HESSD

Interactive
comment

Interactive comment on "The value of satellite remote sensing soil moisture data and the DISPATCH algorithm in irrigation fields" *by* Mireia Fontanet et al.

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Dear, We are grateful to you for the time and effort spent on the review of our manuscript. Our detail response and comments raised by you is attached. We believe our responses and the revisions made to the manuscript fully address the issues raised by the review. These revisions have helped clarify some aspects of our work and improve its interpretation.

Response to reviewer:

GENERAL COMMENTS

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[Discussion paper]

1) CRITICAL: The manuscript does not read well and it needs to be revised by improving structure, avoiding repetitions, and by writing symbols, equations, acronyms consistently. Being a scientific paper, the structure has to be clear for the readership. I found the introduction doesn't flow and lacks background information. Methods/Results/Discussion sections are confusing; methods are scattered throughout the sections and discussion reveals mainly results. Find comments and suggestions in the document attached.

- We have improved the manuscript taking into account your specific comments, avoiding repetitions, writing symbols, and equations consistently. You can see all the corrections in the specific comments section.

- We have also reorganized the manuscript to improve the structure and flow of the manuscript based on the comments raised by the two reviewers. In this context, we have added a sub-section entitled "Spatial resolution analysis" in section 3 (i.e., Materials and Methods). This way, the methods used to estimate the spatial resolution of variables (which where before introduced in the discussion section) were moved to the methods section. We hope this will largely improve the clarity of the manuscript.

2) CRITICAL: The authors investigated the spatial variability of NSSM, NDVI and LST. Although, the spatial resolution of LST and NDVI is 1 km (using MODIS dataset), the spatial resolution of soil moisture is few centimeters by using gravimetric measurements. Thus, the comparison does not make any sense and the respective discussion is wrong. It would be interesting to explore the value of DisPATCh and LST for different field scales over large areas, such as the SG region. Or you explore LST and NDVI at high spatial resolution using Landsat data. Find comments and suggestions in the document attached.

- There is some confusion here. The support volume of gravimetric soil moisture punctual measurements is few centimeters but the reviewer should notice that our comparison is not between point measurements and satellite information. The comparison

is between the average of these measurements over the entire field site (very well distributed with more than 100 measurement points) with satellite information. The average of the soil moisture is representative of the entire field site with a support volume of about 20 ha. Consequently, these two variables have similar support scale and therefore are comparable. We have rewritten part of the manuscript to clarify this issue.

- Another point along the same line is that soil moisture sensor data is also measured at the centimeter scale. This data is interesting because it shows the daily fluctuations of soil moisture. Sensors are well distributed over the entire field site but in this case we have only 5 sensors. Gravimetric measurements show that the average of soil moisture over the entire field site lays always between the maximum and minimum values of these sensors. Based on this, we have chosen to exhibit the minimum and maximum values of these 5 sensors in the figures. This way, the reader knows that the average soil moisture value lays within this region and can therefore appreciate the differences between the average soil moisture and satellite information in days where only sensor data is available. This point was also not clearly explained in the manuscript and we therefore understand the confusion of the reviewer. We have now rewritten the manuscript to clarify this point.

- We agree that it would be interesting to explore the value of DisPATCh and LST for different field scales over larger areas, such as the SG region, but the DISPATCH algorithm has been already well validated over large areas (Escorihulea et al. 2016, Malbeteau et al. 2015 2018, Molero et al. 2016) and we thought it is more interesting to analyze this under different conditions, i.e., punctual heterogeneity produced by local irrigation. Note that we already mentioned in the manuscript that the DISPATCH algorithm is capable to detect water bodies such as rivers, floods and large irrigated areas (page 11, line 7). MAJOR: The authors evaluated DisPATCh NSSM using in situ measurements, however this study needs to be fulfilled by a statistical analysis (Correlation, Bias etc..). The result section would be improved by adding a temporal description/comparison of NSSM.

- We sincerely do not understand this point, we have done more than this. We have conducted a geostatistical analysis of the key data involved, which is more than a simple statistical analysis. Even the field campaigns were designed to characterize the spatial variability. In the end, we decided to only show the variograms because we think it is the information needed to understand the discrepancy observed between satellite information and measurements. Moreover, the scope of the manuscript is not to report a geostatistical analysis but to understand the worth of satellite information for local irrigation.

MAJOR: I don't think that concluding statement: "DisPATCh algorithm fails to describe the fluctuations in water content caused by irrigation" is correct; the current spatial resolution of DisPATCh might still be too coarse for local irrigation detection. However, DisPATCh succeeded to reveal spatial heterogeneity as rivers, irrigation areas, floods 8Escorihuela et al. 2016, Malbeteau et al., 2015 2018, Molero et al., 2016). It would be interesting to discuss the value and the limitation of DisPATCh over irrigated area (from local to large irrigation system). This conclusion needs to be balanced and the limitation of the analysis performed in this study need to be considered.

