Geophysical Research Abstracts
Vol. 19, EGU2017-15778, 2017
EGU General Assembly 2017
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X-Band wave radar system for monitoring and risk management of the coastal infrastructures

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The presence of the infrastructures in coastal region entails an increase of the sea level and the shift of the sediment on the bottom with a continuous change of the coastline. In order to preserve the coastline, it has been necessary to resort the use of applications coastal engineering, as the construction of the breakwaters for preventing the coastal erosion. In this frame, the knowledge of the sea state parameters, as wavelength, period and significant wave height and of surface current and bathymetry can be used for the harbor operations and to prevent environmental disasters.
In the last years, the study of the coastal phenomena and monitoring of the sea waves impact on the coastal infrastructures through the analysis of images acquired by marine X-band radars is of great interest [1-3]. The possibility to observe the sea surface from radar images is due to the fact that the X-band electromagnetic waves interact with the sea capillary waves (Bragg resonance), which ride on the gravity waves. However, the image acquired by a X-band radar is not the direct representation of the sea state, but it represents the sea surface as seen by the radar. Accordingly, to estimate the sea state parameters as, direction, wavelength, period of dominant waves, the significant wave height as well as the bathymetry and surface current, through a time stack of radar data are required advanced data processing procedures. In particular, in the coastal areas due to the non-uniformity of sea surface current and bathymetry fields is necessary a local analysis of the sea state parameters. In order to analyze the data acquired in coastal area an inversion procedure defined “Local Method” is adopted, which is based on the spatial partitioning of the investigated area in partially overlapping sub-areas.
In addition, the analysis of the sea spectrum of each sub-area allows us to retrieve the local sea state parameters. In particular, this local analysis allows us to detect the reflected waves from the coastal infrastructures, e.g. from the harbor jetties. In fact, the reflected waves may significantly complicate the harbour activities (e.g., berthing operations), as they interfere with the oncoming waves thus creating a confused sea [2].

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