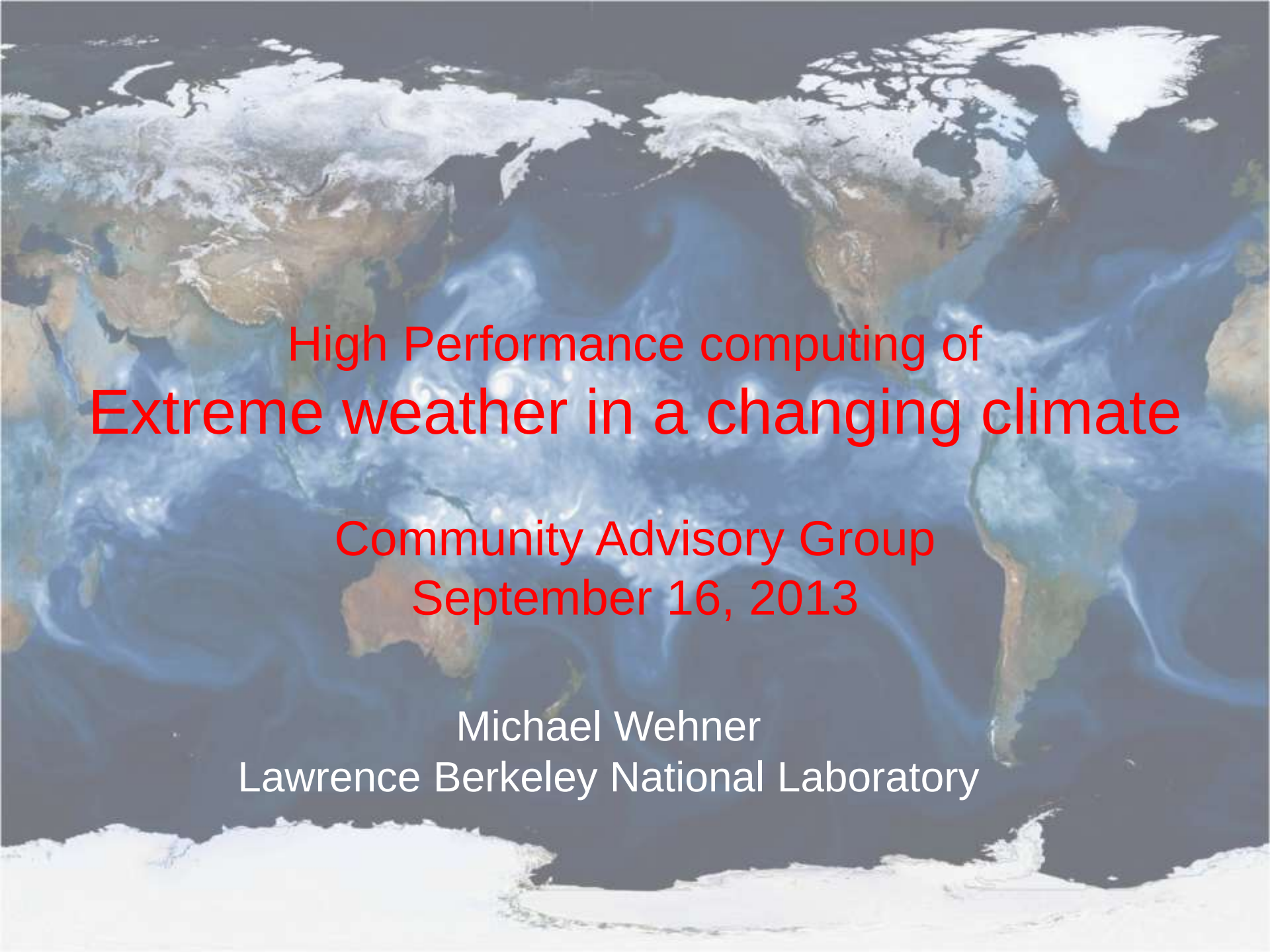


High Performance computing of
Extreme weather in a changing climate

Community Advisory Group
September 16, 2013

Michael Wehner
Lawrence Berkeley National Laboratory

Who am I and what do I do?

