



HARMONIE experiences and user requirements

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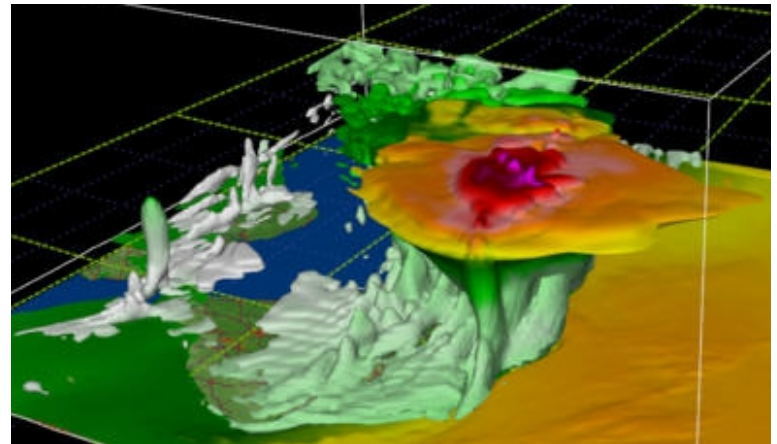
User perspective

- Not working in research department anymore, but production department at KNMI
- Therefore daily interaction with forecasters, user perspective of HIRLAM and HARMONIE forecasts
- Asked to be part of user session at workshop/all staff meeting
- So here it is, the user session (remaining 19 minutes)



Overview presentation

- Experiences HARMONIE with:
 - Large scale systems, line convection on cold fronts
 - Low clouds and fog
 - Small scale showers
- User requirements

