

Jet Propulsion Laboratory
California Institute of Technology

Connecting the Drops Webinar Series, June 2025

The convergence of wildfire data and water management through hydrologic modeling and AI

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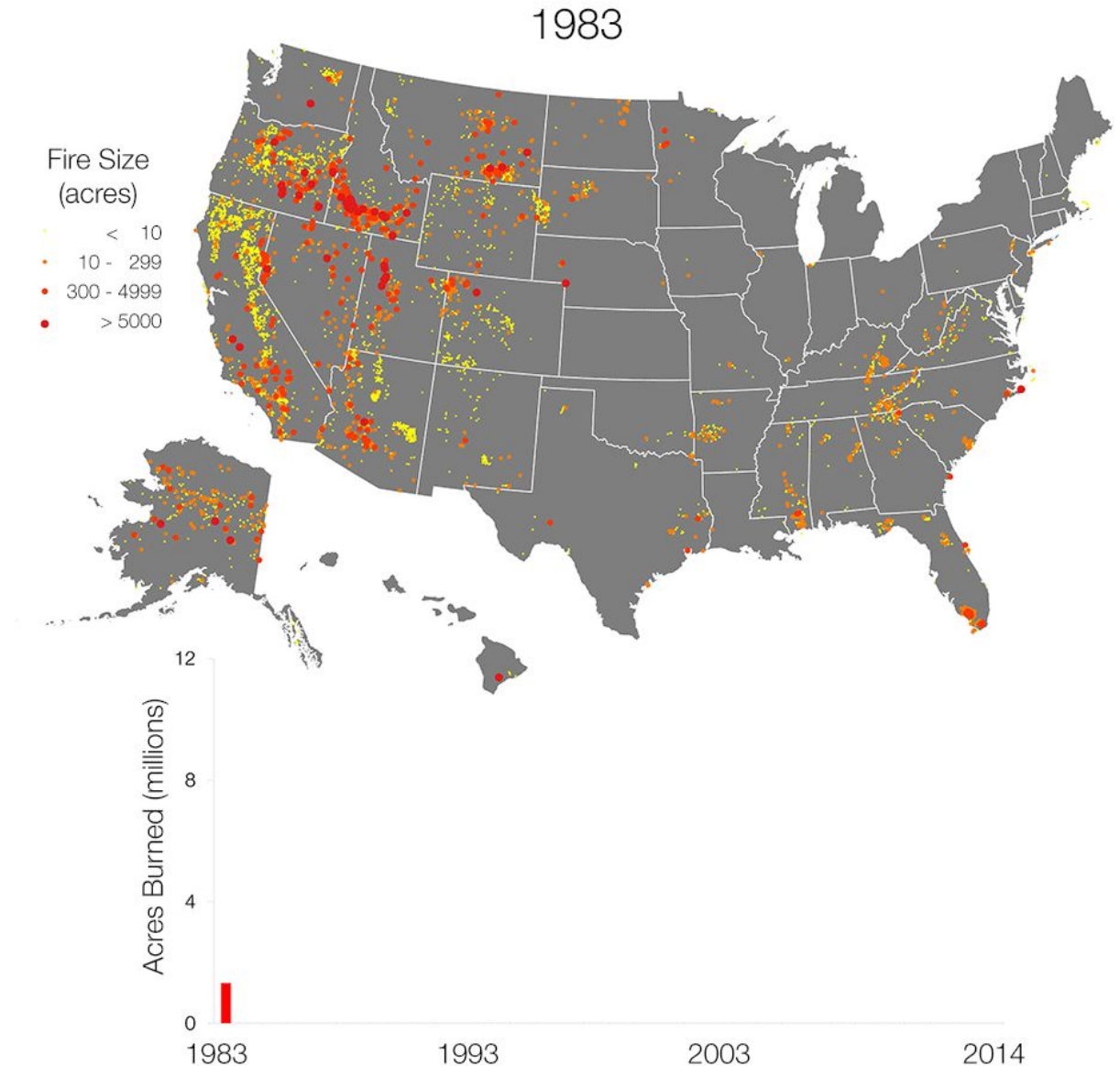
Co-existing with wildfire is the new normal

>7 Million acres burnt in 2022 alone

\$400-900 Billion damage annually

Projected climate future will make it worse

Estimates of wildfire impacts on our freshwaters remain inconsistent



Data from the [National Interagency Fire Center](#) and [Federal Fire Occurrence Website](#).

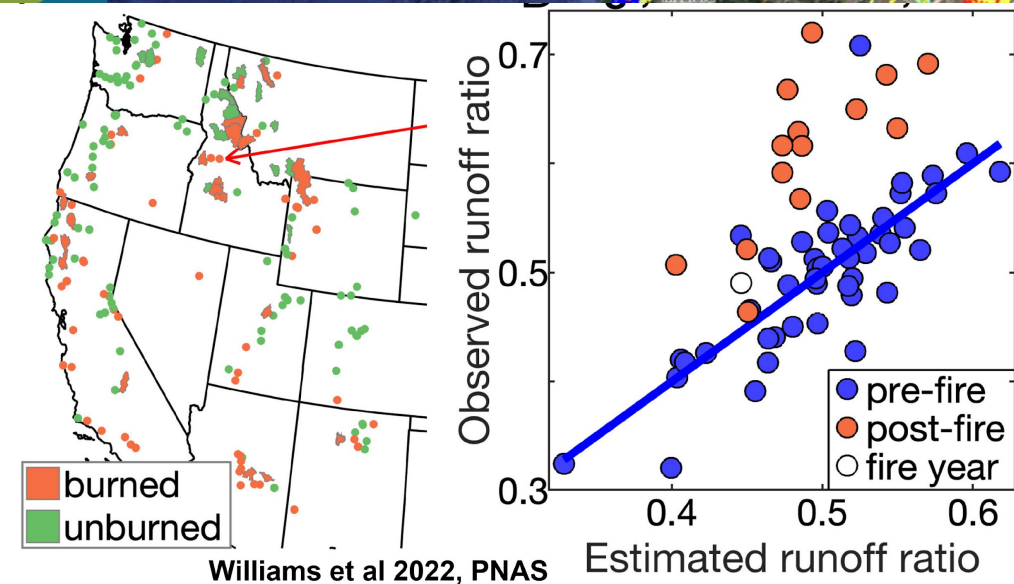
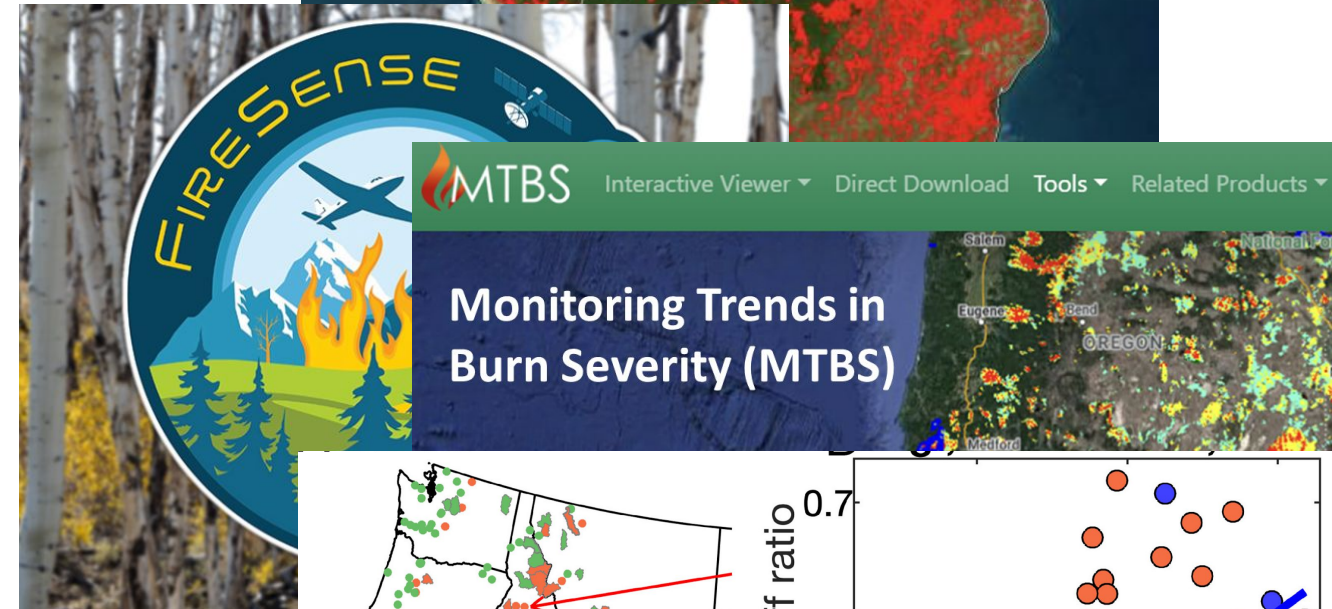
What problems do we solve?

