

Implications of the 2011 Tohoku Earthquake for Subduction Zone Earthquake and Tsunami Hazard

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The earthquake and tsunami that struck northeastern Japan in March 2011 was a terrible human tragedy that should serve as a wake-up call to earth scientists and disaster managers everywhere. It was a megathrust earthquake, involving rupture of the subduction zone plate boundary between the North American and subducting Pacific Plates. These earthquakes can be truly massive - nine out of the ten largest earthquakes ever recorded were megathrust earthquakes. Do we know how big such earthquakes can be, and where the biggest earthquakes can occur? The answers to these questions have important implications for countries that face subduction zones, such as Indonesia, New Zealand, and many south Pacific Island countries.

While hazard assessments generally involve careful consideration of historical record and tectonic setting, the 2011 Tohoku event and other recent events in the Asia-Pacific region suggest that traditional methods for assessing maximum magnitude earthquakes in subduction zones have resulted in gross underestimation of the hazard. An alternative approach would eschew the use of either historical events or geophysical considerations, and simply consider the most dangerous megathrust earthquake ever to have occurred worldwide as being the maximum credible event for any subduction zone. In this talk I will take such an approach for two subduction zones, the Java and Tonga Trenches, where I consider the implications of scenarios similar to the 2011 Tohoku event for the populations of West Java and Tongatapu, respectively.

The scenarios considered here are extreme events, resulting in impacts far exceeding historical precedents for either Java or Tongatapu, and present enormous challenges for disaster management. The question is, should these really be considered the maximum credible events? Unless we can unequivocally state that such events can't occur on these subduction zones – unless we have certain knowledge that it is physically impossible for such events to occur – then I argue that such large events must be considered on any subduction zone, at least at a low level of probability.