

3h-Cycling with Asynoptic Base Time

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synoptic time: 00, (03), 06, ... ,18, (21)

Outline

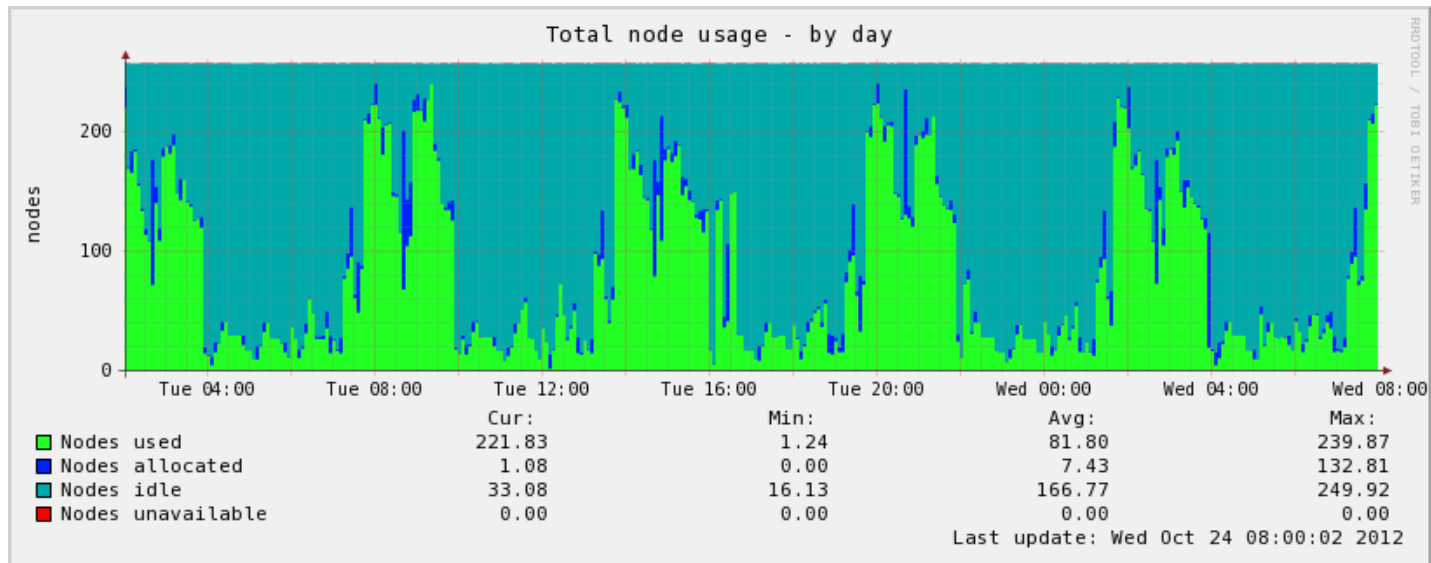
1. Motivation
2. Configuration with asynoptic base time
3. Evaluation
4. Operational experience at DMI
5. Summary

NWP Systems at DMI (2012)

DMI-HIRLAM (High Resolution Limited Area Model) is the operational model used at DMI for forecast of up to two days.

HARMONIE (Hirlam-Aladin Research on Mesoscale Operational NWP in Europe) model has been run at DMI since 2007. Not official yet.

Base time	Model	Grid-Resolution	EC LBC base	Leadtime	Available time
00	HIRLAM	3.3km	18	54h	300 UTC
00	HARMONIE	2.5km	18	36h	400 UTC
00	ECMWF	15km		>10day	630 UTC
06	HIRLAM	3.3km	00	54h	900 UTC
06	HARMONIE	2.5km	00	36h	1000 UTC
12	HIRLAM	3.3km	06	54h	1400 UTC
12	HARMONIE	2.5km	06	36h	1500 UTC
12	ECMWF	15km		> 10day	1830 UTC



Load status with DMI's operational HPC cluster, Dec 2012

Challenges with operationalisation of HARMONIE at HIRLAM operational services

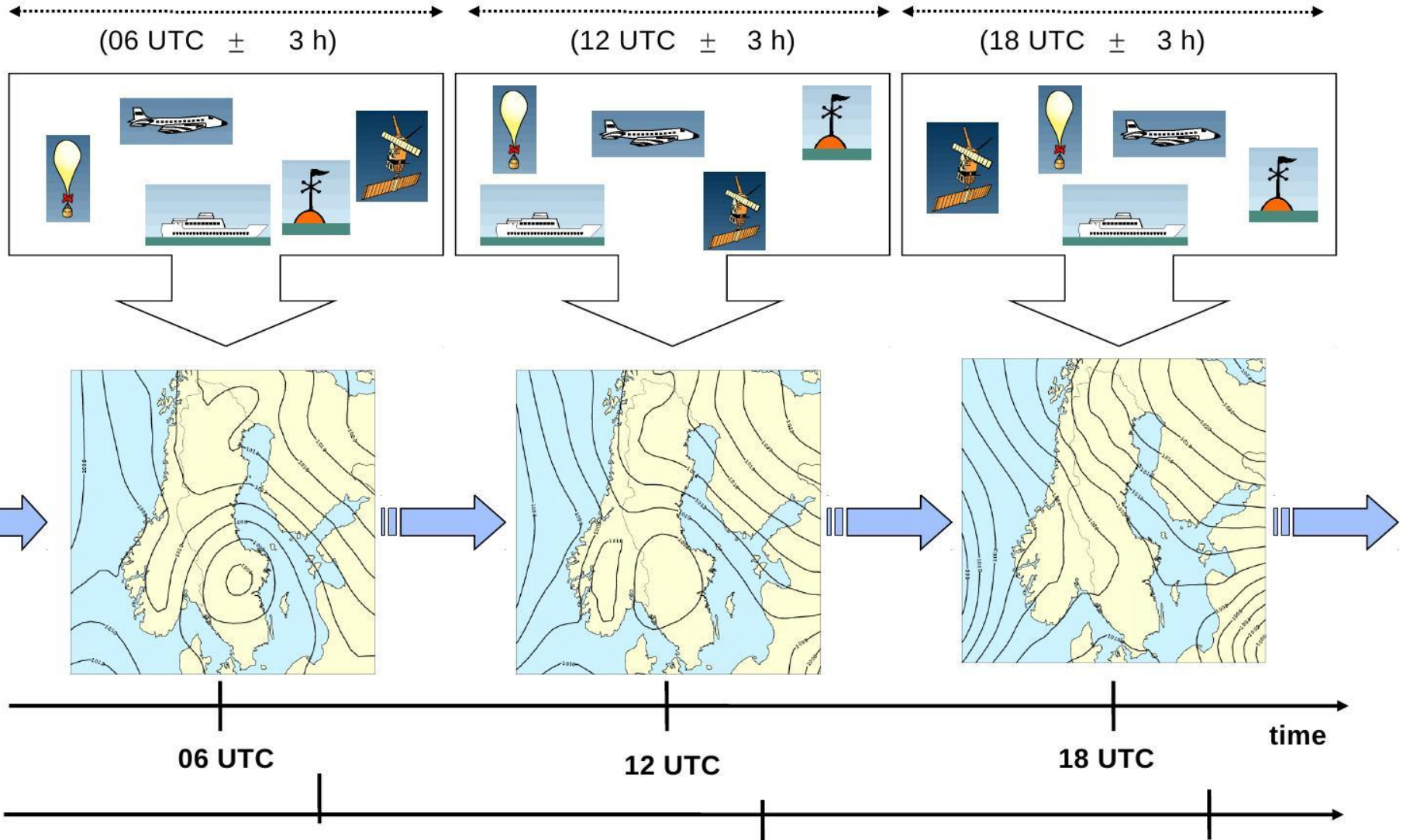
- coexistence of operational HIRLAM & HARMONIE suites
- both are time critical, shall even be more for HARMONIE
- so far, NWP suites are all configured around "synoptic time", hence competitive due to strict delivery constraints
- Late delivery of HARMONIE makes it of only reference value
- **Similar fact exists at other services. At MetEireann, forecasters see it the reason that HARMONIE is not ready for operational use.**

This investigation is about:

To explore a feasible configuration strategy that enables HARMONIE-3DVAR RUC with

- timely delivery
- quality assured
- affordable HPC resource requirement

Cycling With Synoptic Base Time 6h Intermittent DA



(Courtesy of Magnus Lindskog)

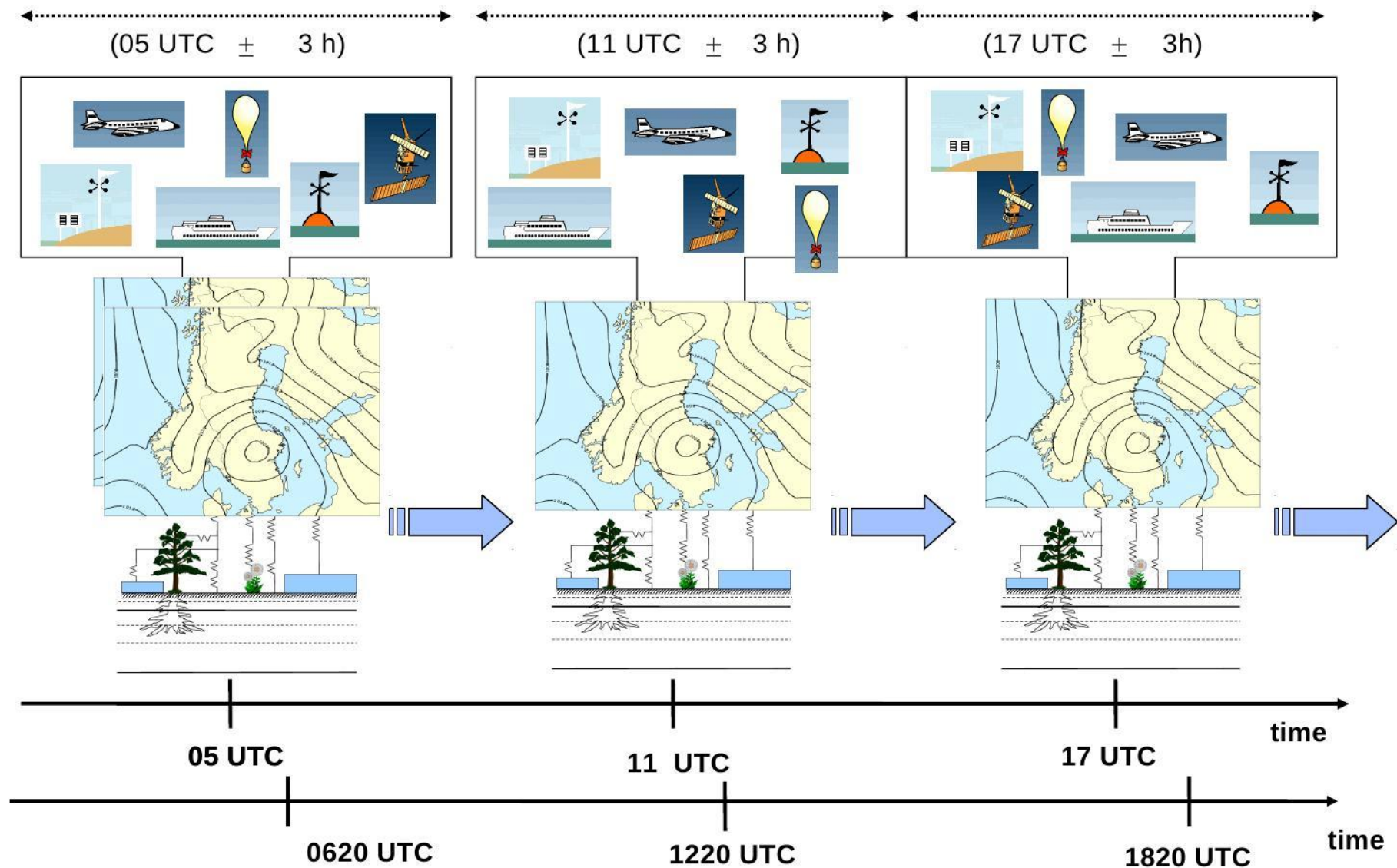
Mission: A frequent and early delivery with HARMONIE 3DVAR

