Evaluation of ASCAT superobbing products for NWP data assimilation

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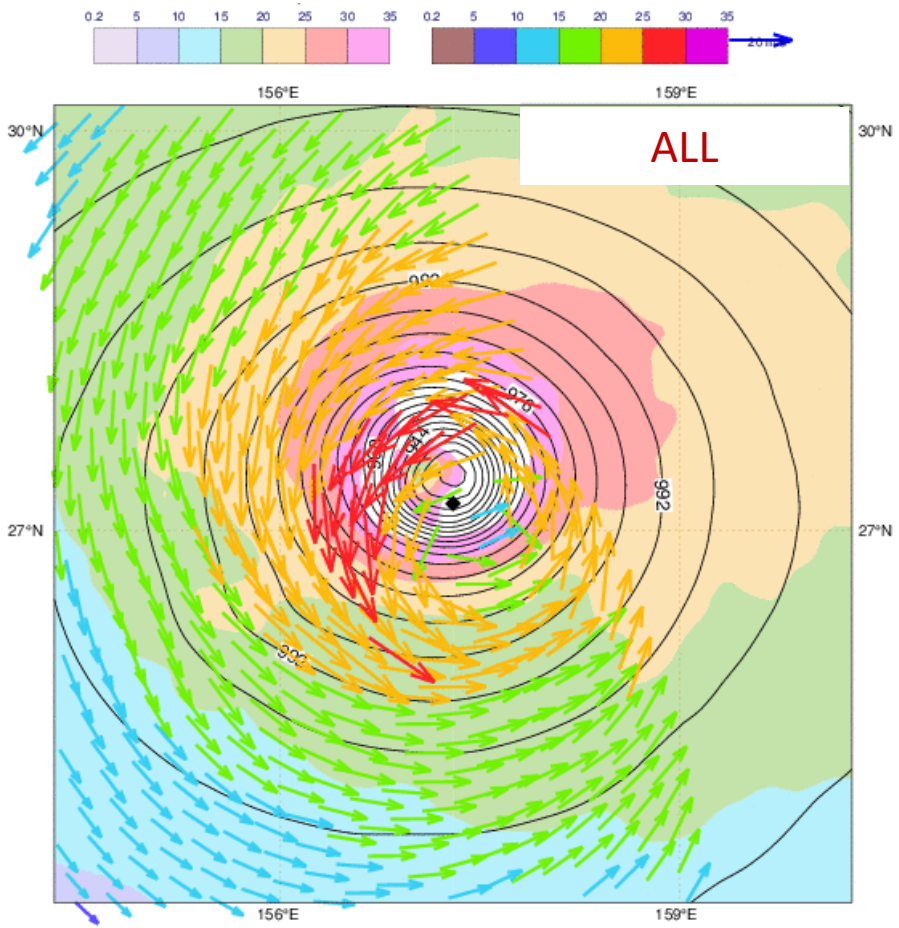
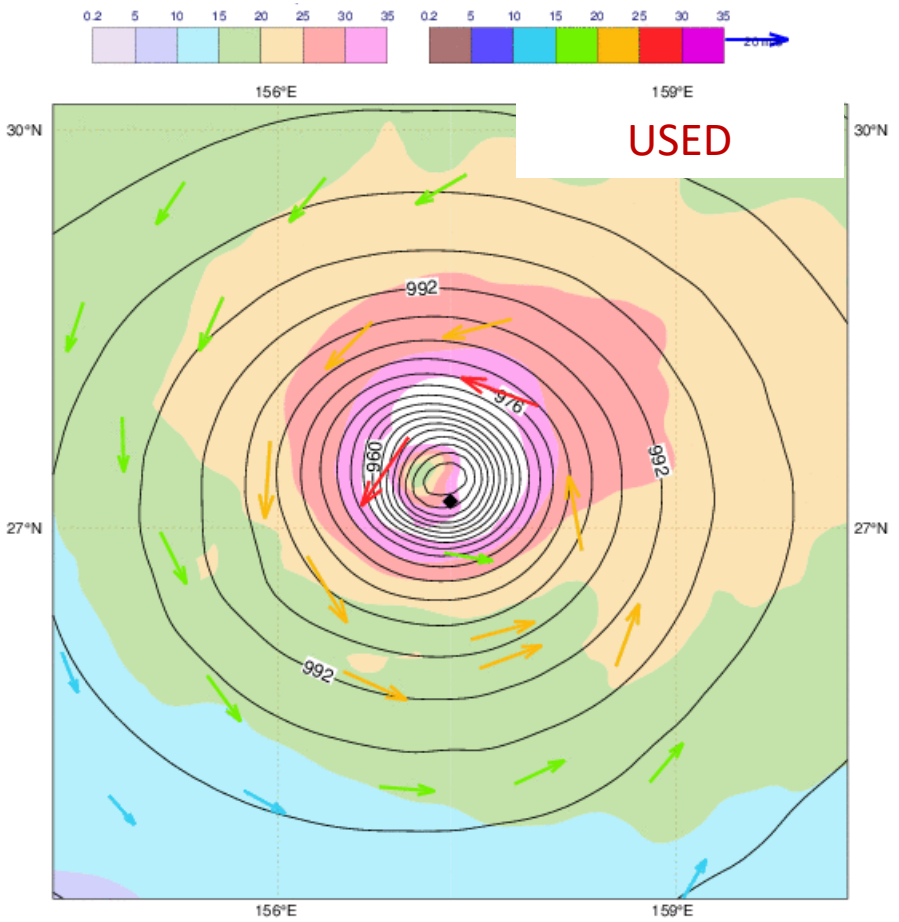
ECMWF

