Scale-dependent SAR Normalized Radar Cross Section distribution

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Outline

- Motivation
- Theoretical Background
- Dataset
- Methodology
- Preliminary Results
- Preliminary Conclusions

Motivation

Is there a SAR pixel-size beyond which the σ_0 distribution is not modulated by low scale features?

- **Usability of scatterometer-derived GMFs for SAR wind retrieval**
- **Use of Ocean Calibration for SAR**

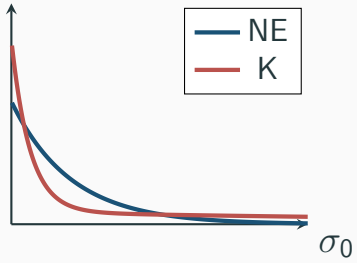
Theoretical Background on sea surface

Hypothesis: Dominant Bragg scattering

$E(\mathbf{r}) = \sum_{i=1}^{N} a_i e^{-j\phi_i}$

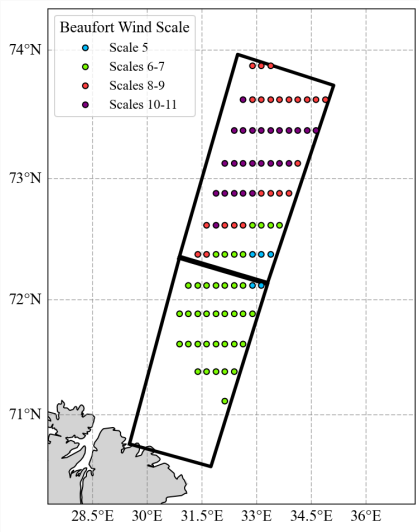
N elementary scatterers

a_i and ϕ_i **ARE**
statistically independent
$\Downarrow$
$\sigma_0 \sim$ **NE**
Scatterometer-like



a_i and ϕ_i **ARE NOT**
statistically independent
$\Downarrow$
$\sigma_0 \sim \mathbf{K}(\nu)$
SAR-like

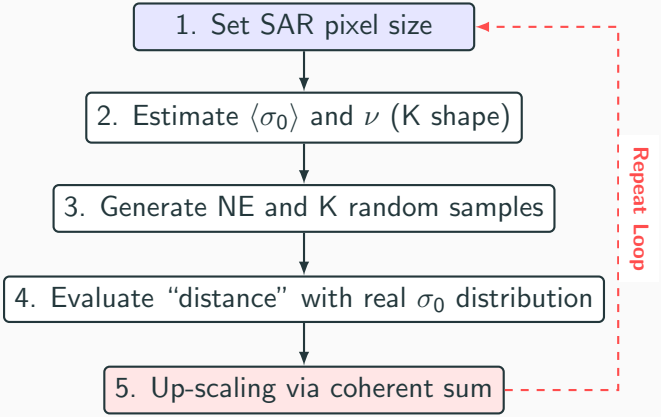
Dataset



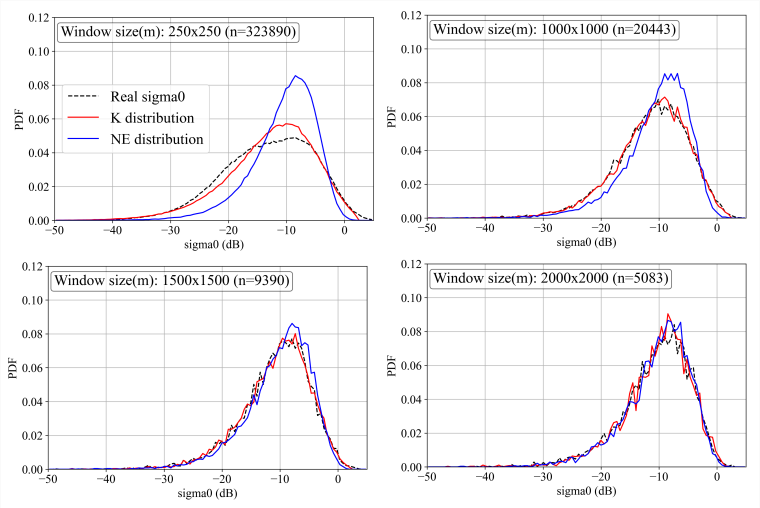
- S-1 IW SLC VV 12th Sep 2016 4:46 UTC
- Polar low event
- Collocation with:
  - WINDSAT data (0.25^{o}x0.25^o) 4:56 UTC from the Rojo list (MAXSS project [1])
  - Closest ERA5 Significant Wave Height (SWH) (0.5^{o}x0.5^o)
- Total of collocated 92 "cells" (25x25 km^2)

