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Hydrology and Earth System Sciences Discussions

Interactive comment on "Suspended sediment fluxes in an Indonesian river draining a rainforested basin subject to land cover change" *by* F. A. Buschman et al.

F. A. Buschman et al.

frans.buschman@gmail.com

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1. General comments

We thank reviewer #1 for the in-depth comments. The reviewer confirmed the particular significance of observing the suspended sediment load in the Berau river, which drains into a shelf sea with high biodiversity and has a drainage basin that is developing rapidly. Considering the rapid developments and relatively pristine conditions in 2007, the paper can be considered to be a benchmark that may serve to perform an impact assessment in the future. Our efforts to quantify the land to ocean transfer of

sediment in a data poor environment can be considered to be part of the IAHS initiative 'Predictions in ungauged basins', which aims to reduce uncertainty in hydrological predictions. Pioneering studies like ours are set out to obtain benchmark data in an ungauged region, which can be the basis of the development of new techniques that serve to cope with data scarcity.

In response to the reviewers'comments, we will better describe the broader context of the study in the revised manuscript. The study is part of the East Kalimantan Programme, which is jointly coordinated by the Netherlands Organisation of Scientific Research and the Royal Dutch Academy of Sciences, and includes 6 other projects focusing on the land-ocean interactions in the Berau region. A study that integrates the findings of the parallel studies in the Berau region will be finished in 2012, which will project future changes in the Berau coastal zone based on land use changes in the catchment predicted from socio-economical developments. Using our research, ecological studies on coral reef conditions and seagrass in the Berau region identify the Berau river as a potential source of pollution. Our main objective of the present study is to obtain an estimate of the annual sediment load, which will be explicated in the revised version of the ms. The sensitivity of the annual sediment load to mean river discharge and the associated river-tide interactions were analyzed to establish the representativity of the estimates. A second objective is to predict at first order how the suspended sediment load may respond to foreseen land use/land cover changes. Since the availible data are too limited to setup a distributed erosion model, only a first order estimate was made using the USLE.

The reviewer indicates that the number of Figures and Tables could be reduced. Reviewer #2 would like to add Figures. We will evaluate the necessity of each Figure. The number of Tables can be reduced by joining Tables 3 and 5 in the revised ms.

2. Specific comments

Abstract

The abstract will be rewritten, taking into the account the general and specific comments of reviewers 1 and 2 on the HESSD version of the paper.

Introduction

In the introduction the objectives will be explicitly mentioned. The current study will be linked to observations of other projects in the Berau cluster, in which coral reef growth and health are under study. In the revised discussion section, a link to the decreasing size of seagrass areas in the inner shelf sea will be made. Within the coastal oceanography project in the Berau cluster, freshwater transport from the tidal river to the coral reefs is being simulated. That study intends to address the effects of increasing sediment loads on coral reefs. In the methods section, a more elaborate overview of the obtained data will be offered. The reviewer remarks that the obtained sediment loads are unique, since they are observed in the tidally affected part of the river. Indeed, the observed sediment load will be closer to the sediment load expelled to sea in comparison with many other studies, as sediment load monitoring usually occurs beyond the tidal limit. The latter issue will be discussed in the introduction of the revised ms. We selected the specific measurement location for obtaining the sediment load of the Berau river for two reasons. Two rivers join just landward of our station, such that all water and sediment is conveyed in a single channel. Secondly, a firm jetty existed to which the instruments could be mounted.

Field site

In the Field site section it is indeed better to cite Figure 2 directly after the first sentence in 2.2, which we will do the the revised ms. The spatial distribution of rainfall was obtained from Voss et al. (1982). Over the past decade, daily rainfall was measured only at one station in the catchment (see Figure R1), as far as we know. In the revised ms, this rainfall time-series will be shown together with time-series of river discharge and suspended load.

Methods

We understand from the comments made by the reviewer that #3.1 of the methods section was too brief. We will extend the paragraph by explaining the procedures to obtain discharge from a HADCP data in more detail. #3.2 and #3.3 present the data as briefly as possible. A time line will be presented instead of Table 2, to help the reader see when the observations were done and at which frequency. We included Figure 4 to show the obtained regression is reliable for conditions of both high and low sediment concentrations. This regression line is not always so nice and linear. In other regions, the regression coefficients sometimes differ significantly with flow regime. Therefore, we take the view that Figure 4 does have an added value, and we will explain why in the revised ms. In #3.4 the USLE is used to give a first order estimate of the sensitivity of sediment load to land use/land cover and rainfall. As stated in the general comments, insufficient data were available to apply a distributed erosion model, such as LISEM or Answers. Therefore, the relatively simple USLE has been applied. The revised USLE was not used, since it involves additional variables that need to be estimated. Since we applied the USLE to a single hillslope, we do not claim to predict soil loss at the catchment scale. The results of the USLE hillslope model is merely used to explore the sensitivity of the catchment-scale soil losses to prospected land use changes, even though the predictions are fairly in agreement with the observed sediment load. The reasoning behind the selection of the USLE will be described in more detail. Also, the parameters that were given in #5.2 will be moved to section #3.4.

