Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Infrastructuur en Waterstaat

The EUMETSAT
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A land-corrected ASCAT coastal wind product

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Introduction

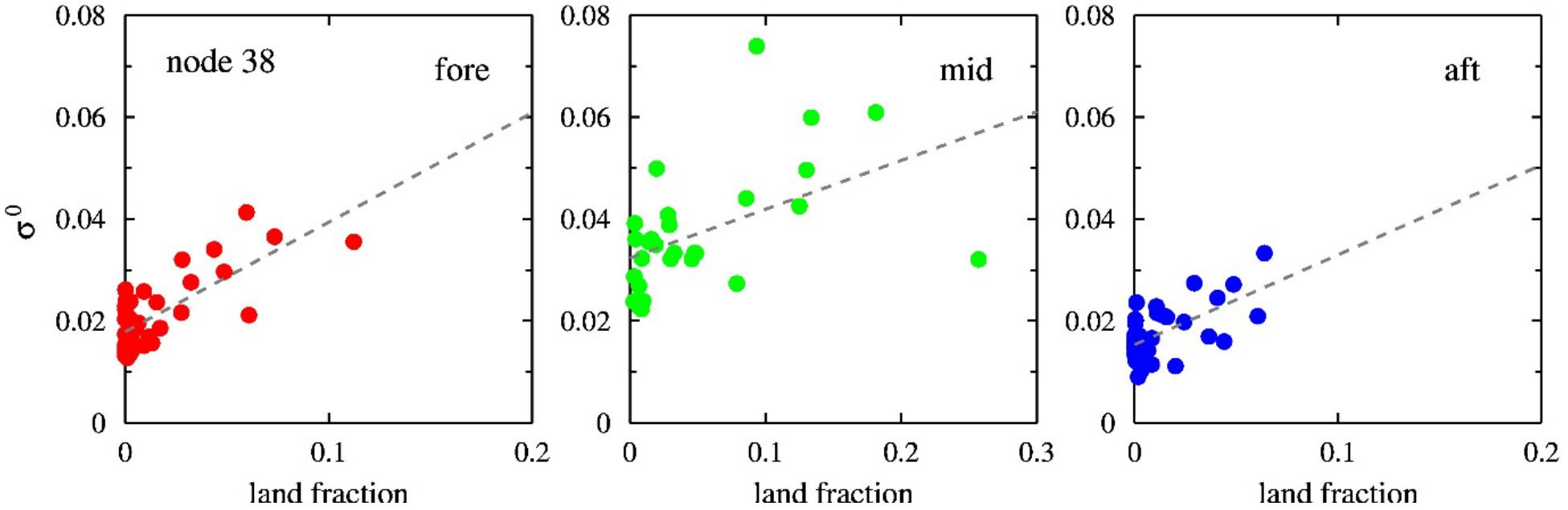
- Clear user need for coastal winds
- Scatterometers hindered by land contamination
- QuikSCAT coastal product by Styles et al., IOVWST 2018

- ASCAT product on 12.5 km grid size:
  - Originally at least 35 km from the coast, because of aggregation of σ^0 values over a square area of 50 km by 50 km with Hamming window
  - Current coastal product has aggregation over a circular area with 15 km radius and approaches coast up to 20 km or slightly less

Motivation

- EUMETSAT developed a new L1B full resolution σ^0 product with a land fraction for each full resolution σ^0 value
- Land fraction based on Spatial Response Function (SRF) from Lindsley and Long (BYU) and high-resolution coastline map (GSHHG) from Wessel and Smith
- For this study EUMETSAT prepared one year of new L1B data (2017) for ASCAT-B
- Land fraction takes shape of SRF into account, but standard coastal processing with new land fraction yields only few new coastal WVCs
- Something else needed…
- Work in progress

