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Joint probability of sea waves and river discharges: a case study

Francesco Viola (1), Giovanni Besio (2), and Lorenzo Mentaschi (3)

(1) Dipartimento di Ingegneria Civile, Ambientale, Aerospaziale, dei Materiali, Università di Palermo, Palermo, Italy (francesco.viola77@unipa.it), (2) Dipartimento di Ingegneria Civile, Chimica e Ambientale, Università degli Studi di Genova, Genova, Italy (giovanni.besio@unige.it), (3) Dipartimento di Ingegneria Civile, Chimica e Ambientale, Università degli Studi di Genova, Genova, Italy (Lorenzo.Mentaschi@unige.it)

The main drivers of physical processes acting in estuarine areas are river discharge and sea waves. The first is responsible for fresh water fluxes, sediment, nutrient and pollutants transport, the second for the diffusion and for littoral dynamics. The description of phenomena evolving between the end of a river and the proximal sea area is challenging because of the difference in water stage, salinity, direction of water fluxes and currents. Rarely coastal areas and proximal rivers mouths are studied in a coupled way, but indeed they should be seen as a continuum and not as two uncorrelated realities separated by a rigid edge. Indeed observations suggest how extreme events as wave storm and river floods are often simultaneous because they are generated by the same large perturbations.
In this work we explore the bivariate distribution of daily river discharge and daily average of sea waves with reference to estuarine areas. We will consider three points on the Sicilian (Italy) shoreline as case studies: one on the North, one in the East and the latter in the South-West coast. Each considered point is an outlet of a basin where measured or reconstructed streamflow series are available from 1979 to 2010. The considered basins differ also in area, ranging from 100 up to 4000 km2. In the same time slot, wave series have been obtained taking advantage of a reanalysis database elaborated on a hourly basis with a model implemented at DICCA (www.dicca.unige.it/meteocean) on the whole Mediterranean basin.
Results show large part of relative frequencies in the range of low discharge and small waves and an exponential decrease for increasing wave height and river flow. Extreme floods never occur in calm sea conditions as sea storms are often accompanied by high levels of river discharges.