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EUMETSAT
OSISAF
OCEAN AND SEA ICE

ASCAT higher resolution winds closer to the coast

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Introduction

- › Scatterometer wind retrievals are challenging in places where the radar returns are not only from the sea surface, but also contain (significant) contributions from land or metal structures like ships or wind farms
- › A Land Contribution Ratio is present in the ASCAT full resolution level 1b data, based on the spatial response functions of the radar beams
- › The OSI SAF ASCAT 12.5 km coastal product makes use of this information, a land correction was introduced using linear interpolation of sea contributions and land contributions to the sigma0 data, this reduces the 'coastal gap' from ~20 km to ~12 km
- › The same algorithm was recently introduced in the 6 km OSI SAF ASCAT winds (demonstration status product)
- › The main topic of this presentation is an attempt to identify the spurious backscatter data from ships and if possible, to reduce their effect on the wind retrievals
- › This is more challenging than land contributions since the presence and contribution of ships is unknown and changing over time

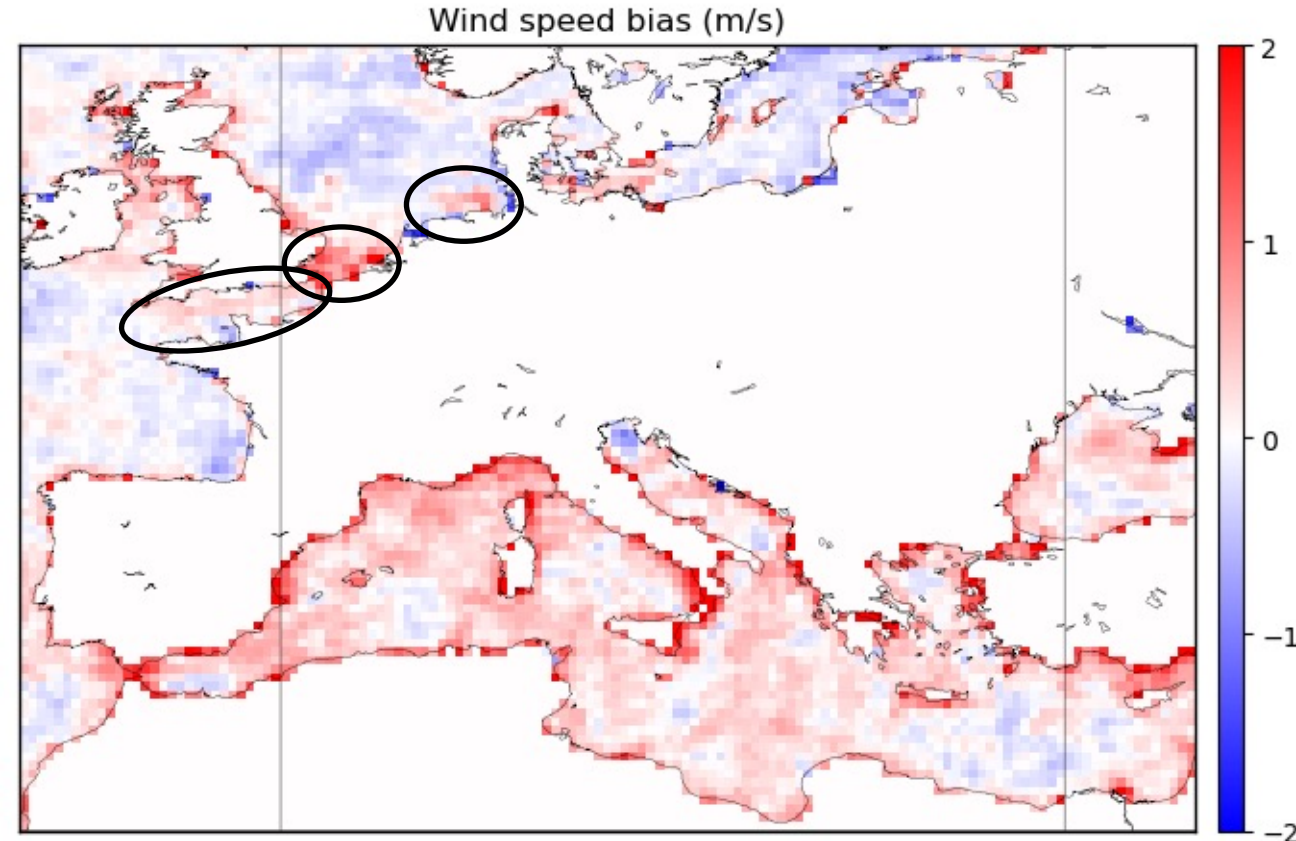
Ship reflections

- > Ship reflections can significantly disturb the scatterometer wind observations
- > Normally, most of the radar beam is reflected away from the instrument, but due to the steel structure, a large part of the power is reflected back to the satellite
- > This results in unrealistic high wind speeds and excessive Quality Control flagging in busy shipping areas
- > We are not sure about the effect of wind farms; they may be less harmful for wind retrievals due to the round shapes of the turbines
- > Ruben Stecher (intern) has looked at SAR images over the North Sea, some areas show many bright spots due to ships and wind farms



