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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Impact of the Hoa Binh Dam (Vietnam) on water and sediment budgets in the Red River basin and delta" *by* D V. Vu et al.

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Items 1, 2: This paper is the first to provide the distribution of water and sediments within the 9 distributaries of the Red River, one of the biggest rivers in the world (ranked 9th by Milliman and Meade 1983, in terms of sediment input to the ocean). We thank the referee for agreeing that in itself it is an important aspect of the paper.

Item 3: The reviewer is right, sedimentation depends on spatial gradients, but the sedimentation process also depends on SPM concentration through hindered settling, and thus on sediment concentration. Tidal pumping is mentioned here because it was studied in detail in a recent paper (Lefebvre et al., 2012) which showed that tidal pumping was a main factor explaining sediment deposition in the estuary, and that estuarine

sedimentation is three times higher in the dry season than in the wet season after the Hoa Binh dam (HBD) impoundment. Besides, the volume of dredged sediments in the Haiphong harbor has drastically increased in the last decades as mentioned in the present paper. In the discussion, we assumed that the extreme turbidity maximum in the northern branches of the Red River estuary should have moved after the impoundment of the HBD towards the harbor estuarine area. Unfortunately, no data are available on the location of the extreme turbidity maximum before HBD impoundment, and we are not able to prove our assumption. Thus, following the comment by the referee, we agree to revise the "discussion & conclusion" section which was certainly confusing. We propose to provide a revised paper where (1) it will clearly be stated that siltation in the delta estuary of Cam River increased (from measurements of the dredged volumes in the Haiphong harbor), and (2) where the role of the combined new water regulation and tidal pumping will be mentioned as a possible origin of this increased siltation. We will clearly state our hypothesis as an assumption, opening up new avenues of research.

Item 4: The reviewer is right; the value of SSC at the boundaries during flood tides is of essential importance for the siltation of estuaries. Available continuous measurements on periods longer than the spring-neap tide cycle were performed in the Cam and Van Uc Rivers in March (dry season) and August (wet season) 2009 at the Cam River mouth and at the Van Uc River mouth. The averaged SSC at the Cam mouth during flood tide was 52 mg L-1 in the dry season and 61 in the wet season, while it was 60 mg L-1 in the dry season and 95 mg L-1 in the wet season in the Van Uc River. Other series of measurements were performed at 1.5m below the surface and 1.5m above the bed during one tidal cycle at the Cam, Bach Dang and Dinh Vu river mouths (Dinh Vu is located just downstream of the confluence between Cam and Bach Dang) in the wet season in 2008, and in the dry season in 2009 (field campaigns presented in Lefebvre et al. 2012, Mari et al. 2012, Rochelle-Newall et al 2011). During flood tides, at 1.5m below the surface, the averaged values lay in the range 72-162 mg L-1 in the wet season and 28-72 mg L-1 in the dry season. At 1.5m above the bed, they

were higher by 4 to 75 mg L-1, depending on the neap-spring tidal cycle. SSC values were always higher at the beginning of flood (just after low tide) than at the end, just before high tide. As no measurements were available for the other river mouths, we decided to fix in our calculations a constant value of 50 mg L-1 at each river mouth over the whole year. This value is within the range and the good order of magnitude for the Cam, Bach Dang and Van Uc Rivers and also corresponds to the value suggested by the Vietnamese standards for water quality (MONRE, 2008). Although it enables the calculation of estimates of sediment flux, this arbitrary value likely underestimates the sediment flux from offshore to the estuary, and thus estuarine siltation. In a revised version of the paper, the measurement of SSC at river mouths during flood tides will be encouraged in future work so as to improve the accuracy of sediment flux estimates. ref added: MONRE, 2008. National technical regulation on coastal water quality, report QCVN 10 2008/BTNMT, Ministry of Natural Resources and Environment, Hanoi.

Item 5: The increased siltation in the estuary is a result and not an assumption (see Item 3 above), but the link with the dam impact and, in particular, the role of tidal pumping, is still a hypothesis. A revised version will state this clearly. Concerning sand transport, the estuaries are mainly composed of silts, and sand is estimated to be 10% of the surface sediments in the mouths of the Red River, in average (Tran and Tran 1995). Perhaps future work should be encouraged to focus on bedload sand transport, this will be added to the conclusions of the revised paper. ref to be added in a revised version of the paper: Tran D.T., Tran D.L., 1995. The role of exogenous dynamics factors on sedimentologic processes in the coastal of Tonkin Gulf. Vietnam Geology, Mineralogy and Petrology, Volume 1-Geology, Hanoi, 185-195.

Item 9: The authors agree to revise the abstract according to the reviewer's suggestions.

Item 10: Three groups of distributaries ("northern", "middle", "southern") were introduced in Table 3 so as to compare our results to previous estimates by Pruszak et al. (2005) and by Luu et al. (2010) who did not consider every mouth but 3 groups (Luu et

al. 2010) or one "northern" group and 5 mouths (Pruszak et al., 2005). We will rewrite the sentence in a revised version.

Item 13: Sections 2.5 and 2.6 are short (9 lines and 8 lines, respectively). Discussing tides and morphology, they show that the Red River delta is tide-dominated in its Northern part, and is thus a muddy estuary where sand transport can be neglected in a first approach. Information on tidal amplitude is of major importance as it shows that tidal pumping can be there significant. We think that these short sections enable the reader to compare the RRD environment to other deltas (wave or tide dominated, with different tidal amplitudes and river discharge, and thus probable different intensities of estuarine siltation).

Conclusion: The authors warmly thank J. Shaw for his review. The authors agree to revise the paper accordingly, as mentioned above, and to integrate all the specific comments.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 333, 2014.