

A PROTOTYPE STREAMFLOW DROUGHT EARLY WARNING SYSTEM FOR THE COLORADO RIVER BASIN



Hydrological drought impacts are widespread and recurring. Scientists on the Data-Driven Drought Prediction project are using machine learning models to develop early warning drought prediction capacity at regional and national scales. Pilot work is focused on streamflow drought onset, duration and severity prediction for gaged and ungaged areas of the Colorado River Basin region.

This project is exploring innovative visualization tools to improve understanding of how streamflow drought is defined and how it manifests at a given location. In addition to a web-based dashboard that enables visualizing the model forecasts, the project is also contributing to the creation of publicly accessible websites that communicate “what is streamflow drought” and impactful historical drought events across the U.S.

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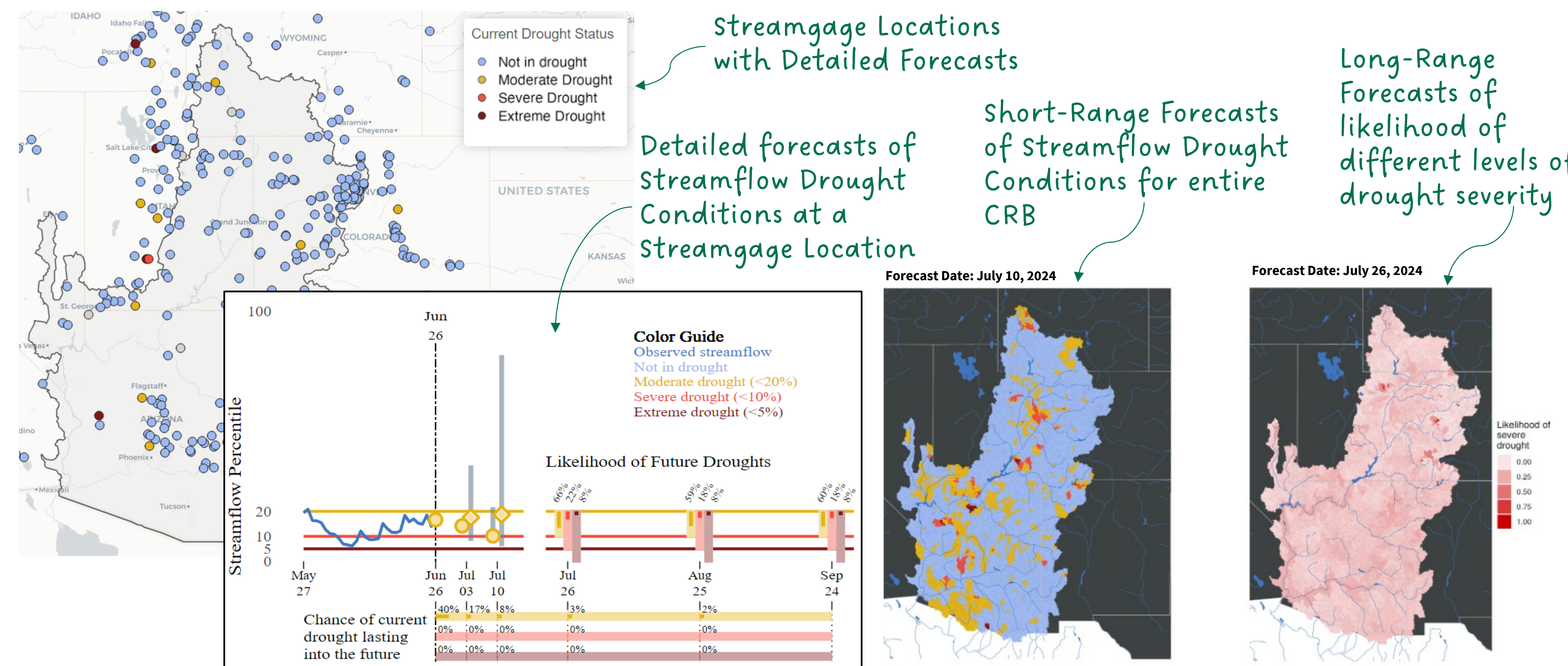
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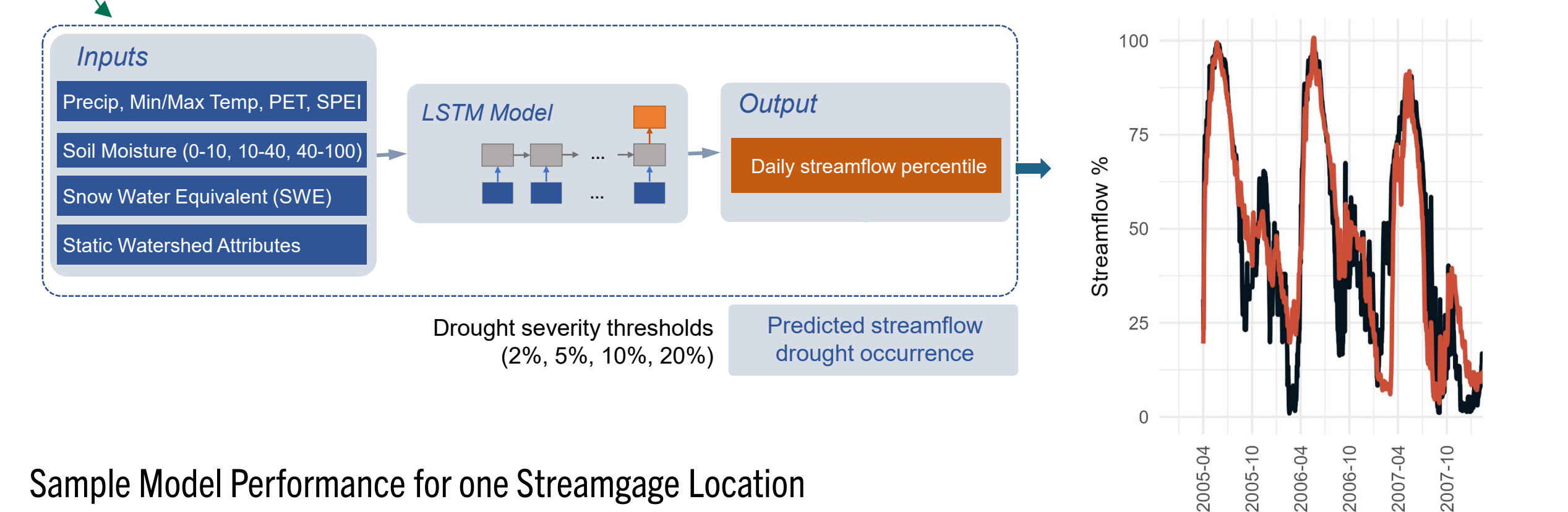
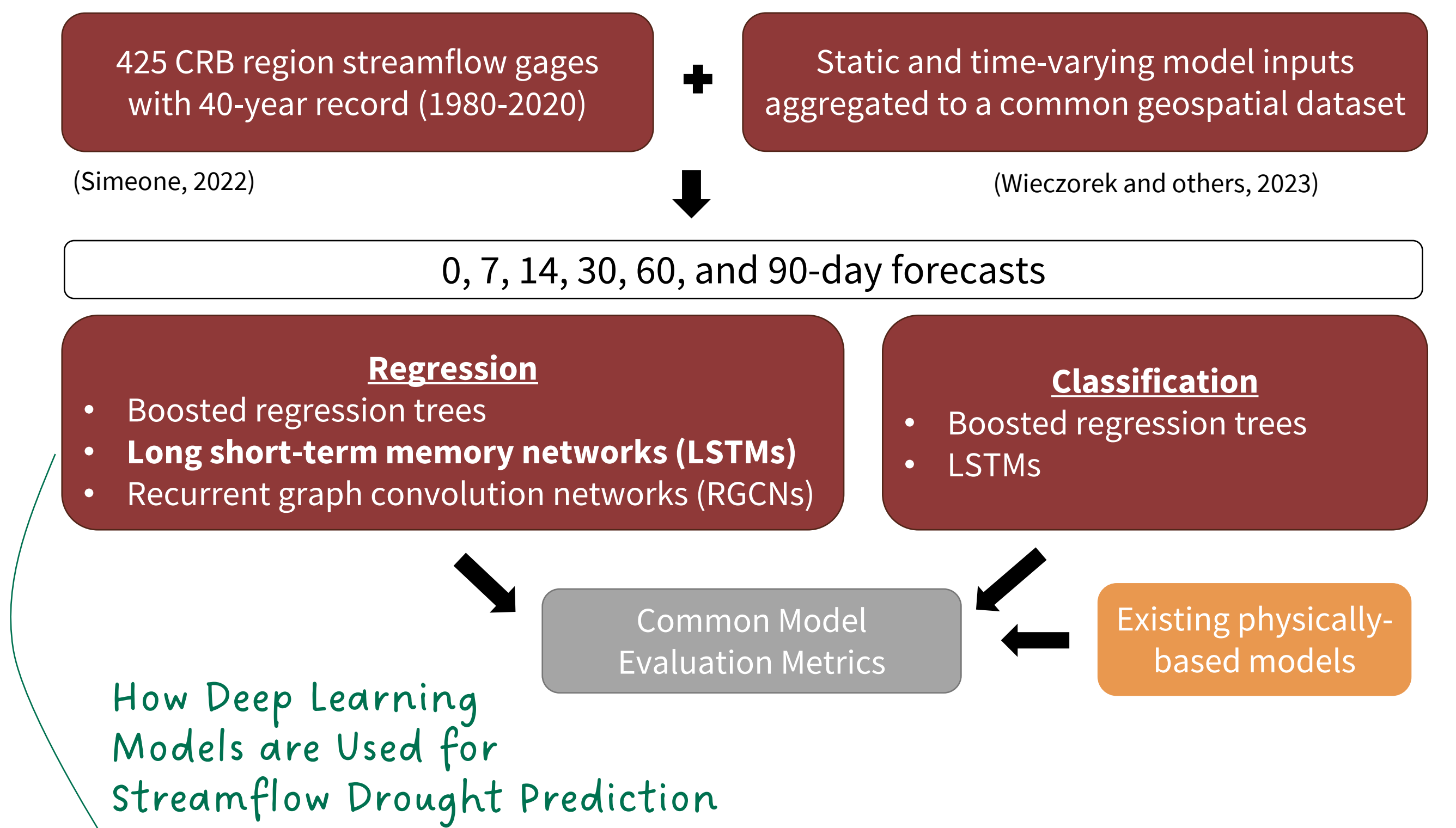
Project Objectives