- Senior scientist in the Computational Research Division
  - Berkeley Lab since 2002
  - Livermore Lab from 1985-2002

- Intergovernmental Panel on Climate Change (IPCC)
  - A lead author of the upcoming 5th Assessment report (2014)

- US National Climate Assessment Report
  - A lead author of the 2nd (2009) and 3rd (2014) reports

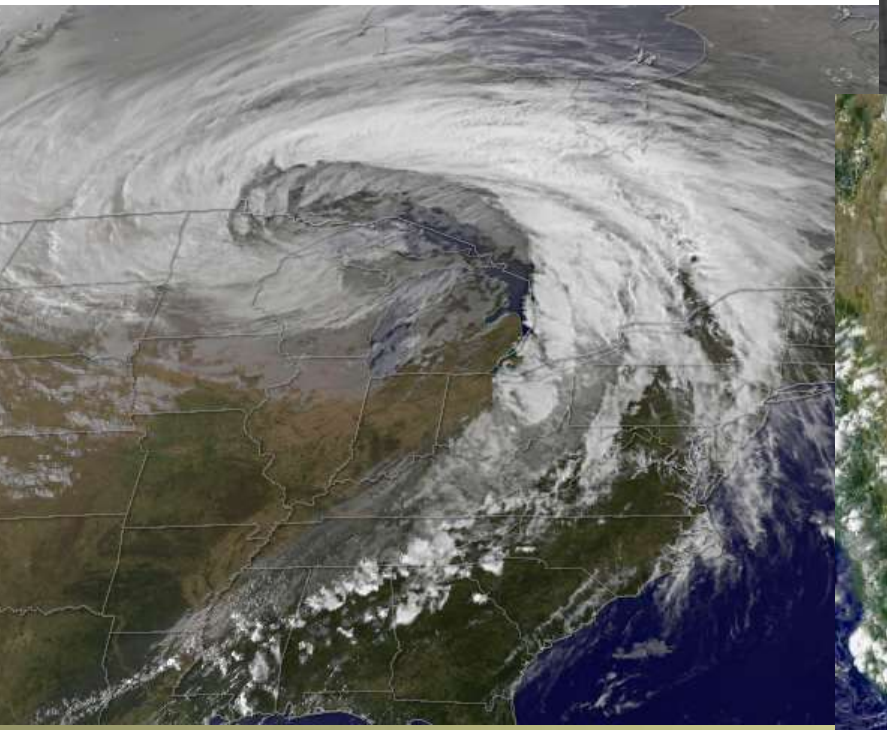
- Assessing confidence in projections of future climate change.
- How will extreme weather change in a warmer world?

Extreme weather

- Heat Waves
- Cold Snaps
- Drought
- Floods
- Extreme Storms
  - Hurricanes
  - Atmospheric Rivers (aka The Pineapple Express)
  - Extra-tropical cyclones

  - Tornadoes, Hail, Wind, Lightning, etc.

