Nitrogen Delivery Efficiency in the Mississippi River Basin

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Project Goals: This research aims to calculate and analyze the spatial distribution of the nitrogen delivery efficiency for crop reporting districts within the Mississippi River Basin using the hydrology model THMB.

Nitrogen leaching in the Mississippi River Basin (MARB) is a primary driver of nitrogen (N) inputs to the Gulf of Mexico. However, while it is assumed that not all nitrogen leached from areas in the MARB makes it to the Gulf of Mexico due to in-transit losses like denitrification, the magnitude and spatial distribution of these losses are not well understood. In this work, we use the Terrestrial Hydrology Model with Biogeochemistry (THMB) to quantify how much nitrogen leached from individual crop reporting districts (CRDs) across the MARB makes it to the Gulf of Mexico. We defined this nitrogen delivery efficiency (DE) as the ratio of how much nitrogen was delivered to the Gulf of Mexico to how much was leached from a particular CRD. To track the nitrate leaching from individual CRDs, both the leaching and delivered nitrogen were normalized using values from a baseline scenario. Results from this study indicate that the average delivery efficiency ranged from 10% to 47% across the MARB (Fig. 1). Areas closer to streams and rivers had higher DE than those further away. Model sensitivity analysis indicated that DE values do not depend on the level of nitrate leaching from individual CRDs. The magnitude and spatial distribution of this DE value is important because previous work has shown that meeting the renewable fuels mandates using traditional economic drivers without considering nitrate leaching values will not necessarily result in water quality improvements. In combination with nitrate leaching output from an ecosystem model, these DE values provide a way for economic models to use estimates of the nitrogen delivered to the Gulf of Mexico in the determination of the mixture and spatial distribution of bioenergy crops needed to meet the RFS and achieve economic and ecological sustainability goals.

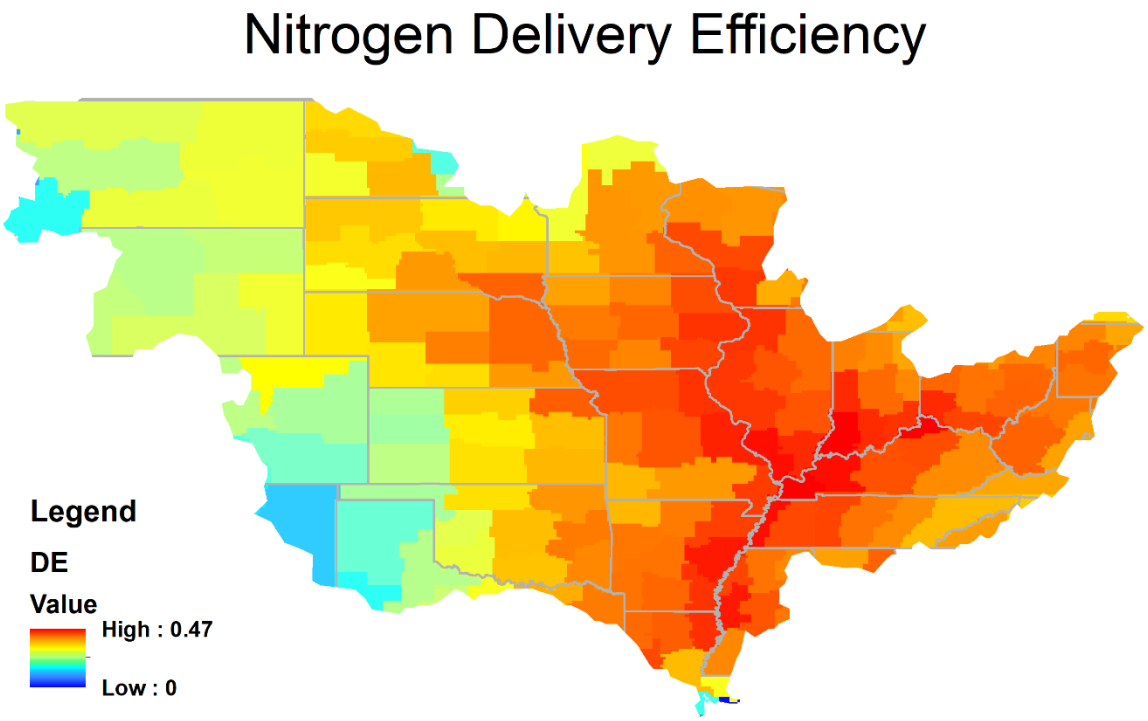

Figure 1: 30-year average delivery efficiency (DE) across the MARB

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