

Assessing the direct assimilation of scatterometer backscatter over the ocean

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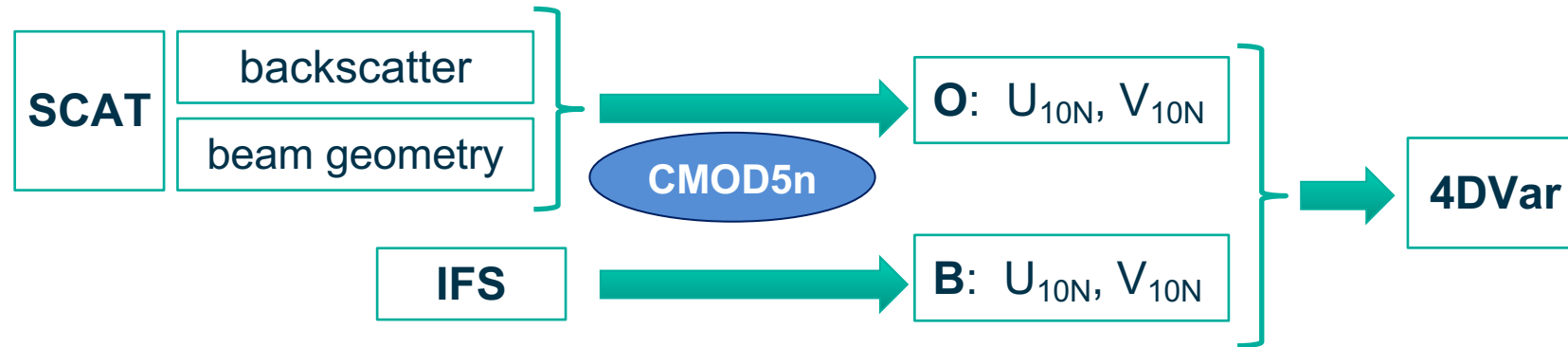
ECMWF

Acknowledgment: EUMETSAT contract EUM/CO/22/4600002712/SLi



ASCAT observations Data Assimilation

Current operational approach common to all the NWP centres (based on L2 wind products)



ASCAT assimilation at ECMWF:

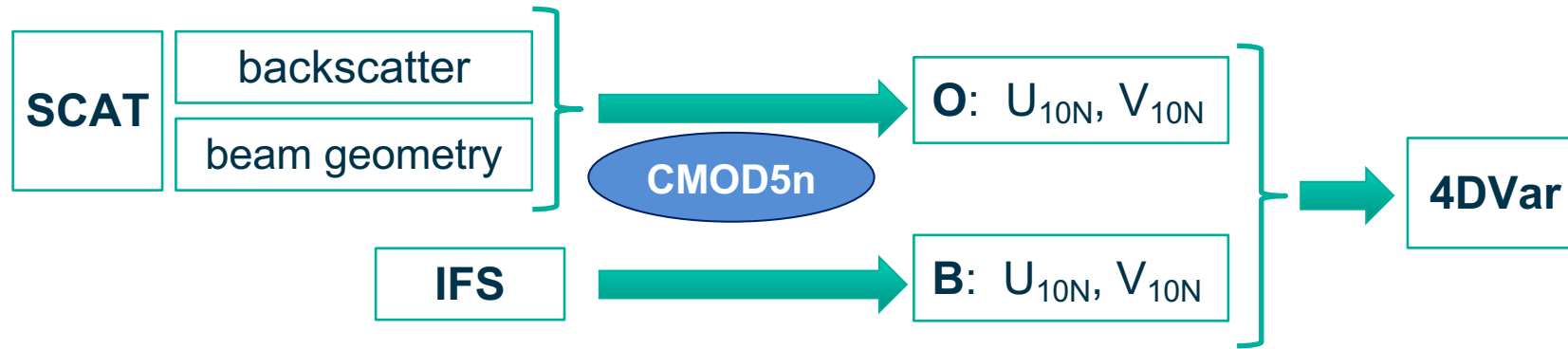
- In-house wind inversion (from 25km grid L1 to L2) using CMOD5n (not the state of the art GMF!)
- 2 wind solutions provided to the 4D-Var: the best one is selected by comparison with the background winds
- ASCAT observations thinned to 50 km
- Max wind speed assimilated: 35 m/s
- Wind vectors assimilated as **10m equivalent neutral winds**

Why assessing the direct assimilation of Sigma0 (using ML)?

