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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Climate change, re-/afforestation, and urbanisation impacts on evapotranspiration and streamflow in Europe" *by* Adriaan J. Teuling et al.

Anonymous Referee #2

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This article presents and a framework to explain changes in evapotranspiration and streamflow since the 1950's in Europe. This is an ambitious attempt to provide answers to a question recurrently asked to hydrologists. The methodology is clearly related to the attribution problem, a topical current issue for which the scientific community is still far from being able to design a well-established methodology. This is why such studies require special attention and care with regards to hypotheses and uncertainties. To my opinion, the proposed study relies on too many hypotheses that are not tested/mentioned clearly and consequently, the results are uncertain and questionable. Two examples are discussed hereafter pointing out the (related) main problems of the paper: i) uncertainties are not stated and quantified and ii) the results are not

validated while they could partially be.

1. The revisited land-use dependent Budyko curves

The land-use attribution relies heavily on the Budyko curves depicted on Figure 1. First I did not understand why this Figure is not discussed in the results section. The authors did a great job in collecting these lysimeter data but the amount of data remains too limited to design the whole modeling framework. Some curves are adjusted on the basis of very few points, e.g. w* is calibrated on the basis of two points for urban areas and these two points are extracted from a unique site of Arnhem. How can we state that this parameter will be representative of all urban areas in Europe? Some land use classes present more experimental points but the w* fitting is far from being satisfying, with large uncertainties, no clear distinct w* values for some classes and again many points are related to the same environmental data (the 26 points originated from only four sites, Table 1). Given the multiple sources of uncertainties, the authors should consider to quantify the parametric uncertainty (the sensitivity of the results to w* fitted values) and should try to validate the fitted w* on independent data (e.g. the streamflow data, see next comment).

2. Validation of the attribution results

The authors propose a validation exercise using GLEAM product and streamflow from near-natural catchments. It should be stated that the comparison to GLEAM cannot be viewed as a strict validation since GLEAM relies on hydrological modelling (different to Budyko but still a model using P and PET inputs). The validation using streamflow time series is to my opinion the unique way to perform a real validation with independent data. To perform a rigorous validation studies, the authors could compute for each catchment the observed "Net" change and compare it with the Net change computed by the Budyko-curves. The authors have the material to perform such validation that will provide a clear diagnosis on the method used for attribution. At this stage, the attribution exercise is more a sensitivity analysis, which is not at the level of the ambitious

objectives of the study.

3. Other comments

p.2 l.13-17: this is a repetition with previous sentences. p.3 l.28-29: I disagree with this statement. The impact of urbanization is probably the most sensitive land use change impact on hydrological processes and it is discussed in the early hydrological literature (Leopold, 1968). See also the large sample studies by DeWalle et al. (2000) and the recent reviews on this topic (Oudin et al., 2018; Salvadore et al., 2015). p.4 A discussion on the attribution problem is missing. There is a large existing literature on attribution studies in hydrology and I suggest that the proposed methodology be described upon the several existing attribution studies and associated methodology (see the reviews by Dey and Mishra, 2017 and Wang, 2014). p.6 l.1-5 Is it verified by local measurements of PET? I do not understand how the "c" linear factor might accounts for "all processes affecting yearly ET for tall vegetation". p.7 6-10: Using 10-yr periods to assess hydrological changes is too small with regard to natural climate variability. p.8 l.28-29: Please clarify the differences in units and how the correlation trends is calculated. Besides, I am not sure that correlation is the more adequate tool, maybe a contingency table would be more appropriate to compare the observed and simulated trends. p.10 l.24-25. Please modify the sentence and replace the term believe.

References

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