Response to Reviewer's Comments on

Large-scale quantification of suspended sediment transport and deposition in the Mekong Delta.

By Nguyen Van Manh

The article 'Large-scale quantification of suspended sediment transport and deposition in the Mekong Delta' aims to quantify and map the sediment transport and sedimentation in the Mekong Delta in Vietnam. The study increases considerably the understanding of the suspended sediment interaction between the Mekong main rivers and lower Mekong floodplains, and also within the floodplains. The manuscript is generally well written, methods are presented with sufficient details and results are mostly clearly illustrated.

I recommend this HESSD manuscript for publication, after the following minor comments are replied thoughtfully and taken into account when revising the manuscript.

0. Abstract: it would be beneficial to add how large part of the sediment entering to the MD at Kratie finally reaches the sea / coastal zone. This is, to my opinion, one of the main results of the paper.

AUTHOR REPLY: Thank you for the comment. We will include the following statement regarding this point based on our results:

The annual trapped sediment varies from 19% to 23% in Cambodian floodplains depending on flood magnitude, and from 1% to 6% in the diked floodplains in Vietnam. The annual sediment load reaching the coast varies from 48% to 60% of the sediment load at Kratie. (Please see also the revised manuscript).

1. Introduction:

1a. Page 4314; line 16: while it is true that there is large difference between Vietnamese and Cambodian floodplains in terms of human interfere, I would not claim that Cambodian floodplains are fully in natural state as there are quite a few roads and few millions of people living there. Please reformulate the sentence here, and elsewhere in the article.

AUTHOR REPLY: We agree and the statement is re-formulated to:

While the Cambodian floodplains show a low level of human interference, the VMD floodplains are heavily altered from their natural state.

2. Study area:

2a. It is unclear for me, to which definition it is based that the Mekong delta starts at Kratie? If looked for example Gupta and Liew (2007), they define that delta starts after the Tonle Sap river and Mekong river confluence. This is indeed justified, as i) Tonle Sap area clearly is not part of the delta, and ii) the tidal impact (during dry season) reaches Phnom Penh but not too much further. Therefore, I would recommend of either justify the current division of the study area or then change the definition

AUTHOR REPLY: We explain and justify defining Kratie as the starting point of the MD as follows:

We define Kratie as the starting point of the Mekong Delta, because it is the first gauging station upstream of Kampong Cham, where bank overtopping initiates the large floodplain inundations on the left bank of the Mekong and the overland flood wave to the Vietnamese part of the delta.

2b. The paragraph starting from page 4316; line 19 is unclear. The Tonle Sap River flows from the Mekong to the Tonle Sap lake from June to September and then reverses back towards the sea. Further, it would be good to mention that the temporally stored water in the lake forms an important part of the dry season flow to the delta. Please rewrite.

AUTHOR REPLY: Following your request the paragraph is modified to:

Tonle Sap includes Tonle Sap Lake and Tonle Sap River. The flow into the Tonle Sap Lake during the rising and high stage of floods is reversed during the falling stage and the following

dry season, thus TSL buffers the flood peak and contributes considerable parts to the dry season discharge downstream of Phnom Penh. TSL stores up to 10% of the total wet season flow volume of Kratie, and reduces the maximum discharge of Kratie by 16% (MRC, 2009). Due to sediment settlement the TSL also retains a considerable proportion of the suspended sediment load.

2c. Page 4316; line 27: the claim that Mekong Delta is the most complex river delta in the world requires a reference

AUTHOR REPLY: We agree that this was a rather subjective statement. We follow the recommendation from the Reviewer 2 and rewrite the statement as below:

The VMD is a very complex river delta as a result of large scale anthropogenic interference encompassing numerous man-made channels, dikes, sluices gates and pumps.

2d. Page 4318; line 1: unclear to which population the _1 million people refer to. Delta obviously has more population, around 17.3 million (according to national statistics).

AUTHOR REPLY: This is typo, thanks for pointing it out. 10 million people live in the VMD excluding the coastal zone. The sentence is rewritten as:

75% of the ≅10 million people living in the VMD excluding the coastal zone live in rural areas (GSO 2012), whereas the rural residential areas are preferably distributed along the dike lines.

3. Model setup and data: the section is well written and everything is well documented;

I do not have comments on it

4. Model calibration and validation: well documented, no comments on this section

AUTHOR REPLY: Thank you.