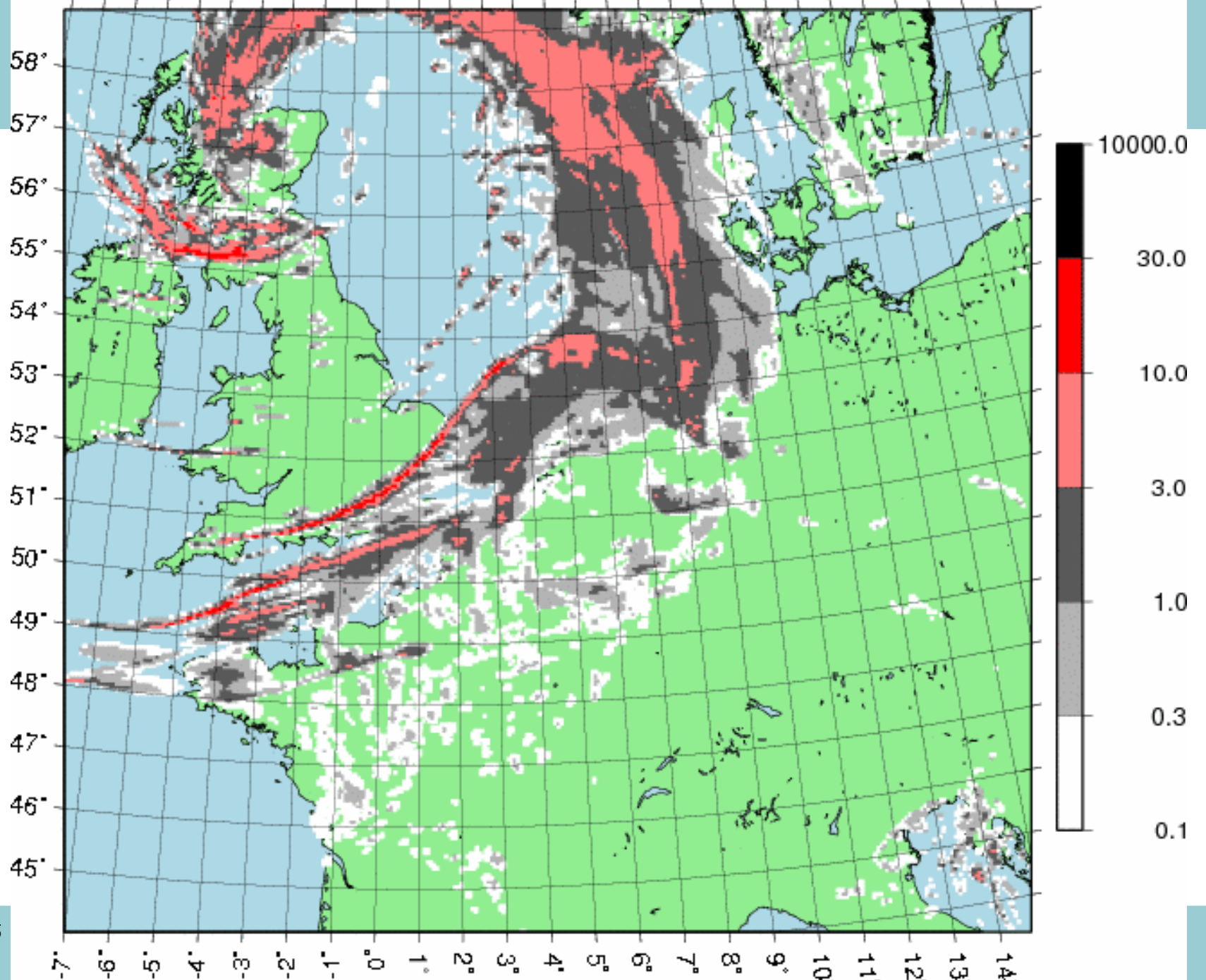




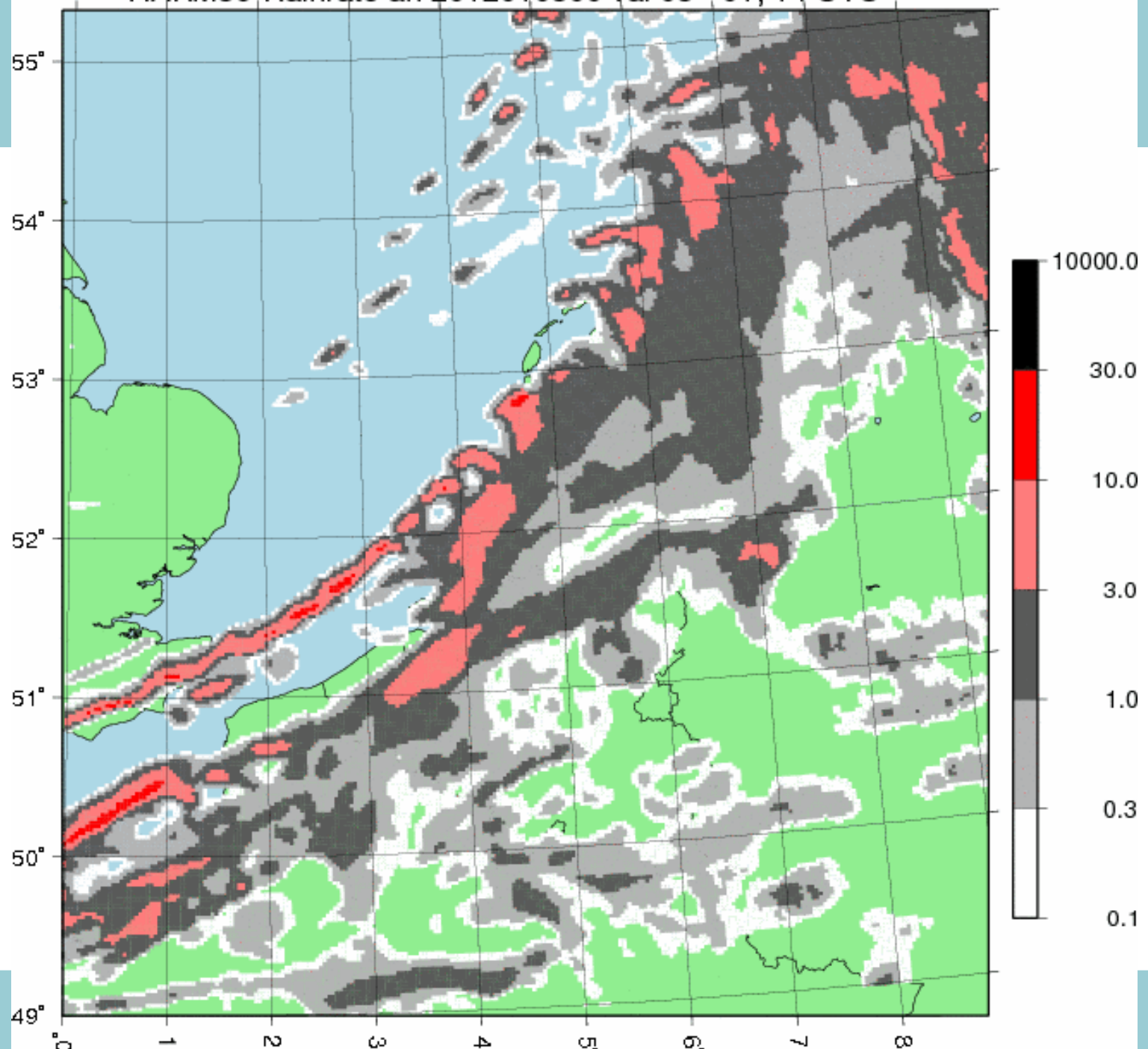
HARMONIE large scale experiences

- Started running HARMONIE on a large domain and on a regular basis from beginning December 2011
- Initially dynamical downscaling from HIRLAM analysis
- Deep cyclones influencing weather on 8-12-2011, 3-1-2012 and 5-1-2012
- Cold fronts passing the Netherlands with line convection
- Qualitatively forecasted very well by HARMONIE, also good guidance on severity of weather on cold front
- Example 3 January 2012

