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 $\sigma_0$ 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: $\text{SRF}(\psi, \text{OT}, \text{pol})$ (Prof. Dave Long)
    - $\psi$ Antenna azimuth angle
    - OT Orbit Time
    - pol beam identifier (HH or VV)
  2. Re-centering procedure

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 $\sigma_0$ noise: $\frac{\sigma_{\sigma_0}}{\bar{\sigma}_0}$
  - $\sigma_{\sigma_0}$ is the $\sigma_0$ 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

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

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

- Date: 10\textsuperscript{th} April
- 1 orbit file (40651.20071011559)
- L1B QuikSCAT Full Resolution files
  - ...
  - Slice centroid position and $\sigma_0$ value
  - Egg position and $\sigma_0$ value
  - $K_p$ coefficients
  - Satellite position and velocity info
  - Orbit Time
  - Antenna info ($\psi$, pol, incidence angle ($\theta$), ...)
  - ...

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General Quality Control

- $\sigma_0$ quality flag
  - scatterometer pulse quality is acceptable
  - $\sigma_0$ 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 $\sigma_0$
  - Interpolated ephemeris data are acceptable for this $\sigma_0$

- frame error status (communication with the SC)
- frame quality flag (telemetry frame)
- Incidence of general QC: 0.6 % HH 0.72% VV
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 $\sigma_{K_p}$) decrease with $\sigma_0$
- $\hat{K}_p$ 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
- $\sigma_0^{HH}$ is noisier than $\sigma_0^{VV}$
- Presence of inter-calibration issues
Future work

- Validation of the LCR-based $\sigma_0$ 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 grieco@icm.csic.es

Thanks