Assimilation of scatterometer winds at ECMWF

**Giovanna De Chiara,
Peter Janssen, Hans Hersbach, Niels Bormann**
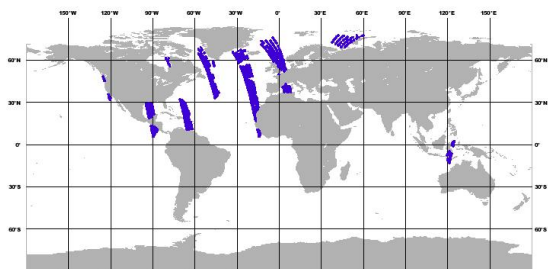
Overview

➢**Scatterometer data at ECMWF**
➢**OCEANSAT-2 scatterometer winds**
➢**Results from the NWP winds impact study**
➢**Summary**

ECMWF

Scatterometer data at ECMWF

ODB database : ECMA   Query: ers2
No. of data points   770

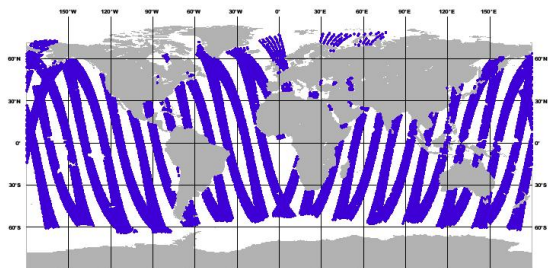**ERS1/ERS2**   **Not Operational Anymore**

➢ **30-01-1996 - 04-07-2011**
➢ **ERS-2: regional since June 2003**

ODB database : ECMA   Query: ascat
No. of data points   16869

ASCAT from METOP-A   Operational

➢ **12-06 2007 onwards**
➢ **Data stable and nominal**

ODB database : ECMA   Query: oceansat2
No. of data points   69110
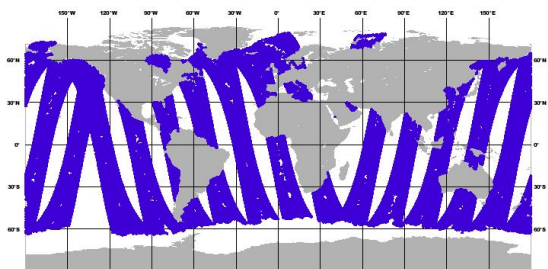
OCEANSAT-2   **Passive Monitoring**

➢ **Launched Sept 2009 by ISRO**
➢ **IFS (CY37R3) – passive monitoring**

Scatterometer data at ECMWF: ASCAT
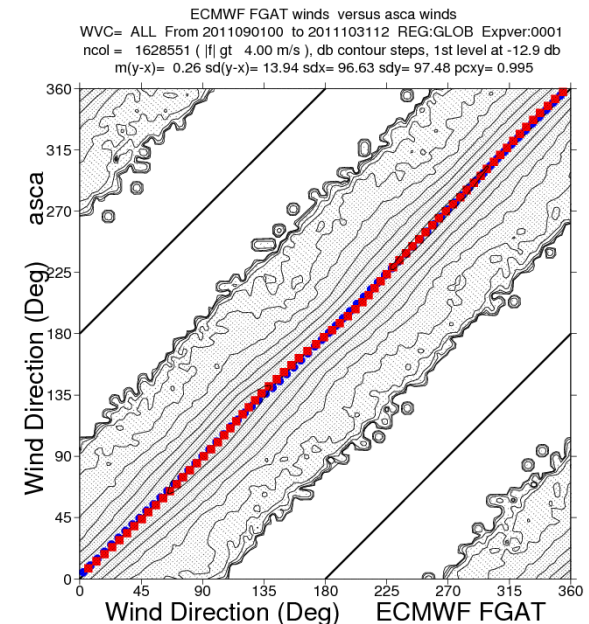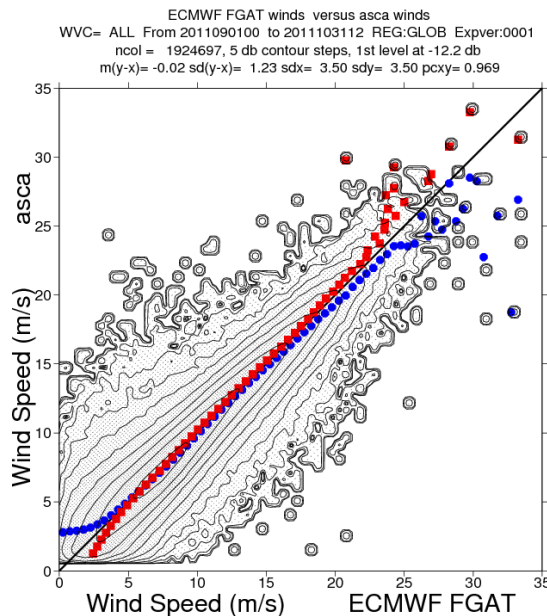
ASCAT (25km):

- ✓ **Wind inversion is performed in-house using the CMOD5.N GMF**
- ✓ **Calibration and Quality control:**
    - • **A bias correction is applied to ASCAT sigma 0 and wind speed**
    - • **Screening: Sea Ice check based on SST**
    - • **Thinning to 100 km**
- ✓ **Assimilated as 10m neutral winds (from Nov 2010)**

Data stable (within seasonal variability):
Wind speed stdv ~1.25 m/s
Wind direction stdv ~14deg

Sep-Oct 2011

ECMWF FGAT winds versus asca winds
WVC= ALL From 2011090100 to 2011103112 REG:GLOB Expver:0001
ncol = 1924697, 5 db contour steps, 1st level at -12.2 db
m(y-x)= -0.02 sd(y-x)= 1.23 sdx= 3.50 sdy= 3.50 pcxy= 0.969

