Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-316-AC1, 2018

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Consistency of satellite precipitation estimates in space and over time compared with gauge observations and snow-hydrological modelling in the Lake Titicaca region" *by* Frédéric Satgé et al.

Frédéric Satgé et al.

frederic.satge@gmail.com

Received and published: 21 December 2018

We are sincerely grateful to the two anonymous reviewers for the time and effort spent in reading this manuscript and making numerous suggestions for improvement. The paper has been substantially revised based on their comments. We acknowledge all the points raised and we have spent time on carefully addressing them all. See our answers below. We also wish to inform you about an additional change concerning one of the Satellite-Based Precipitation Estimates (SPPs). We originally considered SM2Rain-CCI v.1, but, after receiving a personal communication from data developers,

Printer-friendly version

Discussion paper

we now use the updated version SM2Rain-CCI v.2.

Answer to comments from Referee 1

On “Consistency of satellite precipitation estimates in space and over time compared with gauge observations and snow-hydrological modelling in the Lake Titicaca region” Referee’s comment This is a well-written paper. The analysis is quite thorough although the generalizability of the findings may be limited given the small size of the study region. I recommend publication after a minor revision.

Authors’ response:

Thank you.

Referee’s comment:

* In Section 1.3, other evaluation studies were criticized for focusing on "a single or a limited sample of SPEs". The current study can be criticized in a similar vein since it ignores reanalysis-based datasets (WFDEI, ERA-Interim, JRA-55, ...). Yes, these datasets have a coarser spatial resolution, but this does not necessarily mean that they perform worse that satellite-based datasets. Yes, I understand that the current study focuses on satellite-based datasets, but from an end-user perspective the specific source of the precipitation estimates may not matter much.

Authors’ response:

Indeed, the current study focuses on satellite-based datasets and we wanted to test a wide range of products to make a consistent comparison in space and over time. Of course reanalysis-based datasets (WFDEI, ERA-Interim, JRA-55, etc.) could also have been used, since from the point of view of the end user, the actual source of the precipitation estimates may not matter much. However, as you mention, the reanalysis-based datasets have a coarser spatial resolution. Due to the size of our study region, we consequently preferred datasets with spatial resolution equal to 0.25° or higher.

Modifications to manuscript:

This is now better explained in the manuscript in the section 2.3.1, page 7, lines 19-22. “It is worth mentioning that other precipitation datasets with coarser resolution (>0.25°) are currently available but we did not use them because (1) the difference between point-gauge and grid-cell-average measurement would introduce inconsistency and because (2) such low resolution datasets are better suited for observation of global scale precipitation patterns rather than the local dynamics studied here.”

Referee’s comment:

* The analysis is limited to the 10-day time scale because some of the datasets are only available as daily accumulations starting at midnight UTC. This is a drawback of the study since the daily and subdaily variability is, in my opinion, much more important than the 10-day variability. In addition, focusing only on 10-day means hides much of the difference among the datasets. I understand that the paper is already quite long and I don’t expect you to add a daily evaluation but this drawback should at least be mentioned.

Authors’ response:

The 10-day time scale was used for several reasons. As you saw, some of the datasets we used are only available at a daily time step with a daily accumulation period, which does not match the periods used by the gauges. This difference in timing would be expected to result in differences between the reference and assessed datasets. In addition, because precipitation is subject to high spatial variability, many precipitation events detected at the grid-cell scale would not necessarily be detected at the point-gauge level. This is even more pronounced when only one gauge is used for comparison with the corresponding average pixel measurement (which is mostly the case for the pixels considered here due to the scarcity of local gauges). Another reason is the snow modelling analysis. In this part of the protocol, snow cover distribution (SCD) derived from gap-filled MODIS snow products are used as reference. The temporal fil-

ters applied to fill the initial gaps in the MODIS snow products (see section 2.3.2 page 10 line 4-11) led us to consider that these data were more valid at the 10-day than the daily scale, as explained in the manuscript (section 3, page 10, lines 27-33) However, it should be noted that despite the 10-day time scale, significant differences could appear between the satellite-based datasets for each indicator considered in space and over time. This demonstrates that the 10-day time scale enables consistent comparisons.

Modifications to manuscript:

In response to your comment, we have added a few lines to section 3, page 10, lines 25-32 to better explain why we decided to use the 10-day time scale analysis.

“It is noteworthy that the use of a 10-day time scale rather than a daily time scale may conceal some of the differences among the datasets, notably by eliminating any insights into their capacity to capture individual events and higher intensities. However, our choice was based on the inconsistencies we expected between gauges and daily measurements of SPPs as a reason to (i) use a different daily time window aggregation than the local one (8 am to 8 pm) for SPPs delivered at daily scale, (ii) the spatial inconsistency between point-gauge measurement and average grid-cell measurement (Tang et al, 2018), and (iii) the temporal filters used for gap filling of MODIS snow products, which led us to consider that these reference data were more valid at a 10-day scale than at a daily scale.”

