The impact of climate variability on Valley Fever

Jesse E. Bell, PhD
Cooperative Institute for Climate and Satellites – NC
North Carolina State University
NOAA's National Centers for Environmental Information
Asheville, North Carolina

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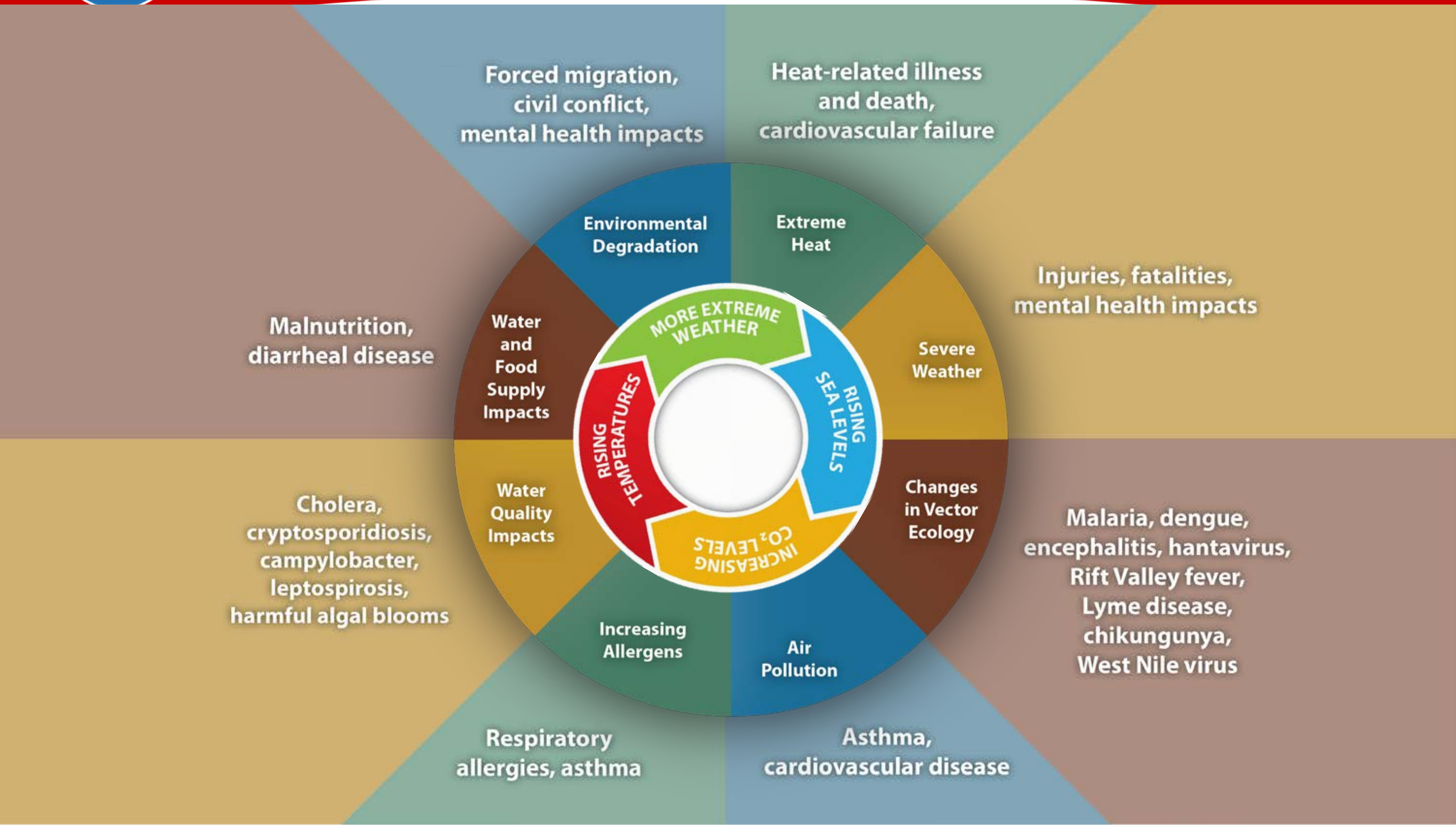


Figure from CDC's Climate and Health Program

THE IMPACTS OF CLIMATE CHANGE ON

HUMAN HEALTH

IN THE UNITED STATES:

A SCIENTIFIC ASSESSMENT

U.S. Global Change
Research Program

Health2016.globalchange.gov

Executive Summary

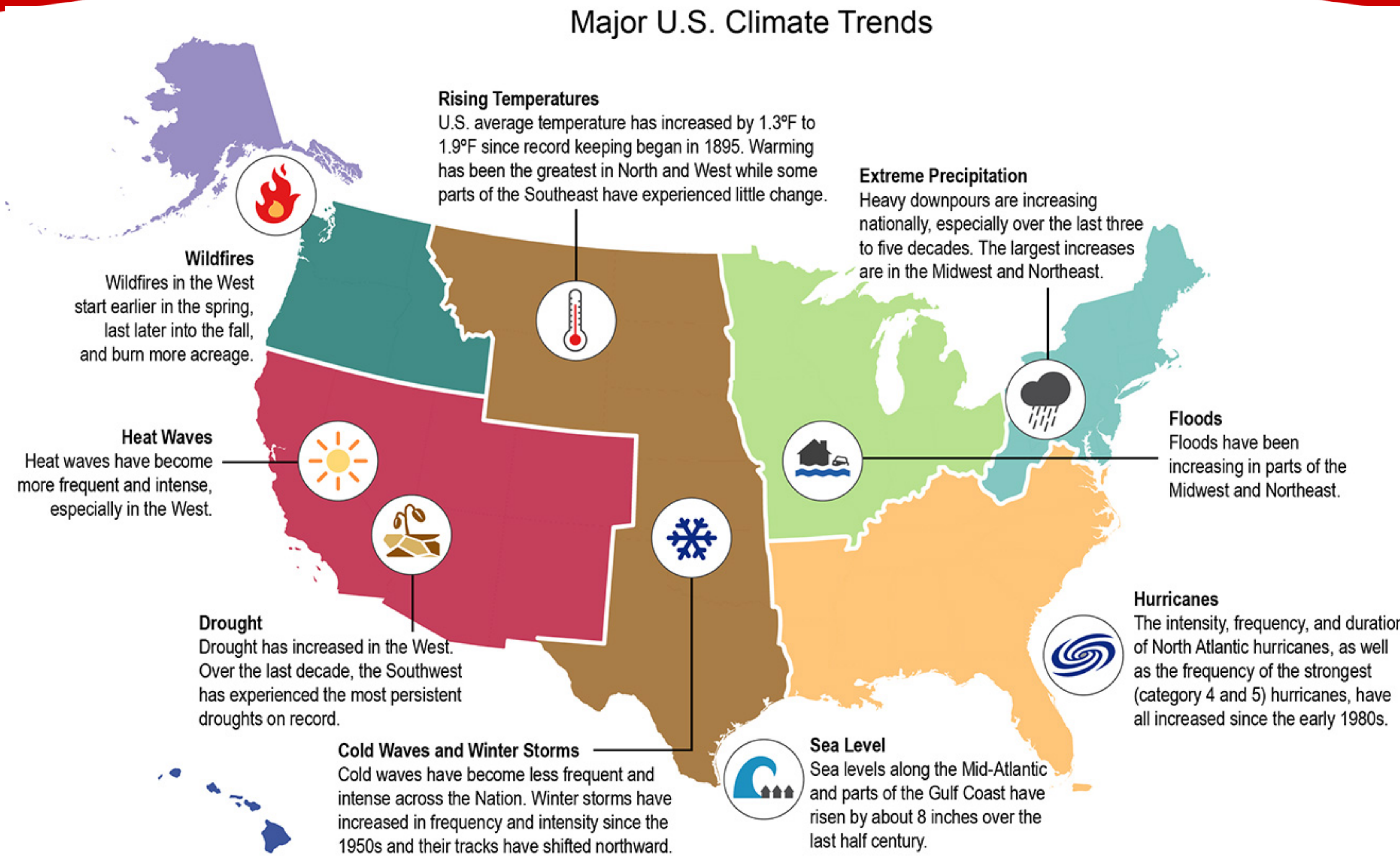
Climate change is a significant threat to the health of the American people.

- Climate change threatens human health and well-being in the United States. The U.S. Global Change Research Program (USGCRP) Climate and Health Assessment has been developed to enhance understanding and inform decisions about this growing threat. This scientific assessment, called for under the President's Climate Action Plan, is a major report of the sustained National Climate Assessment (NCA) process. The report responds to the 1990 Congressional mandate to assist the Nation in understanding, assessing, predicting, and responding to human-induced and natural processes of global change. The agencies of the USGCRP identified human health impacts as a high-priority topic for scientific assessment.

