# STATUS ON THE USE OF SCATTEROMETER DATA AT METEO FRANCE…

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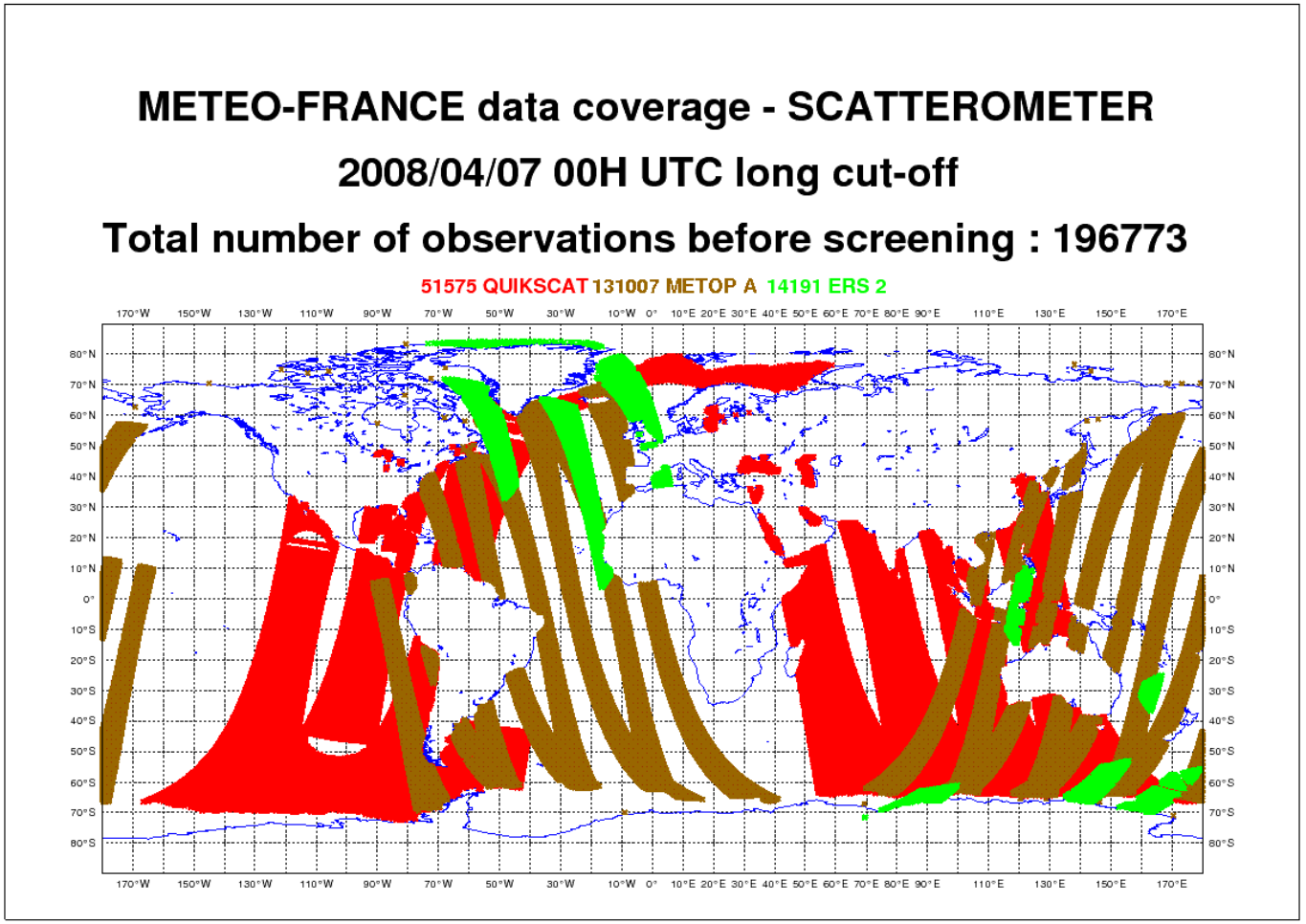
# A view of the coverage of wind scatterometer data, received at Météo France



# Comments on the previous slide

- SeaWinds instrument on board QuikSCAT satellite launched in 1999 by NASA. Ku-band sensitive to the rain. Swath wide of 1800km but only an inner part of 1400km is completely illuminated. Used in Arpège since 2004.
- AMI instrument on board ERS-2 satellite launched in 1996 by ESA. C-band insensitive to the rain. Swath wide of 500km. Used in Arpège since September 2007.
- ASCAT intrument on board MetOp-A satellite launched in 2006, operated by Eumetsat. In C-band too. A twice set of antenna, defining two 550km-wide swaths, with a gap of around 700km. Used in Arpège since February 2008

# Short review on Scatterometer data

- Surface wind over sea retrieved from backscattered signals, trough an heuristic relation, called GMF.
- Wind retrieved with minimizing a cost function, between the basckscatter measurements and the sub-space of solutions (called the 'cone' and described by the GMF).
- Indecisiveness on the wind direction (until 4 solutions). For each solution, associated likelihood, in fact the residual of the minimization or MLE (so-called 'distance to the cone'). Resolved in the assimilation: the closest solution to the model background.
- Before assimilation, quality control, with variations function of the instrument (land, ice, instrumental pb, rain contamination, direction diversity) and in the end, thinning for setting one observation every 100km at best.

# SeaWinds (QuikSCAT) data assimilation

- Data distributed in NRT by NESDIS, footprint of 25km.
- Used home-made inversion developped by ECMWF:
  - at 50km (25km sub-cells are grouped by 4)
  - QSCAT1 GMF
  - until 4 solutions, only the 2 most likely are considered
  - rain flag is a combination of information, furnished by NESDIS, on the rain content in the atmosphere
  - bias correction, speed reduction, more important with higher winds
- No thinning but weight reduced by a factor 4 in the assimilation cost function, equivalent at an assimilation at 100km.

