EMS Annual Meeting Abstracts
Vol. 13, EMS2016-10, 2016
16th EMS / 11th ECAC

Local storminess trends and large-scale climate characterization from one of the world's longest observational wave dataset.

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Multi-decadal time-series of observational wave data beginning in the late 1970's are relatively rare. The present study refers to the analysis of the 37-year long directional wave time-series recorded between 1979 and 2015 at the CNR-ISMAR (Institute of Marine Sciences of the Italian National Research Council) "Acqua Alta" oceanographic research tower, located in the Northern Adriatic Sea, 15 km offshore the Venice lagoon, on 16 m depth.
This length allows to exploit the content not only for modelling purposes or short-term statistical analyses, but also for climatological scale considerations.
The northern part of the Adriatic Sea is characterized by peculiar meteorological and oceanographic aspects, resulting in two main wind and correspondingly wave regimes, strongly forced by the regional orography: the long-fetch south-easterly "sirocco" and the short fetch strong north-easterly "bora" wind generated waves. This two wind regimes act along the major and minor axis of the basin, respectively, sirocco being less frequent than bora, though leading to the highest waves in the Northern Adriatic Sea.
We explore the dataset both to characterize the local average climate and its variability, and to detect the possible long-term trends that might be suggestive of more general large scale patterns. This investigation is particularly interesting applied to the area where the measurements are available whose climate is highly sensitive to even small variations of the large scale climate.
A clear decrease of the significant wave height 99th percentile is evident, paralleled by a smaller, but distributed along the annual cycle, increase of the 50th and 75th ones. Considering the two characteristic wind regimes acting on the area, a distributed decrease of the bora significant wave height can be recognized, repeating the trends found for the overall dataset, while less pronounced tendencies can be addressed for the sirocco conditions.
The evolution of the significant wave height distributions for the first and last 10 years of the time series clearly confirms a decrease of the maximum values, but also an increase of the average storm intensity with a shift from the lower to the central part of the distribution, suggesting that extremes are decreasing.
Furthermore, the just drawn conclusions represent a starting point to explore possible links of wave activity with large-scale north hemisphere teleconnection patterns or weather regimes and, consequently, to derive a physical interpretation of the recognized interdependencies.
For this we refer to the recurring and persistent large-scale patterns of pressure and circulation anomalies, representatives of the atmospheric circulation variability, hence weather systems. Given the local parameter we start from, namely the significant wave height, our main interest is on the storm tracks and jet stream location/intensity over vast areas, which led us to choose the four following reference patterns for the large scale analysis: the North Atlantic Oscillation (NAO), the East Atlantic pattern (EA), the East Atlantic/Western Russia pattern (EA/WR) and the Scandinavia pattern (SCAND).