



UNIVERSITY OF
TEXAS
ARLINGTON

SWAT Conference 2025

HydroFlame: A new NASA platform using SWAT for wildfire-hydrology modeling

Dr. Adnan Rajib

Assistant Professor, Civil Engineering

Director, Hydrology & Hydroinformatics Innovation (h2i) Lab

University of Texas at Arlington



adnan.rajib@uta.edu



@adnanrajib



2015-2025: Thanks to Srini and Arun for bringing me back

Adnan (Faculty & Director)



Stella (PhD)



Haider (Postdoc)



Arushi (PhD)



Karen (PhD)



Bikas (PhD)



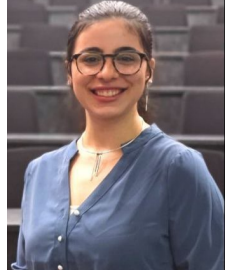
Shihab (PhD)



Sajid (MS)



Analisa (Undergrad)



Antara (PhD)



Dipen (PhD)



Saurya (Undergrad)

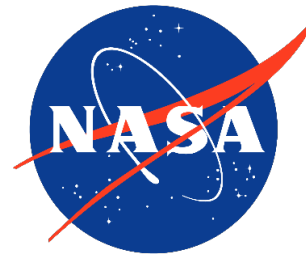
Vera (High School)



Hydrology & Hydroinformatics Innovation (h2i) Lab

7 PhD students, **1 Postdoc**, among others

H2i Lab



U.S. DEPARTMENT OF ENERGY

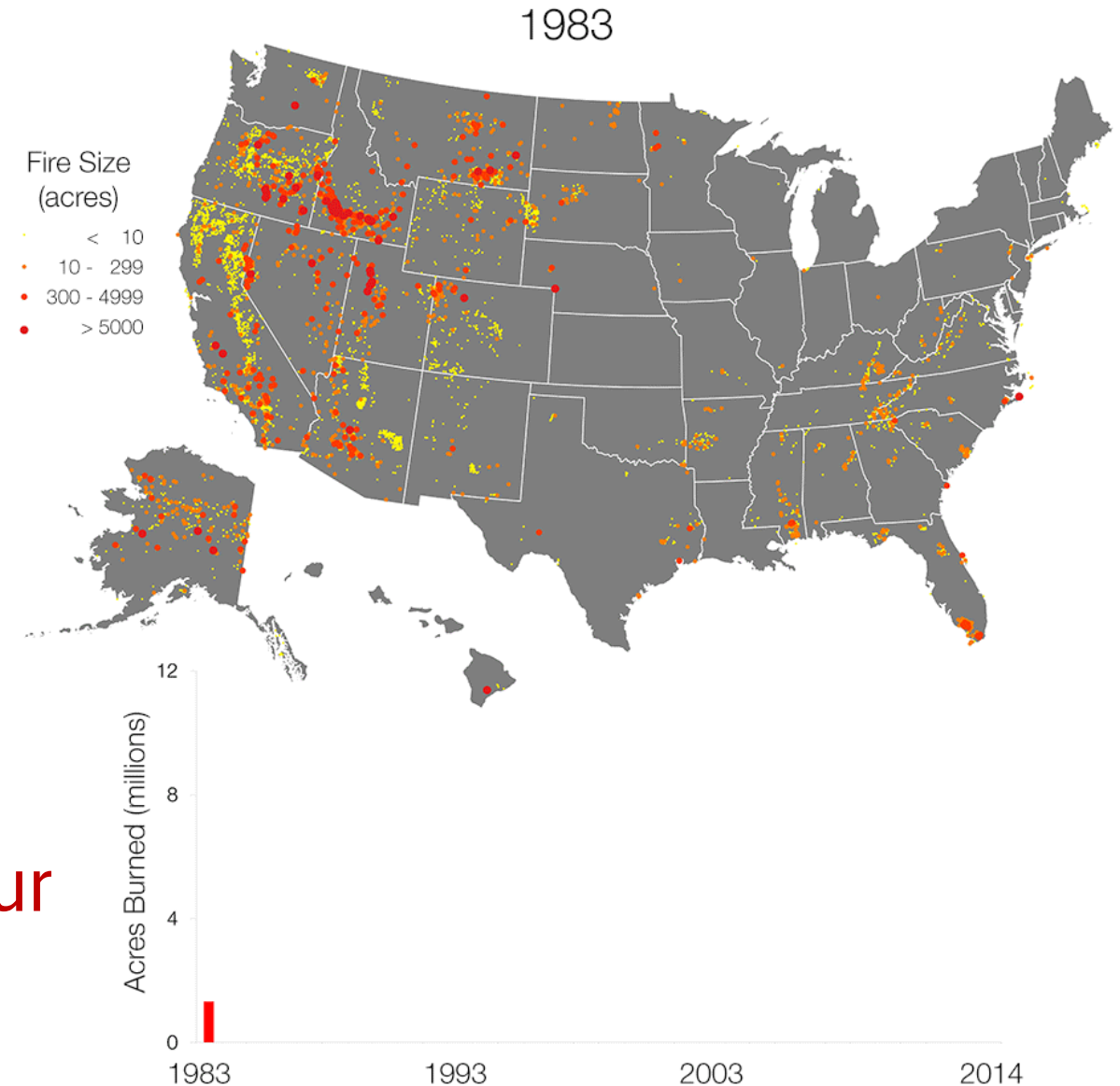
Co-existing with wildfire is the new normal

