Towards QuikSCAT coastal winds at OSI-SAF

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Aims of the project

- Development of pencil-beam scatterometer coastal wind processing
- Development of a QuikSCAT coastal wind climatology

Outline of this presentation

- Implementation of the QuikSCAT Spatial Response Function (SRF)
- Characterization of the slice σ_0 noise
- Analysis of cross-calibration issues
- Conclusions and future work

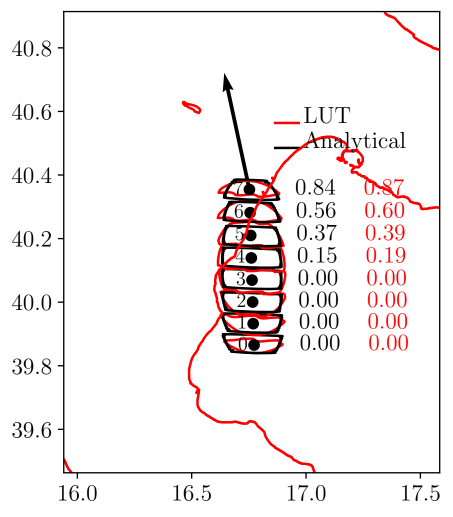
SRF computation: methodology

- Analytical (Spencer et al. 2000)
- Look-Up Table (LUT)-derived. 2-step procedure:
  1. Query of LUT: SRF(ψ, OT, pol) (Prof. Dave Long)
     - ψ Antenna azimuth angle
     - OT Orbit Time
     - pol beam identifier (HH or VV)
  2. Re-centering procedure

M. W. Spencer, C. Wu and D. G. Long, "Improved resolution backscatter measurements with the SeaWinds pencil-beam scatterometer," in IEEE Transactions on Geoscience and Remote Sensing, vol. 38, no. 1, pp. 89-104, Jan. 2000, doi: 10.1109/36.823904.

Land Contribution Ratio (LCR) consistency

- The LCR is the ratio of the footprint area contaminated by land and the total area
- The numbers in the contours indicate the slice index
- The black (red) numbers on the right indicate the LCR computed with the analytical (LUT-derived) SRFs
- **Land contaminated slices may affect the wind field retrieval**



Definition of K_p

- K_p is a measure of the slice σ_0 noise: $\frac{\sigma_{\sigma_0}}{\bar{\sigma}_0}$
    - σ_{σ_0} is the σ_0 noise
    - $\bar{\sigma}_0$ is the expected value
- Theoretical formulation $K_p = K_{p\alpha} + \frac{K_{p\beta}}{SNR} + \frac{K_{p\gamma}}{SNR^2}$ (Fisher 1972)
    - $K_{p\alpha}$, $K_{p\beta}$, $K_{p\gamma}$ are provided in QuikSCAT Full Resolution files
    - SNR is the Signal to Noise Ratio

[1] Fisher, R. E., "Standard Deviation of Scatterometer Measurements from Space", *IEEE Transactions on Geoscience Electronics*, Vol. GE-10, No. 2, April 1972

K_p estimation ($\hat{K}_p$): methodology

- $U_T = \{5, 7.5, 10, 12.5, 15\}$ ms^{-1}
- $\forall U_T \; \sigma_0^{U_T} \triangleq \frac{1}{2\pi} \int_0^{2\pi} NSCAT4DS(U_T, \phi, \theta, p) d\phi$
- $\sigma_0^{U_T}$ is the average σ_0 associated to wind speed U_T
- $\hat{\sigma}_0 \in \sigma_0^{U_T} \pm$ 0.5 dB
- $\hat{\sigma}_0$ (slice σ_0) separated for:
    - pol (HH - VV)
    - view (Fore - Aft)
    - slice index: $0, \ldots, 7$ (0-based numbering)
- Assessment of $\hat{K}_p = \frac{\sigma_{\hat{\sigma}_0}}{\bar{\sigma}_0}$. $\sigma^2_{\hat{\sigma}_0} = E[(\hat{\sigma}_0^i - \bar{\sigma}_0)^2]$, $\bar{\sigma}_0 \equiv \sigma_0^{egg}$

Dataset

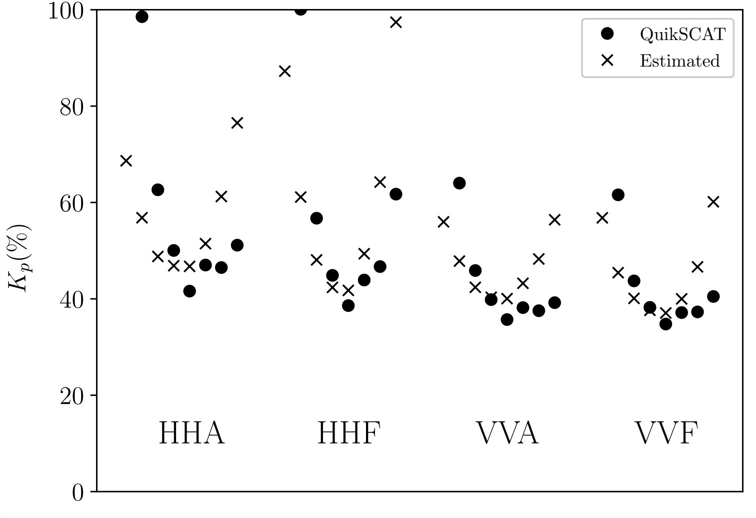
- Date: 10^{th} April
- 1 orbit file (40651.20071011559)
- L1B QuikSCAT Full Resolution files
    - ...
    - Slice centroid position and σ_0 value
    - Egg position and σ_0 value
    - K_p coefficients
    - Satellite position and velocity info
    - Orbit Time
    - Antenna info (ψ, pol, incidence angle (θ), ...)
    - ...

