Soil Moisture and Wildfire Relationships in Oklahoma

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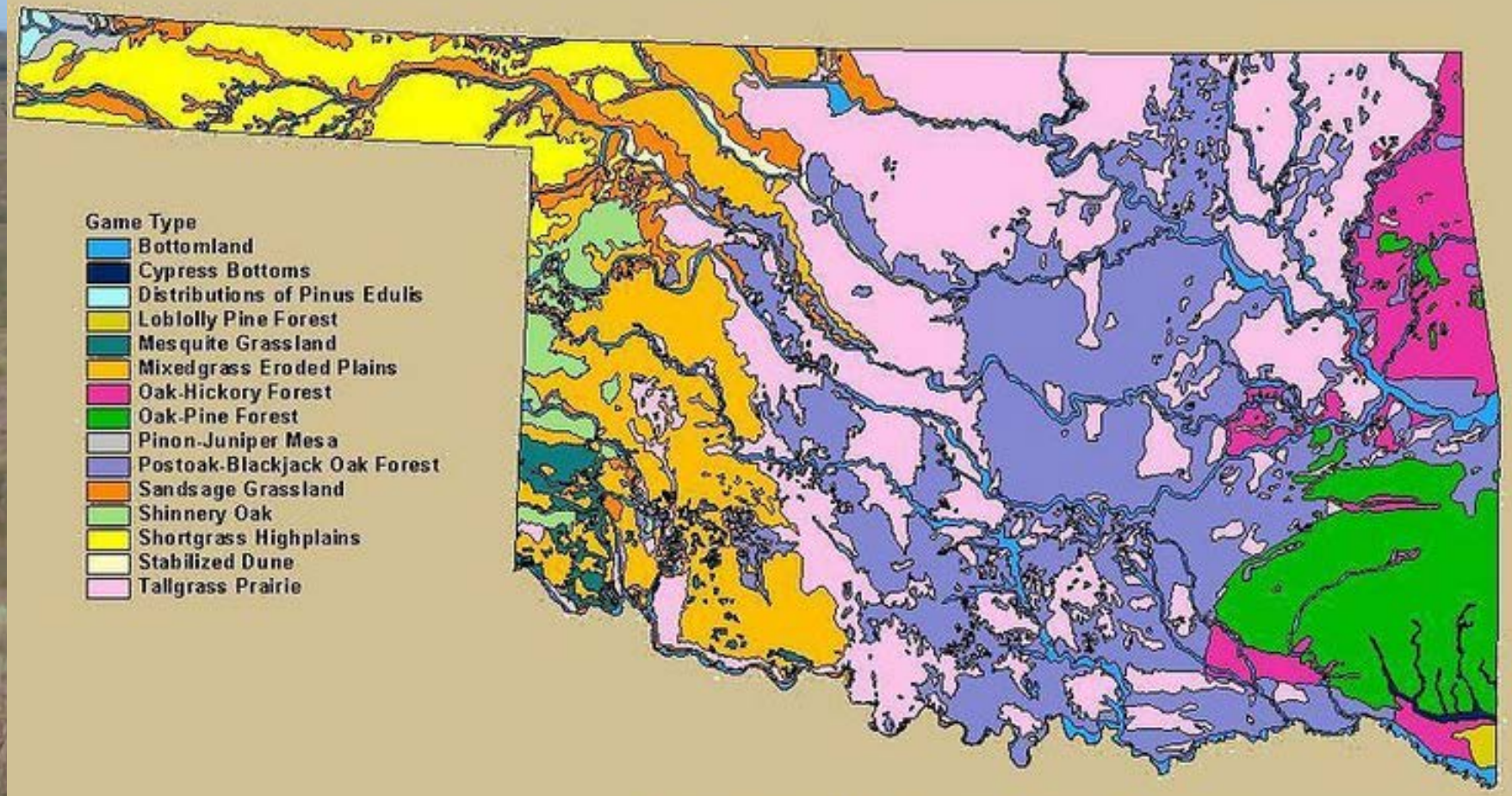
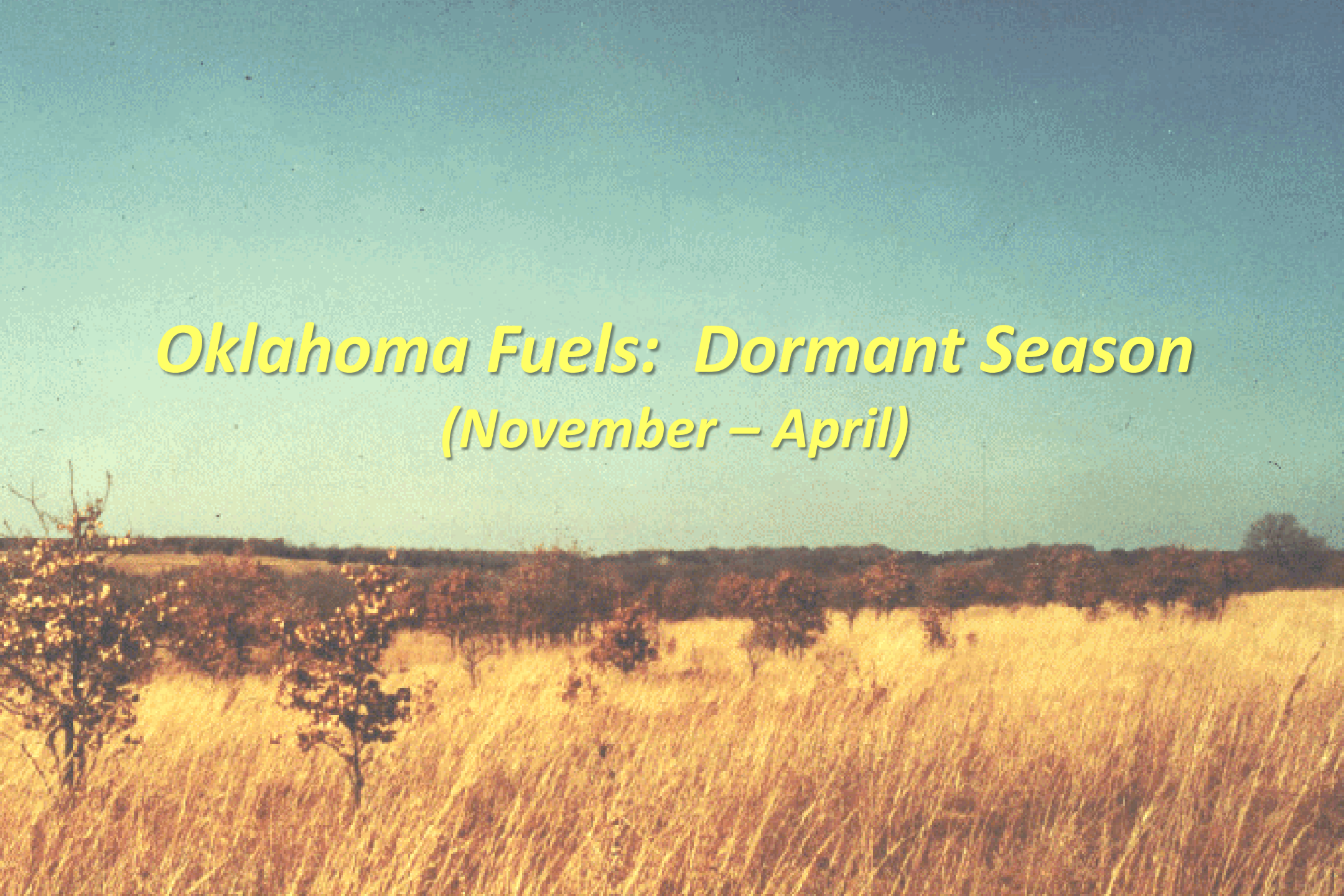
Oklahoma State University, Stillwater, Oklahoma



Map courtesy of Oklahoma Biological Survey


Oklahoma Fuels: Dormant Season
(November – April)


Oklahoma Fuels: Growing Season
(May – October)

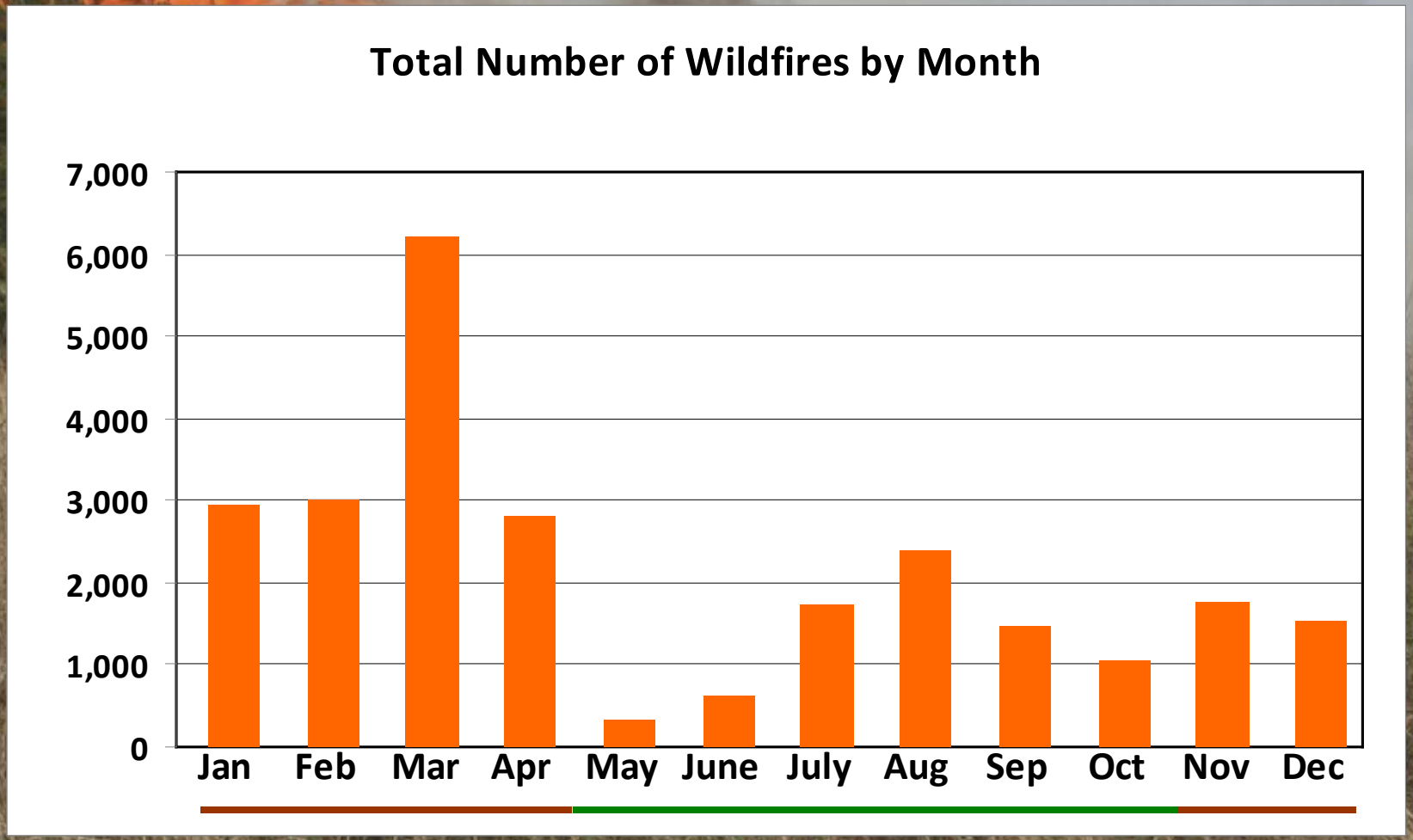

August 4-5, 2012


10:02 84°
KOTV - DT
August 5-10, 2011

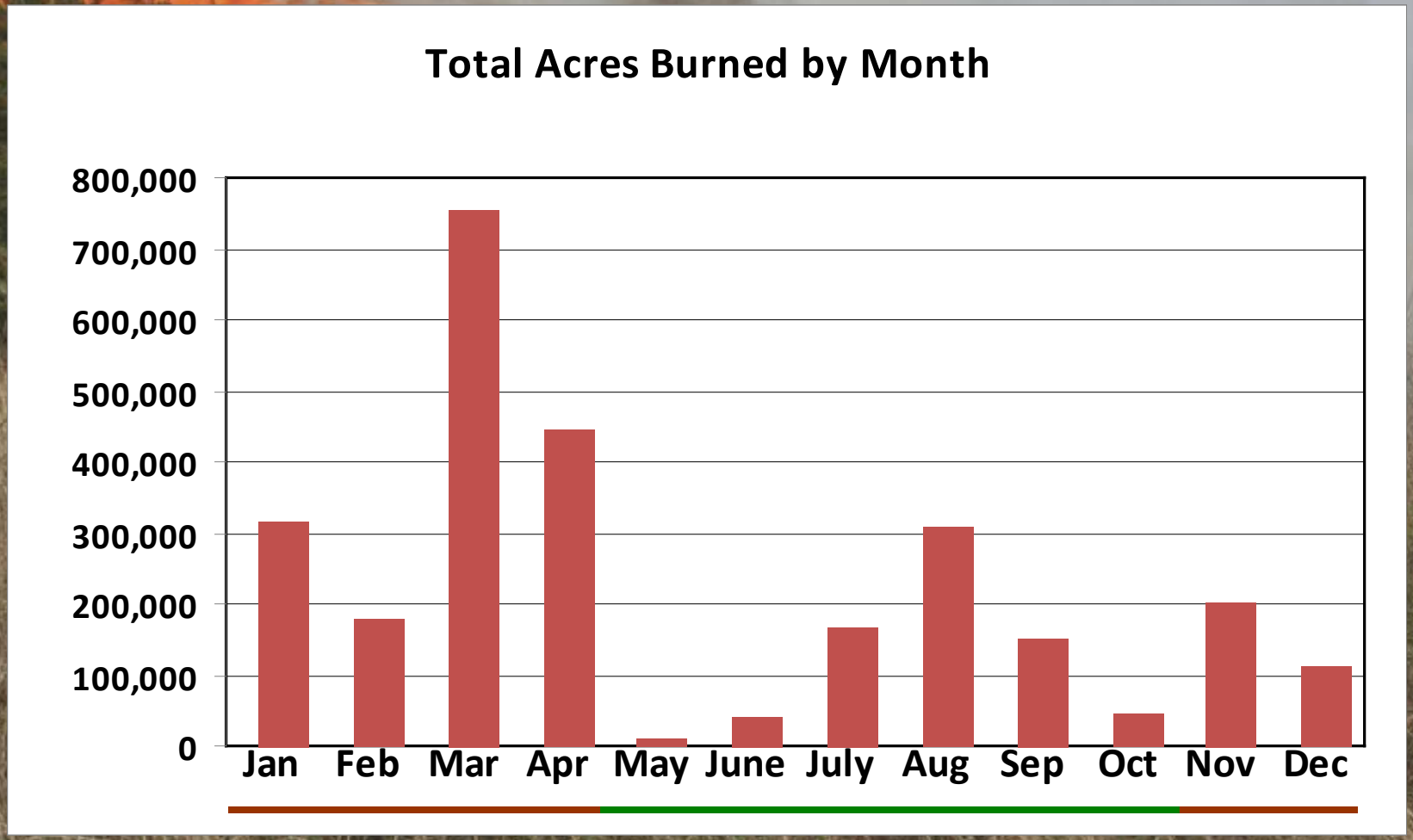
Oklahoma Wildfire Database (25,829 wildfires from 2000-2012)

- Karen Short database (Oklahoma fires) for 2000-2012
- 111 wildfires >= 1000 acres reported to Oklahoma Fire Marshal were added (flagged as likely viable by Karen and not in her database)

