



# Wave inversion in coastal area

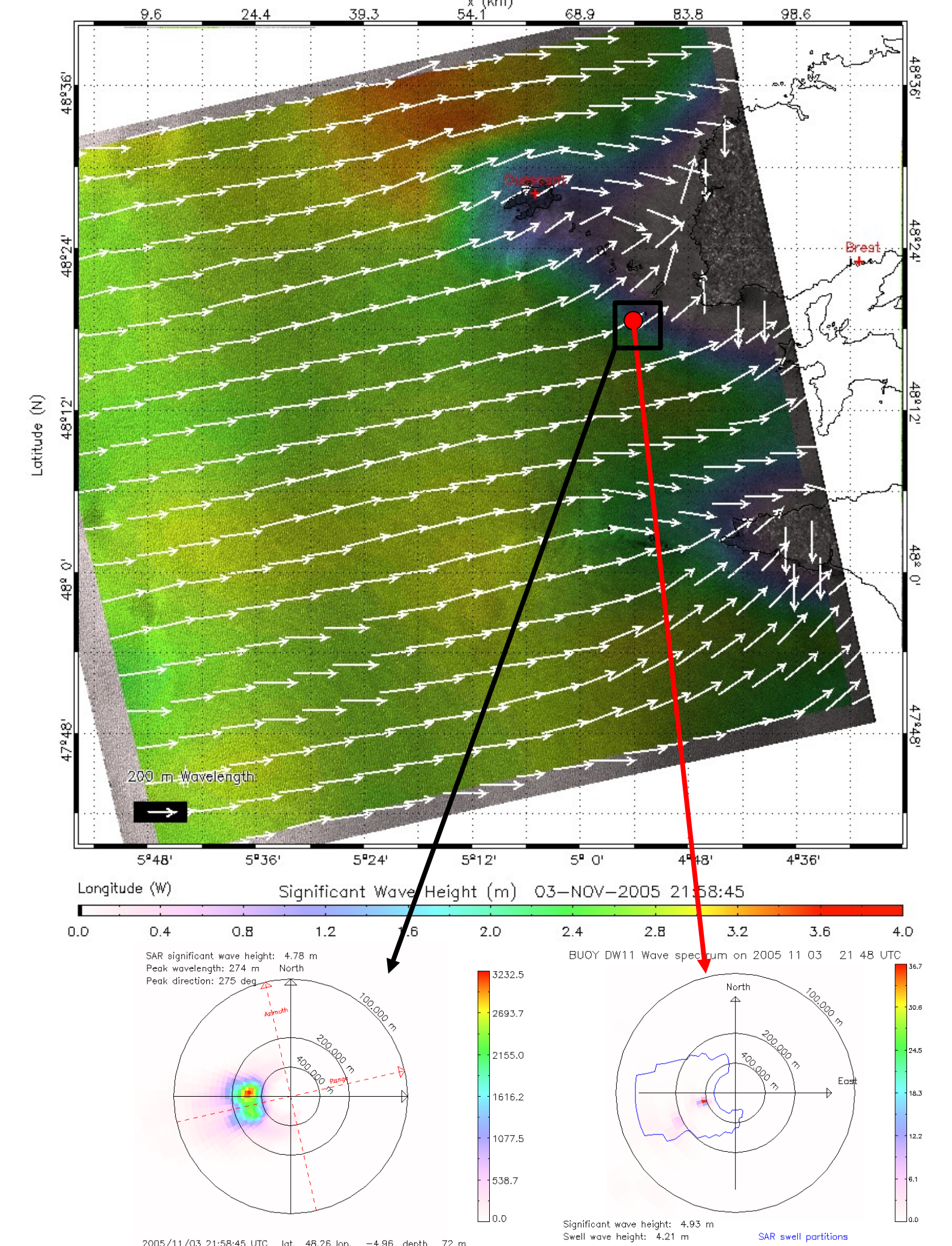
