



Unraveling the relation between land use and subsidence. A case from the Mekong delta, Vietnam

Philip S.J. Minderhoud (1,2), Laura Coumou (1), Esther Stouthamer (1), and Elisabeth A. Addink (1)

(1) Utrecht University, Physical Geography, Utrecht, Netherlands (p.s.j.minderhoud@uu.nl), (2) Deltares Research Institute, Department of Subsurface and Groundwater Systems, Utrecht, Netherlands (philip.minderhoud@deltares.nl)

Subsidence is a natural phenomenon in deltas worldwide. Soft deltaic sediments compact following organic matter oxidation and natural loading by newly deposited sediments and water. Human activities related to land use, such as draining wetlands for cultivation, extracting groundwater for irrigation and loading of the surface by buildings and infrastructure, often amplify natural subsidence rates. In the Vietnamese Mekong delta annual subsidence rates up to several cm are observed. Over the past decades, the delta experienced major alterations of human land use during which the majority of the wetlands and forested areas were turned into agriculture. Different land-use types are assumed to have different subsidence rates, but quantification is lacking.

We used a newly created time series of land-use maps together with INSAR-based subsidence observations to unravel the relationship between land use, land-use history and subsidence in the Mekong delta. Different land-use types and land-use change pathways experienced different subsidence rates. These could be related to specific human-induced subsidence drivers, revealing the indirect, causal relationship between land use and subsidence. Natural land-use classes like marshland and wetland forest showed lowest subsidence rates (6-7 mm yr⁻¹), while classes with intensive agriculture and built-up areas experienced highest rates (18-20 mm yr⁻¹). Variation in subsidence rate within a current land-use class can be (partly) explained by differences in land-use history over the previous 20 years. Our spatially explicit evaluation of dominant land-use change pathways provides valuable insights to aid sustainable land-use planning in both subsiding and currently stable areas of the Mekong delta and similar deltas.