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Baroclinic dynamics at the downstream junction of the Bassac River (Mekong delta, Vietnam)

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Abstract

The Mekong River splits in downstream direction in multiple branches and has seven outlets to the South China Sea (East Sea). The branches all differ in length, depth and width. The delta is forced from upstream by a seasonally varying river discharge and by tides from downstream. The rapidly urbanising Mekong Delta is suffering from salt intrusion For example, in 2016, as a result of El Nino, a historical draught resulted in record saltwater intrusion and significant damage to local agriculture. The excessive groundwater extraction and land use (urban development) are perhaps leading to subsidence rates exceeding absolute sea level rise (see Minderhoud et al., (2015) or Erban et al., (2014)). This results in alteration of the geometry of individual branches, and consequently influences saltwater intrusion patterns in the multi-channel estuarine system of the Mekong Delta

To characterize salinity patterns in the two downstream branches of the Bassac (Tran De and Dinh An) and to understand how freshwater is distributed at the tidal junction into the downstream branches field data were gathered in the period from end of March to early April 2016. During both spring tide and neap tide we measured the vertical and horizontal salinity distribution at HWS and LWS along the Dinh An and Tran De (see Figure 1) with the *moving boat* measurement method, described by Savenije (1989 & 1992). Furthermore, we measured vertical cross- and along-channel velocity profiles by sailing cross-channel transects with a ship-mounted ADCP and we measured vertical salinity structure at three points across the channel (see pre-defined transects in the right panel of Figure 1). In total 5 cross-channel profiles were measured for 12-13 hours (cross-sections shown in right panel of Figure 1) during 5 consecutive days in the transition from neap tide to spring tide in April 2016.

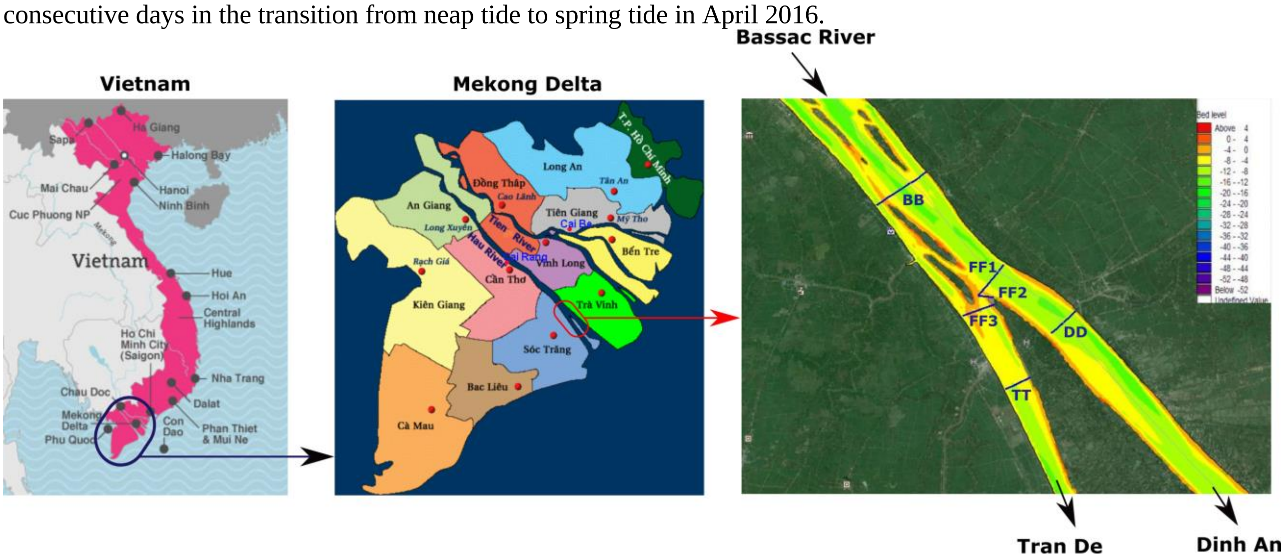

Figure 1, Fieldwork area, including all transects that have been measured during the April 2016 campaign.

A first inspection of the data shows that, although both channels have approximately equal length, due to different depth (Dinh An typically 11 m, Tran De approximately 7m along the main channel) and width (Dinh An approximately twice wider), tidal flow velocities in Tran De are weaker compared to Din Anh. Furthermore, due to the unequal division of freshwater at the junction (largest part into Dinh An), salinity structure in both branches are different. During neap tide, Tran De was more fresh than Dinh An while during spring tide it showed a higher salinity (See Figure 3).

At the junction, saltwater is exchanged between the two channels, but the water of both channels do not fully mix. This causes strong cross-channel salinity gradients to exist relatively far upstream of the junction (See Figure 3, right panel). Nevertheless, both channels demonstrated a partially to well-mixed characteristic in terms of salinity structure. Next, we will analyse the interaction between both downstream channels in further detail, determine salinity budgets at the junction and study how the baroclinic dynamics near the junction affects the division of freshwater. We will try to develop a framework demonstrating how individual branches of estuarine channel networks interact, and how mixing of freshwater and salt water differs from the processes in single channel estuaries.

