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

Giovanna De Chiara,
Peter Janssen, Jean Bidlot, Stephen English

Acknowledgement
Thanks to EUMETSAT for supporting the activity through the project EUM/CO/12/4600001149/JF

ECMWF

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)

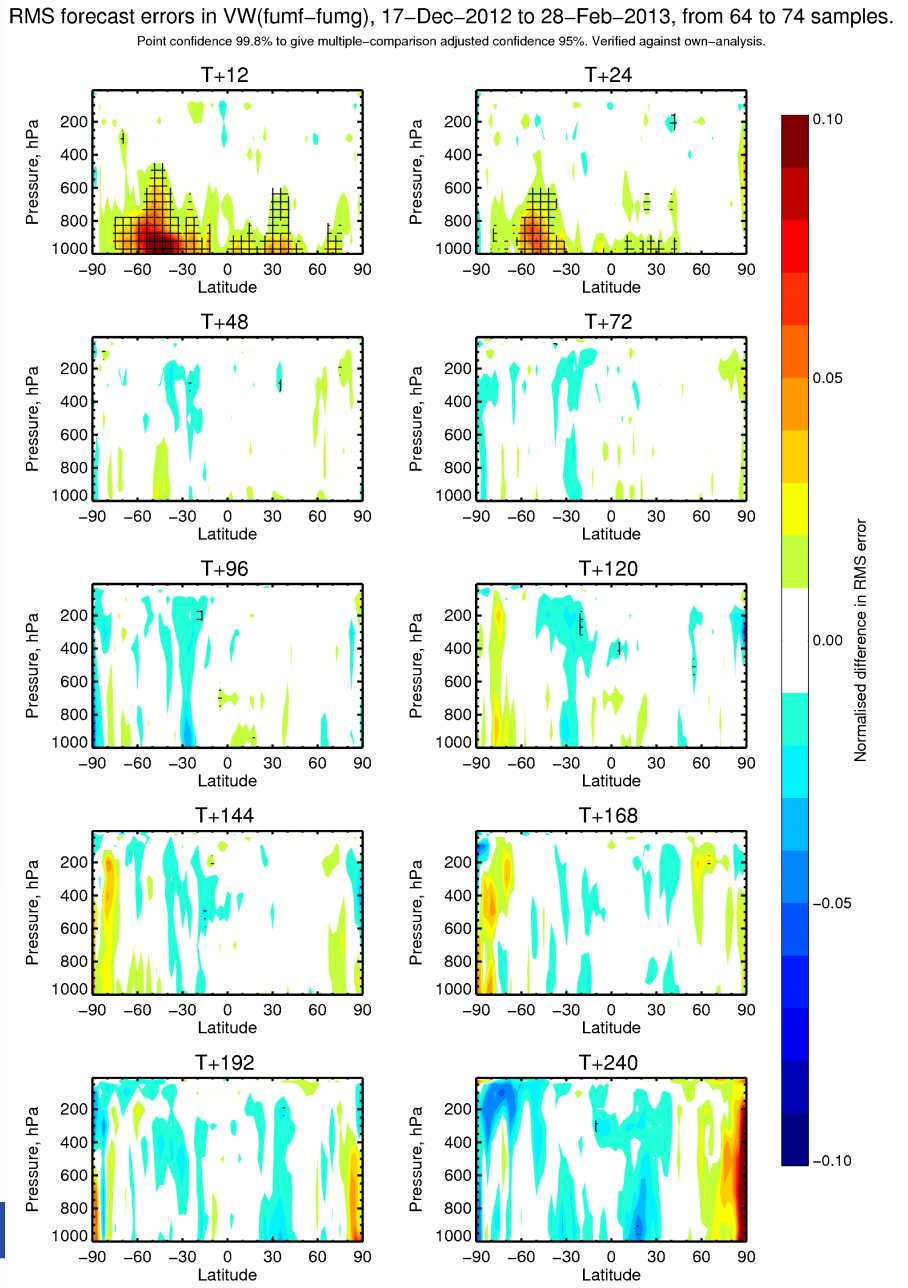
Label	ASCAT-A	ASCAT-B	OSCAT
ALL in	Y	Y	Y
A-O	Y	N	Y
B-O	N	Y	Y
O	N	N	Y
Den	N	N	N

