A case for NASA's next field campaign in dryland ecosystems

Adaptation and Response in Drylands

Andrew Feldman (NASA/UMD)
Sasha Reed (USGS)
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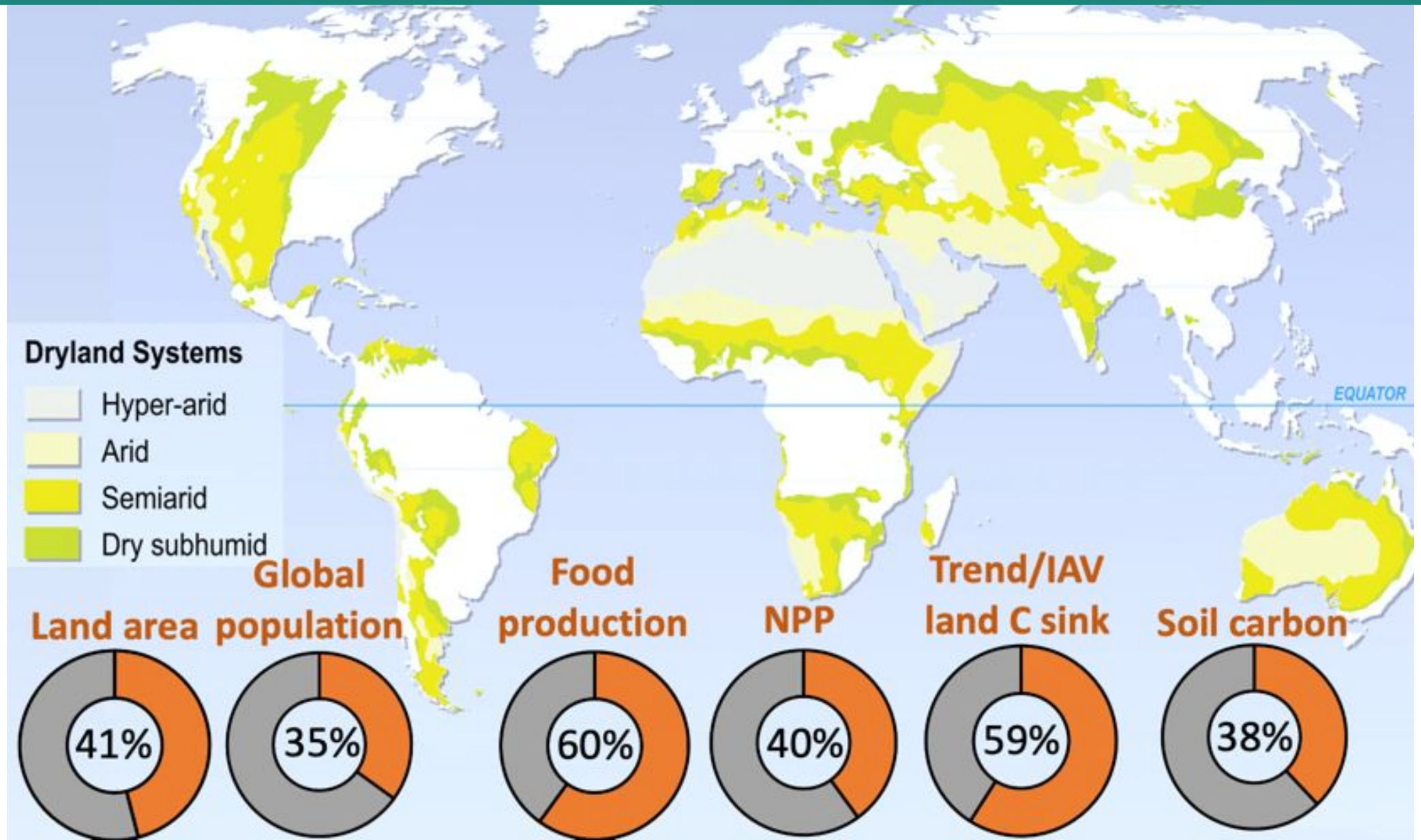
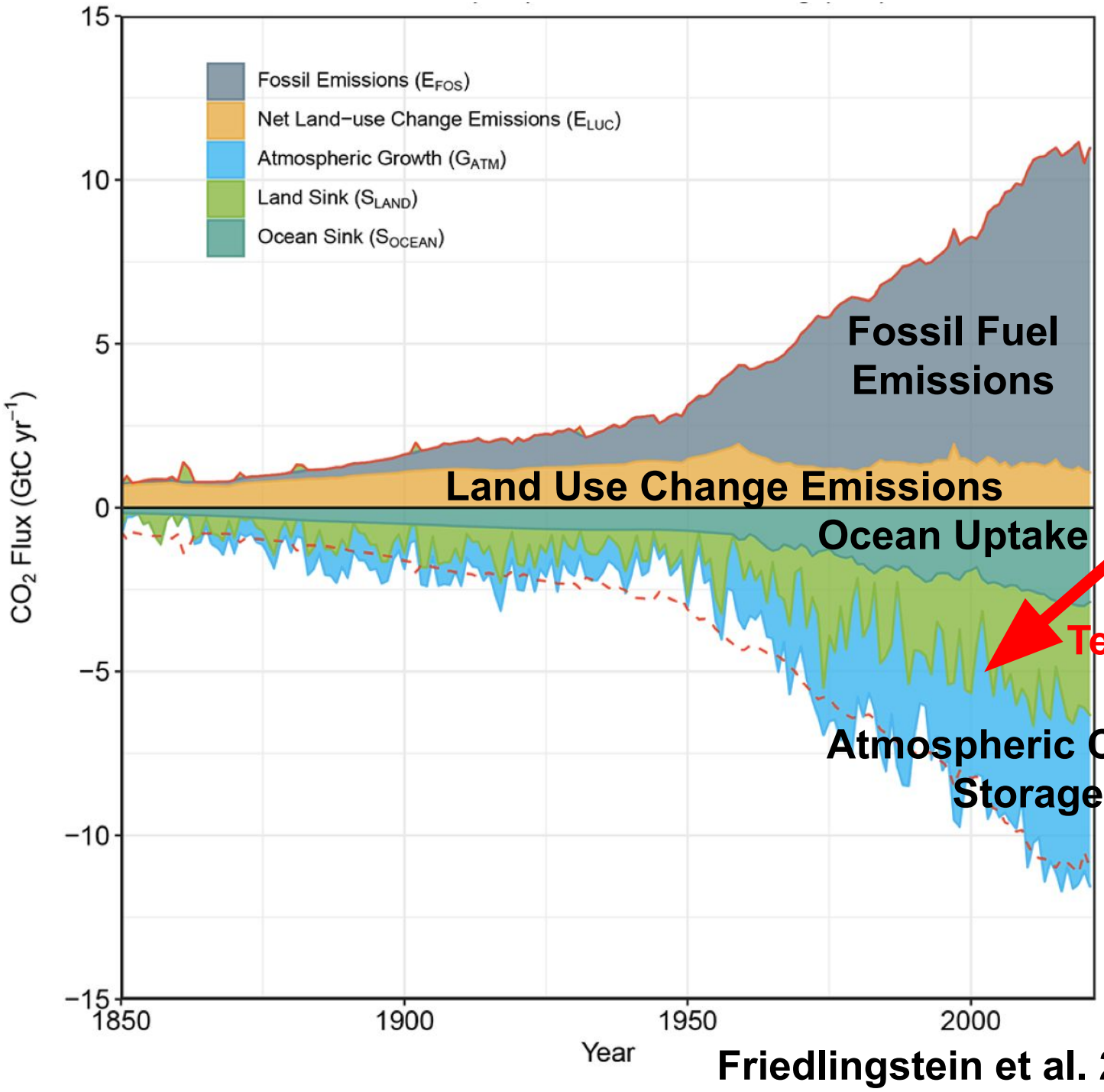
William K. Smith (U. Arizona)
Benjamin Poulter (NASA)
Niall Hanan (New Mexico State U)
Natasha MacBean (Western U.)
Flurin Babst (U. Arizona)
Many Others!!!

