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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Bayesian Network Model for Flood Forecasting Based on Atmospheric Ensemble Forecasts" *by* Leila Goodarzi et al.

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We would like to express our sincere gratitude for the insightful comments. Please see below the responses to the comments, on behalf of the authors.

Comment 1:

"Beginning with the part of the Atmospheric modeling and the simulations performed for the analysis, it is not quite clear but the fine domain used in the model configuration might be too close to the eastern parts of the basin. The fine domain should be depicted at the same figure with the study area (Figure 1)."

Response 1:

Thank you very much for catching this confusing issue, which we will clarify in the next version. We should explain that the red region in Figure 1 is all of the Tehran province. Our case study is a small basin in the north western part of this province, so the model configuration is not close to eastern part and we will correct the Figure 1 in new manuscript.

Comment 2:

"A more important issue is the lack of important information regarding the simulations such as the spin up time, the length of each simulation etc. A table including these characteristics for the 14 cases would be useful."

Response 2:

We will add a table in the next version, see supplement file.

Comment 3:

"The initial conditions are the FNL (page 9) data from NCEP, which are a post process product. The fact that the simulations are in a hindcast mode is something that should be mentioned clearly within the manuscript. Towards this direction it would be quite interesting to also employ a model running with the NCEP forecast analysis. Additionally, it would be interesting to run the model with different forecasting horizons in order to test its performance in periods with higher uncertainties. Finally the creation of an ensemble with the implementation of different cumulus schemes is something needed to be supported better, especially considering that some of them are already known to perform better than the rest."

Response 3:

Thank you for this suggestion. We will mention the use of hindcast mode in the next version. Regarding the use of different forecasting horizons, please see our response to reviewer 1. It is an interesting aspect, but we focused on the short term as this is the recommended lead time for the size of catchment under consideration. Long lead time flood forecasting is very important for large watershed flood mitigation as it provides more time for flood warning and emergency responses (Li et al, 2017). Further work may deal with the transferability of BN to longer lead times and other catchments, and investigate the need for re-training of the BN based on the different characteristics of the meteorological uncertainty for the different lead times, and based on the different catchment characteristics and this can be recommended for future studied in the conclusion. We have used five various cumulus parameterization schemes. Running the model with more cumulus schemes would have been interesting to explore this aspect. However, in the case of our study, it seems out of scope because the purpose of our study is to propose the Bayesian Network (BN) model to estimate flood peak in case of small data size like flood forecasting. In other words, we focused on the hydrological forecasting aspects in our paper. However, we agree that using more cumulus schemes might improve the prediction so, following the reviewer suggestion, we will propose using different cumulus schemes for future work to explore the uncertainties of the meteorological forecast better.

Comment 4:

"In the proposed manuscript only 14 flood cases were implemented resulting in good results. However there is the danger of bias by taking into consideration such a small number of test cases. In any case, the meteorological characteristics for these cases should be analyzed and the cases should be divided into categories. Finally, despite the fact that such events are rare, maybe the authors should also consider taking into account smaller-impact events or maybe employing as initial conditions a dataset covering larger periods."

Response 4:

We agree with the limitation of the small sample size. Using categories of events can be useful, but would even further reduce the sample size for the different categories. With the small number of events in total, we did not attempt to divide the dataset further

and train the BN for the different categories. As it is a semi-arid catchment, we assume that rainfall characteristics is implicitly regarded by the incorporation of our input variables for the BN, which we have checked and documented. In particular, hydrological initial conditions showed to be relevant. A very useful advantage of BN is that there are no minimum sample data sizes needed to perform the analysis, and BN take into account the complete data set (Myllymaki et al., 2002). Also, Kontkanen et al. (1997) demonstrate that BN can show good accuracy of prediction even with rather small data set. Furthermore, Zhang and Bivens (2007) showed that BN is less sensitive to small data set size in comparison with ANN. It is a good idea to include smaller events in order to have more data, but these events would not have relevance for flood warning, and their characteristics is most probably much different, so there would maybe be a trade-off in training the BN for the large and the small events at the same time. We will extend our outlook regarding that aspect.

Once again, we wish to express our highest appreciation to the reviewers for their comments. We provided a first study of a new method in flood warning, which still has some limitations and much further work is required to get more insights and knowledge about general applicability. We hope the manuscript will suit the Journal Natural Hazards and Earth System Sciences and we are happy to provide a revised manuscript. We thank you for your continued interest in our research.

Yours sincerely

The Authors

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Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2019-44/nhess-2019-44-AC2-supplement.pdf

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