5. Results and discussion:

5a. Page 4330; line 21: misspelling VDM should be VMD

AUTHOR REPLY: Yes, VMD

5b. Page 4332; line 2: Most of the water from Tonle Sap river enters to the Bassac but not all, as stated in the text. Please revise.

AUTHOR REPLY: Yes, this correct and the statement is corrected to:

The return flow has much lower SSC than the inflow (i.e. the Mekong flow) due to the settlement of sediment in the TSL. As most of TSL return flow enters the Bassac branch, SSC at Chau Doc is significant smaller than SSC at Tan Chau during the high and falling stage of flood events. During this period SSC at Chau Doc is approximately 50% of SSC at Kratie (Fig. 5b).

5c. Terminology of the sea names is mixed in the article; at the beginning South China Sea is used while later the West Sea and East Sea are used. While West Sea and East Sea are used in Vietnam, those are not, however, internationally used names. Therefore, I would advice to use Gulf of Thailand and South China Sea, respectively, in terms of clarity. Please harmonise the use of these names also in Fig 1.

AUTHOR REPLY: Yes, we follow your suggestion using internationally accepted terms, i.e. using Gulf of Thailand and South China Sea instead of West Sea and East Sea, respectively. The manuscript has been changed accordingly.

6. Conclusions: the conclusion section reads now more like a summary section. I

would recommend of condensing the methods part and list the very key results only, and then extend the concluding remarks, answering question what does these findings mean in wider context.

AUTHOR REPLY: The conclusion has been shortened, now also highlighting the potential application and outlook of the model in the MD (see the revised manuscript).

7. Tables:

7a. Table 2: please indicate what all the abbreviations mean

AUTHOR REPLY: All the abbreviations were explained in the related text section (sect. 4.1). However, we explain them again in the table caption for better readability as below:

Table 1: Model performance for a) Calibration year 2011, and b) Validation for the years 2009 and 2010. The model performance measures are Nash–Sutcliffe efficiency (NSE), Flood Area Index (FAI), and root mean square error (RSME)

Objectives	stations /no. of data points	Calibration (2011)			Validation (2009/2010)		
		NSE	FAI	RMSE	NSE	FAI	RMSE
Water level (m)	13/daily	0.84	-	-	0.74/nodata	-	-
Discharge ($m^3.s^{-1}$)	10/ daily	0.63	-	-	0.51/0.74	-	-
Inundation	571/17	-	0.46	-	-	0.39/0.36	-
River SSC ($mg.l^{-1}$)	2/daily	0.52	-	-	0.2[(1)]//0.78	-	-
Channel SSC ($mg.l^{-1}$)	79/6	-	-	40	-	-	60/nodata
Sedimentation ($kg.m^{-2}y^{-1}$)	11/-	-	-	8.55	-	-	5.27/1.28
				[4.4÷18.8][(2)]	-	-	-

[(1)] in which NSE = 0.9 at Tan Chau and NSE = -0.56 at Chau Doc

[(2)] is the RMSE calculated against the mean 95% confidence interval of the measured deposition

7b. Table 3: now table mixes the sediment load and sedimentation; it is very hard to understand which parts are actual sediment load and which are the sedimentation figures. Please divide the figures to those two categories. Further, does coast mean that this amount of sediment enters to the sea?

AUTHOR REPLY: We follow the suggestion and divide the table into two as shown below.

Table 3: Total sediment load, relative sediment load, flood volume (with reference to Kratie) at key locations in the MD for three flood events.

Subsystem	Flood volume (%)			Sediment load (10^6.ton)			Sediment load (%)		
	2009	2010	2011	2009	2010	2011	2009	2010	2011
Kratie	100%	100%	100%	78.4	43.4	104.2	100%	100%	100%
Cam floodplains	11%	9%	16%	21.4	10.3	27.3	27%	24%	26%
Overflow to VMD	6%	4%	9%	3.5	1.5	7	4%	4%	7%
Tonle Sap Lake	8%	6%	12%	5.2	2.1	10.6	7%	5%	10%
Vietnamese MD	92%	93%	86%	51.8	31	66.3	66%	71%	64%
Tan Chau	67%	70%	60%	41	24.7	50.3	53%	57%	48%
Chau Doc	19%	19%	18%	7.3	4.7	9	9%	11%	9%
Vam Nao	26%	28%	23%	14.7	9.3	18.7	19%	21%	18%
VN floodplains	21%	17%	24%	10.9	5.6	17.6	14%	13%	17%
Coast (Sea)	-	-	-	42	25.9	50.5	55%	60%	48%

Table 4: Cumulative sediment and nutrient deposition mass in different spatial units in VMD floodplain compartments (absolute mass and relative to the sediment load of the flood season measured in Kratie).