# SeaWinds alternative QC?

- Lack of data in rainy systems, pointed, with other weakness, in an internal report on the lost, by our global model Arpège, of the TC GORDON-2006, in the North-Atlantic.
- Test of an alternative QC for increasing the number of data:
  - ✓ rain flag based on the normalized residual Rn (Portabella and Stoffelen, 2001):

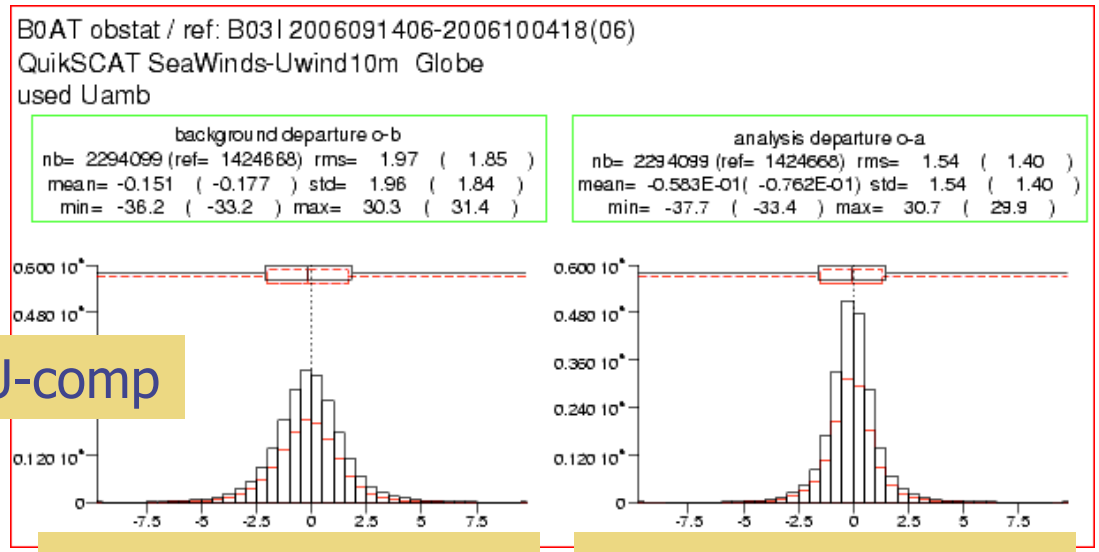
$$Rn = MLE / < MLE >$$

    - Rn>>1 => weak confidence, Rn#1=> good confidence
    - threshold, speed and cell number dependant, defined from collocations with SSMI data
  - ✓ the most likely solution and the most opposite in direction, instead of the 2 most likely, are considered (Hersbach, 2003).

# SeaWinds alternative QC: test

- Arpège in its streched (and operational) version T358C2.4 (between 23km over France and 133km over the SW Pacific), 46 levels on the vertical.
- 4D-Var assimilation at T149 (133km).
- Test with the alternative QC, Reference with the operational practice.
- From 14 September (one week before the lost of Gordon) until 4 October 2006.
- Forecasts at 00UTC until +96 hours.

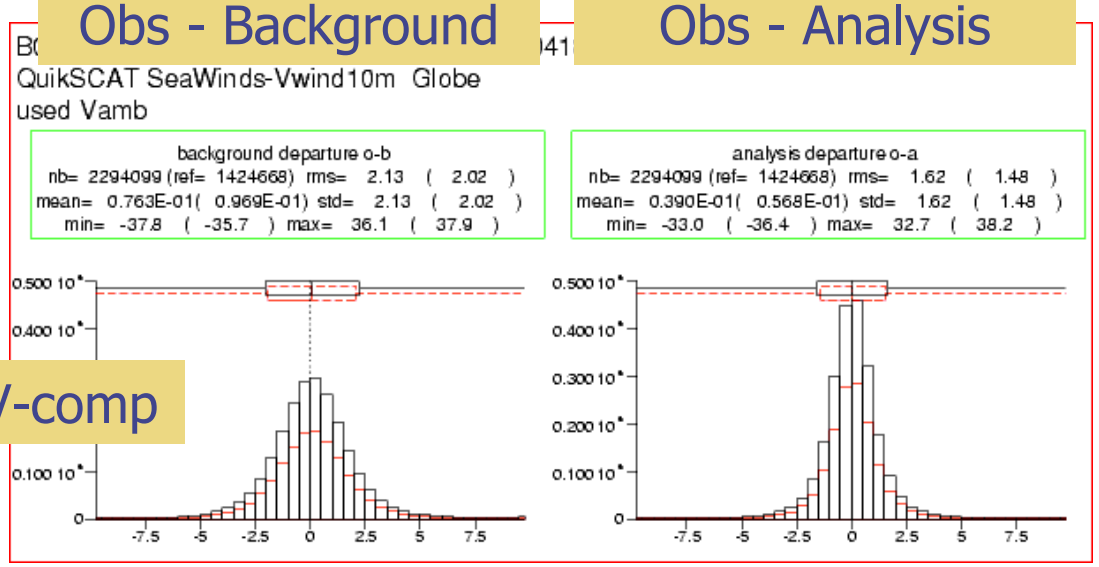
# SeaWinds alternative QC: global impact(1)




U-comp

Obs - Background

Obs - Analysis




V-comp

New QC:

- ✓ (Obs-Back) Vector Diff.

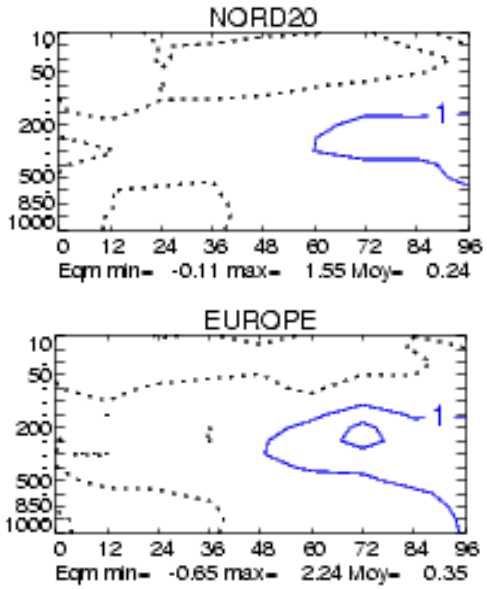
2.9m.s$^{-1}$ wrt 2.7m.s$^{-1}$ in Ref.

- ✓ 61% active data in more.
- ✓ Bias slightly improved.
- ✓ Gaussian distr. respected.

