

## Space-time extremes of oceanic seas

*Francesco Fedele<sup>1</sup>, Alvise Benetazzo<sup>2</sup>*

<sup>1</sup>School of Civil and Environmental Engineering and School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, Georgia, USA

<sup>2</sup>CNR-ISMAR, Venice, Italy

### ABSTRACT

A stochastic approach to model short-crested stormy seas as space-time random fields is presented. Given a storm as a non-stationary sequence of sea states, a space-time (ST) extreme is defined as the largest surface displacement over a given sea surface area during a storm. The associated short- and long term statistical properties are derived by means of the theory of Euler characteristics of random excursion sets in combination with the Equivalent Power Storm model. The relative validity of the new model and its short-term predictions are explored by analyzing stereo video observations of the space-time dynamics over an area of the Northern Adriatic Sea, off the Venice coast, Italy. Further, a detailed analysis of the long-term predictions of ST extremes in stormy seas is presented based on wave data retrieved from NOAA buoy 42003, located in the eastern part of the Gulf of Mexico, offshore Naples, Florida. Both the theoretical and experimental results indicate that, as the sea surface area increases under short-crested wave conditions, space-time extremes noticeably exceed the significant wave height of the most probable sea state in which they likely occur and that they also do not violate Stokes-Miche-type upper limits on wave heights.