HARM36 Rainrate an 2012010300 val 03 - 01, 12 UTC

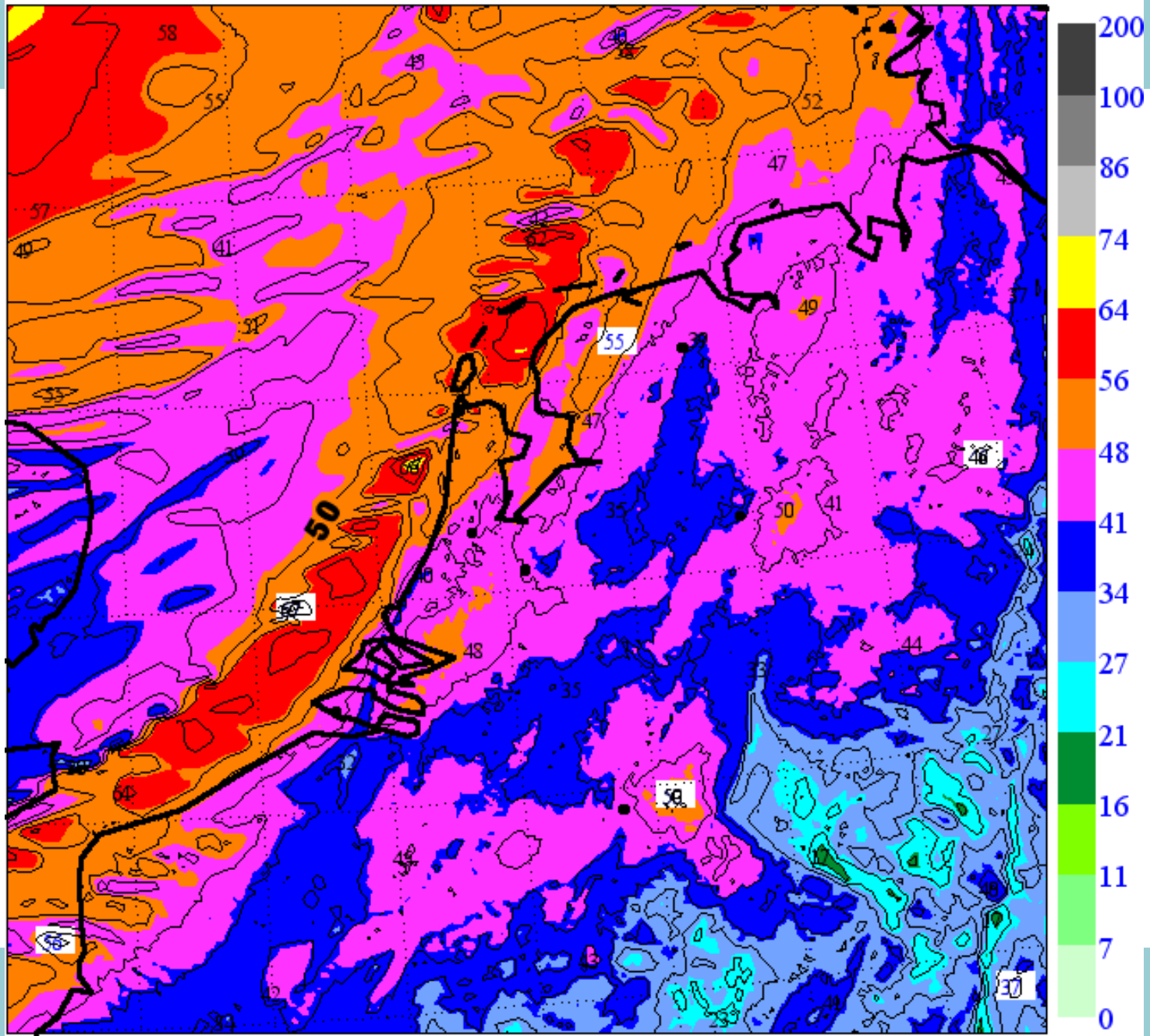


HARM36 Rainrate an 2012010300 val 03 - 01, 14 UTC

