Towards an improved assimilation of scatterometer winds

(+ Preliminary assessment of SMOS winds)

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ECMWF

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 investigate the observation sampling strategies: tests on thinning procedure & observation error

- ✓ 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

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

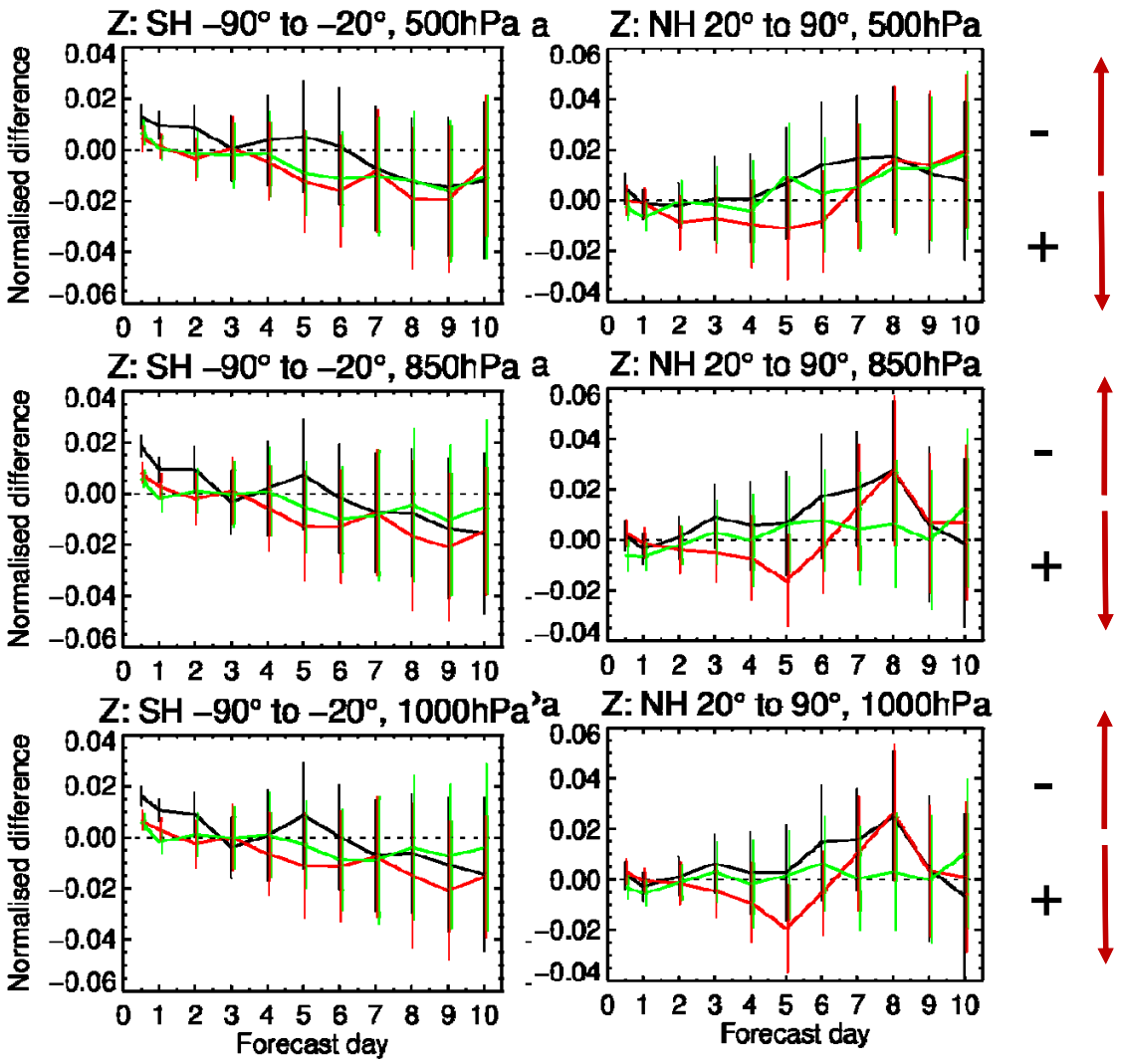
Cy41R2 TCO639 Jul-Sep 2015

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

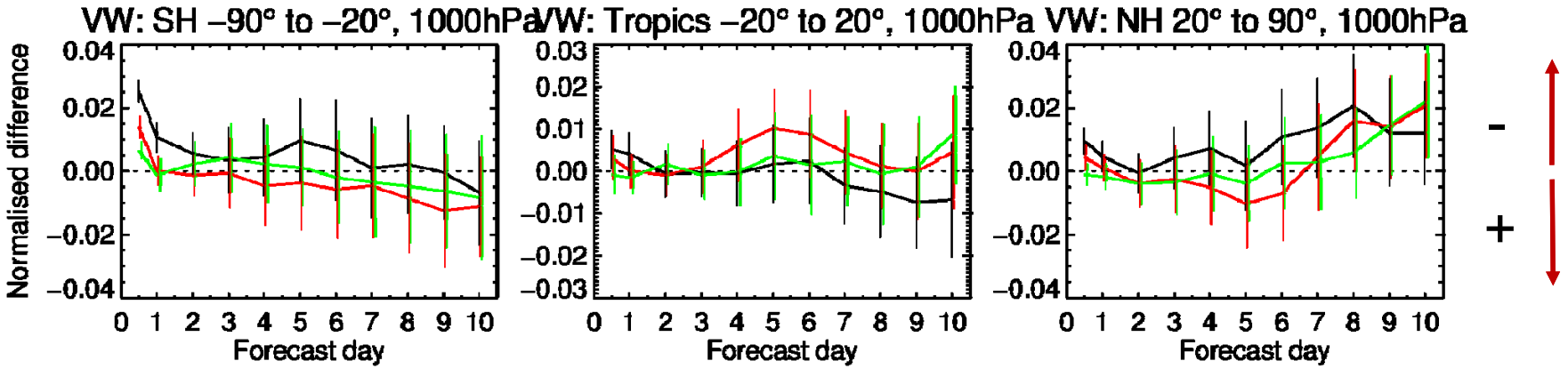
Geopotential RMS Forecast Error Differences



