

Validation of HARMONIE 36h1.3

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Introduction



- What: validation studies about 36h1.3 (+) (https://hirlam.org/trac/wiki/Harmonie_36h1/ValidationTests)
- Motivations
 - A quality assessment in connection with release of 36h1.3, including that about operationally relevant deviations
 - Find suitable default (DA) settings, for three main configurations: AROME, ALADIN and ALARO
 - Establish a technical and meteorological benchmark as reference for future versions

What is "36h1.3"

- Source code based on 36T1 up to bf9
- First official HARMONIE release within HIRLAM (Dec 2010)
- Default configuration
 - AROME/surfex physics, non-hydrostatic
 - 2.5 km domain, 384x400x65
 - 3DVAR, CANARI-OI_MAIN
 - IFS boundary
 - Reference Settings: ECMWF; Makeup

Tested 36h1.3 deviations

- **Physics:** AROME (edkf/edmf), ALARO(surfex/isba), ALADIN
- **DA:** 3DVAR, 4DVAR, surface DA, no-da
- **Domains:** 2.5 km, 5.5 km, 10 km
- **Coupling:** IFS, hirlam, aladin
- **Vertical:** L65, L60, MF_60, L40
- **Build:** Makeup, gmckpack
- **Observation:** conventional, remote sensing
- **Platforms:** ECMWF+member services

Experiment configurations



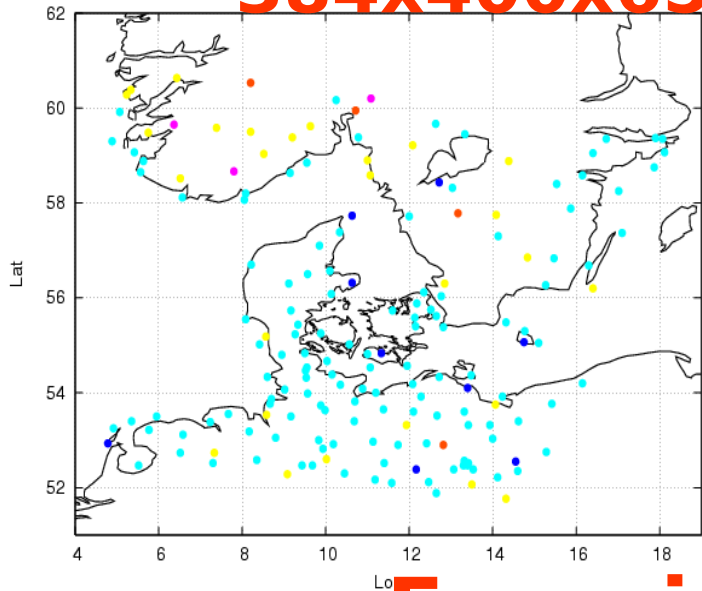
- **Approach:** Intercomparisons about HARMONIE sensitivity experiments, + vs operational HIRLAM
 - Conventional verification, episode studies
 - 10-km scale: ALADIN
 - + RCR (FMI), M09 (DMI), E11 (SMHI)
 - 3 – 5 km scale: AROME, ALARO
 - + S03 (DMI), G05 (SMHI)
- **Two episodes**
 - Jan 2010 (very cold nordic winter, snow storms)
 - Aug 2010 (several cases with strong convection, some missed by HIRLAM forecasts)
- **Baseline + Alternative configurations**



"Denmark"

Exp: F03 Area: ALL 178 stations Period: 20101220-20110101

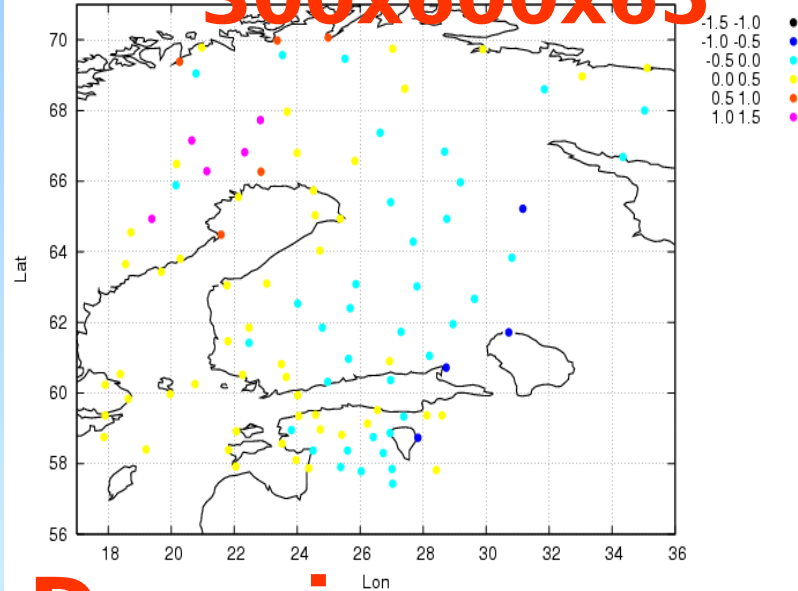
384x400x65



"Finland"

Exp: 36h13_rome7IN Area: ALL 100 stations Period: 201001

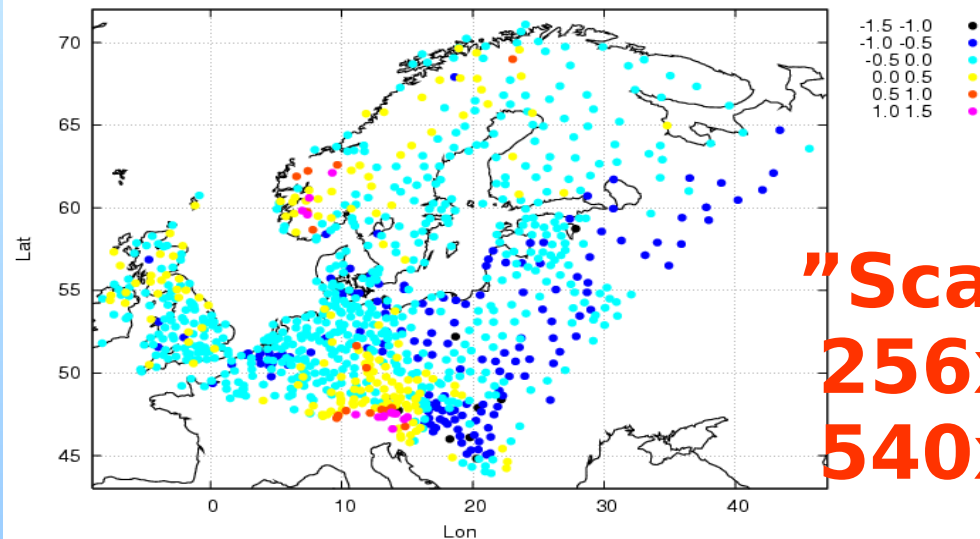
300x600x65



Experiment Domains

Exp: 36h13_ladin3dvar Area: ALL 951 stations Period: 201008

Surface pressure bias [hPa]
At 00,06,12,18 + 00,06,12,18,24,30,36



"Scandiavia"

