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Cape Fear: an outdoor hillslope laboratory

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Hydrological processes occurring at the hillslope scale highly influence the response of natural catchments. However, modelling hillslope dynamics is often extremely challenging, and conceptualizations may be inadequate to simulate such complex processes. Towards this aim, field experiments on natural and artificial catchments have proved highly beneficial.

In this work, we present Cape Fear, an ad hoc designed experimental plot whereby traditional and new measurement systems are integrated for improved comprehension of hillslope processes. This outdoor hillslope laboratory hosts diverse sensing apparatuses, spanning from a system of rainfall simulators, a v-notch weir for input and output fluxes analysis, sophisticated instrumentation for continuous measurements of surface and subsurface water and soil transport, to innovative image-based setups to remotely sense surface waters.

We demonstrate the potential of such a versatile and thoroughly instrumented outdoor laboratory through a proof-of-concept experiment conducted during a natural rainfall event. The response of the plot to the storm is reconstructed based on continuous monitoring of input and output fluxes. Further, an innovative tracer-based approach involving the use of fluorescent particles is utilized to remotely investigate the onset of overland flow from captured images. Insight from experimental observations is utilized to identify the physical phenomena governing the response of the hillslope to the precipitation event.

Cape Fear is a powerful resource for the hydrological community and this small scale experimental observatory is expected to provide diverse and innovative observations to advance current knowledge on hydrological processes at the hillslope scale.