

## **Determining the nitrate contribution of the Red River to the Atchafalaya River in the northern Gulf of Mexico under changing climate**

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**Abstract** The Mississippi-Atchafalaya River system exports each year over  $1.2 \times 10^6$  tonnes of nitrate nitrogen into the northern Gulf of Mexico. The excess nutrient load caused by intensive agriculture in the Upper Mississippi River Basin has been attributed to being a major cause of the hypoxic zone in the Gulf. In addition to the land use effect, future climate change may further modify regional hydrology and nutrient fluxes from land to coastal regions. This study was conducted to quantify nitrate mass loading from the Red River, the last major tributary to the Mississippi-Atchafalaya River system, and to assess the effect of future precipitation change in the Red River Basin on its nitrate input into the Atchafalaya River, which is formed by the confluence of the Red River and the Mississippi River via a diversion control structure in Louisiana. Daily river discharge at the diversion structure and the Atchafalaya was gathered for 2007–2009 to estimate the flow of the Red River. Biweekly–monthly nitrate concentrations in the Red River and the Atchafalaya River were measured for the same period to determine the Red River’s contribution to the total nitrate mass load in the Atchafalaya River. A precipitation change projection based on the HadCM3 model output for IPCC B1 scenario for the 21st century was taken to discern potential changes in discharge and riverine nitrate load from the Red River Basin. We found that despite making up for nearly one third of the total flow in the Atchafalaya River, the Red River exported a marginal amount of nitrate, namely only about 3% of the total nitrate mass load in the Atchafalaya. With a 6% projected decline in precipitation, nitrate input from the Red River would likely decrease in the future, especially during the drier summer months.

**Key words** riverine nitrogen; nitrate; climate change; Red River; Mississippi-Atchafalaya River; Gulf of Mexico