Flash Drought: Current Knowledge, Tools, and Future Opportunities

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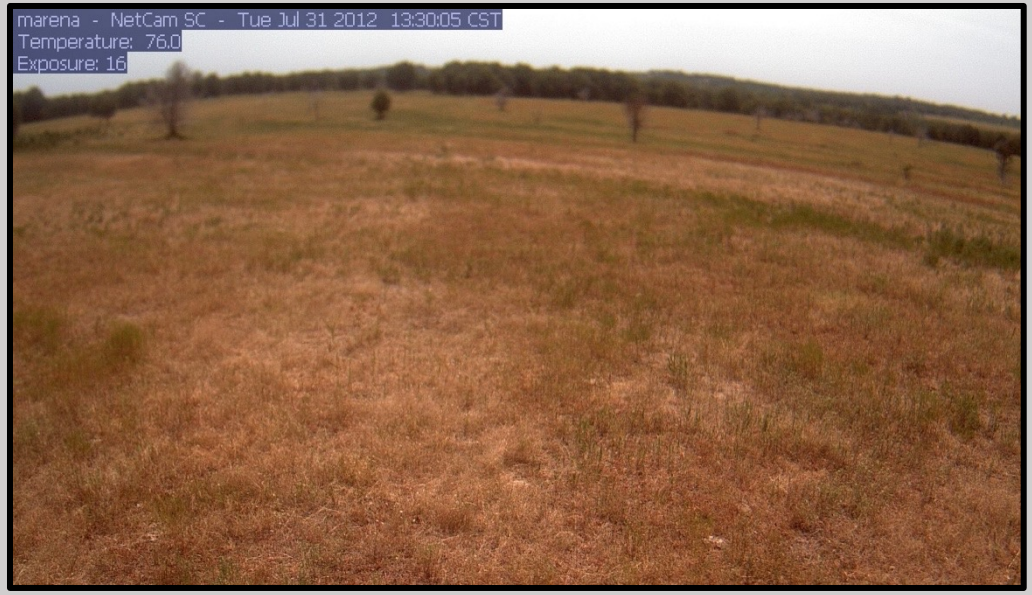
WHAT IS FLASH DROUGHT?

Flash drought is characterized by the rapid intensification toward drought conditions

1 July 2012

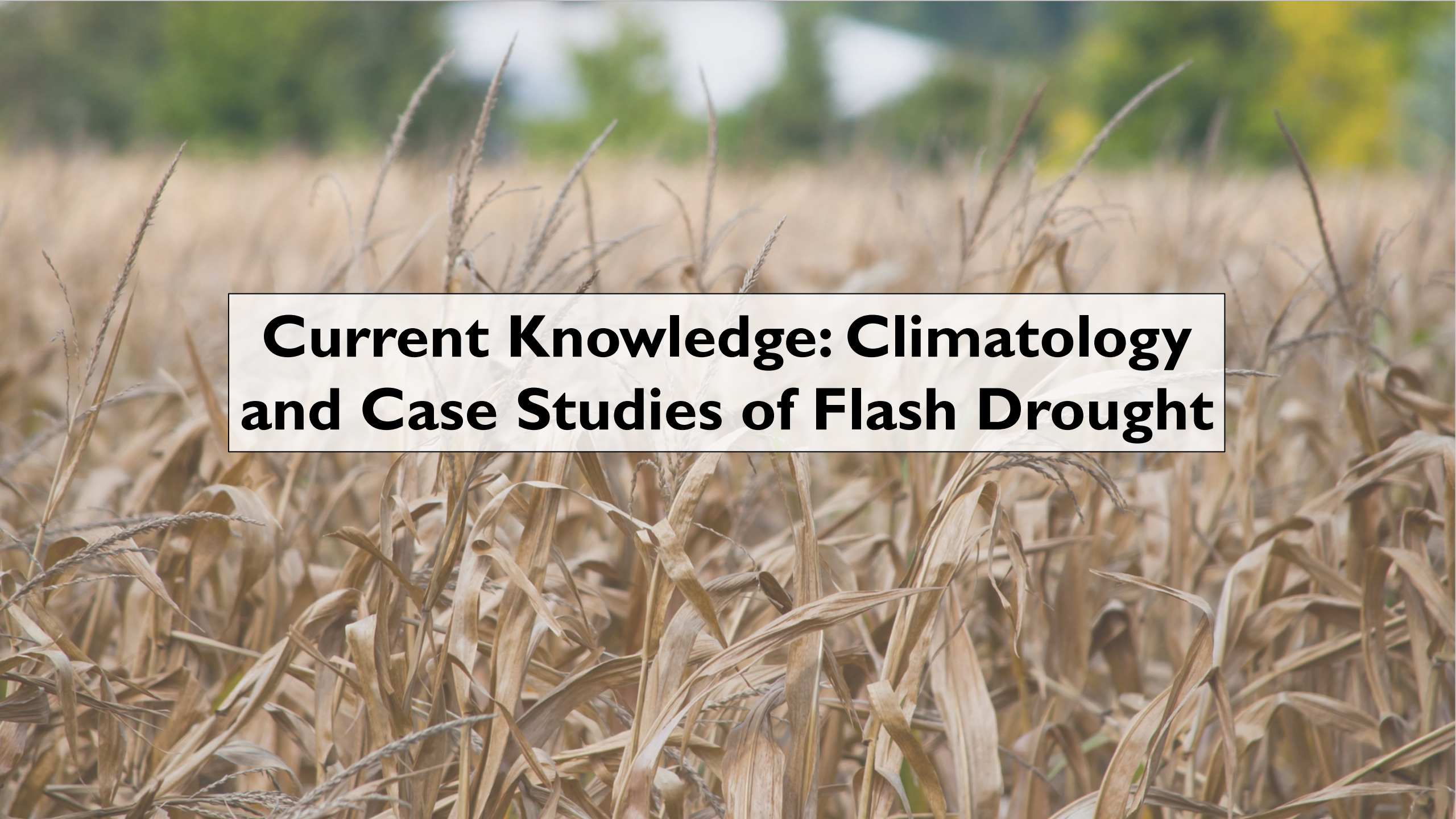
30 days later

31 July 2012



IMPACTS OF FLASH DROUGHT

- Rapid depletion of near-surface and root zone soil moisture
- Excessive moisture stress on ecosystems
- Significant yield loss in agricultural regions
- Increased risk of wildfires

