

## Wave inversion in coastal area

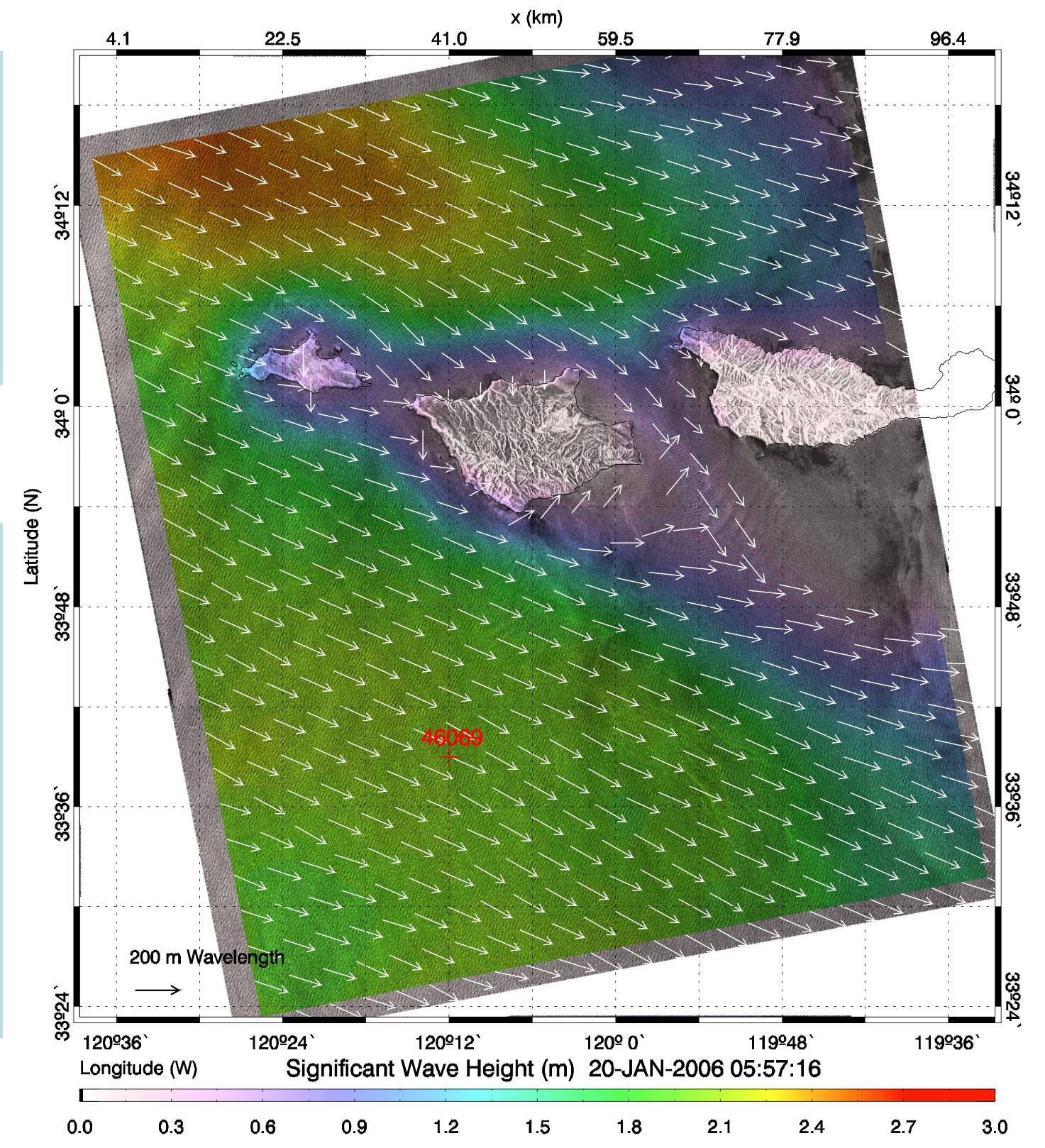
## from ASAR narrow and wide swath SLC

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Wave spectra inversion scheme is adapted for shallow water from ESA's operational processing techniques used for level 2 ocean wave products. Under the low to moderate wind speed observed conditions, overall good agreement is found between in-situ and SAR observations, over a wide range of wave heights and directions, including waves propagating in the radar azimuth direction

