# Temporal Changes in Soil Hydraulic Properties Following Fire and Implications for Water-related Hazards

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San Gabrieal Mountains, CA, 2016 Fish Fire (Photo by Luke Mcguire)


Gila National Forest, New Mexico, 2018 Buzzard Fire (Video captured by AZGS)

- Soil Hydraulic Properties - sorptivity, porosity, infiltration capacity, saturated hydraulic conductivity
- Water related hazards - debris flow, mud flow, rock fall, erosion, flooding

**(McGuire and Youberg, 2019 ESPL)**

## Moderate/High Severity


## Low Severity


**Gila National Forest, New Mexico 2018 Buzzard Fire (Photos taken by Luke Mcguire)**

**Photo of water repellent (hydrophobic) soil**

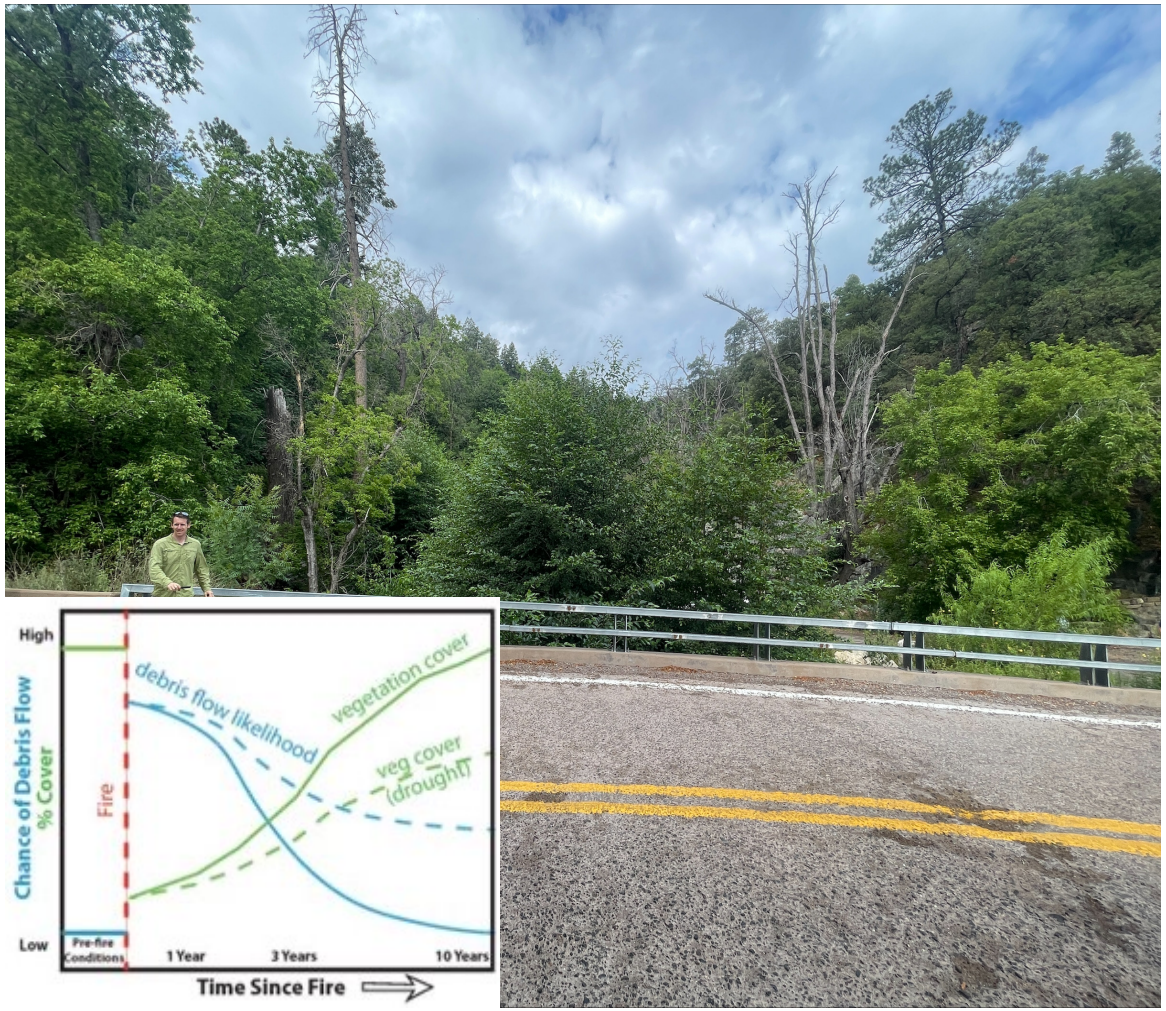
- Increased wildfires
- Soil water repellency
- Increased run off leads to erosion and other water related hazards
- Window of Disturbance estimated (3-5 years)
- Dangers to human safety and extreme costs for infrastructure restoration

**(McGuire and Youberg, 2019 ESPL; Raymond 2020 ESPL; Santi & Rengers, 2020 Treatise on Geomorphology; Liu et al., 2023 ESPL)**

