Quantifying Spatio-temporal Inundation Patterns for Floodplain Restoration on the Lower Cosumnes River, California

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Restoration of floodplain ecosystems within altered riverine landscapes is a global challenge, and one central to solving water management challenges of California broadly and the Delta specifically. Such restoration, intended to support ecological diversity, requires not only the rehabilitation of driving physical processes, but also improved understanding and quantification of the spatial distribution and temporal variability of floodplain inundation patterns. The research presented here formalizes the hydrospatial regime concept, presenting methods for better evaluation of specific physical conditions useful for floodplain management. This new spatio-temporally resolved approach quantifies a floodplain’s hydrospatial regime using 2D hydrodynamic modeling (HEC-RAS) and spatial analysis. Pre- and post-restoration conditions are evaluated for the Oneto-Denier floodplain restoration site along the lower Cosumnes River, California. Modeling is performed for selected historical floods representing previously established flood types distinguished by ecologically-relevant variables such as magnitude, timing, and duration. Modeling output is analyzed and compared within and across flood events and restoration scenarios in space and time using metrics relating to depth, velocity, duration, connectivity, and spatial heterogeneity. Spatially-resolved flow-depth relationships allows for further assessment and comparison of conditions. The quantified and visualized hydrospatial metrics illustrate, for example, where and when different physical conditions are likely to be altered with restoration, and which flood types and where within the floodplain are associated with the greatest difference pre- versus post-restoration. They also demonstrate that physical conditions follow different spatial and temporal patterns across different floods and restoration scenarios. Implications include that variability of flow regimes and their interaction with heterogeneous floodplain topography should be considered in Delta restoration management and more broadly. This research advances floodplain hydroecology and restoration sciences and extends readily-applied methods using 2D modeling output to evaluate restoration scenarios, providing needed information and tools to better manage floodplains for variable conditions that benefit ecosystems.

Keywords: Cosumnes River, floodplain restoration, flow regime, hydrodynamic modeling, spatial analysis

Poster Topic: Modeling