- Define drought in generalized, relevant ways for multiple stakeholder groups.
- Apply data-driven models to determine feasibility of forecasting drought onset, duration and severity days to months in advance.
- Improve methods for drought prediction in areas with heavily regulated streamflow.
- Prototype operational drought assessment and forecast tools that communicate predictions and uncertainty.
- Develop communication and data visualization tools to increase understanding of hydrologic drought.
- Collaborate with partner federal agencies to complement existing forecast tools.

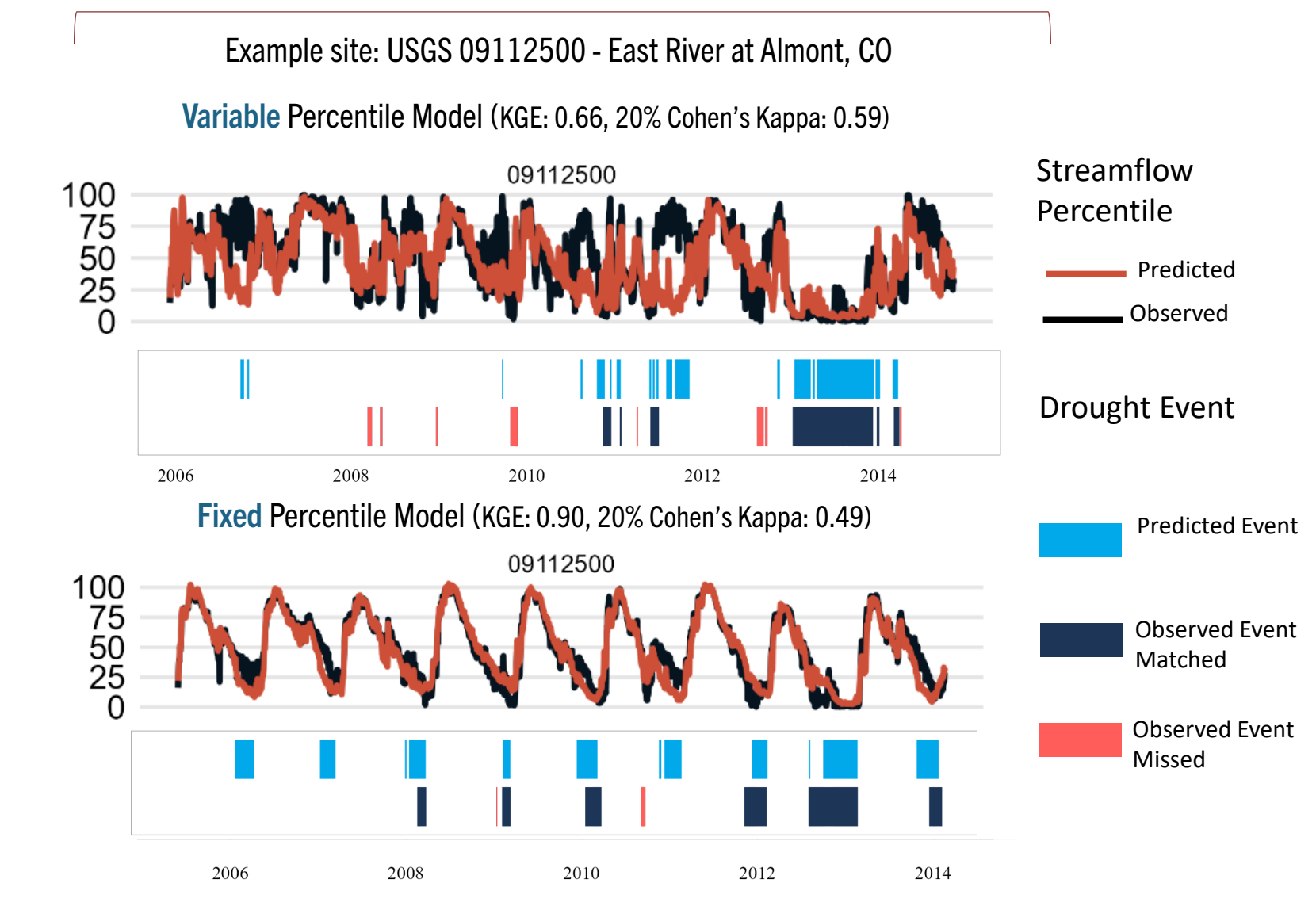
Pilot Colorado River Basin Area Streamflow Drought Early Warning System



Behind the Scenes: Modeling Streamflow Percentiles using Machine Learning



Sample Model Performance for one Streamgauge Location



The LSTM model is a type of recurrent neural network that is designed to learn from sequential data (e.g., natural language, time series). The python open-source package *NeuralHydrology* (Kratzert and others, 2022) was used for all model training.

Use Cases:

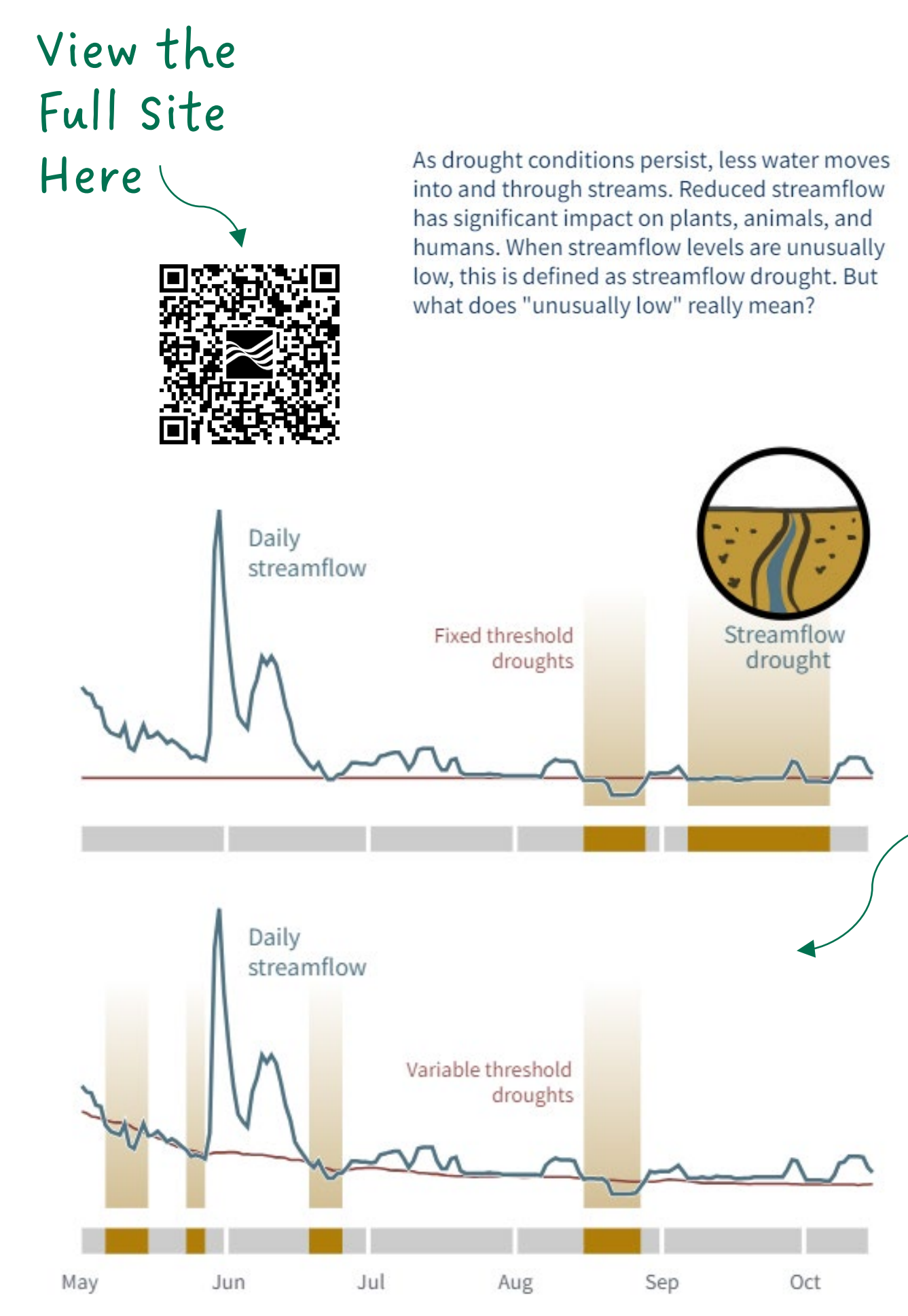
- Interested in Using These Forecast Products or Providing User Feedback? Please reach out!
- Retrospective predictions:** Linking to ecological and socioeconomic datasets to examine the effects of drought on different sectors
- Operational forecasts:** Displayed on internal USGS forecasting web map for testing and user feedback

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Data Visualizations Illustrating How Streamflow Drought Is Identified & Quantified

What is streamflow drought?

