High resolution wide-swath altimetry anticipated from the SWOT mission

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The limit of resolution of Jason-1/2

- Drop in energy of 2-D gridded SSH spectrum (blue) vs alongtrack spectrum (red) at 200 km indicates the mapping resolution (AVISO product) from the nadir altimeter constellations.
- The challenge of the SWOT Mission is to observe SSH at wavelengths shorter than 200 km

The future SWOT mission

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Oceanographic performance requirement

Left: Global mean power spectrum of SSH estimated from Jason series satellites (thick black curve). For wavelength <100km, a linear fit has been applied following (Xu and Fu, 2012). Lower limits of the 68% and 95% percentiles are indicated. Red and blue spectra: baseline and threshold requirement for the SSH accuracy. The baseline (threshold) requirement leads to 15 km (20 km) resolution over 68% of the ocean.

- For oceanography, requirements are specified in the spectral domain
- In order to observe fine scales (~20km wavelength) in most of the regions, the level of noise has to be almost 2 orders of magnitude below conventional altimetry

Spatial distribution of the resolved wavelength (baseline)

- < 35km everywhere
- The small values in the tropical band are caused by shallow spectral slopes that may not reflect ocean eddy signals (e.g., internal waves)

Wet tropospheric correction

- Conventional nadir-looking one-beam radiometer is not sufficient for correcting the cross-track variability of the range errors caused by the tropospheric water vapor.
- The two-dimensional swath measurement of SWOT needs a two-beam radiometer for wet-tropospheric corrections.

Need for the nadir altimeter

- The long-wavelength accuracy of the SSH measurement is expected higher for the nadir altimeter than KaRIn.
- By combining the two measurements simultaneously, a consistent measurement from short (KaRIn) to long wavelengths (altimeter) can be obtained.
- Strong heritage of error analysis from nadir altimetry (T/P, Jason1, Jason2, Saral/Altika, ...)
- Calibration and validation of SWOT in setting the standard for the next generation altimetry missions to continue the climate data record of sea level and improve its resolution and coverage.

Simulated SWOT ocean observations

- With Jason-1 + Jason-2, only large scales >200km are captured. Eddies are severely attenuated.
- The finescale features of the reference truth field are captured by the simulated SWOT observations.
- Drastic Improvement in retrieving the geostrophic velocity (derivative of SSH).

References

- Fu and Ubelmann, 2014: On the Transition from Profile Altimeter to Swath Altimeter for Observing Global Ocean Surface Topography, JTECH (in press)
- Ubelmann et al., 2014: The effect of atmospheric water vapor content on the performance of future wide-swath ocean altimetry measurement, JTECH (accepted)