Idea

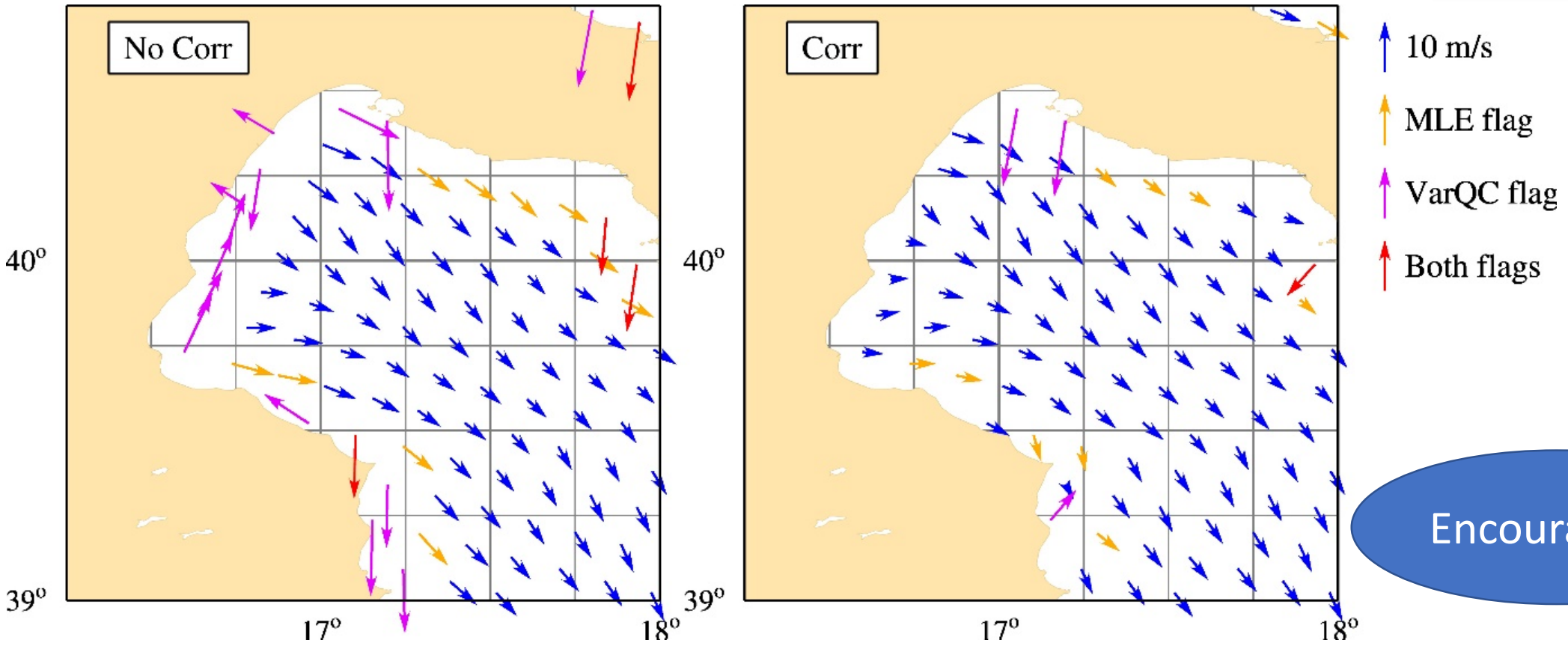


- Make a simple linear regression analysis of σ^0 against land fraction f_L for all σ^0 values contributing to a WVC and for each beam separately
- $\sigma^0 = af_L + b$ (see figure above; dashed line is the regression line)
- Assume $\sigma^0_{sea} = b \ \ (f_L = 0)$ and $\sigma^0_{land} = a + b \ \ (f_L = 1\ )$
- Land correction: $\sigma^0_{corr} = \sigma^0 - af_L$

Processing scheme

1. Standard averaging of all cross sections (and auxiliary data as geographical position and observation geometry), rejecting full resolution footprints with fraction between f_{max} and $1 - f_{max}$, with $f_{max} = 0.02$. If no footprint within the WVC is rejected, the WVC is over the open ocean or over land and no further coastal processing is needed;
2. If any footprint in the WVC has a land fraction exceeding f_{max}, then land correction is applied using only those footprints with land fraction below a threshold land fraction f_T, with f_T to be determined. A minimum number of three footprints is required.
3. If the land fraction fails the quality control in step 2 while step 1 led to a useful triplet of σ^0 values, the result of step 1 is retained.

First Results



Encouraging!

- Gulf of Tarente (Italy), standard coastal product (left) and land corrected product (right) with $f_T = 0.5$. No additional QC.
- Many reasonable looking new coastal winds

How to validate?

- Comparison with buoys:
  - Few reliable coastal buoys available
  - Representativeness in coastal regions may be a problem due to high wind variability in coastal regions
- Comparison with NWP:
  - Known to be problematic near the coast

- For the moment visual inspection of the wind fields

Quality control (1)

- Possible quality control parameters:
  - Threshold land fraction f_T
  - Error in slope of regression line, a
  - Error in intercept of regression line, b
  - Regression error
  - Weight of σ^0 proportional to vertical distance from regression line