ECMWF FGAT winds versus asca winds
WVC= ALL From 2011090100 to 2011103112 REG:GLOB Expver:0001
ncol = 1628551 (|f| gt 4.00 m/s), db contour steps, 1st level at -12.9 db
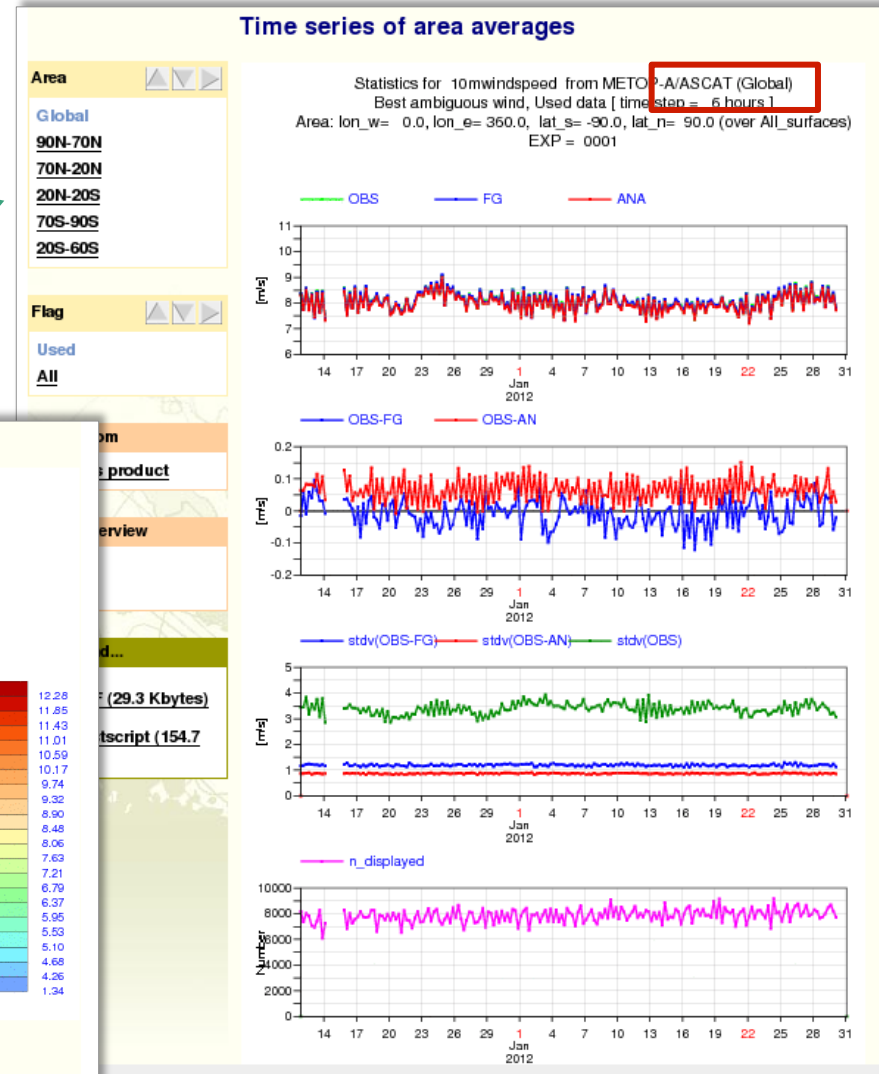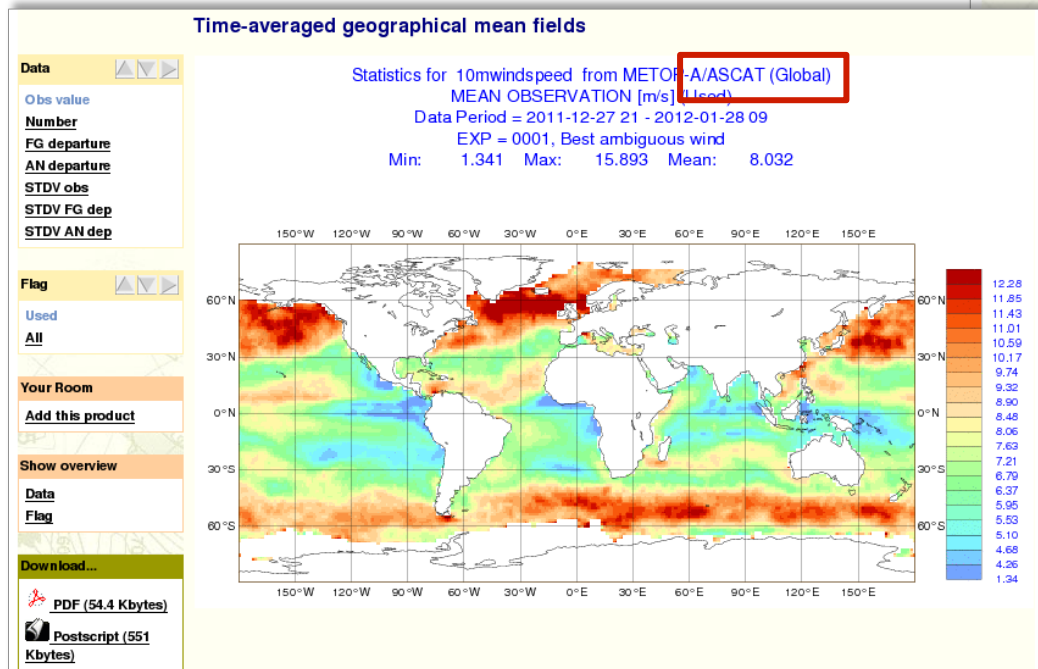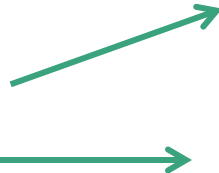m(y-x)= 0.26 sd(y-x)= 13.94 sdx= 96.63 sdy= 97.48 pcxy= 0.995

ECMWF

ASCAT winds monitoring

Daily monitoring results available at:

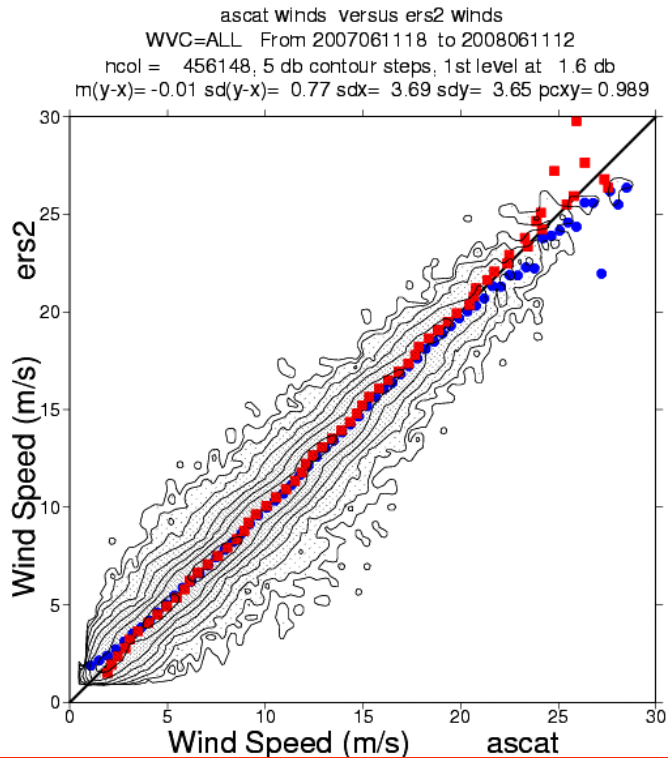http://www.ecmwf.int/products/forecasts/d/charts/monitoring/satellite/wind/scatt/ascat