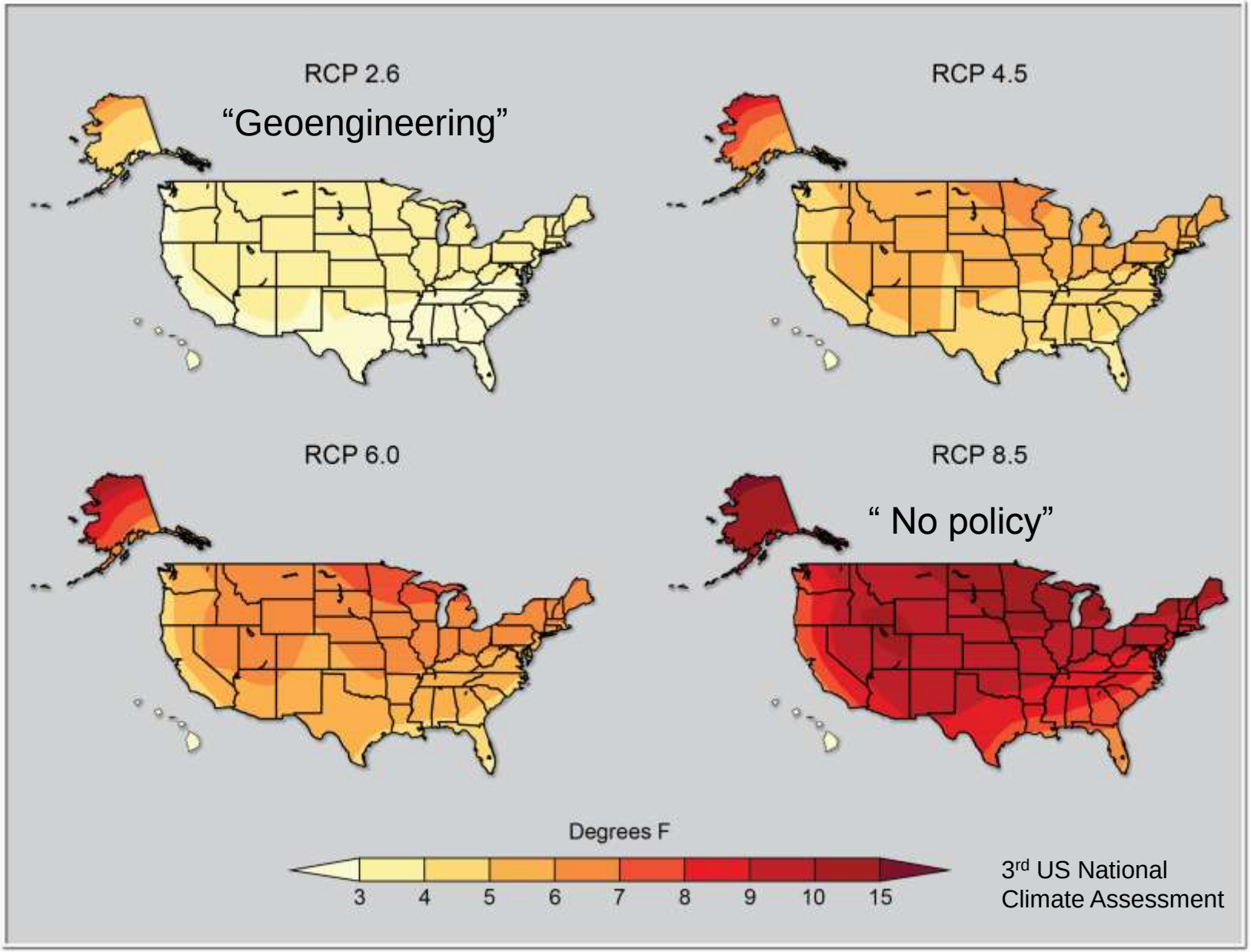
Extreme Weather in a changing climate



US National Climate Assessment

- Draft available at globalchange.gov
  - Mandated by Congress every four years.
  - A very public process.