ASCAT winds in NWP

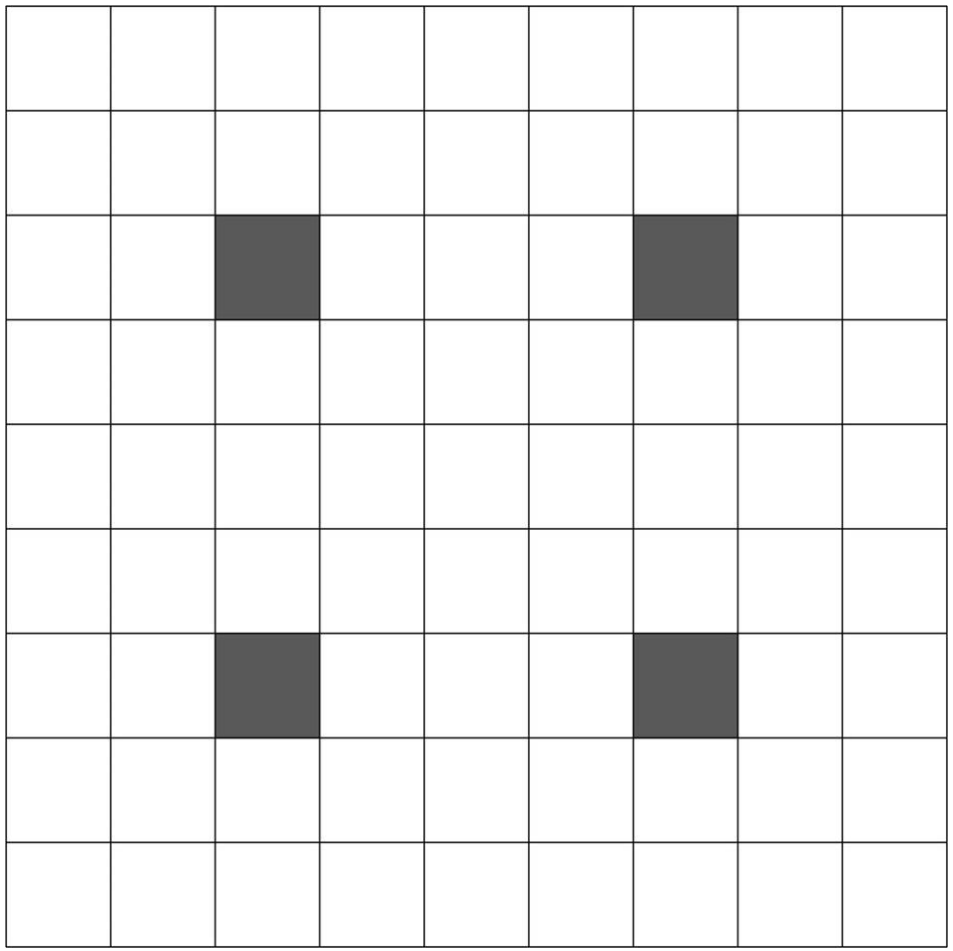


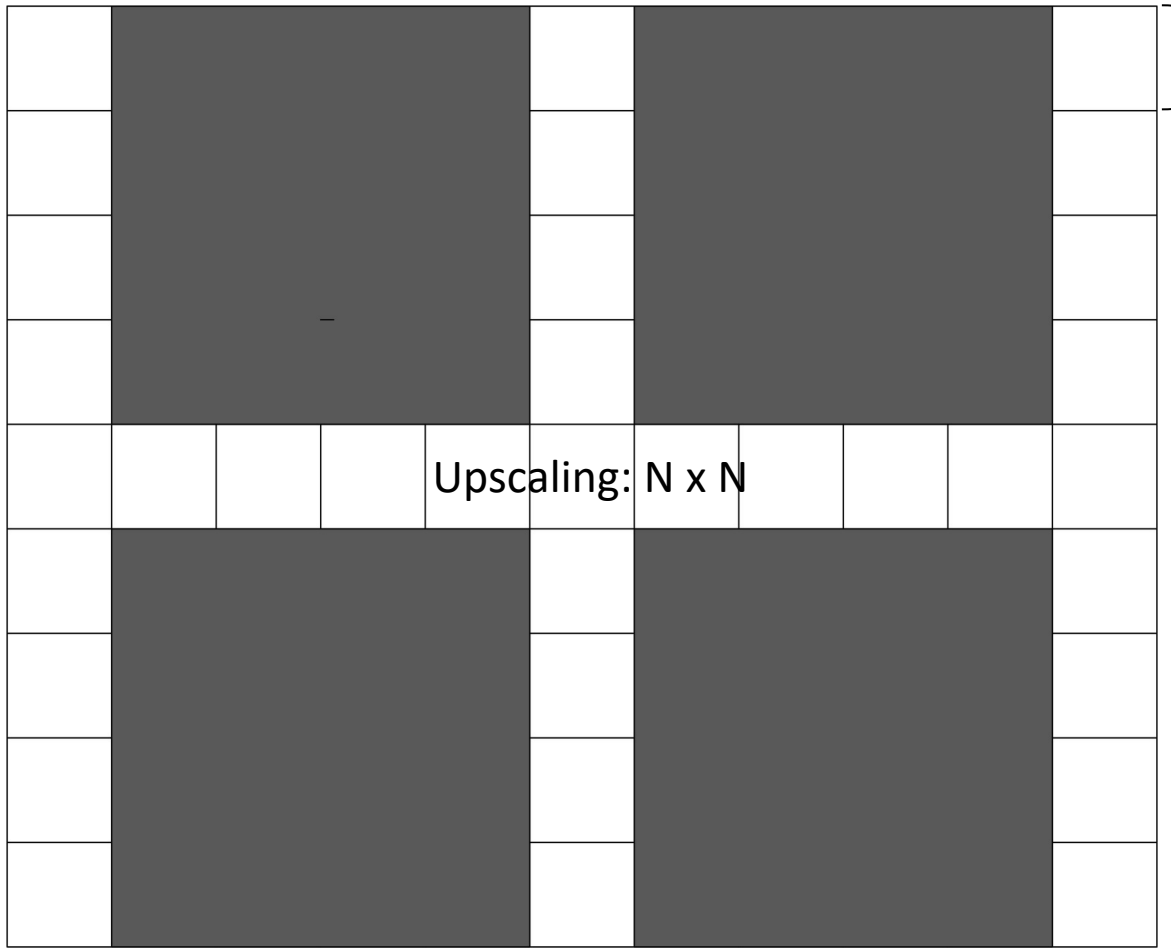
ASCAT 25-km winds



ASCAT 25-km winds thinned
(every 4 along & across track)

Super-Obbing ASCAT winds





Upscaling to low grid resolution:

- Averaged u/v components
- Averaged O/B error variances
- SD u/v within *NxN* box
- Quality assessment of the upscaled product

Impact experiments

- ✓ ICM-CSIS generated low resolution super-obbing products for July and August 2015

Original products	Upscaling	Thinning	Final Resolution	Label
12.5 km	4x4	-	50 km	50 km SO
12.5 km	5x5	-	62.5 km	62.5 km SO
25 km	4x4	-	100 km	100 km SO

- ✓ Testing in IFS the super-obbing ICM products and verify the sensitivity of the system to different product resolutions
- ✓ The super-obbing products are compared to the nominal LR/HR products used with thinning

- ✓ Impact experiments were run at ECMWF using a model grid of ~ 30 km
- ✓ For this first set of experiments a constant observation error of 1.5 m/s was used (as in operations)

