

“TPHiPr: A long-term high-accuracy precipitation dataset for the Third Pole region based on high-resolution atmospheric modelling and dense observations” by Jiang et al.

Overall summary:

Long-term high-accuracy precipitation dataset for the Third Pole is greatly needed, which is also a great challenge for researchers due to complex and bad weather systems over TP. This study seems to provide a novel strategy for potentially catering this challenge. While after carefully reading this manuscript, there are still various aspects confusing me. The largest issues mainly include: (1) the authors generated the TPHiPr based on ERA5\_CNN and gauge observations, why not the ERA5\_Land? (2) The robustness of the algorithm needs to be furtherly demonstrated and revealed, especially the RF as a black box without a detailed description on the parametrization strategy; (3) the current validations of TPHiPr, compared with other gridded precipitation datasets, are not convinced enough; and (4) the overall language and structures are relatively poor, of which still needs to be greatly improved. Therefore, I recommend a “Major” at this stage.

Major concerns:

1. The TPHiPr is generated based on ERA5\_CNN and gauge-based observations. Why did not the authors use the ERA5\_Land with the high resolutions of 0.1 deg and hourly. Even though the authors should give some detailed descriptions on the ERA5\_CNN. Recently, various investigations found that the ERA5\_Land has many advantages, compared with satellite-based precipitation estimates. For instance, “Do ERA5 and ERA5-Land Precipitation Estimates Outperform Satellite-based Precipitation Products? A Comprehensive Comparison between State-of-the-art Model-based and Satellite-based Precipitation Products over Mainland China” .
2. The organization of Introduction is relatively poor and some very related research is just only simply mentioned, for example, in line 79. The authors need to pay great attentions to give a comprehensive review of the merging algorithms to meet the standard of the big journal, *ESSD*. For instance, some recently representative merging algorithms, “A Morphology-based Adaptively Spatio-Temporal Merging Algorithm (MASTMA) for optimally combining multi-source gridded precipitation products with various resolutions”, as well as AERA5\_Asia and AIMERG.
3. As for merging algorithm, at least two major issues should be concerned: (1) the description of

the flowchart is not very clear and readable; (2) the robustness of the algorithm should be further manifested, for instance, why RF is used in this study? And it is also like a black box without any introduction of the parametrizations.

4. The precipitation detection index (POD, FRA, and CSI) is mainly applied for evaluating the precipitation estimates at hourly or sub-daily scales. One issue is greatly confusing me is that the detection abilities of TPHiPr has significant improvements from Figs.10–12, so the question is that what are the advantageous parts of the merging algorithm for these contributions?

5. The author seems to be aiming at improving ERA5\_CNN, however, they compared the qualities of TPHiPr with those of ERA5 in Figs. 6–14, while not ERA5\_CNN or ERA5\_Land, which is greatly strange. Additionally, the spatial resolution of ERA5 (0.25 deg) is much coarser than that of ERA5\_Land (0.1 deg).

6. The evaluation section seem not to be robust and comprehensive, which needs to be greatly redesigned and extended.

7. As to further demonstrating the quality of TPHiPr and the robustness of the merging algorithm, I recommend the authors to add a discussion paragraph for comparing the characteristics and/or the qualities of AERA5\_Asia (AIMERG is optional) with that of TPHiPr: AERA5-Asia “A long-term Asian precipitation dataset (0.1°, 1 hourly, 1951–2015, Asia) anchoring the ERA5-Land under the total volume control by APHRODITE” and AIMERG “a new Asian precipitation dataset (0.1°/half-hourly, 2000–2015) by calibrating GPM IMERG at daily scale using APHRODITE”.

8. The language still need to be greatly improved.

Specific comments:

1. the spatiotemporal resolutions, temporal span, and extent should be noted in the Title and Abstract following the TPHiPr, making it more clear for readers to know the characteristics of this dataset.

2. what’s the relationship between the ERA5 and ERA5\_CNN in this manuscript, which is fully mixed and confused.

3. The Introduction still needs to be further improved, especially the aims of this study. For instance, are the authors sure the rain gauge data is unprecedented?

4. What does the blue line mean in line 109? Is it the extent of the TP?

5. what's the temporal resolution of gauge observations? There are many such points that are not clearly described.

6. the authors seem to generate TPhIPr using ERA5\_CNN and the gauge observations, while they compared the quality of TPhIPr with that of ERA5. And the ERA5\_Land with high spatial resolution of 0.1 deg is not even mentioned in this study. The logicity needs to be redesigned.

7. RF and Kriging are used in many times in Fig. 2, how did you concern the uncertainties and errors from these methods?

8. Fig. 6 presented very limited information.