Forecast Verification – Full System

ALL in (A/B/O) - A/O

Vector Wind RMS forecast error

Verified against own analysis

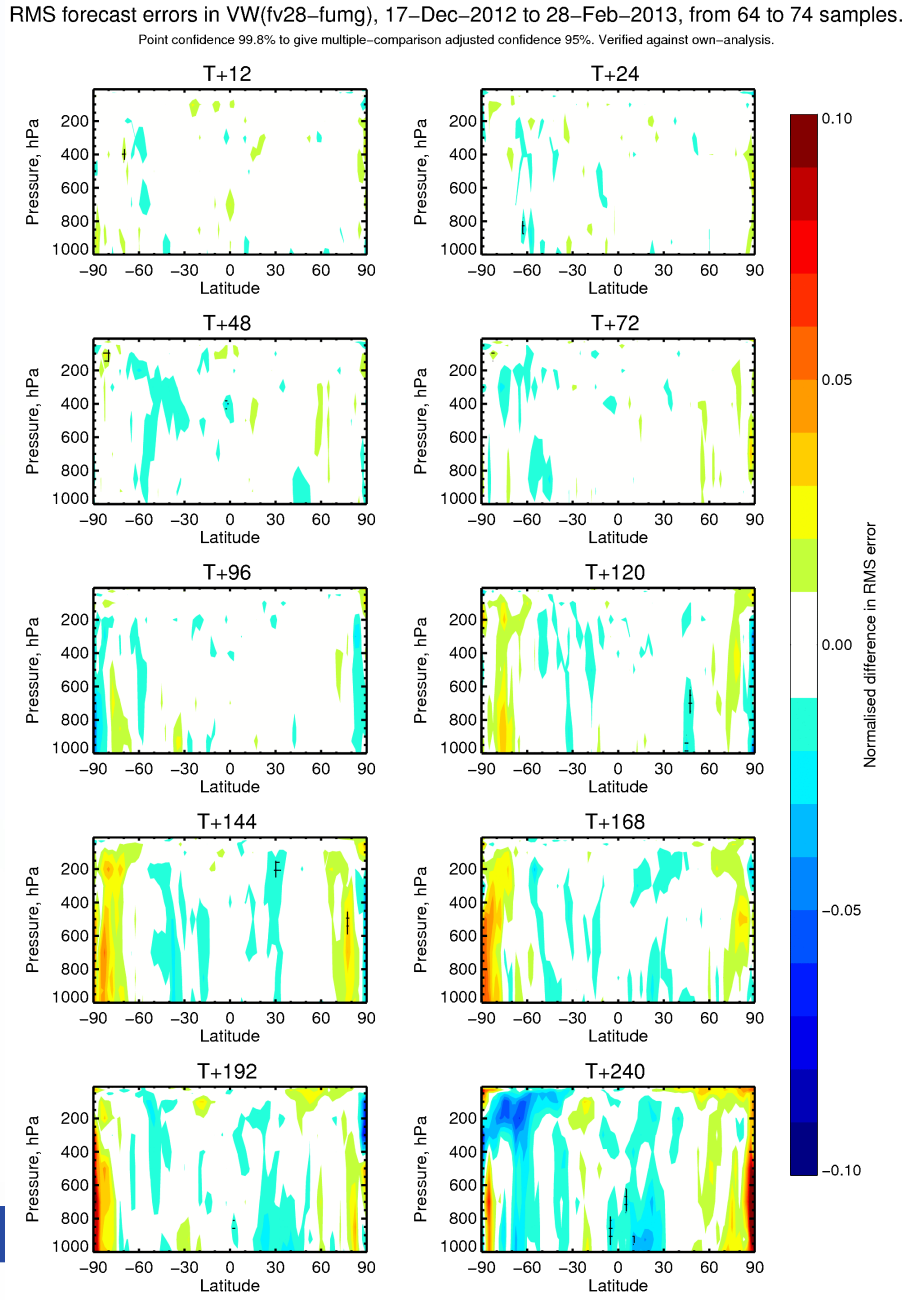


Forecast Verification – Full System

B/O - A/O

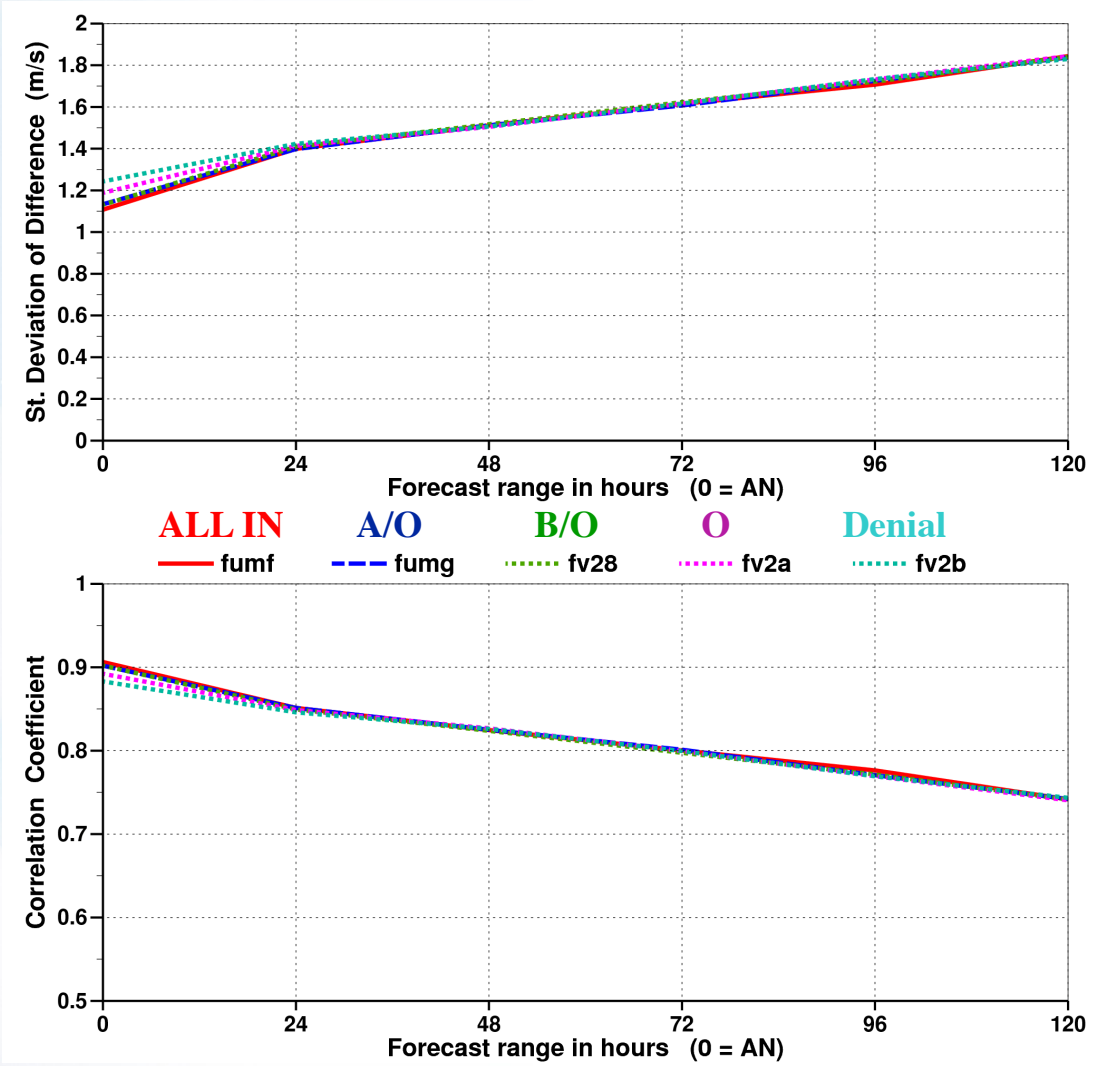
Vector Wind RMS forecast error

Verified against own analysis



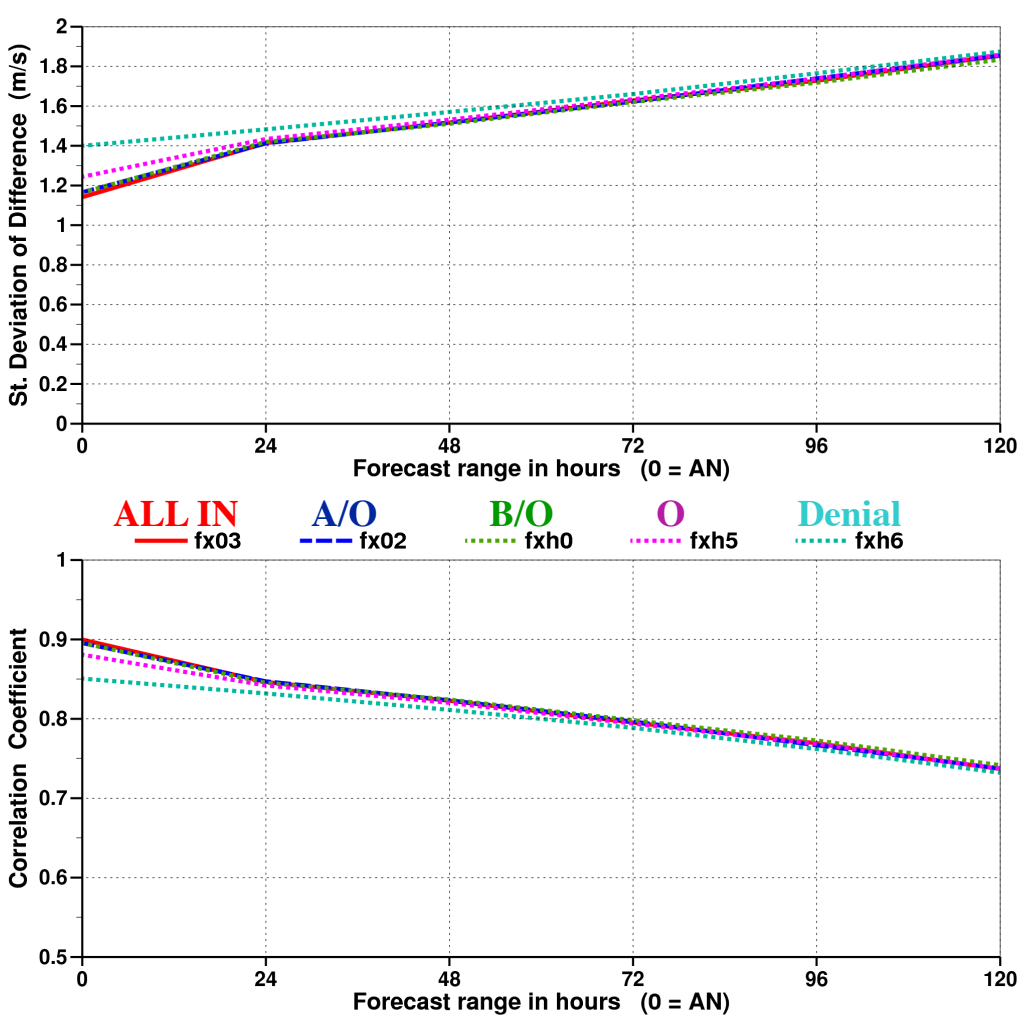
Verification vs Altimeter winds (JASON-1) – Full System

Tropics



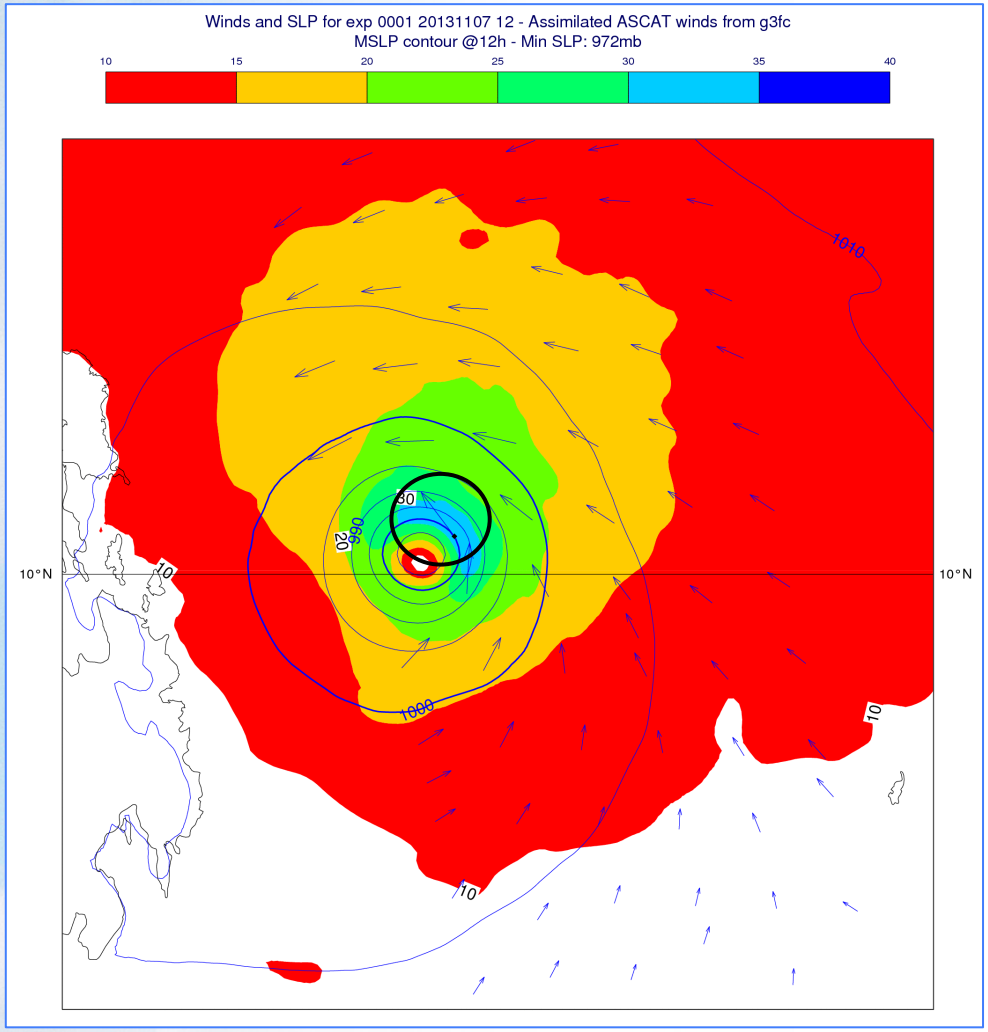
Verification vs Altimeter winds (JASON-1) – Starved+ System

Tropics



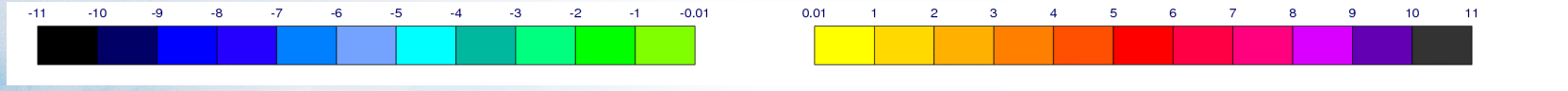
Single Observation Experiments (1 ASCAT-A)

