Across-track Dilation Compensation

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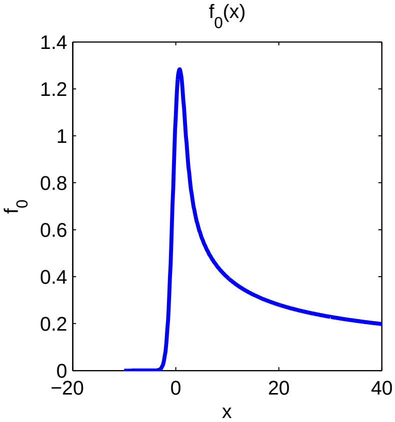
Background

The backscattered mean power of a SAR altimeter can be modeled by the following function, where G is the antenna gain and H_s is the significant wave height, k is the range bin and ℓ is the doppler bin. (TGRS Feb 2015)

$$P_{k,\ell} = G_{k,\ell}\sqrt{g_\ell} f_0(g_\ell(k-k_0))$$

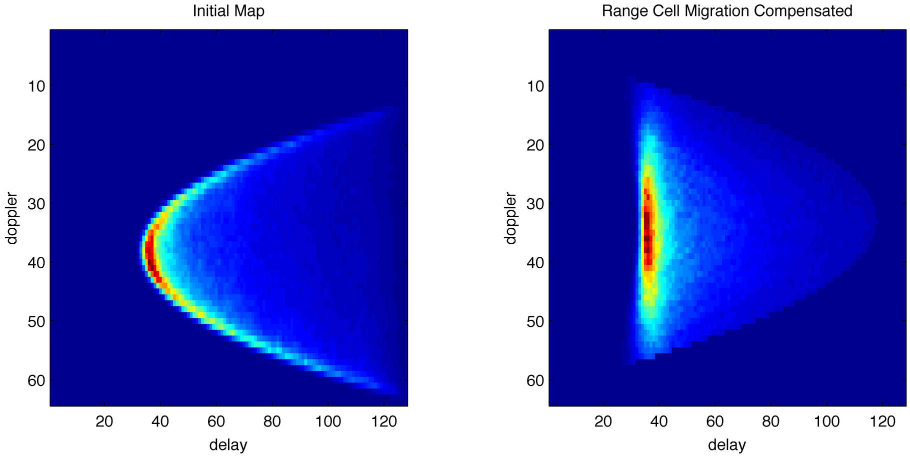
$$f_0(x) = \int_0^\infty e^{-(u^2-x)^2)/2} du$$

$$g_\ell^{-2} = a + b\ell^2 + cH_s^2$$



Range Cell Migration Compensation

The delay doppler map of the power usually is compensated for range cell migration.



