



# Drought in a Changing World

## The Past, Present, and Future of Drought Adaptation and Resilience in the Columbia and Missouri River Basins





How have people experienced  
**abnormal aridity**  
in the Missouri and Columbia basins?

1) Where we are now

2) Where we've come from

3) Where we are going



Montana  
Climate  
Office

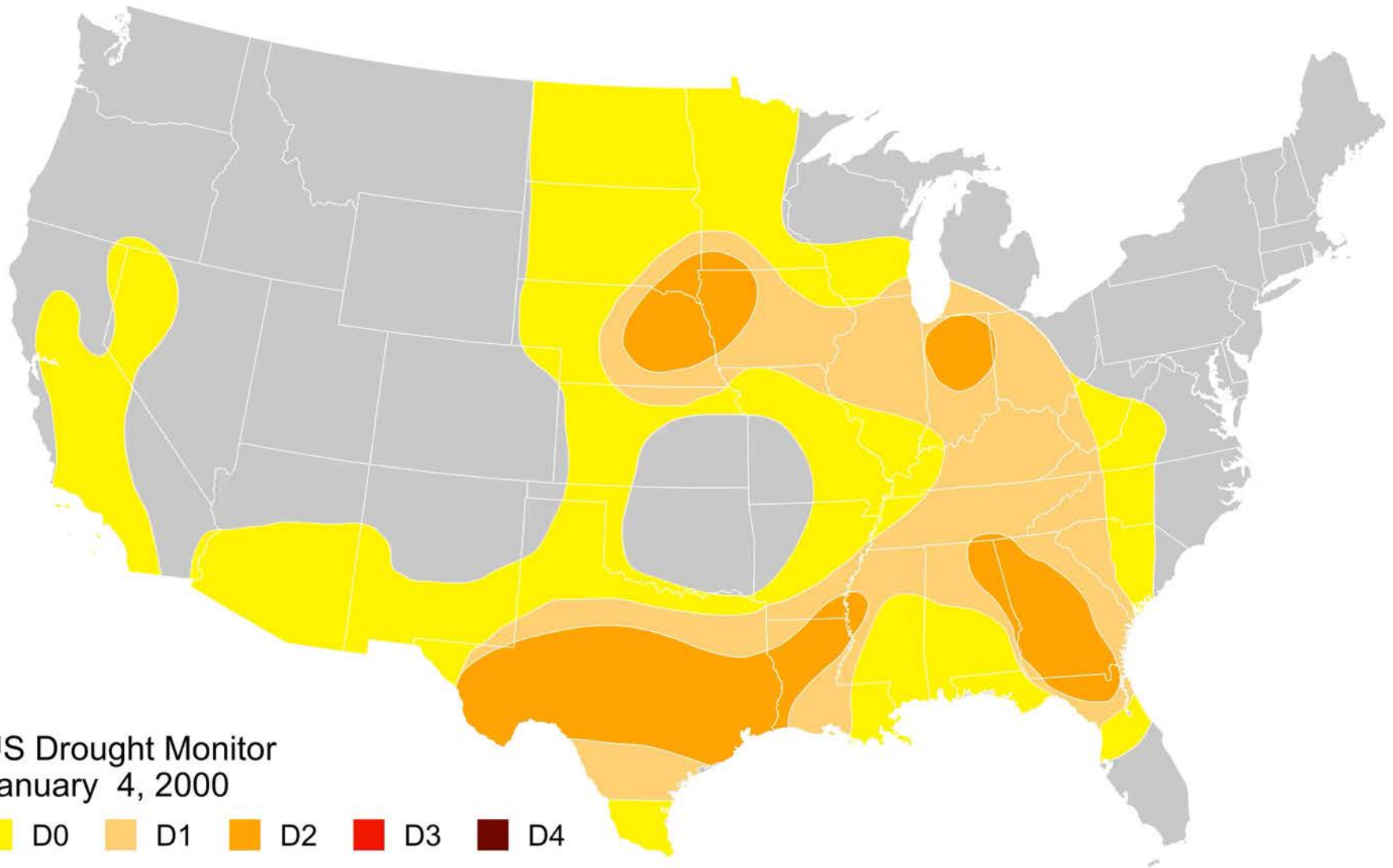


UNIVERSITY OF  
**MONTANA**

*Drought in a Changing World*

Kyle Bocinsky, Montana Climate Office, September 26, 2023

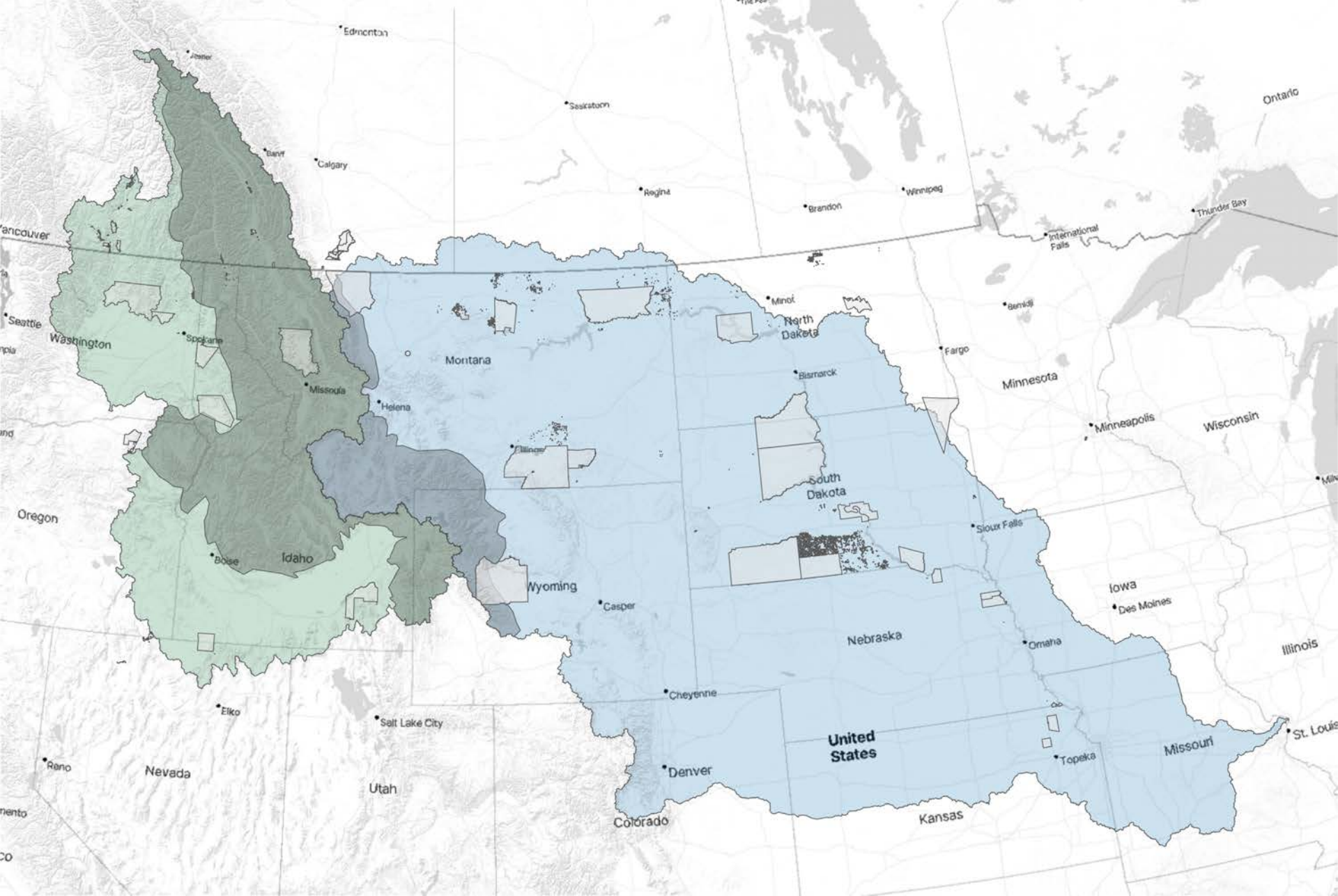
Workshop for Building Drought Resilience in a Changing Climate with Upper Columbia and Missouri Basin Tribes



