Intersection Between Drought and Human Health in the Southwest

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College of Public Health
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Water for Food
DAUGHERTY GLOBAL INSTITUTE
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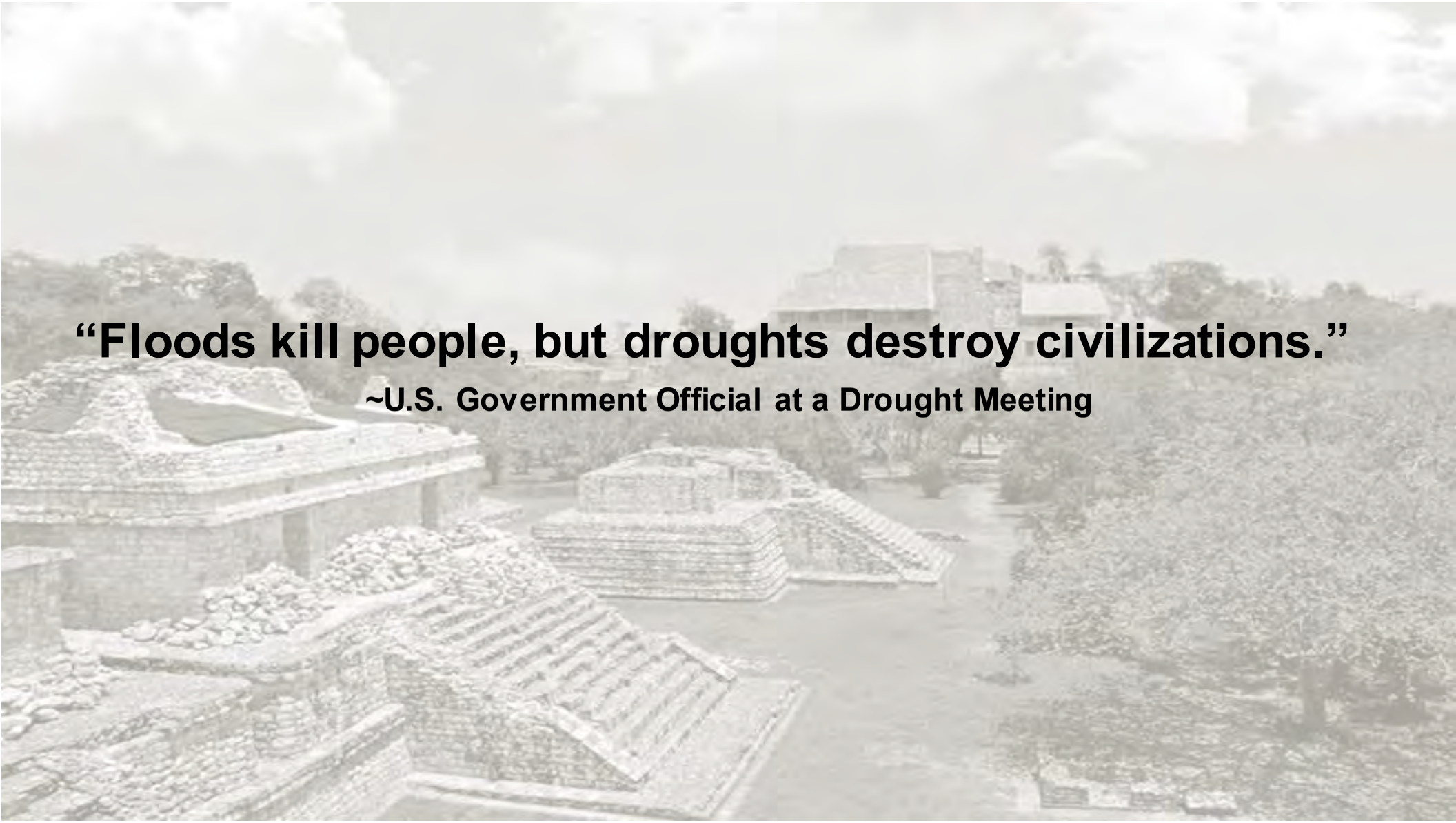
What words come to mind when you think of drought?

How many of those words can connect to health?



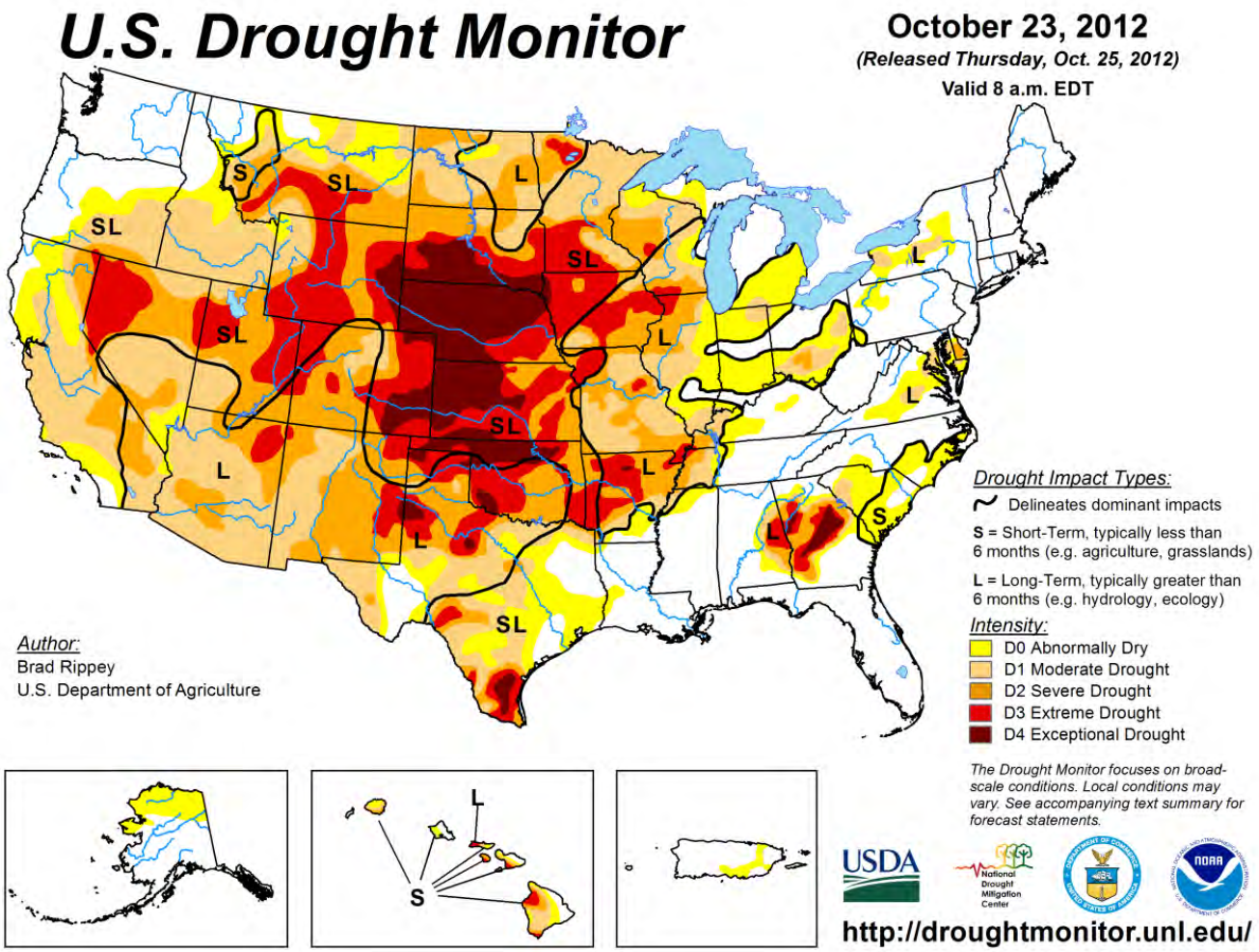
“Floods kill people, but droughts destroy civilizations.”