- **Mean Observed Value**
- **FG departure**
- **Analysis departure**
- **related STDV**
- **analysis: global & latitude bands**
- **all data & assimilated**

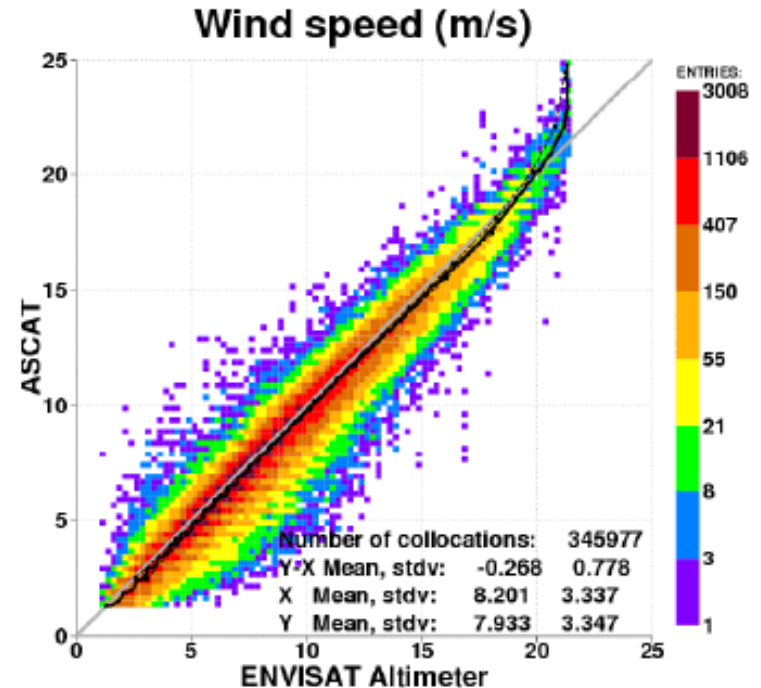# ASCAT winds Monitoring: collocation studies

(1 year - ΔT<1h - Δx <25Km)

ASCAT vs ERS-2

ascat winds versus ers2 winds
WVC=ALL From 2007061118 to 2008061112
ncol = 456148, 5 db contour steps, 1st level at 1.6 db
m(y-x)= -0.01 sd(y-x)= 0.77 sdx= 3.69 sdy= 3.65 pcxy= 0.989

Both ASCAT and ERS-2 data are bias-corrected at ECMWF
They inter-compare very well: no bias, very low scatter

ASCAT vs ENVISAT Altimeter

Wind speed (m/s)

	ENTRIES:
	3008
	1106
	407
	150
	55
	21
	8
	3
	1

Number of collocations:		345977
Y-X Mean, stdv:	-0.268	0.778
X Mean, stdv:	8.201	3.337
Y Mean, stdv:	7.933	3.347

ASCAT and RA-2 winds compare well
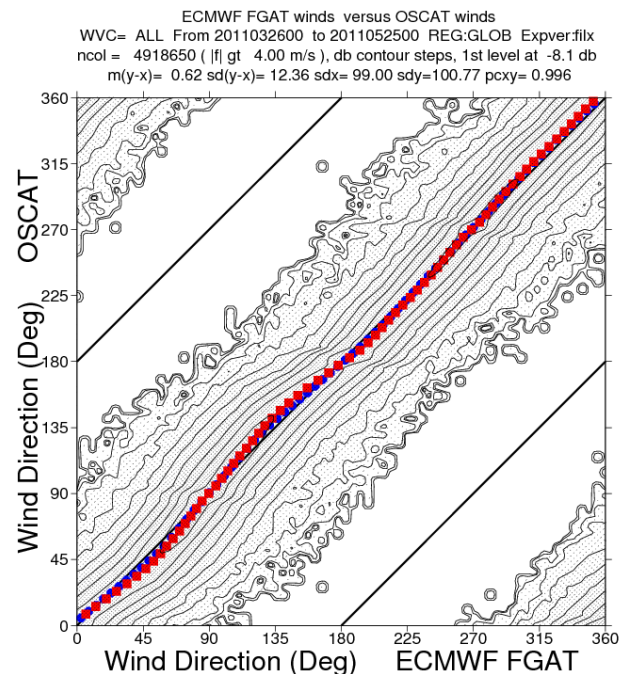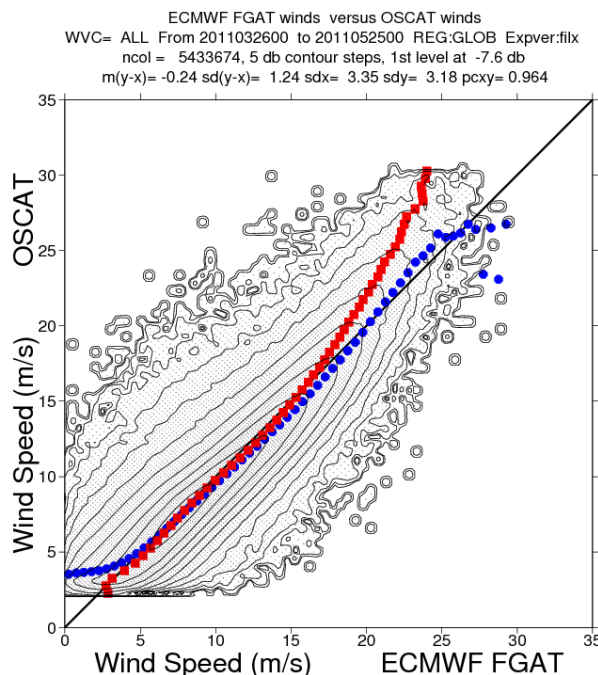
ECMWF

OCEANSAT-2 scatterometer data

OCEANSAT-2 (50km):

- ✓ **ISRO-satellite, launched 23 Sept 2009**
- ✓ **Use level-2 winds product from OSI-SAF (KNMI)**
- ✓ **Calibration and Quality control:**
  - **A bias correction is applied to OSCAT wind speed**
  - **Screening: Sea Ice check based on SST**
- ✓ **Still under passive monitoring.**

