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Bias correction of global high-resolution precipitation climatologies using streamflow observations from 9372 catchments

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We introduce a set of global high-resolution (0.05°) precipitation (P) climatologies corrected for bias using streamflow (Q) observations from 9372 stations worldwide. For each station, we inferred the “true” long-term P using a Budyko curve, an empirical equation relating long-term P, Q, and potential evaporation. We subsequently calculated long-term bias correction factors for three state-of-the-art P climatologies (WorldClim V2, CHELSA V1.2, and CHPclim V1), after which we used random forest regression to produce global gap-free bias correction maps for the climatologies. Monthly climatological bias correction factors were calculated by disaggregating the long-term bias correction factors based on gauge catch efficiencies. We found that all three climatologies systematically underestimate P over parts of all major mountain ranges globally, despite the explicit consideration of orography in the production of each climatology. Additionally, all climatologies underestimate P at latitudes > 60°N, likely due to gauge under-catch. Exceptionally high long-term correction factors (> 1.5) were obtained for all three climatologies in Alaska, High Mountain Asia, and Chile — regions characterized by marked elevation gradients, sparse gauge networks, and significant snowfall. Using the bias-corrected WorldClim V2, we demonstrated that other widely used P datasets (GPCC V2015, GPCP V2.3, and MERRA-2) severely underestimate P over Chile, the Himalayas, and along the Pacific coast of North America. Mean P for the global land surface based on the bias-corrected World-Clim V2 is 862 mm yr−1 (a 9.4 % increase over the original WorldClim V2). The annual and monthly bias-corrected P climatologies have been released as the Precipitation Bias CORrection (PBCOR) dataset — downloadable via www.gloh2o.org/pbcor.