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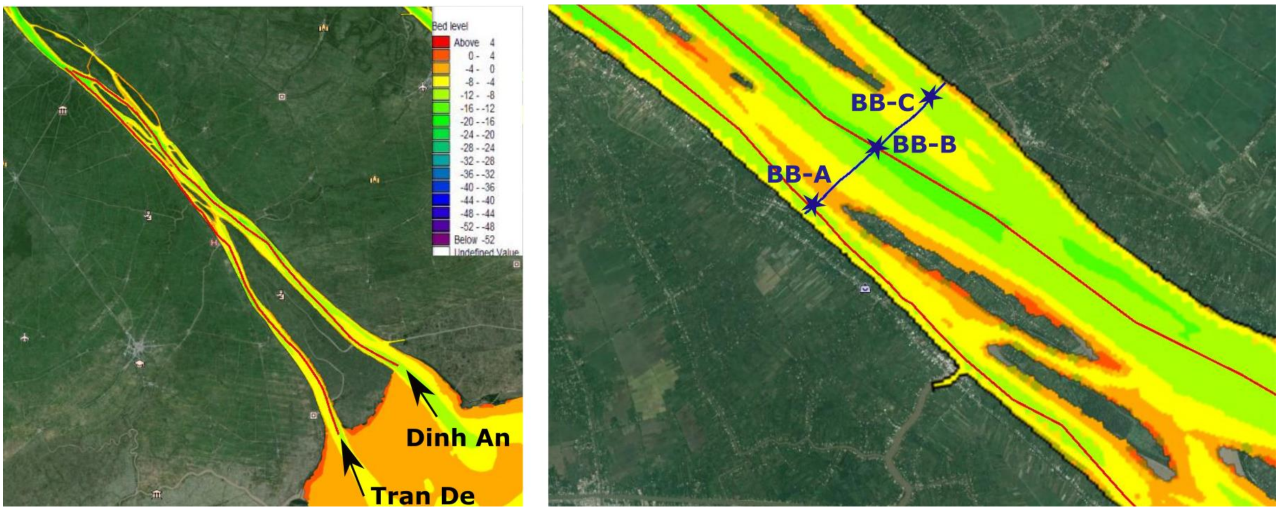

Figure 2.Along-channel transects for which salinity profiles were measured with the *moving boat* method (red trajectories in the left panel). Upstream cross section BB and locations of CTD profiles (blue stars, right panel).

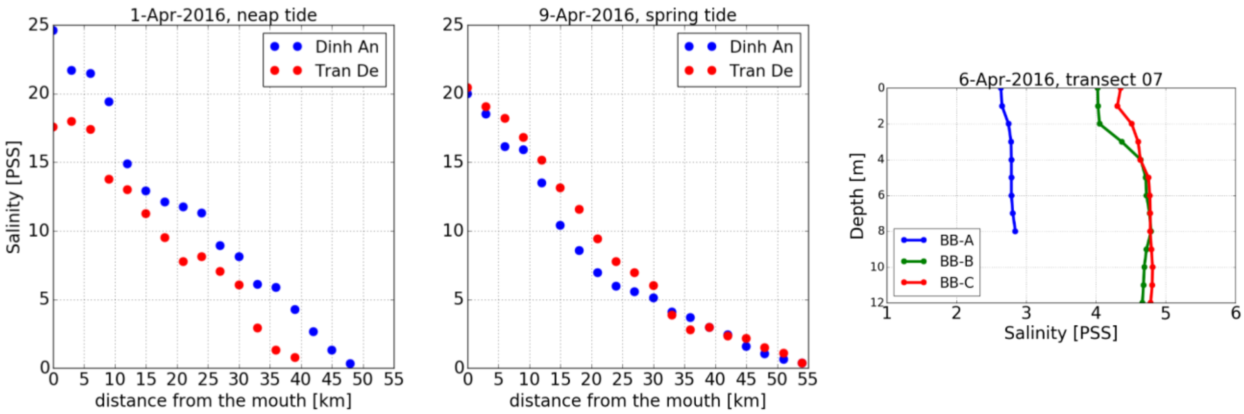

Figure 3, depth-averaged salinity along the estuary at high water slack during neap (left panel, beginning of the campaign) and spring tide (middle panel, end of the campaign). Vertical salinity profile at three locations across transect BB during ebb flow (right panel)

With the help of detailed velocity measurements (hence discharge) across various channels, and by decomposing discharge due to various environmental forces we will analyse the estuarine dynamics in full detail and try to develop a framework demonstrating how individual branches of estuarine channel networks interact, and how mixing of freshwater and salt water differs from the processes in single channel estuaries.

References

Erban, L. E., Gorelick, S. M., and Zebker, H. A. (2014), Groundwater extraction, land subsidence, and sea-level rise in the Mekong Delta, Vietnam, Environ. Res. Lett., 9, 1–6, DOI:10.1088/1748- 9326/9/8/084010,

Minderhoud, P. S. J., Erkens, G., Pham, V. H., Vuong, B. T., and Stouthamer, E. (2015): Assessing the potential of the multi-aquifer subsurface of the Mekong Delta (Vietnam) for land subsidence due to groundwater extraction, Proc. IAHS, 372, 73-76, DOI:10.5194/piahs-372-73-2015.

Savenije, H. H. G. (1989), Salt intrusion model for high-water slack, lowwater slack and mean tide on spreadsheet, Journal of Hydrology, 107, 9–18

Savenije, H. H. G. (1992): Rapid Assessment Technique for Salt intrusion in alluvial estuaries, Ph.D. thesis, IHE report series, No. 27, International Institute for Infrastructural, Hydraulic and Environmental Engineering, Delft, The Netherlands