**Cabin in Madera Canyon, Rio Rico AZ after the 2005 Florida Fire (Photos from AZGS)**

Becky Beers at Frye Fire, Safford AZ 2018

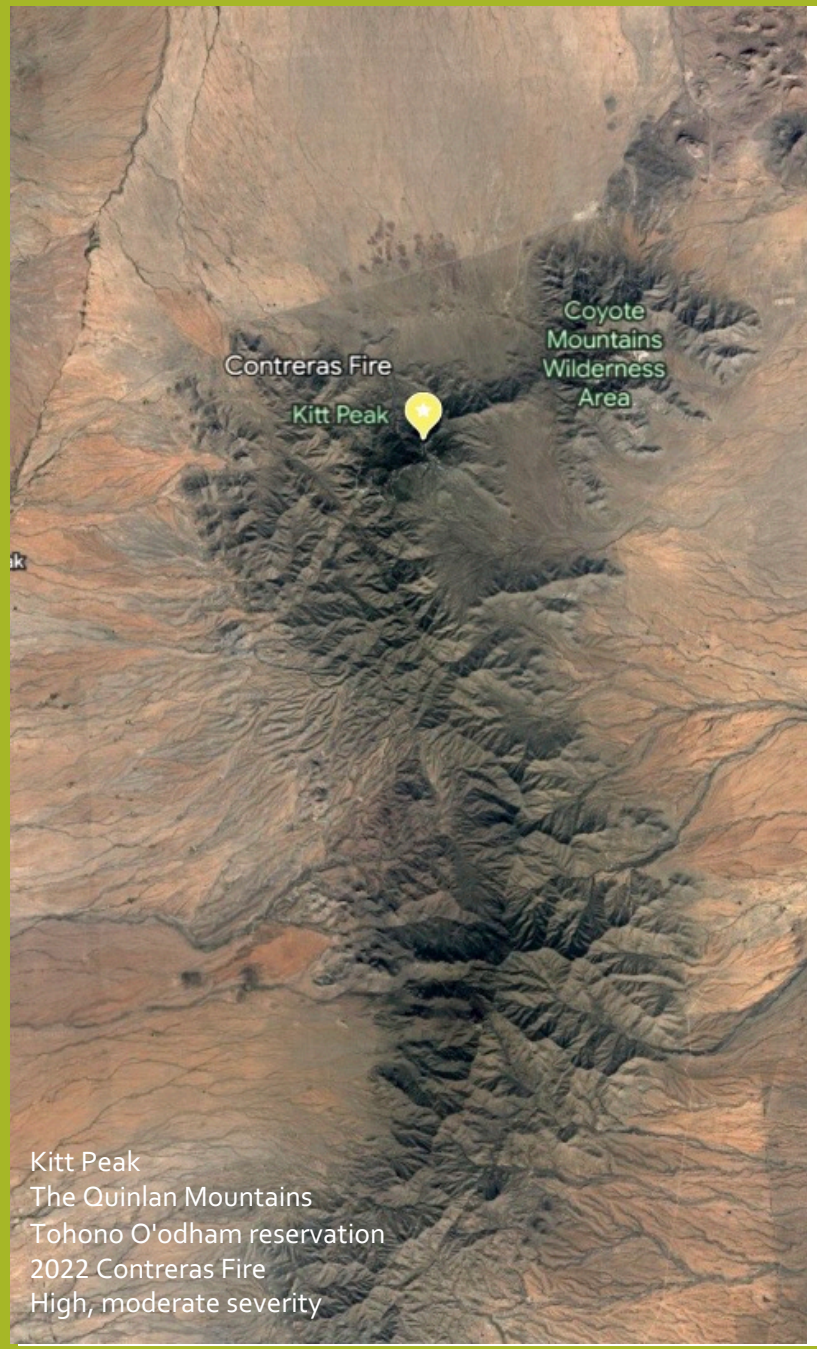
Luke Mcguire at Frye Fire, Safford AZ 2023