Target: A 3DVAR-RUN configuration with shifted data window.

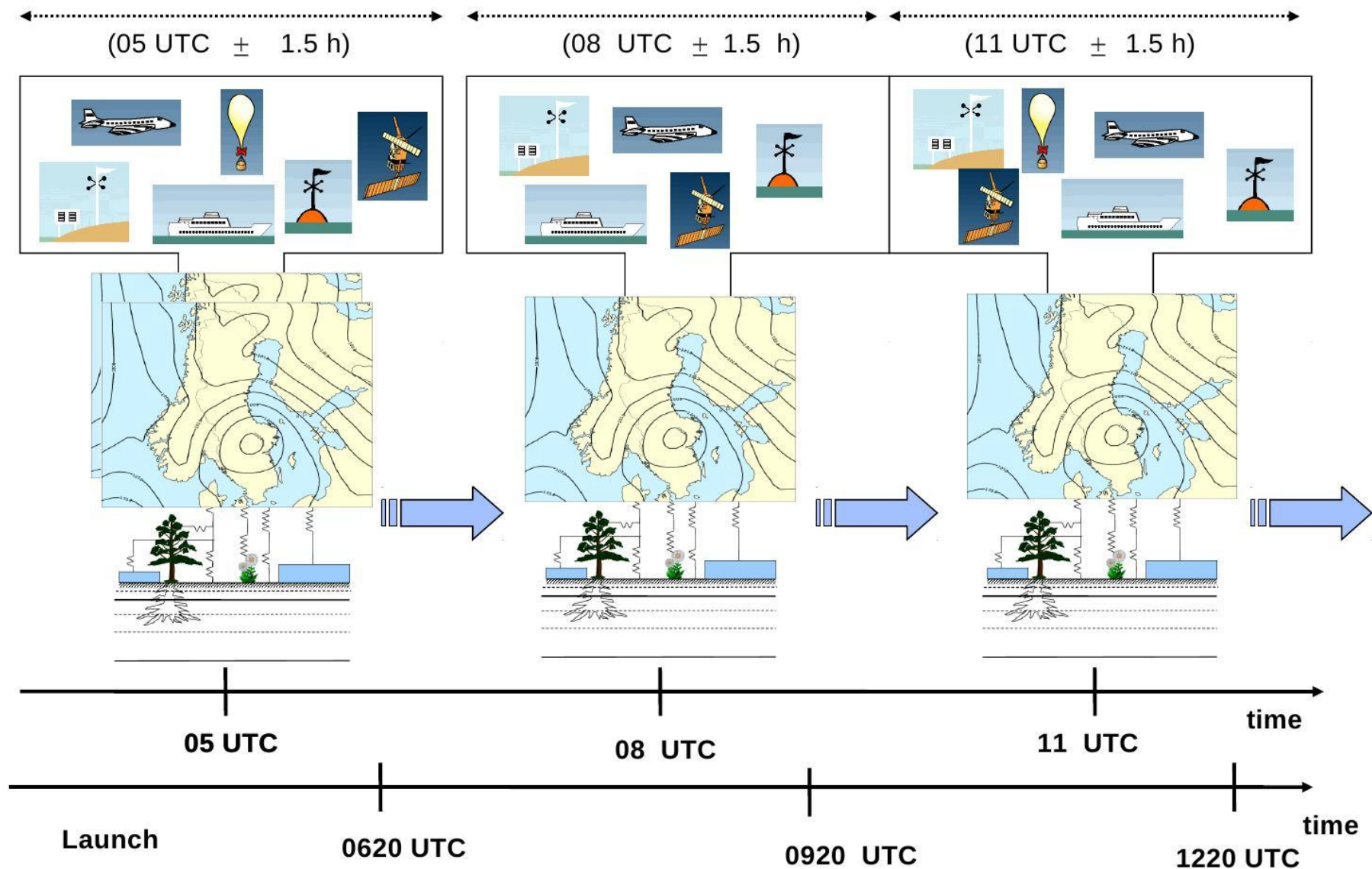
Rational: HARMONIE 3DVAR is more relevant with frequent cycling which can make use of observation data of high temporal and spatial resolution.

How? An asynoptic windowed 3DVAR

Cycling Around Asynoptic Base Time 6h Intermittent DA



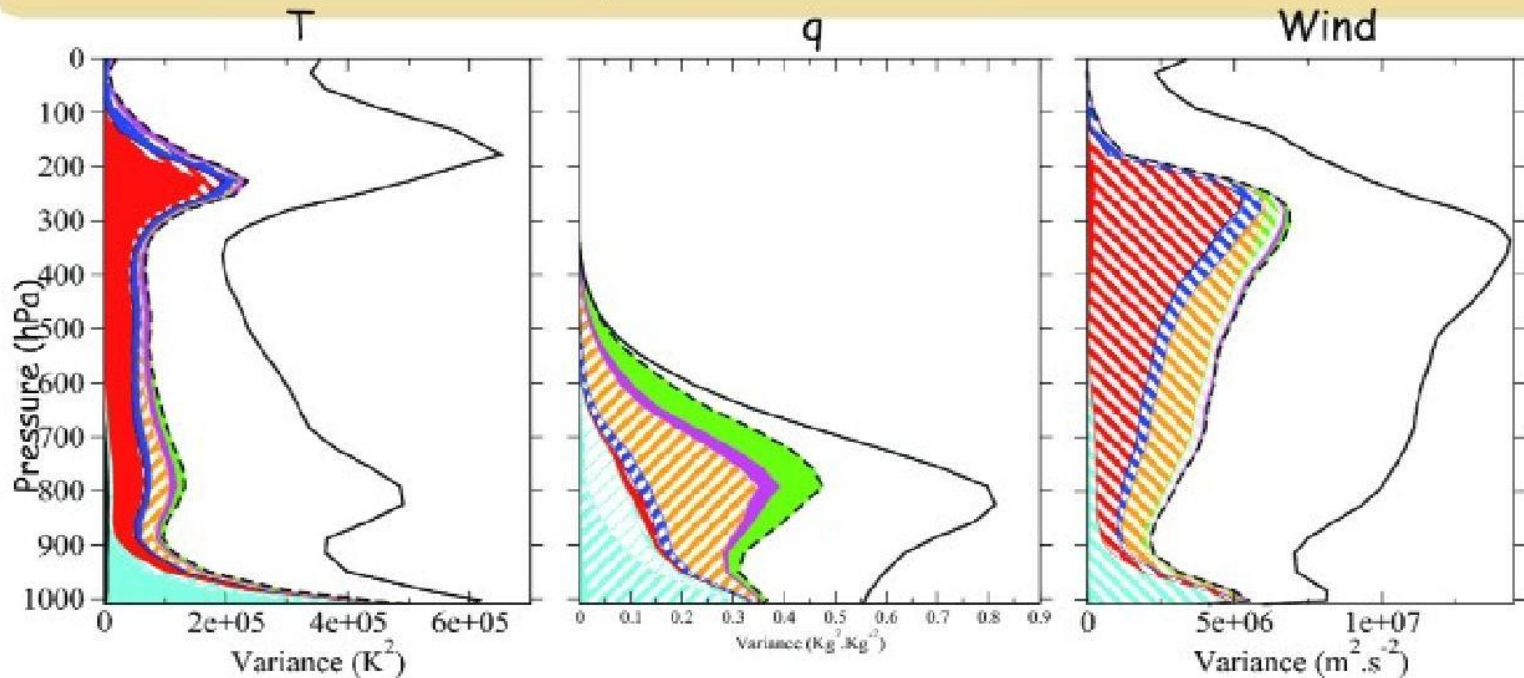
Cycling Around Asynoptic Base Time 3h Intermittent DA (DMI-DKA37)



Implication of an asynoptic windowed 3DVAR (main controversy)

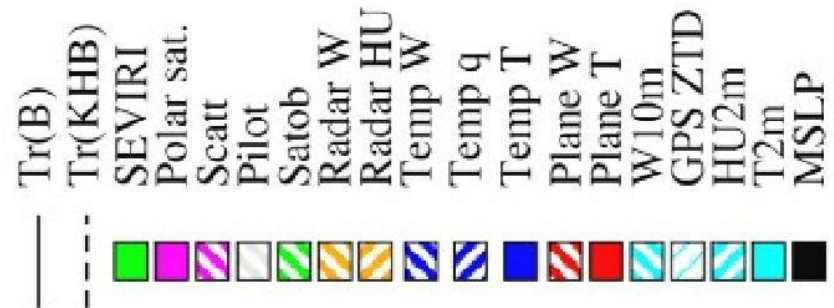
- The expected role of radiosonde data in HARMONIE-type assimilation
 - For synoptic scale NWP and those with large domain, TEMP data remains important
 - For HARMONIE type and RUC application, the importance of TEMP is very much reduced

