Scatterometer winds use in Météo-France

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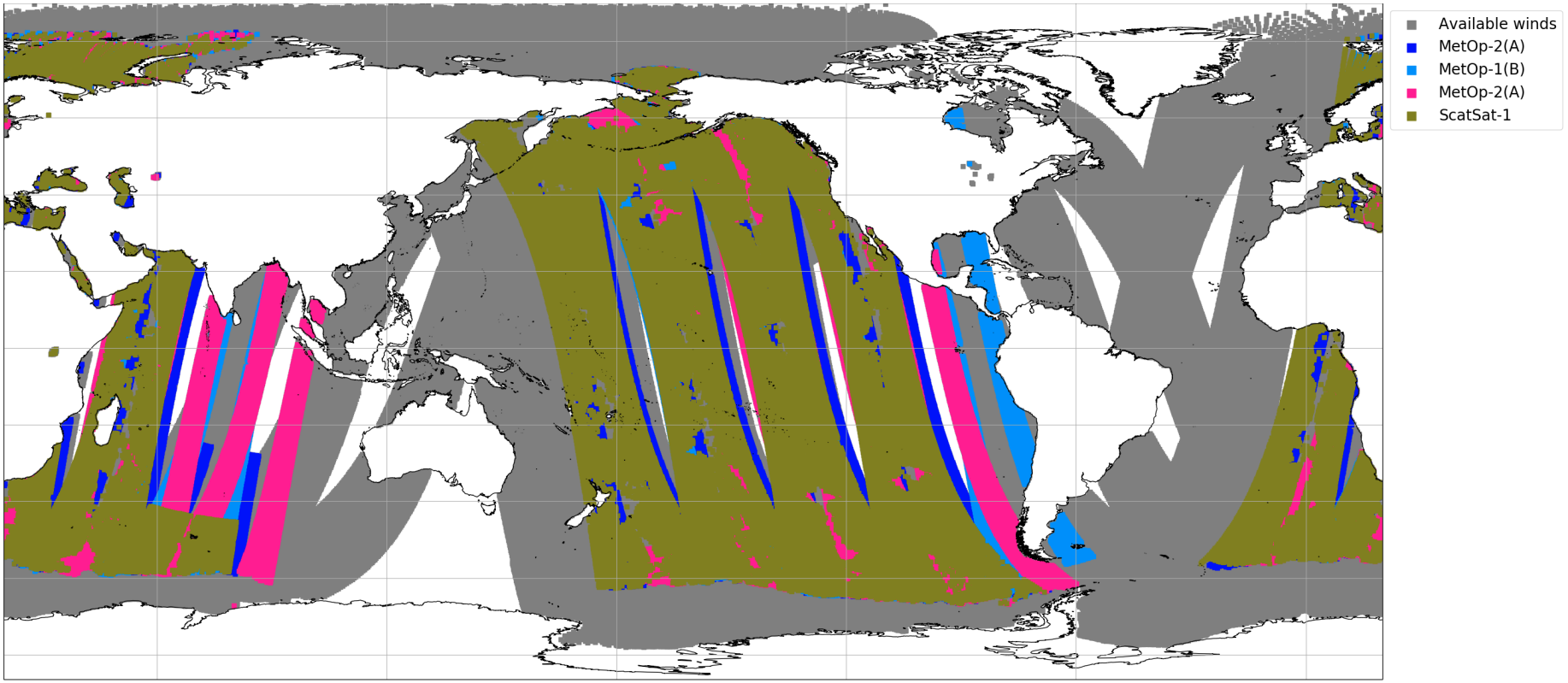
Plan

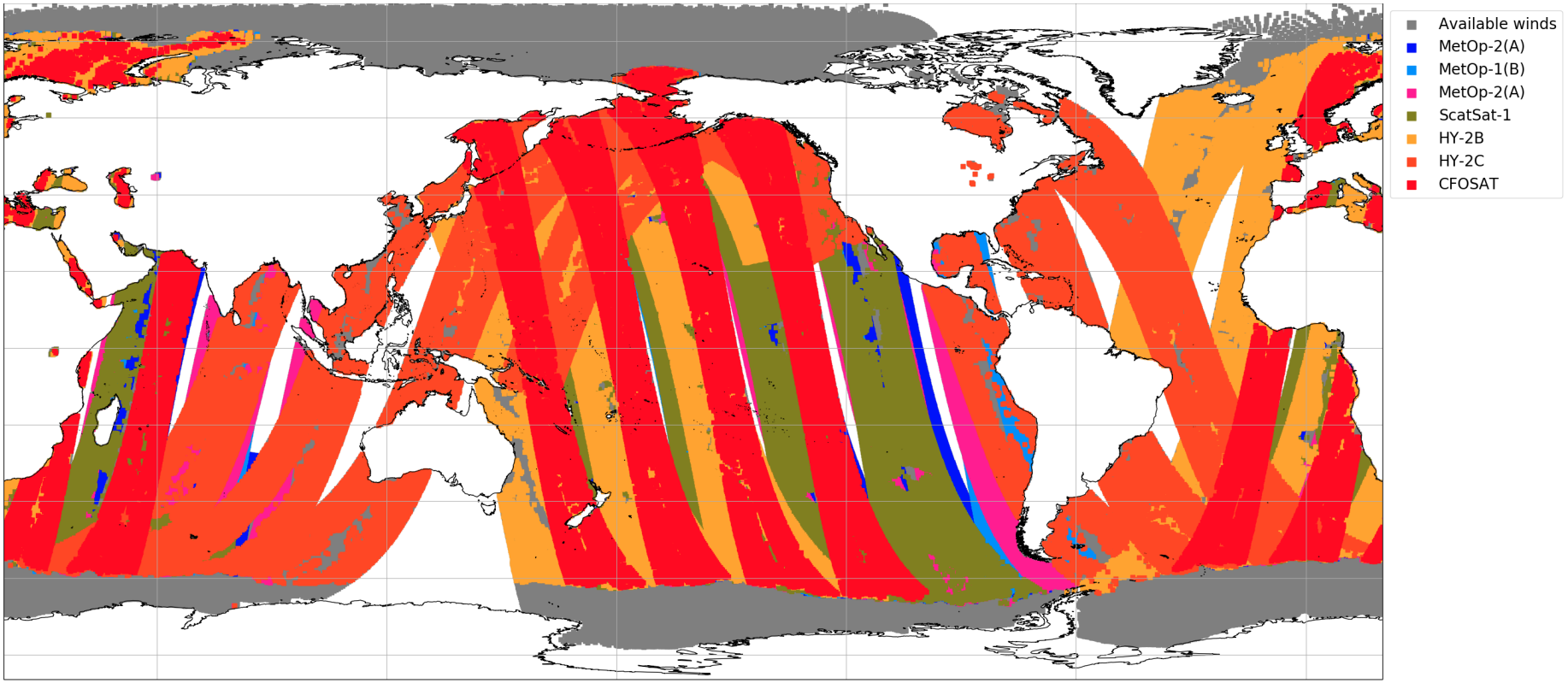
- Scatterometer wind datasets
- Some impacts (positive)
- The global model ARPEGE (some characteristics and evolution)
- Scatterometer processing update
- New datasets monitoring
- Some impacts (mixed)
- Conclusions

