Assessment of mangroves' resilience to land use and climate change in the Pacific Islands

E. Jorquera [a], J.P. Quijano Baron [a], A. Breda [a], S. Sandi [b], D. Verdon-Kidd [c], P.M. Saco [a] and J.F. Rodríguez [a]

[a] School of Engineering and Centre for Water Security and Environmental Sustainability, The University of Newcastle, Australia; [b] School of Engineering, Deakin University, Geelong, Australia
[c] School of Environmental and Life Sciences, The University of Newcastle, Australia
Email: Eliana.jorquera@uon.edu.au

Abstract: The two main islands of the Republic of Fiji, Viti Levu and Vanua Levu, have more than 600 km^2 covered by mangrove wetlands. As in many other Pacific Island countries, mangroves are vital to the economy and ecosystem services, and modifications of the inputs of water and sediments have put pressure on the mangroves' survival. Climate change also exerts further stress on them when their vertical position increases more slowly than sea level rise, leading to mangrove drowning.

This contribution assesses the evolution of a mangrove wetland at the mouth of the Dreketi River (northern coast of Vanua Levu) under future climate change and land use scenarios. The methodology applied consists of water and sediment supply simulation from the upstream catchment linked to the eco-geomorphological modelling (EGM) of the wetland. Three resilience analysis (RA) scenarios and a baseline condition were analysed for a period of 100 years. The first scenario (RA I) studied the influence of land use change from forested to agricultural areas in the Dreketi River catchment. The second scenario examined the change in sediment loads with increased rainfall intensity due to climate change (RA II). Finally, a scenario with a decrease in sediment was assessed (RA III).

Under current conditions the EGM was able to reproduce the distribution of the vegetation, the accretion rates and the average above-ground biomass (Fatoyinbo et al., 2018). For future scenarios, as in many other mangrove wetlands, a noticeable relationship between the sediment concentrations entering the wetland and the mangrove accretion capacity was identified (Lovelock et al., 2015, Breda et al., 2021). Figure 1 presents the changes in the area suitable for mangroves over the time. The increase in sediment for the RA II was introduced gradually over the century. The results indicate that the system is more sensitive to sediment reduction than to sediment increase and that the resilience of the mangrove will depend, to a large extent, on the sediment inputs. However, all the simulated scenarios showed a decrease in the area suitable for mangroves, highlighting the threat of sea level rise for mangrove resilience.

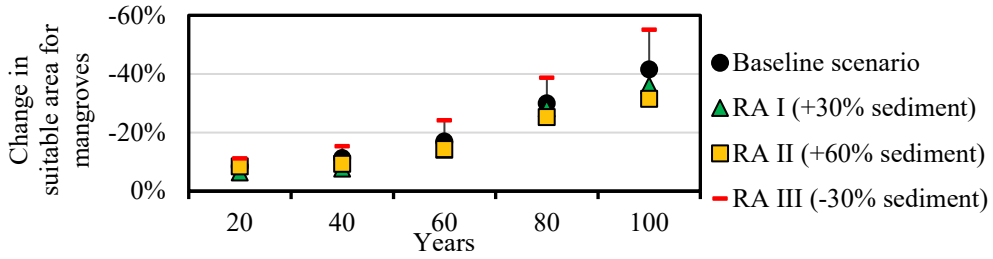

Figure 1. Change in area suitable for mangroves

REFERENCES

Breda, A., Saco, P. M., Sandi, S. G., Saintilan, N., Riccardi, G. & Rodríguez, J. F., 2021. Accretion, retreat and transgression of coastal wetlands experiencing sea-level rise. Hydrol. Earth Syst. Sci., 25, 769–786.

Fatoyinbo, T., Feliciano, E.A., Lagomasino, D., Lee, S.K., Trettin, C., 2018. Estimating mangrove aboveground biomass from airborne LiDAR data: A case study from the Zambezi River delta. Environmental Research Letters, 13, 025012.

Lovelock, C.E., Cahoon, D.R., Friess, D.A., Guntenspergen, G.R., Krauss, K.W., Reef, R., Rogers, K., Saunders, M.L., Sidik, F., Swales, A., 2015. The vulnerability of Indo-Pacific mangrove forests to sea-level rise. Nature, 526, 559.

Keywords: *Pacific Islands, mangroves, eco-geomorphological modelling, climate change*