Assimilation of Scatterometer Winds at ECMWF

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Outline
ASCAT winds monitoring and diagnostics
OCEANSAT-2 winds
Results from the NWP winds impact study
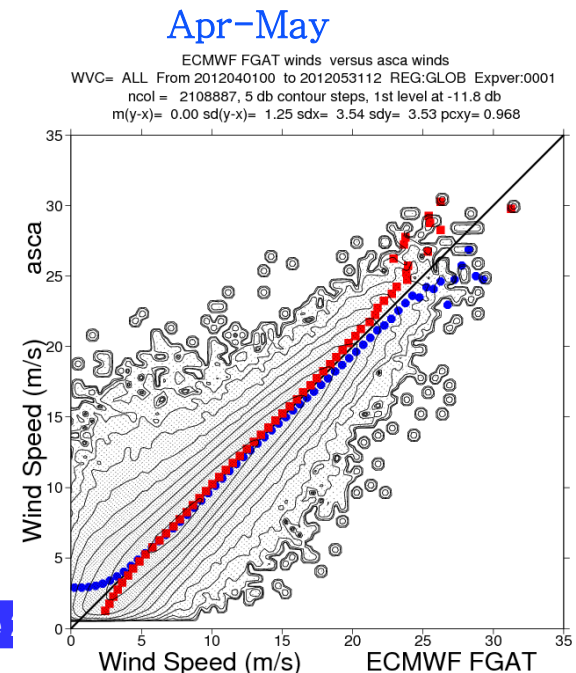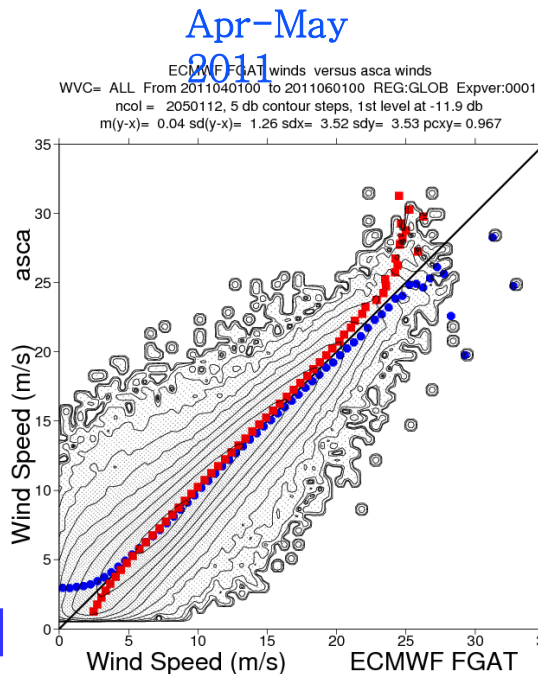
Scatterometer data at ECMWF

ASCAT (25km):

✓ Wind inversion is performed in-house using the CMOD5.N GMF
✓ Calibration and Quality control:
- Sigma nought bias correction before the wind inversion.
- Wind speed bias correction applied after wind inversion.
- Screening: Sea Ice check based on SST and Sea Ice model
- Thinning: 100 km

✓ Assimilated as 10m equivalent neutral winds
✓ Observation error: 1.5 m/s

Data stable in time:
Wind speed stdv ~1.25 m/s
Wind direction stdv ~14deg

Apr-May 2011

Apr-May

ECMWF FGAT winds versus asca winds
WVC= ALL From 2011040100 to 2011060100 REG:GLOB Expver:0001
ncol = 2050112, 5 db contour steps, 1st level at -11.9 db
m(y-x)= 0.04 sd(y-x)= 1.26 sdx= 3.52 sdy= 3.53 pcxy= 0.967

ECMWF FGAT winds versus asca winds
WVC= ALL From 2012040100 to 2012053112 REG:GLOB Expver:0001
ncol = 2108887, 5 db contour steps, 1st level at -11.8 db
m(y-x)= 0.00 sd(y-x)= 1.25 sdx= 3.54 sdy= 3.53 pcxy= 0.968

Analysis & Forecast Sensitivity to Observations

The *analysis sensitivity to observations* (Cardinali et al., 2004) is a measure of the relative influence of the observation on the analysis. It is based on the concept of the self-sensitivity (influence) matrix (from ordinary least-square).

The *forecast sensitivity to observations* measures the impact of the observations on the short-range forecast (24-48 hours). The forecast sensitivity tool developed at ECMWF (Cardinali, 2009) computes the Forecast Error Contribution (FEC) that is a measure of the variation of the forecast error (as defined through the dry energy norm) due to the assimilated observations.

