Emerging influences of rapid sea-level rise on Micronesian mangrove forests: Ground level dynamics in the main communities and prop roots dynamics of a *Rhizophora stylosa* community

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In the western Pacific low-latitude region between the Philippines and Micronesia, the sea level has been rising at over 10 mm/yr (IPCC 2013). In the mangrove habitat situated in the low sediment inflow environment, *Rhizophora* pure forest is generally formed as a pioneer community and mangrove peat is created. However, the mangrove peat accumulation rate is considered to decrease with the vegetation succession because of the decline of tree density of *Rhizophora* sp. The mangrove communities decreased mangrove peat accumulation rate is possibly affected by sea-level rise first. In Pohnpei Island, Micronesia, the surface erosion is not recognized in the *Rhizophora stylosa* and *Rhizophora apiculata* communities, while it is recognized in the communities dominated by other species.

We will report first the ground level dynamics for the main mangrove communities in Pohnpei based on the observation data using the erosion/accumulation observation piles installed into the peat deposits up to the base and secondary the forest dynamics including prop roots of a *R. stylosa* community using the monitoring data for 16 years from 2003 to 2019.

We set five stainless piles with 5 mm in diameter for each observation plot. The observation plots were established seaward and landward sites of four permanent plots, i.e., PR , PC, PS and PK, whose dominant species are *R. stylosa*, *R. apiculata*, *Sonneratia alba* and *Bruguiera gymnorrhiza*, respectively. The landward plot of PK was set between buttress roots of *Xylocarpus granatum*. The ground level dynamics rate (cm/year) of seaward and landward sites for each plot was 0.76±0.48 and 0.28±0.34 for PR, 0.34± 0.22 and 0.23±0.19 for PC, -0.28±0.68 and -0.04±0.36 for PS, -0.42±0.56 and 0.01±0.14 for PK. Namely, accumulation trend in *Rhizophora* communities and erosion trend in *Sonneratia* and *Bruguiera* communities were observed.

The aboveground biomass of PR was estimated using the allometric equation of Komiyama et al. (1988) for *R. stylosa* except prop roots and Komiyama et al. (2005) for *B. gyminorrhiza*. The biomass of densely developed prop roots of *R. stylosa* was estimated by the following procedure because the existed allometric equations are inaplicable, i.e.,1) 5 meters square plots were set at seaward side, central part and landward side of PR, 2) the length and diameter were measured for all prop roots, which were divided into lignified hard one and unlignified soft one, in each plot and the total volume was calculated, and 3) the prop roots biomass was calculated by multiplying the each volume on the each density.

The aboveground biomass in PR increased from 235 t/ha (*R. stylosa*: 212 t/ha, *B. gymnorrhiza*: 23 t/ha) at 2003 to 327 t/ha (*R. stylosa*: 304 t/ha, *B. gymonorrhiza*: 23 t/ha) at 2019. The prop roots biomass of *R. stylosa* increased from 120 t/ha at 2003 to 198 t/ha at 2019. The soft roots increased constantly from 2 t/ha to 41 t/ha during the 16 years, while the hard roots decreased from 137 t/ha to 87 t/ha between 2011 and 2015 and increased again to 158 t/ha at 2019. The total prop roots biomass also decreased

between 2011 and 2015 with the decrease of hard ones. The prop roots dynamics possible suggests that the *R. stylosa* forests are trying to maintain the ground level by accelerating the mangrove peat accumulation rate against the rapid sea-level rise by producing much more new prop roots.

Keywords: Mangrove forest, Mangrove peat, Sea-level rise, Surface erosion, Forest dynamics