  - Very highly reviewed by experts, the government and the public.
  - Similar in intent, but more targeted to the US than the IPCC reports.

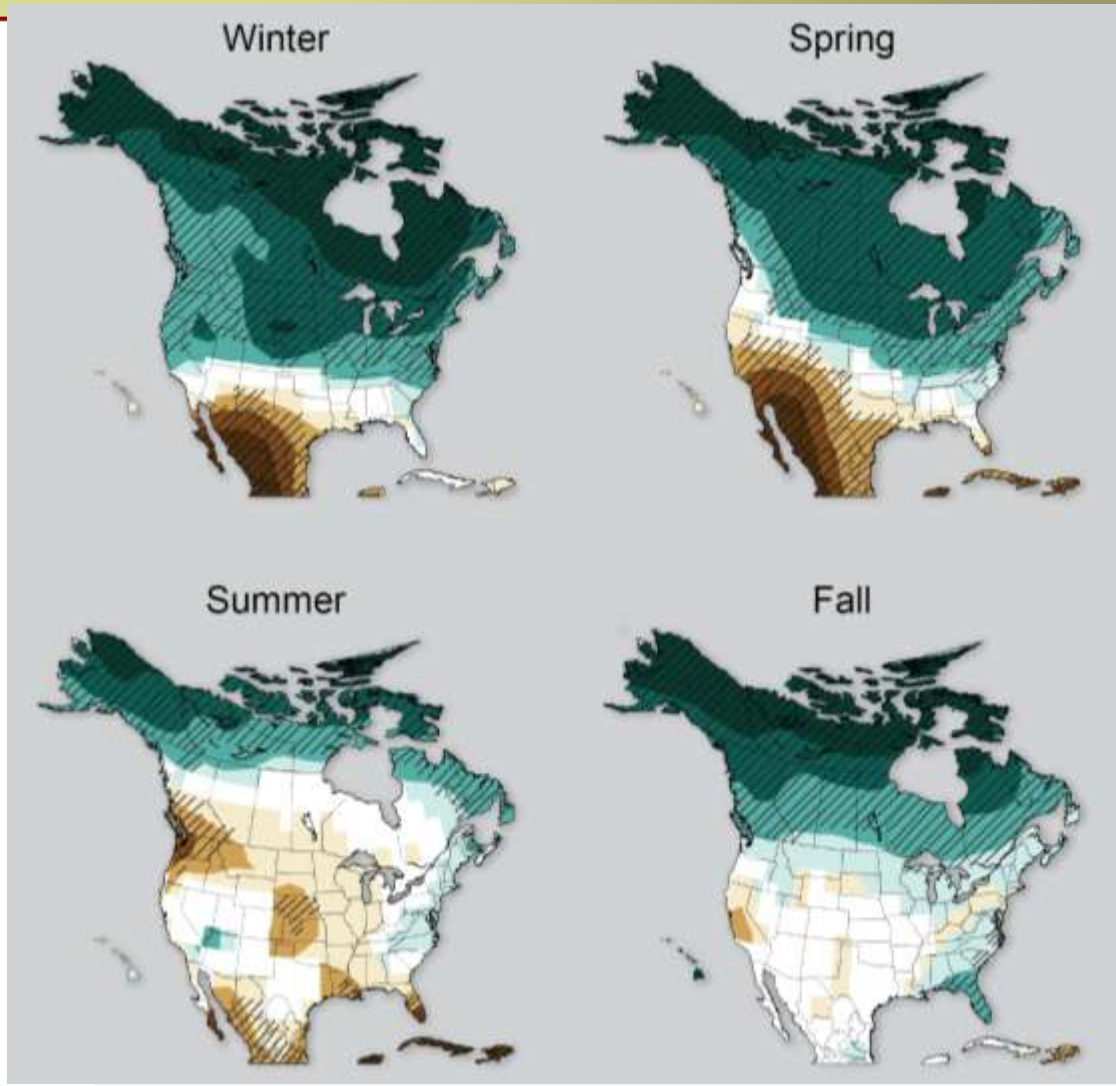
Projected average temperature changes in 2100