The exact derivation of the nonlinear transform being too cumbersome to carry out, most of the inversion schemes partially ignore the complete nonlinear mapping and mostly use the simplifying gradient of a so-called optimized SAR quasi-linear transform that best matches the full nonlinear transform. Here the non-linear contribution removal is performed with a resampling of the image cross-covariance function at short lags.

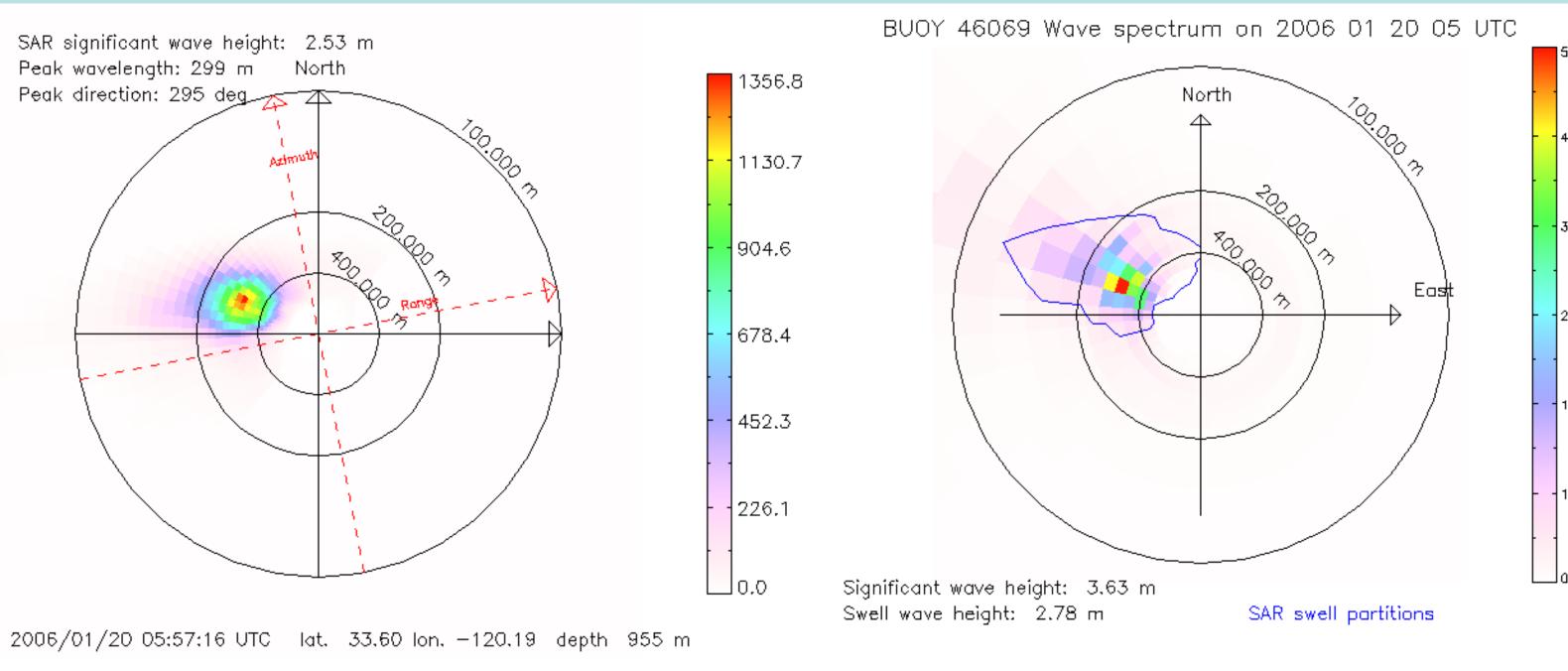
F. Collard, F. Ardhuin and B. Chapron, Extraction of Coastal Ocean Wave Fields from SAR images, IEEE J. Oceanic Engin., Vol 30.(3), pp. 526-533, Jul. 2005.



