Quantitative Assessment of Drought Impacts Using XGBoost based on the Drought Impact Reporter

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Motivation

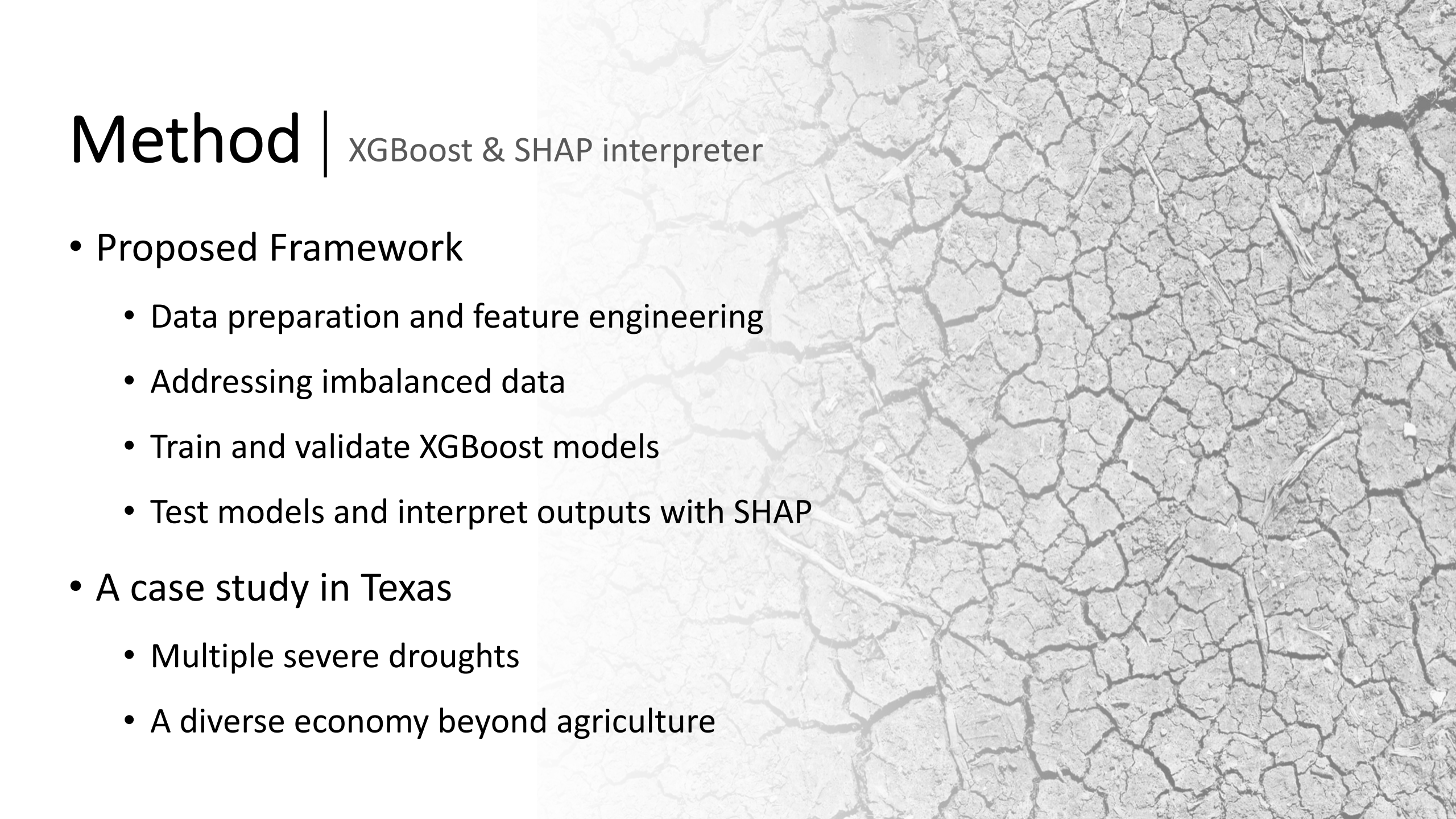
- Ongoing climate change is inclined to increase the frequency and intensity of drought.
- Different to other natural disasters, drought impacts often lack structural and visible existence.
- There is a demand of transforming the information of drought intensity and frequency into drought impacts.
- It is possible to learn drought impacts through machine learning models with using drought indices as independent variables.

