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Decadal climatology and trends in global oceanic precipitation from 27 satellite and reanalysis datasets

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Understanding changes in global oceanic precipitation remains challenging due to limitations in current observational datasets and model deficiencies, particularly in the representation of cloud and precipitation properties within oceanic regions. To address this, we examined climatologies and trends in oceanic precipitation between 2001 and 2020 using a collection of 27 state-of-the-art satellite and reanalysis datasets available on a uniform daily 1°×1° resolution from the Frequent Rainfall Observations on Grids (FROGS) database. The results showed that reanalysis datasets generally report higher annual mean daily precipitation than satellite datasets. The tropical region exhibits the greatest absolute discrepancies in precipitation rates, while arid regions such as the southeast Pacific and Atlantic show significant relative differences among products. An increasing trend is primarily observed in satellite products, whereas reanalyses suggest strong declines. Taken together, reanalyses show pronounced decreases over the Intertropical Convergence Zone (ITCZ) and North Atlantic, contradicting the “wet gets wetter, dry gets drier” (WWDD) pattern. In contrast, the satellites better align with the WWDD pattern, with over half of oceanic regions meeting this expectation. The precipitation trend in the combined reanalysis products also exhibits the weakest consistency with sea surface temperature (SST) trends in wet regions (34.2%), compared with dry regions in the reanalysis cluster (53.4%) and both wet (59.6%) and dry (58.5%) regions in the satellite cluster. We recommend using an ensemble of satellite products for investigating global oceanic precipitation while exercising greater caution when utilizing reanalysis datasets.