



# The Complexity of Drought and Health Research

Jesse D Berman, PhD

Assistant Professor, U. of Minnesota School of Public Health

Division of Environmental Health Sciences

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SCHOOL OF  
**PUBLIC HEALTH**

UNIVERSITY OF MINNESOTA

# How Did I get Involved in Drought and Health Research?



## Drought ma billions in U exports

**GOING GREEN**  
**The Great Drying Strikes Again**  
The drought gripping much of the U.S. may be a reprise of even worse suffering before

By Bryan Walsh @bryanwalsh July 31, 2012

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A field of dried corn plants is seen near Percival, Iowa, on July 26, 2012. The widest drought to date is worse with no signs of abating

The drought of 2012 keeps getting worse. On July 26, the federal government reported that more than two-thirds of the continental U.S. is drier than normal, with 20% of the country in one of the two most extreme stages of

## The Drought of 2012

ALAN TAYLOR | AUG 28, 2012 | 36 PHOTOS | IN FOCUS

This summer, the United States has experienced its worst drought in more than half a century. The Mississippi River is approaching record lows, as far as 20 feet below normal. Throughout the Midwest, meager corn harvests began on the some of the earliest dates ever recorded. Corn and soybean farms are producing far smaller yields this year, which

## The driest season: Global drought causes major worries

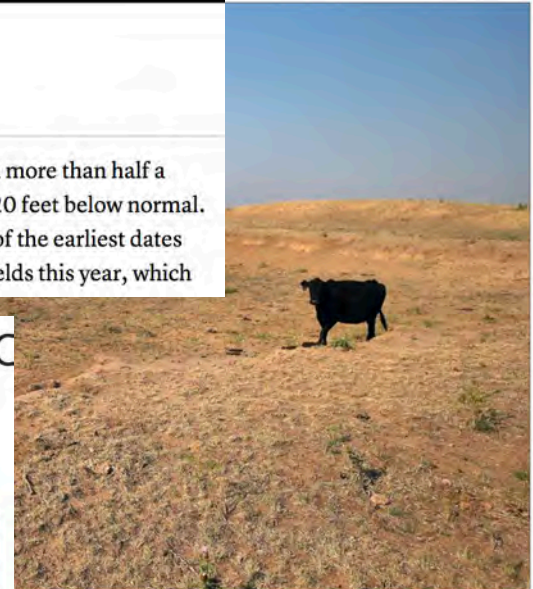
By Tim Lister, CNN  
Updated 8:20 AM ET, Sat September 8, 2012



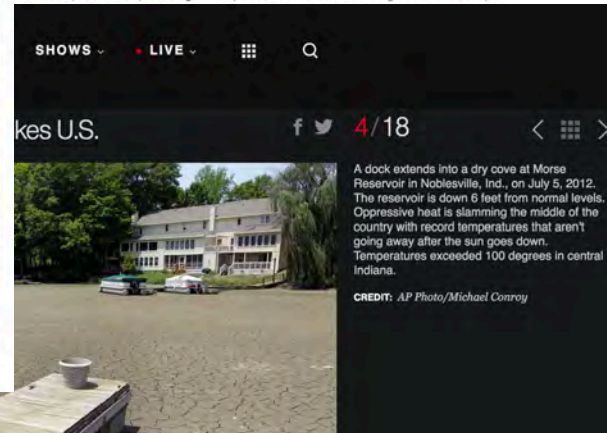
Photos: Photos: Drought around the world

**Drought around the world** - Rain clouds move over the remnants of parched corn stalks near Wiley, on the plains of eastern Colorado, on August 22, 2012. A summer storm came too late to help farmers whose crops were decimated in the exceptional drought in Colorado's eastern plains.

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near Eads, Colorado, on August 22, 2012. The severe drought has dried up



akes U.S.

4/18

A dock extends into a dry cove at Morse Reservoir in Noblesville, Ind., on July 5, 2012. The reservoir is down 6 feet from normal levels. Oppressive heat is slamming the middle of the country with record temperatures that aren't going away after the sun goes down. Temperatures exceeded 100 degrees in central Indiana.