THREE major knowledge-barriers

Data: fire data products/platforms do not provide direct measures of fire impacts on water

Scale: most fire hydrology studies are limited to small scales ($<100 \text{ km}^2$) and a **single fire event**, lacking potential for scale-up

Interoperability: No generalizable, convergent pathway to integrate fire data with hydrology and water quality models

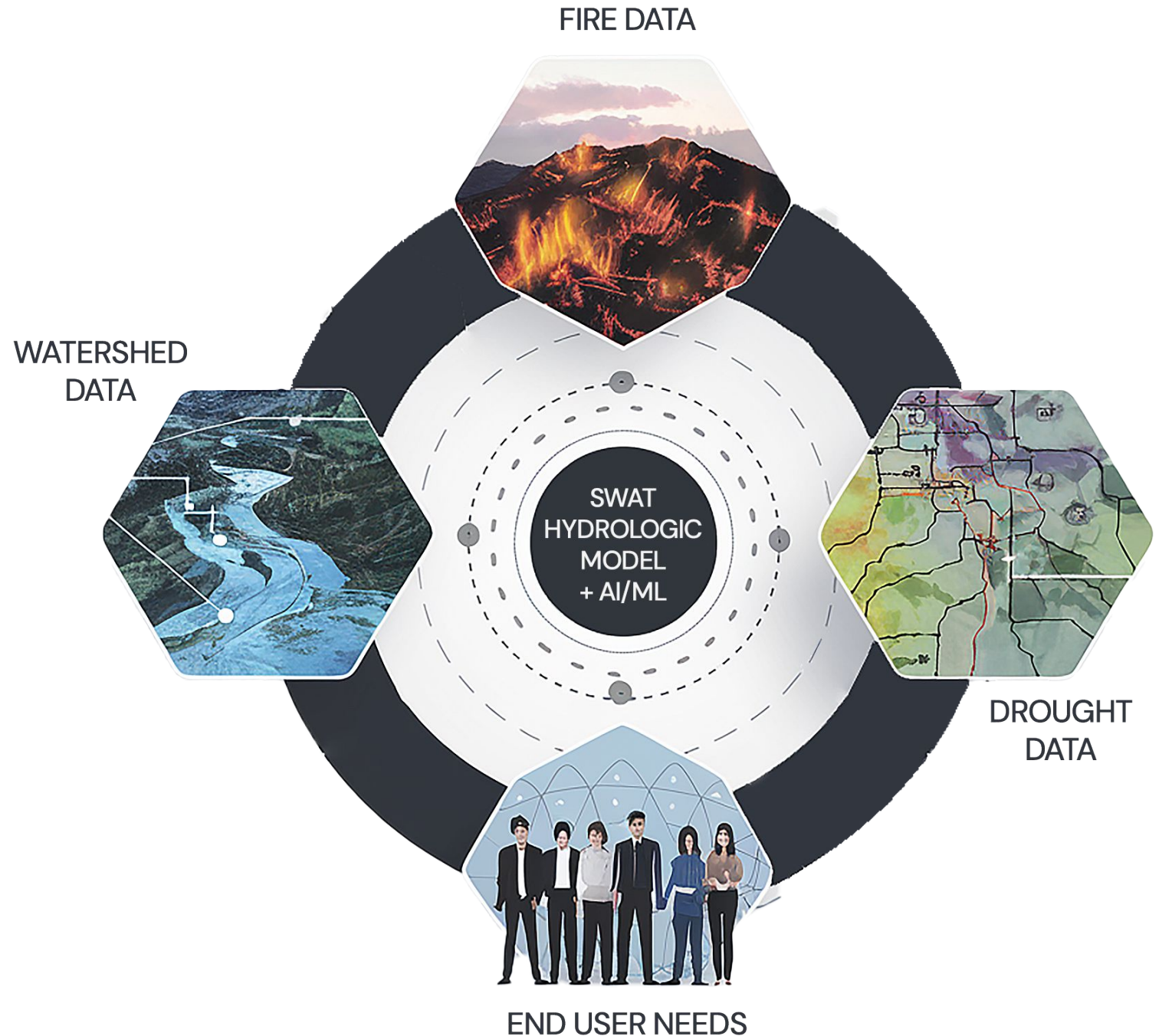


What solution do we offer?

Integrating fire data with watershed models and end-user needs

Large-basin, river network-scale post-fire hydrology & water quality data

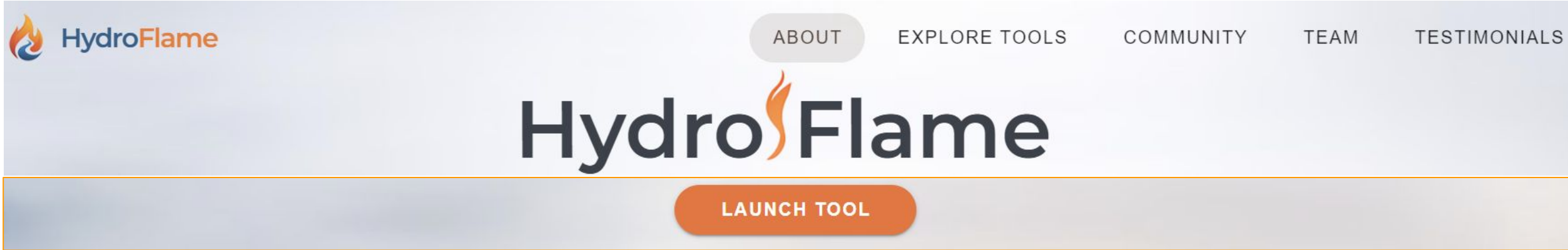
The Convergence



How do we deliver Earth Action?

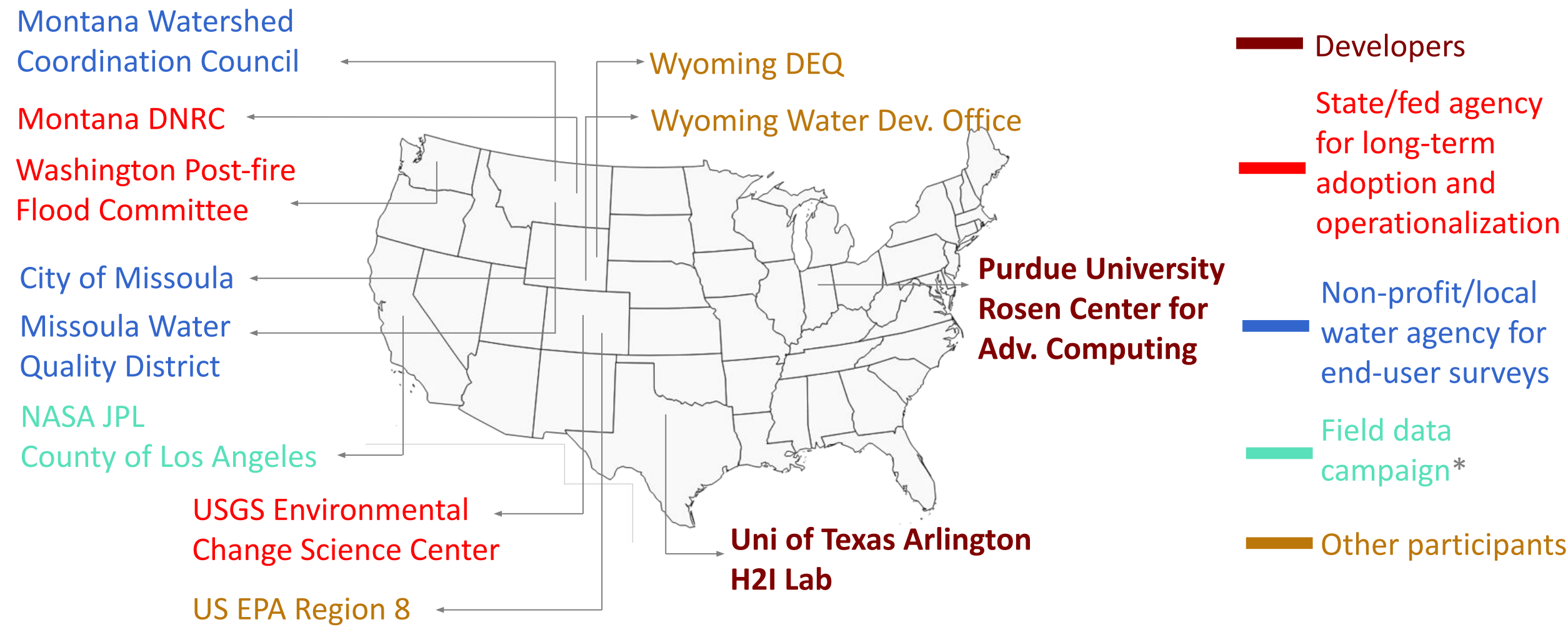
Open Science platform that makes post-fire water modeling and decision-making accessible, transparent, and actionable

www.hydro-flame.org



How do we deliver Earth Action?

