High-resolution coastal bathymetry retrieved from satellite data: a research application within the Co-ReSyF project.

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Ocean swell waves from SAR images

Linear dispersion relationship for ocean surface waves:

\[ \omega^2 = g k \tanh(kh) \]

\[ h(k, \omega) = \frac{1}{k} \tanh^{-1} \left( \frac{\omega^2}{g} \right) \]

- \( k \) \rightarrow wave number
- \( \omega \) \rightarrow angular frequency
- \( h \) \rightarrow depth

Two methodologies to retrieve \( h \) from \( k \) and \( \omega \):

- "Fixed Grid Method" [1]
  - \( \omega \) constant for the entire grid
  - \( h \) computed offshore from wave data (buoys or models)
- "Ray-Tracing Method" [2]
  - \( \omega \) constant for each wave track
  - \( h \) computed offshore using a reference bathymetric model

Both methods need optimal swell conditions (\( \omega \) constant)

Underwater topography estimation through wave length modification in shoaling waves (typically 100 to 10 m)

Discussion and Future Work

The resulting bathymetric models show most of the topographic structures and reproduced the correct slope, with an average of 15 to 20% errors for the absolute depth values, mainly due to the small scale variability of the SAR image.

In the future, the final bathymetry for a given region will result from the average of multiple images, in order to reduce the high variability obtained by individual images. SAR derived bathymetry looks promising and can provide topographic information at higher resolution, especially in remote areas where the traditional hydrographic surveying methods are not performed regularly.

The fusion of SAR and Optical data to provide higher coverage and resolution over shallower waters is under development.

Tests of this synergy will be conducted in the region around Sines, in the southwestern coast of Portugal.

References


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