Scatterometer winds datasets



- 4 used operationally:
  - ASCAT-A since 2008 (8:15 desc. from NORAD, de-orbiting phase)
  - ASCAT-B (9:30 desc.), since 2013
  - ScatSat-1 (8:15 desc. from NORAD) added in July 2019
  - ASCAT-C (9:30 desc.), added in January 2020

Scatterometer winds datasets

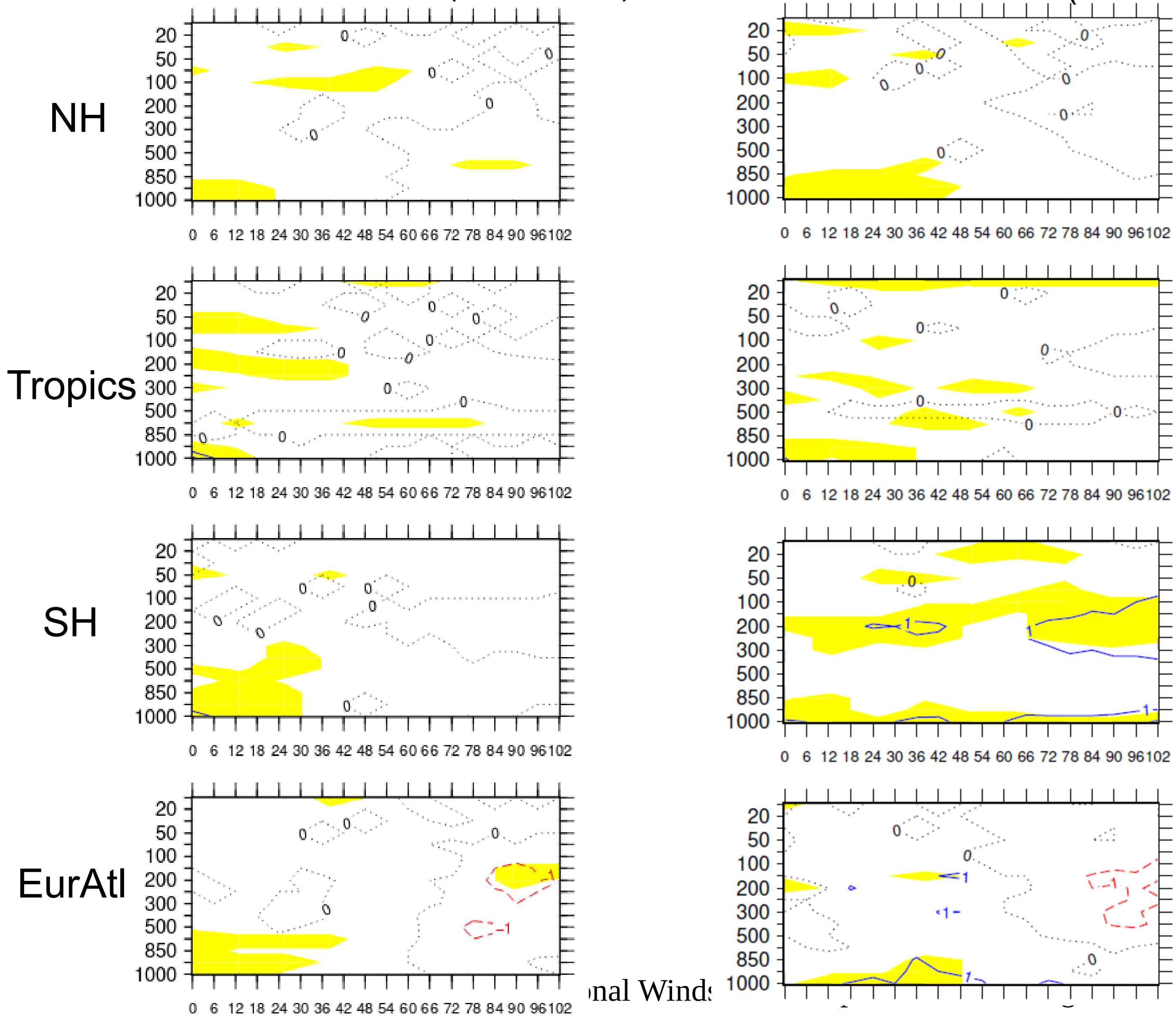


- 4 used operationally:
  - ASCAT-A/B/C and ScatSat-1
- 3 in research mode:
  - HY-2B (6:00 desc.), since Feb 2019, assimilation tests
  - CFOSAT (7:00 desc.), since Jun 2019, monitoring
  - HY-2C (drifting orbit), since Nov 2020, monitoring