~U.S. Government Official at a Drought Meeting

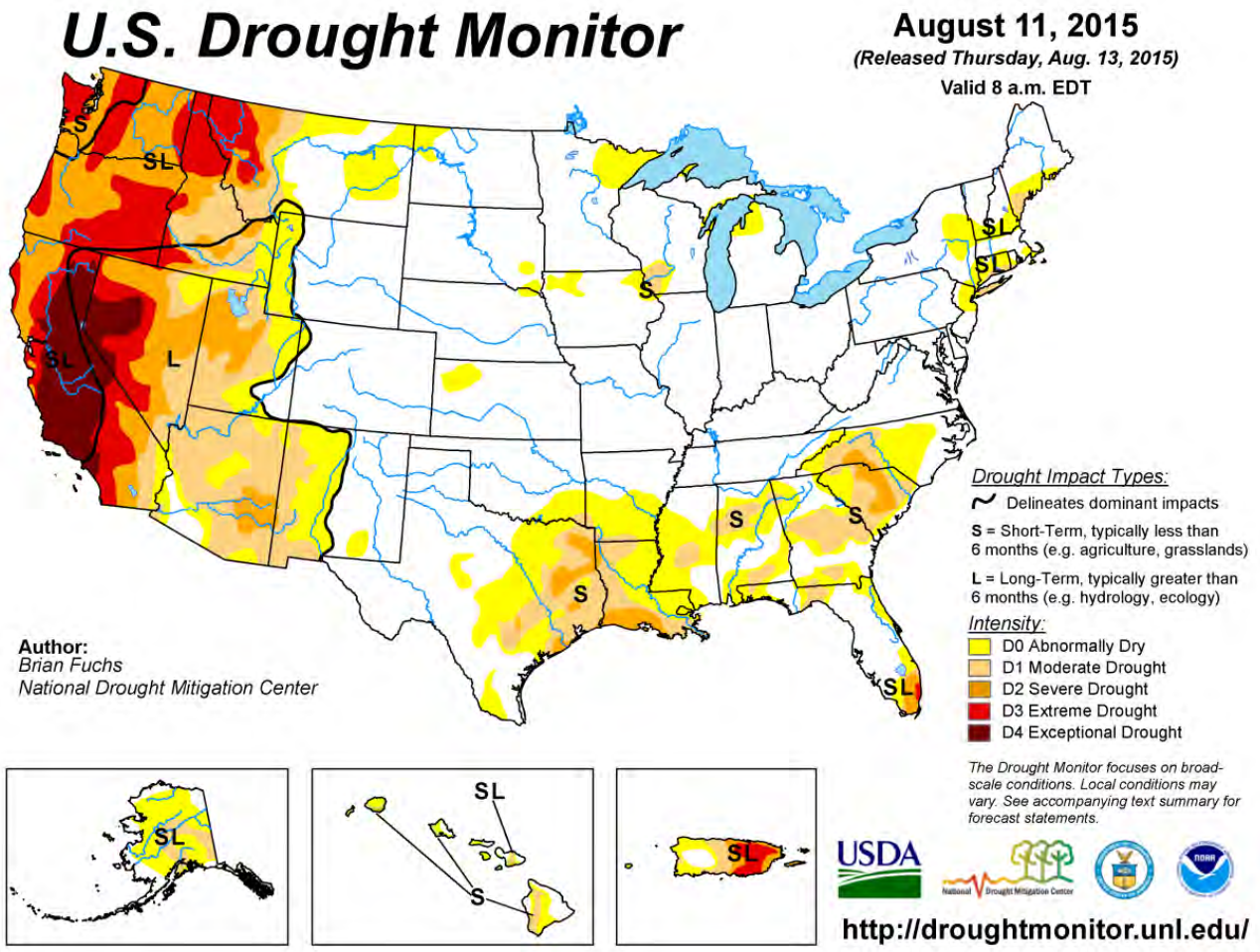
Drought has shaped our society

Dust Bowl of the 1930s

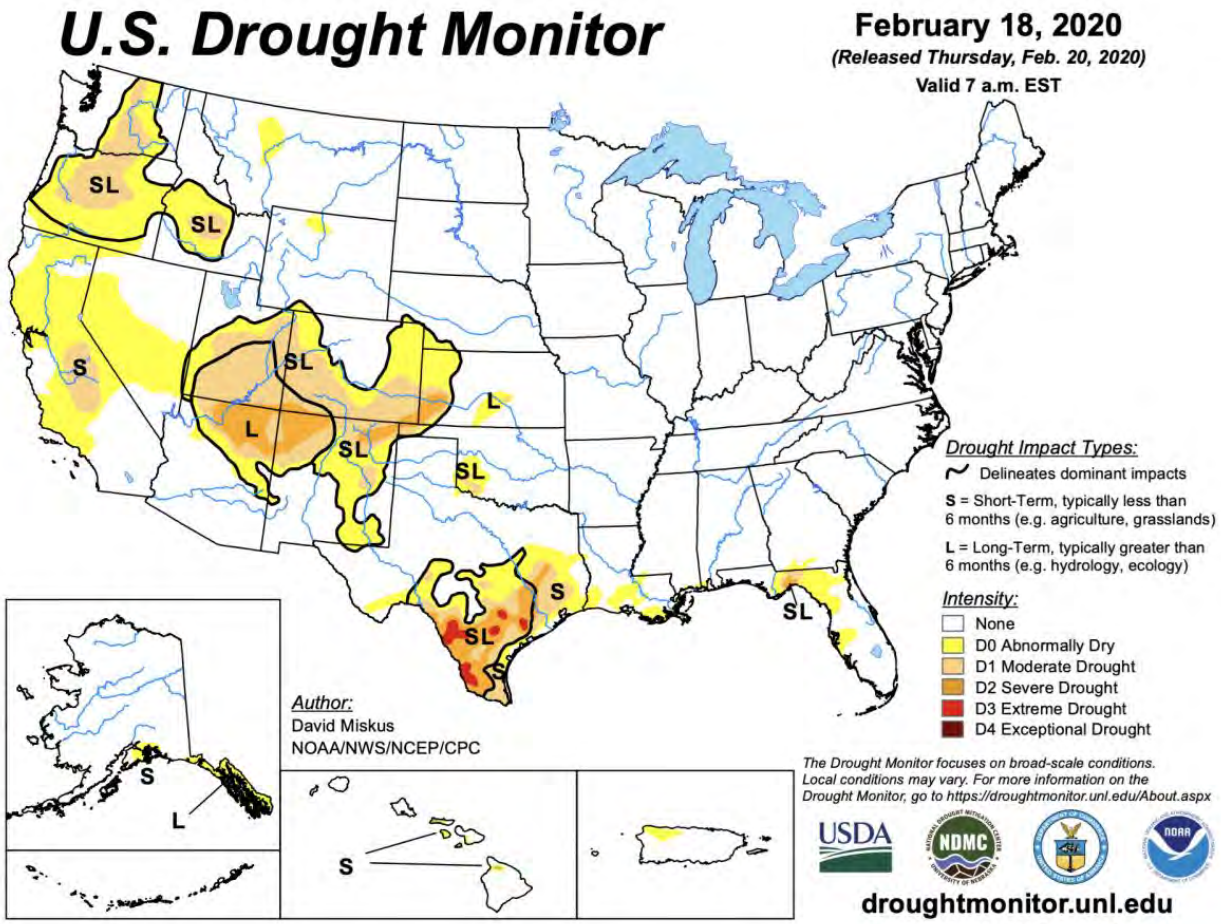
2012 Drought



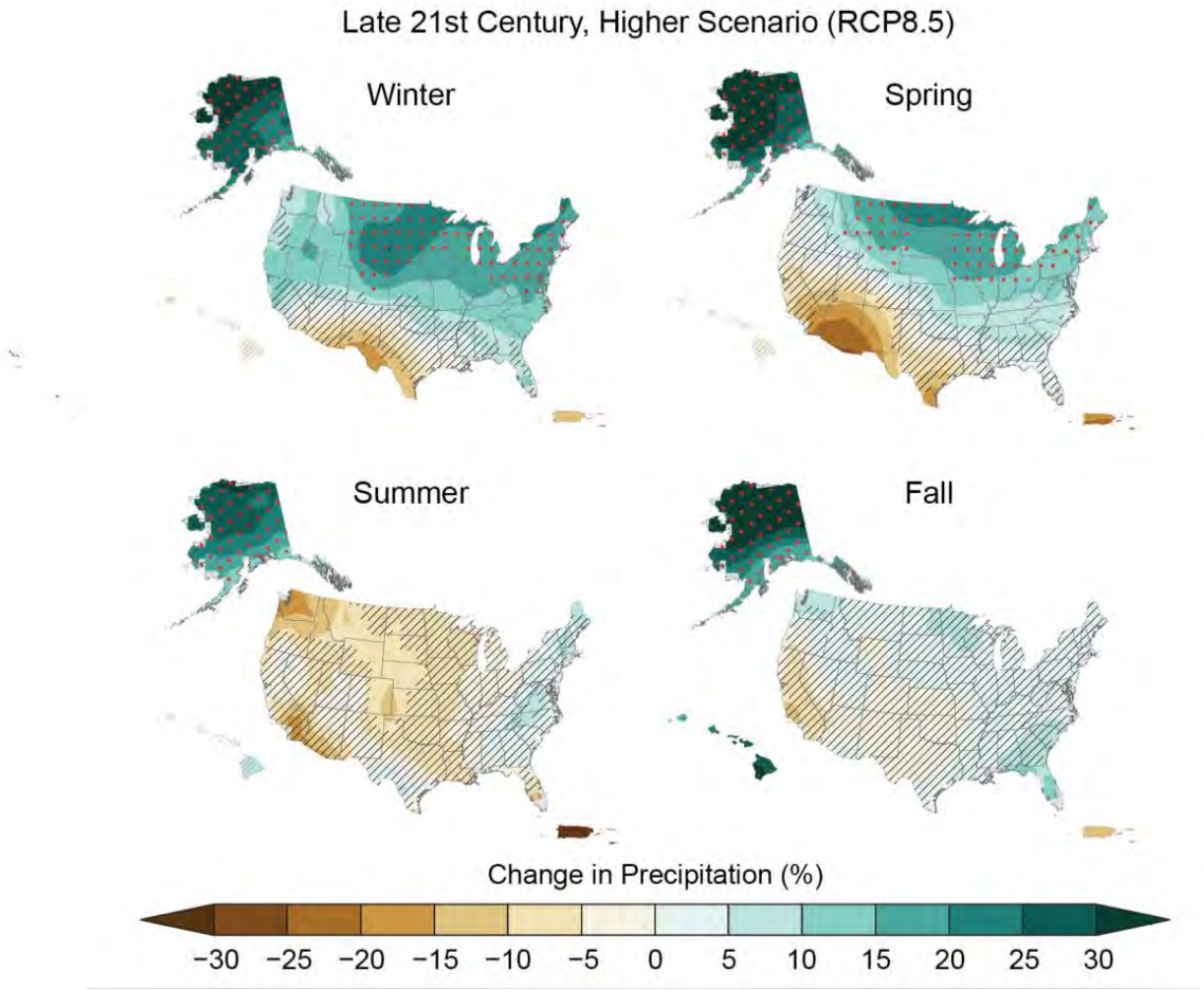
2011-2017 California Drought



Current Conditions

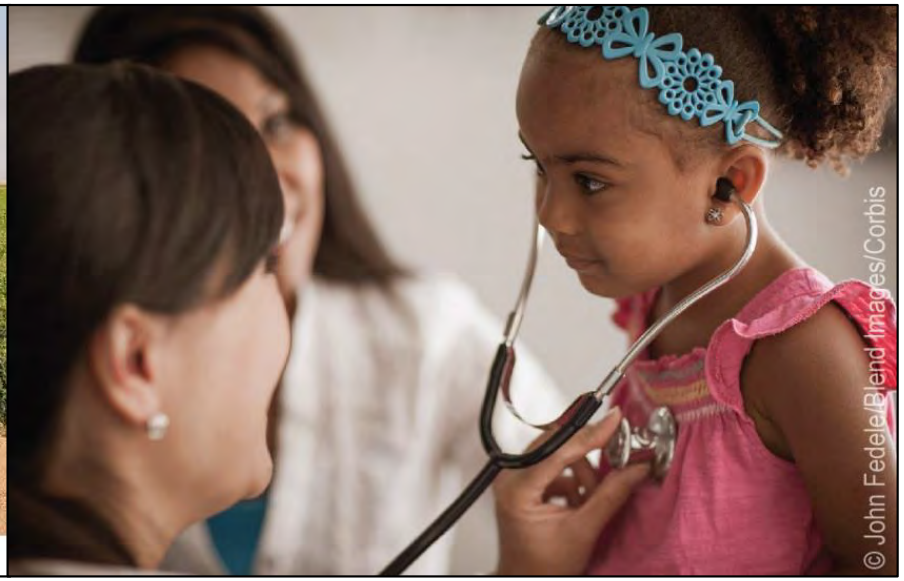


Droughts are changing