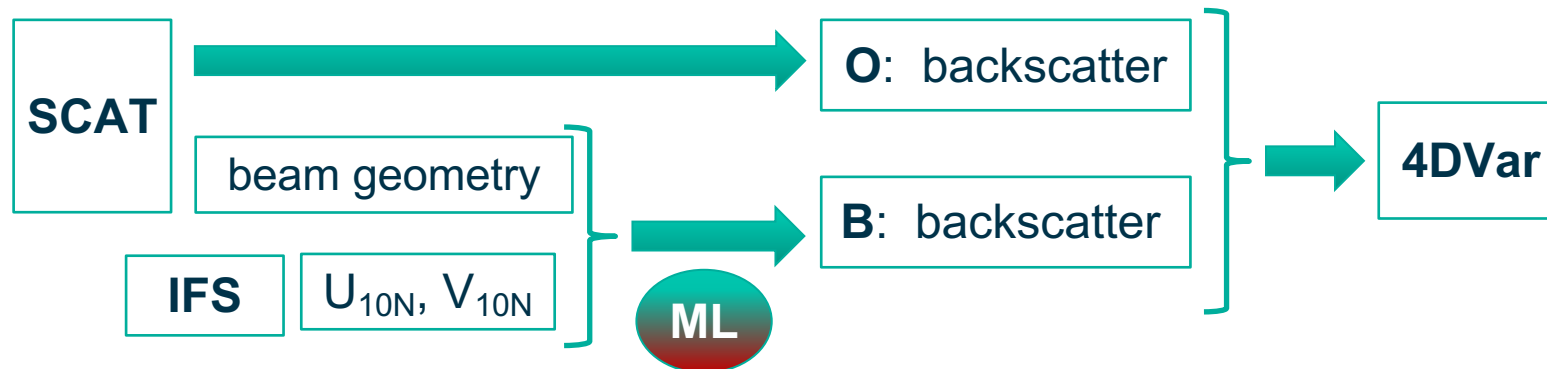
- In IFS most of satellite observations are assimilated as L1 observations (e.g. radiances)
- Why scatterometer observations should be an exception?
 - 4D-Var systems is designed to handle ill-posed (== ambiguous) retrieval problems
 - We are routinely tackling increasingly non-linear forward problems in 4D-Var: "All-sky, all surface, ..."
- Some tests were performed in the past but examples/studies were not found in the literature comparing the impact of assimilating ASCAT sigma0 vs wind retrievals in 3D/4D-Var system
- **Research project (1 year) to prove if it can work or not!**

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Test on the assimilation of backscatter



Why assessing the direct assimilation of Sigma0 (using ML)?