Daily mean reduction



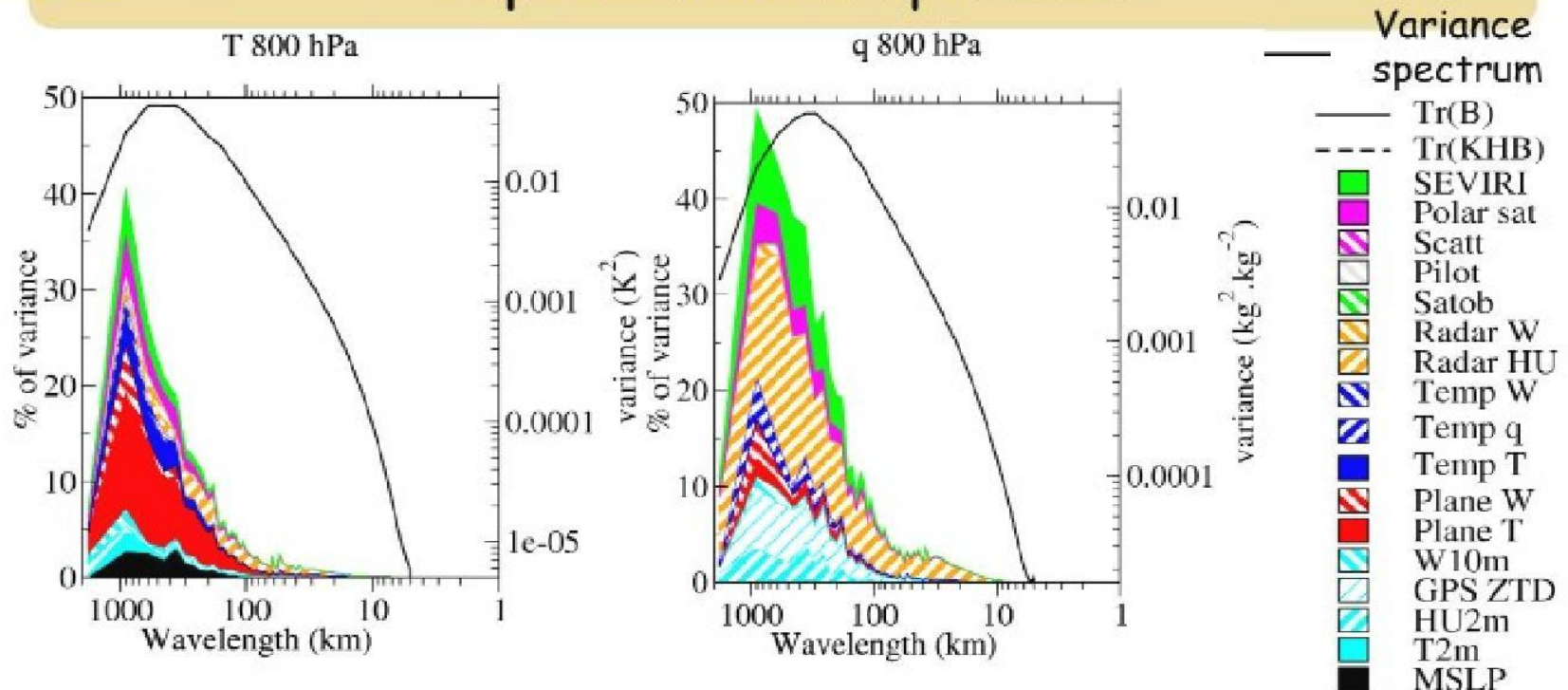
- Most important parts of r are provided by :

- Surface observations
- Plane
- Radar



(Courtesy of Pierre Brousseau et al, ASM 2012)

Spectral decomposition



- Higher reduction of variance error for wavelengths corresponding to the higher values of variance spectra
- For wavelengths shorter than :
 - 200 km, only radar and plane measurements for temperature (GPS for specific humidity) contribute to the variance reduction
 - 100 km, the variance reduction reach only 5% of the error variance and it is only provided by radar observations

(Courtesy of Pierre Brousseau et al, ASM 2012)

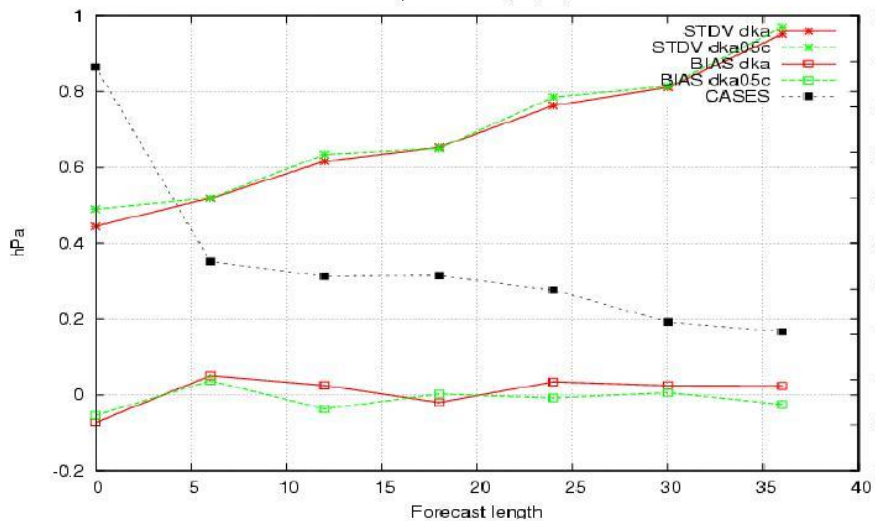
Numerical Experiments

Two numerical experiments at the ECMWF platform comparing to the DMI-DKA (36h1)

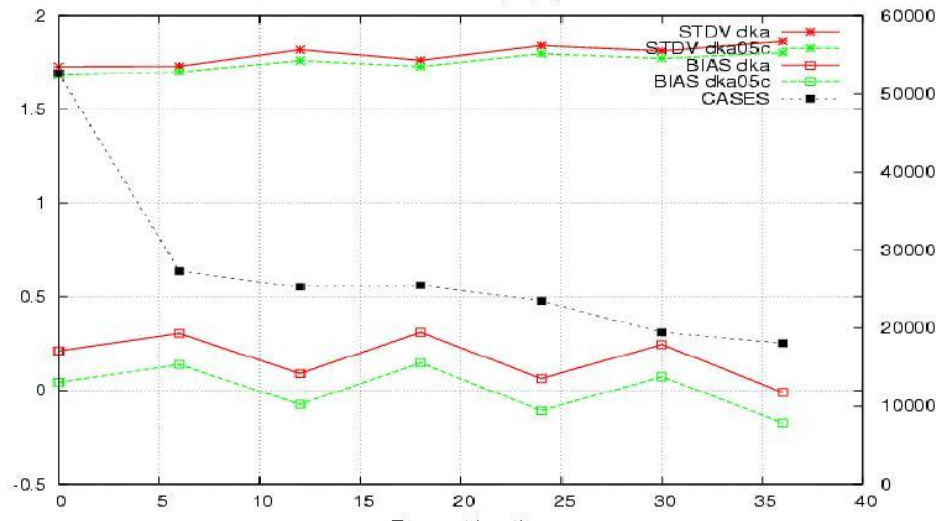
- a. 6-hourly, asynoptic, blending with no upper air 3DVAR
- b. 3-hourly asynoptic, 3DVAR

Comparing 6-h blending with synoptic vs asynoptic

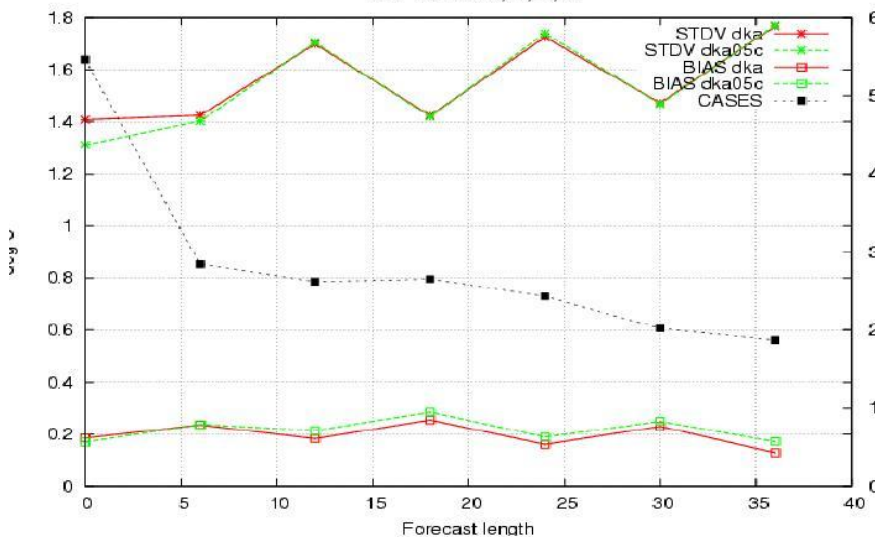
Selection: ALL using 518 stations
 Period: 20120825-20120918
 Mslp Hours: 00,06,12,18



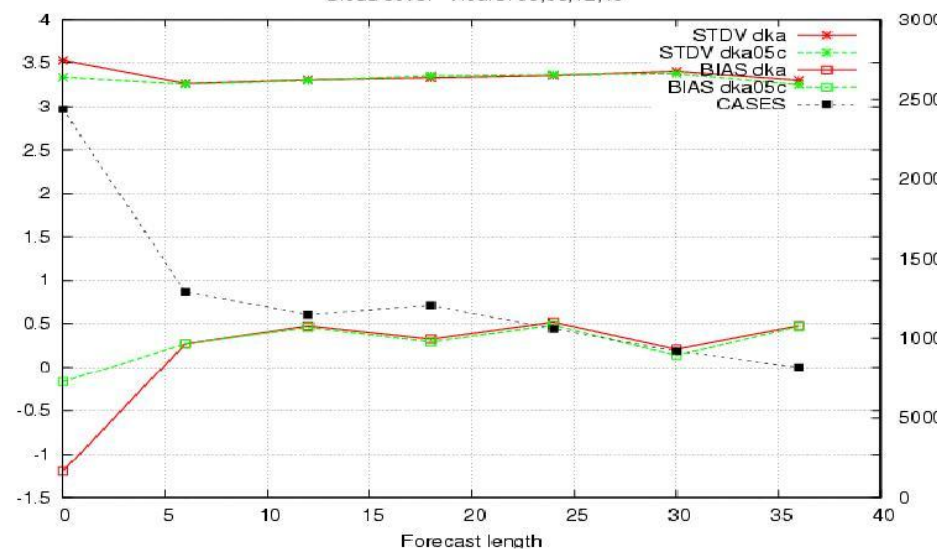
Selection: ALL using 621 stations
 Period: 20120825-20120918
 U10m Hours: 00,06,12,18



Selection: ALL using 642 stations
 Period: 20120825-20120918
 T2m Hours: 00,06,12,18