Comparison to ECMWF FG:
- discrepancy for high winds
- wind direction ok

- Speed stdv ~ 1.24 m/s
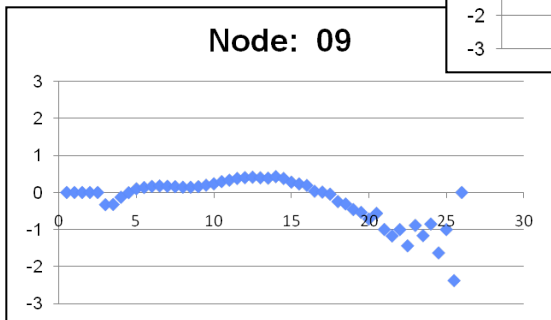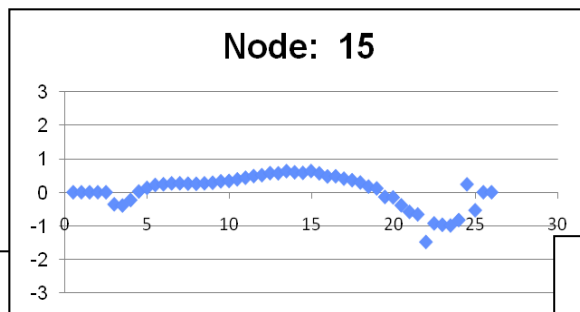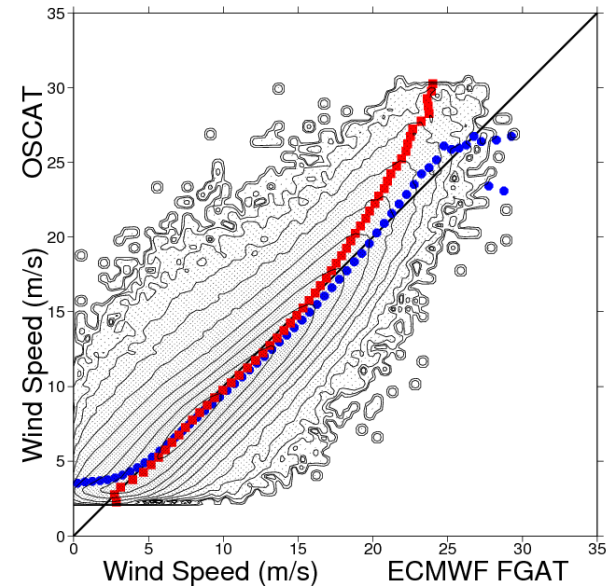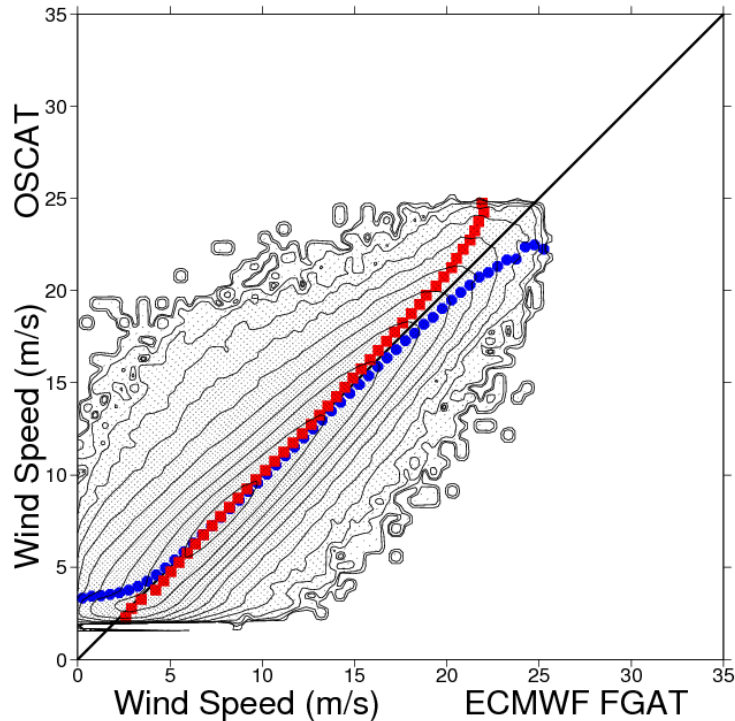- Direction stdv ~ 12.5 deg

26 Mar – 25 May 2011

ECMWF FGAT winds versus OSCAT winds
WVC= ALL From 2011032600 to 2011052500 REG:GLOB Expver:filx
ncol = 5433674, 5 db contour steps, 1st level at -7.6 db
m(y-x)= -0.24 sd(y-x)= 1.24 sdx= 3.35 sdy= 3.18 pcxy= 0.964

ECMWF FGAT winds versus OSCAT winds
WVC= ALL From 2011032600 to 2011052500 REG:GLOB Expver:filx
ncol = 4918650 (|f| gt 4.00 m/s), db contour steps, 1st level at -8.1 db
m(y-x)= 0.62 sd(y-x)= 12.36 sdx= 99.00 sdy=100.77 pcxy= 0.996

ECMWF

OCEANSAT-2 scatterometer data

WIND SPEED BIAS CORRECTION:
- **Hp: OSCAT winds and FG winds have same errors**
- **Average of OSCAT avg bias and ECMWF avg bias**
- **High winds threshold 25m/s**
- **Bias computed for each Wind Vector Cell**

ECMWF FGAT winds versus OSCAT winds
WVC= ALL From 2011032600 to 2011052500 REG:GLOB Expver:filx
ncol = 5433674, 5 db contour steps, 1st level at -7.6 db
m(y-x)= -0.24 sd(y-x)= 1.24 sdx= 3.35 sdy= 3.18 pcxy= 0.964

Bias correction

Node: 15

Node: 09

Node: 21
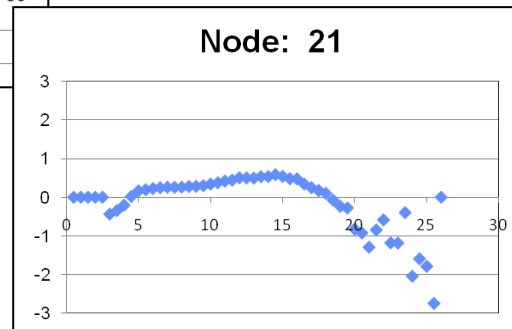
ECMWF

OCEANSAT-2: Bias corrected winds

ECMWF FGAT winds versus OSCAT winds
WVC= ALL From 2011032600 to 2011052000 REG:GLOB Expver:fkio
ncol = 4887024, 5 db contour steps, 1st level at -8.1 db
m(y-x)= -0.01 sd(y-x)= 1.23 sdx= 3.33 sdy= 3.27 pcxy= 0.965

