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Implication of the 2011 Tohoku earthquake on assessment of tsunami hazard and risk in coastal areas of the Pacifi

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The Mw9.0 2011 Tohoku earthquake occurred near Sanriku coast of Honshu that is one of the most seismically active parts of the Japanese subduction zone. Historical tsunamigenic earthquakes are known here since 869 AD and some of them had devastating effect on the nearby coastal areas. However, until March 11, 2011 nobody really expected the occurrence of M9 class mega-earthquake here. Despite all the technical excellence of the JMA early warning system and intensive training program for coastal inhabitants, the follow-up tsunami took nearly 19,000 lives in the Iwate, Miyagi and Fukushima prefectures. Run-ups higher than 10 m were observed along more than 425 km of Sanriku coast. The 2011 Tohoku event clearly demonstrated that M9 class events impose the major tsunami hazard as for nearby as for remote coastal areas and put a question about reality of occurrence of such events in other subduction areas around the Pacific.
Kuril-Kamchatka and Alaska-Aleutian regions are the typical examples of subduction zones where destructive earthquakes and volcanic eruptions repeatedly occur. Since 1737 there were more than 140 tsunamigenic events in the region, including at least six trans-oceanic tsunamis generated by M9 class events (in 1737, 1788, 1946, 1952, 1957, 1964). This region is also open for the impact of far-field tsunamis generated in other Pacific tsunamigenic zones, among them the most dangerous are the South American tsunamis. Tsunami Warning System acts in the Kuril-Kamchatka region since 1958 and in the Alaska-Aleutian region since 1968. Major problem for both systems is the high percentage of false alarms that are issued based solely on source magnitude criterion. The paper summarized some conclusions and recommendations obtained during reconsideration of tsunami hazard in the island arc regions made recently within the project for modernization of the Tsunami Warning System on the Far East coast of Russia. Reconsideration was made on the basis of careful analysis of historical data on tsunami occurrence and coastal manifestation, refining of warning criteria, creation of comprehensive seismotectonic model of Kuril-Kamchatka and Alaska-Aleutian region and application of advanced numerical techniques for calculation of tsunami impact on coastal areas. The main conclusion of the study is that for a particular coastal location the assessment of probability of occurrence of M9 class event in the nearby tsunamigenic zone represents the major challenge for realistic long-term tsunami hazard assessment.