

Earthquake-related phenomena in the Ocean

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More than 100 large ($M > 6$) earthquakes occur in the world every year, most of them being underwater events. Tsunamis are well-known consequence of underwater earthquakes since these waves have their manifestation at shore. Propagating on many thousands of kilometres from a source, tsunamis attack coastlines where they can cause devastating property damage and loss of life. Being located in an epicentre area, other effects of underwater earthquakes have been little known and very rarely observed until recently. Anyway tsunami catalogues often report the following phenomena: ocean colour changes, “boiling” water, huge standing waves, sudden weather changes, unusual sounds, uncommon fish behaviour etc. Developing of the satellite oceanography, deploying oceanographic buoys and bottom stations have already made it possible to observe some of the phenomena. Further investigation of the earthquake-related phenomena is of great importance not only for tsunami hazard reduction but also for better understanding of the oceanic environment.

In this lecture, first we provide general information about tsunamis and other earthquake-related phenomena in the ocean. Descriptions of some great tsunami events including the 2004 Indonesian Tsunami are given. Then we focus on our own contributions to study of tsunamis. We discuss the role of water compressibility in the tsunami problem, and we describe in-situ observations and numerical modeling of elastic oscillations of water layer in tsunami source. We next examine tsunami generation mechanism due to non-linear energy transfer from high-frequency elastic or forced oscillations of water layer to low-frequency gravitational waves.

In the second part of the lecture we describe effects of sudden increase of vertical exchange in the ocean due to seismic bottom motions. Possible physical mechanisms of the phenomenon are discussed. Observations of SST and chlorophyll concentration anomalies above epicenter areas of underwater earthquakes are considered.