

# From **Workflows** to **Streamflows**: How We Build Shared Understanding to Predict Streamflow Droughts Using Deep Learning

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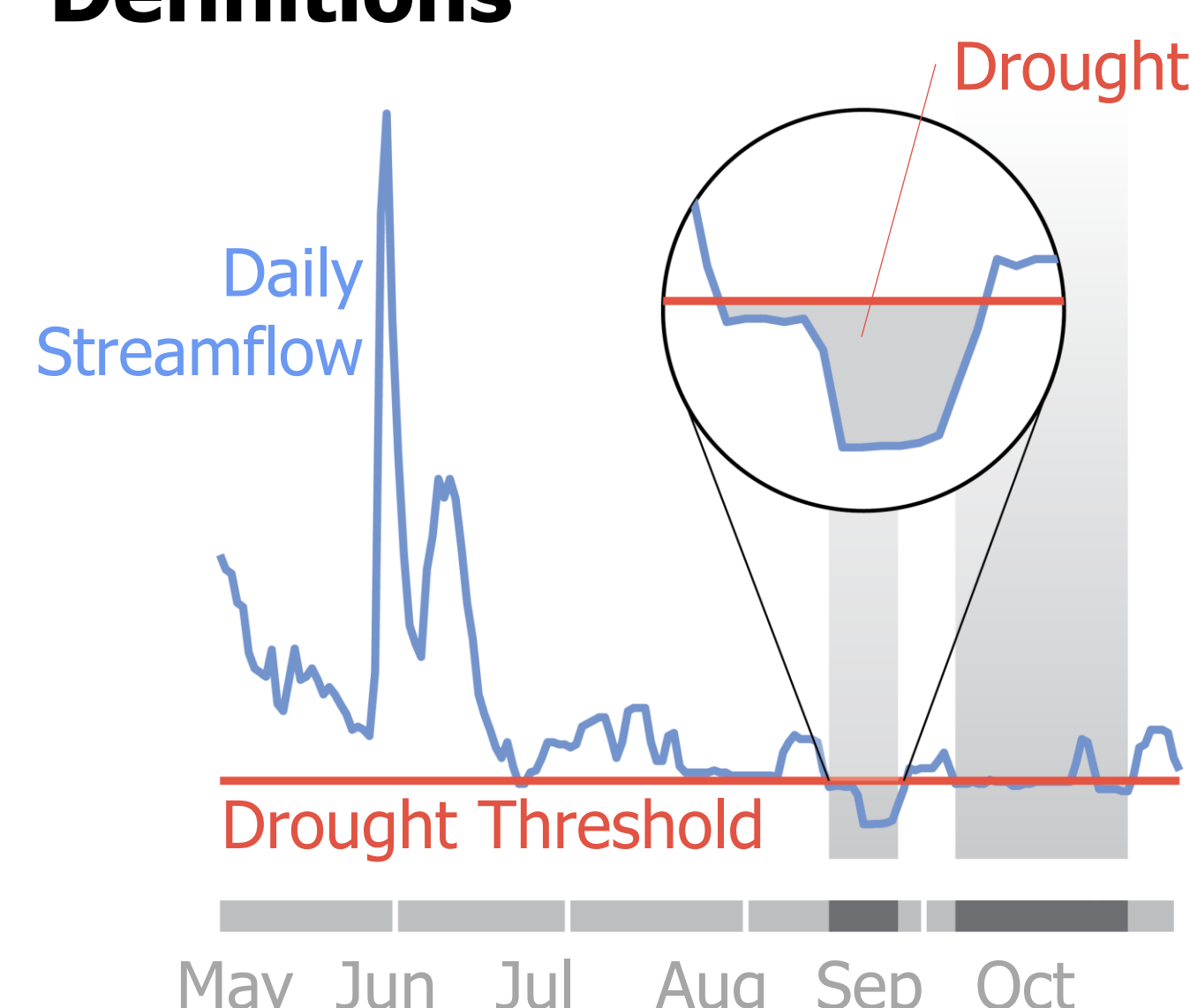