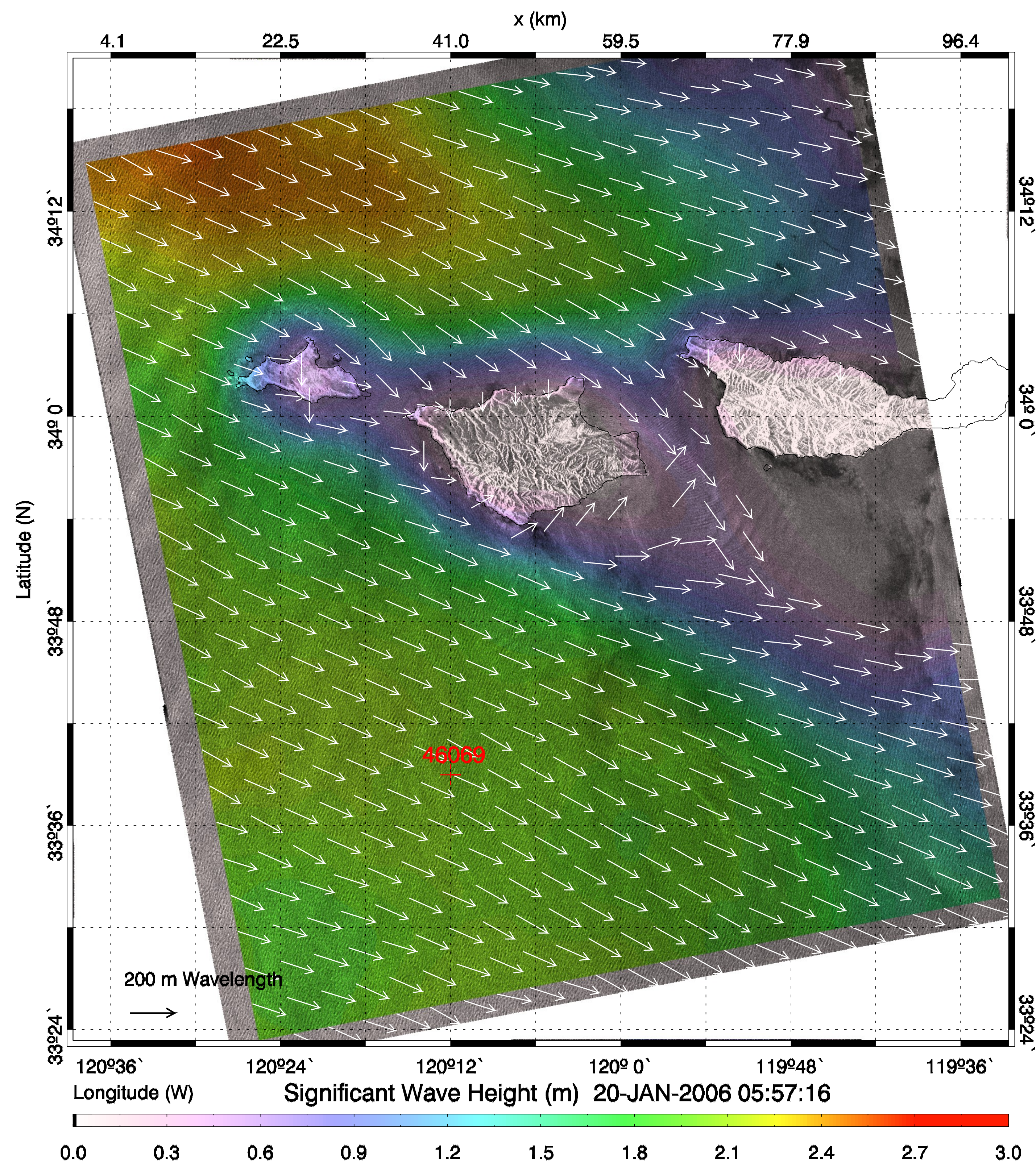
from ASAR narrow and wide swath SLC