Impact experiments

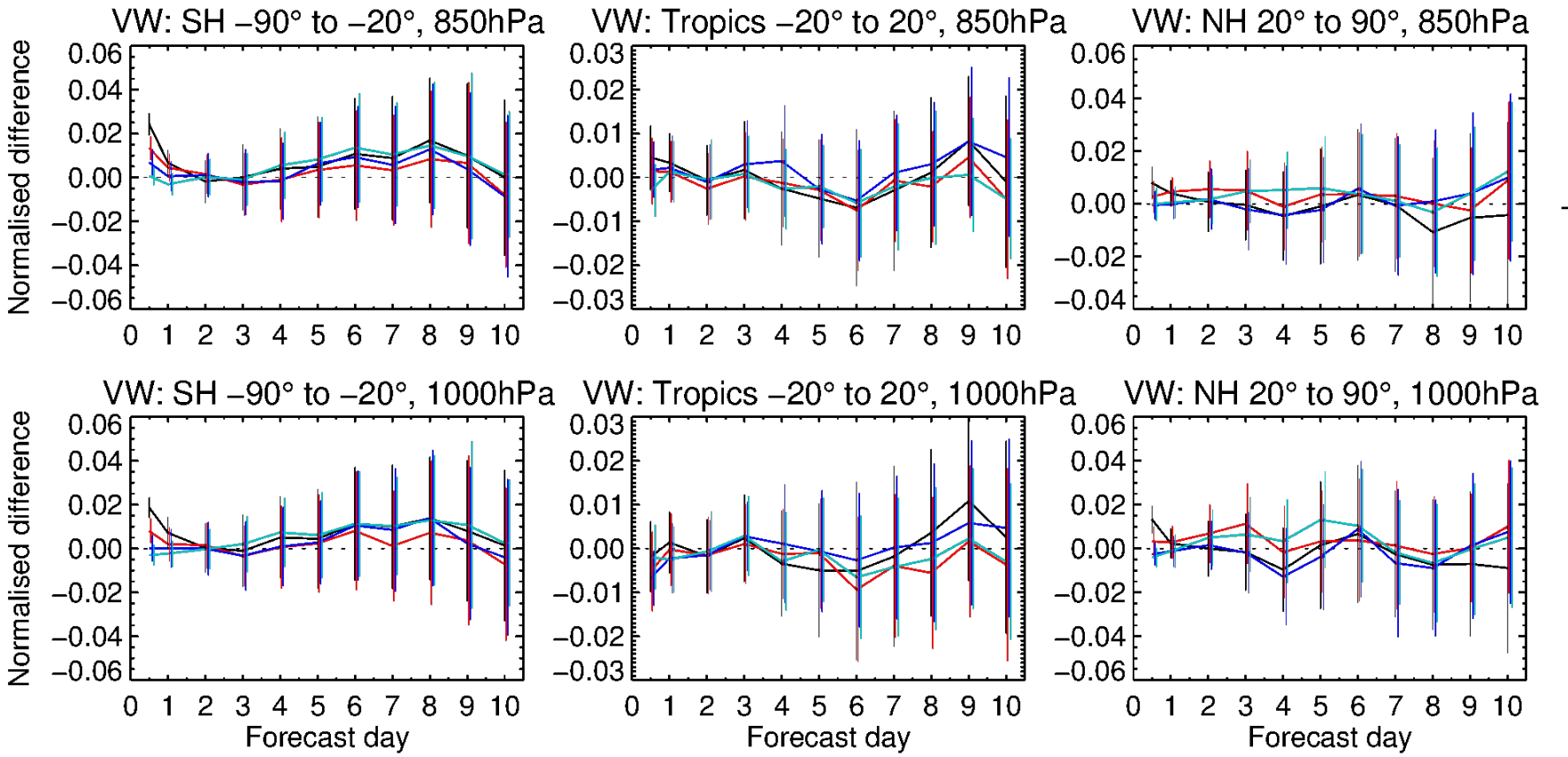
The experiments using the 50 km and 100 km thinned products are compared to the new SO products at 50 km and 100 km, respectively

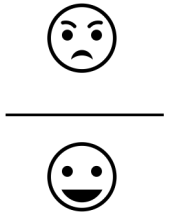
Label	Prod. Resol. (km)	Thinning	Final Obs. Resol. (km)	Obs Error (m/s)	N. Hem.			Tropics			S. Hem.		
					N. Obs	O-B	O-A	N. Obs	O-B	O-A	N. Obs	O-B	O-A
50-Thin	12.5	4	50	1.5	2427618	1.28	0.92	2549895	1.36	0.85	2960842	1.24	0.87
50-SO	**50**	**-**	**50**	1.5	**2161584**	**1.21**	**0.837**	**2293236**	**1.31**	**0.77**	**2651722**	**1.16**	**0.78**
100-Thin	25	4	100	1.5	581994	1.17	0.899	635519	1.3	0.88	743832	1.17	0.89
100-SO	**100**	**-**	**100**	1.5	**551243**	**1.09**	**0.815**	**613342**	**1.22**	**0.80**	**724997**	**1.08**	**0.81**

The experiments using the super-obbing products show lower background and analysis departures than the ones using the thinned products

