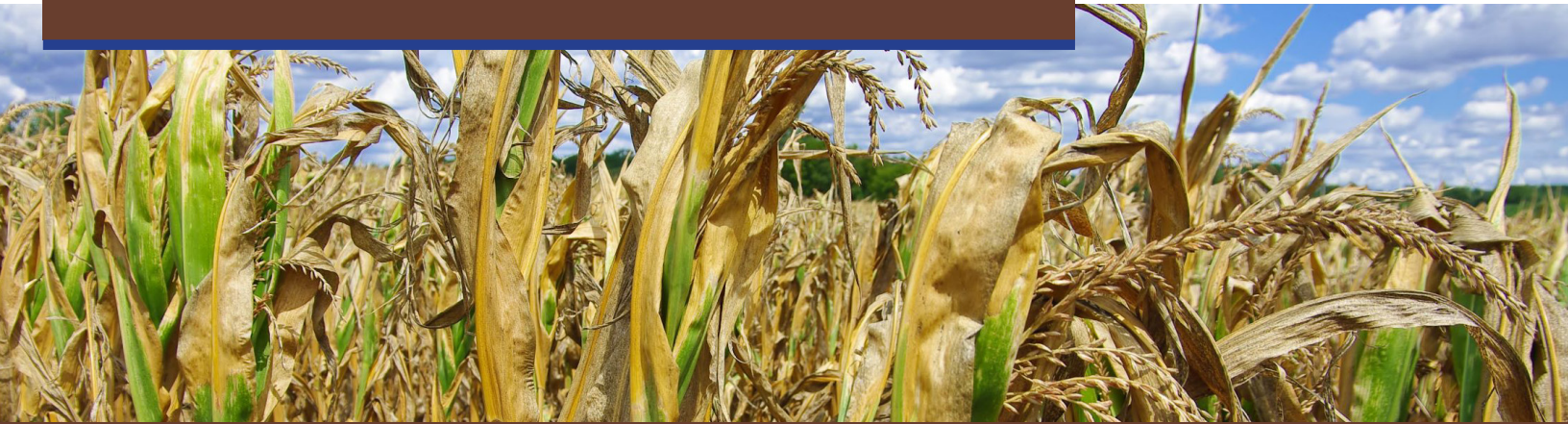


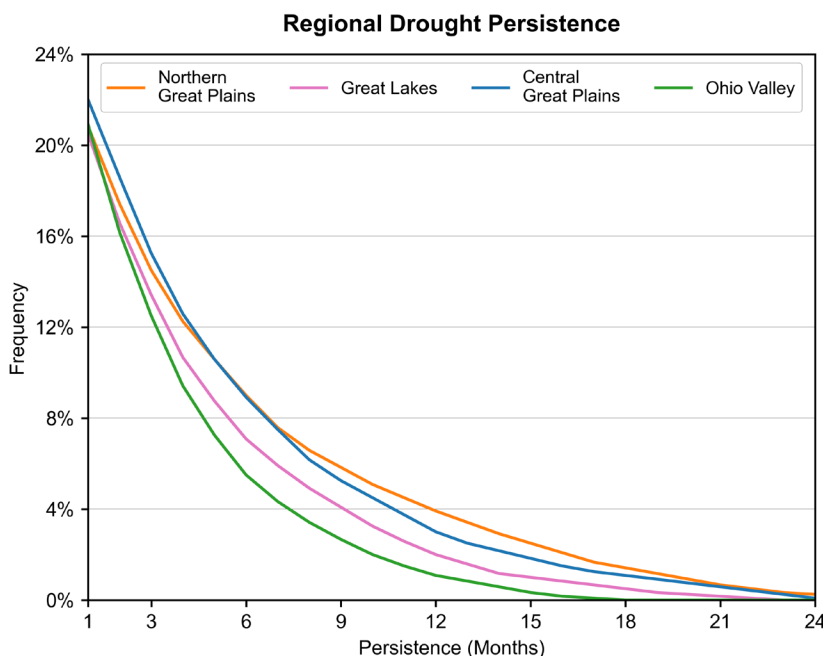
# DROUGHT ONSET, PERSISTENCE, AND RECOVERY IN THE MIDWEST



The Midwest region has endured many droughts that have led to billion dollar losses, with examples over the last 30 years including 1980s, 2005, and 2012. Neither the onset or demise of the 2005 and 2012 droughts over the Midwest were forecast. The goal of this research study led by NOAA's Physical Sciences Laboratory is to build a predictive understanding of drought and to quantify the risks of droughts with certain characteristics in the Midwest region. This summary highlights results focused on the characteristics of drought onset, persistence, and recovery.