Optimum wind sampling

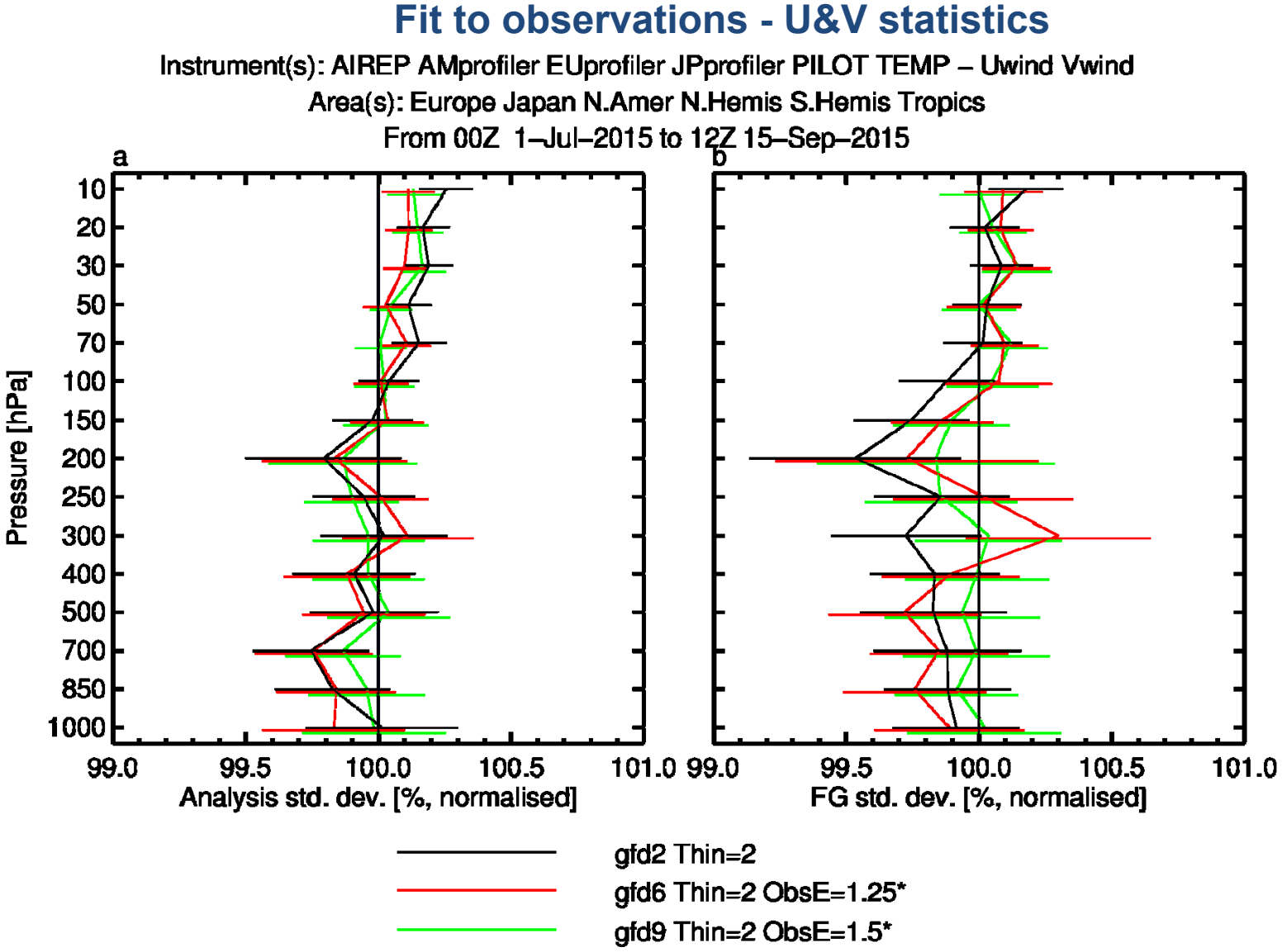
Cy41R2 TCO639 Jul-Sep 2015

Vector Wind RMS Forecast Error Differences

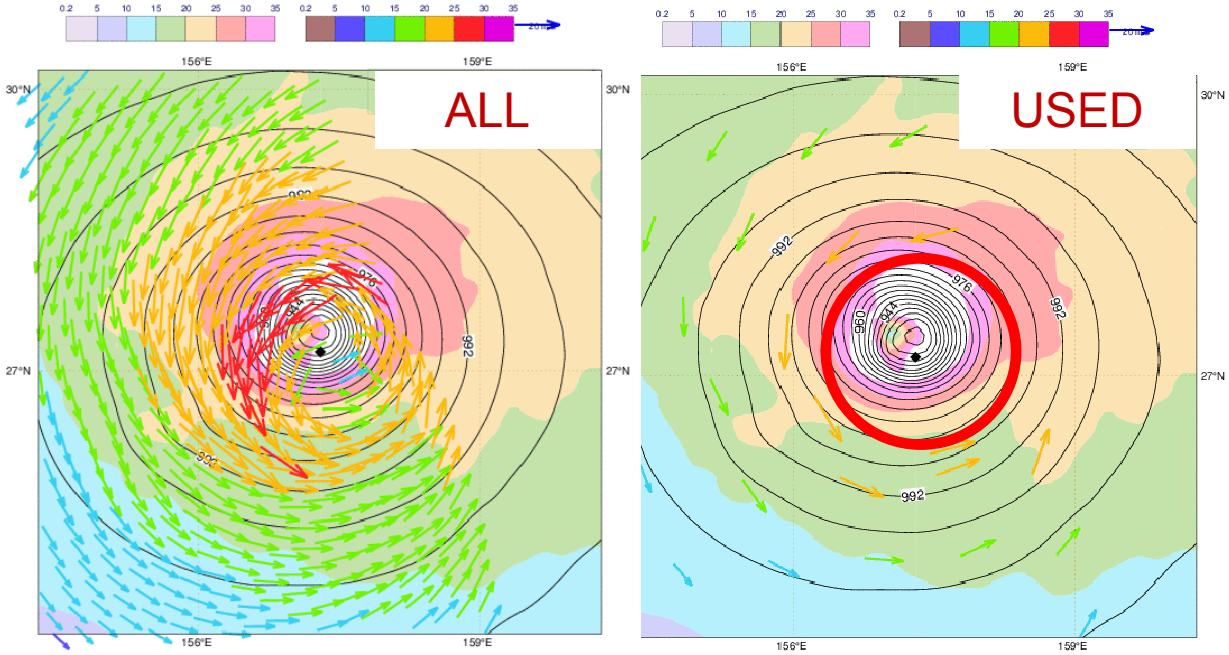


Thin 2 ObsErr 1σ - CTRL
Thin 2 ObsErr 1.25σ - CTRL
Thin 2 ObsErr 1.5σ - CTRL

Optimum wind sampling