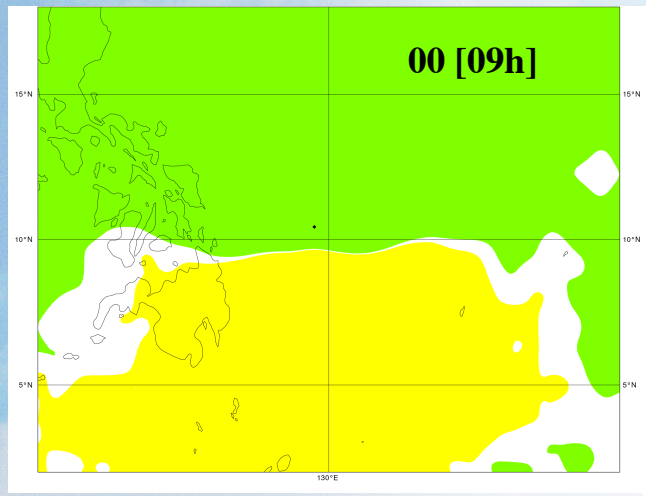
TC Haiyan – CY40R1 2013110712 [Assimilation Window 9 - 21]
1 ASCAT-A obs @ 1pm

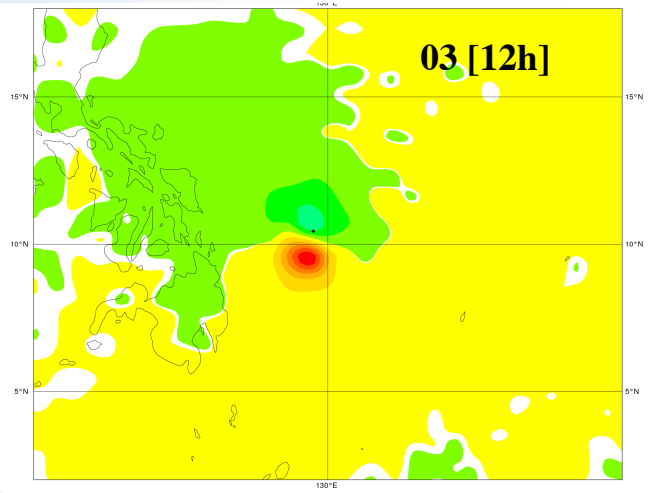


ECMWF

Single Observation Experiments (1 ASCAT-A)

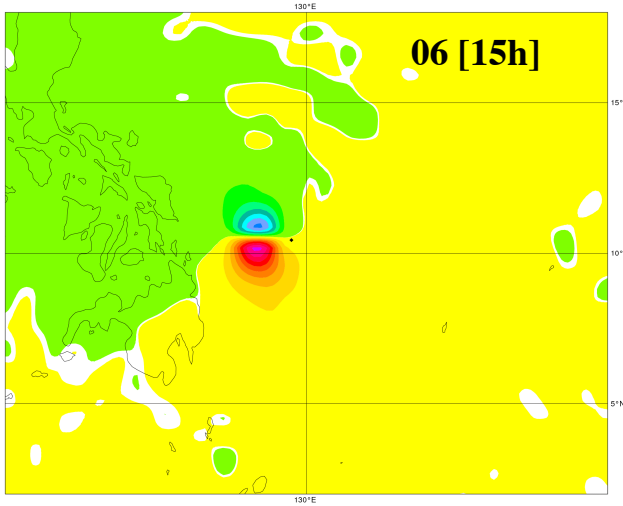


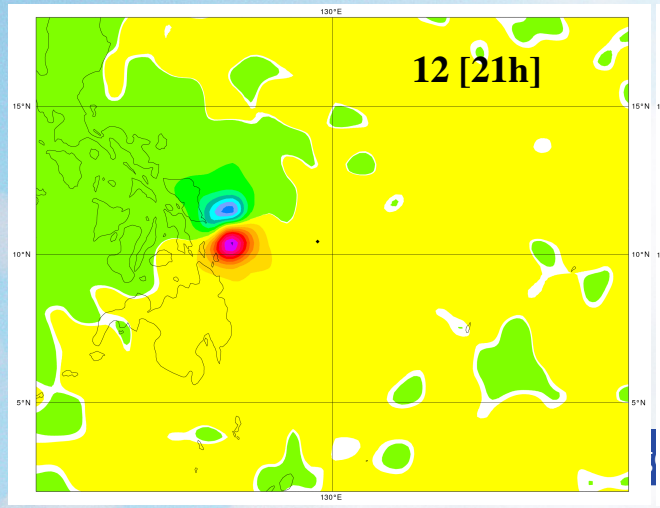


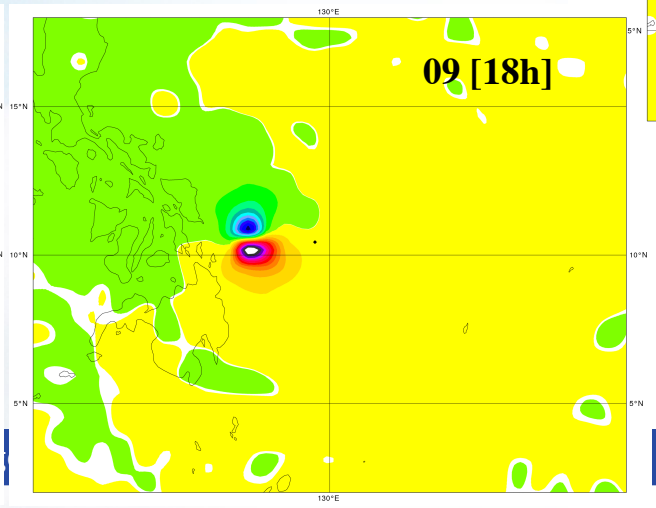


Mean Sea Level Pressure (hPa)
Analysis Increments (Analysis - Background) a
Black diamond: Scatt obs assimilated

T1279



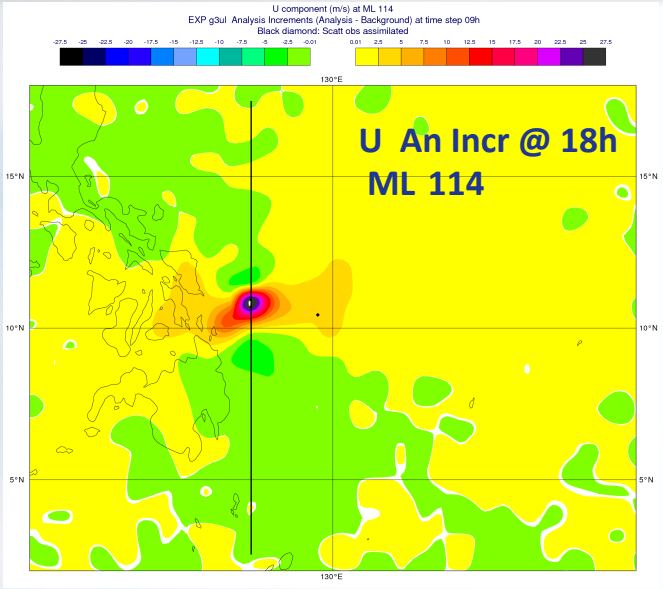




ECMWF

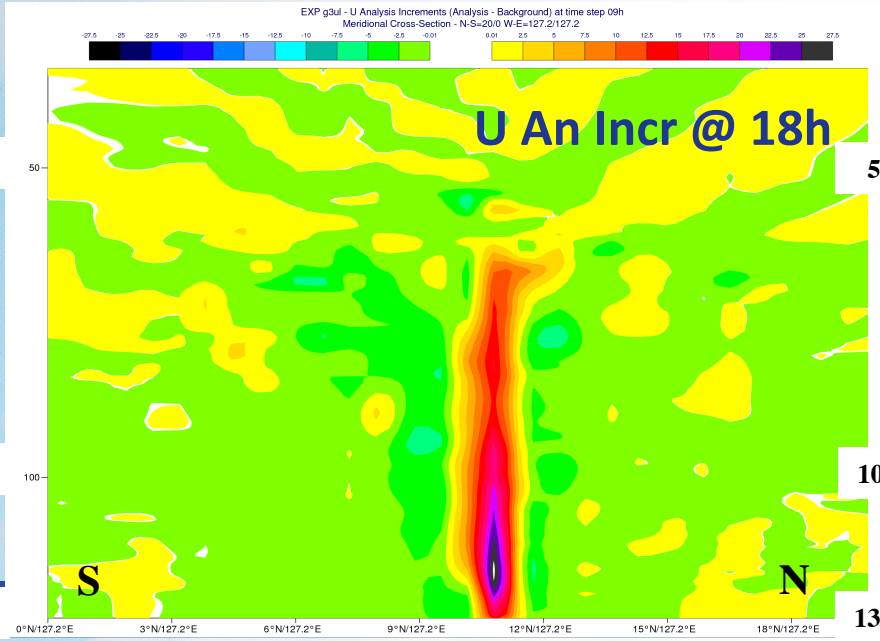
Single Observation Experiments (1 ASCAT-A)

