LiDAR UAS sensing platform for high spatial and temporal resolution mapping of geomorphic evolution

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Water and sediment transport from rivers to adjacent floodplains is a foundational physical process in the generation of complex floodplain, wetland, and riparian ecosystems. In highly transformed natural environments, however, human engineering works often restrict lateral connectivity of water and sediment during flood pulses, restricting important floodplain hydrogeomorphic processes. In California’s Sacramento and San Joaquin River Delta, intentional levee breaching and removal is an emerging floodplain restoration practice intended to generate dynamic geomorphic feature creation and evolution. The localized nature of water and sediments pulses therefore requires high spatial and temporal resolution mapping. We have used a highly mobile Unmanned Aerial System (UAS) platform with robust laser scanning payload to generate repeat topographic observations from Light Detection and Ranging (LiDAR) before and after intentional levee breaches along the lower Cosumnes River, USA. While breach architecture influences hydrogeomorphic process on nearby floodplain areas and main channel reaches, the use of the UAS LiDAR allows for high precision estimation of sedimentation rates, and development and evolution of archetypal crevasse-splay complexes along dominant flowpaths. Advective sediment transport along flow paths helps to generate overlapping crevasse-splay complexes, while turbulent diffusion promotes the incipient formation of lateral levees through large wood and sediment accumulation in near bank areas. It is only from these repeat mapping surveys at high spatial and temporal resolution that deposition and scour volumes can be tied to specific flood events, as the opposed to the current practice that relies on posterior mapping to estimate net flux rates after flood season cessation. Understanding the variable hydrogeomorphic responses to intentional levee breach activities will help engineers design floodplain restoration actions that maximize desired floodplain topographic change while also minimizing potential undesirable consequences such as levee breach closure or excessive upstream channel incision.

Keywords: Geomorphology, Hydrology , Remote Sensing

