Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2017-589-AC2, 2018

Hydrology and Earth System Sciences
Open Access
Discussions

Interactive comment on "A geostatistical data-assimilation technique for enhancing macro-scale rainfall-runoff simulations" *by* Alessio Pugliese et al.

Alessio Pugliese et al.

alessio.pugliese3@unibo.it

Received and published: 15 January 2018

Referee comment:

General Comments: This paper "A geostatistical data-assimilation technique for enhancing macro-scale rainfall-runoff simulations" develops a geostatistical method for enhancing streamflow simulation performance of large-scale rainfall-runoff models. The proposed method has proved to be effective for Tyrol area and shows great potential for basins with few gauges or even ungauged basins.

Authors reply:

We thankfully acknowledge reviewer's useful comments, which will help us to improve the presentation of the study.

Referee comment:

Some major comments: (1) Organizations of Section 5 seem to be not logical. Following "Section 4: study area", some new method (e.g. LOOCV) and new metric (e.g. LNSE) are introduced in Section 5, and then followed by the findings and discussions. This may confuse readers as they may fail to grasp the intention and the core of this paper. It had better reorganize the manuscript in 'Method-Results' order.

Authors reply:

Although we see reviewer's comment, we did not introduce LOOCV and LNSE earlier in the text as these are a common cross-validation procedure (see e.g. Kroll and Song, 2013; Salinas et al., 2013; Wan Jaafar et al., 2011; Srinivas et al., 2008) and a widely used metric (see e.g. Farmer, 2016; Castellarin, 2014). Yet, we do agree that this may generate some confusion.

ACTION: We decided to introduce a new section in the manuscript, in between "Study area" and "Results" sections, titled "4 Assessment of the geostatistical assimilation algorithm" in which we present the structure of the analysis, the cross-validation strategies and the performance index. This section will report the following subsections:

4.1 Structure of the analysis

4.2 Cross-validation strategy

4.3 Performance indices

Nevertheless, before changing the sectioning, and thus the whole structure of the paper, we would like to wait for editor decision.

Referee comment:

(2) The concept of total negative deviation (TND) is very essential to this paper's research. So, it is recommended that TND be explained more clearly with both words and figure. Particularly, Figure 1 should be interpreted in detail, for instance, what does the symbol '1' exactly stand for?

Authors reply:

We are grateful to the reviewer for highlighting this lack of clarity behind the idea of TND. We will add more information about this novel metric in the revised version of the paper. TND is conceived to mimic the slope of a standardised FDC, where the standardisation is an arbitrary reference value (e.g. mean annual flow; see also Pugliese et al., 2014, for other standardisation methods). Therefore, "1" on the y-axis in Fig. 1 represents the equality between a given streamflow record and the reference value.

ACTION: We will add this sentence in P4 L25 : "[...] The equality between a given streamflow value and the reference value Q^* is represented by an horizontal dashed line in Fig. 1, i.e. the threshold given by the equation $q/Q = 1$. [...]"

Referee comment:

(3) Why choose the mean annual flow (MAF) as the reference value in applying equation (3)? Does this mean that you didn't consider the flow above MAF when applying

"TNDTK", according to the definition of TND by the shaded area in Figure 1? If this is the case, more should be elaborated on this.

Authors reply:

We understand that this paper neither explains carefully the idea behind the TND, nor it presents a thorough assessment of its reliability as regional metric summarising FDC's, however we think that this is out of the scope of this paper. Indeed, such assessments have been already carried out in other two independent research studies, where we proposed the TNDTK method and we contrasted its performances against other regional models, such as regional regression and statistical models, which are known to be the state-of-the-art for regional FDC predictions in ungauged basins (see Pugliese et al., 2016, 2014).

ACTION: We will better clarify this in the revised manuscript, providing an interested reader with indications on original literature sources.

Referee comment:

(4) Page 8 line 28. It stated that "each pair includes one of the E-HYPE catchments depicted in Fig. 4 and its corresponding gauged catchment." How to determine the corresponding gauged catchment for a certain E-HYPE catchment? By Equation 4 or other method? Please explain in detail.