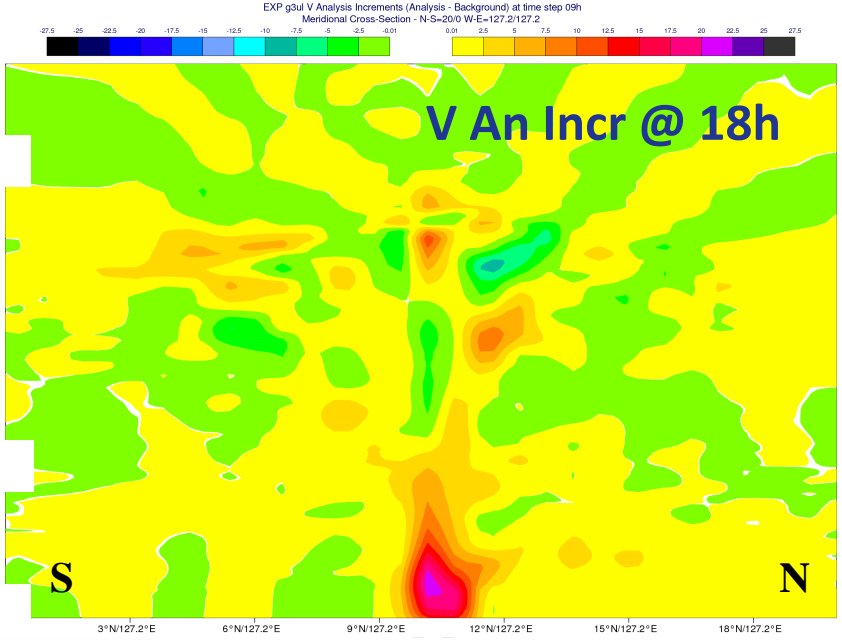
T1279



ML	PL(hPa)
137 ~	1013
114 ~	850
96 ~	500
79 ~	250
60 ~	100

Model Levels





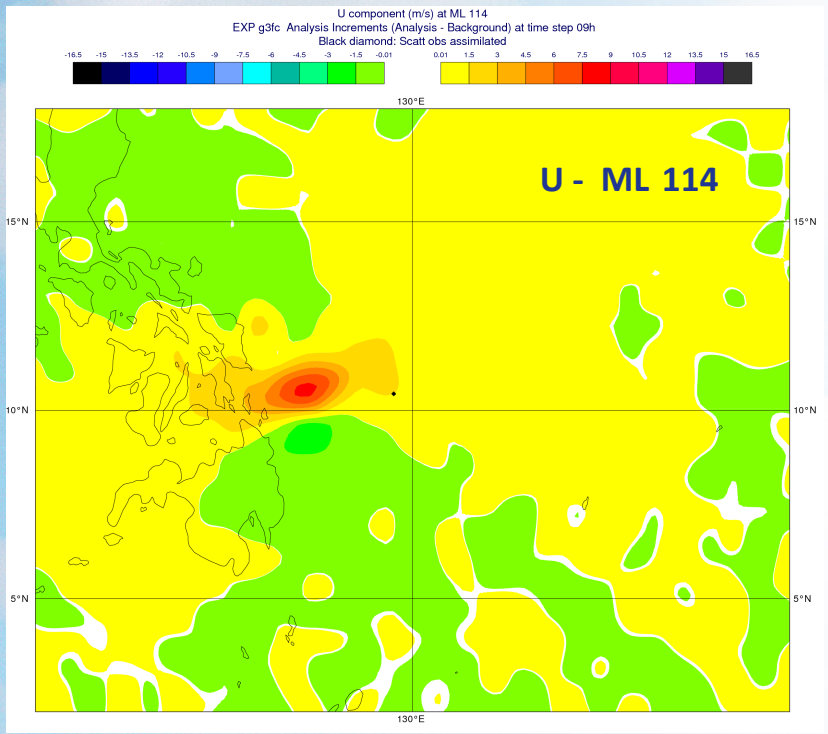
Single Observation Experiments (1 ASCAT-A + 1 AMSU-A)

1 ASCAT-A Obs + 1 AMSU-A (METOP-A):

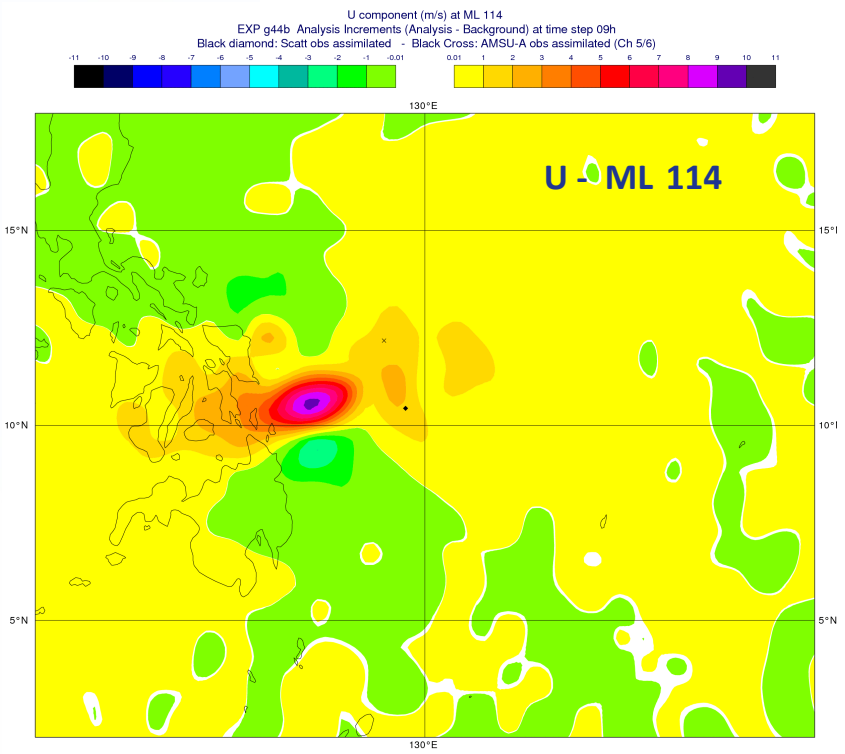
- ch5 (600 hPa / ml 100)
- ch5/ch6 (600/400 hPa – ml 100/90)
- ch9 (100 hPa – ml 60)
- ch9/ch10 (100/50 hPa - ml 60/50)

CY40R1
T511 - An Incr 09 [18h]

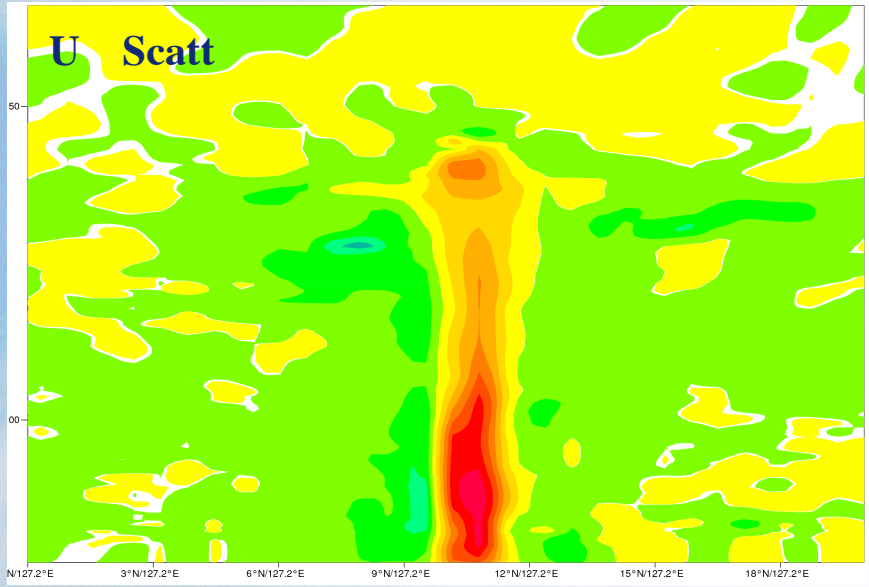
ASCAT-A

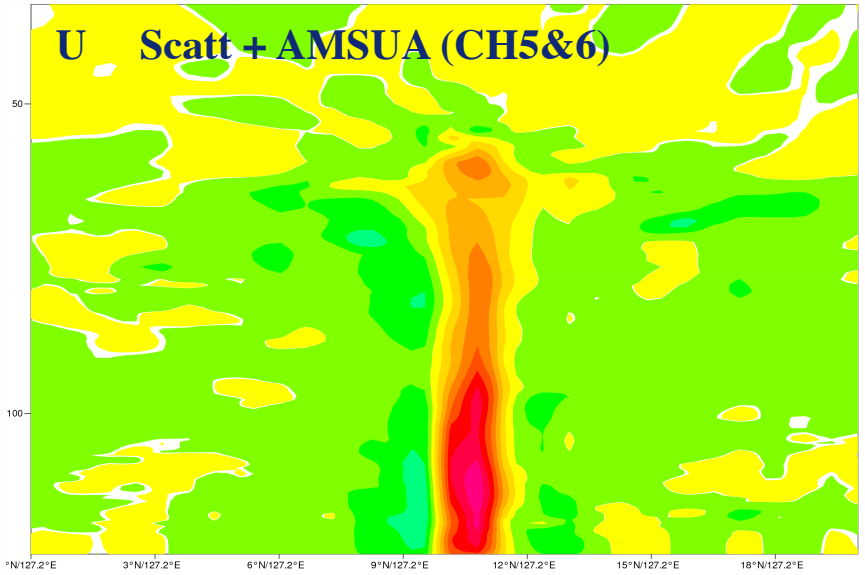


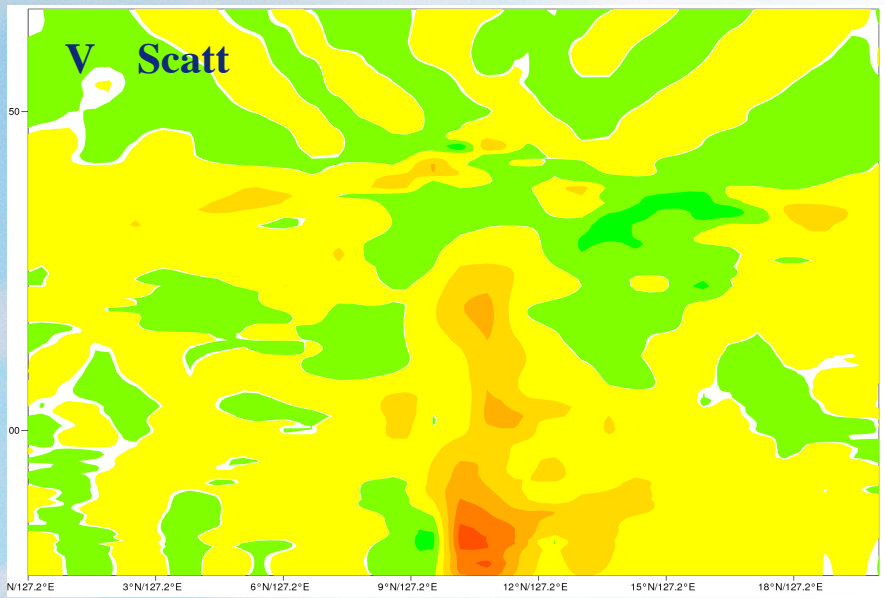
ASCAT-A + AMSU-A (Ch5&6)