256x288x60

540x680x60

Summer (201008), ~10 km

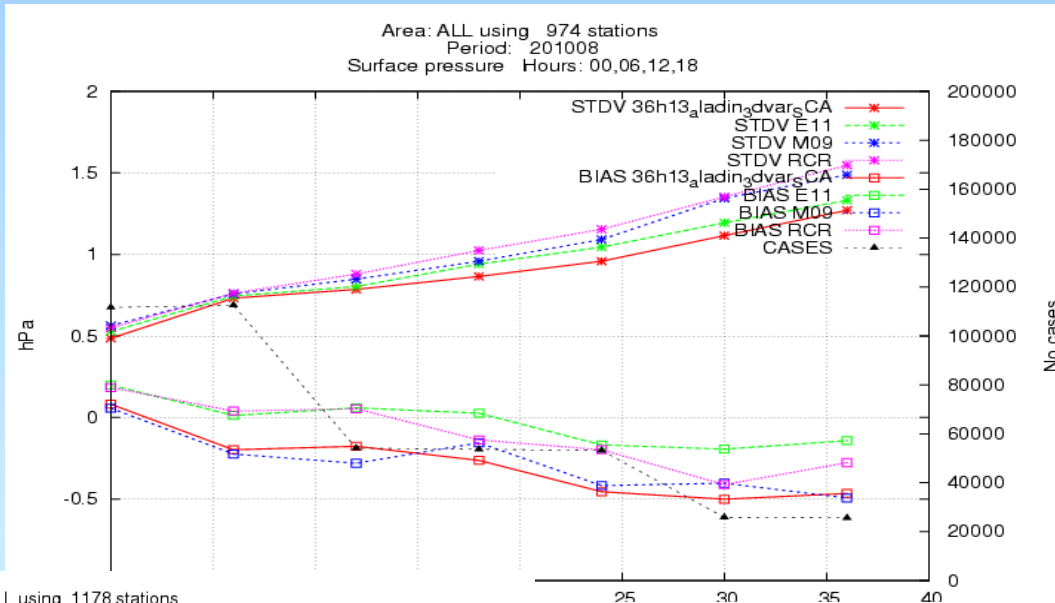


DMI

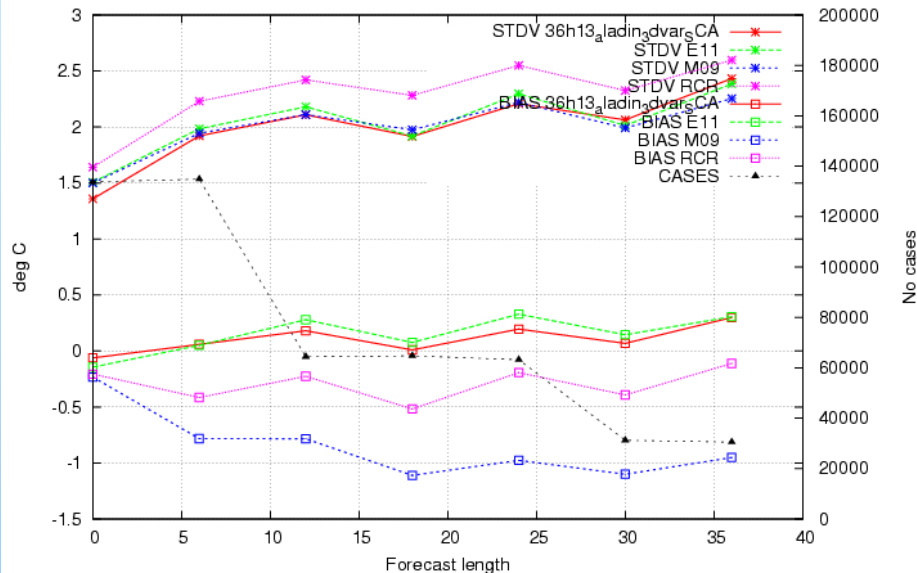
PMSL

T2m

ALADIN
E11
M09
RCR

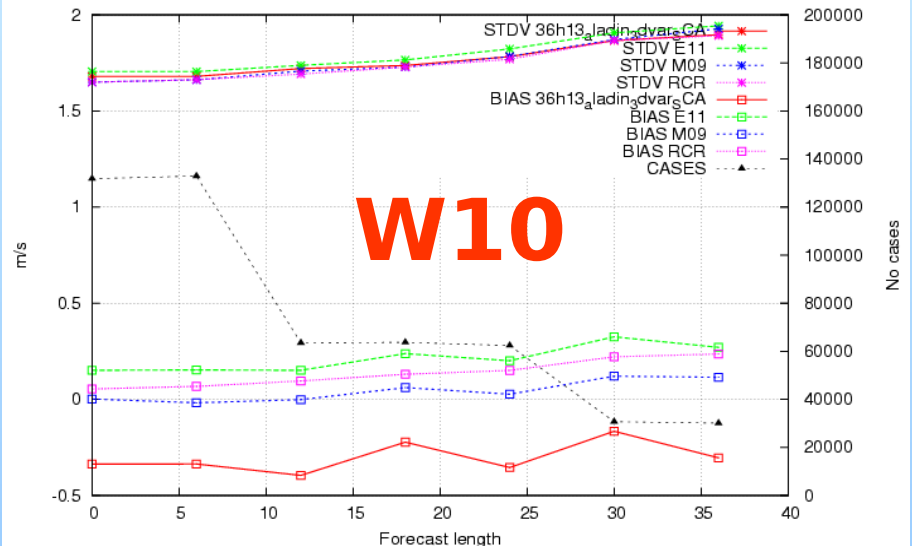


Area: ALL using 1178 stations
Period: 201008
Temperature Hours: 00,06,12,18



leng

Area: ALL using 1171 stations
Period: 201008
Wind speed Hours: 00,06,12,18



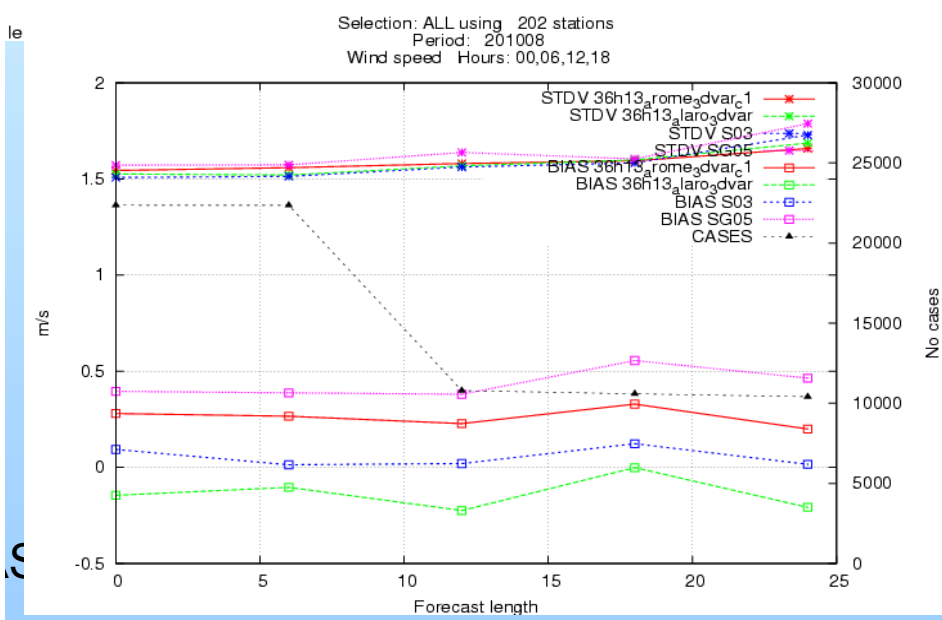
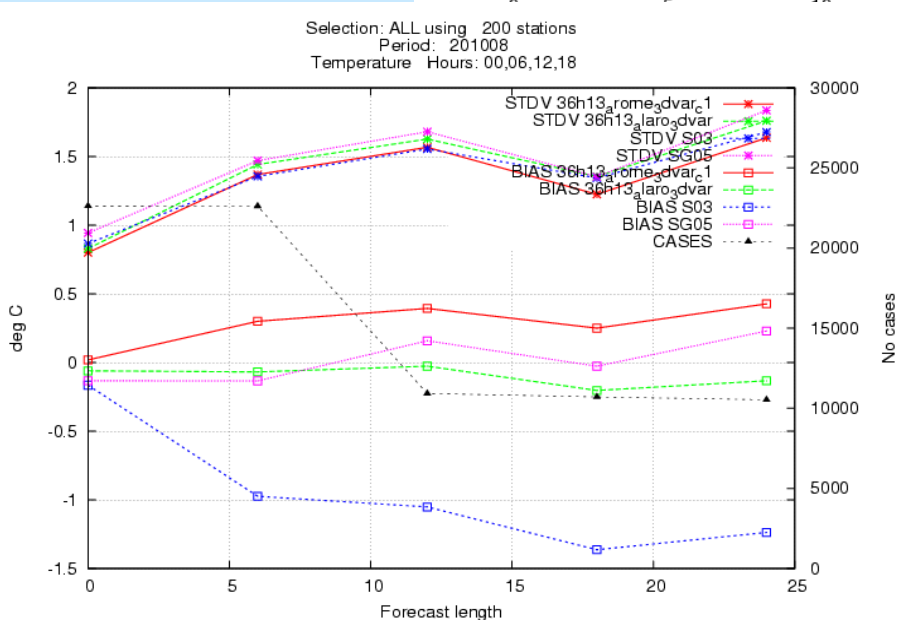
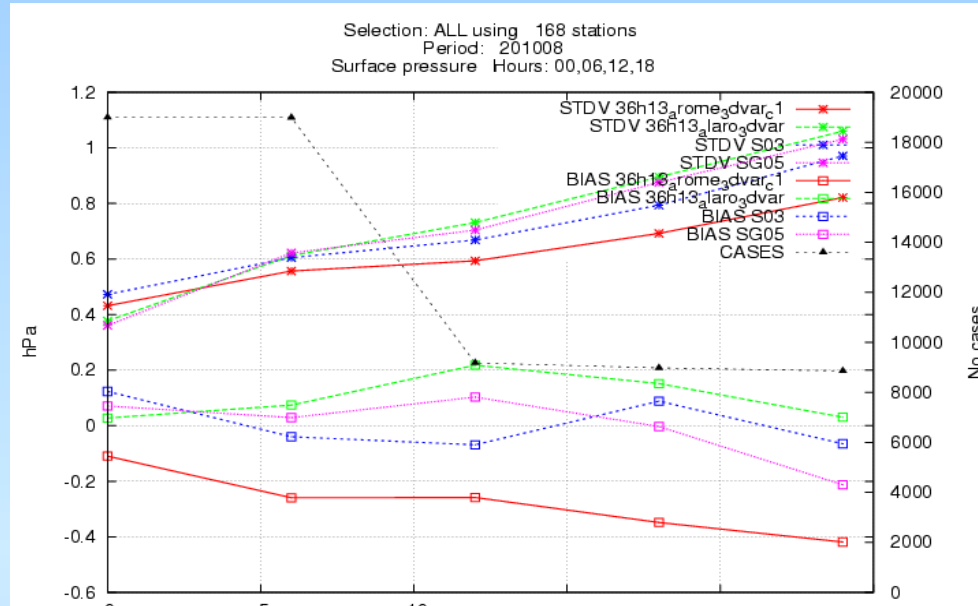
S

W10

201008, ~3 km



AROME
ALARO 5.5
S03
G05

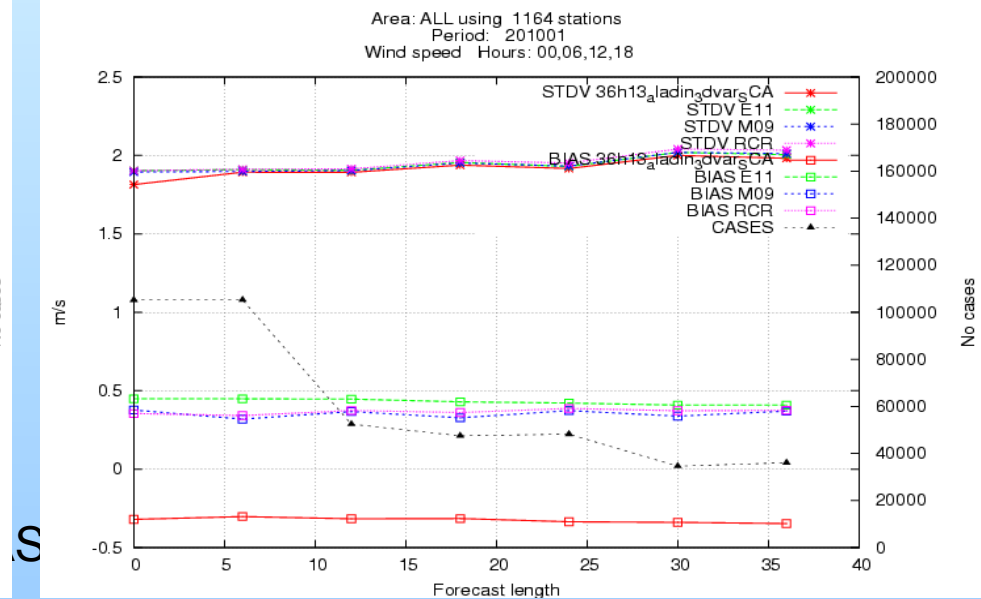
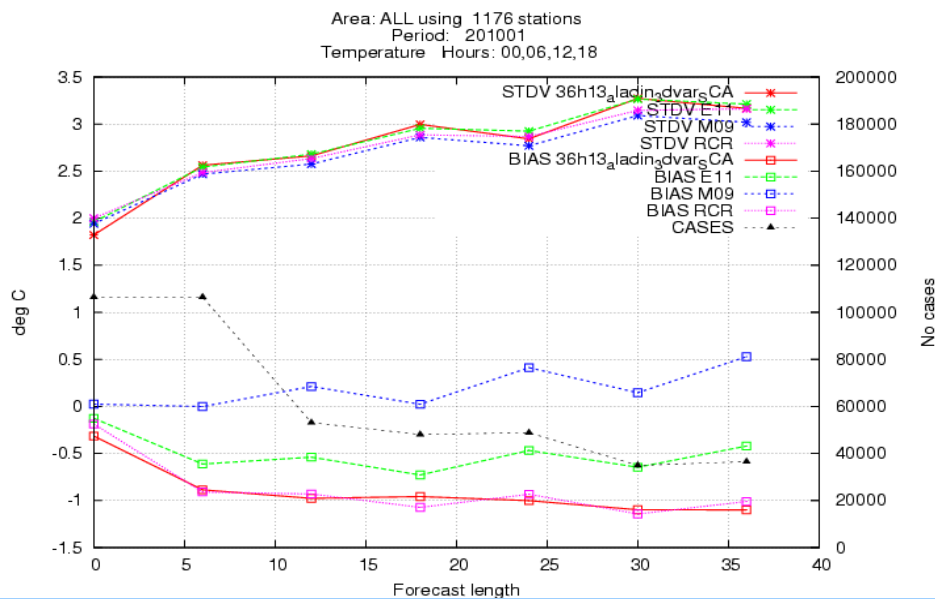
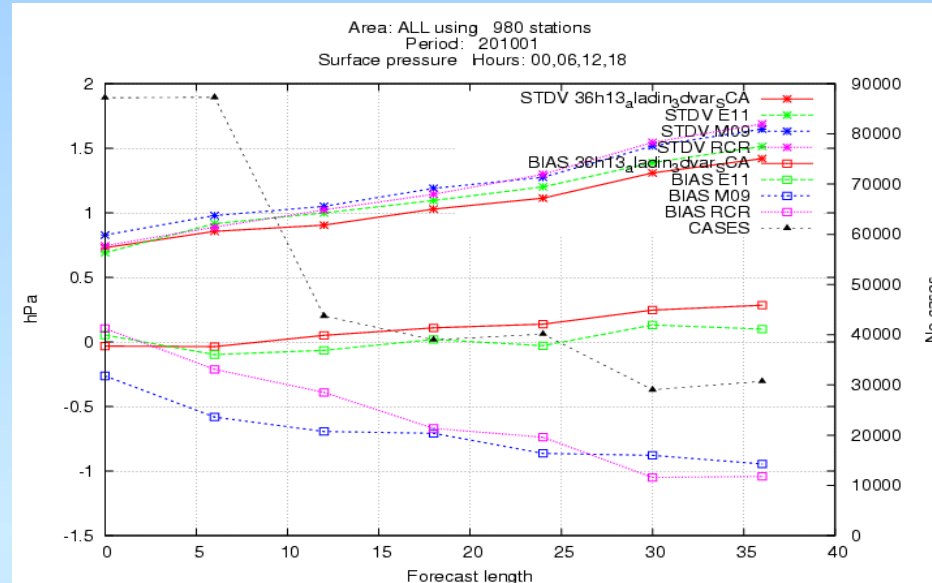


Winter (201001), ~10 km



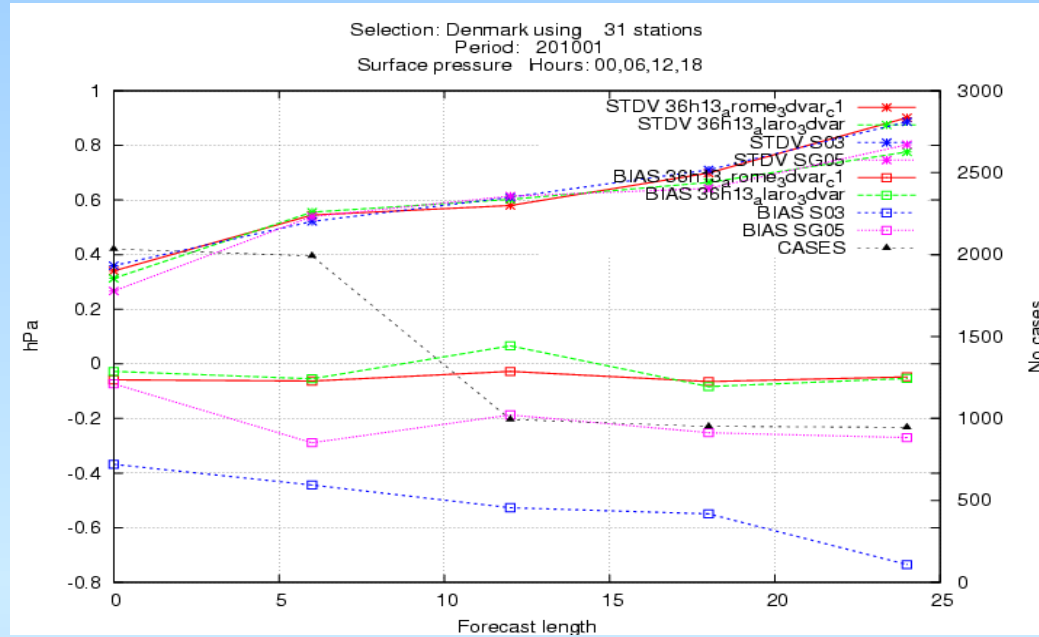
DMI

ALADIN
E11
M09
RCR

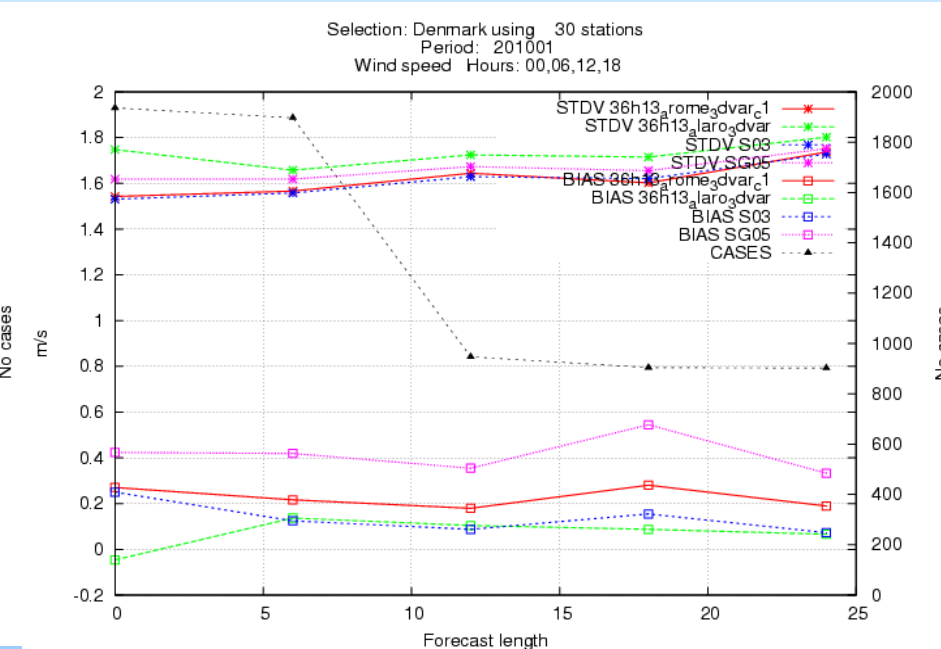
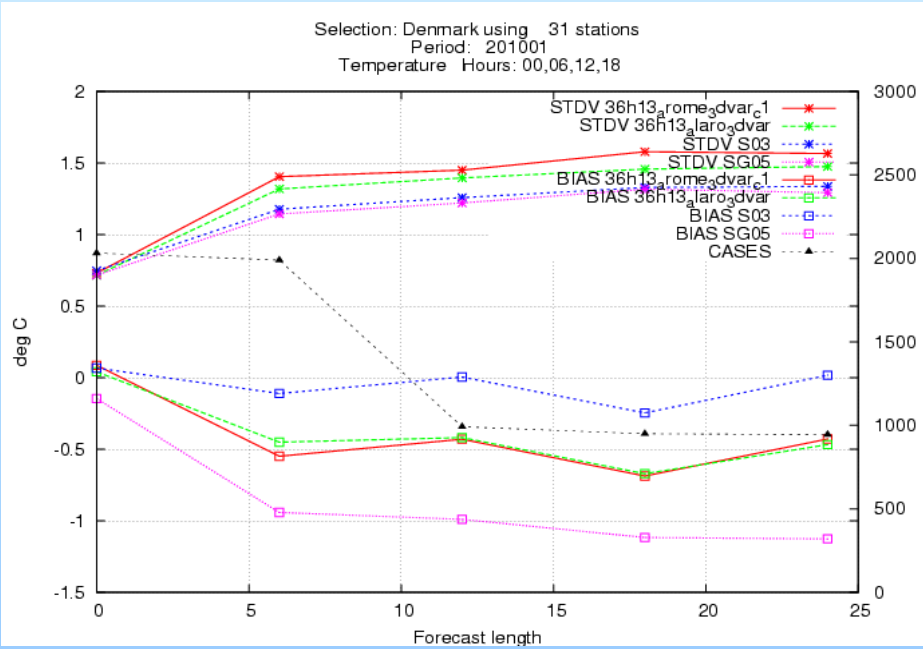