A web of end-users directly involved in design, testing, and operationalization

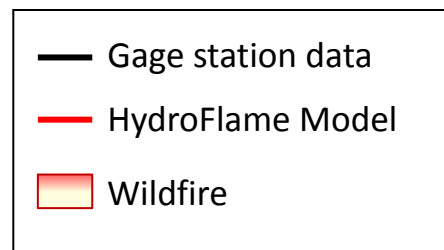
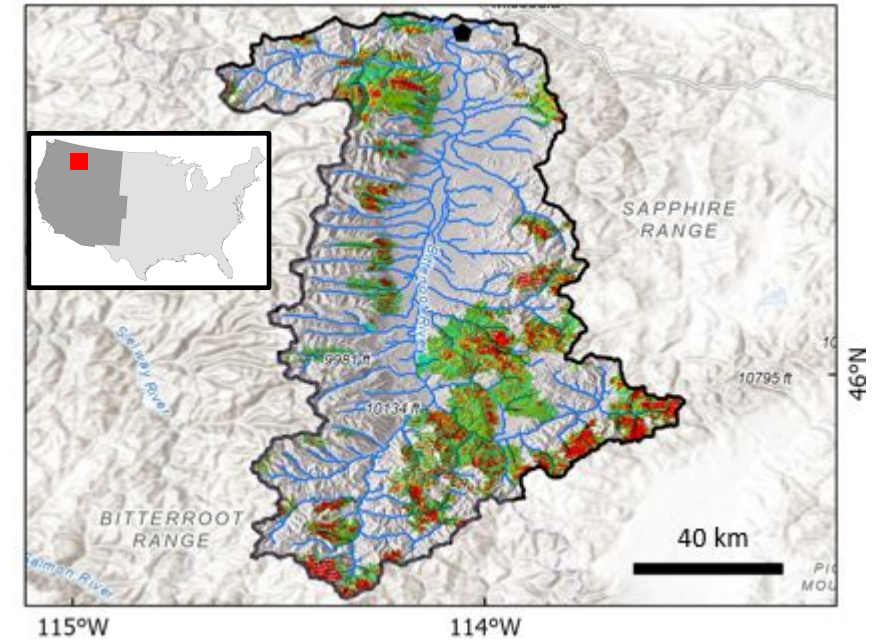
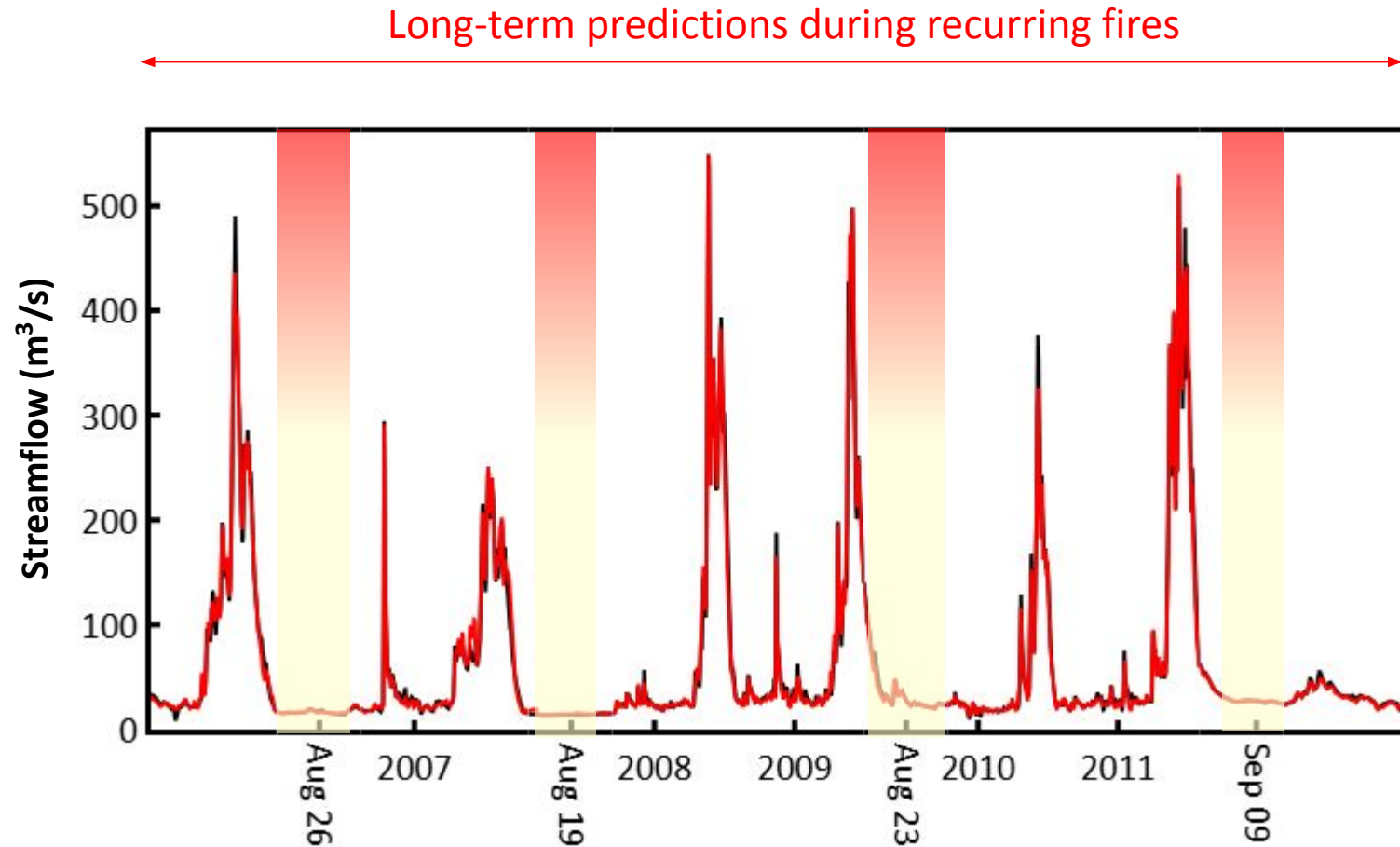


