

## Comment on hess-2022-135

Anonymous Referee #1

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Referee comment on "Long-term reconstruction of satellite-based precipitation, soil moisture, and snow water equivalent in China" by Wencong Yang et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-135-RC1>, 2022

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Based on data fusion and numerical modeling, the authors reconstructed a long-term (1981-2017) 0.1° daily dataset of total precipitation ( $P$ ), liquid rainfall (Rain), snowfall (Snow), snow water equivalent (SWE), snowmelt (Melt), and soil moisture (SM) in China. Reconstructing these hydrological components is a very challenging topic, particularly for west China including the Northwest and Tibetan Plateau. The reader may expect some progress in these regions when seeing the title, but the results of this study show limited progress in these regions. This is certainly not surprising, and it looks like there is a long way to go. Nevertheless, the authors took advantage of two favorable conditions to extend the recent data with better accuracy to the 1980s, which is a clear progress. That is, (1) meteorological data and satellite data in the last decade or so are more abundant, higher resolution and more accurate; (2) Satellite remote sensing data can be used to calibrate a land hydrological model. They are the innovative points of this paper and support its publication. My main comments are as follows.

- Research focus. From the results, the reconstructed  $P$  data are of high quality and may be used by other researchers. However, the significance of the snow data and soil moisture content data is weaker. Especially for snow data, this paper uses the data of Che et al. as training data and the evaluation is also based on the data and there is no validation based on independent data. Given that the time series of Che et al. data is even longer (1979-2020), the snow data presented in this study is not very necessary. I suggest that the snow-related section be greatly weakened, and its validation section could even be removed.
- The abstract needs to describe that (1) the constructed  $P$  is used to drive HBV, which generates snow and SM data, and (2) the reconstruction algorithm and data evaluation use the same data sources, only the data periods are different (if my understanding is correct). The current description will make the reader struggle to find the difference between the training data and validation data.
- Data description. (1) The use of CMPA\_1km is not clearly stated. The authors just say upscale to 0.1 degree, without stating how the 1km-resolution data is used. (2) It

should be made clear that the data in Table 2 are both for training and for validation. If this is not made clear, it is difficult to understand the structure of Figure 1. This once made the reviewer confused. (3) The data introduction section suddenly mentions air temperature and net radiation without introducing the usage of these data. This may confuse the reader.

- Methodological aspects. (1) It is not clear why the HBV model is used, and what are the advantages in reflecting SM and SWE. (2) It needs to be clarified what exactly is meant by 5-fold cross validation, e.g. whether this fold is temporal or spatial, which time periods (or spaces) are used for training and which time periods (or spaces) for validation. This information must be clearly, perhaps in Table 2.
- Validation issues. (1) The data sources used in the current evaluation are the same as those used for training, but validations based on independent data are more convincing. For example, precipitation data need to be validated at stations of pre-CMPA era and SM data need to be validated based on intensive SM observation networks (e.g., the widely used Maqu and Naqu soil moisture measuring networks). (2) Figure 6 shows that overall the reconstruction of P is good, but why are its errors significantly larger in several watersheds in 2017?.

Other comments:

The terms "ground-truth" or "raw observational data" or "observed SWE" are mentioned in the text, but please avoid using them in this way, because in fact they refer to fused data or remotely sensed data.

It is difficult to understand the Continental Basin, suggest to change to NW Continental Basin

P3: "For P, we merged CGDPA and MSWEP to reconstruct the P from CMPA using machine learning techniques; for SM, we used the reconstructed P to drive a hydrological model to reconstruct SM from SMAP level 4". This description (reconstruct the P from CMPA, reconstruct SM from SMAP) is quite confusing.

P8: "For SM, the 1 m root zone SM ...". Although I know what it refers to, for most readers it may not be clear that it is SMAP-L4.

P10: Start a new paragraph from "The validation metric for SWE and SM is KGE in Eq. 3".