

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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Comment on hess-2021-432

Anonymous Referee #1

Referee comment on "Quantifying the uncertainty of precipitation forecasting using probabilistic deep learning" by Lei Xu et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-432-RC1>, 2021

In the presented manuscript, a joint uncertainty modeling method is proposed. The input data uncertainty, target data uncertainty and model uncertainty are jointly modeled in a deep learning precipitation forecasting framework to estimate the predictive uncertainty. The results show that the proposed method can improve precipitation forecasting accuracy and reduce predictive uncertainty. Having said that I am lost and confused. Here are some of my major concern regarding the presented study:

- Precipitation forecasting datasets are usually daily. In this study, the authors use three datasets are all daily. Why the authors convert the data to weekly data? In Line 134, the historical three consecutive weeks are used to forecast the precipitation in the target week. How to determine the "three" weeks?
- Why the authors use NCEP R2, ERA-5 and MERRA-2 data? For exsample, NCEP CFSv2 also have weekly precipitation forecasting data. In this study, MERRA-2 is used as the reference data. Do different reference data in the uncertainty estimation?
- How to determine the structure of the deep learning model in Figure 3? Besides the model parameters, the model structure can also generate uncertainty. Have the authors considered this part of uncertainty in this study?
- Lines 423-424: In the places where the annual rainfall is abundant, the water cycle process is accelerated and the precipitation observations may suffer from large uncertainty. Why this uncertainty dosen't exhibit in Figure 7? There are no larger uncertainty observed in the southern China in Figure 7. Is it contradictory?
- How to calculate RMSE and uncertainty in Table 1? Are they the average of all the grid cells? How dose the uncertainty processing to improve forecasting accuracy and reduce predictive uncertainty? Why some methods have considered uncertainty processing but their RMSE increase compared with the no-uncertainty method? Loquercio's method also considers the data and model uncertainties. Why the uncertainty of Loquercio's method is so large?
- The section "results" is too brief. The authors may analyse how the proposed framework improve RMSE and uncertainties in detail, for example, the contribution of model uncertainty, input data uncertainty and target data uncertainty.

Minor comments:

- The abstract is not complete in my point of view. There are four parts in the abstract usually, i.e., background, method, results and conclusion. The results and conclusion are missing in the abstract.
- Line 150. Is it seasonal or weekly?
- Line 156. NECP or NCEP?
- Lines 268-269. This sentence is unclear; what is the point the authors want to make with it?
- There are many symbols without introduction in Figure 2, such as $x_n^{(l)}$, $\sigma_n^{(l)}$, etc. The $x_n^{(l)}$ is also seen in Equation 16 without introduction.
- Lines 319-320. Which deep learning network is used in this study? CNN, RNN, LSTM or all of them? Please make it clear.
- Line 376. Typographical error.
- Lines 453-454. Please rephrase.

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
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Comment on hess-2021-432

Anonymous Referee #2

Referee comment on "Quantifying the uncertainty of precipitation forecasting using probabilistic deep learning" by Lei Xu et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-432-RC2>, 2022

This study attempts to improve the accuracy of precipitation forecasting by jointly considering multi-source data-model uncertainties in deep learning based modeling framework. A case study conducted in the southern and northern China showed that the developed modeling framework is effective to reduce the uncertainty in precipitation forecasting. In my opinion, this study is valuable and the methodology developed is based on rigorous mathematical formulas that is worthy of recognition. Some of my main comments are listed below

- Line 9-26. It is suggested that some summative results should be added to the Abstract.
- Line 138-159. Adding some key formulas about the TCH algorithm can facilitate the understanding of whole framework.
- Some variables in equations need further explanation, such as the 'I' in Equation (1).
- Line 209. Typographical error. Should be 'estimated'
- Line 349-366. There are many experimental settings. It is suggested to explain them in bullet points, or use a clearer presentation.
- Line 377. In Figure 5, it is recommended to plot the uncertainty estimation results of all datasets for visual comparison.
- Line 402: Add two numbers estimated by Loquercio et al. (2020)'s and Srivastava et al. (2014)'s methods for an intuitive comparison.
- The Results Section lacks some detailed analysis on how the developed method can improve the prediction accuracy.