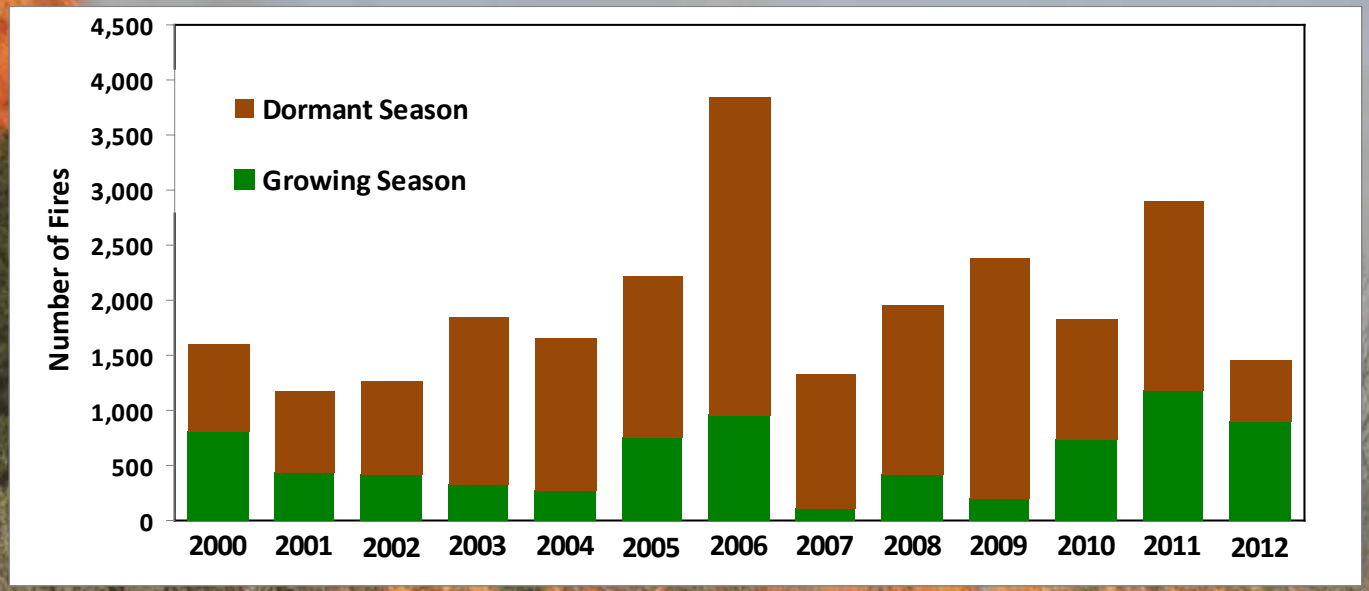
Oklahoma Wildfire Monthly Climatology
(25,829 wildfires from 2000-2012)

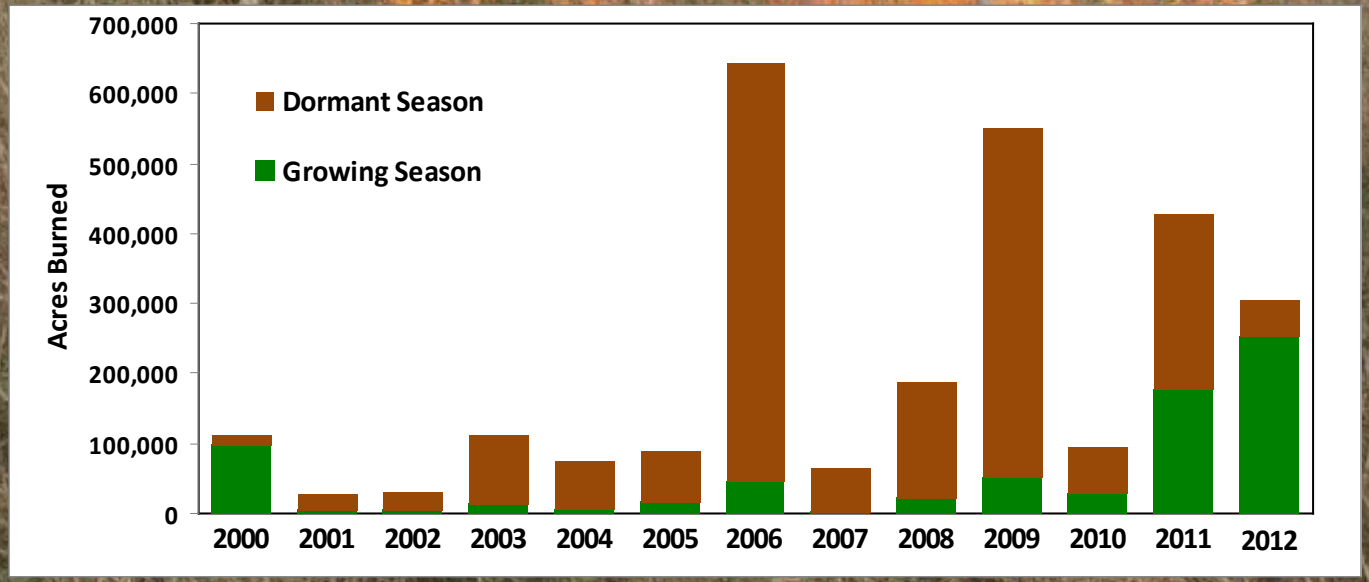


Oklahoma Wildfire Monthly Climatology
(25,829 wildfires from 2000-2012)



Oklahoma Wildfires by Year (2000-2012)

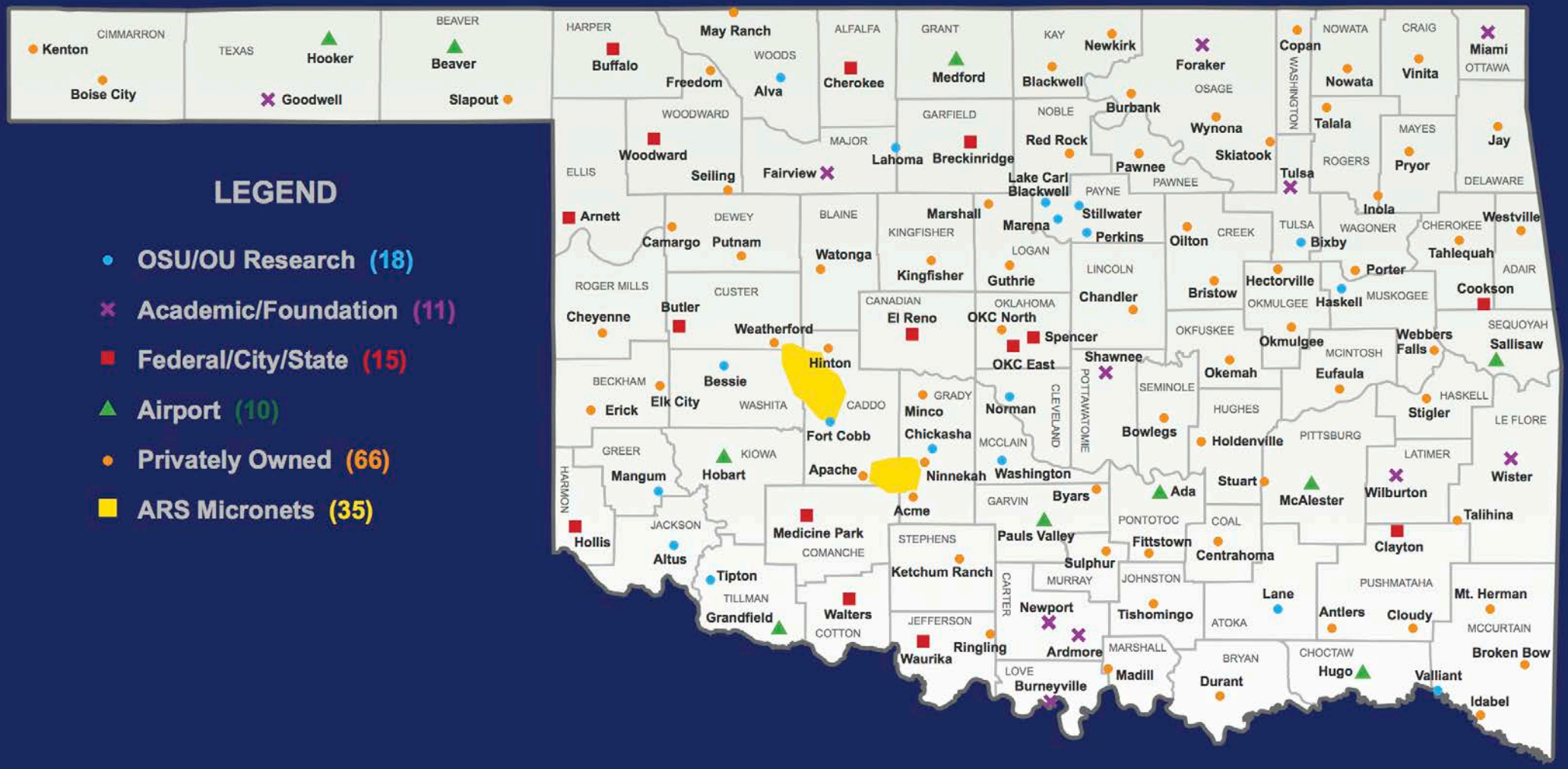




The Oklahoma Mesonet

Mesonet
Oklahoma's Weather Network

SITE LOCATIONS
OCTOBER 2015



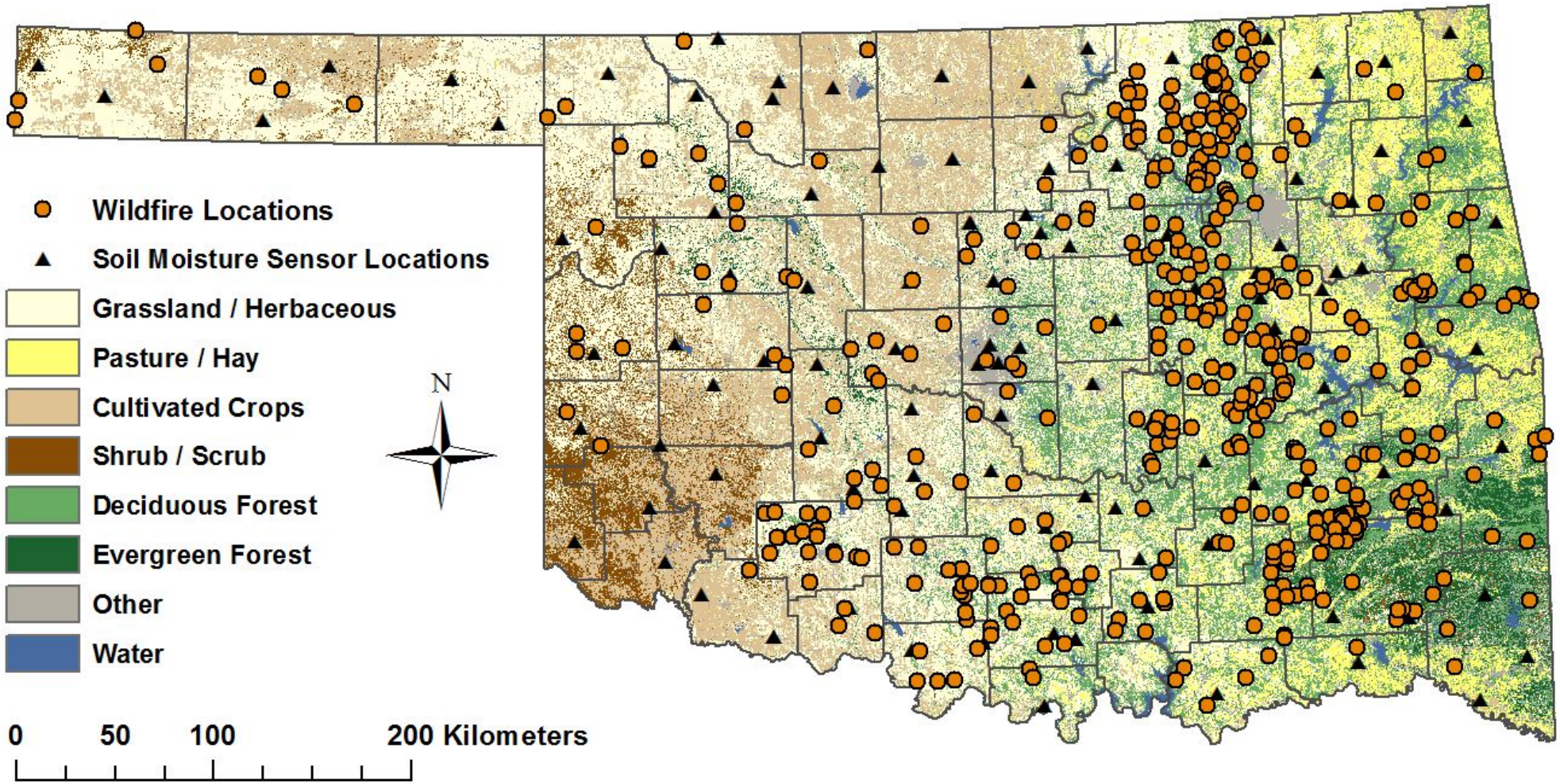
LEGEND

- OSU/OU Research (18)
- Academic/Foundation (11)
- Federal/City/State (15)
- Airport (10)
- Privately Owned (66)
- ARS Micronets (35)

LARGE Wildfires

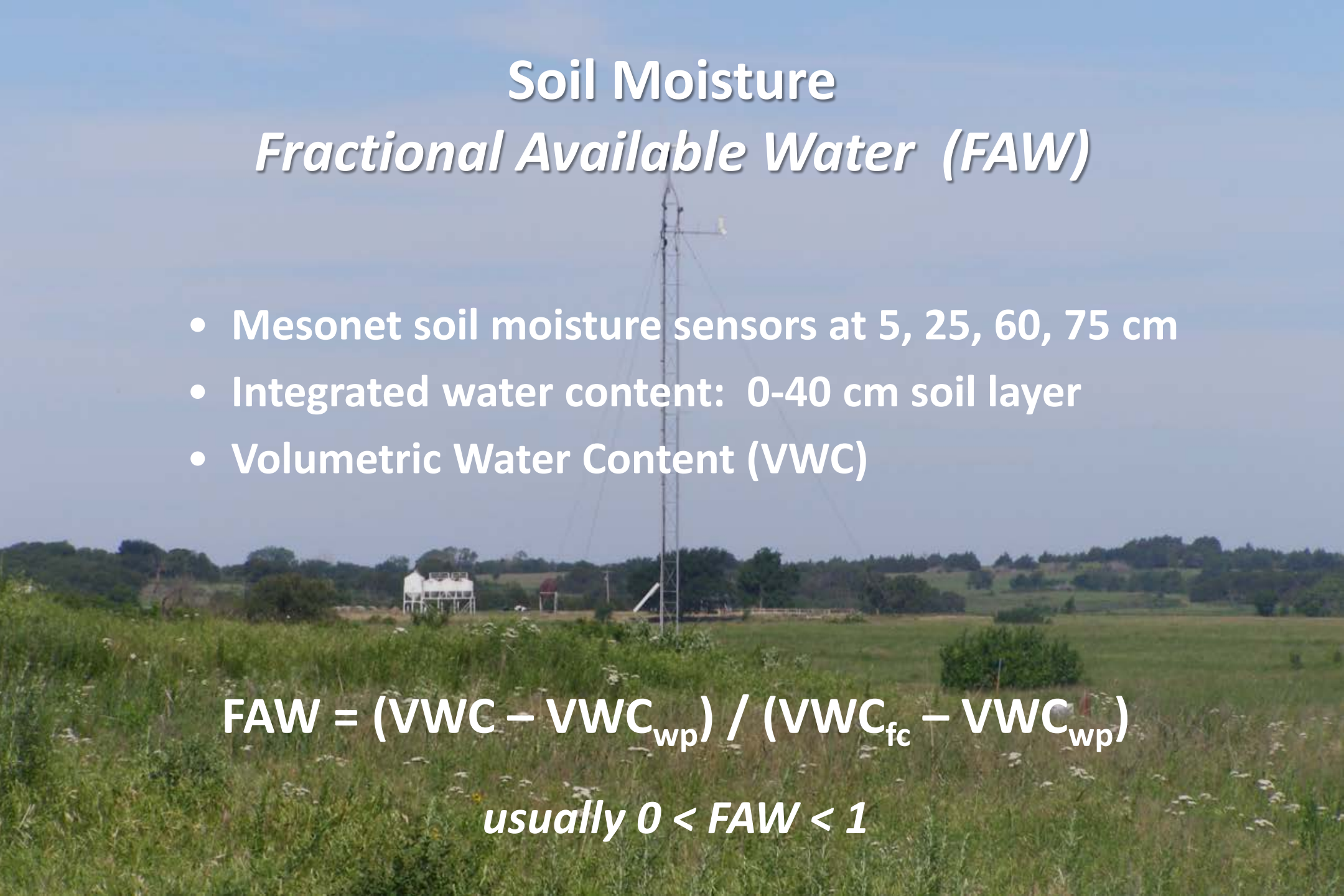
- Wildfires >= 1000 acres (400 ha)
- 501 wildfires (2000-2012)