Why focus on drylands?



Carbon Cycle Variability



Large interannual variability of land carbon uptake

Drives variability of atmospheric carbon storage

Variability is mostly due to drylands!

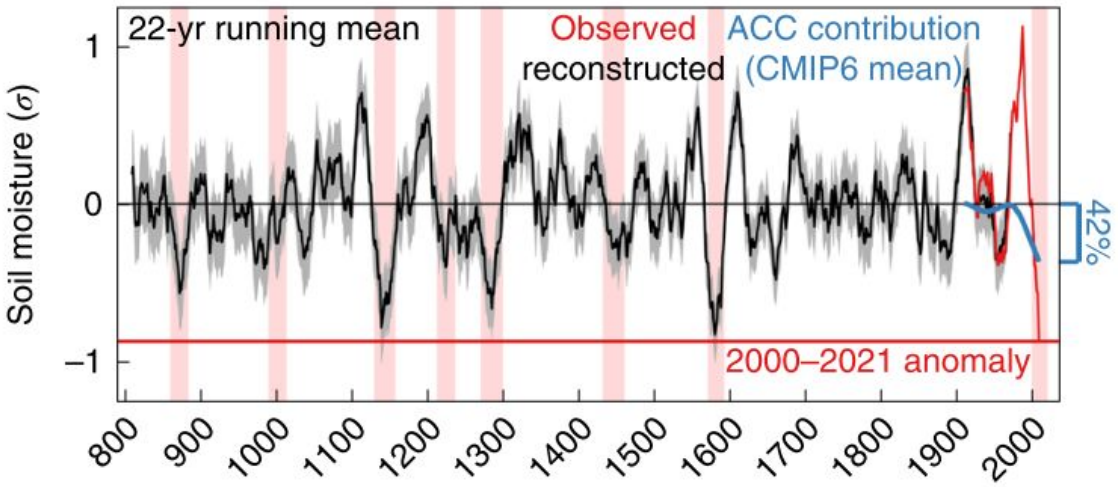
Friedlingstein et al. 2022 (ESSD)

Hotspots for Change: Drought + Heatwaves

BRIEF COMMUNICATION
https://doi.org/10.1038/s41558-022-01290-z
nature climate change
Check for updates

Rapid intensification of the emerging southwestern North American megadrought in 2020–2021

A. Park Williams[1,2]✉, Benjamin I. Cook[2,3] and Jason E. Smerdon[2]



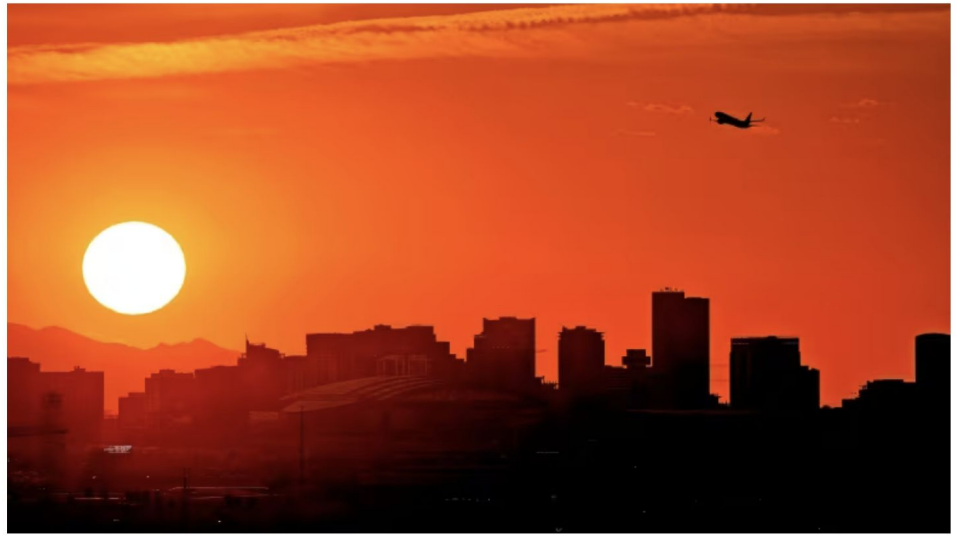
Williams et al. 2022

Recent Western US drought one of largest seen in over 1000 years

It's so hot in Phoenix, Ariz., that 42 C is considered cooler as record high temperature streak ends

