Scatterometer winds activities at ECMWF

(+ Preliminary assessment of SMOS winds)

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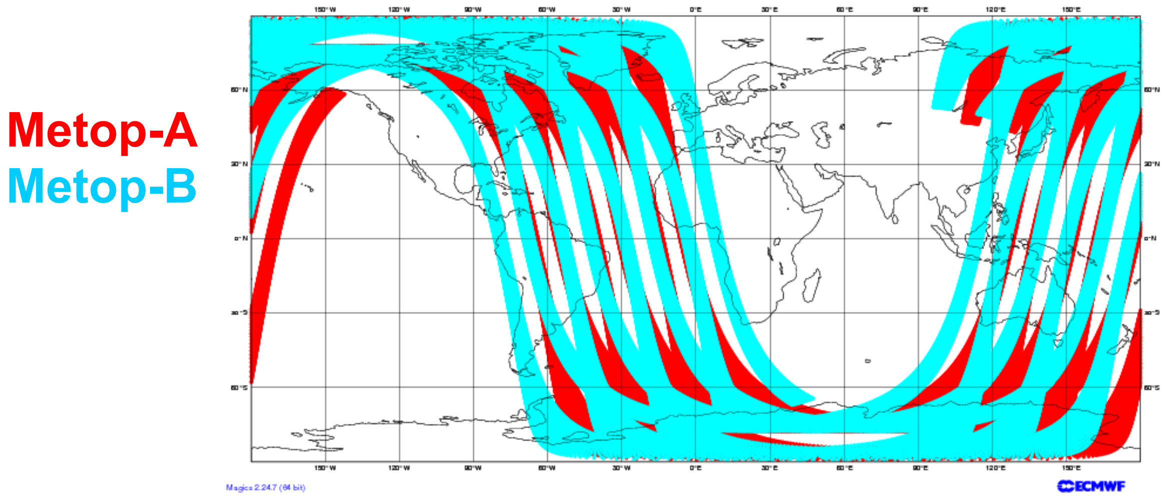
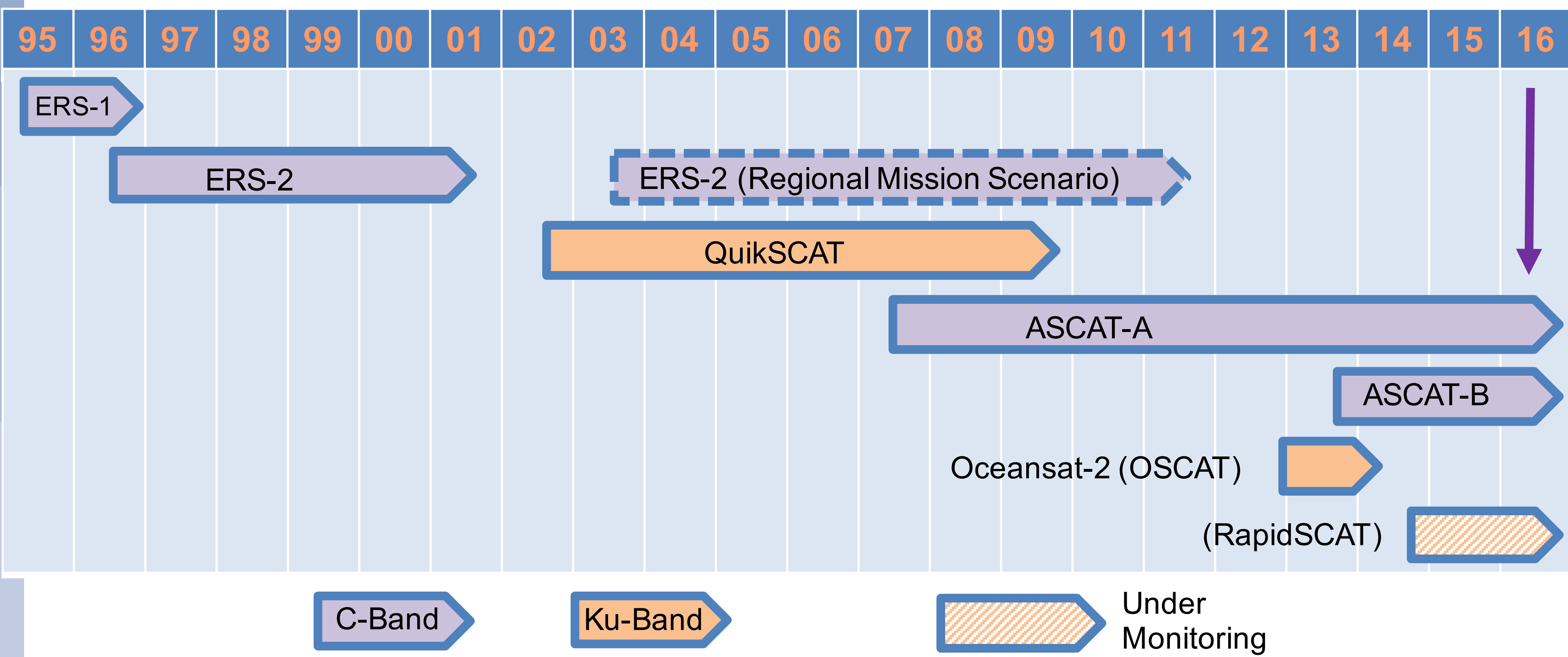
Acknowledgement

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

Operational usage of Scatterometer winds





Scatterometer assimilation strategy

	C-band (e.g., ASCAT)	Ku-Band
Resolution grid	25 km	50 km
σ_0 bias correction	√	-
Wind Inversion	ECMWF	KNMI
Wind Speed bias correction	√	√
QC – Sea Ice check	√	√
Rain flag check	-	√
Thinning	100 km	-
Maximum wind speed assimilated	35 m/s	25 m/s
Assigned observation error	1.5 m/s	2 m/s
4D-Var	2 solutions	1 solution
Assimilated as 10m eq. neutral wind (U&V)	√	√

Scatterometer Research Activities

Research activities are on-going in the framework of a EUMETSAT project with the scope to improve the assimilation of ASCAT winds:

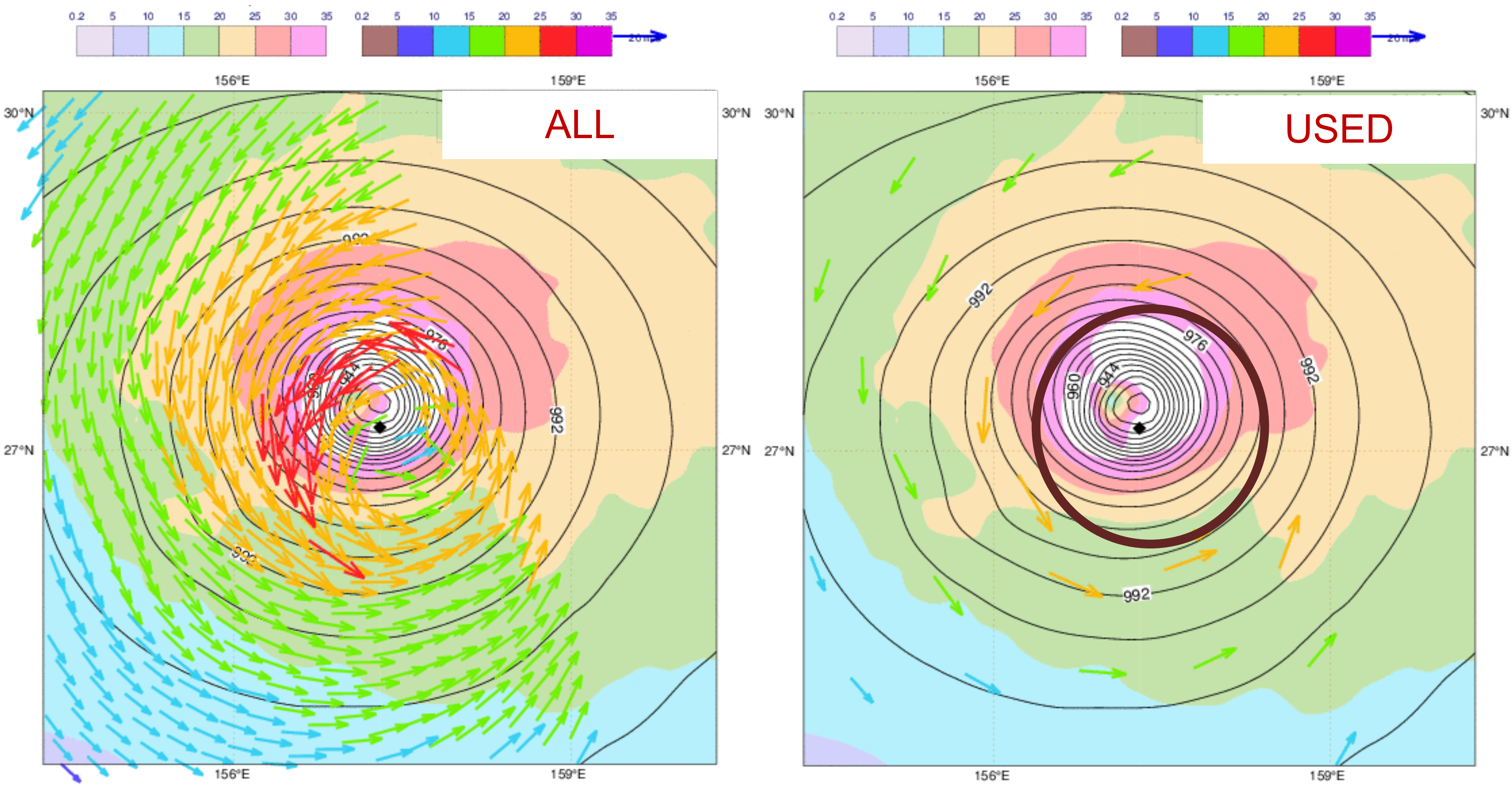
- ✓ to improve the understanding of how to handle and take maximum benefit of very high wind speeds: improvement of the QC to allow extreme observations to be used
- ✓ to investigate the observation sampling strategies: tests on thinning procedure & observation error

Typical Issues: VarQC & background

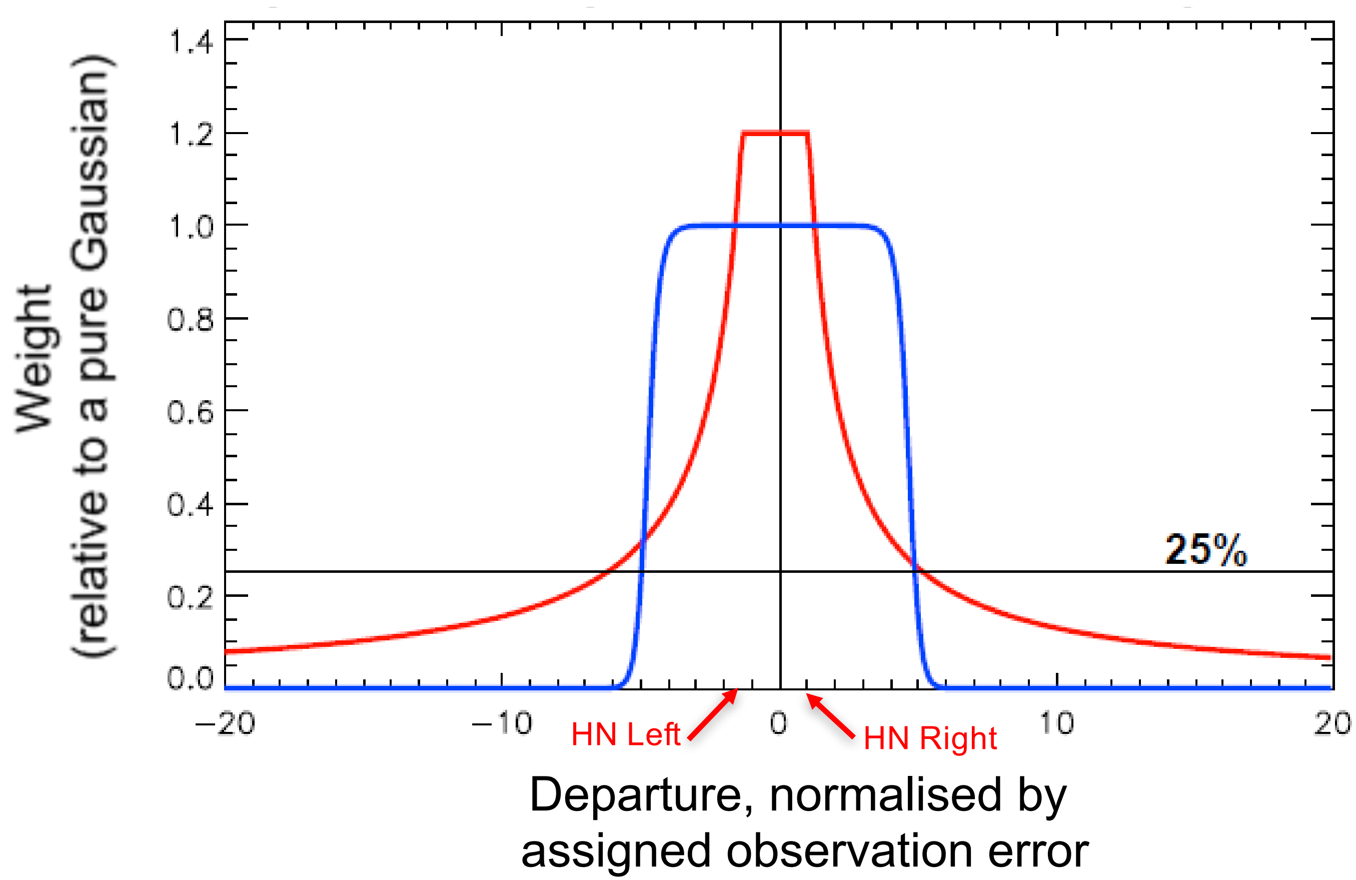
TC KILO – 2015090812 ASCAT-A Observations

