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Meteotsunamis: Atmospherically induced destructive ocean waves in the tsunami frequency band

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In light of the recent enhanced activity in the study of tsunami type waves and their source mechanisms, we consider a poorly known type of tsunami-like waves that are induced by atmospheric processes rather than by seismic sources. The name in the title reflects ongoing discussion in the scientific community regarding the appropriateness of the terms ‘meteorological tsunami’ or ‘meteotsunami’, which prejudges the hazardous nature and the similarity of these atmospherically generated waves to ordinary tsunami waves. The main purpose of the present study is to clarify the hazard possed by these motions and to overview ‘meteorological tsunamis’ in various regions of the World Ocean. The principal source of these tsunami-like ocean waves are travelling air pressure disturbances, including those associated with atmospheric gravity waves, pressure jumps, frontal passages, and squalls, which normally generate barotropic ocean waves in the open ocean and amplify them near the coast through specific resonance mechanisms (Proudman, Greenspan, shelf, harbour, etc.). In contrast to ‘ordinary’ impulse-type tsunami sources, a travelling atmospheric disturbance normally interacts with the ocean over a limited period of time (from several minutes to several hours). Atmospheric processes have broadband energy content; however, destructive events appear to occur only when the atmospheric event has significant energy in frequency bands matching the eigenfrequencies of the corresponding bay or harbour. There are a few places in the World Ocean where hazardous meteotsunamis occur regularly and have been given local names: ‘rissaga’ in the Balearic Islands, ‘marubbio’ in Sicily, ‘milghuba’ in Malta, and ‘abiki’ in Nagasaki Bay, Japan. The energy transferred from the atmosphere to the ocean during extreme events is compa-

rable with the energy of typical seismic/landslide generated tsunami in some regions (e.g. the magnitude 4 tsunami on the Sieberg-Ambrasey intensity scale estimated for the Middle Adriatic). In general, meteotsunamis have similar physics as seismic and landslide-generated tsunamis. In particular, meteotsunamis are modified and amplified by local topography, and can affect the coast in the same destructive manner as ordinary' tsunami waves. The exact meaning of the Japanese term 'tsu-nami' is 'a big wave in a harbour', so it is logical to use a similar term for abnormal tsunami-like atmospherically induced waves in the period range of a few minutes to hours.