The inversion is performed from a small part (4km x 4km) of the full image. Each SAR spectrum is partitioned and only the swell part is considered. For each swell partition, the associated swell partition is considered in the buoy spectra (inside the blue contour on the buoy spectrum). The buoy spectrum is estimated from the 4 NDBC parameters using the Maximum Entropy Method (MEM) from Lygre et Krogstad, JPO v16 1986. The 2D BUOY spectrum is a frequency spectrum and is remapped in the 2D wavenumber space for direct visual comparison with the SAR Spectrum but the colorscales do not match since the BUOY spectrum unit is m^2\*s^2/rad whereas the SAR spectrum unit is m^4/rad.

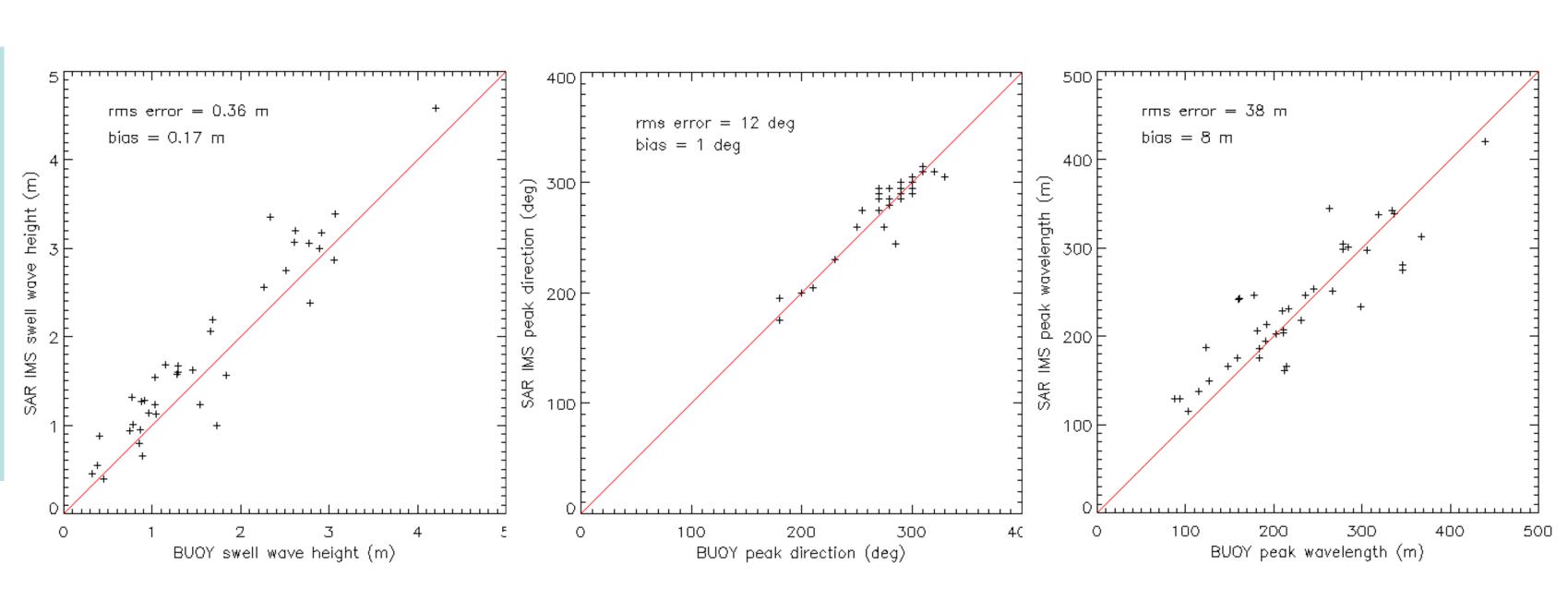
## The different steps in the inversion are:

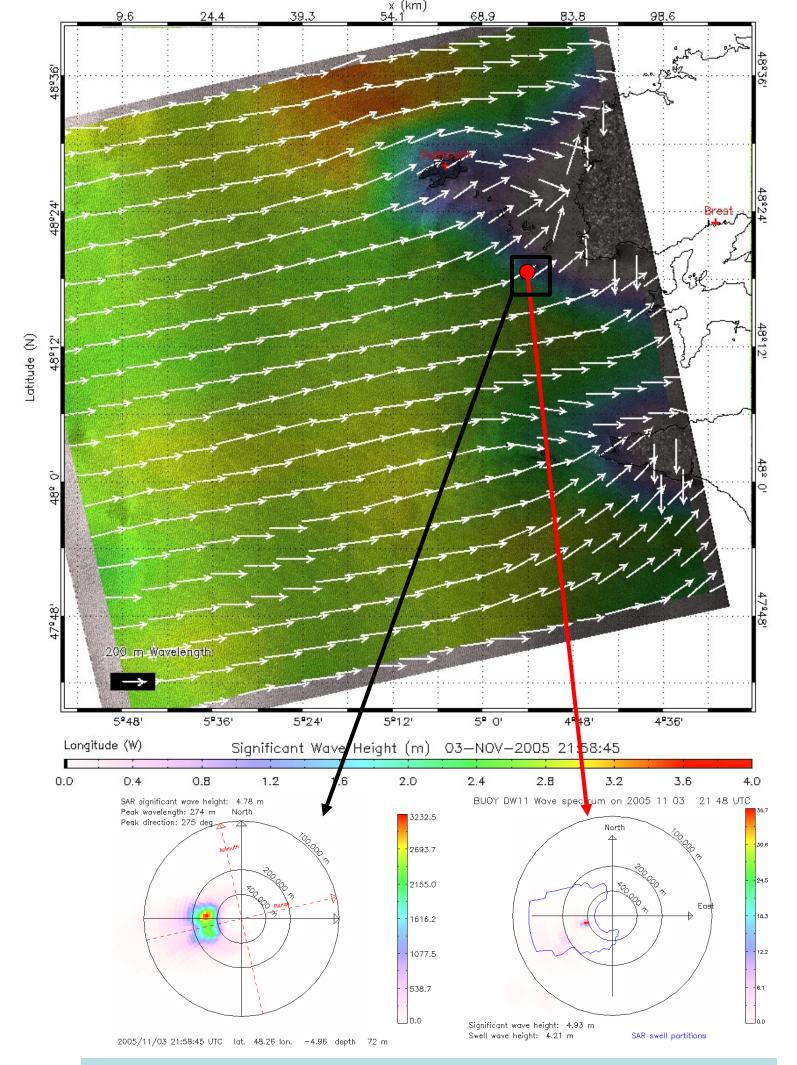
- 2) Wind speed estimation
- 3) Non wave signature removal
- 4) Cross spectra estimation
- 5) Non linear corrections.
- 6) Azimuth cutoff estimation.7) Quasi linear inversion
- 8) Spectral Partitionning
- 9) Ambiguity removal
- 10) Cartesian to polar mapping