Less observations due to:

- Thinning
- VarQC



Huber Norm

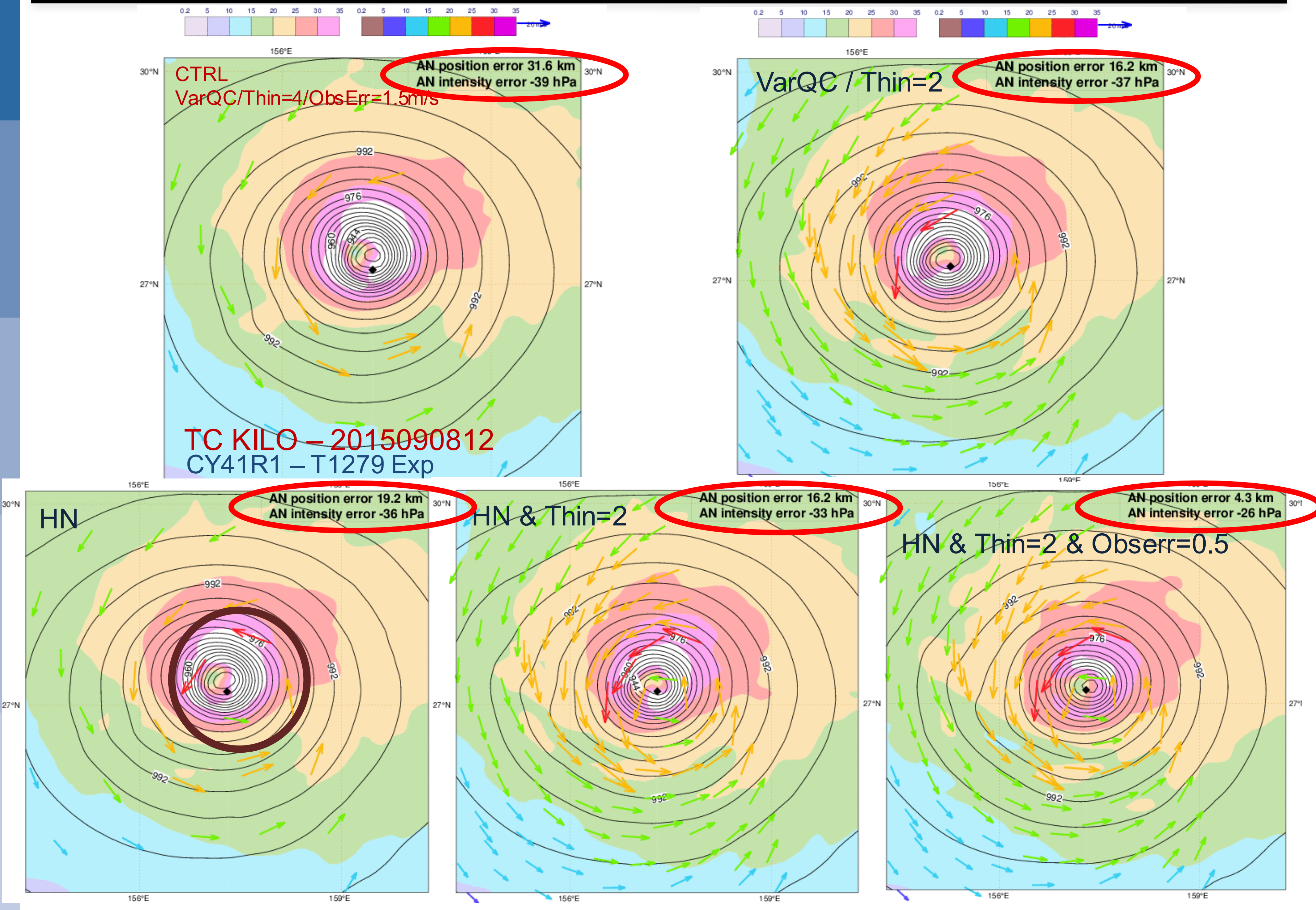


Comparing Observation weights:

Gaussian + flat (VarQC): more weight in the middle of the distribution

Huber Norm: more weight on the edges (to data with large departure)