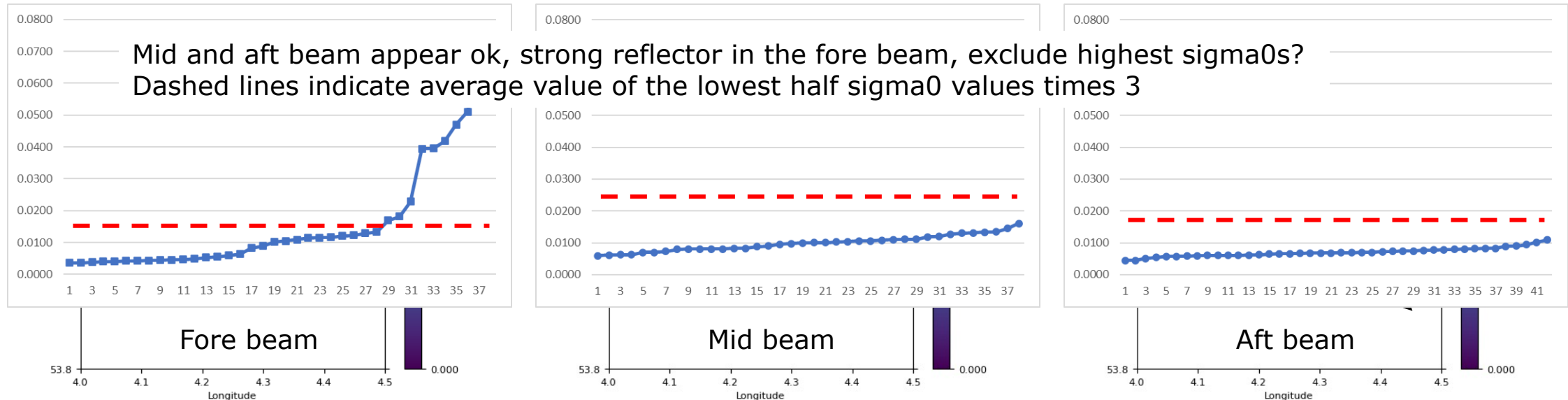
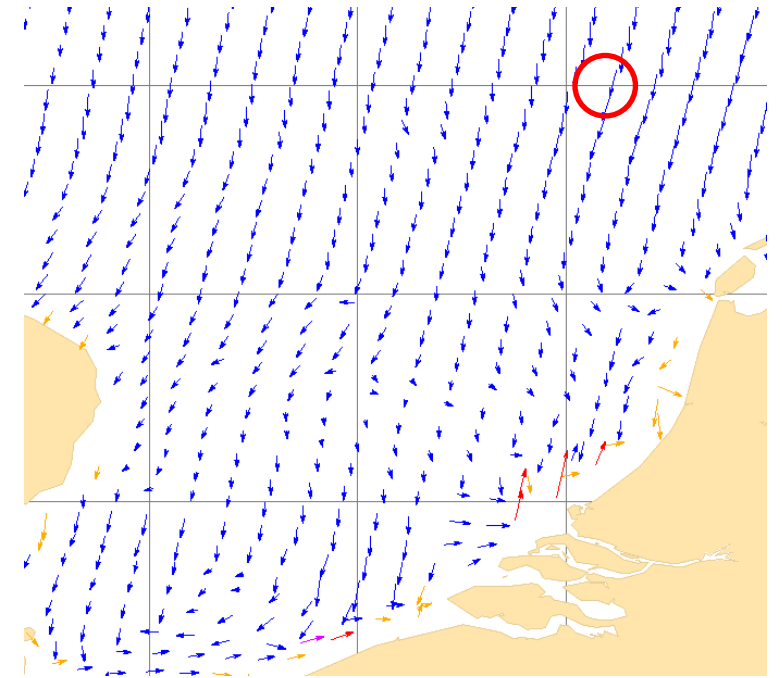
Wind speed bias vs. ECMWF