US Drought Monitor  
January 4, 2000

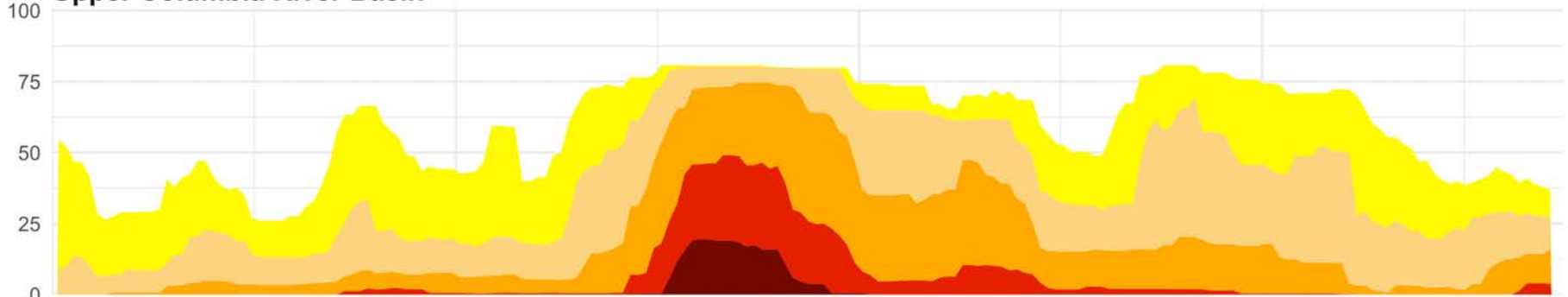
■ D0 ■ D1 ■ D2 ■ D3 ■ D4



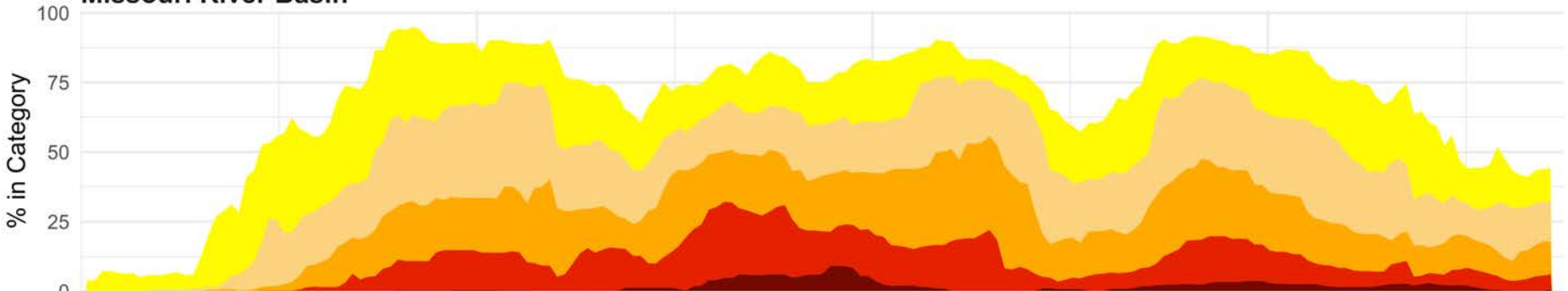


Drought Category D0 D1 D2 D3 D4

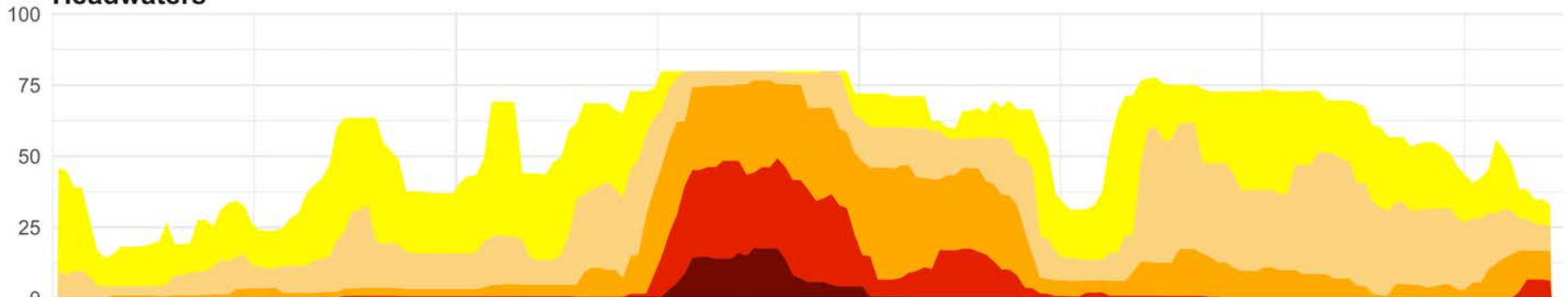
### Upper Columbia River Basin



### Missouri River Basin



### Headwaters

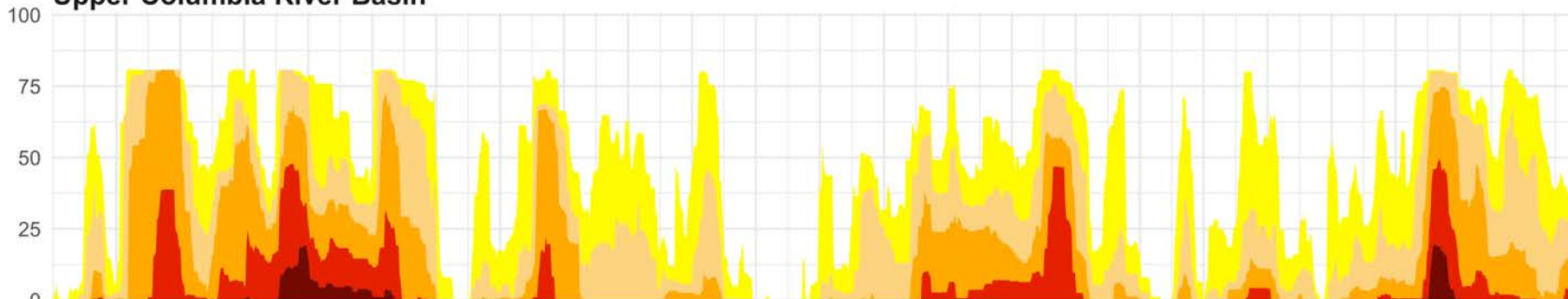


Jan 2020 Jan 2021 Jan 2022 Jan 2023 Year

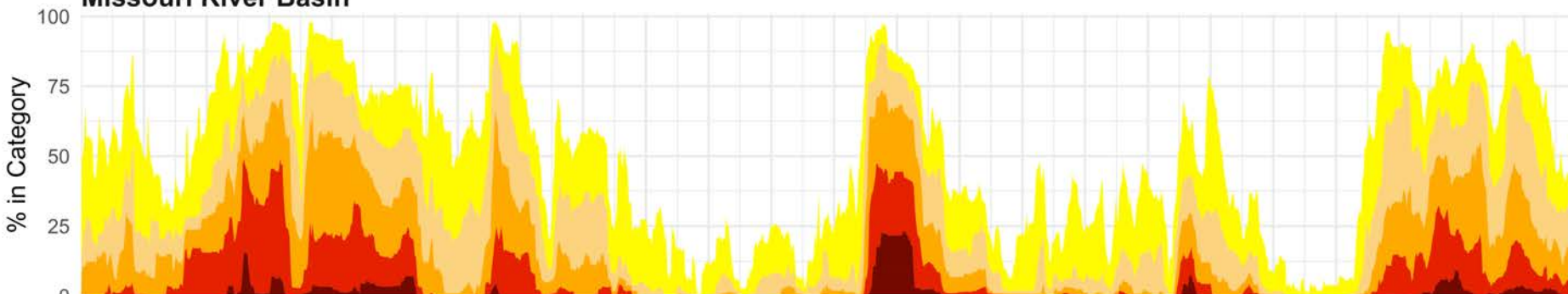


Drought Category D0 D1 D2 D3 D4

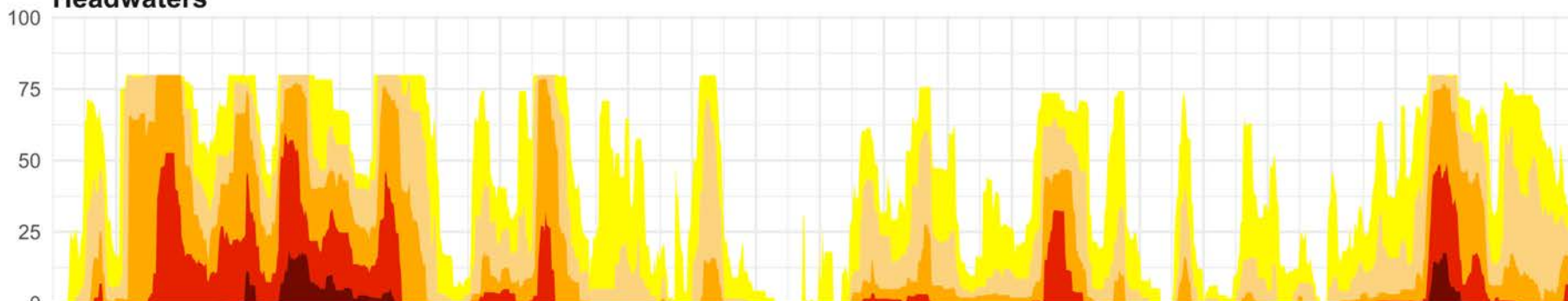
### Upper Columbia River Basin



### Missouri River Basin



### Headwaters



Year



*Drought in a Changing World*

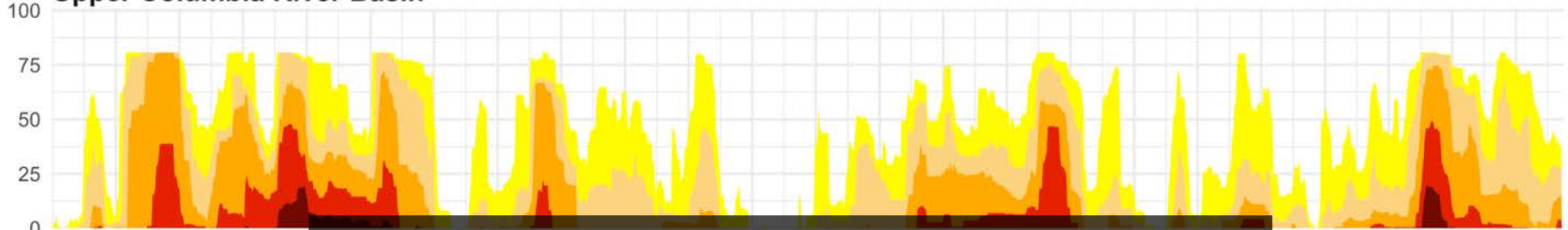
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Workshop for Building Drought Resilience in a Changing Climate with Upper Columbia and Missouri Basin Tribes