Global Observing System – 24 h forecast error contribution – JJA 2011
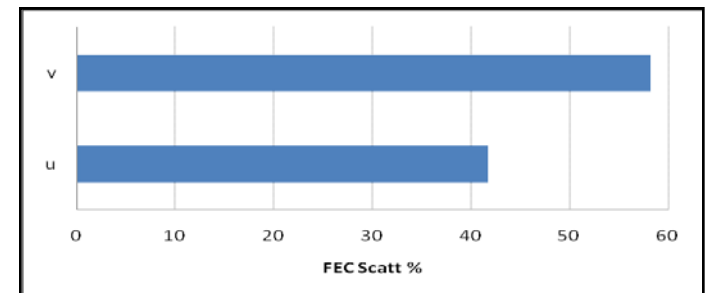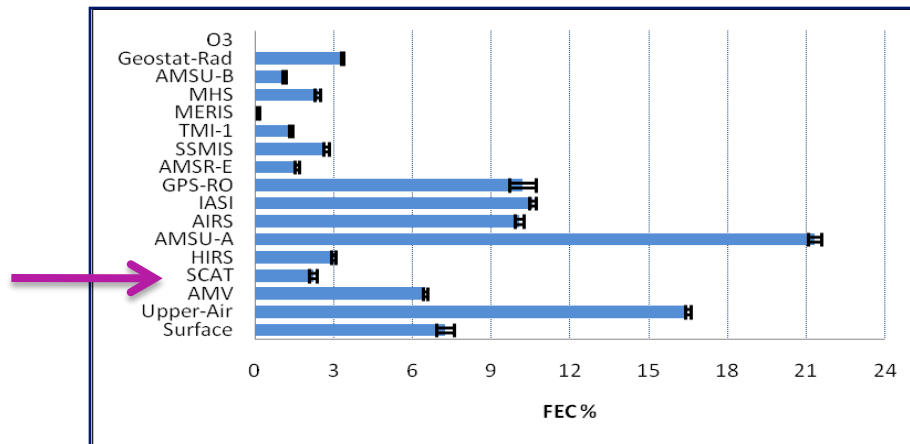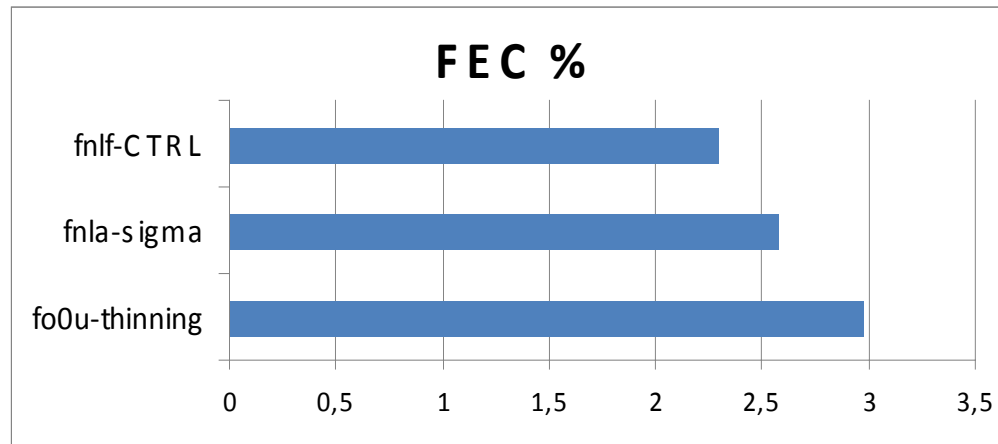
Forecast Sensitivity to Observations

Model Resolution: T511 (~40km); 91 levels up to 0.01hPa

DA system: Incremental 4DVAR with a 12 h window and an analysis resolution of T255 (~80km)

Period: 1 Jun – 31 July 2011

Experiments:

➤ Fnlf ➔ CTRL   (operational configuration)   ➔ *CTRL*

➤ Fnla ➔ CTRL + observation error=1.0 m/s   ➔ *sigma*

➤ Fo0u ➔ CTRL + thinning=2 (every 50km)   ➔ *thinning*

F E C %

	FEC %
fnlf-CTRL	~2.3
fnla-sigma	~2.6
fo0u-thinning	~2.95

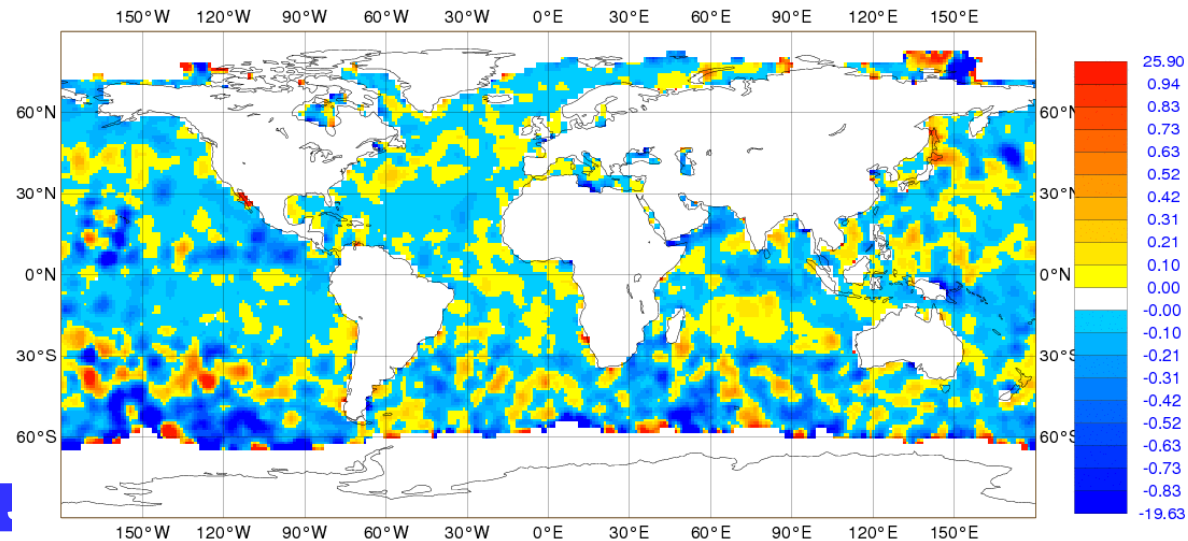(x-axis: 0, 0,5, 1, 1,5, 2, 2,5, 3, 3,5)

ASCAT Forecast Error Contribution

The FEC is positive for forecast error increase and negative for forecast error decrease.

