Referee Comments on Hess Paper 2016-195 – Fairburn et al.

Version 1

General Comments

This paper looks at several attempts to improve hydrological modelling for river run off when driven from a land surface model, with and without data assimilation. The validating river guages are an impressive number, across most of the river basins in france and the length of the analysis period spans several years so in my opinion can be considered robust. There have been a lot of studies over Europe looking at the impact of LAI and Soil moisture assimilation before but this is the first that i have seen that looks at impact in both the land surface model (LSM) and the hydrological runoff model. Within the paper it becomes apparent that the assimilation does not benefit the runoff, in fact in the case of soil moisture assimilation it worsens. The authors do a good job of investigative work to understand why this is, particularly focusing on the performance of the Kalman Filter Jacobians in very saturated and dry conditions. I have not seen this before to such a depth in previous published studies and this makes it novel in my opinion. There is a current focus in coupling hydrological models to limited area domains of either NWP or offline LSMs and so this work will be of interest to both the research and operational community.

Specific Comments

P2 l34 "especially near soil moisture thresholds" do you mean wilting point and saturation values? If so best to expand sentence.

P5 l17 "The original ASCAT values are converted into SSM values..." My understandiing is that this is not correct, the ascat backscatters are converted into a soil wetness index. Is this what is assimilated in your experiments?

Section 2.3 Data Assimilation. Good explanation of background and observation errors for LAI, but no mention of the errors assigned to the ASCAT data. In particular i would be interested to know if you inflate the errors to account for the oversampling issue , i.e. the same ASCAT ob covers several gridpoints.

P10 l2 Typo on Figure number – should be Fig7?

Section 4 Discussion. It seems that the principle problem with the assimilation in the SEKF for this situation is that the LAI assim has little or no sensitivity during winter and the SM jacobians are unrealistically too small. One short term improvement might be to simply increase the variances in the size of the background error covariance matrix in winter which is a realistic response to the known issue of enhanced model and forcing errors. Any thoughts on this?