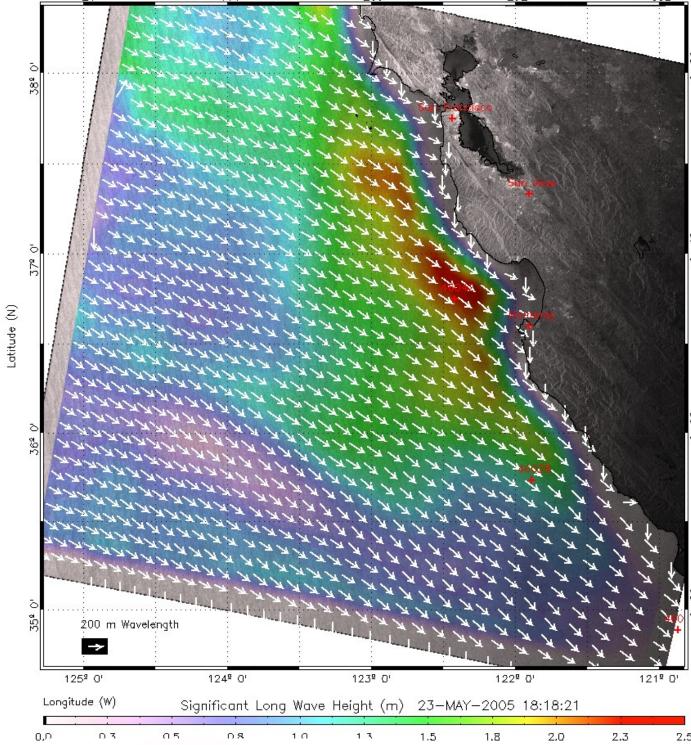
All **integrated parameters** in the comparison below, are estimated from the spectral area inside the blue contour (BUOY spectrum) to ensure a comparison over corresponding swell systems. the validation dataset has been carefully selected to avoid useless situations were the swell cannot be measured due to a low wind speed or too small swell energy.

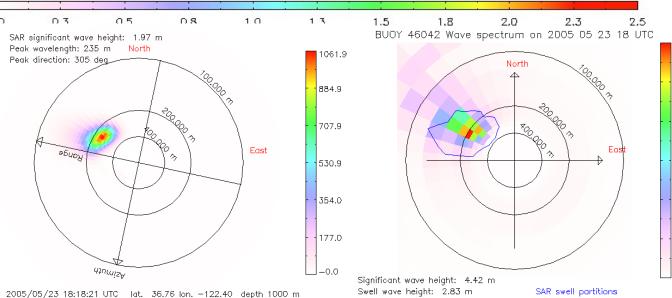
The analysis of SAR images can yield a large amount of information for coastal applications, including wave spectra and their variation in space. A straightforward adaptation of the ENVISAT ASAR level 2 algorithm to the processing of narrow swath complex images is demonstrated.



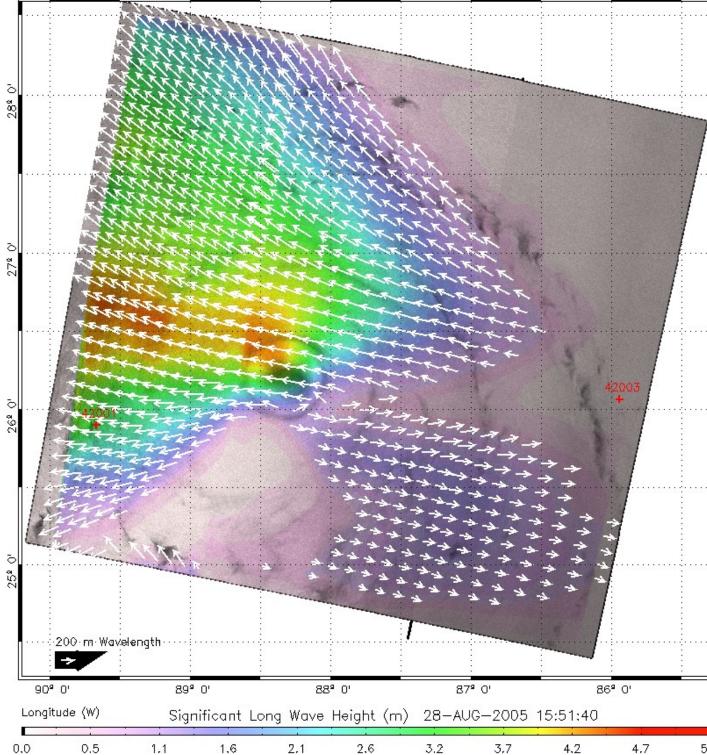


**Storm wave field** in the viscinity of the iroise sea on nov 3, 2005





Storm wave field in the viscinity of Monterey bay on may 23, 2005



The swell wave field in the viscinity of Katrina Hurricane exhibit a caracterisctic assymatric pattern caused by the Hurricane motion towards the north west.