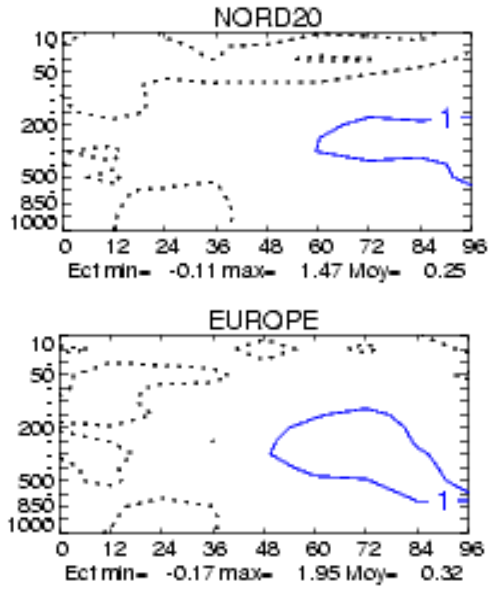
# SeaWinds alternative QC: global impact(2)

Forecast impact on Z parameter (with TEMP as a control, 20 cases):

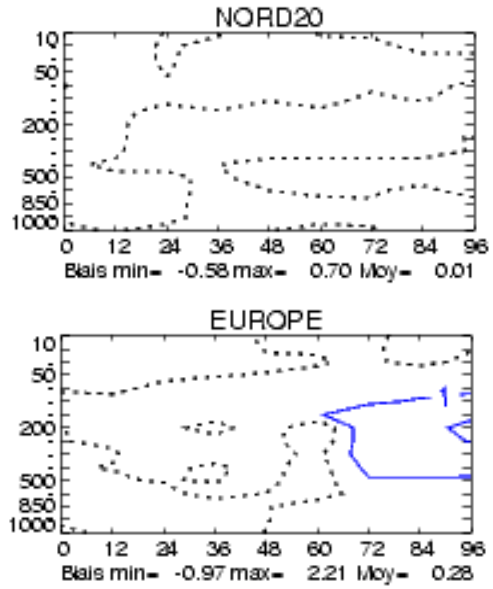
Δ RMS




Δ StD




Δ |Bias|

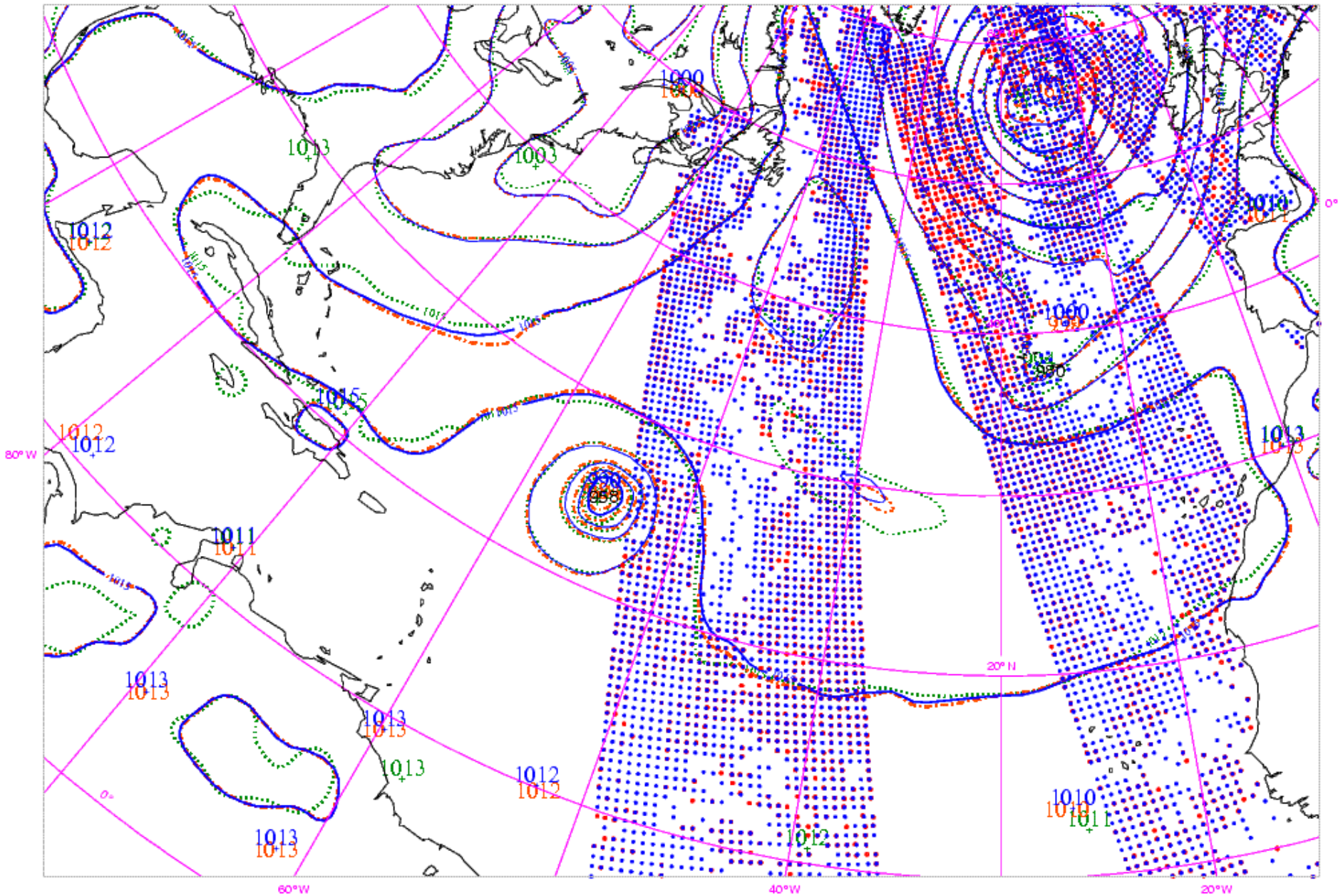



✓ positive impact (blue lines every 1 gpm) on North20, in particular over Europe.

✓ neutral impact on the other parameters (T, Wind), on the other areas and with other controls (its own analysis, ECMWF analysis).

MSLP (hPa) Analysis VT: 20060920H06 and QuikSCAT Winds Observations used.