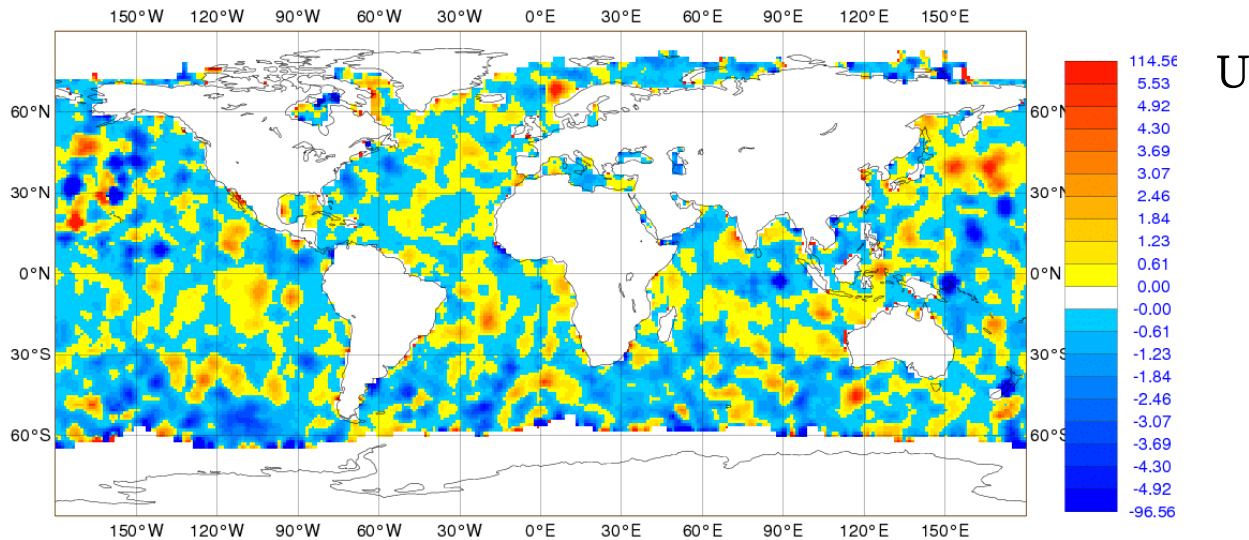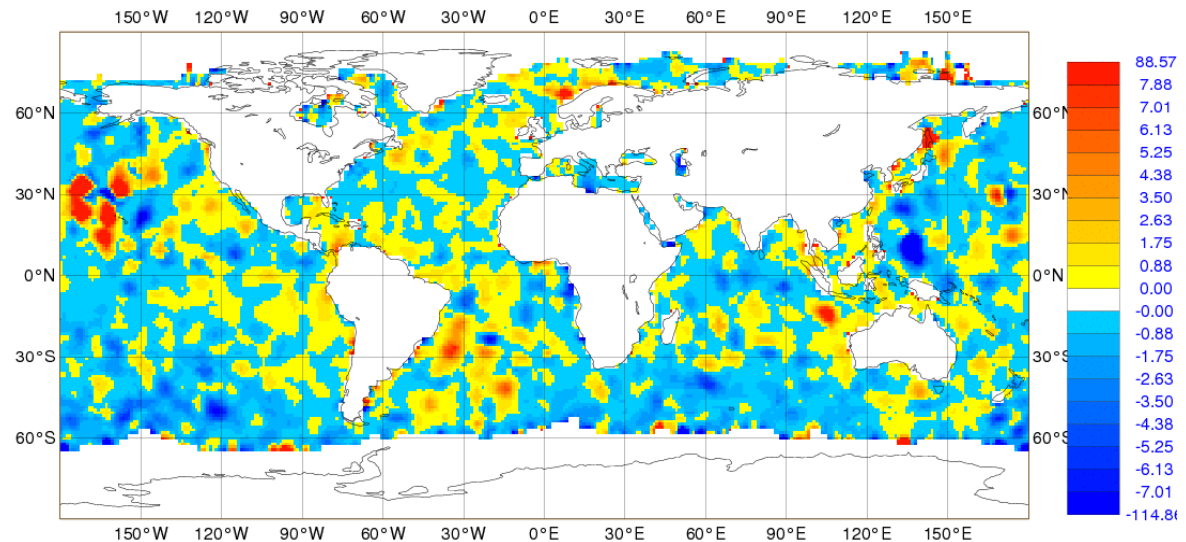Exp *fnlf* (CTRL): Operational configuration
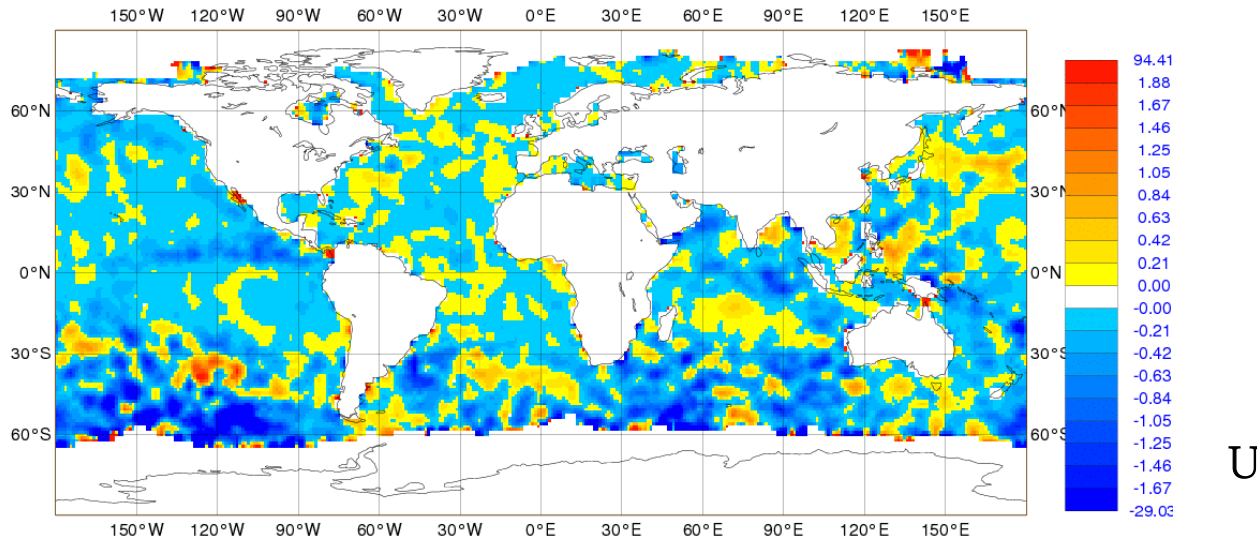
