Geophysical Research Abstracts
Vol. 19, EGU2017-3133, 2017
EGU General Assembly 2017

Reconstruction of groundwater circulation after seashore reclamation

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In recent years, the effects of land reclamation on the coastal groundwater system have received increasing attention in China as extensive reclamation activities have altered the original groundwater dynamics and salinity distribution in the coastal subsurface. Previous studies focused on either the steady-state groundwater flow or the large scale numerical simulation after land reclamation, however the short-period variation of groundwater flow and its impacts on hydrogeochemical system have not often been considered. Furthermore, a permeable coastal boundary assumed exclusively in previous work is often not the case in contemporary engineering practice, and an impermeable coastal boundary with dikes has been adopted in this study. We investigate the temporal variation of groundwater levels in the un-reclaimed clay layer and reclaimed layer based on the continuous observation of 14 monitoring wells in Zhoushan island, China. We use the morphological wave analysis method to study the effect of nonstationary tidal signals on groundwater level fluctuations. The results indicate that the method of continuous wavelet transform is suitable for analyzing the groundwater flow pattern, where short period groundwater level fluctuations are affected by tidal activities through pipes built in the reclamation dike. In particular, the method of discrete wavelet transform (DWT) is proved effective in extracting tidal signals from groundwater level time series. The approximation term in the multi-resolution analysis is well in agreement with original groundwater level data, demonstrating the advantages of the DWT method in obtaining the change trends of geological, hydrological, and climate variables. Additionally, an examination of groundwater samples indicates that saltwater exists in entire reclamation regions. Our study reveals some different groundwater features in reclamation regions where the coastal boundary is impermeable, which could provide significant implications for evaluating the impact of land reclamation on coastal groundwater systems.