25th International Congress on Modelling and Simulation, Darwin, NT, Australia, 9 to 14 July 2023
mssanz.org.au/modsim2023

Resolving temporal-scale differences between paleoclimate reconstructions and a groundwater model for recharge estimation

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Abstract: Most oceanic islands rely on limited freshwater sources stored within a thin groundwater lens floating on top of denser saline groundwater. The size of the fresh groundwater lens is partly a function of rainfall recharge, which is the sole source of fresh water to replenish the lens. The longer-term variability of rainfall recharge, and hence the size of the freshwater resource, cannot be fully quantified from the available short-term hydroclimate data. Paleoclimate records, especially annually resolved tree-ring data, can provide useful information about past hydroclimate to address this limitation. However, since the temporal resolution of these paleoclimate records are annual, it is difficult to use them to inform on recharge which occurs on much shorter time-scales (~daily). Here, we use a non-parametric stochastic framework to disaggregate annual hydroclimate data to a daily resolution over the observational period. We then apply the framework to the paleoclimate variables from tree-ring data to obtain climate reconstruction and estimate groundwater recharge variability at a daily scale for a longer period. The estimated daily recharge over the last centuries obtained from regional and remote tree-ring proxies are finally used to investigate the variability of freshwater in the groundwater lens. We demonstrate the method by introducing the obtained log-term daily recharge series as an input to a calibrated density dependent groundwater model for Rottnest Island, Western Australia.

Keywords: *Low frequency variability, paleoclimate reconstruction, seawater intrusion, 3D FEFLOW model, groundwater recharge*