Impact experiments

Vector Wind RMS Forecast Error

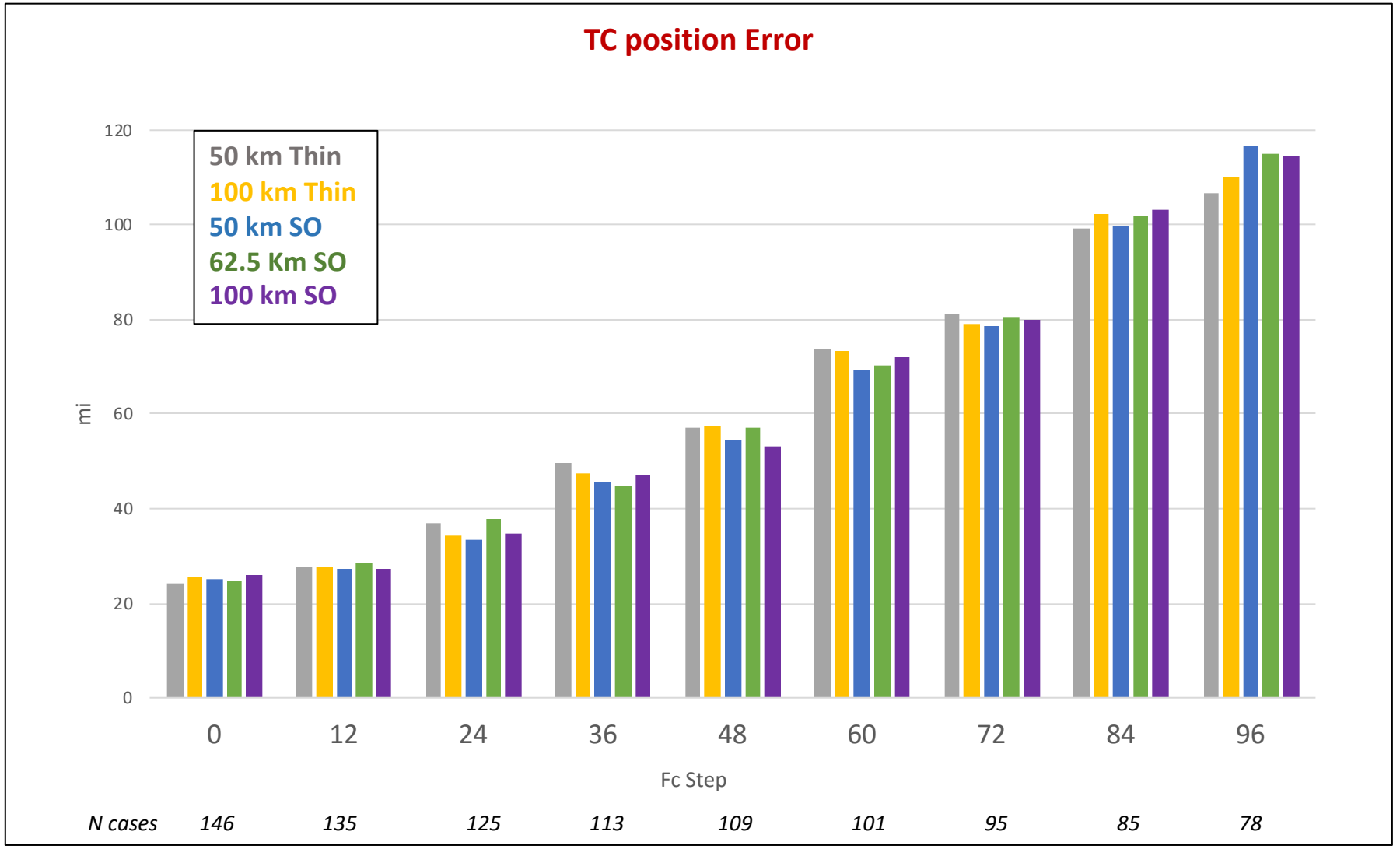




Original prod	Upscaling	Thin	Final Resol
12.5 km	-	4	50 km Th
12.5 km	4x4	-	50 km SO
12.5 km	5x5	-	62.5 km SO
25 km	4x4	-	100 km SO

50 Km Thin – 100 Km Th
50 Km SO – 100 Km Th
62.5 km SO – 100 Km Th
100 Km SO – 100 Km Th

Impact on Tropical Cyclones



Verification versus ASCAT winds

- ✓ The experiments address different scales, different observation input and different errors
- ✓ All the experiments were verified versus a fixed set of ASCAT 12.5 km products and the vector wind error stdev (SDE) computed