Drought Category D0 D1 D2 D3 D4

Upper Columbia River Basin



Missouri River Basin

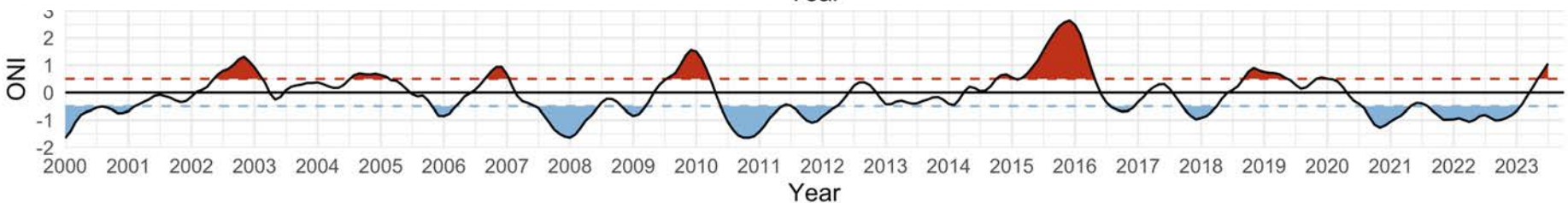


Headwaters

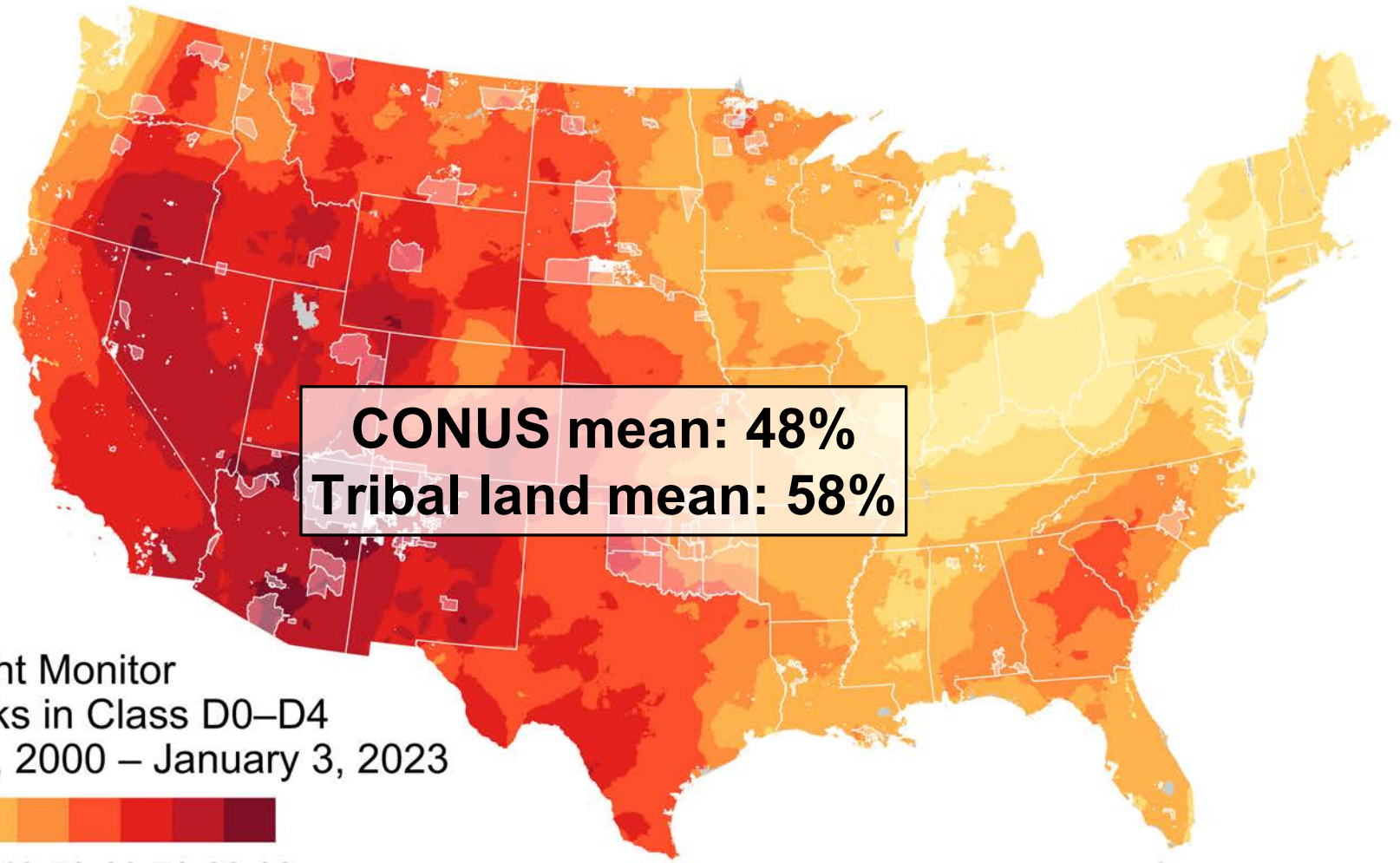


Not El Niño  
or La Niña\*

\*at least not always



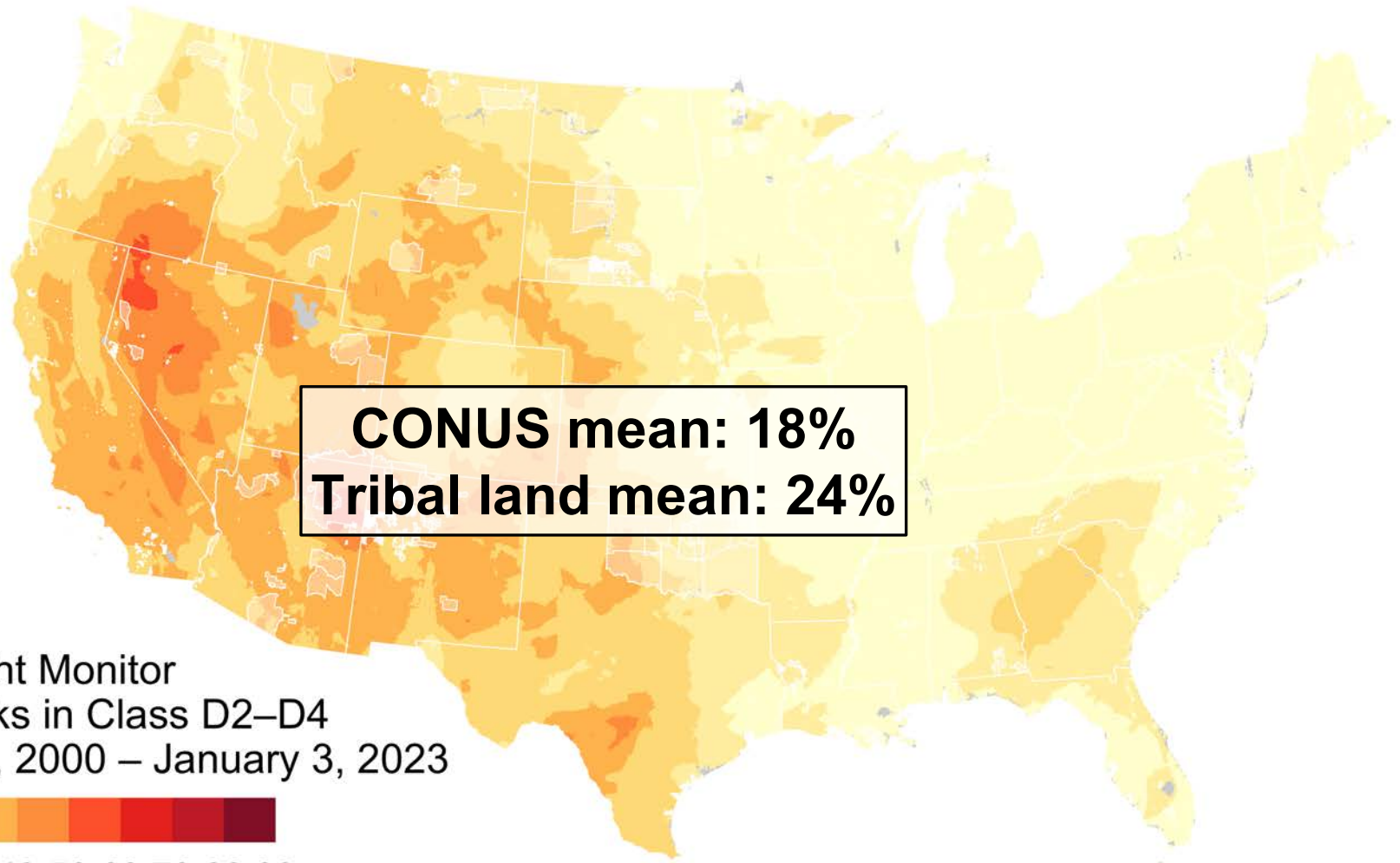




**CONUS mean: 48%**  
**Tribal land mean: 58%**

US Drought Monitor  
 % of Weeks in Class D0–D4  