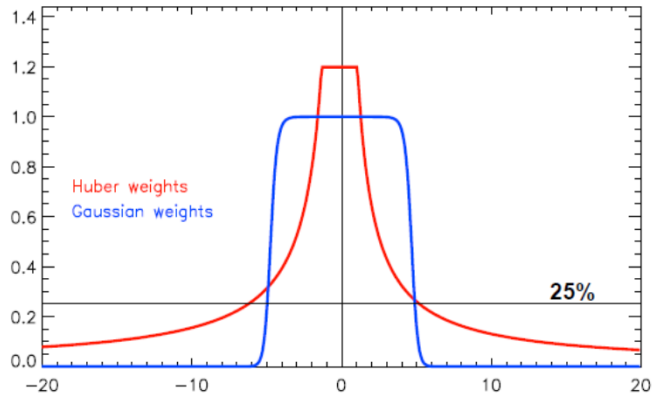
TC case study



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)

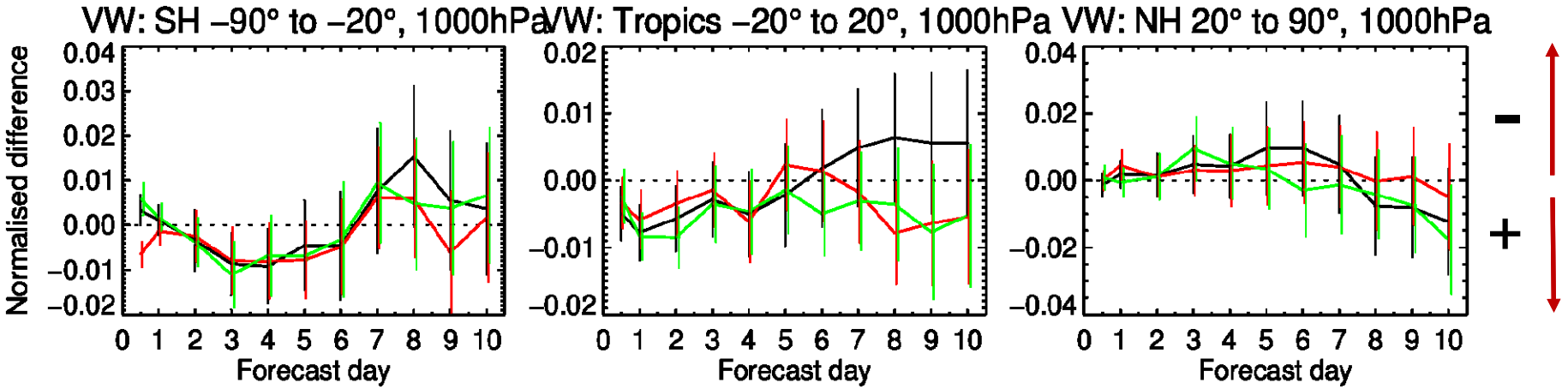


Huber Norm

Cy41R1 TL639 Sep-Nov 2013

- CTRL: VarQC
- HN Left/Right = 1
- HN Left/Right = 1 & No Upper Wind Speed threshold
- HN Left/Right = 3