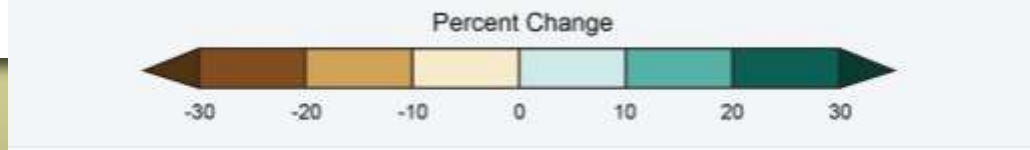


3rd US National Climate Assessment

Projected average precipitation changes in 2100 (No Policy)

No policy → 8-10°F warming



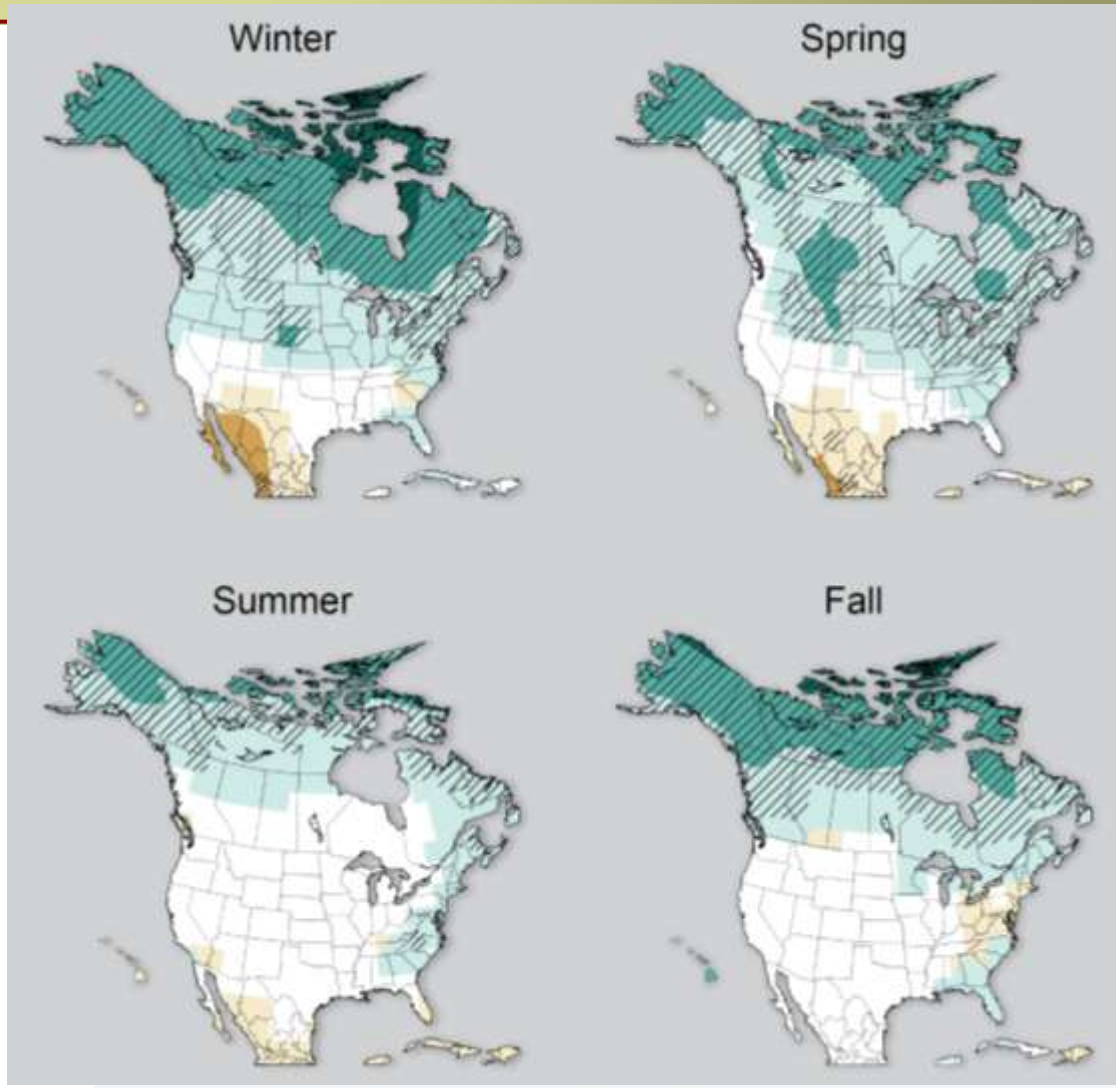


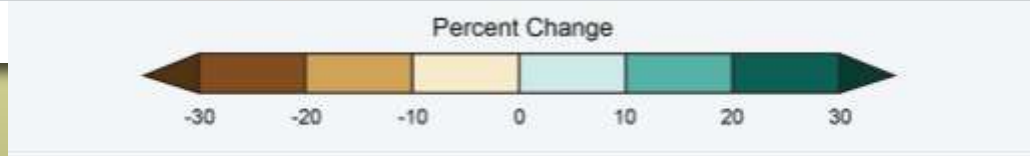
3rd US National
Climate Assessment

Projected average precipitation changes in 2100 (geoengineering)

Geoengineering
and
aggressive emission reductions→

3-4°F warming





3rd US National
Climate Assessment

Are recent extreme weather events a result of global warming?

A good question but not answerable at the moment.

Better to ask:

How has the risk of a particular event changed?

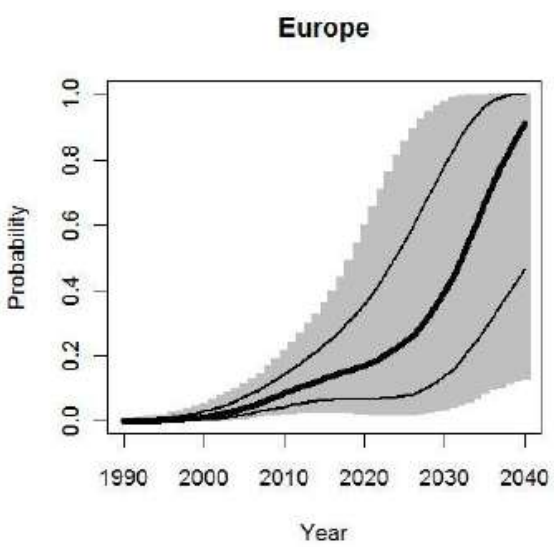
Or

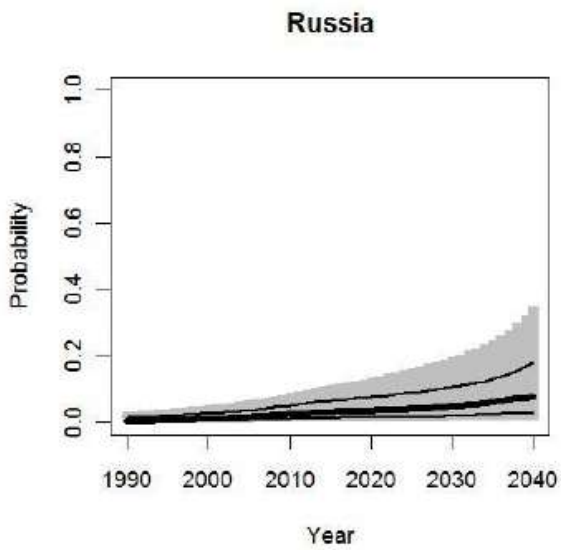
How has global warming changed the magnitude of an event?