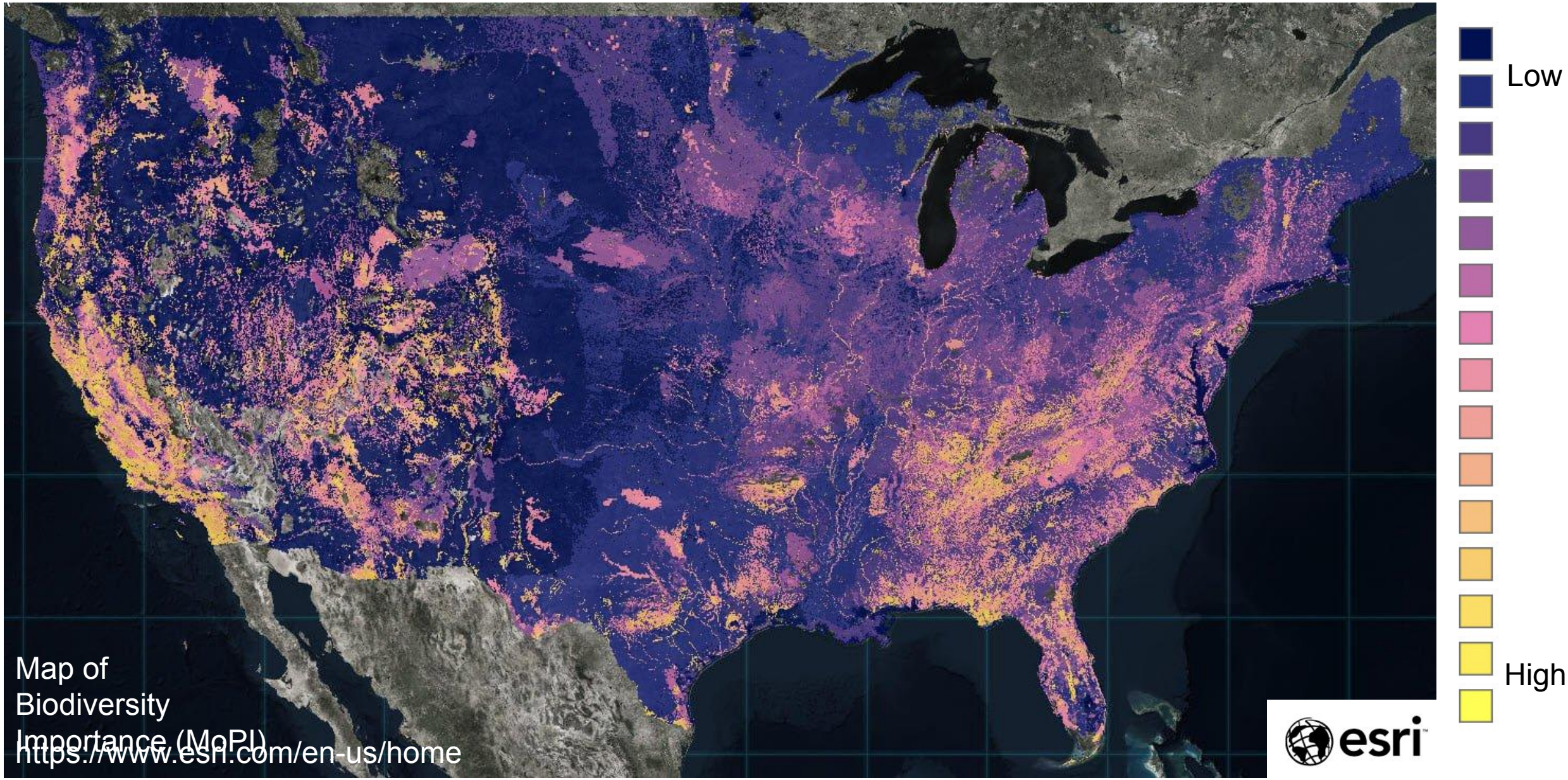
Historic heat began blasting multiple regions across the U.S. in June

The Associated Press · Posted: Jul 31, 2023 9:35 PM EDT | Last Updated: July 31, 2023