- > The plot shows the wind speed bias of 12.5 km ASCAT winds w.r.t. ECMWF forecast winds (Dec 2024, Apr 2025)
- > Both the scatterometer winds and the model winds contain errors
- > Near the coasts some high biases are visible, these can be associated with residual land contamination in the ASCAT backscatter and with ECMWF wind errors due to resolution limitations and poor representation of coastal wind effects
- > The high wind speed biases near the Rotterdam and Hamburg ports, and in the English Channel are likely associated with ship reflections
- > In the Mediterranean, the biases are probably both due to systematic (ECMWF) biases and ship reflections



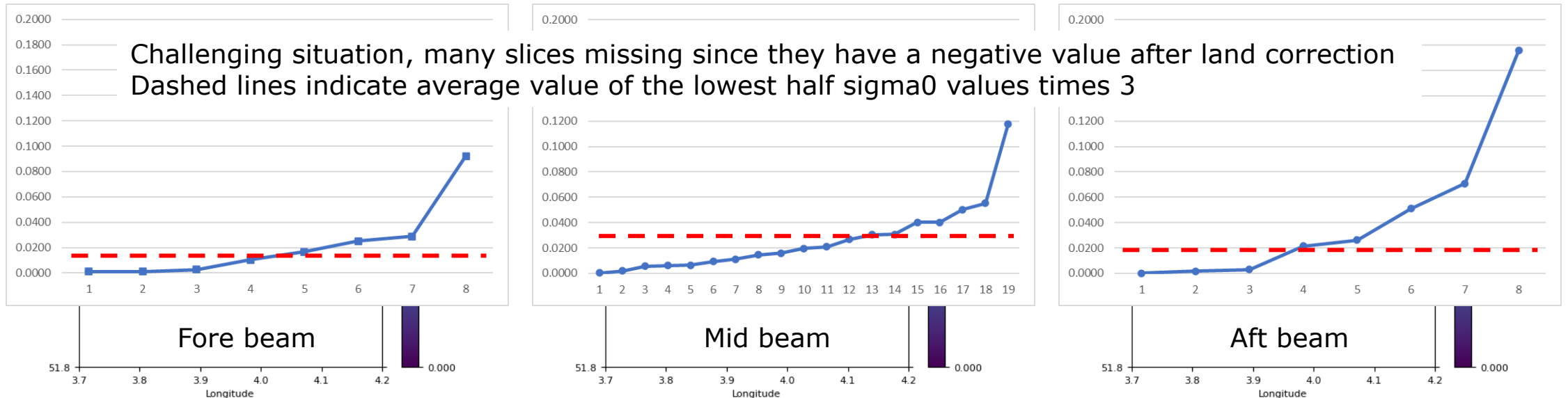
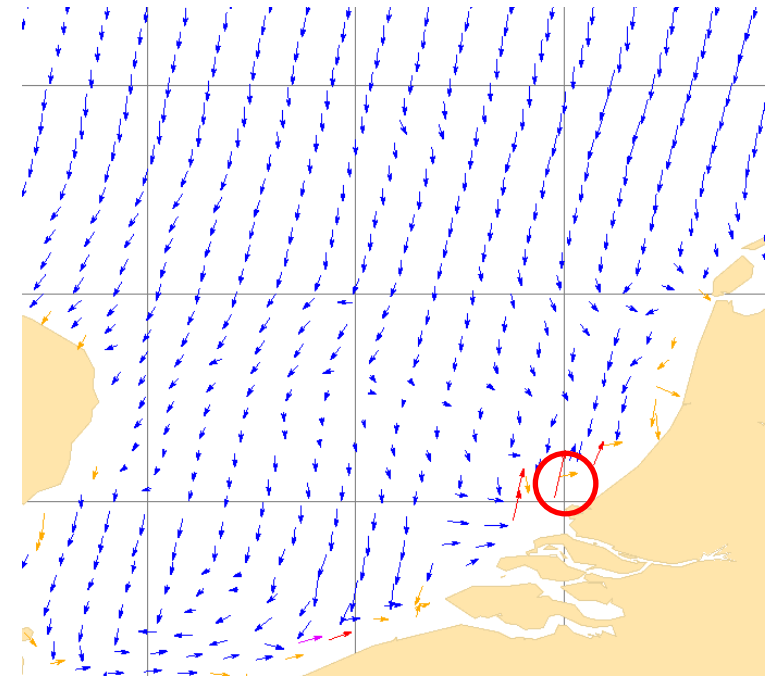
Slice backscatter – 12.5 km

- > The plots below show the sigma0 values (linear space) of individual slices contributing to the beam backscatter of the WVC (indicated in the red circle), arrows point to the satellite
- > The search radius for slices is 15 km from the WVC centre
- > wind speed 8.62 m/s, MLE -1.80
- > KNMI QC set, Kp flag set, VarQC not set



