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TITLE: Impacts of 25 years of groundwater extraction on subsidence in the Mekong delta, Vietnam

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ABSTRACT:

Many major river deltas in the world are subsiding and consequently become increasingly vulnerable to flooding and storm surges, salinization and permanent inundation. For the Mekong Delta, annual subsidence rates up to several centimetres have been reported. Excessive groundwater extraction is suggested as the main driver. As groundwater levels drop, subsidence is induced through aquifer compaction. Over the past 25 years, groundwater exploitation has increased dramatically, transforming the delta from an almost undisturbed hydrogeological state to a situation with increasing aquifer depletion. Yet the exact contribution of groundwater exploitation to subsidence in the Mekong delta has remained unknown. In this study we deployed a delta-wide modelling approach, comprising a 3D hydrogeological model with an integrated subsidence module. This provides a quantitative spatially-explicit assessment of groundwater extraction-induced subsidence for the entire Mekong delta since the start of widespread overexploitation of the groundwater reserves. We find that subsidence related to groundwater extraction has gradually increased in the past decades with highest sinking rates at present. During the past 25 years, the delta sank on average 18 cm as a consequence of groundwater withdrawal. Current average subsidence rates due to groundwater extraction in our best estimate model amount to 1.1 cm yr<sup>-1</sup>, with areas subsiding over 2.5 cm yr<sup>-1</sup>, outpacing global sea level rise almost by an order of magnitude. Given the increasing trends in groundwater demand in the delta, the current rates are likely to increase in the near future.

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