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Salinity intrusion in the Mekong Delta – assessing the impacts of climate change, dam construction and sea level rise

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The Mekong Delta is the most productive agricultural area within Vietnam. The high productivity is based on fertile soils in combination with abundant water during the monsoonal rainy season. During the dry season lasting from January to April, rainfall is practically zero and the agricultural production depends on irrigation water extracted from the dense network of river branches and canals. In the coastal area salinity intrusion may, however, cause severe problems for the agricultural production, as e.g. in the latest event of severe salinity intrusion during the dry season 2015-2016. This situation is expected to increase in future due to the changes in the hydraulic boundaries of the Mekong Delta, e.g. by sea level rise. In fact, the Mekong Delta has been identified as one of the most vulnerable regions for climate change world-wide.
In order to quantify the potential future changes in salinity intrusion, a quasi-2D hydraulic model was developed and calibrated for the whole Mekong Delta covering an area of about 60,000 km2. This model was used to simulate the salinity intrusion in the estuary of the Mekong Delta for a baseline period of 2000 – 2010. The model simulates the salinity dynamics continuously throughout the year, starting with new hydrological year in the Mekong in June with the annual monsoon season. From the resulting salinity intrusion of the 11 base line dry periods the mean salinity intrusion was derived. Future changes were then estimated for the period 2050 – 2060 using a scenario neutral sensitivity based approach. Hereby the boundaries, i.e. annual discharge of the Mekong river and sea level and ocean salinity, were modified based on published estimations of these changes. This includes hydrological simulations of future discharge of the Mekong considering several Global Circulation models and emission scenarios, dam construction in the Mekong basin, effective sea level rise consisting of sea level rise projections, land subsidence and floodplain deposition, and changes in ocean salinity. The impact of these changes on mean salinity intrusion for the future period was quantified for each individual drivers as well as combinations of them. It could be shown that effective sea level rise has the most important impact on salinity intrusion. Salinity intrusion of the critical concentration for irrigation water (4 g/l) may increase in the range of 5.0-10.0 km more upstream of the coast compared to the reference period. However, dam construction, but also the likely reduction in ocean salinity with climate change could alleviate the negative impacts of sea level rise. However, it has to be noted that both the extent of the dam construction as well as the change of ocean salinity is quite uncertain. But nevertheless, the presented results provide an overview of possible changes and provide guidance for future adaptation strategies on climate change and salinity intrusion in the Mekong Delta.