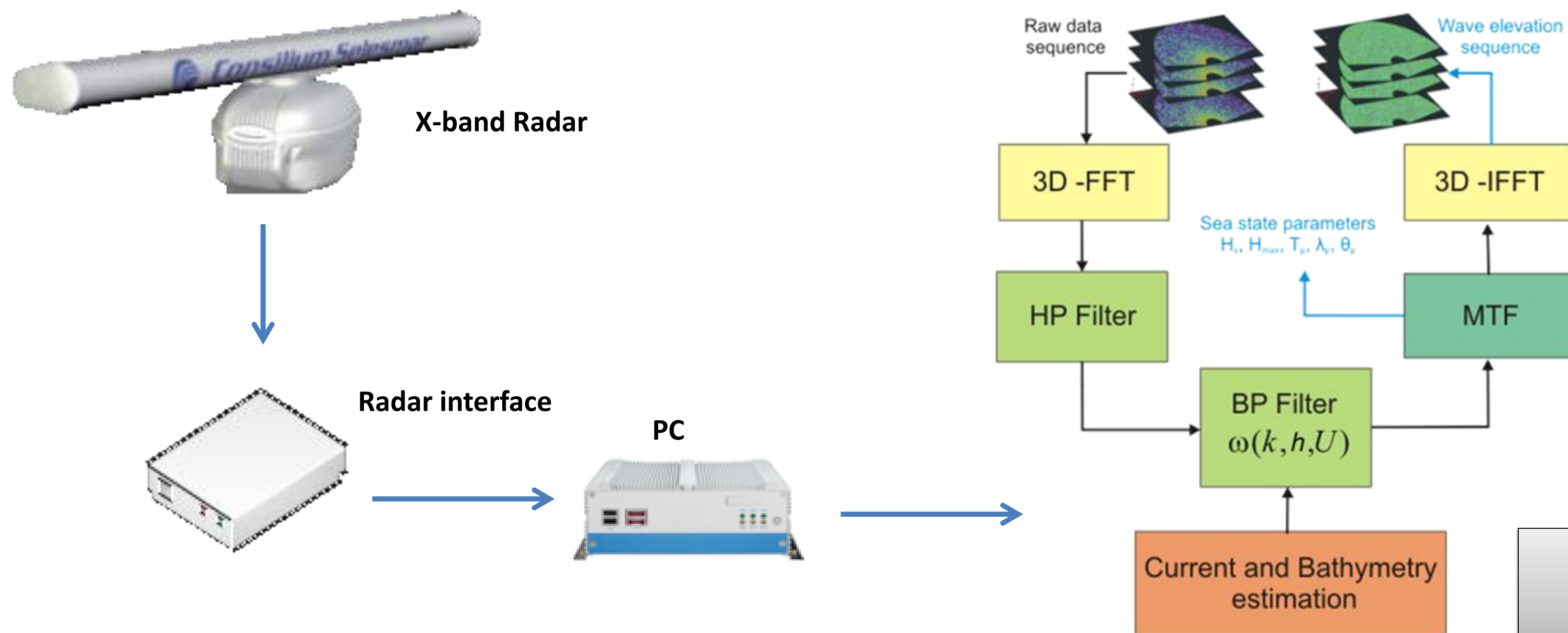


# X-BAND RADAR SYSTEM FOR SEA SURFACE MONITORING

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**Abstract-** The X-Band radar system provides the opportunity to scan the sea surface with high temporal and spatial resolution. This possibility arises from the fact that the backscattering from the sea is captured by the marine radar. Radar imaging of the sea surface provides reliable information about the spatial-temporal behavior of wave fields, [1],[2] as: wavelength, period and direction of dominant waves, significant wave height and high resolution surface and bathymetry maps. With extant installations of nautical radar systems in all marine structures, platforms and ships, the measurements may be implemented in a very cost-efficient way, even during severe meteorological conditions.

