Geophysical Research Abstracts
Vol. 14, EGU2012-1160, 2012
EGU General Assembly 2012

Investigating dependence in the main sea state parameters with copula approach

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The Emilia-Romagna coastal areas are exposed to a high level risk from marine inundation. The impacts and the consequences of sea storms depend both on contemporary wave characteristics and sea elevation and on storm duration.
A bivariate model for each of the six pairs formed with the variables significant wave height, mean wave period, duration and direction is initially proposed for the marine storms identified from data recorded in a four years period, from May 2007 to June 2011, by the Nausicaa buoy, located 8 km offshore the town of Cesenatico, applying the copula approach.
Analysis of the data set shows that there is significant correlation among the above indicated variables.
The analysis of marine storms extracted from the time series reveals that, during the autumn and winter seasons of the period 2008-2010, events associated with Scirocco winds, generally accompanied by the highest water levels due to the major fetch in the Adriatic Sea, occurred with relatively limited wave heights respect to those measured during Bora conditions.
The method is then extended in the attempt to capture the eventual dependence structure between wave height and sea level. Tidal observations are recorded approximatively 40 km northwards of Cesenatico by the Porto Corsini tide gauge managed by ISPRA.
Several families of copulas featuring a wide range of dependence are tested for the different pairs. The copula that best fits the available data is selected by using several different goodness of fit criteria (Akaike's and Bayesian information criteria, root mean square error and construction of empirical copula).
The marine storms analysis includes the bivariate return periods for the pairs significant wave height and duration, based on the selected copula.
Future application to the available data at regional scale could provide useful indications for the vulnerability assessment of the Emilia-Romagna coast from marine flooding.