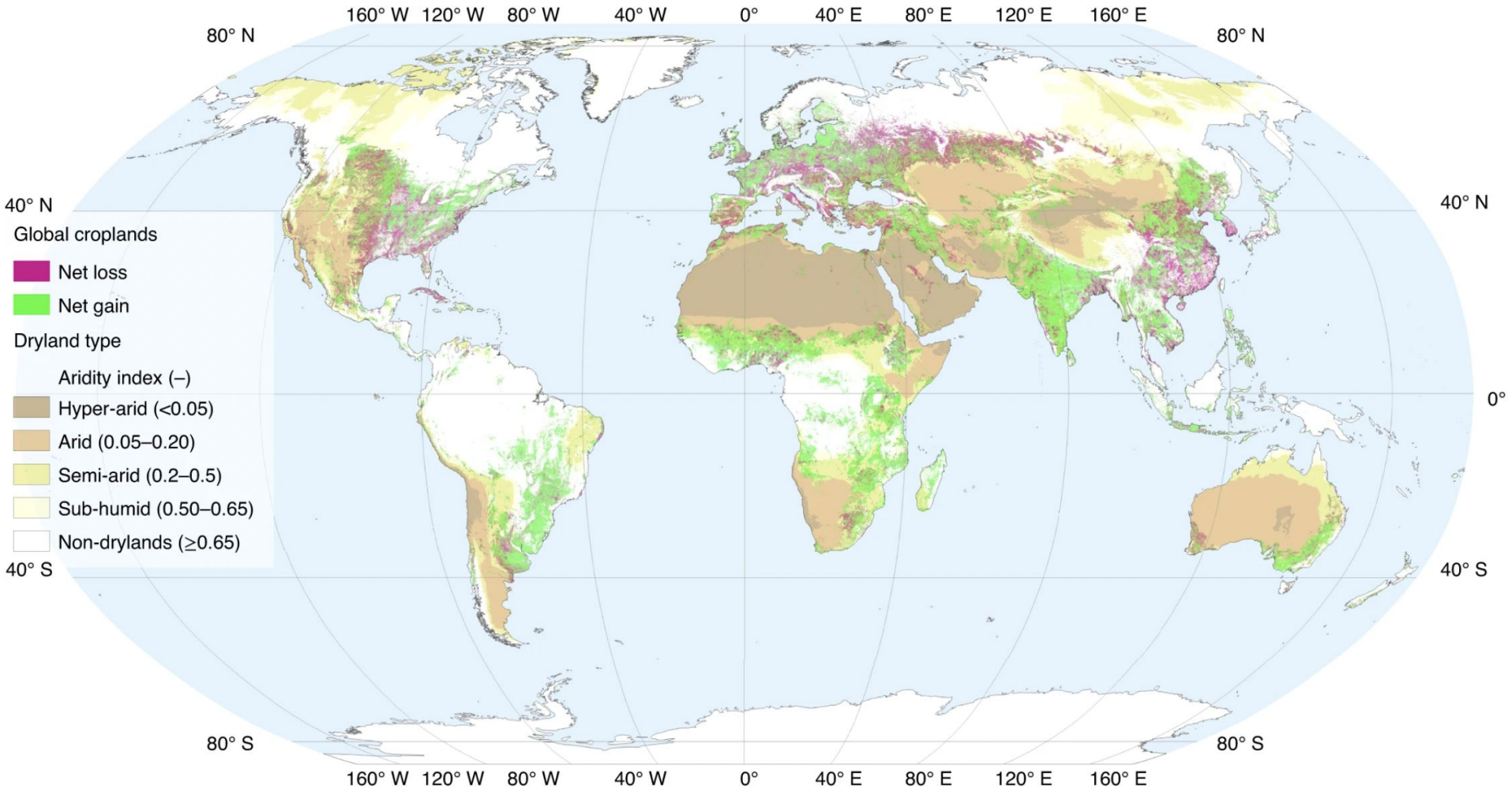


CBC News

Drylands are hotspots of critical biodiversity



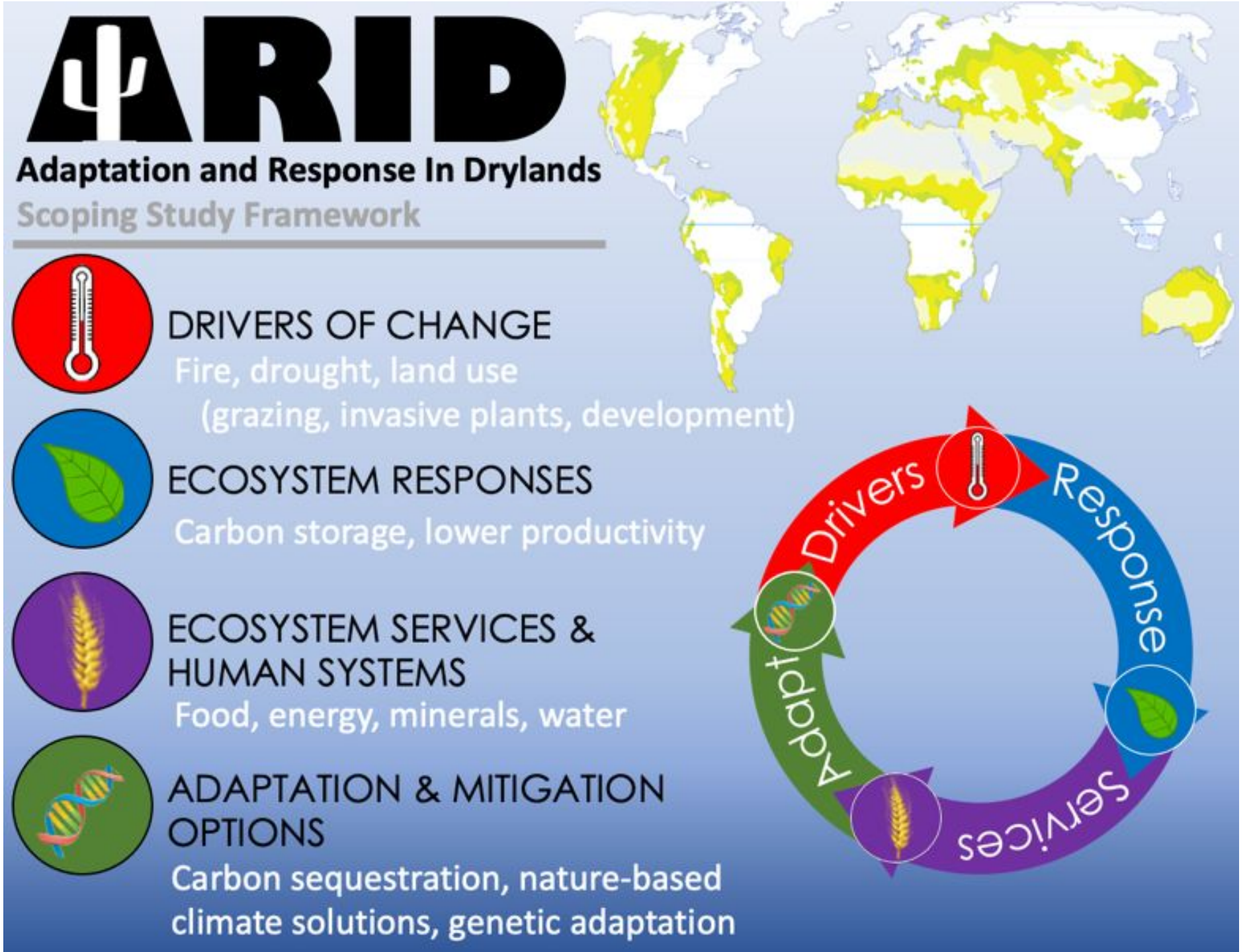
Food Security Implications



Cropland Gains and Losses (Wang et al. 2022 Nature Climate Change)