 January 4, 2000 – January 3, 2023





**CONUS mean: 18%**  
**Tribal land mean: 24%**

US Drought Monitor  
 % of Weeks in Class D2–D4  
 January 4, 2000 – January 3, 2023





Drought Category D0 D1 D2 D3 D4

### Upper Columbia River Basin

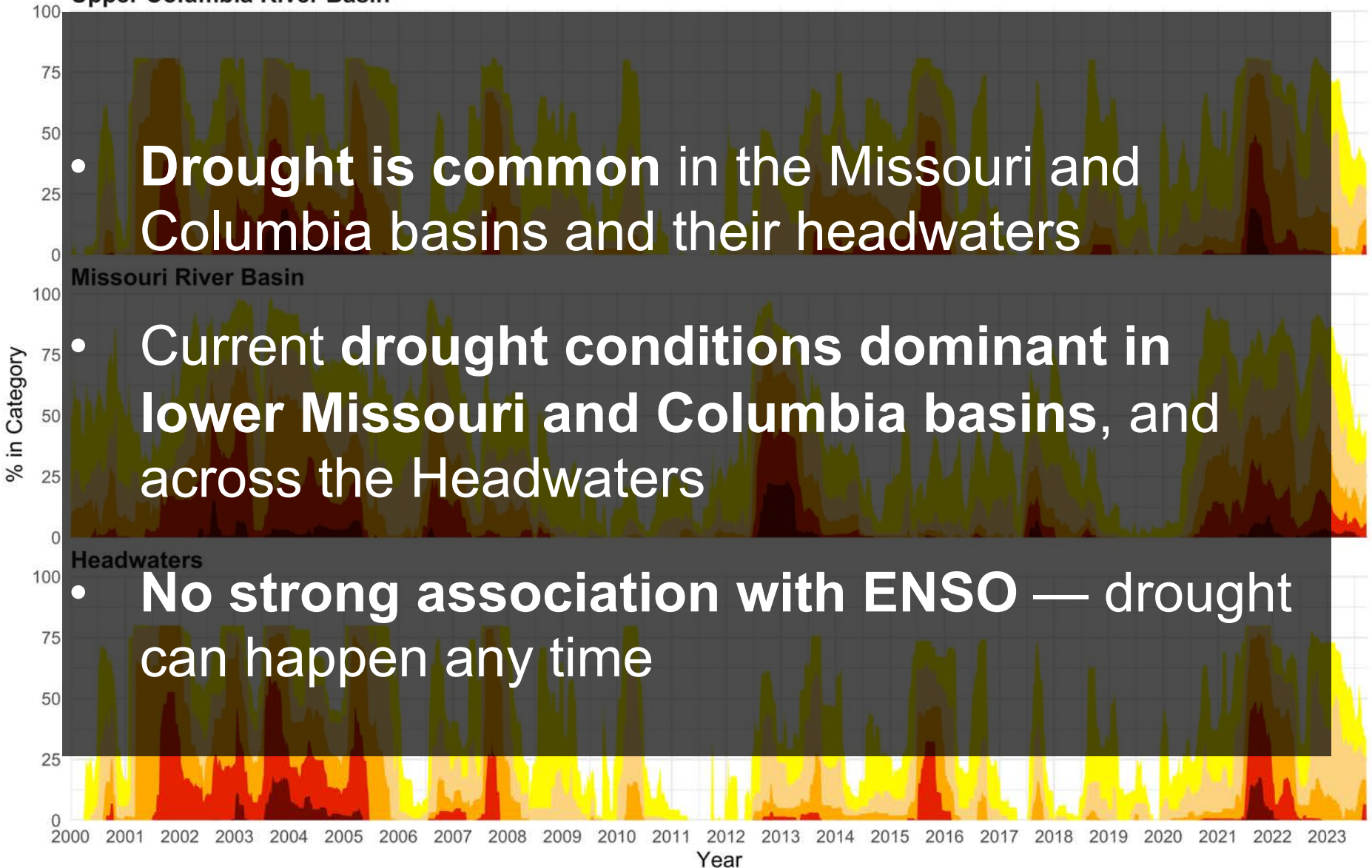
- **Drought is common in the Missouri and Columbia basins and their headwaters**

