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Linking anthropogenic activities and sediment starvation to observed salt intrusion trends in the multi-channel estuarine system of the Mekong Delta, Vietnam

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The low-lying and rapidly urbanizing Mekong Delta, in response to excessive ground water extraction, is experiencing land subsidence rates in the order of 1-4cm/yr that are exceeding sea level rise. Furthermore, sand mining and dredging are changing the channel geometries; hence, tidal propagation is changing in the estuarine channel system. By accelerated dam construction further upstream in Cambodia, Laos and China, the sediment supply has declined, resulting in coastal, channel and bank erosion. All above mechanisms contribute to increased salt intrusion, which is portrayed in the land-use change (e.g. replacement of rice farming with shrimp farming) and record numbers of salt intrusion events as continuously addressed by local authorities.

This research is focused on studying the dynamics and dominant processes of tidal propagation and salt intrusion in the multi-channel estuarine system of the lower Mekong Delta during the dry season, when tidal propagation, salt intrusion and freshwater shortage become significantly important. We present noble historical records of water level, discharge and stationary salinity measurements and extract trends of tidal deformation and saline water intrusion. Furthermore, we apply a state of the art 1D-2D coupled Mekong-wide barotropic model (in D-Flow Flexible Mesh), that links the coastal sea (in 2DH) and the channel network (in 1D).

The in-depth analysis of the model results and studying the short-term processes revealed a crucial role for subtidal water level in temporal variation of freshwater in the multi-channel estuarine system. In studying the long-term processes, we explain the observed historical trends and link them to sediment starvation in the upstream regime. The observed salinity trends could be physically explained and related to barotropic observations, by application of commonly-used analytical salinity models.

The observed trends and the modelled physical processes raise grave concerns over the long-term livelihood of the delta and reveal that anthropogenic activities out-pace global climate change effects in the region. The fate of this mega delta may solely depend on bold, integrated, inter-disciplinary and trans-boundary governance and management measures that require prompt actions.