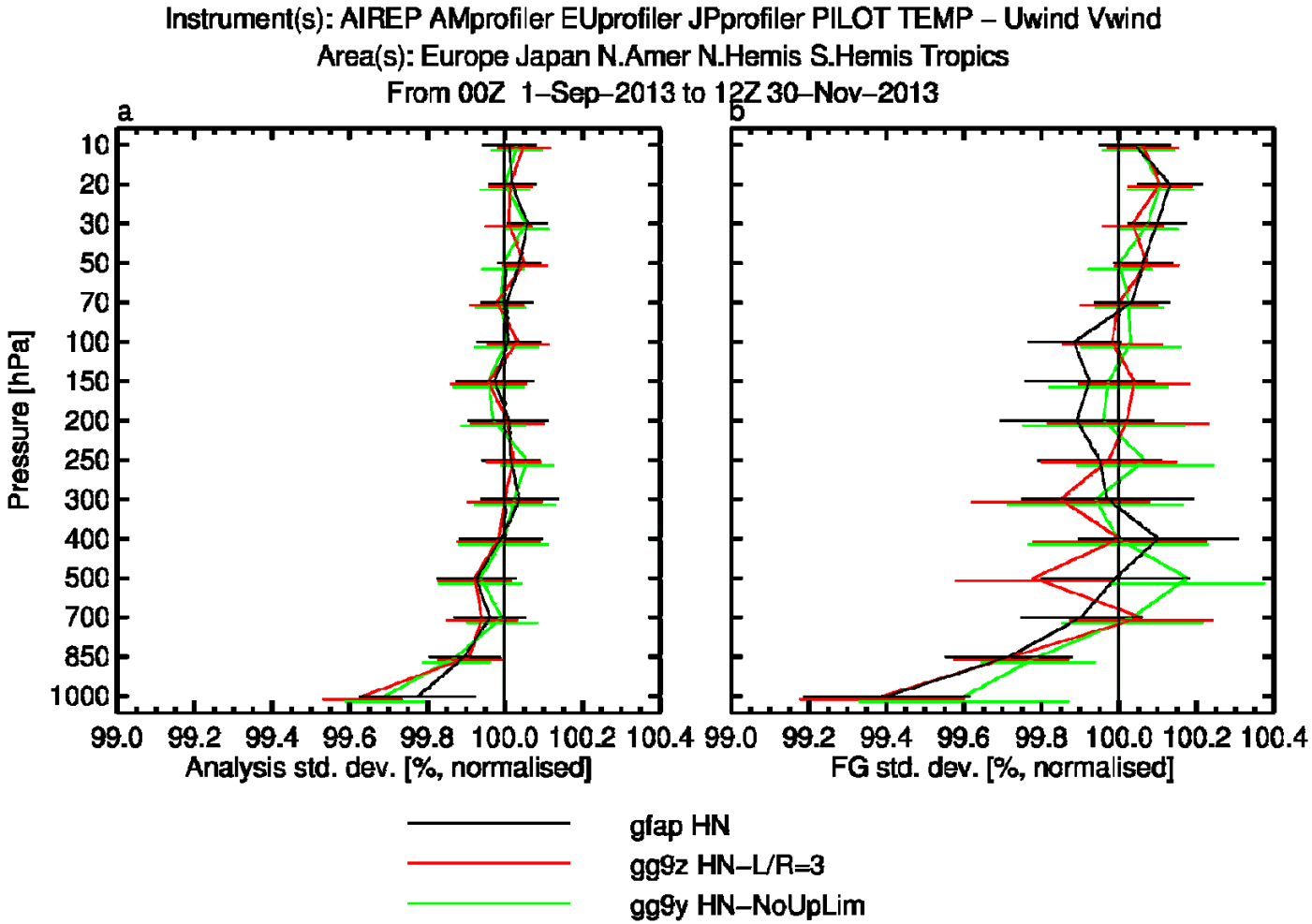
VW RMS Forecast Error Differences



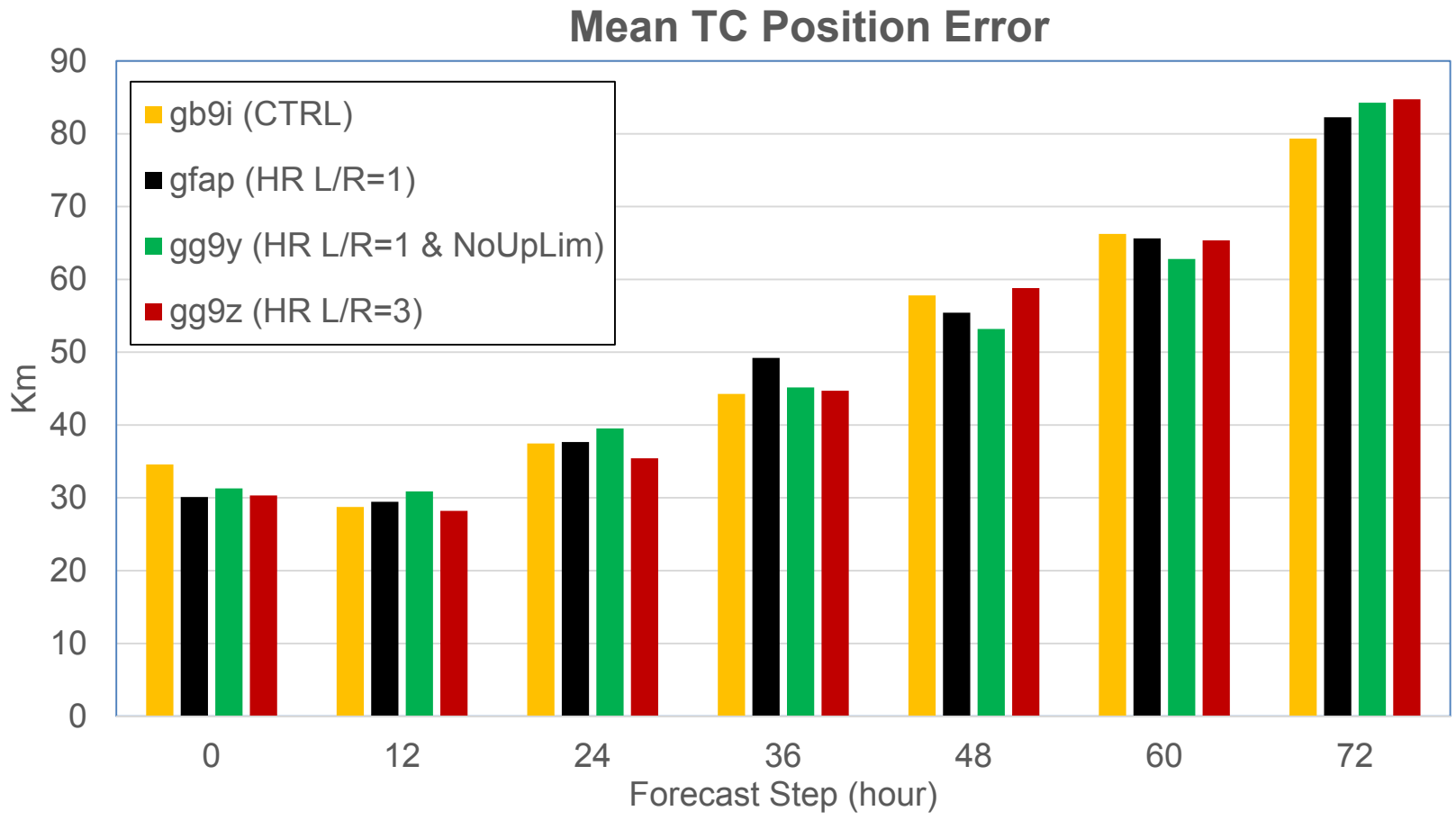
HN L/R=1 - CTRL
HN L/R=3 - CTRL
HN NoUpLim - CTRL