ASCAT Forecast Error Contribution
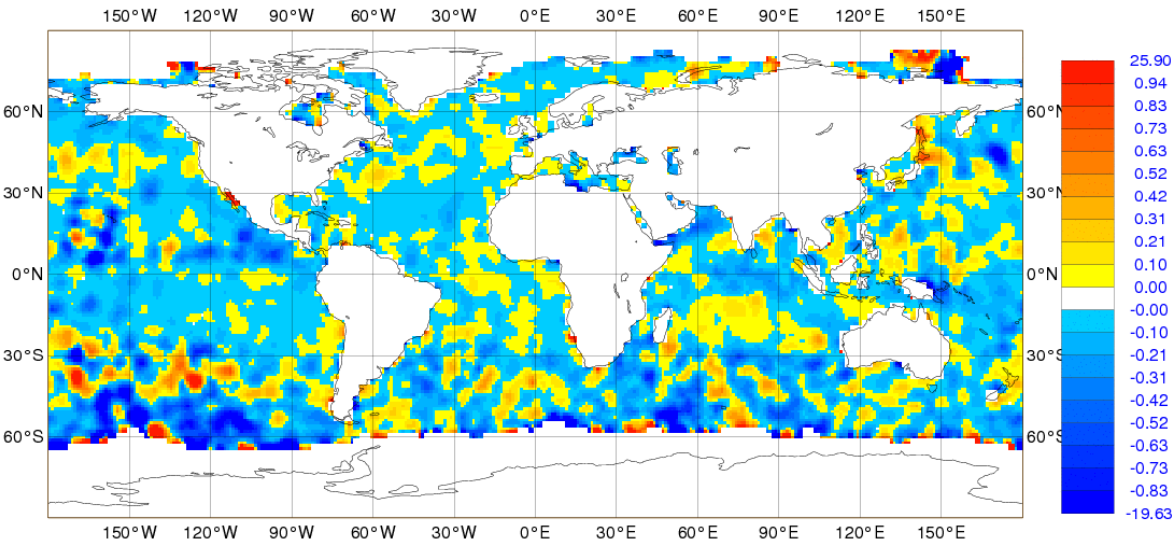
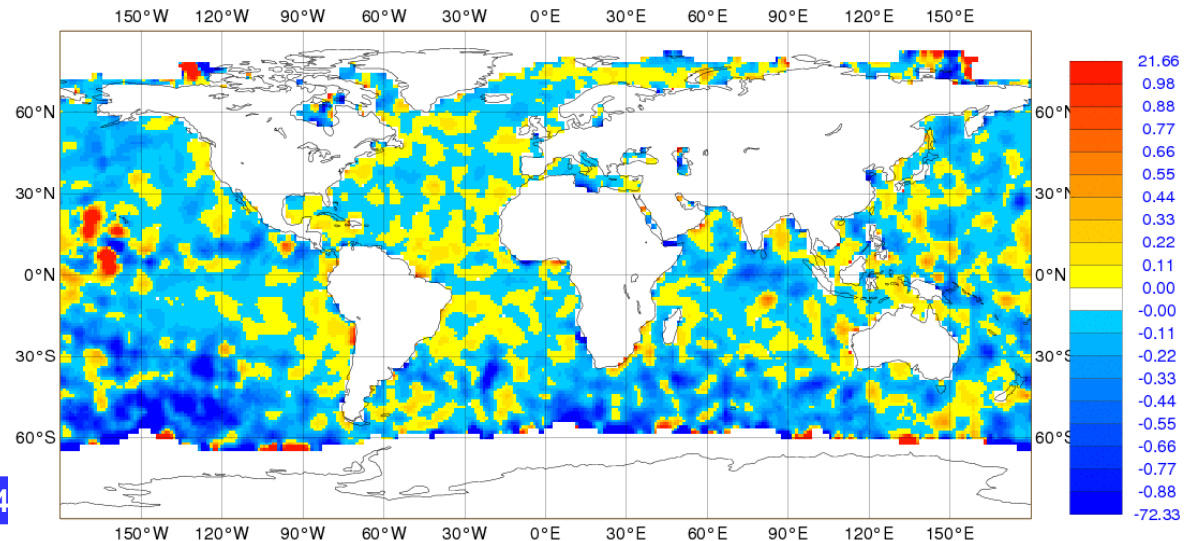Exp *fnla* (sigma): observation error = *1m/s*

