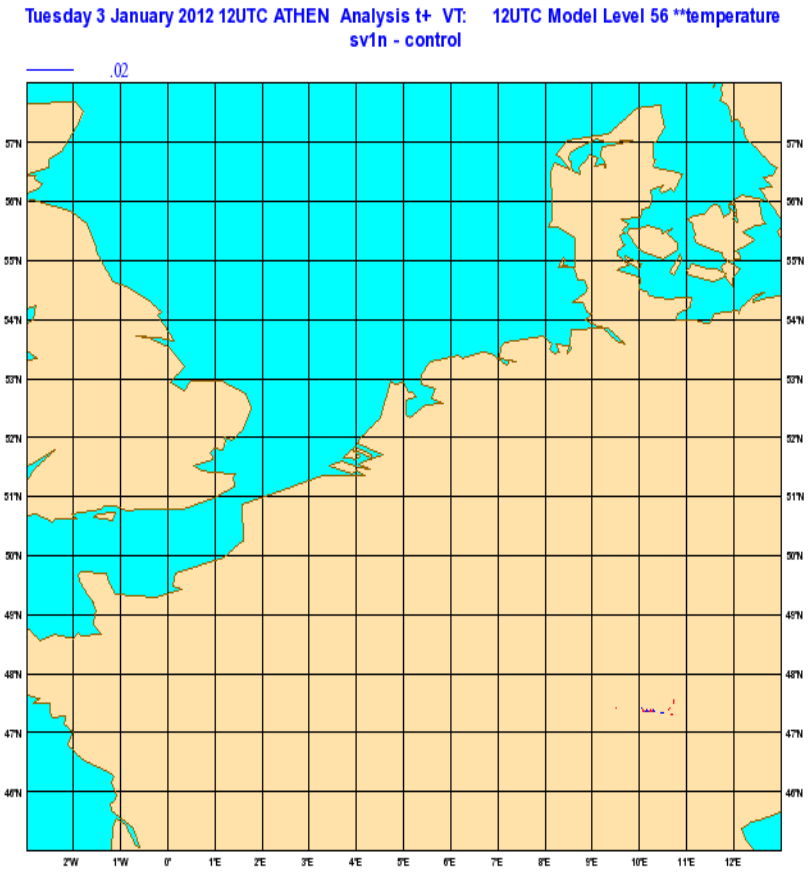
- impact of boundaries
- unrealistic amplification



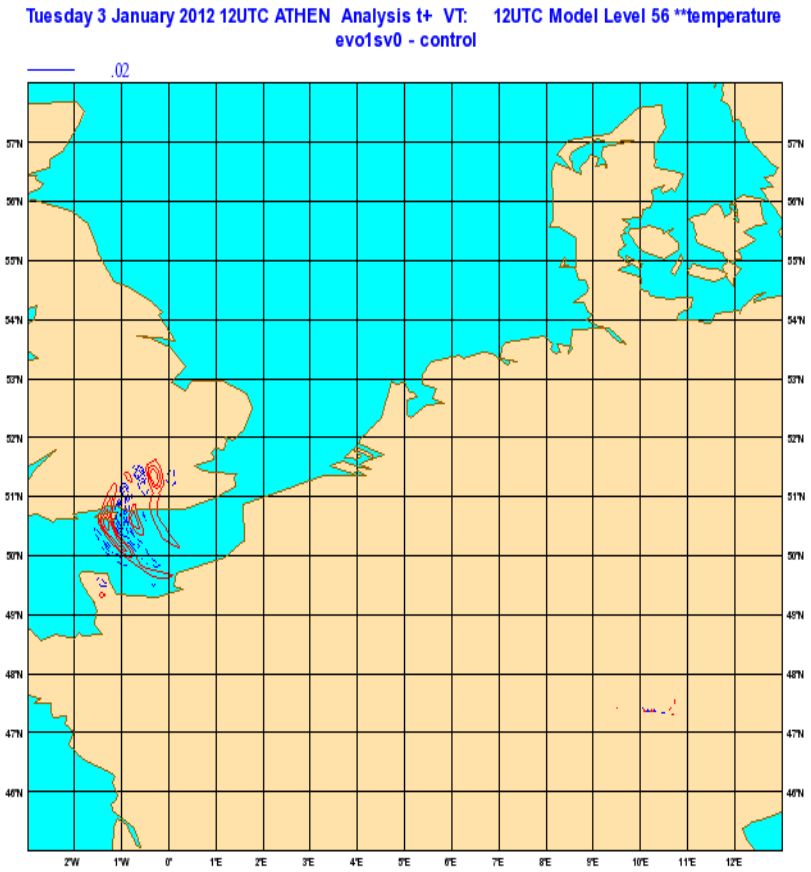
Time evolution of leading SV (n.b. contour changes)



(IC + 0.0 x SV) – IC



(IC + SV) - IC



Conclusion and outlook

- Since beginning 2012 a HARMONIE suite (800x800x60 and 8 cycles/day) runs smoothly at KNMI
- Operational status will be considered in 2012
- In 2012 observation usage will be increased: ModeS, GPS, RADAR MSG cloud data, and ASCAT.
- research on improvement of physics will continue: EDMFM, turbulence length scale, ..
- **M**odel **E**valuation **Tool** will soon be implemented
- Focus on EPS-DA will be intensified

Conclusion and outlook (cont.)

