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Interactive comment on "The Role of Sediment-induced Light Attenuation on Primary Production during Hurricane Gustav (2008)" *by* Zhengchen Zang et al.

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We would like to thank Reviewer#2 for his/her helpful comments. Here are our response and plan:

RC2 point 1: The authors reference the models (papers) which their model is based on (in some cases the same or very similar model), including a hydrodynamic, sediment transport and biogeochemical model. They need to give a short description of the models in the "Methods section", especially the sediment transport and biogeochemical models.

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Discussion paper

Authors: We will add more details about sediment transport and biogeochemical models in section “Model Setup”.

RC2 point 2: Authors should mention why they did not include nutrient river loadings (and show values), boundary conditions (and show values) and provide values of initial conditions. Values can be averages, ranges etc.

Authors: Our model includes fluvial nutrient discharge (data was extracted from USGS Water Data website). The concentrations of biogeochemical tracers along the open boundaries are zero due to the lack of observations and the limited impact on our study area. We will add a new panel in Fig. 3 to show the initial condition of chlorophyll concentration.

RC2 point 3: I am no expert with satellite data, but my understanding is that SeaWiFS is no longer in use? Regardless the authors need to provide information (reference) about the algorithms used to calculated satellite-based chlorophyll-a. Did they use an in-house algorithm? Perhaps also mention why newer satellite data were not used?

Authors: SeaWiFS is active from 1997 to 2010, and its chlorophyll products have been widely used to calibrate numerical model results. In this study, we used SeaWiFS chlorophyll concentration based on OC4 algorithm (line 185), which is a fourth-order polynomial relationship between a ratio of visible bands reflectance and chlorophyll concentration. We also tried to use MODIS satellite data, but the quality of satellite image is unsatisfactory due to thick clouds.

RC2 point 4: It will be useful if the authors could compare model results with actual observations or ranges. E.g. Figure 5 show pre and post hurricane simulations – perhaps the authors can compare the pre-hurricane values to typical Gulf values and the post hurricane to highest values measured during “windy” times (if there are data available).

Authors: We searched World Ocean Database (WOD) and found no data available 1

month before/after the landing of hurricane Gustav in the northern Gulf of Mexico.

RC2 point 5: So much is different in the shelf waters during a hurricane – sediments stirred up, high levels of solids and nutrients in the water (including the surface water), likely breakup of stratification, impact on river loadings and discharge into the shelf and more. I therefore do not think comparing model results, where only differences in sediment enhanced light attenuation is accounted, with satellite data prove that one light attenuation formulation is better than the other. I think it is fine to show the comparison and speculating that it might be better, but I do not think the satellite data prove it one way or another. I think the authors almost make this point themselves by pointing out the limitations and uncertainty of the model.

Authors: As we mentioned in section "Model Uncertainties", there are many factors might potentially impact our model results. Compared with these factors, however, sediment-induced light attenuation is more important during hurricane because of the dramatic increase of SSC. Thus, the uncertainties associated with other terms can be overwhelmed by sediment term, and that is the major reason why we believe better resolving light attenuation by sediment might improve the performance of biogeochemical model during hurricane. Owning to the lack of field measurements during hurricane, satellite image is the only source which can help us evaluate model results.

RC2 General comments RC2 point 6: Abstract: The abstract seems reasonable. I believe the authors can say a little more about model uncertainty since they make a good point in the paper about all the uncertainties in the model. The authors mention "episodic hurricanes" in line 57, but I do not think the authors should rather mention "wind events" or another term when discussing the impact of high winds including tropical storms etc. The abstract also need to be changed based once changes is made to the paper to reflect any changes in the paper.

Authors: We will add more information about model uncertainties in the abstract, and we use "hurricane event(s)" to replace other similar terms in the manuscript to avoid

confusion (details see lines 104, 673 and 684).

RC2 point 7: Introduction: Line 44: Light is one of the primary agents for photosynthesis (also nutrients, temperature) Line 70: Since light attenuation is an important part of the paper, I think the authors should dig a bit deeper in what has been done, perhaps show their equations (or discuss conceptually) etc. I believe some models/papers have discussed CDOM and other influences on light attenuation.

Authors: For Line 44, we will include nutrients and temperature. Line 70: since we show the equation in the following "Model Setup" section, we will add more background information about how these models estimate light attenuation due to CDOM and other light absorbers.

RC2 point 8: Model Description: Line 115: Why nitrogen and silica and not phosphorus? I believe some studies in the Gulf have shown that phosphorus can be important at certain times of the year. Perhaps a sentence why it was not included?

Authors: Primary production in the northern Gulf of Mexico is limited by phosphorus from May to July, so without phosphorus should not impact our model results (August 30th-September 10th).

RC2 point 9: Line 116: Please expand on how chlorophyll-a was estimated. Fennel reference is fine, but perhaps add a sentence or two.

Authors: We will add more information about how to estimate chlorophyll concentration in our model.

RC2 point 10: Line 132: Expanding on my "main points": Provide additional details in the Introduction or this section about the light attenuation formulation used in the paper, what others have done in terms of sediment attenuation, the section of the sediment attenuation coefficients (0.059, 0.025 and 0.075). Are these values based on some median/percentile values? How much faith should we have in these values?

Authors: Additional information will be added in Introduction. For sediment-induced

light attenuation term in previous studies, we mentioned that “Justić and Wang (2014) tentatively employed a new scheme by connecting sediment-induced light attenuation with river discharge and hydrodynamics”. In fact, most biogeochemical models do not have sediment-induced light attenuation term because they are not originally developed for highly turbid water.

In the updated manuscript, we will re-design the sensitivity tests by increasing (decreasing) attenuation coefficient by 20% and 40%, respectively (lines 174-176). Although these coefficients in the sensitivity tests are artificially assigned, the results can provide valuable information about the response of primary production and nutrient to different light attenuation efficiency.

RC2 point 11: Line 171: Should this part not be the Results and Discussion section?

Authors: The part quantitatively evaluates the performance of our model and confirms the readers that our model is well calibrated, so we still put this part in the “Model Validation” section.

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