Huber Norm

Fit to observations - U&V statistics

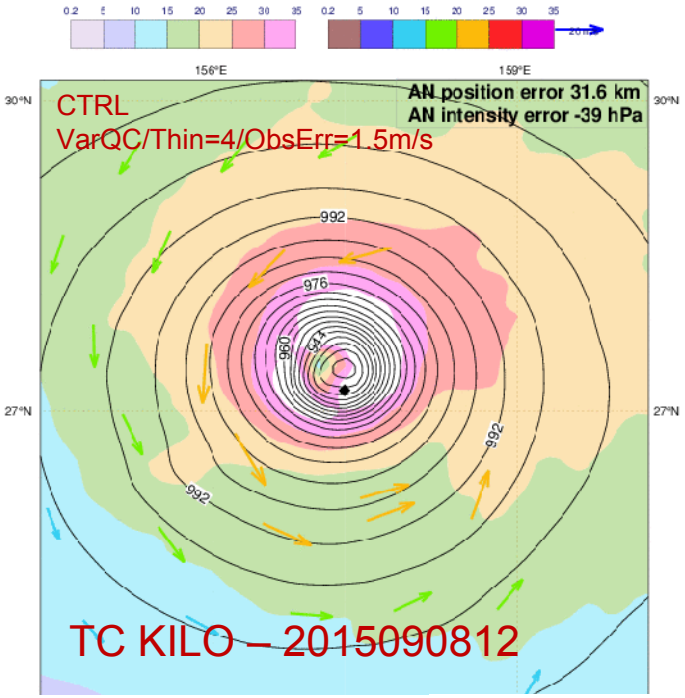


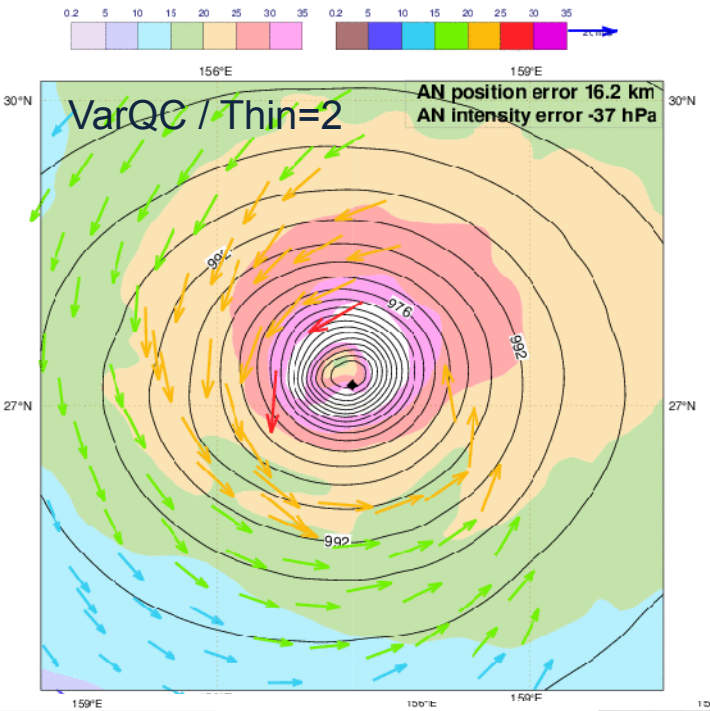
Huber Norm

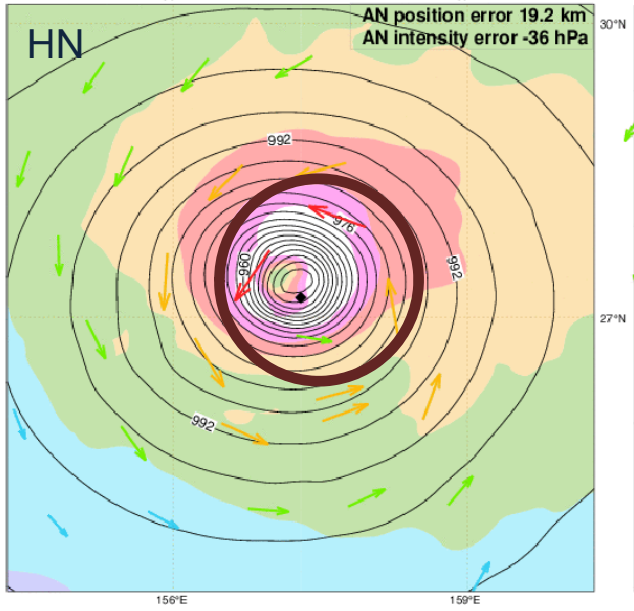


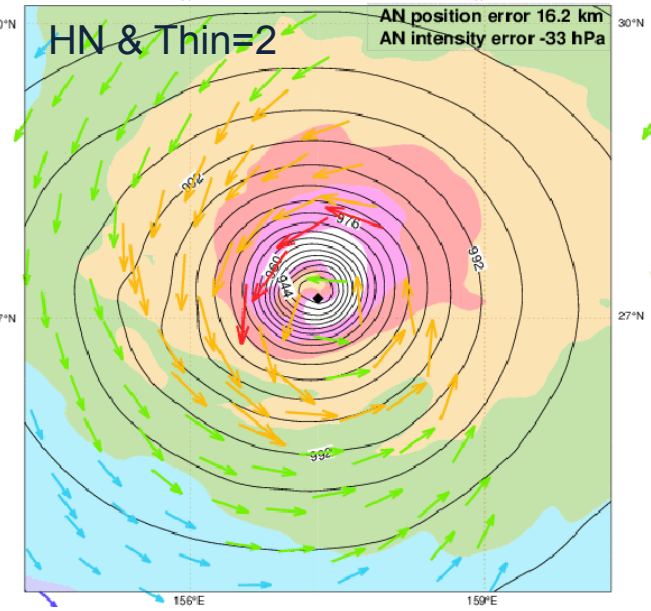
N.Obs: ~	*150*	*130*	*110*	*90*	*75*	*60*	*50*

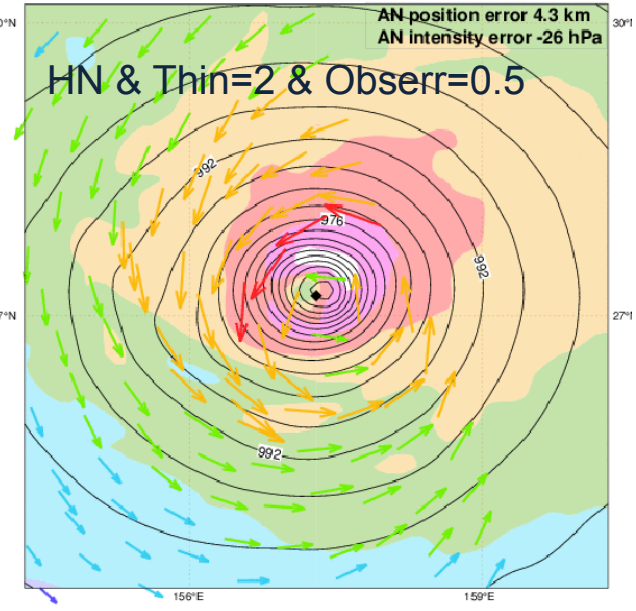
TC QC issues


CTRL
VarQC/Thin=4/ObsErr=1.5m/s
AN position error 31.6 km
AN intensity error -39 hPa
TC KILO – 2015090812


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

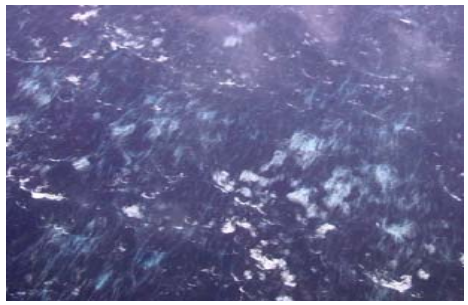

HN & Thin=2 & Obserr=0.5
AN position error 4.3 km
AN intensity error -26 hPa

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
- ✓ Tests on the use of a reduced thinning with a higher observation error showed generally positive results.
- ✓ In IFS the Huber Norm is currently used only for conventional observations. 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 to combine the above changes (Thinning/ObsError/Huber Norm) are ongoing
- ✓ Ongoing analysis on the use of HR products (Hamming window and box-car)
- ✓ Tests will be performed using also the singularity analysis O/B errors (in collaboration with Wenming and Marcos)

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 GMF based on Hwind products in IGOR hurricane**

