Modeling mangrove growth dynamics affected by soil salinity and species composition

*Yoshikai Masaya[1], Takashi Nakamura[1], Sahadev Sharma[2], Jun Yasuoka[3], Ryohei Egawa[3], Rempei Suwa[4], Kazuo Nadaoka[1]

1. School of Environment and Society, Tokyo Institute of Technology, 2. Institute of Ocean and Earth Sciences, University of Malaya, 3. Department of Mechanical and Environmental Informatics, Tokyo Institute of Technology, 4. Forestry Division, Japan International Research Center for Agricultural Sciences

Mangrove forest is an important component of blue carbon ecosystem and plays a major role in climate change mitigation. Though mangroves provide many key ecosystem services, they are disappearing with an alarming rate due to human activities such as deforestation, conversion to fish and shrimp farms. Dynamics of mangrove growth and production is important in mangrove carbon sequestration particularly during the restoration of forests. A process-based model for mangrove growth is an effective tool to assess such dynamics under different environmental settings, but there is no model which explicitly explains the osmotic effects of soil salinity on mangrove forest production that are considered as a major driver of mangrove growth and species zonation. In this study, we aimed to develop a coupled model of mangrove photosynthesis and plant water flux, and upscale the coupled dynamics to a plot-scale model for examining the combined effects of soil salinity and competition with surrounding trees for light on mangrove production. The model was developed under a hypothesis that mangrove production is limited by nutrient uptake rate from soil which is controlled by osmotic effects of soil salinity, and the mangroves control stomatal conductance to maximize nutrient uptake rate so that the production rate is maximized. Shading effects by surrounding trees were computed using a dynamic vegetation model, SEIB-DGVM, (Sato et al., 2007). The developed model showed decreasing stomatal conductance and photosynthetic rate with increasing soil salinity, which is consistent with results from measurements in previous studies. The model was tested with Fukido mangrove forest in Ishigaki Island, Japan, where *Rhizophora stylosa* and *Bruguiera gymnorhiza* are dominant species. The model showed good performance to reproduce the species competition, above-ground biomass for each species along the soil salinity gradient. Thus, it was revealed that mangrove production and species composition can be well reproduced by the model when soil salinity is precisely given as an environmental factor.

Keywords: mangrove, model development, SEIB-DGVM, soil salinity, biomass, blue carbon