ECMWF FGAT winds versus OSCAT winds
WVC= ALL From 2011032600 to 2011052000 REG:GLOB Expver:fkio
ncol = 4402089 (|f| gt 4.00 m/s), db contour steps, 1st level at -8.6 db
m(y-x)= 0.62 sd(y-x)= 12.37 sdx= 99.26 sdy=101.03 pcxy= 0.996
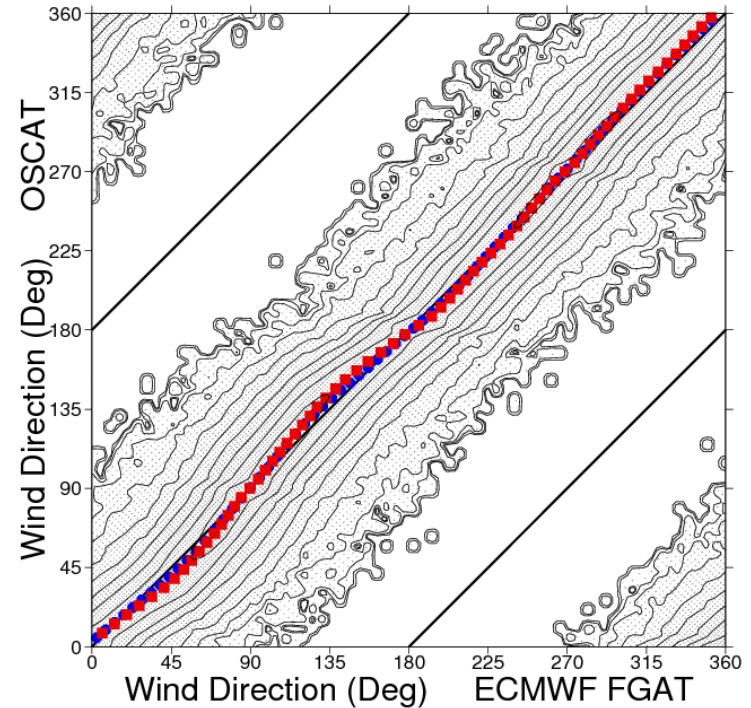
Wind speed bias (m/s) of osca vs ECMWF FGAT for all flows
Globe 0.06 N.Hem 0.1 Tropics 0.19 S.Hem -0.08 MIN -2.38 MAX 5.29
2011032600 - 2011052000, EXPVER = fkio, REGION = GLOB
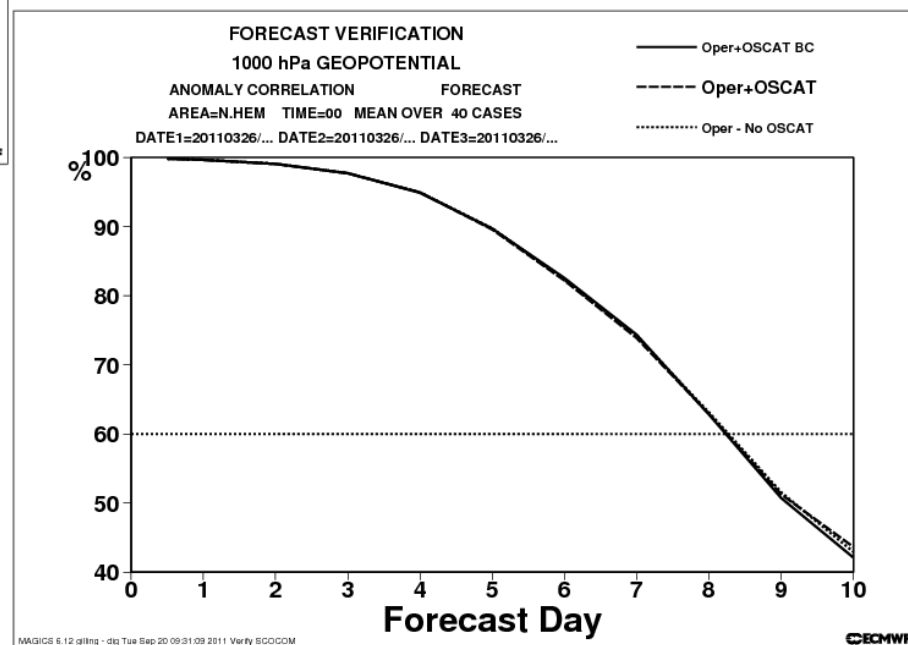