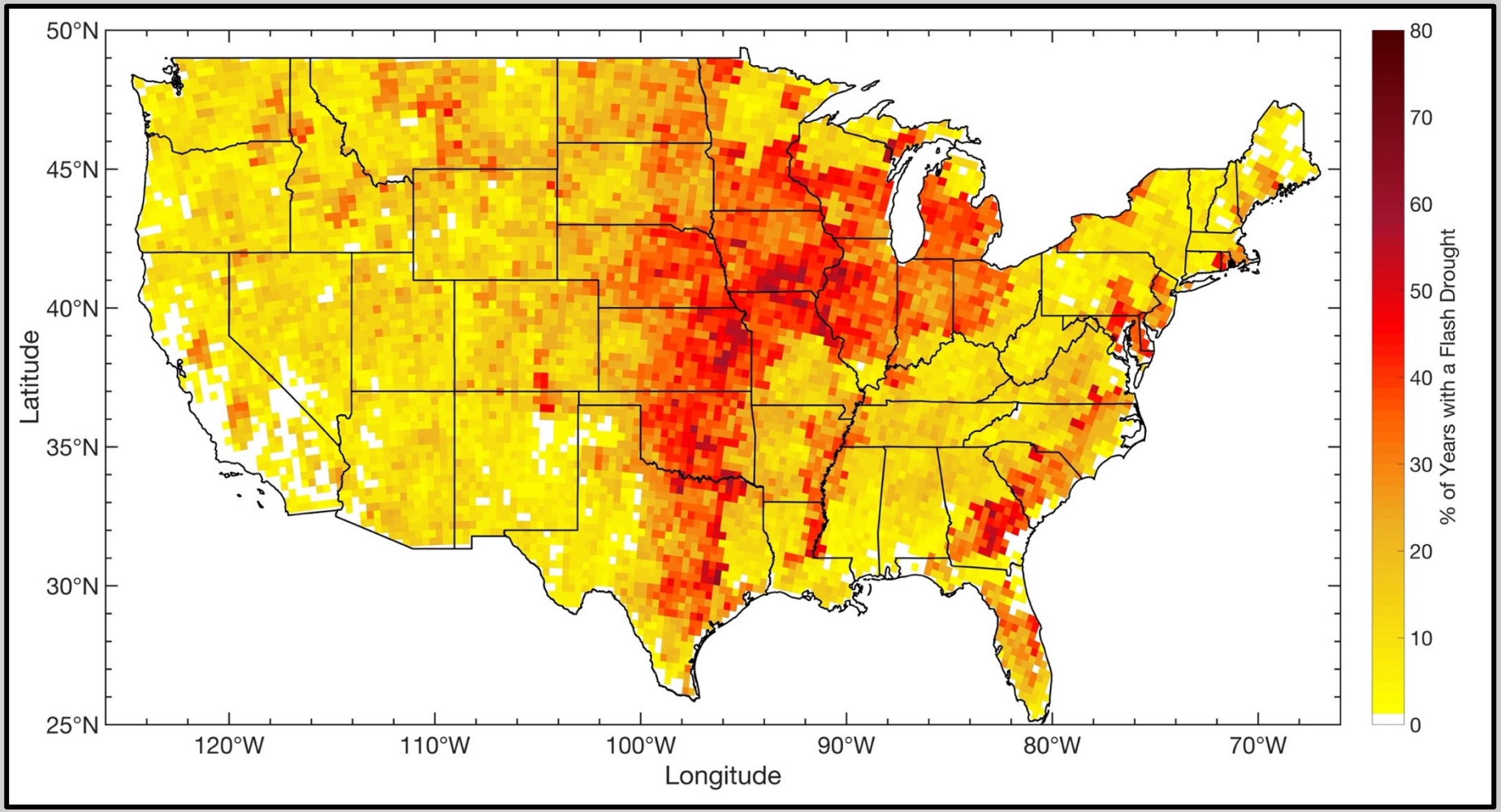


Current Knowledge: Climatology and Case Studies of Flash Drought

CURRENT KNOWLEDGE: CLIMATOLOGY

Dataset:
- North American Regional Reanalysis
- 32 km spatial resolution

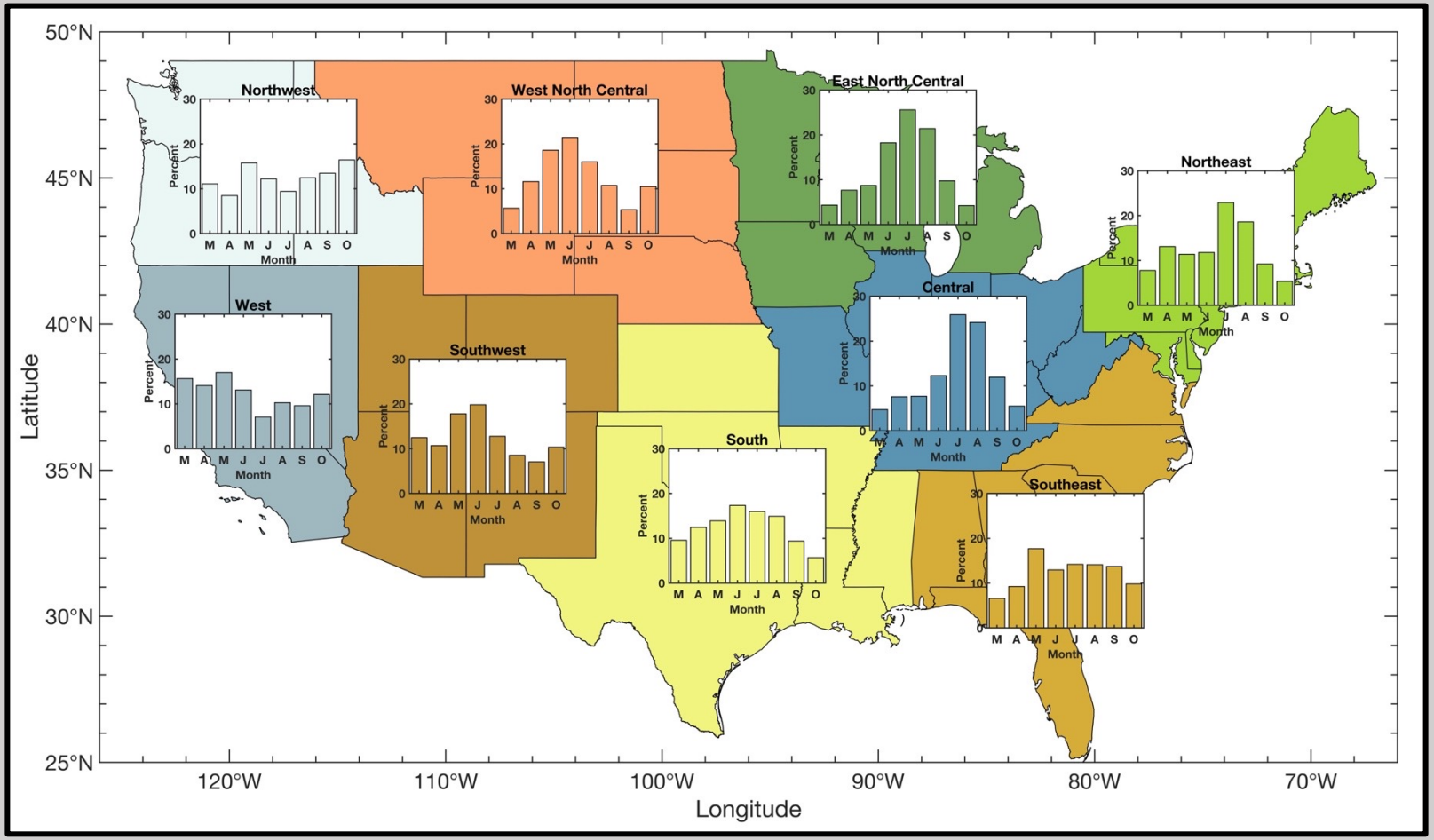
Study period:
- Growing season (April through October)
- 1979 to 2016



CURRENT KNOWLEDGE: CLIMATOLOGY

<u>Western U.S.</u>
Flash droughts occur more frequently earlier in the growing season.

Study period:
- Growing season (April through October)
- 1979 to 2016



<u>Eastern U.S.</u>
Flash droughts occur more frequently later in the growing season.