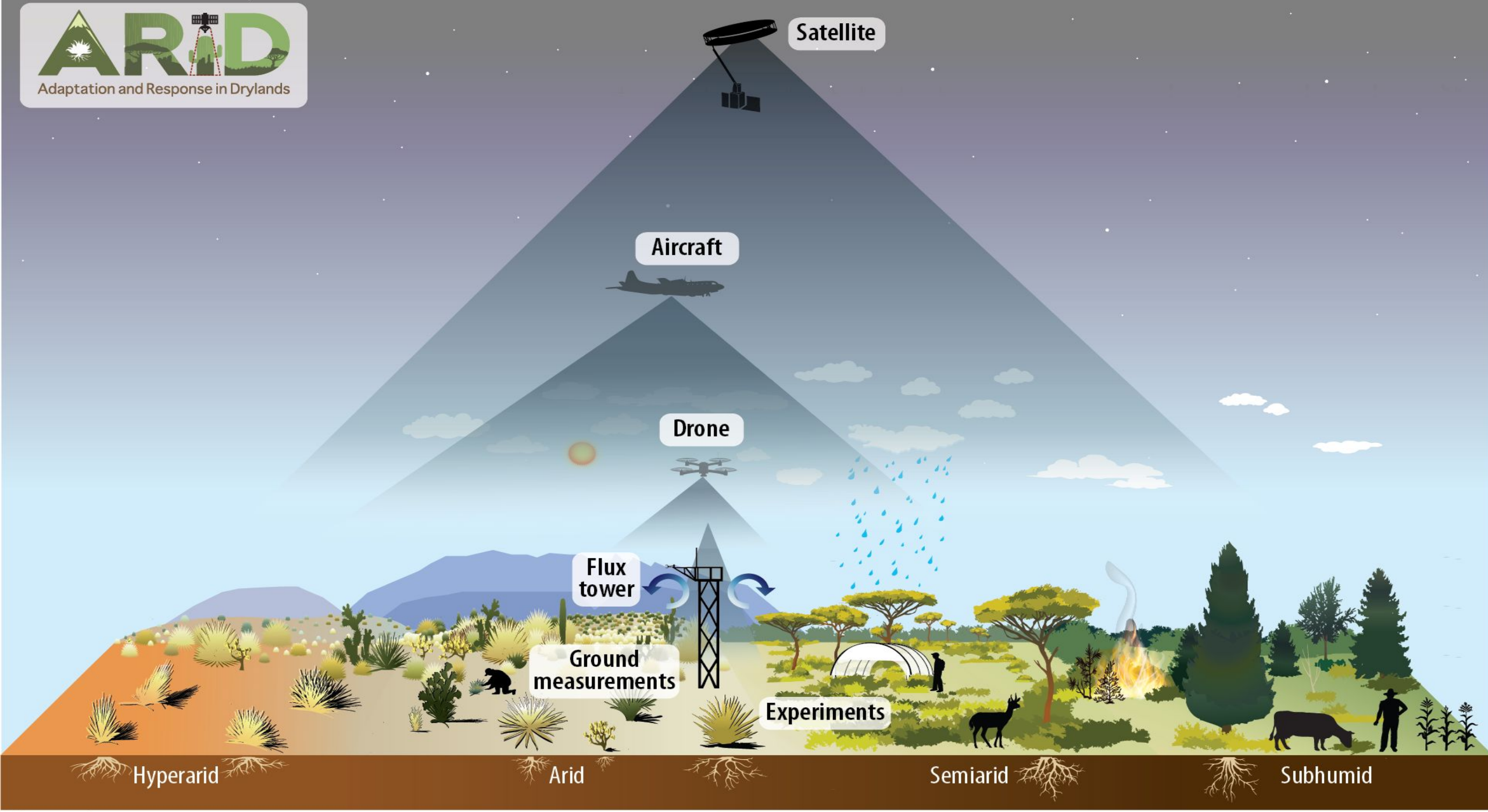
44% of agricultural land and 60% of food production from drylands

Most cropland expansion has occurred in drylands



What is ARID?

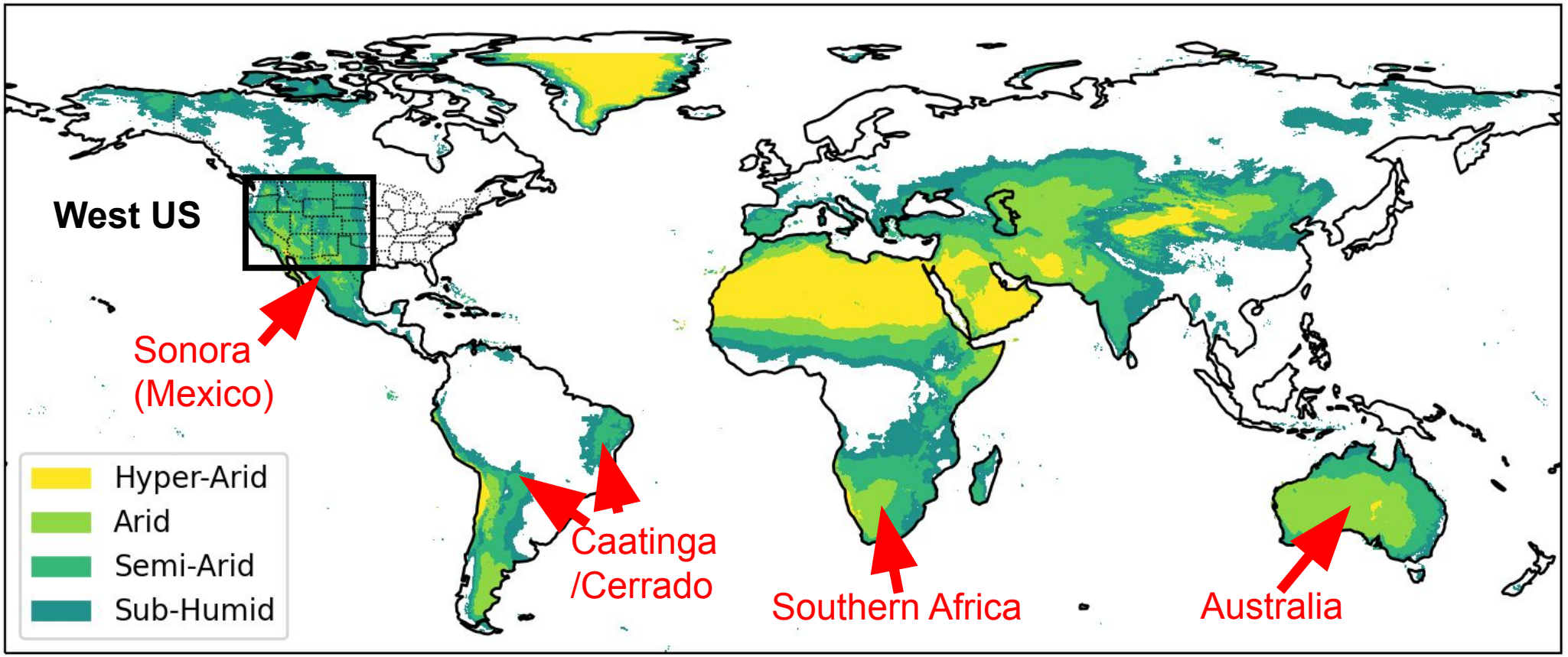
- **Fundamental science** to understand dryland processes
- **Applied sciences** aligned with NASA Earth Science to Action (ES2A)