*Supported by NSF

Use-inspired outputs

Model results reproducing real-life fire scenarios

History of recurring fire → Drought-Fire-Flood sequence



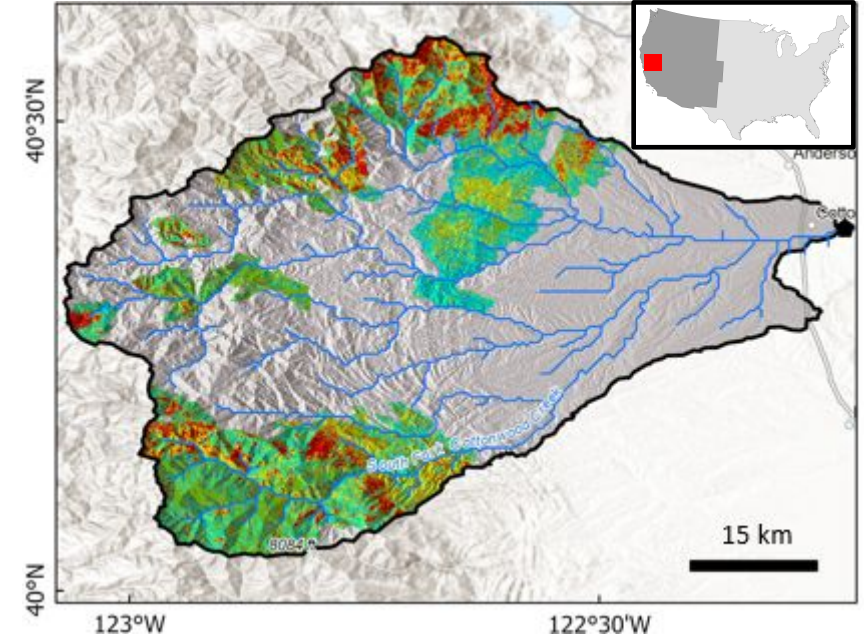
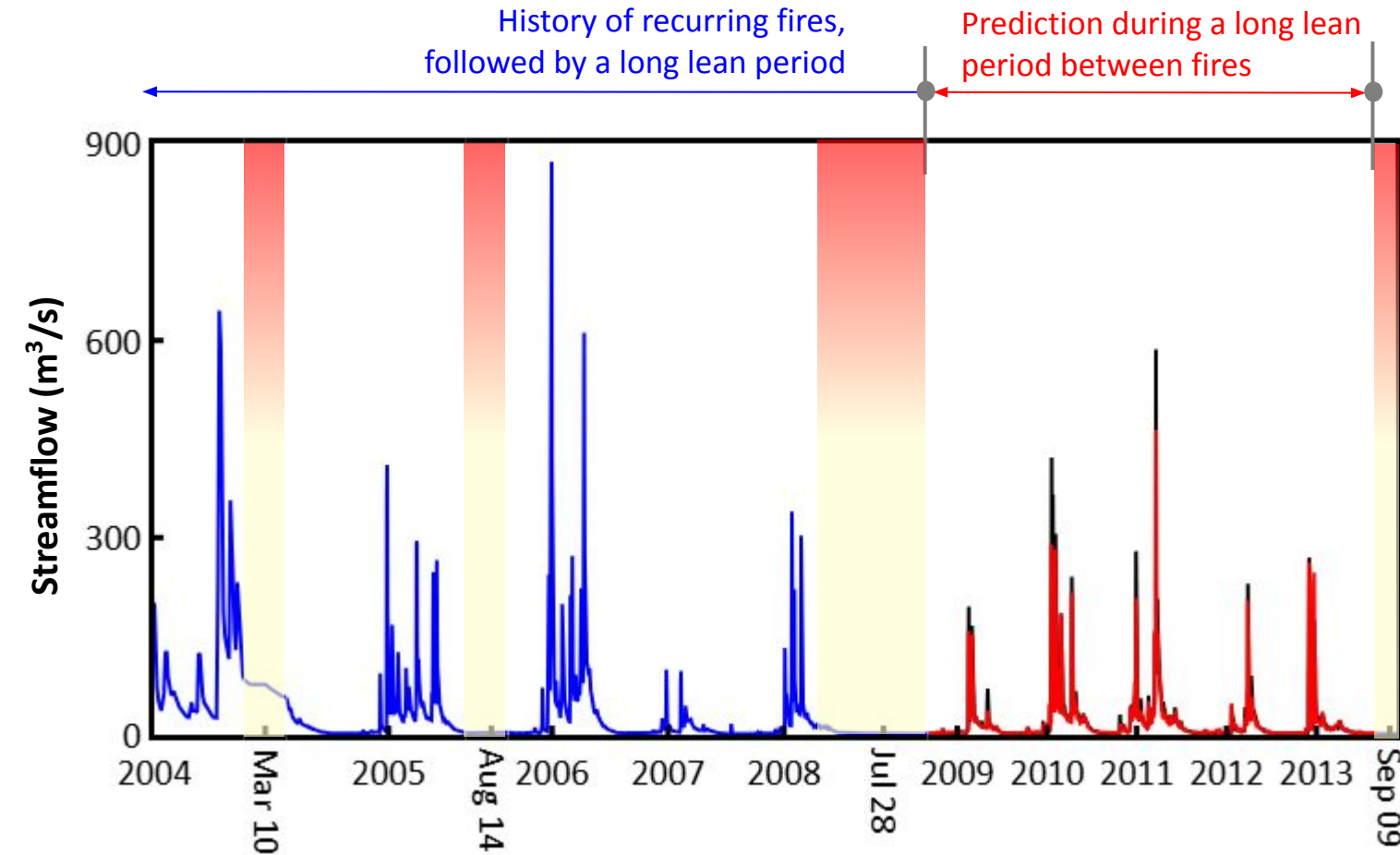
Clark Fork watershed
USGS 12352500
Montana

Uddin et al (in review)

Use-inspired outputs

Model results reproducing real-life fire scenarios

Long lean period between fires → Watershed recovery



- Historical gage station data
- Gage station data (during model predictions)
- HydroFlame model
- Wildfire

Sacramento watershed
USGS 11376000
Northern California

Uddin et al (in review)

Does fire data matter?

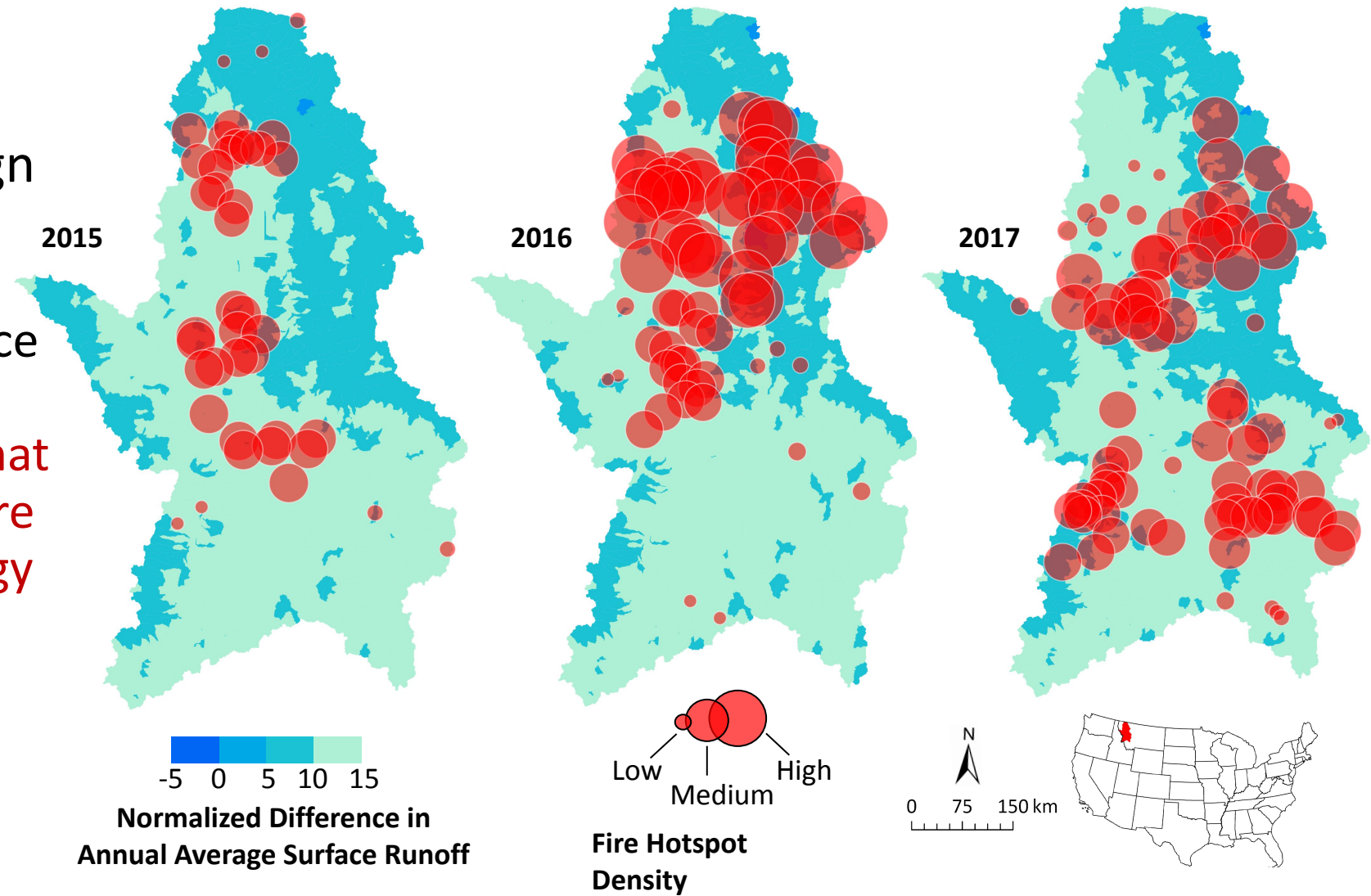
Fire data explains runoff shifts, where traditional models miss the mark