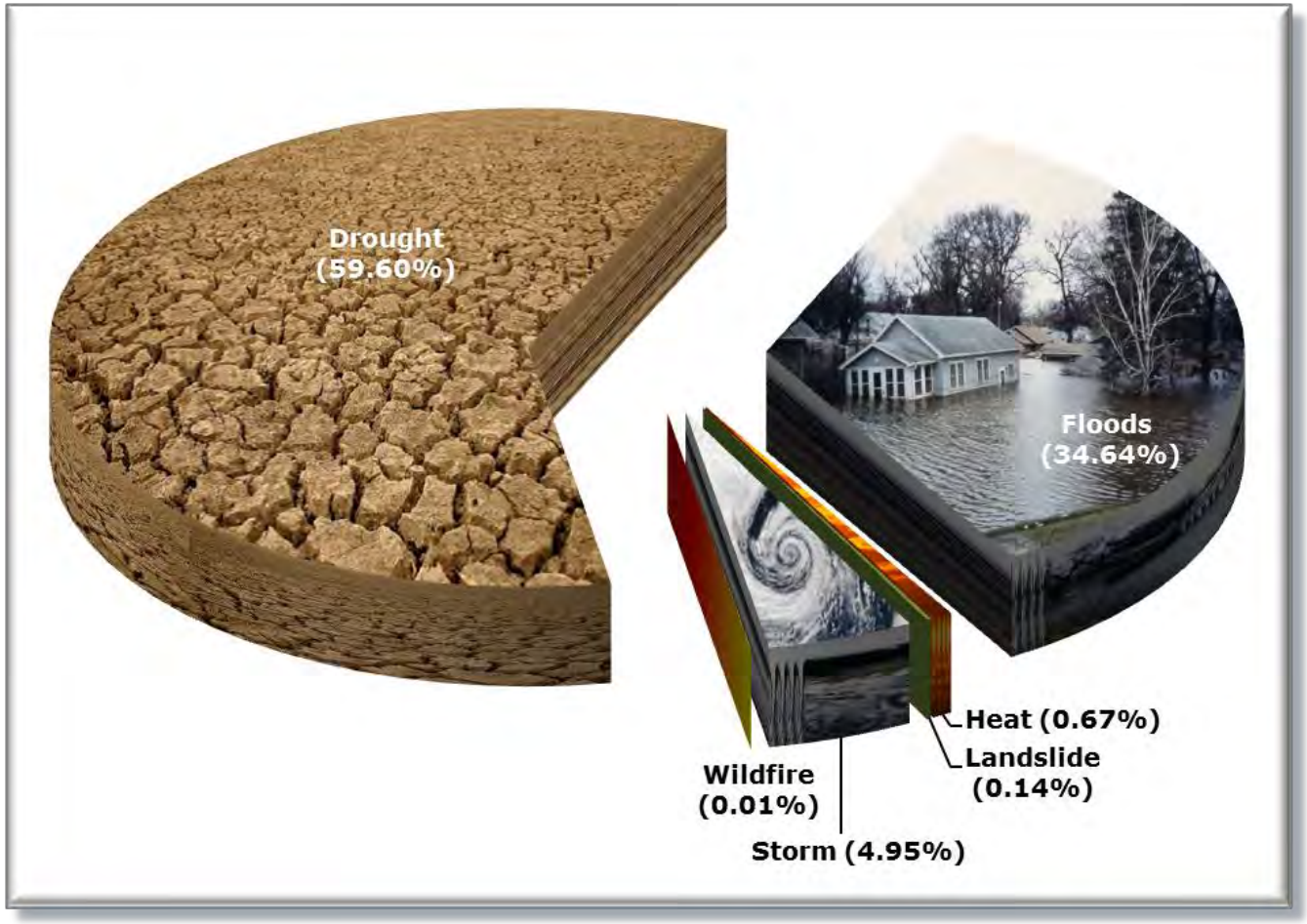


Connecting Drought to Health

he difference between the fields on either side of dairy farmer Tom Barcellos is water. (Tomas Ovalle / For The Times)

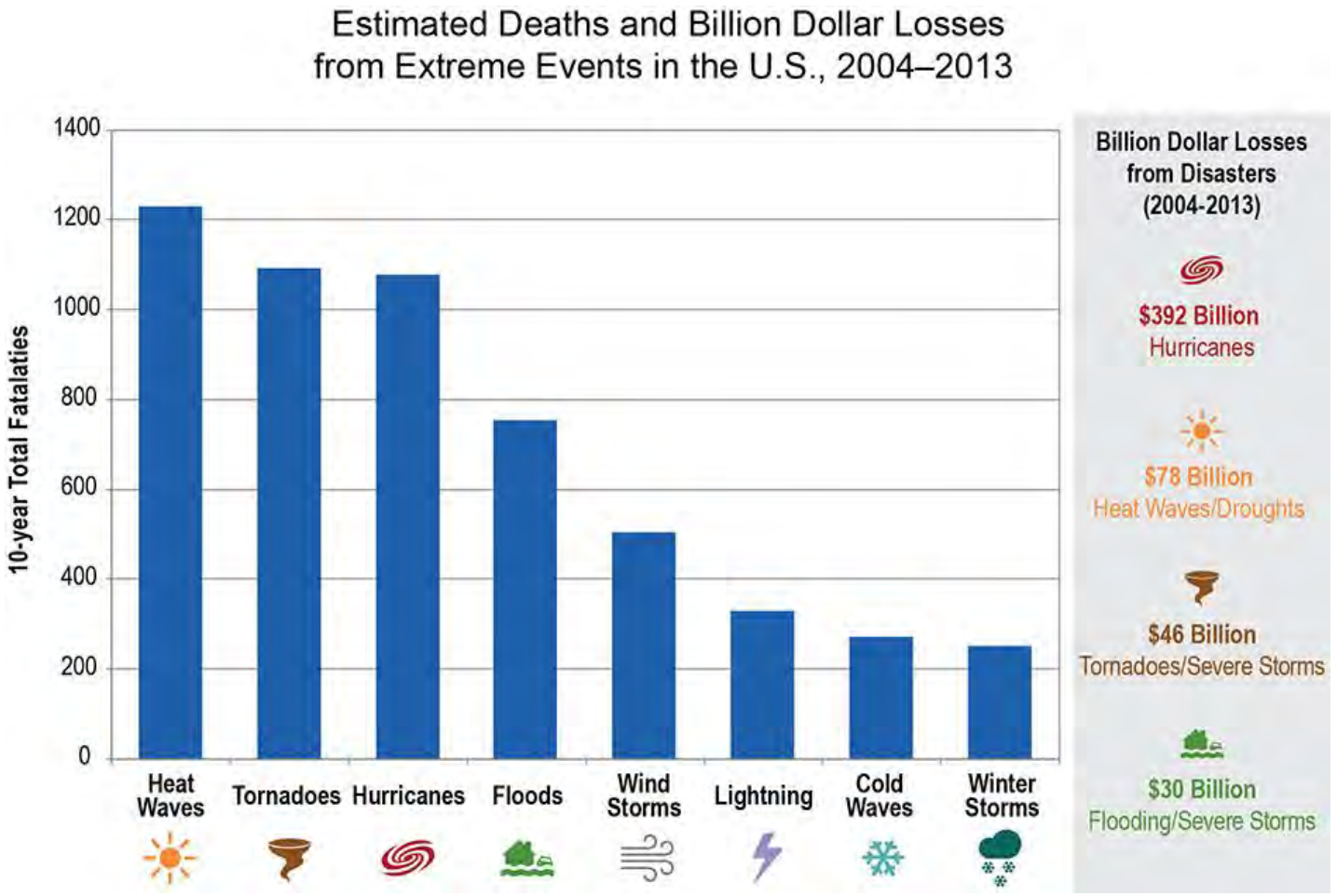


Percentage of disaster-deaths worldwide according to each category of climate-related hazard, (1900-2013)