*Not to scale

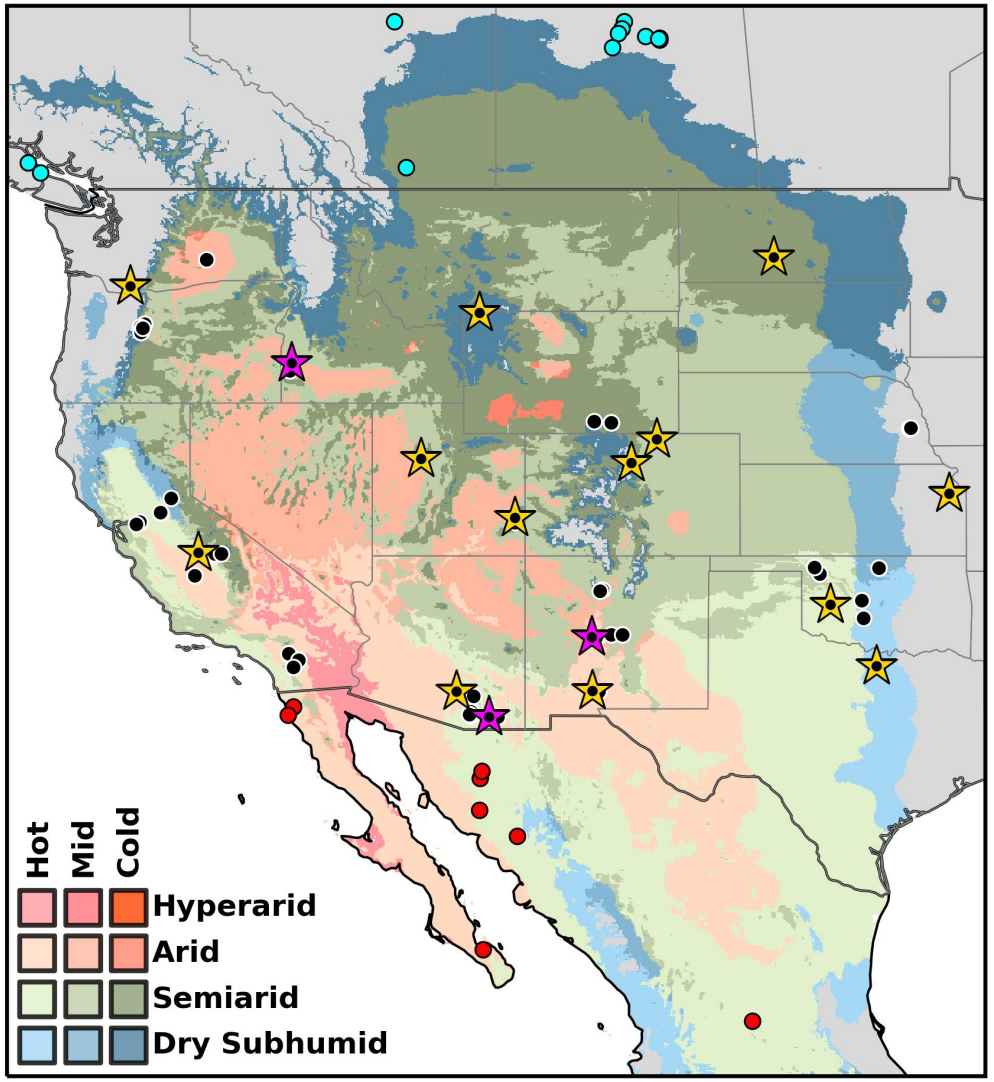
AR00

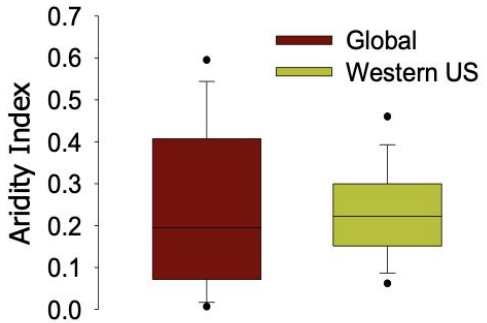
Global approach but **West US focus**



- International engagement started in Red locations
  - Interest in flights and experiments