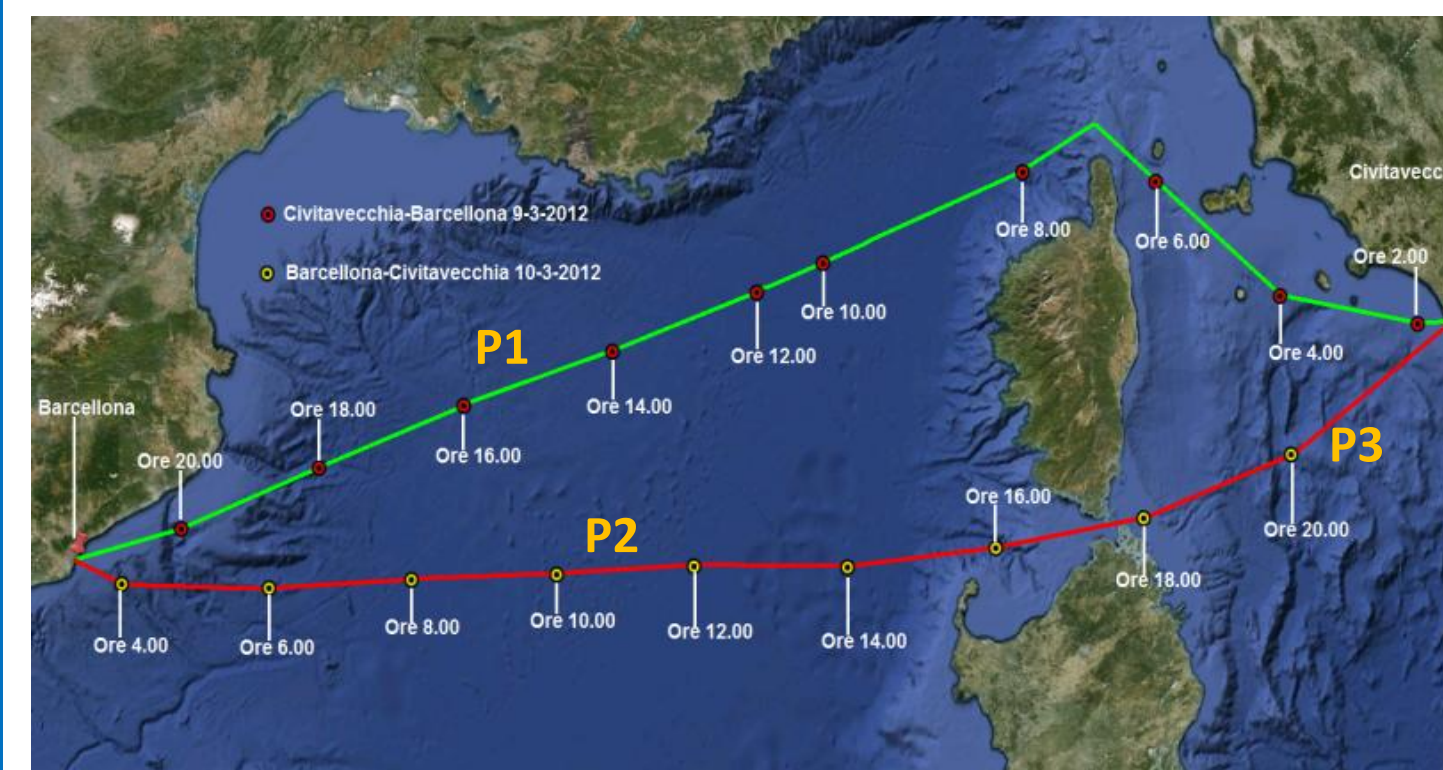


Data processing consists in solving a linear inverse problem where, starting from a series of spatial radar images collected at different time instants, the aim is to determine the elevation of the sea surface. The inverse procedure is summarized in the block diagram on the left. The current and bathymetry estimation represents intermediate step of the processing, they have to be estimated from the radar images and their accuracy strongly effects the accuracy of the results