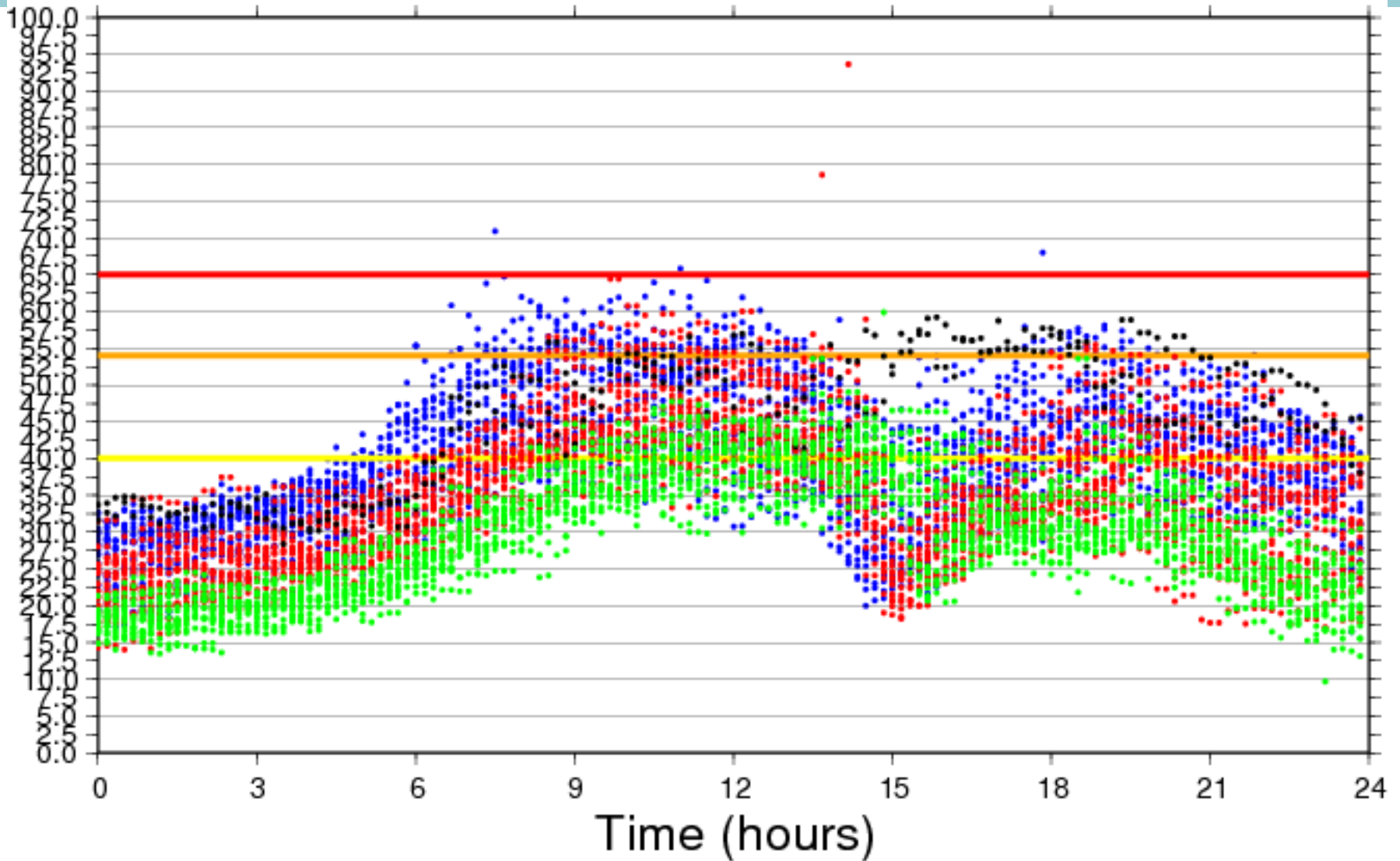




HARMONIE 36H1 t+14 10m Wind gust (kt) forecast VT:14 UTC on 3 January 2012