Global approach but **West US focus**

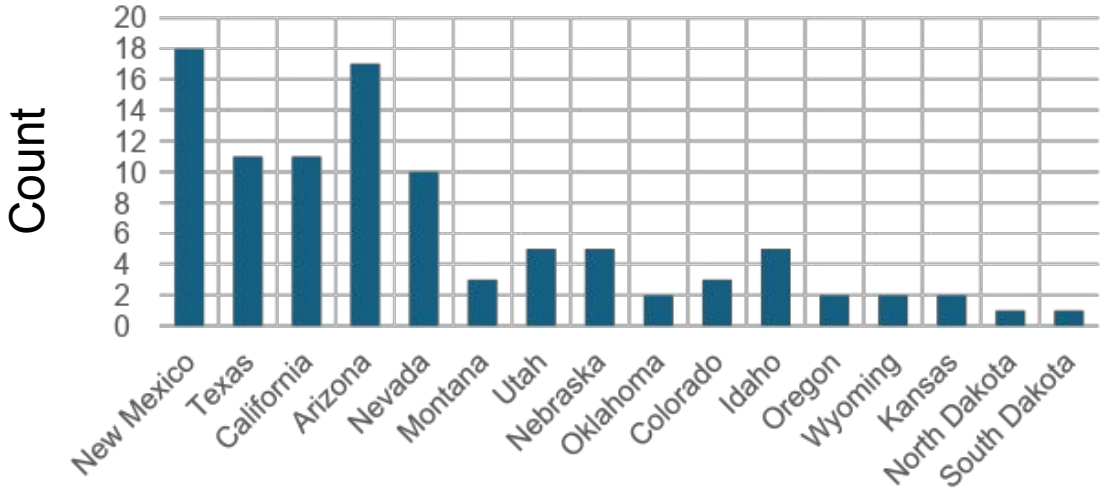


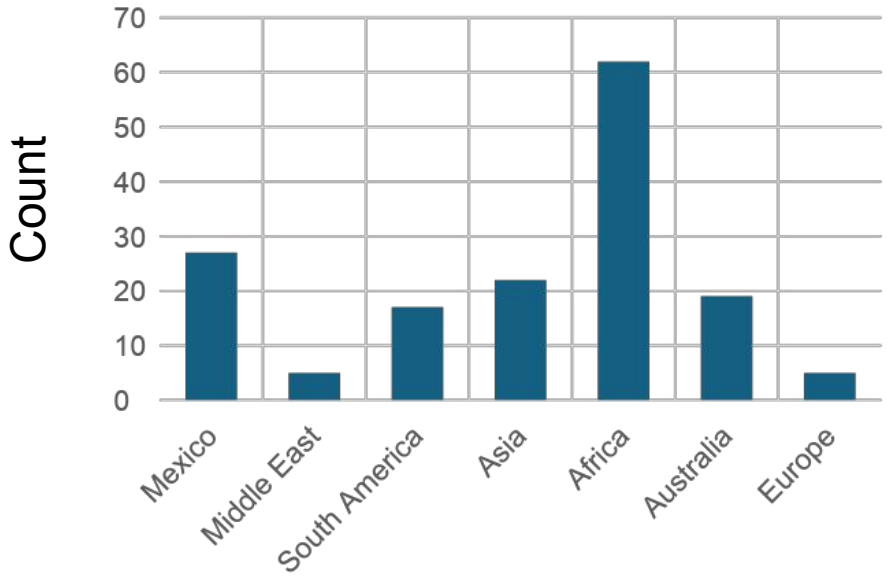


- Existing instrumentation throughout western US that can be complemented with NASA campaign
- Opportunity to capitalize on gradients:
  - Hot to cold (South to North)
  - Dry to wet (West to East)
  - Land cover gradients (natural, rangeland, and cropland)
- Western US aridity is near average of all global drylands
  - Western US representative of global drylands

ARID Community Survey (270 Respondents by April 2024)

Domain Question: Please name a US state or non-US country or region ARID should particularly focus on.





Interest in Western US states like New Mexico, Arizona, Texas, California, Nevada

Also interest in extending east to Great Plains

Respondents suggested:

- **US states: 46%**
- **Non-US locations: 54%**
  - Africa: 41% (most interested in Southern Africa)
  - Mexico: 18%
  - Australia: 13%
  - South America: 12%
  - Asia: 12%

ARID Science Themes

Theme Connection to ARID Pillars

1) Water availability
2) Land-atmosphere interactions
3) Dryland climate variability: pulses, deluges, droughts
4) Disturbance (fire, grazing, land use change)

Drivers of Change

5) Carbon stocks and fluxes
6) Vegetation structure, **biodiversity,** and heterogeneity
7) Dryland geology and soil processes