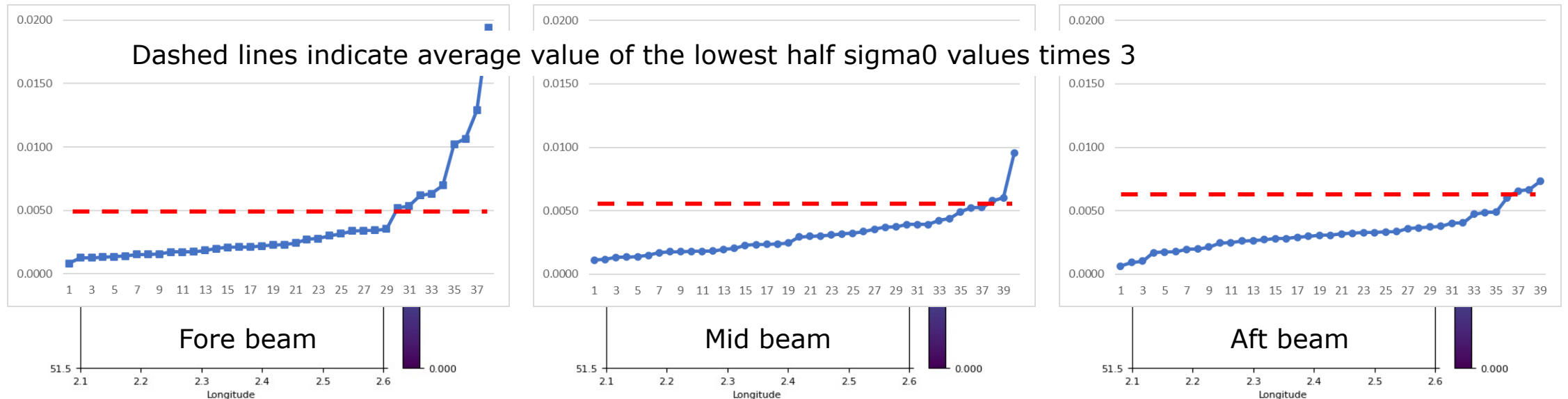
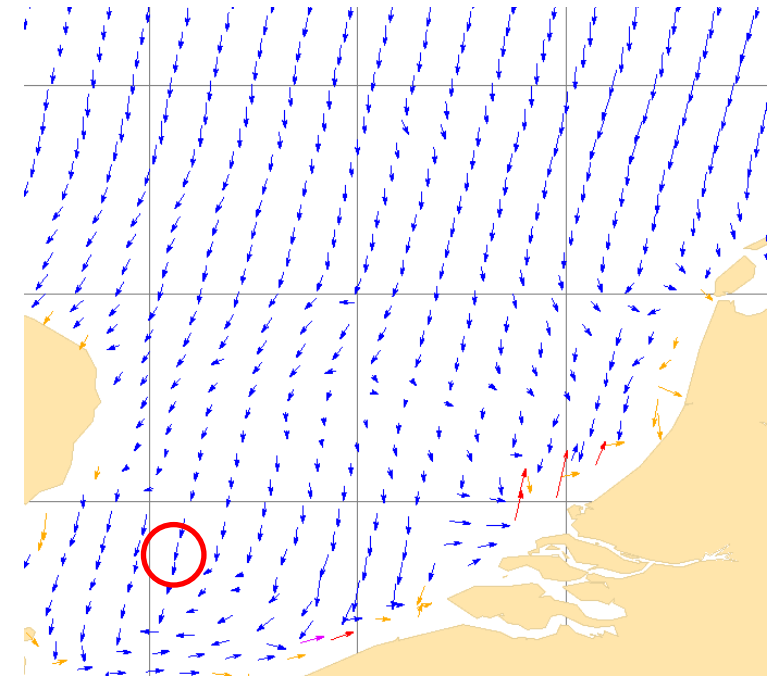
Slice backscatter – 12.5 km

- > The plots below show the land-corrected sigma0 values (linear space) of individual slices contributing to the beam backscatter of the WVC (indicated in the red circle)
- > The search radius for slices is 15 km from the WVC centre
- > wind speed 6.70 m/s, MLE 0.20, **HvH 3.0 m/s, 260° (W)**
- > KNMI QC set, Kp flag set, VarQC set