ScatSat-1 and Ascat-C forecast scores (wind)

ScatSat-1
01/05 to 15/09/2018 (136 cases)

Ascat-C
28/03 to 24/04/2019 (28 cases)



Normalized RMSE differences REF - EXP

Control: ECMWF analysis

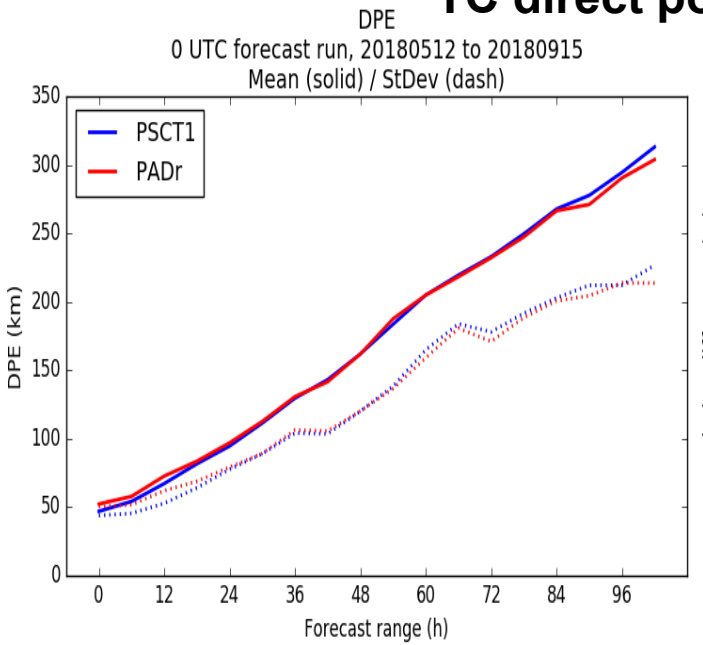
significant

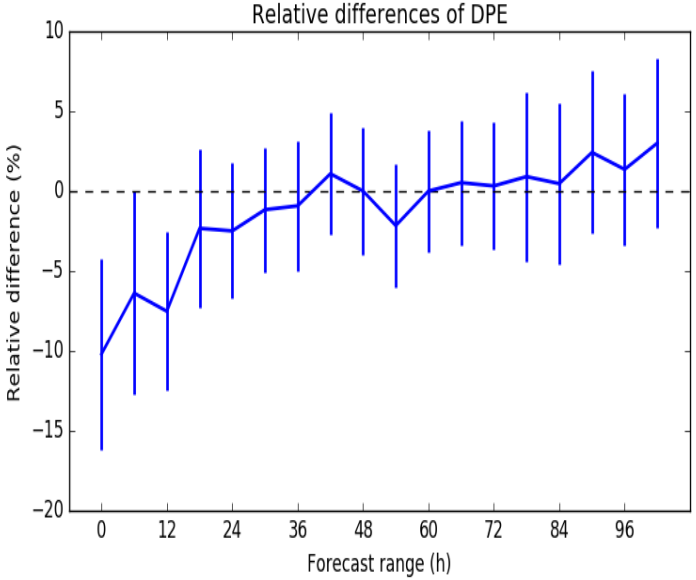
ScatSat-1 forecast scores (Tropical cyclones)