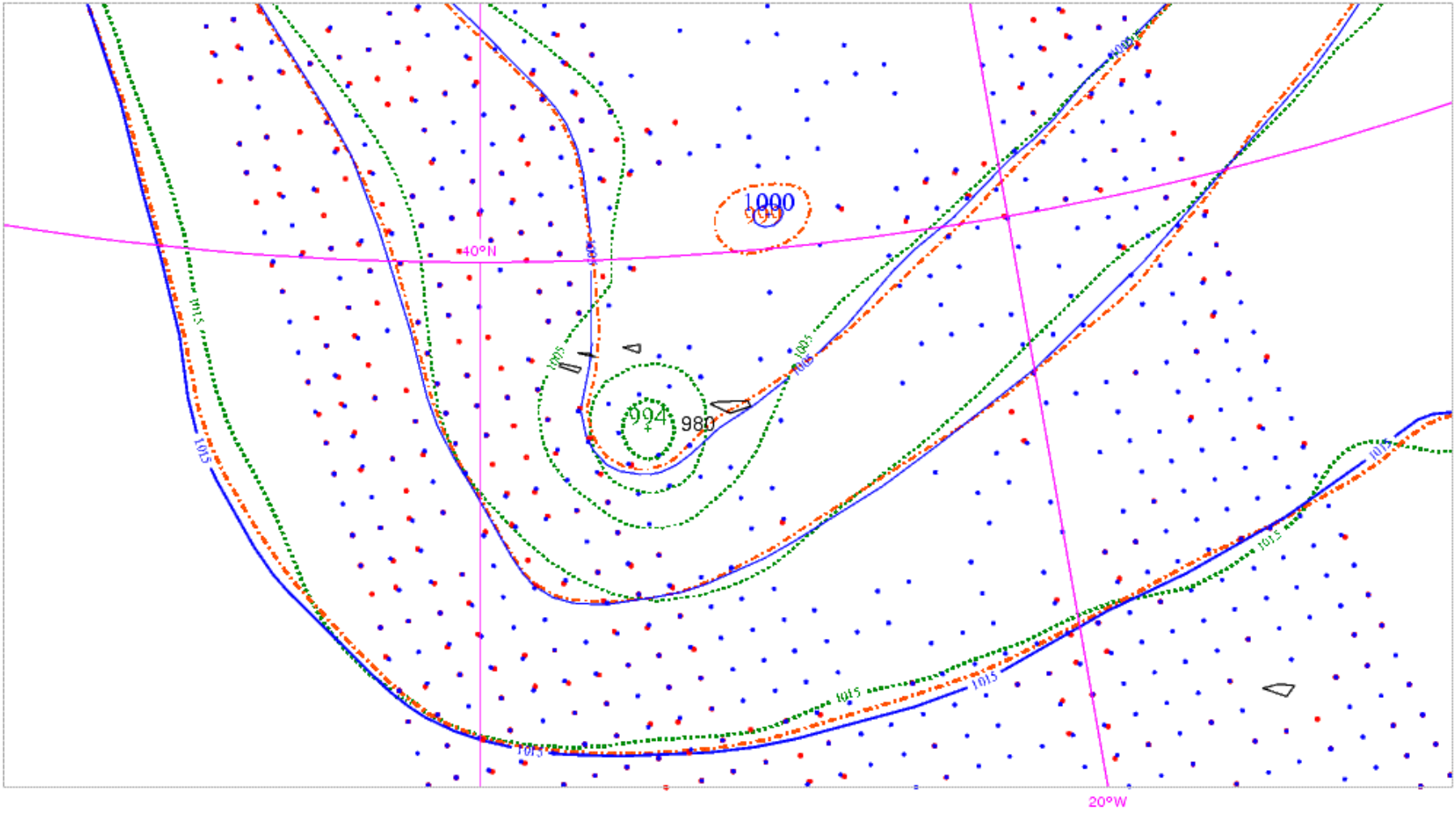
Test (dist2cone rain-QC), Reference (operational use), Control(ECMWF), Tropical Cyclones Min Pressure (NHC Best Tracks).



# GORDON crossing the Azores… Analysis the 20th at 06UTC

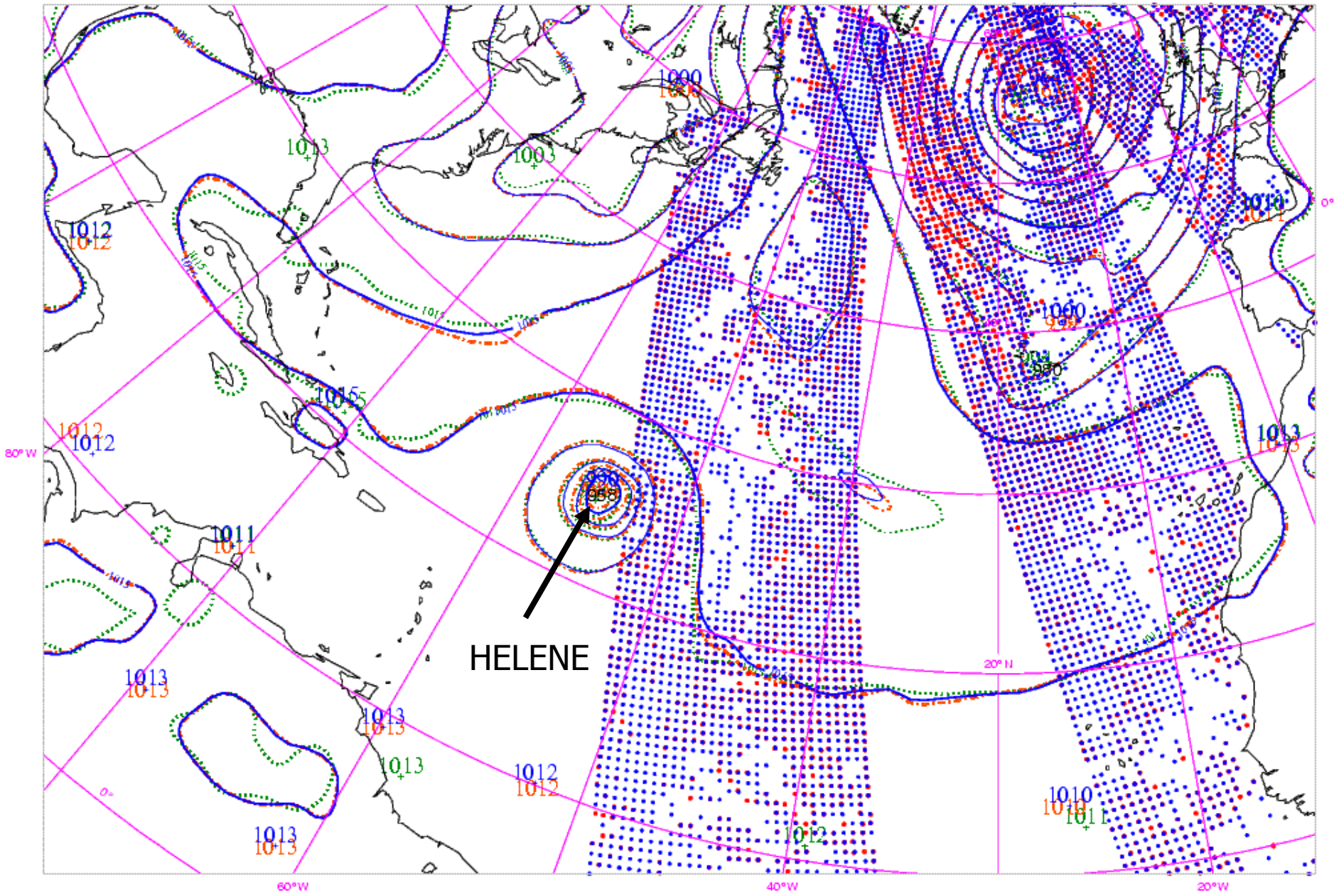
MSLP (hPa) Analysis VT: 20060920H06 and QuikSCAT Winds Observations used.