F.Collard (BOOST), B.Chapron (IFREMER), F.Ardhuin (SHOM), H.Johnsen (NORUT)

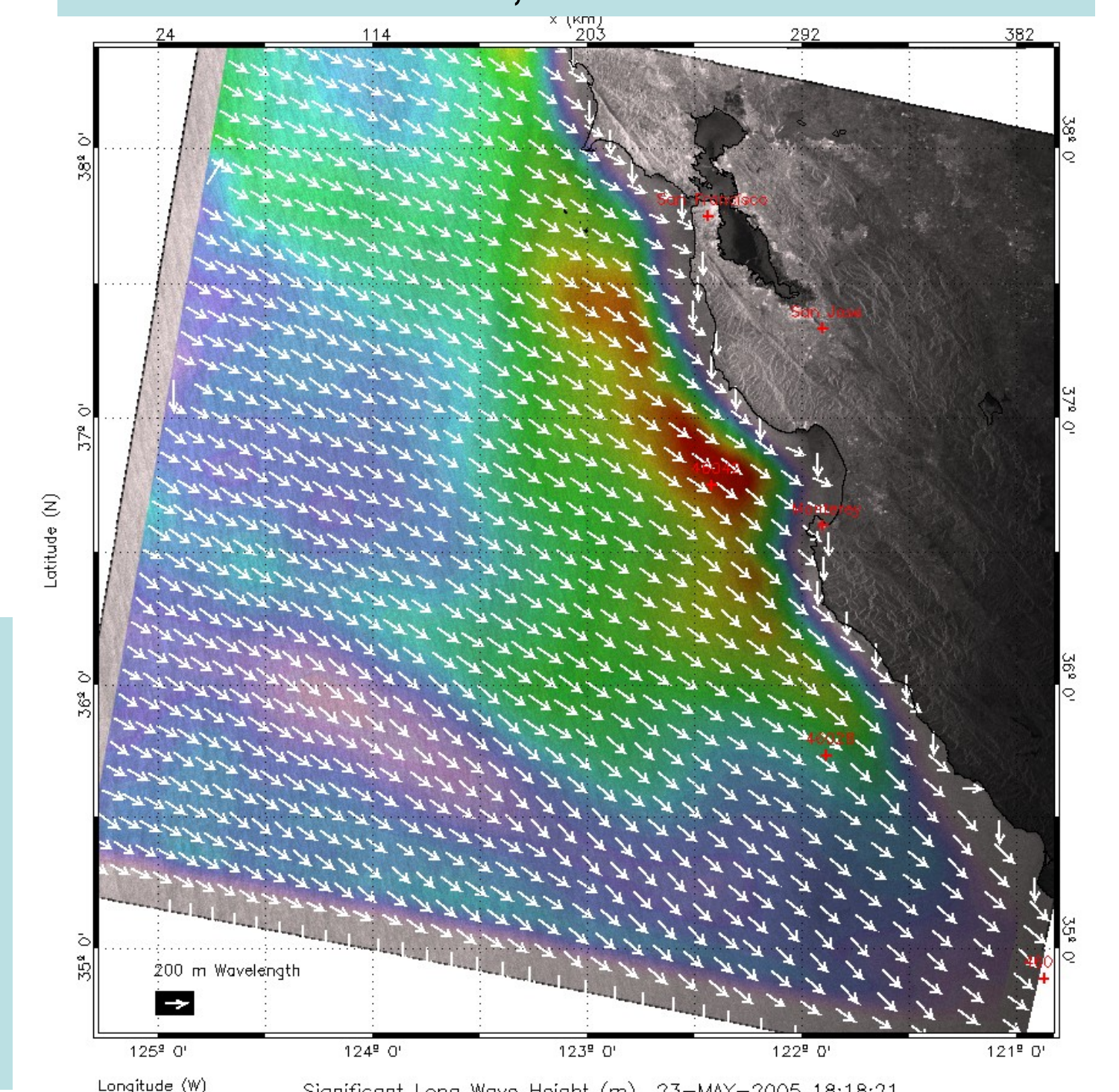
**Wave spectra inversion scheme** is adapted for shallow water from ESA's operational processing techniques used for level 2 ocean wave products. Under the low to moderate wind speed observed conditions, overall good agreement is found between in-situ and SAR observations, over a wide range of wave heights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