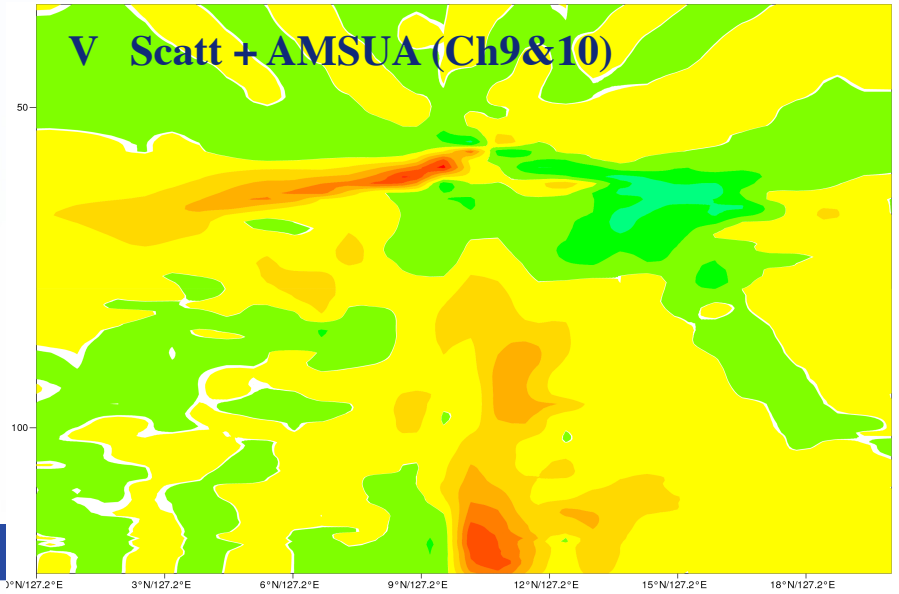


Single Observation Experiments (1 ASCAT-A + AMSU-A)



