Response to comments of Prof. Graham Jewitt on the manuscript "Improved large-scale hydrological modelling through the assimilation of streamflow and downscaled satellite soil moisture observations" By Lopez Lopez, Wanders, Schellekens, Renzullo, Sutanudjaja and Bierkens, 2016

We would like to thank Prof. Graham Jewitt for his comments on the manuscript. They will have an added considerable value to its quality. According with his suggestions, the following aspects of the manuscript will be modified:

General comments:

Comment 1:

Reviewer 1 made some more philosophical comments on the status and nature of global hydrological models. You have commented on this through an addition to the Discussion, but I think there is scope to expand a little more on this aspect both in the Introduction and Discussion. In particularly, the comments "to what effect do we do these improvements?" and "what is the development problem that these global models, improved by the approaches described in the paper, are trying to solve". In fact, the response to the query, rather than your suggested amendment addresses these two points. Please try and include some of that response in the paper itself.

Answer:

In recent years, several large-scale hydrological models have been developed and parallel efforts have been done to improve them. However, various attempts are being made to compare and coordinate the development of large-scale hydrological models, such as the Integrated Project Water and Global Change (WATCH), the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP) as well as the current eartH2Observe Project (E2O) that funds the present research. Although, some comments on this matter were made in the response to review suggestions of Anonymous Referee #1, they were not properly included in the manuscript. We will modify the beginning of section 1. Introduction and the ending of section 4. Discussion to address these aspects according to editor's comments:

1. Introduction

"In recent decades, a number of large-scale hydrological and land-surface models have been developed to quantify the global water cycle components, to analyse the human influence on the global water balance, to study climate change impact on water resources and to assess global hydrological extremes, such as drought and flood risk (Trambauer et al., 2013; Sood and Smakhtin, 2015). Parallel efforts are being carried out to improve their models accuracy. However, various attempts are being made to compare and coordinate the development of large-scale hydrological models, such as the Integrated Project Water and Global Change (WATCH; http://www.eu-watch.org/watermip), the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP; http://www.pik-potsdam.de/research/climate-impactsand-vulnerabilities/research/rd2-cross-cutting-activities/isi-mip) as wells as the current eartH2Observe Project (E2O; http://www.earth2observe.eu/) that funds the present research. The E2O project brings together 10 different large-scale hydrological models and it is actively working on finding shared ways to improve them through new means.

VIC (Liang et al., 1994, 1996), WaterGAP …"

4. Discussion

" … with the obtained results in the present manuscript (Andreadis and Lettenmaier, 2006; Lievens et al., 2015).

The present study is part of the recent efforts in the coordinated development of large-scale hydrological models (e.g. WATCH, ISI-MIP and E2O) moving aside from improving their estimates through specific modifications in the model structure, such as calibrating the model parameters according to in situ observations. Instead, various experiments are carried out to achieve this improvement using global earth-observations products, such as the downscaled AMSR-E soil moisture data. These experiments may constitute a step forward to show the suitability of remotely sensed observations into global models for their application at a river basin scale."

Comment 2:

Figure 5 is quite small and it is difficult to see much detail. Please can you see if this can be improved (different axes - perhaps a log-scale?) or enlarge it.

Answer:

As per the editor's suggestion, Figure 5 will be changed.

Additional references to be included

Sood A. and Smakhtin V. (2015). Global hydrological models: a review, Hydrological Sciences Journal, 60:4, 549-565, doi: 10.1080/02626667.2014.950580.

Trambauer, P., Maskey, S., Winsemius, H., Werner, M., & Uhlenbrook, S. (2013). A review of continental scale hydrological models and their suitability for drought forecasting in (sub-Saharan) Africa. Physics and Chemistry of the Earth, Parts A/B/C, 66, 16-26. doi: http://dx.doi.org/10.1016/j.pce.2013.07.003

Additional modifications in figures to be included

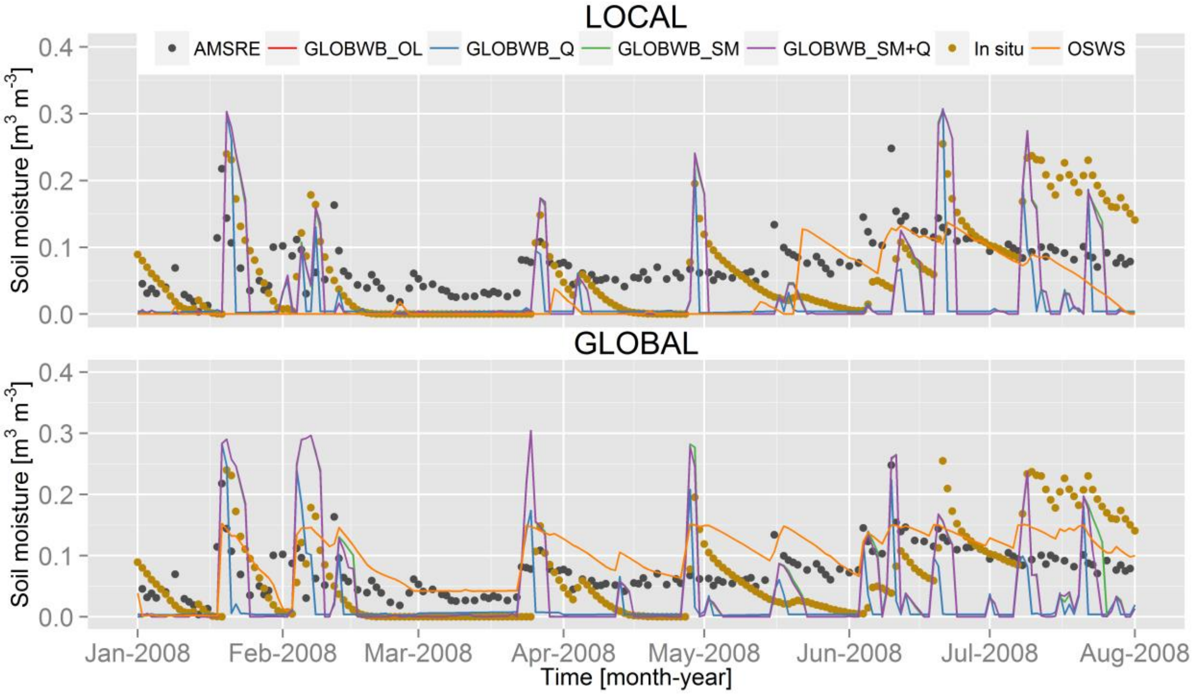

Figure 5. Simulated and observed soil moisture estimates at Y8 soil moisture monitoring site for the time period January 2008–May 2009. The upper panel shows soil moisture time series when local data is used as model forcing. Soil moisture time series obtained with the global forced models are shown in the lower panel. Each panel contains results for each data assimilation scenario plotted with different colours lines (OSWS – orange, GLOBWB_OL – red, GLOBWB_Q – blue, GLOBWB_SM – green, GLOBWB_SM+Q – purple), downscaled AMSR-E observations with dark grey points and in situ soil moisture observations with dark yellow points.