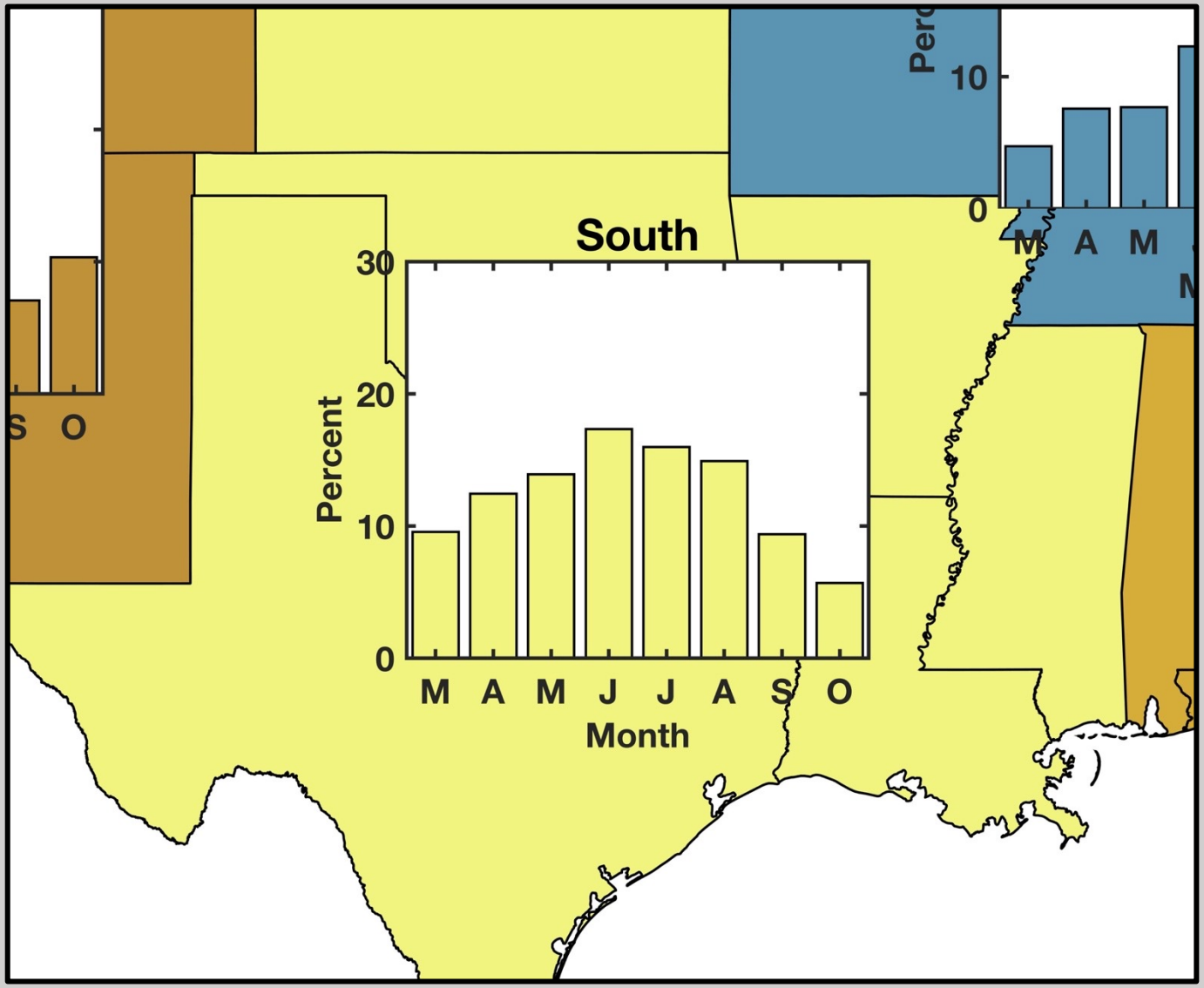
CURRENT KNOWLEDGE: CLIMATOLOGY

South

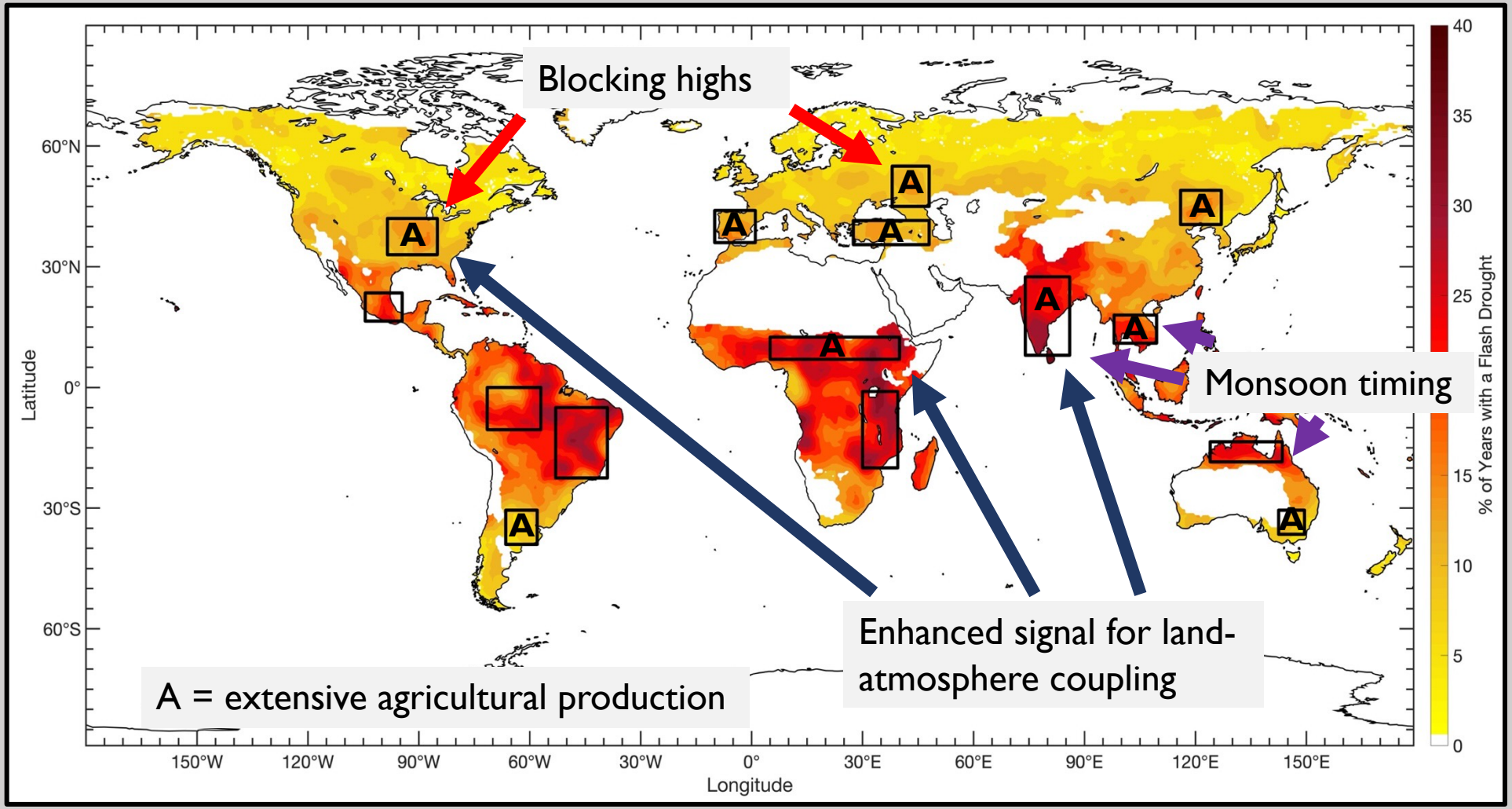
Flash droughts occur more frequently in the middle of the growing season.

Study period:

- Growing season (April through October)
- 1979 to 2016

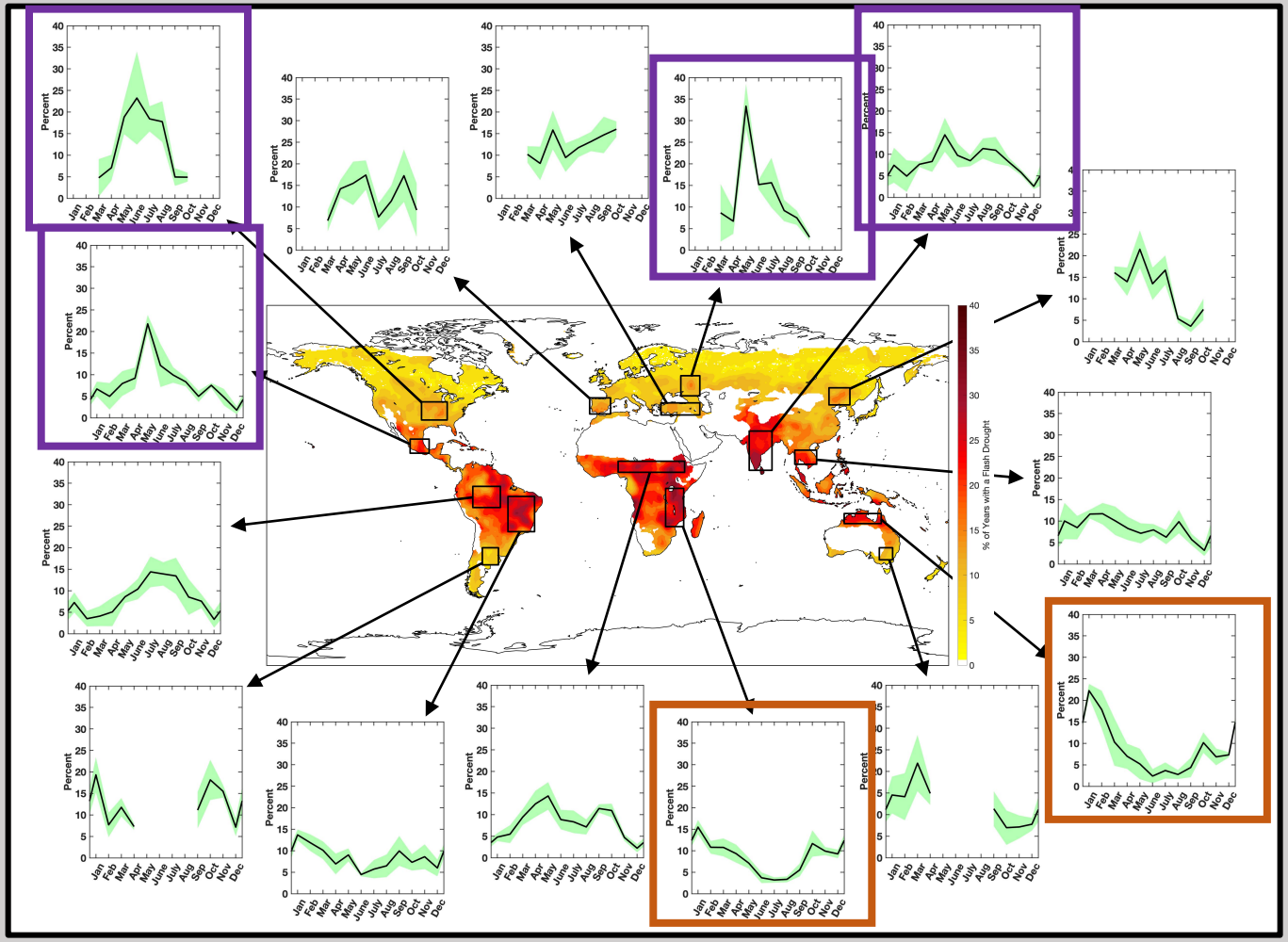


CURRENT KNOWLEDGE: CLIMATOLOGY



CURRENT KNOWLEDGE: CLIMATOLOGY

Northern Hemisphere
Flash droughts generally have their highest frequency in the middle of the Northern Hemisphere warm season (May through July).