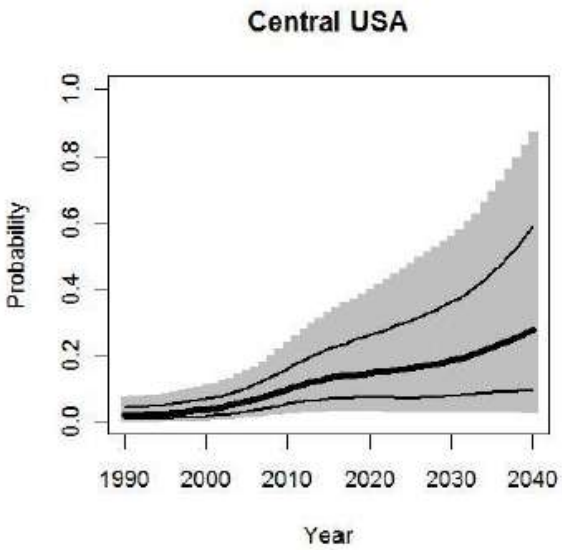
Extreme event attribution

The risk of each of these events has least doubled since the preindustrial era

Event	Risk Change at time of event	Change in risk 2023	Change in risk 2040
Europe 2003	~2X	35X	154X
Russia 2010	2-3 X	2.5-4 X	5-8 X
Texas 2011	1.5-4 X	2-5 X	4-10 X
Midwest US 2012	?	?	







Current state of the art high resolution modeling

CAM5 hi-resolution simulations (0.25°, prescribed aerosols)

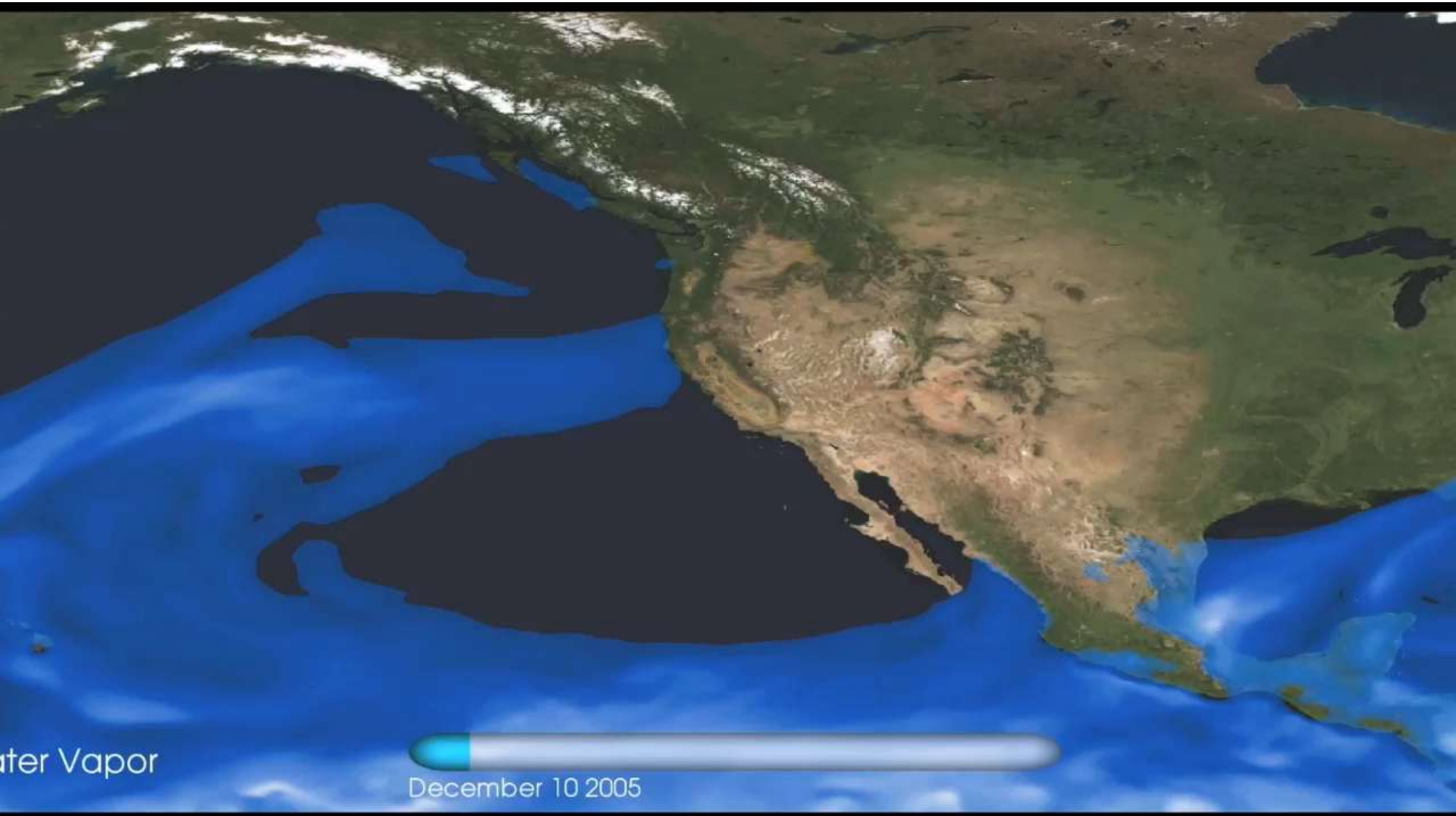
Michael Wehner, Prabhat, Chris Algieri, Fuyu Li, Bill Collins
Lawrence Berkeley National Laboratory

