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The influence of atmosphere-ocean phenomenon on rainfall and streamflow variability across temperate Australia

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Climate modes can have a large influence on the interannual variability in rainfall and streamflow. Moreover, changes in their spatial-temporal patterns are likely to shape changes in hydroclimate in the future as a result of a warming climate. Modeling the links between climate modes, rainfall and streamflow is therefore important for understanding the trajectories in water availability. We examined the effects of four climate variability modes, El Nino Southern Oscillation (ENSO), Indian Ocean Dipole (IOD), Southern Annular Mode (SAM), and Interdecadal Pacific Oscillation (IPO) on variations in annual rainfall and streamflow in four hydroclimate regions in temperate Australian. Climate mode indices, rainfall, and streamflow data from 1975 to 2018 were analyzed for 92 predominately forested catchments in four study regions. The annual variation and long-term fluctuations of rainfall and streamflow in each region were explored using the coefficient of variation, trend analysis, and random forest models to examine relationships to ENSO, IOD, SAM, and IPO. Coefficient of variation analysis showed that the annual variation of streamflow in and among catchments in each region was higher than rainfall. Rainfall and streamflow in each region were strongly influenced by different climate modes, and a higher proportion of variation in rainfall was explained by climate modes. Extreme annual rainfall and streamflow in these regions are related to concurrent phases of regional climate phenomena. These results provide critical baseline information and context for a better understanding of how future spatial and temporal changes in rainfall and streamflow across temperate Australia may manifest.