Abstract: The historic floods of 2011 in the Mississippi River Basin forced the opening of the Morganza Spillway to prevent flooding downstream in Baton Rouge and New Orleans, Louisiana. This routed Mississippi River floodwaters through the Atchafalaya Basin, allowing for an unprecedented opportunity to examine floodplain connectivity and nutrient retention within a freshwater diversion. Three intensive synoptic sampling campaigns were completed over the course of the flood. Synoptic samples were collected in the West Atchafalaya Basin in the Buffalo Cove and Henderson Lake Wildlife Management Units (Figure 1). Samples were analyzed for conservative tracers (anions and water isopes) and non-conservative tracers (dissolved organic carbon, dissolved nutrients, and total nutrients). A hierarchical cluster analysis of conservative tracers delineated “Connected” and “Unconnected Sites.” At the peak of the flood (Synoptic 2), all sites were hydraulically connected. This suggests mixing of “old” and “new” water, and thus has implications for the management of Nitrogen (N), Phosphorus (P), and Carbon (C) export to the Gulf of Mexico.

2011 Storm Sampling

Disconnected Floodplains

- In many cases Nitrogen Removal (i.e. denitrification) is limited by Nitrate availability.
- Accumulation of Organic Matter and NH₄⁺ in these areas leads to water quality and habitat degradation
- Redox Conditions allow for PO₄⁻₃ mobilization, thus lowering water quality.

Connected Floodplains

- Exchange of riverine nitrate into the anoxic zone allows for high nitrogen removal and better water quality
- Perirheic Zones forms, providing a unique gradient of oxic “Floodwater” and suboxic/anoxic “Local water.”

Preliminary Analysis

A hierarchical cluster analysis was utilized to distinguish connected sites (i.e. new water) from disconnected sites (i.e. old water). Then, comparisons of nutrients at the connected and disconnected sites were made across the course of the flood.

Figure 1. A map of the sampling locations for the greater Atchafalaya Basin Storm Sampling. It is important to note the Buffalo Cove (Green) and Henderson Lake (Red) Synoptic Samples were used in this analysis.

Figure 2. Storm hydrograph of the 2011 flood in the Atchafalaya Basin. The timing of the three synoptic sampling campaigns of the Buffalo Cove and Henderson Lake Wildlife Management Units are also shown.

Figure 3. Graphical Representation of Cluster Analysis of Conservative Tracers (Left). Spatial Representation of “Connected” and “Unconnected” sites (Right). Note that all sites in Synoptic 2 had a “Connected” chemical signature.

Figure 4. Preliminary analysis of nutrients across the course of the flood. (Red plots represent disconnected regions and green plots represent connected regions.)