- The purpose of this assessment is to provide a comprehensive, evidence-based, and, where possible, quantitative estimation of observed and projected climate change related health impacts in the United States. The USGCRP Climate and Health Assessment has been developed to inform public health officials, urban and disaster response planners, decision makers, and other stakeholders within and outside of government who are interested in better understanding the risks climate change presents to human health.

Every American is vulnerable to the health impacts associated with climate change

Climate Change and Health



Climate Change and Health

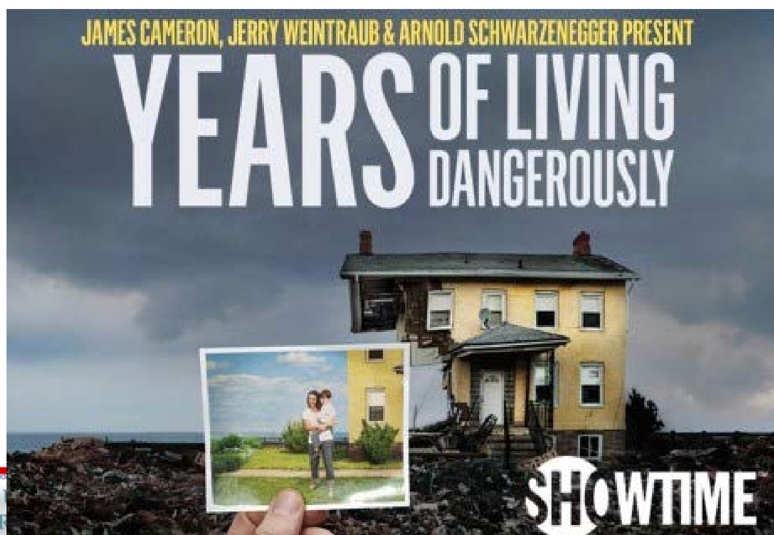
Examples of Climate Impacts on Human Health

	Climate Driver	Exposure	Health Outcome	Impact
Extreme Heat	More frequent, severe, prolonged heat events	Elevated temperatures	Heat-related death and illness	Rising temperatures will lead to an increase in heat-related deaths and illnesses.
Outdoor Air Quality	Increasing temperatures and changing precipitation patterns	Worsened air quality (ozone, particulate matter, and higher pollen counts)	Premature death, acute and chronic cardiovascular and respiratory illnesses	Rising temperatures and wildfires and decreasing precipitation will lead to increases in ozone and particulate matter, elevating the risks of cardiovascular and respiratory illnesses and death.
Flooding	Rising sea level and more frequent or intense extreme precipitation, hurricanes, and storm surge events	Contaminated water, debris, and disruptions to essential infrastructure	Drowning, injuries, mental health consequences, gastrointestinal and other illness	Increased coastal and inland flooding exposes populations to a range of negative health impacts before, during, and after events.
Vector-Borne Infection (Lyme Disease)	Changes in temperature extremes and seasonal weather patterns	Earlier and geographically expanded tick activity	Lyme disease	Ticks will show earlier seasonal activity and a generally northward range expansion, increasing risk of human exposure to Lyme disease-causing bacteria.
Water-Related Infection (*Vibrio vulnificus*)	Rising sea surface temperature, changes in precipi-tation and runoff affecting coastal salinity	Recreational water or shellfish contaminated with *Vibrio vulnificus*	*Vibrio vulnificus* induced diarrhea & intestinal illness, wound and blood-stream infections, death	Increases in water temperatures will alter timing and location of *Vibrio vulnificus* growth, increas-ing exposure and risk of water-borne illness.
Food-Related Infection (*Salmonella*)	Increases in temperature, humidity, and season length	Increased growth of pathogens, seasonal shifts in incidence of *Salmonella* exposure	*Salmonella* infection, gastrointestinal outbreaks	Rising temperatures increase *Salmonella* prevalence in food; longer seasons and warming winters increase risk of exposure and infection.
Mental Health and Well-Being	Climate change impacts, especially extreme weather	Level of exposure to traumatic events, like disasters	Distress, grief, behavioral health disorders, social impacts, resilience	Changes in exposure to climate- or weather-related disasters cause or exacerbate stress and mental health consequences, with greater risk for certain populations.