HydroFlame vs Traditional
"No-Fire" Model*: Runoff
differences consistently align
with burn hotspots

- Confirms fire data influence
- Debunks the status quo that commonly used models are adequate for fire-hydrology

*There is no concept of fire within commonly used hydrology/water quality models; Fire is represented as proxies of land use change

Bhattacharjee et al (in review)



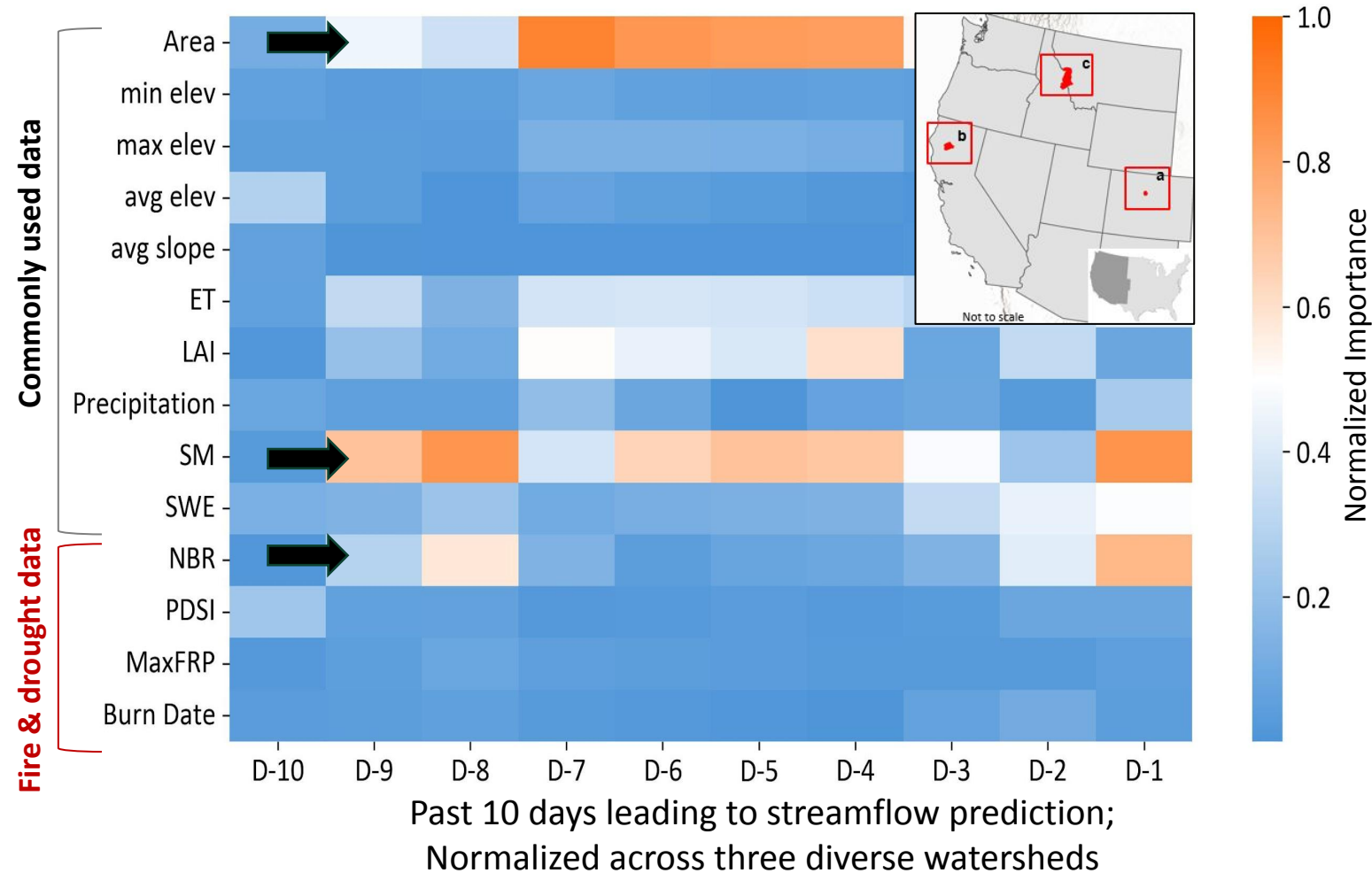
Does fire data matter?

Fire data are key, but not all data types are equally meaningful

Standard runoff predictors fail in burned areas

- Fire data types (NBR, FRP) vary in meaning and may lack hydrologic relevance
- Direct integration of fire data* with traditional predictors is the way forward

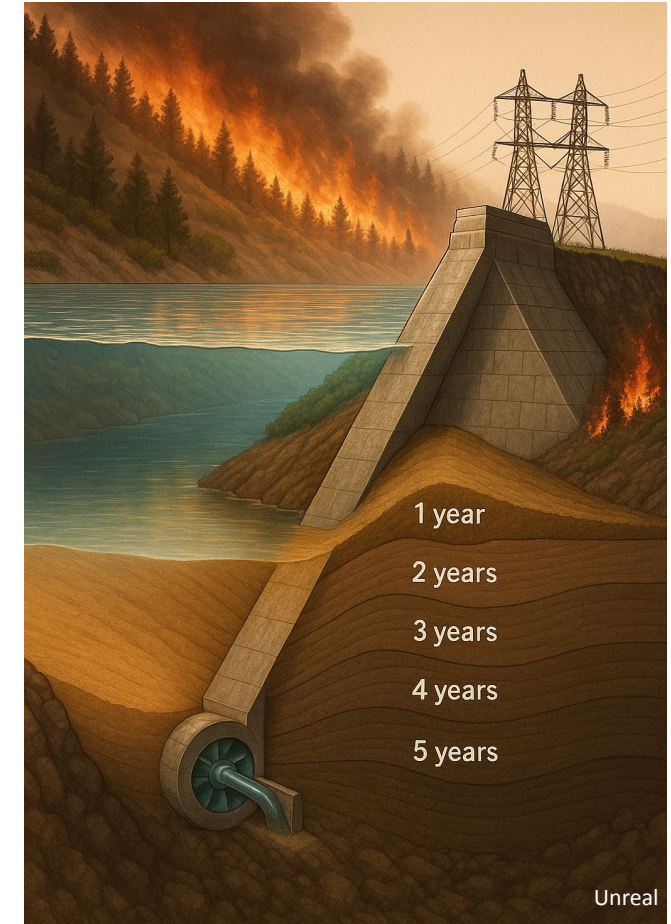
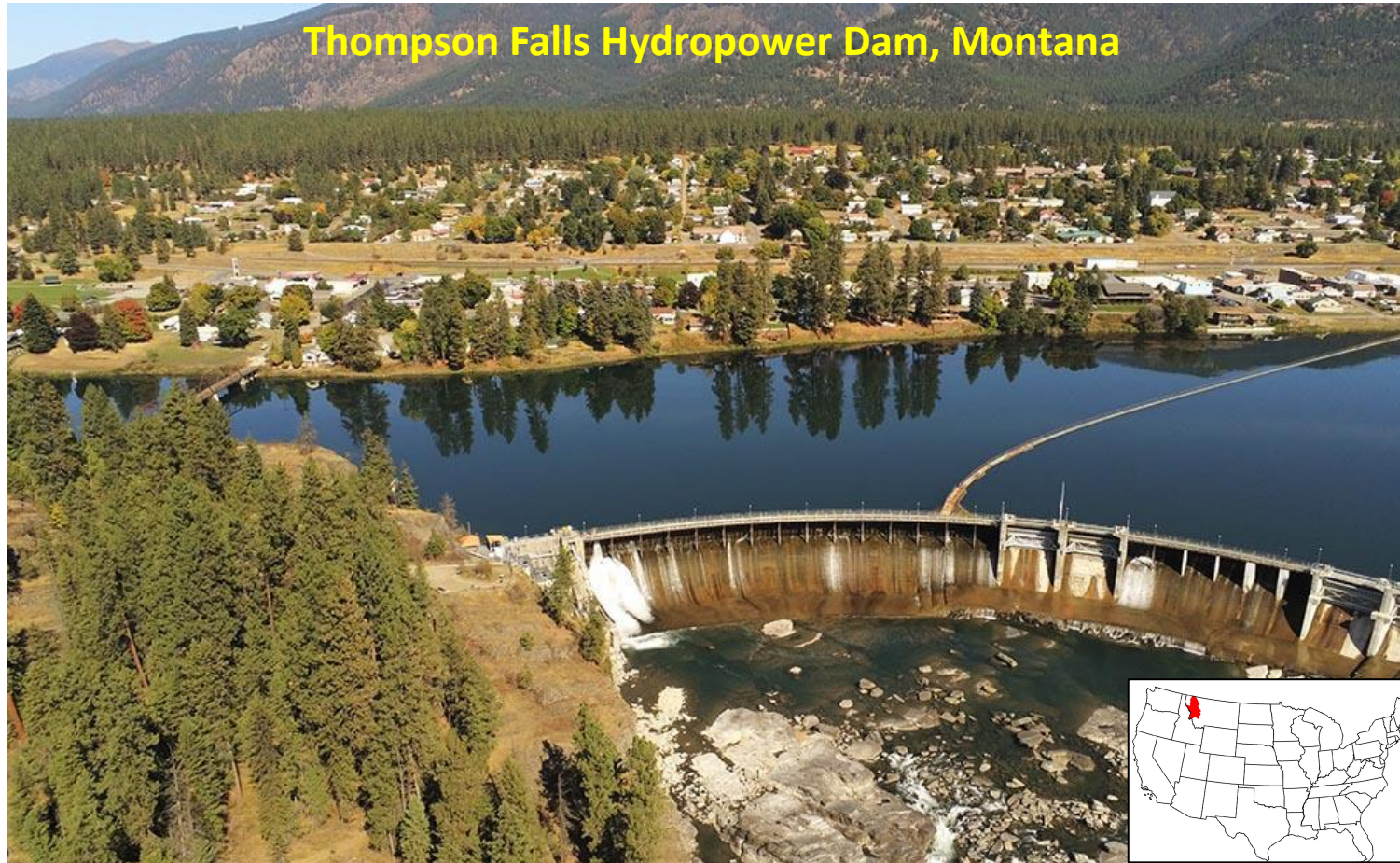
* Not as a proxy