## Goal

to build a  
**Drought Early  
Warning System**  
in the Colorado  
River Basin<sup>1</sup>

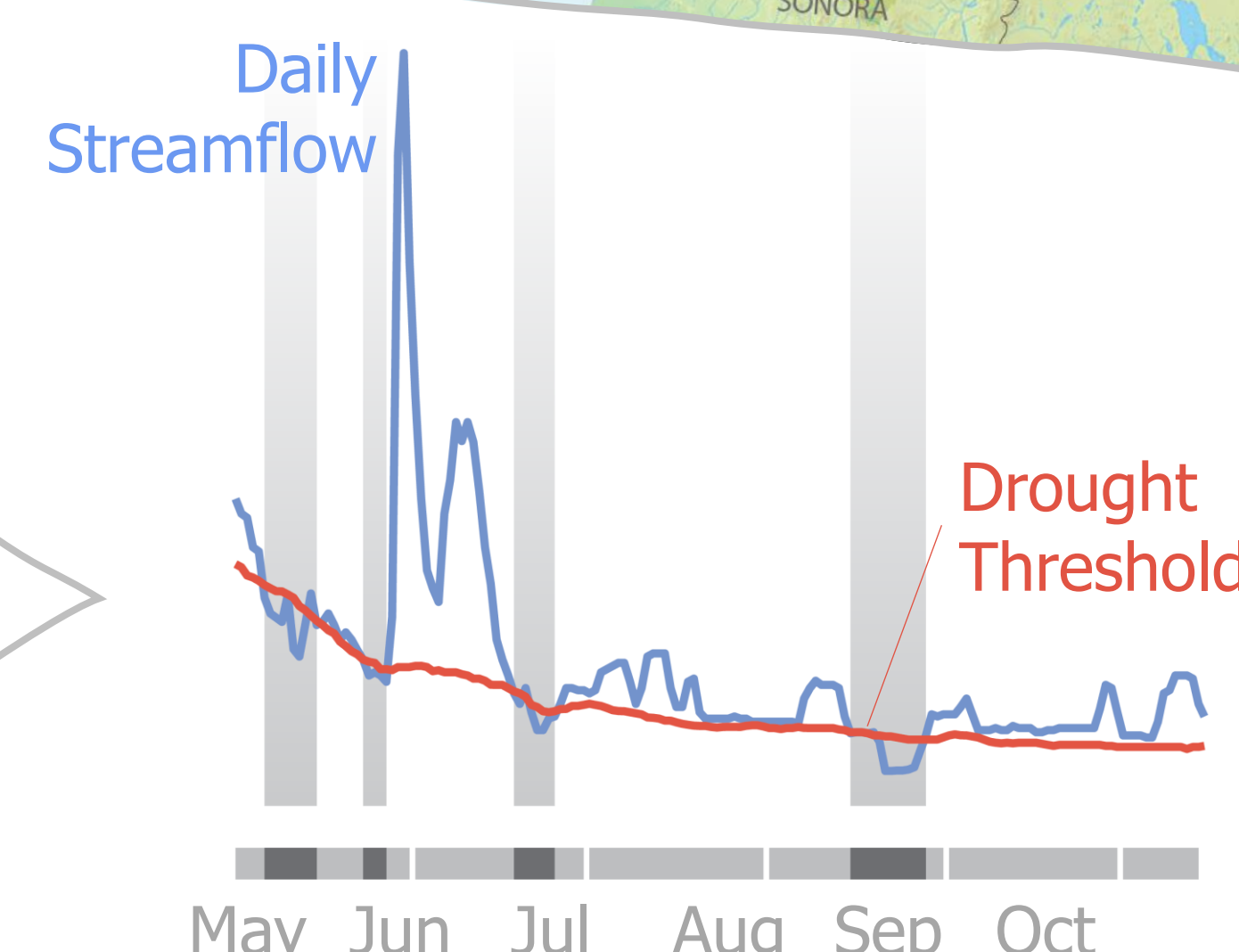
**hydrological drought**  
(*n.*) reduced streamflow  
due to a meteorological  
drought.<sup>2</sup>