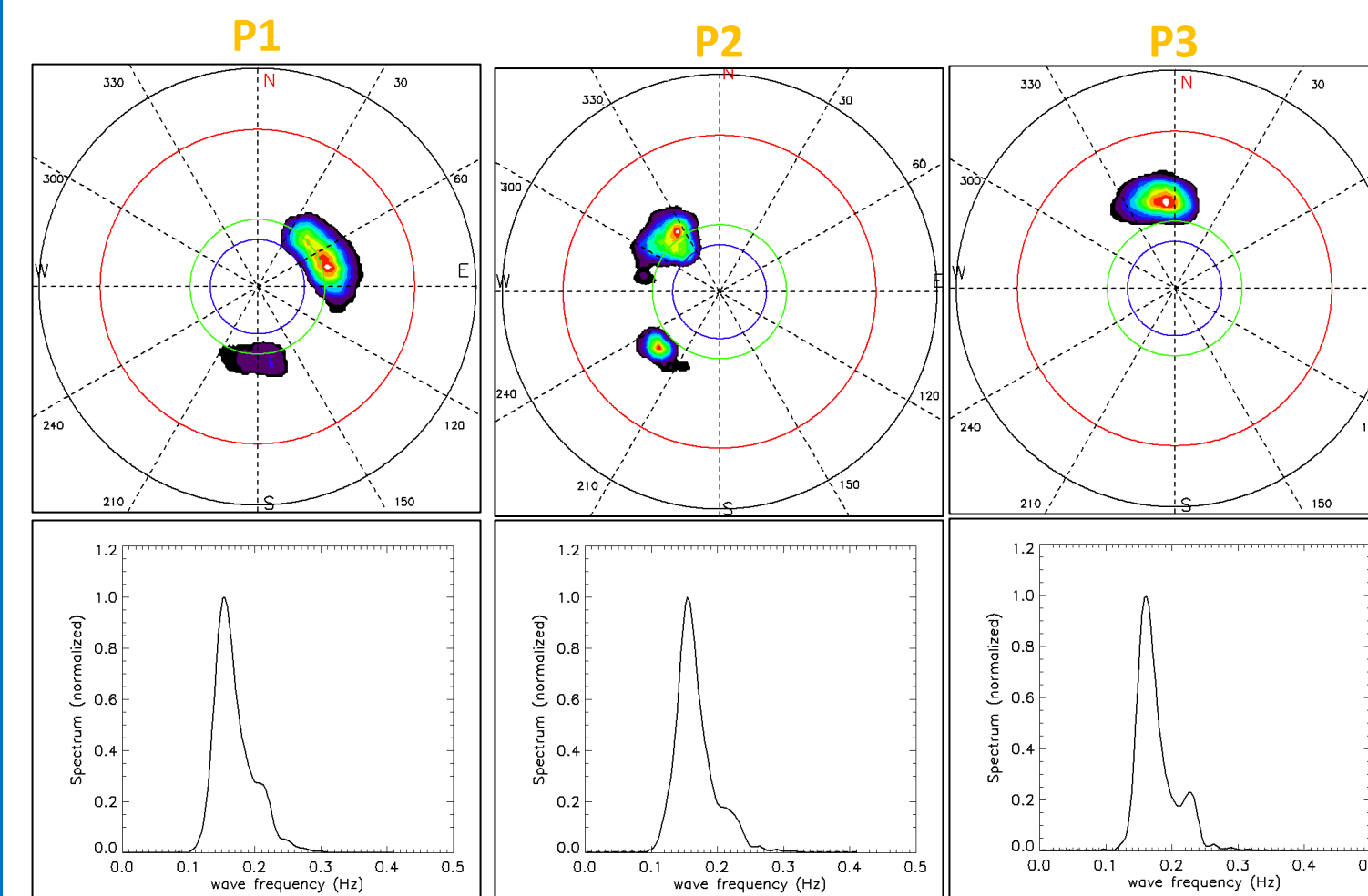
## On board Monitoring

## Coastal Monitoring

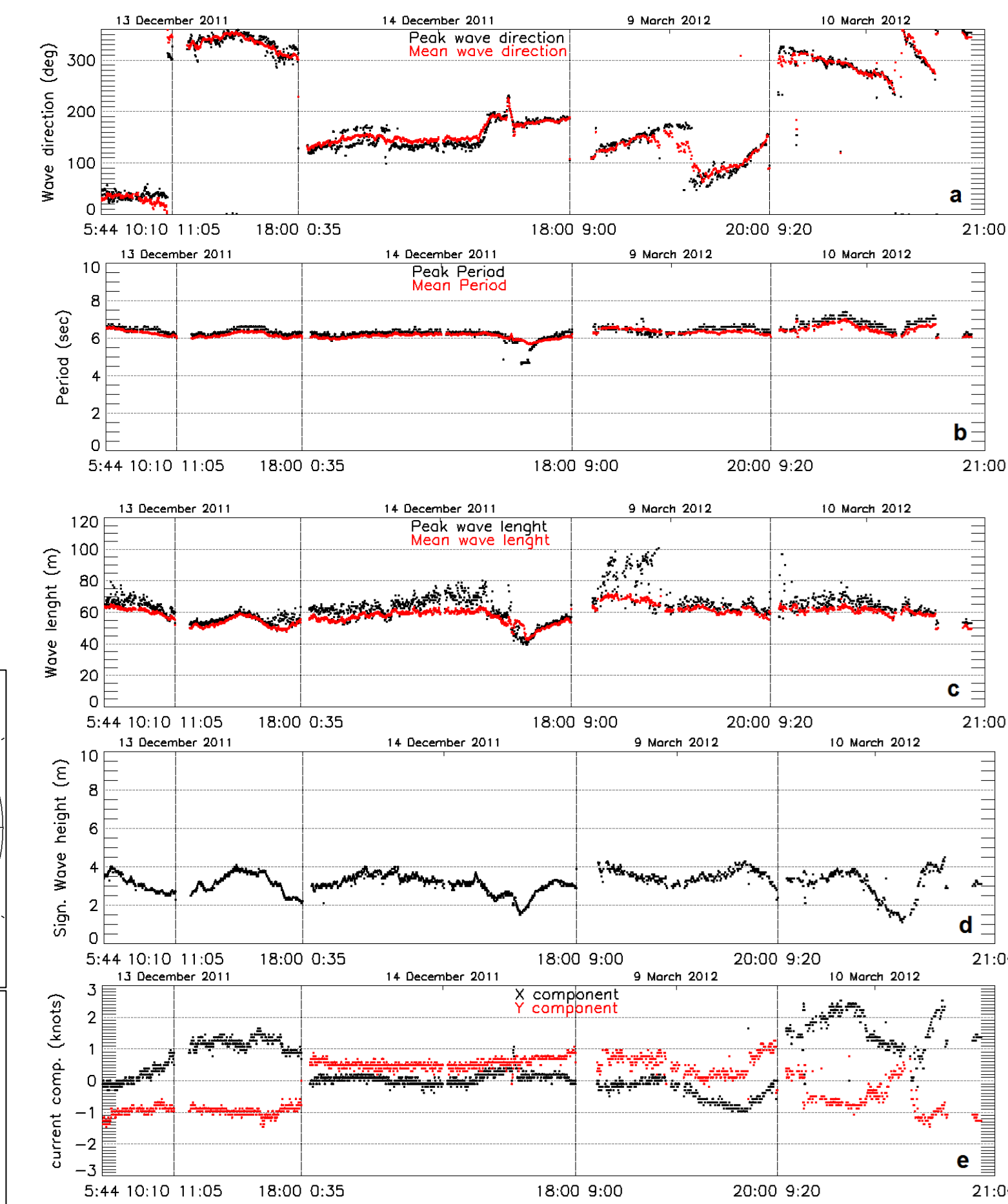
The analysis of the images acquired by an X-band radar installed on a ships allows to have the information about the sea state and the sea surface current. This information may be useful for the navigation when the visibility is poor and/or in presence of rough sea.



Navigation lane from Civitavecchia to Barcelona and return on the 9<sup>th</sup> and 10<sup>th</sup> March 2012