Observed FFX (kt) NL, nNzee (z), zee (b), kust (r), land (g), 2012010300



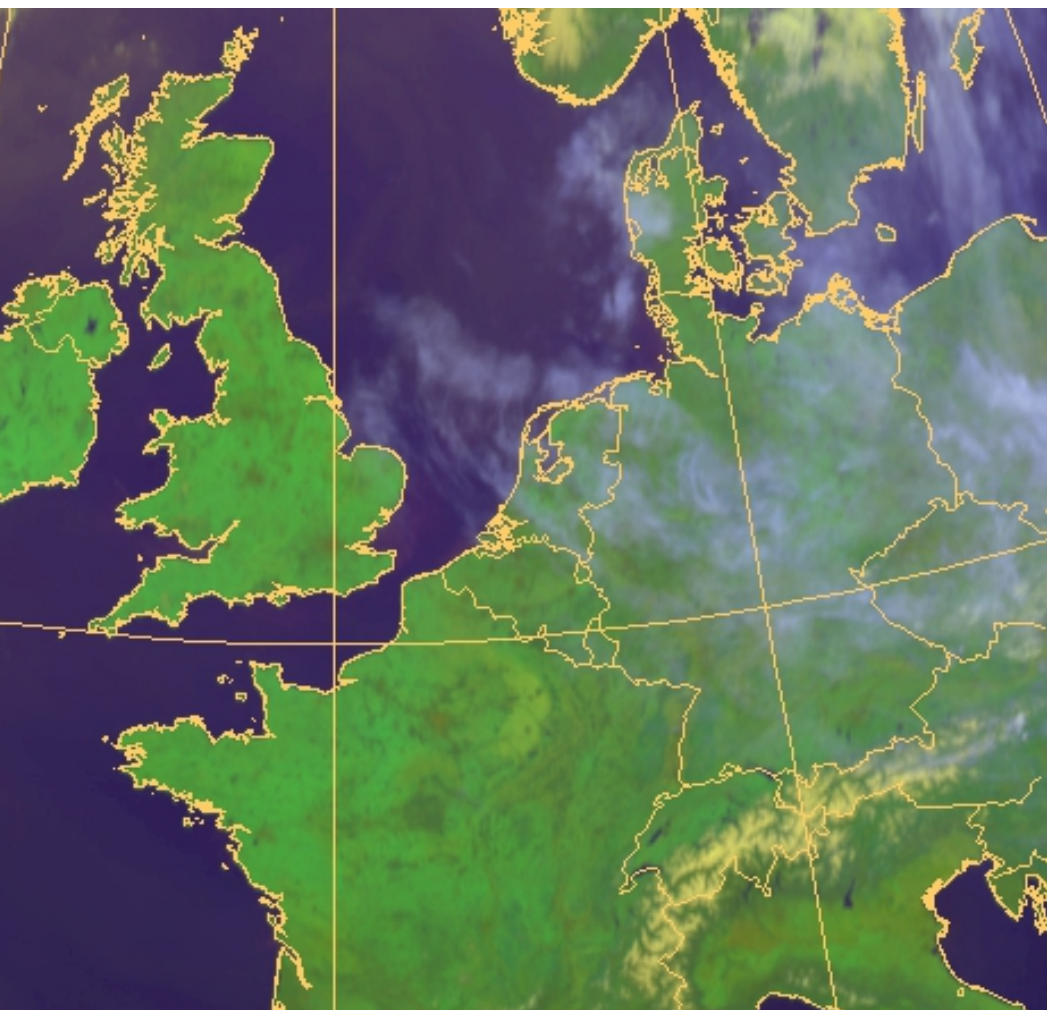
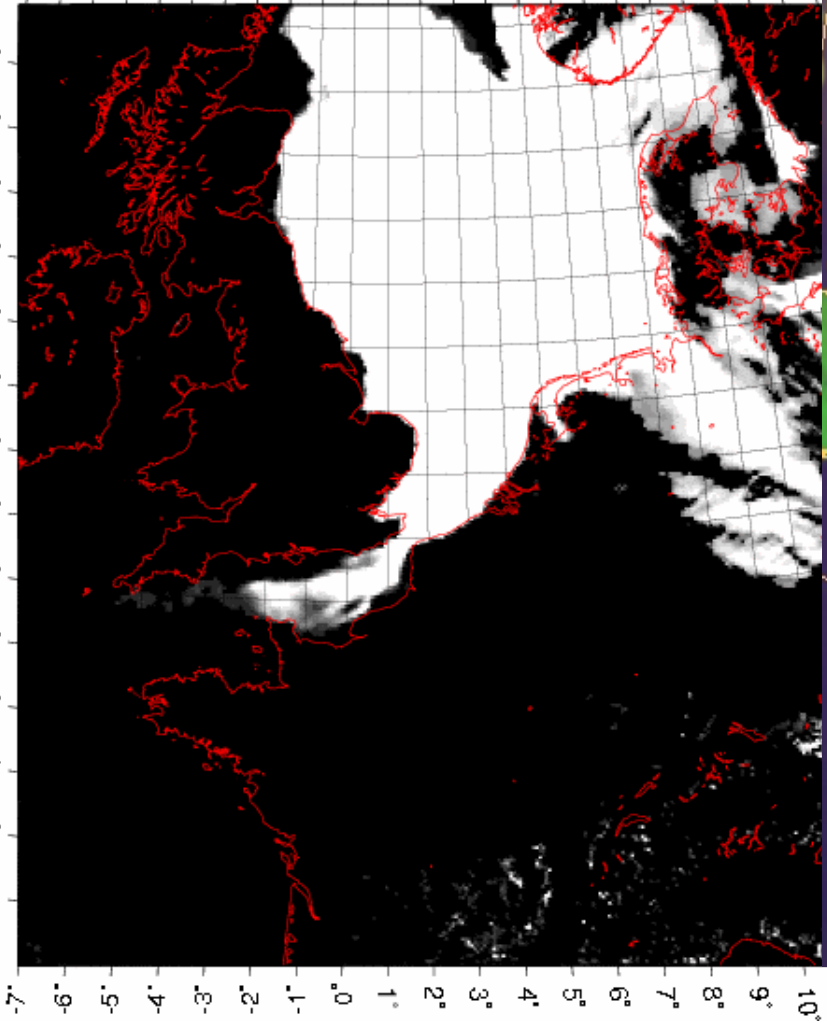