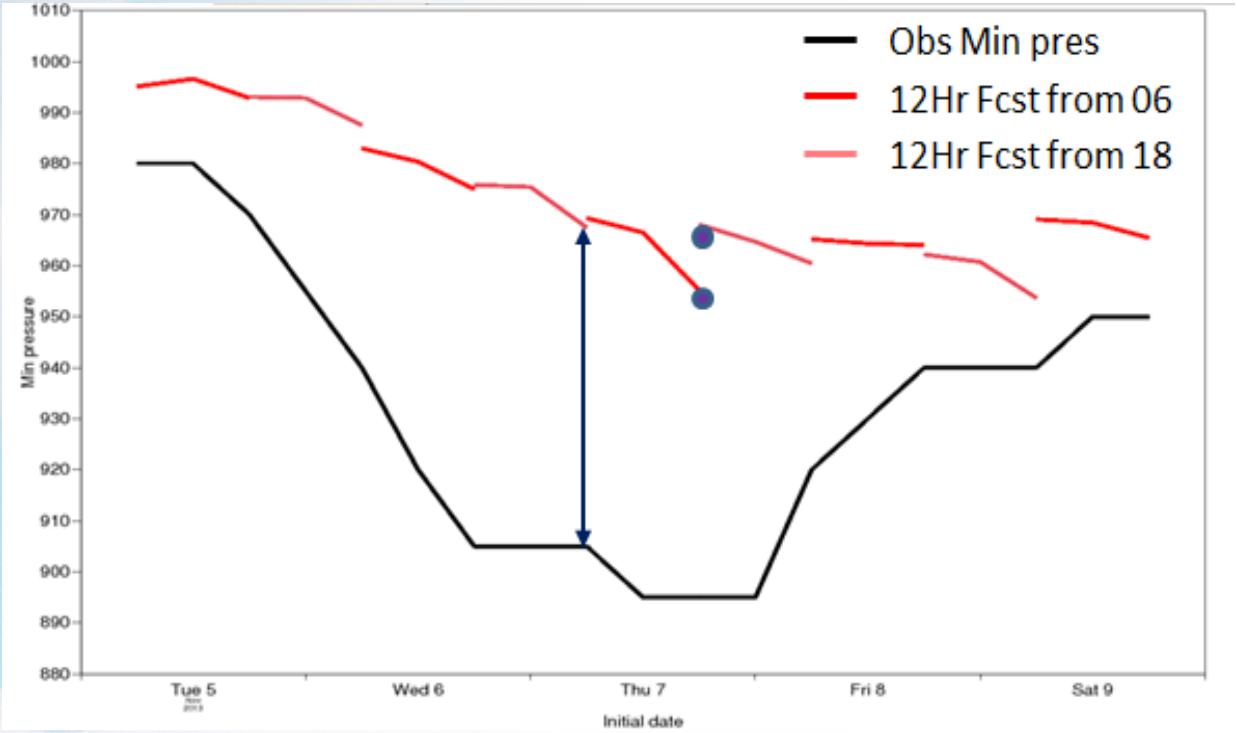






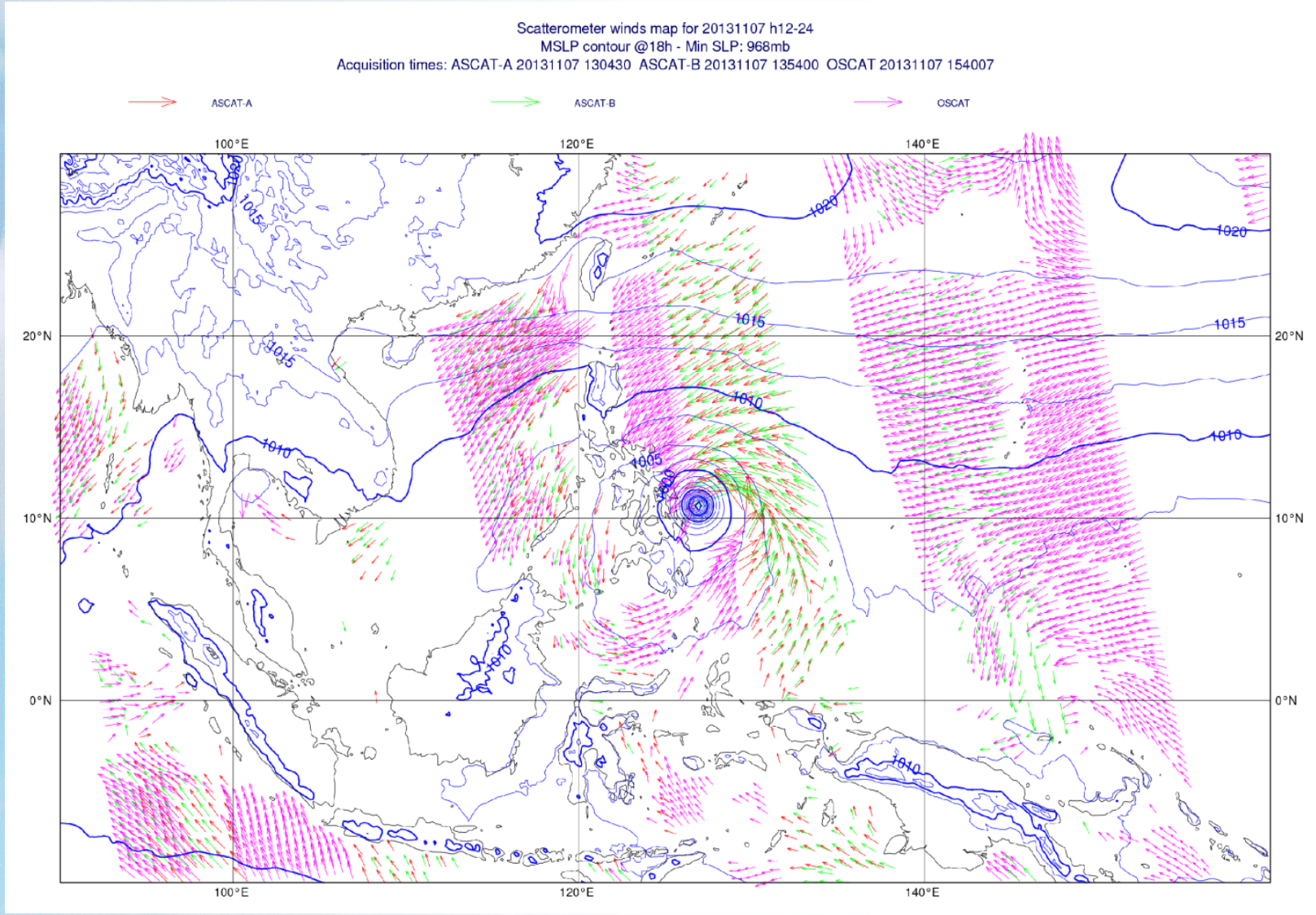
Case study: Typhoon Haiyan

- Typhon 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

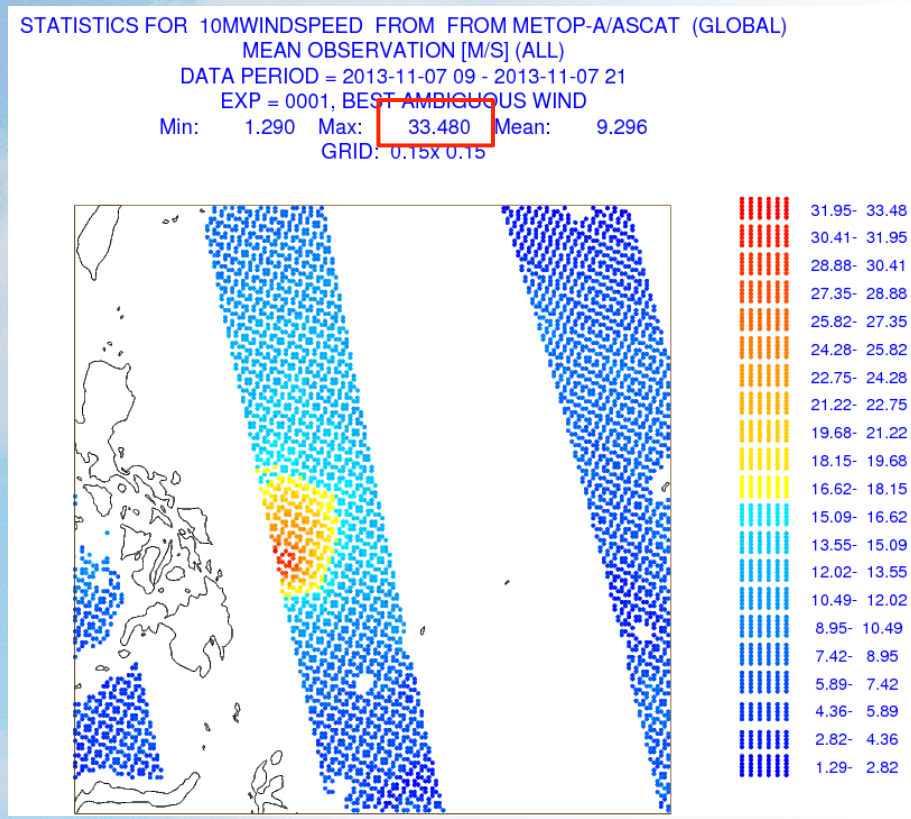


ECMWF

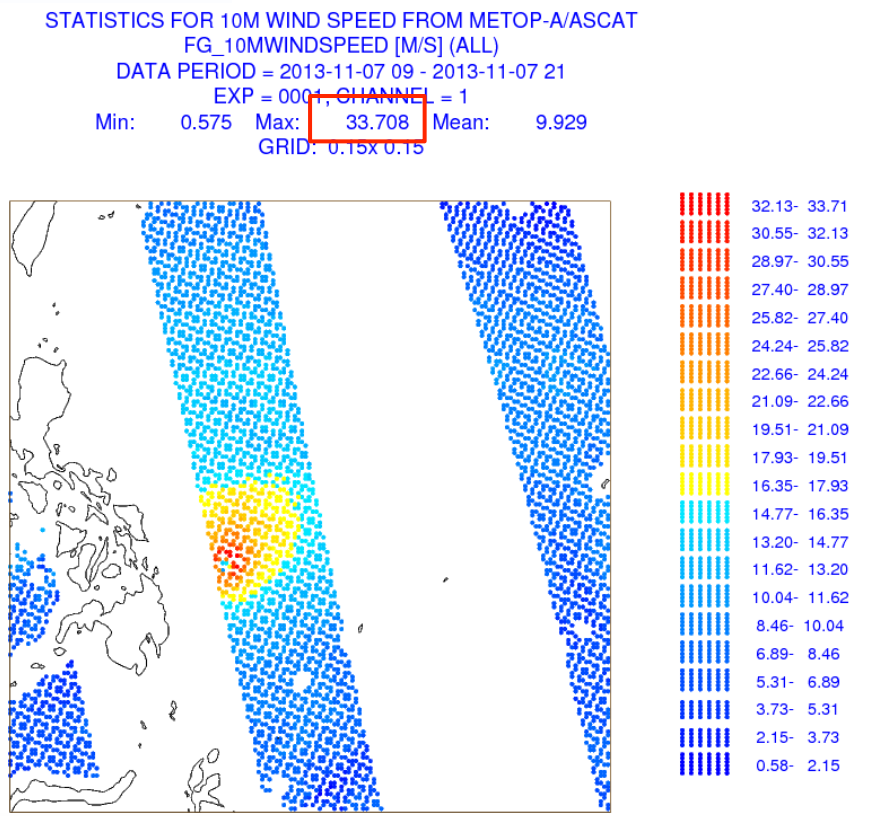
Typhoon Haiyan

All observations (active and passive)