Test (dist2cone rain-QC), Reference (operational use), Control (ECMWF), Tropical Cyclones Min Pressure (NHC Best Tracks).



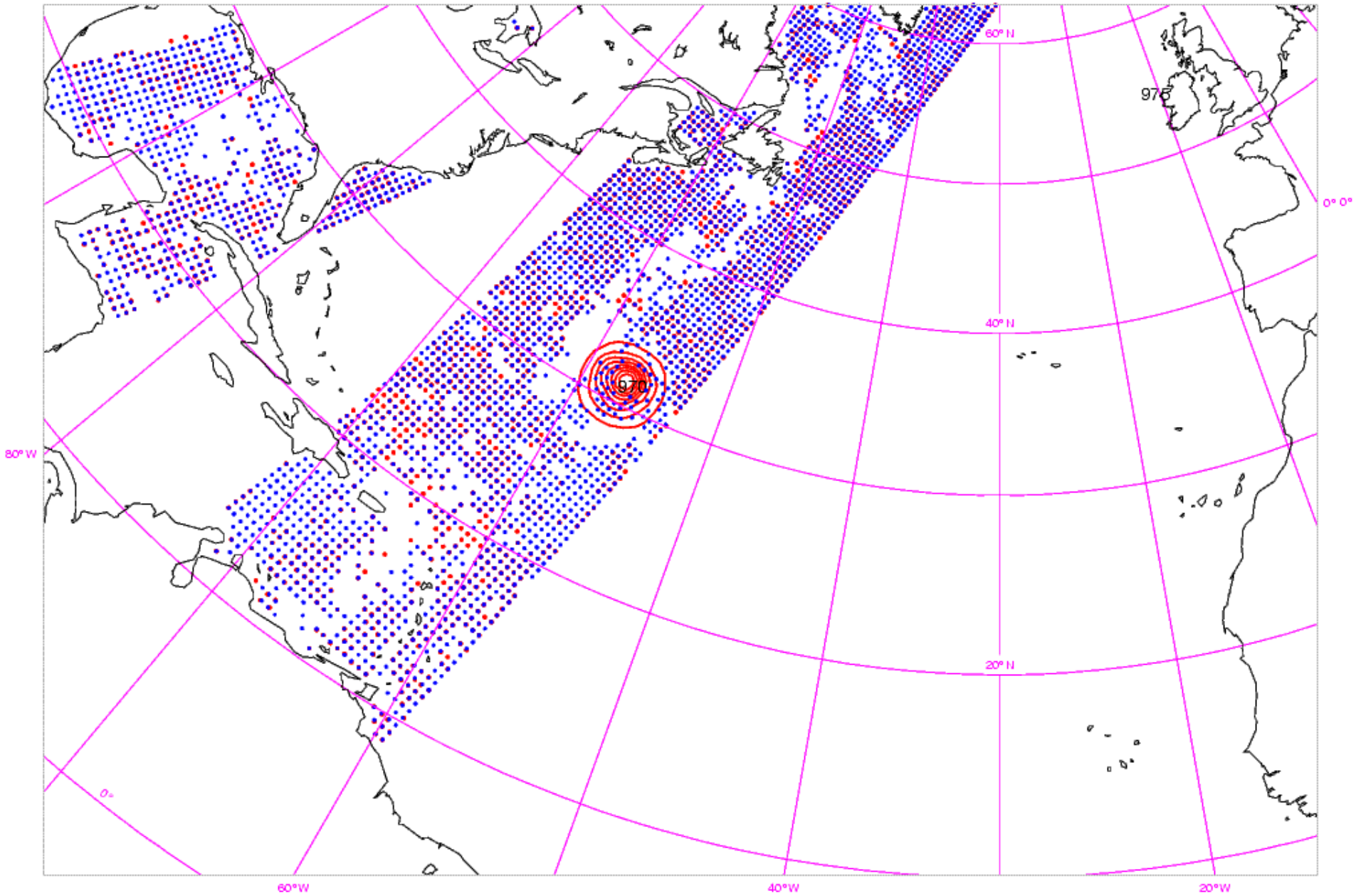
MSLP (hPa) Analysis VT: 20060920H06 and QuikSCAT Winds Observations used.

Test (dist2cone rain-QC), Reference (operational use), Control(ECMWF), Tropical Cyclones Min Pressure (NHC Best Tracks).