Fog and low clouds

- In stable period from 20-30 March 2012, high pressure system over the North Sea
- Relatively warm air over cold water -> potential to form fog and low clouds
- All models had problems with this situation
- HARMONIE worst with fog spreading over entire North Sea and persistent from 25-28 March



HARM36 Cloud cover 2012032700 + 012





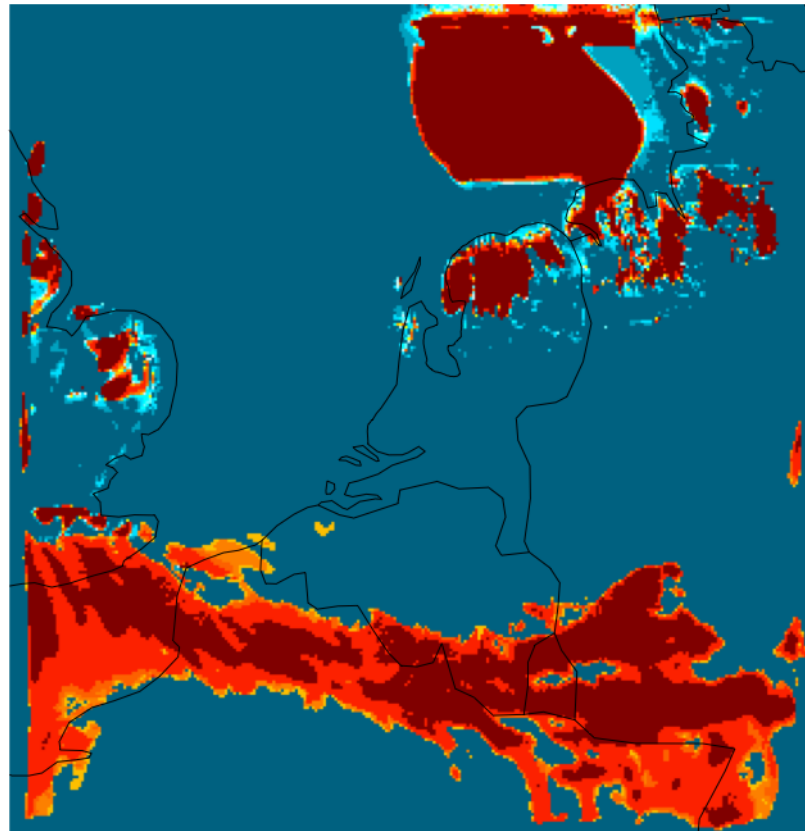
Fog and low clouds

- Fog develops too early over the sea and spreads too quickly, too far
- Often significant area with fractional fog cover visible. In reality it is more often fog/no fog so 1 or 0.
- Maybe variance in temperature and humidity too large in cloud scheme, causing cloud water to develop too early
- Whenever cloud water is present, runaway effect possible due to infrared cloud cooling



