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Feedbacks on Convection from an African Wetland

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The Niger Inland Delta in Mali floods every year late in the wet season. This is in response to rainfall many hundreds of kilometres upstream. Once flooded, the wetland produces a strong mesoscale contrast in surface fluxes. The ready availability of water for evaporation within the wetland contrasts with the strongly moisture-limited sparse vegetation in the surrounding region.

This study examines the impact of the wetland on convection in the region using a satellite thermal infrared (TIR) dataset spanning 24 years. The temporal variability in the wetland extent is quantified using cloud-free data by estimating the morning warming rate of the surface. The same TIR dataset is also used to examine the diurnal cycle of cold (<233K) cloud in the region. Compared with wet season conditions prior to inundation, there is a 54% increase in the daytime initiation of new convective storms in the region of the wetland. This feature is consistent with a hypothesised "wetland breeze" effect driven by the contrast in sensible heat flux. This can produce daytime divergence over the wetland, and strong convergence in the vicinity, particularly on the upwind side of the wetland. A signal of enhanced cloud cover is also found to propagate hundreds of kilometres westwards when the wetland is present. This is made up of increased numbers of long-lived Mesoscale Convective Systems emanating from the wetland region.

The study provides observational evidence of a remote hydrological feedback. Rainfall in the Soudanian zone of West Africa flows down the Niger and its tributaries, producing a wetland of varying extent and timing depending on upstream conditions. Via the processes highlighted here, the wetland then affects both local and regional rainfall. This feedback raises the possibility that changes in upstream water use, for example through large-scale hydroelectric schemes, could have a climatic impact over a wide area.