CREDIT: AP Photo/Michael Conroy

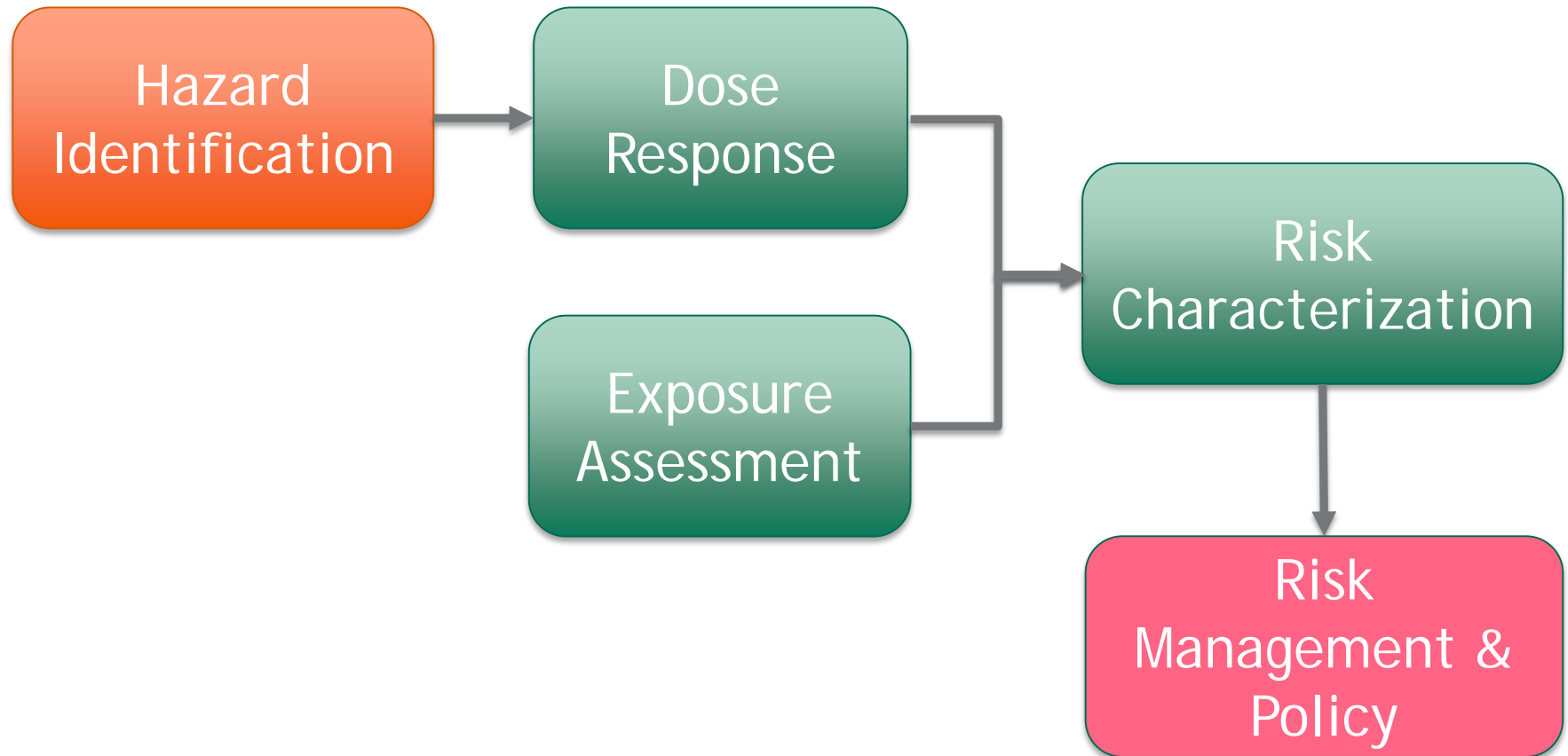
# How Did I get Involved in Drought and Health?

- Asked the question, “Is there an association between drought and health?”
- Limited research examined association between drought and mortality
  - Mental health pathway (e.g. increased suicide deaths: Hannigan et al, 2012; Guiney et al, 2012)
  - Dust storm events (Korea, Taiwan, Italy)
- Almost no research from the U.S.

