Center for Sustainability Science and Strategy

Global Change Forum 47

The Impacts of Extreme Weather Events in the Mississippi River Basin: Enhancing Agriculture Modeling

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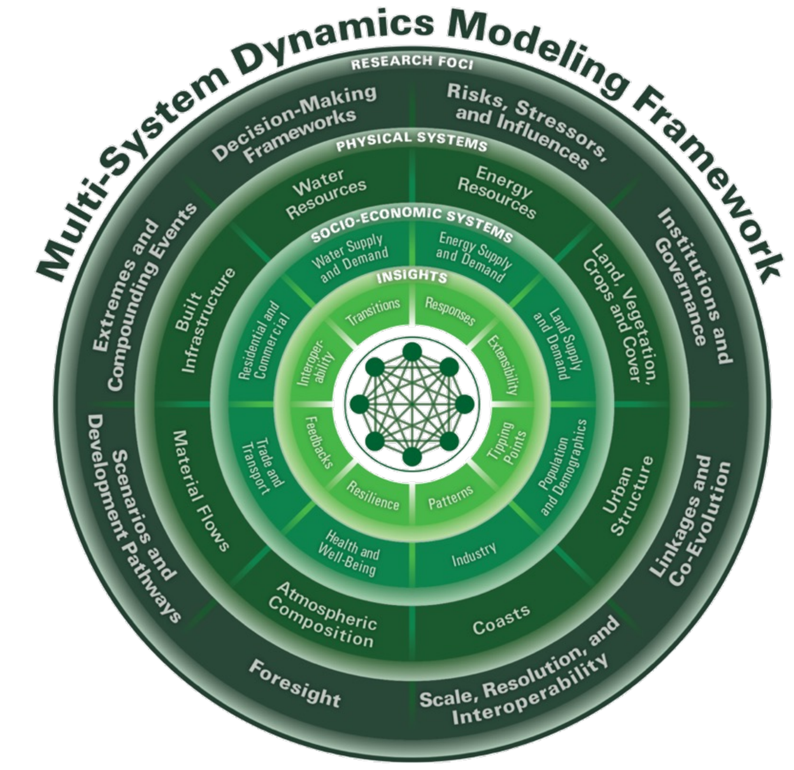


