Assimilation of Scatterometer Winds at ECMWF

Giovanna De Chiara, Peter Janssen

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 $\sim$ 1.25 m/s
Wind direction stdv $\sim$ 14deg
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
The FEC is positive for forecast error increase and negative for forecast error decrease.

**Exp fnlf (CTRL): Operational configuration**
ASCAT Forecast Error Contribution

$\text{Exp } fnla \text{ (sigma)}: \text{ observation error } = 1 \text{m/s}$
ASCAT Forecast Error Contribution

Exp $fo0u$: thinning = 2 $\Rightarrow$ Hor. Res. 50km
Analysis Sensitivity to Observations: ASCAT Observation Influence

U component

V component

ASCAT DFS (%)

CTRL

sigma

thinning
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

Current configuration from 29 Dec 2011

WSp bias: ~ -0.1 m/s
WSp stdv: ~ 1.3 m/s
WDir stdv: ~ 11 deg
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

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
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.
Summary

**ASCAT**
- Routinely assimilated and monitored: monitoring results available on our website;
  - 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.