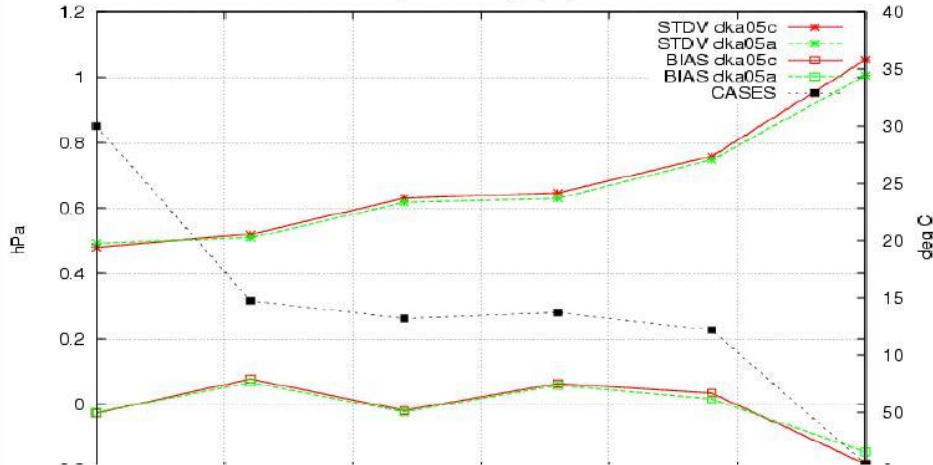


Selection: ALL using 325 stations
 Period: 20120825-20120918
 Cloud cover Hours: 00,06,12,18

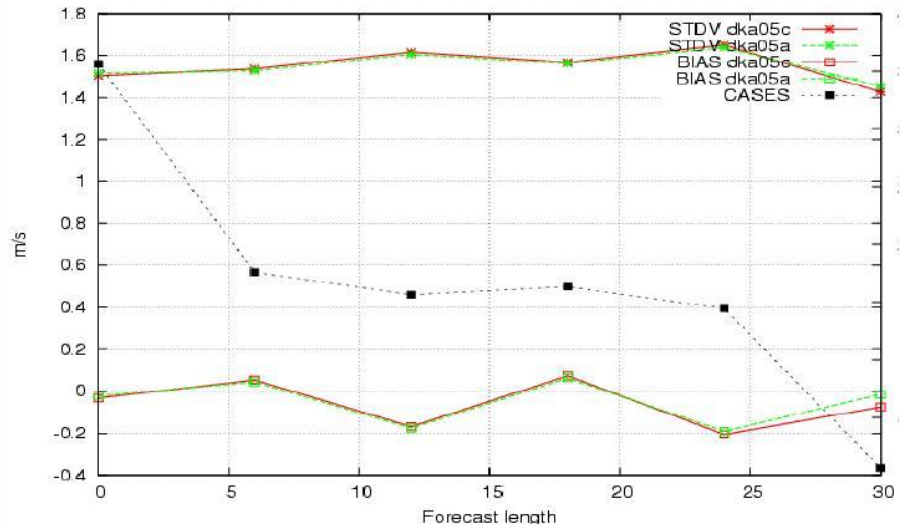


DKA Blending vs 3DVAR

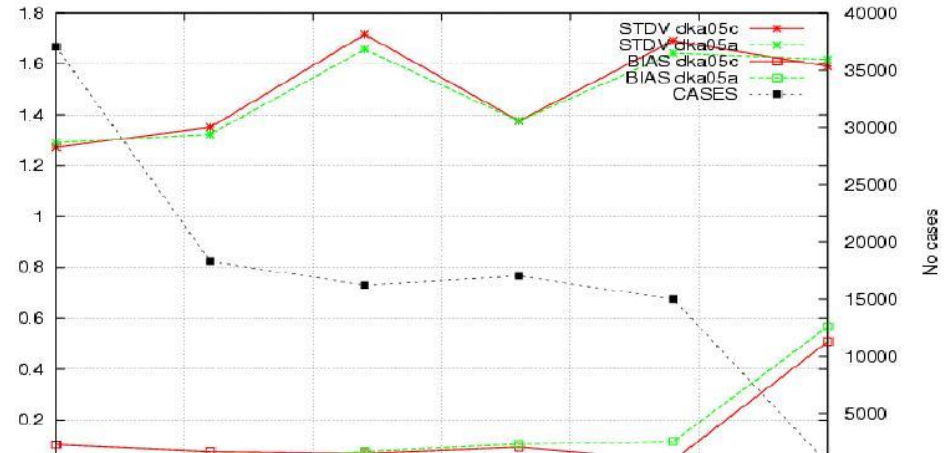
Selection: ALL using 518 stations
 Period: 20120820-20120906
 Mslp Hours: 00,06,12,18



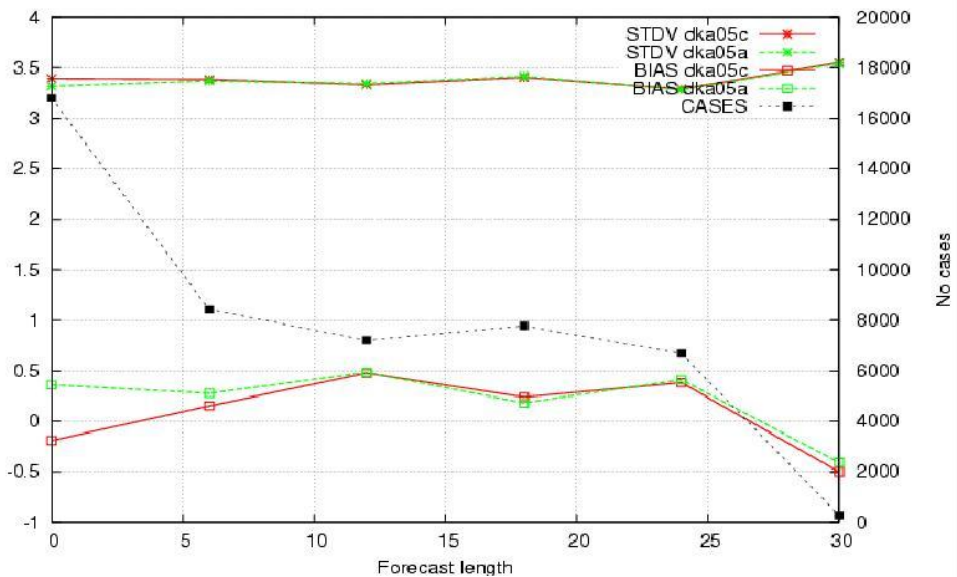
Selection: ALL using 621 stations
 Period: 20120820-20120906
 U10m Hours: 00,06,12,18



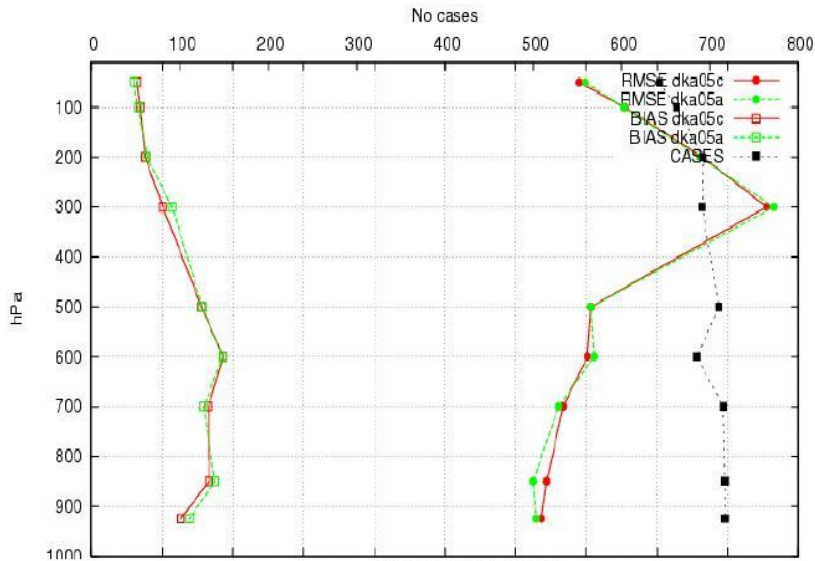
Selection: ALL using 642 stations
 Period: 20120820-20120906
 T2m Hours: 00,06,12,18



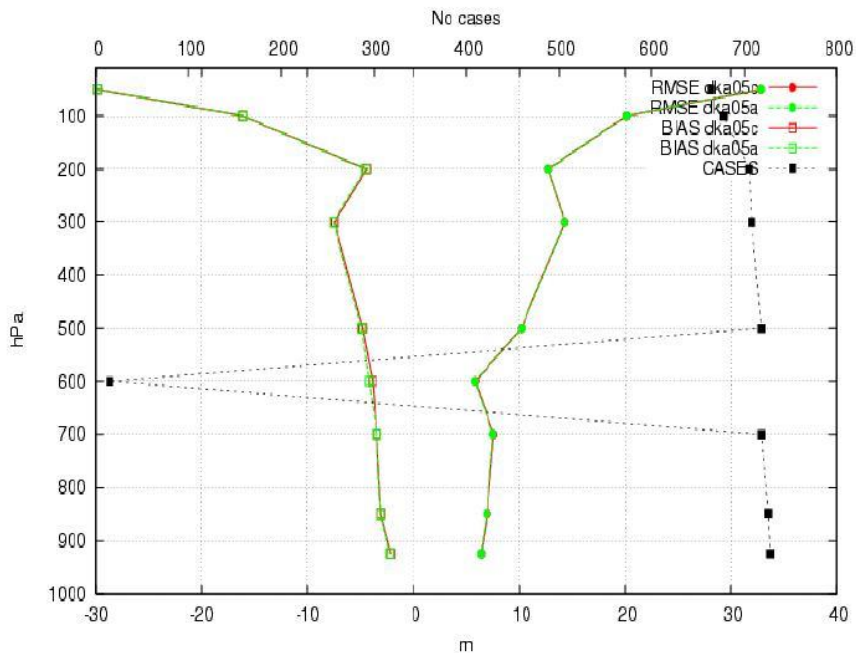
Selection: ALL using 323 stations
 Period: 20120820-20120906
 Cloud cover Hours: 00,06,12,18



