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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Skilful seasonal forecasts of streamflow over Europe?" *by* Louise Arnal et al.

Anonymous Referee #2

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Summary

In this manuscript, the authors assess the predictability of streamflow through the four seasons and 78 regions over Europe. Specifically they compare system 4-driven seasonal streamflow hindcast (CM-SSF) and Extended Streamflow Prediction (ESP, produced by driving Lisflood model with 20 randomly resampled years of historical meteorological observations. The main results is that the CM-SSF shows more skill when the predictions are done with 1 month of lead time for most of the regions and mainly in winter and autumn. The predictability of anomalous seasons is also assessed and the usefulness of the European Flood Awareness System (EFAS) is discussed. Results also suggest a strong dependency between initial conditions, the land surface memory and seasonal predictability for seasonal streamflow forecasting.

Major comments

The manuscript provides a very valuable insights on forecasting capabilities through Europe by comparing of the use of weather forecasts and historical conditions. However the contribution of the paper could be improved if the authors could establish a link between hydrological processes, climatic conditions and seasonal predictability and it is strongly recommended to include an analysis on these topics (eg. CM-SSF predictability skills in snow-dominated regions, arid regions, cold regions, etc.)

As the study region is very large, a quantitative comparison through the seasons and regions is a hard task. It is necessary to include some numbers in the result and discussion sections, perhaps there is a link between different hydro climatic regions, ungauged regions, etc. and seasonal forecast skill.

Minor comments For the different sections of the manuscript, I have some minor comments that are listed below:

Abstract The abstract needs to clarify the scientific questions and give a more quantitative assessment for the forecasting comparison (not only lead time). It is strongly suggested to include a brief methodology, materials, datasets and methods.

1. Introduction General comments

The scientific question is clear, the literature review is good but focused on European regions It would be very nice to include studies in other regions. (eg. Mendoza et al. 2014 in the Andes and Seibert et al. 2017 in southern Africa).

P1L28. Are these large-scale climatic patterns the only predictors for seasonal climatic conditions in Europe?

P2 L12. How much is high to measure forecast quality?. The response time for IHC is one of the terms that modulate the predictability of flows but also the storage capacity of watersheds in different hydrological processes (eg. Glacier, sub-surface process).

P3 L.15. Are there any efforts or initiatives to improve communication and outreach?

2. Data and methods

P3 L27 I strongly suggest to improve this paragraph by including information on spatial distribution, time step for modelling, quantity and quality of the data, etc.

P3 L29.Please include a citation for the Lifsflood model. The name of the hydrological model, should be included in the abstract

P4 L1, Please explain what hydrological processes were calibrated

P4 L3-14 This paragraph should be moved to section 2.1. More detail should be given to EFAS-WB (i.e., references, hydrological processes reproduced, model uncertainties, etc.) Please include forecast quality indices whenever EFAS-WB is considered the best estimate of hydrological state.

P5 L15, Did you assess of sub-monthly predictability of streamflow? Are the time scales considered enough Is that time step enough for decision makers?

P5 L 22. Please explain if the performance measures of Crochemore et al. (2016) are the ones described in the next numerals.

Sections 2.2.1 to 2.2.5 should be addressed in a Figure as a resume scheme for forecast skill.

3. Results 3.1 Overall skill of the CM-SSF In this section almost all the comparison between CM-SSF and ESP is qualitative and general. The authors could further contribute to the forecasting literature, by relating the spatial distribution of skill with physical processes and watershed type. (Eg. Do snow dominant basins shows more predictability than rainfall dominated ones?)

3.2 Potential usefulness of the CM-SSF P 8 L 31. Did the authors find specific regions where the predictability of extreme years was better/worse? If that was the case, can you please provide an explanation? P 9 L1. For most seasons (and regions?) Table 1.

This is a great contribution, downscale the regional to local scale. As commented before, it is recommended to include dominant physical processes, aridity index or other descriptors to better understand forecast skill of in different hydro climatic regimes.

4. Discussion 4.1 Does seasonal climate information improve the predictability of seasonal streamflow forecasts over Europe?

P9 – L11, In my opinion, Meiβer et al. (in review) should not be cited if there is not an accessible reference. I suggest including a DOI, or delete the reference.

P9 - L21. “The CM-SSF is more skillful in many at predicting anomalously low and high streamflows than ESP in certain season and regions”. It is very difficult to qualitatively judge the skill of the predictions, but at least in terms of geographic regions, the authors could add quantitative indicators, e. g. 60% of the analyzed regions shows better performance in CM-SSF predictions rather than ESP forecast.

P10 - L8: Same comment as before.

P10 – L14-16. The analysis done in this paragraph and link to hypothesis across physical processes is desirable and should be expanded across the manuscript.

4.2 What is the potential usefulness and usability of the EFAS seasonal streamflow forecast for flood preparedness?

P11 – L23 Meumann et al. (submitted to J. Hydrometeorol.), same comment than Meiβer et al. (in review).

4.2 Aspects for future work P13 – L3-5. “The impact of this evaluation strategy in this paper should be minimal,..” But how does it impact low flows or drought predictability?

P13 -11-14. Statistical or probabilistic approaches (eg. Han and Coulibaly, 2017; Mendoza et al. 2017), should be discussed. Future work could include a different comparison, merging climate forecast with other predictors.

References

Han, S., & Coulibaly, P. (2017). Bayesian Flood Forecasting Methods: A Review. Journal of Hydrology. Mendoza, P. A., Rajagopalan, B., Clark, M. P., Cortés, G., & McPhee, J. (2014). A robust multimodel framework for ensemble seasonal hydroclimatic forecasts. Water Resources Research, 50(7), 6030-6052. Seibert, M., Merz, B., & Apel, H. (2017). Seasonal forecasting of hydrological drought in the Limpopo Basin: a comparison of statistical methods. Hydrology and Earth System Sciences, 21(3), 1611.

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