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Cohesive sediment distribution on floodplains driven by crevasse-splay hydrograph characteristics

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A wide range of diffusive and advective overbank depositional processes have been identified in large river systems, yet the propensity of crevasse-splays makes them a key mechanism of floodplain development and sediment sequestration. Crevasse-splays may define the locations of some channel avulsions through their extensive deposits, and may preserve key hydrological and climatic information in their resulting sedimentary records. This makes understanding their formative processes and controlling factors important for our interpretation of the preserved sedimentary structures in these deposits. Unlike their deltaic counterparts, however, little is known about how the controls exerted by the main splay channel (i.e. the timing and variation of peak flow and sediment discharge) affect the spatial distribution of cohesive and sandy-silt fractions across crevasse splays.

Here, we explore how the magnitude and frequency of flood events affects (i) the morphology of crevasse-splays and (ii) the distribution of different (cohesive versus non-cohesive) sediment fractions across a receiving floodplain basin. We develop a set of idealized crevasse-splay deposits using Delft-3D, parameterized with real-world data pertaining to grain-size and input hydrology form the Mekong River, Cambodia. Our results demonstrate that highly variable hydrographs are characterized by a more uniform distribution of cohesive sediment across the receiving floodplain basin, as well as a more subdued morphology. Conversely, more uniform hydrographs are characterized by cohesive material that settles closer to channels, constructing more pronounced levee systems. Our findings imply that the thicker near-channel deposits laid down under more uniform hydrographic regimes may stand a better chance of being preserved. Therefore, the use of floodplain sedimentary architecture to infer palaeohydraulic characteristics should account fully for the potentially confounding role of hydrograph sequencing and variability.