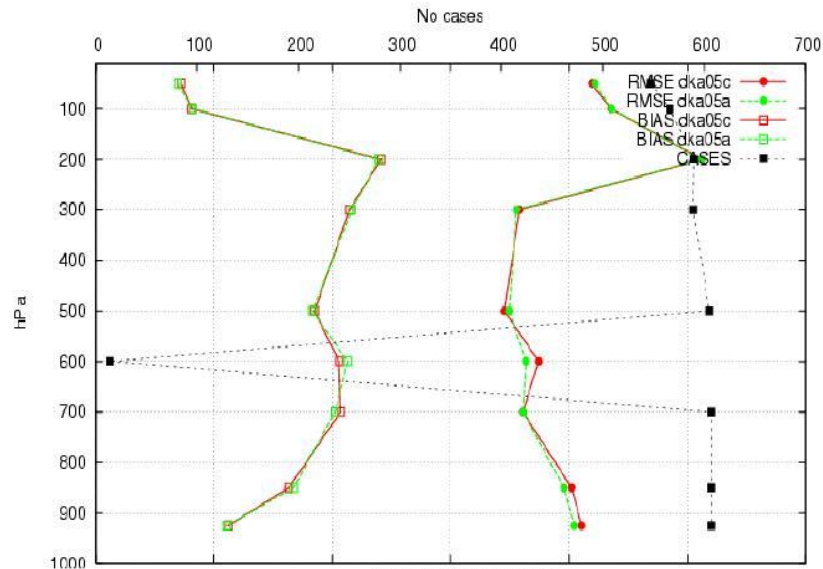
24 stations Selection: ALL
 Wind speed Period: 20120820-20120909
 Statistics at 00 UTC Used 00,12 + 12 24



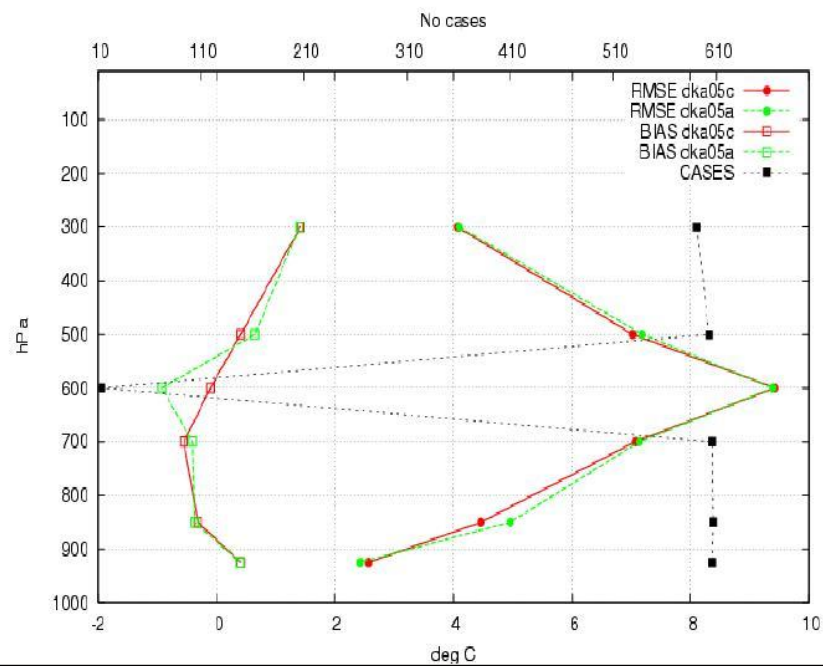
24 stations Selection: ALL
 Height Period: 20120820-20120909
 Statistics at 00 UTC Used 00,12 + 12 24



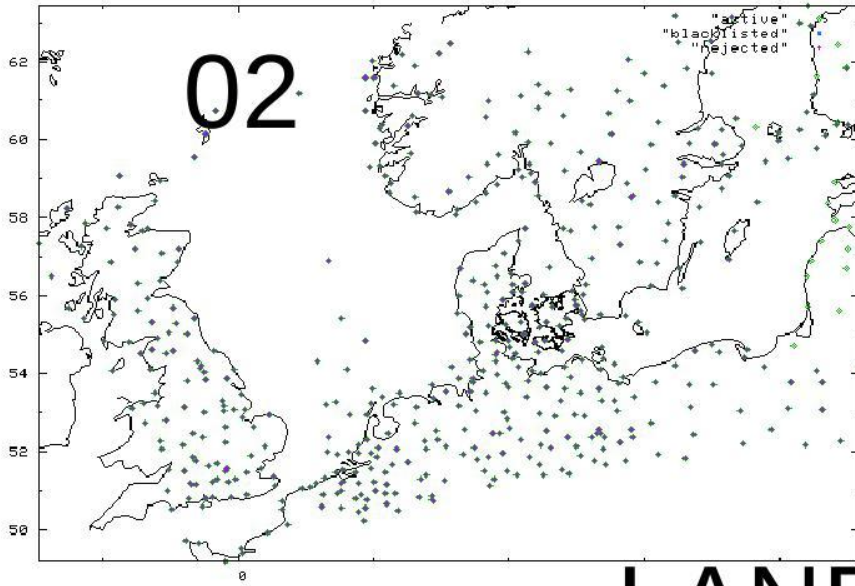
24 stations Selection: ALL
 Temperature Period: 20120820-20120906
 Statistics at 00 UTC Used 00,12 + 12 24



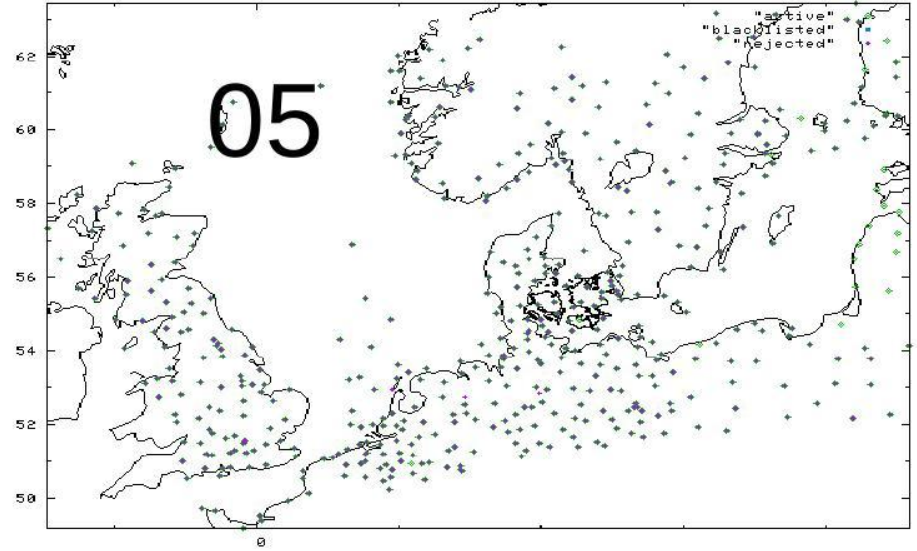
24 stations Selection: ALL
 Dew point temperature Period: 20120820-20120906
 Statistics at 00 UTC Used 00,12 + 12 24



