Response to Reviewer #1

General comments: I enjoyed reading your manuscript on the use of MODIS data to develop and validate the surface water fraction estimates for the Mediterranean Region. Even though the surface water derivation from EO data was studied a lot in the last years, the authors demonstrate the importance of further refinement of knowledge on the surface water dynamics.

We thank the reviewer for her/his kind words about our study and valuable suggestions to improve the quality of the manuscript. Below we explain in detail how we have incorporated these comments in the manuscript.

(1) **Comment:** The temporal frequency of the Landsat dataset used to generate the GSW dataset (for the years before 2013) is still insufficient to represent the actual surface water dynamics, especially for the areas where the surface water is rapidly changing (reservoirs, floodplains, dynamic coastal areas). I liked how Figure 2 was used to demonstrate the missing monthly data history over time. However, I've missed the reference to that figure in the text, and the explanation on how this was determined? Does the figure show the missing value pixels (masked out) over sample locations shown in Figure 1? I'd even suggest that all figures should be referenced somewhere in the text.

Response: The reviewer is correct that Figure 2 indeed demonstrates the proportion of missing data/valid data in the Landsat-based GSW monthly dataset over time. Figure 2 actually shows the percentage of pixels with valid observation calculated over the entire Mediterranean region shown in Figure 1. We realized that this was not well explained in the text. We consequently revised the text and the caption of Figure 2 to make it clearer.

Changes in manuscript:

P4L12: added "the percentage of pixels with valid observation in JRC's GSW monthly water history dataset for each month between January 2000 and October 2015 calculated over the entire Mediterranean area. The figure illustrates".

P4L15: added "Mediterranean".

P5L3: replaced "valid data points" with "pixels with valid observation".

P5L4: added "entire".

(2) **Comment:** P7L11 Please include a proper citation for GEE, e.g. https://www.sciencedirect.com/science/article/pii/S0034425717302900

Response: We have included the suggested paper in our citation.

Changes in manuscript: P7L11: added a reference "Gorelick et al. 2017".

(3) **Comment:** Did you consider making your GEE scripts public, under a proper license? This will enable the reproducibility of your research and should be trivial to do.

Response: This is a good suggestion. At present, the work of this paper was partly done in GEE (i.e. collecting training and validation dataset from GSW monthly history data) and partly in the R software environment (i.e. building the regression model and applying the model to MODIS time series data). In our opinion the code at present still lacks appropriate documentation to make it publicly available. We are nonetheless open to share the code with interested researchers, and now mention this in the data availability section (P26).

Changes in manuscript: P27L8: the data availability section now reads "The final derived 18 years of surface water fraction maps for the Mediterranean region are open available through https://doi.org/10.17026/dans-xrz-y92s. The GEE and R code used for this paper are available on request from the first author."

(4) **Comment:** P14 Validation: Spain is a very sunny area, how does your algorithm perform in temperate areas?

Response: We are currently finalizing a follow-up manuscript, which we expect to submit soon. In that manuscript we provide an in-depth evaluation of this dataset for monitoring surface water dynamics across various climate regions. We did realize however that the title of the manuscript, as well as the titles of Sections 4.3 and 5.3 were suggesting a more formal validation effort; as a consequence we have adapted those. For the present paper, we think that the examples can illustrate the potential of our dataset, which is the main purpose here. Nonetheless, we can share with the reviewer an example for a temperate areas (taken from our manuscript under preparation). The figure below shows the evaluation results for Bardaca Wetland, a Ramsar wetland in Bosnia and Herzegovina. Monthly water extent time series obtained from MODIS SWF show a good agreement with those from JRC'GSW (r=0.88).

