Maximum Magnitude of Subduction-Zone Earthquake around Eastern Japan Estimated by Seismic Moment Conservation Principle: Part 2

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Kagan & Jackson [2013, BSSA] estimated maximum magnitude of events which will occur along subduction zone in the world based on the seismic moment conservation principle by applying that to background seismicity from 1977 to 2010. The key point of this method is to replace total seismic moment rate with the tectonic moment rate M_T. Note that because the plate coupling rate χ among components of M_T has large uncertainty, the maximum magnitude obtained is dependent on χ. To avoid confusion, the magnitude and the seismic moment are represented by "m" and "M", respectively. They modeled a seismic-moment-frequency-distribution by the truncated G-R law, tapered G-R law and Gamma distribution. These laws have two parameters: $β(=b/1.5)$ and M_c (is characteristic seismic moment which represents the maximum magnitude. Corresponding magnitude is m_c). Truncated G-R law do not have events larger than m_c. Whereas tapered G-R law and Gamma distribution allow occurrence of events larger than m_c. Therefore, it is problematic to treat m_c of Tapered G-R law and Gamma distribution as the maximum magnitude. Hirose et al. [2014, SSJ] estimated m_c off Tohoku as 9.26 by the truncated G-R law if χ is 60% by applying the seismic moment conservation principle to earthquakes occurred along the Kuril-Kamchatka-Japan trench from 1977 to 2013. There is also Utsu law with upper limit magnitude in addition to the truncated G-R law. In this study, we introduce the formulation of seismic moment conservation principle about Utsu law, and apply it to the same data set as Hirose et al. [2014, SSJ]. As the result, if assumed M_T (χ = 60%) is correct, the maximum magnitude of events which will occur off Tohoku in the future is estimated as 10.03. There is a possibility that the Tohoku-oki earthquake is not always the largest event in this area.

Keywords: Seismic moment conservation principle, Maximum magnitude, Utsu law