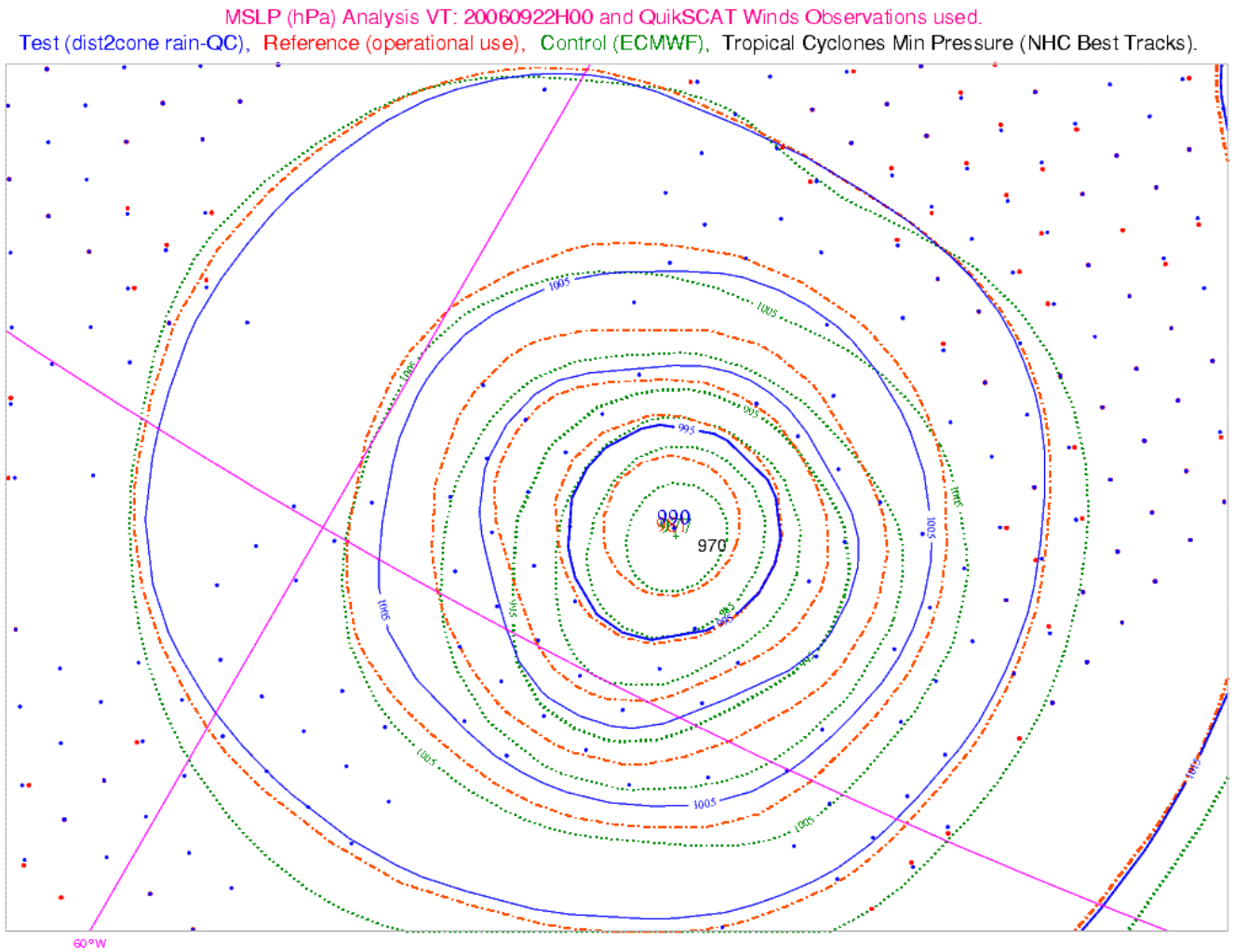


MSLP difference (hPa) Analysis VT: 20060922H00 and QuikSCAT Winds Observations used.

Test(dist2cone rain-QC) minus Reference(operational use), Tropical Cyclones Min Pressure (NHC Best Tracks).



# Zoom on HELENE: MSLP fields of different models




- QuikSCAT data in the core of HELENE only with the new QC.
- Difference in pressure maximale (+9 hPa for the test against the reference).

# As conclusion on the alternative QuikSCAT QC:

- Positive global impact in term of Analysis (gain in number of used data) and in term of Forecast (gain in the Northern H.).
- But no improvement in the track of the TC GORDON.
- More, the analysis of the TC HELENE seems degraded, with a core « ALWAYS » equal or less deep than in the reference.

Short term way (for improving the TC deepening) ?:

- o bias correction, in particular for the high speed
- o the impact in term of forecast on these patterns

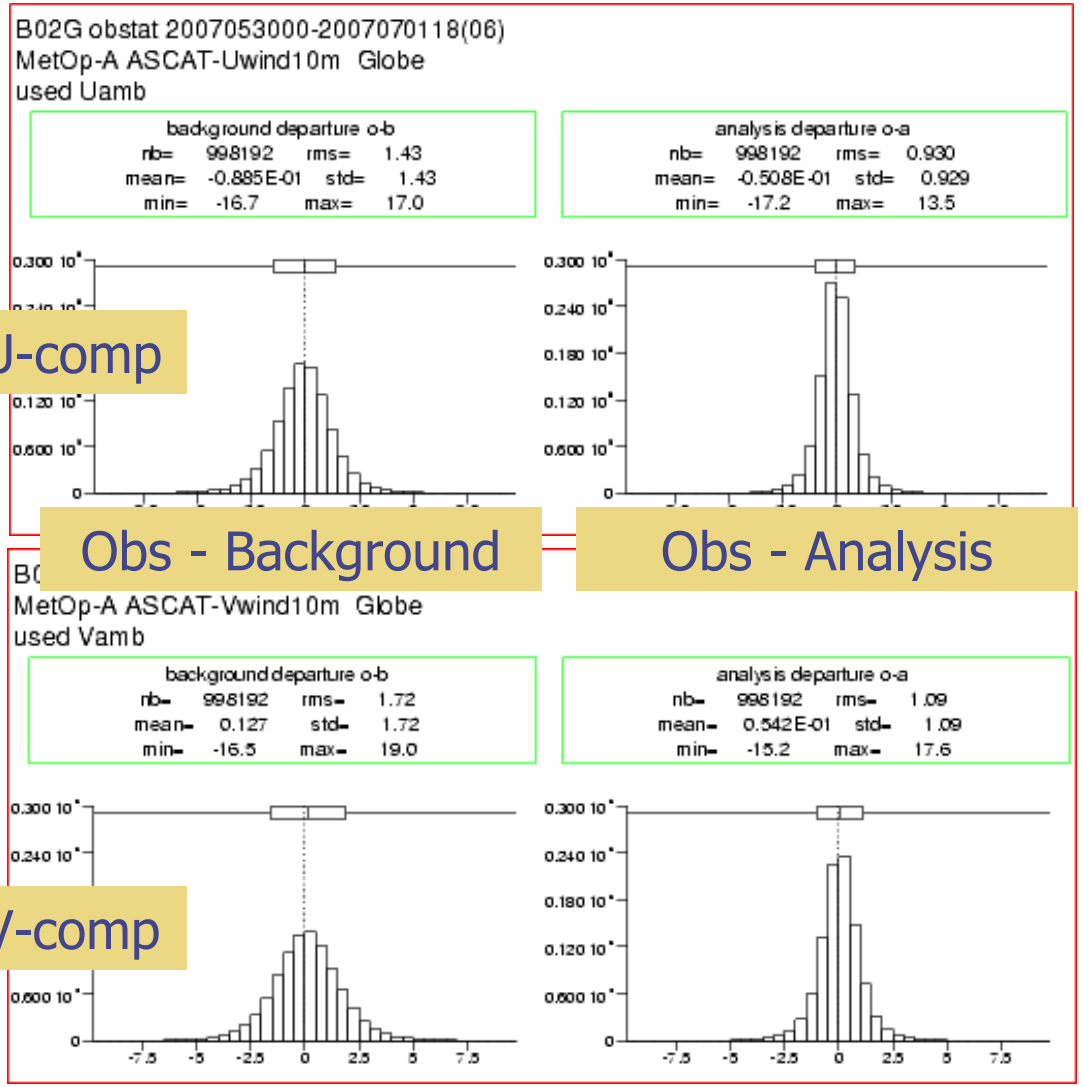
Longer term way ?:

- o GMF revision: NSCAT2 (KNMI), QSCAT1-MOD (NESDIS)
- o to consider more solutions (MSS approach by Portabella and Stoffelen, 2004)

# ASCAT (MetOp-A) data assimilation

- Not home-made inversion but wind product from KNMI in the frame of the OSI SAF for Eumetsat (CMOD5 GMF and Bias correction of +0.5m.$s^{-1}$ (KNMI User Manual)).
- Data on a 'grid' of 25km.
- KNMI quality flags used for the selection of data (monitoring flag, KNMI flag, variational flag).
- Thinning at 100km (at best one data out of 16 used).
- A sample of high quality.
- Experiment with Arpège shows a weak impact but significant (unfortunatelly no TC during the period June 2007).
- Light improvement of the model fit to other wind observations of same type (Dribu, QuikSCAT, Dropsondes).