General Quality Control

- σ_0 quality flag
  - scatterometer pulse quality is acceptable
  - σ_0 cell location algorithm converges
  - Frequency shift is within the range of the x factor table
  - Spacecraft temperature is within calibration coefficient range
  - An applicable attitude record was found for this σ_0
  - Interpolated ephemeris data are acceptable for this σ_0
- frame error status (communication with the SC)
- frame quality flag (telemetry frame)
- Incidence of general QC: 0.6 % HH 0.72% VV

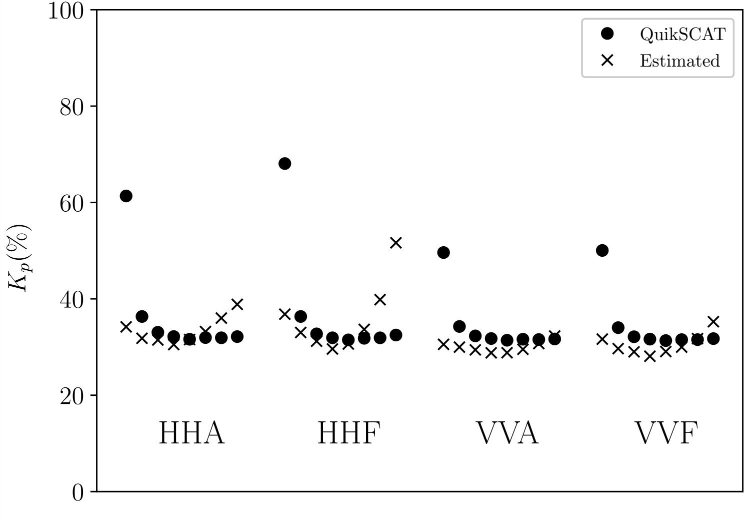
σ_0^5

	sl 0	sl 1	sl 2	sl 3	sl 4	sl 5	sl 6	sl 7
HHA	68 (281±28308)	56 (98±3175)	48 (62±15953)	46 (50±151)	46 (41±108)	51 (47±932)	61 (46±12071)	76 (51±566)
HHF	87 (363±8916)	61 (100±8518)	48 (56±9395)	42 (44±137)	41 (38±1958)	49 (43±126)	64 (46±674)	97 (61±1035)
VVA	55 (157±874)	47 (64±68)	42 (45±45)	40 (39±35)	40 (35±7)	43 (38±16)	48 (37±48)	56 (39±99)
VVF	56 (160±2783)	45 (61±213)	40 (43±22)	37 (38±5)	37 (34±5)	39 (37±19)	46 (37±27)	60 (40±151)



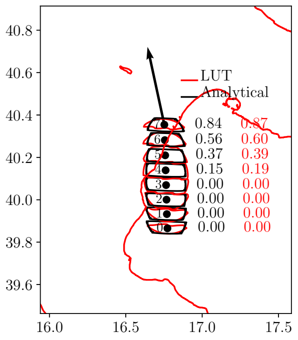
σ_0^{15}

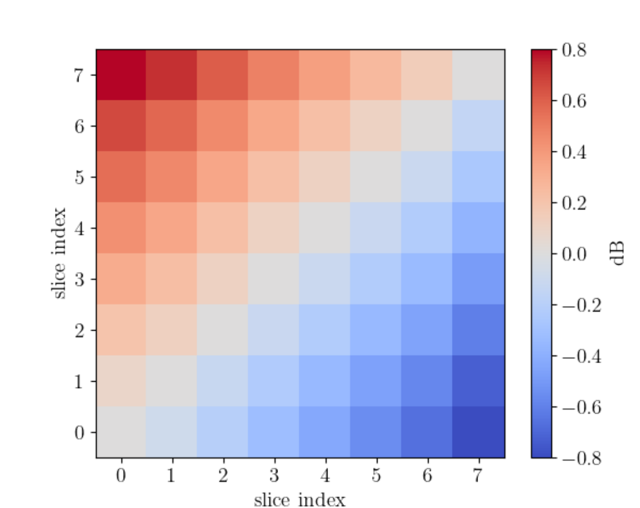
	sl 0	sl 1	sl 2	sl 3	sl 4	sl 5	sl 6	sl 7
HHA	34 (61±13)	31 (36±2)	31 (33±2)	30 (32±0)	31 (31±0)	33 (31±0)	36 (31±0)	38 (32±2)
HHF	36 (68±96)	33 (36±3)	31 (32±0)	29 (31±0)	30 (31±0)	33 (31±0)	39 (31±0)	51 (32±4)
VVA	30 (49±5)	29 (34±1)	29 (32±0)	28 (31±0)	28 (31±0)	29 (31±0)	30 (31±0)	32 (31±0)
VVF	31 (50±6)	29 (34±1)	29 (32±0)	28 (31±0)	29 (31±0)	29 (31±0)	31 (31±0)	35 (31±0)



Cross-calibration issue: inter-slice biases for QuikSCAT HH beam

The black numbers in the SRF contours indicate the slice index





Preliminary conclusions

- Significant differences between analytical and LUT-derived SRFs
- $\hat{K}_p$ and K_p (and σ_{K_p}) decrease with σ_0
- $\hat{K}_p$ has a parabolic trend w.r.t. the slice index (expected)
- K_p is overestimated for slices 0 & 1; K_p is underestimated for slices 6 & 7
- σ_0^{HH} is noisier than σ_0^{VV}
- Presence of inter-calibration issues

Future work

- Validation of the LCR-based σ_0 correction scheme
- Set-up of a K_p-dependent regression scheme
- Implementation of the coastal processor

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Questions? Please contact me at

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Thanks