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The response of land-atmosphere interactions and the atmospheric circulation across West Africa to intraseasonal variability

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Across West Africa rain-fed agriculture fulfils approximately 80% of the food needs of the population and employs 60% of the workforce. It is therefore critical to understand the effects of intraseasonal rainfall variability across West Africa. Previous work has shown that land-atmosphere interactions across West Africa can influence daily variability in deep convection characteristics and the impact of 10-25 day precipitation variability. Using earth observations and reanalyses, this study investigates the land surface response to 20-200 day precipitation variability and its impact on land-atmosphere interactions and the West African monsoon.

Surprisingly, even though the sensitivity of the land surface across the Sahel to strong convection is short-lived (days) and daily precipitation patterns are strongly heterogeneous, a coherent regional-scale land surface response to 20-200 day precipitation variability is observed. This sensitivity of the land surface affects land-atmosphere interactions on a regional scale and perturbs the West African monsoon circulation. For example, during sub-seasonal periods of low rainfall, soil moisture significantly decreases across the Sahel and land surface temperatures increase by up to 2°C. Surface drying and warming across the Sahel is associated with an intensified heat low and a northward shift of low-level monsoon westerlies. During periods of high rainfall, the surface moistens and cools, which is associated with a high pressure tendency across the Sahel. This high pressure tendency dampens the heat low circulation across West Africa and reduces regional moisture fluxes. We show that the land surface response to 20-200 day rainfall variability across West Africa can have a significant impact on the monsoon circulation. This suggests that improving the representation of land-surface processes across West Africa has the potential to improve sub-seasonal forecast predictability and enhance early warning systems.