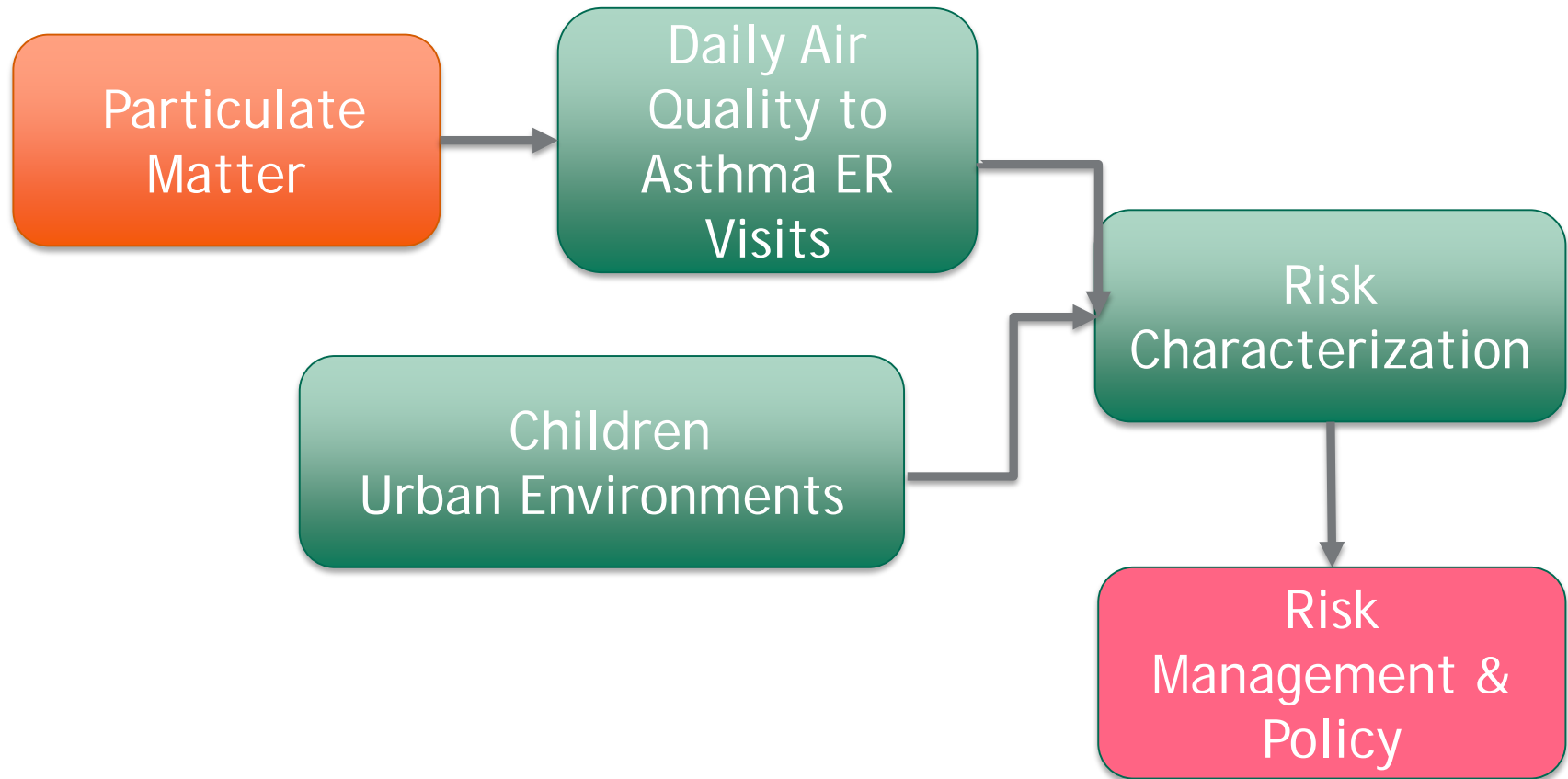
## So Why is This?

# How do we evaluate the health risks from environmental exposures?

# The Classic Approach to Risk Assessment



# The Classic Approach to Risk Assessment: An Air Pollution Example



**But for Drought this Pathway is Far  
More Complicated!**

# How Come??

- Can affect people through multiple pathways
  - **What is our disease of interest?**
- Gradual Onset/Slow to Develop
  - **When is someone exposed to drought or not?**
- Multiple drought indices for multiple drought definitions
  - **Which drought index is the best to examine?**
- Broad geographic exposure
  - **Who are the susceptible populations?**
- Drought doesn't occur in isolation
  - **Should we consider co-occurring disasters?**



