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Hydrology and Earth System Sciences Discussions

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Interactive Comment

Interactive comment on " Simplifying a hydrological ensemble prediction system with a backward greedy selection of members – Part 2: Generalization in time and space" *by* D. Brochero et al.

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It was shown in the companion paper (Brochero et al., 2011) how the interchangeability of members of the Hydrological Ensemble Prediction System (HEPS) at hand can be exploited through the participation of hydrological models in the subset of hydrological members selected. In a similar fashion, this paper proposes the evaluation of random selections with and without the guidance of the response found with Backward Greedy Selection and Cross Validation, hereafter BGS-CV. (see Fig. 4 and 6 of this report).

Additionally, to avoid confusion that can bring the explicit analysis of members of the MEPS in the selected subset, on account of its inherent interchangeability, Fig. 4 and paragraphs that considered their interpretation will be removed.

1 General Comments

1.1 As already indicated by the reviewer G. Thirel, there is some obvious redundancy with the companion paper "Part 1: Optimization criteria". As a reviewer allocated only for Part 2, this results in a well organized paper, which could be read without often switches to Part 1. If "Part 1" will be accepted, then I agree with G. Thirel concerning shortening section 2 and dropping Table 1 from the "Part 2". Your answer to G. Thirel goes in the right direction.

We tried to give independence to each paper to facilitate its evaluation and reading. However, whereas the part one was accepted, the new version of the second part has the following changes:

- Elimination of Table 1.
- Sections 2, 3 and 4 will be reduced substantially.
- Modification of Fig. 2.
- Elimination of Fig. 4.
- Insert a new figure showing the performance of the initial HEPS (800-member) on different FTHs (see Figure 3 of this report).
- Insert a new figure showing the generalization of the BGS-CV selection on different FTHs (see Figure 4 of this report).

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1.2 I have a general concern on the selection methodology. I agree here with the comments of the reviewers on “Part 1”. ECMWF EPS members are independent, so it is useless to have a "a-posteriori" statistic of the ECMWF member contributions (Your Fig 4 in Part 2) to the member selection. In operational mode you would need to propagate all 50 members through the hydrological model. According to Table 5 (Bold criterion) and depending on the test area you can reduce a priori only the number of hydrological models you consider (e.g. for basin “K7312610” you can disregard in operational mode 6 of 16 models). You should find a technique in order to decide “a priori” how to reduce the numbers of EPS members to propagate through your suite of hydrological models, and this is exactly what the procedure of Molteni et al. (2001) is doing previous to make a limited-area downscaling of ECMWF EPS

You are right. Consequently we will remove Figure 4 as has been proposed in the new version. With respect to the reduction of ECMWF EPS members, we propose in the Part 1 a new section on the methodology explaining how to interpret or use the solution found with BGS-CV. Then the proposed section in Part 1 would be the following:

“**3.5 Interpretability of hydrological members’ selection**
In the case of MEPS in which the members are not perfectly interchangeable (e.g. Meteorological Service of Canada –MSC, TIGGE database, etc), the selection of hydrological members with BGS focuses directly on the combinations of hydrological members that maintain or improve characteristics of the super ensemble of reference.

But in the HEPS driven by a MEPS with interchangeable members (e.g. ECMWF EPS), the selection should be directed more clearly to a method of selection and weighting of hydrological models based on their participation in the final selected subset. Therefore, we can create a new simplified high-performance HEPS using the same proportion

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of the hydrological members associated with a random choice of the meteorological members.

For example if the final selection shows that the simplified HEPS should consist of ten members for the hydrological model “A” and thirty members for the hydrological model “B”, then we should expect to achieve a high performance HEPS if we randomly pick ten meteorological members to evaluate the hydrological model “A” and thirty meteorological members, randomly chosen once again, to assess the hydrological model “B”. Sect. 4.3 presents such an analysis.”

Also in the new version of this paper (Part 2), Fig. 4 and Fig. 6 show the performance of the solution based on random experiments that are set-up following these guidelines:

- Experiments considering the participation of hydrological models found with BGS-CV : taking into account the participation of hydrological models to assign to each model a number of members chosen randomly from ECMWF EPS.
- Without considering any “a priori” participation of hydrological models: hydrological members are picked randomly from the initial 800-member HEPS.

Furthermore, it would be interesting to combine the most representative models in each basin with a small number of representative members of the ECMWF EPS by a technique such as that proposed by Molteni et al. (2001). This comment will be placed in the Conclusions section.

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2 Specific Comments: Page (line)

2.1 2787 (20) The reference on a EGU presentation (Velazquez, 2010) for the description of the setup is rather inadequate. Change to Velazquez et al. (2011, Adgeo)

Done, see reference to Velázquez et al. (2011).