TC QC issues



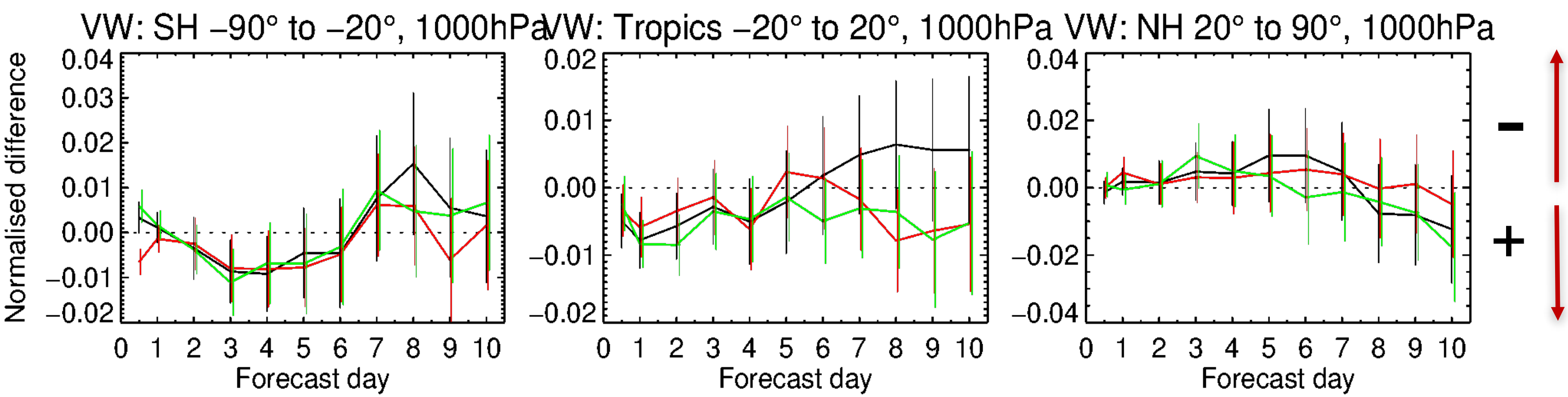
CTRL
VarQC/Thin=4/ObsErr=1.5m/s
AN position error 31.6 km
AN intensity error -39 hPa
TC KILO – 2015090812
CY41R1 – T1279 Exp
VarQC / Thin=2
AN position error 16.2 km
AN intensity error -37 hPa
HN
AN position error 19.2 km
AN intensity error -36 hPa
HN & Thin=2
AN position error 16.2 km
AN intensity error -33 hPa
HN & Thin=2 & Obserr=0.5
AN position error 4.3 km
AN intensity error -26 hPa

Huber Norm

Cy41R1 TL639 Sep-Nov 2013

- VarQC [CTRL]
- Huber Norm Left/Right = 1 [HNL/R=1]
- HN Left/Right = 1 & No Upper Wind Speed threshold [HN NoUpLim]
- HN Left/Right = 3 [HN L/R=3]