[1] M. Portabella, F. Cossu, E. Makarova, and A. S. Rabaneda, "MAXSS: Validation of the multi-mission wind product and the input scatterometer and radiometer data products," Institut de Ciències del Mar (ICM-CSIC) and Barcelona Expert Center (BEC), Technical Report D3-VR-MM, Version 1.0, Nov. 2023, document prepared under ESA Contract No. 4000132954/20/I-NB.

Methodology

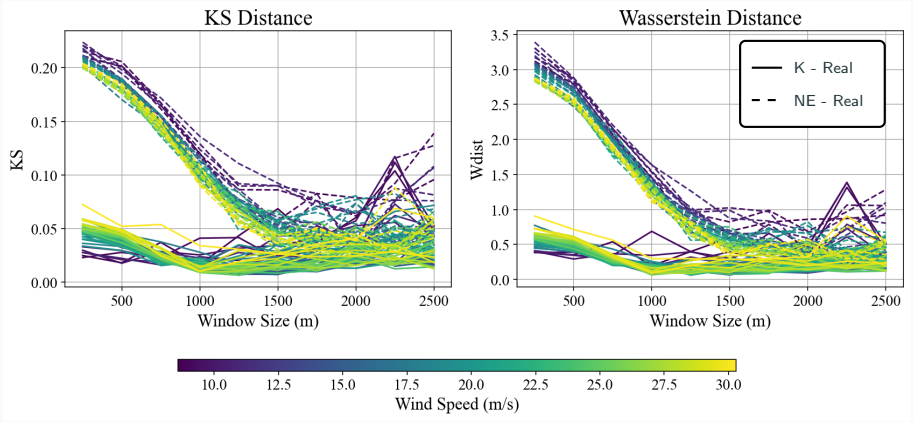


Preliminary Results: σ_0 distributions

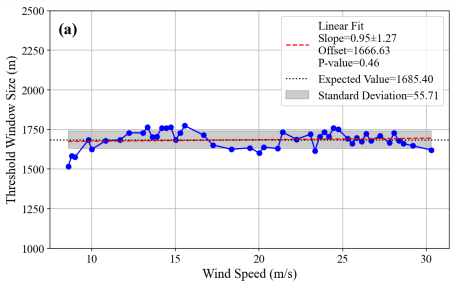


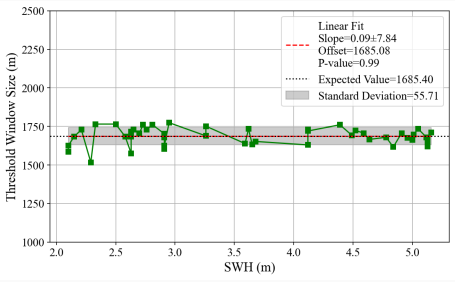
Distance among distributions

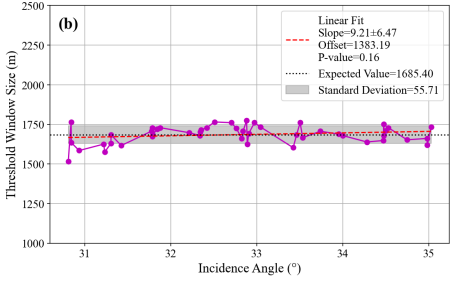
$$\Delta^{th} \approx 1.7 \text{ km}$$



Dependency of Δ^{th} on U, SWH and θ







- Δ^{th} does not depend on U, SWH and θ

Preliminary Conclusions

- Real σ_0 distribution in line with theory
  - **K** model is effective
  - Real $\sigma_0 \rightarrow$ **NE** with increasing Δ
- $\Delta^{th} \approx 1.7$ km
- Negligeable dependency of Δ^{th} on U, SWH and θ

Future Work

- Expand the dataset (**now it's too limited!**)
- Check the dependency on:
  - Wind Direction
  - Mean Wave Direction
  - Wave Age
  - Wave Groupiness

Suggestions are welcome!