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Meteotsunamis: the hazard in the coastal areas

Chiara Visentin[1], Nicola Prodi[1], Elena Benvenuti[1], Elena Marrocchino[2], and Carmela Vaccaro[2]
[1]University of Ferrara, Department of Engineering, Italy
[2]University of Ferrara, Department of Environment and Prevention Sciences, Italy

Meteotsunamis (or meteorological tsunamis) are long, progressive sea waves triggered by external forcings due to meteorological events as e.g., air pressure disturbances, wind gusts and fast-moving storms that are observed in beaches of enclosed basins and/or in ocean waves entering the harbors and bays. The atmospheric disturbance in open sea generates near the surface water the localized waves, that travel at the same speed but with a period ranging from a few minutes to two hours. The waves propagate toward the shore amplifying near the coast due to resonance mechanisms related to the bathymetric characteristics of the waterbody and the topography of the coastal line. Therefore, a meteotsunamis results from two resonance effects: an external resonance between the air pressure disturbance and the long sea waves in the open sea, followed by an internal resonance between the incoming long waves and the harbor/bay eigenmodes.

Meteotsunamis have been observed all around the globe, but the most destructive events happened at a limited number of sites where meteorological and resonance conditions (i.e., intense resonant amplification due to the harbor/bay geomorphology, dynamic instability, frontal passages, gales, squalls, storms, tornadoes, convection cells, and atmospheric gravity waves) are satisfied at the same time. Examples of these sites are the North-East Adriatic Sea, the Balearic Islands (Spain) and the Sicily Strait (Marrobbio). Over the years, this natural phenomenon recorded an increase (higher frequency of Medicanes) and it has caused structural damages to properties and infrastructures along the coastal areas, as well as human casualties.

In the last fifteen years, numerous studies have addressed the issue of producing statistics and hazard estimates for meteotsunamis, even though in situ data are scarce and often available with a low spatial and temporal resolution. Numerical atmospheric-ocean models, mostly running with simulated air-pressure disturbance and calibrated over data of real events, were therefore carried out seeking to establish a shared approach for hazard estimation and meteotsunamis short-term forecast. Selecting appropriate models for this natural phenomenon is important in the view of planning coastal intervention in danger areas and quantifying the hazard in the harbor/bay in relation to geomorphological changes. In this light the PMO-GATE project (Preventing, Managing and Overcoming Natural-Hazards Risks to mitiGATE economic and social impact project) in the framework of the Interreg V Italy-Croatia 2014-2020 Program aims to develop a joint innovative methodology to strengthen and consolidate the collaboration against natural disasters specific to the NUTS Italy-Croatia in order to increase the level of protection, resilience and prevention of natural disasters through shared management methodologies and multi-risk overcoming of

extreme events, such as meteotsunamis, to deal with natural risk with greater awareness and effectiveness.

In particular, it is crucial to understand whether and how the hazard estimate would be modified due to coastal changes brought about by the rise in the sea level expected as a consequence of climate changes.