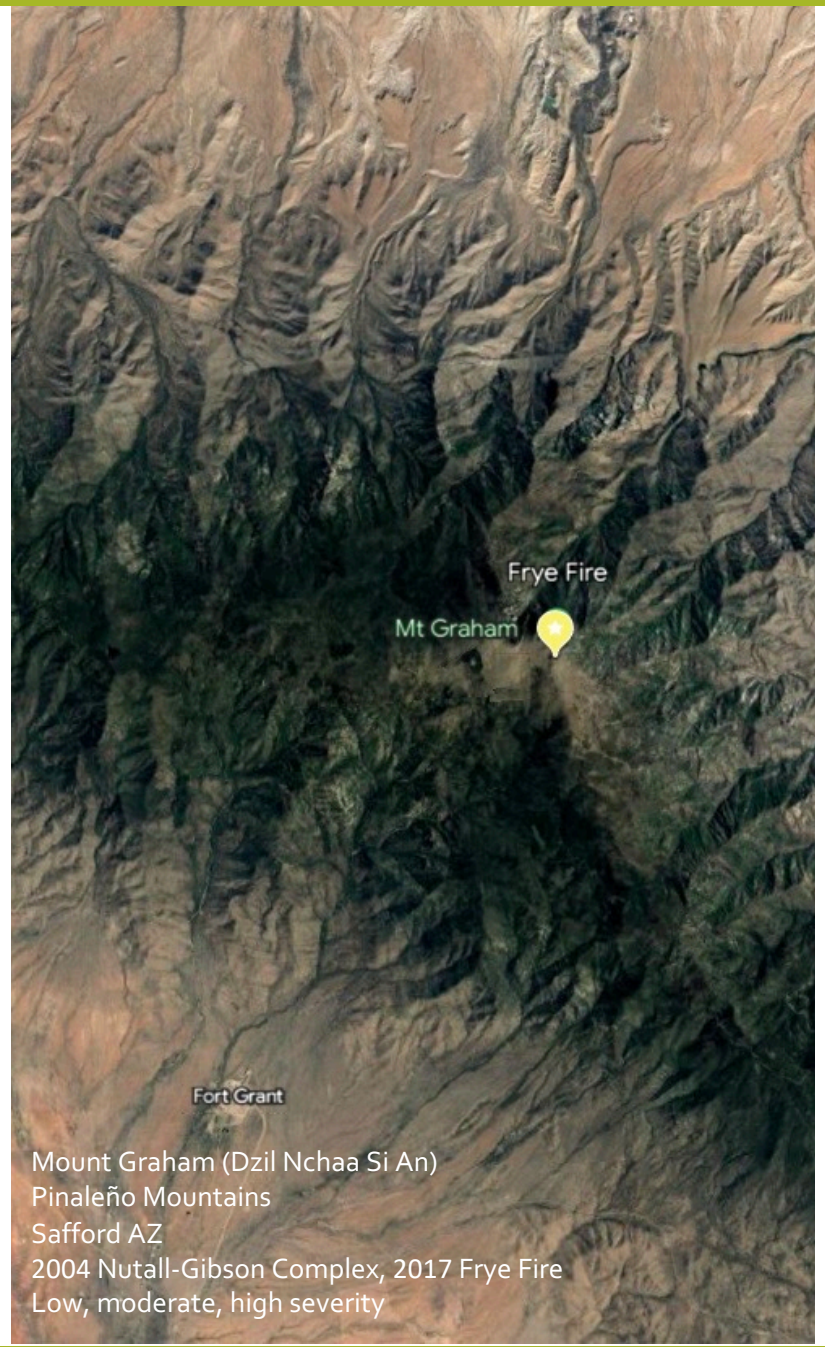



- Saturated hydraulic conductivity estimated to go down immediately after fire and return to normal levels within 3–5-year window of disturbance.
- Find trends in post fire recovery time
- How do fires affect soil hydraulic properties? How long is the window of disturbance in burned areas in Arizona?

**Diagram by Luke McGuire**
**Photos taken by Becky Beers AZGS**
**(Liu et al., 2023 ESPL)**




Kitt Peak
The Quinlan Mountains
Tohono O'odham reservation
2022 Contreras Fire
High, moderate severity




Mount Graham (Dzil Nchaa Si An)
Pinaleño Mountains
Safford AZ
2004 Nutall-Gibson Complex, 2017 Frye Fire
Low, moderate, high severity

