

Answer to comments from Referee 1

On “Sustainability of water uses in managed hydrosystems: human- and climate-induced changes for the mid-21st century” by Fabre et al.

▪ **Referee comment**

This paper analyses water scarcity in two Mediterranean watersheds. For 2050 scenarios of future water availability and water demand are calculated, "water demand satisfaction indicators" are set up and compared to values from 2000. In principle the overall topic of the manuscript is highly relevant, since the Mediterranean region is facing severe water shortage already today which is accelerated by anticipated global change. Also the methods used are adequate.

*However, the paper contains a high level of redundant information compared to two recent papers by the same authors: A. Grouillet et al. (2015), *Journal of Hydrology* 522, 684–696 deals with historic and future water demand. B. Fabre et al. (2015), *Hydrol. Earth Syst. Sci.*, 19, 1263–1285 deals with a historic comparison between water demand and water availability. All papers use the same catchments, the same models and the same data. A manual check revealed a high level of analogy. Several figures and paragraphs of the texts are similar, some parts even identical. This is especially true for parts of the introduction, study area and methodology (Fig. 1 and 2). This means, the present paper needs to be condensed to build upon published information and needs to concentrate on really novel findings that have not been published before.*

Authors' response

We would like to thank the Referee for reviewing our submission and for his interest in the topic.

However, we were surprised at the Referee's judgement on this paper's redundancy with the two published papers Grouillet et al. (2015) and Fabre et al. (2015).

While the paper from Fabre et al. (2015) presented the development of the integrated modelling chain and its validation over a past period of nearly 40 years and the paper from Grouillet et al. (2015) aimed at reconstructing historical water demand and at proposing a trend scenario of water uses according to local socio-economic projections and under 9 climate scenarios, the submitted paper relies on these two previous publications to provide an integrated analysis of the balance between water availability and water uses under both human- and climate-induced changes for the mid-21st century. Projections of water demand satisfaction were carried out according to four combinations of water use and climate scenarios. The work presented in the submitted paper made it possible to assess risks of unbalance between water uses and water availability while considering uncertainty that stems from the spread of 18 climate scenarios (9 GCMs under two Radiative Concentration Pathways). The risks of unbalance were considered through human water demand satisfaction but also through compliance with environmental flow requirements, another element not included in the published papers by Fabre et al. and Grouillet et al.

We would wish to stress the fact that given the amount of data processing and the complexity of developing an integrative modelling approach, a single paper could not provide enough details to explain rigorously all the different aspects that were first exposed in the previous papers (Fabre et al., 2015; Grouillet et al., 2015) while exposing this original study that consisted in running our integrated modelling chain to assess the sustainability

of planned water uses in the studied river systems under multiple climate change scenarios, and to contribute to determining the possible causes of unsustainability. On the other hand, it was not possible to write this new paper without providing the reader with minimum information on the studied catchments, the models and data used.

Moreover, we were surprised at the fact that using the same catchments, models and data for validation over the past and future projections would be a problem. As was underlined in Fabre et al. (2015) the calibration and validation of the integrative model over a long past period is essential before using the model for projections; projections of risks of future water stress in different study areas with a different model does not seem to make much sense.

The referee also underlined that some parts of the text were similar between the published papers and the submitted paper.

In the introduction only paragraph 4 (p.9250 line 27 to p.9251 line 12) addressed an issue cited in the introduction of Fabre et al. (2015), which is the need to account for the influence of human water use and management on streamflow.

In the study area section, many similarities can indeed be found between the submitted paper and Fabre et al. (2015). However if one considers it necessary to first develop the model and then apply it for projections of future changes on the same study areas, then the usefulness of writing a different presentation of the study areas seems limited. The referee also underlined that Figure 1, which represents the study areas, was similar to Figure 1 of Fabre et al. (2015). Indeed Figure 1 of the submitted manuscript condenses Figures 1 and 3 of Fabre et al. (2015), showing the location of the main human pressures on water resources and the conceptual representation of the study areas through resource and demand nodes. It seems to us that this figure is essential to the submitted paper, which would be much more difficult to follow without a correct representation of the study areas.