# Complicating Issue #1: The Disease Affects Drought Exposure Choice

Drought has been linked to a number of different health outcomes

## **Direct Effects**

- Mental health
- Nutritional
- Waterborne Disease

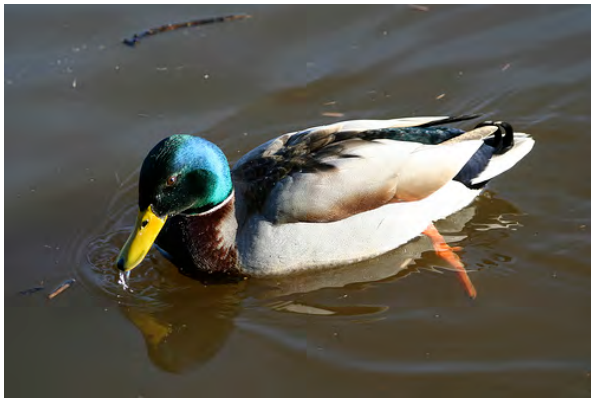
## **Indirect Effects**

- Air Quality
- Vectorborne Disease
- Injury

**Should our measure of “drought” change based on what outcome we are interested in?**

# Complicating Issue #1: The Disease Affects Drought Exposure Choice

Let's use infectious disease as a case study: **West Nile Virus**



# Complicating Issue #1: The Disease Affects Drought Exposure Choice

Drought conditions cause birds to congregate in smaller areas



Rapid disease incubation; enhanced zoonosis when drought ends

# Complicating Issue #1: The Disease Affects Drought Exposure Choice

Let's use infectious disease as a case study: **Lyme Disease**



A tick that is questing for a host

# Complicating Issue #1: The Disease Affects Drought Exposure Choice

## West Nile Virus

- Reduced surface water
- Long-term drought
- Perhaps hydrological (?)

## Lyme Disease

- Vegetation/Soil
- Short-term extreme drought
- Also consider heat?
- Perhaps meteorological/  
ecological?

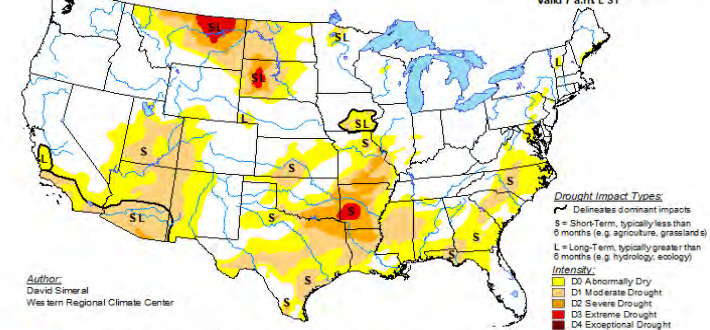
**Different health outcomes; different droughts  
characteristics of concern!**

# Complicating Issue #2: Creating the Drought Exposure

How do we decide on the appropriate measure of “drought” when there are over 150 drought indices in circulation?