- We have changed the sentence "DisPATCh algorithm fails to describe the fluctuations in water content caused by irrigation" with "DISPATCH algorithm did not properly reproduce the temporal fluctuations of the average water content caused by local irrigation in this field site".

- To clarify the advantages of DisPATCh we have added in the introduction section: "DISPATCH succeed to reveal spatial heterogeneities as rivers, large irrigation areas and floods (Escorihulea et al. 2016, Malbeteau et al. 2015 2018, Molero et al. 2016).

MINOR: (1) Figures 1 to 4 need to be improved before publication. I suggest that they can be merged into one figure with two subfigures (figures 2, 3 and 4 into one map + zoon out figure 1 in order to see the coastline and Barcelona). (2) DisPATCh pixels on figure 4 are not squared, any explanation? Is it really 1x1 km?

- We think that we can merge Figure 1, 2 and 3 like the figure is shown below (Figure 1), but we think that merge also Figure 4 is too much information in a single figure.

- It is not exactly 1 x 1 km, it is 0.9 x 1.1 km.

SPECIFIC COMMENTS:

- Page 1 line 8: we delete "climate change ".

- Page 1 line 12: we can modify this part with: "Nowadays, different kinds of methodologies exist for measuring soil moisture; 1) in situ measurements, which can be obtained through fixed stations or field measurements, 2) Remote Sensing, where satellites, airplanes and drones estimate soil moisture, and 3) modeling, representing a hydrological system."

- Page 1 line 22: we can modify the sentence with "when irrigation maintains wet conditions".

- Page 1 line 27: we can delete "and"

- Page 2 line 12: we can delete "The use of soil moisture measurements can also improve weather forecasting, which is currently based on atmospheric moisture."

- Page 2 line 1: we can add some information: "Here, we highlight that soil moisture measurements from the root zone yields important information for field irrigation scheduling, determining to a great extent the duration and frequency of each irrigation needed for plant growth as a function of water availability (Blonquist et al., 2006; Jones, 2004; Campbell, 1982). Therefore, the main goal of irrigation scheduling is to apply the minimum volume of water guaranteeing maximum yield".

- Page 2 line 16: we can add " and with atmospheric conditions (Koster and Suarez, 2001)".

- Page 3 line 7: There is the possibility to remove: "which is often based on passive microwave radiometry".

- Page 3 line 25: we can connect better both sentences with "the first one is during the ascending overpass at 6:00 am and the second one is the descending overpass at 6:00 pm local solar time".

- Page 3 line 16: We can modify the sentence with "Since SMOS NSSM have been validated on a regular basis since the beginning of its mission (Bitar et al., 2012; Delwart et al., 2008), it is considered suitable for hydro-climate applications (Lievens et al., 2015; Wanders et al., 2014). "

- Page 4 line 7: We can delete authors and add "studies".

- Page 4 line 11: Your comment is "This makes it sound like its 'just another algorithm'. Rephrase the sentence in a way that introduces DISPATCH already as a superior method". We do not know or we do not have any reference that this algorithm is superior than the other algorithms.

- Page 4 line 17: Your comment is " Great! But why do we need it validated in irrigation fields? Highlight the importance of having this. Also, was there anywhere a mention between differences in soil moisture in irrigation vs rain fail? That is critical and missing here. We think that is necessary validate this algorithm in irrigation fields because one of the aim of this algorithm is monitor soil moisture for irrigation scheduling and management. Thus, this validation is the next step for the algorithm. We assume that precipitation and irrigation increase water content in the field and this process is measured by soil moisture sensors, but we consider that there is no difference between them except the scale effect (general rain fall versus local irrigation).

- Page 4 line 23: We can change "lot" by "lon".

- Page 5 line 5: We can change "has" by "represents"

- Page 6 line 8: We can change the title of the subsection " Remote Sensing Soil Moisture Measurements" by "DISPATCH Soil Moisture Measurements".

- Page 6 line 9: We can modify the sentence "The main objective of the DISPATCH

algorithm is to downscale" by "DISPATCH algorithm aims to downscale".

- Page 7 line 7: We can delete "Remote Sensing soil moisture".

- Page 10line 18: We can delete "One may thus see that".

- Page 11 line 14: We can change "information " by "NSSM".

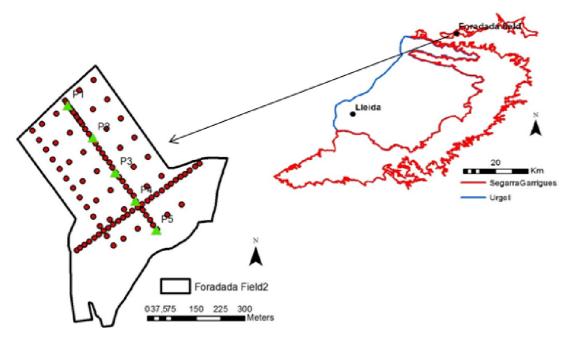Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-94, 2018.

Fig. 1. Figure 1