Location of Wildfires and Soil Moisture Sensors Used in Research Study



Soil Moisture

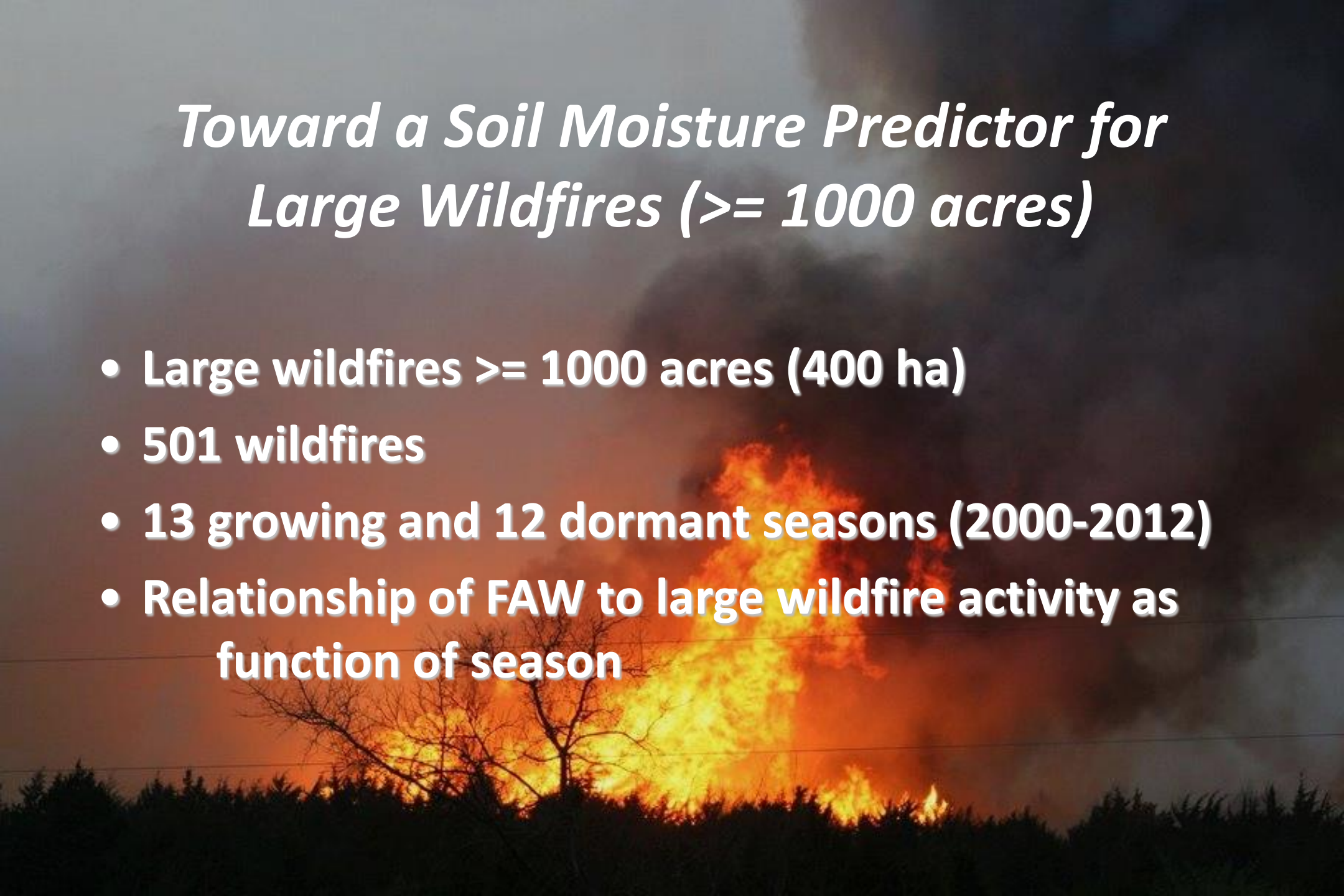
Fractional Available Water (FAW)



- Mesonet soil moisture sensors at 5, 25, 60, 75 cm
- Integrated water content: 0-40 cm soil layer
- Volumetric Water Content (VWC)

$$FAW = (VWC - VWC_{wp}) / (VWC_{fc} - VWC_{wp})$$

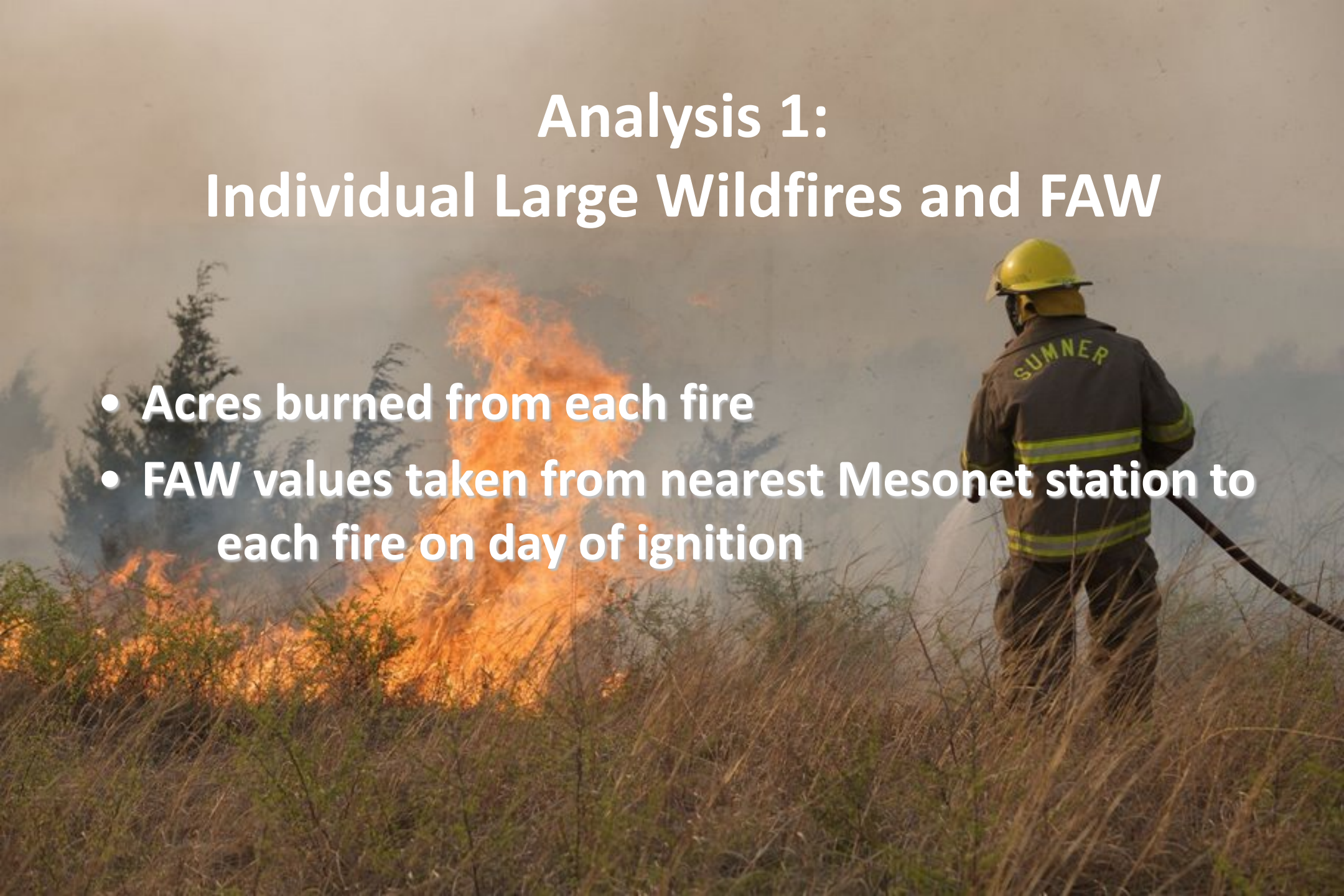
usually $0 < FAW < 1$



Toward a Soil Moisture Predictor for Large Wildfires (>= 1000 acres)

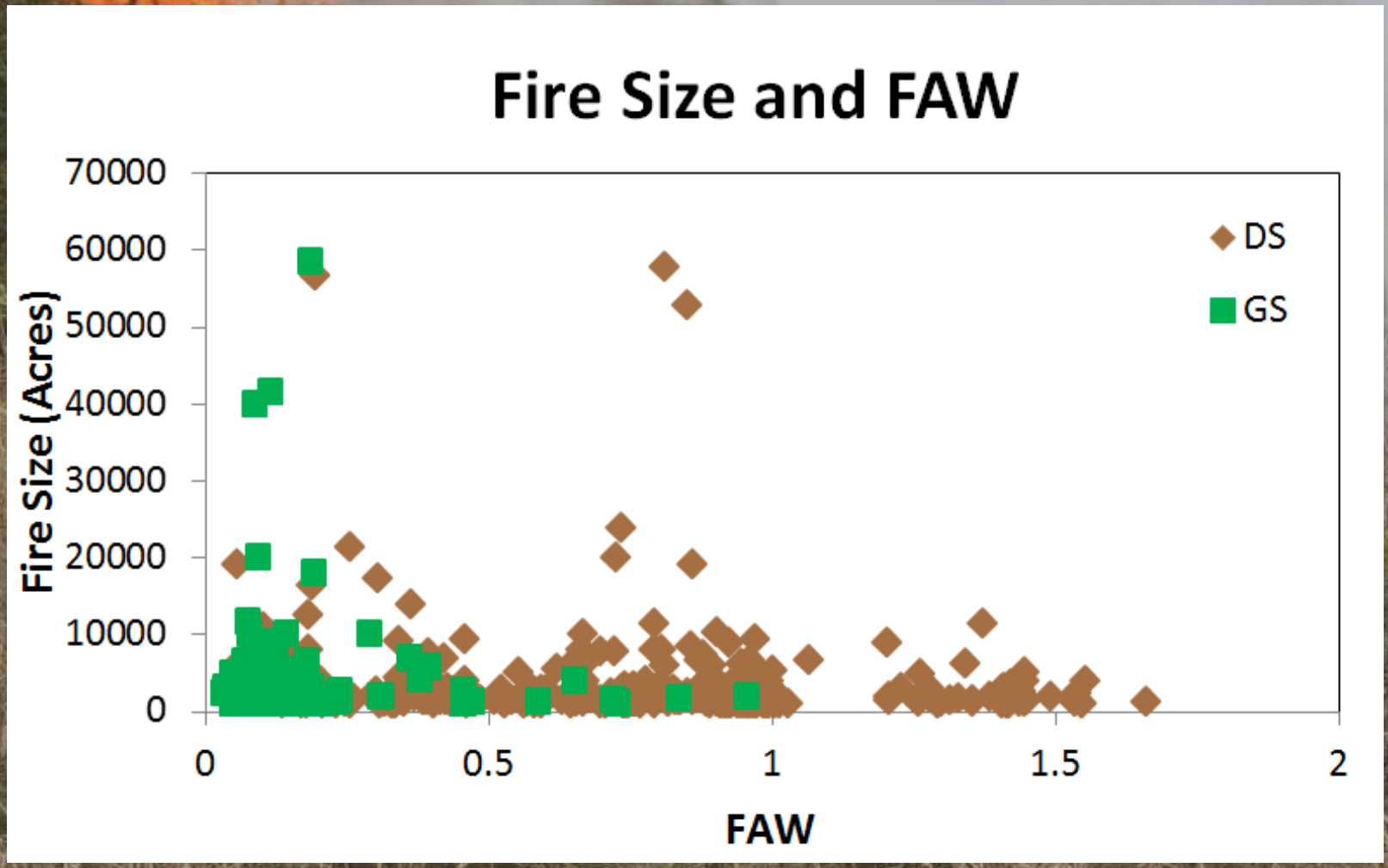
- Large wildfires >= 1000 acres (400 ha)
- 501 wildfires
- 13 growing and 12 dormant seasons (2000-2012)
- Relationship of FAW to large wildfire activity as function of season

Analysis 1:
Individual Large Wildfires and FAW



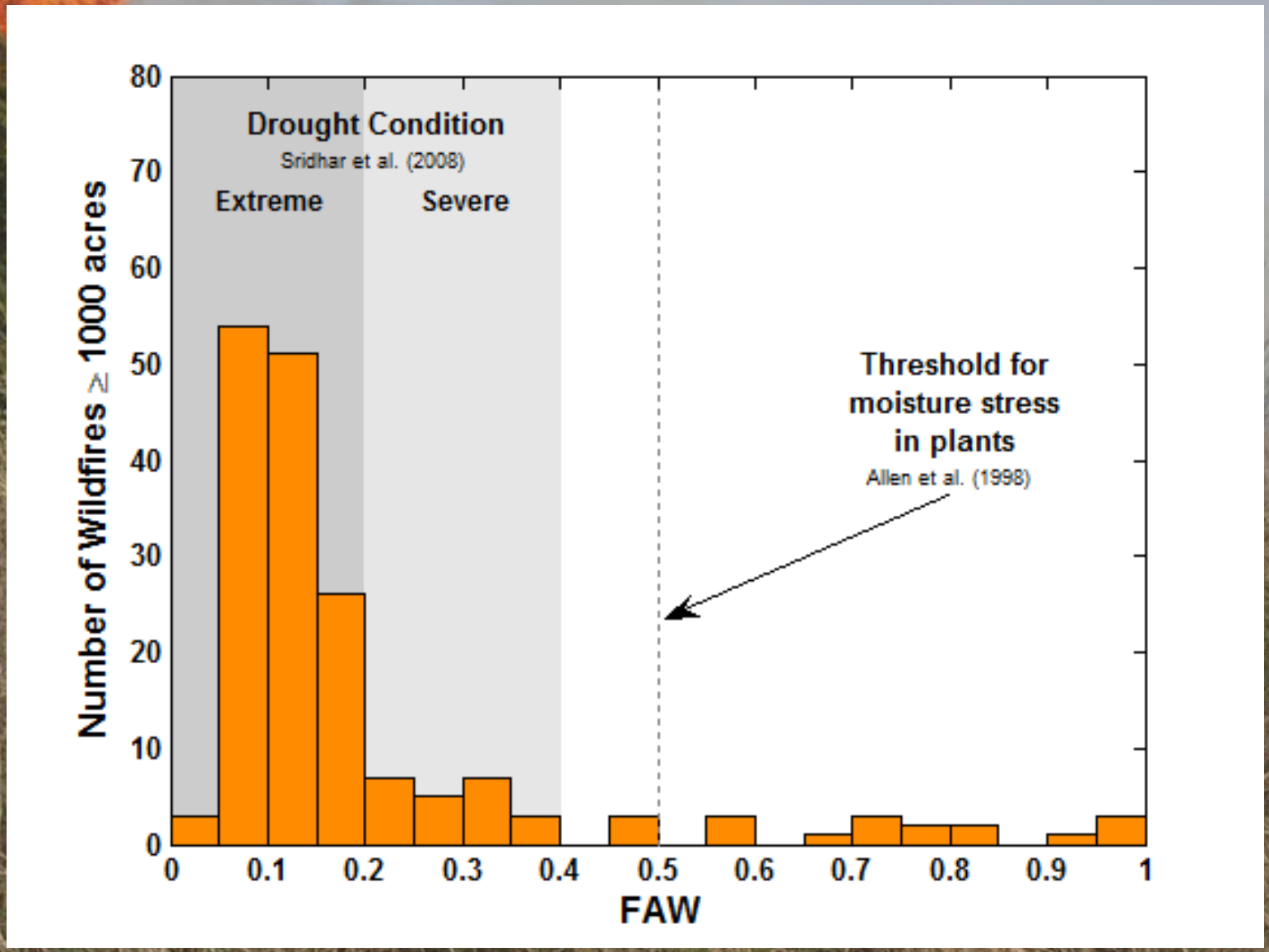
- Acres burned from each fire
- FAW values taken from nearest Mesonet station to each fire on day of ignition