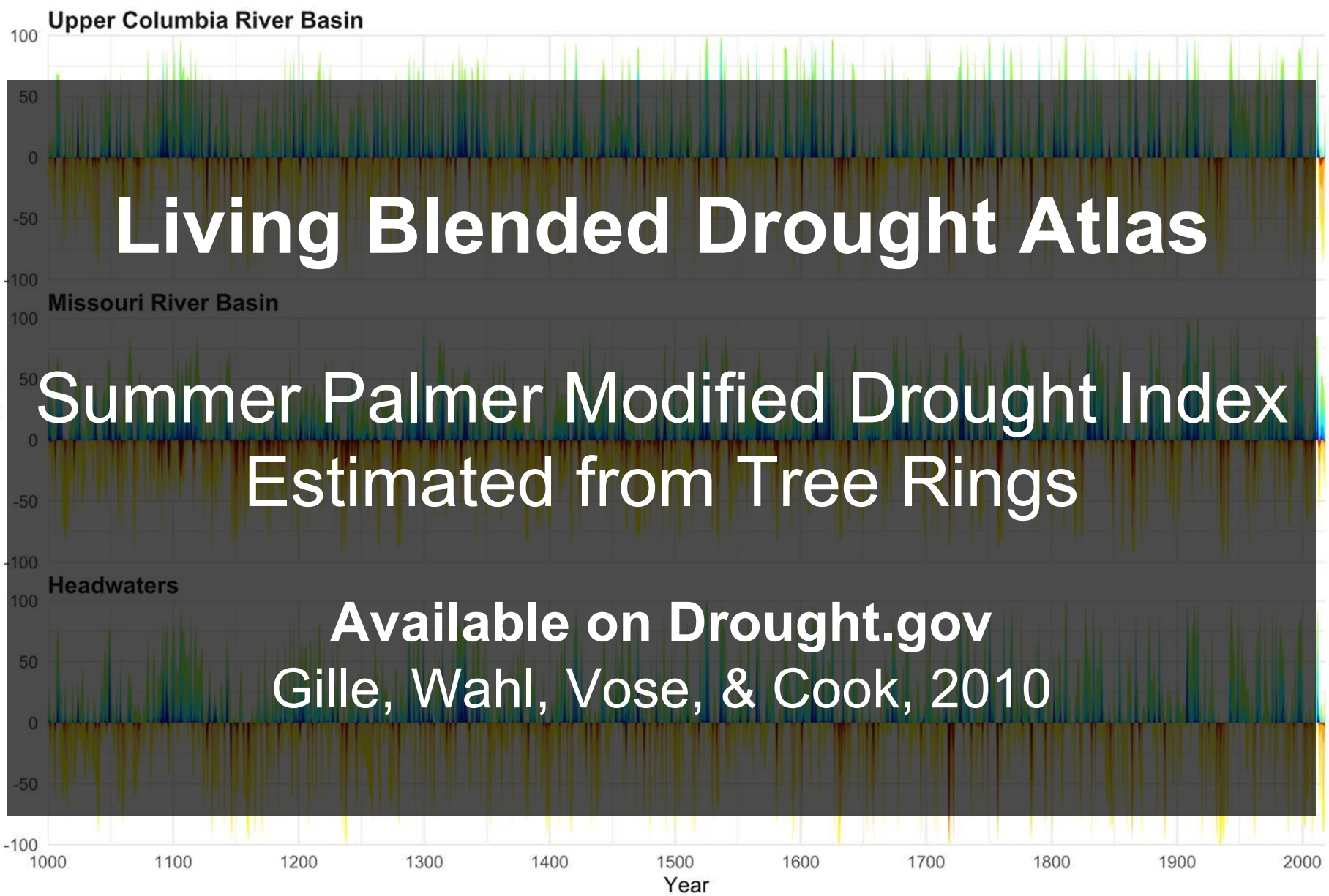
### Missouri River Basin

- **Current drought conditions dominant in lower Missouri and Columbia basins, and across the Headwaters**