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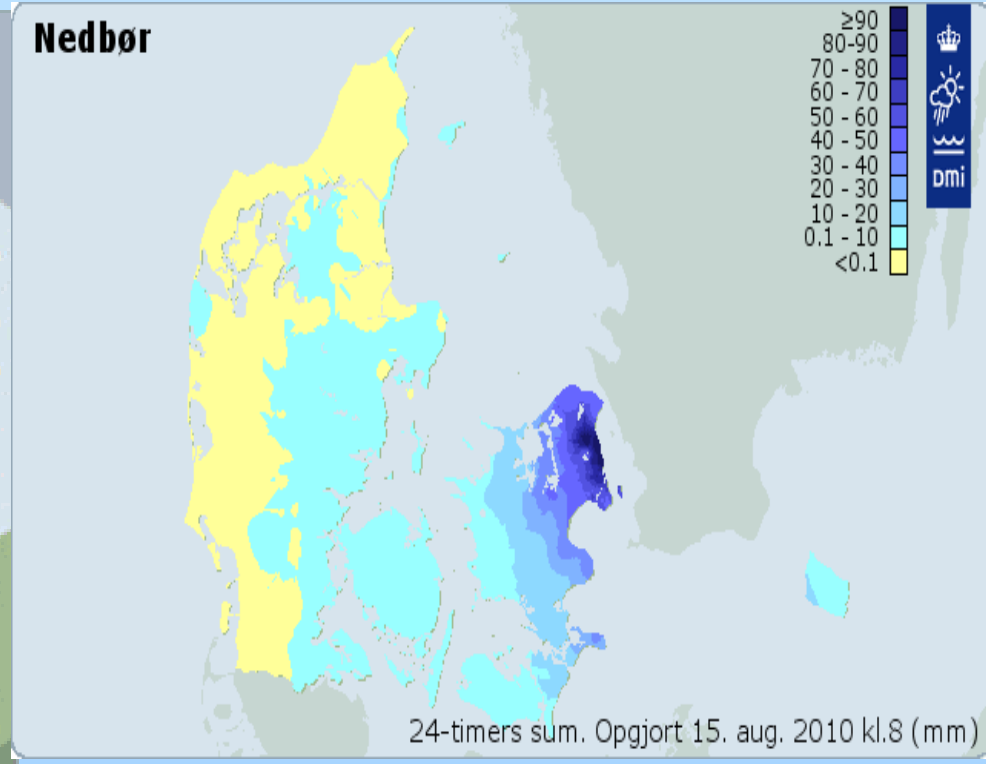
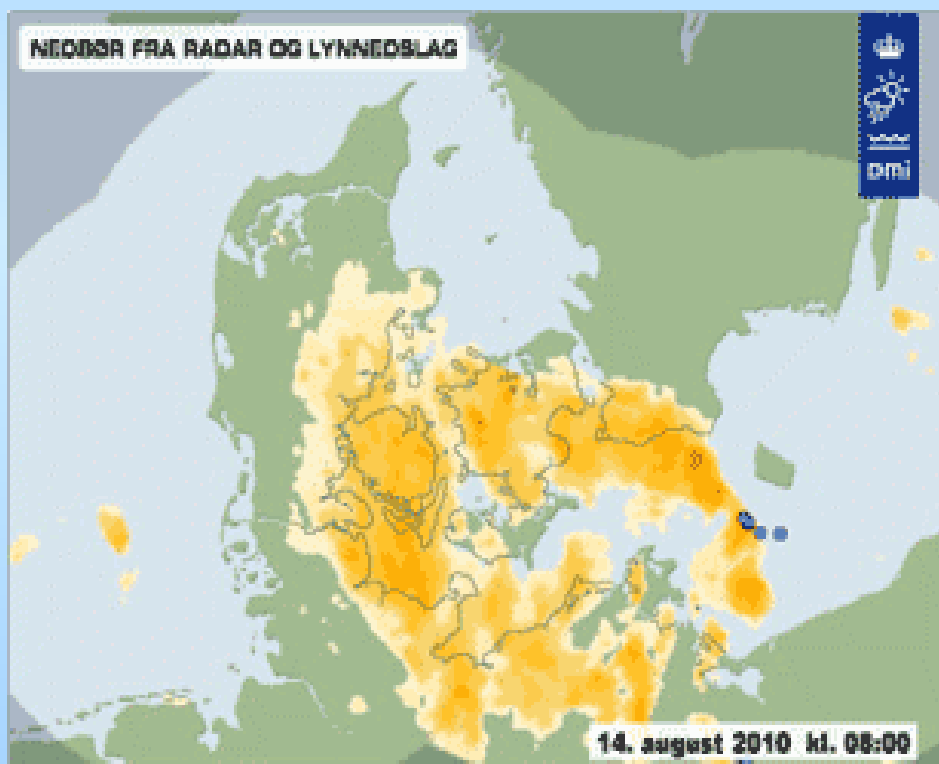
201001, ~3 km



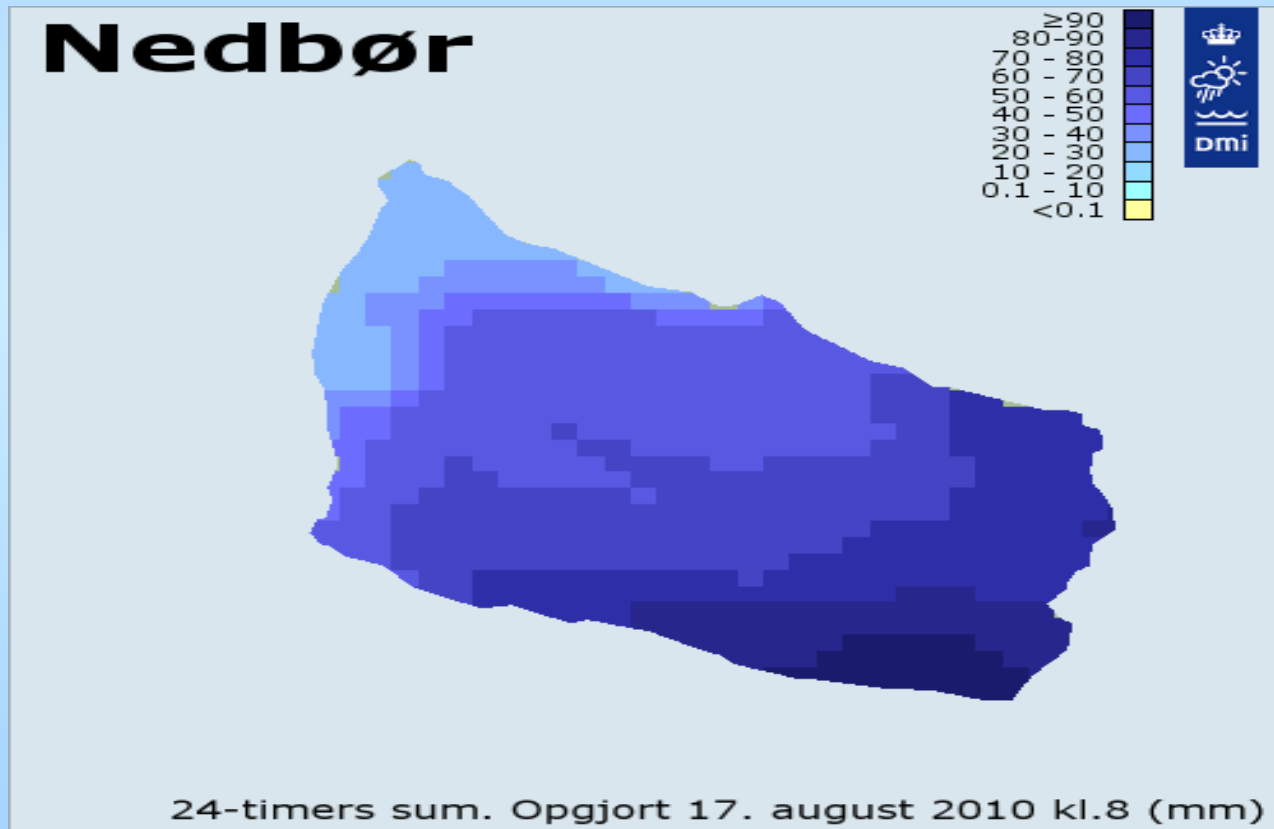
AROME
ALARO 5.5
S03
G05



Aug 14 2010 Copenhagen torrential rain

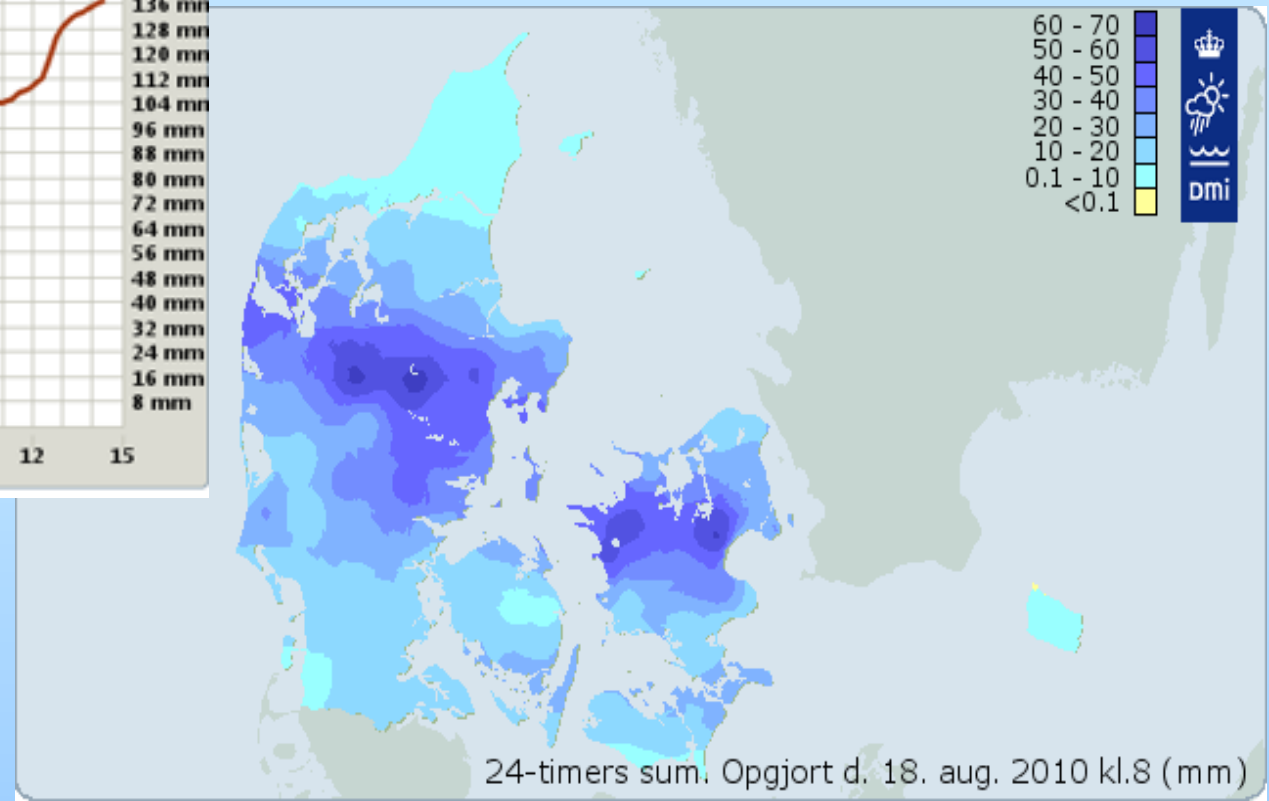
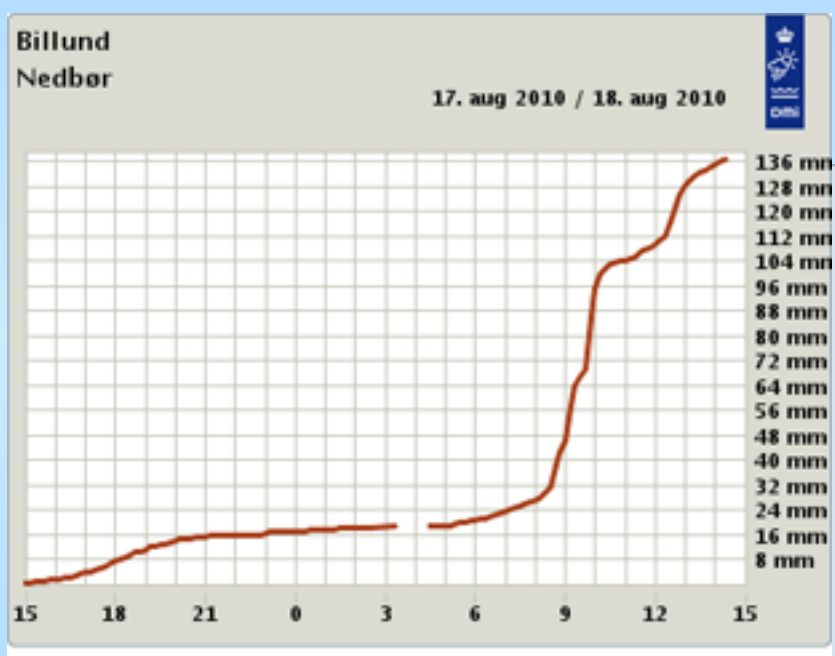