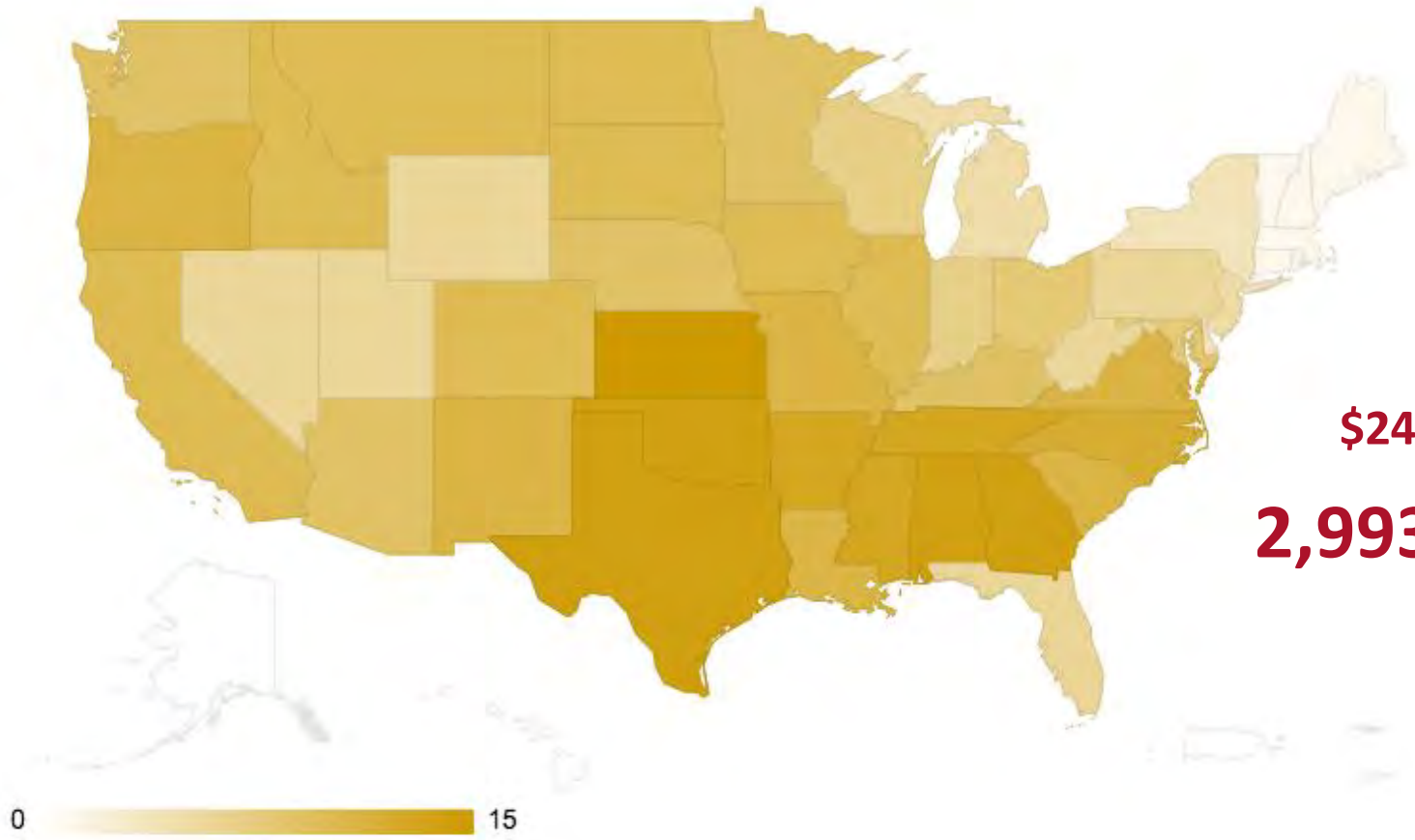
Source: Adapted from EM-DAT: The OFDA/CRED International Database, Belgium 2012
Keim, ME Extreme Weather Events: the role of public health

Drought Impacts



Bell et al., 2016

1980-2018* NOAA Billion-Dollar Drought Disasters (CPI-Adjusted)



25 Events

$241 Billion Lost

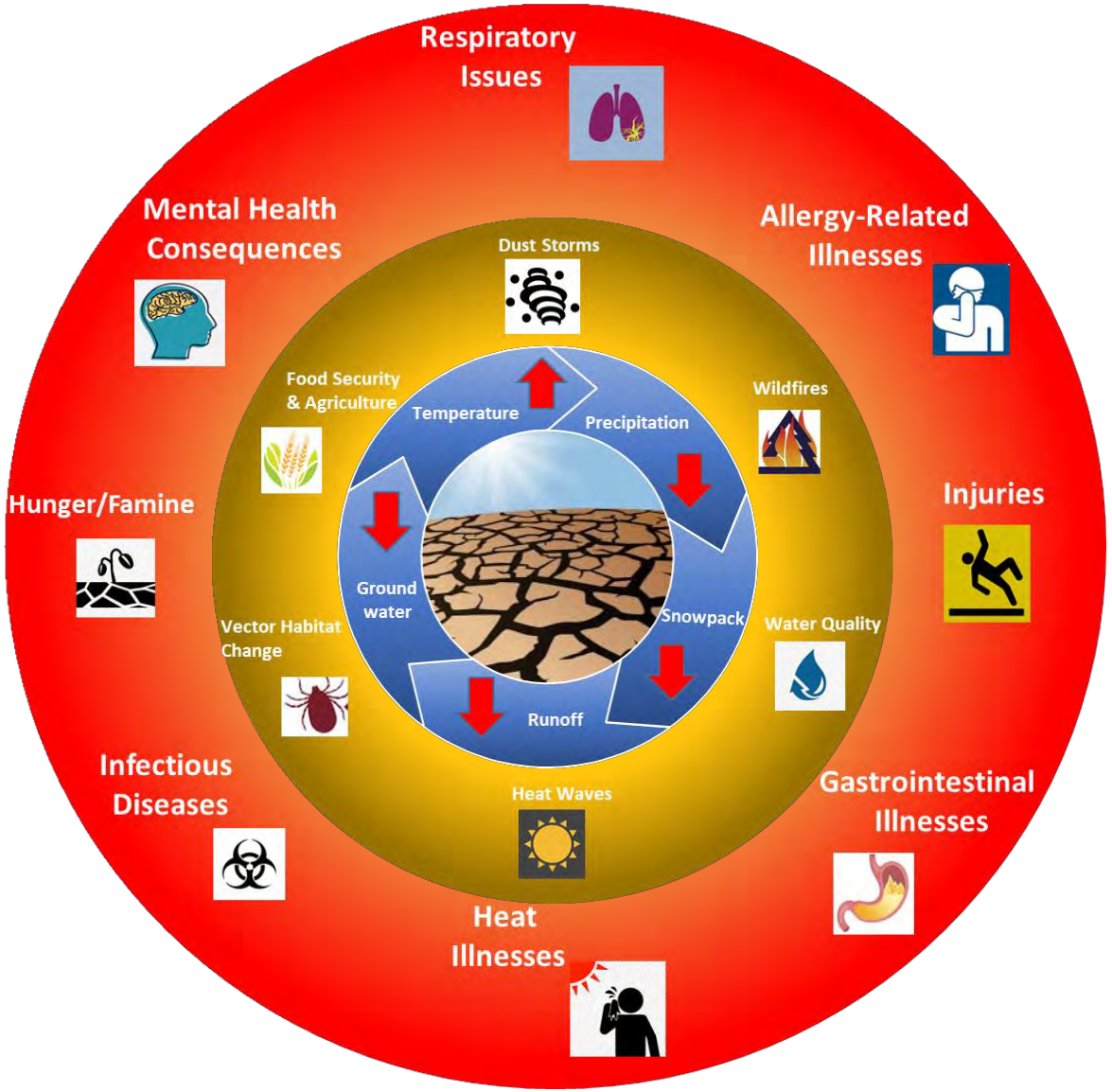
2,993 Deaths

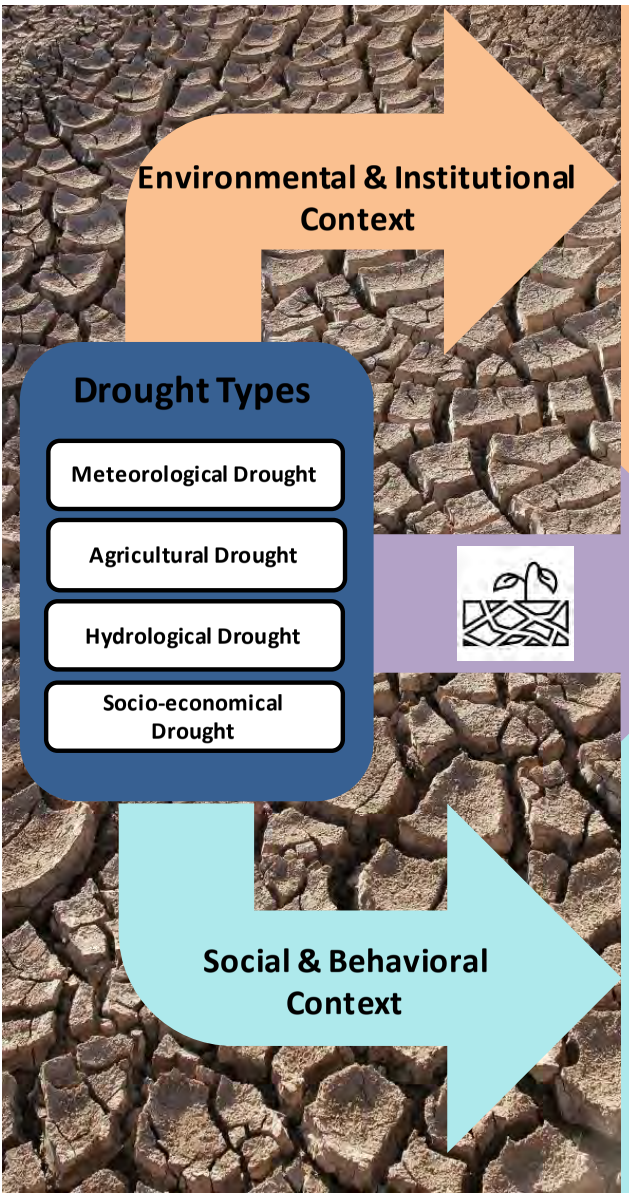
NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2018). https://www.ncdc.noaa.gov/billions/