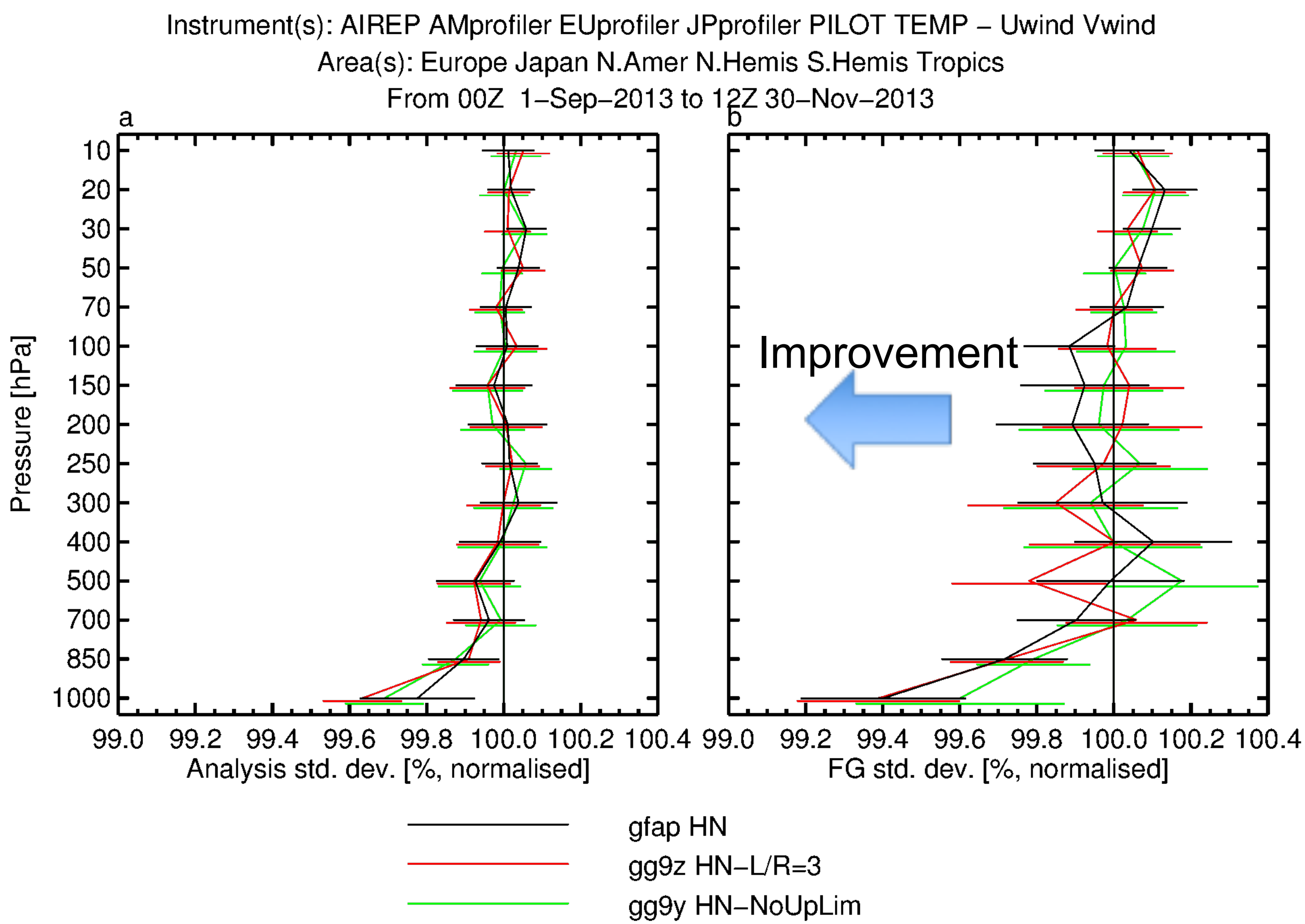
VW RMS Forecast Error Differences



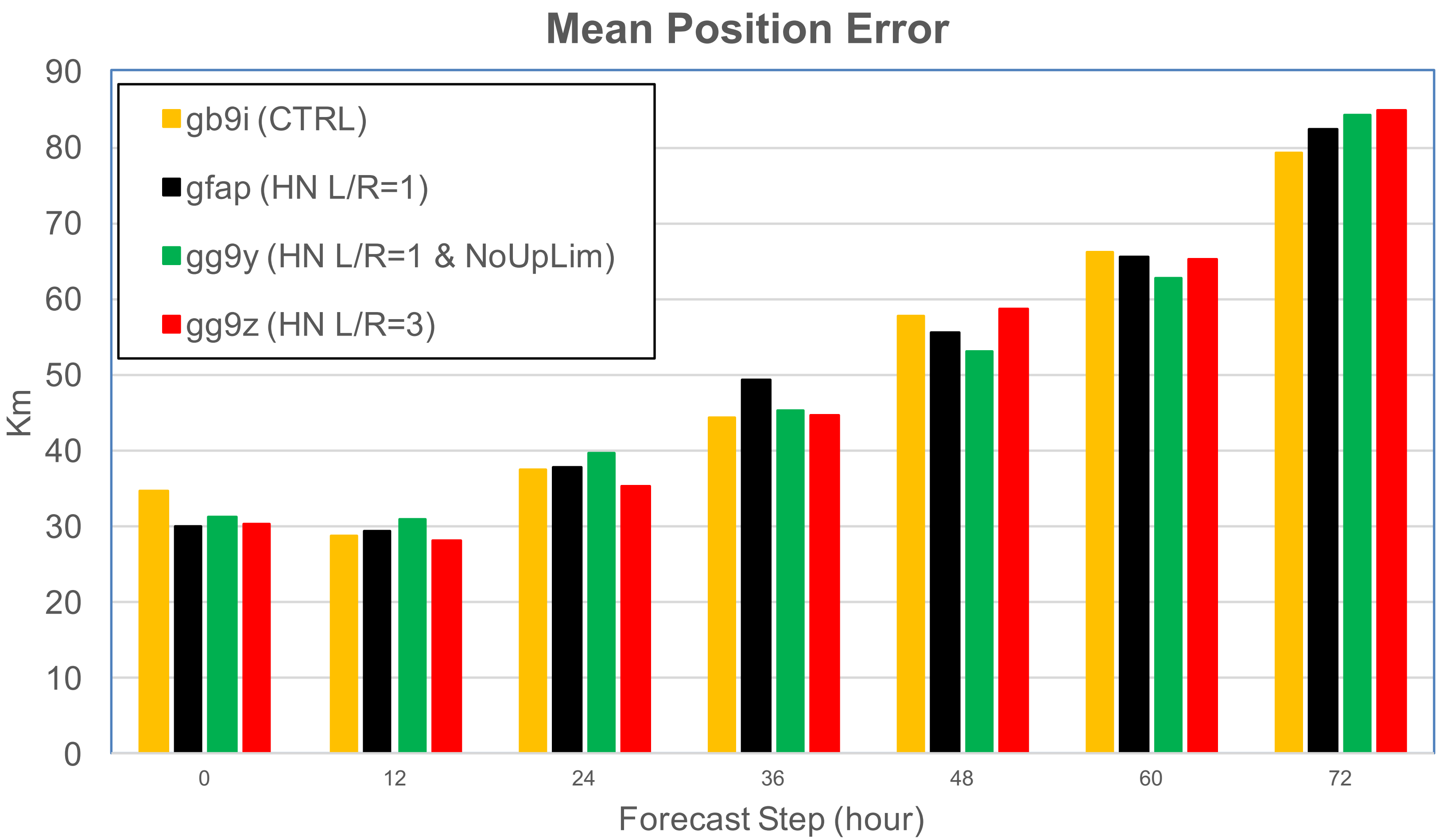
HN L/R=1 - CTRL
HN NoUpLim – CTRL
HN L/R=3 - CTRL

Huber Norm

Fit to observations - U&V statistics



Huber Norm



N.Obs: ~	*150*	*130*	*110*	*90*	*75*	*60*	*50*

Optimum wind sampling

- ✓ For spatially correlated observations the thinning is used to reduce their error-correlation. It is important to find the best balance between thinning and the observation error.

- ✓ Current ASCAT configuration:
  - 25 sampling km products
  - Thinning = 1 out of 4 (100 km)
  - Observation Error (σ)= 1.5 m/s
  - Wind speed threshold = 35 m/s