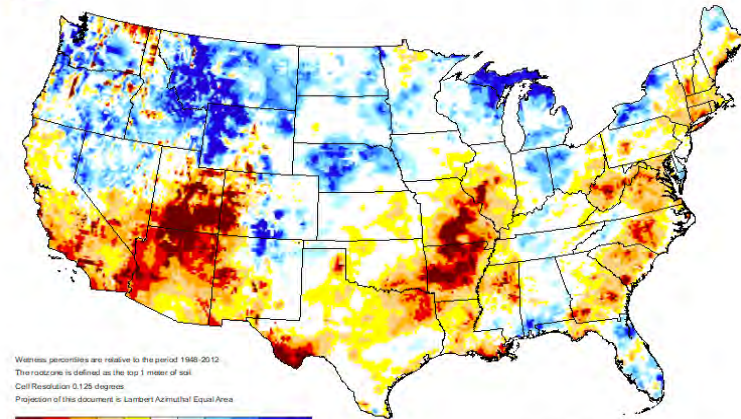
## U.S. Drought Monitor

November 28, 2017  
(Released Thursday, Nov. 30, 2017)  
Valid 7 a.m. EST

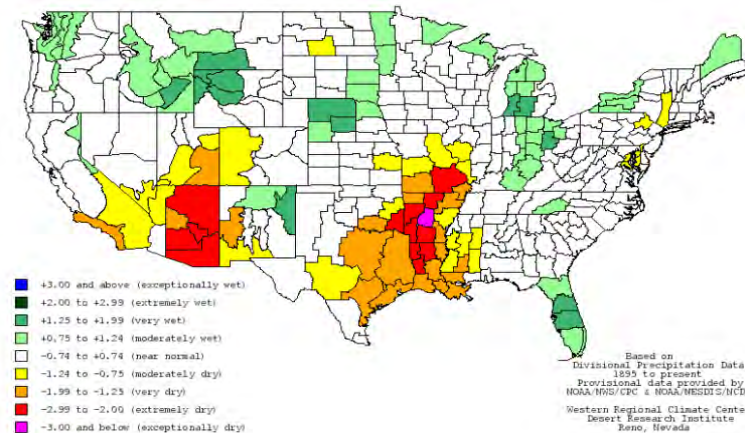


## GRACE-Based Root Zone Soil Moisture Drought Indicator

December 04, 2017



## 3-month Standardized Precipitation Index through the end of November 2017



# No Consensus in the Literature Regarding Drought Indices

Article	Health Outcome	Drought Measure
Friel et al (2014)	Mental health	Hutchinson drought index
Hanigan et al (2012)	Suicide	Hutchinson drought index
Berman et al (2017)	Mortality, Cardiovascular, Respiratory Disease	U.S. Drought Monitor
Coopersmith et al (2017)	Coccidioidomycosis	Soil moisture
Salvador et al (2019)	Mortality	SPEI and SPI

# Complicating Issue #2: What do we Look for in a Drought Exposure?

Three drought features are critical to understand health vulnerability: 1) **severity**, 2) **spatial extent**, 3) **time frame**

**Identifying which are most important for the selected health outcome will drive our choice of a drought indicator**



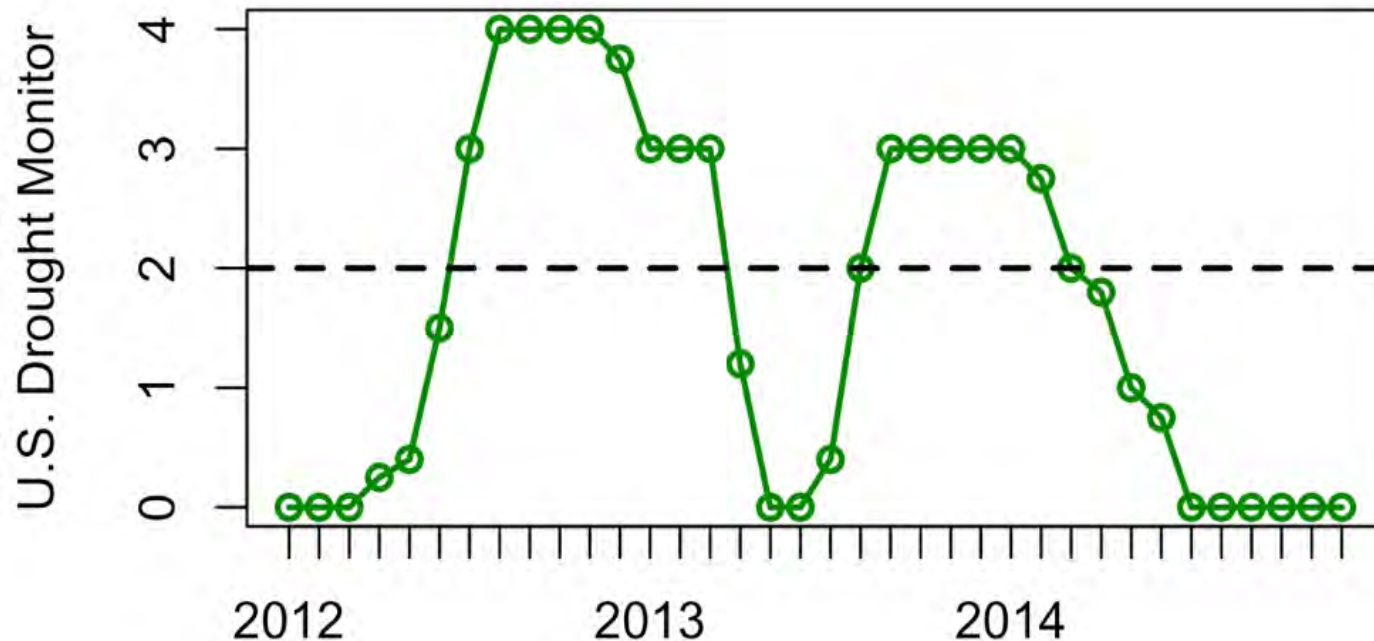
# Complicating Issue #2: Creating the Drought Exposure - Severity of Drought

Severity refers to **magnitude** of water deficit compared to normal conditions

- **BUT**, drought indices estimate severity differently. Inconsistent scales make comparability across studies difficult.