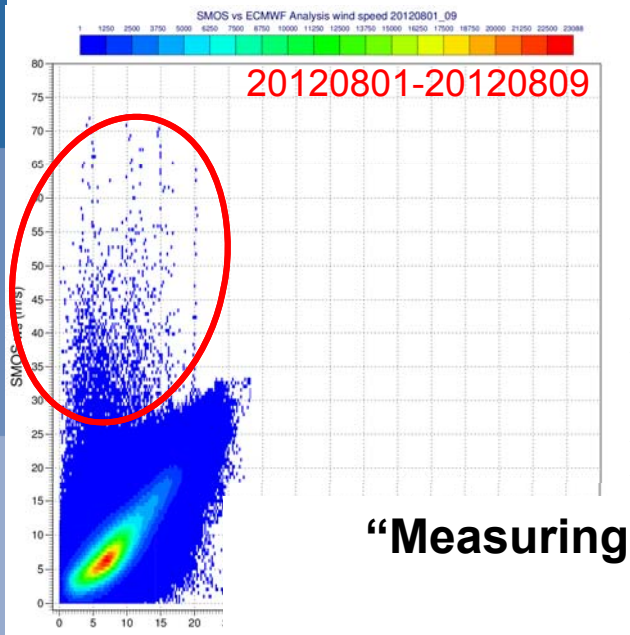
SMOS STORM dataset available from 2010 to 2015 **http://www.ifremer.fr/cersat/images/smosstorm2/**

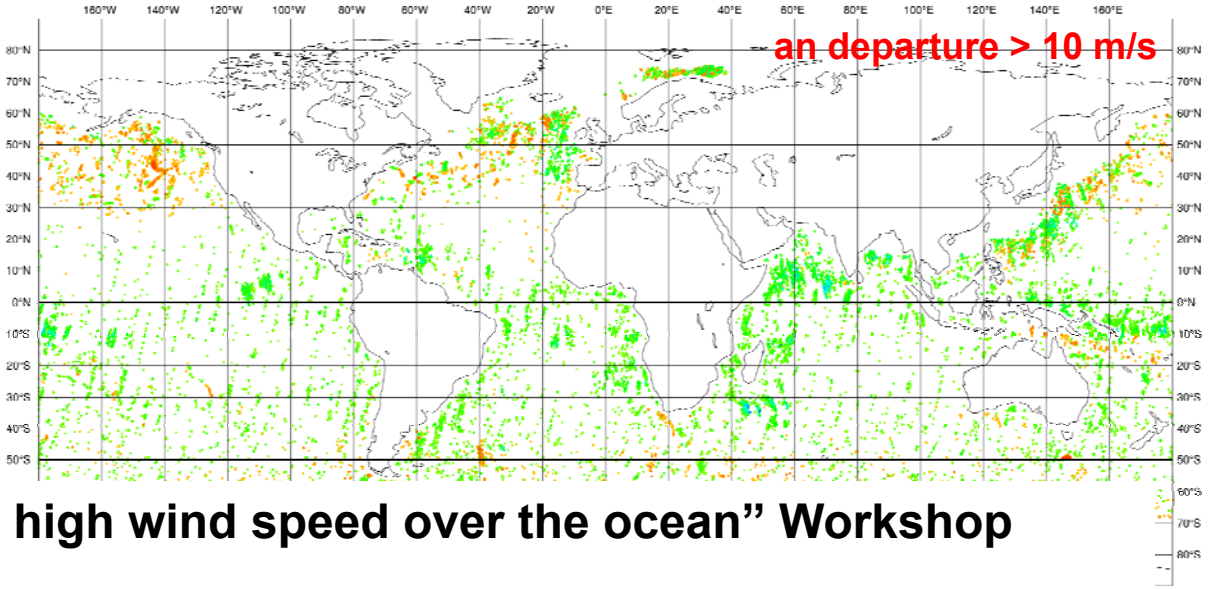
SMOS Full swath coverage dataset available at **ftp://eftp.ifremer.fr/storm/data/smosstorm/l2**

