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2011 Megathrust Earthquake that Revealed the Existence of Two Types of Great Earthquakes

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A megathrust earthquake of magnitude (Mw) 9.0 hit the Tohoku-Kanto district of Japan, on 11 March 2011. This earthquake ruptured almost all of the seismic segments between the Pacific coast of the Tohoku district and the Japan Trench, causing devastating tsunamis. How did this event grow to such a scale? The prime factors that had not been recognized before are the double seismic segmentation along the Japan Trench and its strong initial break induced the secondary rupture during the earthquake. We show the similarity between this earthquake and the 1964 great Alaska earthquake, in terms of seismic activities both before and after the events, together with their asperities in each initial rupture region. Based on these characterizations, we suggest that these earthquakes belong to a new type of great earthquakes distinct from the 1960 Chile and 2004 Sumatra earthquakes, which mainly extended laterally along their trench axes.

Keywords: 2011 Megathrust Earthquake in Japan, Mechanism of Great Earthquakes, 1964 Alaska Earthquake, 1960 Chile Earthquake, 2004 Sumatra Earthquake