Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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Comment on hess-2021-34

Anonymous Referee #1

Referee comment on "Evaluation of Integrated Nowcasting through Comprehensive Analysis (INCA) precipitation analysis using a dense rain-gauge network in southeastern Austria" by Esmail Ghaemi et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-34-RC1, 2021

In the manuscript entitled "Evaluation of INCA precipitation analysis using a very dense rain gauge network in southeast Austria" the authors evaluate the ability of the blended radar–rain-gauge INCA (Integrated Nowcasting through Comprehensive Analysis) precipitation analysis product (1km x 1km) provided by ZAMG (the Austrian Central Institute for Meteorology and Geodynamics) to detect and estimate precipitation for the period 2007-2018 in southeast Austria. They use the WegenerNet (a dense rain gauge network with about 1 station per 2 km2) as the "true precipitation" for this evaluation. The authors perform various comparisons between the two datasets, i.e., annual precipitation (for each pixel and the area-mean), seasonal precipitation, and extreme precipitation; they also test the detection of precipitation, implement an event-based evaluation and compare extreme convective short-duration events. They use four comparison and three detection indices and separate the study period into three sub-periods (2007-2011, 2012-2014, 2015-2018), based on the performance of INCA. Some of their main findings are that the INCA product generally overestimates the annual-mean precipitation, it detects precipitation better during the wet seasons, and the two datasets (INCA and WegenerNet) have a noticeable difference in the extremes. Finally, the ability of INCA in detecting precipitation is smaller in the cells closer to ground stations which are used as input for INCA, especially in the wet season. The authors concluding remark is that "careful consideration must be taken when using merged rain-gauge–radar products, especially in extreme events" which is an important conclusion indeed.

• The manuscript is concise and grammatically correct. The methods are robust, the results are adequately explained and the figures are clear and well presented. The overall presentation is good. Some revisions are proposed here that mainly deal with the aim of the paper and potential improvements.

Main Remarks:
• The aim of the manuscript is to evaluate the INCA precipitation product. Therefore, the reader can use this study to decide whether INCA is an effective product of high-resolution precipitation for their needs. The authors, though, never clearly arrive at a conclusion

about this (except for the last sentence: "Careful consideration must be taken when using merged rain-gauge–radar products, especially in extreme events"). Maybe there should be a discussion section or at least a paragraph where the authors can comment on the evaluation of the INCA product in comparison to other products, and, if possible, radar-rain-gauge blended ones. What have other studies presented in terms of rainfall products performance in Austria or other regions with similar topographic/climatic characteristics? What do these results mean for the INCA performance? Is the model reliable, or other approaches should be preferred?

• The authors should also clearly emphasize the contribution of their study. Compared to previous evaluation studies conducted for INCA (Haiden et al., 2011; Kann et al., 2015; Kann and Haiden, 2011), what is the contribution of the present study?

• The abstract also does not include the main output of the manuscript, which is whether the INCA precipitation product is eventually a viable choice for hydrological models and decision-making in agriculture and economy (as stated in the beginning). The abstract is also a bit wordy, I think it can be written more concisely.

• Finally, some of the concluding statements need to be better explained and developed, either in the "Conclusions" section or in other sections of the manuscript. Specifically:
1) Lines 485-486: "We conclude that this overestimation is a result of systematic errors from newly installed radars"
Also, in lines 279-282: "From 2012 to 2014, INCA considerably overestimated precipitation in almost all grid cells, and the annual area-mean difference rose to almost 29 % in 2013... We interpret this as an error, introduced by the new radar, which was partly removed by the calibration with ZAMG station data."
Maybe I am missing soothing here but it is not clear in the manuscript whether this is the reason for overestimation. To be more specific, in Table B1 we can see that the radars were replaced on 10/2011, 10/2012, and 11/2013. If this is the reason for overestimation for the second period (2012-2014), why does overestimation also occur during the period 2007-2011? (I assume you have considered hydrological years (September to October))

2) Line 486: "This overestimation was partly removed in the INCA algorithm using reference gauges."
Do you mean that there was no overestimation in the cells near the reference gauge? Maybe a clearer sentence should replace this one.

3) Lines 503-505: "In general, INCA has been improving in detecting and estimating precipitation. However, there are errors due to radar estimates and the algorithm for merging radar and rain gauges, which can negatively affect the INCA analysis product."
Maybe it is better the conclusions to be understood without the need to read the whole manuscript, you could explain, how is INCA being improved and which are the specific errors.

Other remarks:
• Some references are needed in certain sections. Specifically, lines 36-44, 193-195.

• Consider removing the word “very” from the manuscript title. It seems redundant.

Minor suggestions:
• Lines 82-84: Can you give more details about the stations, e.g., average altitude, and also give details about the types of stations presented in Figure 1 in the text. They are not mentioned in the manuscript.
• Table 1: Consider adding a column with the values which indicate a satisfactory accuracy for each metric
• Avoid creating one-sentence paragraphs throughout the manuscript
• Line 351: change to: “exceeding the 99th quantile”
• Lines 429 and 439: It is a bit informal to start the paragraphs in this way
• Lines 490-491: Consider changing the sentence to: “This could be because the INCA algorithm removes false precipitation events and unintentionally...”

References:
Haiden, T., Kann, A., Wittmann, C., Pistotnik, G., Bica, B., Gruber, C., 2011. The Integrated Nowcasting through Comprehensive Analysis (INCA) System and Its Validation over the Eastern Alpine Region. Weather and Forecasting 26, 166–183. https://doi.org/10.1175/2010WAF2222451.1
Kann, A., Haiden, T., 2011. INCA – an operational nowcasting system for hydrology and other applications. Weather and Forecasting 26, 10.
Kann, A., Meirold-Mautner, I., Schmid, F., Kirchengast, G., Fuchsberger, J., Meyer, V., Tüchler, L., Bica, B., 2015. Evaluation of high-resolution precipitation analyses using a dense station network. Hydrol. Earth Syst. Sci. 19, 1547–1559. https://doi.org/10.5194/hess-19-1547-2015