

JULY 30, 2018

NAVIGATING CHANGING RISK FROM EXTREME EVENTS



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An aerial photograph showing a residential area completely inundated with floodwater. The water is a dark, murky brown color, covering the houses, yards, and streets. The houses have various roof colors, including grey, brown, and white. Some trees are still visible above the water level. The overall scene depicts the severe impact of a weather extreme event.

WHAT ARE WEATHER EXTREMES?

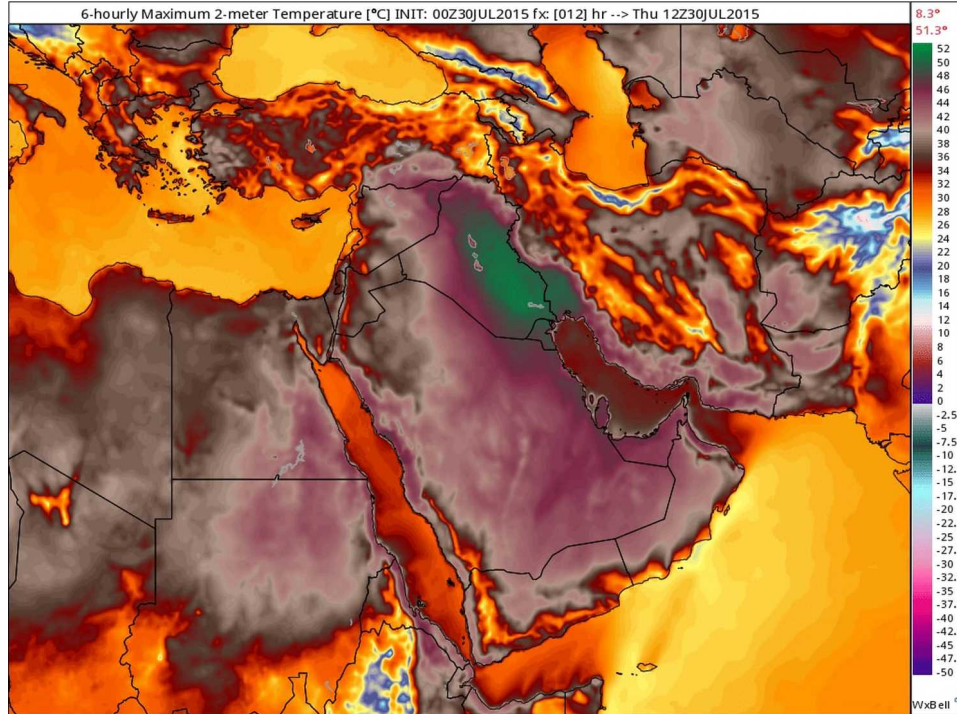


Coastal Flooding (Hurricane Sandy, NYC)



Extreme Precipitation (Oct. 14, 2017, Naperville, IL)

EXTREME HEAT



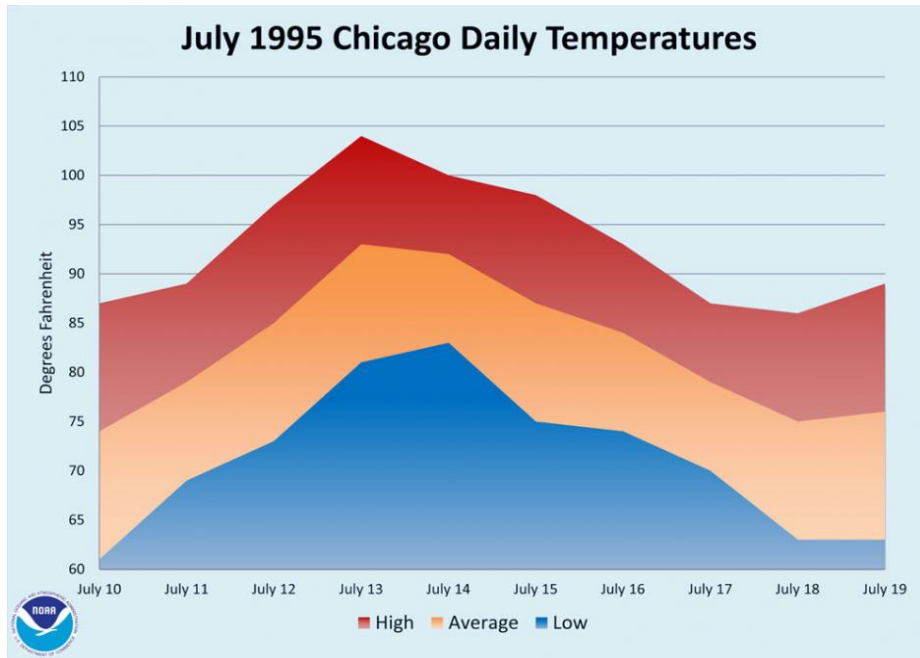
Bandar Mahshar, Iran

165° F (feels like temp)

Temperature 115° F

Dew Point 90° F

ONE MAN'S EXTREME IS ANOTHER MAN'S NORMAL!