Research Questions

- Can we predict complex and various drought impacts through typical drought indices?
- Do the models help us understand the relationships among drought impacts and indices?
- Are the results from the models interpretable and understandable for the drought experts?

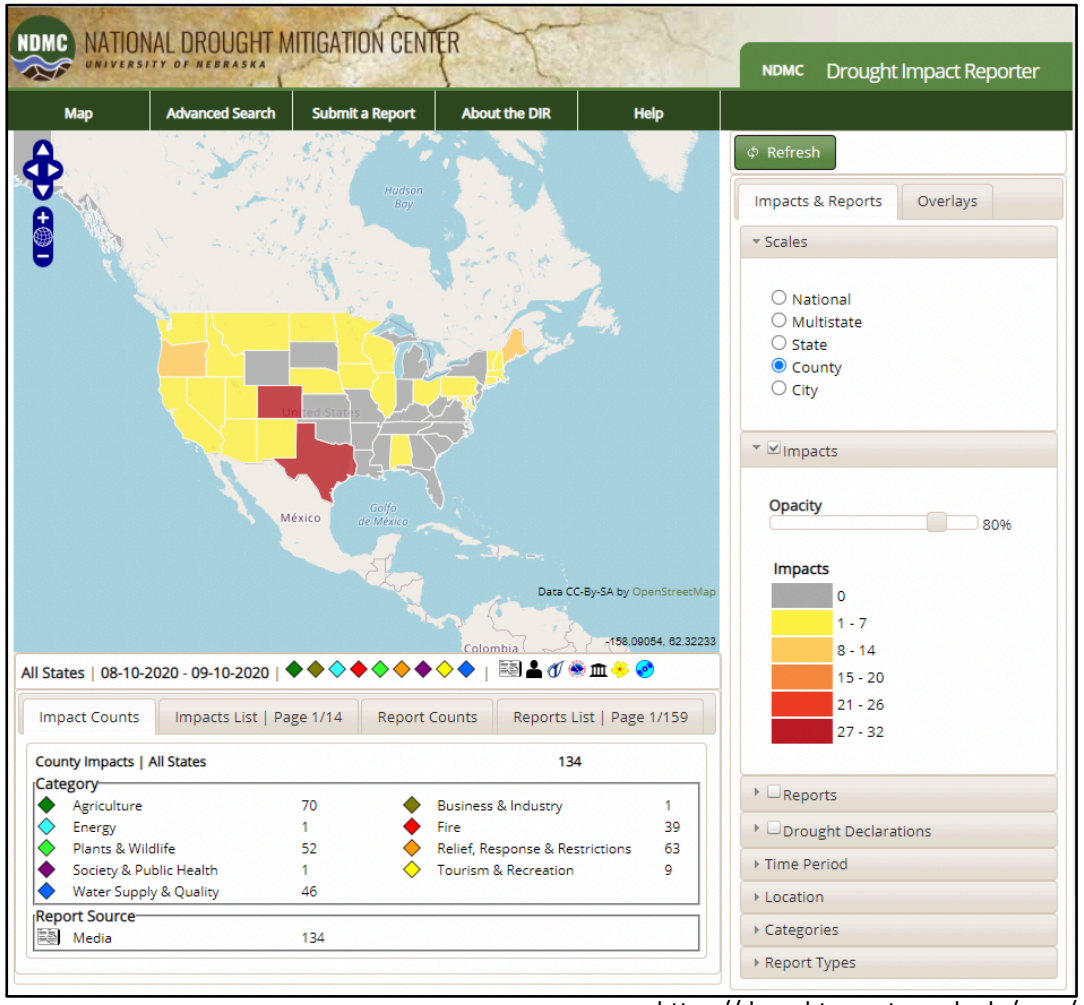
Method | XGBoost & SHAP interpreter

- Proposed Framework
  - Data preparation and feature engineering
  - Addressing imbalanced data
  - Train and validate XGBoost models
  - Test models and interpret outputs with SHAP
- A case study in Texas
  - Multiple severe droughts
  - A diverse economy beyond agriculture