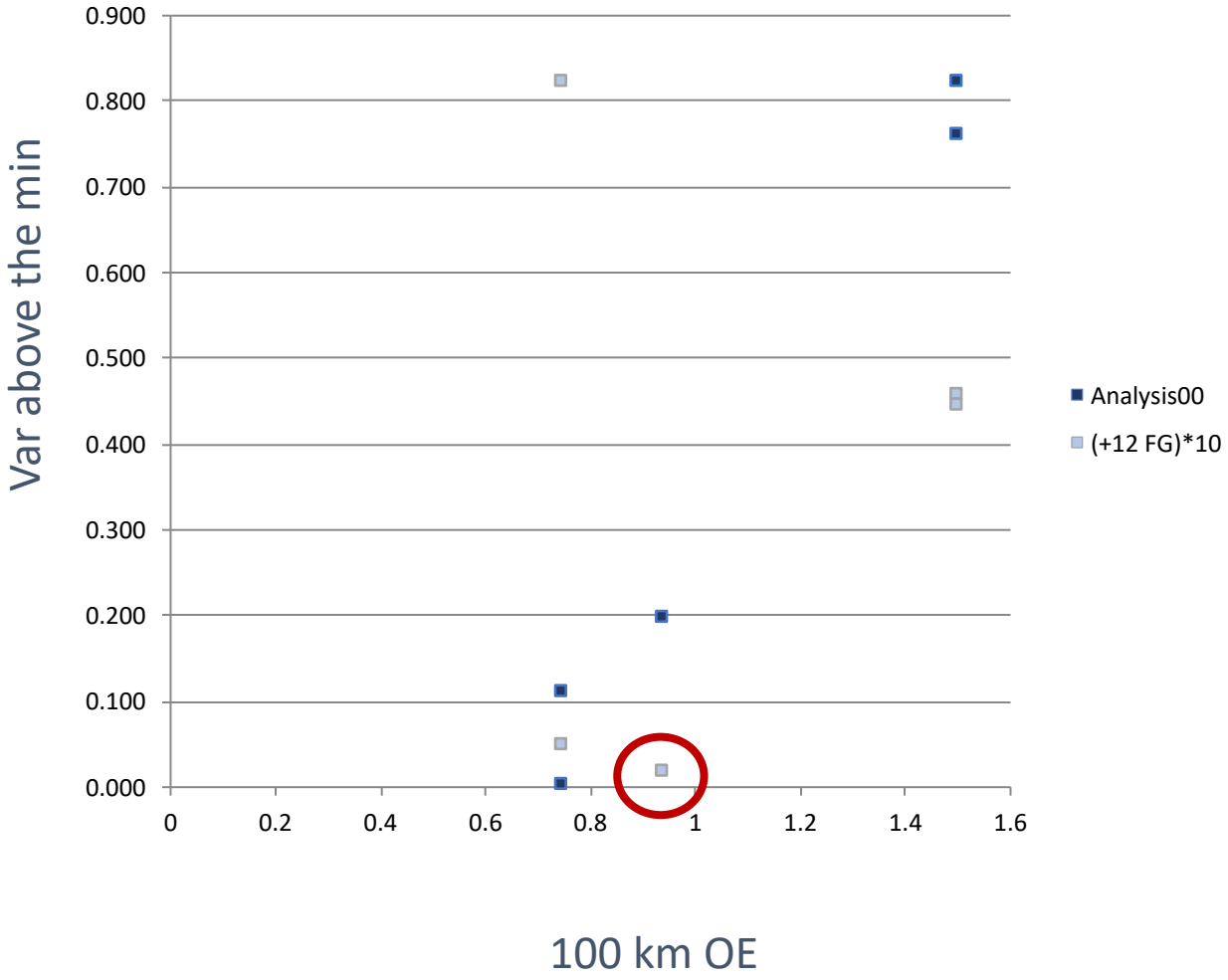
		vector SDE	100-km OE	e var above min
AN	50 km Thin	1.587	0.75	0.109
	50 km SO	**1.552**	**0.75**	**0.000**
	62.5 km SO	1.614	0.94	0.198
	100 km SO	1.780	1.50	0.759
	100 km Thin	**1.797**	**1.50**	**0.822**
FC+12	**50 km Thin**	**2.197**	**0.75**	**0.821**
	50 km SO	2.179	0.75	0.048
	62.5 km SO	**2.178**	**0.94**	**0.017**
	100 km SO	2.188	1.50	0.456
	100 km Thin	2.188	1.50	0.443

- ✓ The aggregated observation errors on a scale of 100 km were estimated (100 km OE)
- ✓ Based on the wind vector SDE the variance was computed

The superobbing product experiments wind fields fit better with the ASCAT observations