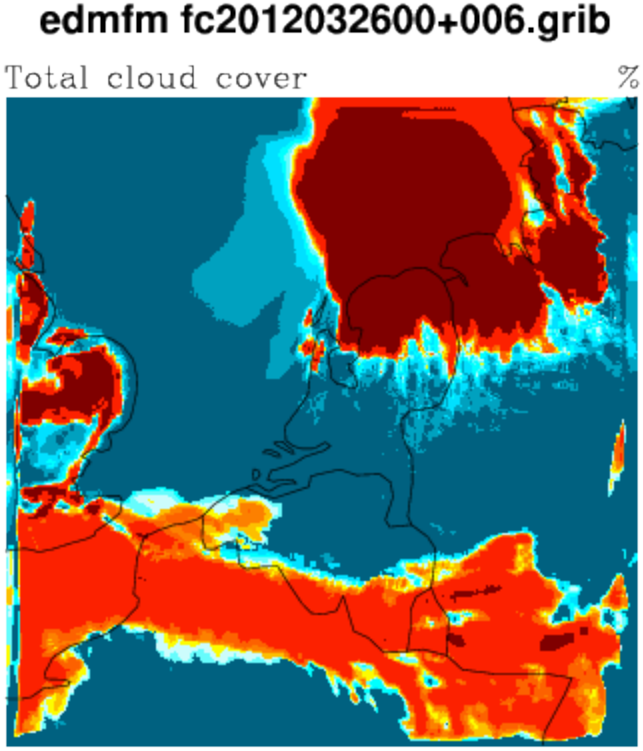
- Harmonie is increasingly part of externally funded projects:

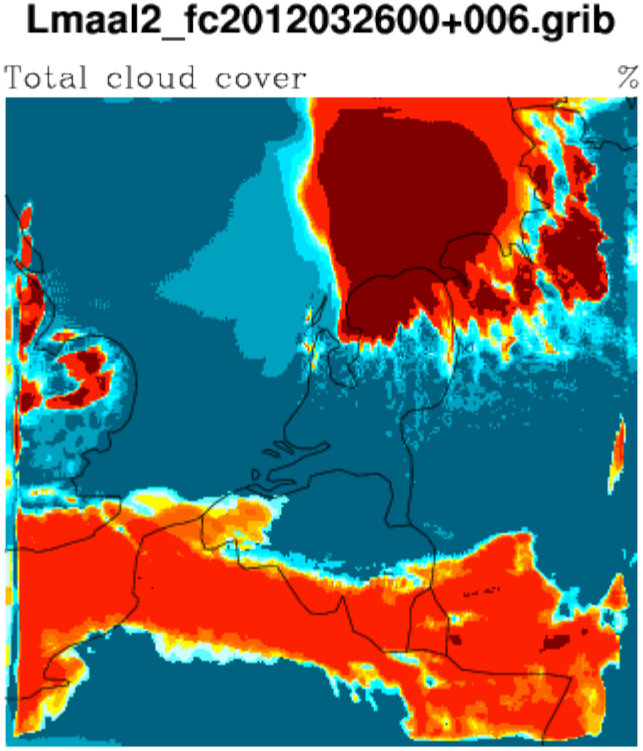
  - IMPACT (5y Postdoc+2PhD): the impact of changing climate on critical weather parameters

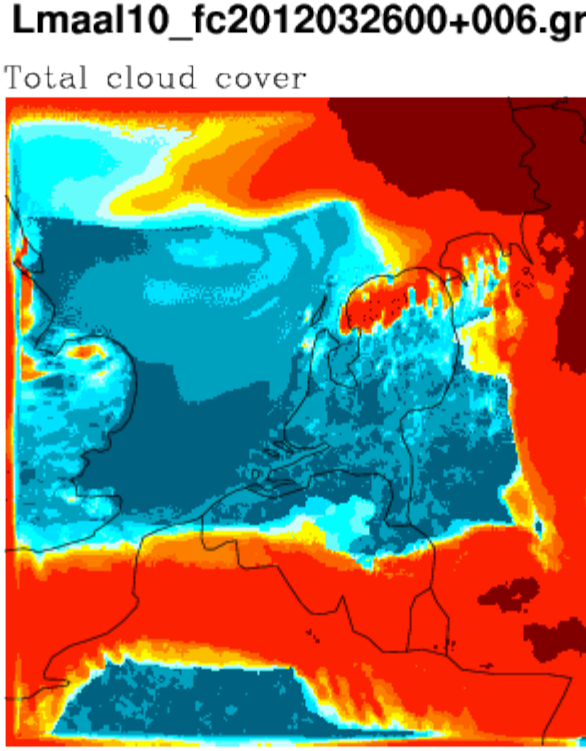
  - SBW (3y 2Postdoc): production of an extreme wind climatology for the Netherlands (re-analysis is being considered)

  - MyWave (2y Postdoc): ASCAT assimilation

  - CLEOPATRA (2y Postdoc): simulation of extreme weather events in connection with airborne radars


edmfm fc2012032600+006.grib
Total cloud cover
0.0010.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1


Lmaal2_fc2012032600+006.grib
% Total cloud cover
0.0010.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1


Lmaal10_fc2012032600+006.gr
% Total cloud cover
0.0010.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1