## Definitions



**Fixed** thresholds: streamflow is  
"unusually low" or "in drought"  
whenever it drops below a static  
threshold. Here, that threshold is  
defined as 10% of daily streamflow  
from all days and all years.<sup>2</sup>

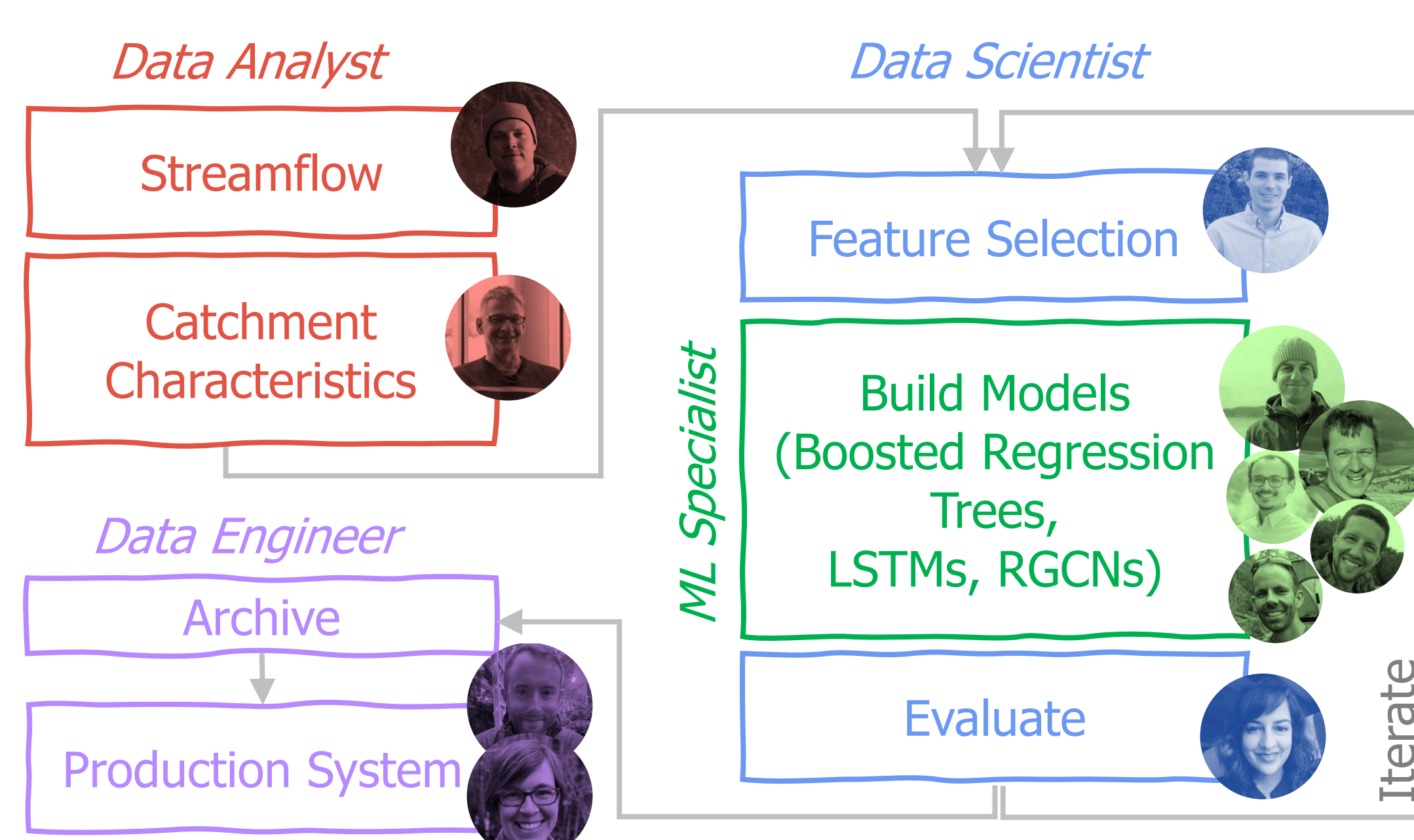
**Variable** thresholds: drought occurs if  
streamflow falls below the lowest 10%  
of observations ever recorded for that  
day. The result is a threshold that varies  
throughout the year.<sup>2</sup>