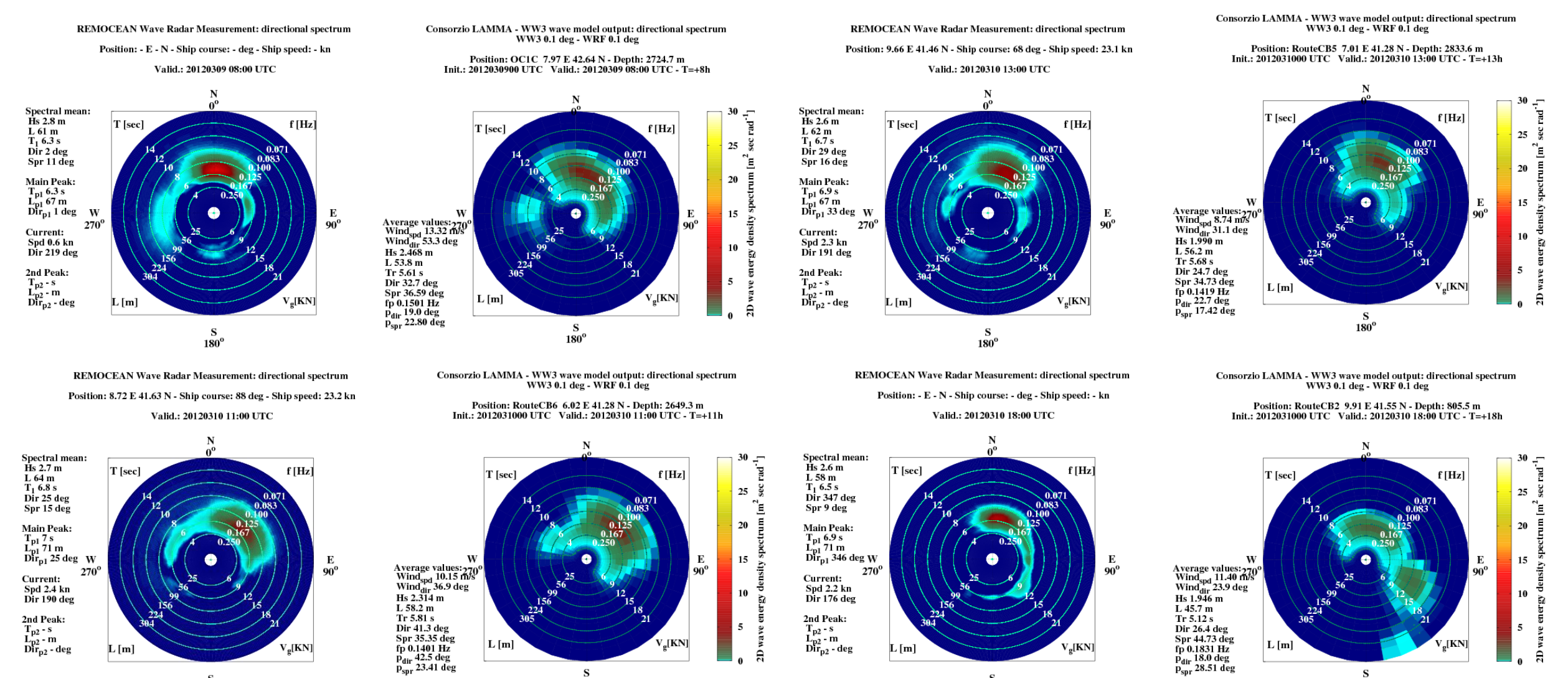


2-D Directional Spectrum and 1-D Spectrum provided by the system

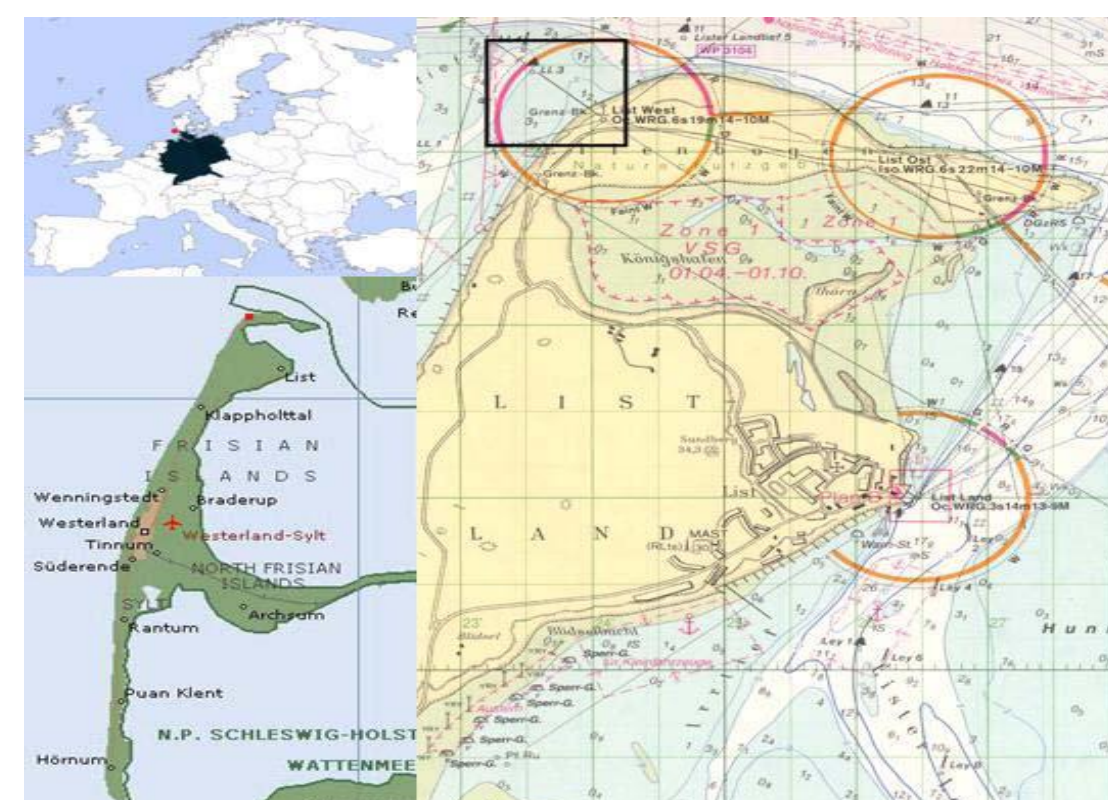