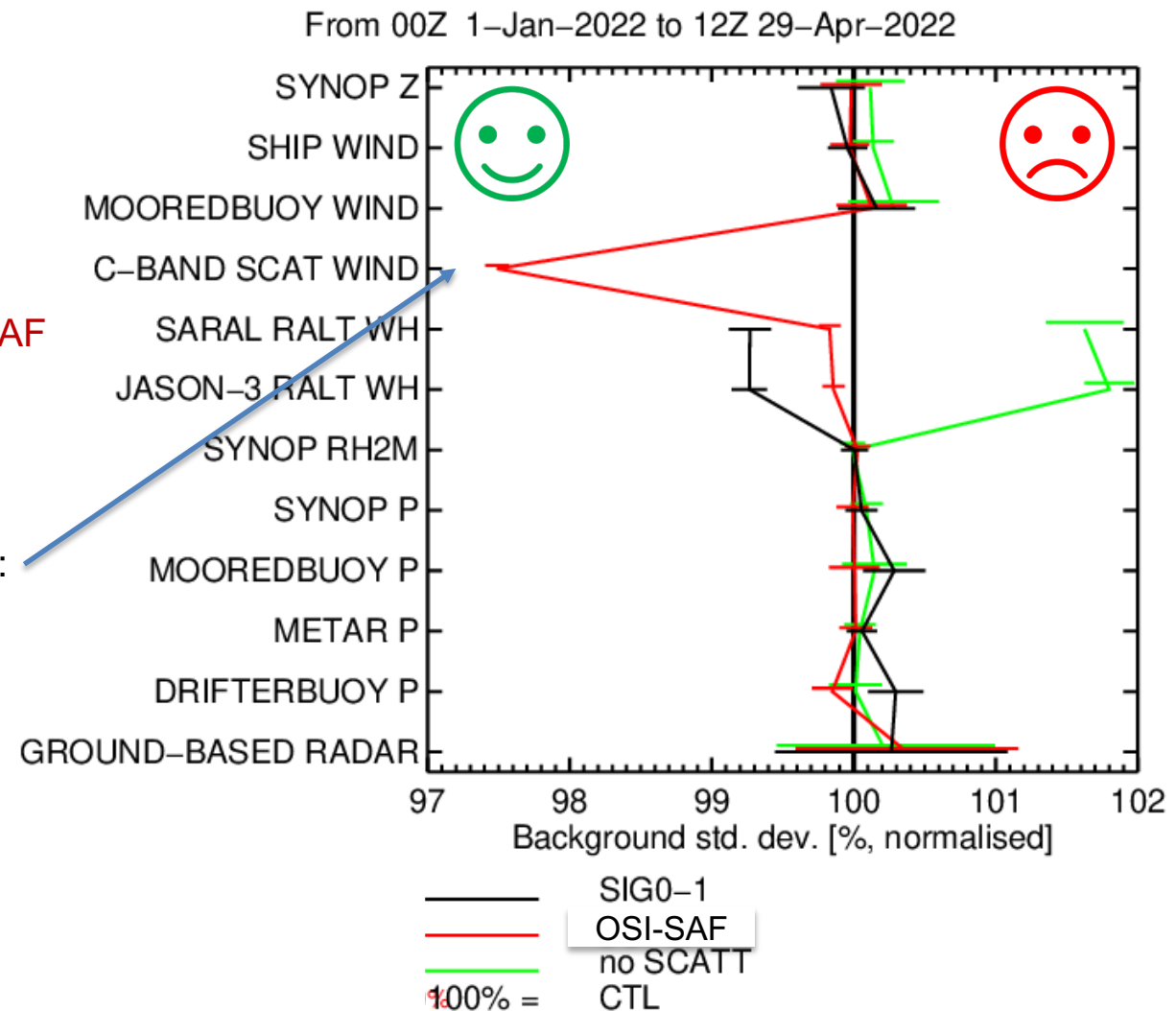
Impact experiments: Metop B+C ASCAT only (other scatts not assimilated) over 4 months in 2022:

- **CTL (or U/V):** assimilate ambiguous u/v retrievals as done in **operations** (using CMOD5.n)
- **SIG0:** assimilate **ASCATs as sigma0**
- **No SCATT:** remove all ASCAT data
- **OSI-SAF U/V:** OSI-SAF (KNMI) chosen wind retrievals (same as CTL but different wind product)

Short-range forecast departure statistics – surface observations

Normalized SD (%) compared to CTL (U/V – what we do now)

