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Hydrology and Earth System Sciences
Discussions

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

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R.C.: Reviewer's Comment A.R.: Author's Reponse

Referee #1 This manuscript quantiïňĄes temporal changes of surface water volume water storage in the Mackenzie Delta based on multispectral images and altimetry data. The authors validates (1) classiïňĄcation of land water surface with multispectral images, (2) water level estimates by altimetry data, and (2) surface volume estimations retrieved by both multispectral and altimetry data. The manuscript is well-written and easy to follow their methodology and results. However, I am compelled to say that the present manuscript misses to demonstrate the scientiïňĄc signiïňĄcance to stand

alone in a HESS's publication. The authors fail to demonstrate its originality of the manuscript. The authors described "the originality and novelty ... (P3L7)".However, I felt that the present manuscript just applied existing approaches proposed by Frappart et al. (2006b, 2010, 2012) for long-time period in the target area. I could not understand challenges and difiňĄculties in the present manuscript. I understand that the authors processed a number of data carefully and correctly. However, scientiïňĄc paper needs to demonstrate (1) scientiïňĄc questions or challenges that present human being does not know/understand, (2) to propose how to solve the issue (i.e., hypothesis) and (3) discuss to differentiate its originality from existing studies. I suggest the authors to reconstruct the manuscript again to demonstrate its originality. The present manuscript is quite good as engineering/technical description paper, but needs originality as a scientiïňĄc paper.

We thank Referee 1 to offer us the opportunity to improve our manuscript (supplement information joined here). In the corrected version of the manuscript, we detailed in what our methodology differs from what we published before in other large-scale basins: "In the past, this approach has been applied in tropical (e.g., the Amazon (Frappart et al., 2012), Mekong (Frappart et al., 2006b)) and peri-Arctic (e.g. the Lower Ob' basin, (Frappart et al., 2010) major river basins allowing to provide direct observations of the spatio-temporal dynamics of surface water storage. Several limitations prevent them to be used over estuaries and deltas. The first is the too coarse spatial resolution of the datasets used for retrieving the flood extent that ranges from 1 km with SPOT-VGT images used in the Lower Mekong Basin to $\sim 0.25^{\circ}$ with the Global Inundation Extent from Multi-Satellite (GIEMS, Papa et al., 2010) for the Lower Ob' and the Amazon basins. The second is inherent to the datasets used in these studies. For the Mekong Basin, due to the small number of available spectral bands present in the VGT sensor, a mere threshold on NDVI was applied. For the Amazon and the Lower Ob', as GIEMS dataset is using surface temperatures from SSM/I, no valid data are available at less than 50 km from the coast. The originality and novelty of the study is the use of multi-space mission data at medium spatial, temporal and spectral resolutions to monitor

surface water storage changes in a deltaic environment over a fifteen-year time period."

We also explained which scientific questions motivated our study: "Earlier studies pointed out i) the lack of continuous information in the Mackenzie delta to study the spatial distribution of water levels during the flood events and to analyze the relationship between flood severity and the timing and duration of break-up in the delta (Goulding et al, 2009b), ii) the importance of the tributaries to the Mackenzie River (i.e., Peel and Arctic Red rivers) on break-up and ice-jam flooding in the delta (Goulding et al., 2009a). As the goal of this study is to characterize the spatio-temporal dynamics of surface water, both in surface and storage, in the Mackenzie delta, north west territories of Canada, in response to spring ice break-up and snow melt, over the period 2000-2015, it will provide important new information for a better understanding of the hydro-climatology of the region." We widely modified the structure of the manuscript to put the stress on the scientific results. We added a supplementary information file for the technical aspects. We strengthened the introduction and conclusion on the interest of our study for the hydro-climatological community. We divided in the former version section 5 (results and discussion) in 2 separated sections: the results (section 5) and the discussion (section 6). You will find our detailed answers to your comments below.

[OtherIssues] RC 1: page 2 line 32: What are traditional methods? A.R 1: We meant networks of in-situ gauge stations that are insufficiently dense in this region for the monitoring of the wetlands hydrodynamics although denser than in many regions of the world thanks to the efforts of the Canada Water Office to provide a good monitoring of Canadian rivers and lakes. We replaced this sentence with: "However, it is nearly impossible to provide a long-term monitoring with traditional methods using in-situ measurements in such a large and heterogeneous environment. Satellite remote sensing methods are the only way to solve this problem offers a unique opportunity for the continuous observation of wetlands and floodplains".

RC 2: page 7 – line 1-7 (Section4.1): How did authors decide the criteria? A.R 2: We applied the approach proposed by Sakamoto et al., (2007). In this method, as

explained in our manuscript, pixels are considered as water-related pixels if: - CASE 1: EVI-LSWI<=0.05 and EVI<0.3 - CASE 2: EVI <= 0.05 and LSWI <= 0 In our study, for the case 2, we only use EVI <=0.05 since no negative values were found for images (Figure S1). This approach was validated through comparison against the few available Landsat 8 images over our study area.

RC 3: page 9 – line 1: Please describe the deïňĄnition of the "errors". A.R 3: We better defined the errors in the manuscript. For the figure 3a, surface extent is calculated using Sakamoto et al., (2007) classification: 0 = vegetation, 1 = permanent water, 2 = inundated pixel and 3 = mixed pixel. Only classes 1 and 2 are used for the figure 5a. Errors are calculated using the mixed pixels, corresponding to the class 3. This explanation has been added in the manuscript as follow: "Following Sakamoto et al. (2007) method, all pixels of 8-day image have been classified into 4 classes: class 0 corresponding to vegetation, class 1 to permanent water, class 2 to inundation and class 3 to mixture of land and water. Map of annual average of land water surface, composed of inundated and permanent water bodies, was obtained at spatial and temporal resolutions of 500 m and 8 days respectively from June to September over the 2000-2015 period (Figure 3a) using classes 1 and 2." . . . "Maps of errors made on land water surface duration with associated standard deviation are shown in Figure 3c and 3d over 2000-2015. Errors on land water surface duration are calculated using mixed pixels, corresponding to the class 3 in Sakamoto et al., (2007) classification. Standard deviation of error is presented in Figure 3d."

RC 4: page 9 line 35: It is better to explain the method of Emmerton e tal. (2007) since the authors used Emmerton et al.'s results for the validation. A.R 4: The following sentence has been added to the manuscript: Emmerton et al., (2007) classified the Mackenzie Delta habitat in lakes, channels, wetlands and dry floodplains using information from a topographic maps derived from aerial photographies taken during the 1950's for low water periods.

RC 5: I recommend the authors to discuss generality of their approach. Namely,

what kinds of difiňĄculty do you expect if the other researchers would apply the same method for other areas? A.R 5: In our opinion, this approach can be applied in any other deltaic and estuarine environments as MODIS and altimetry data are available globally. We added the following sentence in the conclusion: “This approach can be applied to any other deltaic and estuarine environments as MODIS and altimetry data are available globally. The major limitations are i) the presence of clouds and dense vegetation cover that prevent the use of MODIS images, ii) the relatively coarse spatial resolution of MODIS images, iii) the coarse coverage of altimetry tracks. They can be overcome i) using SAR images for flood extent monitoring as Frappart et al. (2005), ii) using images with a higher spatial resolution, iii) combing information the different altimetry missions orbiting simultaneously. The recent launches of Sentinel-1, Sentinel-2 and 3 offer new opportunities for flood extent monitoring at higher spatial (from $\sim$10 m to 300 m) and temporal (a few days) resolutions”.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2017-170/hess-2017-170-AC1-supplement.pdf

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