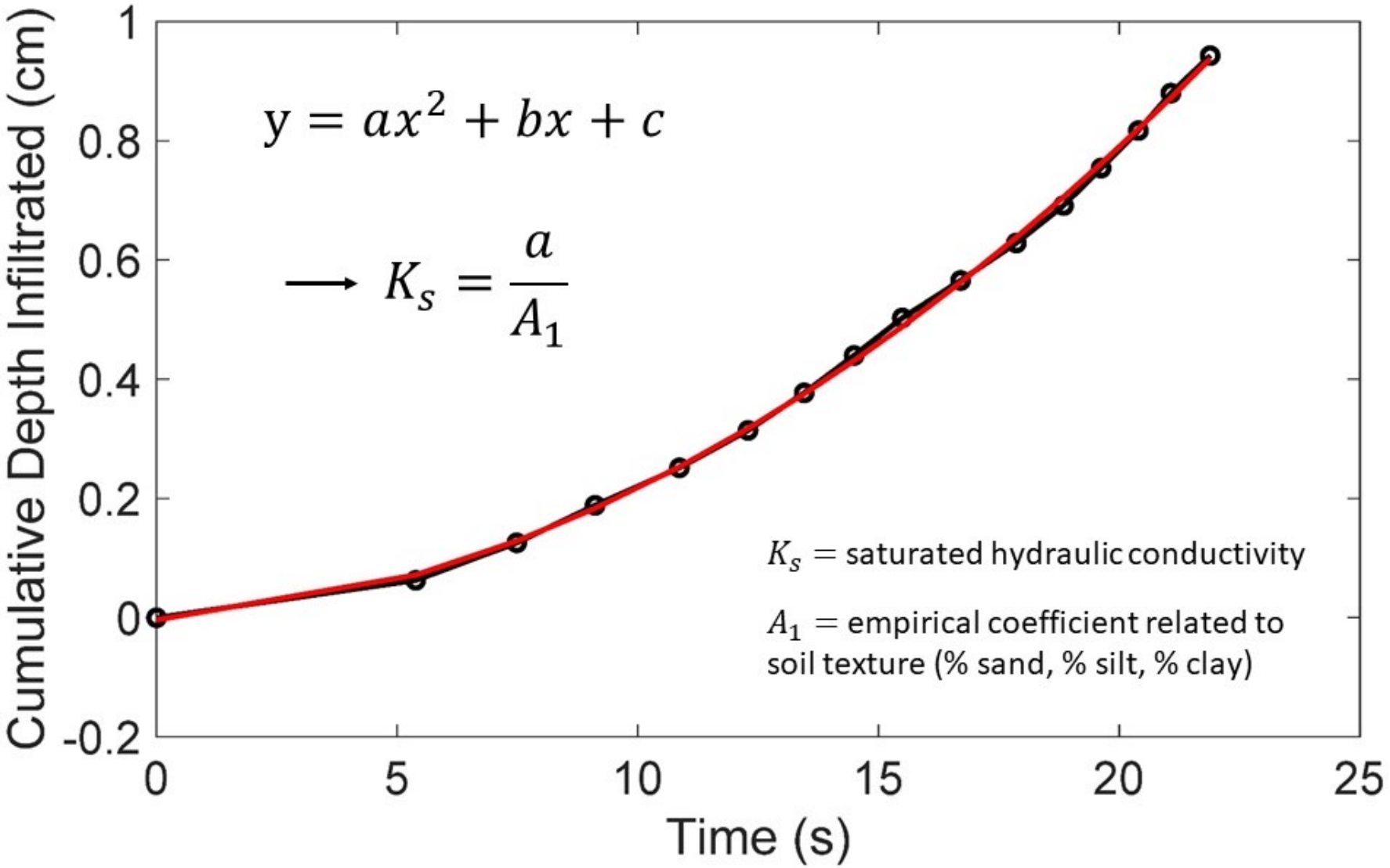

Pinal Mountains
Globe AZ
2021 Telegraph Fire
High, moderate severity


Phoenix
Tonopah
Buckeye
Mesa
Apache Junction
Telegraph Fire
Globe
Morenci
San Tan Valley
Gila River
Maricopa
Florence
Casa Grande
Frye Fire
Safford
Duncan
Gila Bend
Marana
Tucson
Ajo
Why
Contreras Fire
Organ Pipe Cactus National Monument
Benson
Sahuarita
Green Valley
Coronado National Forest
