SPATIO-TEMPORAL CHANGE OF RACCOURCI OLD RIVER: INSIGHTS FROM GEOPHYSICAL, HYDROLOGIC, AND GEOMORPHOLOGICAL DATA

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A suspended sediment concentration discrepancy was observed between endpoints of an 85-mile reach of the lower Mississippi River from the Old River Control Structure to Baton Rouge, LA. These differences account for between 10 and 20 percent of the suspended sediment load carried by the Mississippi River. It is unknown where or to what extend floodplain deposition may play in this discrepancy. To investigate potential sinks of the sediment along this reach, in 2020 and 2021, the U.S. Geological Survey (USGS) and the U.S. Army Corps of Engineers (USACE) conducted a series of airborne and waterborne geophysical surveys on Raccourci Old River (ROR), an oxbow lake created by an artificial cutoff of a meander bend beginning in 1845.

Approximately 120 km of airborne Frequency Domain Electromagnetics (AEM) was flown across Raccourci Island (RI, a large island located in the center of the horseshoe shaped oxbow lake) and along the thalweg of ROR. Sixty km of 1-D waterborne electrical resistivity were collected within ROR. These provided a detailed look at the layering of sediments beneath the entire survey area. Direct-push electrical and hydraulic logs in addition to sediment cores were collected on RI and adjacent to ROR to ground-truth the geophysical results. A grain size analysis was conducted on sub-samples from the drill cores to facilitate geophysical to lithologic transforms of the AEM and waterborne resistivity cross sections.

Sediment volumes accumulated in ROR were calculated using accretion rates derived from historical USACE and USGS bathymetric surveys collected in 1961, 1999, and 2013. Sediment volume estimates on RI were based on Cs-137 isotopic dating and were limited to a single time step, 1964-2016, from the peak isotopic deposition to the date of sampling.

Historic maps of the Mississippi River prior to the 1845 cutoff date show that ROR was a sandy bend of the Mississippi River—a sharp contrast to the fine-grained sediment that has filled it since the cutoff. This sand layer was the target for the final calculation of the total volume and mass of sediment accumulated in ROR since the cutoff event in 1845. The sediment accumulation rates from the historical bathymetric surveys were used to peel back layers from the AEM data until the 1845 surface was identified. A volume above this surface was calculated and the lithologic transforms linking the grain size information from the drill cores to the values from the AEM and waterborne resistivity data were used to estimate bulk densities of the sediment contained in that volume. These mass and volume estimates are critical to understanding the transport and deposition of sediment along this reach of the Mississippi River.