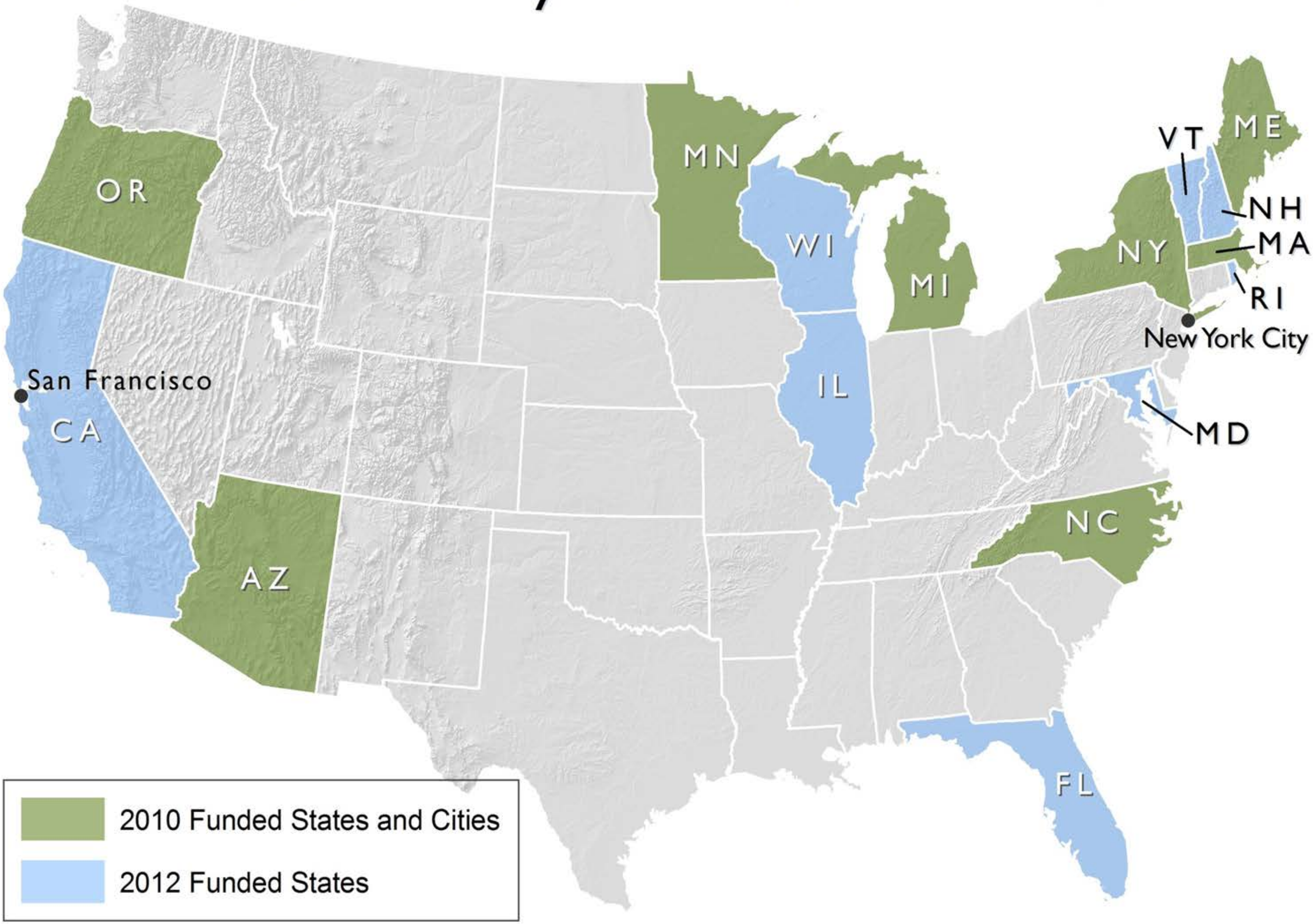

CDC
CENTERS FOR DISEASE
CONTROL AND PREVENTION

Engagement

- CDC's Climate and Health Program
  - Nation's only investment in climate change preparedness for the public health sector
  - Climate Ready States and Cities Initiative
    - 16 States and 2 Cities



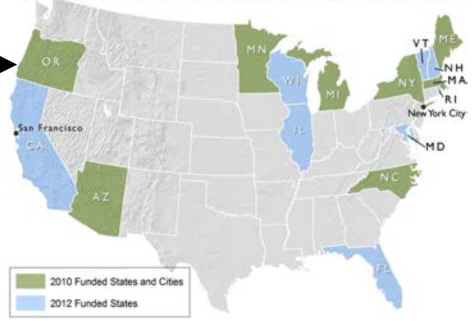
CDC Climate Ready States and Cities Initiative