# Complicating Issue #2: Creating the Drought Exposure - Severity of Drought

**Is drought severity the same, if you consider the time point of a drought event?**



USDM conditions for Jasper County, IA from 2012-2014

# Complicating Issue #3: Creating the Drought Exposure - Time Frame of Drought

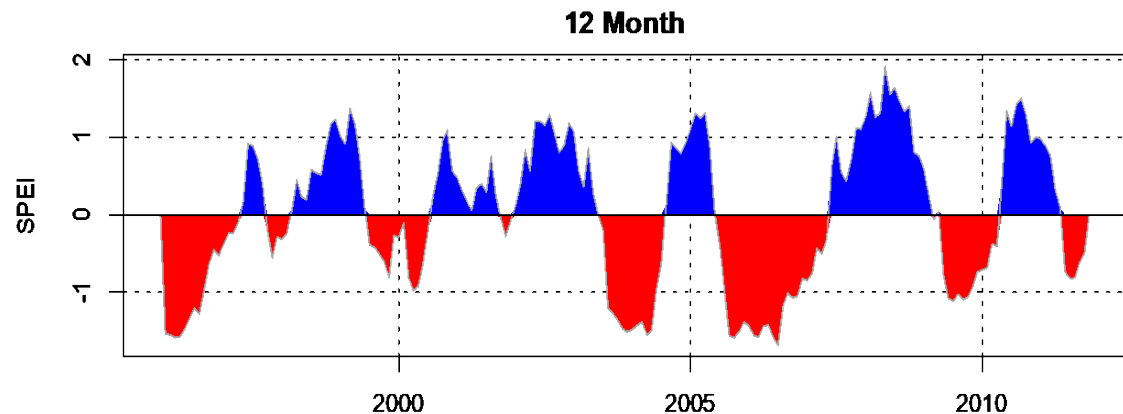
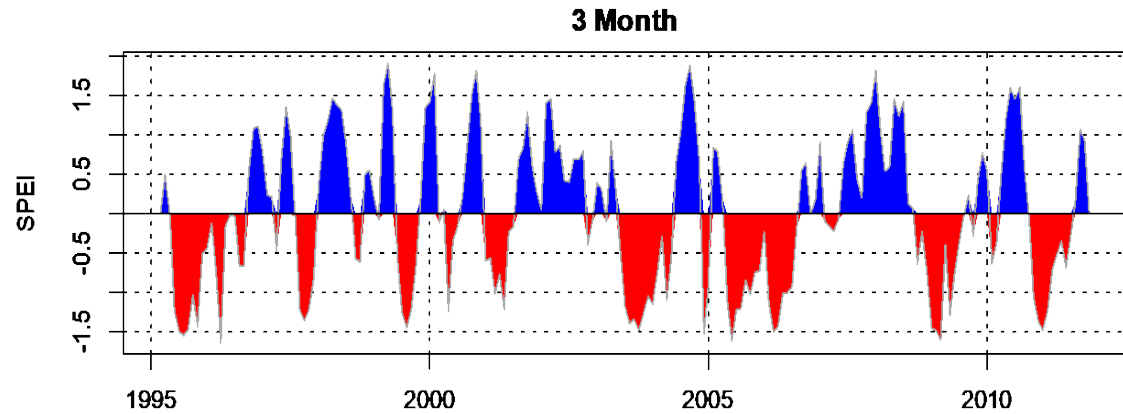
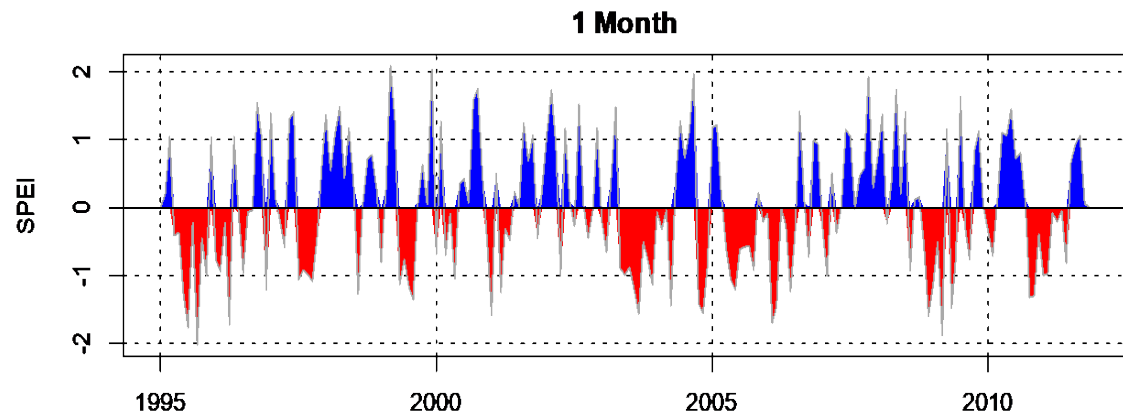
Drought has two separate time components: 1) Time Scale and 2) Duration