### Headwaters

- **No strong association with ENSO — drought can happen any time**





# Living Blended Drought Atlas

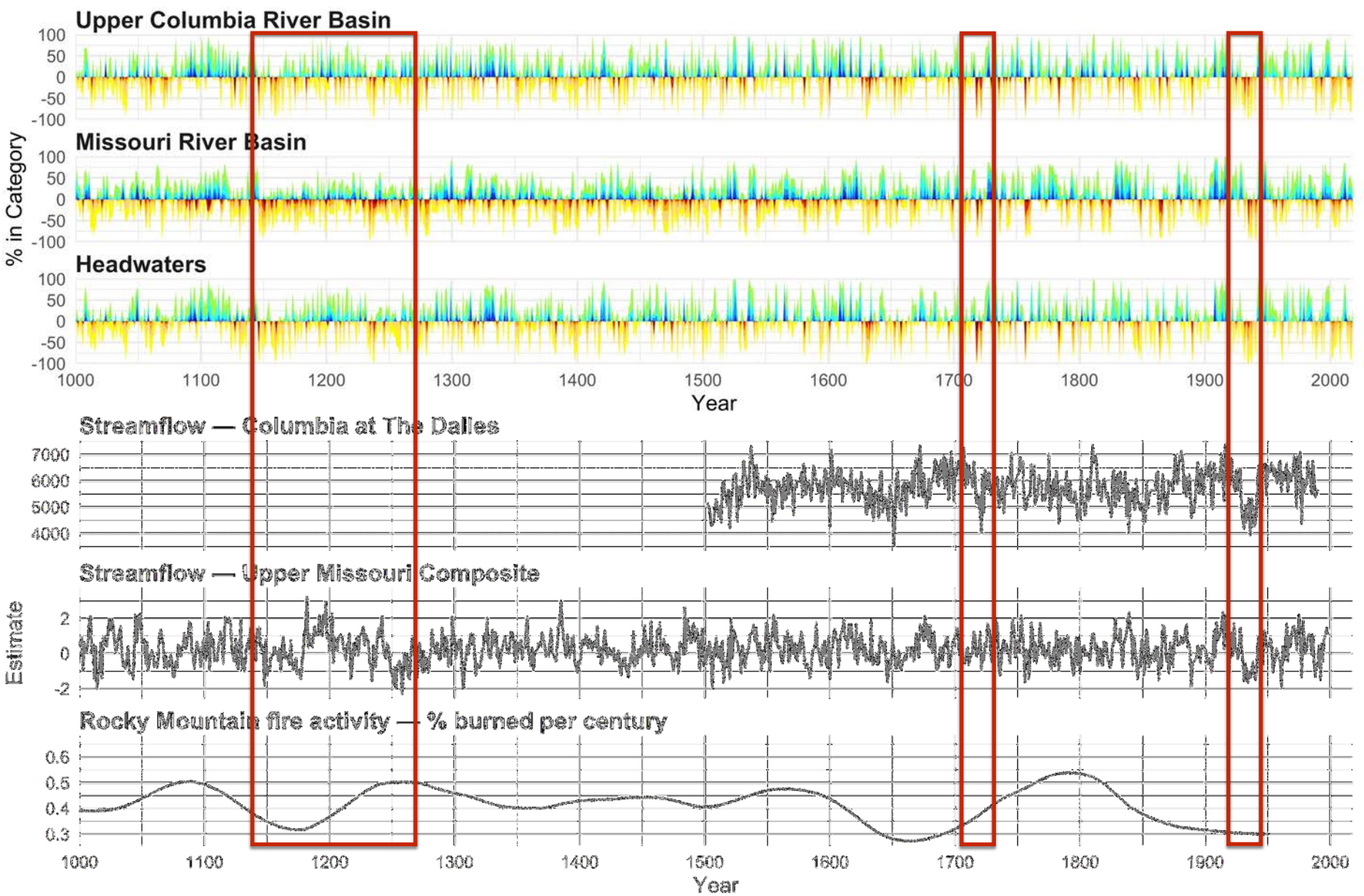
## Summer Palmer Modified Drought Index Estimated from Tree Rings

Available on [Drought.gov](https://Drought.gov)  
Gille, Wahl, Vose, & Cook, 2010