Slice backscatter – 12.5 km

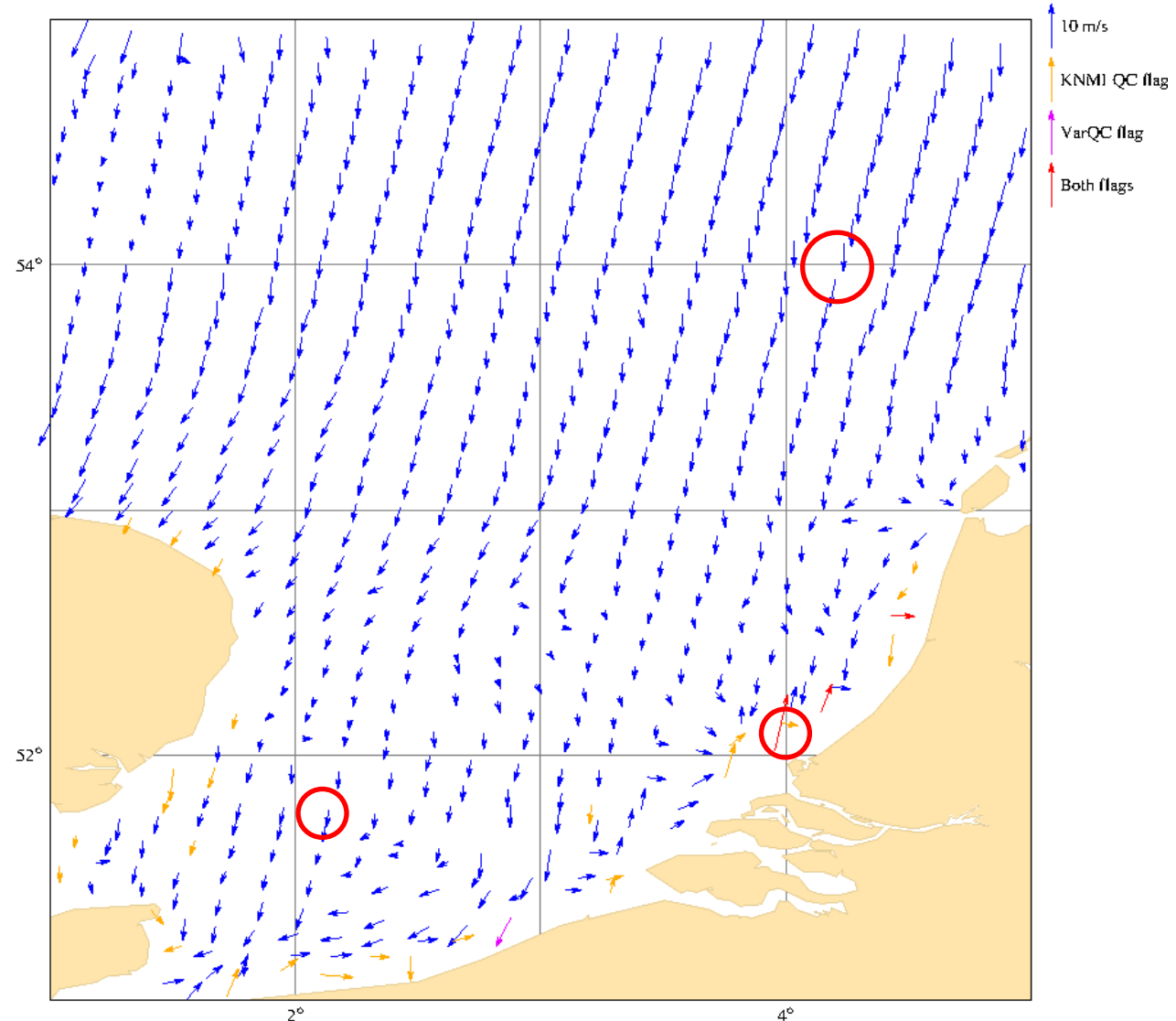
- > The plots below show the sigma0 values (linear space) of individual slices contributing to the beam backscatter of the WVC (indicated in the red circle)
- > The search radius for slices is 15 km from the WVC centre
- > wind speed 6.13 m/s, MLE -2.00
- > KNMI QC set, Kp flag set, VarQC not set