synop z 20120916 02 UTC

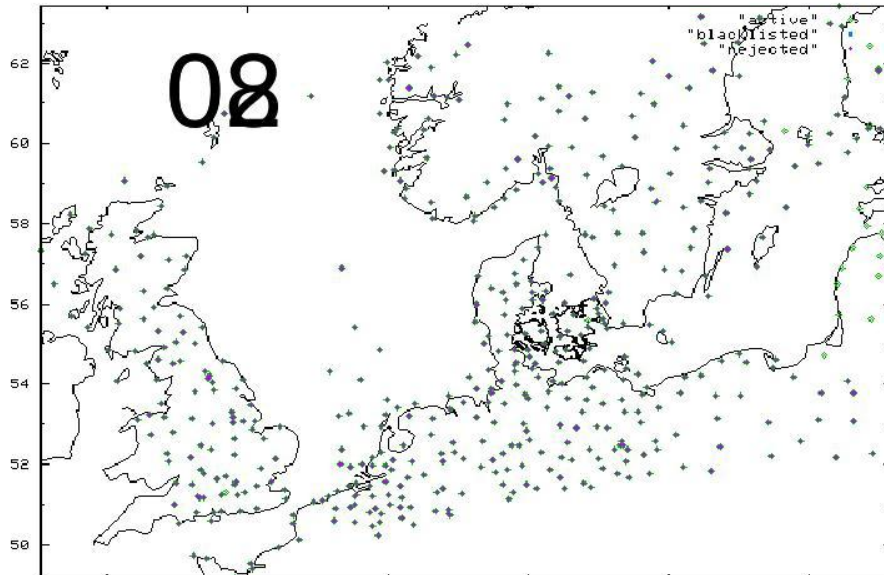


synop z 20120917 05 UTC

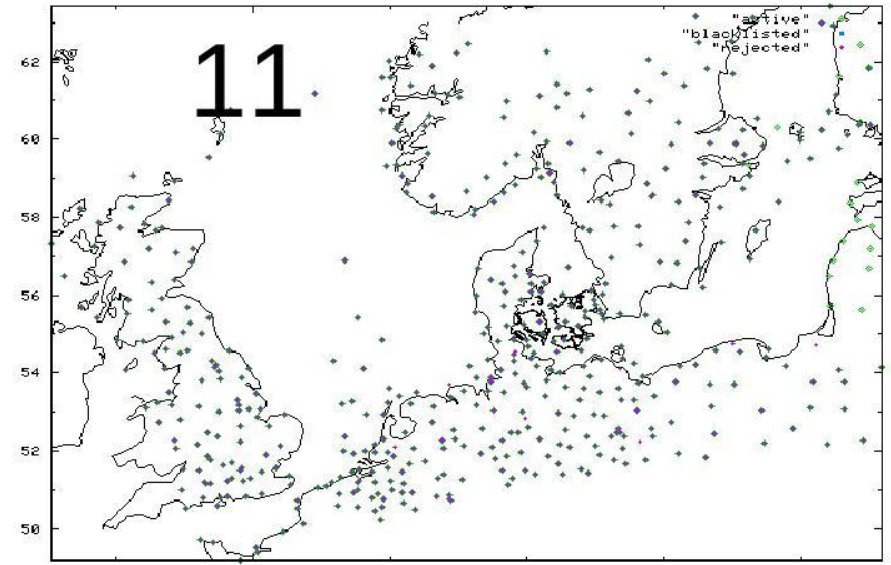


LAND SYNOP

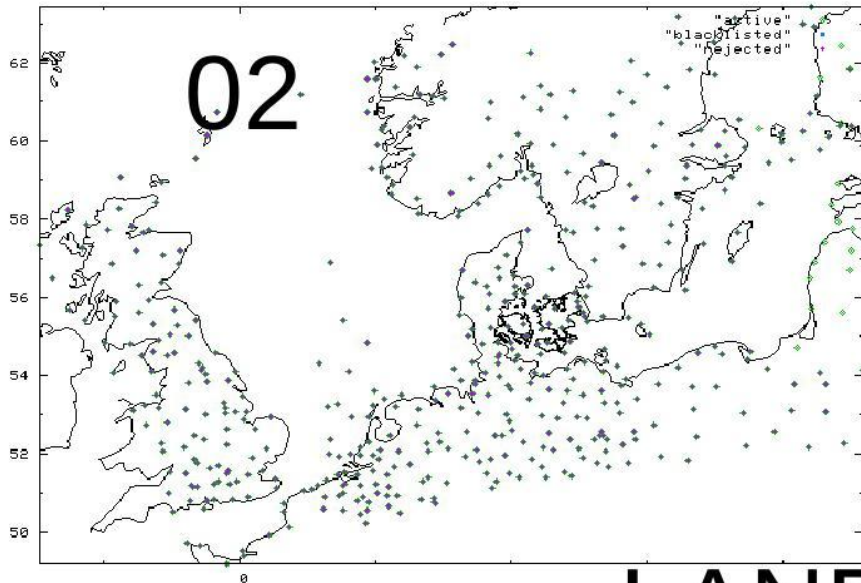
synop z 20120916 08 UTC



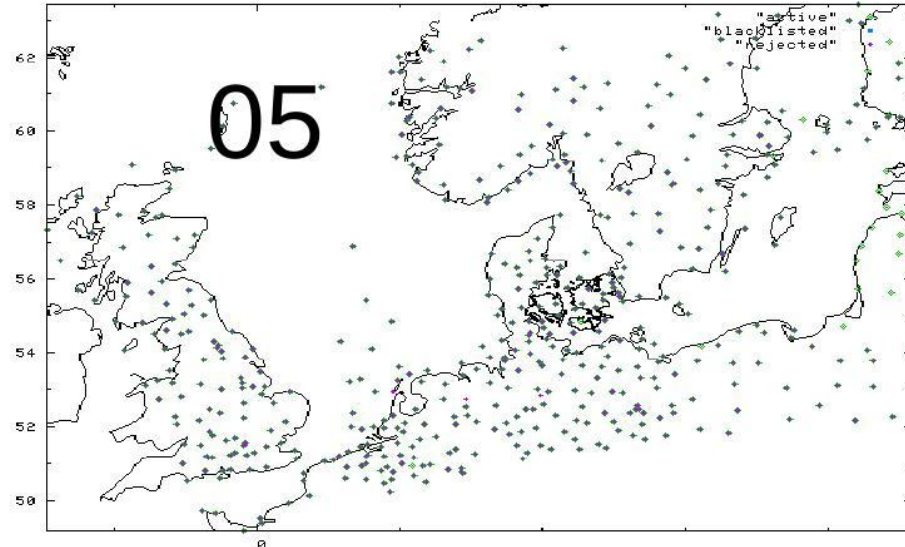
synop z 20120916 11 UTC



synop z 20120916 02 UTC

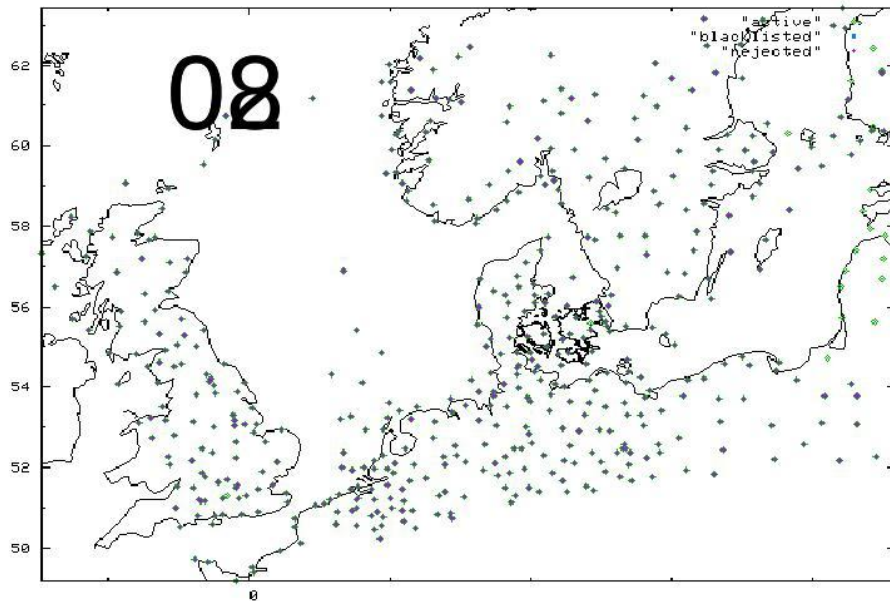


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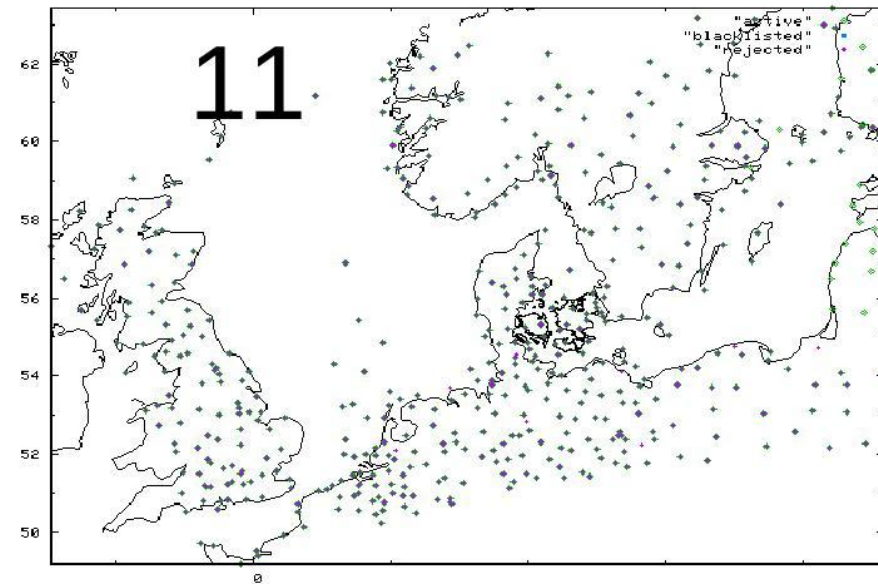