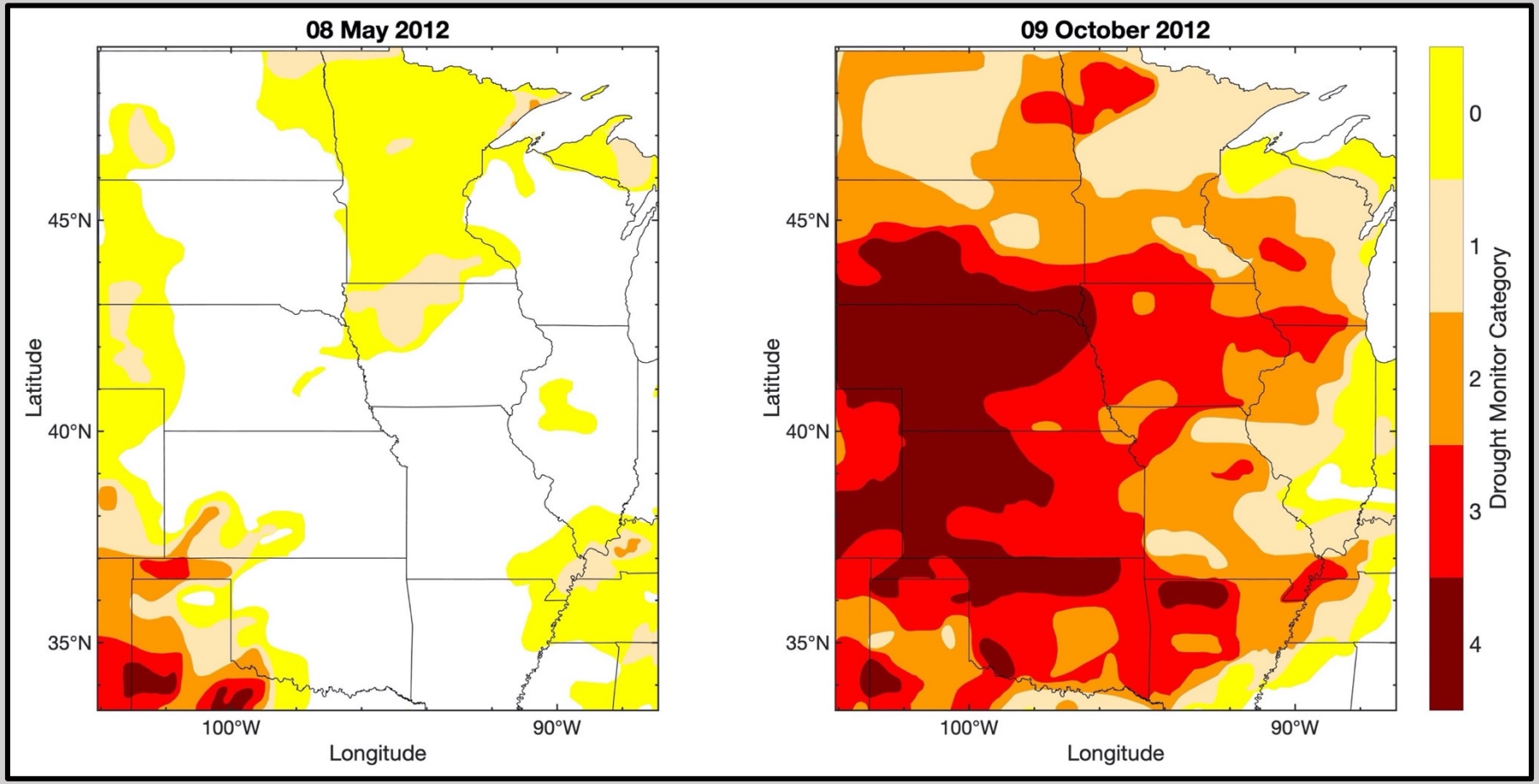


Southern Hemisphere
Flash droughts generally have their highest frequency in the middle of the Southern Hemisphere warm season (December through February).