Health Surveillance Data

- ✓ Drought can be a slow evolving
- ✓ The impacts are not immediate
- ✓ Can require multiple steps for health outcomes
- ✓ Surveillance is not designed to connect drought and health

Drought → ? → Health Outcome


Respiratory Issues
Allergy-Related Illnesses
Injuries
Gastrointestinal Illnesses
Heat Illnesses
Infectious Diseases
Hunger/Famine
Mental Health Consequences
Dust Storms
Wildfires
Water Quality
Heat Waves
Vector Habitat Change
Food Security & Agriculture
Temperature
Precipitation
Snowpack
Runoff
Ground water



Environmental & Institutional Context

Drought Types

- Meteorological Drought
- Agricultural Drought
- Hydrological Drought
- Socio-economical Drought

Social & Behavioral Context

- Water Supply
- Local Environmental Conditions
- Preparedness of Health Departments
- Agricultural Management Practices
- Power, Transportation, Communication and Healthcare Infrastructure

Exposure Pathways

- Increase in Dust and dust Storms
- More Frequent Wildfires
- Decrease in Water Quality and Quantity
- More Frequent and More Intense Heat Waves
- Change in Vector Habitat and Range
- Loss of Agriculture and Food Security

Health Outcomes

- Respiratory Issues
- Allergy-related Illnesses
- Injuries
- Infectious Disease
- Hunger/Famine
- Heat Illnesses
- Gastrointestinal Illnesses
- Mental Health Consequences

- Social Determinants of Health
- Occupation
- Rural/Urban
- Race/Literacy/Age
- Dependence on Caregivers and Medication

Threat Multiplier

Compromised Quantity and Quality of Water

Surface Water

Courtesy of USGS

Groundwater

Courtesy of USDA

Secondary/Related Events

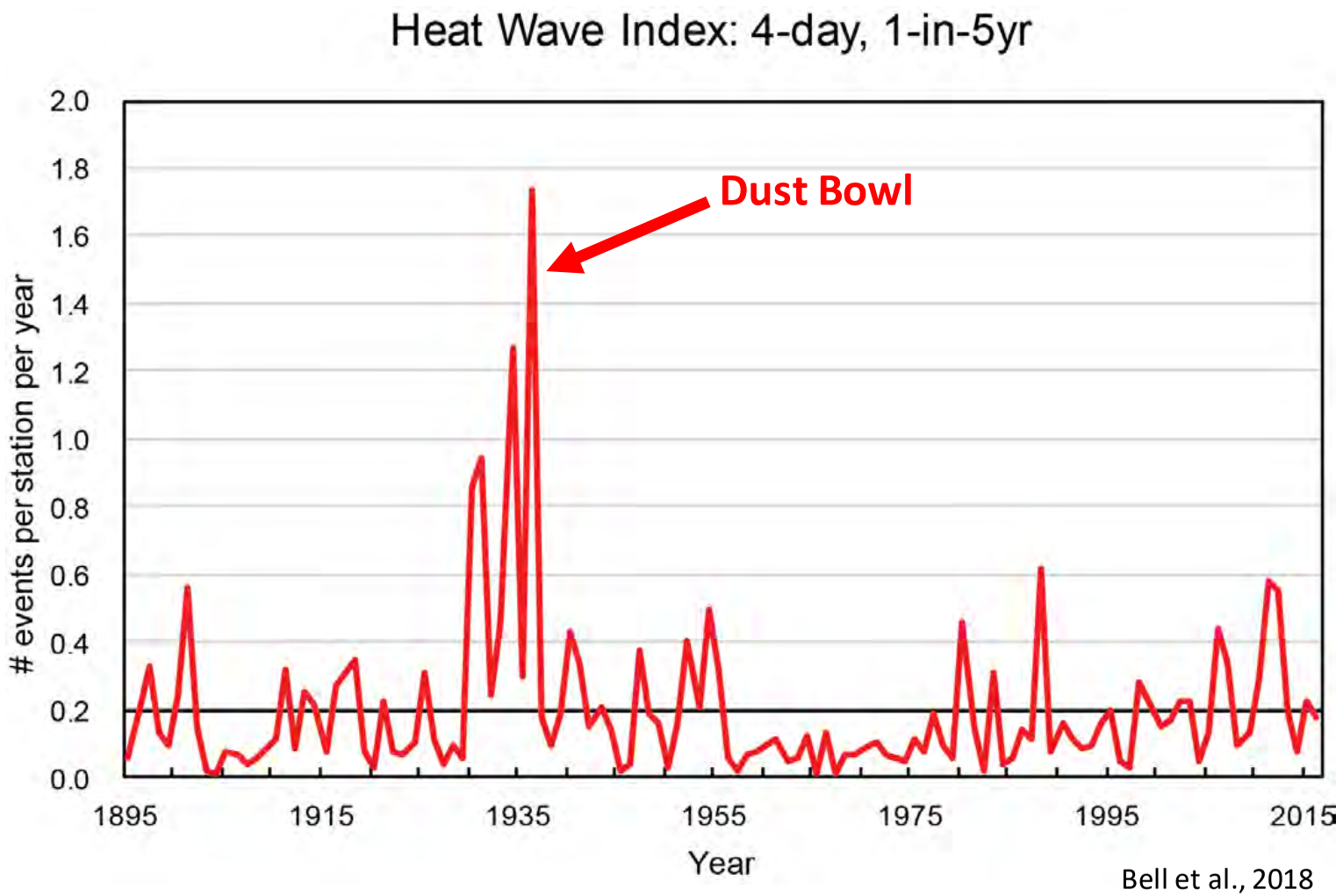
- Extreme heat
- Wildfires
- Dust storms/haboobs
- Rain/storm effects

