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A comparative study of the Indian summer monsoon hydroclimate and its variations in three reanalyses

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This study examines the Indian summer monsoon hydroclimate in the National Centers for Environmental Prediction (NCEP)-Department of Energy (DOE) Reanalysis (R2), the Climate Forecast System Reanalysis (CFSR), and the Modern Era Retrospective-Analysis for Research and Applications (MERRA). The three reanalyses show significant differences in the evaporation, low-level winds, and precipitable water fields over India. For example the large local continental evaporation over India in R2 is significantly reduced in CFSR and MERRA. The mean boreal summer 925-hPa westerly winds in the northern Indian Ocean are strongest in R2, and continental evaporation (precipitable water) over India is least in CFSR (R2). Despite these climatological differences between the reanalyses, the climatological evaporative (for both local and remote) sources for rain events over central India show some qualitative similarities. However, major differences appear when interannual variations of the Indian seasonal monsoon are analyzed. R2 displays the most local evaporation in wet Indian monsoon years, followed by MERRA and CFSR. The remote oceanic moisture contributions to anomalous seasonal monsoons, especially from the Arabian Sea and the Bay of Bengal, are most pronounced in CFSR. We claim that rainfall may not be necessarily the most appropriate metric to observe the relationship between the seasonal Indian monsoon strength and its intraseasonal activity. Furthermore this study suggests that this relationship is best observed in the evaporative sources of intraseasonal rain events over central India. These findings are consistent across the reanalyses and provide a basis to improve the predictability of intraseasonal variability of the Indian monsoon. The analysis suggests that the land-atmosphere interactions contribute significant uncertainty to the Indian monsoon in the reanalyses, which is consistent with the fact that most of the global reanalyses do not assimilate any land-surface data because the data are not available. Therefore, the land-atmosphere interaction in the reanalyses is highly dependent on the land-surface model and it's coupling with the atmospheric model