Acres Burned

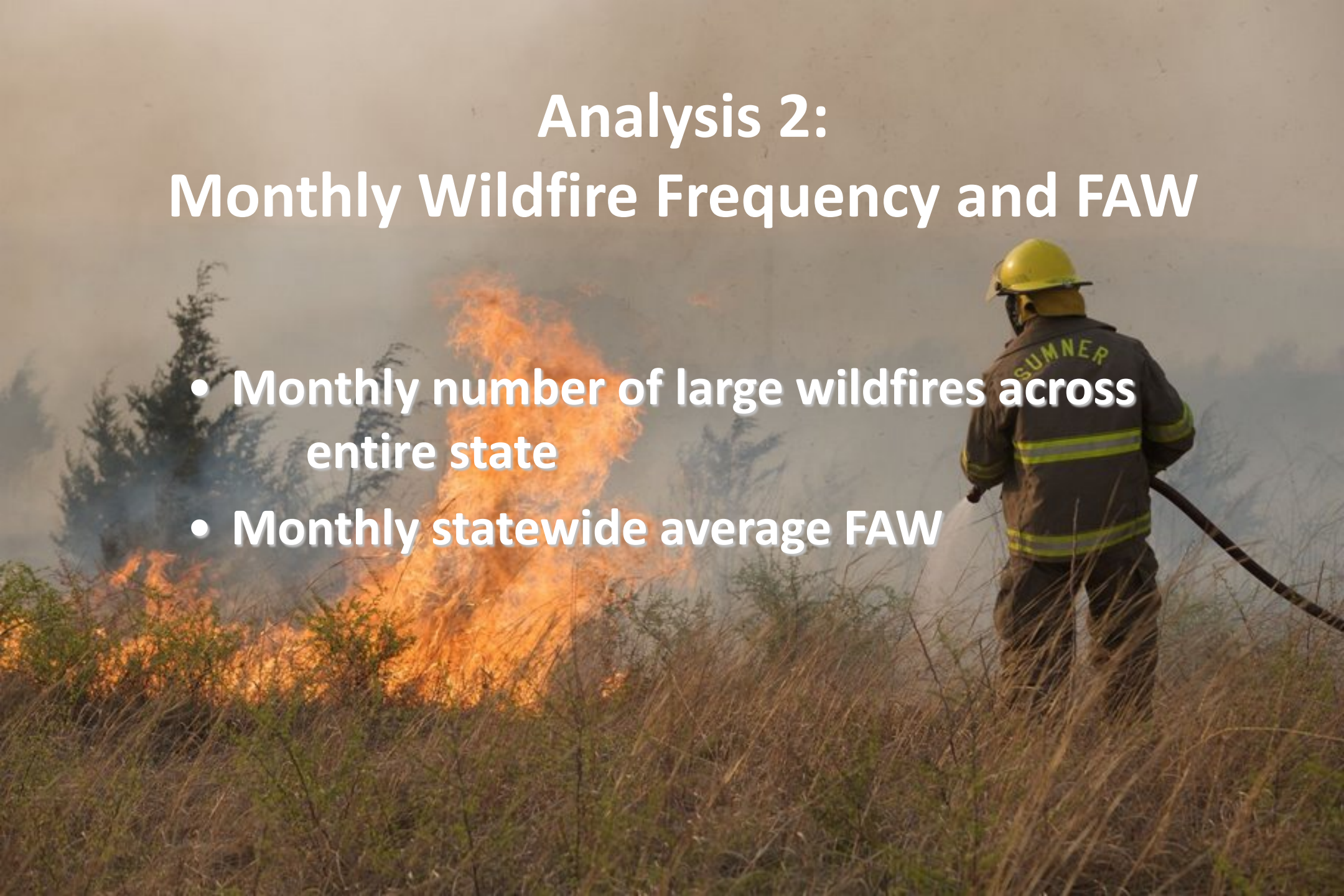


Growing Season Wildfires

(*Soil Science Society of America Journal*, 2015)



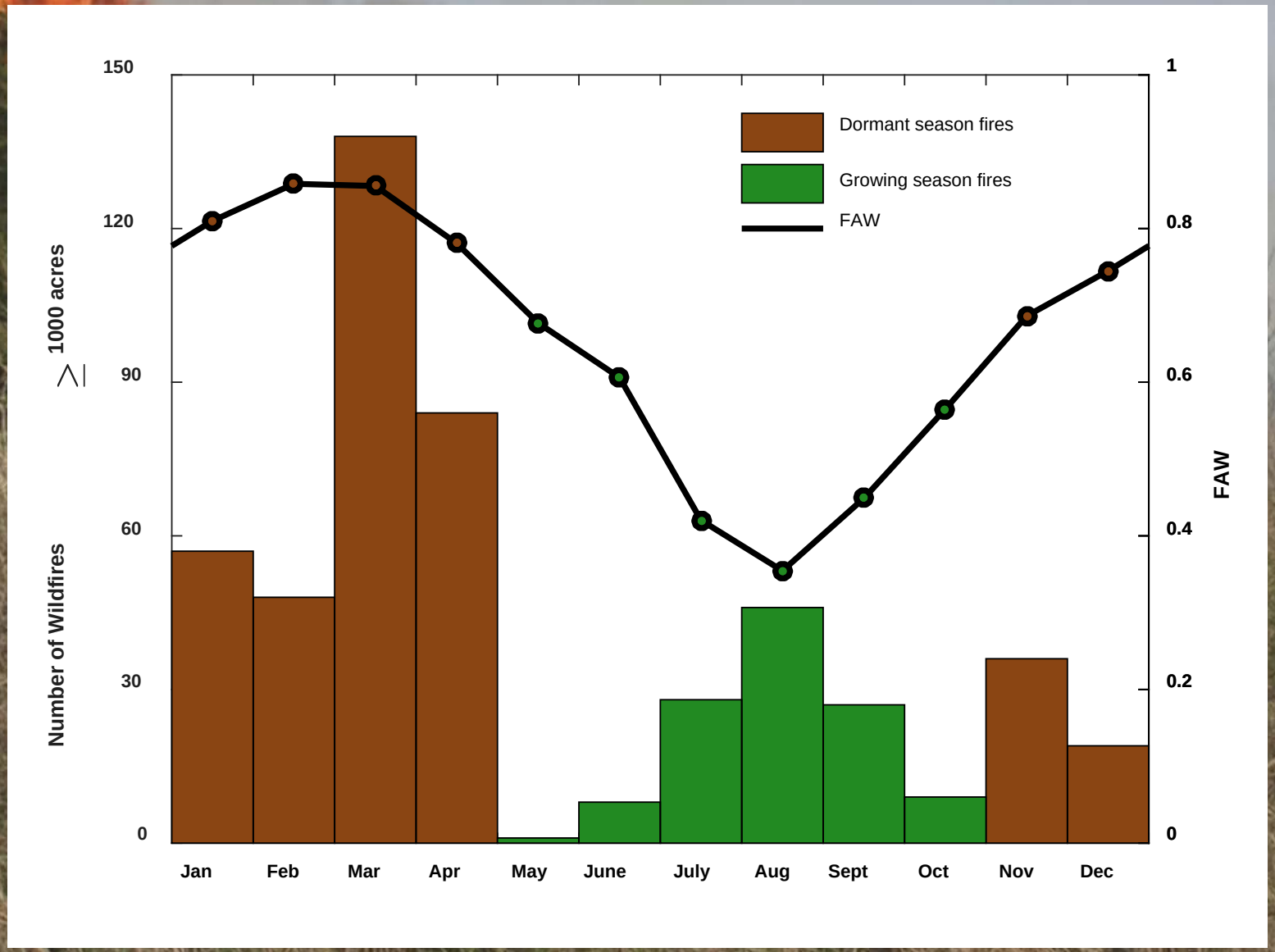
Analysis 2:
Monthly Wildfire Frequency and FAW

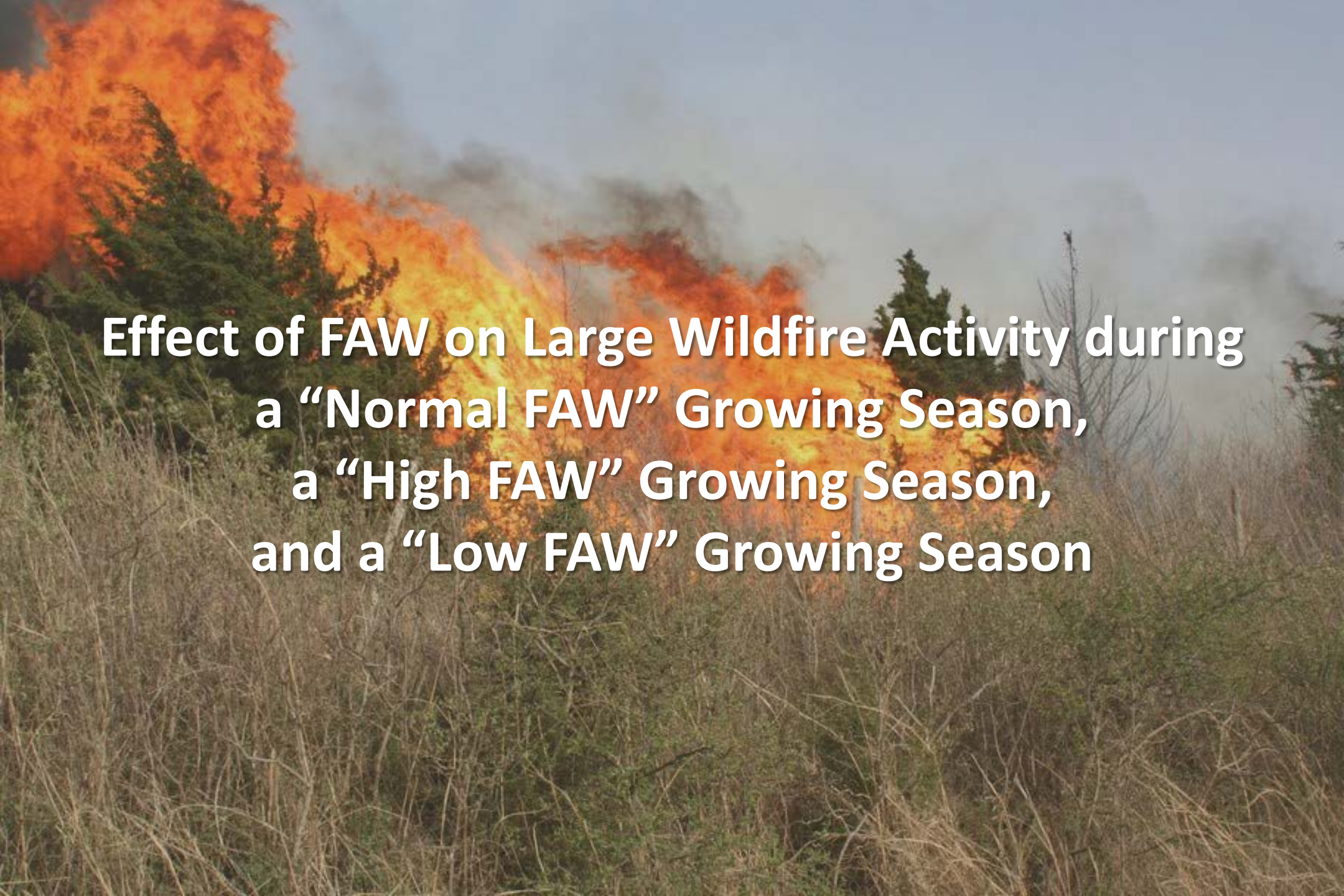


- Monthly number of large wildfires across entire state
- Monthly statewide average FAW

Large Wildfires by Month

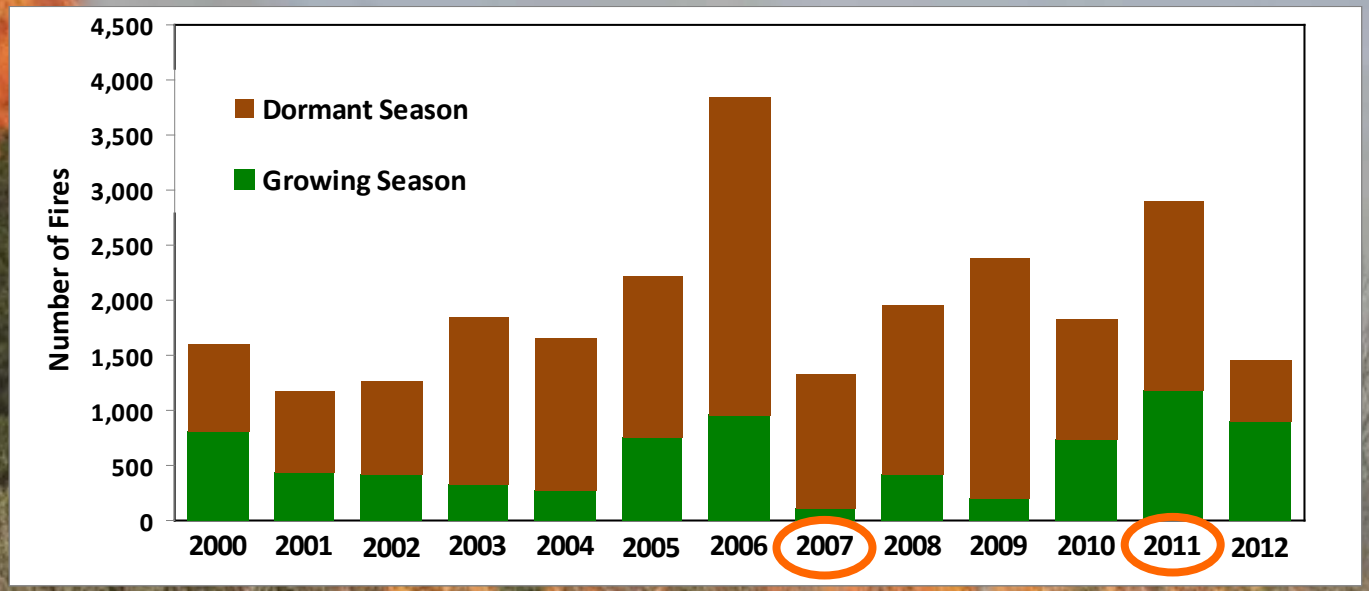
(*International Journal of Wildland Fire*, 2016)