CURRENT KNOWLEDGE: CASE STUDIES

2012 Flash Drought – Central US

United States Drought Monitor

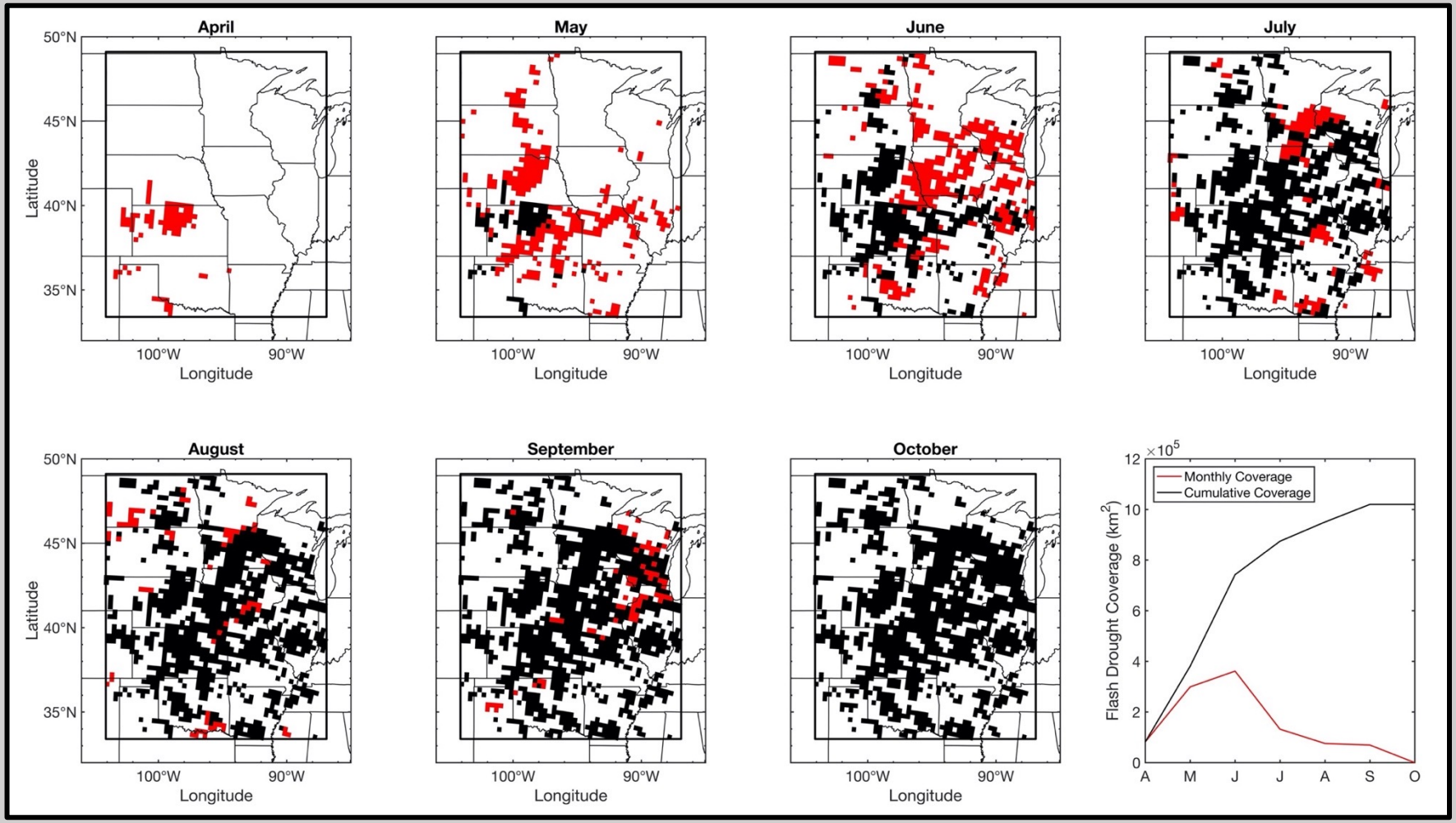


CURRENT KNOWLEDGE: CASE STUDIES

2012 Flash Drought – Central US

Red pixels:
New monthly flash drought development

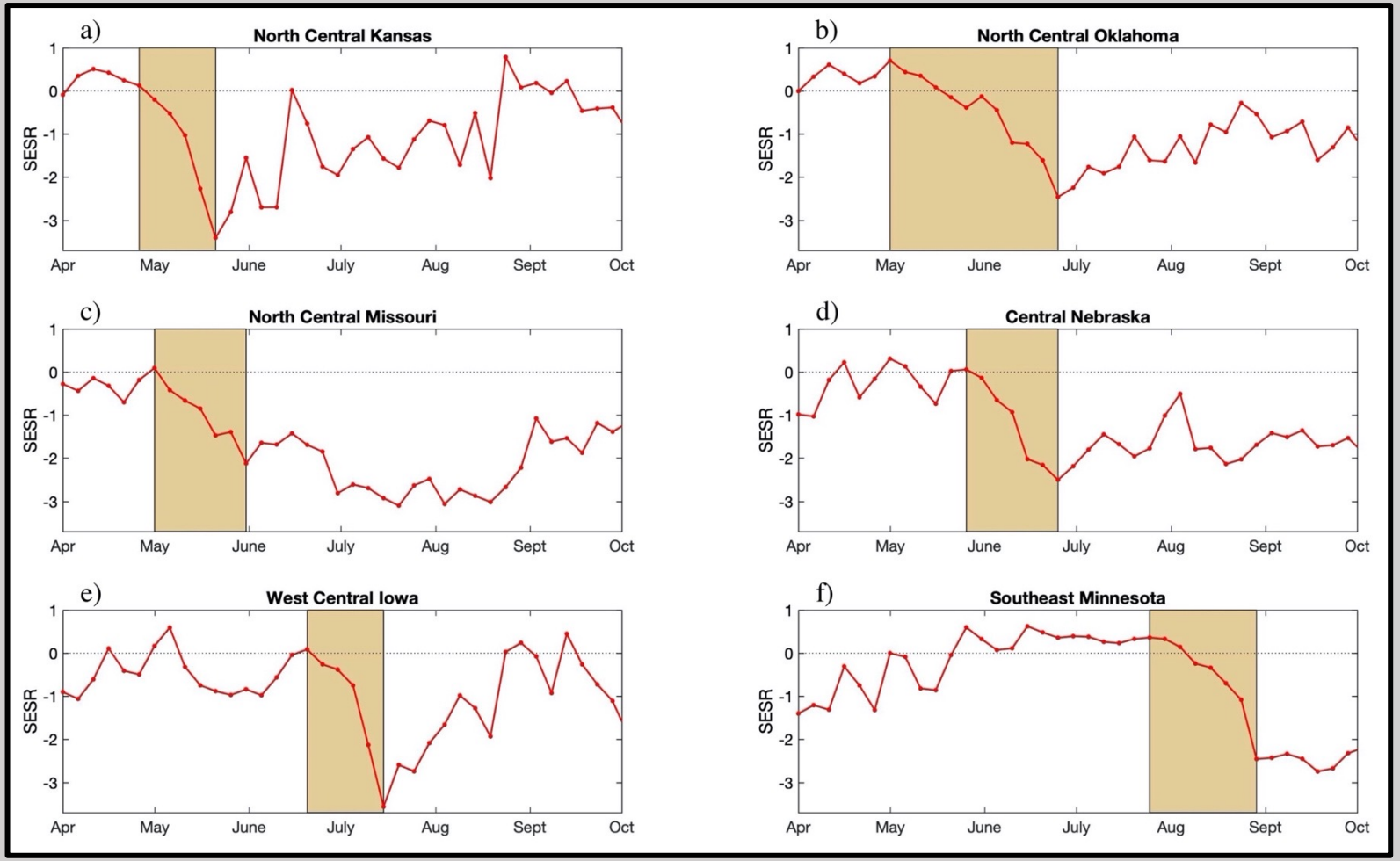
Black pixels:
Previous flash drought development

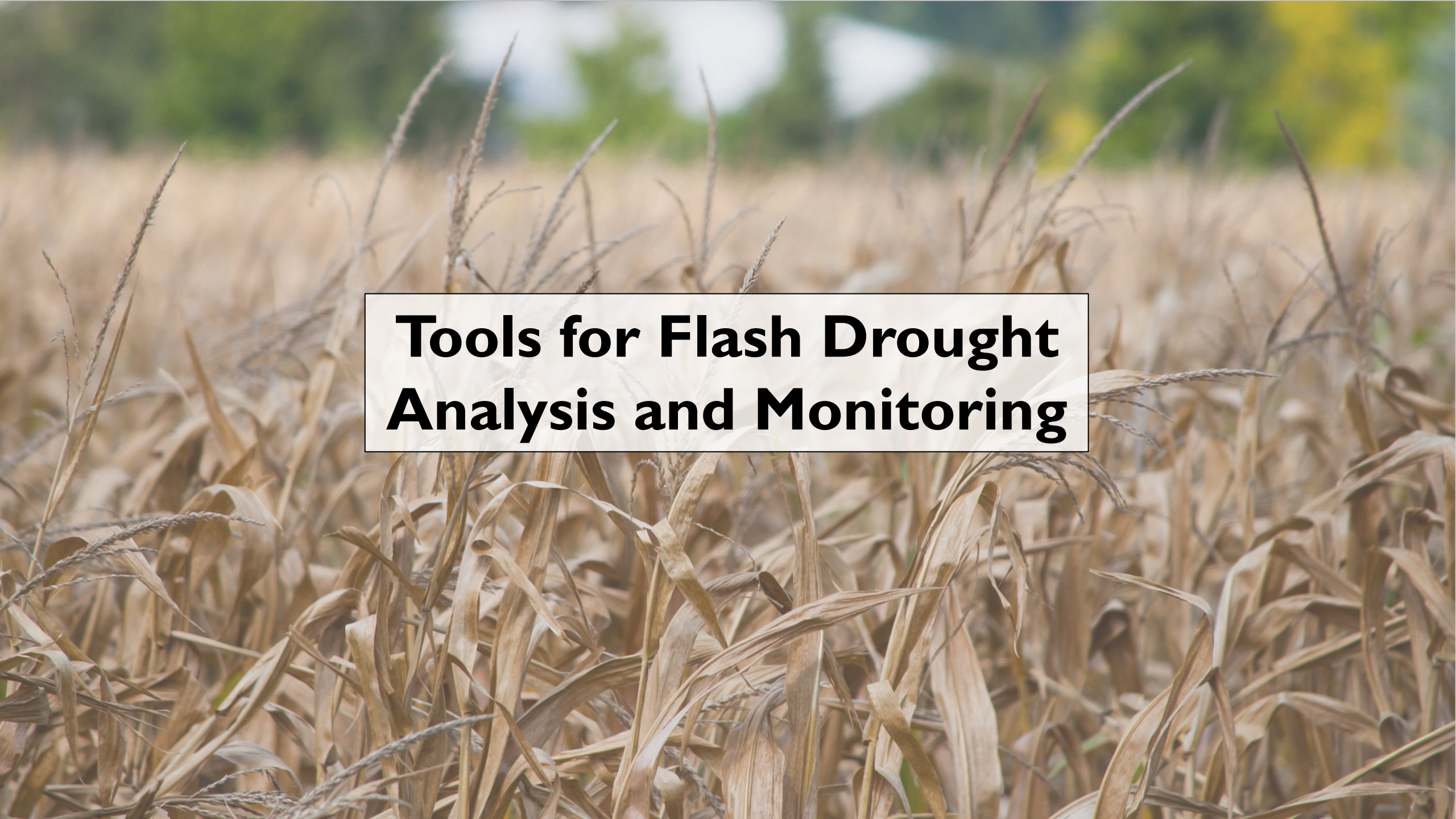


CURRENT KNOWLEDGE: CASE STUDIES

2012 Flash Drought – Central US

The shaded tan region on each panel represents the temporal period for flash drought development.