Courtesy of FCC

Courtesy of USGS

Courtesy of NOAA

Extreme Heat and Drought



Bell et al., 2018

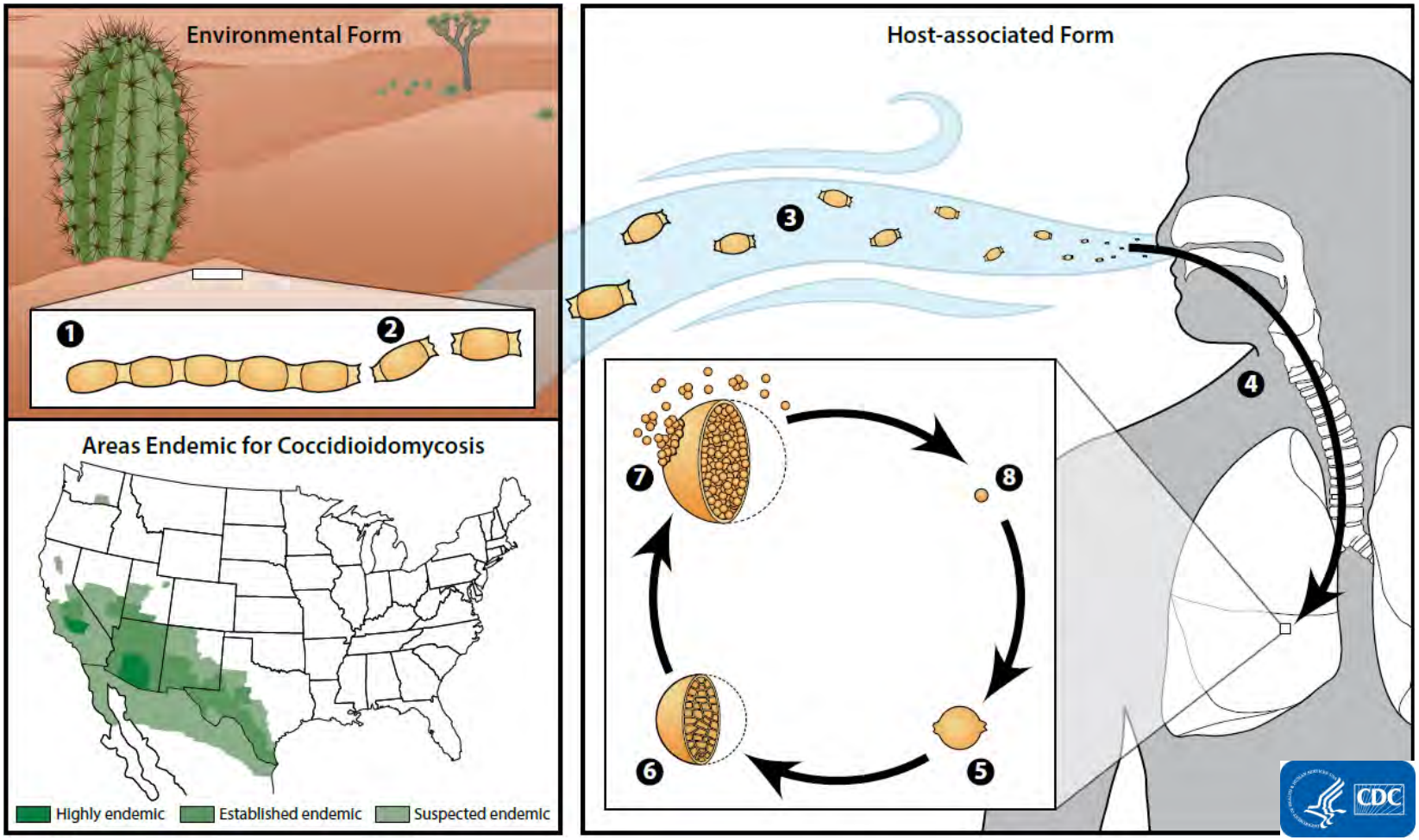
Increased Disease Incidence

- Infectious disease
- Chronic disease
- Vectorborne and zoonotic disease

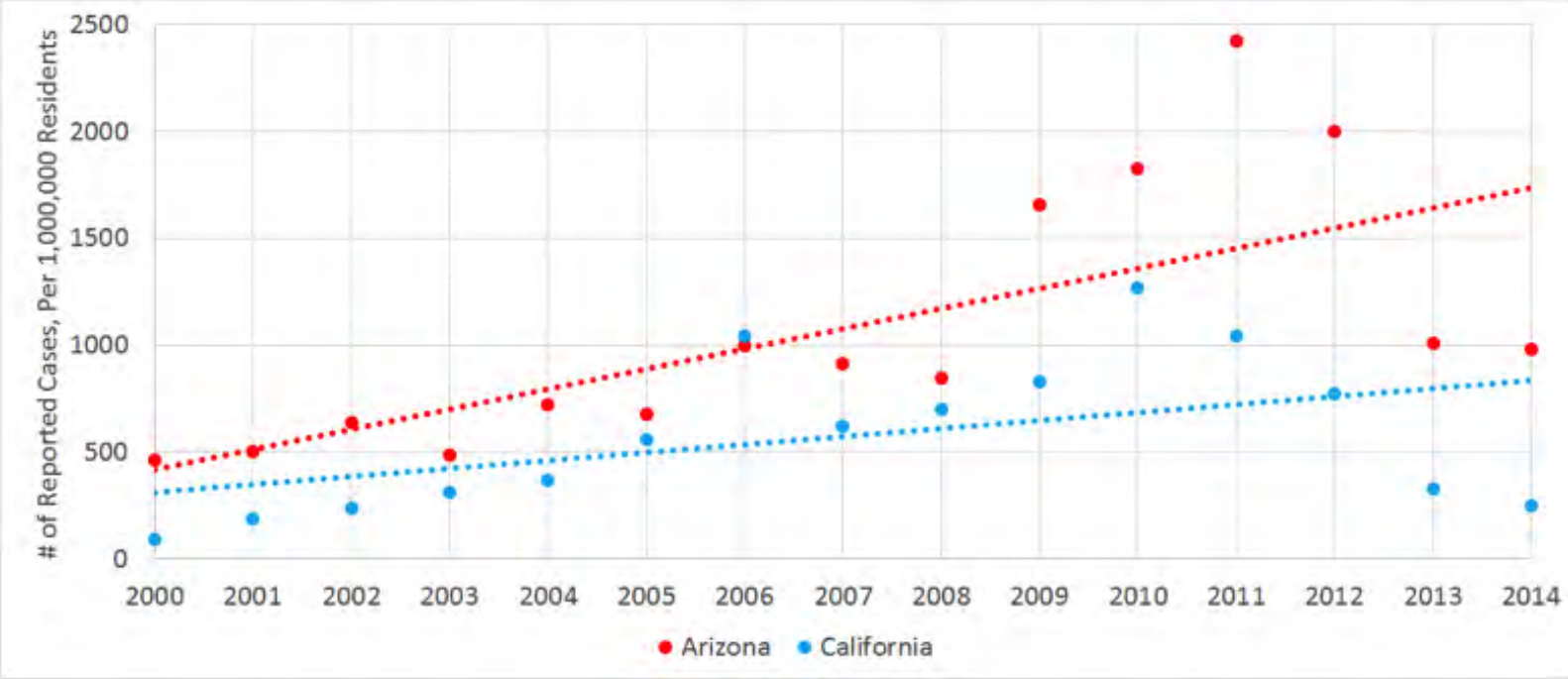
Courtesy of USGS

Courtesy of NSF

Life Cycle of Coccidioidomycosis



Increasing Incidence of Valley fever



Shriber, J., Conlon, K. C., Benedict, K., McCotter, O. Z., & Bell, J. E. (2017). Assessment of Vulnerability to Coccidioidomycosis in Arizona and California. International Journal of Environmental Research and Public Health, 14(7), 680.

Valley Fever

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Research Article

Relating Coccidioidomycosis (Valley Fever) Incidence to Soil Moisture Conditions

E.J. Coopersmith, J. E. Bell, K. Benedict, J. Shriber, O. McCotter, M.H. Cosh

Accepted manuscript online: 6 March 2017 Full publication history

DOI: 10.1002/2016GH000033 View/save citation

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Abstract

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Coccidioidomycosis (also called Valley fever) is caused by a soil-borne fungus, *Coccidioides* spp., in arid regions of the southwestern United States. Though some who develop infections from this fungus remain asymptomatic, others develop respiratory disease as a consequence. Less commonly, severe illness and death can occur when the infection spreads to other regions of the body. Previous analyses have attempted to connect the incidence of coccidioidomycosis to broadly-available climatic measurements, such as precipitation or temperature. However, with the limited availability of long-term, *in-situ* soil moisture datasets, it has not been feasible to perform a direct analysis of the relationships between soil moisture levels and coccidioidomycosis incidence on a larger temporal and spatial scale. Utilizing *in situ* soil moisture gauges throughout the southwest from the U.S. Climate Reference Network (USCRN) and a model with which to extend those estimates, this work connects periods of higher and lower soil moisture in Arizona and California between 2002 and 2014 to the reported incidence of coccidioidomycosis. The results indicate that in both states, coccidioidomycosis incidence is related to soil moisture levels from previous summers and falls. Stated differently, a higher number of coccidioidomycosis cases are likely to be reported if previous bands of months have been atypically wet or dry, depending on the location. This article is protected by copyright. All rights reserved.

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Volume 1 • Issue 1 • March 2017 • Pages 1–64

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Additional Health Risks

- Sanitation and hygiene
- Recreational risks
- Mental and behavioral health

Courtesy of CDC

Courtesy of USACE

Courtesy of House Committee on Agriculture

Complex Pathways: Mental Health

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Local

Kansas farmer on alarming suicide rate: 'Nothing gets farmers more down than a drought'

By: Emily Younger

Posted: May 21, 2018 09:34 PM CDT
Updated: May 21, 2018 11:34 PM CDT

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nsw act

Farmer's recovery from depression which led to two suicide attempts shows cost of drought at family level

STEVE Germon left a suicide note on the porch and set about putting down calves he couldn't feed before turning the gun on himself. Then a ute screamed towards him, his 17-year-old daughter at the wheel.