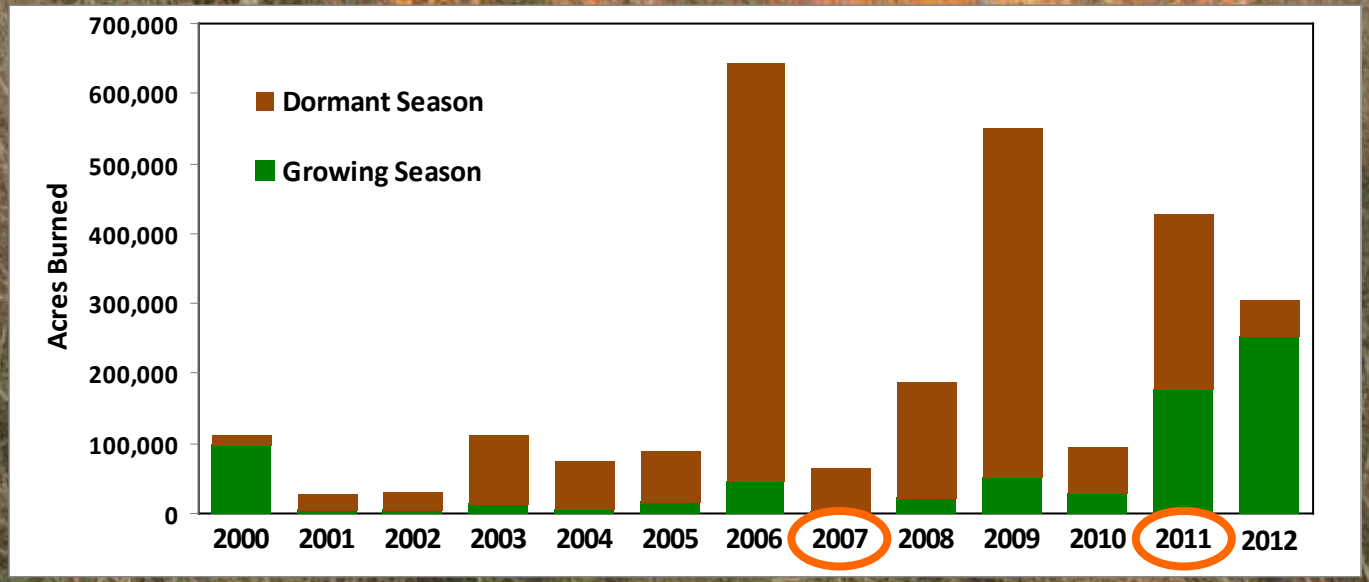




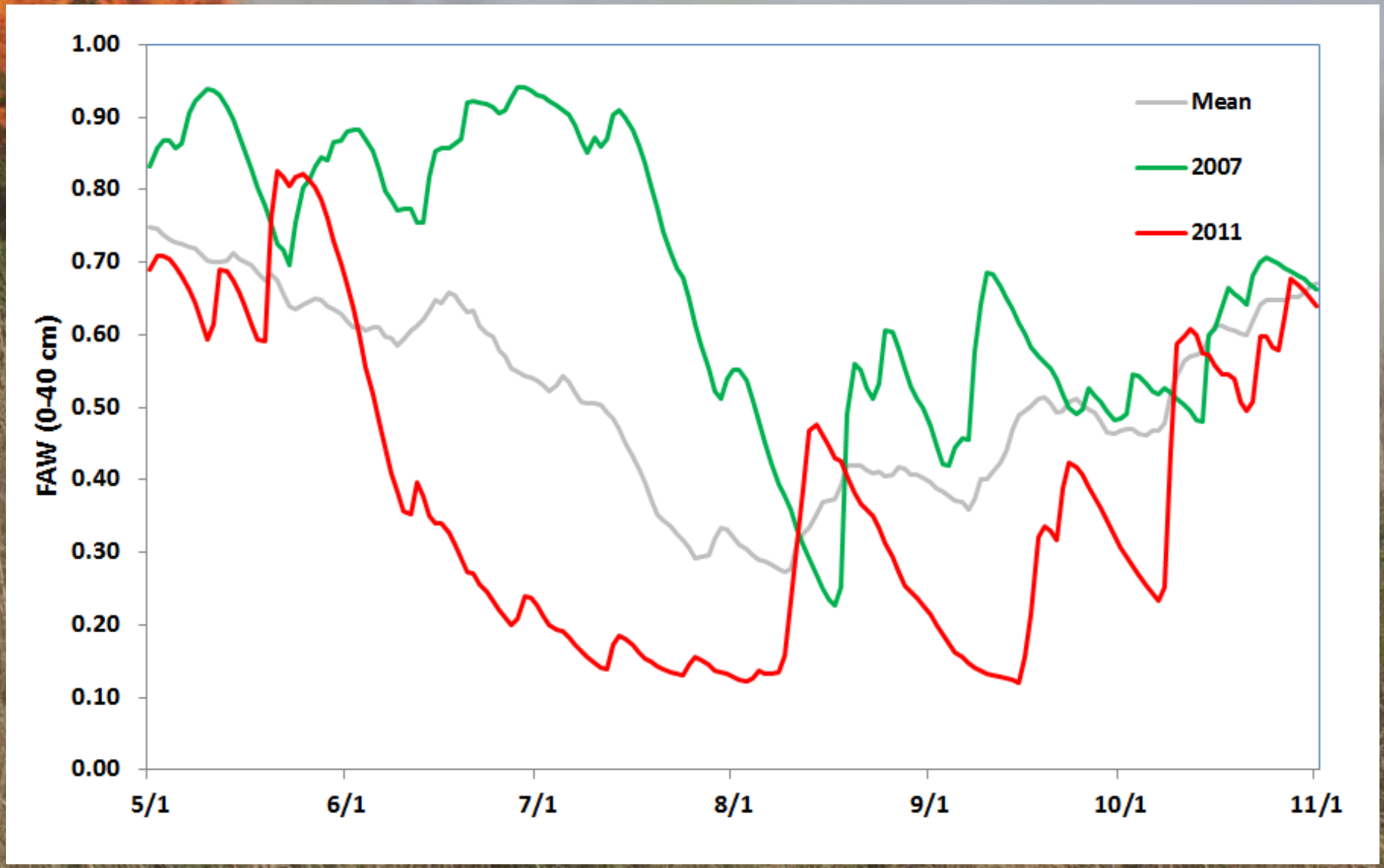
Effect of FAW on Large Wildfire Activity during a “Normal FAW” Growing Season, a “High FAW” Growing Season, and a “Low FAW” Growing Season

Oklahoma Wildfires by Year (2000-2012)





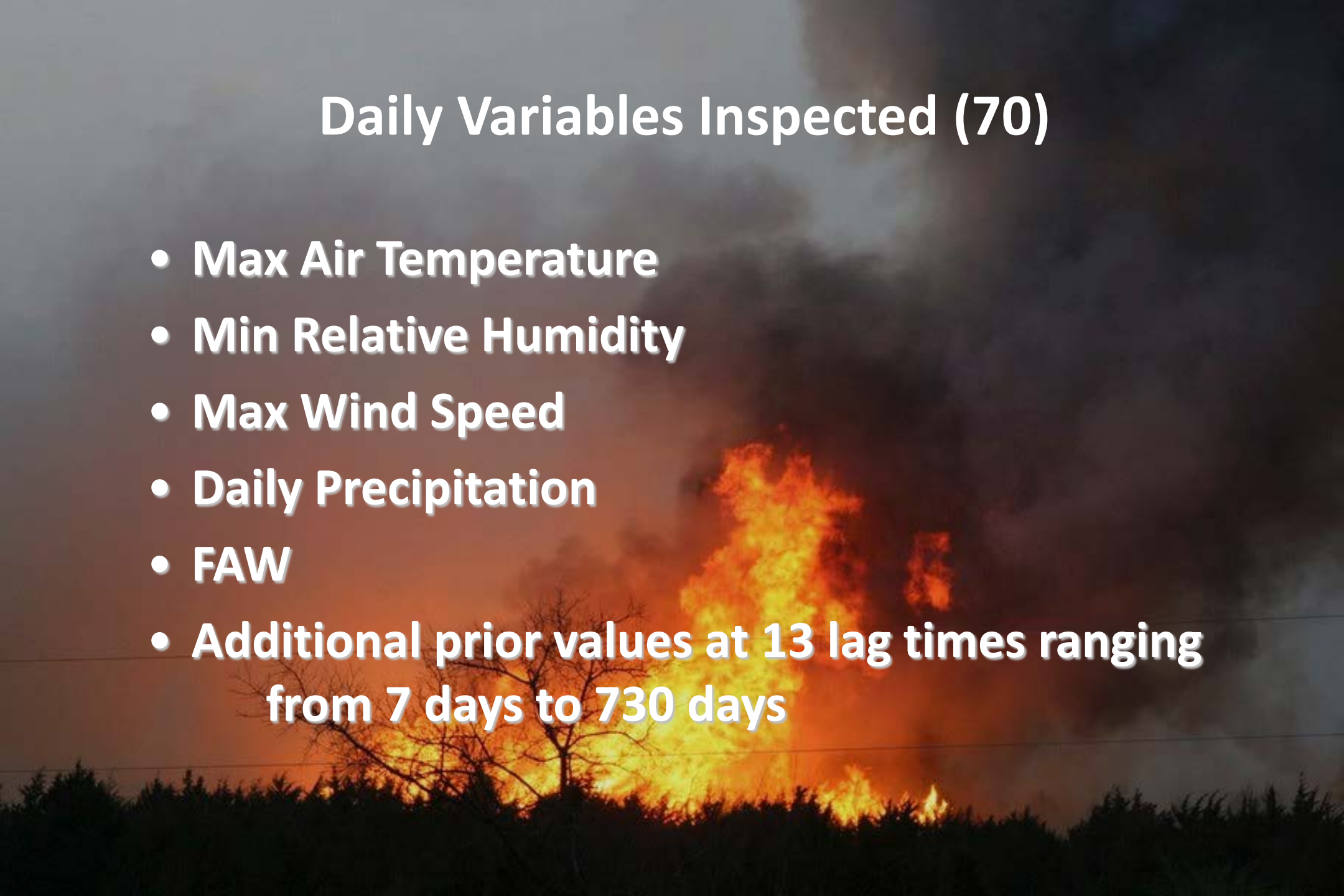
Effect of FAW on Growing Season Fire Activity



Analysis 3:
Logistic Regression

(*International Journal of Wildland Fire*, 2016)

- Statewide average weather/soil conditions during each GS or DS day
- Lags of 7 days to 730 days prior were considered
- Models for growing and dormant seasons
- Daily probability of a fire >= 1000 acres somewhere in the state during each season

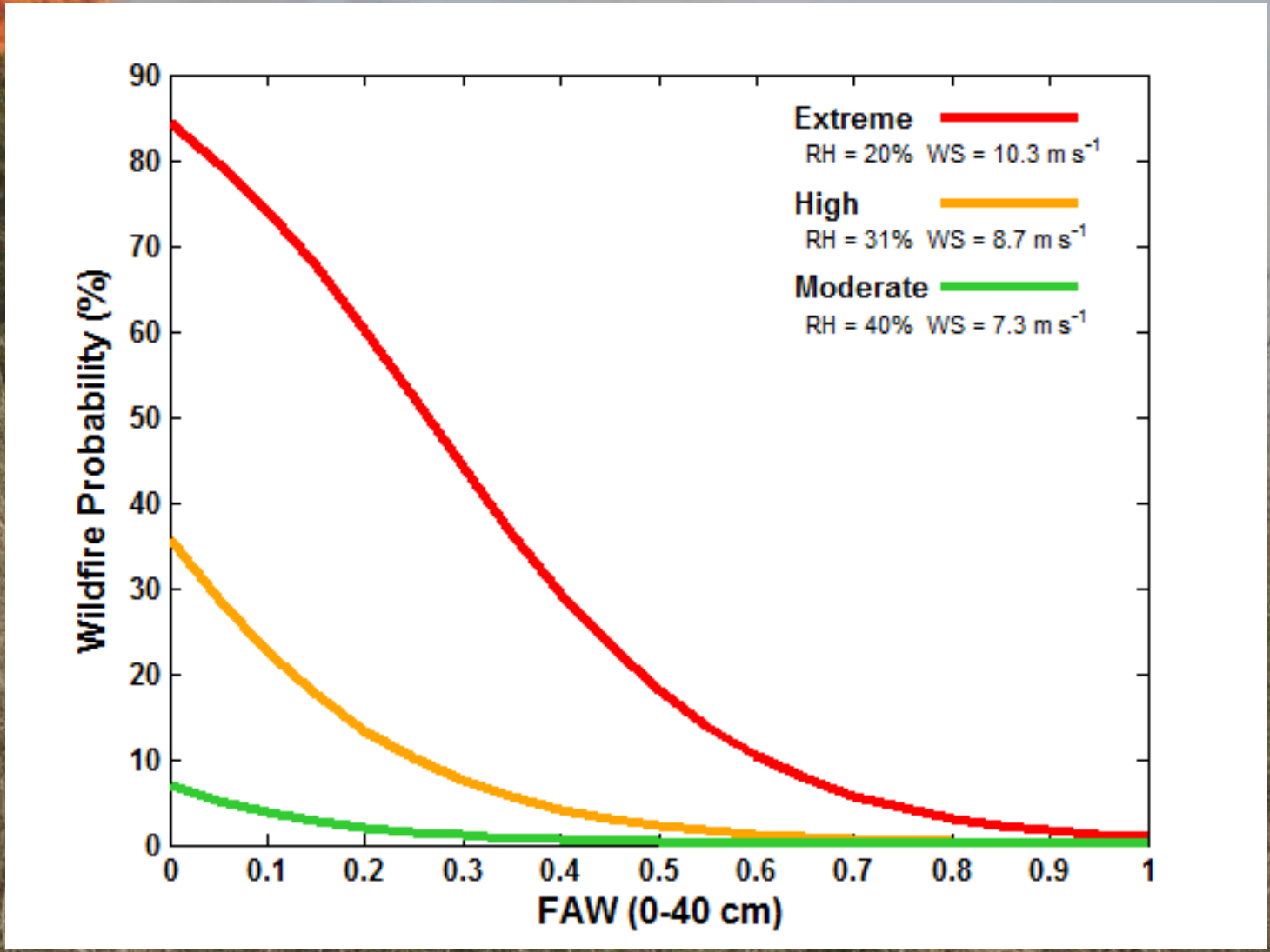


Daily Variables Inspected (70)

- Max Air Temperature
- Min Relative Humidity
- Max Wind Speed
- Daily Precipitation
- FAW
- Additional prior values at 13 lag times ranging from 7 days to 730 days


