Sediment dynamics and C-sequestration in the midwestern USA reservoir, Lake Decatur

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The interception of fluvial sediments and nutrient run-off by dams has resulted in the sequestion of 150-300 Tg of organic C (OC) per annum in reservoirs, which is nearly equivalent to the burial rate of OC in the global ocean. The accumulation of OC also drives significant production of the greenhouse gas, methane. Predicting how this globally important anthropogenic biogeochemical setting will behave in response to changes in land use and climate is especially challenging due to the large number of reservoirs world-wide and their relatively short lifetimes (~10^2 yrs).

A study of Lake Decatur has been undertaken to evaluate how sedimentation and OC burial evolve over the lifetime of an impoundment. The 12 km^2 impoundment in Illinois was created by damming the Sangamon River in 1922. The Sangamon River watershed is a study site within the U.S. NSF's Intensively Managed Landscape Critical Zone Observatory (IML-CZO, http://criticalzone.org/iml/).

Lake bed age models were developed from historical sediment thickness surveys, coring to pre-dam surfaces, and ^{137}Cs and ^{210}Pb distributions in the lake bed. The highest observed sediment accumulation rate (~2 cm/yr) was from the pre-dam river channel. Slower rates (< 1cm/yr) were from the shallower, flanking pre-dam floodplain surfaces. The shallower sites exhibited a mixing profile between pre-dam sediments and incoming eroded soils created by resuspension events over the first 40 years. The dam was raised by ~ 1m in 1956, thereafter the deposition of soil-derived mud dominated over mixing. A pronounced depletion of ^{13}C in the OC after ~1970-1980 likely reflects the eutrophication of the lake in response to fertilizer application in the watershed. The changes in sediment dynamics and OC inputs impacted C-burial and degradation. The observations are examples of how the reservoir sedimentary C-cycle responds to forcings such as nutrient influx and water depth. These in turn provide lessons concerning how reservoirs might respond to future climate and land use perturbations.