JACK MORPHET

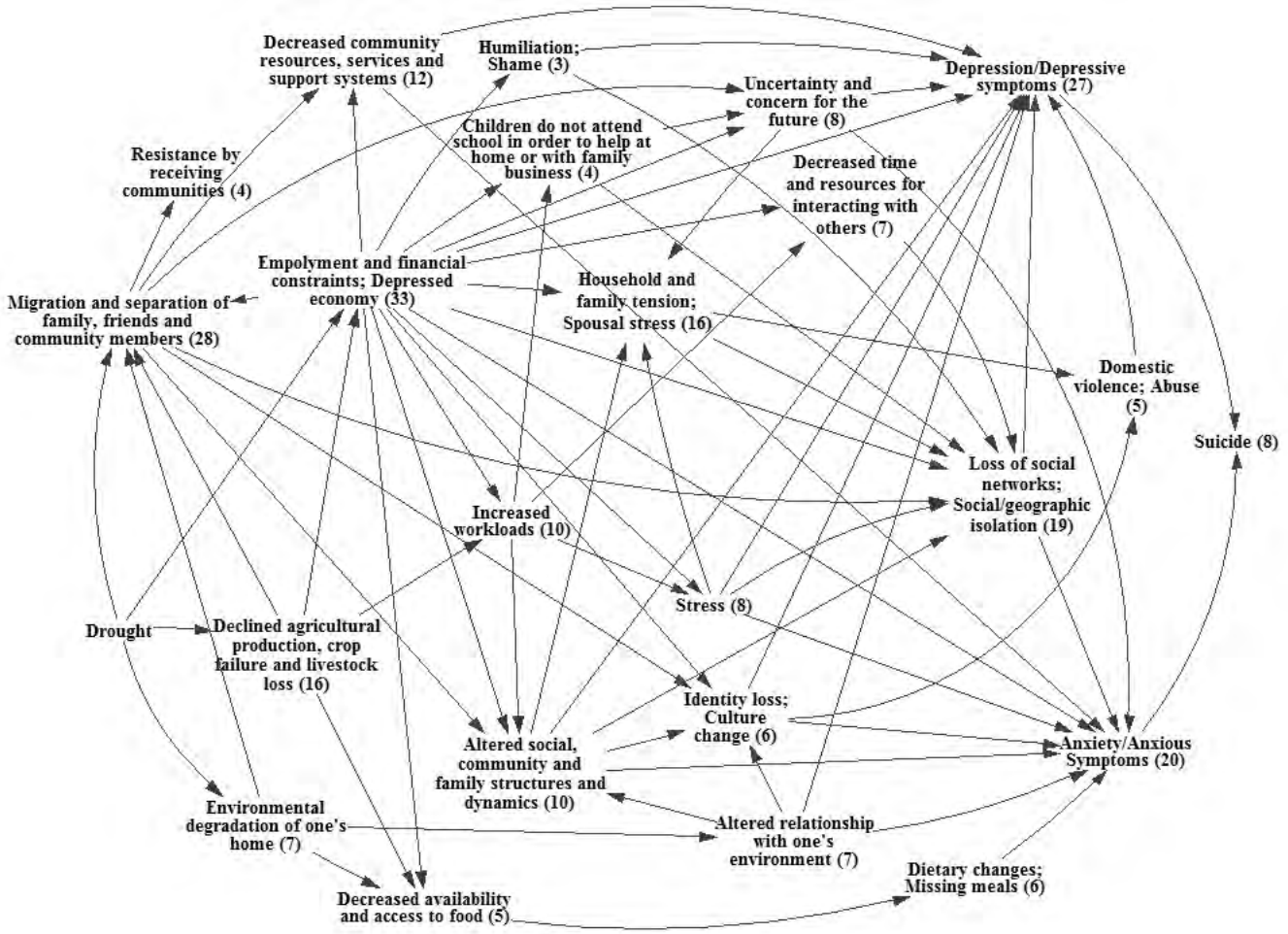
The Sunday Telegraph JULY 1, 2018 1:00AM

NSW stricken by severe drought

DAIRY farmer Steve Germon knows what it's like to be on the brink of suicide. He has been there twice in the past three years.

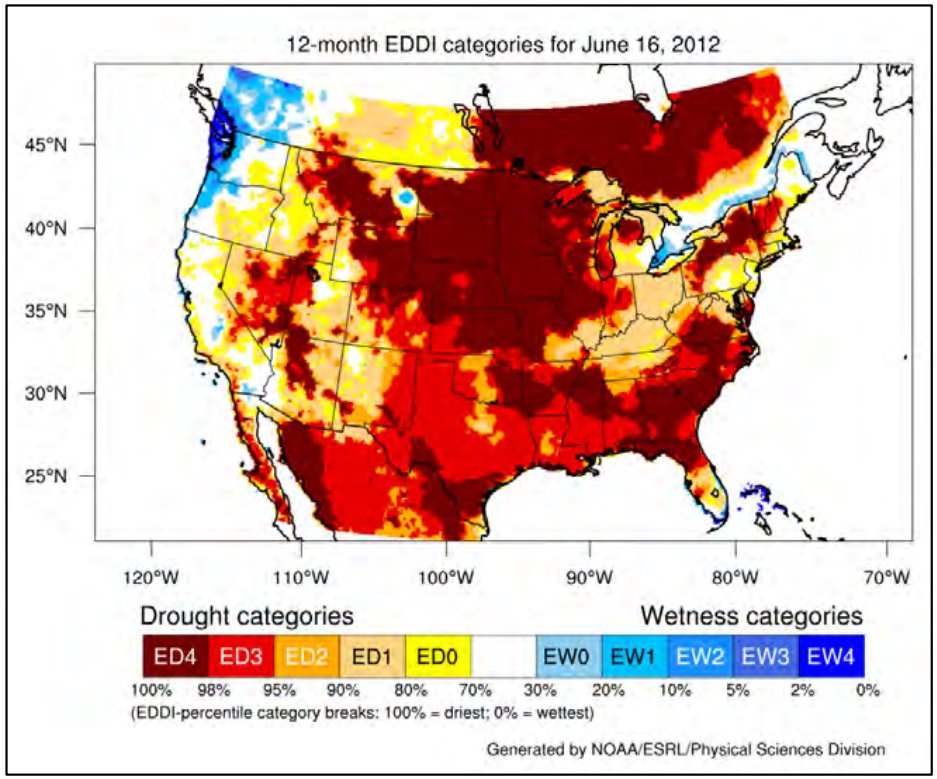
…at saved him in 2015, but those lonely moments last year

Causal Process Diagram



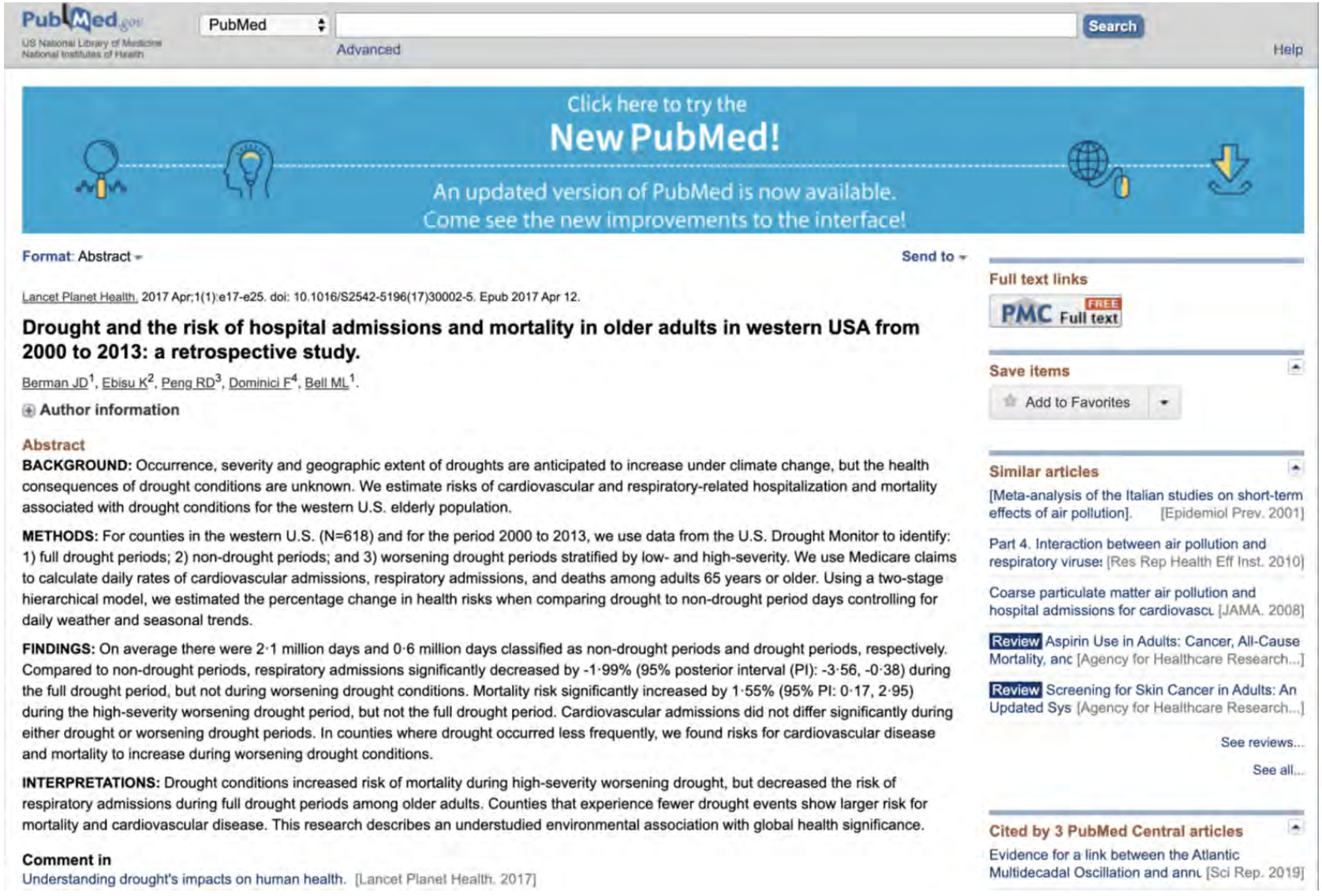
Vins, H., Bell, J., Saha, S., & Hess, J. J. (2015). The mental health outcomes of drought: a systematic review and causal process diagram. *International journal of environmental research and public health*, *12*(10), 13251-13275.

Drought and Mortality



County-level Mortality

1980-2014



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Lancet Planet Health. 2017 Apr;1(1):e17-e25. doi: 10.1016/S2542-5196(17)30002-5. Epub 2017 Apr 12.

Drought and the risk of hospital admissions and mortality in older adults in western USA from 2000 to 2013: a retrospective study.

Berman JD[1], Ebisu K[2], Peng RD[3], Dominici F[4], Bell ML[1].

Author information

Abstract

BACKGROUND: Occurrence, severity and geographic extent of droughts are anticipated to increase under climate change, but the health consequences of drought conditions are unknown. We estimate risks of cardiovascular and respiratory-related hospitalization and mortality associated with drought conditions for the western U.S. elderly population.