## What We Do

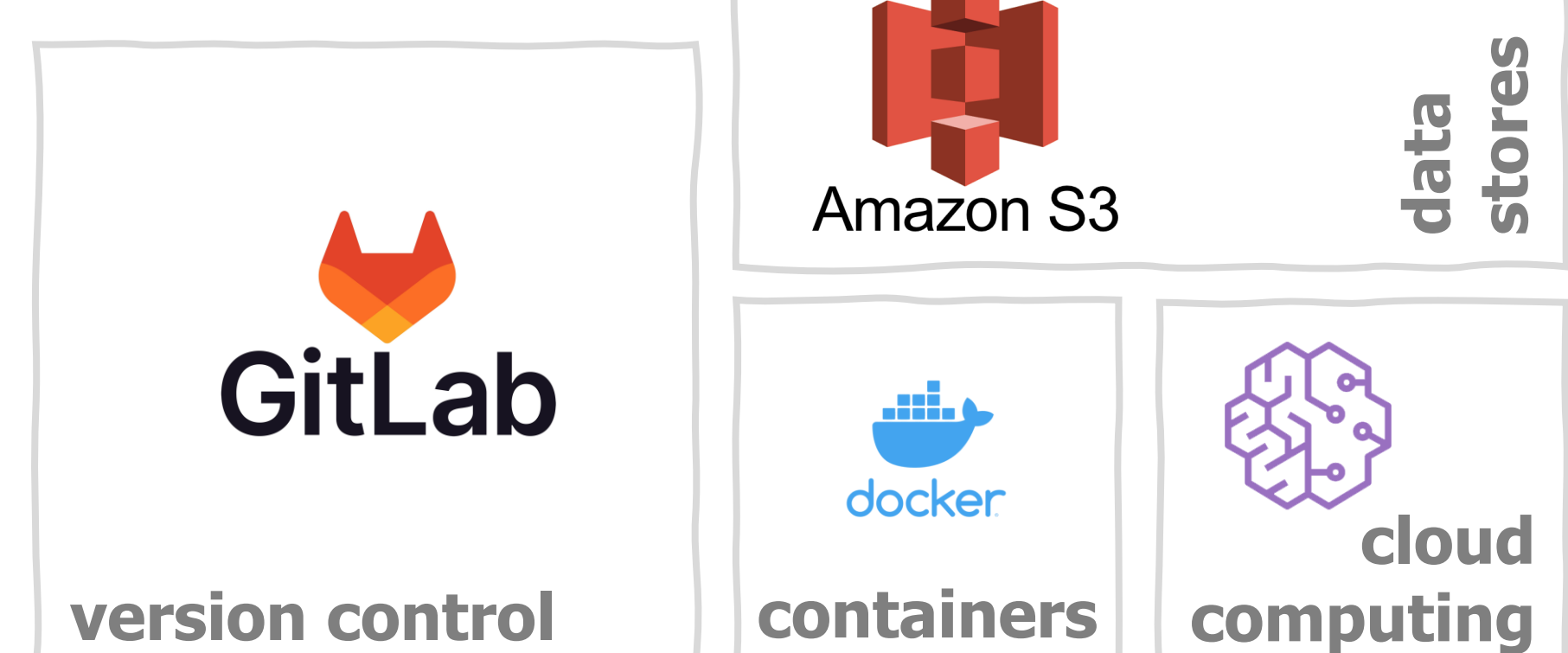
### Planning

System managers are  
often concerned with  
the **frequency**,  
**duration**, or **severity**  
of extreme events. The  
USGS *Data-Driven  
Drought Prediction  
project* is piloting the  
use of event metrics to  
evaluate model  
performance.