Sonoyta
Topawa
Tubac
Sonoita
Sierra Vista
(McGuire and Youberg, 2019)
110°0'0"W
109°45'0"W
32°45'0"N
Study Area
To Safford
Safford
Tucson
2004 Nuttall-Gibson Complex
2017 Frye Fire
0 50 100 km
0 5 10 km
N

Mini Disk Infiltrometer

Transect and Mini Disk Infiltrometer

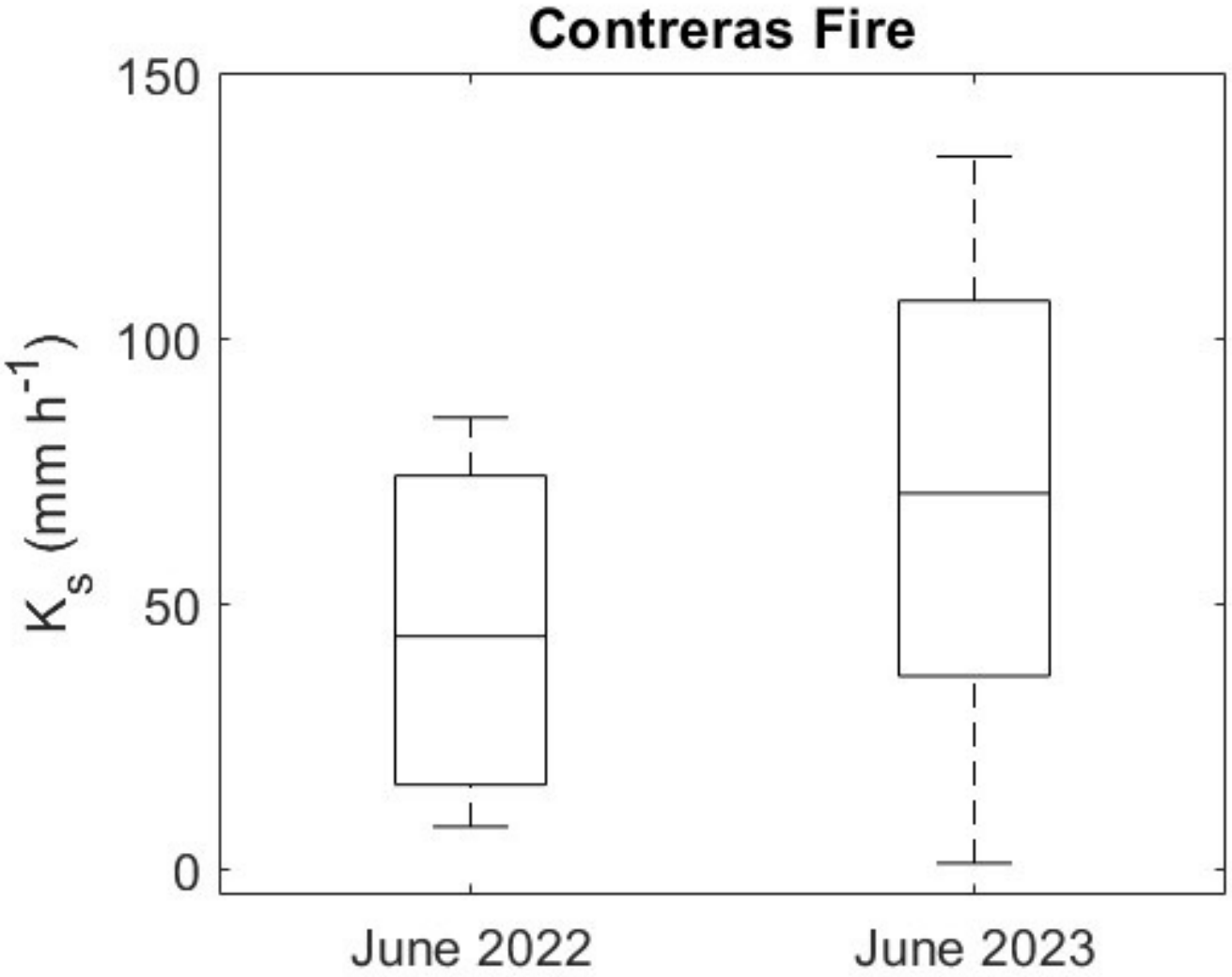
# Estimate $K_s$ by fitting a curve to data obtained from infiltrometer