ASCAT Forecast Error Contribution

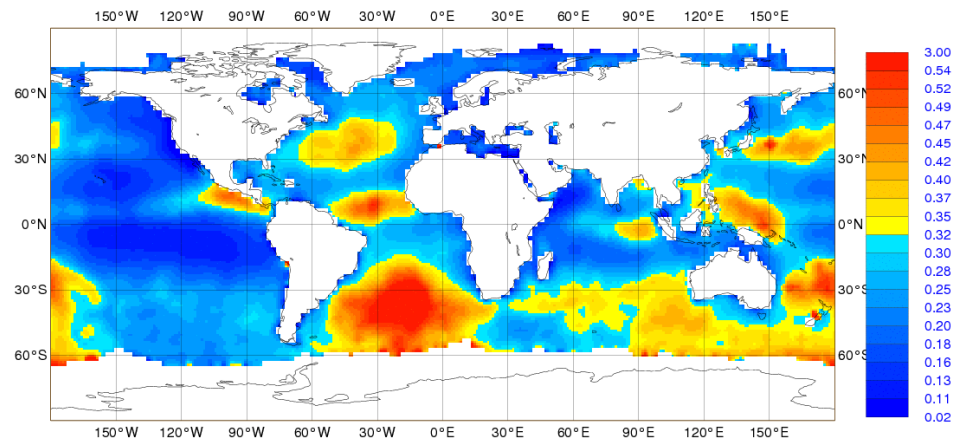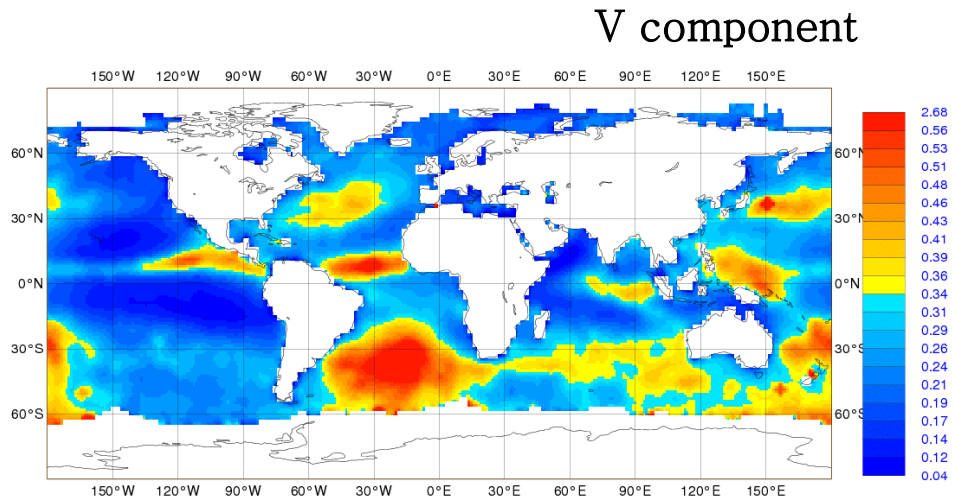Exp *fo0u:* thinning *= 2* => Hor. Res. 50km

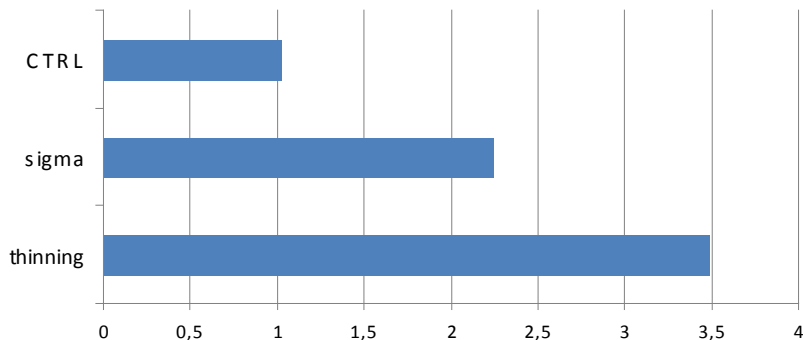# Analysis Sensitivity to Observations: ASCAT Observation Influence

V component

U component

ASCAT DFS (%)

OCEANSAT-2 Scatterometer data

OCEANSAT-2 (50km):