Tools for Flash Drought Analysis and Monitoring

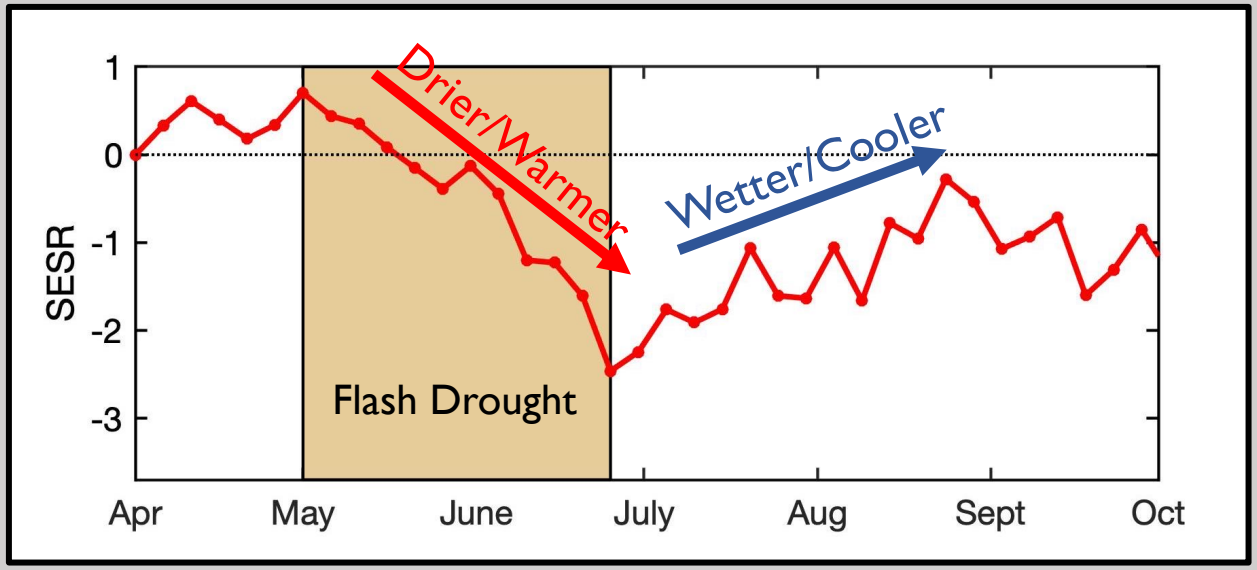
FLASH DROUGHT TOOLS: SESR

Standardized Evaporative Stress Ratio (SESR)

- The evaporative stress ratio (ESR) is the ratio of evapotranspiration (ET) to potential evapotranspiration (PET)

$$ESR = \frac{ET}{PET}$$

- Provides a measure of overall moisture stress on the environment
- ESR values are standardized (ESR → SESR)

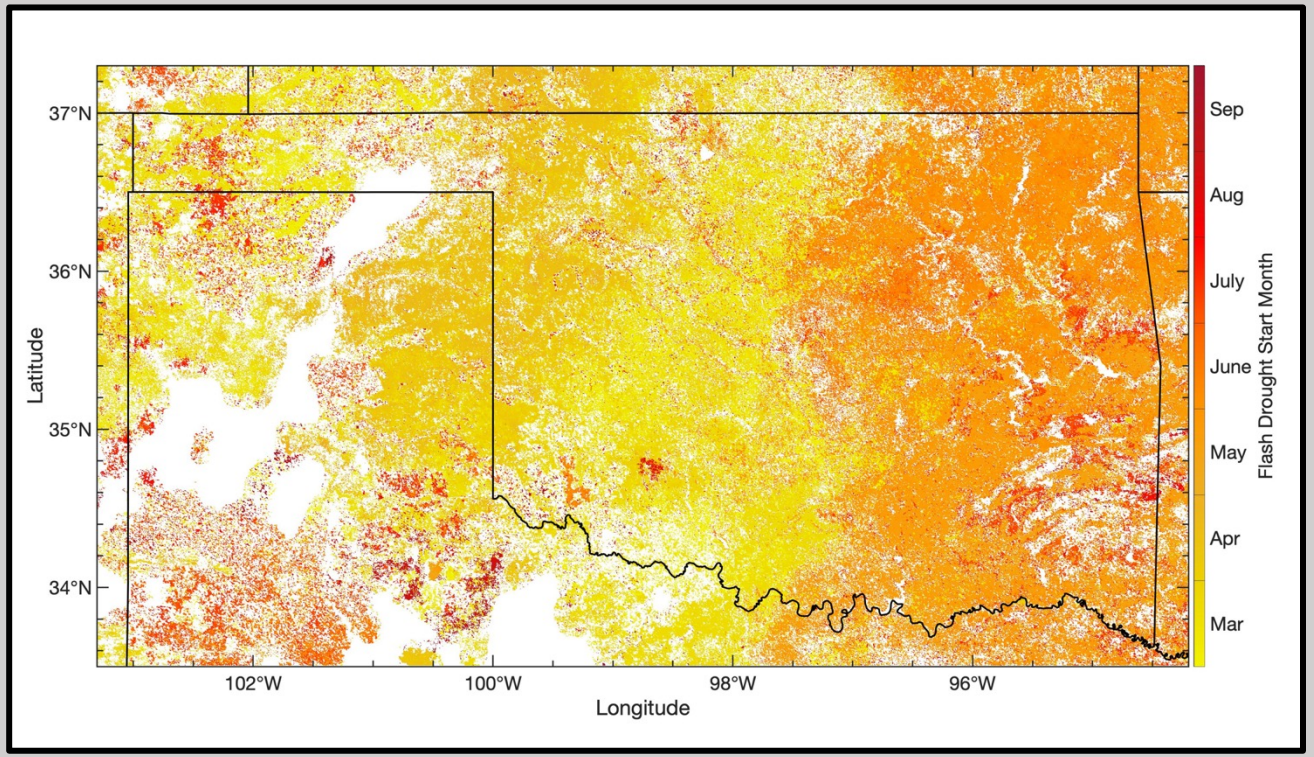


FLASH DROUGHT TOOLS: LSWI

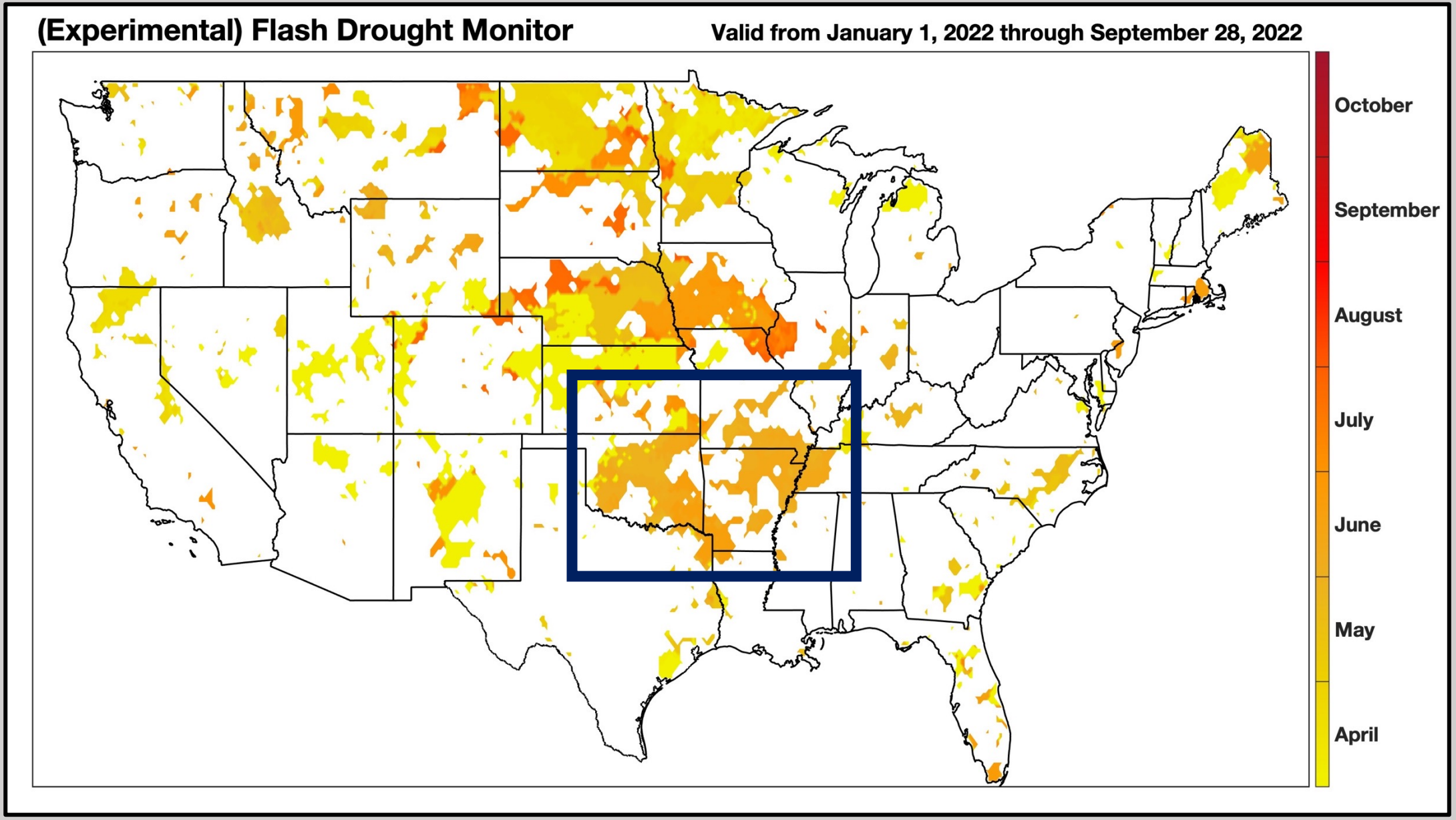
Land Surface Water Index (LSWI)

