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The Altimeter Processing System (ALPS)-2 needs to filter large-magnitude, spatially correlated errors from the SWOT observations before assimilation into numerical ocean models.



Background

U.S.NAVAL RESEARCH

ABORATORY





- KaRiN noise is low-magnitude, random sensor noise.
 Roll, timing, phase, and baseline errors are spatially correlated along- and across-track. Three of them have relatively high magnitudes.
 - 3. Wet troposphere error is geophysical and will be estimated by an onboard radiometer. Can also be estimated using global atmospheric models.



Background



| Wavenumber (cyc/km) | | | | | | |
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The SWOT simulator includes along-track wavenumber power spectral density (PSD) estimates for each correlated error source.

The inverse FFT of each estimated spectrum represents a filtering kernel that can be passed over the SSH observations.

Here, we show preliminary results which quantify how well this process estimates each error







Each error source has a specific across-track shape.

Therefore, at each alongtrack point we can estimate:

Error=shape_function * a_i

where a_i is a magnitude that satisfies the condition.

a_i is estimated by making a least squares fit between the error and the across-track shape function at each along-track point.



ifft of the spectra compare favorably with the lagged autocovariance of a long string of error output. Our kernel is reasonable.





- The kernel is convolved over a_i to generate a filtered version of a_i.
- That smoothed a_i can be used to reconstruct a smoothed error field based on Error=shape_function * a_i.
- The next section provides examples and quantifies how well the filtering recreates the true error sources generated by the SWOT simulator.



U.S. NAVAL LABORATORY ALPS-2 SWOT Data Processing Results – Roll estimate



True roll error - [a_i filtered * roll_shape]





True phase error

a_i filtered * phase_shape 10



True phase error

a_i filtered * phase_shape 11





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True phase error – [a_i filtered * phase_shape]









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True baseline error – [a_i filtered * baseline_shape]





True timing error

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Results – Timing estimate



True timing error – [a_i filtered * timing_shape]



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ALPS-2 can read in SWOT simulator data and filter the error sources based on the spectral estimates.



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- The method provides a reasonable estimate of the correlated error sources and can be used to filter the SWOT data.
- Next steps:
- 1. Need to apply to the real SSH data instead. Current results are currently too idealized.
- 2. Based on step (1), calculate real reduction of error plus potential damage done to real geophysical structures with spectra similar to the spectral estimates we used.
- 3. Once filtering code is solidified, need to run Observing System Simulation Experiments (OSSEs) to quantify how much the processing and filtering affects ocean state estimation and forecasting using more realistic versions of the SWOT data.