Climate and Environmental Data Pathway

State and Local
Health Departments

CDC Climate Ready States and Cities Initiative



NOAA → CDC → State and Local Health Departments; CDC → Health Studies

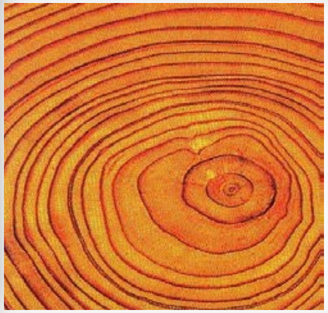
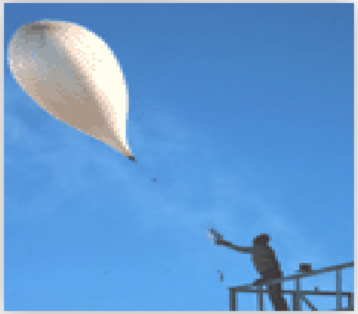
Health Studies

Data Received from Many Sources

NCEI is responsible for preserving, monitoring, assessing, and providing public access to the Nation's treasure of climate and historical weather data and information.







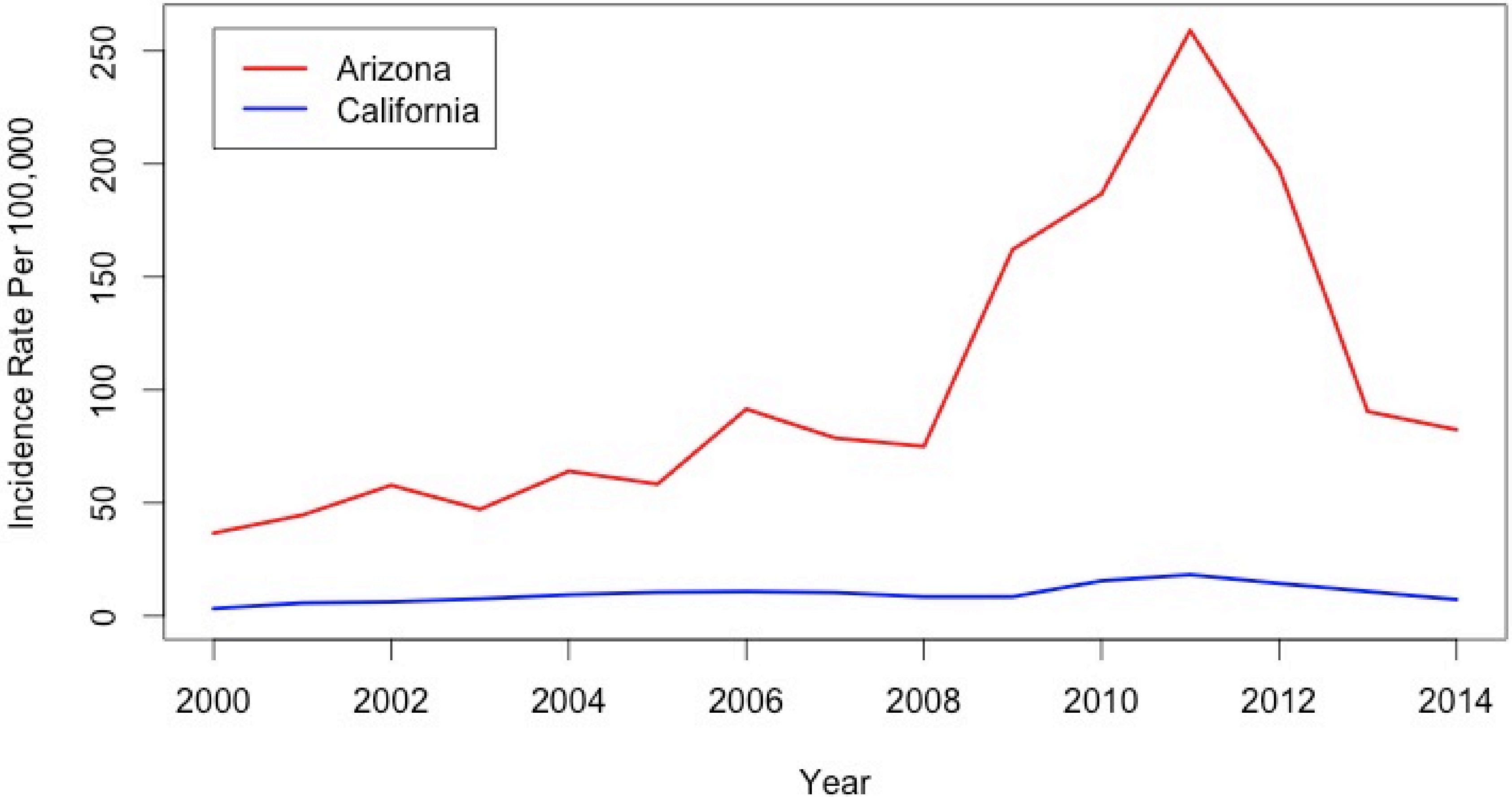
Valley Fever

- Coccidioidomycosis, also known as valley fever, is a fungal infection arising from inhalation of *Coccidioides immitis* and *Coccidioides posadasii* spores.
- It is endemic in the southwestern United States, with the highest incidence in Arizona and California.
- Inhalation of a single spore may be enough to cause illness, and approximately 40% of infected people experience symptoms that can range from mild (e.g., flu-like) to severe (e.g., community acquired pneumonia, meningitis, and disseminated infections).