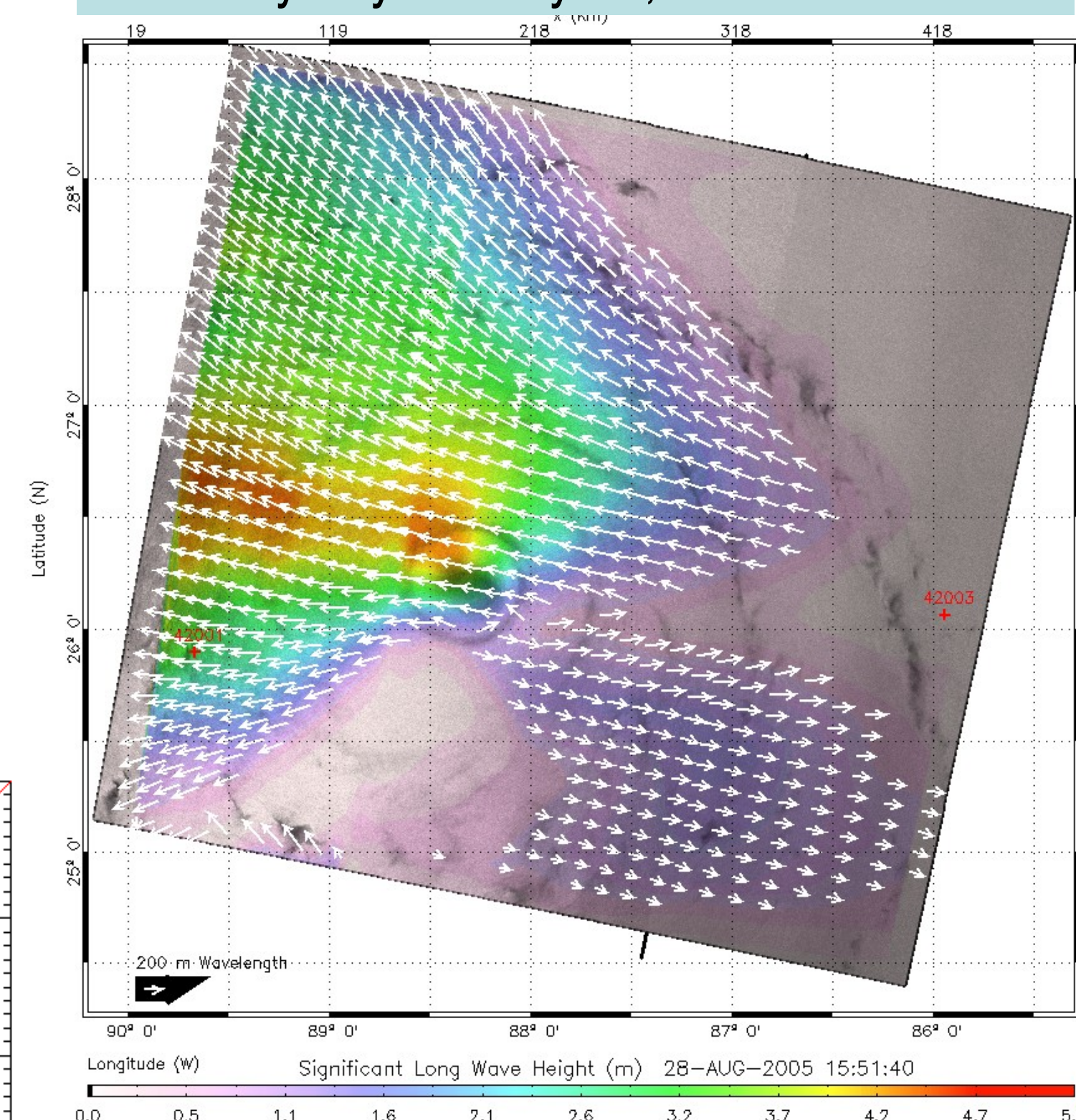
**F. Collard, F. Ardhuin and B. Chapron,** Extraction of Coastal Ocean Wave Fields from SAR images, IEEE J. Oceanic Engin., Vol 30.(3), pp. 526-533, Jul. 2005.