- **Time Scale** – the period over which *average dryness* is evaluated
- **Duration** – the length of a drought event

# The Drought Time Scale

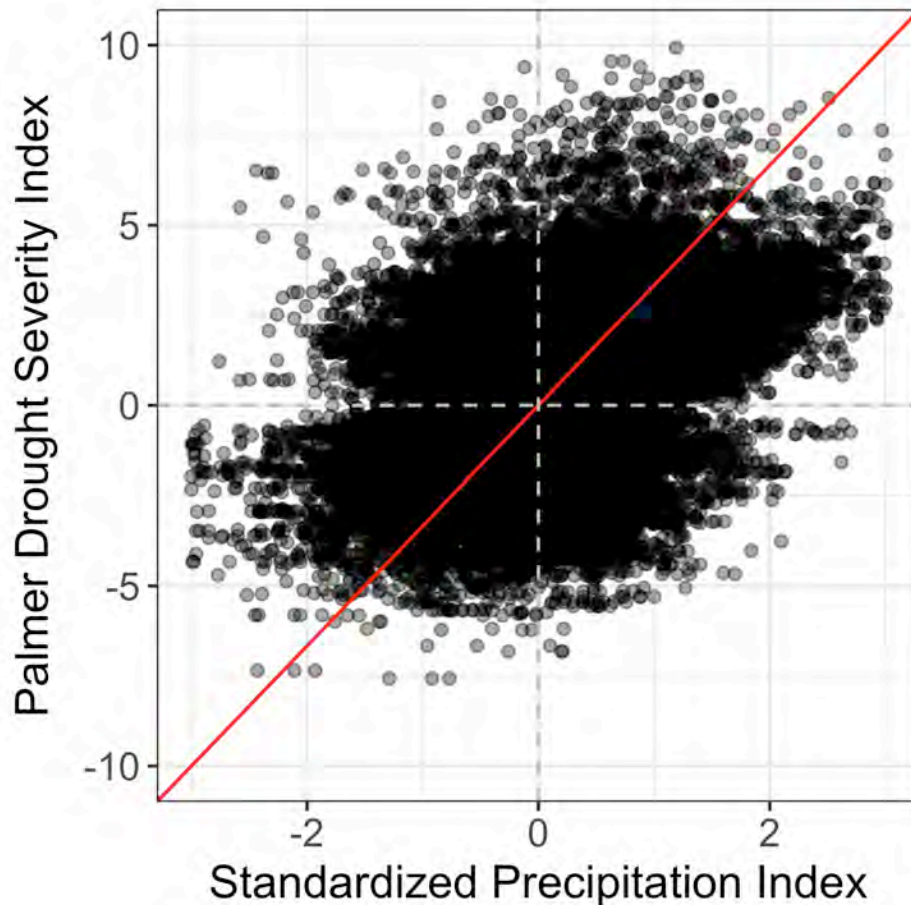
Most indices allow **time scales** of 1-month up to several years

**Which is best for a health effects study?**



# The Drought Time Scale

What happens if one study uses a 9-month variable and another uses a 1-month variable?