Heat Index at Midway was 125° F

Average temperatures were 20° F above normal

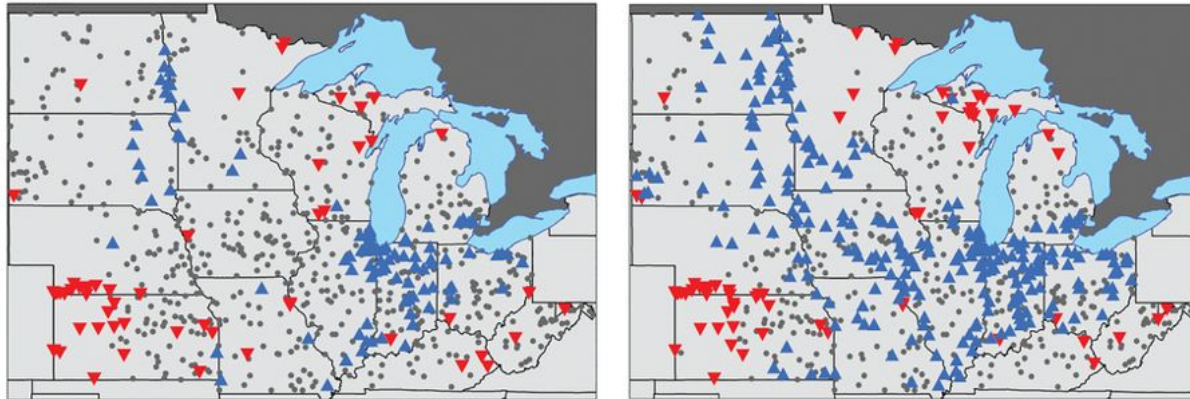
The average temperatures in Phoenix, AZ for the same time was over 90° F

An aerial photograph showing a residential area that has been severely flooded. The water is dark and murky, covering most of the ground. Several houses with grey roofs are visible, some partially submerged. There are many green trees scattered throughout the area. A red vertical bar is on the left side of the image. The text "WEATHER EXTREME TRENDS ARE CHANGING" is overlaid in white, bold, sans-serif font across the center of the image.

WEATHER EXTREME TRENDS ARE CHANGING

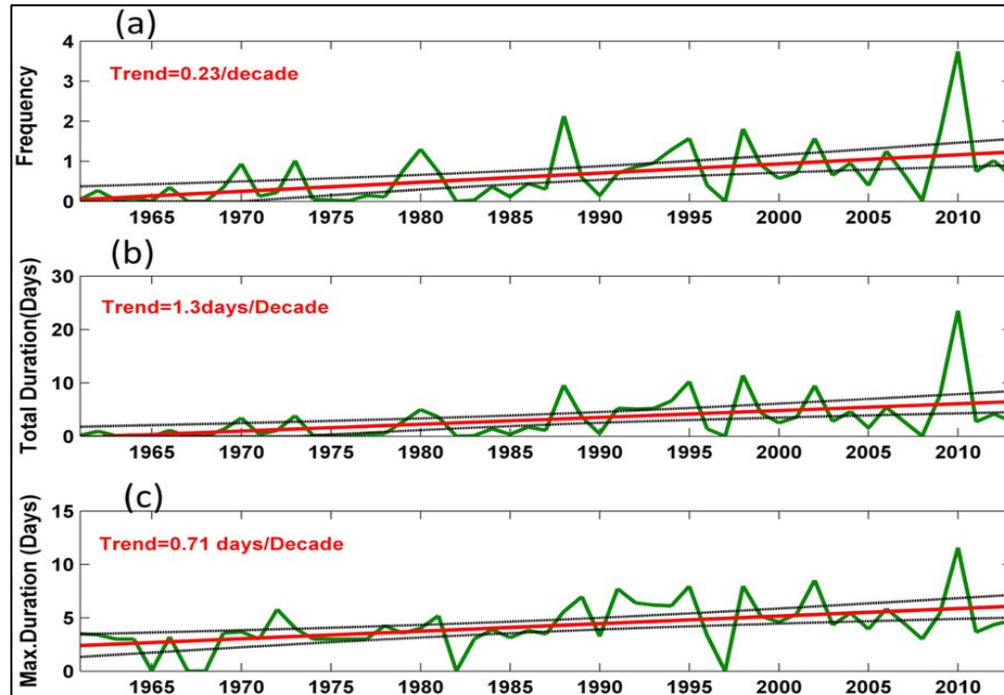
FREQUENCY OF EVENTS

Flood magnitude and frequency in the central U.S., 1962-2011



Changes in flood magnitude (left) and frequency (right). Blue indicates increasing frequency and red shows decreasing frequency. Credit: *Nature Climate Change*, 2015.

