

Interactive comment on “Quantification of surface water volume changes in the Mackenzie Delta using satellite multi-mission data” by Cassandra Normandin et al.

Anonymous Referee #2

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Normandin et al. used multi satellite sensor integration (multispectral and radar altimetry) to quantify both surface water extent and volume dynamics across the Mackenzie Delta for a time period of 15 years. The information (time series) generated in this study is of high relevance for many applications and the methodology used is appropriate and well documented/ described. Although this is not the first study to combine satellite altimetry with remotely sensed surface water extents for water volume estimations, the application of these methods over a large and complex river delta and a 15-year time period makes this study a significant contribution to the field and of great interest to the HESS community. Nevertheless, the manuscript is rather premature and not suitable for publication in its present form. The authors fail to clearly distinguish

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their work from work that has already been done and the significance and novelty of their research isn't presented in its full potential. In addition, the authors leave it up to the readers to find the key results and highlights of the research. Rather than conveying the findings in a limited number of carefully designed figures and tables, the authors present an abundance of material that makes it difficult for the reader to ingest and enjoy the paper. The writing of the paper is often in the style of a technical report and the manuscript lacks flow in the argumentation and a proper discussion section, where the limitations and implications of the research are discussed in detail. Due to these issues, the manuscript is not suitable for publication in HESS in its present form and needs to undergo major revisions before it can be considered suitable for publication.

Specific Comments: The number of Figures and Tables is very high in relation to the information and novelty content of the manuscript. I highly recommend to reduce the number of Figures so that only the key information and results is presented. For example, the statistics presented in three separate tables 3,4 and 5 should be easy enough to show in a single graph, which would also make it much easier for the reader to get the main points without having to search. The same applies to the abundance of inundation extent and duration maps that are shown. Introduction: line 7 to 23: This sounds like the study area section (which should go to methods). page 2 line 29: Thus, the understanding of these dynamic environments is a societal and scientific stake to anticipate and manage 30 their evolutions at medium and long term time scales. This is confusing and I do not follow what your argument is here. Consider re-writing and clearly making your point. page 2 line 33: I agree with you that they probably are the only way but I would be carefull with this statement, considering that large-scale 3-d hydrodynamic modeling is getting more and more powerful and feasible. Also airborne remote sensing is an alternative. Consider rewriting. page 3 line 4: use quantify surface water extents instead of “spatial extent of surface water extents” page 3 line 8: The whole intro is poorly structured and lacks argumentative flow, which makes it rather difficult to read. It reads a bit like a “staccato” listing of important but often slightly unrelated and repetitive pieces of information. Consider rewriting the intro with

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improved flow and less repetitions and focus on the a) background, b) significance and innovation and c) motivation of your research, rather than a very detailed description of your study area and corresponding environmental processes. You should clearly state that the sensors that you integrated haven't been integrated in this way for this particular quantification (if this is the case) and add more emphasis on the usefulness of the information about surface water extent and volume that you are generating in this study (which is certainly of very high importance). What can a time series of surface water volume be used for (i.e. studying climate feedback or sea level rise...). page 3 line 6: Where you cite papers that have "successfully applied this approach": You should describe the very closely related studies with more detail and then highlight what your study adds to this existing body of knowledge. line 36. Given the very high relevance of existing large scale surface water extent time series for your study (you could have used some of those for validation), you may want to consider to cite the state-of-the-art literature here: Pekel, J., A. Cottam, N. Gorelick, and A. S. Belward (2016), High-resolution mapping of global surface water and its long-term changes, *Nature*, 540, 418–422, doi:10.1038/nature20584. Tulbure, M. G., M. Broich, S. V Stehman, and A. Kommareddy (2016), Surface water extent dynamics from three decades of seasonally continuous Landsat time series at subcontinental scale in a semi-arid region, *Remote Sens. Environ.*, 178, 142–157, doi:10.1016/j.rse.2016.02.034. Klein, I., Gessner, U., Dietz, A.J., Kuenzer, C., 2017. Global WaterPack – A 250 m resolution dataset revealing the daily dynamics of global inland water bodies. *Remote Sens. Environ.* 198, 345–362. doi:10.1016/j.rse.2017.06.045 page 3 line 10: In my opinion, the study region section is unnecessarily lengthy. Consider focusing only on the information that is relevant to your study and methods. Consider improving the reading flow by connecting sentences with similar information. page 4 line 6: Are you sure it's "raw radiance"? You mention further down it's surface reflectance. page 4 line 25: It is true that there will be plenty of data gaps in the OLI time series but what is the time step that you require for the surface water extent dynamics in your study? How quickly does the extent change over time? What about Sentinel-2? page 6 line 4: You may want to consider Tulbure,

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Klein and Pekel 2016 and mention that the state of the art for this type of classification is machine learning but that you chose a simplified spectral indices approach because... page 6 line 31: You think one OLI image is enough for cross-validation? page 7 line 8: you mean $\frac{2}{3}$ of the "annual" study period from June to September? Your study period is 2000-2015 right? page 8 line 6: What is rough delineation of cross sections? Do you have DEM data or do you just refer to location of rivers? page 8 line 9: What is the refined process? page 12 line 24: The correlation between discharge and surface water volumes should be discussed more here. Due to the size of the delta, there would be significant lag effects (time that the flow takes to pass through the delta) that are not captured by a simple correlation. You may want to consider to have a look at similar type of models and discuss your work in that context (i.e. Heimhuber, V., Tulbure, M.G., Broich, M., 2017. Modeling multidecadal surface water inundation dynamics and key drivers on large river basin scale using multiple time series of Earth-observation and river flow data. *Water Resour. Res.* 53, 1–19. doi:10.1002/2016WR019858). The relationship between discharge and water volume is unlikely to be linear so an r^2 of 0.66 is pretty high for your application - I recommend discussing. Figure 3: A scale bar would make it easier to get an idea of the size of the index images that are shown in each panel. Figure 5: You might want to keep the direction of your colour bar consistent (i.e. more days is red, less days is blue). page 13 line 6 & Figure 6: Given that the surface water extent of the first time step of your annual time period is always the highest, maybe you should have started the annual time period 1 month earlier, to ensure that you always capture the peak of the flood extent. I find it problematic that you state that surface water extent is maximum in June, given that you never looked at May. Figure 7: How about overlaying the classified 500m pixel MODIS and Landsat image to highlight the differences. Give pixels where both agree one colour and then another colour for only water on Landsat and one for only water on MODIS.

Technical Corrections: page 1, line 20: In this study, the dynamics of surface water extent and volume "are or were" analyzed from 2000 to 2015 by combining multi-satellite information from MODIS multispectral images at 500 m spatial resolution and river

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stages derived from ERS-2 (1995-2003), ENVISAT (2002-2010) and SARAL (since 2013) altimetry data. page 2 Line 5: Discharge instead of discharger page 7 line 10: you mean Hereafter? page 13 line 11: “.” missing after MODIS? page 13 line 20: mistake in “Frthat” page 13 line 23: Sentence starting with “Besides, these...” is grammatically wrong and I do not get the point.

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