>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



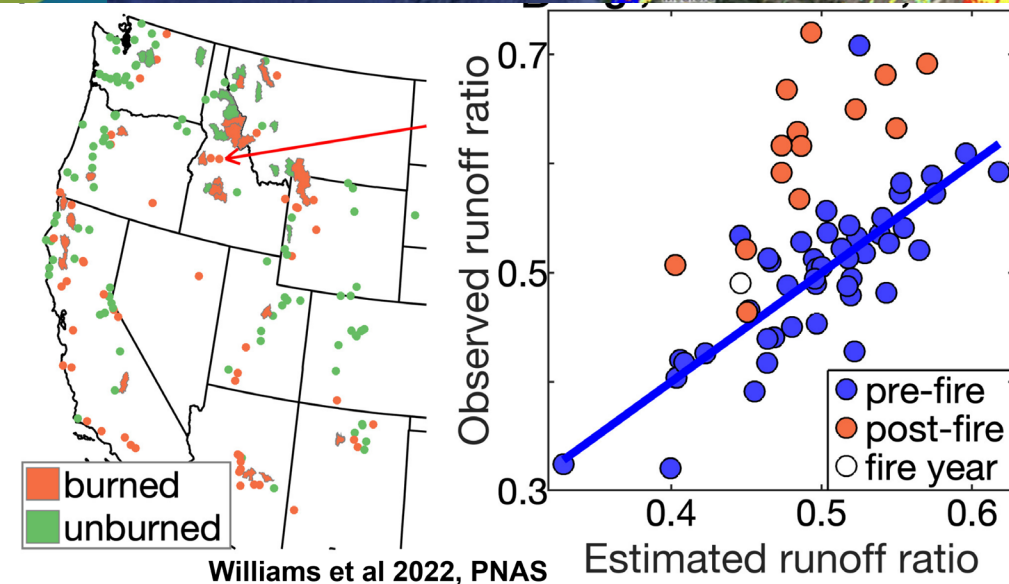
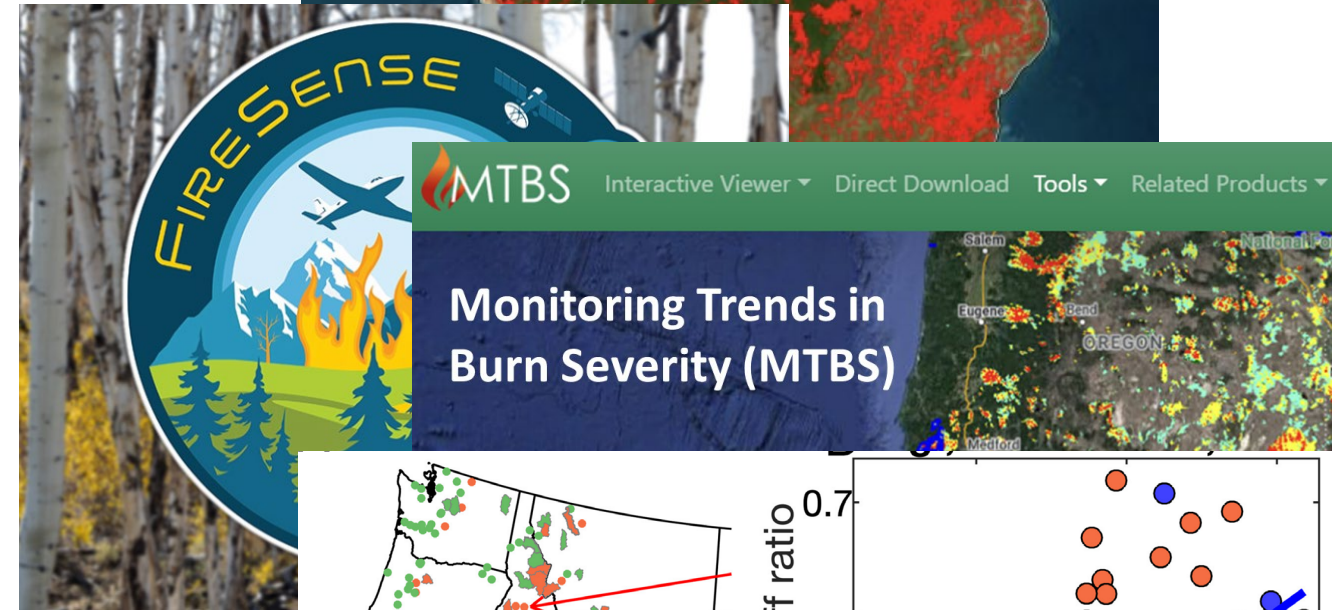
What problems do we solve?

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

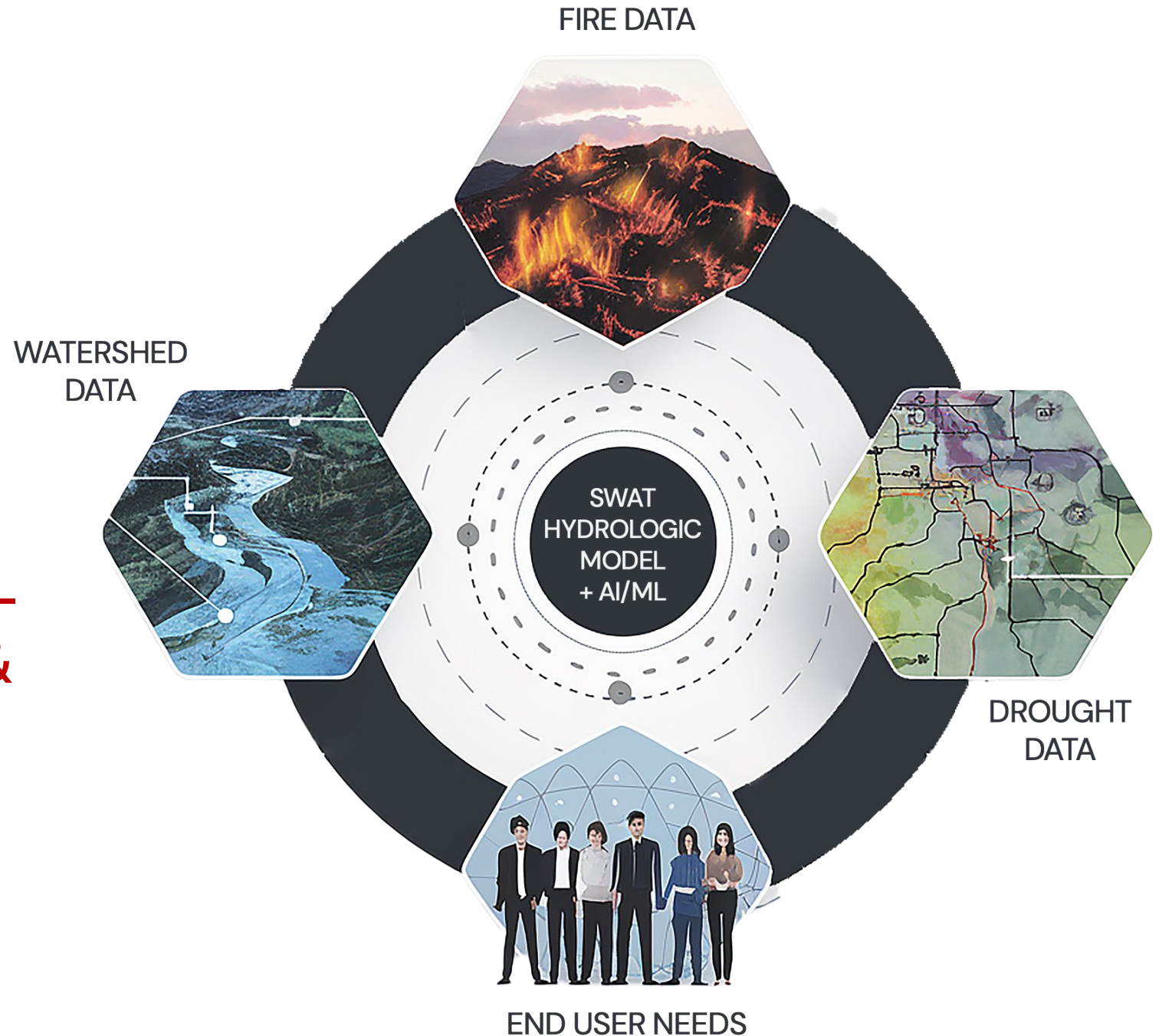


What solution do we offer?