Growing Season Wildfires
10:02 84°
KOTV - DT

Fractional Available Water



Growing Season

Large Multi-Day 2011 Growing Season Wildfires

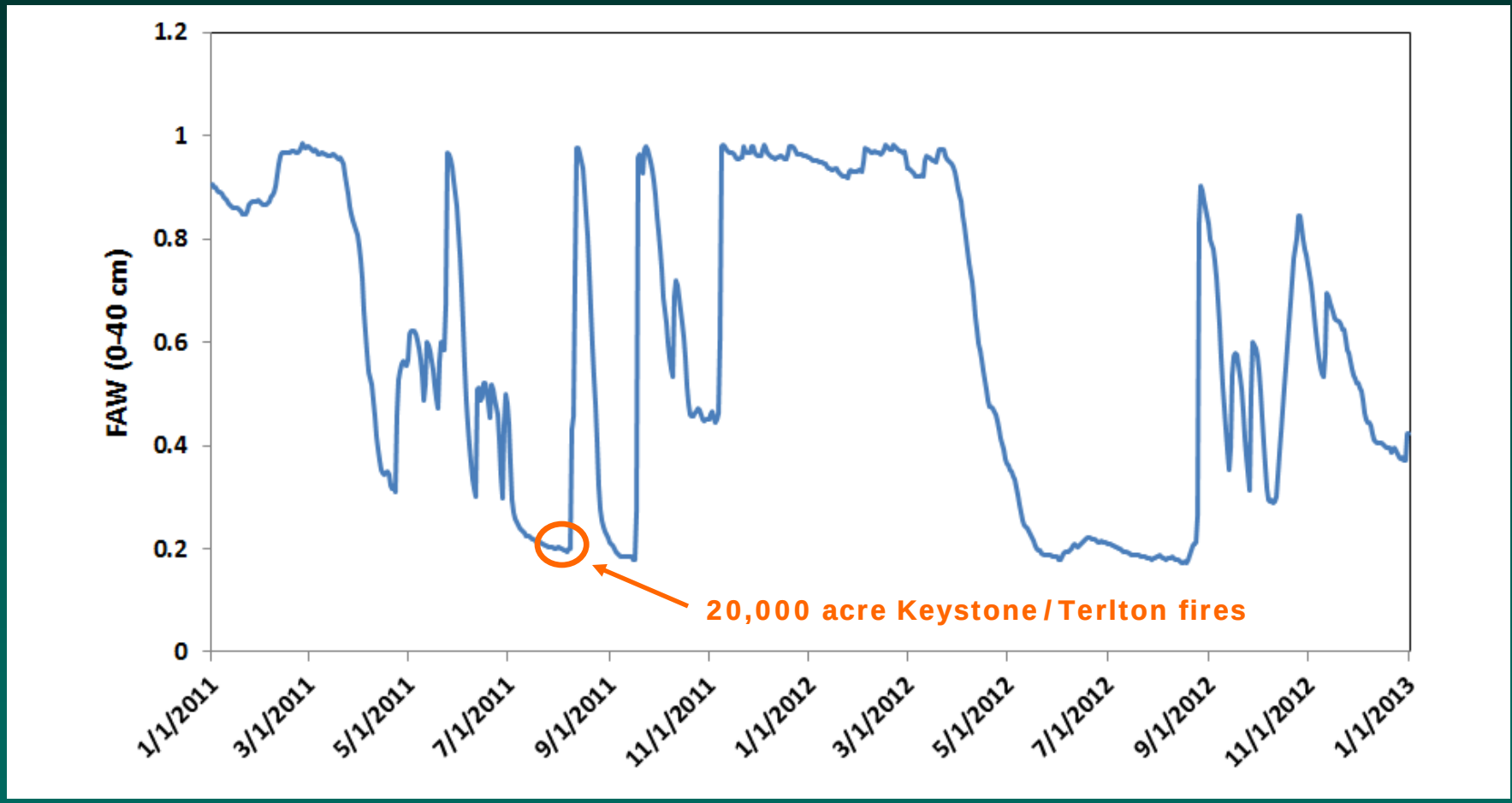
Keystone/Terlton Complex

August 5-10, 2011

20,129 acres (8146 ha)


SKYNEWS 6
10:03 84°
NewsOn6.com

Fractional Available Water (FAW)
(Oilton)



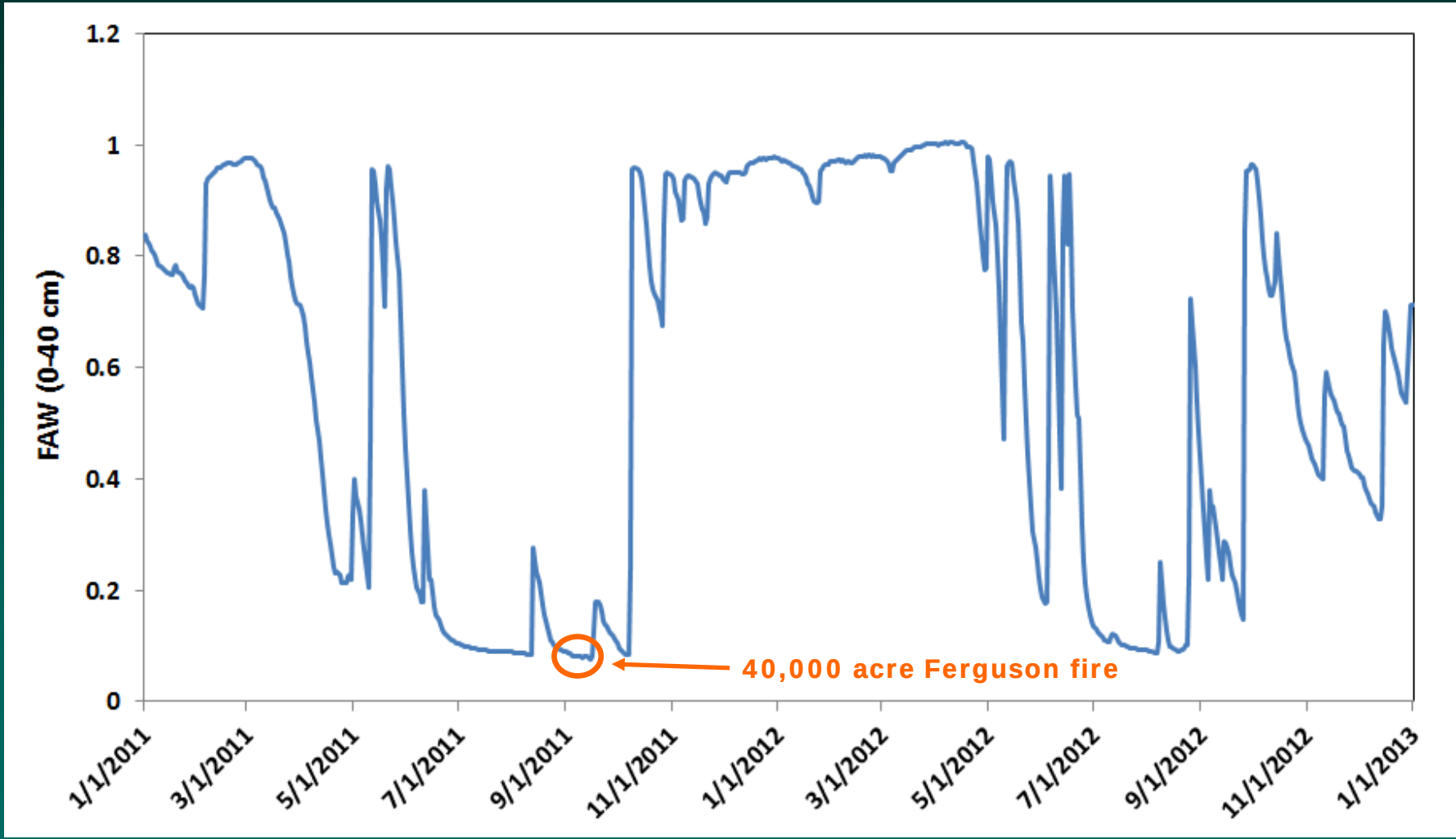
Ferguson Fire

September 1-10, 2011

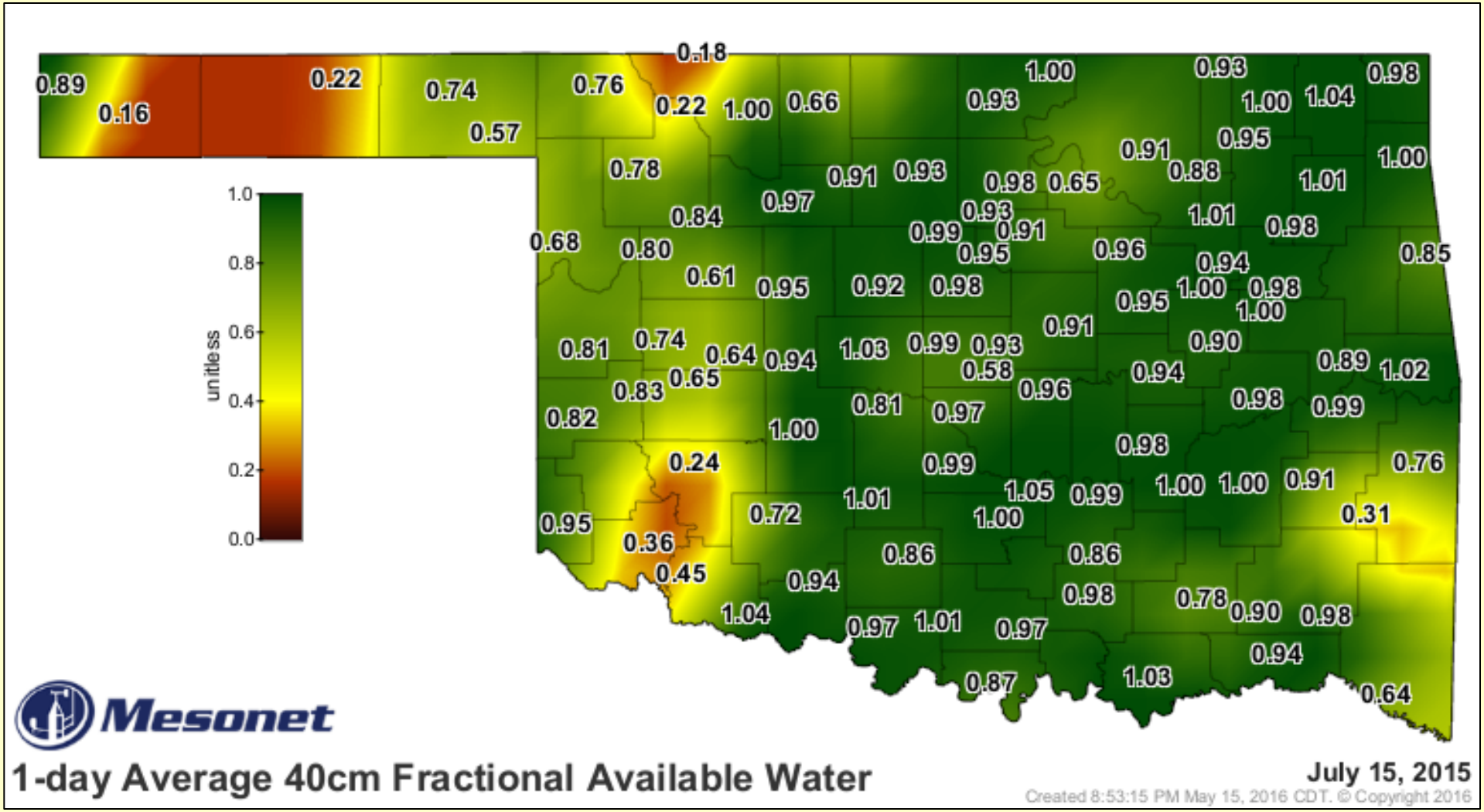
39,907 acres (16,150 ha)


LIVE
ON THE PHONE:
COMANCHE COUNTY WILDFIRE
11:02 70°
RUSTY SURETTE
RED CROSS SPOKESMAN
News9.com

Fractional Available Water (FAW)
(Medicine Park)