- ✓ Testing several options of thinning and Observation Error

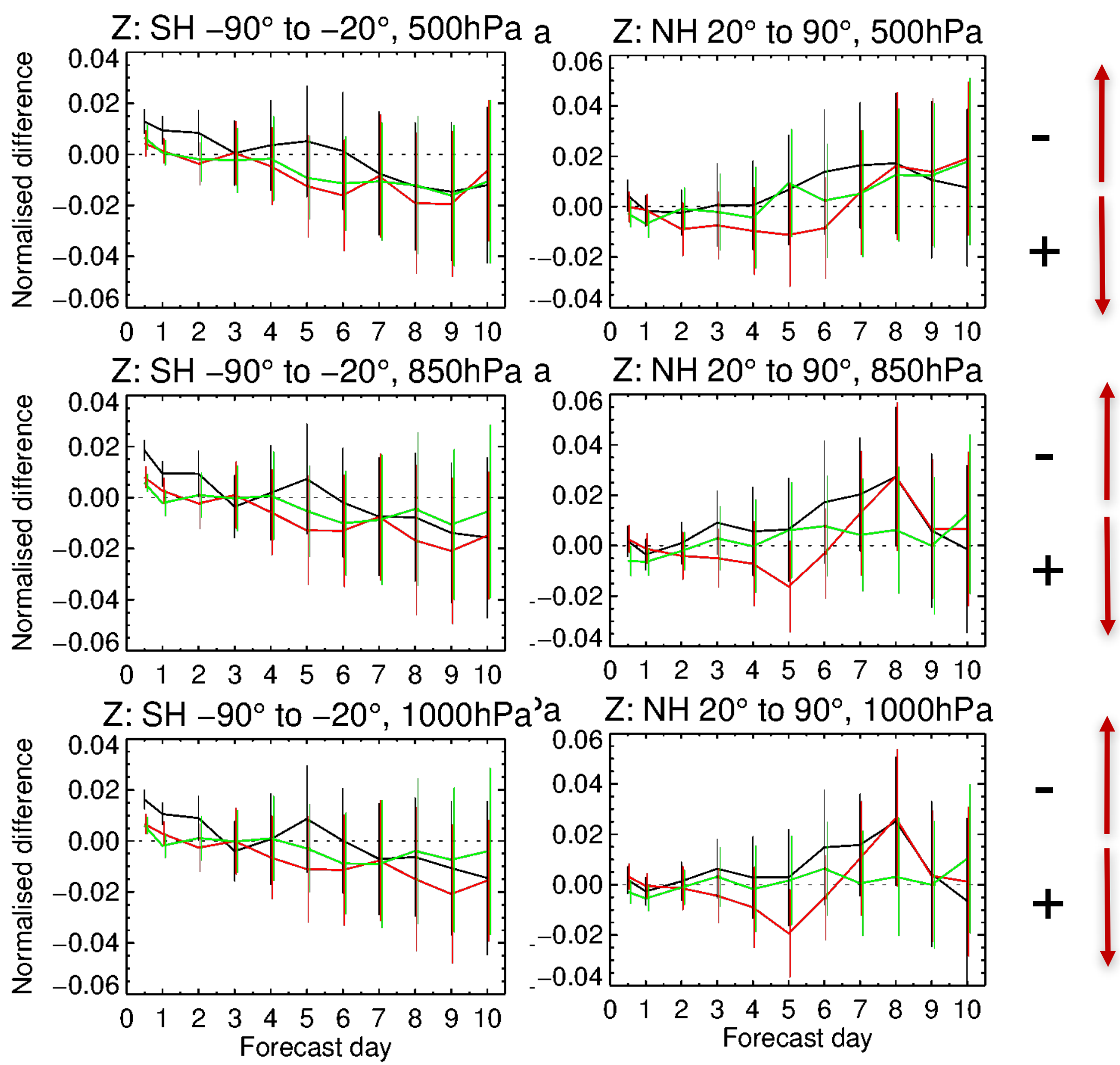
	Thinning	Obs Err (σ=1.5)	Obs. Error (m/s)
CTRL	4	σ	1.5
Th2 / OE1σ	2	σ	1.5
Th2 / OE1.25σ	2	1.25σ	1.875
Th2 / OE1.5σ	2	1.5 σ	2.25
Th2 / OE1.75σ	2	1.75 σ	2.625
Th2 / OE2σ	2	2 σ	3
Th4/OE0.67σ	4	0.67σ	1