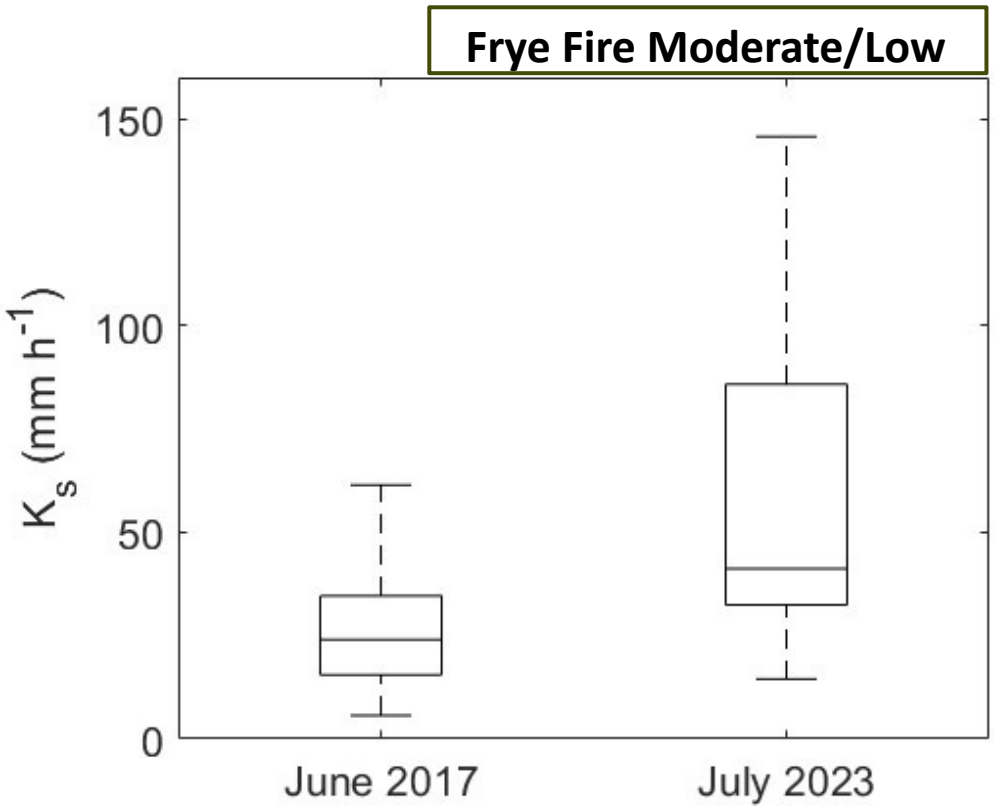


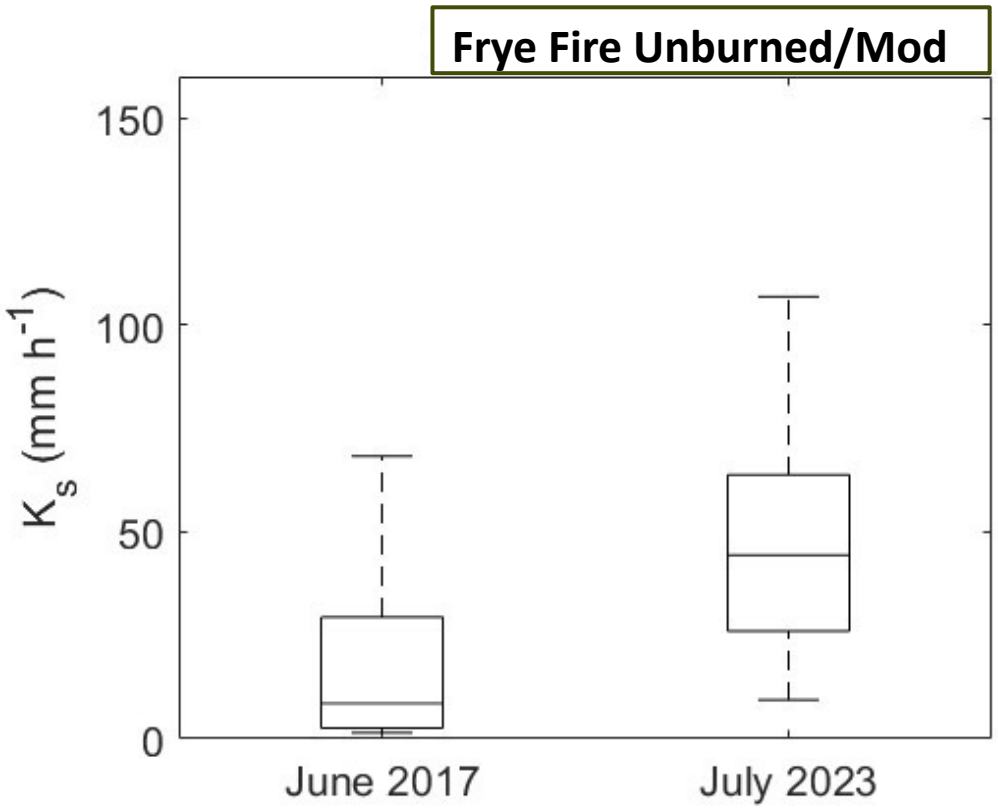
# Results

June 2022 median Ks: 44 mm/h

June 2023 median Ks: 71 mm/h

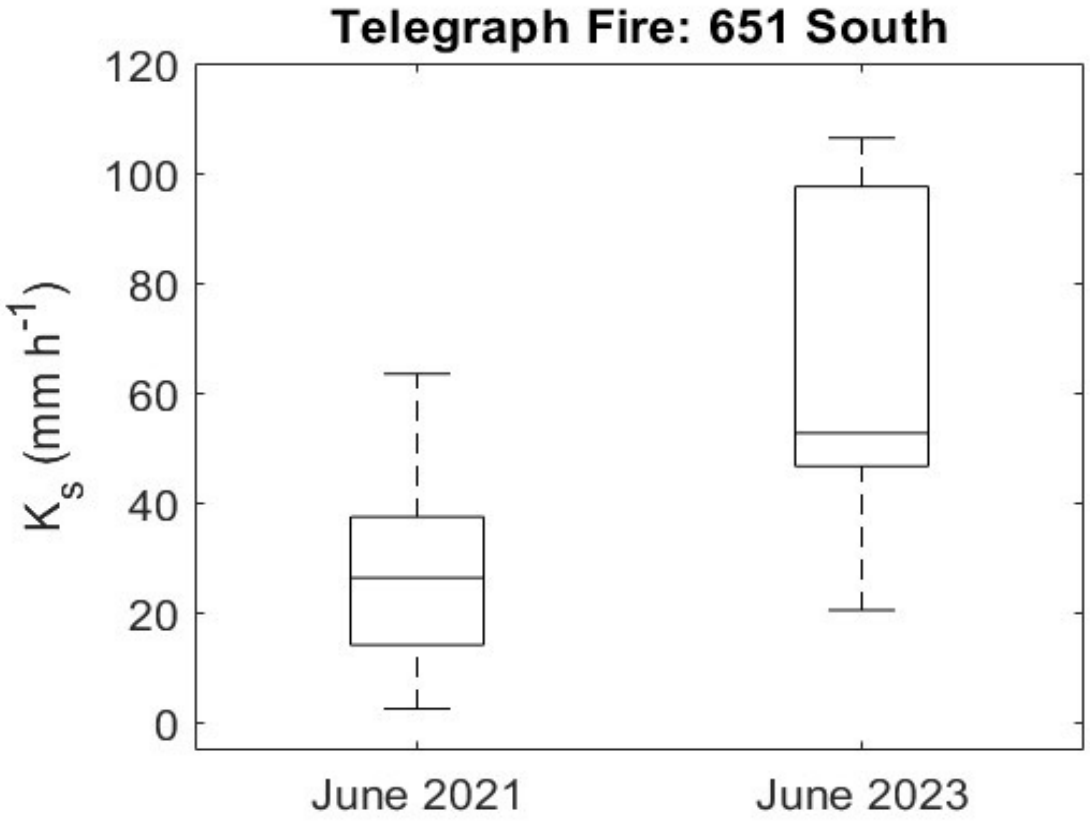