Control: best track

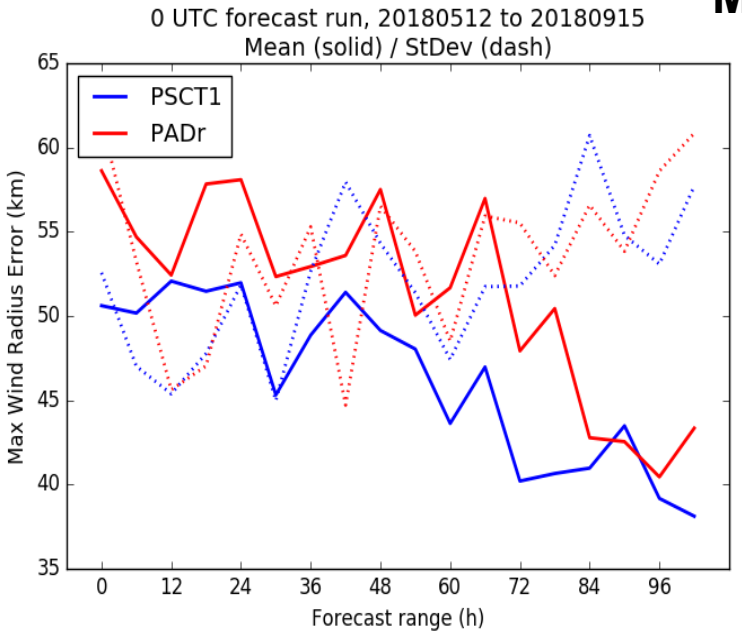
TC position better analysed

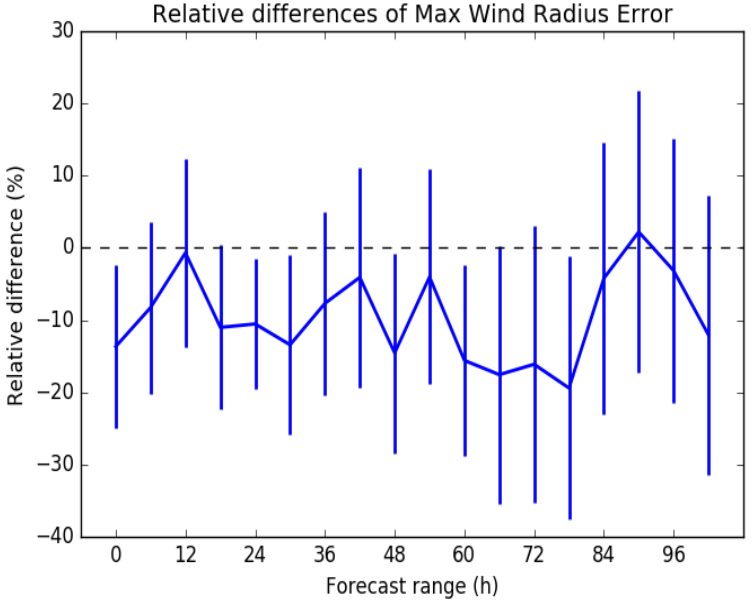
TC direct position error





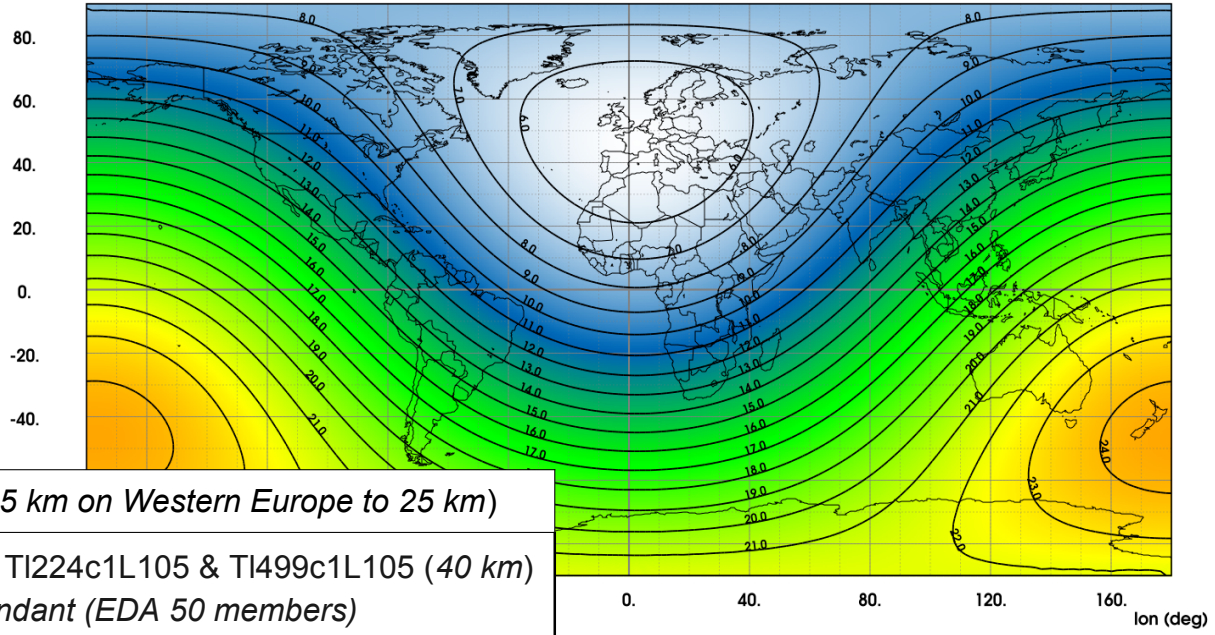
Max wind radius error





Max wind radius error reduced

The global model ARPEGE



Operational configuration:
(43T2 version)

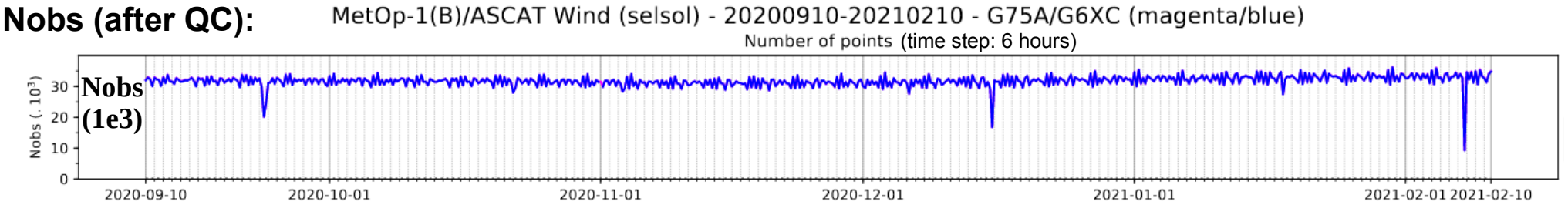
resolution	*Stretched grid* Tl1798c2.2 L105 (*5 km on Western Europe to 25 km*)
assimilation	*4DVar* (6 h cycle) 0, 6, 12, 18 UTC: Tl224c1L105 & Tl499c1L105 (*40 km*) *Full B-matrix flow dependant (EDA 50 members)*
forecast	4 forecasts per day up to 114h

Next configuration in preparation (2021), major changes:
(46T1 version)