METHODS: For counties in the western U.S. (N=618) and for the period 2000 to 2013, we use data from the U.S. Drought Monitor to identify: 1) full drought periods; 2) non-drought periods; and 3) worsening drought periods stratified by low- and high-severity. We use Medicare claims to calculate daily rates of cardiovascular admissions, respiratory admissions, and deaths among adults 65 years or older. Using a two-stage hierarchical model, we estimated the percentage change in health risks when comparing drought to non-drought period days controlling for daily weather and seasonal trends.

FINDINGS: On average there were 2·1 million days and 0·6 million days classified as non-drought periods and drought periods, respectively. Compared to non-drought periods, respiratory admissions significantly decreased by -1·99% (95% posterior interval (PI): -3·56, -0·38) during the full drought period, but not during worsening drought conditions. Mortality risk significantly increased by 1·55% (95% PI: 0·17, 2·95) during the high-severity worsening drought period, but not the full drought period. Cardiovascular admissions did not differ significantly during either drought or worsening drought periods. In counties where drought occurred less frequently, we found risks for cardiovascular disease and mortality to increase during worsening drought conditions.

INTERPRETATIONS: Drought conditions increased risk of mortality during high-severity worsening drought, but decreased the risk of respiratory admissions during full drought periods among older adults. Counties that experience fewer drought events show larger risk for mortality and cardiovascular disease. This research describes an understudied environmental association with global health significance.

Comment in

Understanding drought's impacts on human health. [Lancet Planet Health. 2017]

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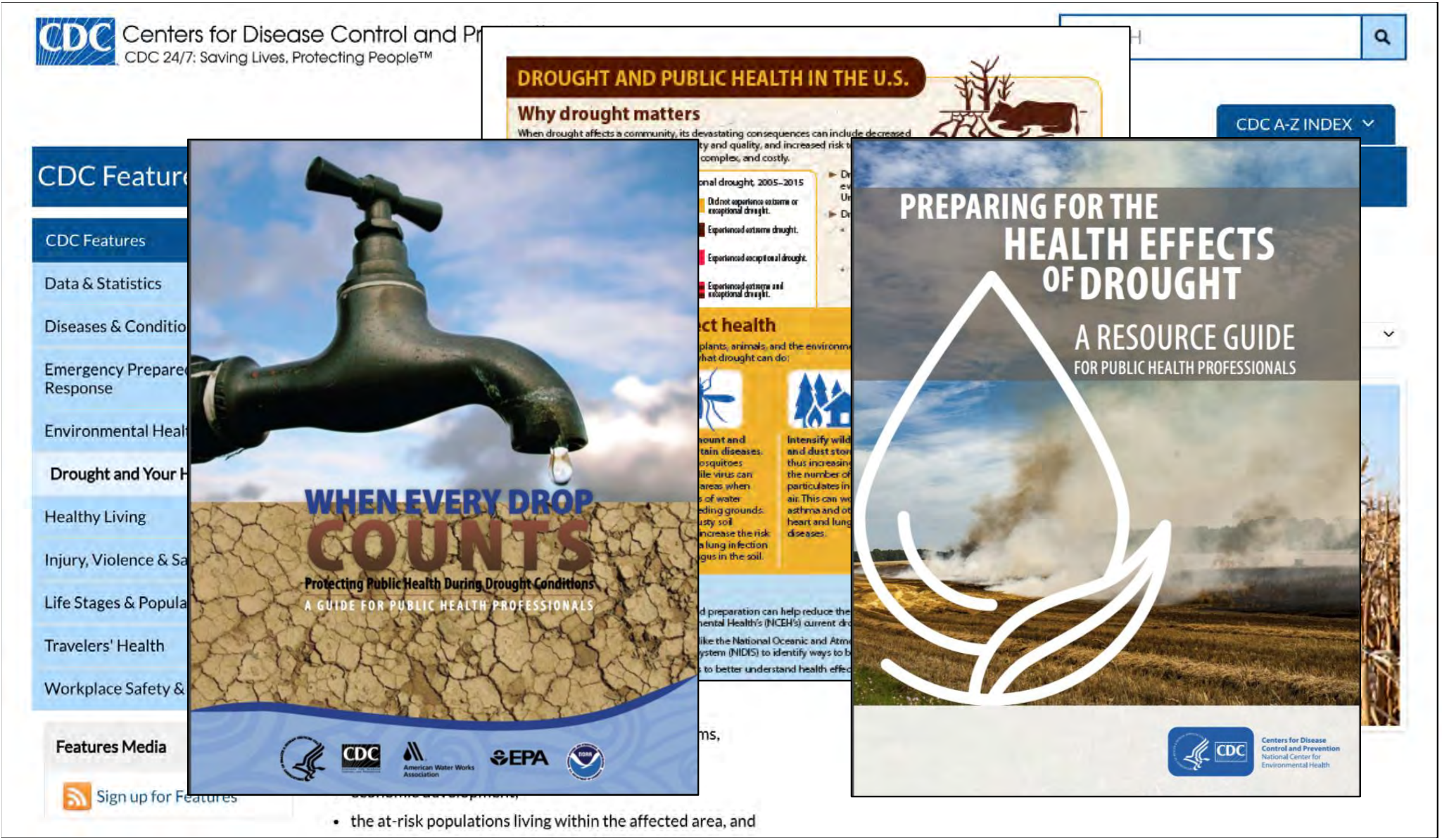
Nebraska Study on Drought and Mortality: *Significant Positive Relationships*

Age	Race	Gender	Mean	Mean IRR	95% HPD Interval	
45-54	white	Male	0.00678	**1.0068**	0.00243	0.0106
45-54	White	Female	0.0109	**1.0109**	0.00604	0.0153
55-64	White	Male	0.00582	**1.0058**	0.00317	0.00872

Incidence Rate Ratio (IRR):
IRR less than 1 suggests decreasing mortality rates with increasing drought severity and larger than 1 suggests increasing mortality rates with increasing drought severity

What Connections Do You See?

Engagement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Why drought matters
When drought affects a community, its devastating consequences can include decreased
complex, and costly.
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Did not experience extreme or exceptional drought.
Experienced extreme drought.
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• the at-risk populations living within the affected area, and

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June 17-19, 2019 | Atlanta, GA

Thank you to our Summit Planning Partners:

Centers for Disease Control and Prevention (CDC)
National Integrated Heat Health Information System (NIHHIS)
Environmental Protection Agency (EPA)
Natural Resources Defense Council (NRDC)
UNL National Drought Mitigation Center (NDMC)

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Summit

- Over 50 attendees

Topics Discussed

- Environmental Exposure
- Water Quality/Quantity
- Heat
- Air Quality
- Disease
  - Valley fever and West Nile
- Vulnerable Populations
- State, Local, and Tribal Health Departments
- Non-Government Organizations
- International
- Next Steps

Participants

- American Geophysical Union
- Arizona Department of Health Services
- Atlanta Regional Commission
- Carolinas Integrated Sciences and Assessments
- CDC/Division of Environmental Health Science and Practice
- CDC/Mycotic Diseases Branch
- CDC/National Center for Environmental Health
- Centers for Disease Control and Prevention
- Council of State and Territorial Epidemiologists
- Emory University
- Environmental Protection Agency
- Florida State University
- Georgia Department of Public Health/Environmental Health
- Metropolitan North Georgia Water Plant
- National Aeronautics and Space Administration
- National Drought Mitigation Center
- National Integrated Heat Health Information System
- National Resources Defense Council
- NOAA/National Integrated Drought Information System
- Oak Ridge Institute for Science and Education
- Pala Band of Mission Indians
- Pan-American Health Organization
- U.S. Geological Survey
- University Corporation for Atmospheric Research
- University of Arizona
- University of Colorado at Boulder
- University of Houston
- University of Minnesota
- University of Nebraska Medical Center

Outcomes

- **Building Collaboration**
  - Establish local meetings and/or a yearly summit, which will focus on issues of drought, heat, health, and other related issues.
- **Communication and Education**
  - Engage with climate and health communicators, including policymakers, who can assist in disseminating messages about drought to the wider public.
- **Data and Indicators**
  - Assess drought indicators for scale and location, so that they can be adapted for health usage.
- **Coordination and Implementation**
  - Identify interdisciplinary teams, and develop a community of practice that can act as a workgroup to achieve the goals of the implementation strategy.
- **International Synergies**
  - Assess ongoing international activities and connect with international groups/efforts for drought and health. Integrate knowledge from existing efforts into future NIDIS workshops.
- **Research**
  - Explore interdisciplinary mechanisms for collaboration on research questions.
- **Resources and Support**
  - Create funding strategy, with designations for time, personnel, funds, and resources to address next steps.

Engagement Strategies

Public Health Preparedness

Emergency Preparedness

Healthcare Preparedness

Drought and Health Workshop Goals

- Share the current state of knowledge on drought and health
- Identify gaps and needs for evidence-based research, capacity building, and communication
- Engage and develop a drought and health community of practice
- Jointly develop a collaborative, multi-partner NIDIS Drought & Public Health Strategy that builds upon Summit outcomes.

Acknowledgements

UNMC Center for Preparedness Education

- Rachel Lookadoo, JD
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CDC Climate and Health

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- Paul Schramm, MS MPH

NIDIS

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- Veva Deheza
- Rocky Bilotta
- Joel Lisonbee

My Team

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- Jagadeesh Puvvula
- Qianting Li

Mike Hobbins

All of the state and local partners

- Matt Roach
- Steering committee
- University of Arizona

All of the federal and academic partners

Everyone else…

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