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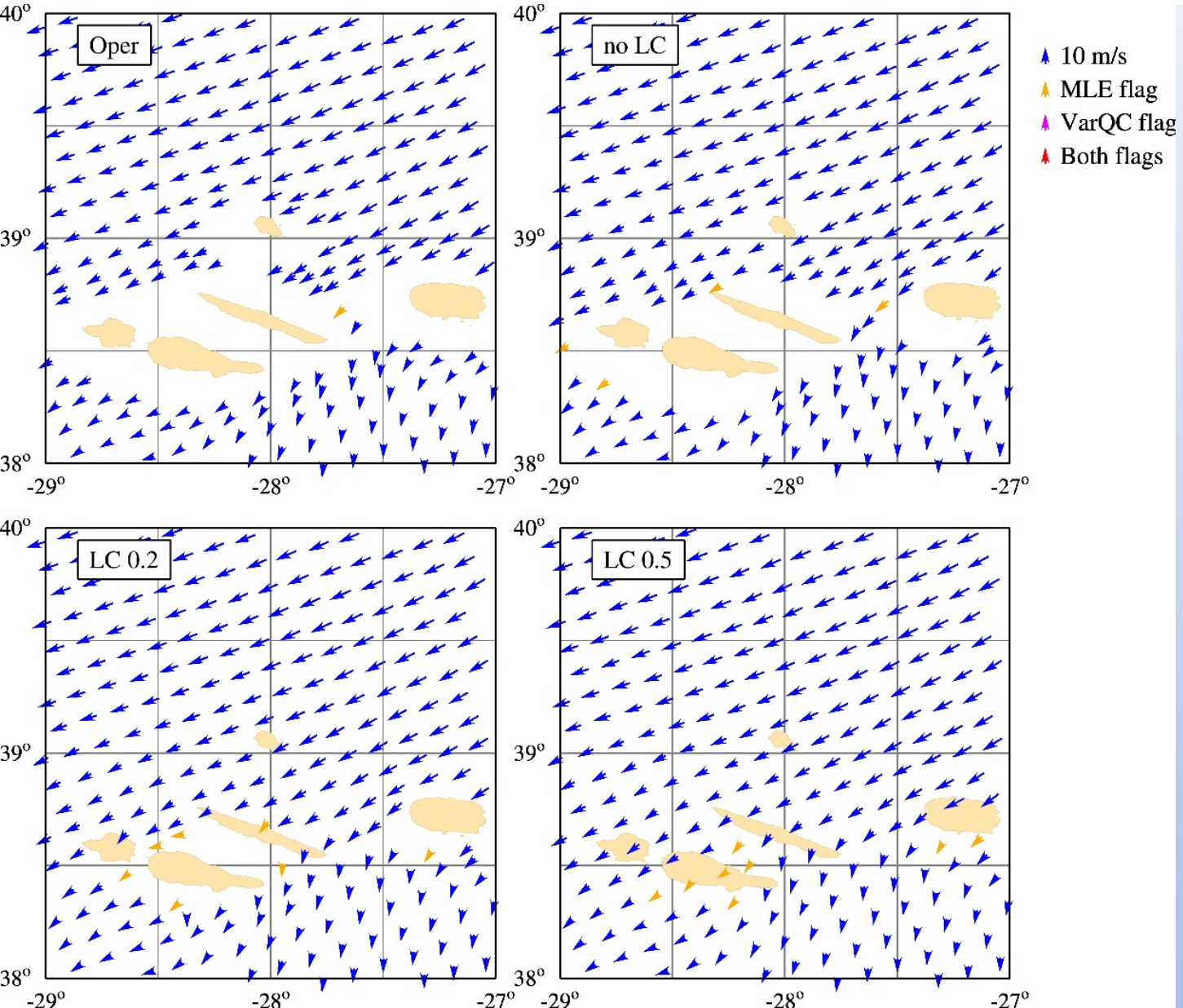
Quality control (2)



Madeira Isles (Portugal)

Oper: current operational product

no LC: current processing with new land fraction (few new WVCs)

LC 0.2: land correction with $f_T = 0.2$ (a lot more new WVCs)

LC 0.5: land correction with $f_T = 0.5$ (still more new WVCs, but also some flagged)