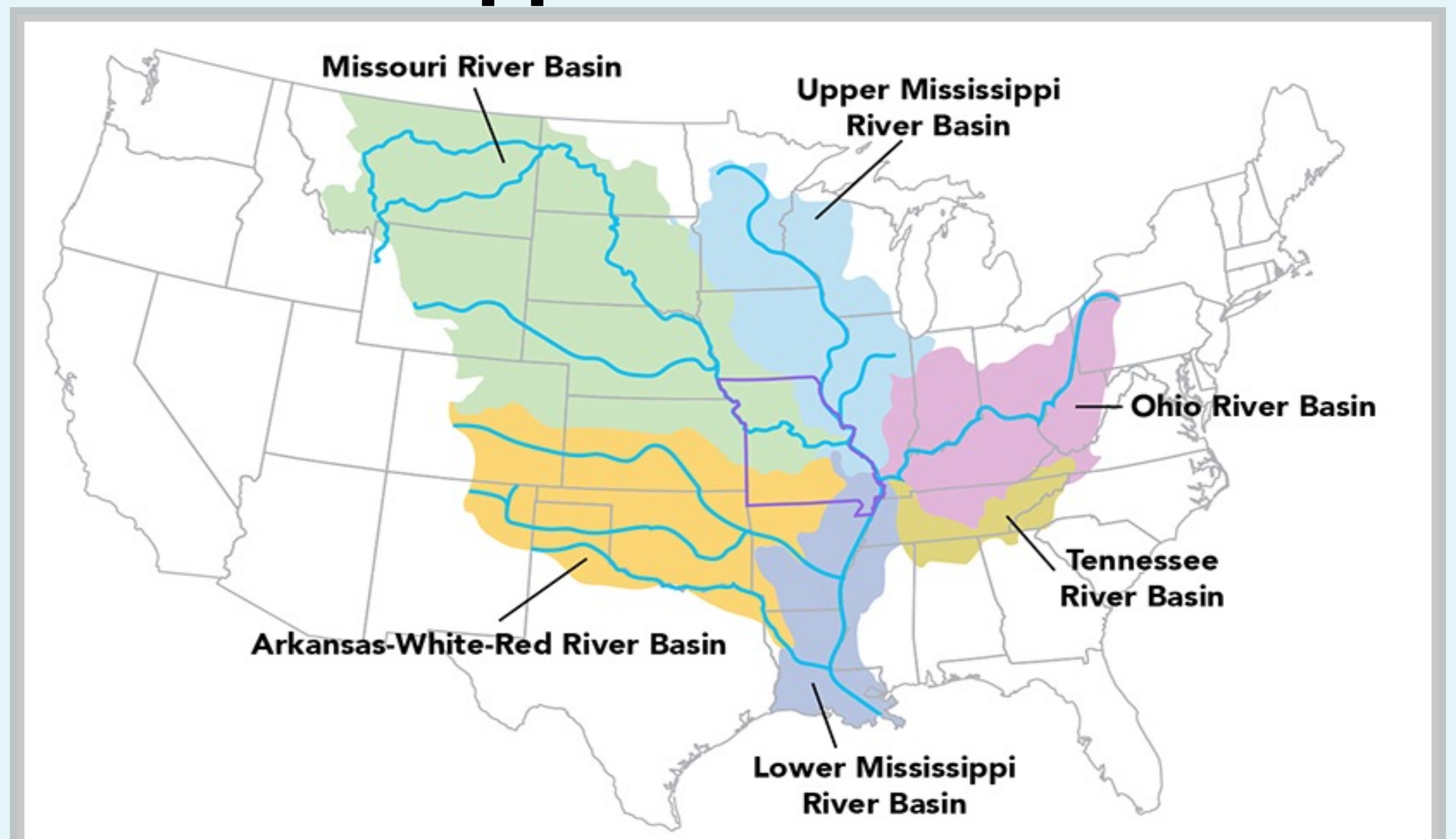
Project Aims

To understand U.S. local and countrywide impacts from extreme weather events in the Mississippi River Basin.

We are particularly interested in the economic and environmental effects from these events and will estimate them using the Multi-System Dynamics (MSD) approach of interconnected physical and socioeconomic systems.

The overall focus of this project is on agriculture, land use modeling, water modeling, transport infrastructure, and scenario discovery.

The Mississippi River Basin



The above image is from Missouri Department of Natural Resources (n.d.).

References

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Winchester, N., Ledvina, K., Strezepek, K. & Reilly, J.M. (2018). The Impact of Water Scarcity on Food, Bioenergy and Deforestation. *The Australian Journal of Agricultural and Resource Economics, 62*(3), 327-351. https://doi.org/10.1111/1467-8489.12257