Assimilation of scatterom

ECMWF
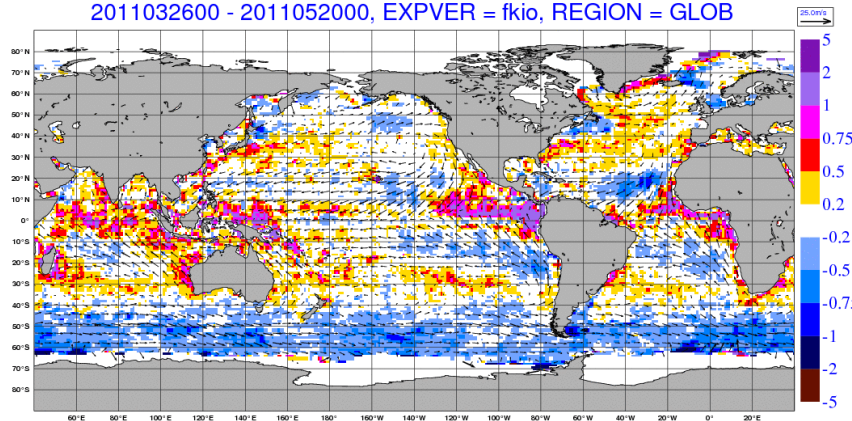
OSCAT: Forecast impact
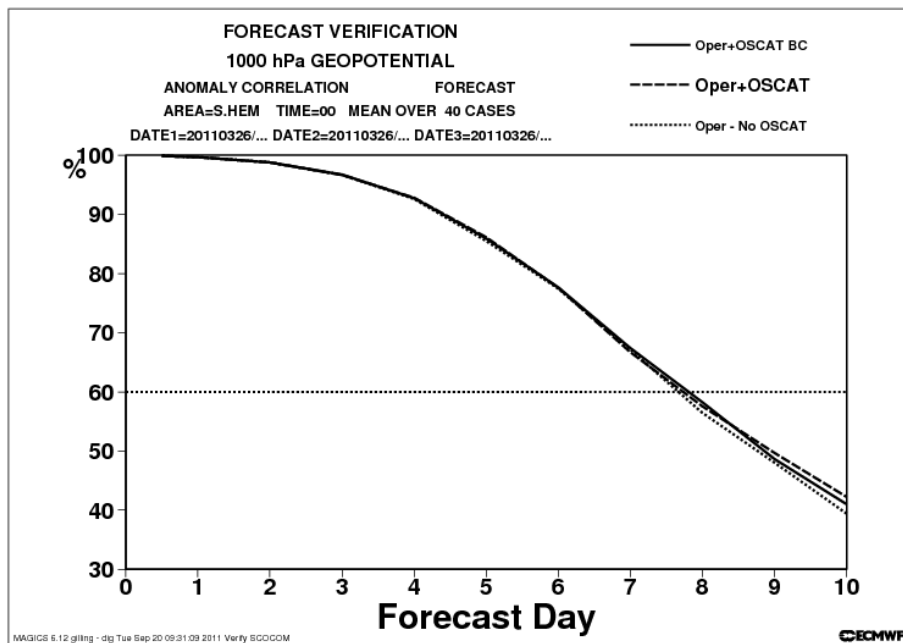
Impact on the forecast scores:
- **26 March – 20 April 2011**
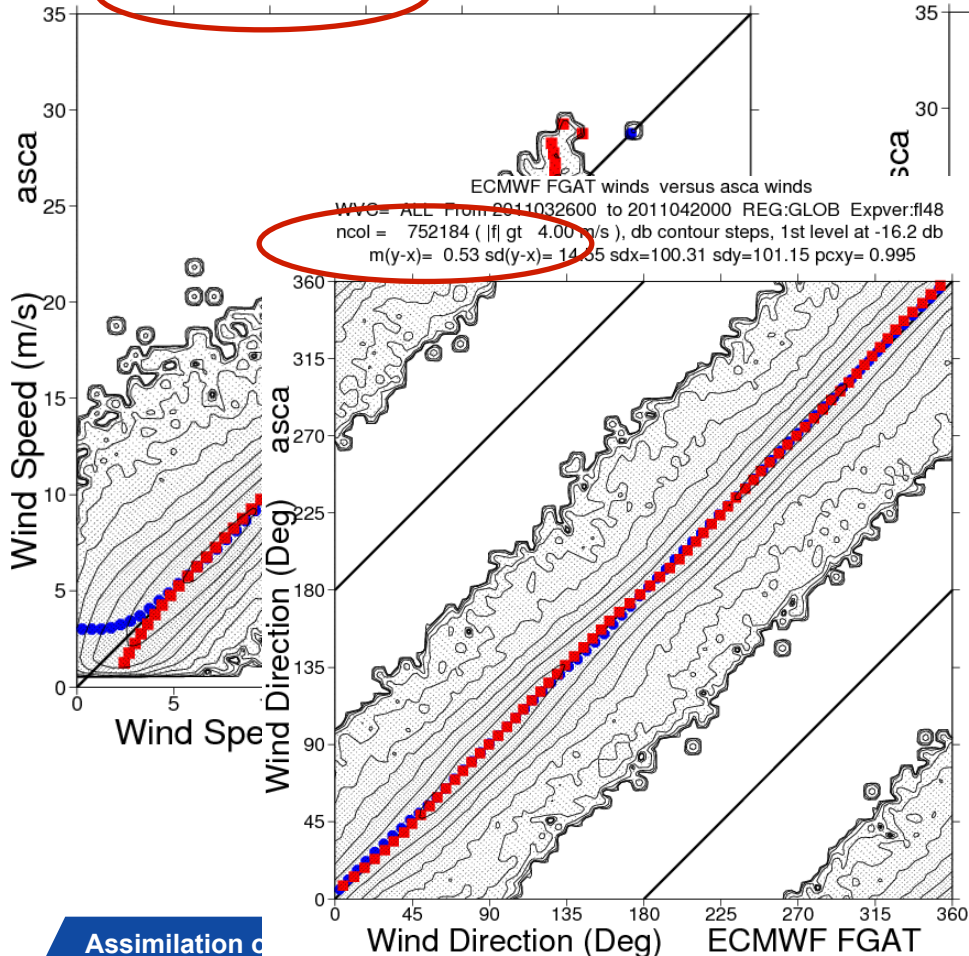- **Neutral impact but more stable system**