Data | Dependent and Independent Variables

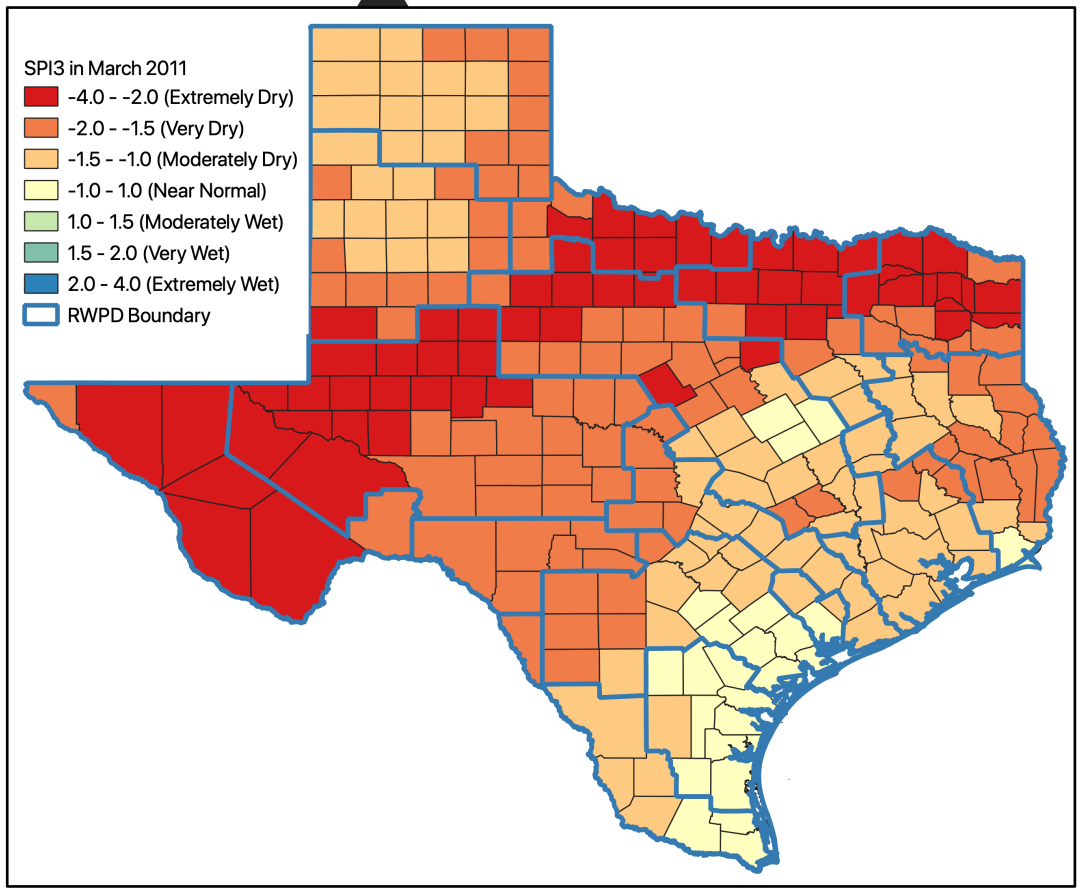
Dependent Variable – Drought Impact Reporter



https://droughtreporter.unl.edu/map/

Independent Variables – SPI & geographic region & season and month

Jan	Feb	Mar	Apr	May	Jun	… …



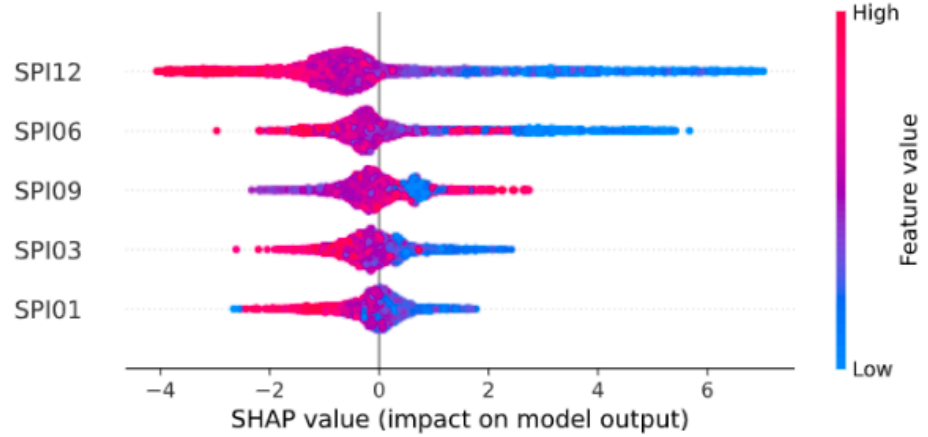
Results | Summary of model performance & the best-performing model