Amplitude Compensation

Compensating for the amplitude term

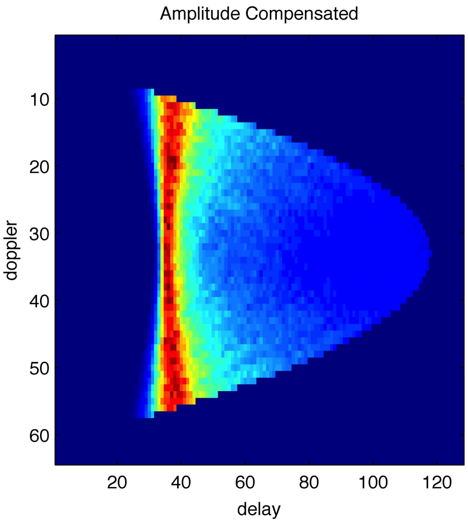
$$G_{k,\ell}\sqrt{g_\ell}$$

in the power

$$G_{k,\ell}\sqrt{g_\ell}f_0(g_\ell(k-k_0))$$

we create a delay dopple map that is of equal amplitude for all doppler

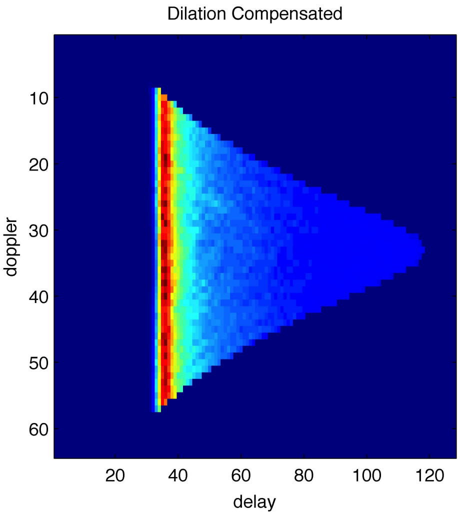
$$P'_{k,\ell} = f_0(g_\ell(k-k_0))$$



Dilation Compensation

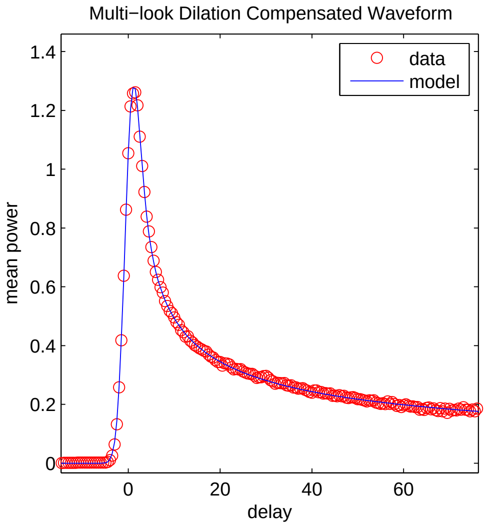
Compensating for the range scaling g_ℓ we create a power waveform that is identical for all dopplers.

$$P''_{k,\ell} = f_0(g_0(k - k_0))$$



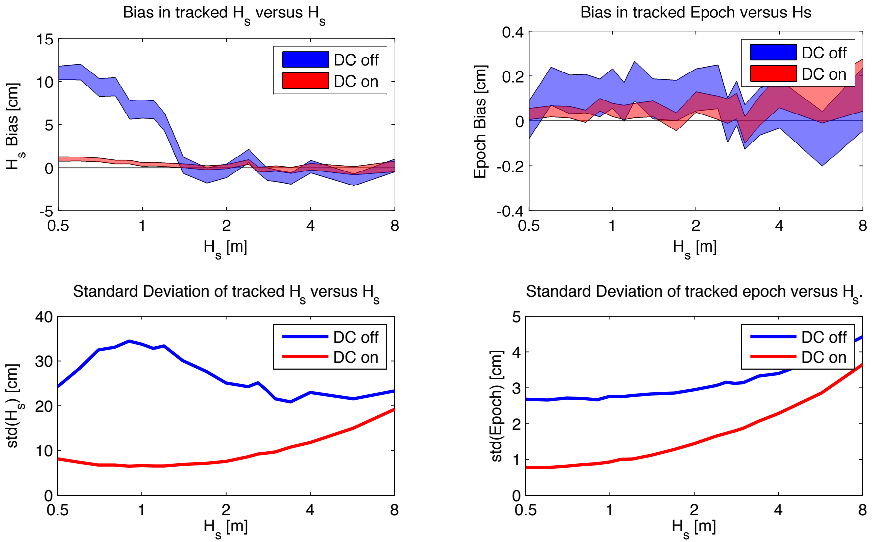
Multi-look waveform

The multi-look waveform is the average of the dilation compensated power, and is fit by simply $P = Af_0(g_0(k - k_0))$.

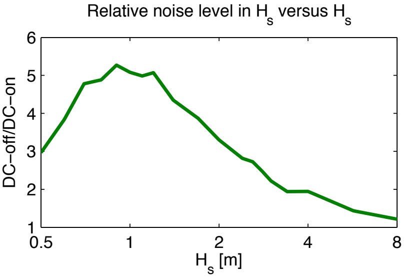


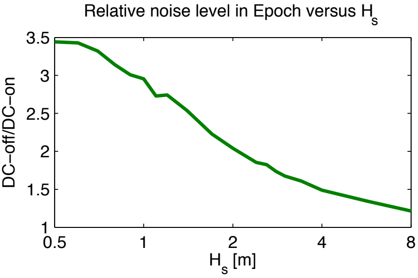
Tracking Improvements

Comparing the tracked H_s and Epoch using this Dilation Compensated (DC) waveform with the conventional waveform.



Tracking Improvements





Conclusions

- Noise level has been reduced by up to a factor of 5, leading to higher precision measurements.

- Multi-look waveform is represented by $P = Af_0(g_0(k - k_0))$.

- The range scale g_0 depends only on the significant wave height. The offset k_0 depends only on the epoch.

- Waveform depends only on the sea state, e.g. it does not depend on the anti-aliasing filter.

- Retracking computation reduced by two orders of magnitude.

Acknowledgments

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Thank you for your attention