Slice outlier removal

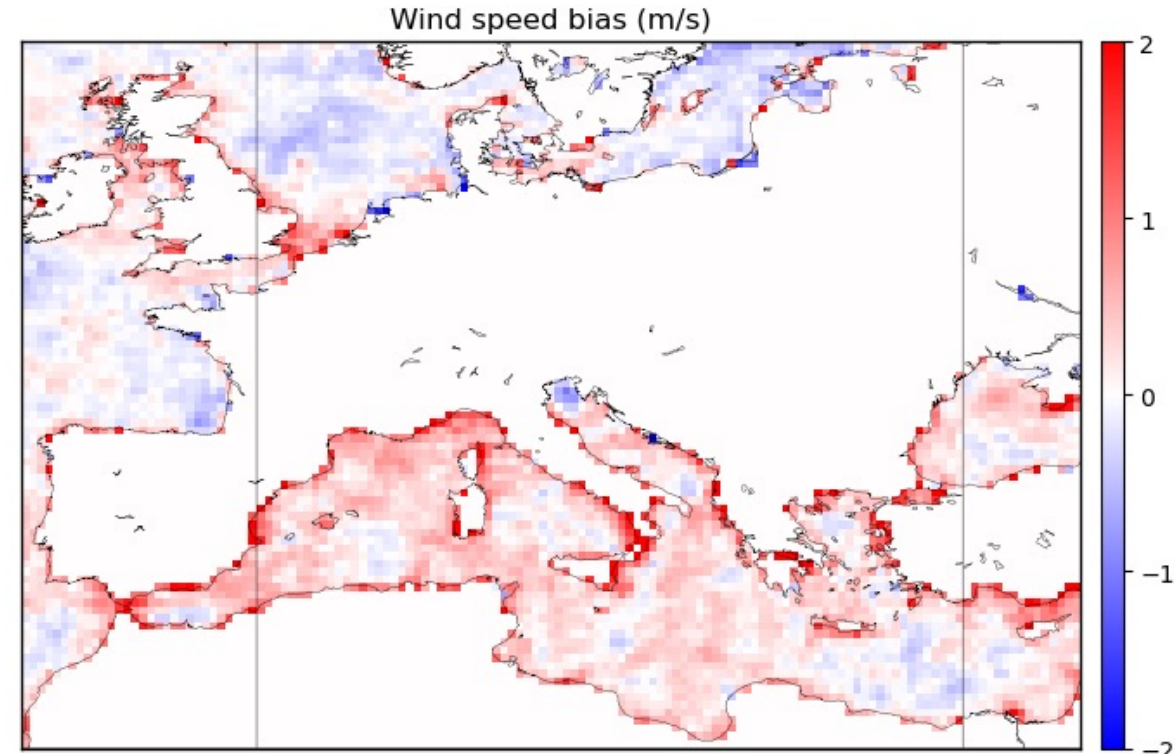
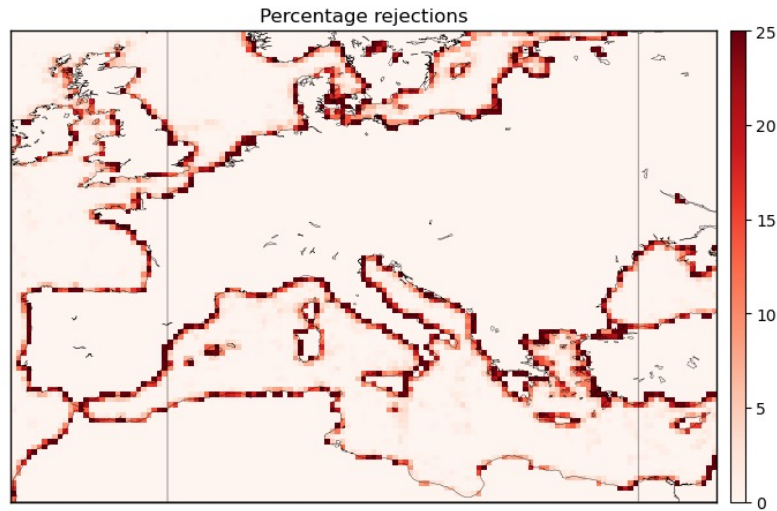
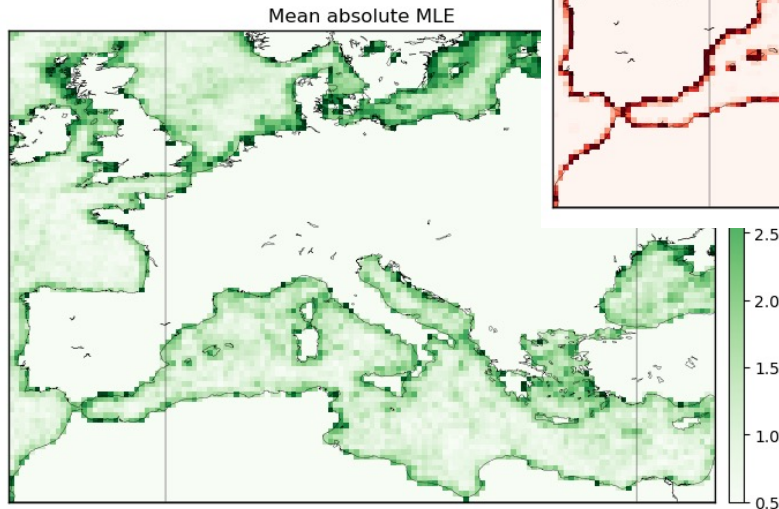
- > The sigma0 average value of the lowest half of the slices is computed
- > All slices having a sigma0 value of more than 3 times (2 / 1.5 times) this average are removed before averaging slice values to a WVC view (coastal and non-coastal WVCs)
- > This is done only when the difference between highest and lowest slice sigma0 value is larger than 0.005 (indicating a local corner reflection) and the lowest slice value is lower than a GMF cross wind value of 10 m/s (indicating a wind speed of less than 6 – 10 m/s)
- > Using three times the average leads to 0.4% extra accepted WVCs in coastal areas

