Self-sustaining mechanisms for the interannual variability of the Australian summer monsoon

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In northern Australia (NAUS), mean rainfall during the Australian summer monsoon (AUSM) season exhibits distinct interannual variability despite weak influence from tropical sea surface temperature (SST) variability. This study investigates maintenance mechanisms for the AUSM rainfall variability to reveal its self-sustaining nature under the atmosphere-ocean-land surface interaction. When the AUSM is stronger than usual, the low-level monsoonal circulation intensifies as a Rossby-wave response to the stronger convective activity over NAUS. The intensified surface westerlies over the tropical southeastern Indian Ocean (SEIO) enhance oceanic evaporation and downstream moisture transport into NAUS. This wind-evaporation-convection feedback is verified through a moist static energy budget analysis. The feedback mechanism effectively works if SST cooling due to the stronger AUSM activity is weak enough so that it does not suppress the oceanic evaporation in the tropical SEIO. Our mixed-layer heat budget analysis based on an ocean model hindcast experiment reveals that wind-induced anomalous downwelling in the subsurface SEIO partially offsets the SST cooling. The effect of soil moisture and land-surface evaporation for the persistency of rainfall anomalies is also argued.

