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Interactive comment on "Climate change effects on the hydrology of the headwaters of the Tagus River: implications for the management of the Tagus-Segura transfer" *by* Francisco Pellicer-Martínez and José Miguel Martínez-Paz

Anonymous Referee #1

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GENERAL COMMENTS

The manuscript studies the effects of climate change on the Tagus-Segura water transfer. According to the authors, the work constitutes a new contribution because it analyzes the impact of climate change in an inter-basin water transfer from an integrated water management perspective. Despite they cite a recent article where the issue has already been addressed (Morote et al., 2017), they explain that their approach includes three new aspects: 1) specific modelling of climate scenarios; 2) hydrological modelling and; 3) simulation of the system management under the current operating rule.

In my opinion, despite the subject could be really interesting for the future management of Tagus-Segura water transfer, the selected methodology does not constitute a new contribution to the existing literature. Besides, although the estimation of climate change socioeconomic impacts for the case study could be considered as a novelty, it is scarcely developed. Demand curves are mentioned for the first time in the Discussion section, the methodology to obtain them is not further explained and plots are not provided. Finally, some of the data, methods and assumptions should be deeply reviewed (e.g., the operating rule they apply is no longer into force).

SPECIFIC COMMENTS

Page 3, Line 27: "(...) having a Mediterranean climate". It is more accurate to define the basin climate as Continental-Mediterranean (CHJ, 2015).

Page 4, Lines 7-11: "Moreover, a large part of these water resources (up to 650âĂć106 m3yr−1) are susceptible to being transferred to the neighbouring Guadiana River Basin and, further away, to the SRB. The former can receive up to 50âĂć106m3yr−1, of which 20âĂć106m3 are for the maintenance of the wetland of Tablas de Daimiel and 30âĂć106m3 are for urban use in La Mancha (Albacete), while the SRB can receive up to 600âĂć106m3yr−1 (gross volume), the maximum monthly flow being 60âĂć106m3". According to this paragraph, Guadiana River Basin can receive up to 30âĂć106m3 for urban use in La Mancha (Albacete). Nevertheless, urban supply to the city of Albacete is provided from the Tagus-Segura water transfer (CHJ, 2016). Moreover, the water rights for Albacete and its area of influence are 24,59 millions of cubic meters per year (24 come from surface resources and 0,59 are groundwater) (CHJ, 2016). Authors should clarify this statement and the origin of the data they provide.

Page 4, Line 13 - Page 5, Line 11: "The operating rule (Fig. 2) basically consists of two conditioning factors (BOE, 2014)". The considered operating rule (BOE, 2014) is not longer in force, because the most recent one was included in Law 21/2015.

Page 9, Lines 4-5: "The locations of the 12 gauging stations that have observed flows, which previously have been naturalized (...)". It is not fully clear if the authors applied a procedure to obtain the naturalized inflows or if these inflows come from the River Basin Authority. In the case they have used the Water Rights Analysis Package (WRAP; Wurbs, 2005), further information should be provided in relation to the demands' supply, reservoir management and other human activities considered to obtain the naturalized inflows. Moreover, it would be interesting to compare the naturalized inflows of the WRAP with the ones of the River Basin Authority. Finally, if WRAP has not been used, the reference should be removed.

Page 9, Lines 7-9: "Each series of observed flows was divided into two periods (Klemeš, 1986), the first (from September 1985 to July 1995) being used in the validation and the second (from August 1995 to December 2009) being used in the calibration". Authors should clarify why they used a calibration period of only 14 years (which I consider is really short for a monthly time step) when there are available inflow time series from 1940 to the current date.

Page 9, Lines 22-24: "Among these series provided by the regionalised models, the 10 that best fitted the historical series for both temperature and precipitation were assembled on a monthly basis (...)" Authors should explain which is the control period considered, as well as the method used to test the goodness of fit and the test results. Which models were finally selected for the basin?