Referee’s comment:

* For some of the precipitation datasets it is incorrect and confusing to refer to them as "satellite precipitation estimates (SPEs)". I’m referring to those that are also based on reanalysis and/or gauge data. Consider using "P datasets" instead of "SPEs" throughout the paper.

Authors’ response:

We agree that the use of “satellite precipitation estimates (SPEs)” could be confusing.

But as all the datasets we used mostly rely on satellite data, we would like to keep the keyword “satellite” in the paper. We thus propose to use “satellite-based precipitation products (SPPs)” to avoid any confusion.

Modifications to manuscript:

The term “Satellite Precipitation Estimates (SPEs) has been replaced by satellite-based precipitation products (SPPs) throughout the manuscript and in the figures.

Referee’s comment:

* Page 11 line 13: "useless" could be misinterpreted. Perhaps "less suitable" or "less well-performing"?

Authors’ response:

Done. We have changed “useless” to “less suitable”.

Referee’s comment:

* "Pixel" should be "grid cell" throughout the manuscript.

Authors’ response:

Done. We have changed “pixel” to “grid-cell” throughout.

Referee’s comment:

* Please use perceptually uniform colormaps in the figures. For an explanation, see the following website: https://peterkovesi.com/projects/colourmaps/. Use a divergent colormap with either white or gray in middle for the %B panels in Figure 5c. This will help the interpretability of the figures.

Authors’ response:

Done. We have changed the color in Figure 5 c to grey for “unbiased” estimates (-15% to 15%) which facilitates the observation of systematically precipitation over/under

estimation by the SPPs. We have also changed the CC and CRMSE color scale to green, yellow, orange and red to refer to the four classes considered (<0.5, 0.5-0.6, 0.6-0.7 and >0.7). We also changed the color scale used in figure 6 to green, yellow, orange and red to refer to the four scales considered (<0.5, 0.5-0.6, 0.6-0.7 and >0.7).

Referee's comment:

* The title is pretty long. How about: "Consistency of satellite precipitation estimates with gauge observations and snow hydrological modeling in the Lake Titicaca region"?

Authors' response:

The words "over time and space" are very important as they express part of the originality of the current paper. We would consequently prefer to keep the title in its original form, but replace "satellite precipitation estimates" by "satellite-based precipitation products" based on your preceding comment.

Modifications to manuscript:

The title has been changed to "Consistency of satellite-based precipitation products in space and over time compared with gauge observations and snow-hydrological modelling in the Lake Titicaca region

Referee's comment:

* Please use dataset version numbers throughout the manuscript for reproducibility.

Authors' response:

Done. We now include dataset version numbers throughout the manuscript.

Referee's comment:

* "12 hydrological years (2000-2012)": 12 should be 13 I think.

Authors' response:

In our analysis, we use hydrological years and not calendar years. Therefore, 2000-2012 refers to the period from the 1st of October 2000 to the 30th of September 2012, i.e. 12 hydrological years.

Modifications to manuscript:

Based on your comment, we have added a few lines to clarify it in section 3, page 10 line 21-23: “Each assessment step was analyzed according to three 4-year time windows (2000-2004, 2004-2008, 2008-2012) and one 12-year time window (2000-2012) in which a hydrological year corresponds to a period starting on 1st of October to the following 30th of September.”

Referee’s comment:

* The Beck et al. (2017) citation is outdated (the title has changed and the paper is not in discussion any more). In addition, the citation for MSWEP is wrong (it should be https://journals.ametsoc.org/doi/10.1175/BAMS-D-17-0138.1)

Authors’ response:

We originally cited another article by the same authors which also appears in the discussion. We have changed the reference as follows:

Beck, H. E., Vergopolan, N., Pan, M., Levizzani, V., van Dijk, A. I. J. M., Weedon, G., Brocca, L., Pappenberger, F., Huffman, G. J. and Wood, E. F.: Global-scale evaluation of 23 precipitation datasets using gauge observations and hydrological modeling, Hydrol. Earth Syst. Sci., 6201-6217,https://doi.org/10.5194/hess-21-6201-2017, 2017.

Modifications to manuscript:

We have also added the reference you suggest referring to MSWEP dataset to Table 1.

References :

Tang, G., Behrangi, A., Long, D., Li, C. and Hong, Y.: Accounting for spatiotemporal errors of gauges: A critical step to evaluate gridded precipitation products, J. Hydrol., 559, 294–306, doi:10.1016/j.jhydrol.2018.02.057, 2018.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-316, 2018.

Printer-friendly version

Discussion paper