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Economy Wide Model

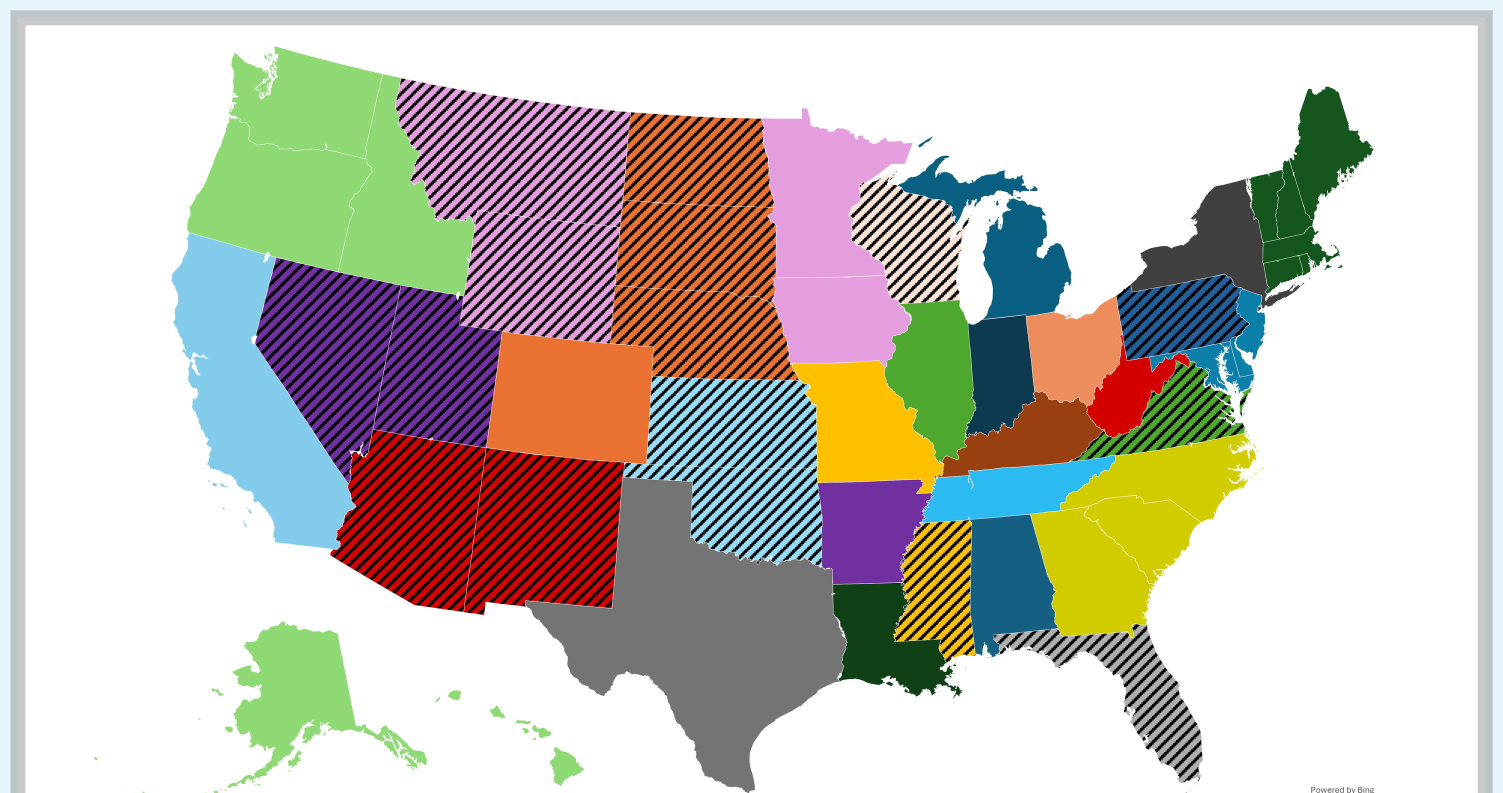
USREP

The economic model used for this project is the MIT U.S. Regional Energy Policy (USREP) Model. This is a recursive-dynamic computable general equilibrium model of the U.S. economy designed to analyze energy and environmental policies. In the past it has been used to explore energy and environmental policies including efficiency and equality, fiscal issues, leakage through trade, and air pollution co-benefits. It has also been used for energy and resources research (Yuan et al., 2019).

Some key features of the model include the representation of: (1) capital stock evolution; (2) population, productivity and labour supply; (3) energy-saving technical change; (4) natural resource inputs; and (5) advanced energy supply technologies.

In the version of the model we use, it is calibrated to the WiNDC database (Rutherford & Schreiber, 2019) and split into 30 regions, as shown below.

USREP Regional Disaggregation



Methodology

Given the reliance on the Mississippi River Basin for agricultural production, USREP will represent a disaggregated agriculture sector, split by the type of agriculture as well as irrigated and rainfed crops.