Integrating fire data with an AI-powered SWAT

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

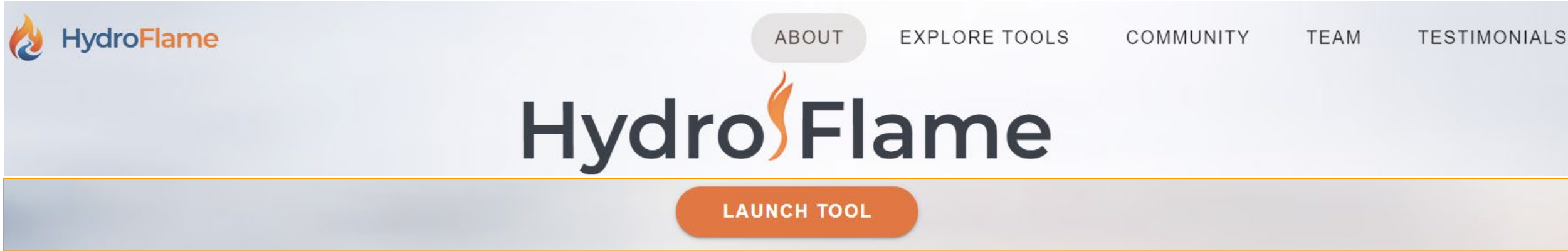
The Convergence



How did we transform SWAT for fire-hydrology?

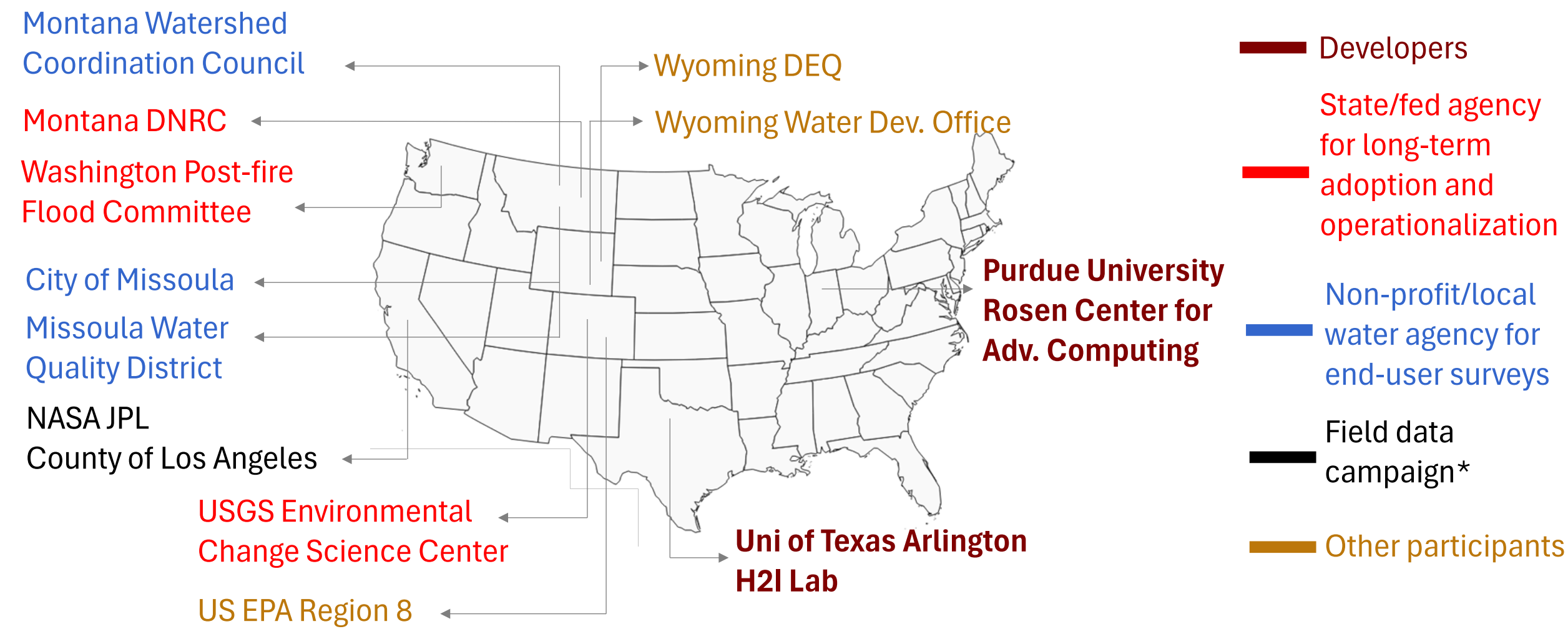
Open Science SWAT-based platform that makes post-fire water modeling and decision-making accessible, transparent, and actionable