Optimum wind sampling

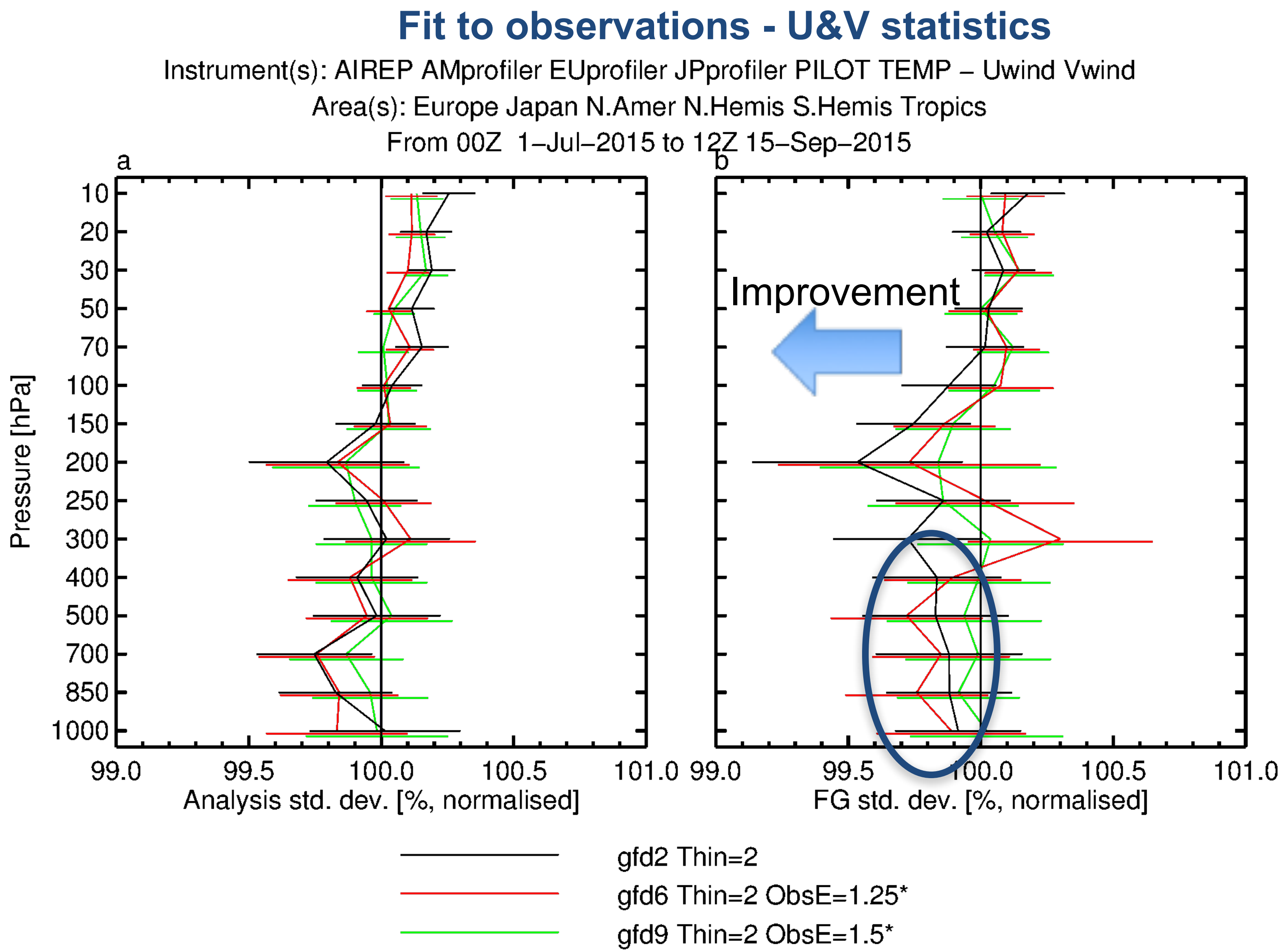
Cy41R2 TCO639 Jul-Sep 2015

Thin 2 ObsErr 1σ - CTRL
Thin 2 ObsErr 1.25σ - CTRL
Thin 2 ObsErr 1.5σ - CTRL

Geopotential RMS Forecast Error Differences



Optimum wind sampling



Conclusions

- ✓ Several activities are on-going aimed to improve the scatterometer assimilation strategy, taking also into account the EPS SG scatterometer features (better representation of high winds and higher spatial resolution):
  - maximize the benefit of strong winds
  - assess the optimum product resolution and wind sampling

- ✓ Results on the use of the Huber Norm for ASCAT data showed positive impact in the Tropics and Southern Hemisphere and on TCs forecast.

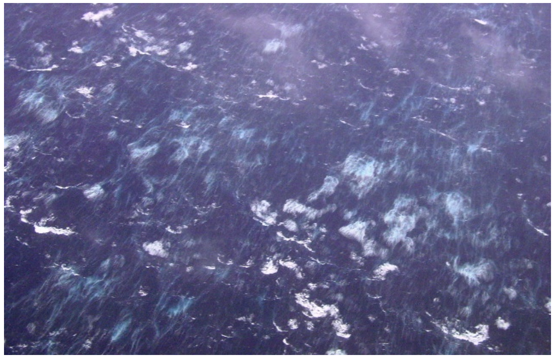
- ✓ Tests on the use of a reduced thinning with a higher observation error show generally promising results.

- ✓ Tests to combine the above changes (Thinning/ObsError/Huber Norm) are ongoing.

- ✓ Ongoing analysis on the use of HR products (Hamming window and box-car).

SMOS wind speed database

- ✓ Soil Moisture and Ocean Salinity (SMOS) mission provides multi-angular L-band (1.4 GHz) brightness temperature (resolution range 30/80 km)
- ✓ L-band is less affected by rain, spray and atmospheric effects than higher mw frequencies (C-band, Ku-band)
- ✓ There is no saturation at high wind speed like for radars
- ✓ Sea foam, generated by breaking waves which mainly depends on surface wind strength and sea state development, increases the microwave ocean emissivity
- ✓ In the framework of the SMOS+STORM project, Ifremer developed a SMOS wind speed product.



SMOS STORM dataset available from 2010 to 2015
http://www.ifremer.fr/cersat/images/smosstorm2/

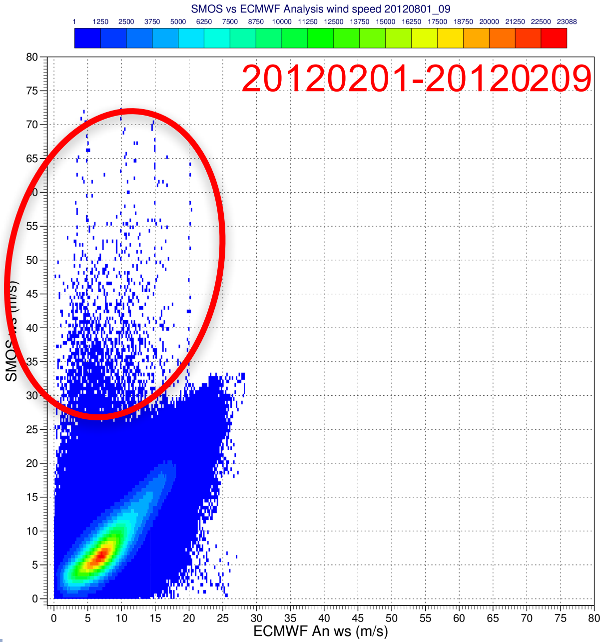
SMOS Full swath coverage dataset available at
ftp://eftp.ifremer.fr/storm/data/smosstorm/l2