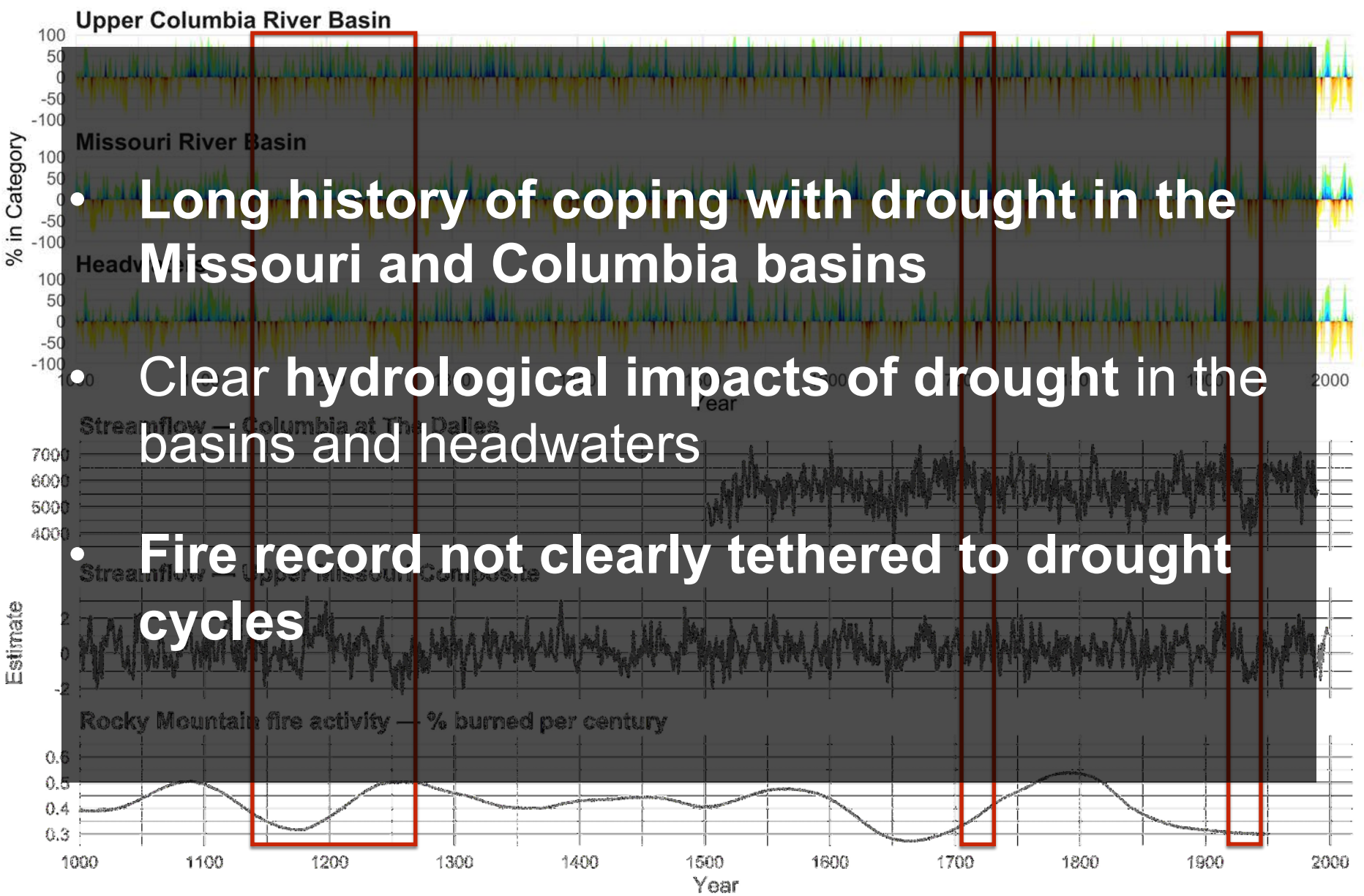






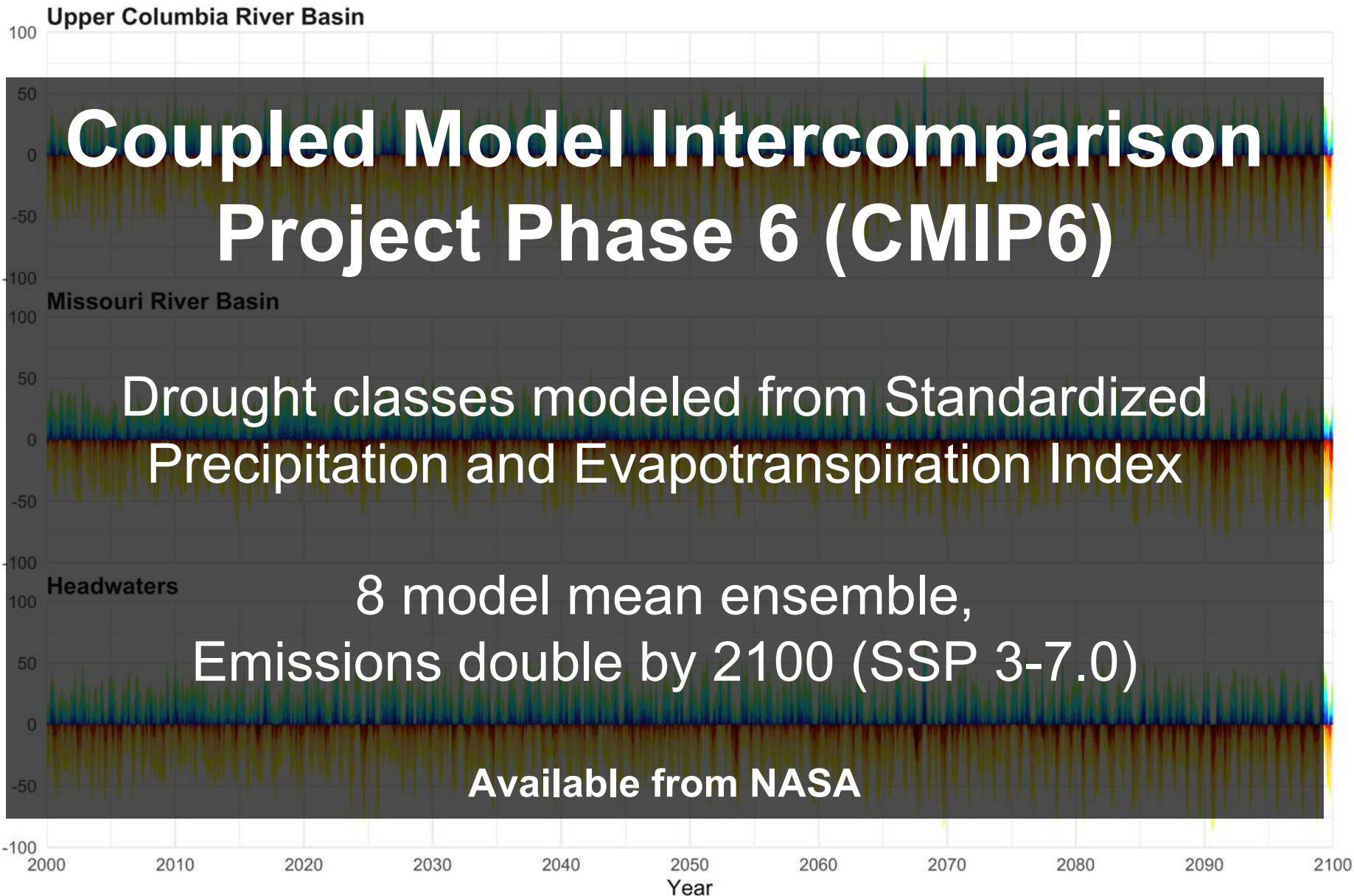






- Long history of coping with drought in the Missouri and Columbia basins
- Clear hydrological impacts of drought in the basins and headwaters
- Fire record not clearly tethered to drought cycles