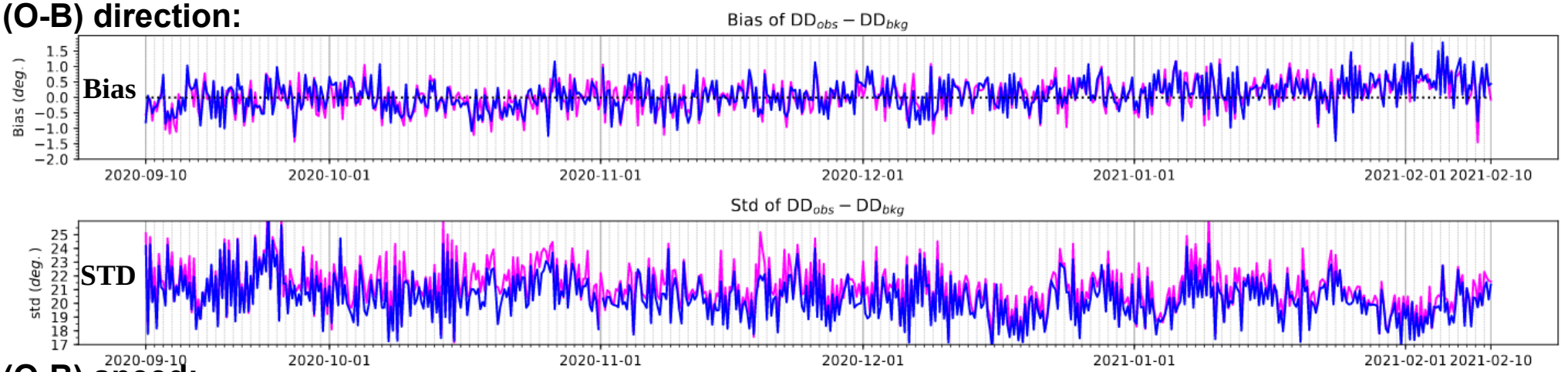
	operational (43T2)	***double (46T1)***
deep convection	Geleyn/Bougeault scheme with anti-gps v3 (Marquet et al 2019)	New scheme based on *Tiedtke* 1989, *Bechtold* et al. 2004, 2008, 2014 (IFS scheme)
air-sea fluxes	ECUME scheme (Belamari and Pirani, 2007)	*ECUME V6* (Belamari et al, 2016)
solar radiation	SW 6 bands from Fouquart and Bonnel (1980) modified by Morcrette et al. (2008)	SRTM from Mlawer et al. 1997 with Mclca solver (Pincus et al 2003)
sea-ice	analysis update (from OSTIA)	*1D scheme GELATO* (Salas y Melia 2002)

Model background double (2) versus oper (1)
e.g. ASCAT-B monitoring, time series 10/09 to 10/02/21

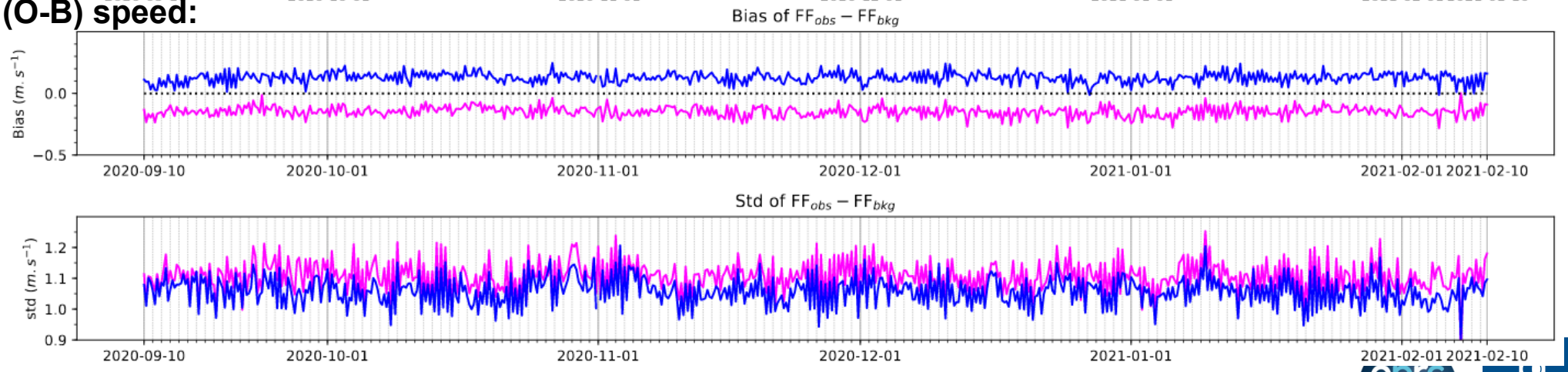
Nobs (after QC):



(O-B) direction:



(O-B) speed:

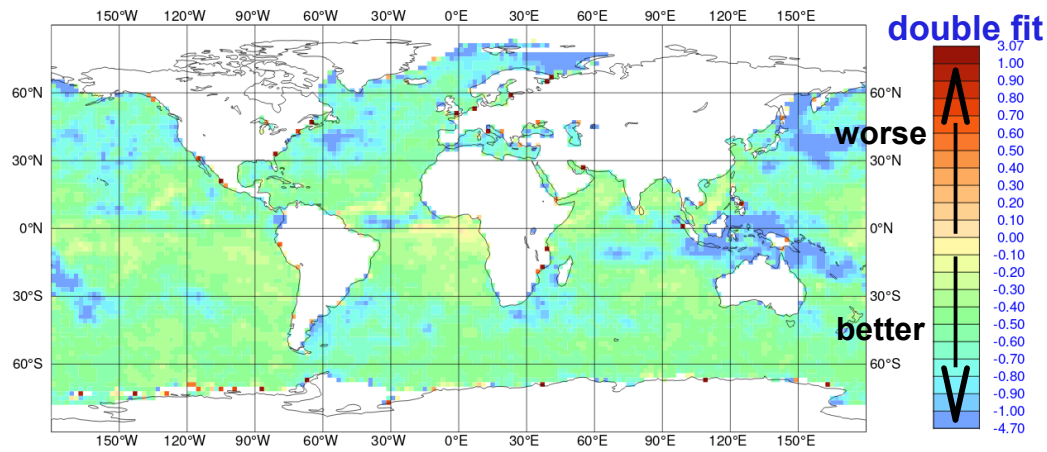


Model background double (2) versus oper (1) eg ASCAT-B monitoring, 01/01 to 10/02/2021