Verification versus ASCAT winds

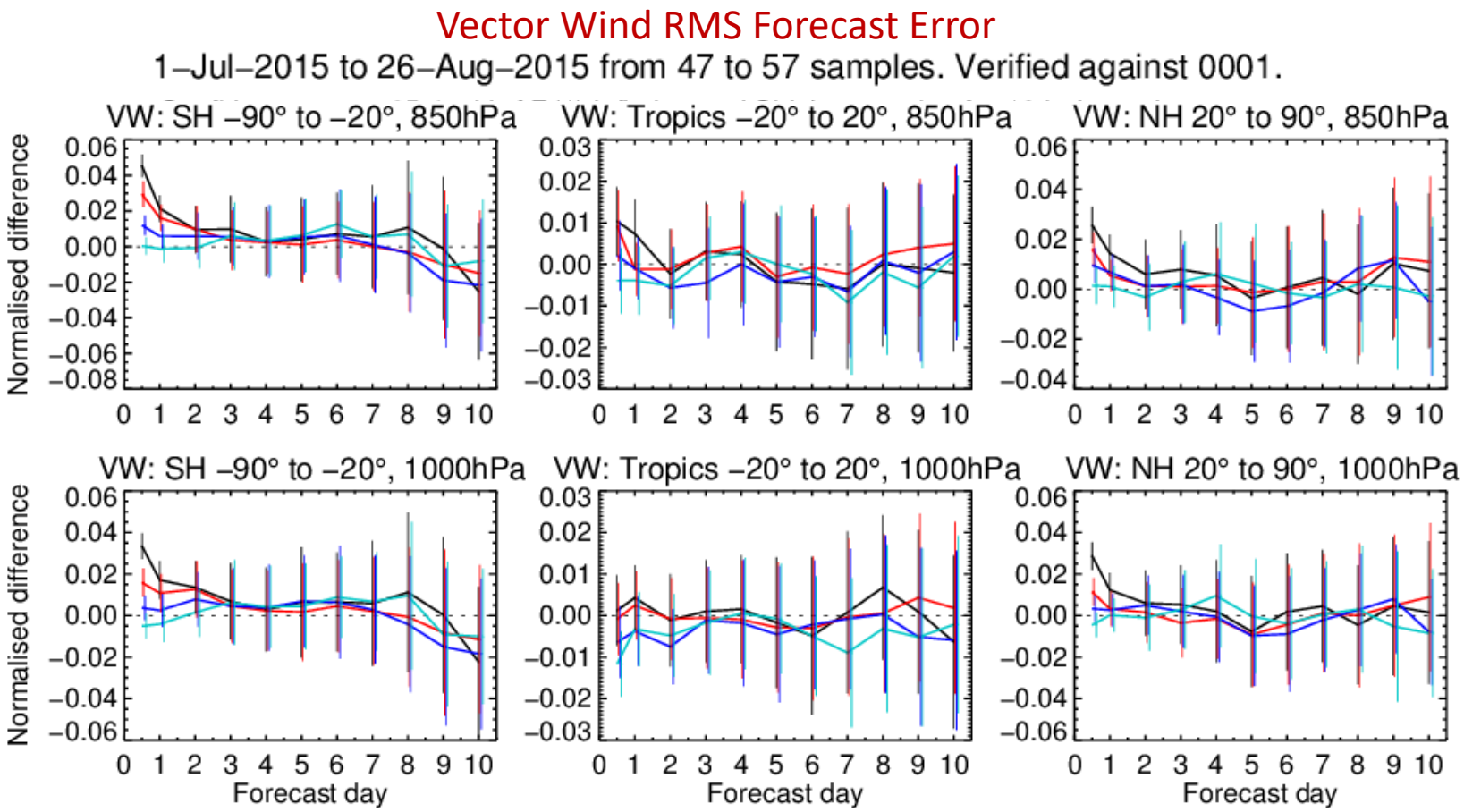
- ✓ The aggregated observation error at 100 km scale (OE) is a good reference for comparing different processing methods (QC, thinning, superobbing)

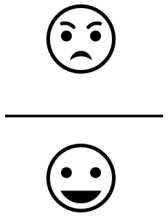


- ✓ 100-km OE of ~1 m/s appears optimal in line with estimated 100-km ASCAT error
- ✓ 50 km ASCAT with OE=2m/s or similar

Impact of (variable) observation errors

- ✓ ICM also provided observation errors (OE) and background errors (BE) which were computed based on the wind variability within the wind vector cell [1]
- ✓ In the IFS the background error cannot be changed so the OE was changed in order to have the same ratio OE/BE
- ✓ Super-obbing products experiments show slightly lower background and analysis departures than the thinned products experiments