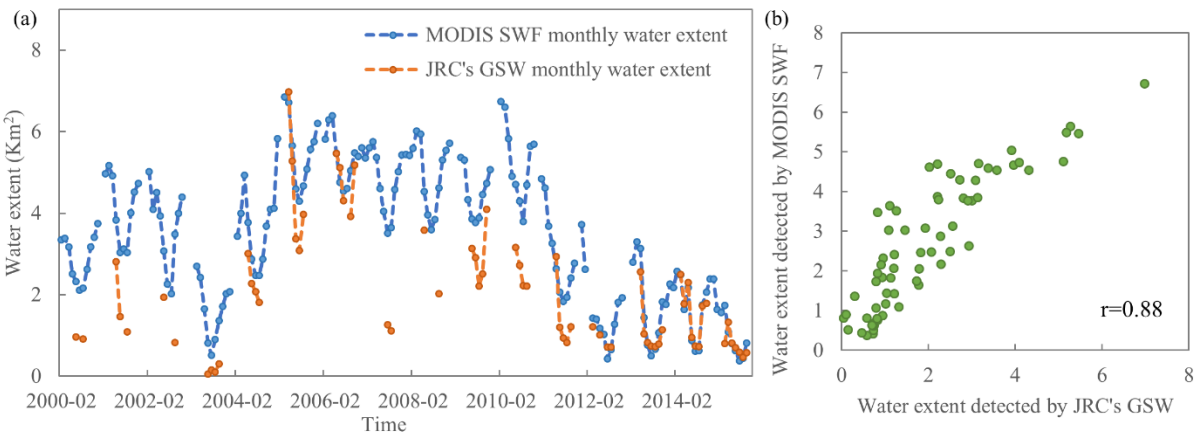

Figure 1 Comparison of monthly water extent (km^2) time series obtained from MODIS SWF and JRC'GSW.

Changes in manuscript: P1L1: replaced "Development and Validation of a" with "A New".

P14L1: the sub-title of Sections 4.3 now reads "Demonstrating the representation of surface water dynamics by the new MODIS dataset".

P20L4: the sub-title of Sections 5.3 now reads "MODIS-derived surface water dynamics for selected lakes".

(5) **Comment:** Figures 4-6 - you may need to upscale these map (using reduceRegolution() in GEE), it's really hard to distinguish waterbodies at that scale, making these figures more or less useless.

Response: We agree with the reviewer that interpreting a 500 m resolution map for a large region is cumbersome. However, we want to show results for the entire region, and given that surface water presence can be rather local. We are in favor of keeping the maps in the way that they are, because in our view main features and differences are visible. Note that in the case of Landsat-based GSW, we have indeed aggregated the Landsat 30 m pixels to 500 m pixels. We do realize however that the resolution of the figures was not optimal in our initial submission. We have now provided the same Figures 4-6 with higher quality and larger size, which can be downloaded by readers from the full-text HTML version online. In these improved figures, individual MODIS grid cells can be clearly separated.

Changes in manuscript: P17L1: replaced "determined by" with "obtained from"

P17L3: added "that our MODIS dataset detected a"

P17L3: deleted "as detected by MODIS and negative values indicate larger water fraction as detected by"

(6) **Comment:** Figures 7-8 - add a scatterplot for both charts will significantly improve understanding of the differences between these datasets

Response: Following the reviewer's suggestion, we have added two scatterplots for Figure 7 and 8 in the revision.

Changes in manuscript: P22-23: updated Figure 7-8.

P20L5: replaced "c" with "d"

P20L6: replaced "7c" with "7d"

P20L7: replaced "464" with "461"

P20L8: added "(ρ =0.95)."; replaced "except for" with "Note that in"; deleted "when"

P21L1: replaced "through" with "throughout"; deleted "whole"

P21L2: added "Water extent derived from MODIS SWF also had a close match with that from GSW (Figure 7c; r=0.95)."

P21L3: replaced "72" with "73"

P21L5: added "showed relative high correlation with water level data (ρ=0.69). It also"

P21L6: replaced "results" with "water extent derived"

P21L7: added "and d; r=0.88"

P21L11: In table 6 replaced "464" with "461"; replaced "72" with "73"; added one row "Doñana 714 70"

P22L4: added “Scatterplot of water area determined by JRC’s GSW versus that determined by MODIS SWF. *r* represents the Pearson’s correlation between two datasets; (d)”.

P22L8: added “. ρ represents the Spearman rank correlation between water area and water level”