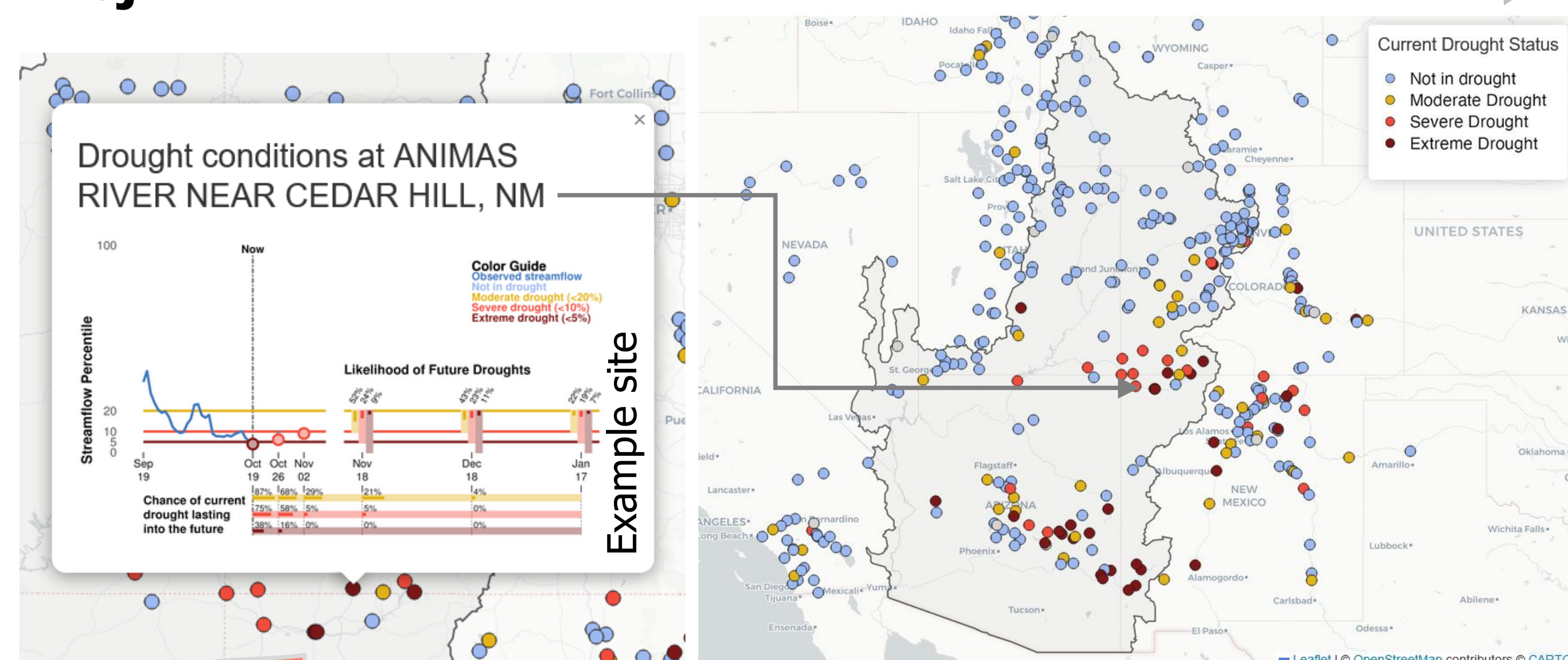
The project's  
challenges involve  
communicating what  
**event metrics**  
represent and  
convincing decision-  
makers that machine  
learning models can  
be **trusted** to make  
predictions for  
difficult-to-predict  
phenomena.