1.5 times value removed



Slice outlier removal

- > The outlier removal results in marginal reductions in wind speed bias and QC rejection rates and a small increase in MLE
- > A limit value of around 3 yields the highest number of retrievals



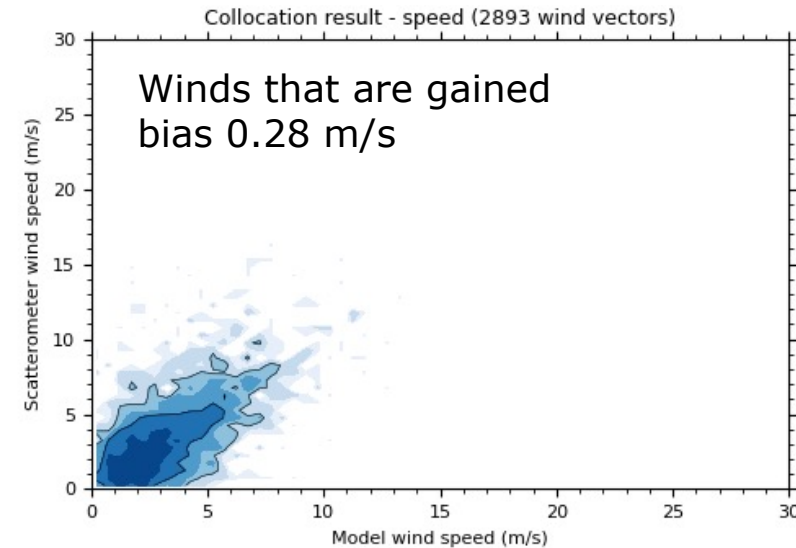
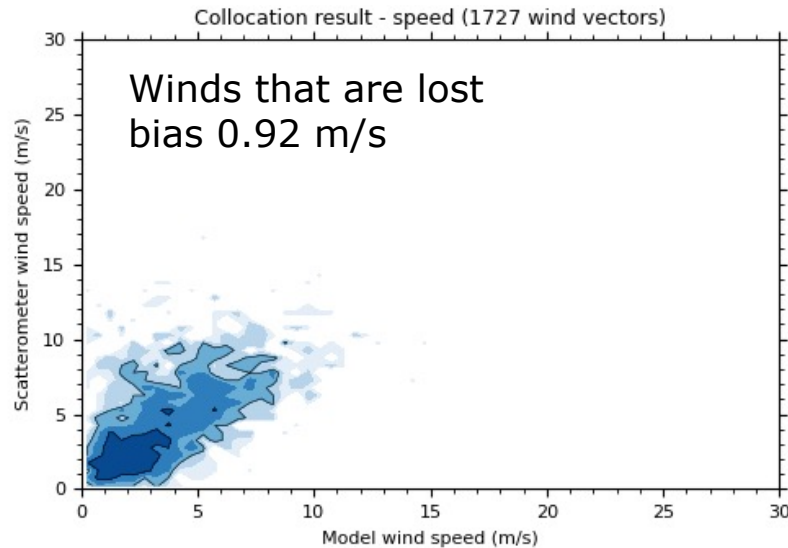
Not all positive biases are due to ship reflections; ECMWF winds may also have (negative) biases!

3 times value removed

Effect of outlier removal - coastal winds

	No outlier removal	With outlier removal
Nr. of coastal winds	605322	607590 (+0.4%)
Speed bias (m/s)	0.32	0.30
Stdev u (m/s)	1.92	1.92
Stdev v (m/s)	2.01	2.01