HydroFlame in action: Socio-environmental impact

Enables scenario planning for numerous plausible "fire-weather" extremes

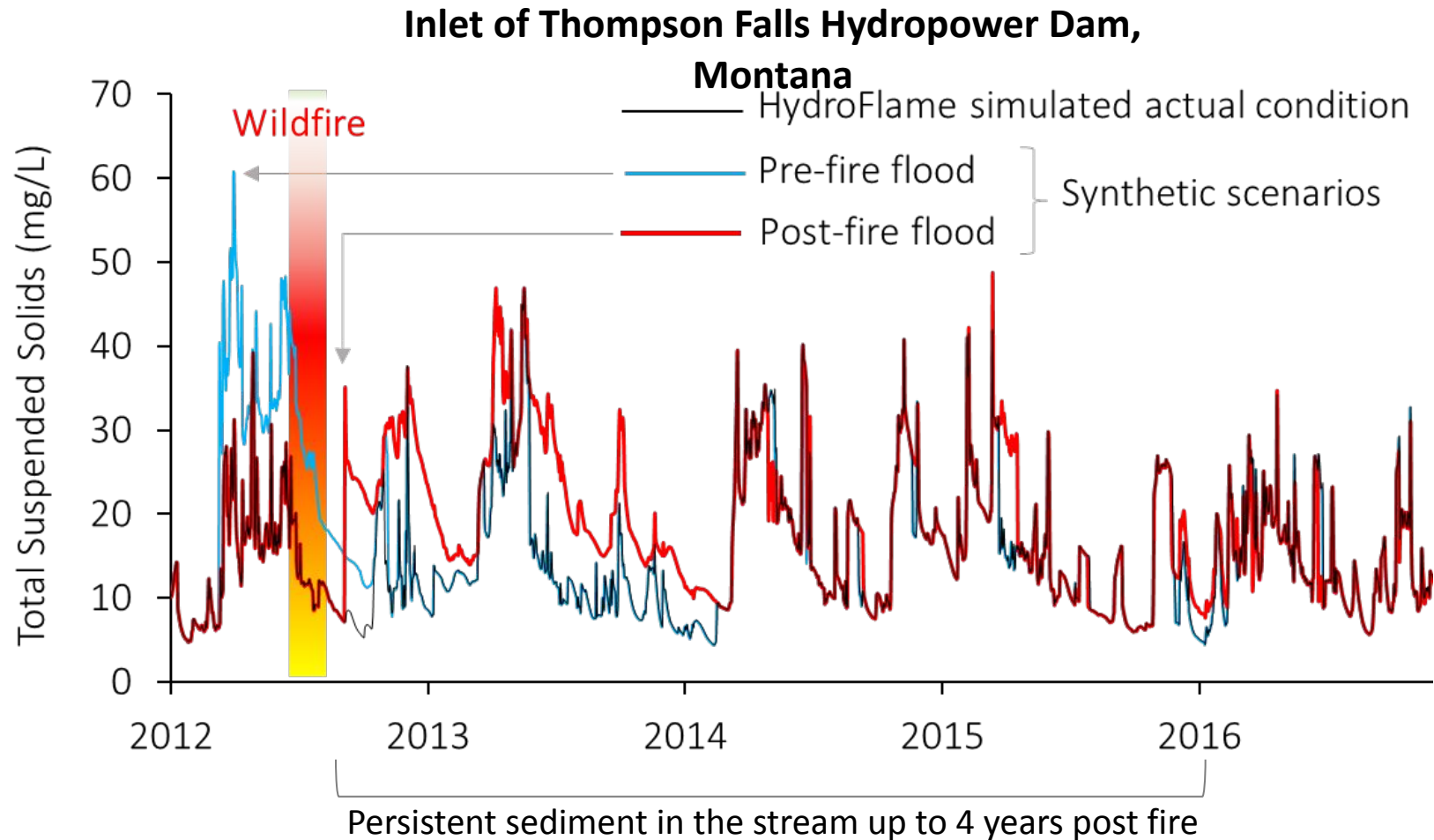
Persistent sediment from recurring fires → Compromised hydropower operations