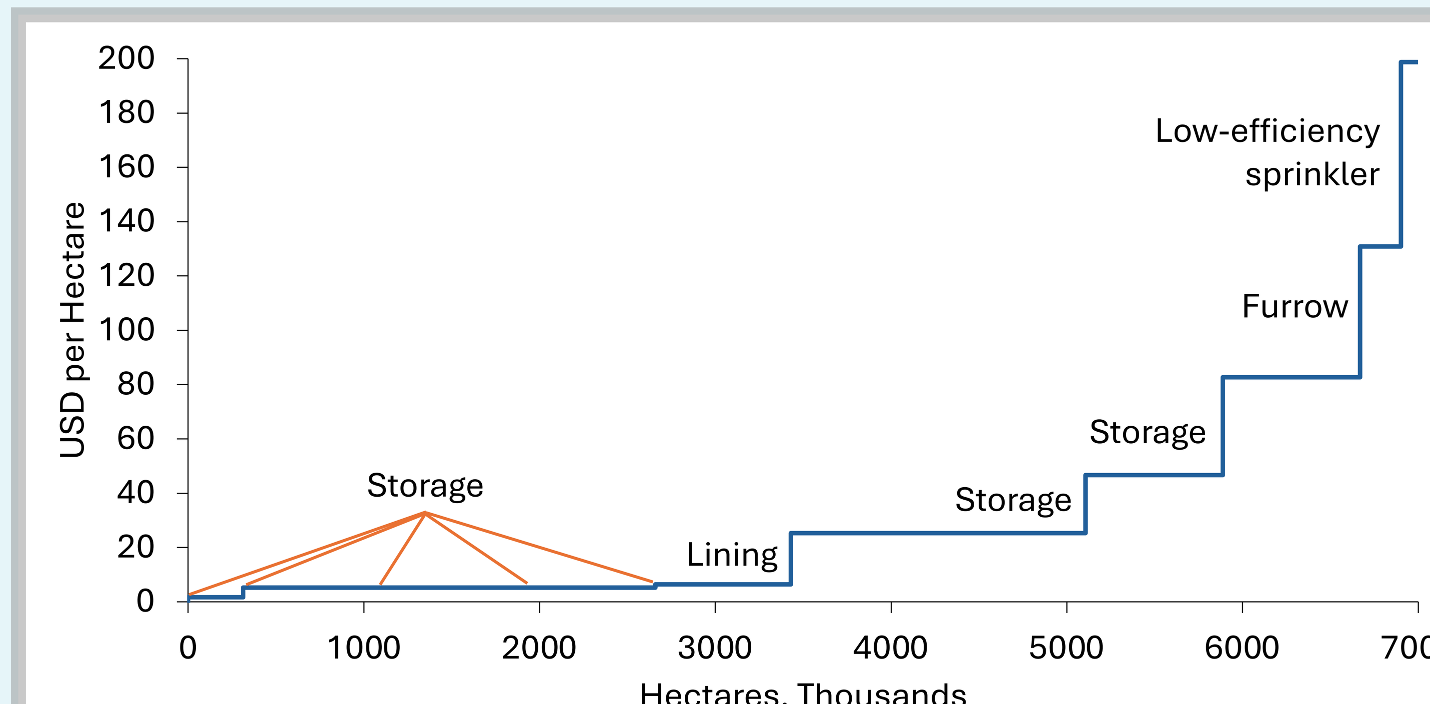
Representing Irrigated and Rainfed Crop Production

To represent irrigated and rainfed crops in USREP, we will use a similar methodology to Ledvina et al. (2018) and Winchester et al. (2018).

This includes (1) dividing land payments net of irrigation costs between irrigated and rainfed production, (2) allocating the value of aggregate crop production to irrigated and rainfed crops, and (3) allocating input costs for each crop type (Winchester et al., 2018).

To represent the costs related to upgrading the irrigation capacity of agricultural land, we will use the data and irrigable land supply curves provided by Ledvina et al. (2018) and illustrated below.

Irrigable Land Supply Curve



The above figure is from Ledvina et al. (2018).

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