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Discussions

Interactive comment on "Integrated validation of assimilating satellite derived observations over France using a hydrological model" *by* D. Fairbairn et al.

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The authors present in this manuscript some results from experiments of data assimilation of surface soil moisture and leaf area index on streamflow simulations over France with the Safran-Isba-Modcou (SIM) hydrometeorological chain.

I will briefly comment here on a single specific issue in this study, that may however call into question all streamflow results presented in the manuscript.

The authors selected 500 gauging stations over France for comparison between observed and simulated streamflow, but they do not provide any information on the rationale behind this selection. Yet, all results from this study are based on this very

comparison, mainly through the Nash-Sutcliffe Efficiency (NSE). As a brief aside, their interpretation of the NSE detailed P8L8-9 is incorrect: a negative NSE value means that the model performs worse than a constant model with a value equal to the average of all observations.

There are three distinct but related flaws in the selection of hydrometric gauging stations here given the use of streamflow observations made by the authors:

1. They provide results as distributions of NSEs over the ensemble of stations (or a subset, but I will get back to this point later on). However, given their spatial distribution on the French river network, this distribution will be biased towards rivers along which a high number of stations are considered, like the upstream Allier river in the Massif Central mountain range (with very close yellow stations in the centre of Figure 2). This is particularly an issue when NSEs are considered, because such a criterion emphasizes the fit to high flows and these are usually highly correlated due to flood propagation along a single river like the Allier for example. This is however a relatively minor issue in my opinion compared to the next one.

2. Much more importantly, a large part of the selected stations have their observed streamflow heavily influenced by anthropogenic water management. This is somewhat and partially acknowledged by the authors P9L15-16 for southeast France. However, there are many other parts of France where anthropogenic water management stongly influences streamflow observations, through reservoir operations (see the list of dams in France, corresponding water usages, and storage capacity here: http://www.barrages-cfbr.eu/) for hydropower, irrigation, drinking water, flood and low-flow alleviation and recreation purposes, through abstractions mainly for irrigation and drinking water (see the list and quantification of all abstractions for recent years here: http://bnpe.eaufrance.fr/). This is a serious issue for this study as SIM simulates only natural streamflow, as recalled P5L12-13. As a consequence, any improvement from data assimilation in NSEs shown by the authors may be interpreted in terms of simulations closer to influenced streamflow. The data assimilation procedure may therefore

tend to drive simulations in a direction closer to the observed (influenced) streamflow but opposite to the natural (unobserved) streamflow. The overestimation of drainage and runoff by SIM recalled P1L8 and shown in Figure 6 may for example be partly attributed to the abstractions being not accounted for. Low NSE values may also be partly attributed to effects of reservoir management for reducing flood peaks, sustaining low-flows, or producing hydropower.

In order to overcome such widely recognized issues, and for disentangling climate-driven effects from local anthropogenic influences, reference hydrologic networks have been set up for different countries over the past decade or so (see e.g. Burn et al., 2012; Whitfield et al., 2012). In France, such a reference network has been set up for low flows (Giuntoli et al., 2013), with a subset also valid for high flows (Giuntoli et al., 2012). This reference network includes stations with long records, gauging catchments with low anthropogenic influence, and with high quality measurement on low (resp. high) flows. The list of stations included in this reference network, as well as corresponding streamflow data are available from the Global Runoff Data Centre (GRDC) (http://www.bafg.de/GRDC/EN/Home/homepage_node.html) and identified in the GRDC as the French contribution to the "Climate sensitive stations". The record length constraint used for defining this reference network may be relaxed for the present study. It has to be noted that metadata in the French hydrometric database (http://www.hydro.eaufrance.fr/) are often too optimistic when anthropogenic influence comments are concerned, because (1) such metadata are not always filled in and (2) the default label is "Not influenced".

3. As already pointed out by Referee #2, the various NSE graphs show simulation results for only a artificially chosen (and not clearly identified spatially) subset of stations based on positive values of the NSE for any simulation. This is indeed a rather dubious way of dealing with anthropogenically influenced stations, but also with badly simulated stations with high groundwater influences (9L16-17).

Given the three points above, I would strongly recommend the authors:

1. To consider only catchments with low anthropogenic influence in order not to compare apples and oranges and avoid drawing conclusions on the ability of SIM (with or without data assimilation) to simulate anthropogenically influenced streamflow,

2. To show scatter plots of NSEs instead of distributions (possibly with marginal distributions) to reduce the potential spatial bias effect mentioned above.

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