edkfnovar_fc2012032600+006.grib

Total cloud cover %



0.00 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1



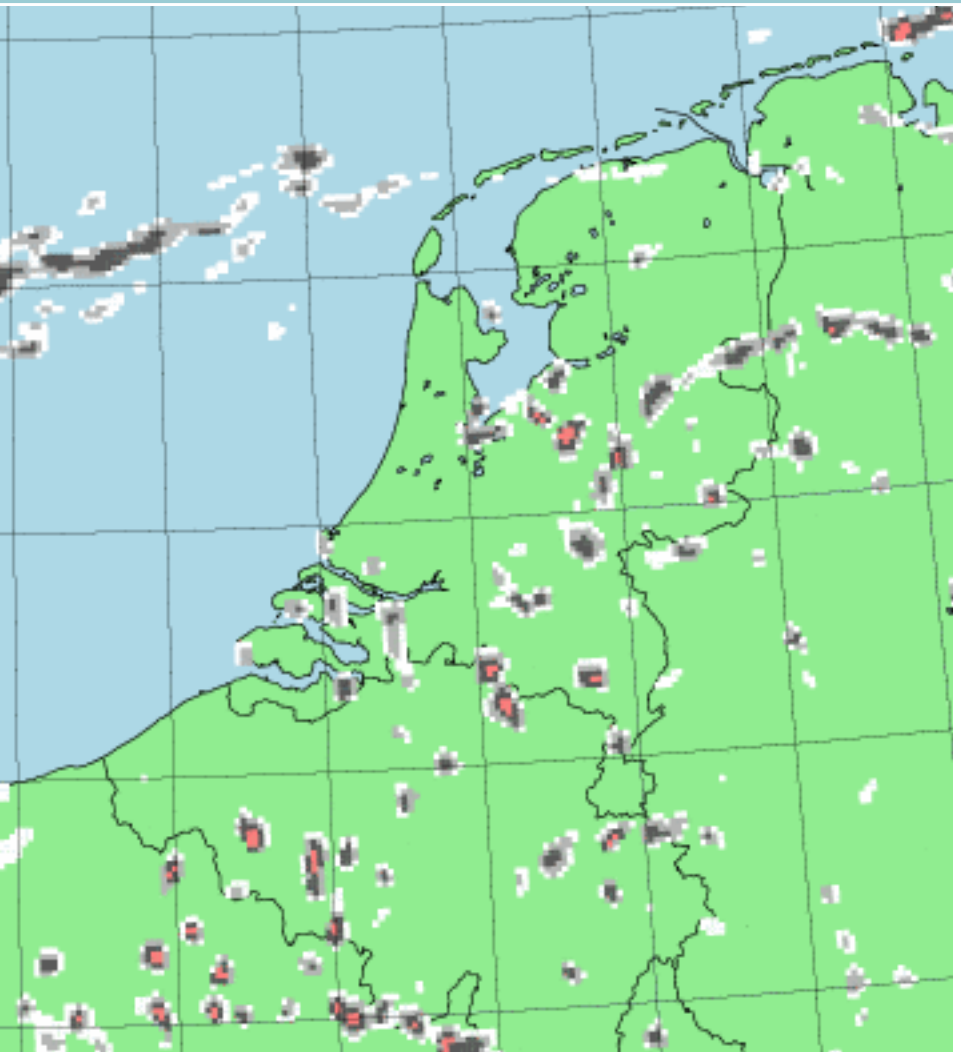
Fog and low clouds

- In addition to too much fog and low clouds over the sea, low clouds in warm sectors often too thick and with a too low cloud base.
- A number of cases with cloud base at the surface and fog diagnosed because of cloud water in lowest layer of model.
- Also too often small scale showers due to thick clouds.
- Maybe caused by too large variance in cloud scheme close to the surface, in combination with deficient cloud top entrainment. Length scale in stable conditions being too small, moisture trapped in too shallow layer.
- Clouds too persistent, not enough fog developing over land due to too high cloud cover.

