Effect of typhoon intensity and frequency on forest dynamics and material cycle using the Spatially Explicit Individual-Based Dynamics Global Vegetation Model (SEIB-DGVM)

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Typhoon is a major natural disturbance, which would give a dramatic impact on forest especially in coastal area of the world. For long-term period, the extent of damage that affects the forest structure and subsequent recovery, largely depends on the characteristics of the disturbance, such as intensity and frequency. Given the changing climate, typhoon is expected to become stronger and to come more frequently in the future, especially in the Northwest pacific. (Mei et al. 2016; Lin et al. 2015). However, few studies have focused on the impact of changes in typhoon frequency and intensity on forest dynamics and material cycles. To elucidate them, in this study, we use the spatial explicit individual based dynamic global vegetation model (SEIB-DGVM, Sato et al., 2007) in Tomakomai Flux Research Site from 1901 to 2100. Comparing with other Dynamic global vegetation model, SEIB-DGVM has a great advantage that can represent the three-dimensional forest structure based explicitly on local competition among individual trees on the virtual forest stand (Sato et al. 2009, 2010).

In this study, we run the SEIB-DGVM with the variation of different typhoon characteristics: typhoon intensity and frequency. First, we validate the SEIB-DGVM at Tomakomai site, and then simulate for the future from 2017 to 2100. About the future part, we did a series of scenarios experiment simulation by changing the intensity and frequency of typhoon. We categorize the typhoon frequency into six ranks: 1, 2, 4, 8, 16, and 20 times for 84 years (2017-2100). For each typhoon frequency, we divided typhoon intensity into 10 levels with interval of 10% from 10-100%. The percentage of typhoon intensity represents how much damage the typhoon will cause (= tree mortality). Six levels frequency and ten levels intensity make up 60 groups of simulation scenarios. Each simulation over an 84-year period (2017-2100) was repeated 10 times. We address the following questions in this study: (1) whether SEIB-DGVM can reconstructs the forest in Tomakomai or not in historical period. (2) how do forest ecosystem respond to changes in two key typhoon characteristics in the context of projected climate change.

Keywords: Typhoon intensity and frequency, Forest dynamics, Material cycle, Typhoon scenario simulation

