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MJO-induced land-atmosphere feedbacks across East Africa

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Across East Africa, sub-seasonal rainfall variability predominately depends on the phase of the Madden Julian Oscillation (MJO). Rainfall is enhanced during MJO phases 2 to 4, and suppressed during phases 6 to 8. Given that MJO-induced anomalous precipitation can persist beyond several days, a significant surface response is expected. Using earth observations and reanalysis data, this work illustrates how MJO-induced precipitation anomalies promote a surface response which feeds back onto local and regional atmospheric conditions.

MJO-induced rainfall suppression across East Africa decreases surface soil moisture across semi-arid regions including southern South Sudan, western Kenya and northern Uganda. In regions predominately covered in grass and cropland, reduced soil moisture increases surface sensible heat fluxes and elevates land surface temperatures. A drier and warmer surface promotes an increased boundary-layer height and reduces surface pressure. We identify that spatial variations in the surface response to MJO-induced anomalous precipitation, impacts the intensity of the Turkana jet. Across southern South Sudan and in the exit region of the Turkana jet, reduced soil moisture increases land and near-surface temperatures, whilst in north-east Kenya and in the entrance region of the jet, no land surface temperature response is observed. The difference in surface response between the jet entrance and exit regions increases the pressure gradient along the Turkana channel, and thus intensifies the jet. Since the intensity of the Turkana jet controls the transportation of moisture from low-lying regions of East Africa into Central Africa, we highlight that surface-induced variations in jet intensity impacts rainfall totals across East Africa. Furthermore, due to the Turkana jet response to spatial variations in surface warming, we also identify that the magnitude of MJO-induced anomalous precipitation is influenced by surface conditions prior an MJO event. For example, when the surface over southern South Sudan is anomalously dry, MJO-induced precipitation suppression is greater. This presentation will highlight that to fully exploit predictability from the MJO, forecast models must correctly represent surface processes and land-atmosphere interactions. Future work evaluating sub-seasonal forecast models and improving the representation of land-atmosphere interactions will enhance the lead-time of early warning systems.