Aug 17 2010 Bornholm flashflood



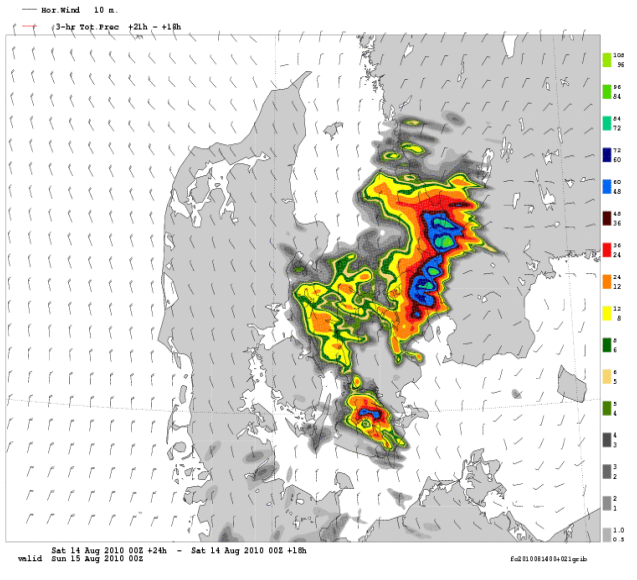
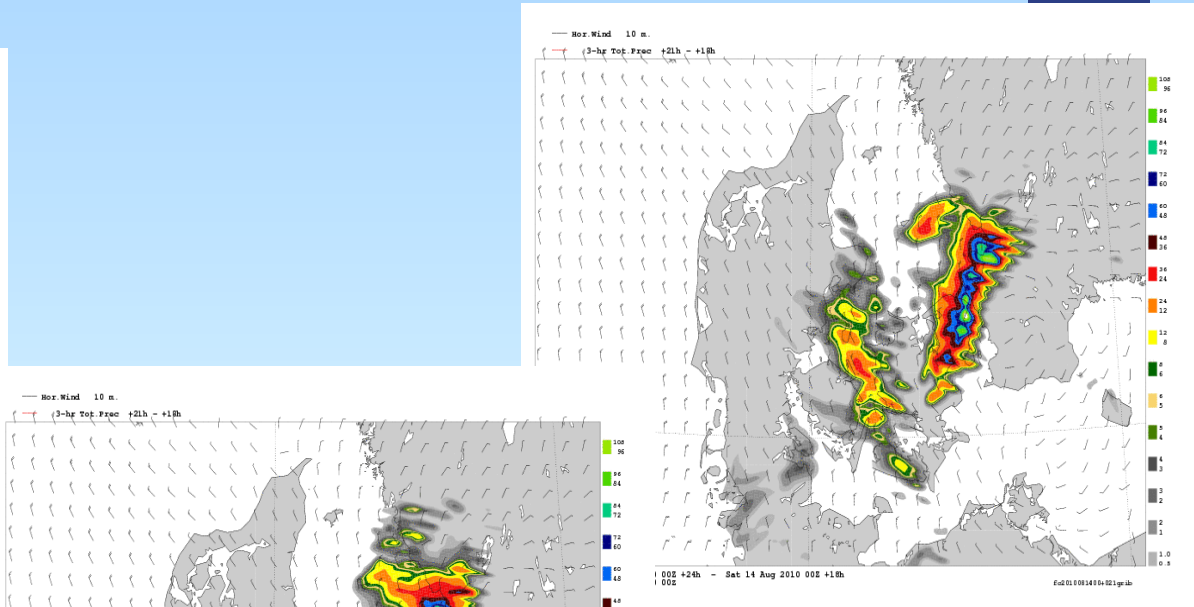
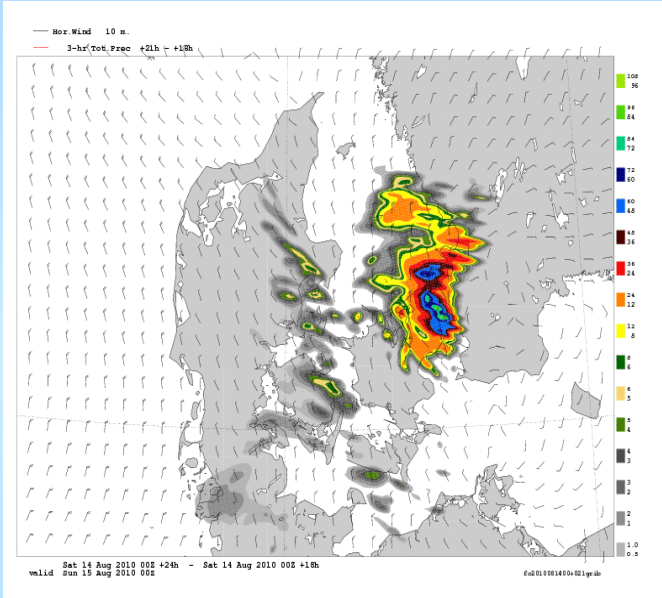
Yang et al, ASM 2011

Aug 18 2010 Billund torrential rain



Pang et al, AOM 2011

Aug 14: AROME 3h precipitation +21h

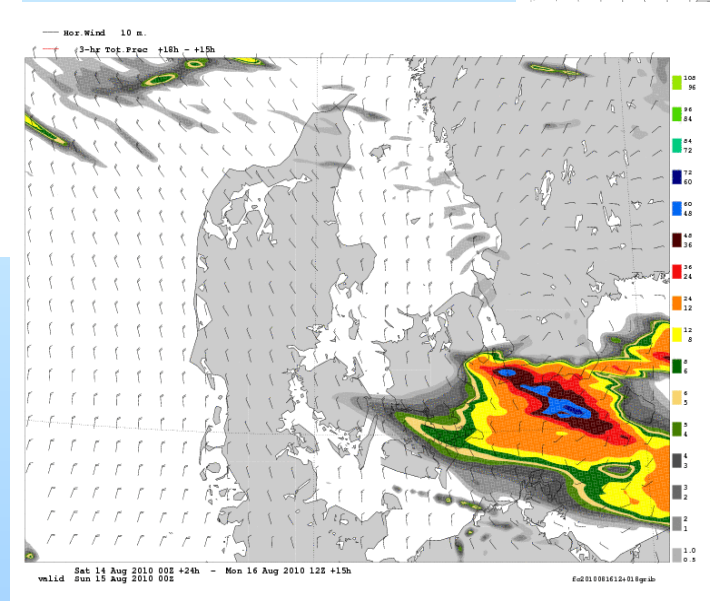
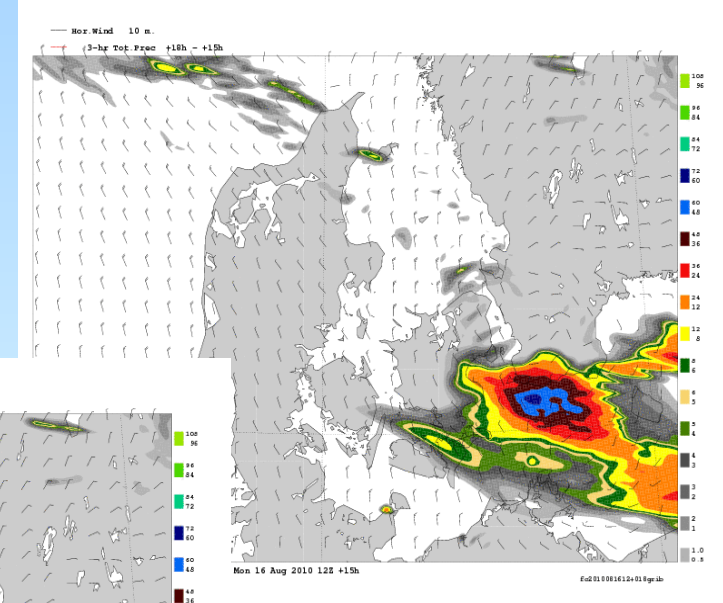
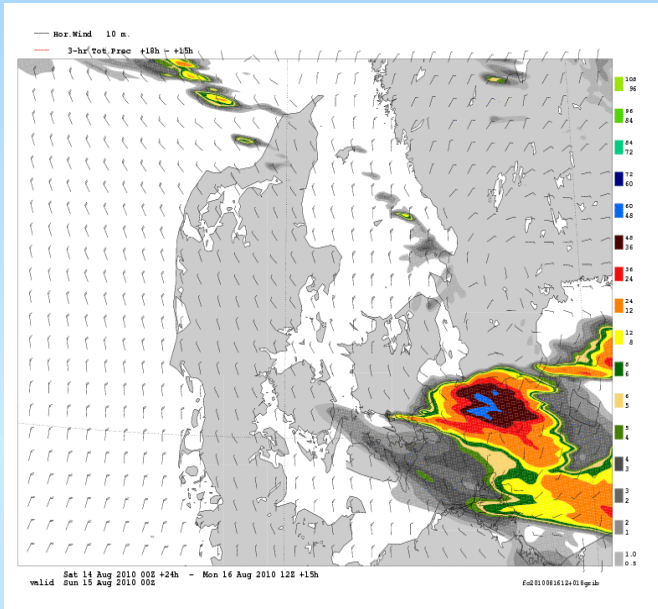


No DA

surface DA

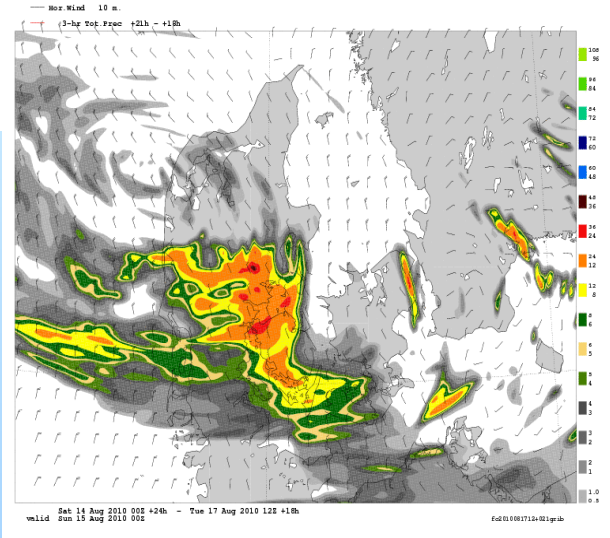
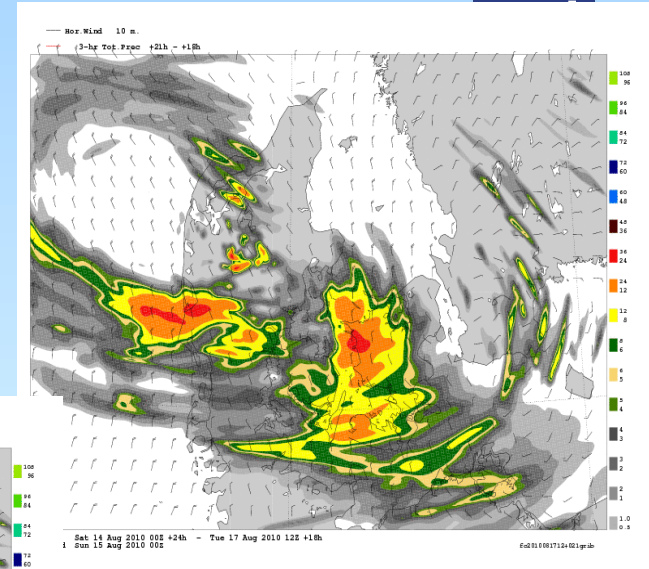
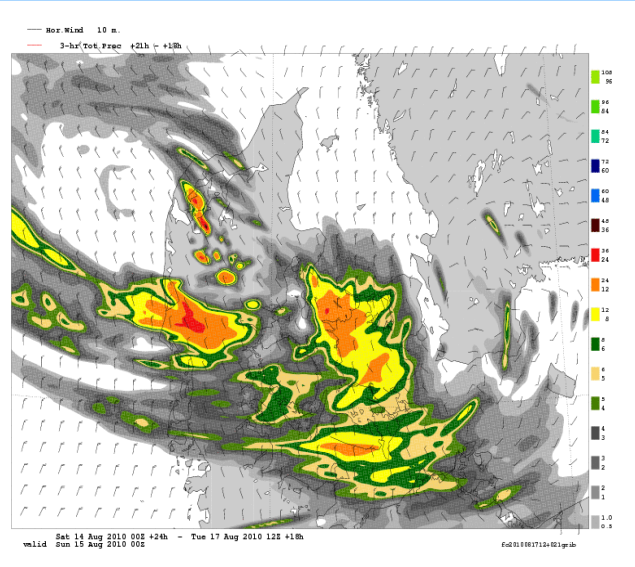
Yang et al. ASM 2011
With DA