# Complicating Issue #4: What if it is Not Just Drought, but Co-Occurrence with Other Extreme Events?

Extreme Heat

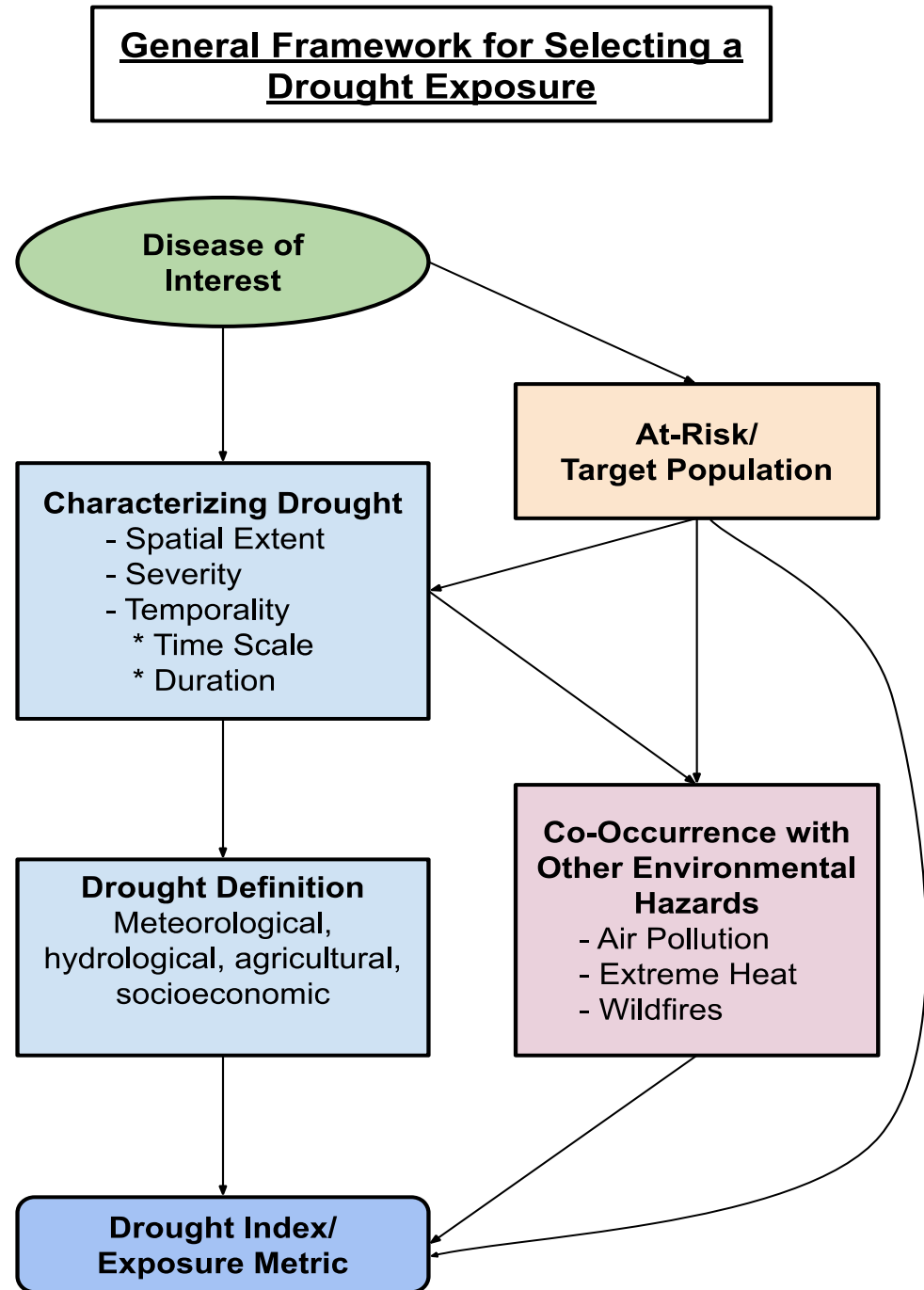
Brush and wildfires



Dust Storms



# Outline for Choosing a Drought Exposure



# So What Do Epidemiologists Need from Drought and Climate Experts?

- In a perfect world, a single drought metric designed specifically for health studies
- Ways to compare severity, duration, and extent across different metrics
- Accessible downloads of drought data
- Links of drought conditions to Census GEOID's
  - Climate regions are not optimal for health assessments
- Better knowledge of what policy makers need from us!



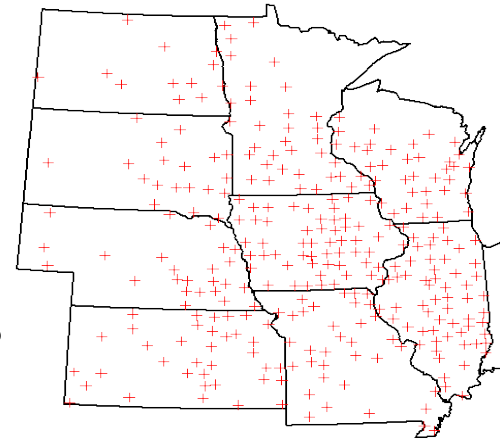
# Some New Research into the Health Effects of Drought

# The Impact of Drought Conditions on Occupational Psychosocial Stress among a Midwest Farmers Cohort



# The Impact of Drought Conditions on Occupational Psychosocial Stress among a Midwest Farmers Cohort

- A longitudinal assessment of 518 farmers across 312 counties in 9 Midwestern states



- Survey of occupational psychosocial stress from 2012-2015 (6-month intervals)
- Association between job related stress and changing drought conditions

Supported by a Great Plains Center for Agricultural Health pilot grant  
through CDC/NIOSH

# Any Questions?

**Email: [berma186@umn.edu](mailto:berma186@umn.edu)**