Summary of model performance

Category of Drought Impacts	Ratio of Impacts	Evaluation		
		Accuracy	Recall	F2 Score
Agriculture	0.69	0.86	0.93	0.92
Plants & Wildlife	0.29	0.79	0.79	0.74
Society & Public Health	0.50	0.90	0.96	0.94
Water Supply & Quality	0.36	0.78	0.51	0.55
Fire	0.11	0.88	0.80	0.68
Relief, Response & Restrictions	0.36	0.85	0.72	0.74

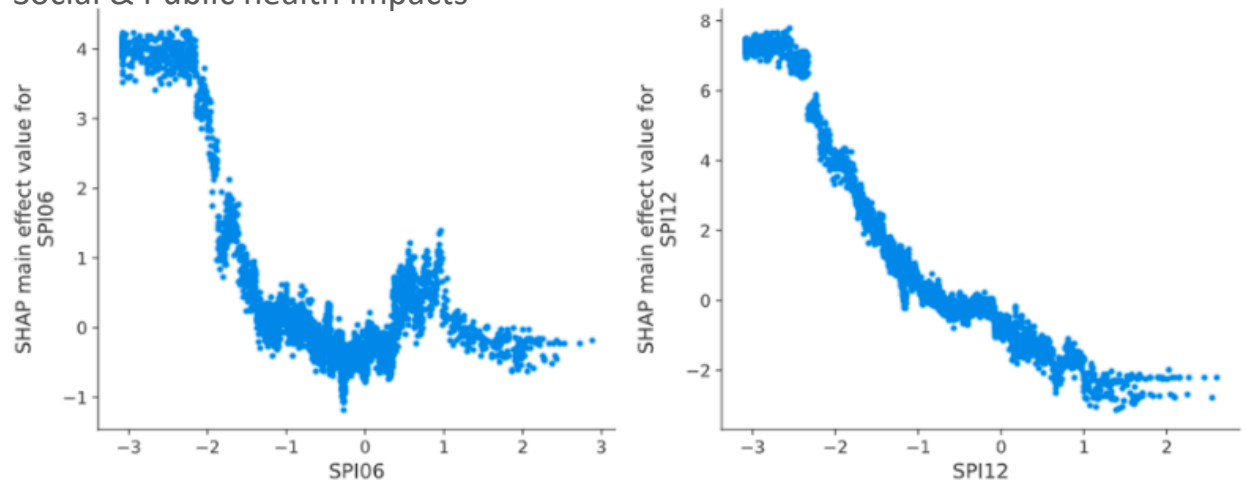
SHAP summary plot for SPI

Social & Public health Impacts



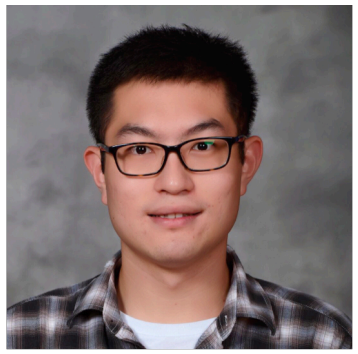
SHAP main effect plot for SPI6 and SPI12

Social & Public health Impacts



Conclusions and Future Work

- The proposed framework based on XGBoost had a good performance to predict multi-category drought impacts on the case study in Texas.
- The model outputs of the society and public health impact are explainable for drought experts.
- This work provides a possibility to explore the relationships among various drought impacts and indices.



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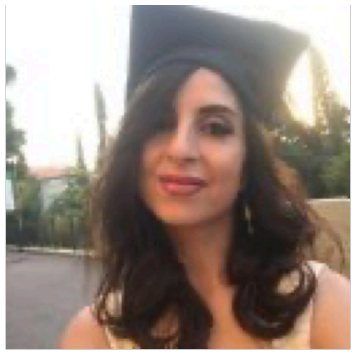
In Climate Assessment and Impacts



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Thank you!