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Discussions

Interactive comment on "Satellite-driven downscaling of global reanalysis precipitation products for hydrological applications" *by* H. Seyyedi et al.

Anonymous Referee #1

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Major comment This paper evaluated a statistical precipitation downscaling algorithm, namely SREM2D, through downscaling GLDAS 100 km resolution precipitation data into 25 km resolution. TRIM3B42V7 precipitation data were used in calibrating the SREM2D algorithm. Downscaled precipitation data, as well as original GLDAS precipitation data, were evaluated against the radar based NCEP stage IV and USGS stream flow data. The main conclusion is that the downscaled precipitation data significantly mitigate the underestimation bias of the GLDAS precipitation data. Therefore, the downscaling technique presented in this paper is useful for hydrological applications.

The study has good scientific significance. The paper is well written and organized. However, I have some concerns about the analysis and conclusions in this paper. But overall, the paper is still in good quality can could be published after minor revisions.

In the paper, the authors claimed that the GLDAS data underestimate precipitation for most of times through quantitative statistics and hydrological simulation. The GLDAS precipitation data are at 100 km spatial resolution, while TRMM and the downscaled GLDAS are at 25 km spatial resolution. For every GLDAS 100-km grid, the precipitation value could be understood as the average of the precipitation values of 16 (4x4) 25-km sub-grids. It is normal that the GLDAS precipitation values are smaller than some sub-grid precipitation values, especially when precipitation only partially covers the 100-km grid, which happens frequently. Taking an extreme example, if there is only one 25-km grid having 16 mm precipitation in a 100-km grid, the GLDAS precipitation should be 1 mm to hold the total precipitation amount. It may not be fair for the GLDAS data to compare it with radar, TRMM, and the downscaled GLDAS data directly with precipitation intensity. In addition to precipitation intensity, the total precipitation volume should be considered in the comparisons. Therefore, I question whether the conclusions of figure 5 and figure 7 are still held if all 25-km precipitation data are aggregated into 100 km.

Runoff results were simulated at the resolution of precipitation data products. Except the GLDAS data, the rest precipitation data are at 25 km resolution. As described above, the precipitation value of each GLDAS grid can be viewed as the average of 16 precipitation values of 25-km sub-grid within the GLDAS grid. It is very possible that precipitation only happens in some but not all sub-grids. Therefore, there must be some sub-grids having higher precipitation values than the average. Rainfall-runoff relationship is not linear. The total runoff amounts should be different, if simulating runoff with the GLDAS precipitation value and the sub-grid precipitation values respectively over the same GLDAS grid. The total amount of GLDAS precipitation may just concentrate to a few instead of all 25-km sub-grids. Due to nonlinear rainfall-runoff relationship, it

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is very possible that the total runoff simulated at the sub-grid scale is more than the amount simulated at the GLDAS scale. That is to say, it may not be fair to claim that the GLDAS underestimate precipitation because it comes with lower stream flow.

My last concern is about the spatial pattern of downscaled precipitation, which is a characteristic of precipitation as important as amount. No description and discussion about the spatial pattern of the downscaled GLDAS precipitation data. For a large river basin, precipitation spatial pattern (at 25 km resolution) may not be essential for stream flow simulation at the basin outlet because flow routing may conceal the influences of precipitation spatial pattern. But precipitation spatial pattern is very important for simulating soil moisture and evapotranspiration. A reliable precipitation downscaling scheme should take care of both the amount and the spatial pattern of precipitation. Therefore, I suggest the authors to add descriptions and discussions about the performance of the SREM2D algorithm on precipitation spatial pattern.

Minor comments (1) I cannot find the reference “Hossain and Anagnostou (2006).” (2) “In this study we present a two dimensional stochastic error model (SREM2D) to downscale and adjust GLDAS precipitation data using as reference the higher resolution and accuracy TRMM3B42V7 satellite precipitation product.” The wording of this sentence may be changed since this paper does not focus on presenting the SREM2D algorithm.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 9067, 2014.