Geophysical Research Abstracts
Vol. 13, EGU2011-4888, 2011
EGU General Assembly 2011

Response of a coastal aquifer to multi-scale sea level and precipitation fluctuations.

Stamatia Arvanitidou (1), Christina Karamperidou (2), Upmanu Lall (2), Konstantinos Katsifarakis (1), and Christoforos Koutitas (1)

(1) Department of Civil Engineering, Aristotle University of Thessaloniki, Greece (sarvanit@civil.auth.gr), (2) Columbia University, Earth & Environmental Engineering, New York, United States

The region of South Florida, US is an area of complex groundwater/surface water interactions, which are strongly coupled to sea level fluctuations and precipitation changes. This makes S.Florida one of the areas most vulnerable to climate variability and change with high socio-economic, flooding, transportation, water supply and ecological impacts that are further stressed by its increasing population.

Most of the methods used in coastal aquifer modeling are predicated on an assumption of statistical stationarity, i.e. the past represents the future. However, the understanding of the low frequency structure of climate, as well as the notion that the climate (and other aspects of the environment) is being anthropogenically modified, renders this assumption invalid; persistent and recurrent climate regimes at multiple time scales significantly change large scale atmospheric circulation patterns and the associated hydrologic variables. For coastal aquifers, the above-described quasi-periodic nature of the climate system results in quasi-periodic fluctuations in the coastal boundary and in inland hydrology; the latter includes fluctuations in precipitation patterns and in freshwater demand for urban, agricultural and ecological use. In particular for South Florida, low-frequency climate phenomena, such as the El Niño/Southern Oscillation and the Atlantic Multidecadal Oscillation, have been shown to significantly influence annual or seasonal rainfall variations, as well as sea levels. Here, we demonstrate the effect of such multi-scale (from seasonal to interannual to decadal) changes in the coastal boundary and in the precipitation patterns using an idealized 2-D cross-sectional two-layered (fresh-salt water) numerical model, which represents the generalized flow conditions in the Biscayne aquifer in South Florida. The persistence of the hydrologic response to the multi-scale forcings is of particular interest. The simulations investigate the importance of considering jointly sea level and precipitation fluctuations in acquiring estimates of the movement of the saltwater/freshwater interface in conditions induced by natural climate variability and anthropogenic climate change.