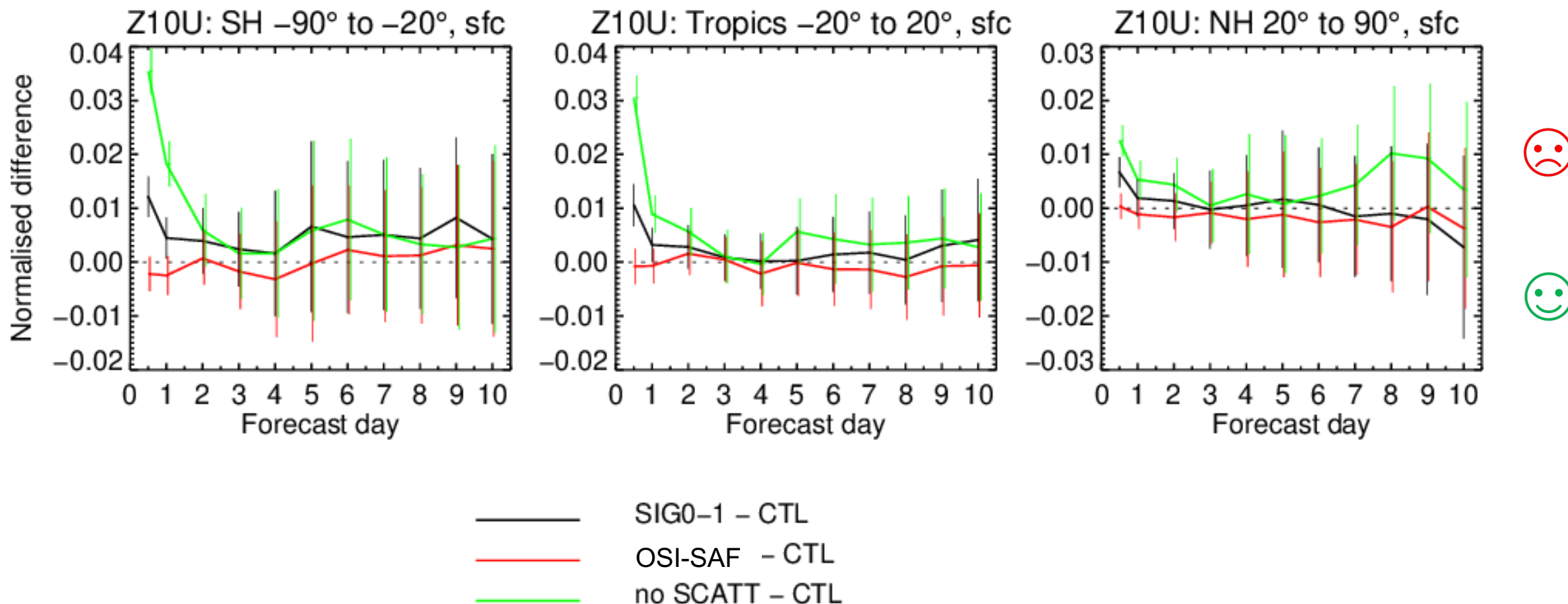
- Clear degradation when **SCATT** removed
- SCATT tends to have good impact on SWH.
- **SIG0** seems to improve the SWH stats compared to CTL and **OSI-SAF**
- **SIG0** – may have some surface pressure issues
- **OSI-SAF** retrieved winds have better scatt departure stats than CTL: (o-b) reduced by more than 2 %



Impact on the medium-range forecast

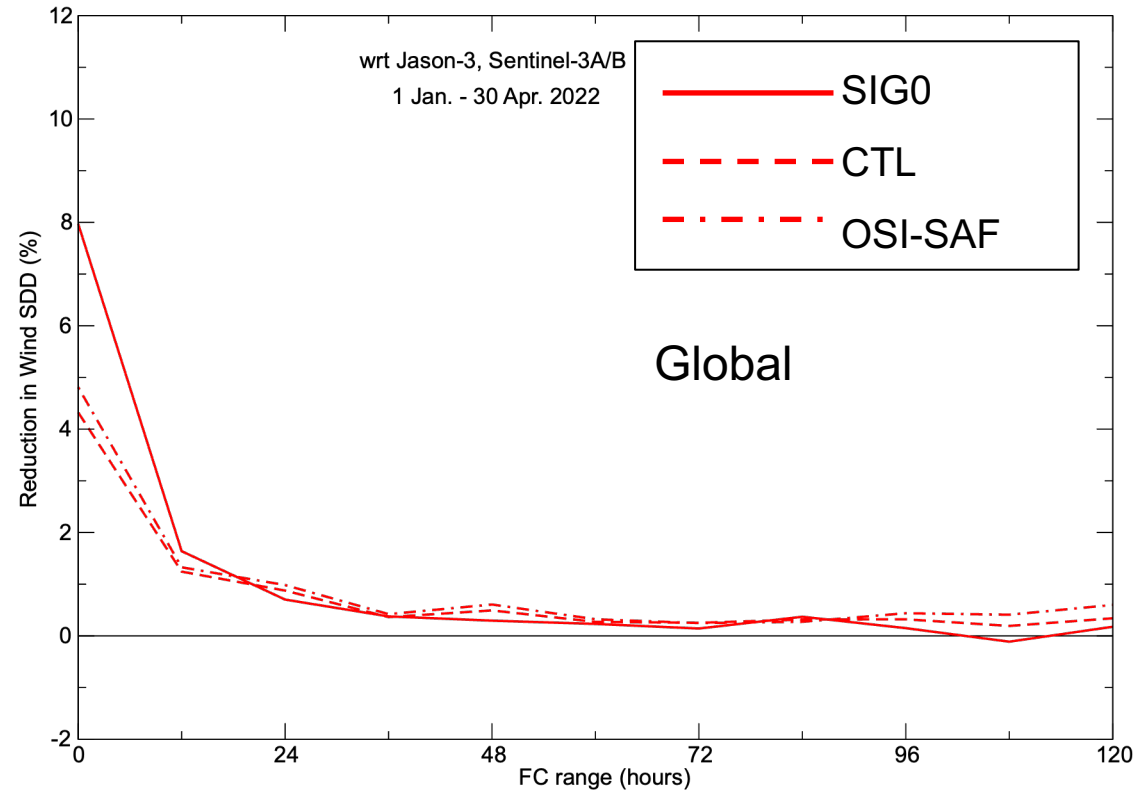
Root mean square forecast error

U10 m winds vs operational analyses (CTL == what we do now)