Kevin Reed, University of Michigan

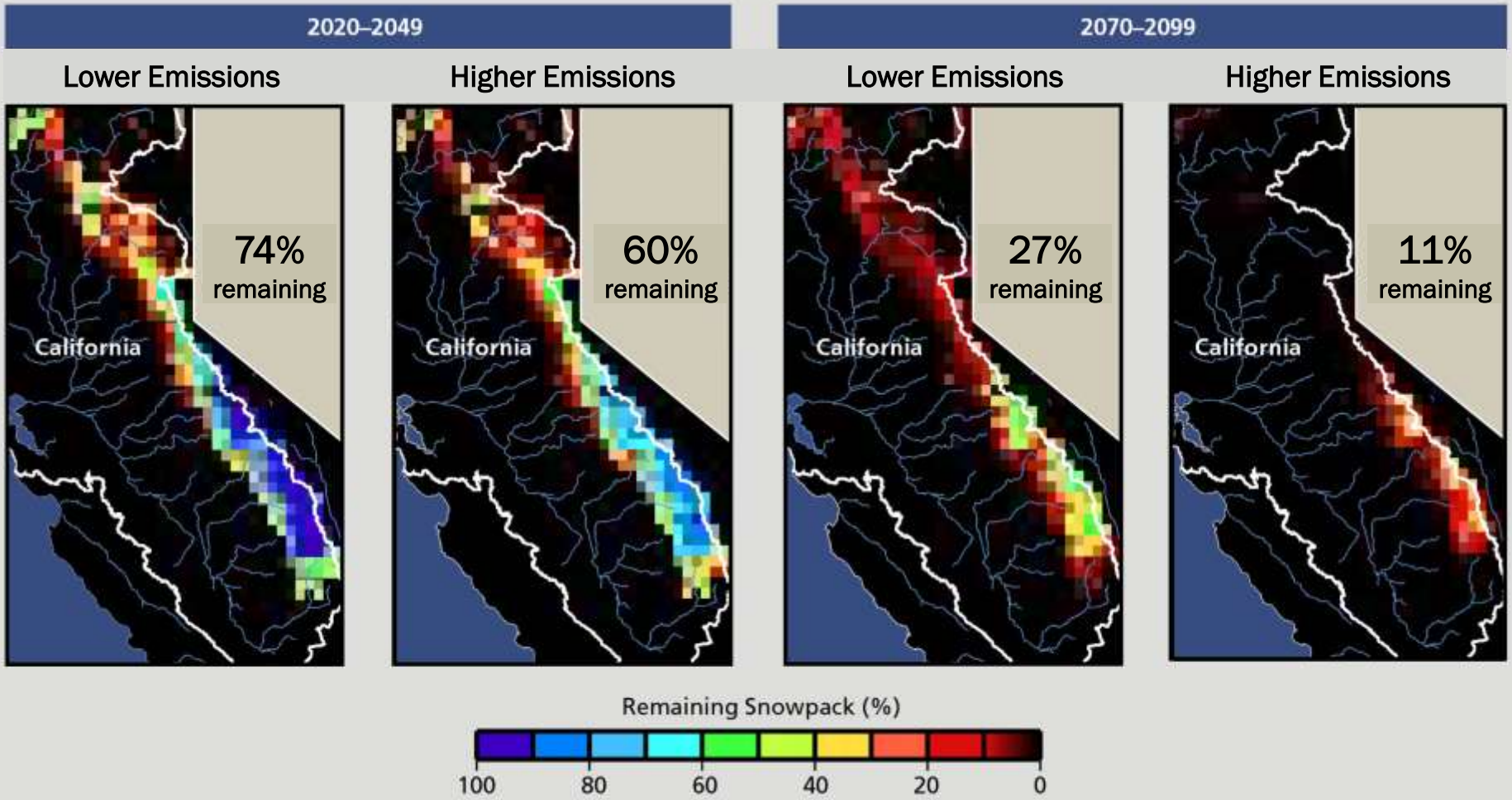
Andrew Gettelman, Julio Bacmeister, Richard Neale
National Center for Atmospheric Research

