Modeling Carbon Fluxes in Forested Wetlands in the Mississippi River Deltaic Plain Under Various Hydrologic Conditions

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Forested wetlands represent significant carbon (C) sinks. C dynamics in forested wetlands have been shown to be impacted by climate change. However, our understanding of the impact of climate change on the magnitude and variability of C storage and fluxes in forested wetlands in the Mississippi River Deltaic Plain (MRDP) remain limited. In this study, we applied a process-driven wetland biogeochemistry model, Wetland Carbon Assessment Tool DeNitrification-DeComposition model (WCAT-DNDC) to explore the responses of C dynamics in the swamp forests of Lake Maurepas, Louisiana, to climate change-induced hydrologic conditions. Eleven sites inside the Lake Maurepas swamp forests from the Coastwide Reference Monitoring System (CRMS) were selected for this modeling study. These sites represent three major swamp forest habitat types with different hydrological and salinity regimes: healthy, relict, and degraded. The climate change scenarios (dry, normal, and wet years) were determined by the Palmer Drought Severity Index (PDSI) for Southeast Louisiana during 2000-2023. The wet year with high water level from high flow during the spring season was simulated to represent the Mississippi River (MR) diversion condition. The WCAT-DNDC was calibrated and validated using field observed above- and below-ground net primary productivity in Lake Maurepas swamp forests with good agreements. Simulation results indicate that the responses of the C fluxes (productivity, sequestration, decomposition, export) in Lake Maurepas forested wetlands vary substantially to changes in hydrologic conditions especially during drought-induced saltwater intrusion conditions that could result in increased C loss and such loss could be reduced by MR diversion. The responses are complex and variable due to the non-linear relationships between C cycling processes and environmental drivers in the swamp forests impacted by both freshwater and saltwater under climate change and management of land and freshwater, such as the MR diversion/reintroduction into Lake Maurepas swamp forests. Data and information from this study may help ecosystem-based management of Lake Maurepas forested wetlands under the impacts of climate change and MR diversion.