Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2020-403-AC1, 2020
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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Assimilation of probabilistic flood maps from SAR data into ahydrologic-hydraulic forecasting model: a proof of concept" *by* Concetta Di Mauro et al.

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Received and published: 6 December 2020

Dear Arnoud Goossen, We would like first to thank you for the useful and detailed comments you have provided. We will take your suggestions into account in the revised version of the manuscript in case it will be accepted for revisions. We would like to seize the opportunity to clarify some aspects that you have pointed out in your review hereafter:

1) You pointed out that the introduction is long and does not focus enough on the specific research gaps and that too much room is given to the different Data Assimilation (DA) methods. In the intro-duction we explained that the number of studies aiming at

assimilating flood extent maps into flood forecasting models is small when compared to the ones using water levels derived from EO data. Among the studies assimilating flood extent, only few use a Particle Filter-based approach like the one introduced by Hostache et al. in 2018. In our opinion different assimilation methods are only briefly discussed in the introduction and no details are provided. We would argue that a brief de-scription of the main characteristics is useful being the selection of the most appropriate filter one of the open questions in this field of research. However, we will make sure that in the revised version of the introduction all unnecessary details will be removed.

2) Concerning the objectives, it is true that they are defined twice in a slightly different way and we agree that this may indeed create some confusion. The paper will be modified accordingly. We would like to clarify that the main objective of this study is to further assess the main strengths and limita-tions of a previously proposed DA framework by applying the method in a fully controlled environ-ment. A secondary objective is to propose a new framework for evaluating the performance of dif-ferent DA approaches for assimilating Synthetic Aperture radar-derived flood probability maps into a hydraulic model.

3) With respect to the apparent lack of clarity concerning the contribution of this paper to the improvement of flood model predictions, we will add more explanations to the revised version of the manuscript. We argue that the method used in the paper has the potential to support EO- based modelling in sufficiently large floodplains where flood inundations remain visible to satellite sensor over a sufficiently long period of time. Indeed, these two main constraints must be satisfied to enable the application of the proposed framework and to make use of the analysis carried out in this manuscript. Moreover, it is worth noting that the proposed DA framework can be applied to a variety of flood inundation forecasting chains. The main reason for this is that it does not require any updating of the state variables and parameters of the model.

4) In Giustarini et al. (2016), the prior probability is assumed to be 0.5 since no infor-

mation on the prior can be obtained. In this paper, however, because of the synthetic nature of the experiment, the prior is known as it can be derived from the true binary flood extent maps. Moreover, we have also carried out the experiment with a default value of the prior (0.5) and found that its value has no effect on the results of the experiment, as explained in the lines 279 -283 of our paper.

- Minor argument 1: "It is mentioned that there could be other possible sources of uncertainty, I sug-gest some examples". It is true that other sources of uncertainty: "...input data, model parameters, in-itial conditions and model structure represent sources of uncertainty that affect the reliability and ac-curacy of flood forecasts" were only mentioned in the abstract (lines 2-3). We will add such exam-ples to another section of the paper as well.

- Minor argument 2: The neglection of the convective acceleration for the simulation of the spilling of the water in the floodplain is rather common in order to simplify the shallow water equation. The 2D solver that has been used in the floodplain is the acceleration solver (Bates et al., 2010; De Almeida et al., 2012) which neglects only the convective acceleration. In addition, the hydraulic model used here is based on the set-up defined in Melissa Wood et al. (2016) as mentioned in line 116.

- Minor argument 3: The temperature is considered to calculate the evapotranspiration term in the hydrological model.

- Minor argument 4: You have said that it is unclear if the α value based on the desired effective ensemble size has been used before. We would like to explain that the use of a tempering coefficient based on the effective ensemble size (EES) is commonly used in Particle Filters (van Leeuwen, 2019). The EES is used to obtain an idea of the number of particles that will have a not negligible weight after the assimilation.

- Minor issue 1: In line 68-69 it is mentioned that other sources of uncertainty could influence the model system, it is true that these sources are only listed in the abstract and in a future version of the paper we will take into account this comment.

- Minor issue 2: "no later inflow in ..." is incorrect. This is a typo. Indeed, it should be written "lateral inflow".

- Minor issue 4: The revisit time is around 3- 4 days, which means 2 Sentinel-1 satellite images are acquired on average every week. The revisit time for a single orbit is 6 days but in our case study we are considering many orbits (ascending and descending) so the revisit time will be 3-4 days as shown in the enclosed image, which means 2 satellite images per week. The combination of orbits will give us an image with a higher frequency of acquisition compared to the single orbit. The acquisition dates used in the paper were actually derived from real acquisition dates of SENTINEL 1 over the area in a different year. When a third satellite of the constellation will become operational, the revisit time can be lowered even further.

- For the other minor issues reported we agree that those corrections should be made in the new version of the paper in case it will be accepted for revisions.

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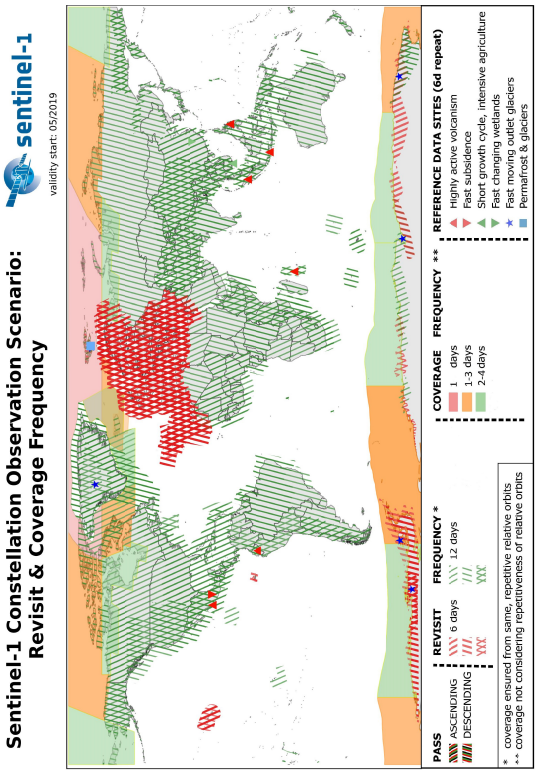
Sentinel-1 Constellation Observation Scenario:
Revisit & Coverage Frequency
sentinel-1
validity start: 05/2019
PASS
ASCENDING
DESCENDING
REVISIT
6 days
12 days
FREQUENCY *
COVERAGE FREQUENCY **
1 days
1-3 days
2-4 days
REFERENCE DATA SITES (6d repeat)
Highly active volcanism
Fast subsidence
Short growth cycle, intensive agriculture
Fast changing wetlands
Fast moving outlet glaciers
Permafrost & glaciers
* coverage ensured from same, repetitive relative orbits
** coverage not considering repetitiveness of relative orbits

Fig. 1.