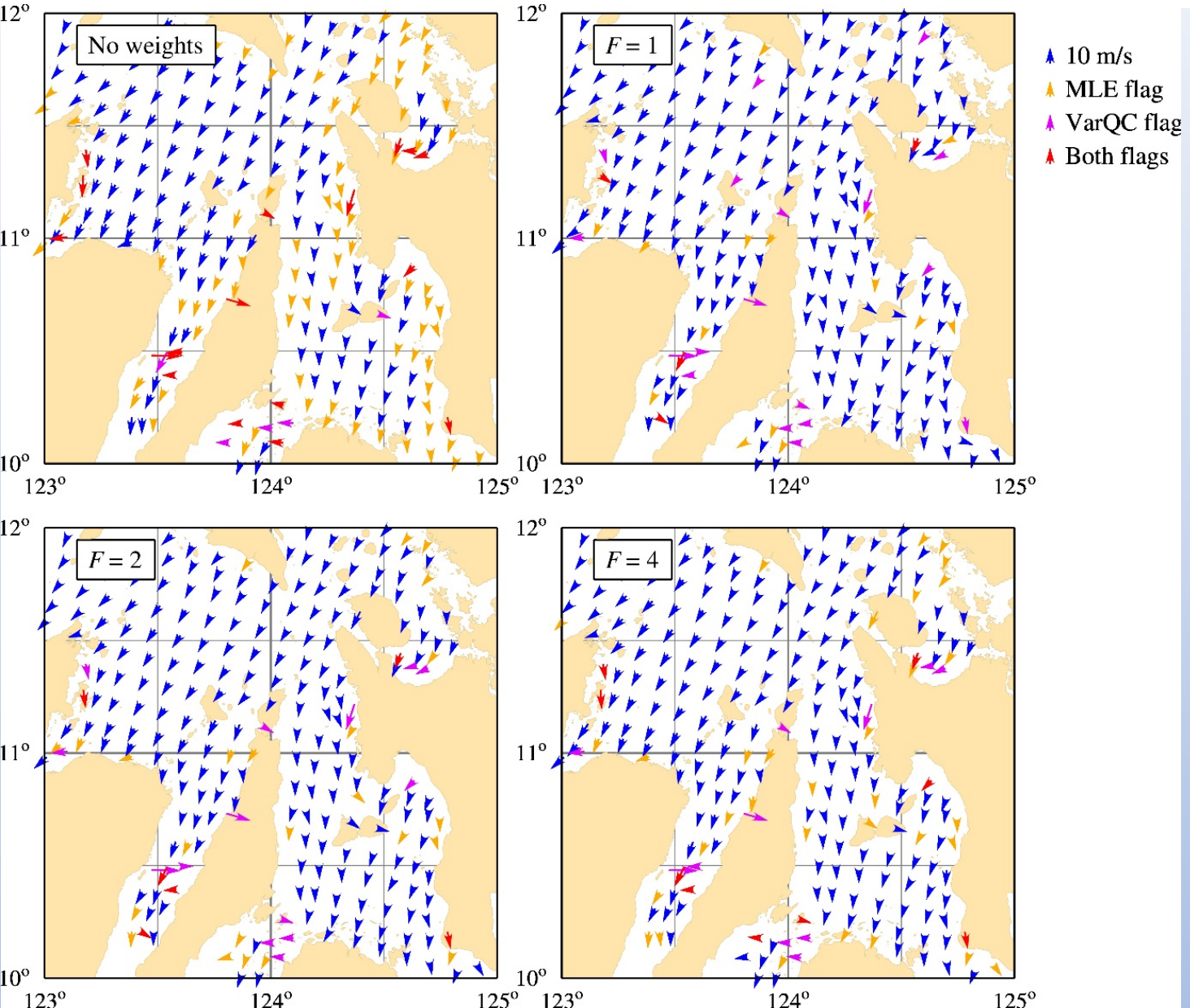
$f_T = 0.5$ seems a good choice

Quality control (3)

- QC based on regression parameters (a, b, and regression error) relies on open-ocean thresholds for flag settings and have only a cosmetic effect by reducing the number of flagged WVCs near the coast.
- For a large number of coastal WVCs the K_p flag is set, indicating that the spread of the σ^0 values contributing to a WVC exceeds the open ocean threshold. (Note: K_p is recalculated from the land-corrected σ^0 values.)
- This is mitigated by giving in the K_p calculation each σ^0 value a weight w proportional to its distance from the regression line $\Delta = \sigma^0 - af - b$:

  $w = \exp\left(-\left[\frac{\Delta}{F\sigma_e}\right]^2\right)$ with F the strength parameter and σ_e the standard deviation of the regression error.
- Gaussian weights give good results

Quality control (4)



Philippines, January 1, 2017

$F = 1$ yields reliable looking results; K_p flagging much reduced (K_p flag is part of the MLE flag depicted in orange)

$F \rightarrow \infty$ corresponds to no weights

Future plans

- Use GSHHG coast lines at highest resolution (100 m) to calculate distance from the coast
- Make statistics of wind and regression parameters as function of the distance from the coast
- Determine final QC settings

Conclusions

- ASCAT land correction based on regression analysis shows good results, but
- More quantitative validation needed