### Tools \*

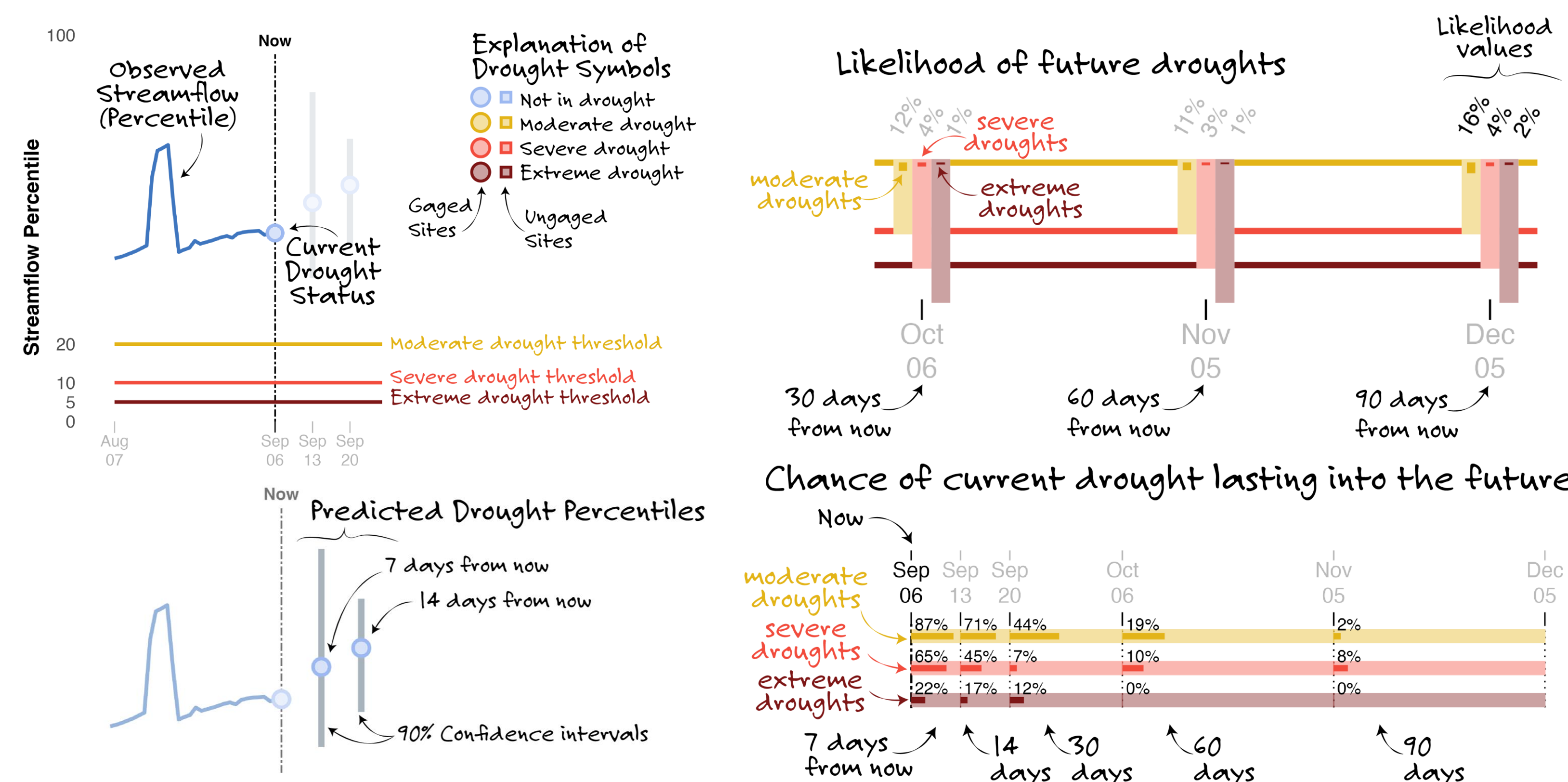


We use tools that enable **version control**,  
programmatically access of data from remote data  
**stores, containers, and cloud computing.**