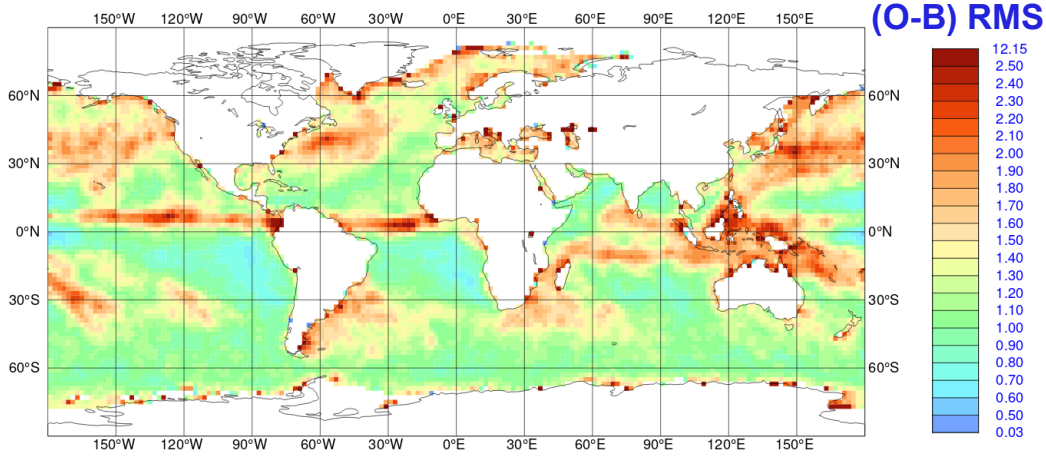
Meridional Component of 10m Wind (m/s) from MetOp-1(B)/ASCAT
Active data [time step = 6 hours]
RMS of fgdep, All_surfaces, Area = global
exp = arpA.4dvarfr G6XC minus G75A, Data period = 2020-12-31 21:00 - 2021-02-10 21:00
Grid : 2.0 x 2.0 / Min: -4.703 Max: 3.066 Mean: -0.578

ASCAT-B
meridional component V

Meridional Component of 10m Wind (m/s) from MetOp-1(B)/ASCAT
Active data [time step = 6 hours]
RMS of fgdep, All_surfaces, Area = global
exp = G6XC, Data period = 2020-12-31 21:00 - 2021-02-10 21:00
Grid : 2.0 x 2.0 / Min: 0.027 Max: 12.146 Mean: 1.296



RMS (O-B) difference (2)-(1)

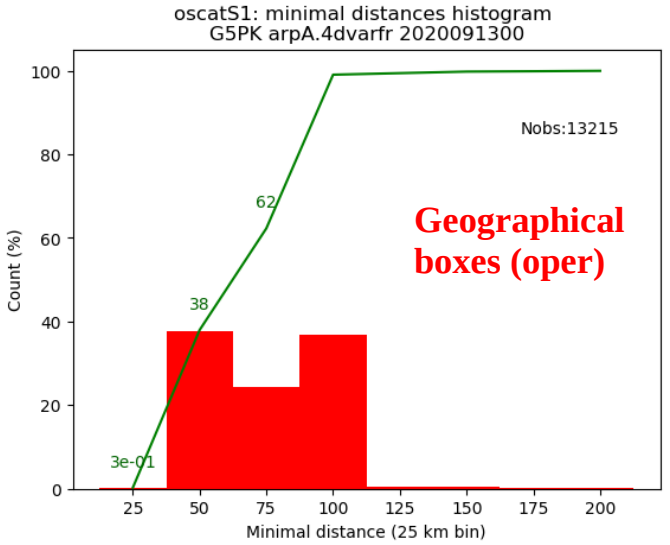


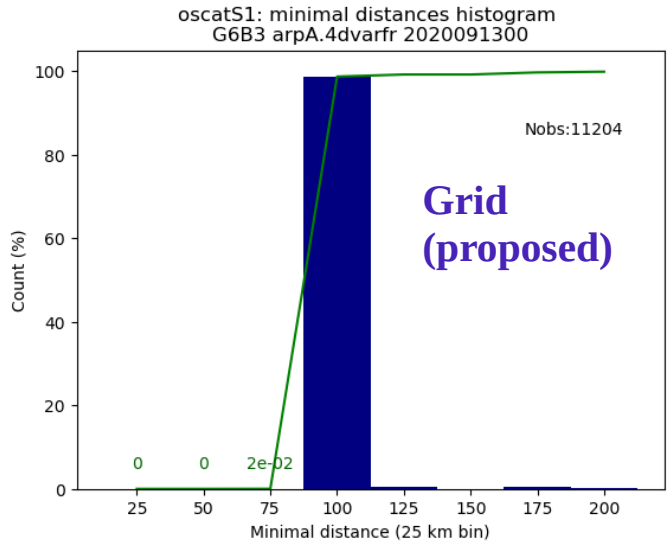
RMS (O-B) in (2)

- Better fit of ARPEGE double to ASCAT-B winds almost everywhere w.r.t ARPEGE oper
- With regional differences larger, where (O-B) RMS are the largest:
  - mainly in areas of deep convection (SPCZ, Oceania)
  - along the storm track of northern hemisphere (winter period here)
  - also some improvements along the north pole ice pack