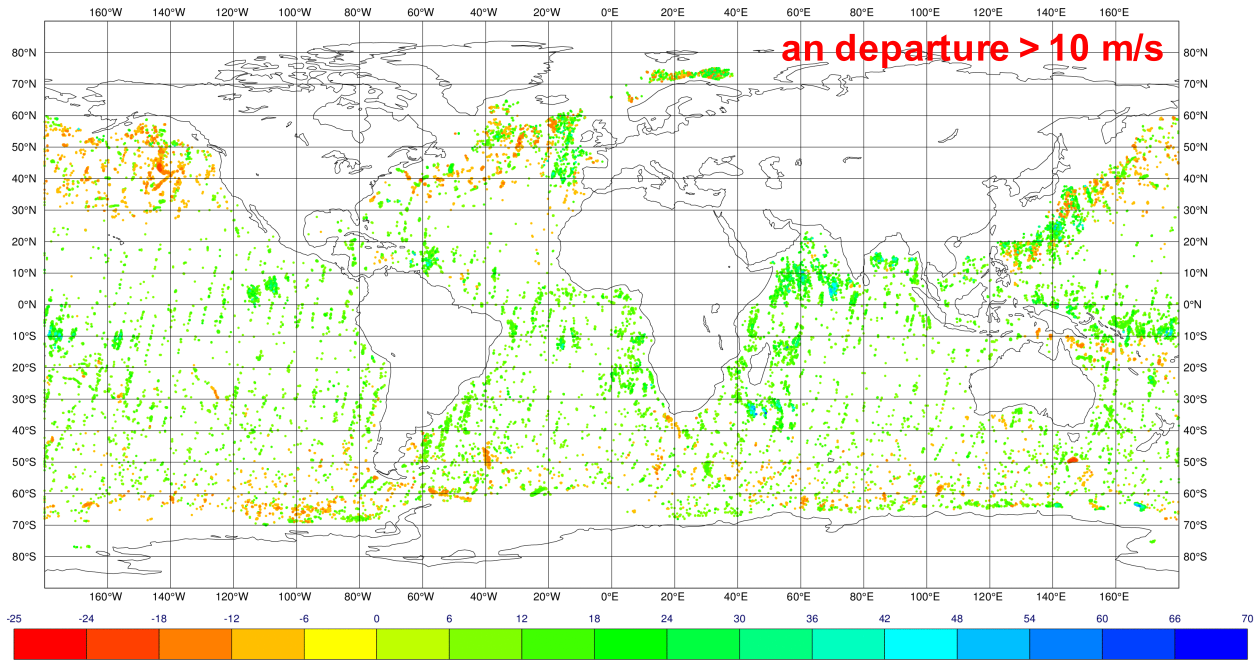
SMAP data based on SMOS derived GMF will be soon available, too.

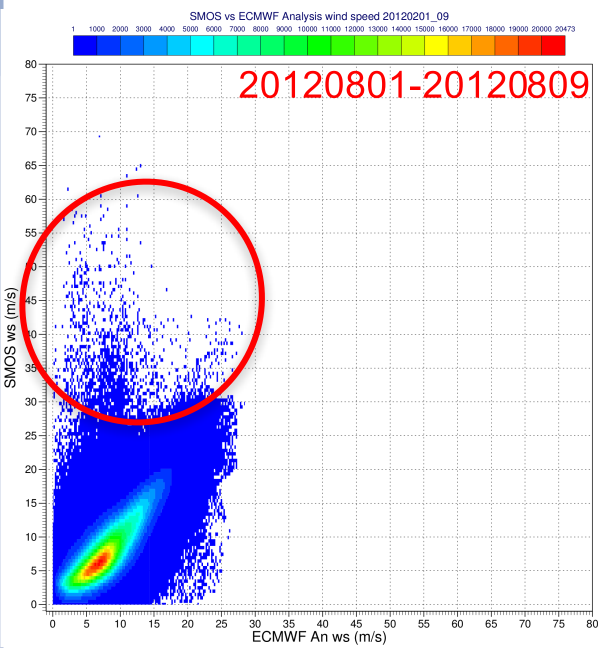
ESA contract 4000101703/10/NL/FF/fk CCN5

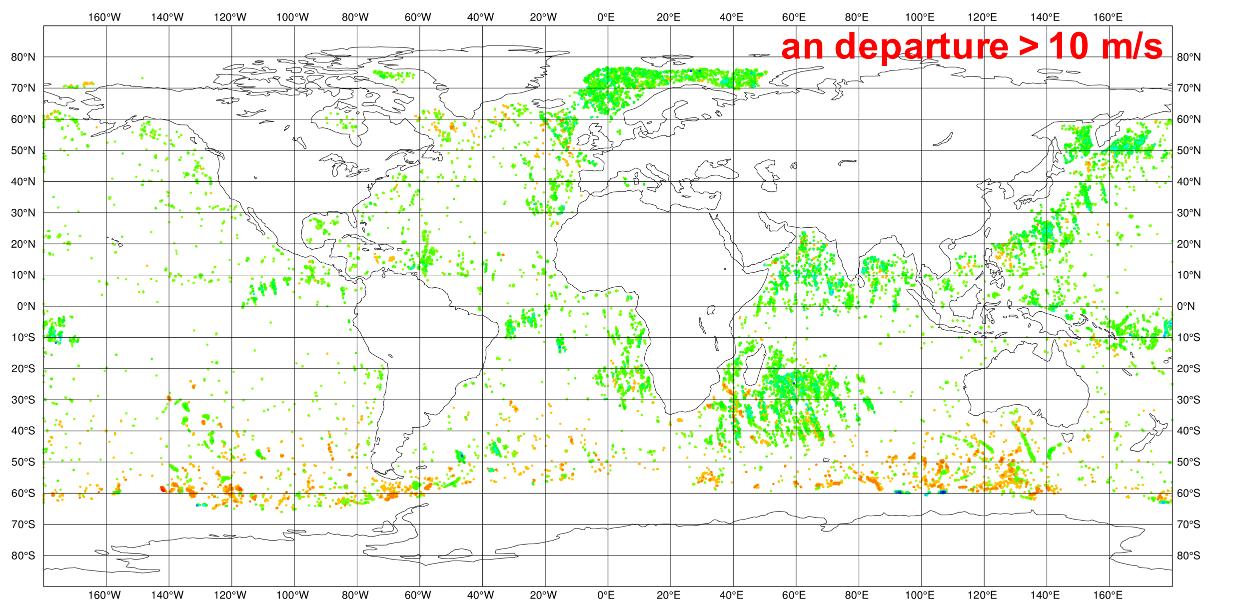
***Reul, N., J. Tenerelli, B. Chapron, D. Vandemark, Y. Quilfen, and Y. Kerr (2012), SMOS satellite L-band radiometer: A new capability for ocean surface remote sensing in hurricanes, J. Geophys. Res., 117, C02006, doi:10.1029/2011JC007474.*

SMOS vs ECMWF AN wind speed - preliminary results









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- ✓ Tests to combine the above changes (Thinning/ObsError/Huber Norm) are ongoing.

- ✓ Ongoing analysis on the use of HR products (Hamming window and box-car).

- ✓ Initial evaluations of wind speed information from SMOS has started.