- ✓ ISRO satellite launched in Sept 2009
- ✓ Use of L2 wind products from OSI-SAF (KNMI)
- ✓ Quality control:
  - – Screening: Sea Ice check on SST and Sea Ice model
  - – No thinning; weight in the assimilation 0.25
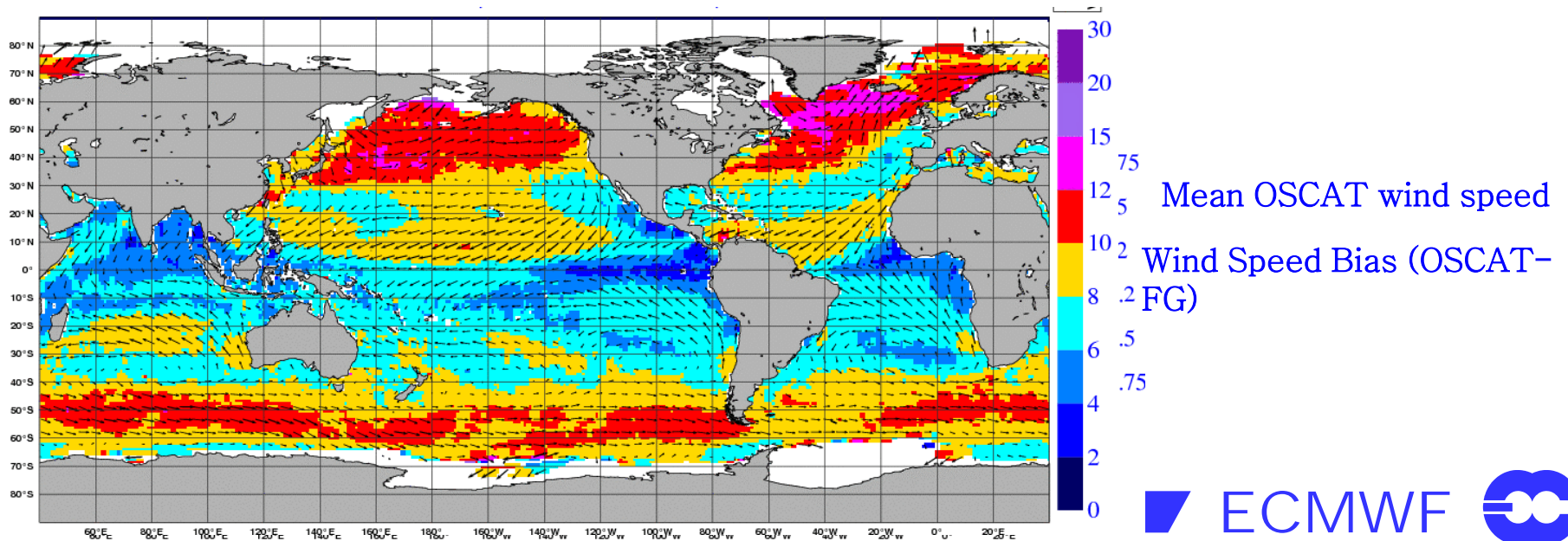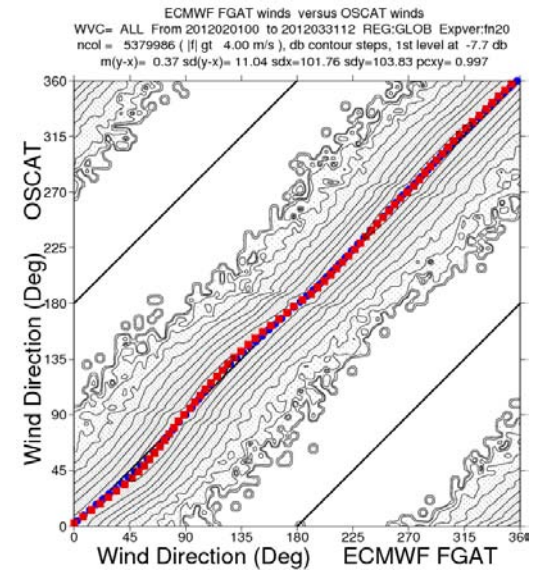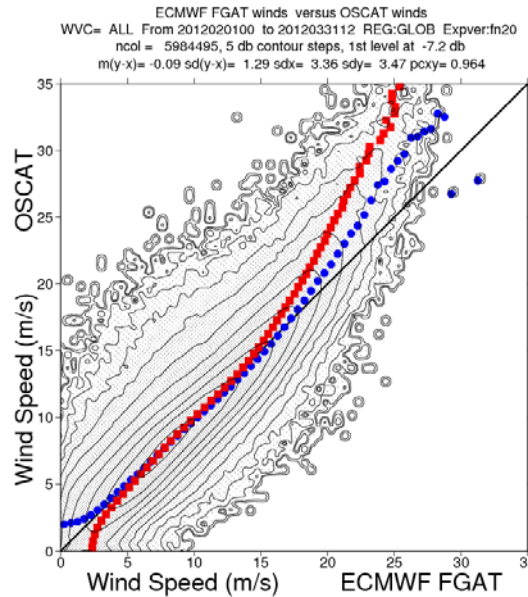- ✓ Still under passive monitoring.

OCEANSAT-2 scatterometer data

1 Feb – 31 Mar 2012

Current configuration from 29 Dec 2011
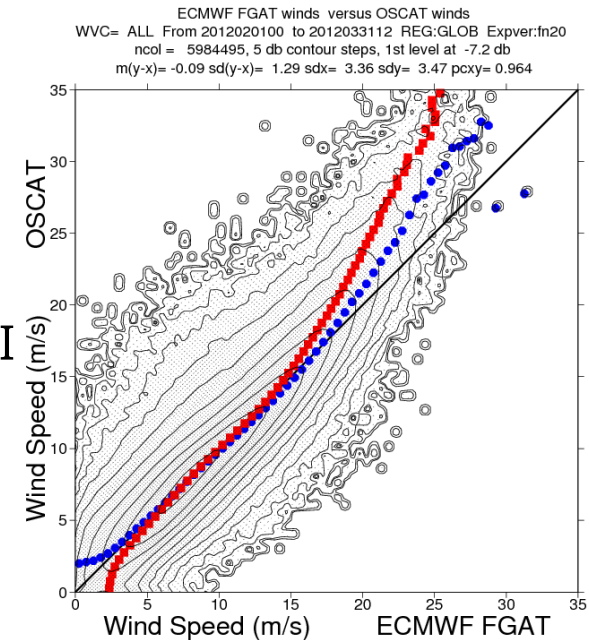
WSp bias: ~ −0.1 m/s
WSp stdv: ~ 1.3 m/s
WDir stdv: ~ 11 deg

Mean OSCAT wind speed

Wind Speed Bias (OSCAT–FG)

ECMWF

OCEANSAT-2 scatterometer data

OCEANSAT−2 (50km):