Authors reply:

The selection criteria of the 11 sites used for comparing the proposed technique with EHYPE simulations have been explained in section 4 Study area (which will be Section

5 in the revised manuscript).

ACTION: We will change the sentences on P7 L10

"[. . .] We selected only those E-HYPE prediction nodes located within Tyrol, which were the closest to one of the available streamgauges. In terms of selection criteria, we selected the E-HYPE catchments that showed limited differences in terms of (1) drainage areas (<14%) and (2) distance between catchment centroids (<15km). These criteria resulted in 11 E-HYPE prediction nodes that are evenly distributed in the study region (see red lines in Fig. 4). [. . .]" with

"[. . .] Among all E-HYPE prediction nodes available in Tyrol we selected only those whose catchments were the closest to gauged ones, i.e. differences in terms of drainage areas <14% and distance between catchment centroids <15km. These criteria resulted in the selection of 11 E-HYPE prediction nodes that are evenly distributed in the study region (see red lines in Fig. 4). [. . .]". Finally, it is worth noting that Eq. (4) does not deal with catchment selection, but with empirical TND computation only.

Referee comment:

Minor Comments: (1) I notice that Equation 1 takes the symbol i as indicator of catchments, while in Equation 4 it represents the quantiles of qi. This should be avoided. Please use a different symbol. (2) In Figure 9, the black dashed line indicates the observed streamflow series, which is not in line with its legend, where the black solid line is plotted. This is a minor mistake that could have been avoided. (3) In Figure 10, the meaning of the black triangles is interpreted in the title. This is not a good idea. Please use legends instead. (4) What does 'TNDTK' mean in the title of Section 2.1? DO NOT use abbreviation before it is defined.

Authors reply:

(1) The reviewer is right. We will substitute i with j in Eq. (1). (2) Thanks. We will change accordingly. (3) Thanks. We will add a legend for both the black triangles and catchment boundaries. (4) Thanks. We will drop both TNDTK and GAE-HYPE from the title of the sections.

References

Castellarin, A., 2014. Regional prediction of flow-duration curves using a three-dimensional kriging. J. Hydrol. 513, 179–191. https://doi.org/10.1016/j.jhydrol.2014.03.050

Komma, J., Reszler, C., Blöschl, G., Haiden, T., 2007. Ensemble prediction of floods – catchment non-linearity and forecast probabilities. Nat Hazards Earth Syst Sci 7, 431–444. https://doi.org/10.5194/nhess-7-431-2007

Kroll, C.N., Song, P., 2013. Impact of multicollinearity on small sample hydrologic regression models. Water Resour. Res. 49, 3756–3769. https://doi.org/10.1002/wrcr.20315

Pugliese, A., Castellarin, A., Brath, A., 2014. Geostatistical prediction of flow–duration curves in an index-flow framework. Hydrol Earth Syst Sci 18, 3801–3816. https://doi.org/10.5194/hess-18-3801-2014

Pugliese, A., Farmer, W.H., Castellarin, A., Archfield, S.A., Vogel, R.M., 2016. Regional flow duration curves: Geostatistical techniques versus multivariate regression. Adv. Water Resour. 96, 11–22. https://doi.org/10.1016/j.advwatres.2016.06.008

Salinas, J.L., Laaha, G., Rogger, M., Parajka, J., Viglione, A., Sivapalan, M., Blöschl, G., 2013. Comparative assessment of predictions in ungauged basins - Part 2: Flood and low flow studies. Hydrol. Earth Syst. Sci. 17, 2637–2652. https://doi.org/10.5194/hess-17-2637-2013

Srinivas, V.V., Tripathi, S., Rao, A.R., Govindaraju, R.S., 2008. Regional flood frequency analysis by combining self-organizing feature map and fuzzy clustering. J. Hydrol. 348, 148–166. https://doi.org/10.1016/j.jhydrol.2007.09.046

Wan Jaafar, W.Z., Liu, J., Han, D., 2011. Input variable selection for median flood regionalization. Water Resour. Res. 47, W07503. https://doi.org/10.1029/2011WR010436

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2017-589, 2017.