# UNDERSTANDING DRIVERS OF ARIDIFICATION AND THEIR INTERACTIONS WITH DROUGHT

What is the difference between a very long drought (multiple decades) and a permanent change toward a more arid climate? There is a fundamental need for a unified framework to define, identify, and quantify the drought-to-aridification continuum. As simple as this might seem, there is no broad consensus on what constitutes drought in a changing climate, nor how to distinguish the relative contributions of drought and aridification across the dryness spectrum. Furthermore, in regions where droughts commonly last for several years and can occasionally last for decades, how can a very-long drought be distinguished from a permanent change?

Furthermore, uncertainty measurements are seldom incorporated into drought assessment frameworks, but are critical for better depictions of drought. Addressing this problem requires a process-level understanding of the links between aridification and drought, from the complex interactions involving snowpack, land surface properties, vegetation, and river flow, to the impacts of anthropogenic forcing and the variability on multi-decadal timescales that can arise naturally within the climate system.

Aridification could be considered a regional manifestation of climate change towards warmer and/or drier conditions. Understanding this phenomenon relative to natural variability has a range of implications for practices within the resource management community. For example, understanding aridification versus drought can inform which periods of record are most relevant for activities ranging from long-term resource planning to short-term model calibration. This would clarify the nuance between sporadic drought, multi-year drought, multi-decadal drought (i.e., megadrought), aridification, and other drought-related terminology as decision-makers pursue acute response actions and longer-term strategies. Understanding the origins of aridification and its impact on drought is key to informing short-term risk management and long-term adaptation.

## Priority Actions:

1. There is a fundamental need for a unified framework to define, identify, and quantify the drought-to-aridification continuum. This may include providing a timescale for how long a trend needs to be in place for it to be considered aridification.

## Research Questions:

1. What are the drivers of regional aridification—anthropogenic vs. natural, predictable vs. unpredictable—and how does aridity influence drought characteristics (e.g., onset, recovery, frequency)?
2. How do anthropogenic forcings impact soil moisture, snowpack and snowmelt, plant physiology, and wildfire linkages with drought?
3. How does aridification interact with droughts? Will aridification increase serial droughts and pan-continental droughts in addition to increasing intensity and frequency of individual droughts?
4. Will the interaction between aridification and drought lead to abrupt changes or tipping points in drought and aridity regimes?
5. Can research on regional hydroclimate attribution science be employed to better differentiate persistent drought from aridification and improve predictability?
6. How do different climate drivers influence both drought and aridity and how do those drivers influence drought demise but not aridity?

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