- ✓ ISRO satellite launched in Sept 2009
- ✓ Use of L2 wind products from OSI−SAF (KNMI)
- ✓ Calibration and Quality control:
  - Screening: Sea Ice check based on SST and SI model
  - No thinning; weight in the assimilation 0.25
  - A wind speed bias correction is applied

ECMWF FGAT winds versus OSCAT winds
WVC= ALL From 2012020100 to 2012033112 REG:GLOB Expver:fn20
ncol = 5984495, 5 db contour steps, 1st level at -7.2 db
m(y-x)= -0.09 sd(y-x)= 1.29 sdx= 3.36 sdy= 3.47 pcxy= 0.964

Bias correction

Wind Speed Bias Correction applied in the 4D−Var:
 − average of OSCAT avg bias and ECMWF avg bias
 − wind speed and Wind Vector Cell dependent
 − wind speed threshold: 25 m/s

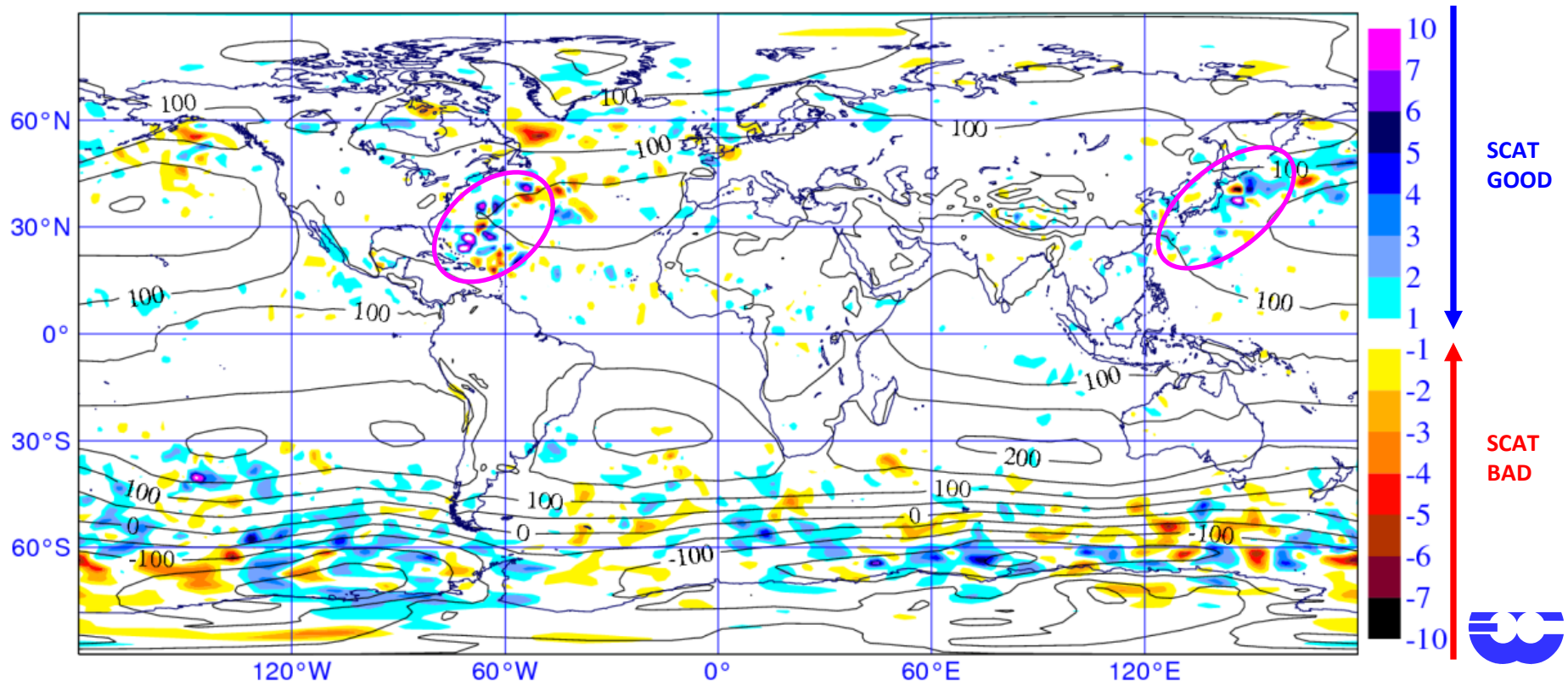Node 15
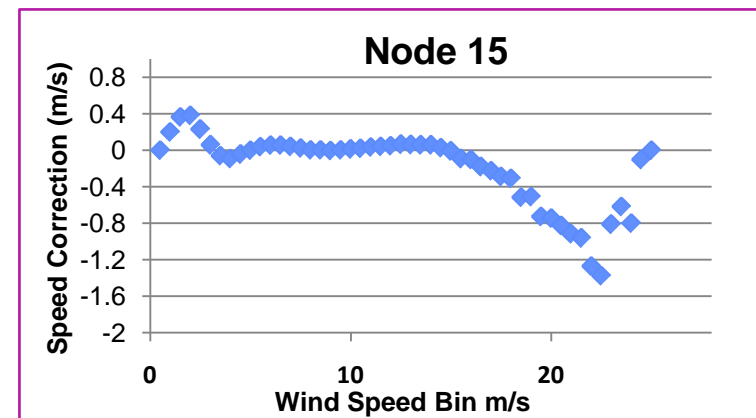
NWP wind impact study