# Quality of ASCAT wind:




U-comp

V-comp

Obs - Background

Obs - Analysis

Ascat assimilation test with Arpège June 2007:

- ✓ ~30 000 data used per day
- ✓ Wind-Vector Difference

2.2m.s$^{-1}$ wrt 2.6m.s$^{-1}$ for QS

- ✓ |Bias|~0.1m.s$^{-1}$ on each component
- ✓ Gaussian distr. respected

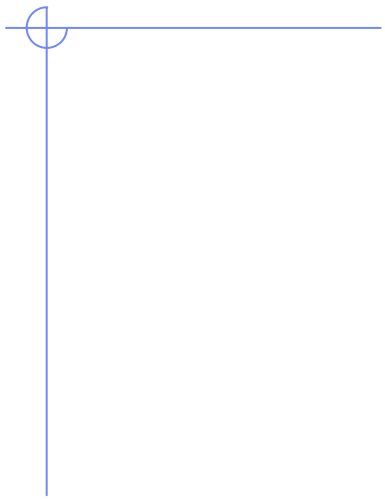
# Forecast impact with Ascat: Bootstrap test on Z parameter, with TEMP as a control (32 cases)

- Different range of forecast, until +96H, different levels (in hPa) and different areas
- + (resp -) means a positive (resp negative) impact at 90%, ++ (resp --) at 95%

Paramètre Z ; 32 cas

| Domain | NORD20 | | | | | | | | | TROPIQ | | | | | | | | | SUD20 | | | | | | | | | EUROPE | | | | | | | | | AMNORD | | | | | | | | | ASIE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Range | 0 | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 0 | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 0 | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 0 | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 0 | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 0 | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 |
| 10 | | | | | | | | - | | ++ | | + | | | | | -- | | | | | - | | | | | + | | | | | -- | | -- | -- | -- | | | | | | | | | | | + | | | | | | | | |
| 30 | | ++ | ++ | ++ | | | - | | | ++ | ++ | + | + | | | | | -- | | | | | - | | | | + | | | | ++ | ++ | | ++ | | | | ++ | | | | | | | | | | | | | | | | | |
| 50 | | ++ | ++ | ++ | | | | | | | ++ | | | ++ | | | | | | | ++ | | | | | | | | ++ | ++ | ++ | ++ | | | | + | | | | | | | | | | | | | | | | | |
| 70 | | ++ | ++ | ++ | ++ | | | | | | ++ | | + | ++ | | | | | | | ++ | | | ++ | | | | | ++ | ++ | ++ | ++ | | | | | | | | | | | | | | | | | | | | | |
| 100 | + | ++ | ++ | + | ++ | | | | | ++ | | + | + | | | | | | | | | | ++ | | | | | ++ | ++ | ++ | ++ | | | | + | | | | | | | | | | | | | | | | | |
| 150 | | + | | | | | | | | ++ | ++ | ++ | + | + | | | | | | | | | | | | | | | ++ | | | | | | | | | | | | | | | | | | | | | | | | |
| 200 | | | | | | | | | | | | ++ | | | | | | | | | | | | | | | | - | | | | | + | | | | | - | | | | | | | | | | | | |
| 250 | | | | | | | | | | | | ++ | | | | - | | | | | | | | | | | | -- | | | | | | | | | | -- | - | | | | | | | | | | | + |
| 300 | | | | | | | | | | | | ++ | | | | | | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ++ |
| 400 | | | | | | | + | | | | | | | | | | | - | + | | | | | | | | | | | | | | | | | | | -- | | | | | | | | | + | | | | ++ | | + |
| 500 | | | | | | | ++ | | | | ++ | | | | | | | | ++ | | | | | | | | | | | | -- | | | | | | | -- | | | | | | | | | | | | + | ++ | + | ++ |
| 700 | | | | | | | | | | | + | | | | | | | - | | | | | | | | | | | | -- | | | | | | | | | | | | | | | | | | | | | | | |
| 850 | | | | | | | | | | | | | | | | | | | | | | | ++ | | | | | + | | | | | | | | | | | ++ | | | | | ++ | | | | | | | | |
| 925 | | | | | | | | | | | | | | | | | | | | | | | ++ | | | | | | | | | | | | | | | -- | | | | | ++ | | + | | - | | | | |
| 1000 | | | | | | | | | | | | | | | | | | | + | | + | | ++ | | | | | | | | | | | | | | ++ | | | | | + | | | | | | | | | | | |

- Main impact (positive) in the high levels in North20 (Europe and North-America) and Tropics