Aug 17: AROME 3h precipitation +18h



DA
Yang et al, ASM 2011

Aug 18: AROME 3h precipitation +21h

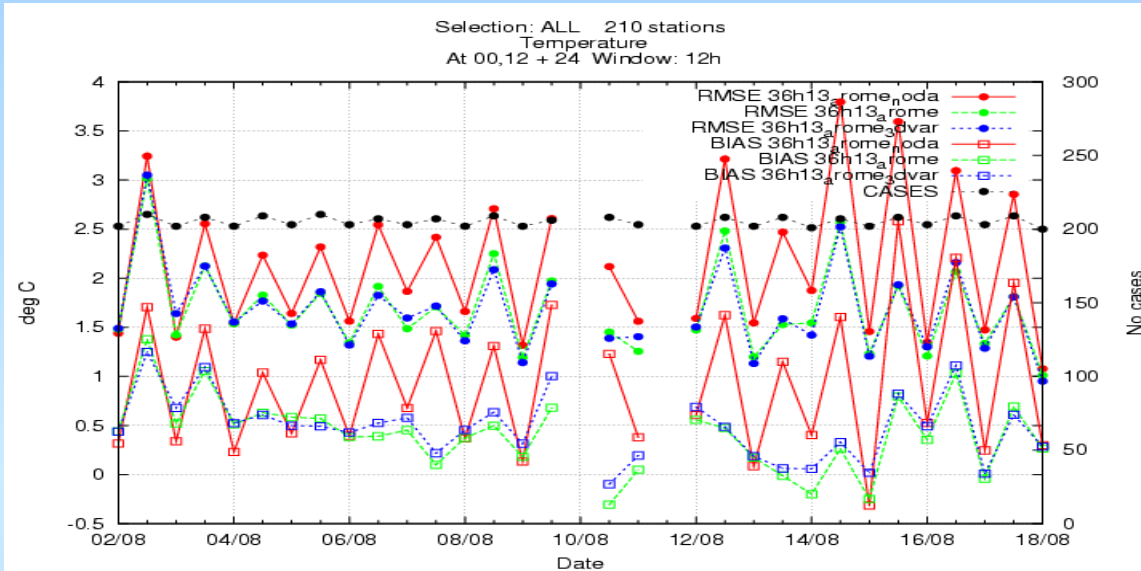


No DA

Surface DA

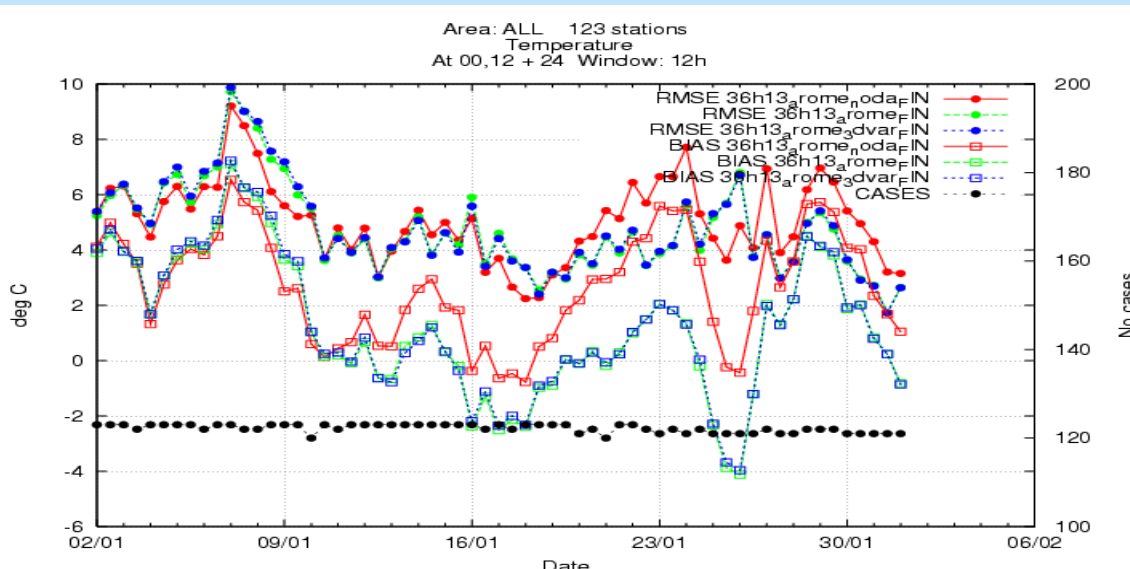
DA
Yang et al, ASM 2011

Impact of data assimilation: T2



201008

No da
surface da
3dvar+da

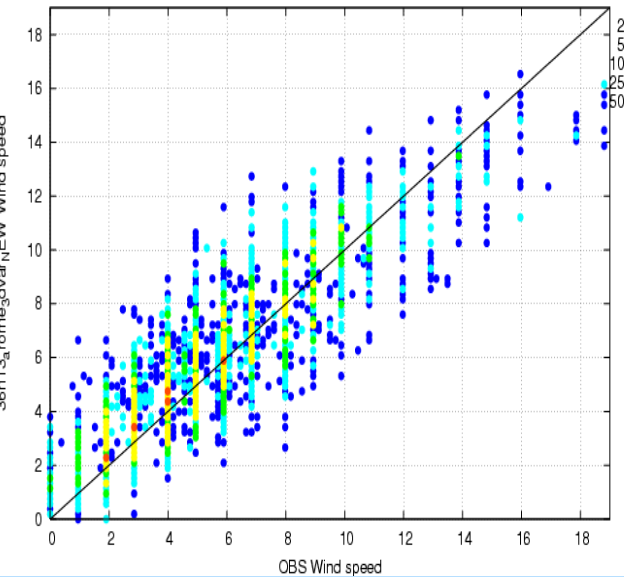


201001

W10m over Denmark, Jan 2010

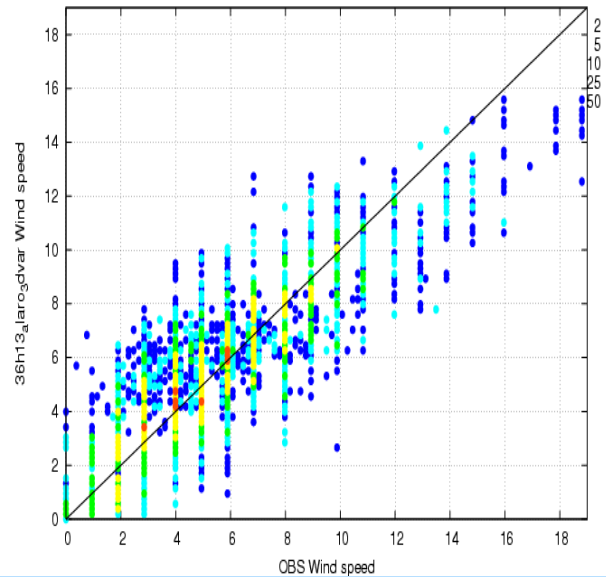


Scatterplot for 30 stations Area: Denmark
Wind speed
At 00,06,12,18 + 06 18
Period: 201001



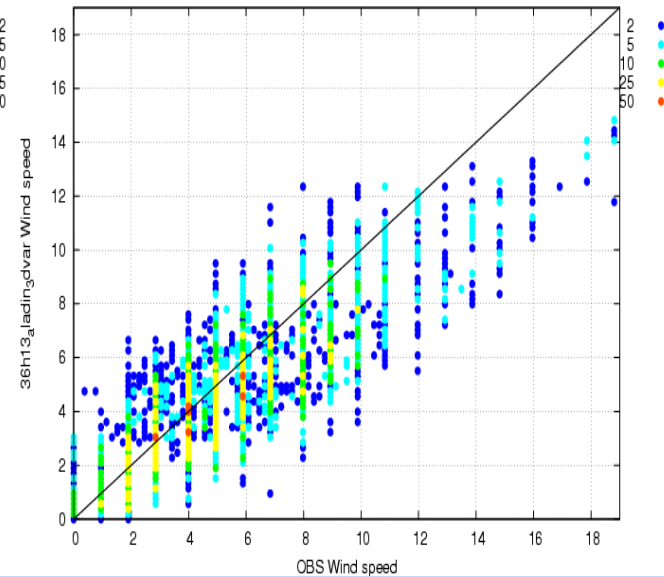
AROME

Scatterplot for 30 stations Area: Denmark
Wind speed
At 00,06,12,18 + 06 18
Period: 201001



ALARO 5.5

Scatterplot for 30 stations Area: Denmark
Wind speed
At 00,06,12,18 + 06 18
Period: 201001

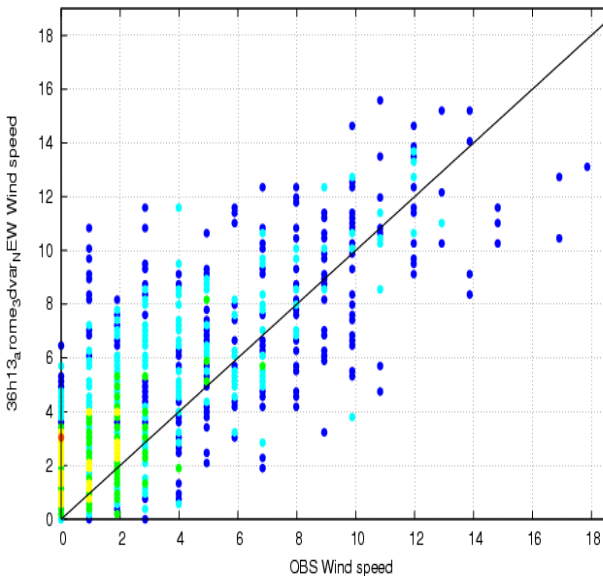


ALADIN 5.5

W10 over mountains, Jan 2010

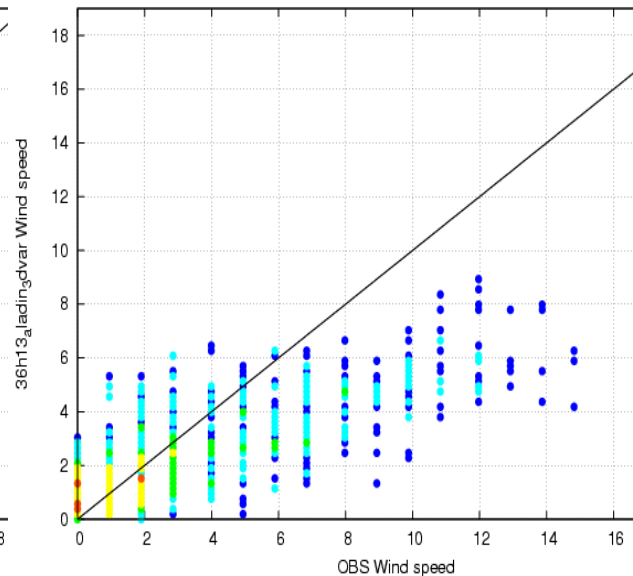


Scatterplot for 7 stations Area: Eumou
Wind speed
At 00,06,12,18 + 06 18
Period: 201001



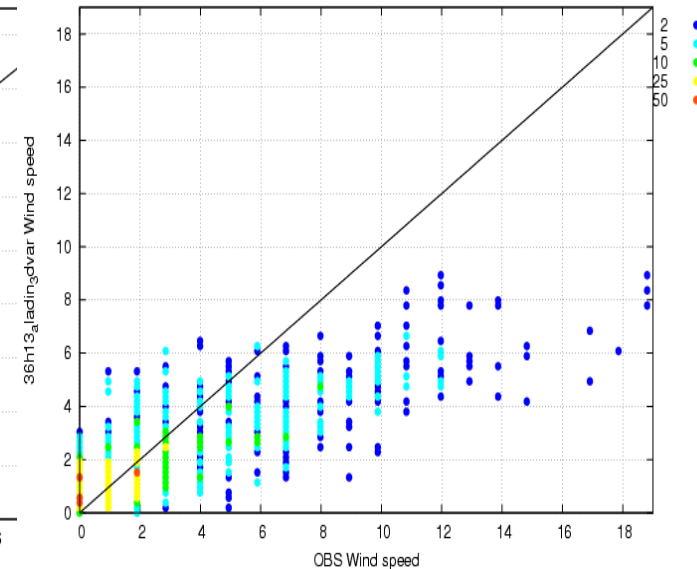
AROME

Scatterplot for 7 stations Area: Eumou
Wind speed
At 00,06,12,18 + 06 18
Period: 201001



ALARO 5.5

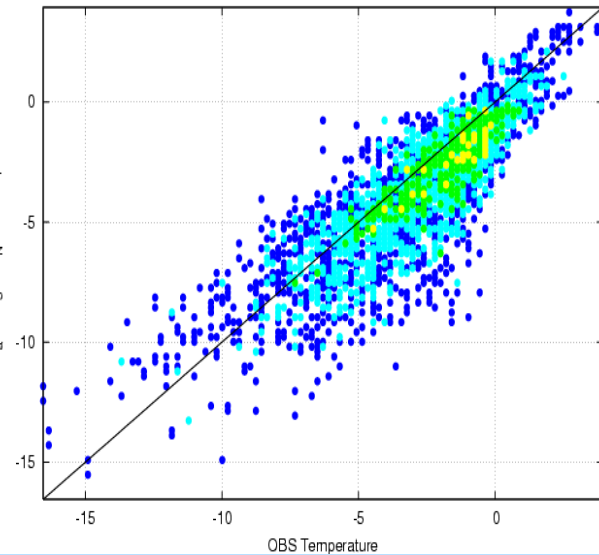
Scatterplot for 7 stations Area: Eumou
Wind speed
At 00,06,12,18 + 06 18
Period: 201001



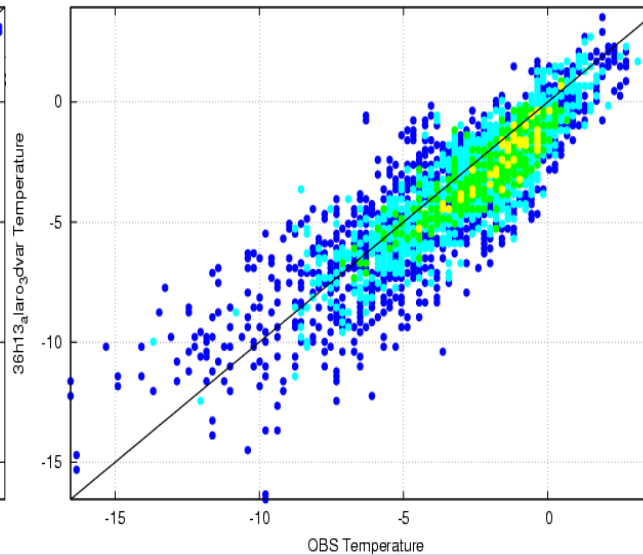
ALADIN 5.5

T2 over Denmark, Jan 2010

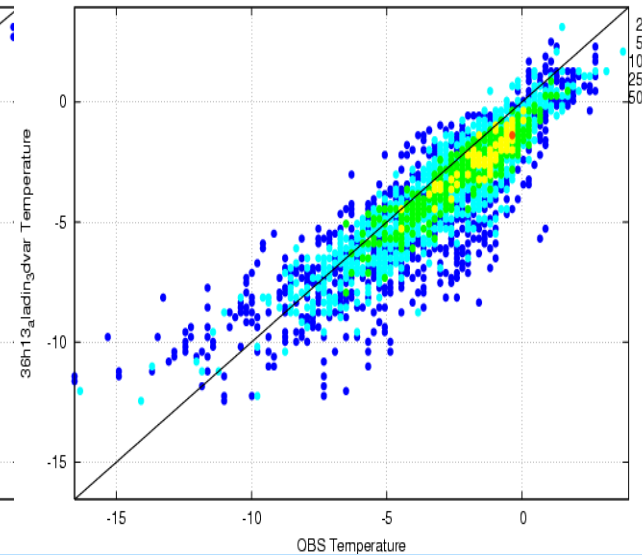
Scatterplot for 31 stations Area: Denmark
Temperature
At 00,06,12,18 + 06 18
Period: 201001



Scatterplot for 31 stations Area: Denmark
Temperature
At 00,06,12,18 + 06 18
Period: 201001



Scatterplot for 31 stations Area: Denmark
Temperature
At 00,06,12,18 + 06 18
Period: 201001



