Impact Studies Of Ascat Winds in the ECMWF 4D-var Assimilation System

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ASCAT impact study

Monitoring and assessment of the impact of ASCAT wind observations on the Global Observing System (GOS).

- Evaluate the impact of ASCAT winds on the Global Observing System
- Better characterize the impact on analysis and forecasts of severe events i.e. tropical cyclones
- Improve the Assimilation Strategy

Observing System Experiments in different GOS configuration

✓ Full System:
  copy of the Operational System

✓ Starved System:
  Full System without
  • Geostationary Satellites
  • MW Imagers (AMSR-E/TMI/SSMIS)
  • AMVs

✓ Starved+ System:
  Starved System without AMSU-A

Experiments set-up
- T511 (~40km)
- CY38R1
- 17 Dec 2012 – 28 Feb 2013
- Use of Ocean Currents (Mercator)

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<tr>
<th>Label</th>
<th>ASCAT-A</th>
<th>ASCAT-B</th>
<th>OSCAT</th>
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<td>ALL in</td>
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ALL in (A/B/O) - A/O

Vector Wind RMS forecast error
Verified against own analysis
Forecast Verification – Full System

B/O - A/O

Vector Wind RMS forecast error

Verified against own analysis

12^th^ IWW - 16-20 June 2014 – Copenhagen
Verification vs Altimeter winds (JASON-1) – Full System

Tropics
Verification vs Altimeter winds (JASON-1) – Starved+ System

Tropics

![Graph showing correlation coefficient and standard deviation of difference over forecast range in hours.](image)
Single Observation Experiments (1 ASCAT-A)

TC Haiyan – CY40R1 2013110712 [Assimilation Window 9 - 21]
1 ASCAT-A obs @ 1pm
Single Observation Experiments (1 ASCAT-A)

Mean Sea Level Pressure (hPa)
Analysis Increments (Analysis - Background)
Black diamond: Scatter obs assimilated

T1279
Single Observation Experiments (1 ASCAT-A)

ML  PL(hPa)
137 ~ 1013
114 ~  850
96 ~  500
79 ~  250
60 ~  100
Single Observation Experiments (1 ASCAT-A + 1 AMSU-A)

1 ASCAT-A Obs + 1 AMSU-A (METOP-A):
- ch5 (600 hPa / ml 100)
- ch5/ch6 (600/400 hPa – ml 100/90)
- ch9 (100 hPa – ml 60)
- ch9/ch10 (100/50 hPa - ml 60/50)

ASCAT-A

ASCAT-A + AMSU-A (Ch5&6)

CY40R1
T511 - An Incr 09 [18h]
Single Observation Experiments (1 ASCAT-A + AMSU-A)

- **U Scatt**
- **V Scatt**
- **U Scatt + AMSUA (CH5&6)**
- **V Scatt + AMSUA (Ch9&10)**
Case study: Typhoon Haiyan

- Typhoon Haiyan hit the Philippines on the 8 November 2013 with winds of about 315 km/h.
- ECMWF forecast well the storm trajectory but the storm lacked in intensity and strength both in the analysis and forecasts.
- Reported central pressure was 895 hPa at 00 UTC on 8 November (uncertainty on the observation)
- ECMWF analysis was 966 hPa

The difference in the minimum pressure was partially due to the model resolution
Typhoon Haiyan

Scatterometer winds map for 20131107 12:24
MSLP contour @12h - Min SLP: 968 mb
Acquisition times: ASCAT-A 20131107 130430 ASCAT-B 20131107 135400 OSCAT 20131107 154007
Typhoon Haiyan

All observations (active and passive)

10m ASCAT-A wind speed

10m FG wind speed

STATISTICS FOR 10M WIND SPEED FROM METOP-A/ASCAT (GLOBAL)
MEAN OBSERVATION [M/S] (ALL)
DATA PERIOD = 2013-11-07 09 - 2013-11-07 21
EXP = 0001, BEST AMBIGUOUS WIND
Min: 1.290 Max: 33.480 Mean: 9.296
GRID: 0.15x0.15