Zone	Item	Unit	2009	2010	2011
VMD	Sedimentation	10^6 ton	2.27	0.43	6.56
		% of Kratie	3%	1%	6%
	Nutrients	10^3 ton	152.5	28.8	439.9
PoR	Sedimentation & Nutrients	PoR/VMD	58%	68%	66%
LXQ		LXQ/VMD	28%	23%	23%
THA		THA/VMD	14%	8%	10%
VMD	Sedimentation ($kg.m^{-2}$)	Min	0.05	0.01	0.10
		Mean	1.02	0.36	2.10
		Max	27.2	6.85	58.44
	Depth	(mm)	0.90	0.30	1.80
	Nutrients	($g\ m^{-2}$)	68.5	24.4	141.0

8. Figures:

8a. Figure 5 (right tile): as in Table 3, it is not clear which part of the sediment in the subsystems actually stays there and which moves to the next subsystem. Please indicate clearly the SS load and sedimentation in the Figure. Further, add clearly the proportion of the sediment reaching the coast in each point. Ideally reader would get a good understanding of the sediment balances in the system, which would be very important result, to my opinion.

AUTHOR REPLY: Thanks for the suggestion. We updated figure 5 as below.

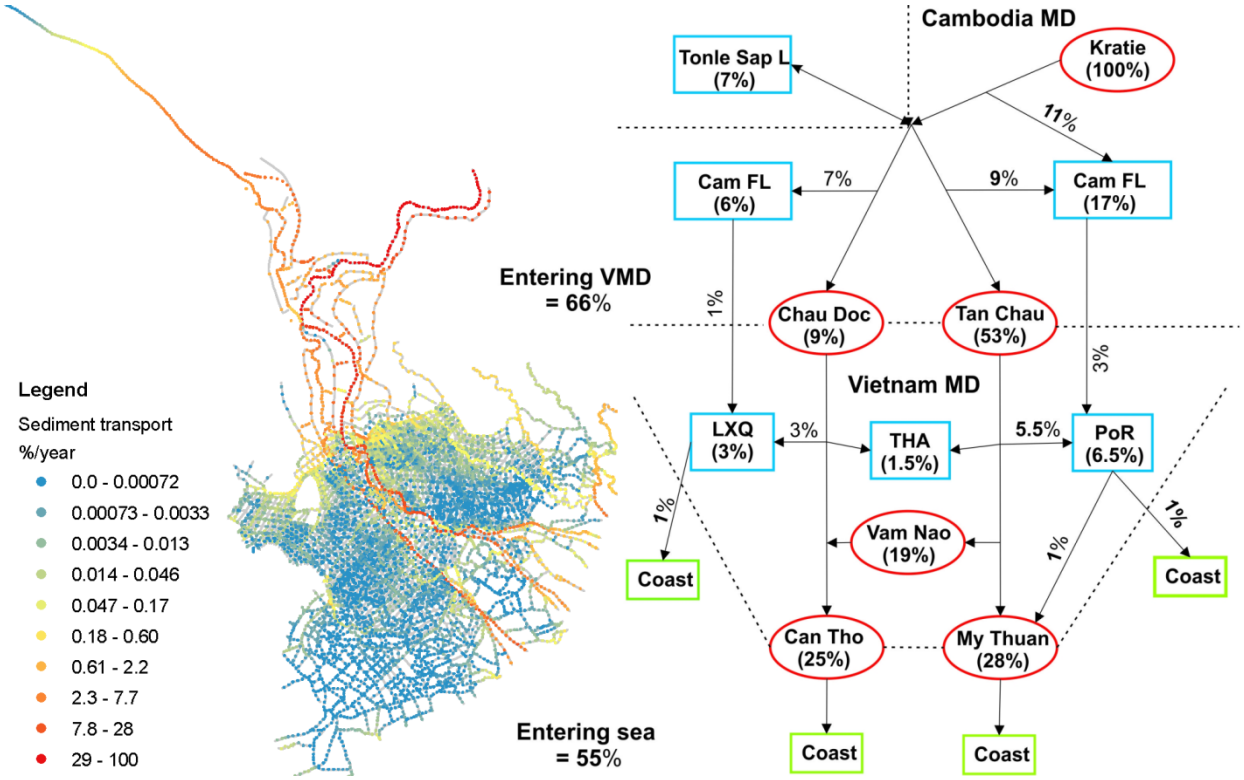

Figure 6: Left: Proportion of transported sediment in the MD compared to sediment load at Kratie for the year 2009. Right: Sediment transport (arrows) and sediment deposition (turquois rectangles) to and in subsystems, and sediment transport to key gauging stations (red circles) for the year 2009.