AROME

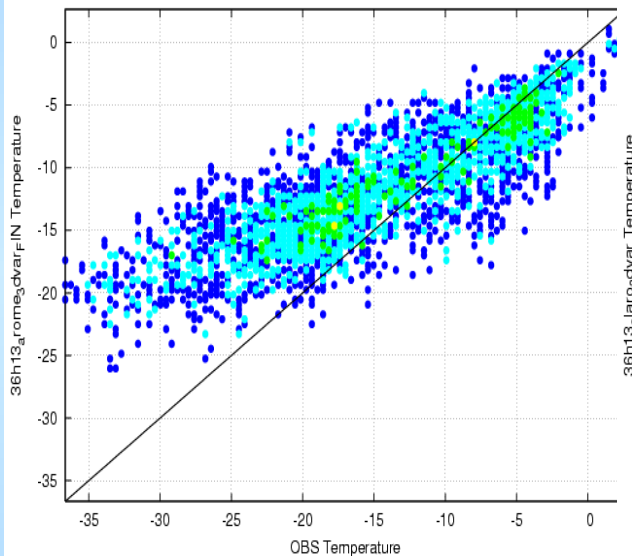
ALARO 5.5

ALADIN 5.5

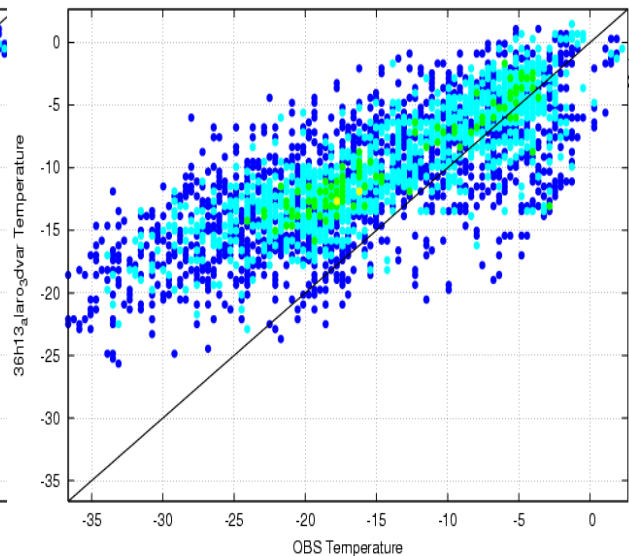
T2 over "FINLAND", Jan 2010



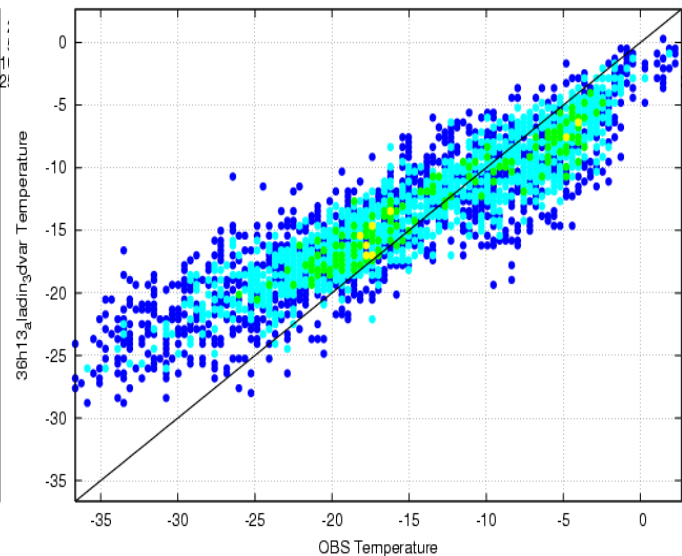
Scatterplot for 39 stations Area: Finland
Temperature
At 00,06,12,18 + 06 18
Period: 201001



Scatterplot for 39 stations Area: Finland
Temperature
At 00,06,12,18 + 06 18
Period: 201001



Scatterplot for 39 stations Area: Finland
Temperature
At 00,06,12,18 + 06 18
Period: 201001



AROME

ALARO 5.5

ALADIN 5.5

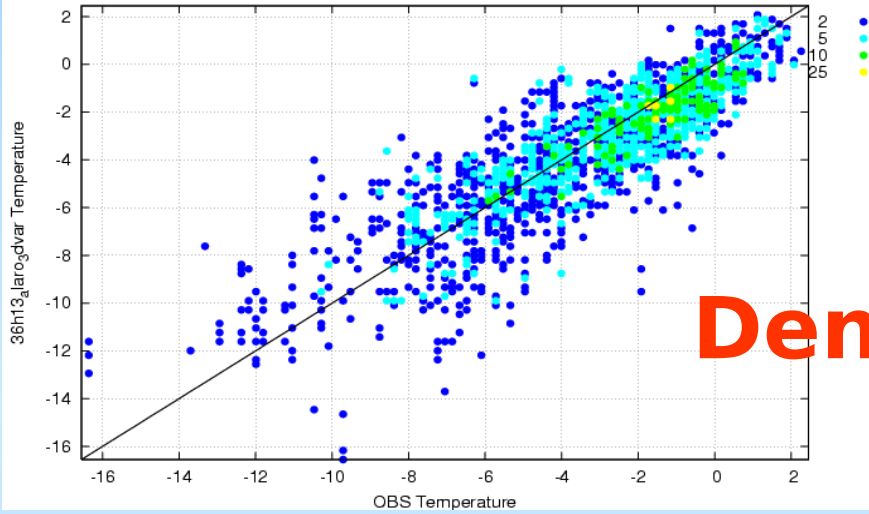
ALARO, T2

surfex

isba

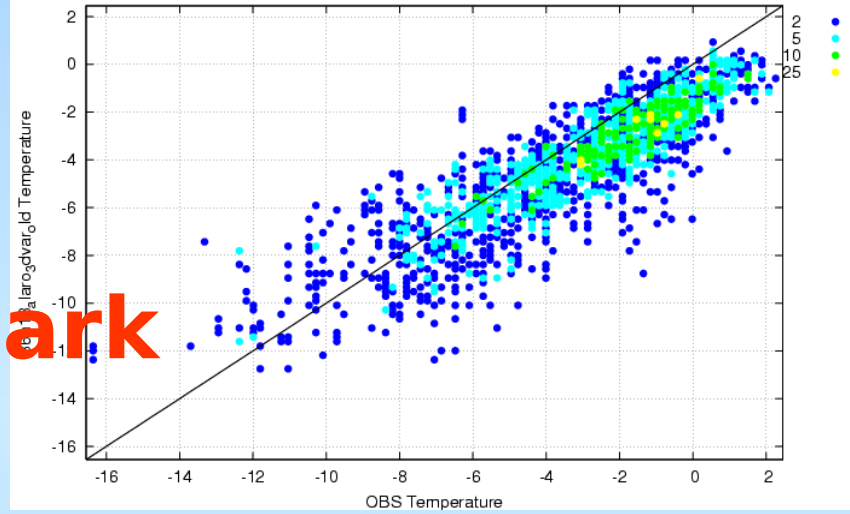


Scatterplot for 22 stations Area: Denmark
Temperature
At 00,06,12,18 + 06 18 30
Period: 201001

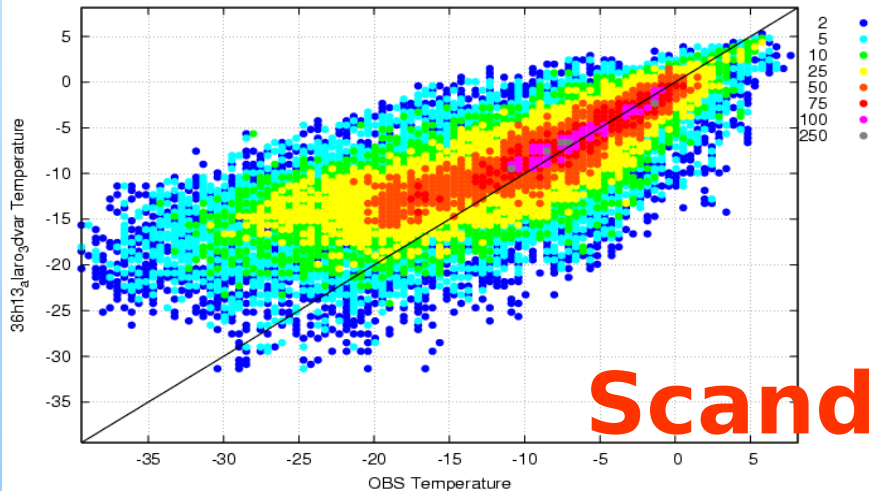


Denmark

Scatterplot for 22 stations Area: Denmark
Temperature
At 00,06,12,18 + 06 18 30
Period: 201001

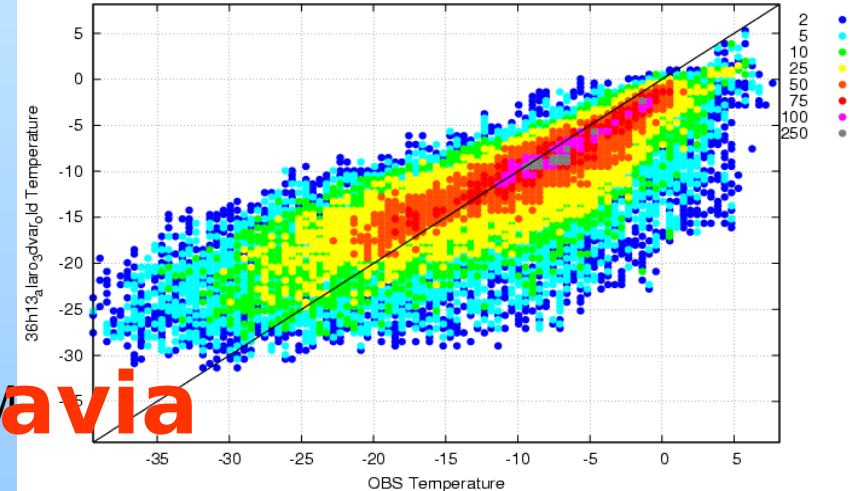


Scatterplot for 368 stations Area: Scandinavia
Temperature
At 00,06,12,18 + 06 18 30
Period: 201001



Scandinavia

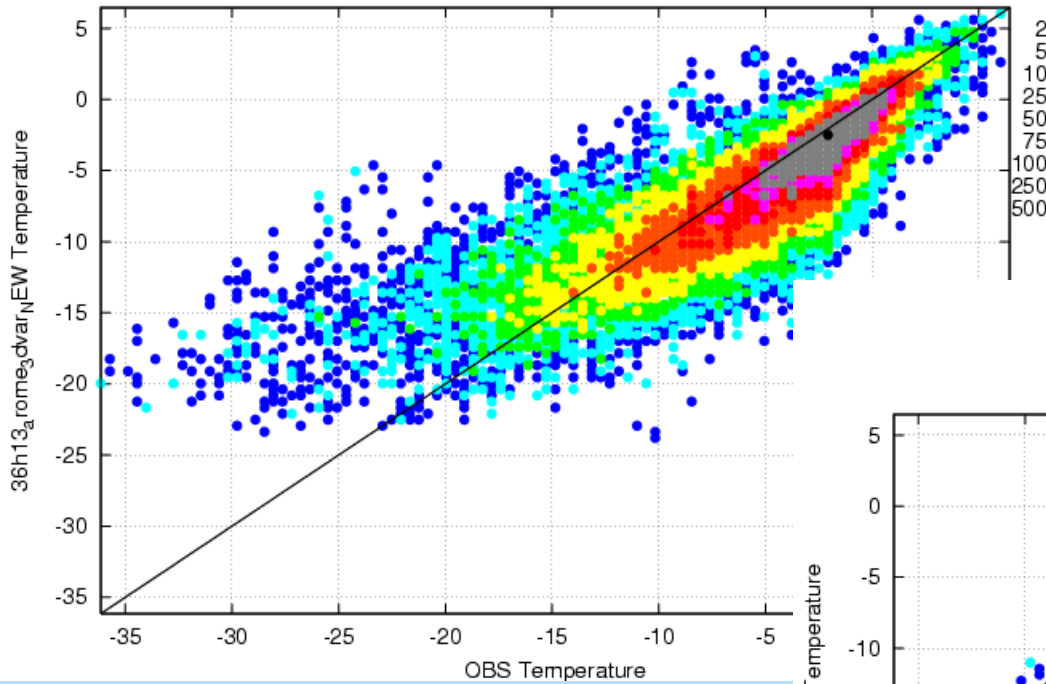
Scatterplot for 368 stations Area: Scandinavia
Temperature
At 00,06,12,18 + 06 18 30
Period: 201001



AROME, T2

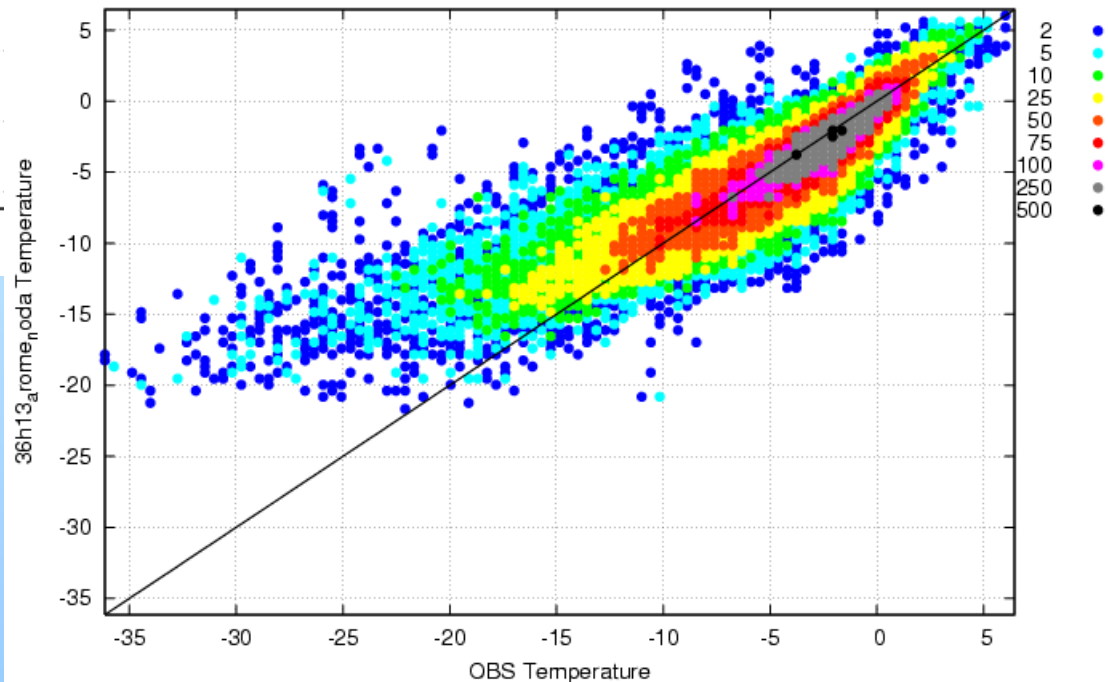


Scatterplot for 231 stations Area: ALL
Temperature
At 00,06,12,18 + 06 18
Period: 201001



with DA

Scatterplot for 231 stations Area: ALL
Temperature
At 00,06,12,18 + 06 18
Period: 201001



no Da

Yang

Summary



- Two month-long validation runs with various configurations, which provide quality as well as technical benchmark for future systems
- Lots of experiences and knowledges gained by joint contribution from staffs at several HIRLAM institutes
- Numerous technical and quality deficiencies exposed, many improved, some remains

Conclusions



- HARMONIE forecasts (AAA) have a generally comparable skill, sometimes favorable, verification at both 2km and 10 km scale in comparison to operational HIRLAM
- AROME delivers competitive forecast skill for extreme rainfall events. ALADIN surface wind forecasts tend to be too weak. Poor HARMONIE performance for cold winter temperature. Snow modeling may need to a closer look
- Surface assimilation clearly beneficial. 3D-VAR impact neutral
- Local adaptations need to take into account different model characteristics