www.hydro-flame.org



HydroFlame brings a large SWAT user community together

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



*Supported by NSF

HydroFlame in NASA spotlight



6 MIN READ

NASA Data Powers New Tool to Protect Water Supply After Fires

September 24, 2025

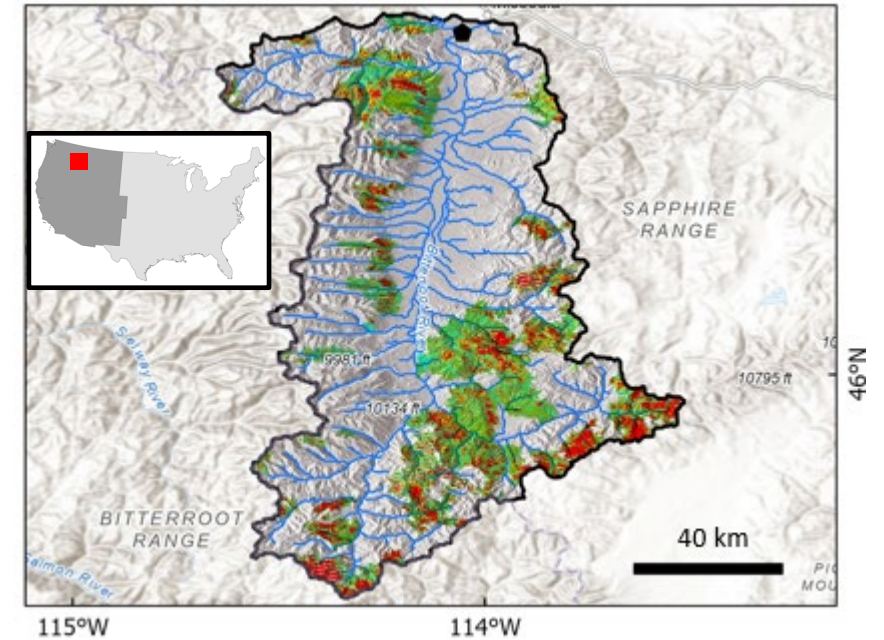
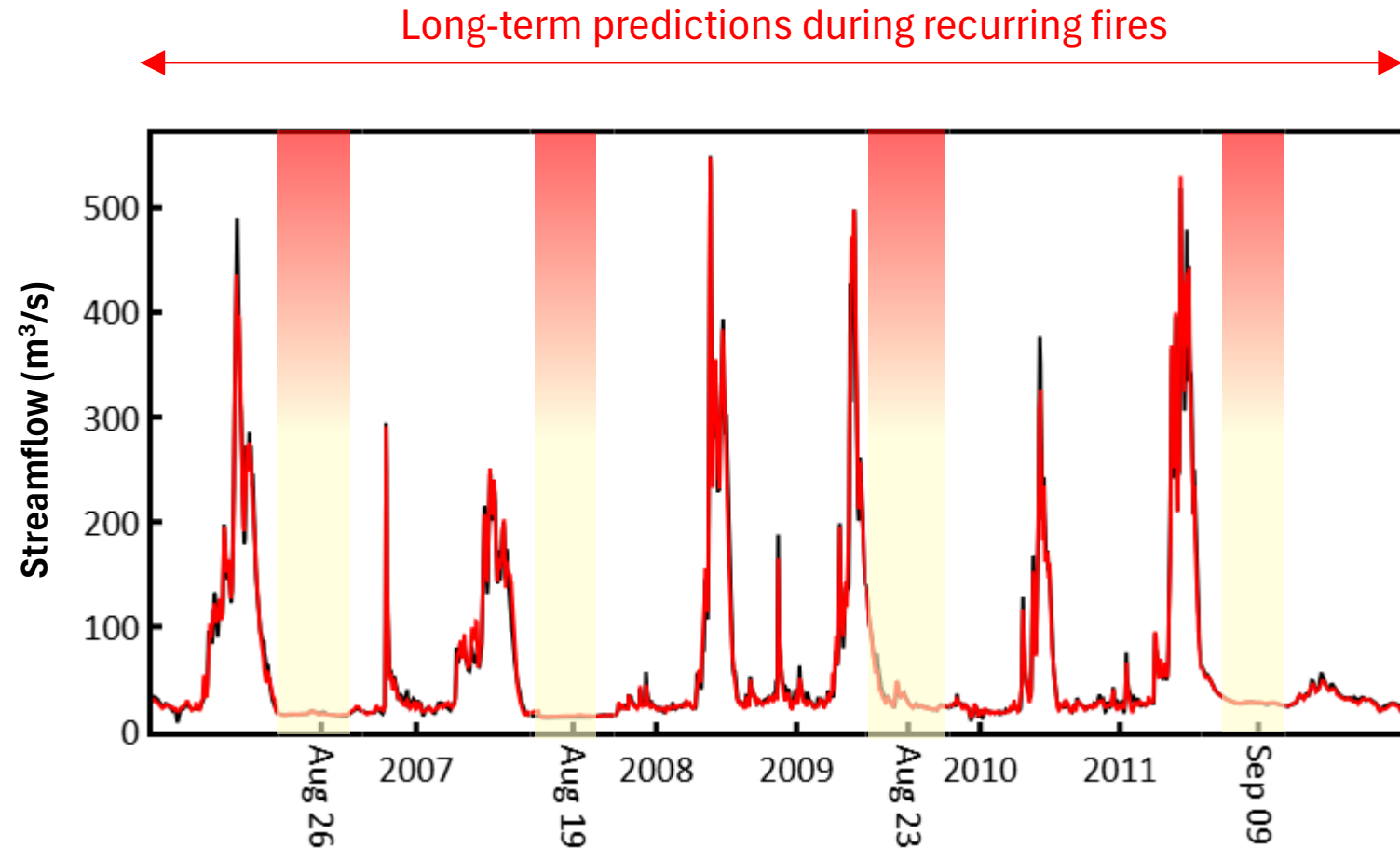


<https://science.nasa.gov/earth/nasa-data-powers-new-tool-to-protect-water-supply-after-fires>

Use-inspired outputs

Model results reproducing real-life fire scenarios

History of recurring fire → Drought-Fire-Flood sequence



— Gage station data
— HydroFlame Model
Wildfire

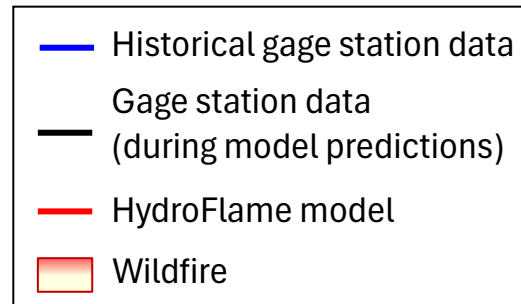
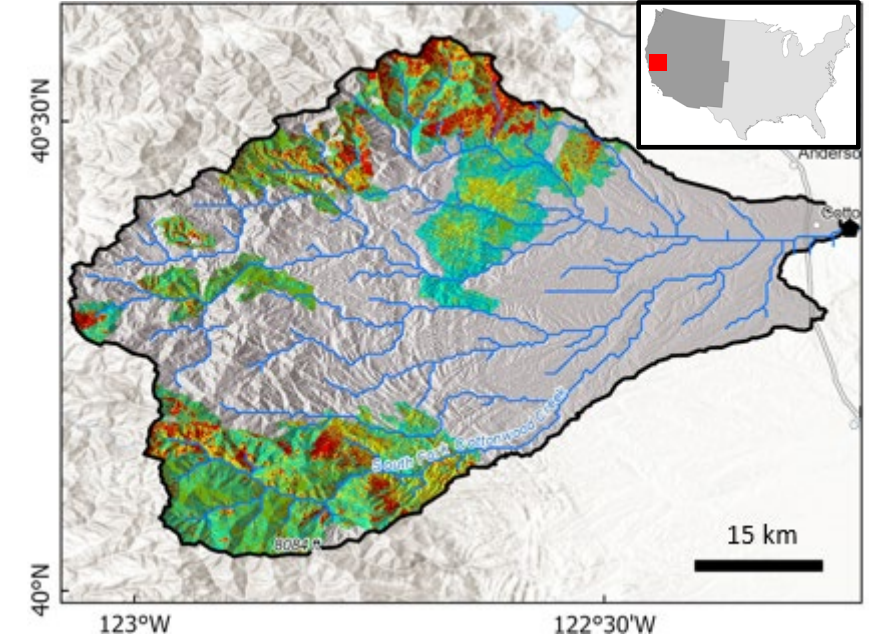
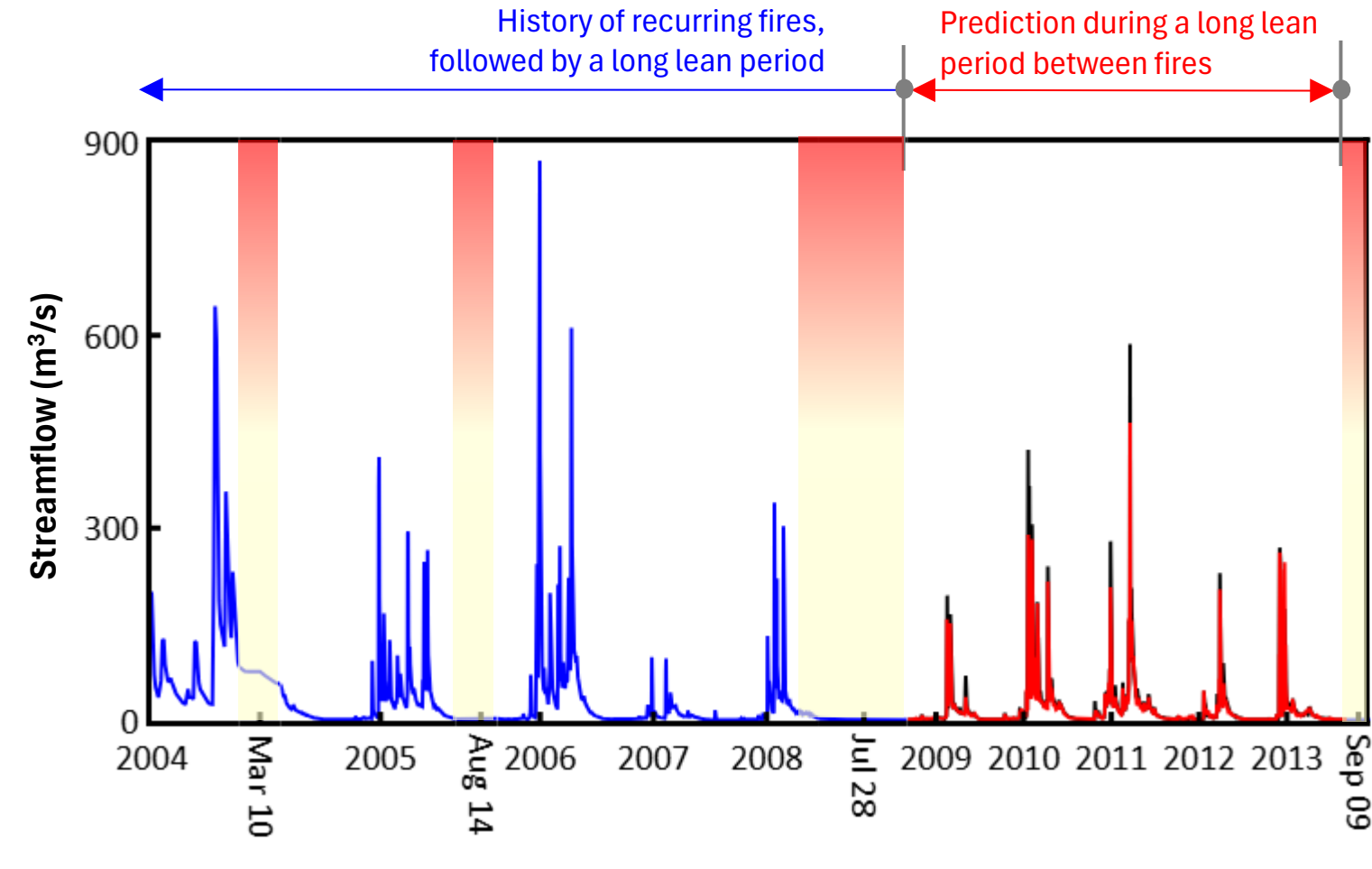
Clark Fork watershed
USGS 12352500
Montana