8b. Figure 9: it is not easy to understand what the difference between the modelled and measured sedimentation mean (unit and values missing; i.e. is the modelling larger or lower than the measured). Please revise the figure to be clearer.

AUTHOR REPLY: We added the unit and a scale to the legend for the comparison of measured and simulated deposition. However, the maps are intended to show the spatial distribution of the differences along with an indication of the scale, not the actual values. The detailed comparison measured vs. simulated deposition is shown in Figure 5c.

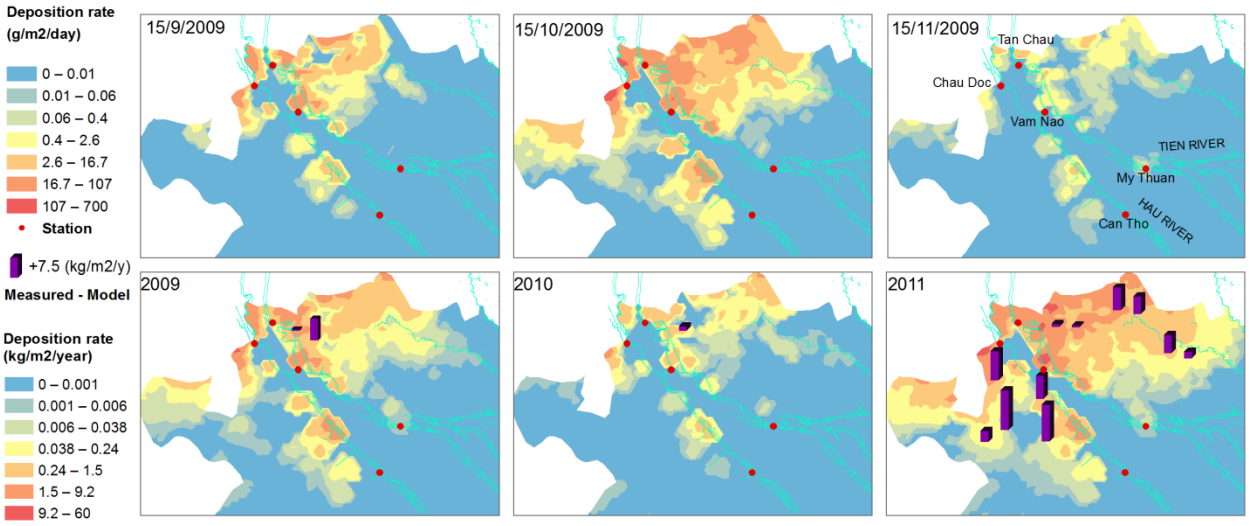

Figure 10: Map of sedimentation in the VMD floodplains. Top: Sediment deposition rate ($g.m^{-2}.day^{-1}$) of particular days during the period of compartment opening (left), during flood peak discharge (center) and during the period of compartment closing (right). Bottom: Cumulative sediment deposition ($kg.m^{-2}.year^{-1}$) in 2009, 2010 and 2011. The bars show the differences of cumulative sediment deposition between measurements and simulation ($kg.m^{-2}.year^{-1}$), the values are in figure 5c.

References:

GSO: Statistic Yearbook of Vietnam 2012, Gen. Stat. Off. Vietnam, 150 [online] Available from: http://www.gso.gov.vn/default.aspx?tabid=512&idmid=5&ItemID=14153 (last access 24/5/2014), 2012.