Storm wave field in the vicinity of the Iroise sea on nov 3, 2005



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

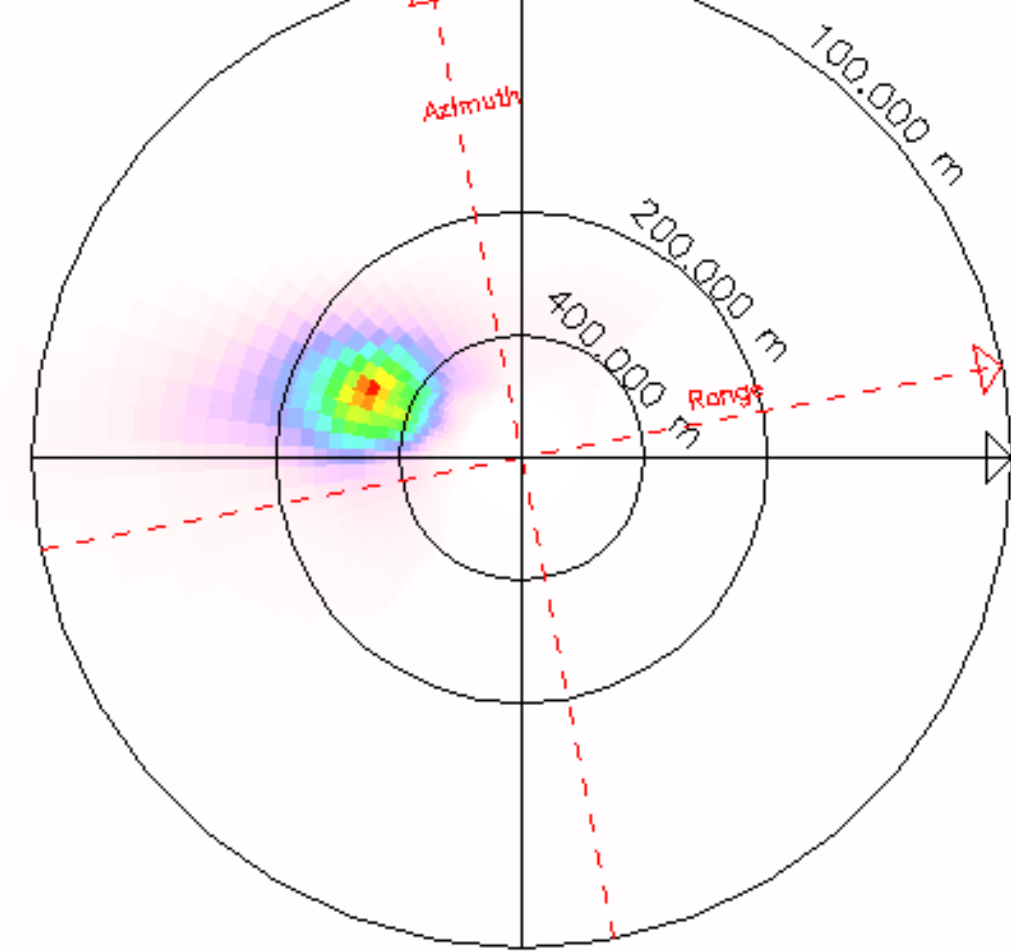


The swell wave field in the vicinity of Katrina Hurricane exhibit a characteristic asymmetric pattern caused by the Hurricane motion towards the north west.