STATISTICS FOR 10M WIND SPEED FROM METOP-A/ASCAT FG_10M WIND SPEED [M/S] (ALL)
DATA PERIOD = 2013-11-07 09 - 2013-11-07 21
EXP = 0001, CHANNEL = 1
Min: 0.575 Max: 33.766 Mean: 9.929
GRID: 0.15x0.15

12th IWW - 16-20 June 2014 – Copenhagen
Typhoon Haiyan

Used observations

10m ASCAT-A wind speed

Statistics for 10m wind speed from Metop-A/ASCAT (Global)
Mean observation [m/s] (used)
Data period = 2013-11-07 09 - 2013-11-07 21
Exp = 0001, Best ambiguous wind
Min: 1.290 Max: 24.990 Mean: 9.718
Grid: 0.15x0.15

10m FG wind speed

Statistics for 10m wind speed from Metop-A/ASCAT
FG_10MWINDSPEED [m/s] (used)
Data period = 2013-11-07 09 - 2013-11-07 21
Exp = 0001, Channel = 1
Min: 1.533 Max: 33.358 Mean: 10.377
Grid: 0.15x0.15
Experiments Configuration

T511 (~40km) - CY38R1

g004: CTRL

g00a: Scatterometer Denial

g0qe: Thinning=2 (~50 km) & obs weight 1/4

g0q6: No Thinning & obs weight 1/16

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STATISTICS FOR 10M WINDSPEED FROM FROM METOP-A/ASCAT (GLOBAL)
MEAN OBSERVATION (USED)
DATA PERIOD = 2013-11-07 09 - 2013-11-07 21
EXP = G0QE, BEST AMBIGUOUS WIND
Min: 1.740  Max: 24.990  Mean: 9.566
GRID: 0.50 - 0.50

STATISTICS FOR 10M WINDSPEED FROM FROM METOP-A/ASCAT (GLOBAL)
MEAN OBSERVATION (USED)
DATA PERIOD = 2013-11-07 09 - 2013-11-07 21
EXP = G0Q6, BEST AMBIGUOUS WIND
Min: 1.760  Max: 28.130  Mean: 9.933
GRID: 0.50 - 0.50

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Typhoon Haiyan
Conclusions

Summary

ASCAT-A and ASCAT-B are consistent and have the same impact on the system.

Verification against independent observations shows that the assimilation of scatterometer winds is beneficial on the analysis, largest impact coming from ASCAT:
  o Main impact is in the Tropics
  o A positive impact on the short range forecast is seen in the starved systems

Single observation experiments showed that:
  o the impact of Scatterometer winds can be propagated up to the tropopause
  o ASCAT and AMSU-A do not work one against each other

A Typhoon Haiyan showed that for small scale events the QC and the thinning may prevent the strongest wind to be used in the analysis:
  o Tests on several thinning configurations are under examination on a global scale and for TC
  o Different VarQC settings are under testing
  o The QC will be revisited by testing the Huber Norm
ASCAT & OSCAT assimilation strategy

ASCAT (25km)
- Wind inversion is performed in-house using the CMOD5.N GMF
- Assimilated as 10m equivalent neutral winds
- Calibration and Quality control:
  - Sigma nought bias correction before the wind inversion
  - Wind speed bias correction after wind inversion
  - Screening: Sea Ice check based on SST and Sea Ice model
  - Thinning: 100 km
  - Threshold: 35 m/s
- Observation error: 1.5 m/s

OCEANSAT-2 (50km)
- Use of L2 wind products from OSI-SAF (KNMI)
- Wind speed bias correction (WVC and WS dependent)
- Quality control:
  - Screening: Sea Ice check on SST and Sea Ice model
  - No thinning; weight in the assimilation 0.25
- Observation error: 2 m/s
- Threshold: 25 m/s
Regional statistics show that the larger impact is in the SH.
Forecast Sensitivity to Observations – Full System

**FEC (J) x single obs**

- **ALLin**
- **A/O**
- **B/O**
- **O**

- **OSCAT**
- **ASCAT-B**
- **ASCAT-A**

**N. Observations (x 100000)**

- **OSCAT**
- **ASCAT-B**
- **ASCAT-A**