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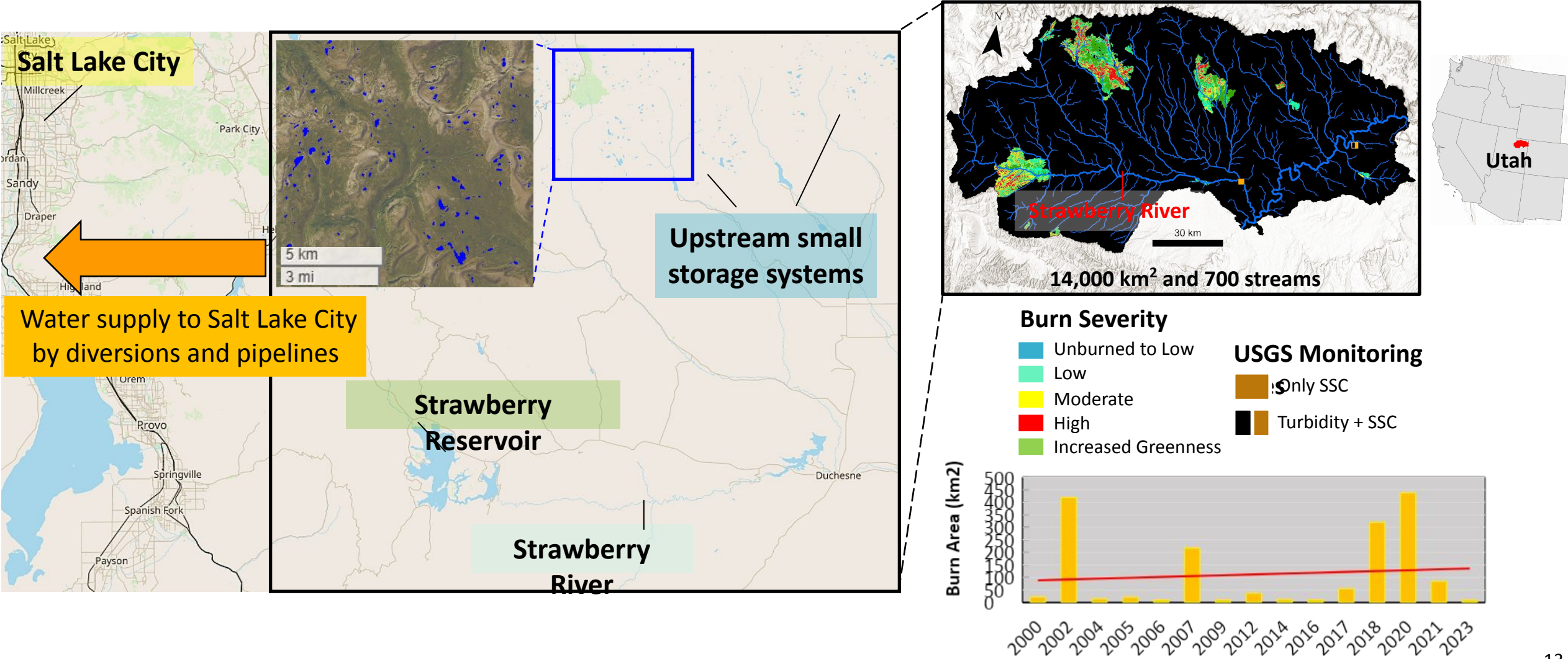
Persistent sediment from recurring fires → Compromised hydropower operations



HydroFlame in action: Socio-environmental impact

Improved decision-making by filling data gaps or providing data where there is none

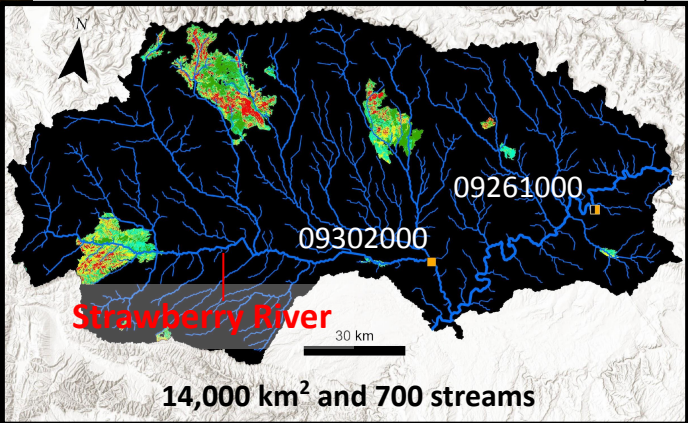
Persistent sediment from recurring fires → Increased water supply & treatment costs



HydroFlame in action: Socio-environmental impact

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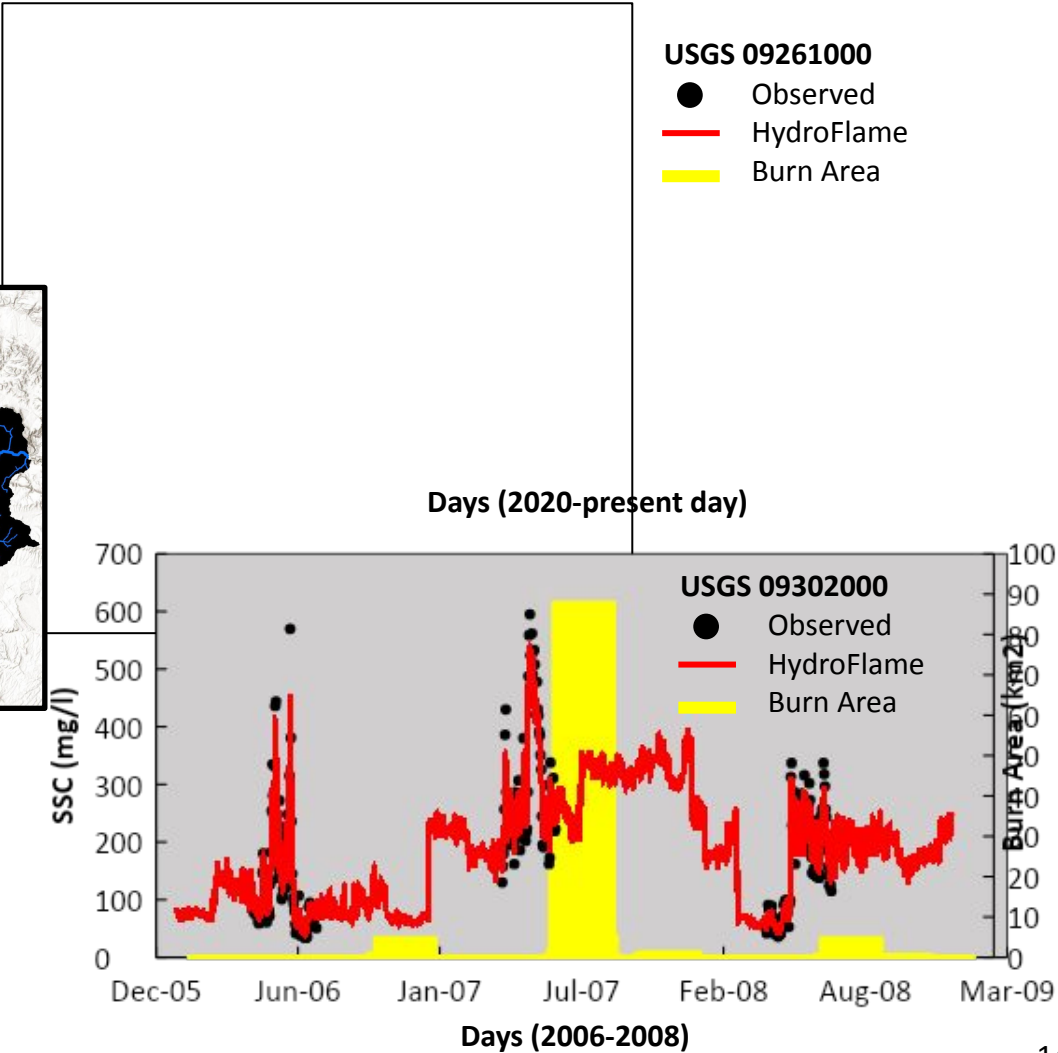
Persistent sediment from recurring fires → Increased water supply & treatment costs