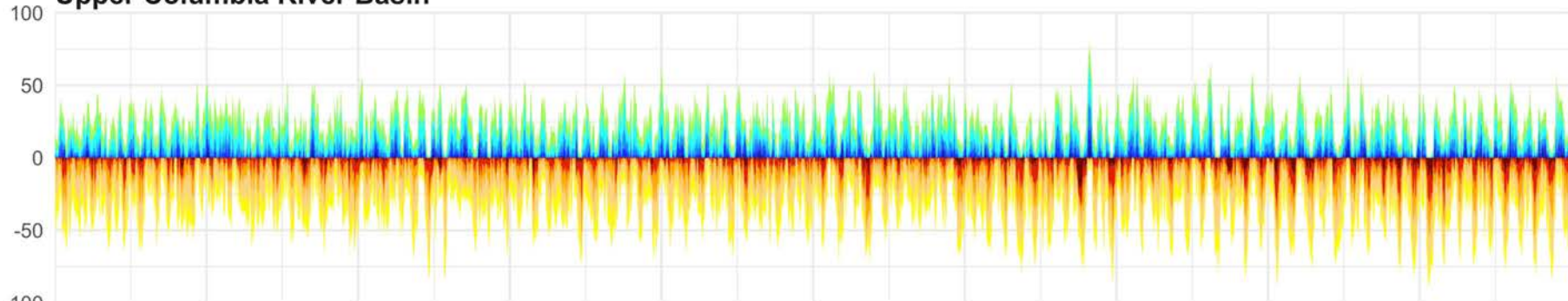






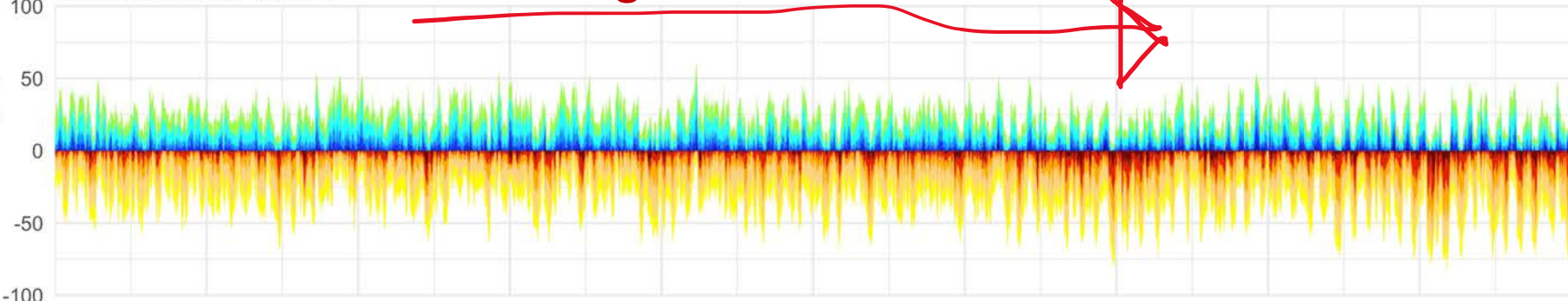


### Upper Columbia River Basin

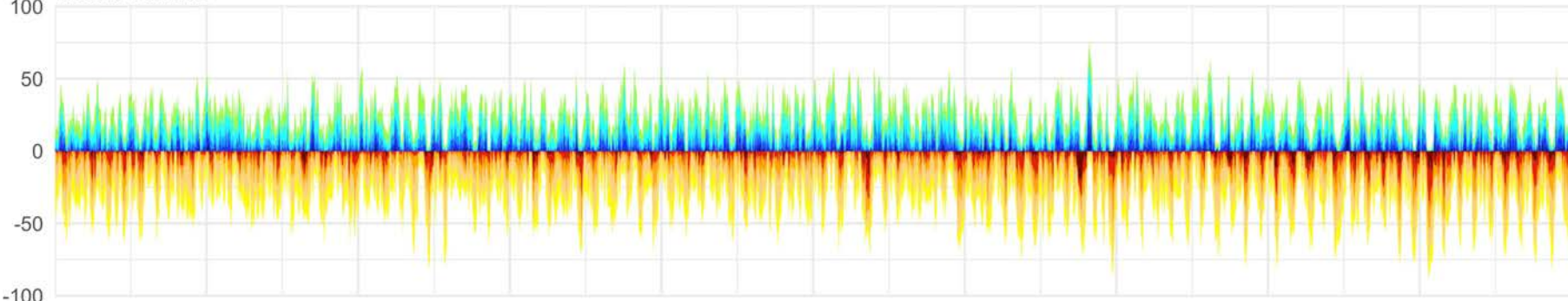


### Missouri River Basin

**Increasing seasonal extremes?**



### Headwaters

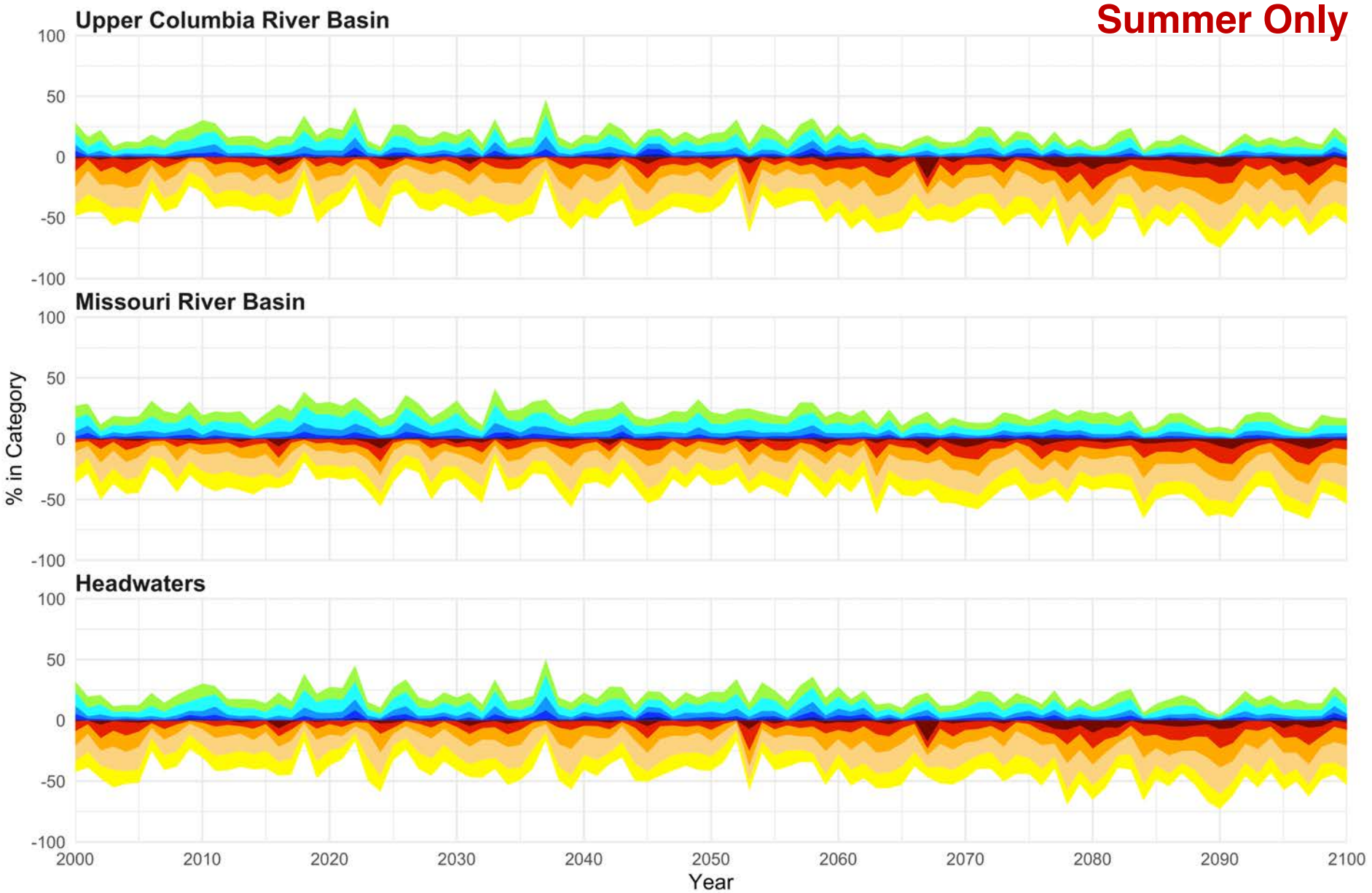


2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100  
Year





**Summer Only**





D4 D3 D2 D1 D0 W0 W1 W2 W3 W4

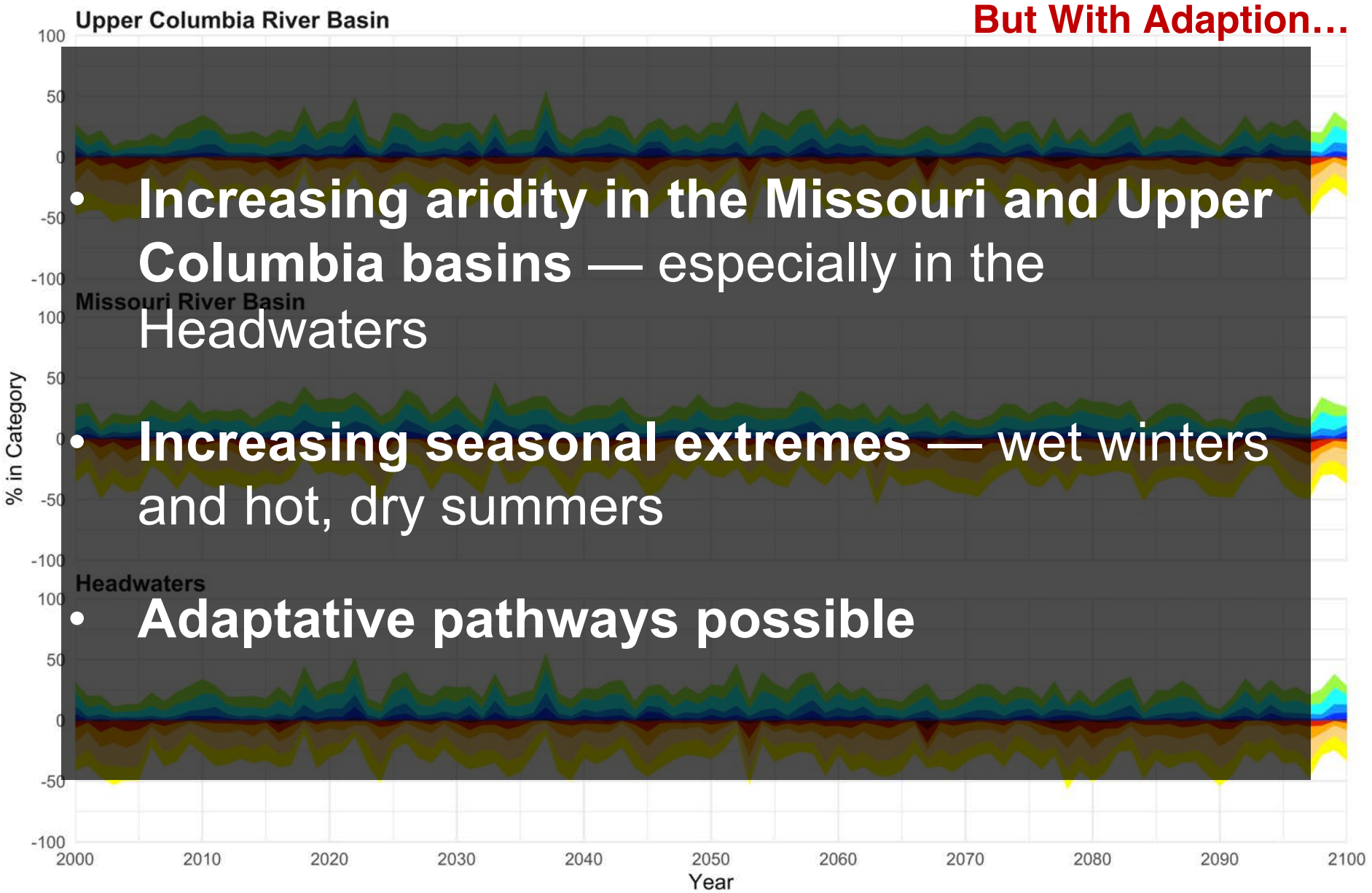
**But With Adaption...**







**But With Adaption...**



- Increasing aridity in the Missouri and Upper Columbia basins — especially in the Headwaters

- Increasing seasonal extremes — wet winters and hot, dry summers

- Adaptative pathways possible



# How will we adapt to drought in a changing world?

## Points of departure

- 1) Strengths and vulnerabilities in taking a long view of drought
- 2) Persistent colonial legacies
- 3) Sovereignty:  
Food, water, data, culture, trust