10m ASCAT-A wind speed



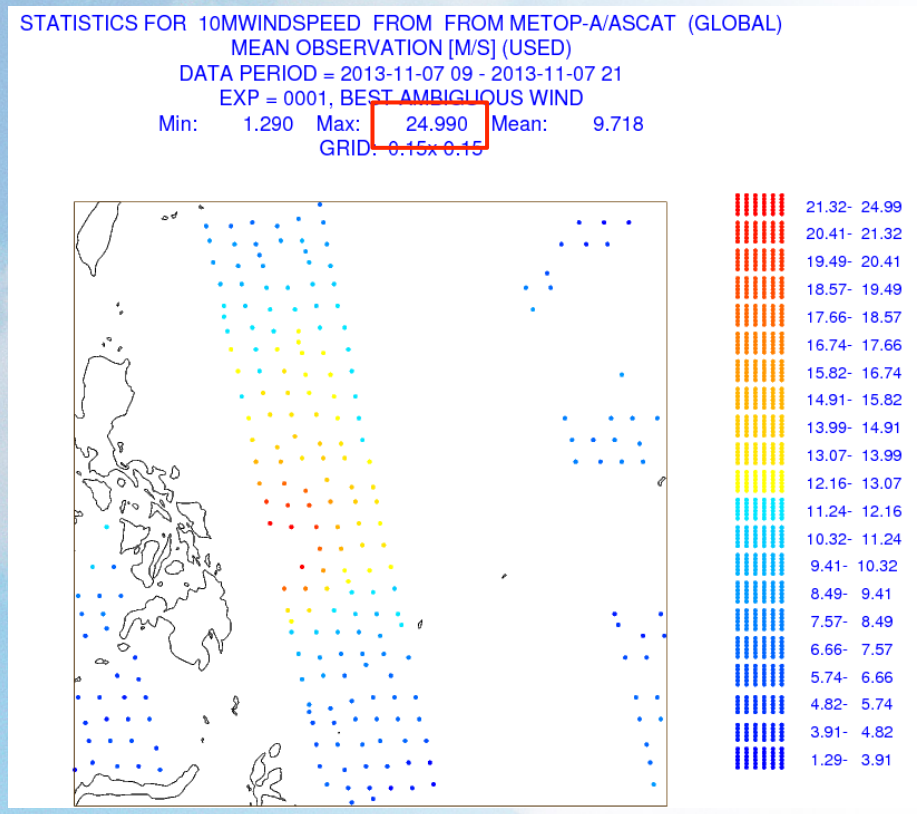
10m FG wind speed



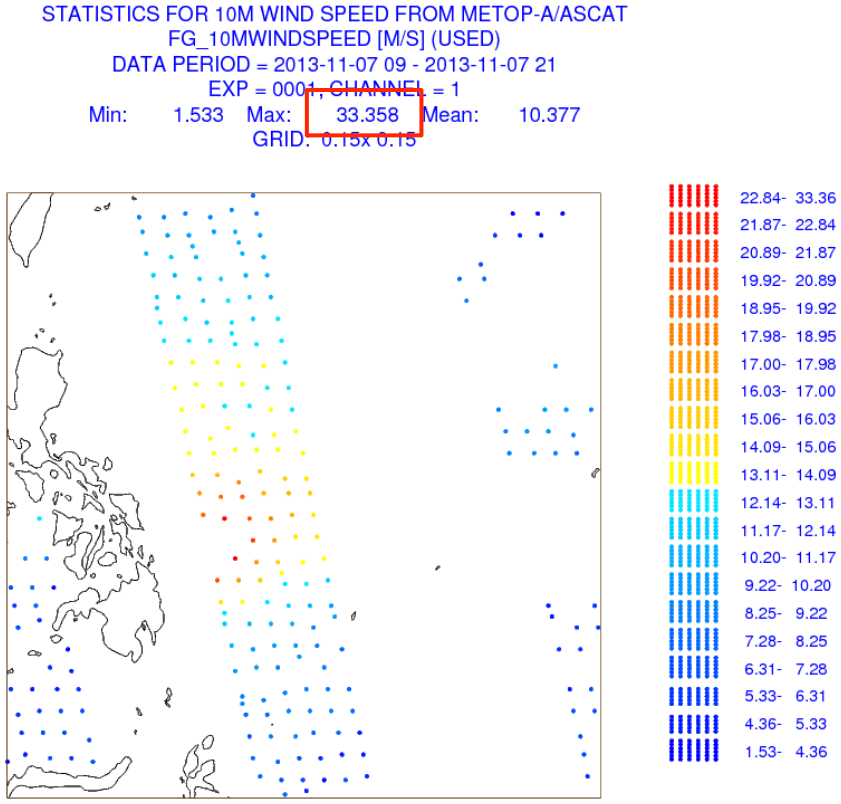
Typhoon Haiyan

Used observations

10m ASCAT-A wind speed



10m FG wind speed



ECMWF

Typhoon Haiyan

Experiments Configuration

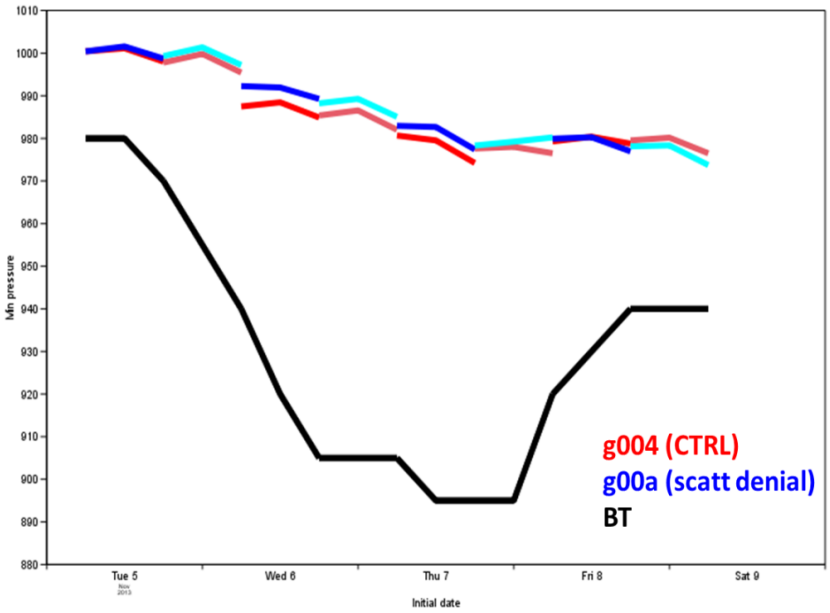
T511 (~ 40km) - CY38R1

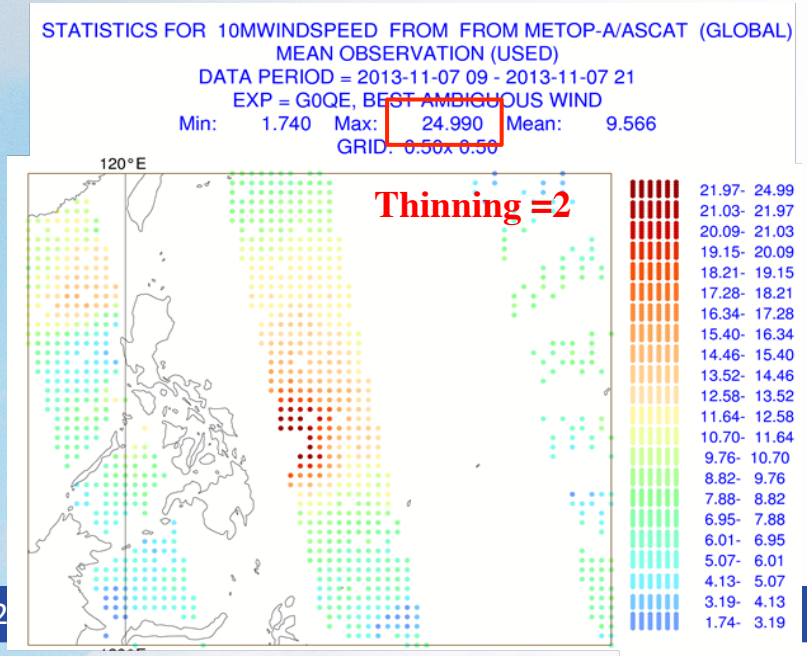
g004: CTRL

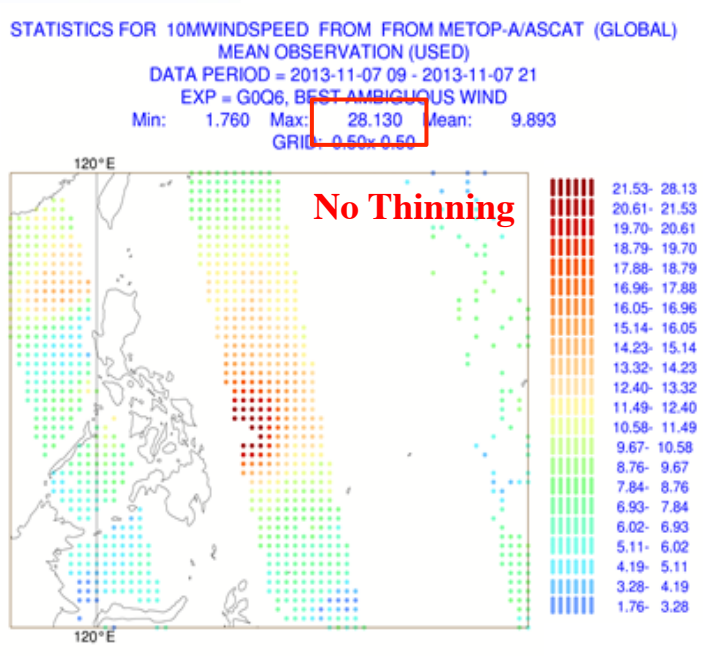
g00a: Scatterometer Denial

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

g0q6: No Thinning & obs weight 1/16







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:

- **Main impact is in the Tropics**
- **A positive impact on the short range forecast is seen in the starved systems**

Single observation experiments showed that:

- **the impact of Scatterometer winds can be propagated up to the tropopause**
- **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:

- **Tests on several thinning configurations are under examination on a global scale and for TC**
- **Different VarQC settings are under testing**
- **The QC will be revisited by testing the Huber Norm**

ASCAT & OSCAT assimilation strategy

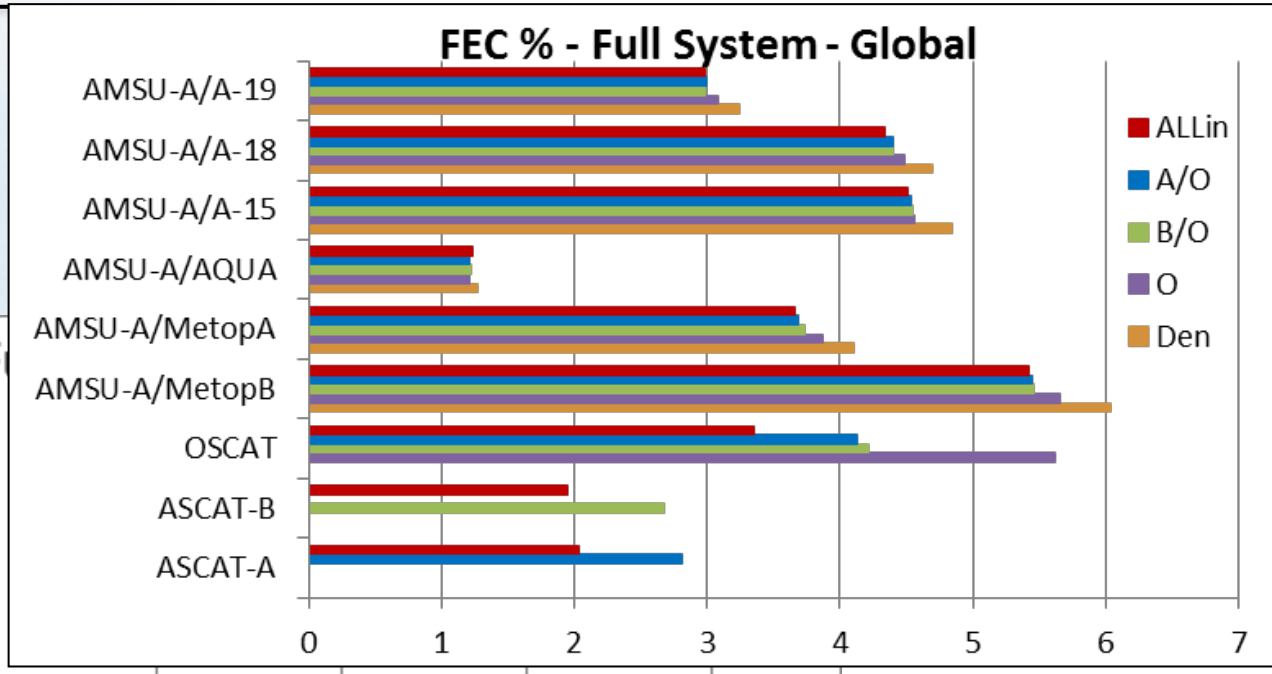
ASCAT (25km)

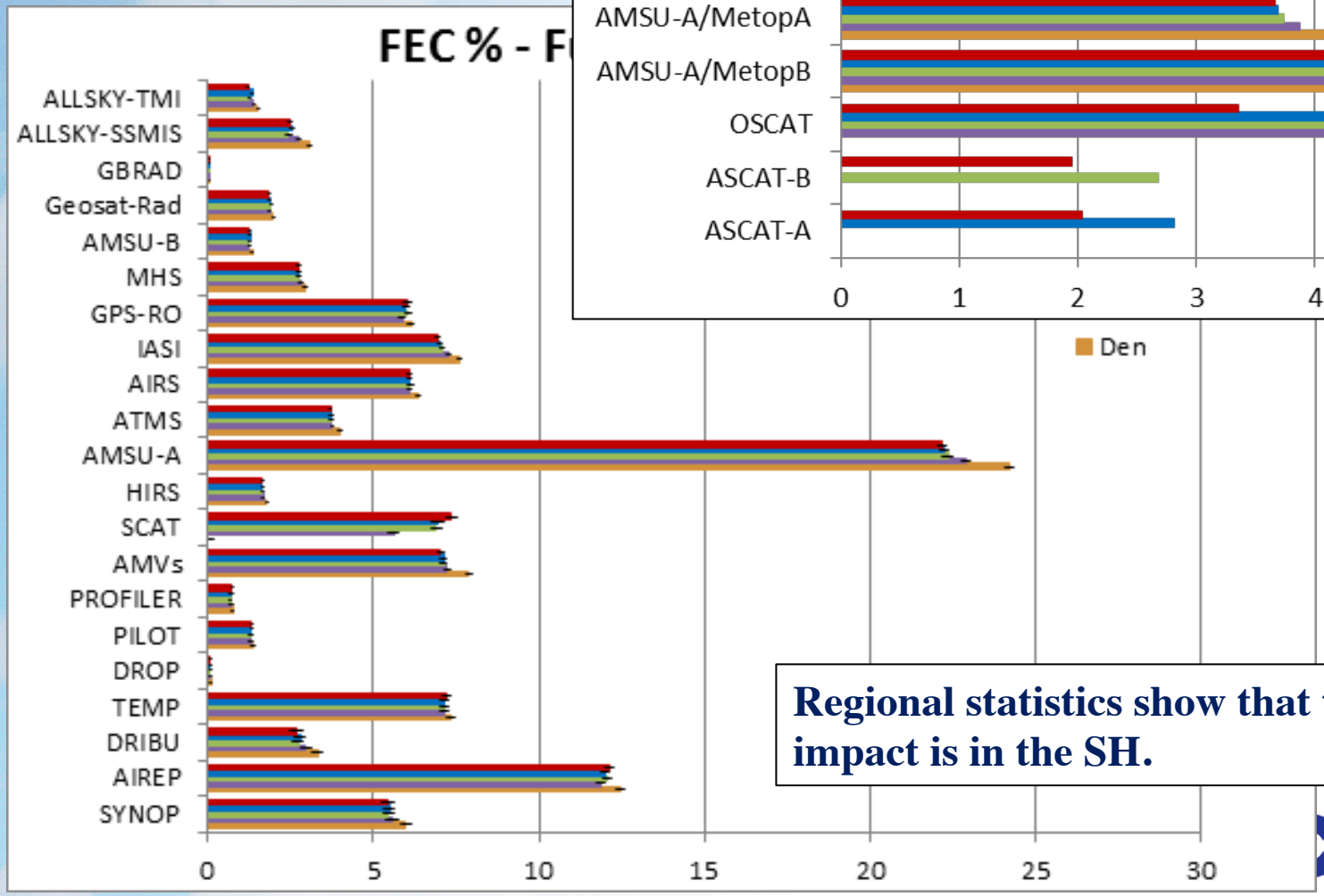
- ✓ **Wind inversion is performed in-house using the CMOD5.N GMF**
- ✓ **Assimilated as 10m equivalent neutral winds**
- ✓ **Calibration and Quality control:**
  - **Sigma nought bias correction before the wind inversion**
  - **Wind speed bias correction after wind inversion**
  - **Screening: Sea Ice 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**