**The different steps in the inversion** are :

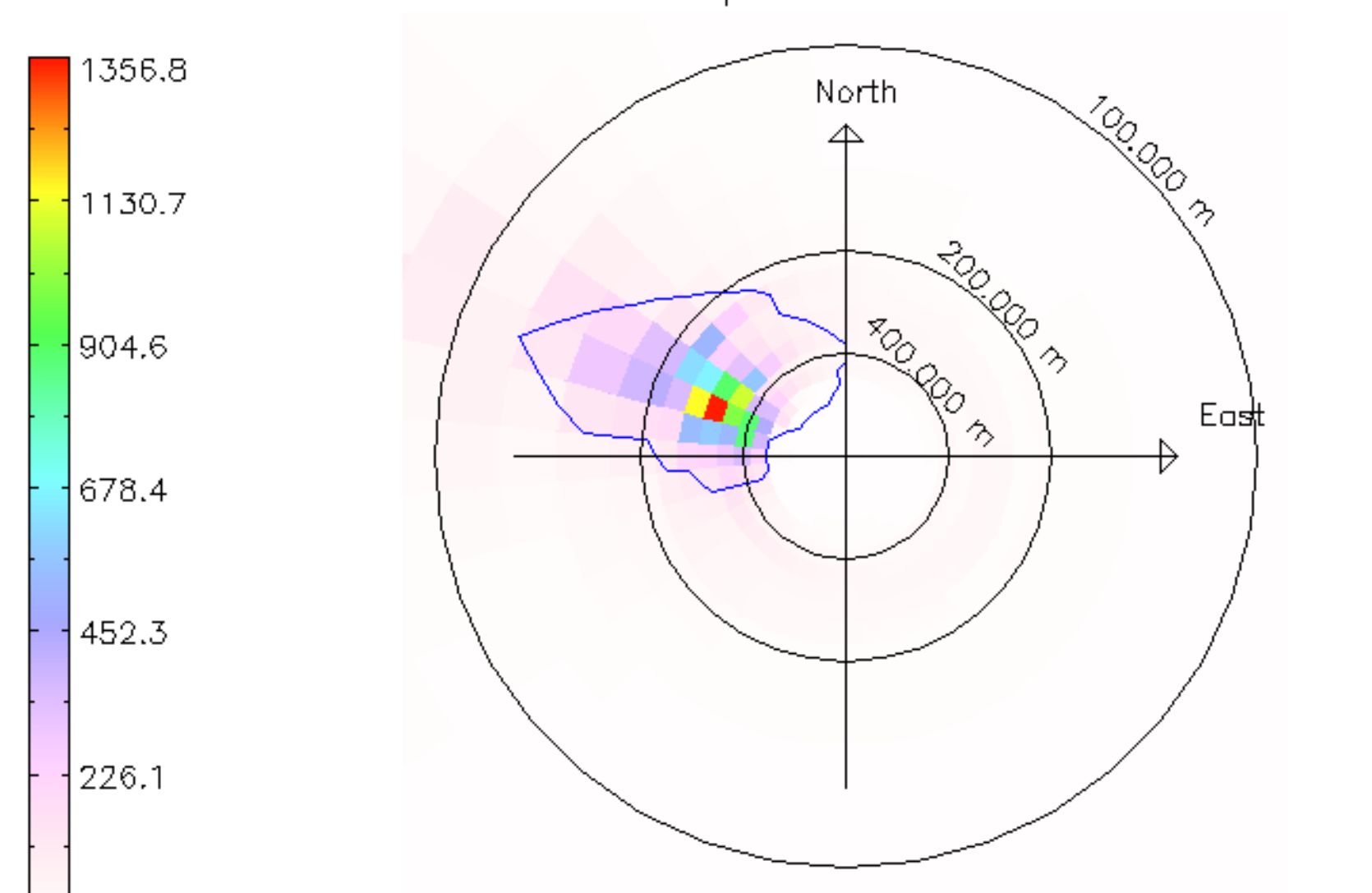
- 2) Wind speed estimation
- 3) Non wave signature removal
- 4) Cross spectra estimation
- 5) Non linear corrections.
- 6) Azimuth cutoff estimation.
- 7) Quasi linear inversion
- 8) Spectral Partitioning
- 9) Ambiguity removal
- 10) Cartesian to polar mapping

SAR significant wave height: 2.53 m  
Peak wavelength: 299 m North  
Peak direction: 295 deg