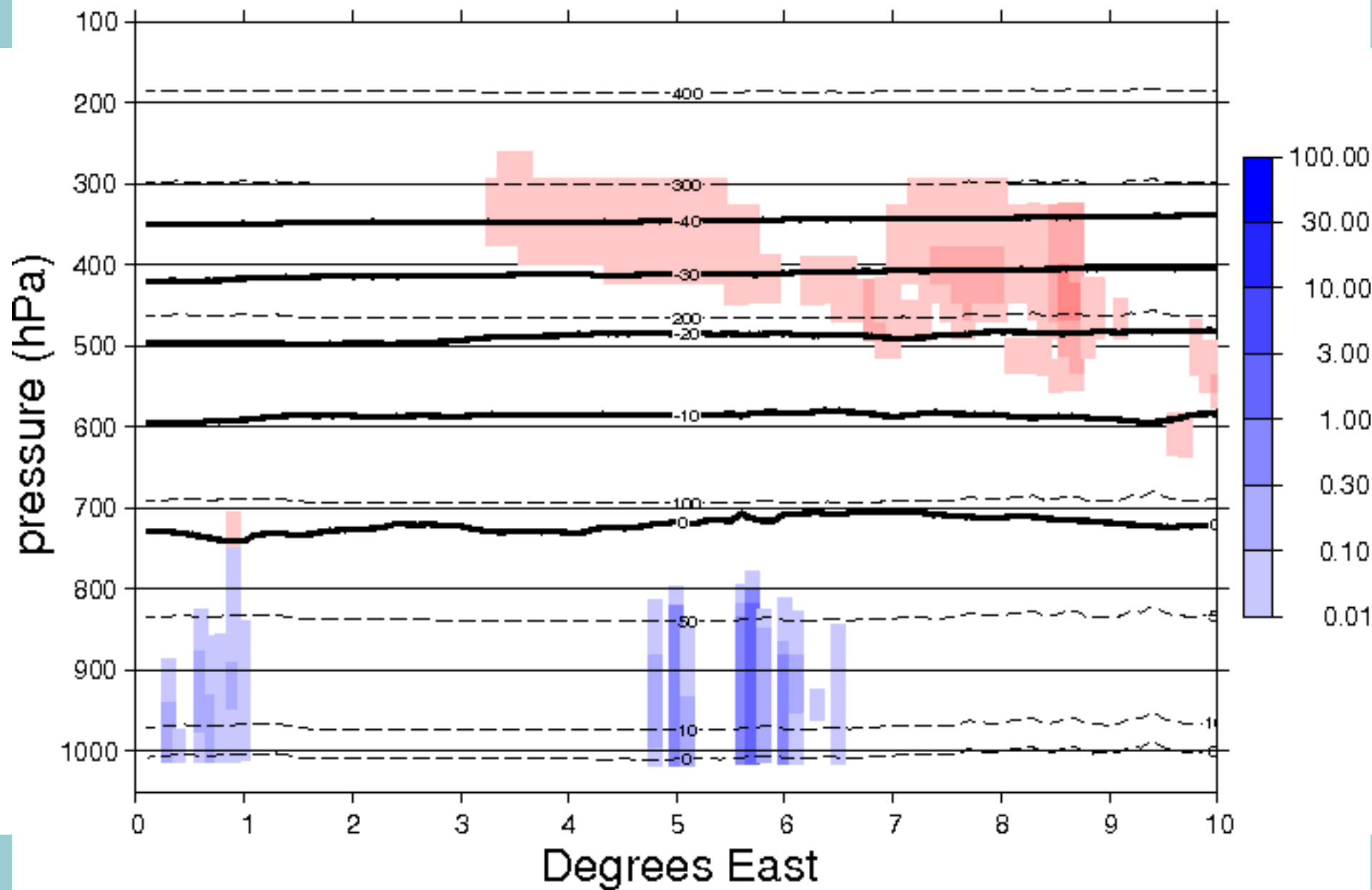


Small scale showers

- HARMONIE giving too much precipitation in cases with relatively shallow clouds
- Convection starting too quickly
- Showers with intensity of 1-3 mm/hr from clouds of around 1500 m thick, but with whole cloud $T > 0^{\circ}\text{C}$
- In reality some very light drizzle observed, < 0.1 mm
- Clouds too thick or clouds giving rain too quickly?



Prec wwee +09 fcst 2012050306 in mm/ur





User requirements

- Quality of HARMONIE in extreme conditions (convection associated with deep cyclones) high, good guidance on what weather to expect plus associated phenomena!
- Also seen good guidance in case of severe deep convection, weakly forced (nighttime) convection still challenge
- Low clouds and fog extremely important for aviation, important customer
- Correct climatology in model for low clouds and fog important because:
 - Especially persistent fog in March bad for confidence in HARMONIE and acceptance by meteorologists
- Important to have good average scores, but behavior for extreme conditions also important, show scores for more extreme thresholds



User requirements

- Possible improvements through:
 - adjustment of **physics** (length scale in turbulence scheme, variance close to surface in cloud scheme)
 - additional **use of observations** (satellite and ceiling height)
 - Verification of cloud water/ice path, satellite cloud cover
- Indication of uncertainty, develop **ensembles** with HARMONIE. How to perturb physics and arrive at the right spread/skill? Get spread in many physically and dynamically different conditions from relatively small number of ensemble members?

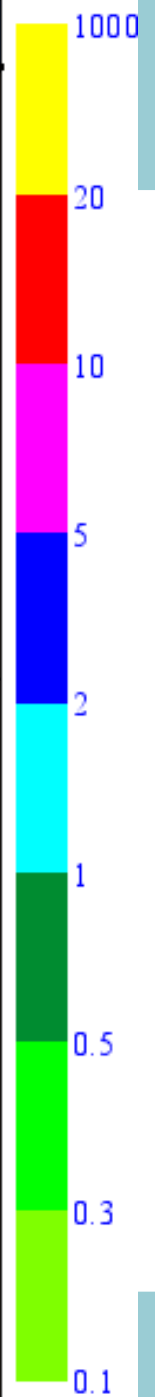


Summary

- HARMONIE gives excellent guidance in large number of cases
- Weak points: fog over the sea, weakly forced deep convection, low clouds
- Important for acceptance to take away persistent problems
- Verification of cloud physical parameters and extremes (especially EPS) may help in development, improve the usage of models and systems

14:00

I



BuienRadar.NL - 1x1km - 17 december 2010 14:00

21





Growth of anvils may show if vertical mass flux is too strong or not.

Distributions of brightness of cloud tops, especially large anvils, may point to shortcomings in microphysics

In verification often only averages are shown, in addition to normal weather extremes very important, **also** show verification of extremes, especially for ensembles.