Panels a)- e) depict the sea state parameters time series estimated during the four days of navigation.

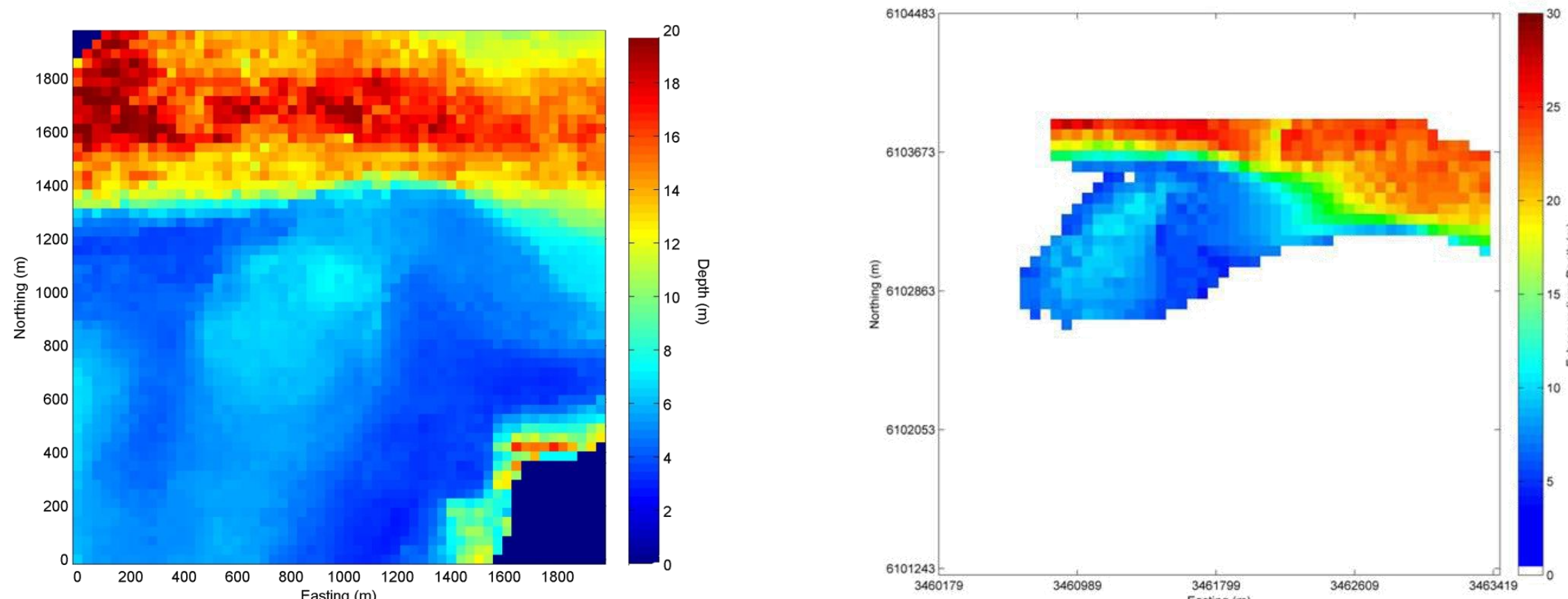
## Comparison of the 2-D Directional Spectrum