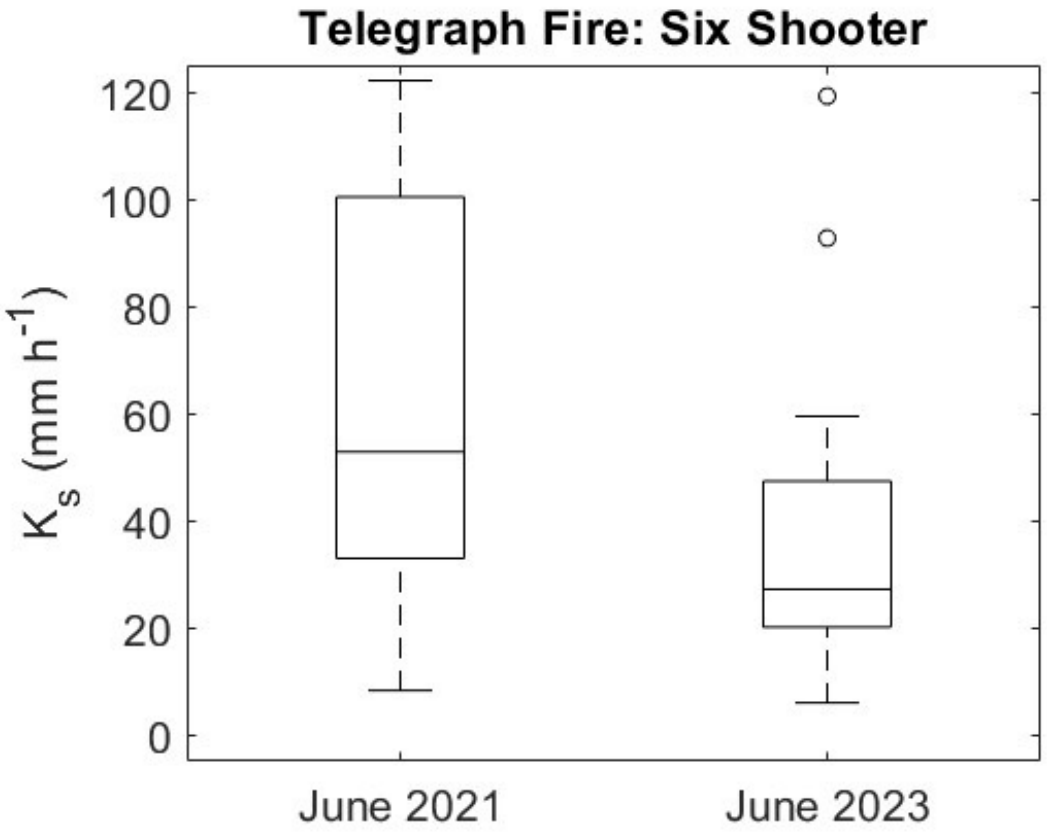



June 2017 median Ks: 24 mm/h
July 2023 median Ks: 41 mm/h

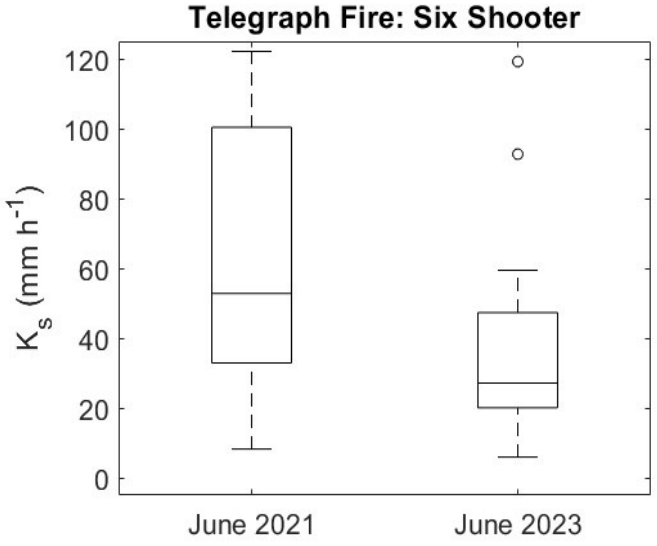
June 2017 median Ks-9 mm/h
July 2023 median Ks-44 mm/h

