A land-corrected ASCAT coastal wind product

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IOVWST 2021
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 $\sigma^0$ 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 $\sigma^0$ product with a land fraction for each full resolution $\sigma^0$ 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
• Make a simple linear regression analysis of $\sigma^0$ against land fraction $f_L$ for all $\sigma^0$ 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 $\sigma_{sea}^0 = b$ ($f_L = 0$) and $\sigma_{land}^0 = a + b$ ($f_L = 1$)

• Land correction: $\sigma_{corr}^0 = \sigma^0 - af_L$
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 $f_{\text{max}}$ and $1 - f_{\text{max}}$, with $f_{\text{max}} = 0.02$. 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 $f_{\text{max}}$, 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 $\sigma^0$ values, the result of step 1 is retained.
• 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

First Results

Encouraging!
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 $\sigma^0$ proportional to vertical distance from regression line
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 \(\sigma^0\) values contributing to a WVC exceeds the open ocean threshold. (Note: \(K_p\) is recalculated from the land-corrected \(\sigma^0\) values.)

• This is mitigated by giving in the \(K_p\) calculation each \(\sigma^0\) value a weight \(w\) proportional to its distance from the regression line \(\Delta = \sigma^0 - af - b\) :

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

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

$F \to \infty$ 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