2.2 2788 (3-5) Do you have any reference on how the “distributed models” have been downgraded to “lumped” and how their performance is affected by such structural change?

In Perrin (2000) you can find the conceptualization and the impact of scaling of distributed models to a “lumped” scale.

2.3 2815 Please declare also in the caption that symbols refer to the clustering evaluated in Table 4. It would be also useful to highlight in the Map which areas were used for selection and which only served to verify the methodology.

The new Fig. 1 and Fig. 2 (given at the end of this document) facilitate the understanding of the methodology in terms of basins used in the process of selection and extrapolation.

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Interactive Comment

3 Final considerations: The capability of the methodology to reduce computational need in operational mode (paramount goal of the study) apply only to the selection of hydrological models. The authors reply to Reviewer G. Thirel answers already the few technical flaws of the paper. I suggest the editors and the authors to explore the possibility to transfer Figure 2 to “Part 1” and re-arrange “Part 2” in order to obtain a compact paper, that could be labelled as “Technical-note”.

The suggestion to change the Fig. 2 for Part 1, like other reviewers suggestions, have been made in Part 1. In the same way, we proposes a restructuring of Part 2 in order to obtain a compact paper.

Note: The complete captions for the figures below are:

- Fig. 1. Location of the catchments grouped by clusters. Some of them have been used in the BGS-CV process, while the others have been used for extrapolation. The colours identify the five regions evaluated in this paper.
- Fig. 2. Generalization test methodology for the hydrological members' selection found with BGS-CV.
- Fig. 3. Interquartile range (iqr) of RD_{MSE} and δ ratio assessed in the 28 catchments under two HEPS schemes: 16-member HEPS (16 hydrological models are driven by the deterministic forecast from ECMWF) and the 800-member HEPS (16 hydrological models are driven by the 50-perturbed member forecast from ECMWF).
- Fig. 4. Evolution of the normalized sum (NS) to evaluate the response sensibility with regard to the interquartile range (iqr) of 200 random experiments in different

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FTHs following these guidelines: 1. Considering the participation of hydrological models found with BGS-CV (vertical blue bars), and 2. Without regard to any "a priori" participation of hydrological models, i.e. completely random selection (vertical cyan bars).

- Fig. 5. Comparison between the initial ensemble (800 members) and the ensemble selected (50 members) for a lead time of 9 days. **(a)** Figure above: observed flow; figure below: CRPS (x-axis formatted as: day/month). Note the correspondence between higher observed flows and higher CRPS. **(b)** Figure above: observed flow; figure below: IGNS (x-axis formatted as: day/month). **(c)** Reliability diagram error (MSE based on vertical distances between the points). **(d)** Rank histogram for the 50 hydrological members selected. The horizontal dashed line indicates the frequency $(N/d+1)$ attained by a uniform distribution. **(e)** Occurrences of the employed models in the final solution of 50 hydrological members.

- Fig. 6. Evolution of the normalized sum (NS) to evaluate the response sensibility of the extrapolation of results in the nearest catchments. Each vertical bar represents the interquartile range (iqr) of 200 combinations of 50 hydrological members under the following guidelines: the combination is oriented with the same proportion of hydrological models found with BGS-CV (blue vertical bars), the selection is completely random (cyan vertical bars). Note the deficiency of the selections' extrapolation in basin A69 to basin A79, notably for early lead times (2 to 5 days); these results do not appear in the figure because they are above 7.

- Fig. 7. Hydrological Models participation. Distribution in the five regions (clusters) are presented in **(a)**, **(b)**, **(c)**, **(d)**, and **(e)**. Model performance evaluated as the mean rank index is shown in **(f)**.

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References

Brochero, D., Anctil, F., and Gagné, C.: Simplifying a Hydrological Ensemble Prediction System with a Backward Greedy Selection of Members, Part 1: Optimization criteria, Hydrol. Earth Syst. Sci. Discuss., 8, 2739–2782, doi:10.5194/hessd-8-2739-2011, 2011.

Molteni, F., Buizza, R., Marsigli, C., Montani, A., Nerozzi, F., and Paccagnella, T.: A strategy for high-resolution ensemble prediction. I: Definition of representative members and global-model experiments, Quarterly Journal of the Royal Meteorological Society, 127, 2069–2094, doi:10.1002/qj.49712757612, 2001.

Perrin, C.: Vers une amélioration d'un modèle global pluie-débit au travers d'une approche comparative, Ph.D. thesis, Institut National Polytechnique de Grenoble (INPG), France, 2000.

Velázquez, J. A., Anctil, F., Ramos, M. H., and Perrin, C.: Can a multi-model approach improve hydrological ensemble forecasting? A study on 29 French catchments using 16 hydrological model structures, Advances in Geosciences, 29, 33–42, doi:10.5194/adgeo-29-33-2011, 2011.

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