Geophysical Research Abstracts
Vol. 18, EGU2016-18, 2016
EGU General Assembly 2016

Coastal hazards and groundwater salinization on low coral islands.

James P. Terry (1) and T.F. May Chui (2)

(1) Zayed University, Dubai, United Arab Emirates (james.terry@zu.ac.ae), (2) University of Hong Kong, Hong Kong, China (maychui@hku.hk)

Remote oceanic communities living on low-lying coral islands (atolls) without surface water rely for their survival on the continuing viability of fragile groundwater resources. These exist in the form of fresh groundwater lenses (FGLs) that develop naturally within the porous coral sand and gravel substrate. Coastal hazards such as inundation by high-energy waves driven by storms and continuing sea-level rise (SLR) are among many possible threats to viable FGL size and quality on atolls. Yet, not much is known about the combined effects of wave washover during powerful storms and SLR on different sizes of coral island, nor conversely how island size influences lens resilience against damage. This study investigates FGL damage by salinization (and resilience) caused by such coastal hazards using a modelling approach.

Numerical modelling is carried out to generate steady-state FGL configurations at three chosen island sizes (400, 600 and 800 m widths). Steady-state solutions reveal how FGL dimensions are related in a non-linear manner to coral island size, such that smaller islands develop much more restricted lenses than larger islands. A 40 cm SLR scenario is then imposed. This is followed by transient simulations to examine storm-induced wave washover and subsequent FGL responses to saline damage over a 1 year period. Smaller FGLs display greater potential for disturbance by SLR, while larger and more robust FGLs tend to show more resilience. Further results produce a somewhat counterintuitive finding: in the post-SLR condition, FGL vulnerability to washover salinization may actually be reduced, owing to the thinner layer of unsaturated substrate lying above the water table into which saline water can infiltrate during a storm event. Nonetheless, combined washover and SLR impacts imply overall that advancing groundwater salinization may lead to some coral islands becoming uninhabitable long before they are completely submerged by sea-level rise, thereby calling into question the sustainability of atoll communities that face recurrent coastal hazards.