Comparison between directional spectrum generated by X-band (REMOCEAN) system and WW3 model provided by LAMMA-Toscana



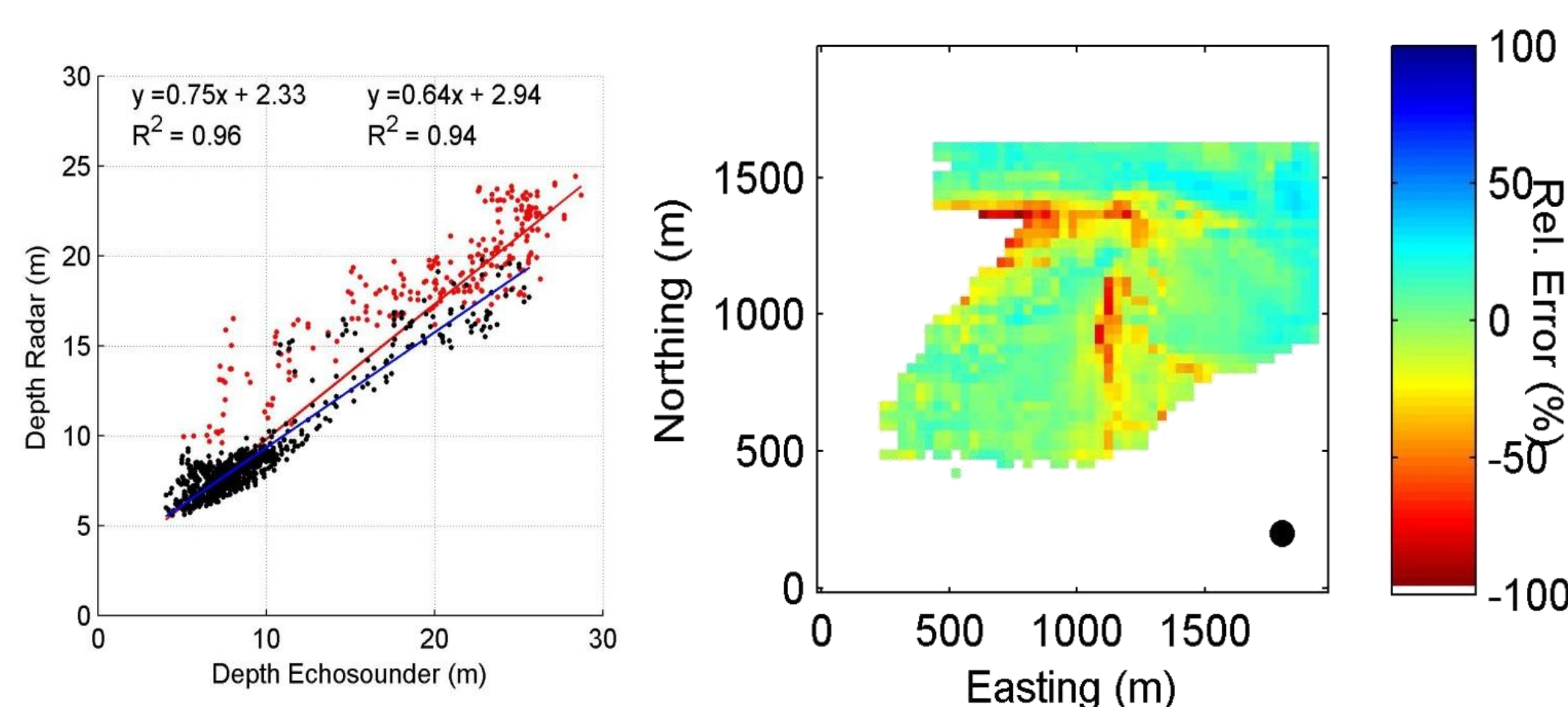
Coastal area of Sylt island in Germany, the black square indicates the area of analysis where x-band radar images have been acquired



Average bathymetry estimated over 12 hours of acquisition (spatial resolution equal to 34 m)

Multibeam echosounder bathymetric data (spatial resolution equal to 42 m).

## Validation



Left: Scatter plot between the echo-sounder's bathymetry and the X-band radar bathymetry. Right: The spatial distribution of the relative error, which depicts the error sources: Deepest and steepest areas.