Uddin et al (in review)

Use-inspired outputs

Model results reproducing real-life fire scenarios

Long lean period between fires → Watershed recovery



Sacramento watershed
USGS 11376000
Northern California

Uddin et al (in review)

Does fire data matter?

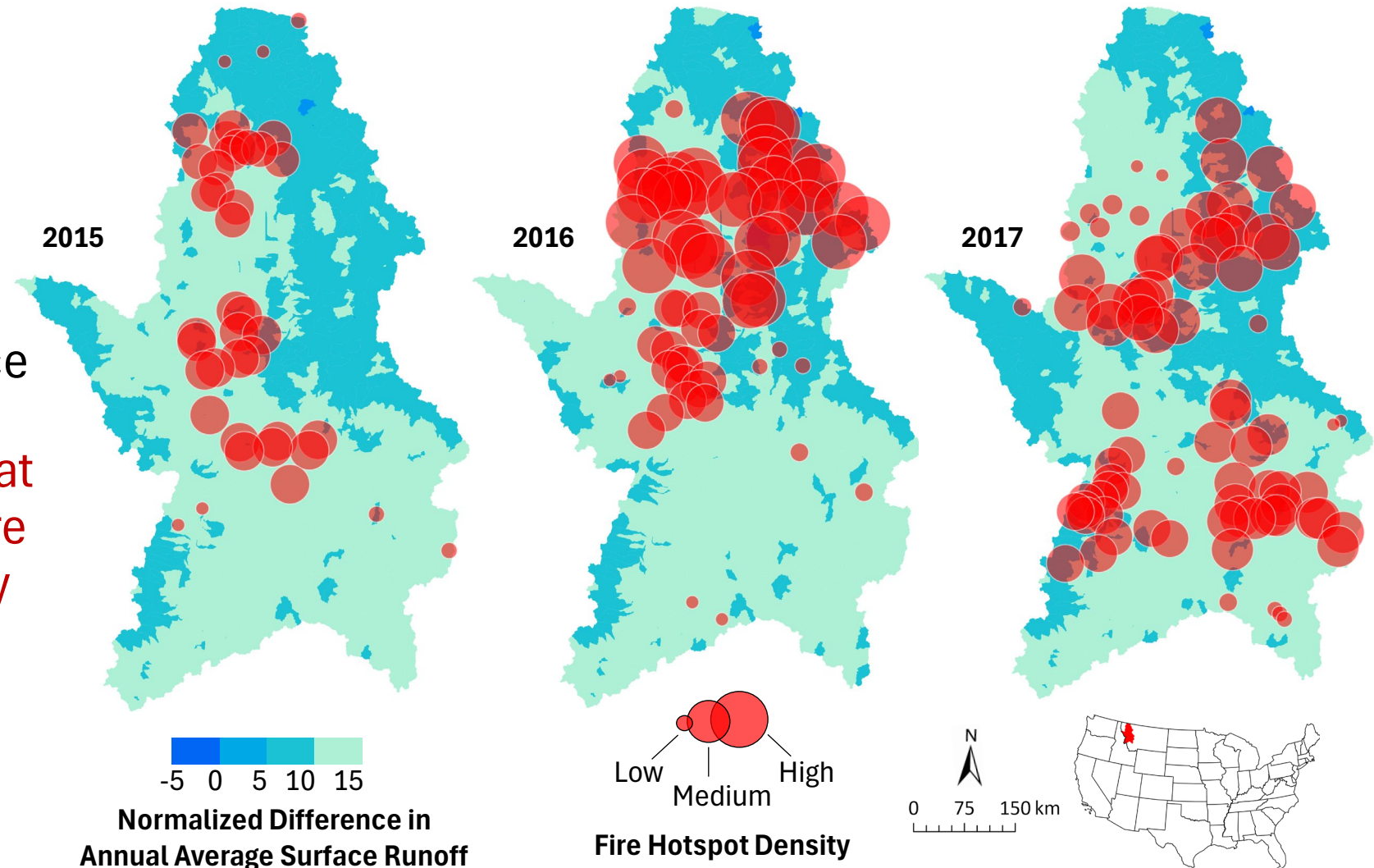
Fire data explains runoff shifts, where traditional models miss the mark