Scatterometers upgrade : thinning

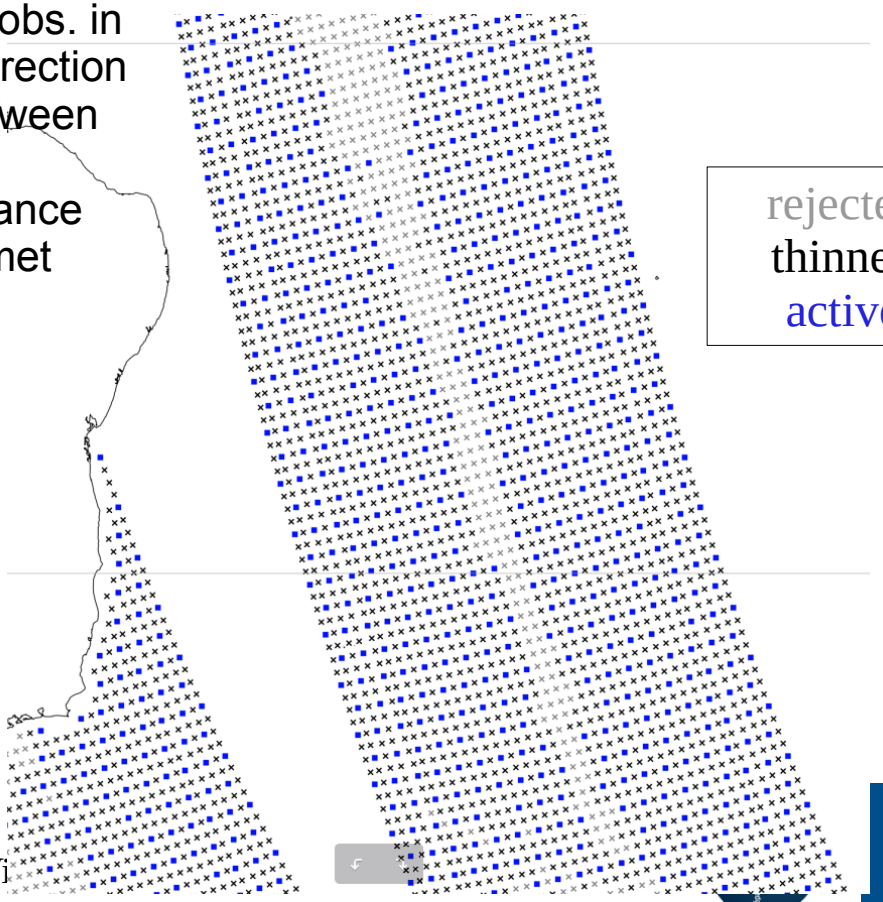
Thinning algorithms





- 100 km thinning for 50 km wvc resolution
- Current thinning based on geographical boxes does not work properly (e.g for ScatSat-1 62% of data closer each other than 100 km)
- Proposed: data selection on the observation grid
- e.g ScatSat-1:

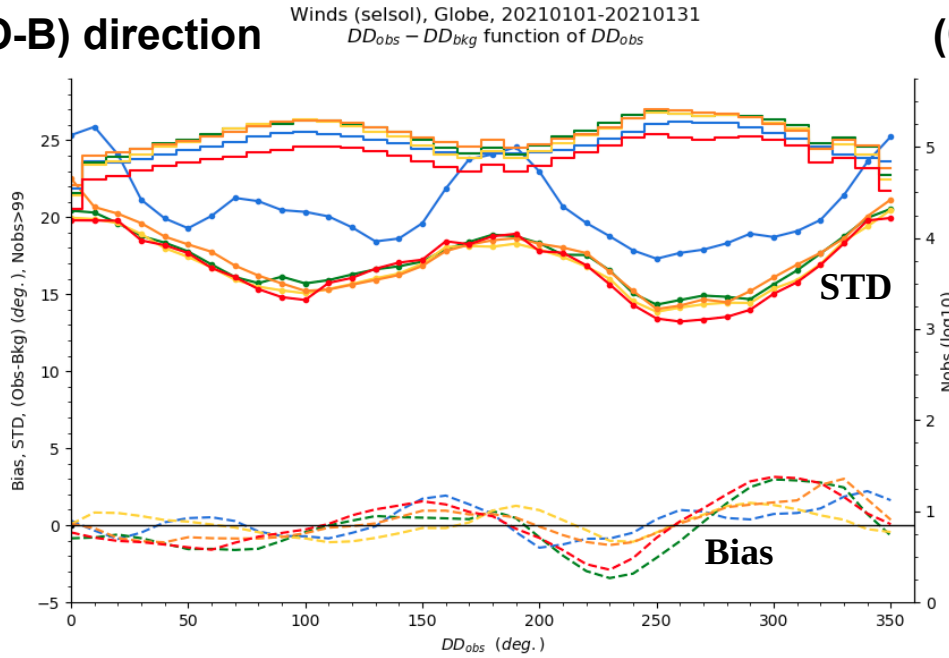
  - 1 in every 2 obs. in each swath direction
  - interlace between lines
  - minimal distance 100 km now met



