Analyzing Environmental Influences on Corn Yield: A Data-Driven Study in Champaign, Illinois

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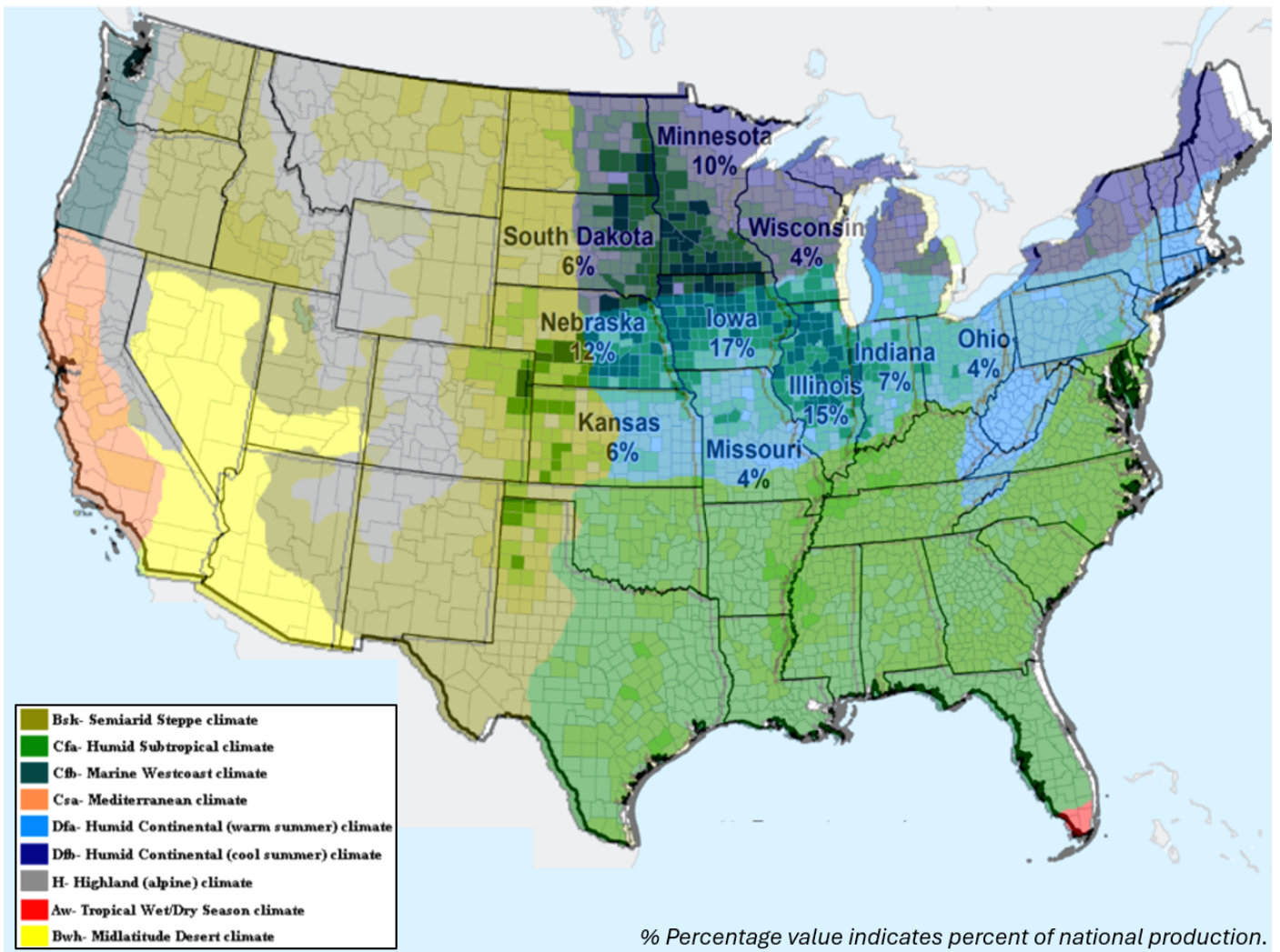✉ — Correspondence possible via [GitHub Issues](#)

Abstract

Project proposal

Crop models are computational tools that assess the effects of environmental variation and cultivation strategies on crop yield (Chapagain et al., 2022; Huang et al., 2019). By incorporating factors such as precipitation, humidity, temperature, fertilization, and soil properties, crop models establish relationships between input parameters and agricultural yield outcomes. From a structural perspective, crop models can be either empirical or mechanistic. Empirical models create statistical relationships based on existing data, while mechanistic models aim to explain relationships by exploring physiological mechanisms and causal connections (Reynolds and Acock, 1985). From a parameter standpoint, crop models generally include weather, soil, and crop-specific parameters to estimate crop biomass. Weather parameters cover solar radiation, precipitation, temperature, and more, while soil parameters focus on humus content, organic matter content, and other soil characteristics. Crop-specific parameters include maximum crop yield, specific nitrogen uptake rate, and related factors. In this project, we aim to replicate Hartmut Bossel's 'Field Crop Cultivation' simulation model as a white-box reference and develop a black-box model using SVD, PCA, and/or Fourier series. The original model is a parsimonious one, primarily focusing on the dynamic effects of precipitation on crop yield across a spectrum of crops in Germany. Initially created in BASIC (Hartmut, 1985) and later in Vensim (Hartmut, 2007) for educational purposes, the model simulates the impact of water and nutrient (nitrogen) availability on plant growth dynamics. Built from first principles, it captures complex interactions between water and nutrient dynamics and can be adapted to different scenarios by applying specific plant and soil parameters.

Data description

The dataset we plan to use is the meteorological records of Champaign, Illinois. We want to predict corn yield by analyzing precipitation and temperature. Data will be obtained from wunderground.com (Savoy, IL Weather History | Weather Underground). And daily temperature and the annual precipitation amount would be needed. The format would be primarily in CSV. The four columns will be temperature (including max, avg and min) and precipitation every day, while the rows will be the date for a whole year.

United States: Corn Production

Map legend:
- Bsk- Semiarid Steppe climate
- Cfa- Humid Subtropical climate
- Cfb- Marine Westcoast climate
- Csa- Mediterranean climate
- Dfa- Humid Continental (warm summer) climate
- Dfb- Humid Continental (cool summer) climate
- H- Highland (alpine) climate
- Aw- Tropical Wet/Dry Season climate
- Bwh- Midlatitude Desert climate

State production percentages:
- Minnesota 10%
- South Dakota 6%
- Wisconsin 4%
- Nebraska 12%
- Iowa 17%
- Indiana 7%
- Ohio 4%
- Illinois 15%
- Kansas 6%
- Missouri 4%

% Percentage value indicates percent of national production.

Corn

References

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