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How climate controls the flux of nitrogen by the Mississippi River and the development of hypoxia in the Gulf of Mexico

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ABSTRACT: The intensification of agriculture in the central U.S. is commonly cited as the primary cause of the increase in nitrogen (N) flux by the Mississippi River since the 1950s and the development of seasonal bottom-water hypoxia in the northern Gulf of Mexico. Over the past two decades, however, agricultural land use and land cover have remained relatively constant. With high N inputs each year, climate variability could now be controlling the variability in N leaching from land and transport through the river system. In this study, we examine how precipitation in specific regions of the central U.S. affects the nitrate-N flux by the Mississippi River and the extent of hypoxia in the Gulf of Mexico. Precipitation amounts across the Corn Belt in the previous November- December and in March-April-May are together a strong predictor (r^2 = 0.68) of the spring nitrate flux by the Mississippi. A hypoxia model shows that the year-to-year variability in central U.S. climate must be considered in developing nutrient management policy. During a wet year, an N reduction of 50-60%close to twice the recommended target is required to meet the goal of reducing the hypoxia zone to less than 5,000 km² in size. A higher reduction goal is particularly important considering the expected changes in climate in the coming decades.

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