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

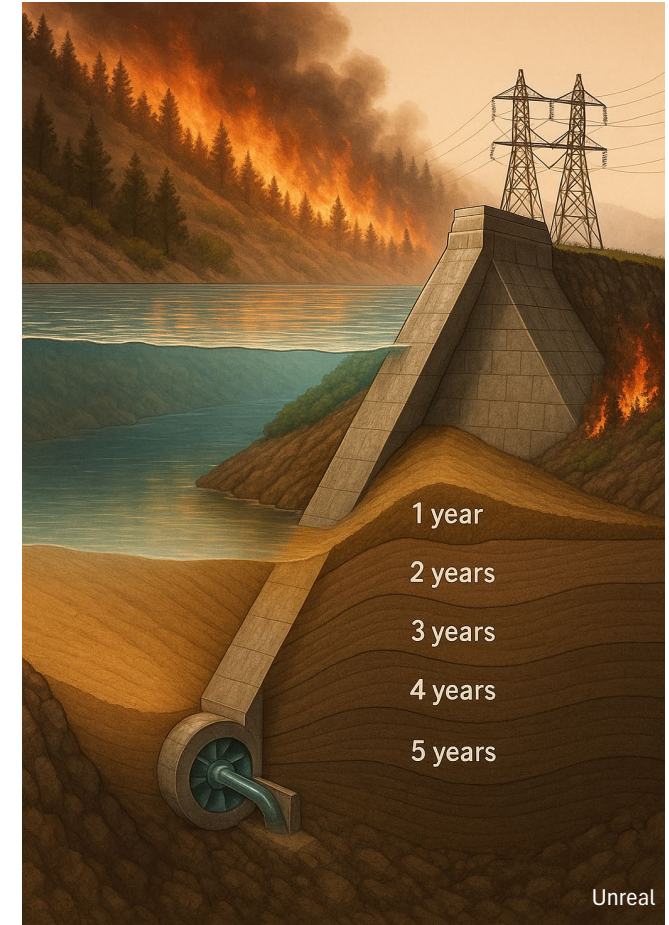
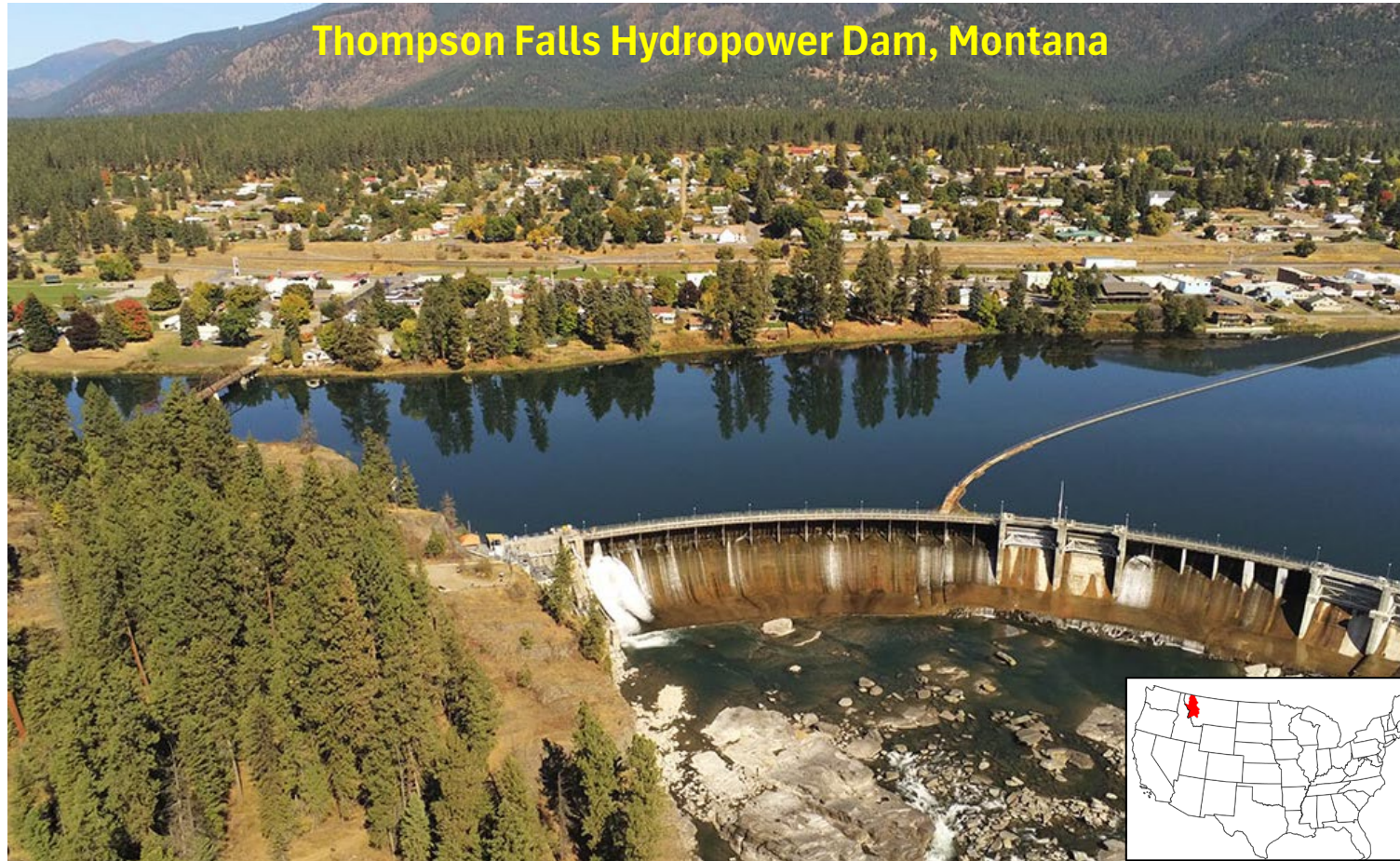
Bhattacharjee et al (in review)