Forecast Sensitivity to Observations – Full System

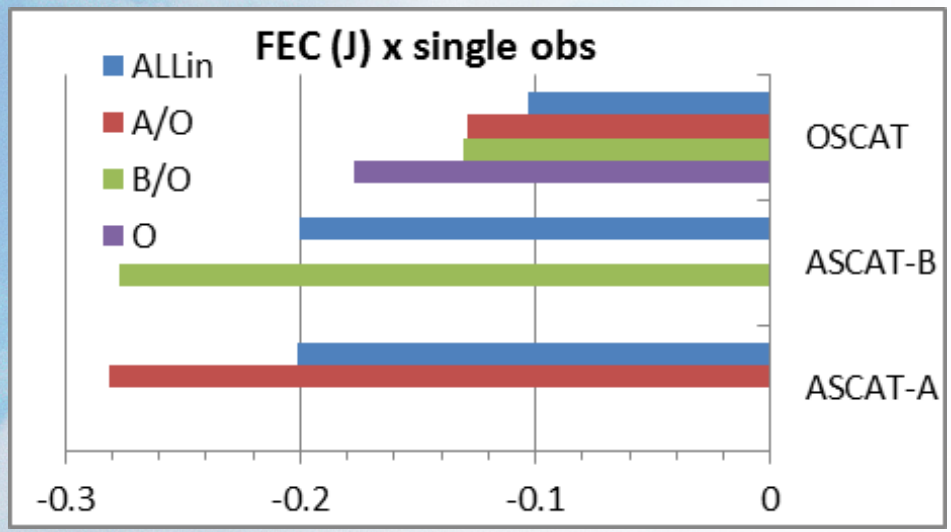


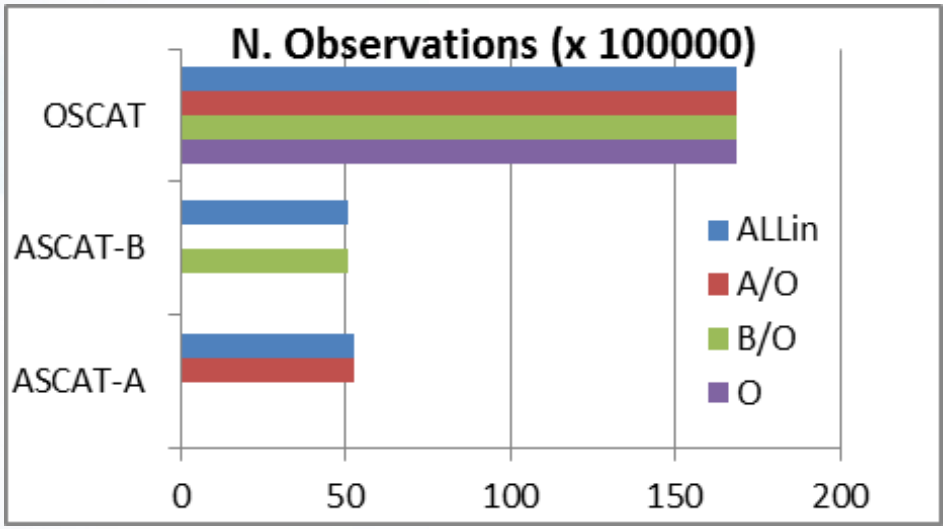


Regional statistics show that the larger impact is in the SH.

ECMWF

Forecast Sensitivity to Observations – Full System



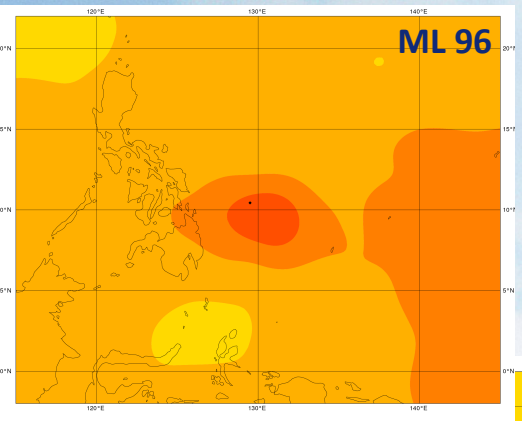


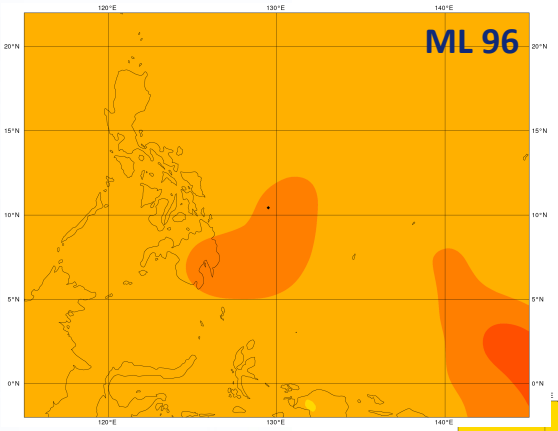
Single Observation Experiments (1 ASCAT-A)

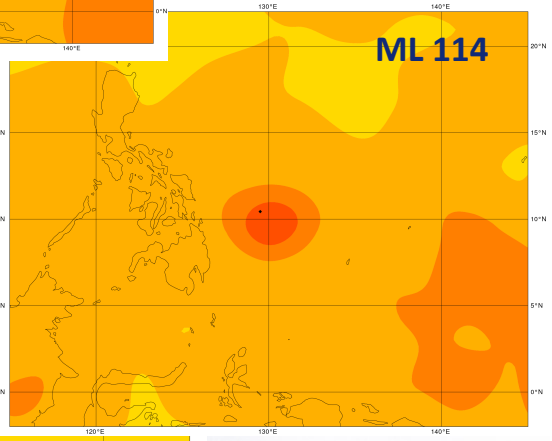
U-comp

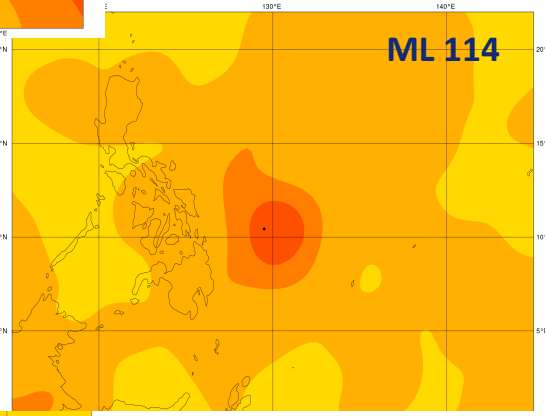
EDA Background Error

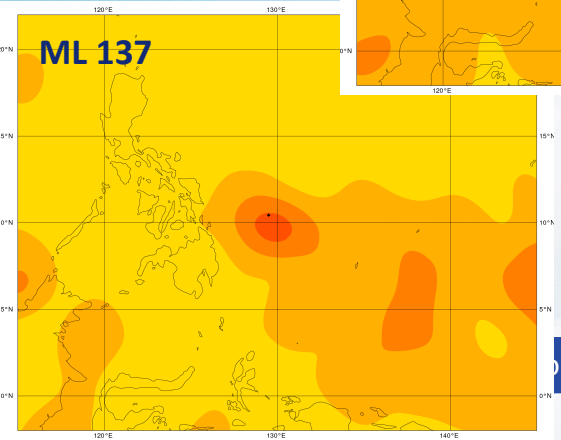
V-comp

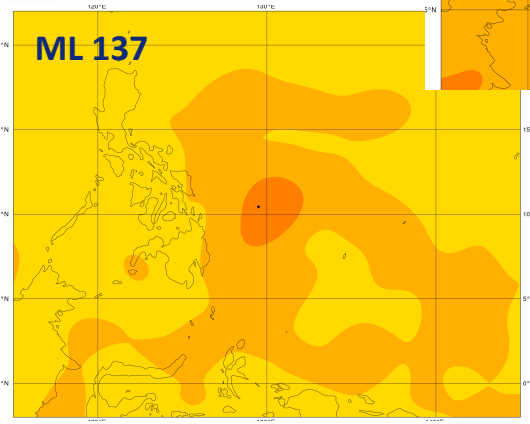












penhagen

ECMWF