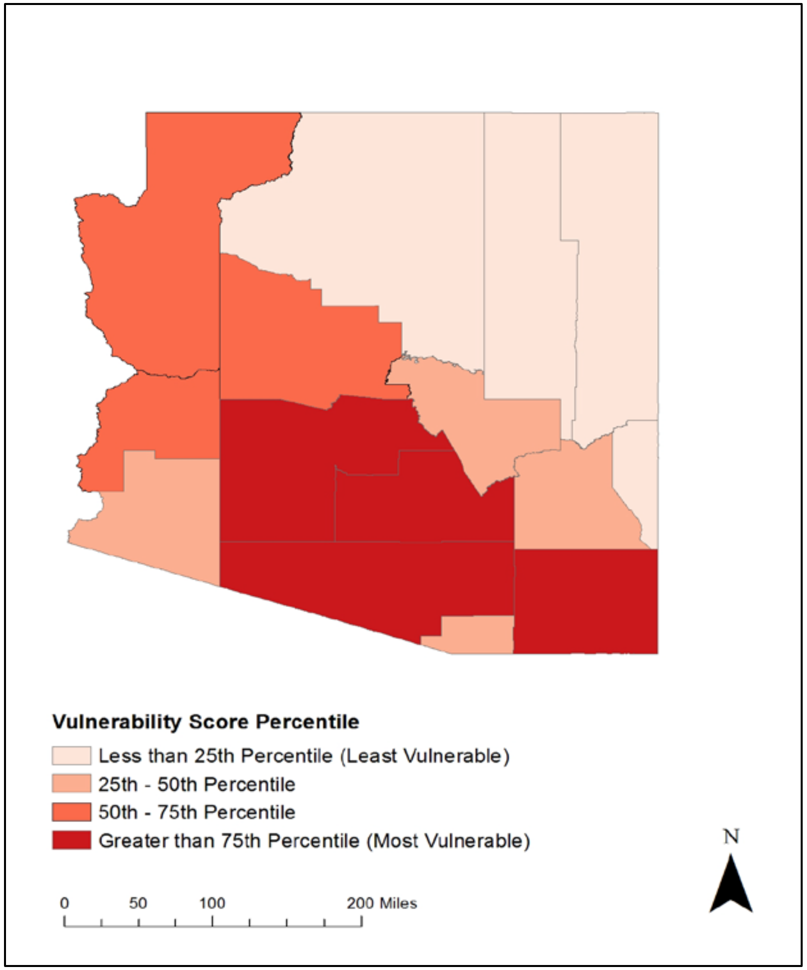
Valley Fever and Climate

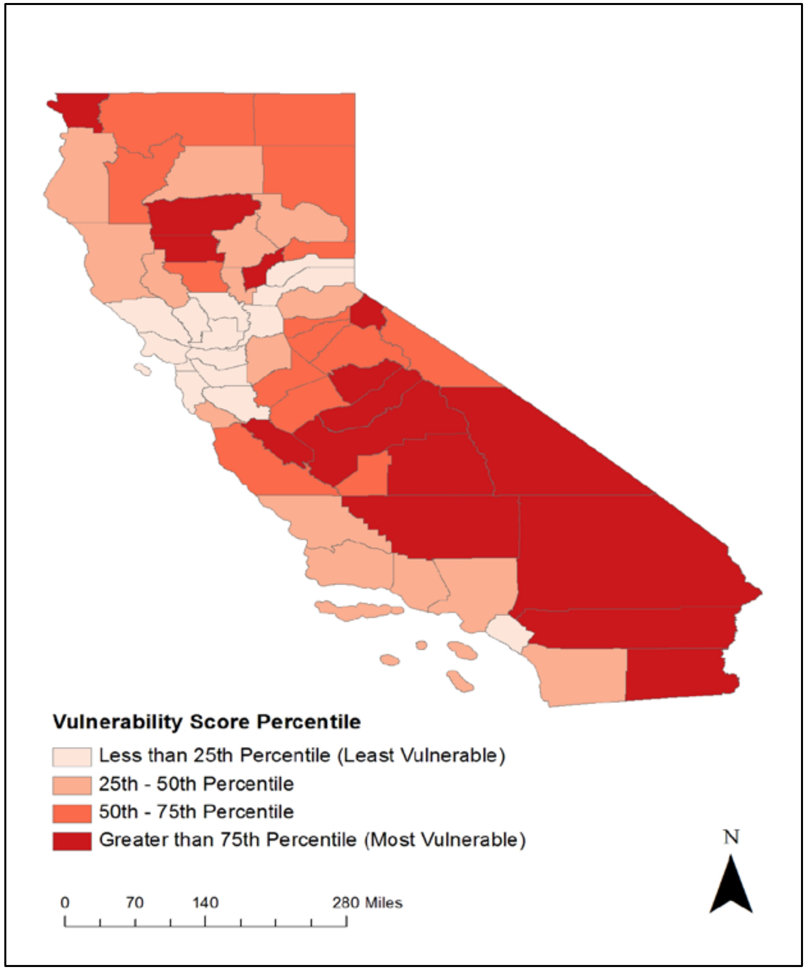
- *Coccidioidodes* spp. depend on climate drivers such as precipitation and temperature for spore growth and development.
- This project links climate variables (soil moisture, temperature, precipitation, and drought indices) to changes in incidence of valley fever for Arizona and California.
- By exploring relationships between climate variability and valley fever, this work can provide a way to assess vulnerability and provide early warning to health departments.

Increasing Incidence



Vulnerability Score





	Both States	Arizona Index	California Index
Overall Variability	**0.42**[1]	0.08	**0.62**[1]
Overall Precip. Variability	**-0.23**[1]	0.16	**-0.28**[1]
Overall Temp. Variability	**0.43**[1]	-0.07	**0.61**[1]
Overall SPEI Variability	**0.37**[1]	-0.42	**0.61**[1]
Fall Variability	**0.23**[1]	-0.09	**0.33**[1]
Fall Precip. Variability	**-0.27**[1]	-0.50	**-0.31**[1]
Fall Temp. Variability	**0.25**[1]	0.09	**0.31**[1]
Fall SPEI Variability	**0.33**[1]	-0.29	**0.54**[1]
Spring Variability	**0.23**[1]	-0.48	**0.42**[1]
Spring Precip. Variability	**-0.26**[1]	-0.26	**-0.25**[1]
Spring Temp. Variability	**0.26**[1]	-0.47	**0.43**[1]
Spring SPEI Variability	**0.29**[1]	-0.50	**0.49**[1]
Summer Variability	**0.48**[1]	0.10	**0.64**[1]
Summer Precip. Variability	0.01	0.14	0.08
Summer Temp. Variability	**0.53**[1]	0.01	**0.64**[1]
Summer SPEI Variability	**0.37**[1]	-0.34	**0.61**[1]
Winter Variability	0.18	0.46	0.11
Winter Precip. Variability	**-0.23**[1]	0.41	**-0.39**[1]
Winter Temp. Variability	**0.24**[1]	0.40	0.20
Winter SPEI Variability	0.08	-0.08	0.10

Forecasting

Arizona

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Year X**
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Year X-1**
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Year X-2**

California

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Year X**
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Year X-1**
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Year X-2**

Cases of valley fever in year X…
…are inversely correlated with actual soil moisture in year X-1
…and directly correlated with hours above 5% in year X-2

Cases of valley fever in year X…
…are inversely correlated with actual soil moisture in year X-1
…and inversely correlated with hours above 5% in year X-2

Cases of valley fever in year X…
…are inversely correlated with hours above 10% in year X-1
…and inversely correlated with hours above 10% in year X-2

- NOAA USCRN soil observations were able to determine that coccidioidomycosis incidence is inversely correlated with soil moisture levels from the previous year's summer (and even earlier summers in California).
- **Atypically dry summers are likely to precede higher number of coccidioidomycosis cases in the following years.**

Conclusions

1. Climate and human health are directly linked to each other.

2. Climate controls seasonal patterns that regulate the distribution of many human pathogens.

3. Understanding these relationships can provide opportunities for early warning to public health departments.

4. Climate and environmental data from NOAA provides an opportunity to unlock these relationships.

5. This project links climate variables (soil moisture, temperature, precipitation, and drought indices) to changes in incidence of valley fever for Arizona and California.