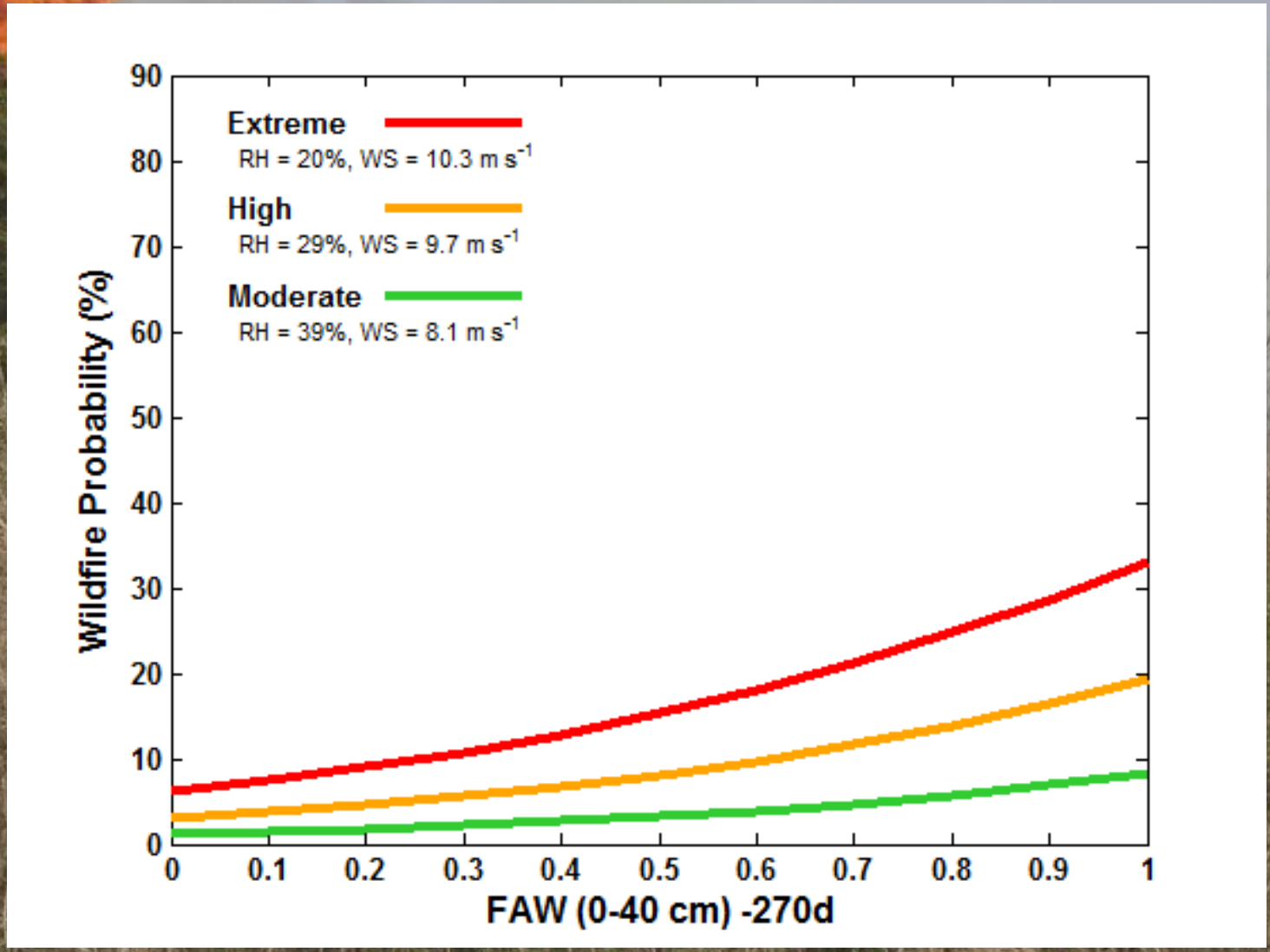


Summer of 2015: Large Wildfire Activity = Minimal



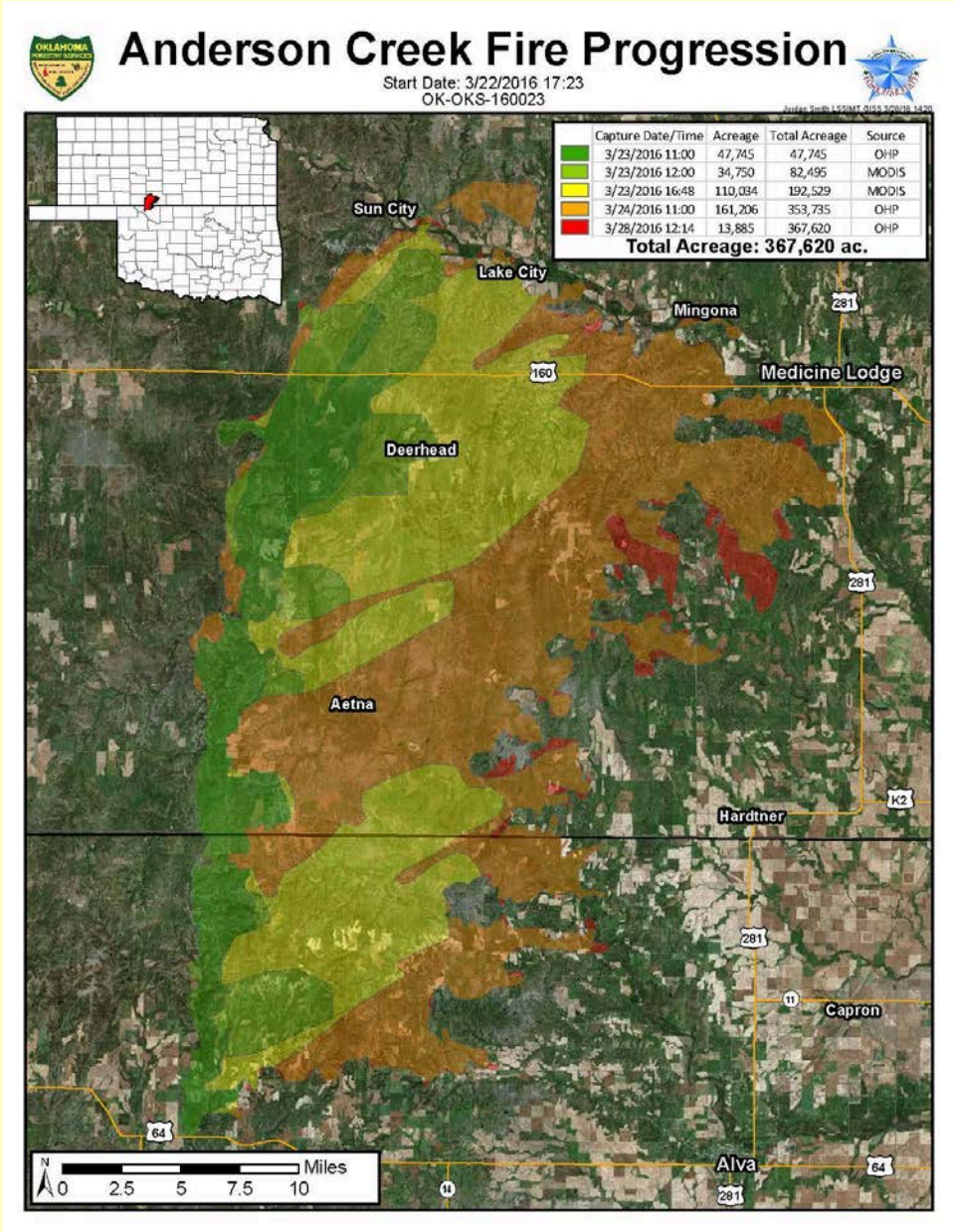

Dormant Season Wildfires

Fractional Available Water

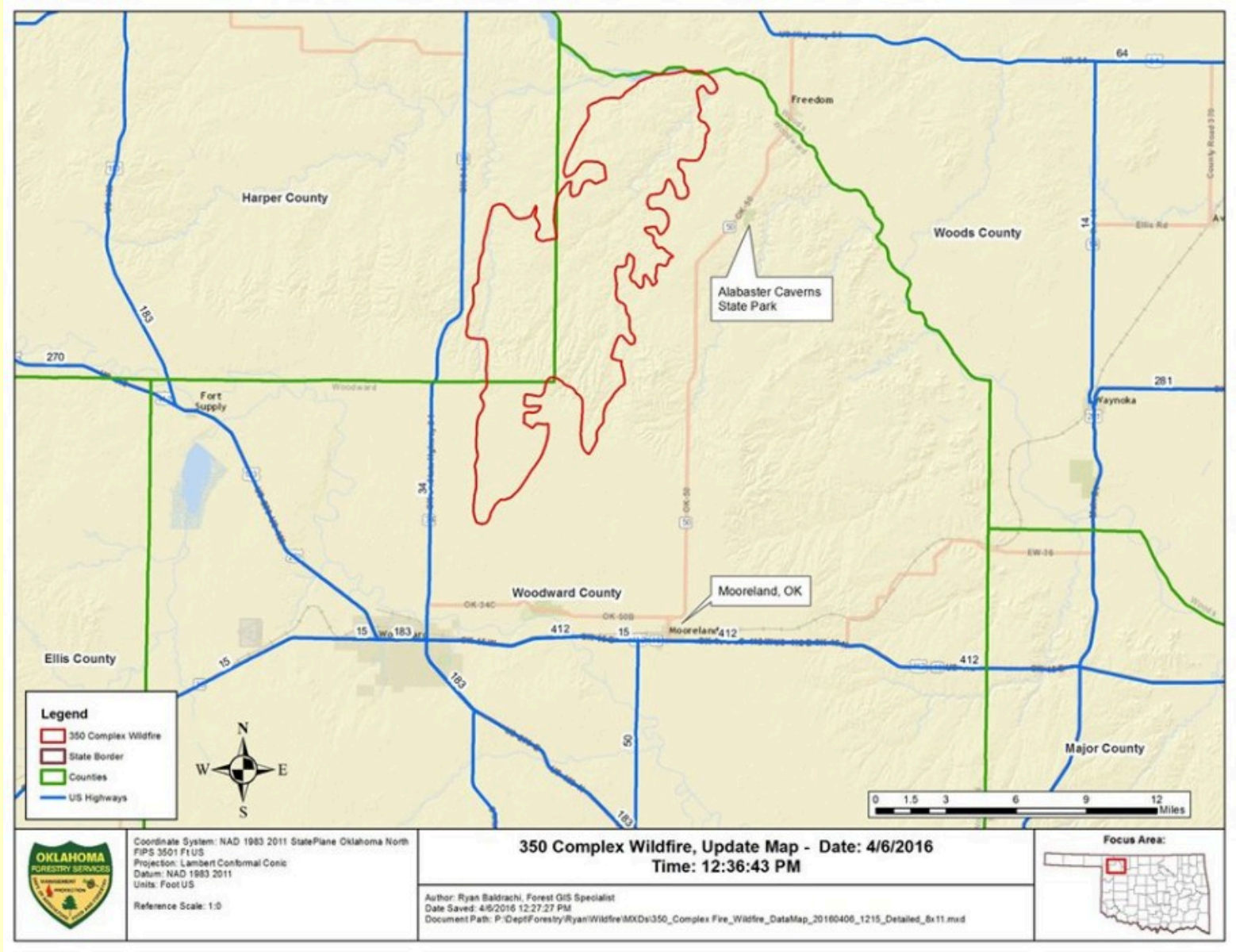


Dormant Season

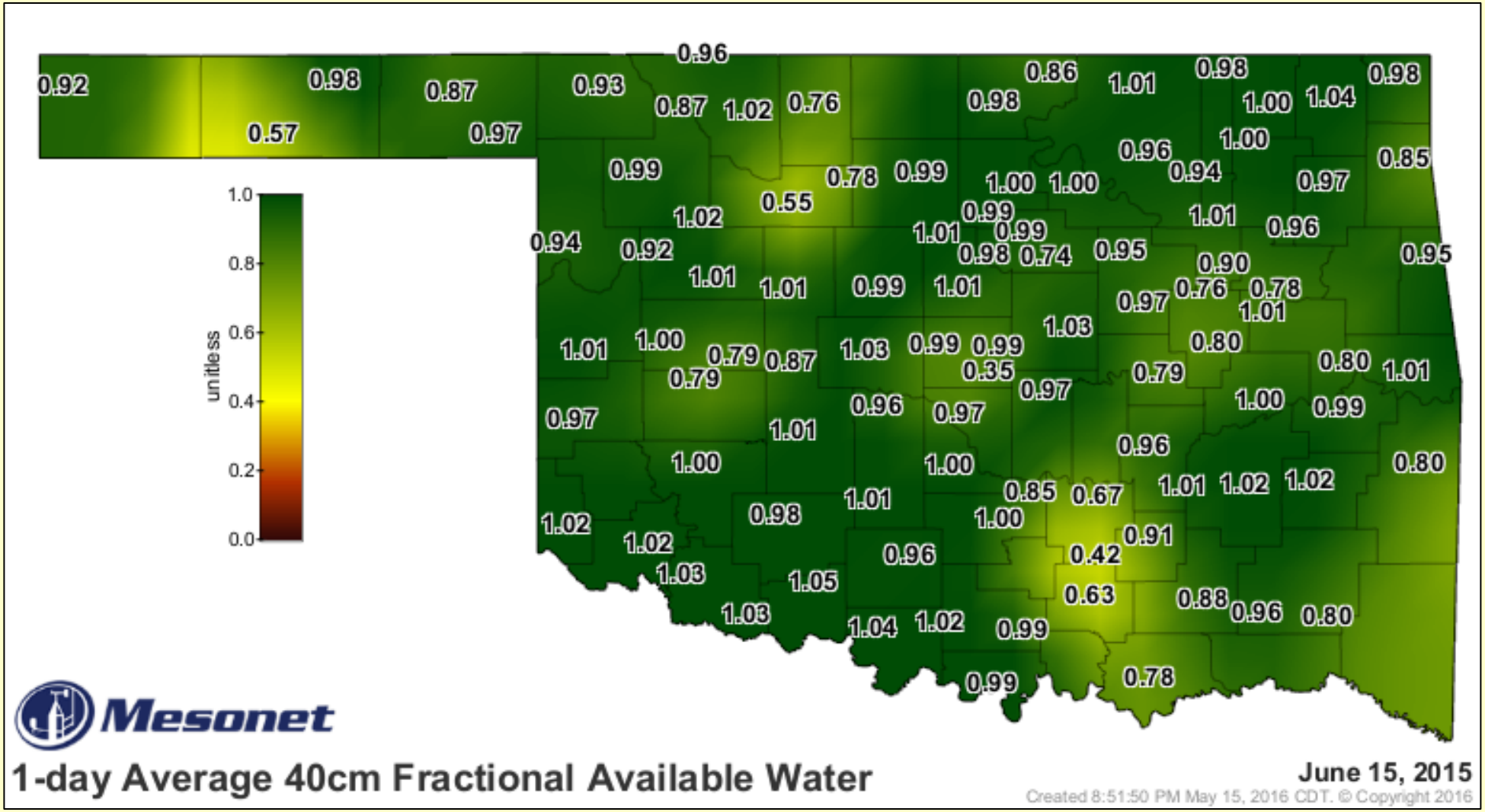
Anderson Creek Fire (March 22 – April 3, 2016)
367,620 acres



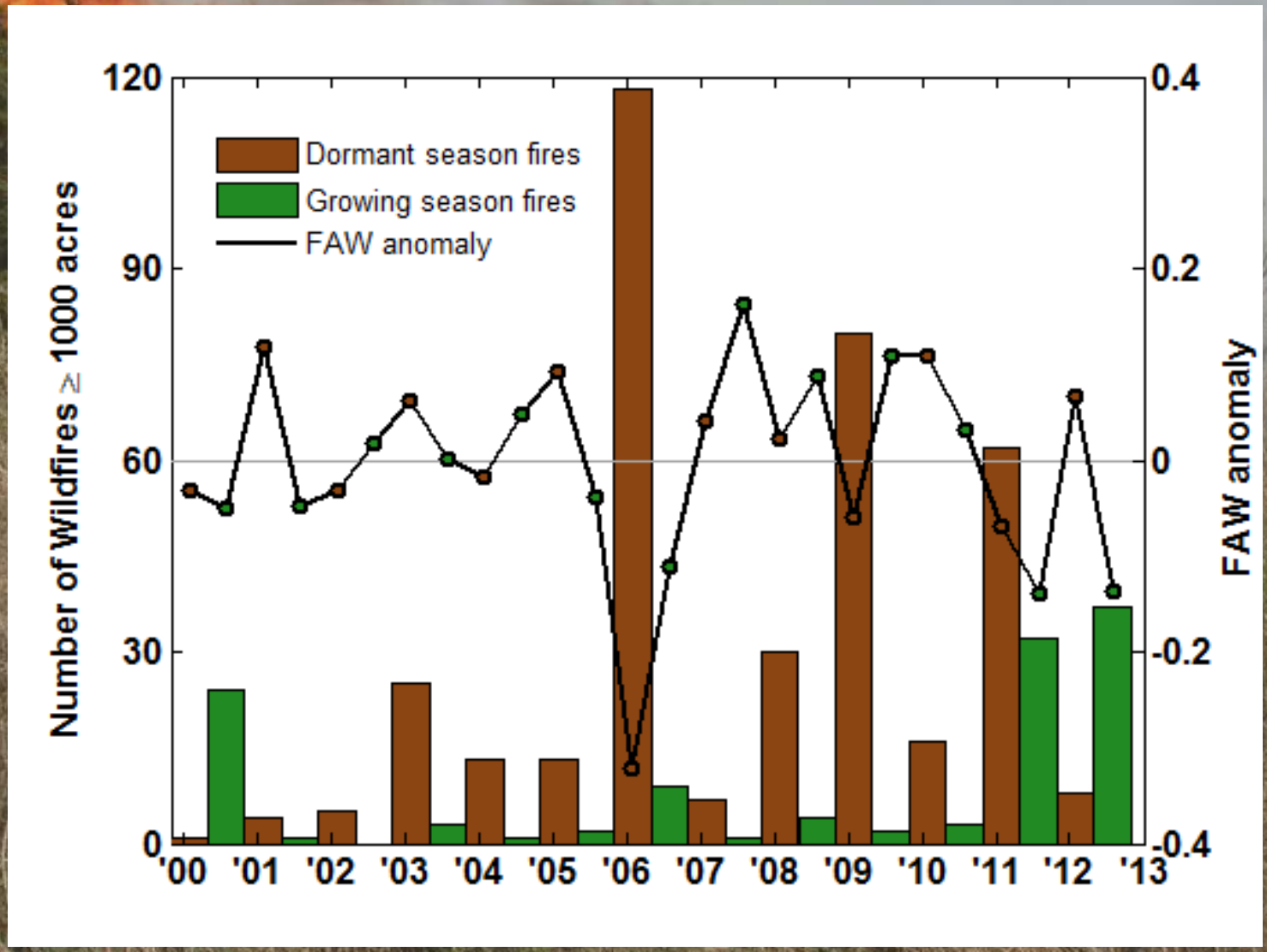
360 Complex Fire (April 5-11, 2016)
57,440 acres