USGS Monitoring

- Only SSC
- Turbidity + SSC

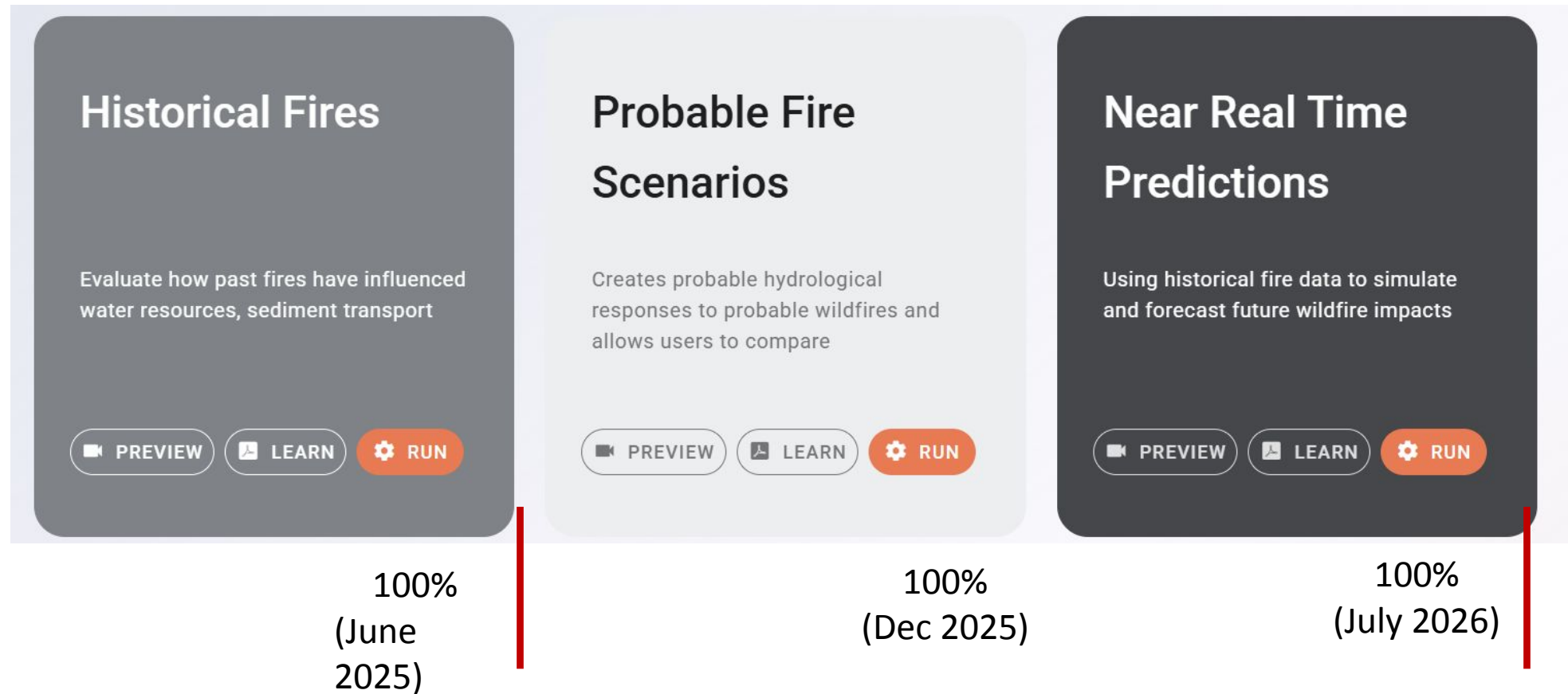
SSC = Suspended Sediment Concentration
Turbidity = In FNU units



Data-to-Decision

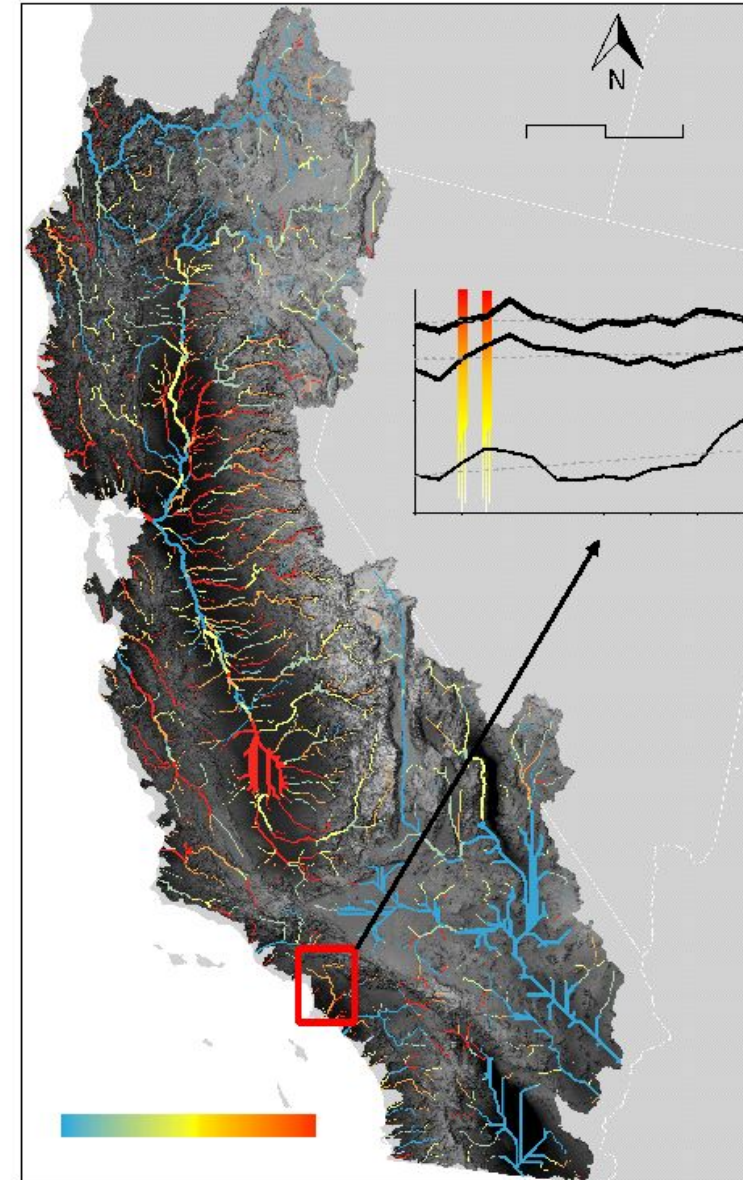
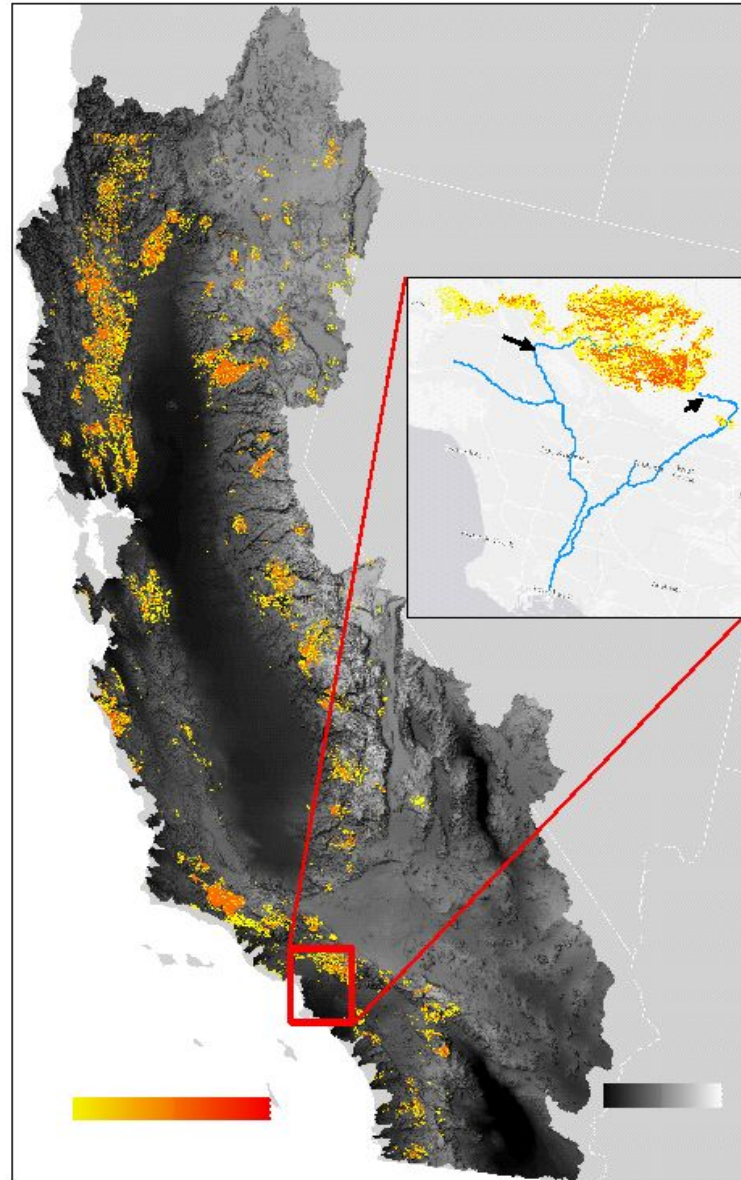
HydroFlame delivers post-fire water data to end-users enriched with value-added attributes

www.hydro-flame.org



Where can we go from here?

A post-fire sediment change rates, hotspots, and extremes database for the Western US



Unverified results.
Proposed work.

Take Home Message

- A one-stop, **convergent solution** to make post-fire hydrology and water quality management accessible, transparent, and actionable.
- When fully developed, our project will **fill data gaps**, conceptual and technological barriers in post-fire water management.
- An incubator of **NASA's Earth Science to Action** paradigm.