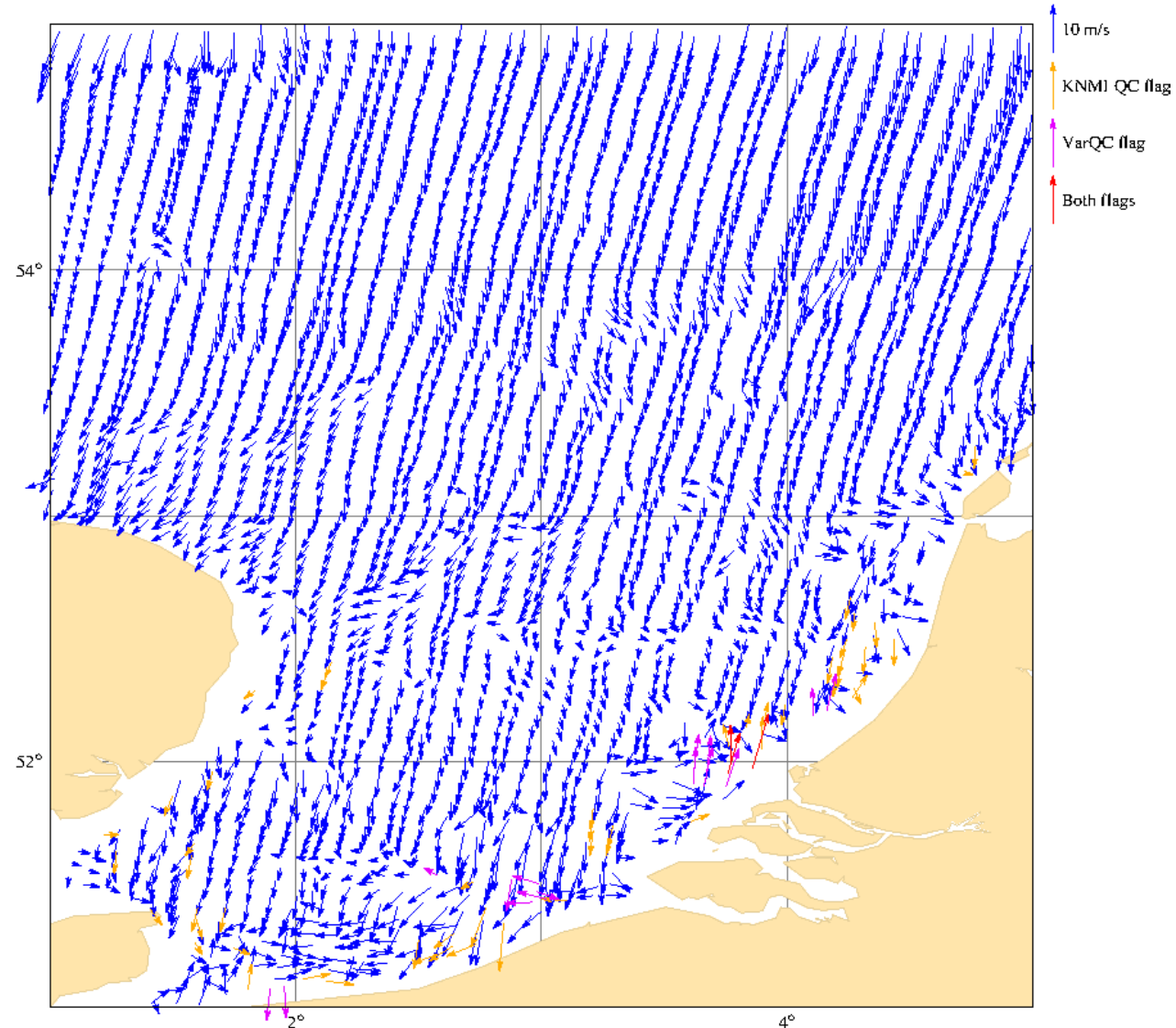
6 days of data



Slice outlier removal (6)

- > The sigma0 average value of the lowest half of the slices is computed
- > All slices having a sigma0 value of more than three times (two times, 1.5 times) this average are removed before averaging slice values to a WVC view (coastal and non-coastal WVCs)
- > This is done only when the difference between highest and lowest slice sigma0 value is larger than 0.005 (indicating a local corner reflection) and the lowest slice value is lower than a GMF cross wind value of 10 m/s (indicating a wind speed of less than 6 – 10 m/s)

1.5 times value removed



Conclusions

- › The land correction was successfully implemented in the 6 km ASCAT high resolution wind product, this reduces the 'coastal gap' from ~ 20 km to ~ 12 km.
- › The ASCAT wind retrievals can be improved by removing full resolution backscatter slice observations that are impacted by reflections of ships or other metal structures.
- › For now, the best recipe appears to be to compute the average value of half of the slices contributing to a view, those having the lowest values. Then, three times this value is taken and any slices with higher backscatter values are removed from the averaging process.
- › The 'three times' criterium is probably somewhat arbitrary, but it appears to yield the highest number of accepted wind retrievals.
- › Using this screening recipe, some improvement is seen: lower wind speed biases and lower quality control rejection rates in busy shipping areas.
- › Some scenes close to the coast remain challenging due to the combination of reflections from land and ships.