2006/01/20 05:57:16 UTC lat. 33.60 lon. -120.19 depth 955 m

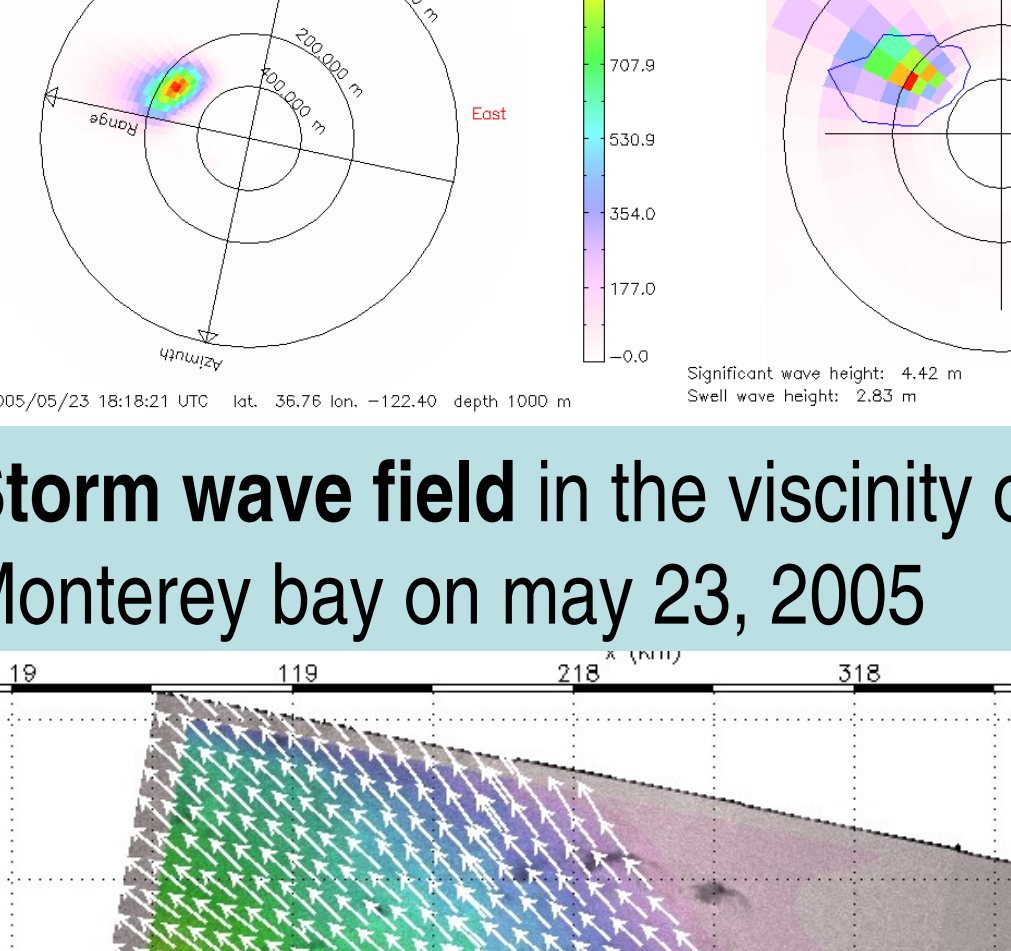
BUOY 46069 Wave spectrum on 2006 D1 20 05 UTC



Significant wave height: 3.63 m  
Swell wave height: 2.78 m

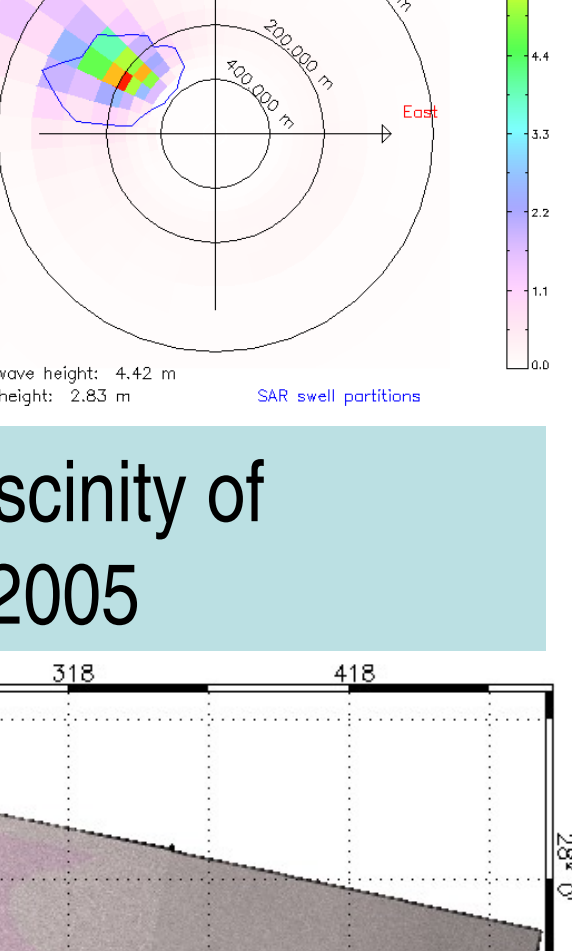
SAR swell partitions

SAR significant wave height: 1.97 m  
Peak wavelength: 235 m North  
Peak direction: 310 deg



2005/05/23 18:18:21 UTC lat. 36.76 lon. -122.40 depth 1000 m

BUOY 46042 Wave spectrum on 2005 05 23 18 UTC



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.

