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Hydrology and Earth System Sciences Discussions

Interactive comment on "A past discharge assimilation system for ensemble streamflow forecasts over France – Part 2: Impact on the ensemble streamflow forecasts" *by* G. Thirel et al.

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1.Several comparisons have been done in the past (e.g. Rudiger et al., 2009, or recently Albergel et al. 2010, submitted to HESSD, or http://www.ecmwf.int/research/ESA_projects/SMOS/conf/files/derosnay_pm4.pdf pages 11 to 15). These comparisons are limited to the surface soil wetness, and in some cases the soil moisture is normalised. Such comparisons are not relevant for

our application. Paris et al. (2008) worked on the Grand Morin and performed some comparisons also on root zone soil moisture, but on the 1997/2000 period which does not correspond to the period studied in our paper.

In the paper we say that in general the increment is small (except during high precipitation events), with no biases. This means that the total soil moisture is not highly modified (the maximum is 0.25 m3/m3 for W3 in Figure 6 for the Doubs river. The impact of the assimilation on other variables than discharge remains to be done and will need another comprehensive study. It must be done also in conjunction with a careful analysis of the quality of the discharge measurements. It requires significant new effort and can be the subject of a new paper.

Paris Anguela, T., Zribi, M., Hasenauer, S., Habets, F., and Loumagne, C.: Analysis of surface and root-zone soil moisture dynamics with ERS scatterometer and the hydrometeorological model SAFRAN-ISBA-MODCOU at Grand Morin watershed (France), Hydrol. Earth Syst. Sci., 12, 1415-1424, doi:10.5194/hess-12-1415-2008, 2008

Rüdiger, C., Calvet, J.-C., Gruhier, C., Holmes, T., De Jeu, R., and Wagner, W.: An intercomparison of ERS-Scat and AMSR-E soil moisture observations with model simulations over France, J. Hydrometeorol., doi:10.1175/2008JHM997.1, 2009

2.As explained in the Part 1 of the article, "the variance of the observation error was defined using the quantiles 1 (Q1) of observed streamflows (daily flow that is exceeded 99% of the time as provided by the "Banque Hydro" database). For streamflows under this quantile, the observation variance errors were defined to be proportional to Q2 (i.e. the errors on measurements were proportional to Q1), and above Q1 they were taken about (7%) of the square 10 of the observed streamflow (corresponding to measurement error proportional to 7% of the measured streamflow)." Thus, "The variance of observations error was simply estimated by a squared observed discharge function." was replaced by "The variance of observation error was simply estimated by a function of the square of the observed discharge."

3.Subgrid parameterisations in relations with hydrology in the ISBA model are fully described in Habets et al. (2008). It comprises a subgrid runoff scheme and a subgrid drainage scheme. This points are described into details in Part 1 of the paper. We think that it is not necessary to repeat them in Part 2.

Habets F., A. Boone, J.L Champeaux, P. Etchevers, L. Franchistéguy, E.Leblois, E. Ledoux, P. Le Moigne, E. Martin, S. Morel, J. Noilhan, P.Quintana Segui F. Rousset-Regimbeau, P. Viennot (2008)) : The SAFRAN-ISBA-MODCOU hydrometeorol-ogical model applied over France, Journal of Geophysical Research D: Atmospheres 113, D06113 (2008) 18

4.We are aware of this point, but we preferred to focus on a faster reactivity and to implement a simple method that can be applied to a wide range of basins. The BLUE does not take it directly into account as in it the soil moisture / discharges relation is only described along the assimilation window, which was taken to 1 day in the study. We assume that an upstream correction, that would be correct for an upstream sub-basin, but not for a dependent downstream sub-basin a few days later, would be quickly corrected due to the high frequency of the BLUE assimilations.

5.We are not sure to understand what the reviewer means here, because the section 2.1 is dedicated to the model, not to the assimilation system. Moreover, if some additional discussion about one particular point of the assimilation system itself has to be done, it would surely be better to put it in the Part 1. Concerning the background error, we know that a lack of balance can be created between background/observation errors, for large or small basins, as explained in Part 1. It results in too low increments for large basins due to an observation error too high compared with their background error. This point will be investigated in the future.

6.For areas where soil moisture is not so important for discharge generation, one should think about selecting another variable to modify in the model. For the example of Australia, which is prone to flash floods on very dry soils, the use of very short

term radar predictions would definitely be more efficient than the assimilation of discharges for modifying the soil moisture. For the Amazon, to modify the water volume store into the rivers could be a good method. We also point out in the paper that, even in France, our assimilation has to be completed by e.g snow or piezometric head assimilations (this point is discussed in Part 1).

7.As responded to another reviewer, the analysis of other fluxes was not possible because of the additional CPU time and storage costs it would have needed.

8.The ensemble used is directly given by the ECMWF EPS

9.The pixels are independent in ISBA, due to the absence of any lateral fluxes. However, the background (i.e. soil moisture) errors where computed with SAFRAN rainfall errors, which are spatially correlated. Thus, a kind of spatial correlation of soil moisture state variables is taken. Moreover, the state variable adds the pixels values of each sub-basins, and each increment is applied conjointly to these pixels, so soil moisture are correlated (this method has been taken as simple as possible and could be improved in the future).

10.The increment is: (B-1+Ht Rˆ-1 H)ˆ-1 Ht Rˆ-1 (obs – sim) We consider dry periods, so with low (but not negligible) flows. H will be very low (because H=delta(sim)/delta(SM), which is very low because the soil moisture has almost no influence on discharges) and R∼obsˆ2∼simˆ2. As R, B stays of the same order. For the case of assimilation for a single station, the increment can thus be simplified: B Ht Rˆ-1 (obs – sim) All the terms of this equation are more or less of the same order than they would be on wetter conditions (the variations of B are limited along time, compared to variations of H), except H. So, as H is much lower, the increment is lower.

11.These biases were quantified by Rousset Regimbeau (2006) http://tel.archives-ouvertes.fr/tel-00197071/fr/ (fig. 2.17, page 117, green curve) on another period. The mean precipitation varies from 2.1 mm/d the first day to 2,4 mm/d the day 10.while the SAFRAN analysis using all the available precipitation observations is 2 mm / d.

The operational services of Météo-France (unpublished) estimates that the SAFRAN analysis, using only data available at D+1 (no climatological data), underestimate the precipitation by 10 %. However, the effects of this over- and underestimation were not quantified on discharge for now.

12.The conclusion section has been reduced, especially its summary part.

All the editorial comments have been addressed.

Figures: Figures 6 and 7 have been combined, as well as figures 9 and 10.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 2455, 2010.