## Project Deliverable \*\*



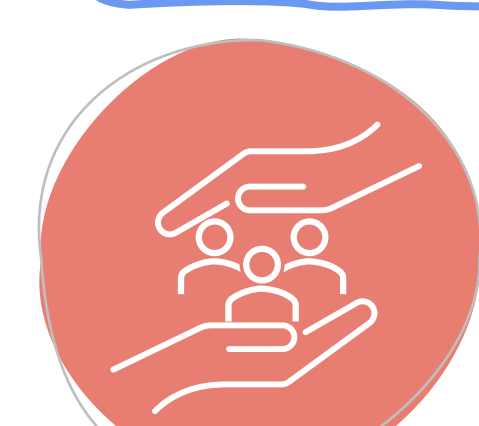
### How to read



## How We Do It

### Psychological safety

is a group-level  
phenomenon  
where team members  
believe they can take  
risks without being  
shamed by other  
team members.<sup>1</sup>



Inclusion Safety



Contributor Safety

Improves the  
likelihood of process  
innovation

### Learning in public

is simply sharing  
what you are new  
to with other  
people.

... My work is in  
progress, but I will  
share it anyway.



Learner Safety

Demystifies the  
development  
process & invites  
feedback and  
collaboration

### Peer [code] review

is subjecting work  
to the scrutiny of  
peers.

Main branch is  
"protected"  
and can only be  
changed with  
Pull Requests.

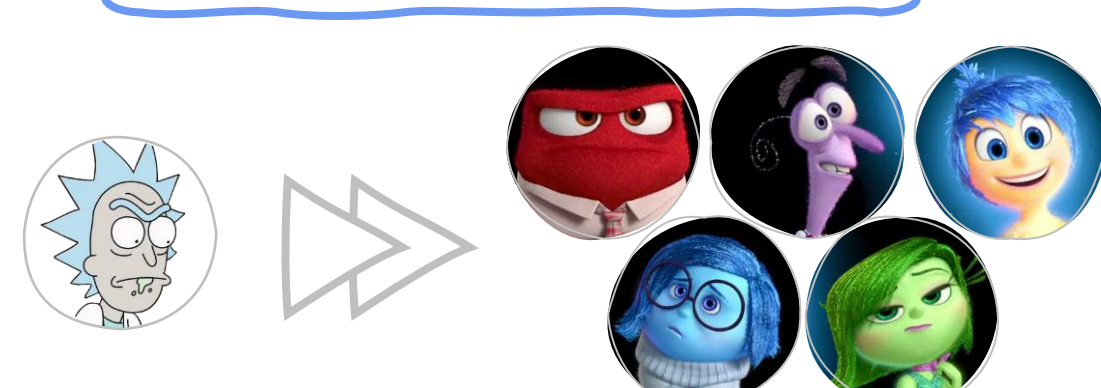


Challenger Safety

Improves work quality  
& contributes to the  
collective  
understanding of the  
work

We aim to move  
away from the  
lone-genius  
model of science  
and towards a  
**Shared-  
understanding  
model.**

Promotes a culture of  
inclusivity & collective  
ownership of outcomes



All knowledge  
is **embodied**,  
and no  
knowledge is  
known unless  
it is known by  
**many**.<sup>2</sup>

1. USGS Drought Prediction: [www.usgs.gov/mission-areas/water-resources/science/drought-prediction-science](https://www.usgs.gov/mission-areas/water-resources/science/drought-prediction-science)
2. "what is streamflow drought": [labs.waterdata.usgs.gov/visualizations/what-is-drought](https://labs.waterdata.usgs.gov/visualizations/what-is-drought)
3. Edmondson, Amy (1999). "Psychological Safety and Learning Behavior in Work Teams" (PDF). *Administrative Science Quarterly*, 44 (2): 350-383. doi:10.2307/2666999. JSTOR 2666999. S2CID 32633178.
4. Roos, Johan, & Von Krogh, Greg. (2016). "Organizational epistemology" (Book). *Springer*. ISBN: ISBN-0-312-12498-8

Search for "Water Resources Mission Area Data-Driven Drought Prediction project" to learn more.

\* Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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