Thank you for your attention

36h1.3 problems & fixes

- **AROME/surfex**
 - strong wind bias (canopy_drag)
 - Edmfm: bug fix
 - noisy wind over sea in windy condition
 - Negative Q
- **Technical aspects:** data retrieval; archiving; build
- **DA:** correction on obs data use

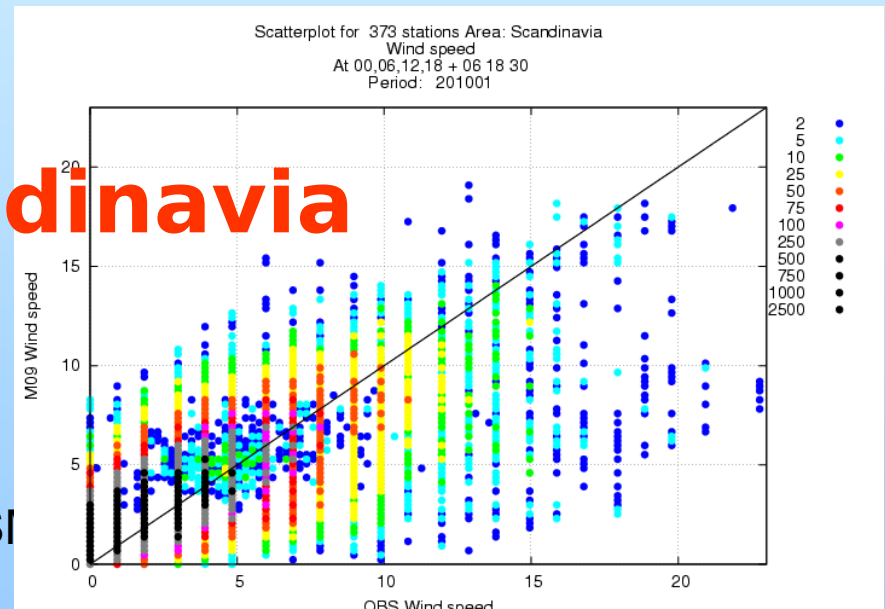
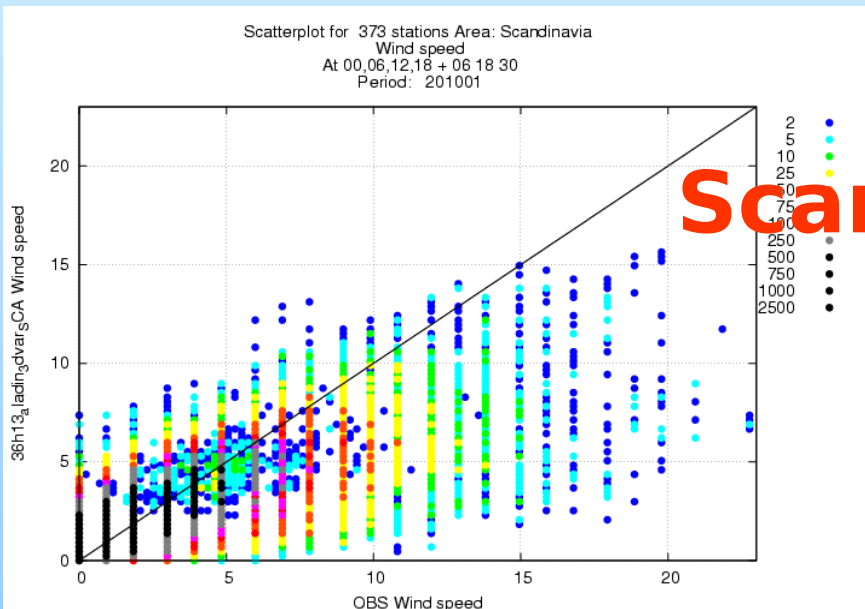
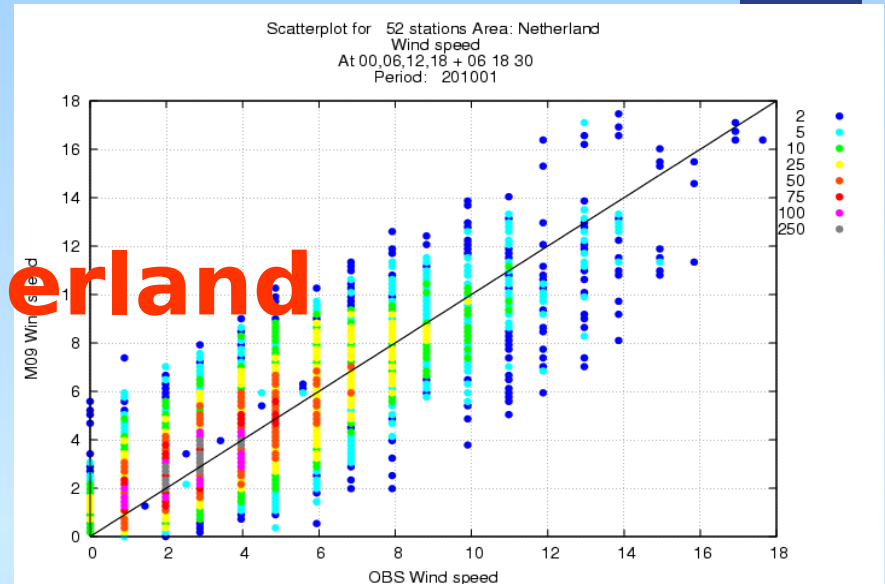
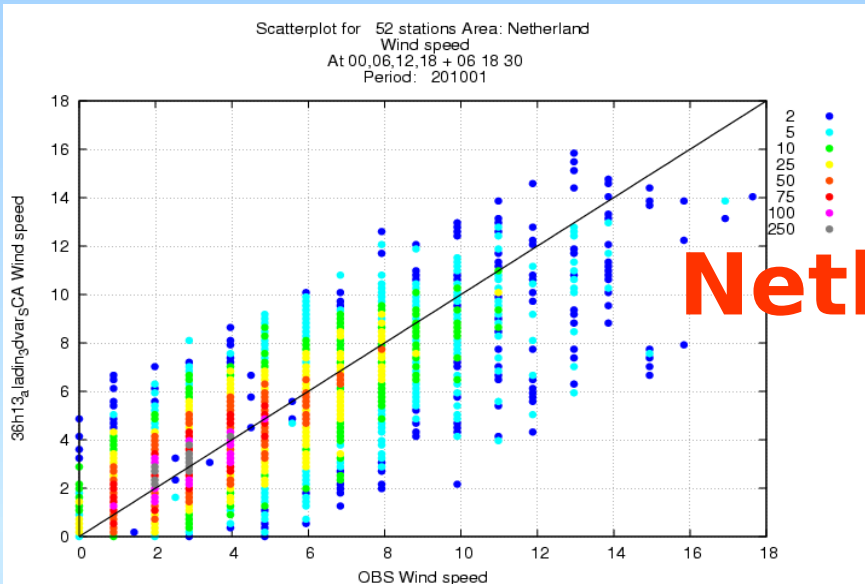
For operational use, consider stable 36h1-branch, or 36h1.4

ALADIN 10 W10 Hirlam M09



Netherlands

Scandinavia



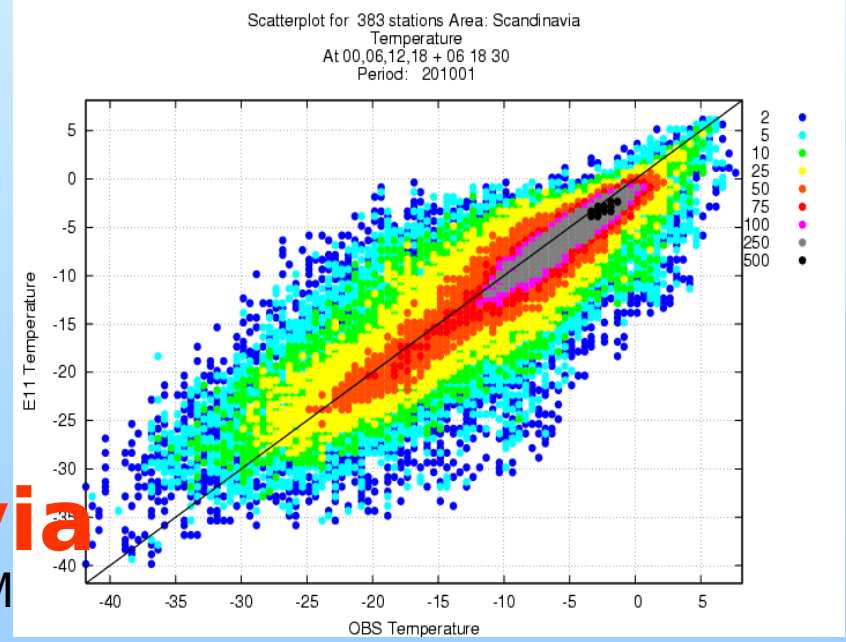
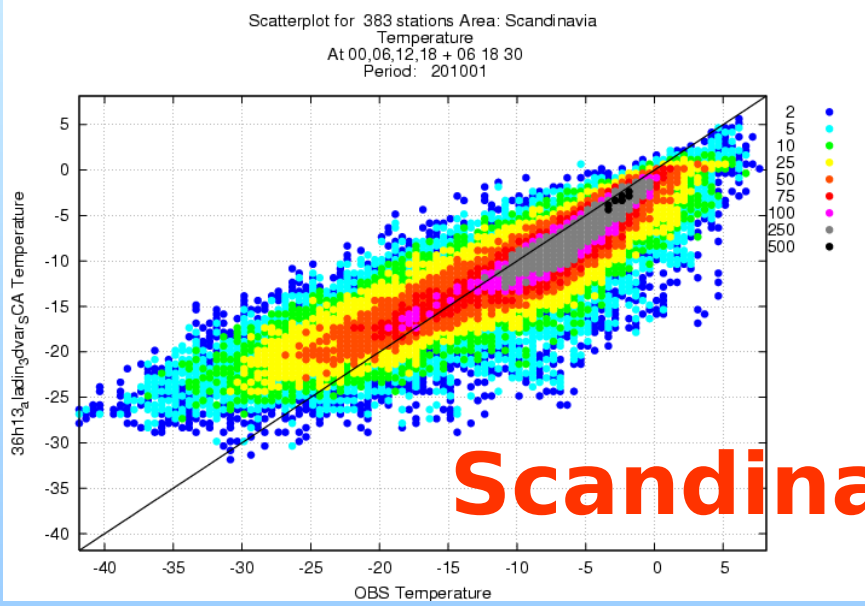
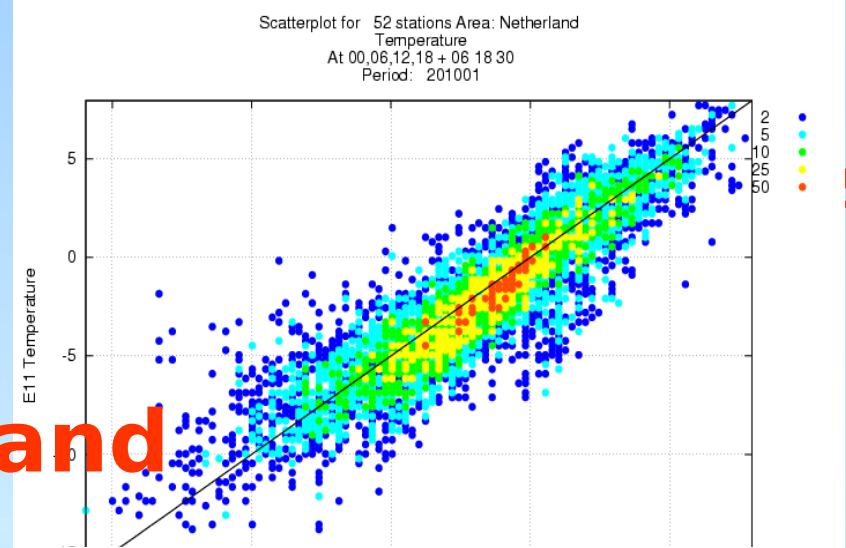
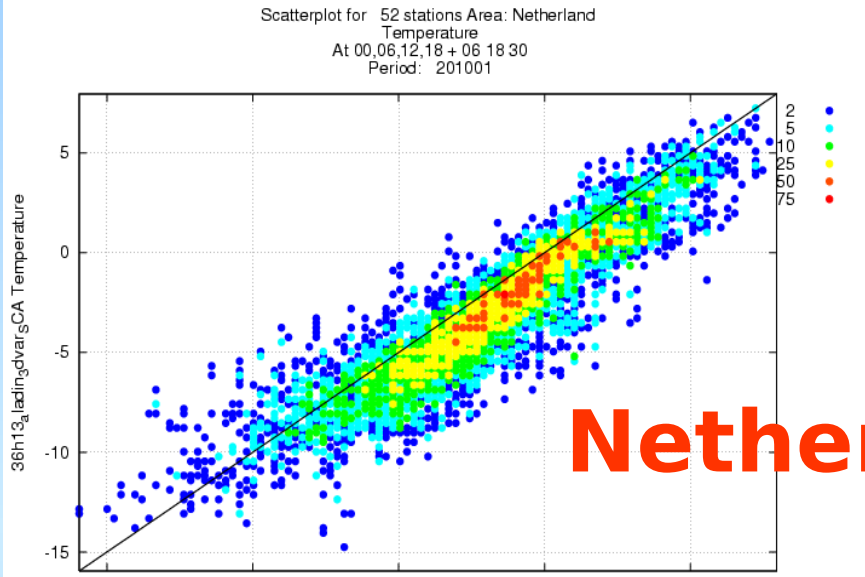
SI

ALADIN 10 T2

Hirlam



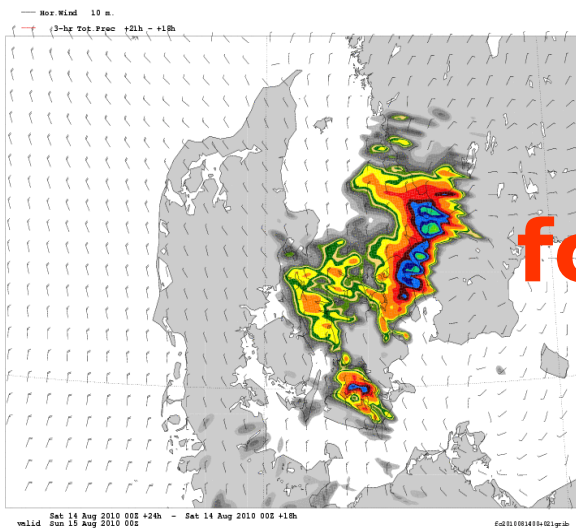
Netherlands



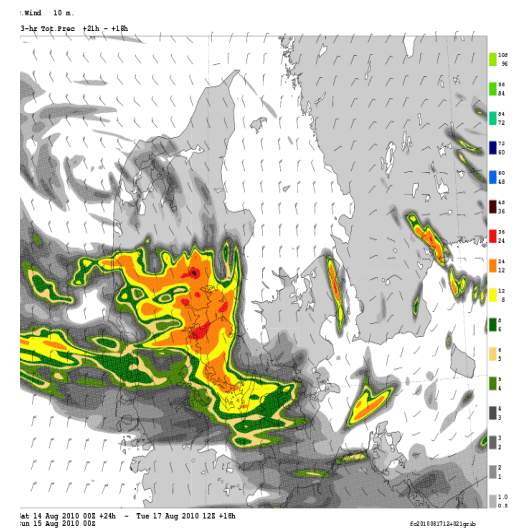
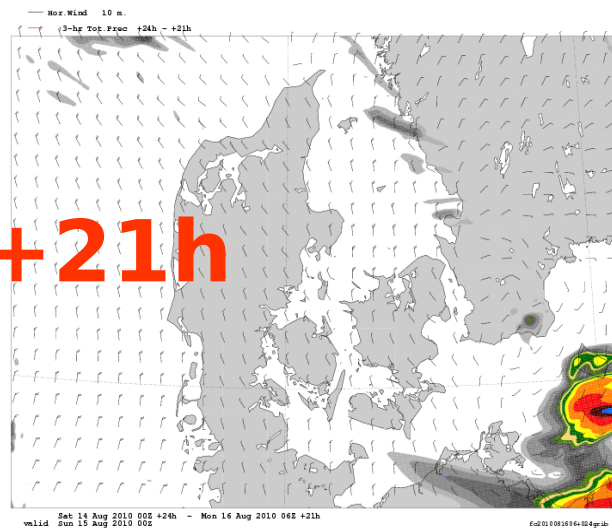
Scandinavia

SM

Impact of DA?



