Geophysical Research Abstracts
Vol. 19, EGU2017-12032, 2017
EGU General Assembly 2017

Subsidence in the Mekong Delta; contribution of groundwater exploitation to total subsidence

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The Vietnamese Mekong Delta, the third's largest delta in the world, experiences annual subsidence rates up to several centimeters. These relative high subsidence rates outpace global sea level rise by an order of magnitude and strongly increase vulnerability of the delta to river flooding and storm surges, salinization and permanent inundation. Extraction of groundwater from the deltaic subsurface is indicated as a major driving mechanism; however the exact contribution of groundwater over-exploitation to subsidence in the Mekong delta has not been quantified yet. The objective of our study is to determine the contribution of groundwater extraction-induced subsidence to total subsidence. For this purpose we built a 3D numerical groundwater flow model of the Mekong delta and simulated the hydrological response to 25 years of groundwater exploitation. Subsequently, land subsidence caused by aquifer-system compaction due to groundwater over-exploitation was calculated using a land subsidence module. Calculated extraction-induced subsidence gradually increased over the past two decades to significant annual rates of several centimeters. Our results suggest groundwater extraction to be a dominant driver of subsidence in the Mekong delta, but leave room for other subsidence drivers, like loading and drainage. Our results are the first urgently needed quantifications of extraction-induced land subsidence at delta scale for the entire Mekong delta. With groundwater demand rising continuously, related subsidence rates are likely to increase further in the near future. As such, groundwater extraction-induced subsidence seriously threatens the long-term survival of the low-lying Mekong delta and should be taken into account in delta management strategies.