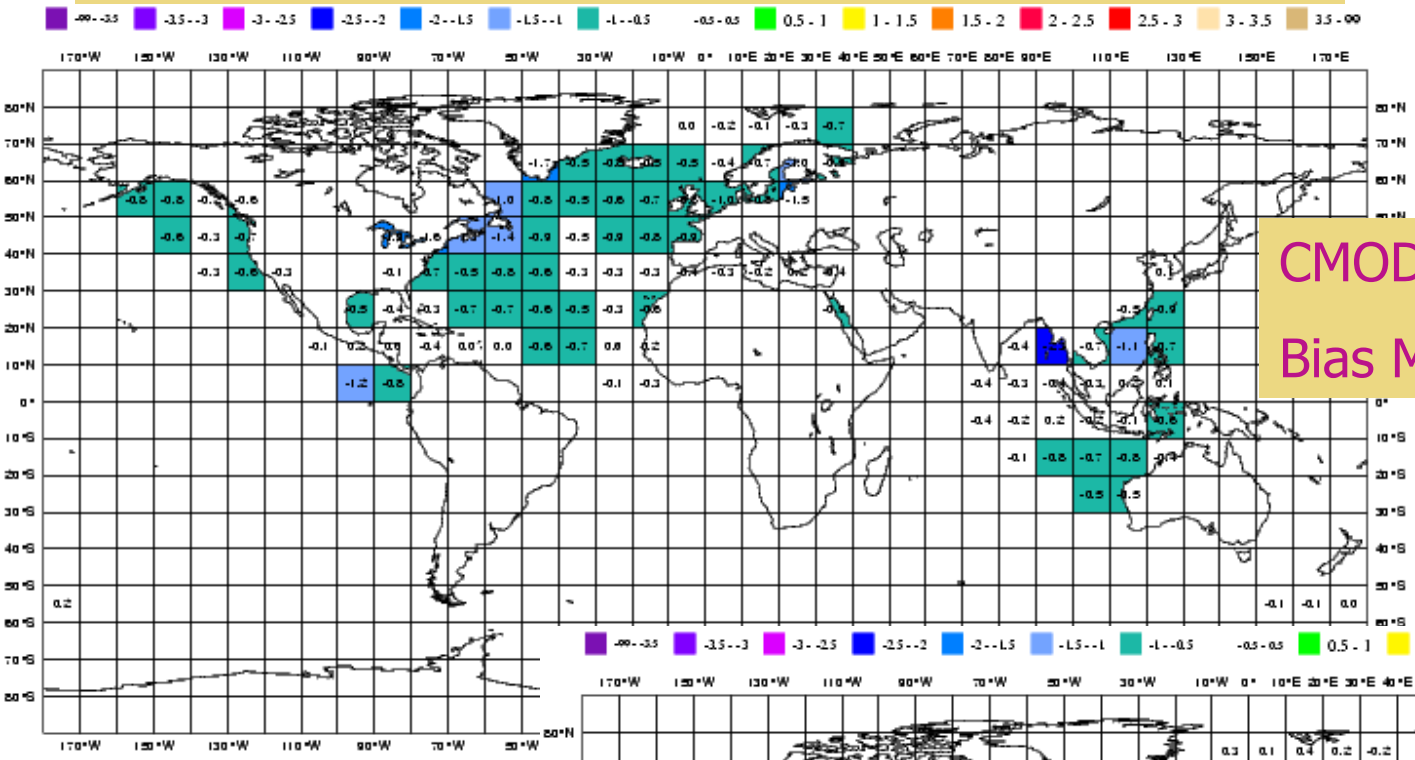
And that will be the end ?

# What about AMI on board ERS-2 ?

- Introduced in operational Arpège in September 2007.
- insensitive to the rain.
- First home-made inversion with CMOD5 (Hersbach *et al,* 2007).
- Only 2 winds exhibited, opposite in direction
- High speed (>35 m.s $^{-1}$) not used
- But a known negative bias of –0.5 m.s$^{-1}$
- CMOD5 revised by Abdalla and Hersbach (2007) for giving CMOD5.4:

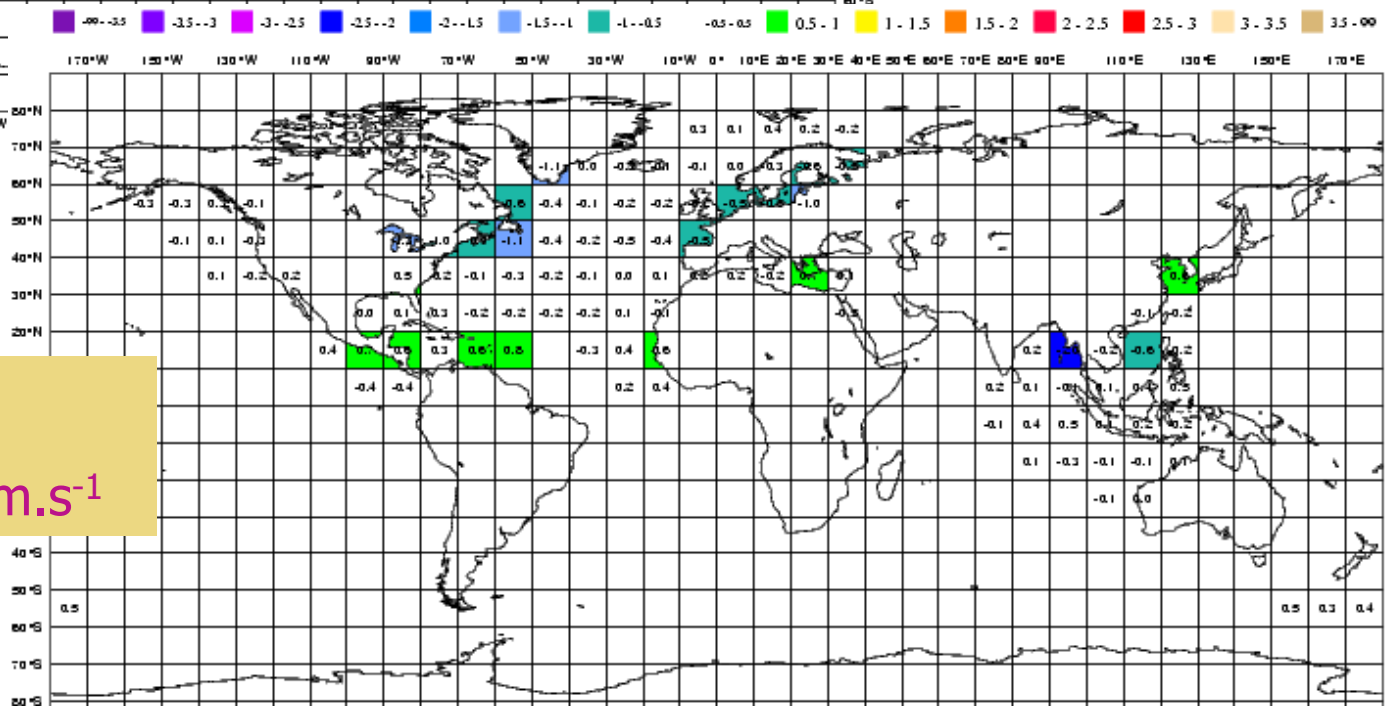
$$CMOD5.4(speed) = CMOD5(speed - 0.45 m.s^{-1})$$

# ERS-2 Speed Bias in June 2007, by 10°x10° boxes:



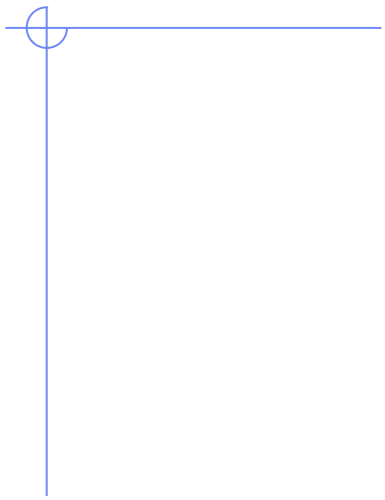

CMOD5

Bias Mean: -0.5 $m.s^{-1}$




CMOD5.4

Bias Mean: -0.1 $m.s^{-1}$



And that is now the end !