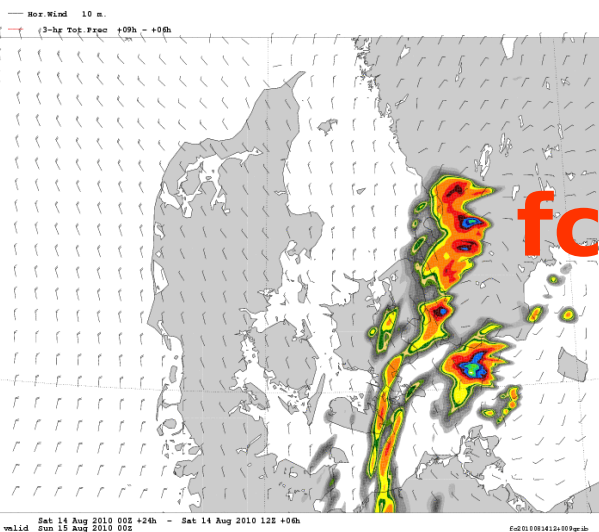
fc+21h



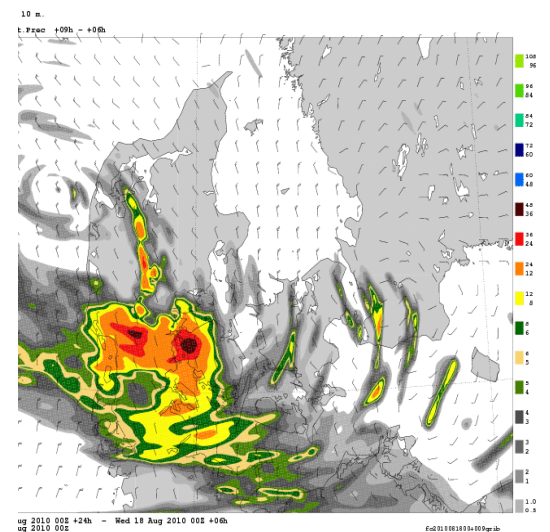
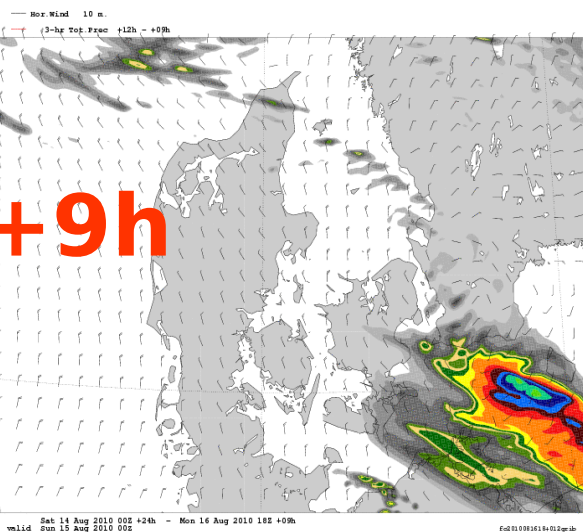
14 Aug

17 Aug

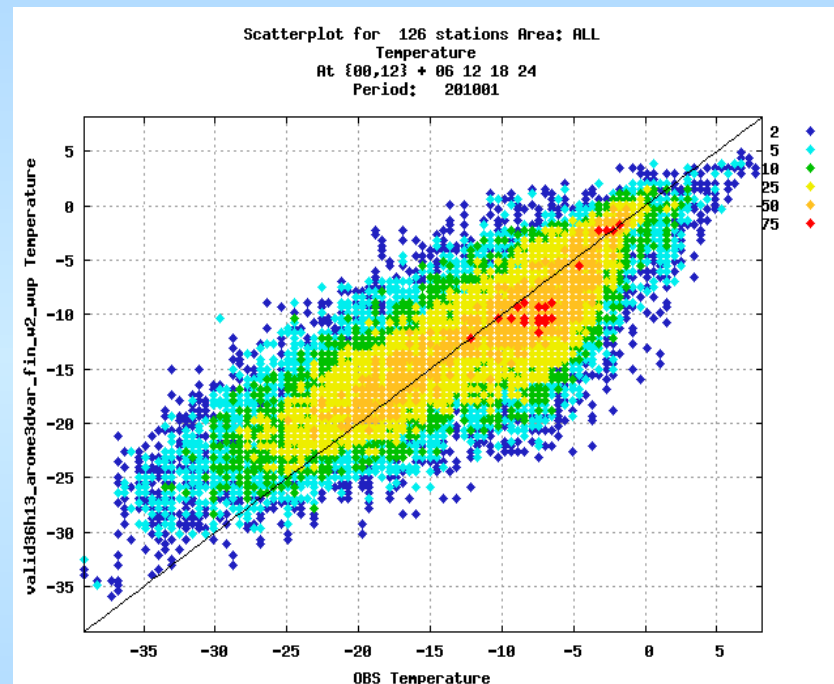
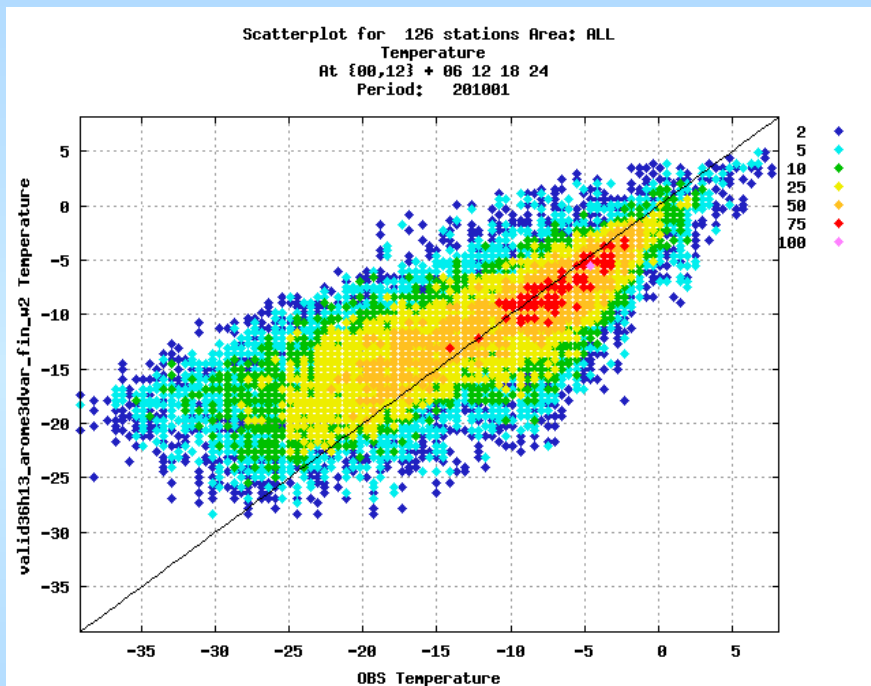
18 Aug



fc+9h

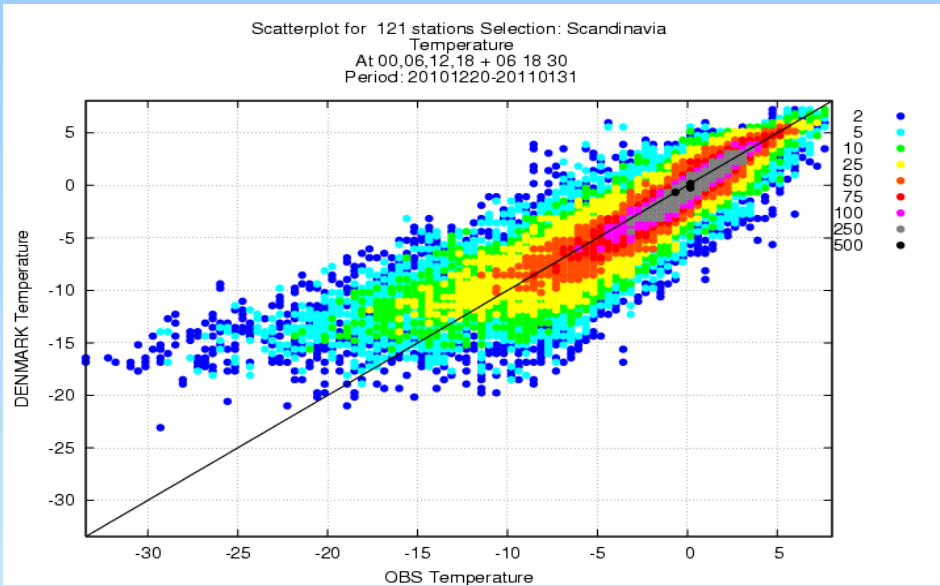


FINLAND, Jan 2010



"cold"-start

"warm"-start

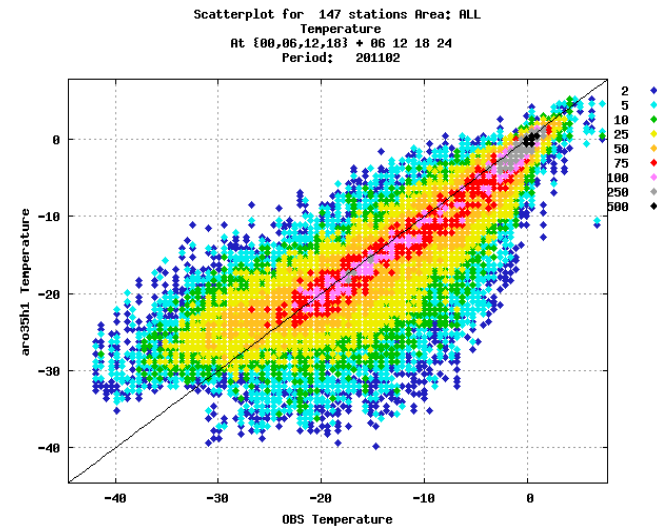
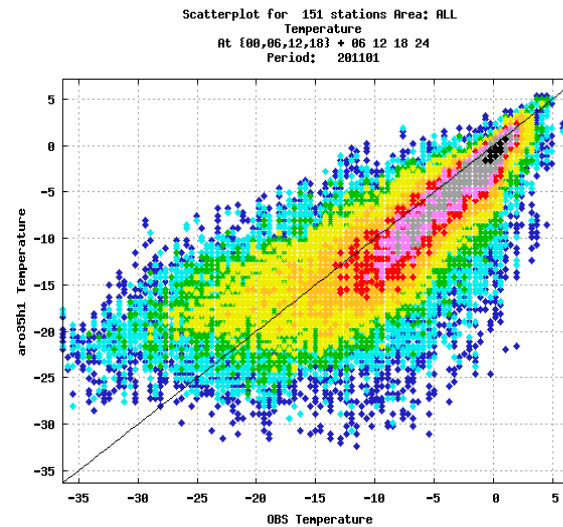
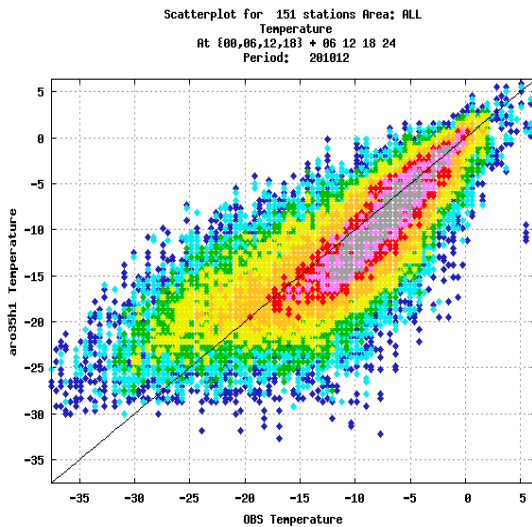


**“Denmark”, 36h1.3
Jan 2011**

Dec 2010

**“FINLAND, 35h1”
Jan 2011**

Feb 2011



Reservations about results



- **Point-wise verification provides only a sanity-check**
 - Meso-scale phenomena is not well covered in synoptic network, and generally has poor (deterministic) predictability: interpret scores with caution!
 - Double penalty issue especially on precipitation forecast
- **Area coverage and episode length insufficient to cover interesting weather**
 - Snow and ice modelling
 - extreme conditions (storm, temperature, wind)
 - Not looked at: outflow problems, fog, gust
- **Boundary coupling issue not directly investigated (direct ECMWF coupling)**

Near future plan

- Following to be included in 36h1.4 (May?)
 - Correction about surface drag in AROME
 - Edmfm for AROME
 - ECPHY
- To be featured/corrected (37h1.0, autumn 2011)
 - Elimination of unnecessary calculation in e- zone
 - OpenMP to be extended to surfex; Surfex-related i/o issue; Start-up issue (for cy37h1?)
 - Enabling of more remote sensing data
 - Noisy surface wind over sea under windy condition
 - negative Q