Dryland Response

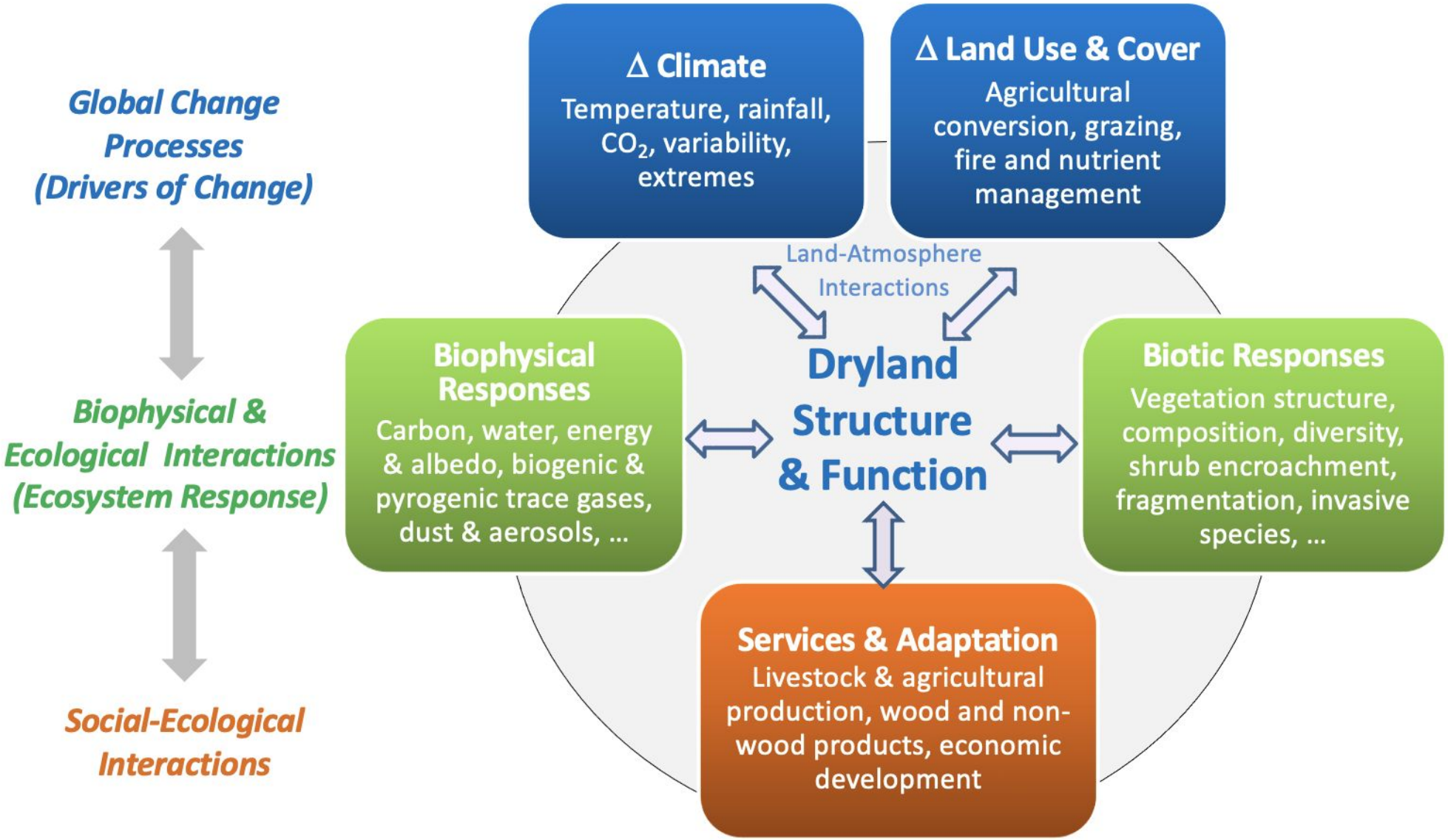
8) Cropland and rangeland management

Management and Services

9) Adaptation and mitigation (social ecological systems)

Adaptation under Change

ARID: Adaptation and Response in Drylands - Conceptual Diagram



Subset of our ARID Supporters/Partners (Growing Fast!)

Domestic

- Agencies
  - Bureau of Land Management (BLM)
  - US Geological Survey (USGS)
  - National Park Service (NPS)
  - US Department of Agriculture (USDA)
- Networks
  - AmeriFlux and FLUXNET
  - NEON
  - LTER
  - CyVerse Data Infrastructure
  - EarthLab (UC Boulder)
- Tribal
  - Several (confidential until permission obtained

International

- Southern Africa
  - BioSCape Community (South Africa)
  - Okavango Research Institute (Botswana)
  - Gobabeb-Namib Research Institute
- South America
  - SECO
  - DryFlor
- Mexico
  - National Autonomous U. Mexico
  - MexFlux
- Australia
  - Centre of Excellence (Western Sydney University, University of Melbourne, ANU)
  - CSIRO
- Conservation International

NASA ARID Meetings with End-Users

- October 2023 Tucson, Arizona:
  - 30 Data End-Users including BLM, USGS, USDA, NPS
- May 2024 Albuquerque, New Mexico:
  - Several tribal members in an in-person listening session
  - Visits with school in Navajo Nation

NASA ARID Desired Main Outcomes

1. Determine the degree to which dryland ecosystems are driving the global carbon cycle and its variability under climate change and extremes

2. Improve understanding of ecosystem processes and livelihoods in drylands under more extreme droughts and heatwaves and provide actionable data for end-user decision frameworks

Marcy Litvak
(U. New Mexico)

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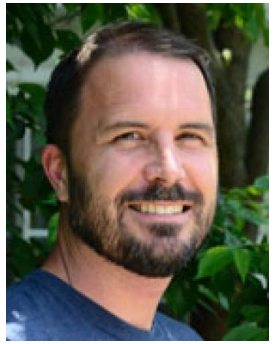

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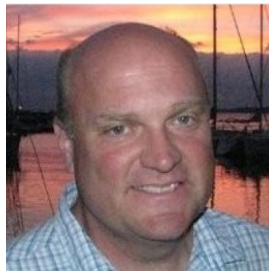

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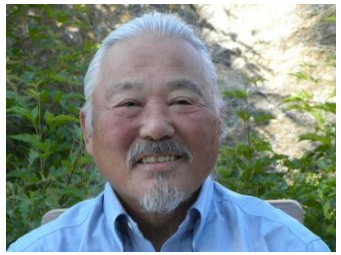

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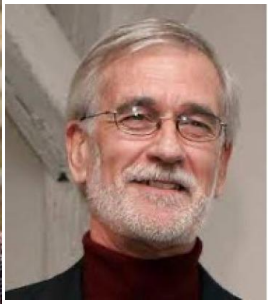

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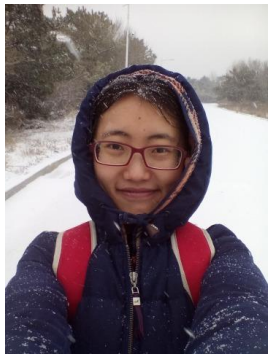

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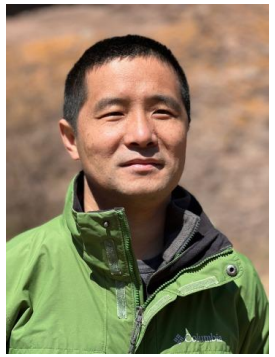

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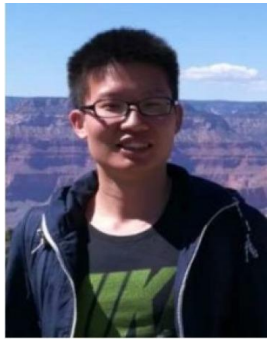

Zheng Fu
(U. Arizona)

ARID Steering Committee

So many ways to participate

- Webinars
- Data-user listening sessions
- Survey
- Working groups
- Round Tables
- International meetings
- Virtual seminar series
- Manager knowledge exchanges

ARID Website

Website: aridscoping.arizona.edu

The science, knowledge, and action taken will be WAY better if everyone is involved!

ARID Survey