LAND SYNOP

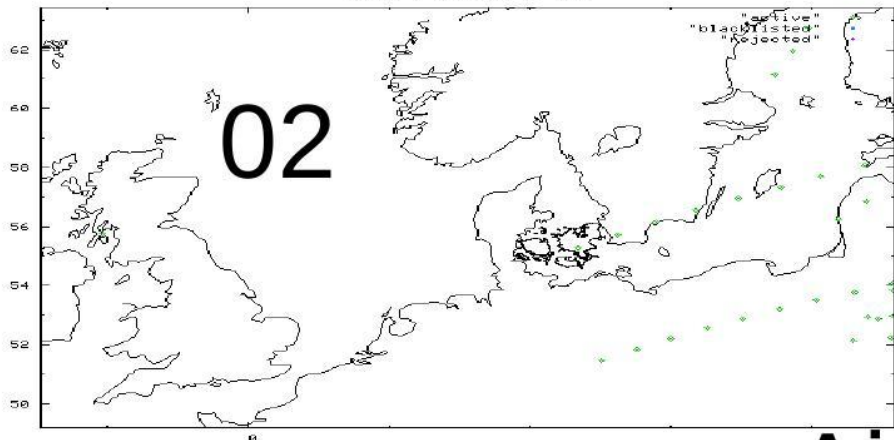
synop z 20120916 08 UTC



synop z 20120916 11 UTC

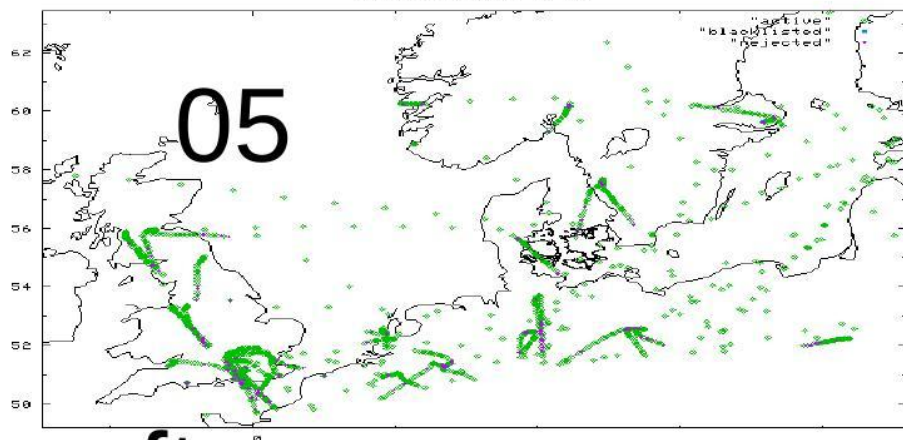


airep t 20120916 02 UTC



02

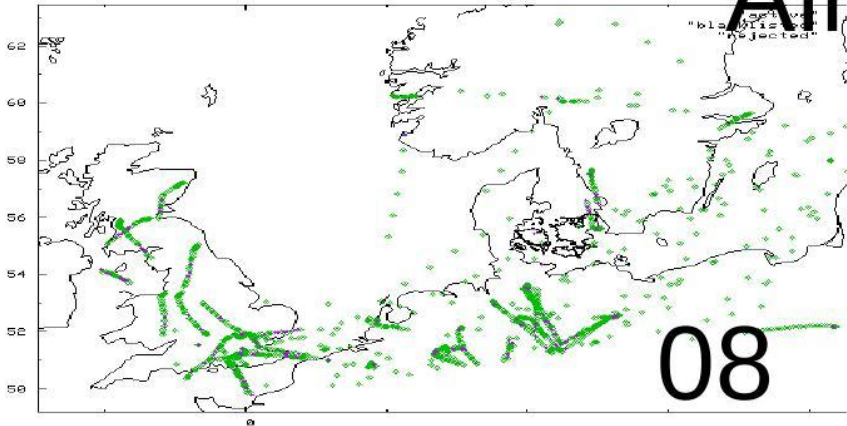
airep t 20120916 05 UTC



05

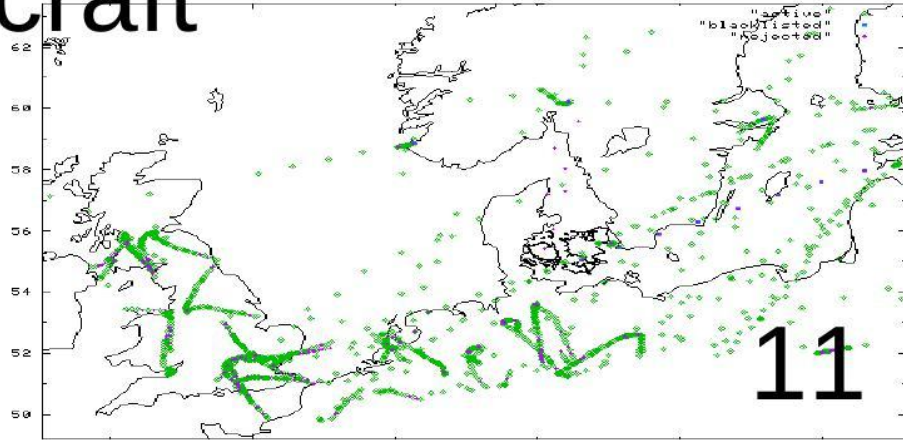
Aircraft

airep t 20120916 08 UTC



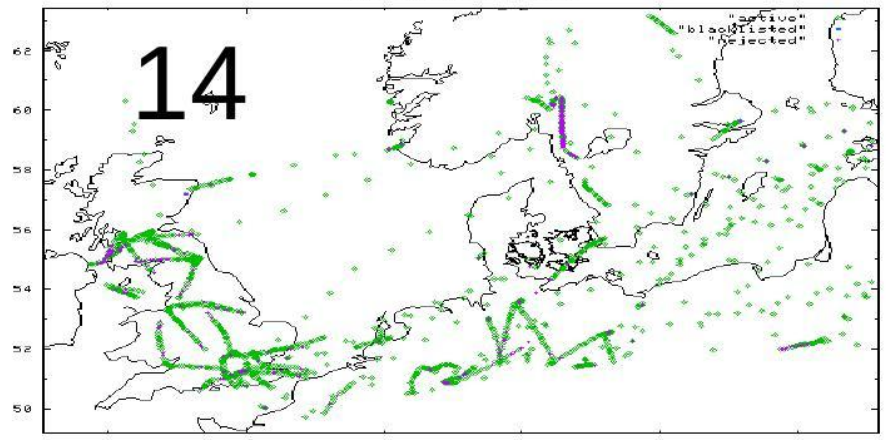
08

airep t 20120916 11 UTC



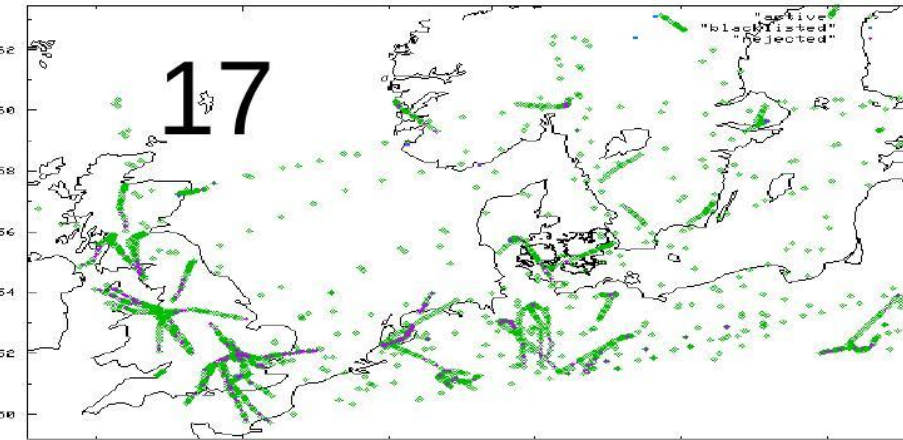
11

airep t 20120916 14 UTC



14

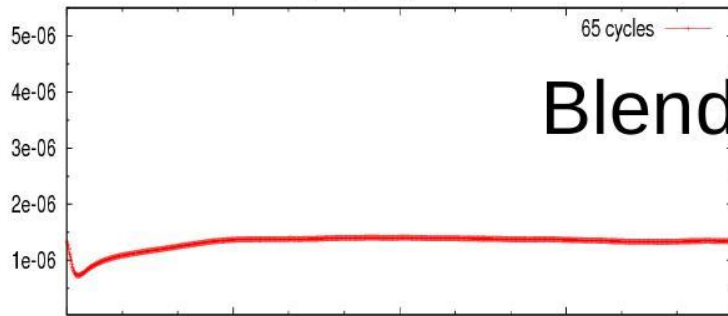
airep t 20120916 17 UTC



17

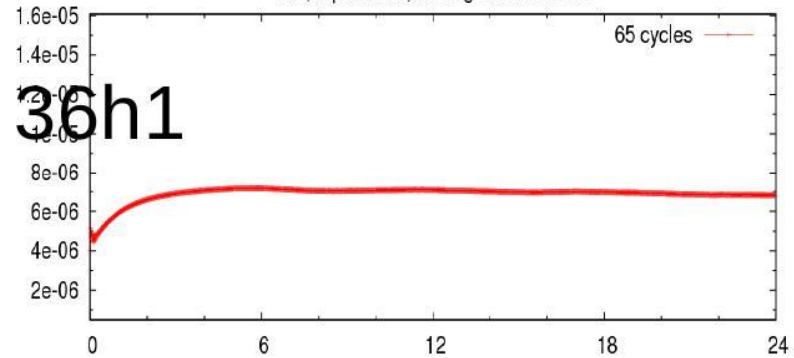
3DVAR-RUC vs Blending

dka, rain, averaged for 201209

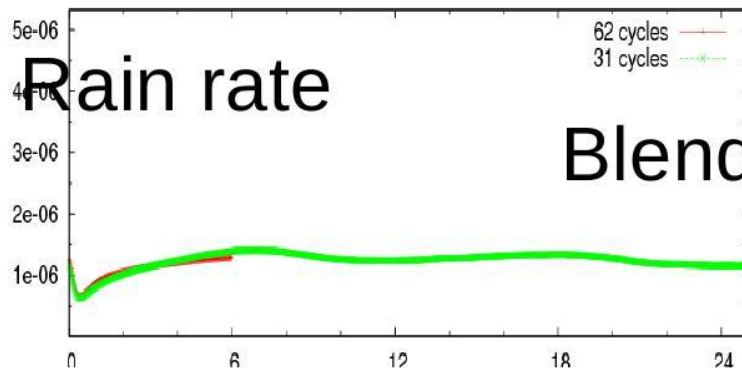


Blending, 36h1

dka, liquidwater, averaged for 201209



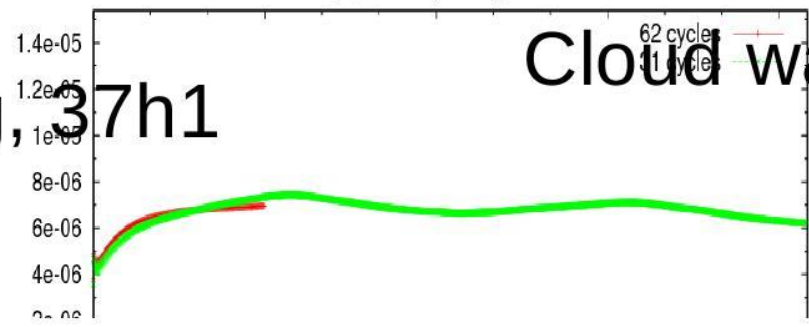
dka05, rain, averaged for 201209



Rain rate

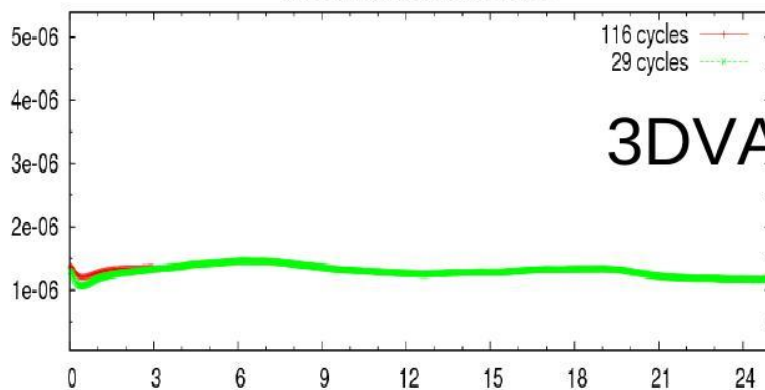
Blending, 37h1

dka05, liquidwater, averaged for 201209



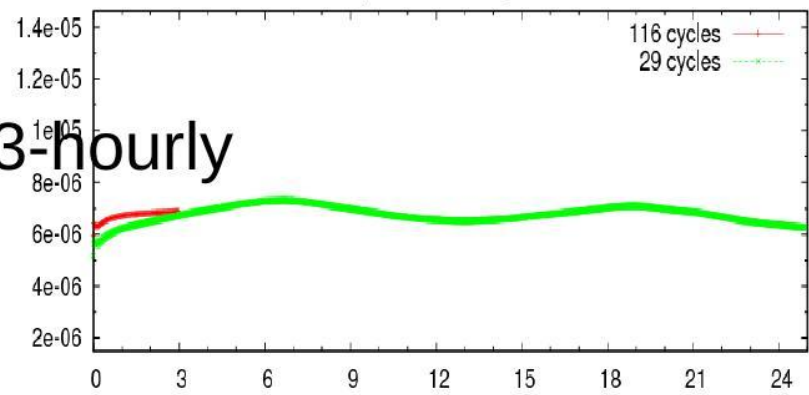
Cloud water

dka05a, rain, averaged for 201209



3DVAR, 3-hourly

dka05a, liquidwater, averaged for 201209



Integration hour

Integration hour

Summaries from parallel experiments

- For HARMONIE cycling with only surface assimilation included, a configuration with shifted base time has little negative quality consequence due to the fact that observation data are largely continuous.
- For HARMONIE 3DVAR RUC, the main consequence of a (1-h) shift in base time is the loss of TEMP data in the assimilation system, the impact of this appears quite limited even with a system with no remote sensing data (but with the LSMIXBC scheme in which ECMWF boundary is used via spectral nudging on the background)
- With these results, HARMONIE at DMI has recently been upgraded to 37h1.2 with 1h shifted base time, since Dec 2012.

NWP Systems at DMI (April 2013)

DMI-HIRLAM (High Resolution Limited Area Model) is the operational model used at DMI for forecast of up to two days.