SMAP data based on SMOS derived GMF will be soon available

***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

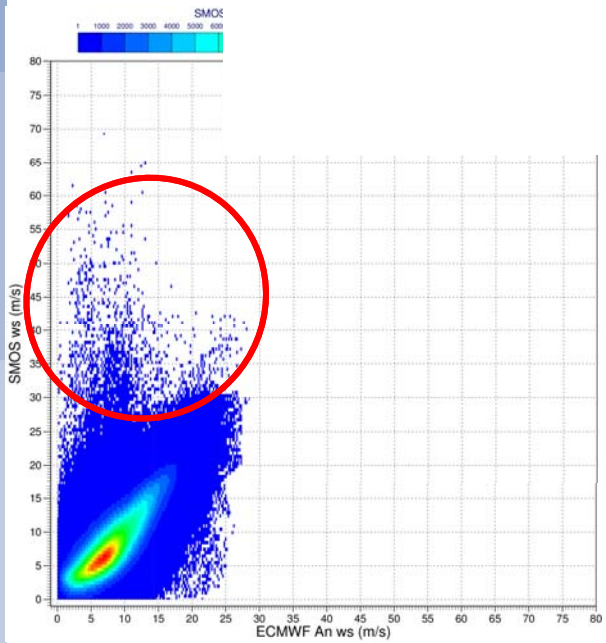


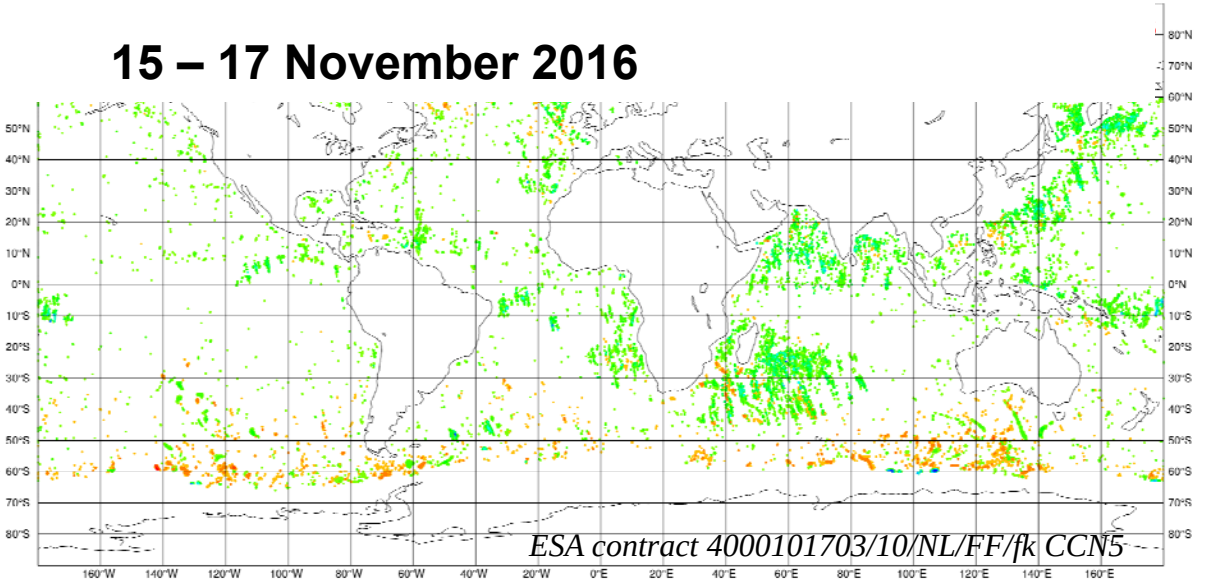


“Measuring high wind speed over the ocean” Workshop

UK MetOffice – Exeter – UK

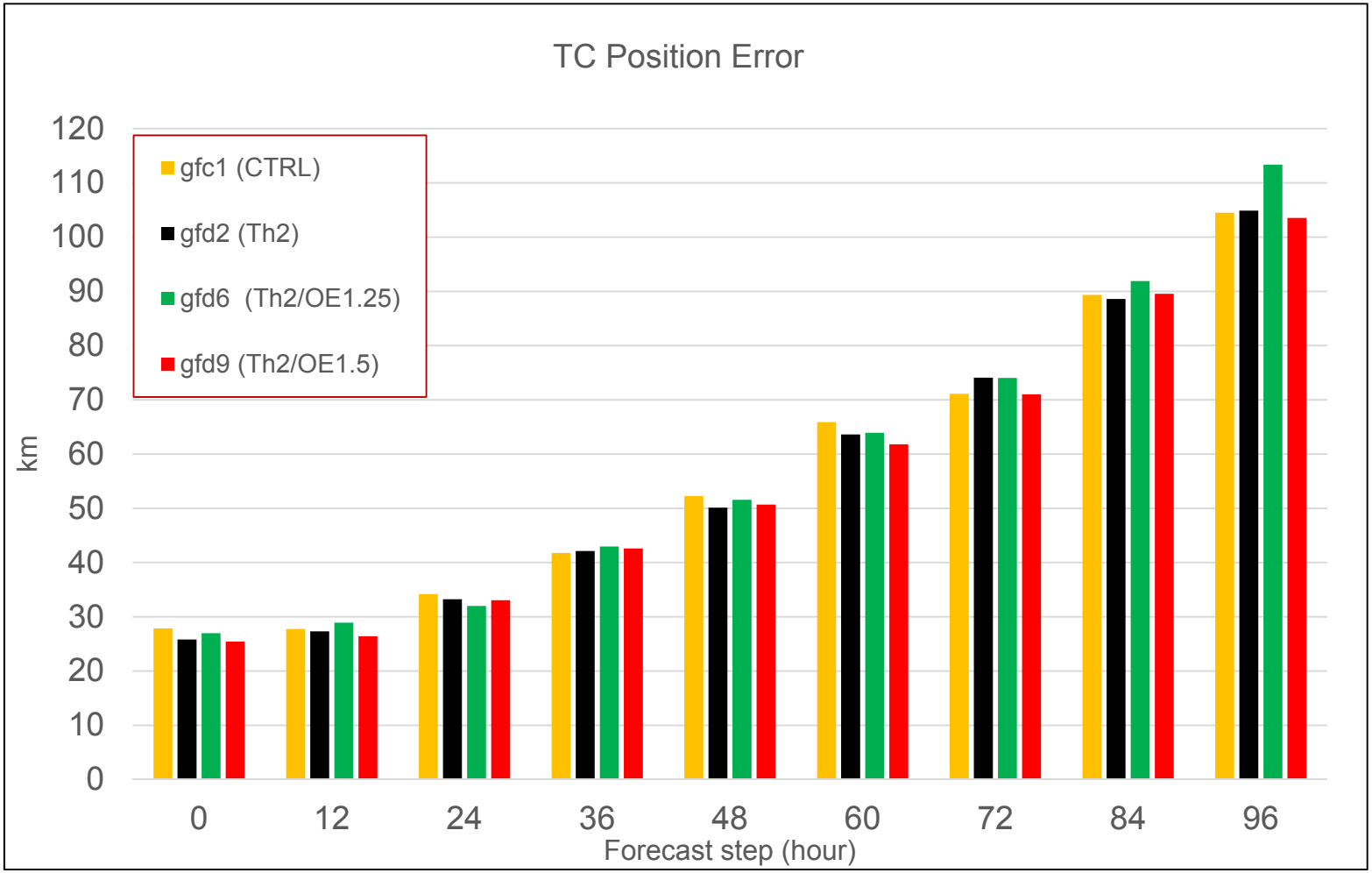
15 – 17 November 2016





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

Optimum wind sampling



N.cases: ~	*205*	*180*	*170*	*150*	*140*	*130*	*120*	*110*	*100*