- Water-related VI (represents total water content in vegetation)
- Uses near-infrared (ρ_{858}) and shortwave infrared (ρ_{1640}) bands
- Has been used to identify drought conditions and has a high sensitivity to the severity of drought
- 500 m spatial resolution and 8-day temporal resolution (LSWI derived from MODIS Terra surface reflectance)

2011 Flash Drought using LSWI

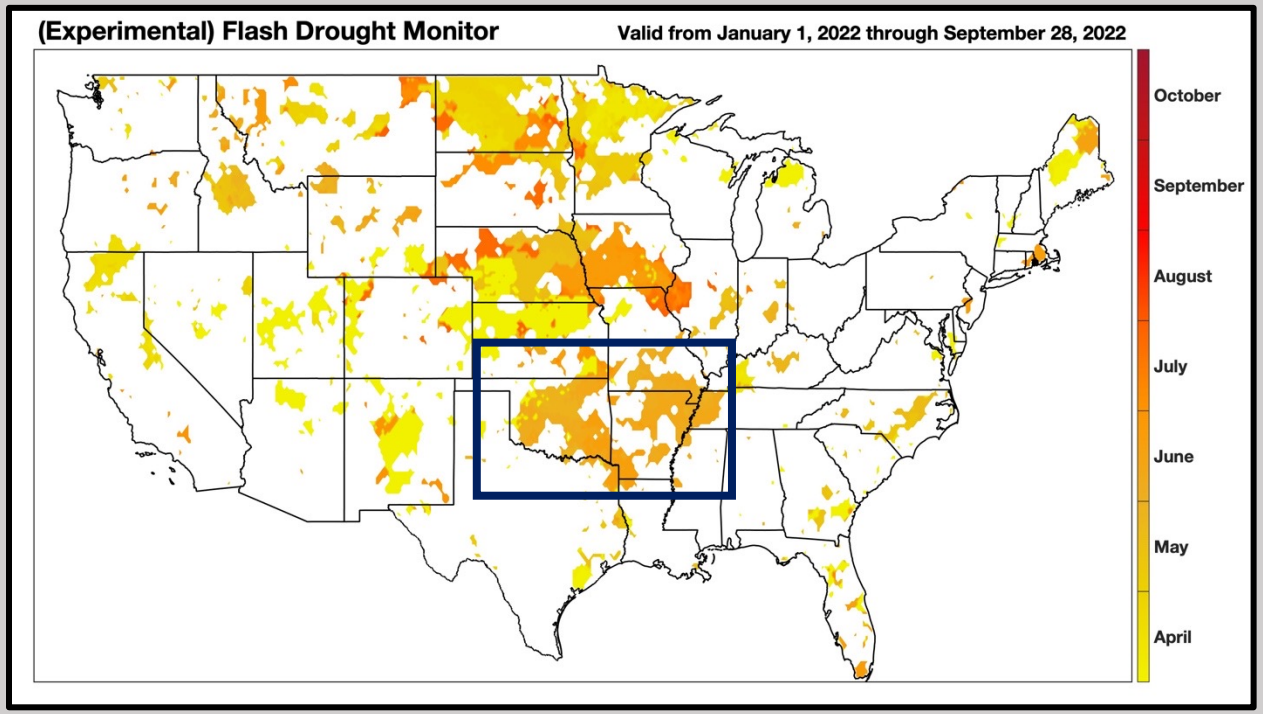


FLASH DROUGHT TOOLS: MONITORING

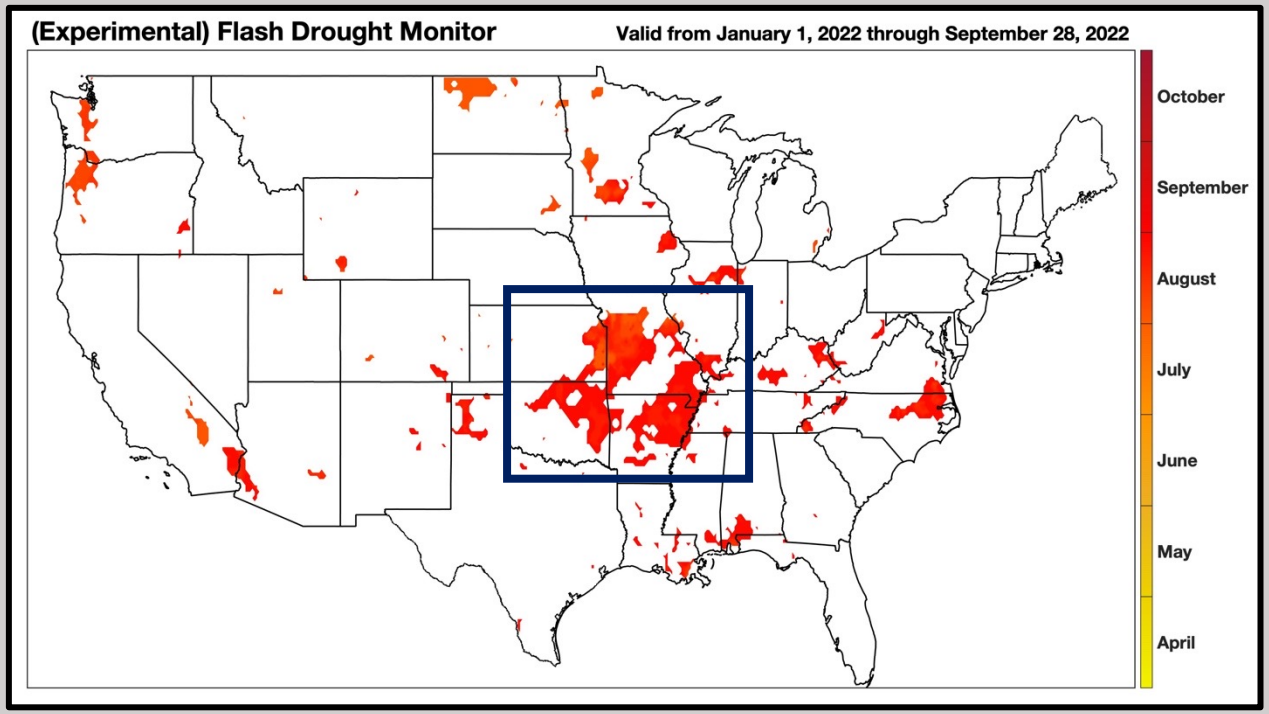


FLASH DROUGHT TOOLS: MONITORING

Prior to 31st July



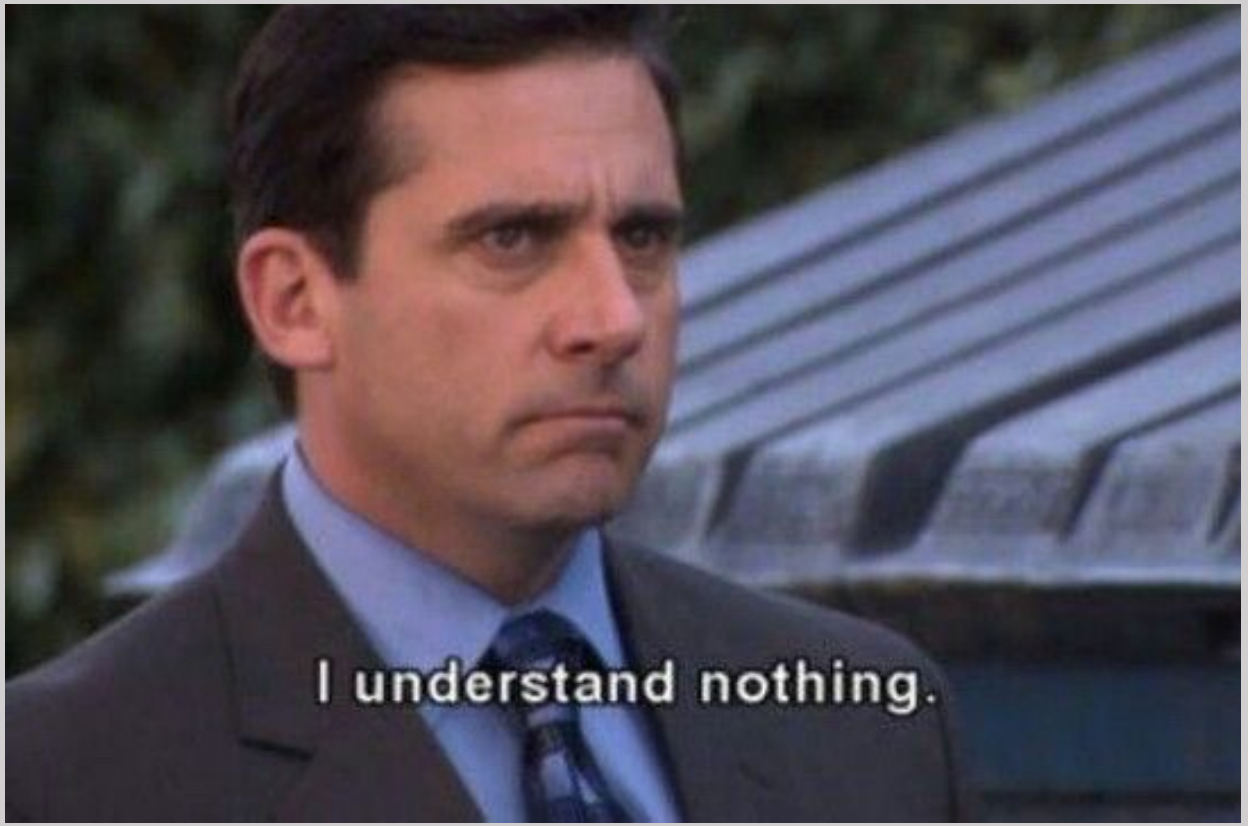
After 1st August




Future Opportunities

FLASH DROUGHT: FUTURE OPPORTUNITIES

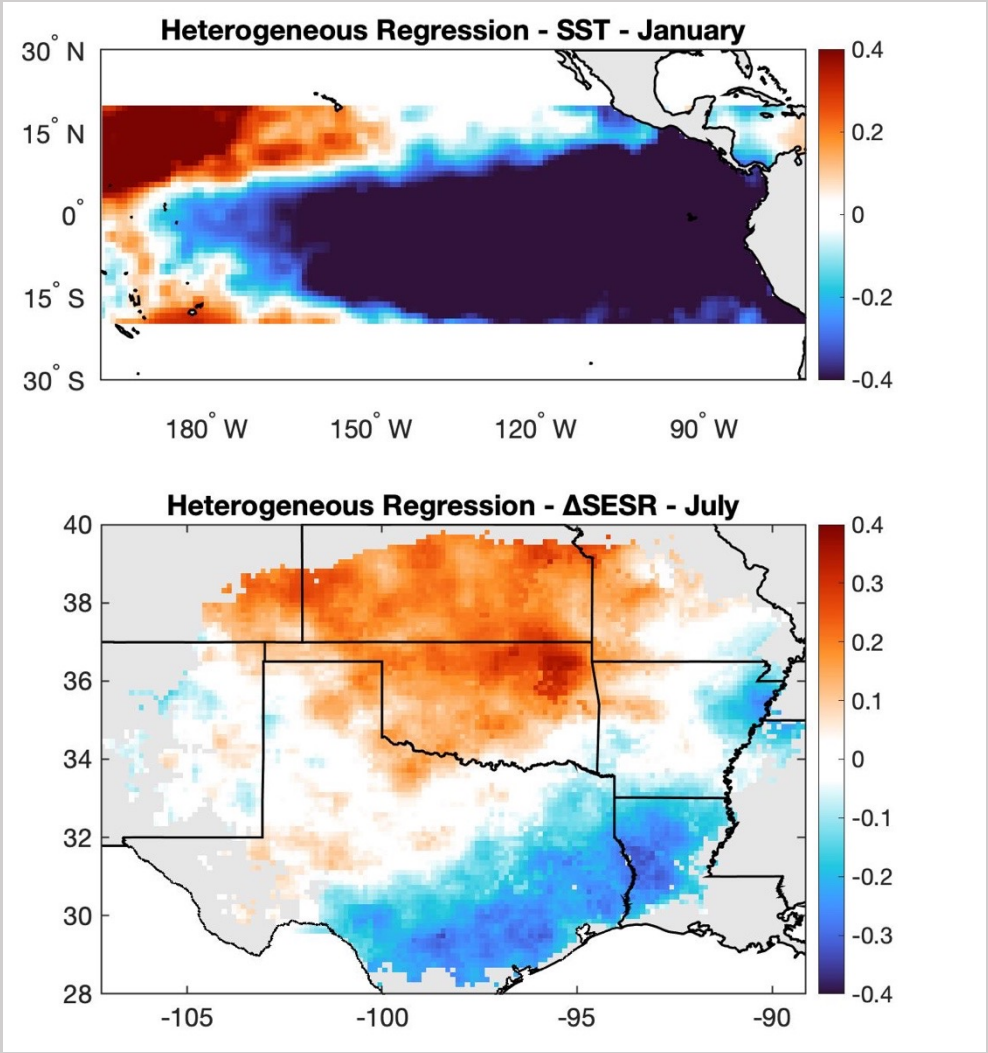
What do we know about flash drought and S2S predictability?