June 1, 2011

Extreme storms in California

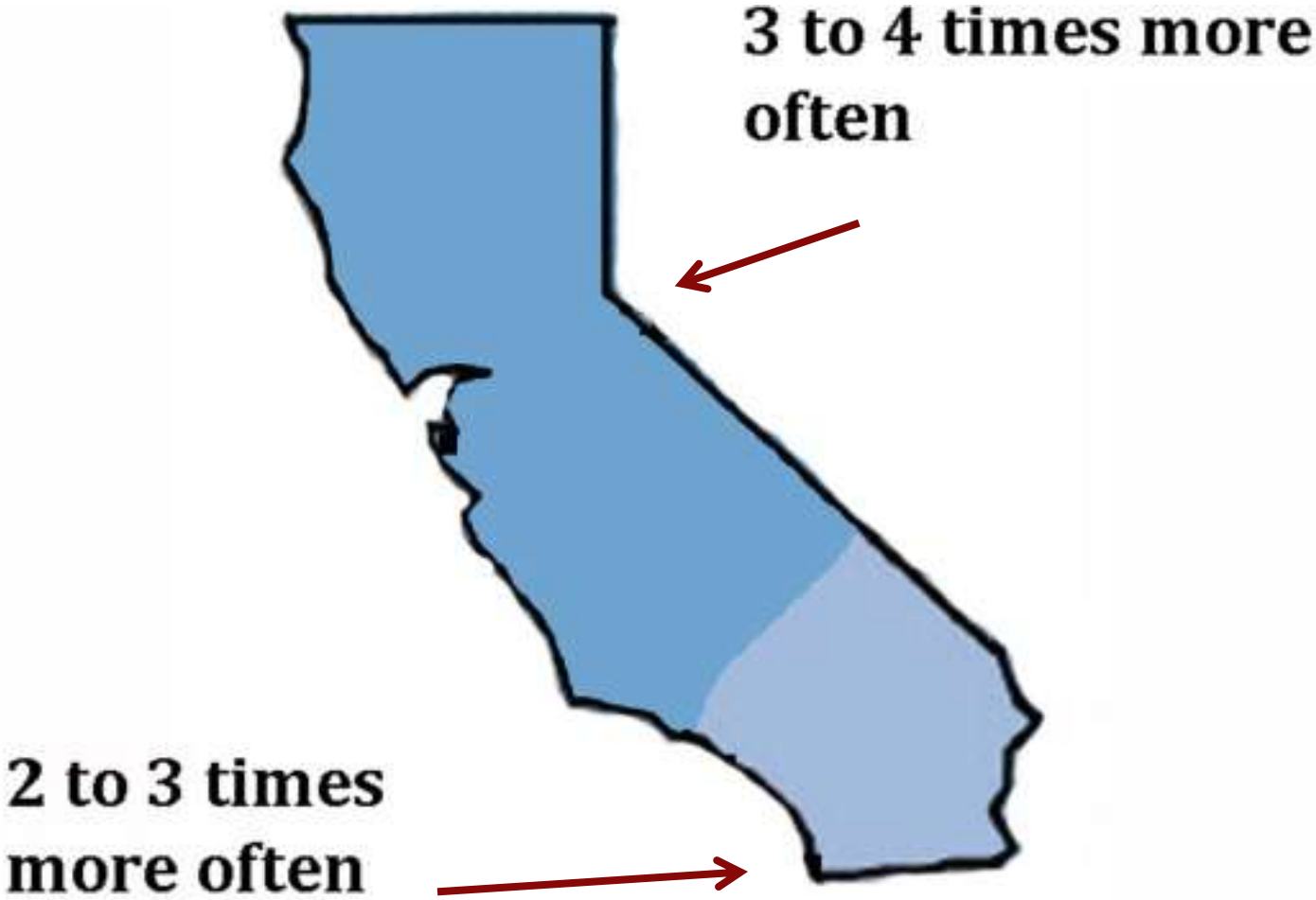


what does climate change mean for California?



Reduced snow pack → less water supply → drought

Extreme precipitation will be more frequent in California



More extreme rainfall → floods

Conclusions

- The high performance computing at Berkeley Lab is enabling us to better understand the causes of extreme weather and how it changes in a warmer world.
- Climate change is having an impact on the US, California and the Bay Area.
- Society has a choice as to how much warmer the world will be.

Questions?

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Katrina
NASA/NOAA