HydroFlame in action: Socio-environmental impact

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

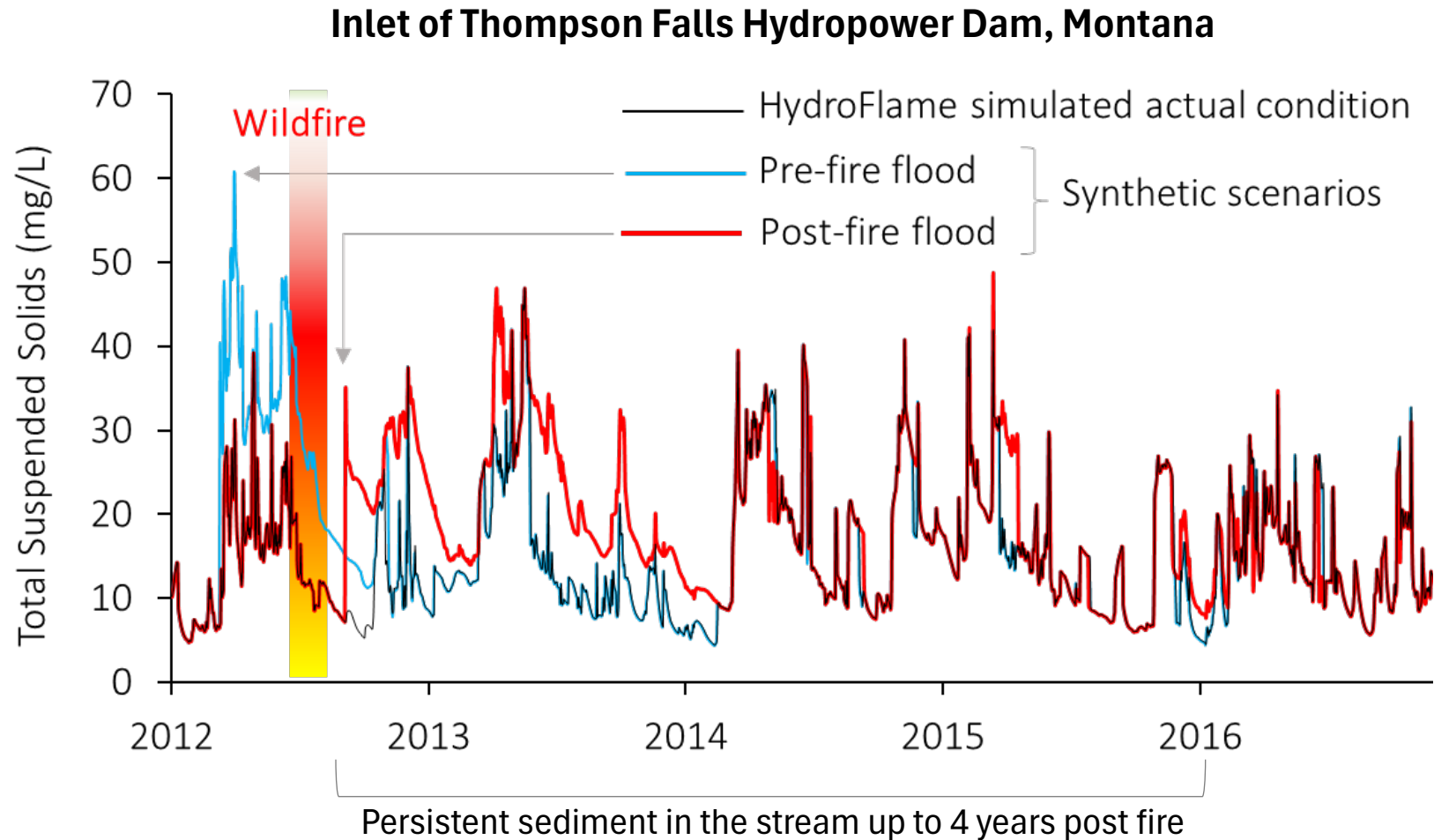
Persistent sediment from recurring fires → Compromised hydropower operations



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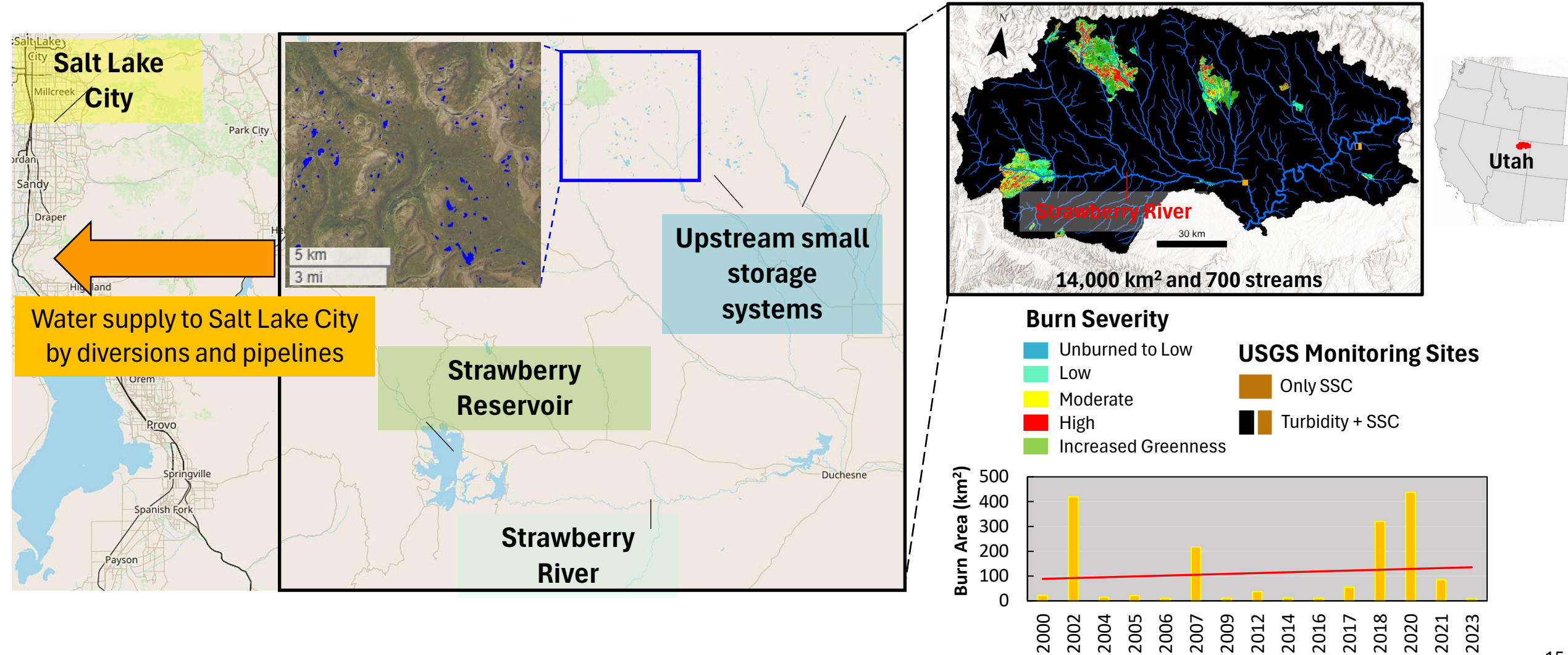
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HydroFlame in action: Socio-environmental impact

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

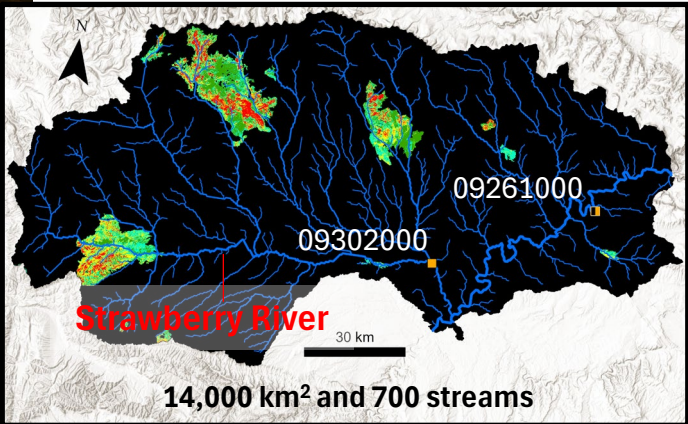
Persistent sediment from recurring fires → Increased water supply & treatment costs