As for similarities in the Methods section, on the 7 pages of methods in the submitted paper, 2 are indeed quite similar to the published paper Fabre et al. (2015), since it seemed to us that a minimum of information on the models used needed to be provided in order to better understand the submitted paper. The Referee underlines that Figure 2 is similar to the figure describing the integrative modeling framework in Fabre et al. (2015). Indeed, since this submitted paper uses the model developed and validated over the past in Fabre et al. (2015) to project future risks of water stress, these figures are bound to be similar. However environmental flows were added and indicators used were different compared to Fabre et al. (2015).

▪ **Referee comment**

A recent paper: J. Fabre et al. (2015), Proc. IAHS, 371, 43–48, creates additional problems in this respect. This open access publication is a conference proceedings but comprises exactly the same information as the present manuscript: It compares future water availability and water demand and develops the same indicators as the present study. It contains almost identical results: figure 3/4/5 of this manuscript (in parts of totally) are

therefore strictly speaking already published. I leave this decision to the editor of HESS, how published conference proceedings with very similar content are evaluated in terms of copyright and redundancy.

Authors' response

As suggested by the Referee, we wait for the Editor's response regarding the treatment of conference proceedings. But we also strongly believe that the submitted paper carries much more information than the 6-page conference proceedings paper and has a true added value compared to it. We believe it is a little bit of a stretch to say the paper contains exactly the same information as the present manuscript. The subject of the conference proceedings paper was a basis for discussion on non-stationarity in hydrological modeling. It contained mostly similar results to the submitted paper however the latter contains additional information on environmental flows, an analysis of anthropogenic pressure on water resources, a full analysis of the sustainability of water uses and management as they are planned in the two basins, and a complete discussion of the results. Moreover while the proceedings paper presented projections of water demand satisfaction for two illustrative demand nodes in each catchment, the submitted paper presents and analyses results for all demand nodes (i.e. 6 nodes within the Herault catchment and 8 nodes within the Ebro catchment).

Figure 3 is indeed in the proceedings paper in its same form. This figure could perhaps be removed from the submitted paper or better cited from the proceedings paper. However not including this figure in the submitted paper may make the interpretation of the projections of water stress more difficult for readers not wishing to refer to the proceedings paper.

Figure 4 is partly published in the proceedings paper. However only two demand nodes per study area were presented, whereas figure 4 of the submitted paper presents water demand projections for all studied demand nodes of the Herault and the Ebro basins.

The same can be said regarding figure 5. Moreover the proceedings paper shows results for a slightly different methodology for the estimation of water stress: environmental flows Q_{MIN} were calculated differently in the proceedings paper and the thresholds of agricultural water deficit for calculating the indicator F were different.

▪ **Referee comment**

But also disregarding the conference proceedings, the two published papers in HESS and Journal of Hydrology call for major revision of the present manuscript: The authors must shorten their paper, build upon their own published work and crystallize real new results. This is true for all parts of the present manuscript.

Authors' response

We would like to stress that while Referee 1 insists on the redundancy with two published papers (Fabre et al., 2015 and Grouillet et al., 2015) Referee 2 noticed that the submitted paper complements the published work. Once again we would like to wait for a response by the Editor before we consider resubmitting a radically different version of our paper as suggested by the Referee 1.

As already underlined, we do believe our paper concentrates on novel findings compared to the two published papers. Although it builds on the models described in Fabre et al. (2015) and Grouillet et al. (2015), the methodology consisting of using the integrated model in different combinations of water use and climate scenarios to assess the sustainability of planned water uses is original, and so is the consideration of environmental flows. In Grouillet et al. (2015) water demand projections are given for 9 climate scenarios (18 in the submitted paper), on average between the different climate scenarios (while the range of uncertainty due to the 18 climate scenarios is given in the submitted paper). Moreover the spatial scale for water demand in the Ebro basin is different between the two papers: while water demand is summed over each of the 20 sub-basins in Grouillet et al. (2015) it is grouped into demand nodes linked to the main storage dams and supplied by the main irrigation canals.