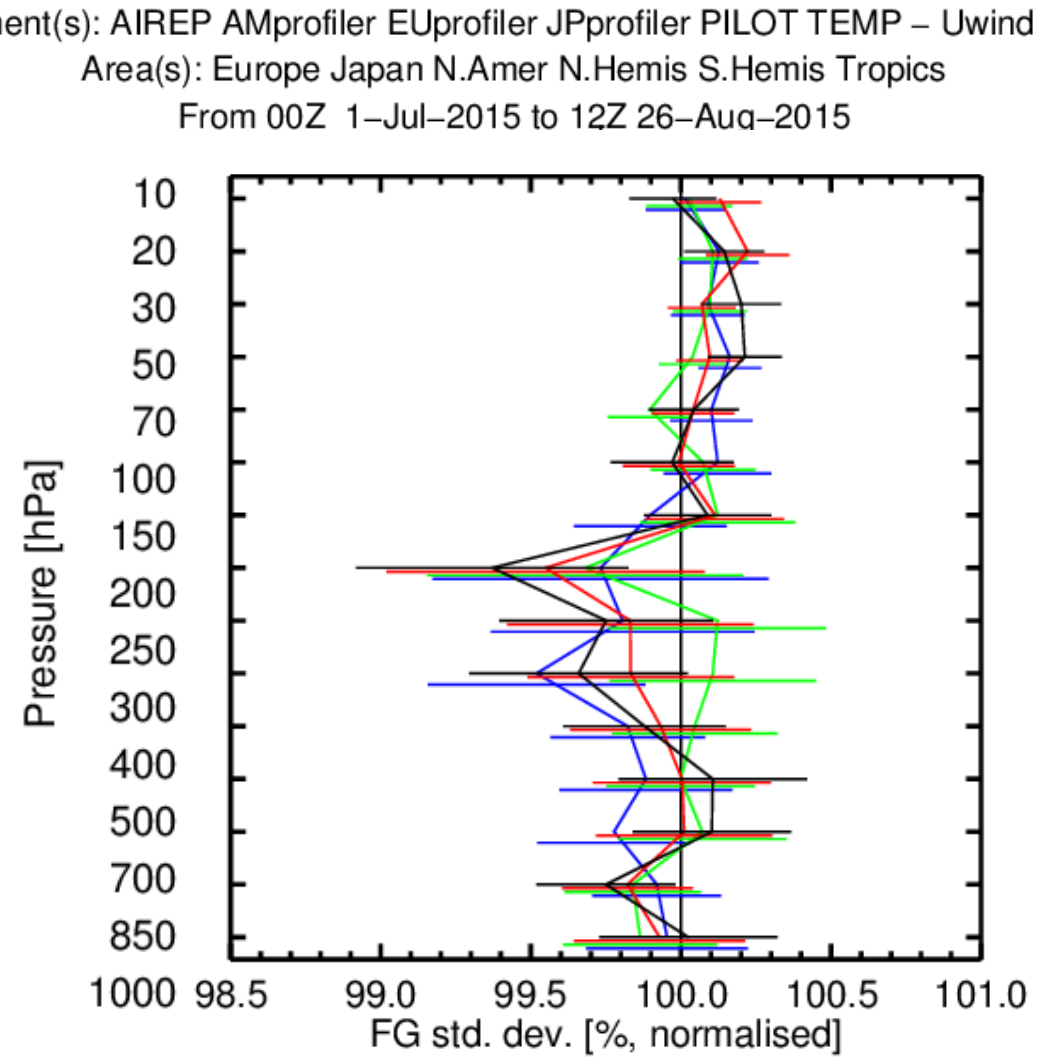




50 Km Th – 100 Km Th
50 Km SO – 100 Km Th
62.5 km SO – 100 Km Th
100 Km SO – 100 Km Th

[1] Lin, W., Portabella, M., Stoffelen, A., Vogelzang, J., and Verhoef, A., "ASCAT wind quality under high subcell wind variability conditions," *J. Geophys. Res. Oceans,* **120** (8), pp. 5804–5819, 2015.

Impact of (variable) observation errors: fit to observations



50 Km Th
50 Km SO
62.5 km SO
100 Km SO

100% = 100 km Th

The 100 km SO product experiments fit slightly better with in-situ observations

Conclusions

- ✓ Experimental ASCAT super-obbing (lower resolution) datasets were generated by ICM
- ✓ Impact experiments were run at ECMWF to assess their impact in the data assimilation system, testing the sensitivity of the system to different ASCAT product resolutions
- ✓ In terms of forecast verification, the differences of RMS Fc error are not statistically significant
- ✓ TC position forecast: the differences are within the model resolution
- ✓ The experiments using super-obbing products show reduced analysis and background departures
- ✓ Verification versus ASCAT 12.5 km dataset shows that the SO products have reduced VRMS than the thinned ones
- ✓ The optimal OE for 100 km products is about 1 m/s
- ✓ Further investigations will be performed: experiments with fixed but different OE for each dataset
- ✓ Further verifications over extreme events like TC where higher resolution might help (tests will be performed at operational resolution)