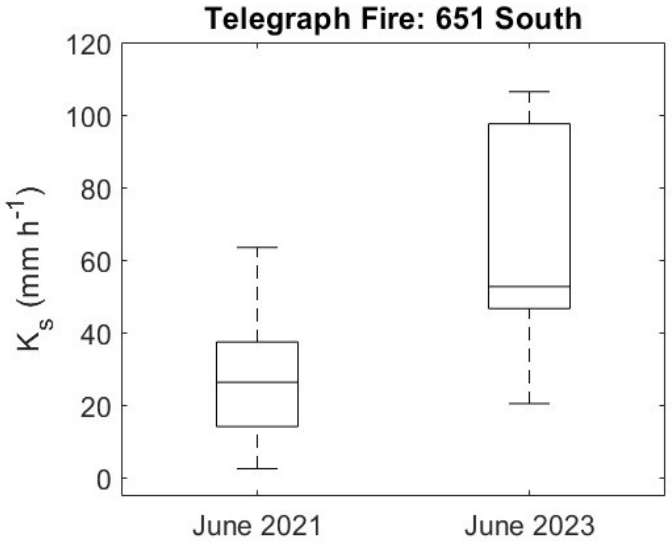


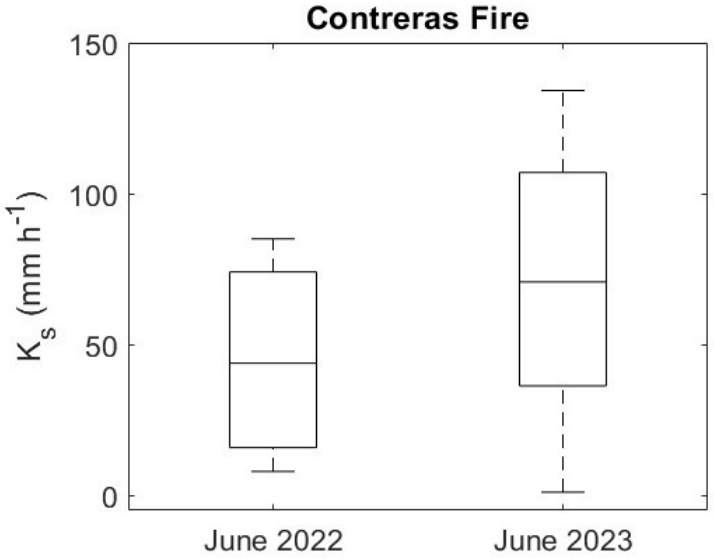



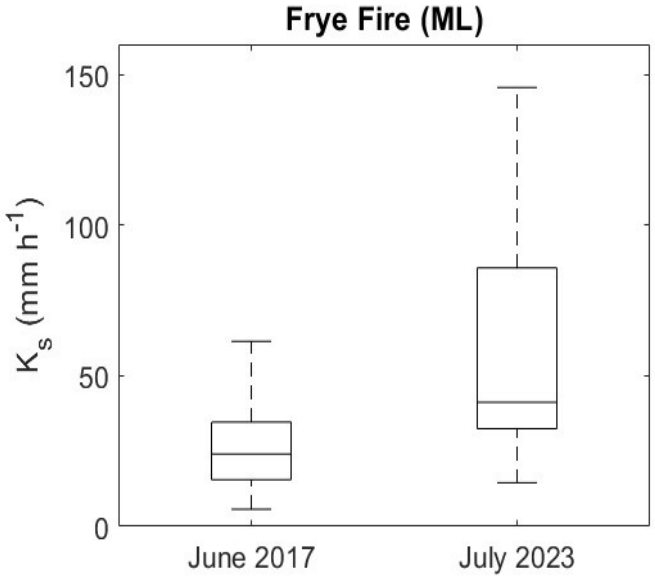

June 2021 median Ks: 27 mm/h
June 2023 median Ks: 53 mm/h

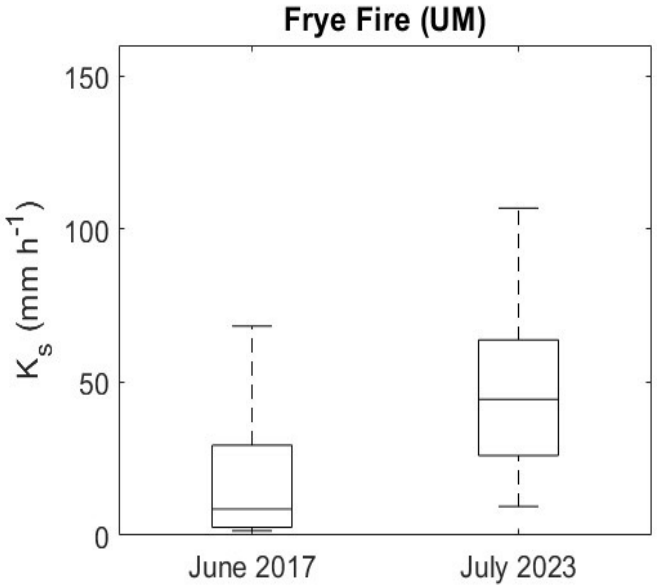
June 2021 median Ks: 53 mm/h
June 2023 median Ks: 27 mm/h




- Substantial changes in Ks over periods of one year.
- Continued monitoring needed to quantify window of disturbance.

# Conclusion

- Find trends in post fire recovery time.
- How long is the window of disturbance in Arizona?
- Ks increased at 4 of 5 sites.
- Trends in post fire recovery time in periods of one year or less.
- More data needed.


Thank You!

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**Becky Beers, Tao Liu,**
**Alexander Gorr, Joseph Martinez**