(O-B) statistics (bias, STD), by direction and speed

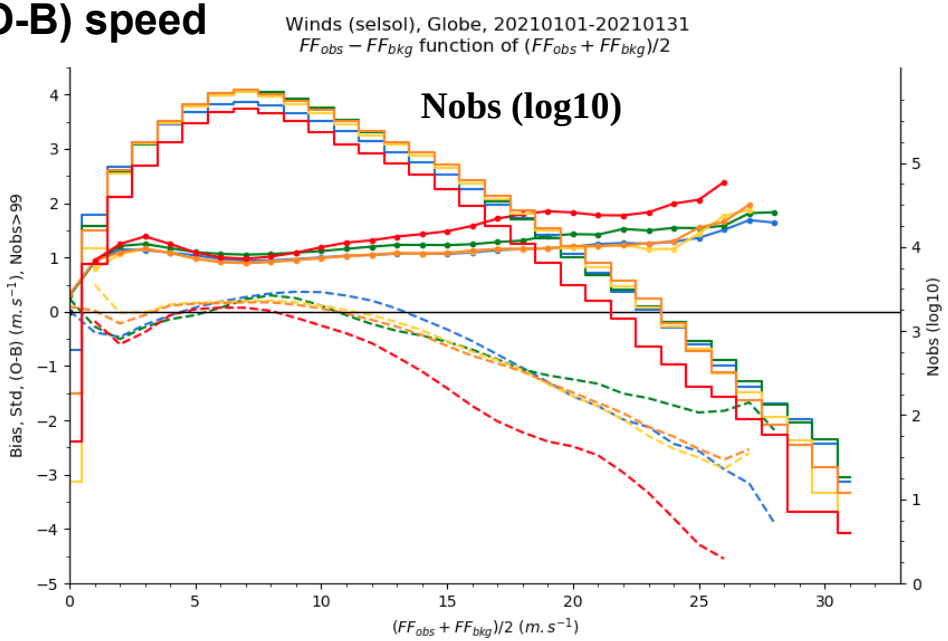
ASCAT-B SCATSAT-1 **(OPER)** **HY-2B** **HY-2C** **CFOSAT** **(TEST)**

(O-B) direction



Wind direction

(O-B) speed



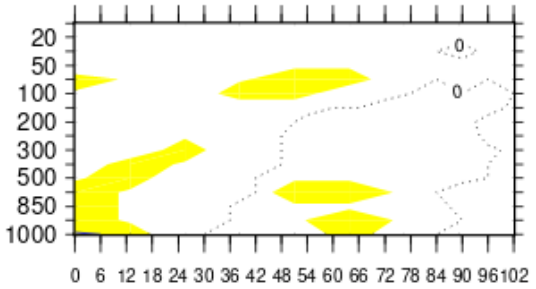
Wind speed

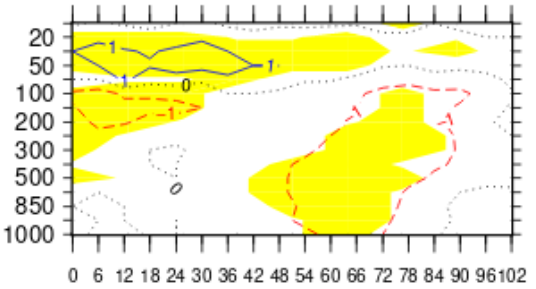
- Direction: bias low, similar statistics for Ku-band family, STD(ASCAT) higher (due to less ambiguities?)
- Speed: similar statistics between instruments, except for CFOSAT

HY-2B forecast scores (wind and geopotential)

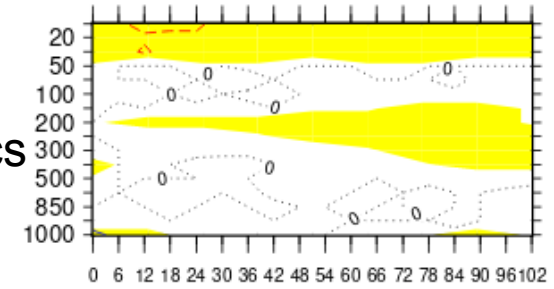
Wind | **Geopotential**

NH

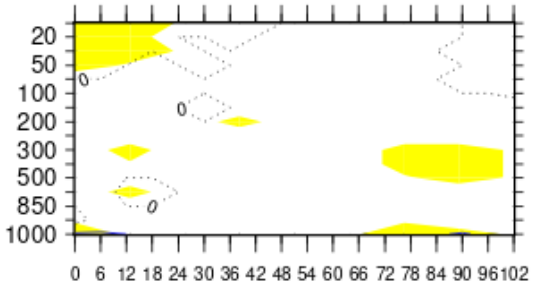


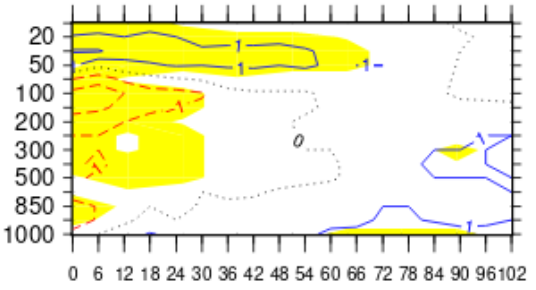


Tropics

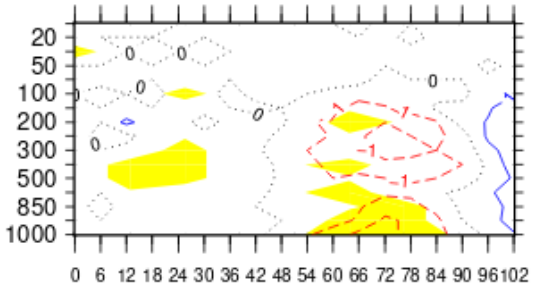


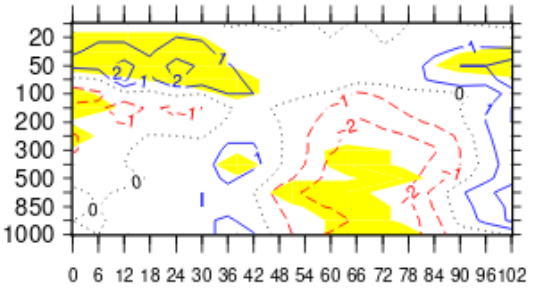
SH





EurAtl





Normalized RMSE differences REF - EXP

Control: ECMWF analysis

10/09 to 09/11/2020 (61 cases)

significant

Conclusions

- ASCAT-A/B/C and ScatSat-1 assimilated operationally, HY-2B/C et CFOSAT in evaluation mode or test.
- ScatSat-1 and ASCAT-C showed some minor but significant positive impacts on the forecast scores, and also on the TC analyses.
- Next version of ARPEGE in preparation fits better to scatterometer winds, mainly in the areas where the main changes apply (deep convection, ice pack).
- New instruments HY-2B/C have similar (O-B) statistics wrt ScatSat-1 (rotating Ku-band beams), CFOSAT differs mainly by its wind speed bias more negative when the wind speed increases.
- Nevertheless various HY-2B assimilation tests have mixed impacts (remains a degradation in the NH in the last test)
- So improvements in the assimilation of these data must be sought (obs error, H operator, bias correction)