Results

Indeed, plots of S versus Q and C versus Q can be added (see Figure R2). In rivers these plots often show linear relations. Since the tides play an important role in this cross-section under study, especially the sediment rating curve (upper panel of Figure R2) shows a large scatter around the mean suspended sediment concentration. Suspended sediment concentrations can be substantially higher during spring tide than during neap tide, while the river discharge remains unchanged. We will exclude these figures in the HESS paper, since it is obvious that in a tidal river these relations are nonlinear.

Section 5 describes the sensitivity of sediment load to land use/land cover in the HESSD version, which was presented separately from the observations. The reviewer points out that parts of this section may better be presented in other sections. We agree that #5.1 can be moved to the introduction and the methods sections. The first part of #5.2 can also be moved to the methods section. The last part of #5.2 can be presented as a separate subsection of #4, which will then be named 'results' instead of 'observations'. Table 4 provides the default input parameters for the USLE, including the land cover factor. We prefer to present this collection of variables in a Table, which improves the readability. Table 4 will be presented in the methods section. To reduce the number of Tables, Tables 3 and 5 can be merged, which directly shows the values of Cm that were used for the sensitivity study. The model results are indeed very similar to the observations. We do not want to emphasize this, since we realize that the model may partly be right for the wrong reasons. The model only gives a first order estimate of the sediment load as a function of land cover/land use.

Discussion

In the third paragraph of the discussion section, we will add several lines related to the sensitivity to land cover/land use change. Table 6 will be moved to the first results subsection concerning discharge, since it basically is a summary of the rainfall time-series (Figure R2). The Table gives insight in the rainfall conditions during the observations. Figure 7 shows the tidally averaged discharge, which varies gradually, without showing the shape of a recession curve. Only after the highest peak of river discharge at Julian day 545, the river discharge reduces according to a recession curve.

Conclusion

The last sentence of the conclusion section will be moved to the discussion section, such that the conclusions bring the paper to closure.

3. Technical comments

We will make several technical corrections in the HESSD version of the paper. We would be happy to receive an additional list of technical corrections, to further improve our paper.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 7137, 2011.

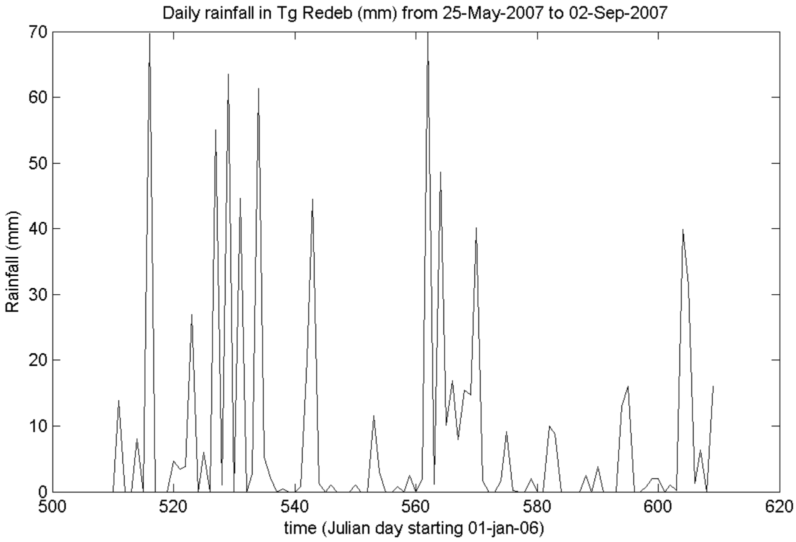

Fig. 1. Time-series of rainfall observed at the airport of Tanjung Redeb.

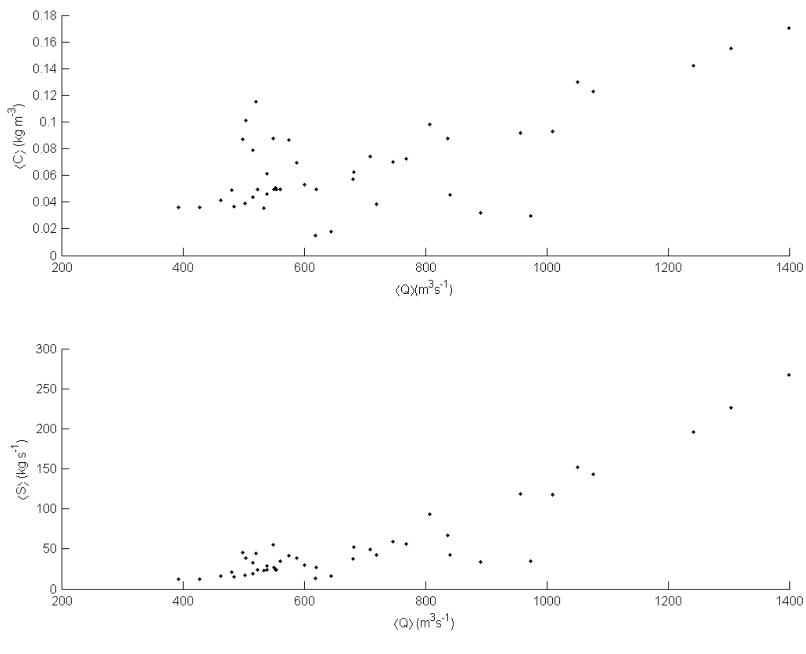

Fig. 2. Suspended sediment rating curve (upper panel) and suspended sediment load versus tidally averaged discharge.