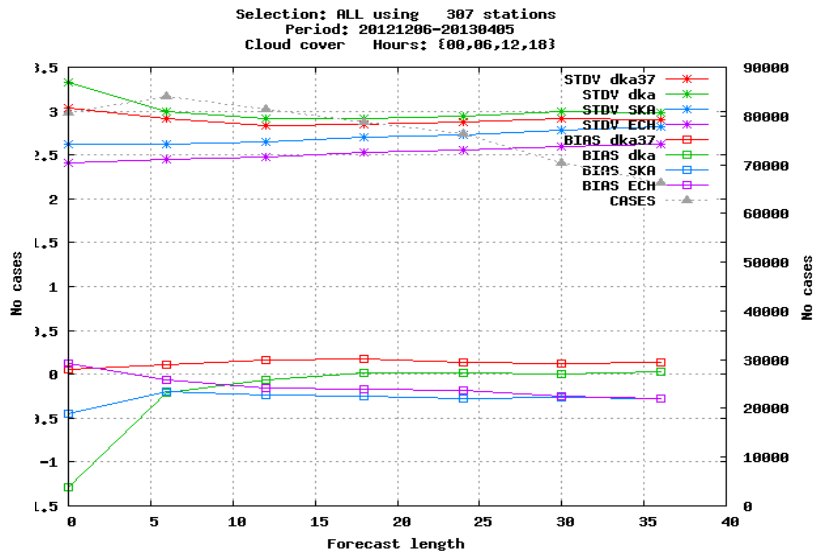
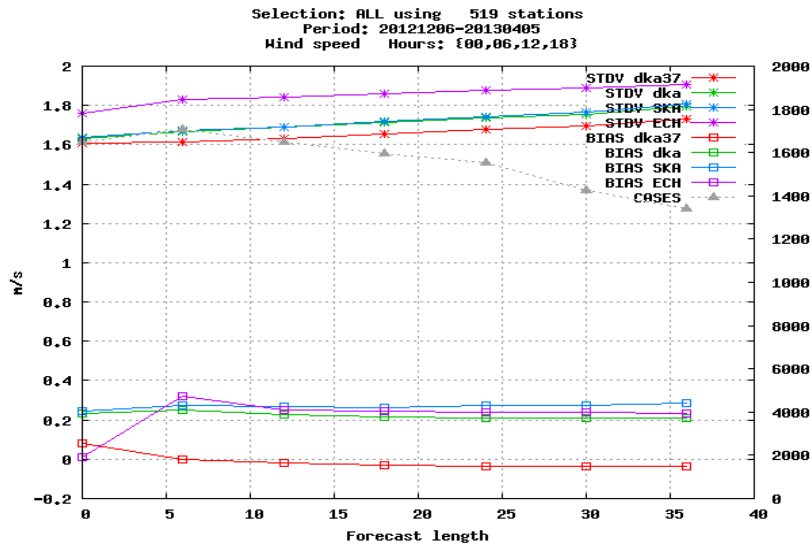
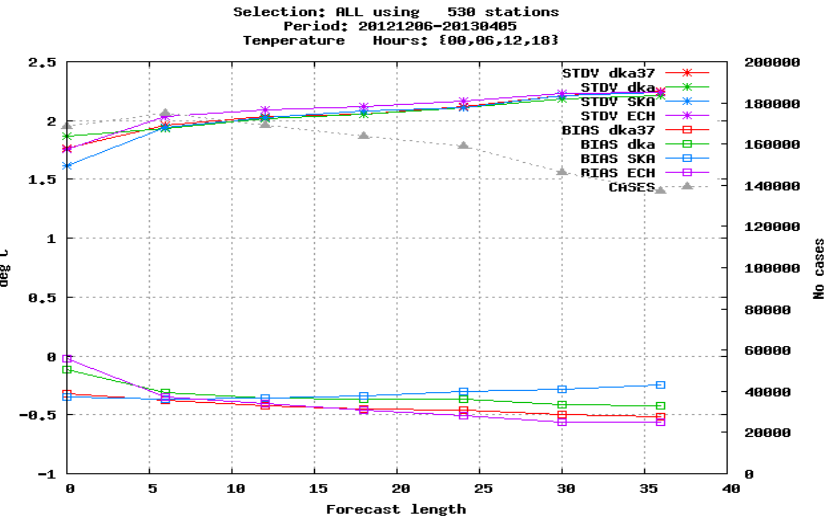
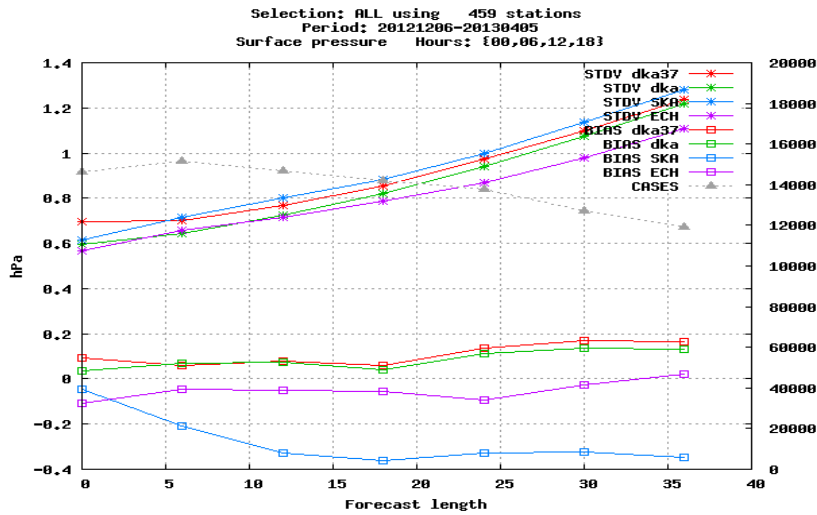
HARMONIE 3h-RUC started at DMI since Dec 2012.

Nominal time	Base time	Model	Lead time	Previous delivery time 2012	Present delivery time 2013
00	23	HARMONIE	58h	400	200
00	00	HIRLAM	54h	300	300
03	02	HARMONIE	58h		500
00	00	ECMWF	>10day	630	630
06	05	HARMONIE	58h	1000	800
06	06	HIRLAM	54h	900	900
09	08	HARMONIE	58h		1100
12	11	HARMONIE	58h	1600	1400
12	12	HIRLAM	54h	1500	1500
15	14	HARMONIE	58h		1700
12	12	ECMWF	>10day	1830	1830

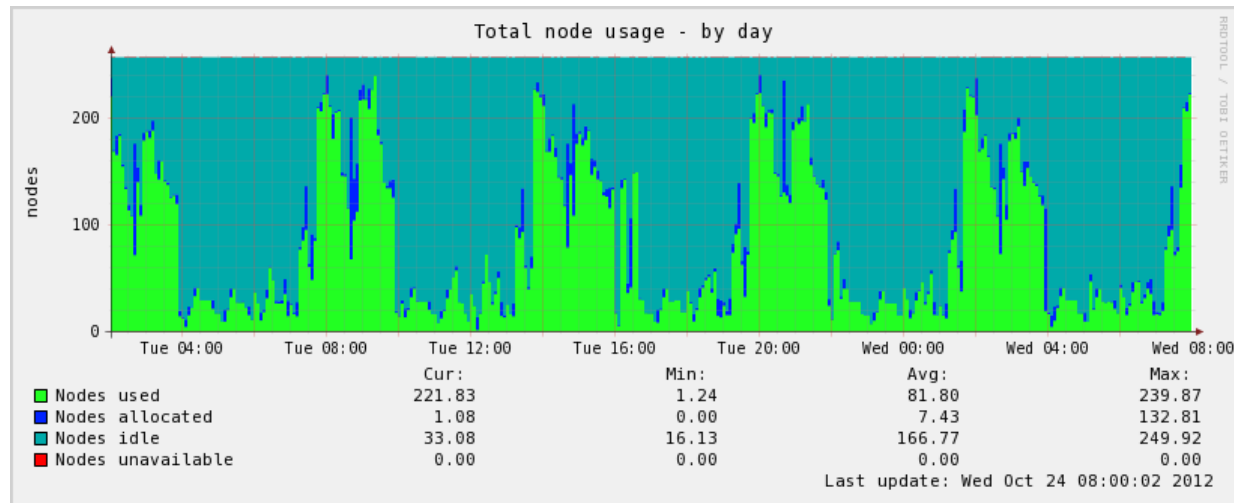
(all time in UTC)

Observation Verification

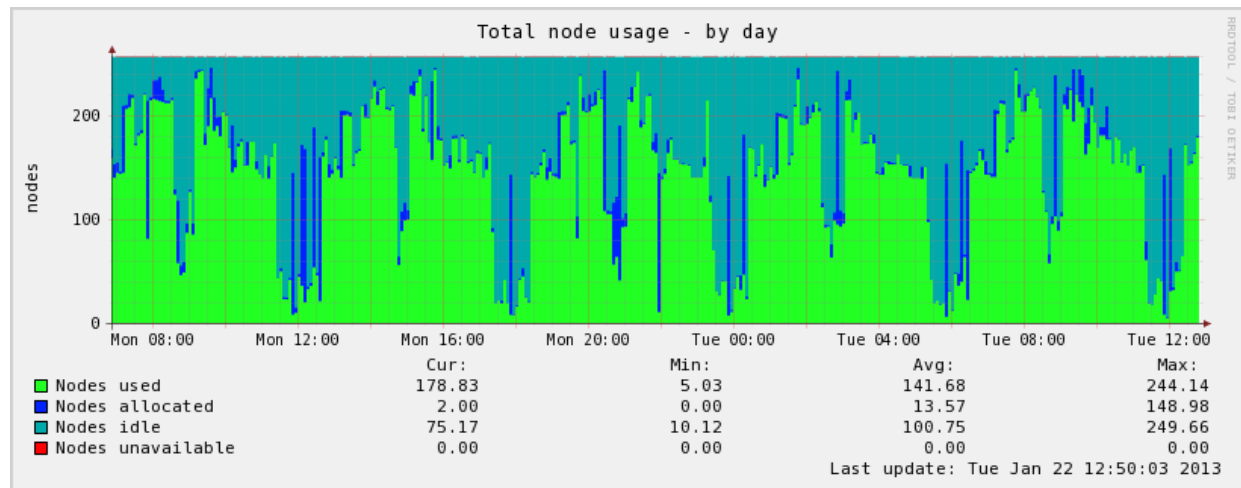
DMI-Harmonie 37, 36, HIRLAM vs ECMWF



Utilisation of HPC resource at DMI



HARMONIE 6h cycling with synoptic base time, Oct 2012



HARMONIE 3h cycling with asynoptic base time, Jan 2013

Achievements

The proposed configuration with asynoptic base time enabled implementation of an upgraded HARMONIE system at DMI with

- a more frequent and timely delivery
- new capability with 3DVAR-RUC
- meteorological quality assured
- a better and balanced utilisation of HPC resource