N. Hemisphere

S. Hemisphere

OSCAT assimilation: Effect on ASCAT assimilation

OSCAT not assimilated

**OSCAT WSBC assimilated**
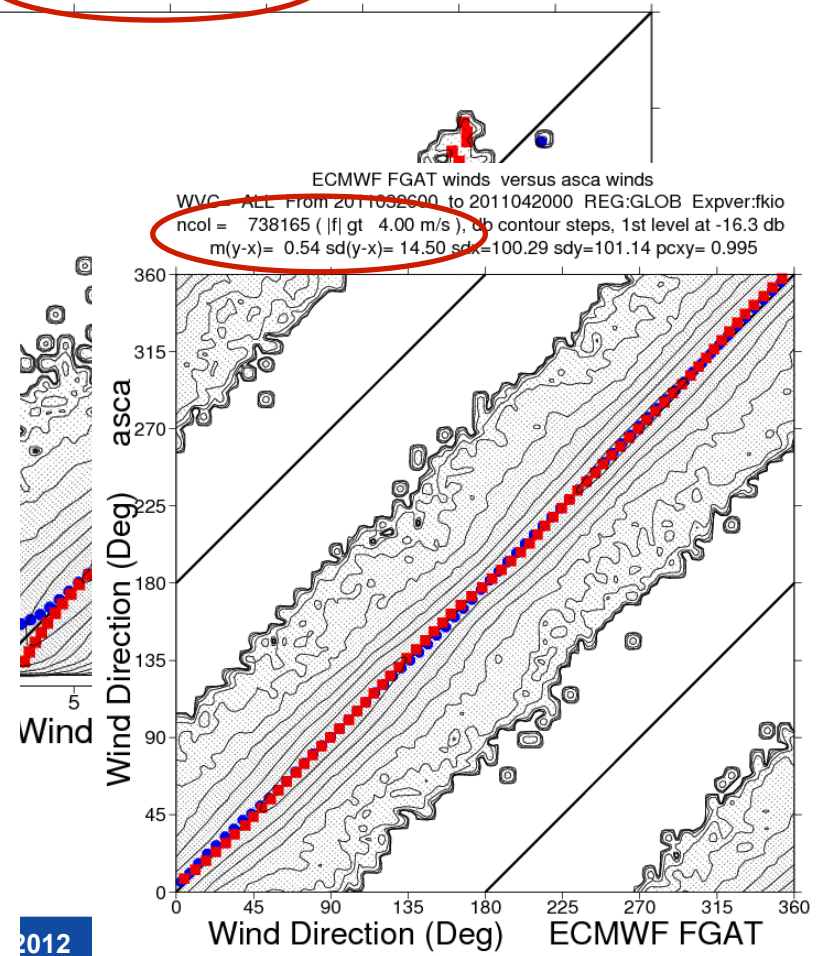
NWP wind impact study

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+48h FC:
Scatterometer denial - Control
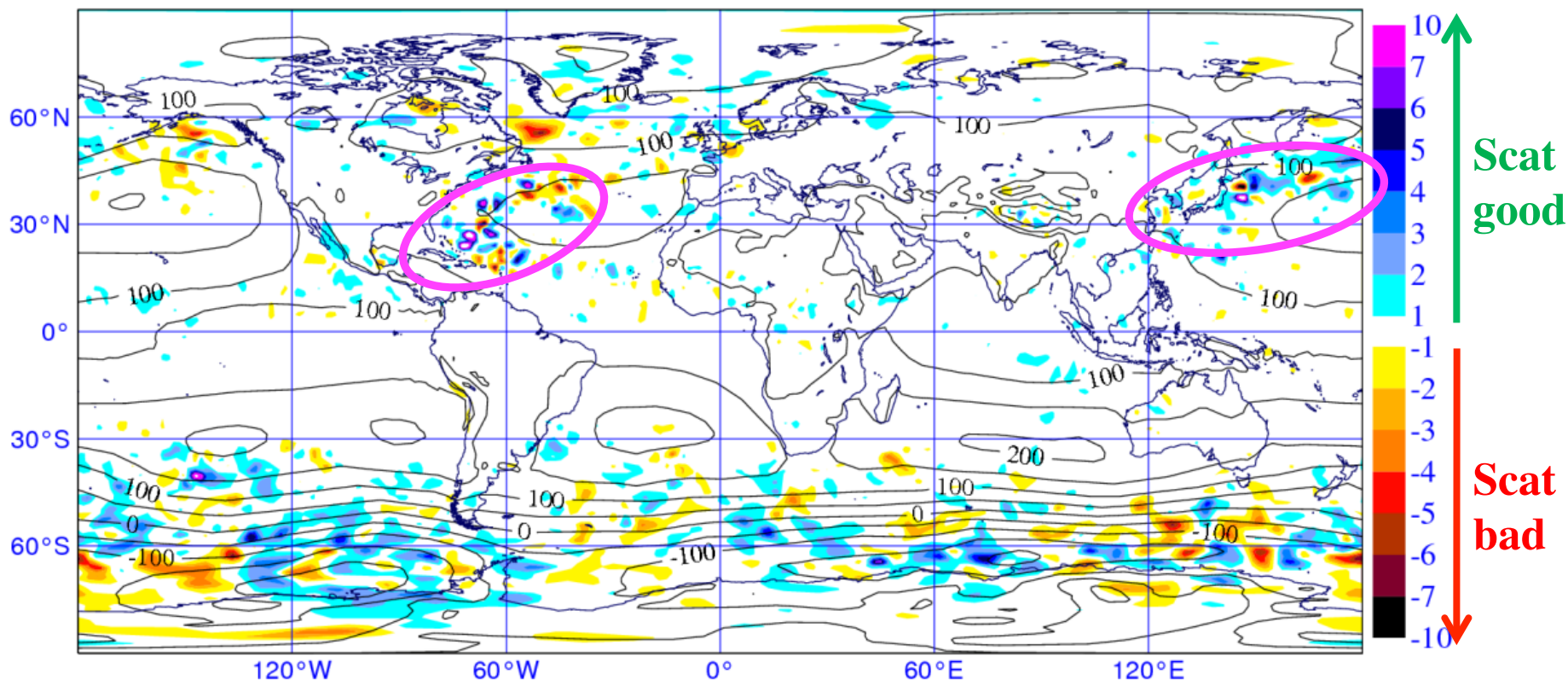
NWP wind impact study:
Tropical Cyclone Tracking Forecast Error

▪ **For each storm the TC centre and SLP have been detected (Vitart et al. 1997) from the ECMWF model fields for each experiment (Ctrl, AMV denial, SCAT denial)**

▪ **TC centre position and SLP have been compared to values from NHC and JMA.**

▪ **Limited number of cases: 56 at 12 h, dropping to 32 at 96 h forecast.**
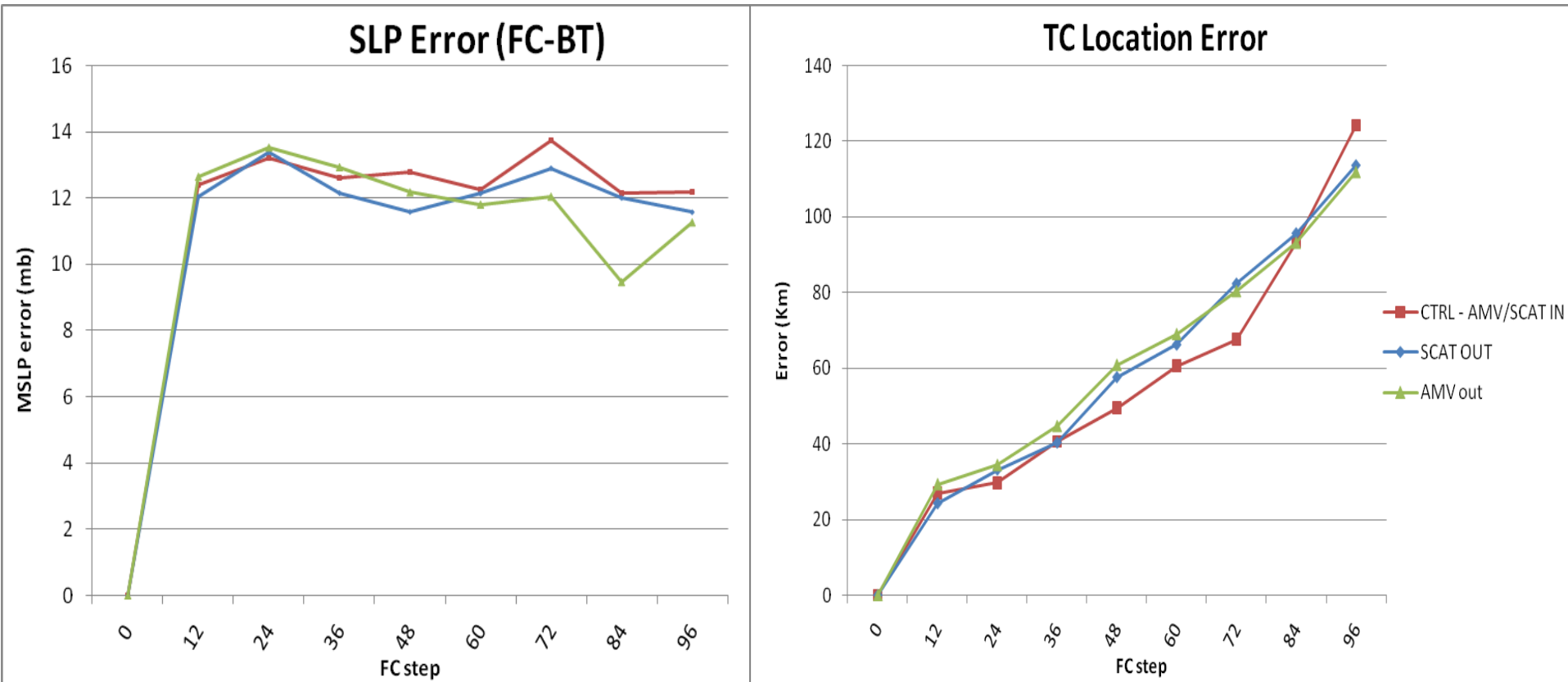
ECMWF