FLASH DROUGHT: FUTURE OPPORTUNITIES

Future Opportunities for Collaboration

- Database of flash drought events from 1979-present (local to global)
- Connecting flash drought development to atmospheric and oceanic patterns
- Multi-week forecasting using subseasonal models (e.g. SubX models)

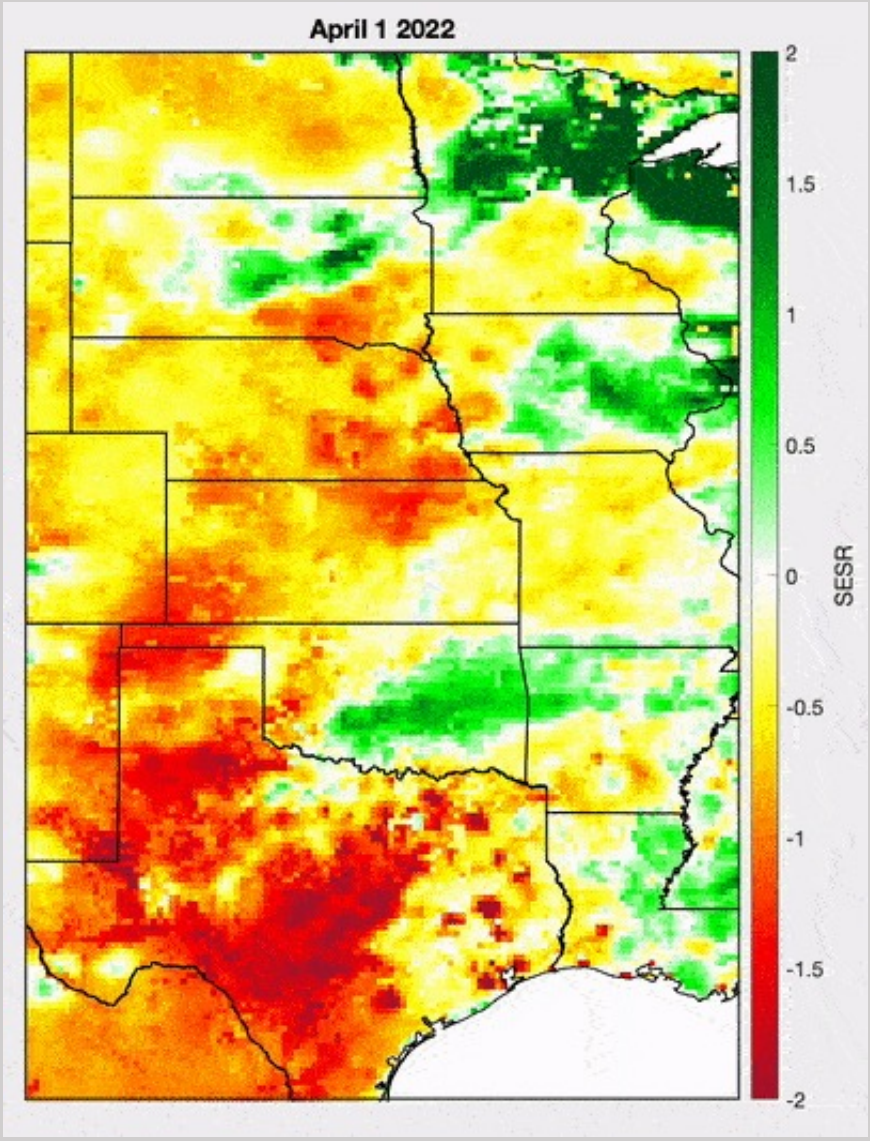


CONCLUSIONS

Current Knowledge
- Climatology of flash drought (local to global)
- General evolution of flash drought (spatial and temporal)

Tools
- Standardized Evaporative Stress Ratio (SESR)
- Land Surface Water Index (LSWI)
- Near-real time monitoring of flash drought

Future Opportunities
- Database of flash drought events
- S2S predictability of flash drought



Contact Information:

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