Model Resolution: T799 (~25km); 91 levels up to 0.01hPa
DA system: Incremental 4DVAR with a 12 h window and an analysis resolution of T255 (~80km)
**Period**: 15 Aug – 30 Sept 2010
Experiments: Control (full observing system) vs Scatterometer denial

Difference in RMS error for 1000 hPa geopotential, T+ 48 FC
Scatterometer denial – Control

NWP wind impact study:
Tropical Cyclone Tracking Forecast Error

- For each storm the TC centre and SLP have been detected (Vitart et al. 1997) from the ECMWF model fields for each experiment (Ctrl, AMVs denial, SCAT denial)
- TC centre position and SLP have been compared to observation values from NHC and JMA
- Limited number of cases: 56 at 12 h, dropping to 32 at 96 h forecast

Track Forecast Error

SLP Error (FC-BT)
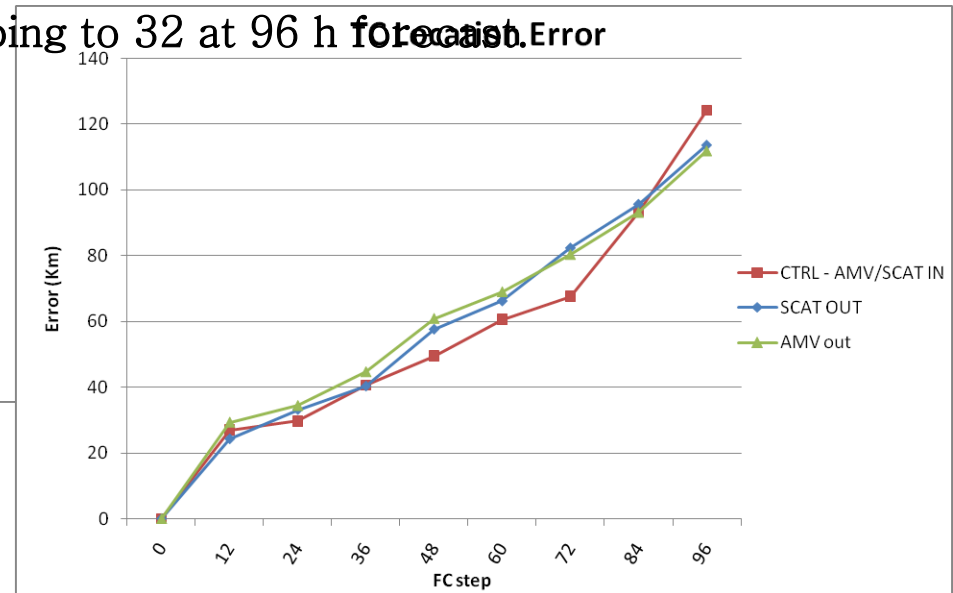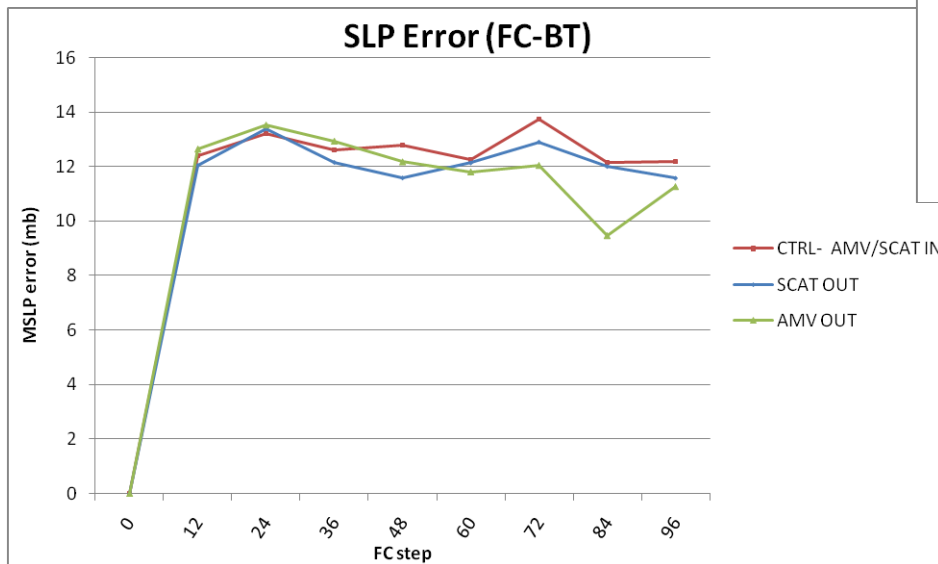
Summary

▪ASCAT – Routinely assimilated and monitored: monitoring results available on our web site;

– METOP-A ASCAT stable and good quality; IFS ready to assimilate METOP-B ASCAT;

– Assessment of Ascat impact into the 4D-Var system ongoing: possible improvements of analysis and forecast impact by revision of the spatial resolution or observation error. Other parameters to be analyzed (Ocean currents, stability effects…).

▪ OSCAT – Ingestion of OCEANSAT-2 L2B winds (passive monitoring);

– On average OSCAT winds are lower than model winds; Bias detected in the SH to be   investigated;

– Wind speed bias correction applied and wind assimilated up to 25m/s;

– Neutral impact on forecast scores but more stable system;

– Operational assimilation planned ~ Summer 2012.

▪ NWP WIND IMPACT STUDY

– The impact of Scatterometer winds have been investigated during the 2010 TC season;   Scatterometer winds have a good impact in the analysis and forecast in tropical storm   areas;

– The impact of the Scatterometer and AMV winds on the forecast of the TC neutral to positive,   small benefit for the location of the TC centre