

B会場 | 一般セッション：S09. 地震活動

📅 2025年10月22日(水) 9:00 ~ 10:30 📍 B会場(409+410)

[S09] 地震活動

座長:大澤 亮(東北大学大学院)、下村 海渡(東京理科大学)

9:15 ~ 9:30

[S09-08] 日本海溝沈み込み帯における滑り挙動の深さ方向変化に対応した三領域での地震活動の比較

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Understanding the characteristics of seismicity and its spatial variation is crucial in seismology. Off Iwate, in the Japan Trench subduction zone, markedly different modes of fault slip are observed depending on the plate interface depth. From shallow to deeper portions, slip modes range from slow earthquakes (e.g., very low frequency earthquakes and tectonic tremors) (Baba et al., 2020; Nishikawa et al., 2019; 2023), to megathrust earthquakes such as the 1994 Sanriku Haruka-Oki earthquake, and to aseismic creep inferred from small repeating earthquakes (e.g., Uchida et al., 2012; Igarashi, 2020). However, no statistical studies have evaluated seismicity characteristics across three distinct slip-behavior regions.

This study employed statistical models of seismicity to quantify the characteristics of earthquake activity in these three regions to examine the relationship between these characteristics and the slip regimes. The offshore Iwate region was subdivided into three zones: (1) the slow earthquake zone, (2) the asperity zone, and (3) the repeating-earthquake and creeping zone. Statistical analyses were conducted separately for each zone across three distinct periods: (1) October 1, 2001 to December 31, 2010; (2) August 15, 2016 to August 31, 2020; and (3) September 1, 2020 to December 31, 2024. We analyzed earthquakes of magnitude 2.3 or greater from the Japan Meteorological Agency (JMA) catalog. To quantify the seismicity characteristics, we applied the temporal ETAS model (Ogata, 1988) and estimated the Gutenberg-Richter b -value using the maximum likelihood method (Utsu, 1964; Aki, 1965). Parameter estimation was performed using Markov Chain Monte Carlo (MCMC) techniques.

The analysis revealed clearly distinct characteristics among the three zones. In the slow earthquake zone, the expected number of aftershocks was the highest, indicating enhanced aftershock productivity. Additionally, seismicity in this zone frequently formed spatiotemporal clusters like swarm activity, potentially reflecting recurrent episodes of transient aseismic slip. In contrast, the asperity zone exhibited the lowest background seismicity rate, suggesting strong interplate coupling. Meanwhile, the repeating-earthquake and creeping zone showed the highest background seismicity rate, likely resulting from an elevated rate of stable creep along the plate interface.

Furthermore, in the repeating-earthquake and creeping zone, a kink in the magnitude-frequency distribution was consistently observed near M 3.7 across all analyzed periods, indicating a discontinuity in b -value. When the b -value was estimated using maximum likelihood method for events of M 3.7 and greater, it was more than twice that obtained from events of M 2.3 and above. We then calculated the rupture arrest probability,

defined as the ratio of the number of earthquakes within a given magnitude bin to the cumulative number of earthquakes of the same or larger magnitude. The results revealed a sharp increase in rupture arrest probability around M 3.7; it remained at approximately 15% for magnitudes between M 2.3 and M 3.6, but rose to over 23% at M 3.7. These findings suggest the existence of a characteristic spatial scale within the creeping zone—approximately 1 km, corresponding to the source dimension of M 3.7 events— which likely acts to inhibit further rupture growth beyond the magnitude threshold.