Page 9, Lines 25-27: "Based on the average monthly temperature data of the three climatic scenarios, the potential evapotranspiration series were estimated using the Thornthwaite method (...)". For example, it considers that PET is null when the temperature is near zero. According to the authors, "(...) while the average annual temperature is 11 âŮęC, in the coldest months there are values less than zero (...)" (Page 3, Lines 29-30). As Thornthwaite method considers that potential evapotranspiration (PET) is null when the temperature is near zero, it could undervalued the PET in the Tagus basin. Authors should discuss the reasons why this approach was selected.

Page 10, Figure 5: According to the figure, only one of the considered thermo-pluviometric stations (3044) is located inside the basin, which according to the authors has an area of 7.000 km2 (Page 3, Line 26). How could you assure that the temperature is properly characterized, considering that you only take into account 6 points (5 of them outside of the basin), for such a large area? Have you compared the bias between the observed precipitation and temperature values and the modeled ones for the control period of the climate models?

Page 12, Lines 3-5: "The values of the criterion coefficients calculated in the hydrological modelling show that the model employed reproduced properly the surface flows in the THRB: high values of ENS and R2, together with low relative errors (ERMS) and volume errors (PBIAS)". According to Table 2, calibration values are in the range of 0,51-0,87 for the NSE. Nevertheless, NSE values for the validation period oscillate between -0,36 and 0,57. Moreover, 10 out of 12 sub-basins show NSE values below 0,50 during the validation period. Regarding these results, it is not possible to state that the hydrological model is properly reproducing the surface flows during the validation period. Authors should consider model re-calibration or even the use of another hydrological model.

Page 12, Lines 8-11: "The simulation of the historical climate series of 1940-2010 with the calibrated model provided an average annual resource of 954.6âĂć106m3yr−1 (Q). This series was temporally translated to the 2020-2090 time period in order to reproduce a future climate scenario without climate change (No CC). The simulations for climate change scenarios RCP 4.5 and RCP 8.5 with the same calibrated model indicated that the THRB could suffer a considerable loss of its natural water resources". The meaning of "temporally translated" is not clear. Are reduction/increase coefficients obtained from the RCPs applied to the precipitation/temperature 1940-2010 time series to simulate "future conditions"?

Page 12, Lines 12-15: "The RCP 4.5 scenario forecasted a value of 575.6âĂć106m3yr−1, representing a decrease of 39.7 %, while the RCP 8.5 scenario predicted a 46.6 % decline in resources to 508.9âĂć106m3yr−1, on average (Fig. 7). This is due to a combination of a reduction in precipitation (15% and 20% for each scenario, respectively) and an increase in potential evapotranspiration resulting from an increase in temperature of 2.2°C and 3.4°C, respectively, for the CC scenarios RCP 4.5 and 8.5". These results should be contrasted and discussed in relation to previous studies of climate change impacts under RCP scenarios in the basin (CEDEX, 2017; Guerreiro et al., 2017; Lobanova et al., 2016; Lobanova et al., 2018).

Page 18, Lines 1-5: "The whole irrigated area in the SRB is divided into seven irrigation zones (IZs); for each of them the water demand curve is estimated from a linear programming model that optimises the Gross Value Added (GVA) by the optimal cultivation plans according to the water supply. This crop programming includes the irrigation situations of woody crop maintenance, the change from irrigated to rainfed crops and the abandonment of irrigation polygons, as well as the impact on employment". Demand curves are mentioned for the first time in the Discussion section. If these demand curves are obtained by the authors, further insight should be provided in the Methodology section, and plots included in the Results section. In any other case, sources should be properly referenced.

OTHER COMMENTS

- There is a mispelling in one of the authors' names: it should be Francisco instead of Fancisco - Figure 6. The text does not match the figure (it represents the DSS diagram instead of the distribution of climate stations with AR5 information and the grid obtained from Spain 02v5. - Acknowledgments: As Spain02 v5 datasets have been used, authors should include the following text: "The authors thank AEMET and UC for the data provided for this work (Spain02 v5 dataset, available at http://www.meteo.unican.es/datasets/spain02)" - Page 20. Lines 13-18. There is an updated work from the same institution, which uses the same climate models considered in the present work: CEDEX, 2017. Evaluación del impacto del cambio climático en los recursos hídricos y sequías en España. Informe final. Ministerio de Agricultura,

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- Additional suggested references:

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