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Spatial partitioning of precipitation in the terrestrial water cycle and the role of dataset agreement

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The study of the water cycle at planetary scale is crucial for our understanding of large-scale climatic processes. There have been numerous studies that quantified the water cycle and its components, i.e., precipitation, evaporation, and runoff, over the land and the ocean. However, very little is known about how water fluxes are distributed across regions with different climatic or land properties. Here, we address this gap by providing robust estimates for terrestrial precipitation over a suite of land cover types, biomes, elevation zones, and precipitation intensity classes. We achieve this by estimating the mean annual precipitation of a 17-dataset ensemble between 2000 and 2019 at 0.25° spatial resolution. Our estimate of annual terrestrial precipitation is at approximately 114 000 ± 9 400 km^3, with about 70% falling over one third of the grid cells, 80% over the 0 – 800 elevation zone, and two-thirds over forested regions. Our results also highlight that despite the current progress in the development of global scale data products there are still substantial uncertainties over the arid and/or high-elevation areas. Bigger discrepancies appear within the reanalysis data products, while remote sensing estimates show a better agreement with the in-situ ground truth. These results help to detect regions of high observational fidelity and pave the way to further explore and improve observational uncertainties. At the same time, we provide consistent estimates that can be used for benchmarking the precipitation partition in the climate models, and most importantly that can be used to assess future changes in global precipitation.