▪ **Referee comment**

The introduction needs more structure, should be condensed and subdivided into paragraphs according to relevant topics. Redundancy compared to the published papers must be avoided. At the end a clear research gap and working hypothesis needs to be developed: What is really new in this paper, how does it build upon existing work? As the main topic of the present paper is water scarcity, relevant papers on water scarcity methodologies need to be introduced and later discussed in the context of the present work: The excellent review (Whitepaper by Brown and Matlock, 2011) is one example. More specific examples include the application of the WEAP tool.

Authors' response

Once again we would like to wait for a response by the Editor before we consider resubmitting a radically different version of our paper as suggested by the Referee.

▪ **Referee comment**

But also the methodology needs to be shortened, since water availability and demand have been calculated and published before using the same model and the same methods. The water scarcity indices have only been introduced in the conference proceedings, so this could a new topic, the paper could focus on. This only if redundancy with the conference proceedings has been clarified (see above). But why do the authors call their indices "indicators for water demand satisfaction"? They are indices for water scarcity and should be compared to existing indices, e.g. reviewed by Brown and Matlock (2011).

Authors' response

We would like to underline that the submitted paper's originality goes beyond the proposed water scarcity indices. We believe the projections of balance between water demand and availability (including environmental flows) and their associated analysis form the core of this paper. Indeed, if we had first computed water demand in the future (under a baseline trend socio-economic scenario and 9 climate scenarios), future water availability had never been calculated, and the balance between water demand and availability under climate change

uncertainties had not been assessed. This was done here under the current climate conditions (1976-2005) and under a range of 18 climate scenarios. Hence, sustainability of the current (2000s) and future (2050 trend scenario) water uses was assessed through an original combination of scenarios. Also it seems to us that the submitted paper would somewhat lack clarity with only references to the published papers and no description of the models used and the areas studied.

The overall analysis of water demand satisfaction and compliance with environmental flows and level of consumptive use contribute to the topic of water scarcity, however the indices of water demand satisfaction were called so for more precision. The magnitude of the gap between water demand and water availability is a related, descriptive notion, but is not sufficient to characterize water scarcity (see e.g. Jaeger et al., 2013).

Reference:

Jaeger, W.K., Plantinga, A.J., Chang, H., Dello, K., Grant, G., Hulse, D., McDonnell, J.J., Lancaster, S., Moradkhani, H., Morzillo, A.T., Mote, P., Nolin, A., Santelmann, M., Wu, J. Toward a formal definition of water scarcity in natural-human systems. *Water Res. Research*. 49, 1-12, 2013.

▪ **Referee comment**

Also in the result section entire paragraphs need to be removed, e.g. 4.1.2 on water demand scenarios, which has been published before. Again the problem with the published conference proceedings needs to be solved, because as stated above, the majority of the results are contained therein.

Authors' response

We believe removing entire paragraphs such as 4.1.2 on water demand scenarios would make the rest of the results quite difficult to follow. If the Editor invites us to submit a new version of our paper, we propose to be more clear about the fact that water demand projections were already presented in Grouillet et al. (2015) (although as state earlier the spatial scale was not the same and more climate scenarios were added) and about the added value of the presented results compared to the paper from the IUGG conference proceedings.

▪ **Referee comment**

A more detailed review is only meaningful, if redundancy is removed and a fundamentally updated version is submitted.

Authors' response

Although we do not agree with the Referee on the level of redundancy between our published papers and the submitted paper, we fully understand the revision process and will submit an updated version of the paper trying to clarify the relations between our different papers, if the Editor invites us to do so.