- Clear degradation when ASCAT is removed
- OSI-SAF products better than SIG0 in the short range

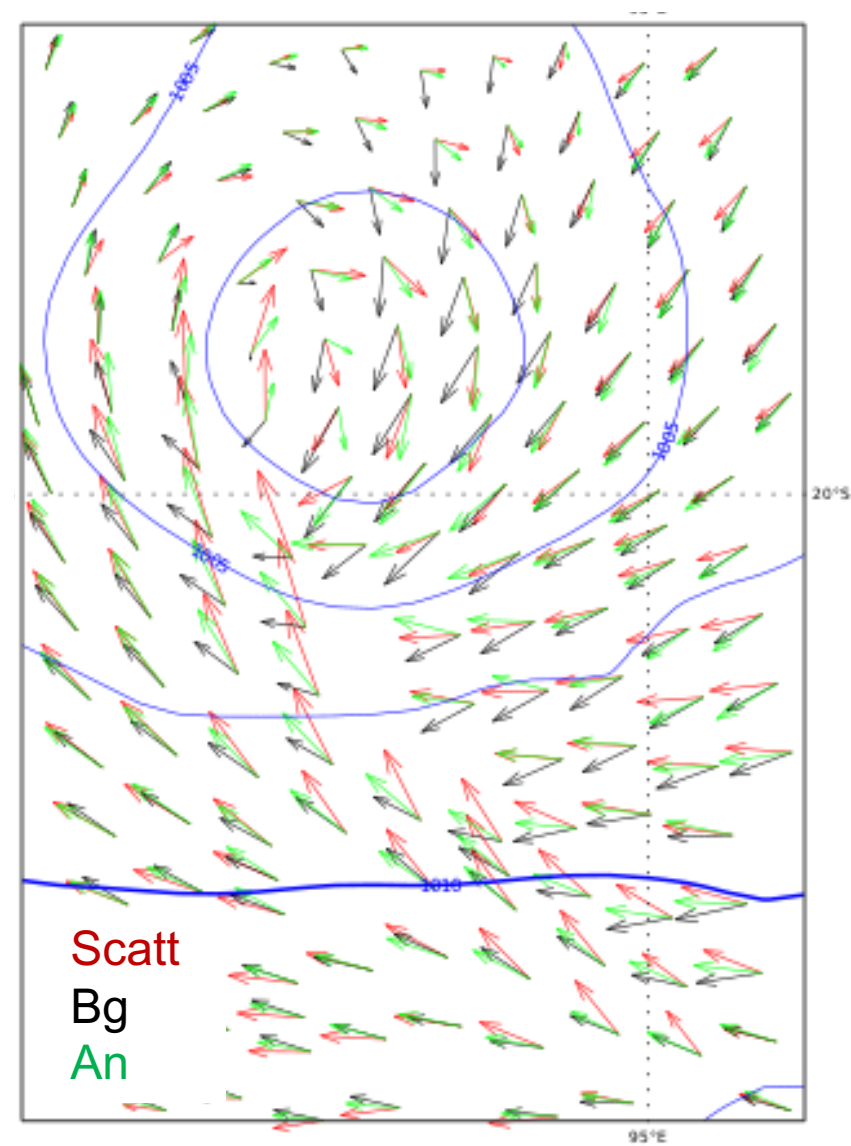
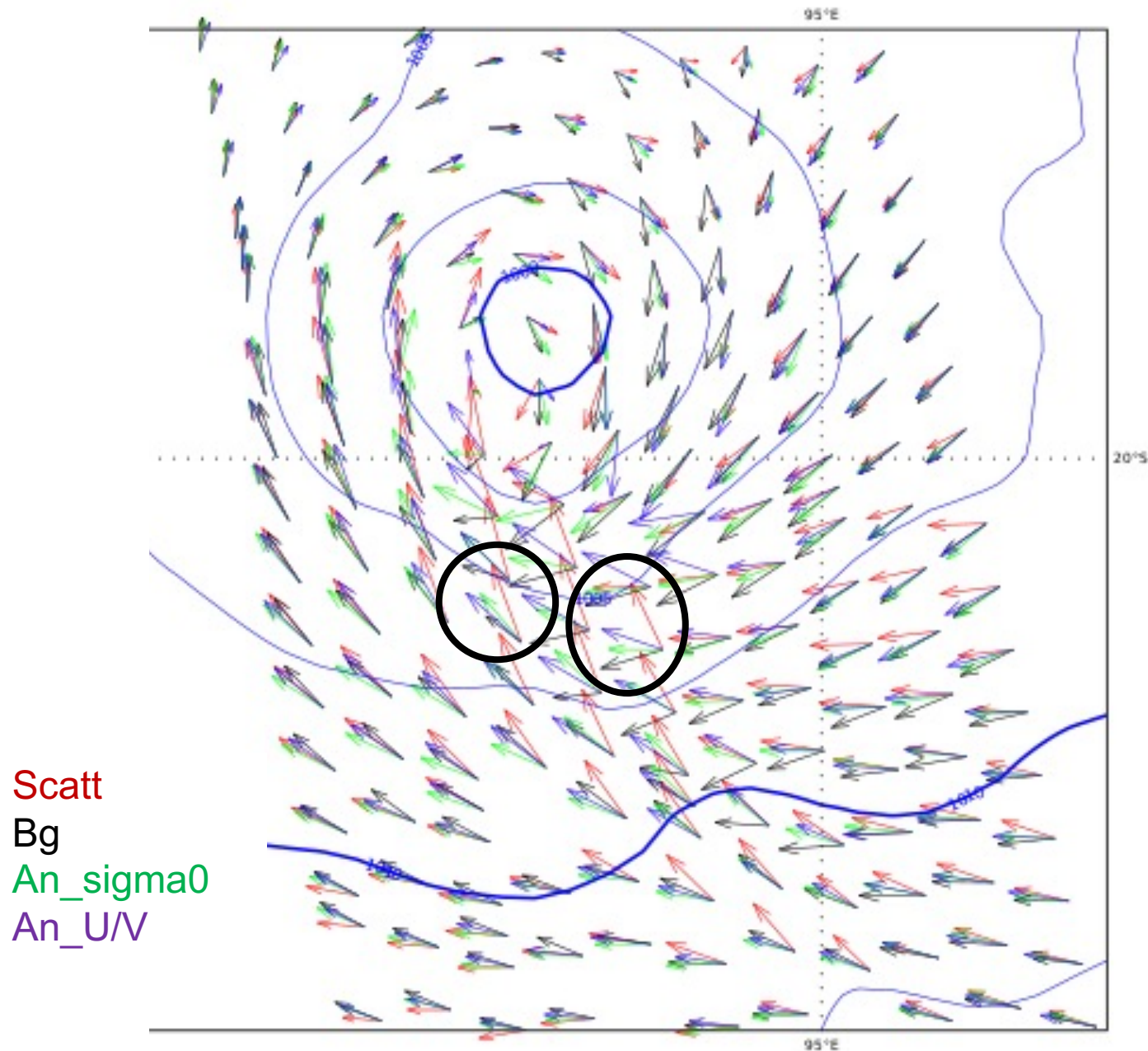
Verification against altimeter 10-m wind speed



% reduction of standard deviation of wind speed forecast errors compared to No SCATT

TC Bill – 20220316 12 UTC

KNMI L2
used



Take-home message:
the assimilation of sigma0 has an impact on the wind direction too

Conclusions

- Results suggest that the sigma0 (backscatter) assimilation is viable and it has comparable performance to assimilating the ambiguous wind retrievals (the one in operations)
 - Comparing with no SCATT, we clearly retrieve useful wind speed and direction information from sigma0
- Encouraging results with assimilation of sigma0 but not perfect:
 - SWH and 10m wind speed look slightly better when verified against buoys and altimeters;
 - Some minor degradations (e.g. psurf, AMVs);
 - Some forward-model issues with high winds (*small number of high winds are available for ANN training*).
 - For tropical cyclones:
 - position errors slightly worse, intensity is OK
 - Sigma0 not turning the winds as much as CTL

→ Not ready to replace the operational assimilation of SCAT U/V.

OSI SAF L2 winds will most likely be used in the assimilating of SCA EPS-SG winds

The framework of this work is the base for the current project on GNSS-R (see tomorrow's presentation from Maria Paola)