HydroFlame in action: Socio-environmental impact

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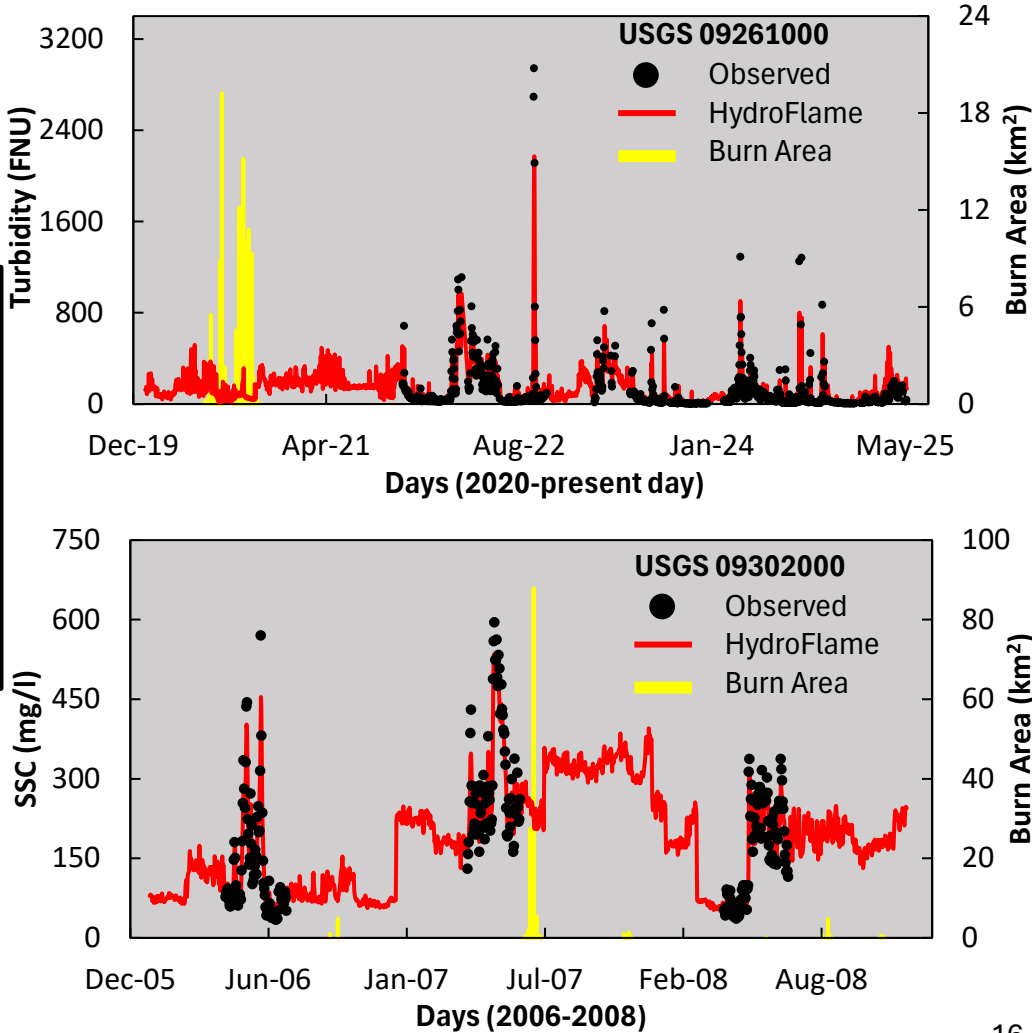
Persistent sediment from recurring fires → Increased water supply & treatment costs



USGS Monitoring Sites

- Only SSC
- Turbidity + SSC

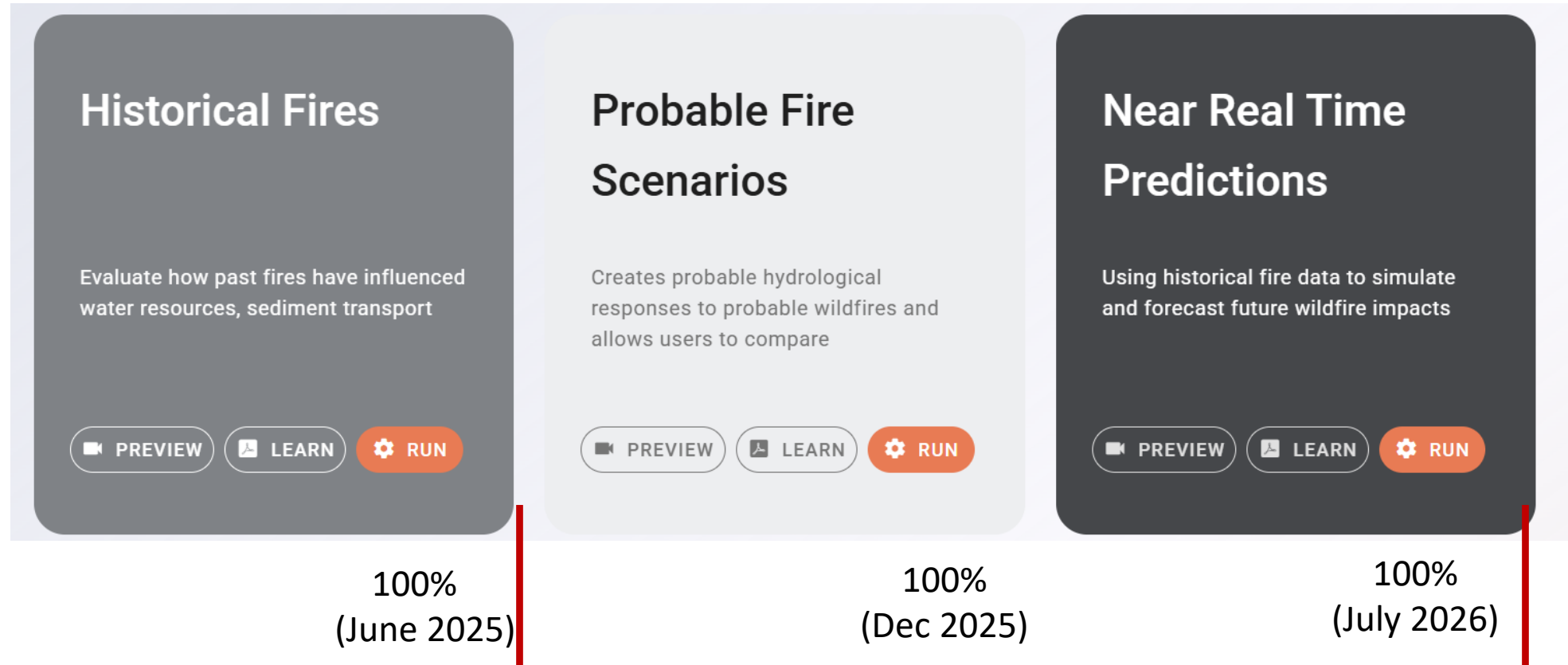
SSC = Suspended Sediment Concentration
Turbidity = In FNU units



Data-to-Decision

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

www.hydro-flame.org



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.