## Drought Persistence

The frequency of drought persistence in each of the four Midwest sub-regions indicates that the likelihood of drought duration depends on location (Figure 1). Droughts tend to last longer in the Great Plains regions than they do in the Great Lakes or Ohio Valley regions. The Northern Great Plains was four times more likely to experience a drought lasting at least 12 months than the Ohio Valley. Drought duration is related to the climatological precipitation seasonal cycles, in which much of the Northern Great Plains experiences a single wet season that spans April-October while the Ohio Valley receives appreciable precipitation during all months.



**Figure 1:** Frequency of drought persistence in each region. Frequency (percent) is on the y-axis, and persistence (months) is on the x-axis.

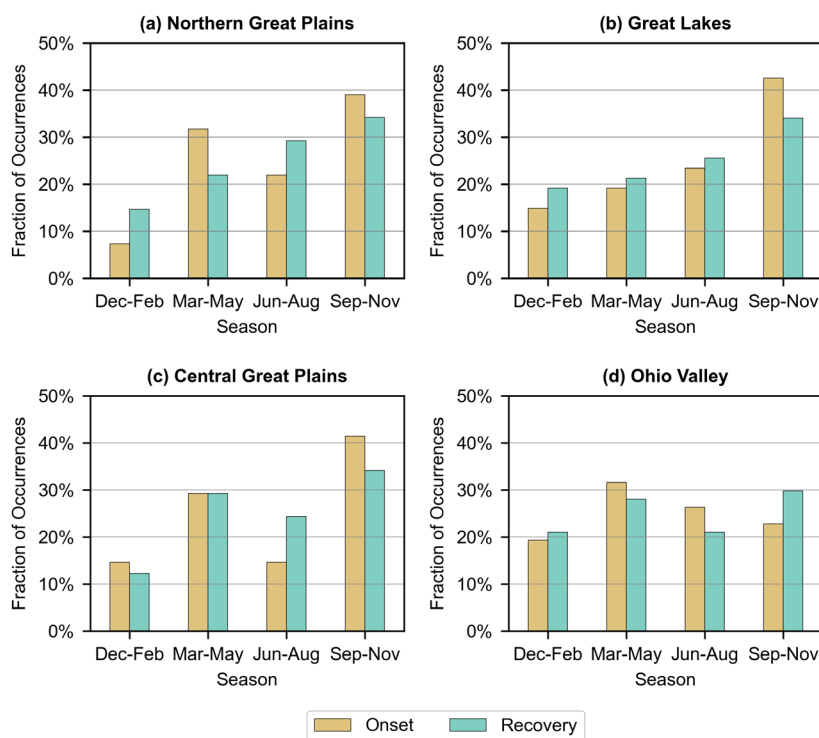
### Key Takeaways:

- Droughts last longer in the Great Plains than they do in the Great Lakes or Ohio Valley regions. Fewer opportunities for drought amelioration are found in the Great Plains throughout the year because the majority of precipitation is observed during the warm season.
- Drought onset and demise follow the precipitation seasons, whereby droughts tend to begin and end during seasons with appreciable precipitation.

## Drought Onset and Recovery

Droughts begin and end during preferred seasons in each Midwest sub-region (Figure 2). The preferred seasons generally follow the precipitation seasonal cycle, whereby droughts tend to begin and end during seasons with appreciable precipitation. For the Great Plains, droughts overwhelmingly begin and end outside of winter, the dry time of year, with a maximum in June-August and September-November. Spring and fall maximums in drought onset and recovery are related to increased precipitation variability during these seasons relative to summer.

Drought onset and recovery in the Great Lakes and Ohio Valley regions of the Midwest occur more equitably across the seasons than is observed over the Great Plains regions. The Ohio Valley region experiences drought onset and recovery more frequently in spring, while the Great Lakes regions experiences drought onset and demise more frequently in fall because precipitation variability is greatest during these seasons over these regions.



**Figure 2.** Fraction of drought onset (brown) and recovery (teal) in each region by season.

**Project Methods:** A monthly integrated drought index (IDI) is used to measure drought during 1916-2015. This version of an IDI, adapted from Mo and Lettenmaier (2014, 2018), is defined as the average of three-month standardized runoff and monthly standardized total land surface moisture from four land surface models included in the [UCLA Experimental Surface Water Monitor](#). Total moisture is the sum of column integrated soil moisture and snow water equivalent. Four regions within the Midwestern United States, shown on the right, are considered: Ohio Valley, Great Lakes, Central Great Plains, and Northern Great Plains. These regions were identified by applying a hierarchical clustering algorithm based on [Ward \(1963\)](#) to the monthly IDI. The monthly IDI for each region is quantified by calculating the average IDI of all grid points within them. Following [Mo \(2011\)](#), a regional drought event is defined as the time from which the regional IDI falls below  $-0.8$  standardized departures (onset) to when the IDI exceeds  $-0.2$  standardized departures (recovery)