Summary

SCATTEROMETER DATA ASSIMILATED:

▪**ERS-2 SCAT** **- Permanent switch-off on 4 July 2011;**
- **Data was stable and within nominal values**

▪**ASCAT** **- Routinely assimilated and monitored: monitoring results available on ECMWF website;**

▪ **OSCAT** **- Ingestion of OCEANSAT-2 L2B winds (passive monitoring)**
- **Wind speed bias correction computed and applied and wind assimilated up to 25m/s;**
- **Operational assimilation planned for ~ May 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 forecast of tropical cyclones neutral to positive, with small benefits in terms for the location of the cyclone centre.
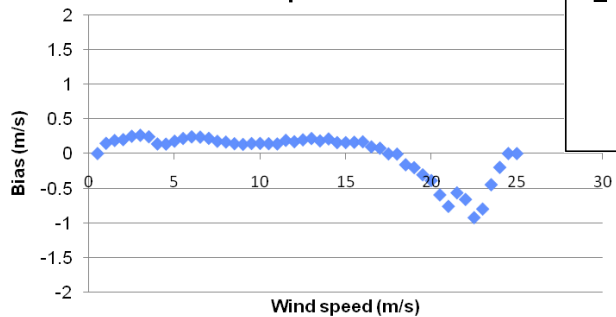
ECMWF

OSCAT data: new dataset (29 Aug 2011)
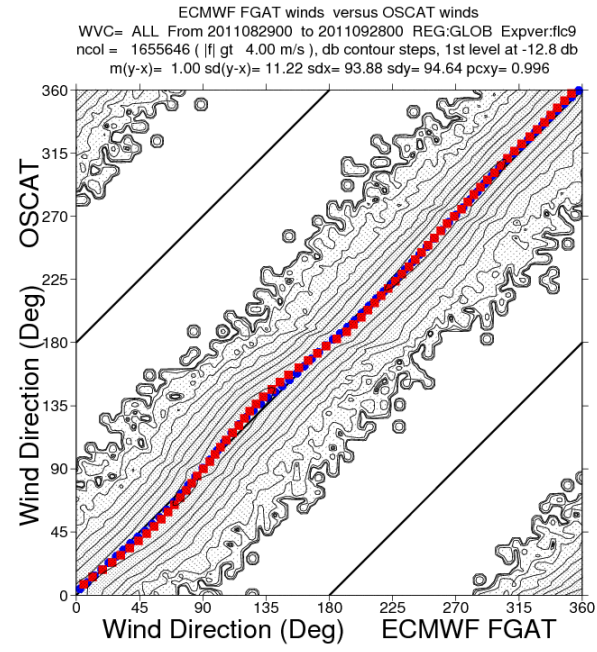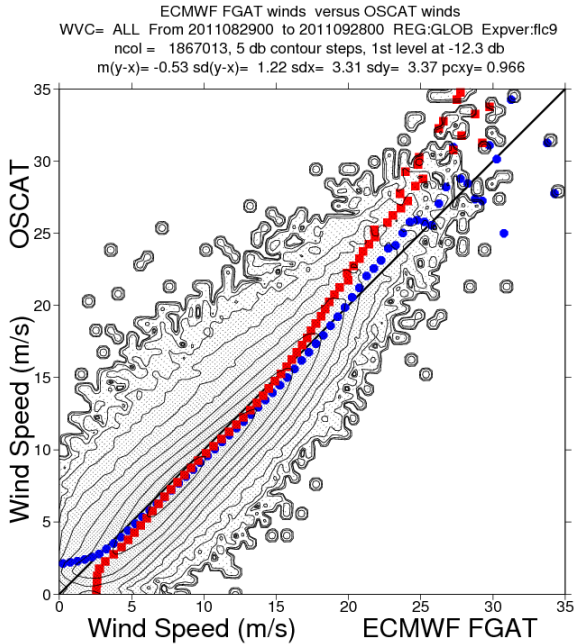
On average OSCAT winds underestimate model winds.
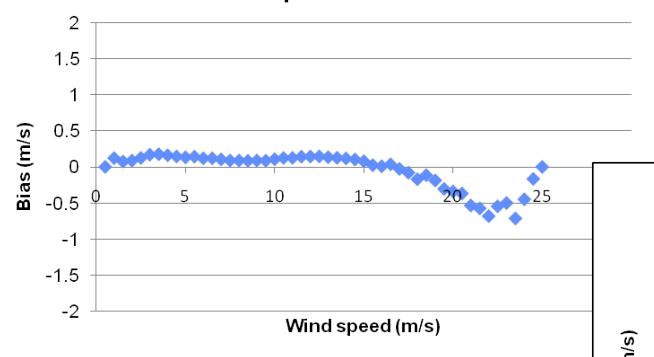
Discrepancy for high winds is lower.

WS stdv: ~ 1.22

WD stdv:~11.3