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Land effects on organised convection –mechanisms and applications

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Different from oceans, the land surface can dry out, creating strong gradients in surface fluxes and temperatures. Characteristics of the land surface affect cloud development and growth through changes in heating and moistening of the lower troposphere, affecting convective stability and inducing mesoscale circulations in areas of differential heating. On larger scales, land surface conditions can affect the positioning of atmospheric features such as dry lines, zones of atmospheric moisture convergence and regions of high wind shear, creating environments that are known to favour convective organisation. Furthermore, the partitioning of turbulent surface fluxes is closely tied to surface conditions such as vegetation cover and soil moisture, which can be heavily altered by humans via land use change and have a direct impact on storm patterns. Global warming is another anthropogenic factor that is expected to increase surface temperature gradients, particularly in semi-arid regions, which has already been found to intensify organised convection in the Sahel via increasing wind shear. On shorter time scales, the memory of the land surface relative to the atmosphere implies a level of storm predictability from land surface conditions that promises applications in storm forecasting from hourly to seasonal time scales. At the same time, even our latest convection-permitting forecasting and climate models may still struggle to capture key processes.
On the example of West Africa, a region known to exhibit strong land-atmosphere interactions, I will discuss our current understanding of land surface effects on organised convection and its drivers, the human component in driving trends, and how we may use our knowledge for improved storm predictions. Finally, I will illustrate why process-based model evaluation is crucial and outline the relevance for other hotspots of land-based organised convection.

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