6. By exploring relationships between climate variability and valley fever, this work can provide a way to assess vulnerability and provide early warning to health departments.

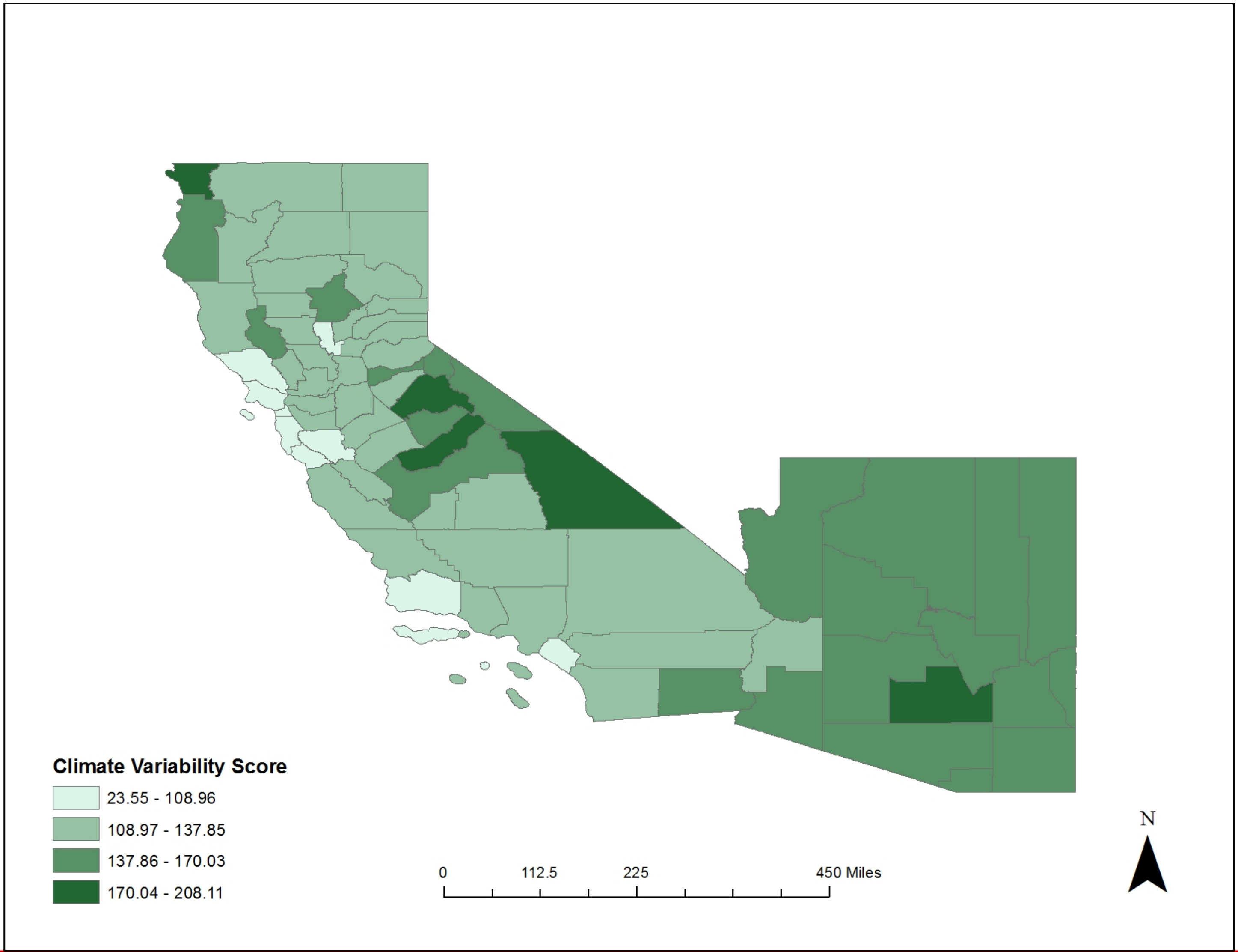
7. This project demonstrates an example of the limitless opportunities that exist in combining human health data with NOAA climate data.

Thank you!

Contact information:

Jesse E. Bell, PhD

jesse@cicsnc.org


Climate Variability Score
23.55 - 108.96
108.97 - 137.85
137.86 - 170.03
170.04 - 208.11
0
112.5
225
450 Miles
N