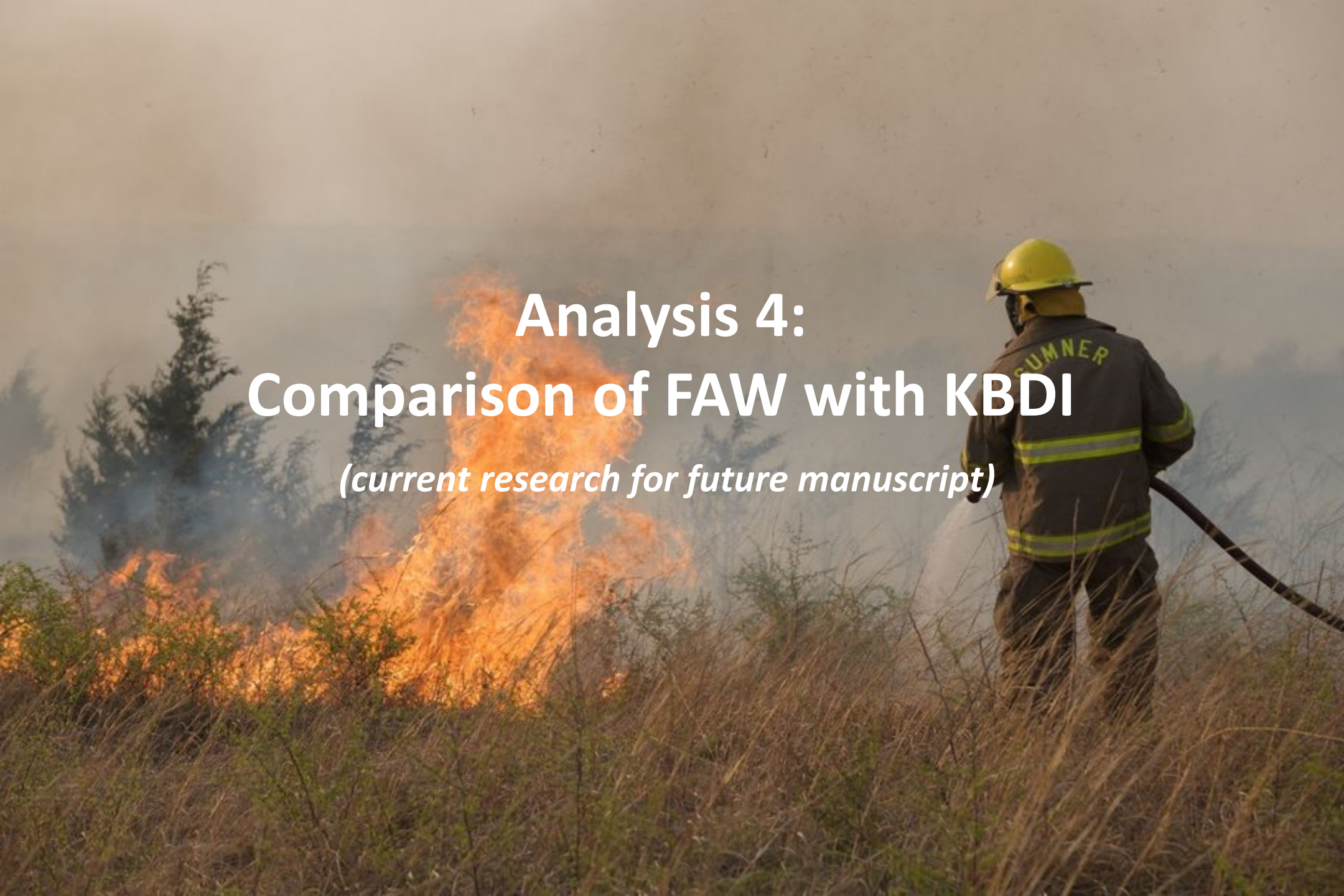


270 Days (9 Months) Prior to March 15, 2016



Statewide Average FAW Anomaly and Number of Wildfires >= 1000 acres



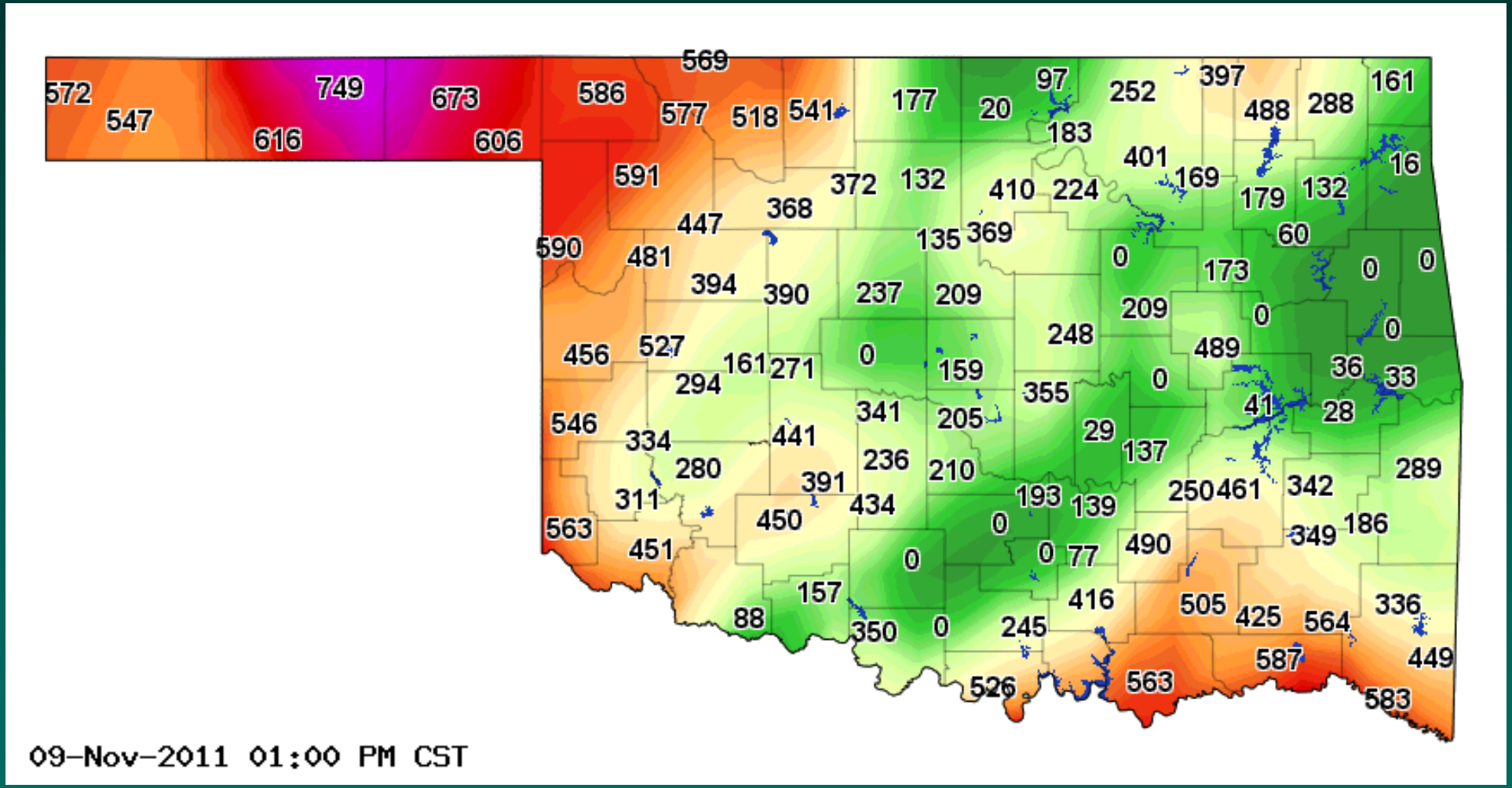


Analysis 4:
Comparison of FAW with KBDI

(current research for future manuscript)

Keetch-Byram Drought Index (KBDI)

Function of daily max temp and precipitation

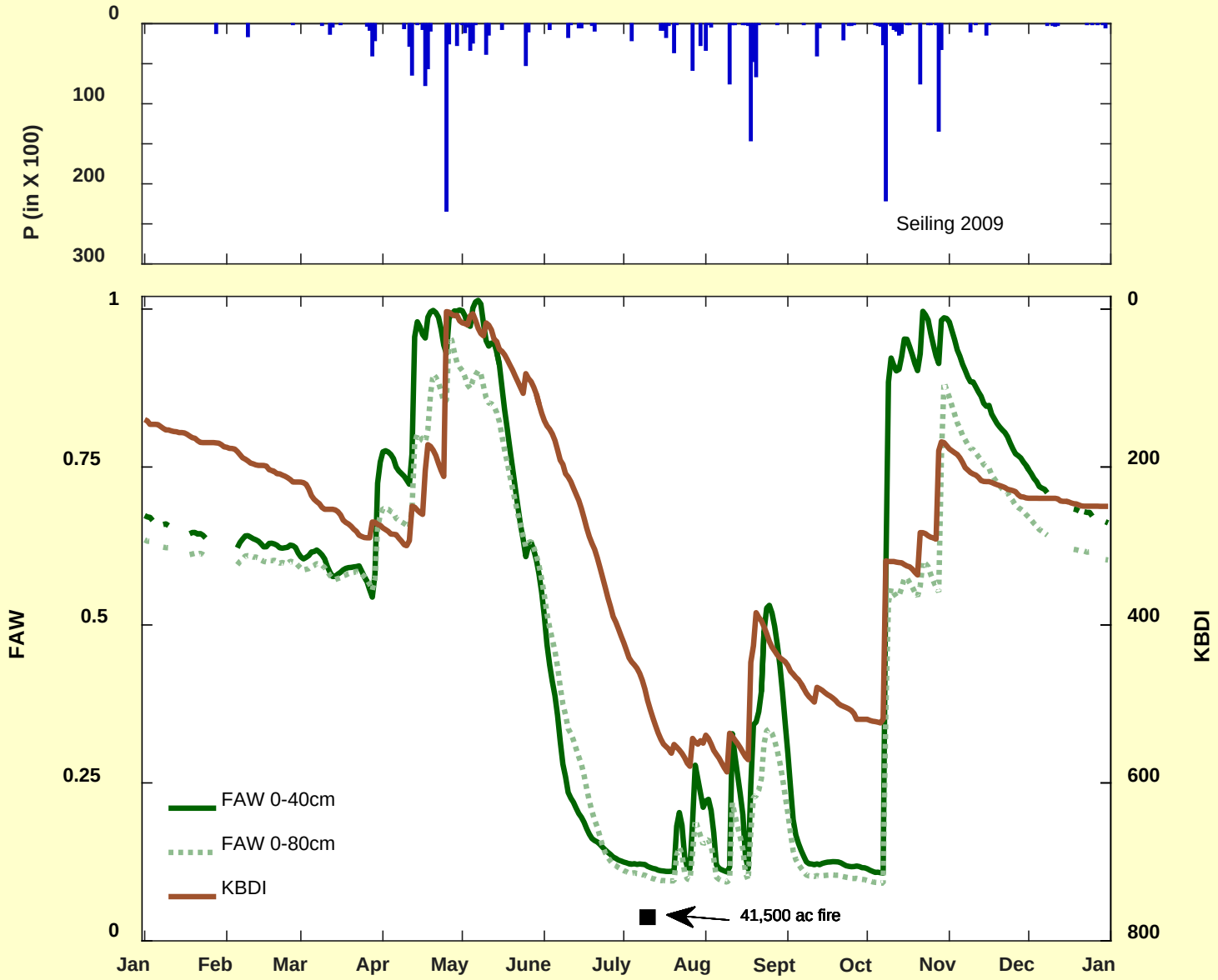


KBDI Limitations

- Uses only daily max air temperature to estimate daily ET
- Subtracts off first 0.2” of a continuous rainfall event (assumes intercepted by tree canopy)
- Doesn’t take into account soil properties
- Assumes an 8” water holding capacity of the soil

Daily Statewide Values (2012)

Daily Values at Seiling (2009)



Some Salient Conclusions

- Large wildfires during the GROWING season are strongly associated with concurrent LOW soil moisture (FAW)
- Large wildfires during the DORMANT season are strongly associated with HIGH soil moisture (FAW) during the previous growing season (- 9 months)
- Concurrent and lagged soil moisture can and should be considered in making fire danger assessments for growing and dormant seasons
- FAW a better predictor of large wildfire activity than KBDI, especially during growing season

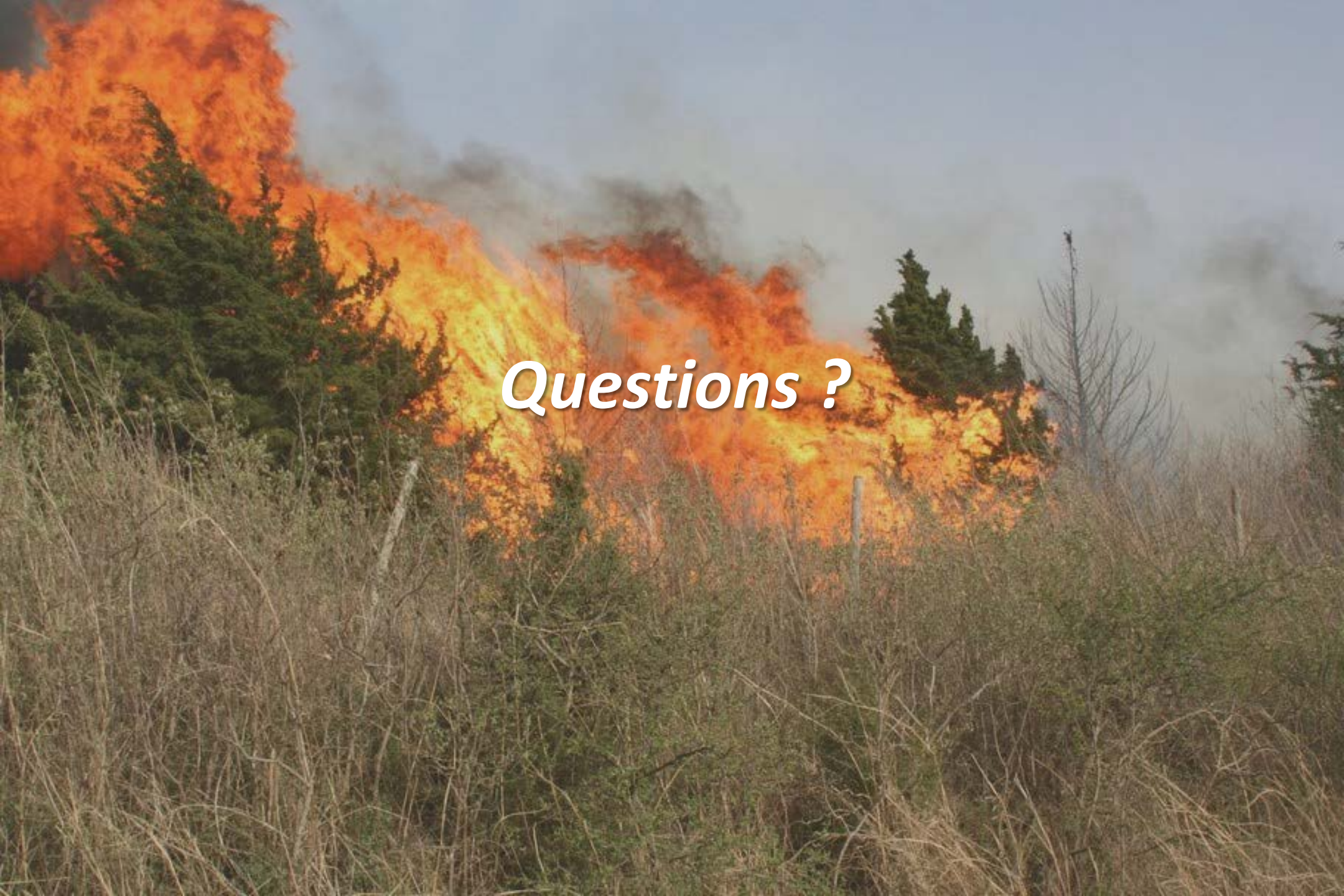
Funding Acknowledgements

Joint Fire Science Program

JFSP 11-1-2-19 (2011-2015)

Oklahoma Cooperative Extension Service

Oklahoma Agricultural Experiment Station


Questions ?