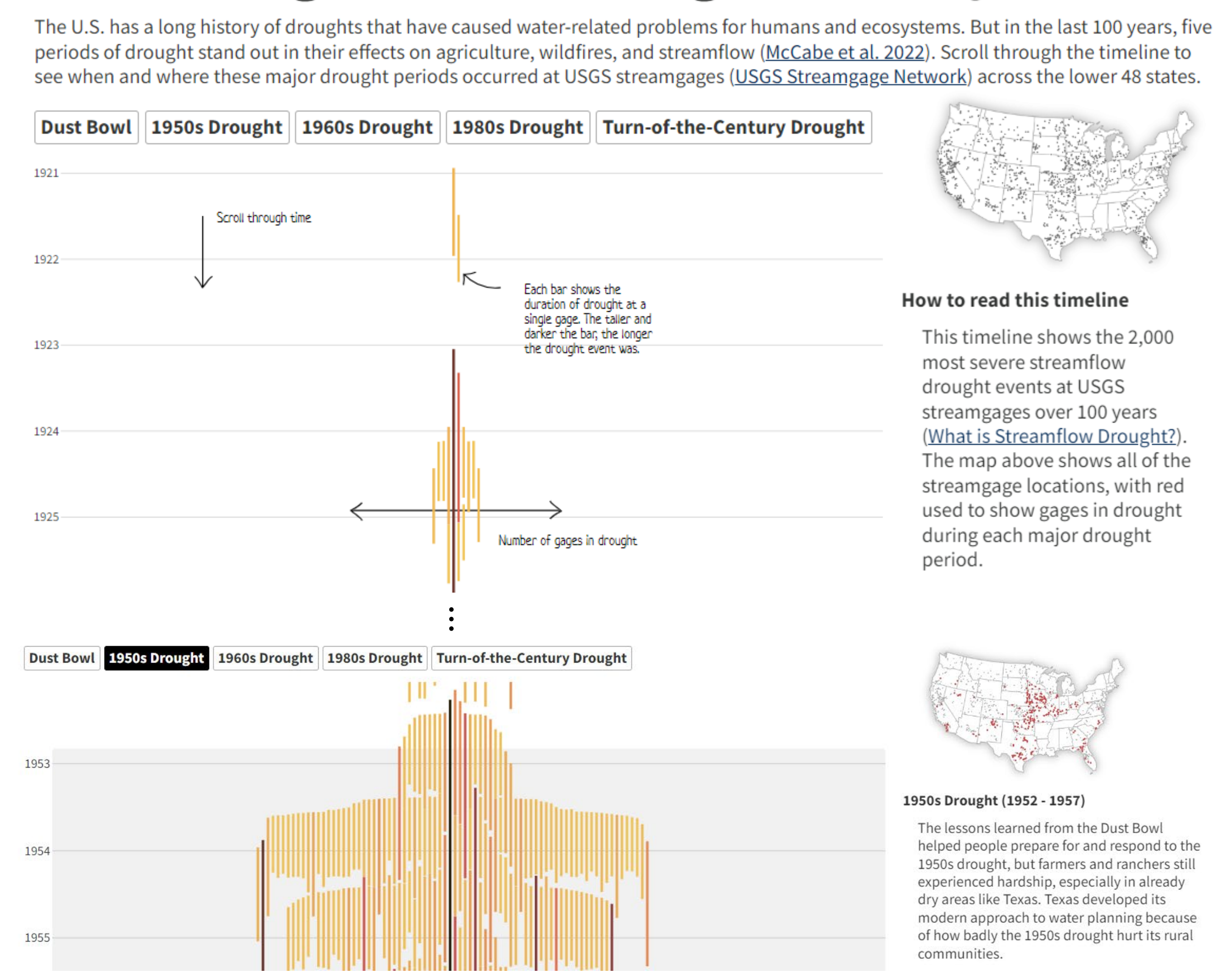


Depending on your water use type, management constraints, and location, different ways of defining drought may be more useful than others.

Components of a streamflow drought event

- Duration: Length of drought
- Intensity: Extent of drying
- Severity: How long and how dry

Five droughts that changed history



View the Full Site Here

Acknowledgements

This research was funded by the U.S. Geological Survey (USGS) Water Availability and Use Science Program as part of the Water Resources Mission Area Data-Driven Drought Prediction Project. Computing resources were provided by USGS Cloud Hosting Solutions.

This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information.

More Information and Available Data Releases:

Scott D. Hamshaw, Ellie White, and William Watkins, 20230508, Data-Driven Drought Prediction Project Model Outputs: Daily Streamflow and Streamflow Percentile Predictions for the Colorado River Basin Region, <https://doi.org/10.5066/P97NIH7Y>

Hammond, J.C., Pulver, B.A., and Hamshaw, S.D., 2023, Preliminary streamflow percentile predictions for ungaged areas of the Colorado River Basin, 1981-2020, <https://doi.org/10.5066/P9911VBJ>

Wiczorek, M.E., Hafen, K.C., and Staub, L.E., 2023, Data-Driven Drought Prediction Project Model Inputs for Upper and Lower Colorado Portions of the National Hydrologic Geo-Spatial Fabric version 1.1 and Select U.S. Geological Survey Streamgauge Basins, <https://doi.org/10.5066/P98168LO>.