DURATION

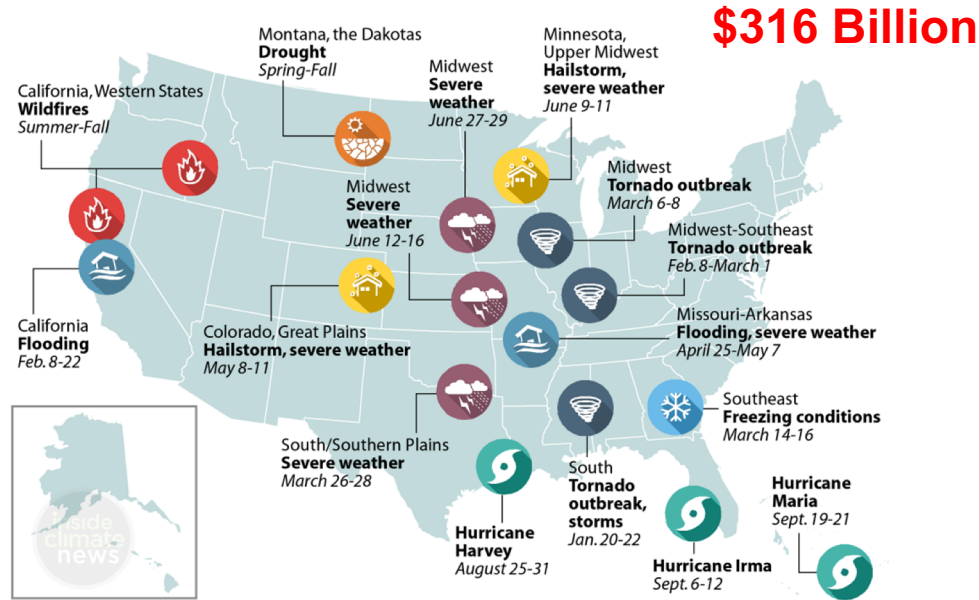


Heat Waves in India

WHAT IS THE CURRENT RISK FOR WEATHER EVENTS?

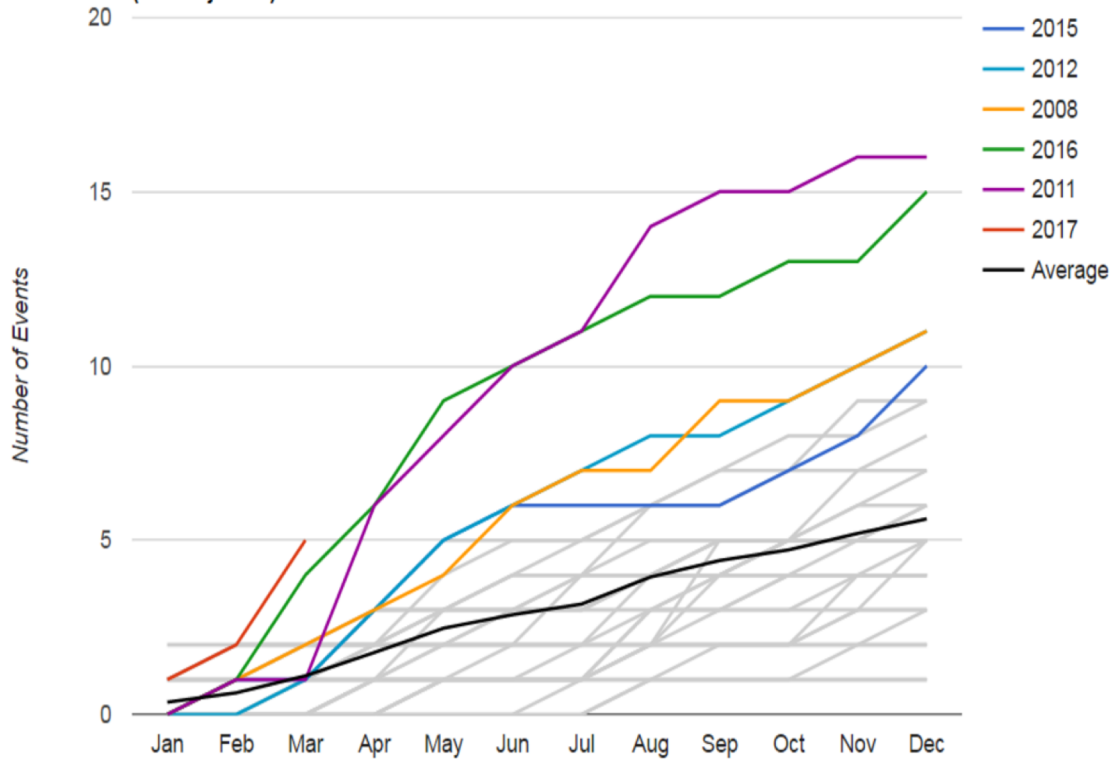
U.S. 2017 Billion-Dollar Weather and Climate Disasters

NOAA counted 16 weather and climate disasters in 2017 that each exceeded \$1 billion in losses, including the western wildfires that it combined into a single, \$18 billion event.



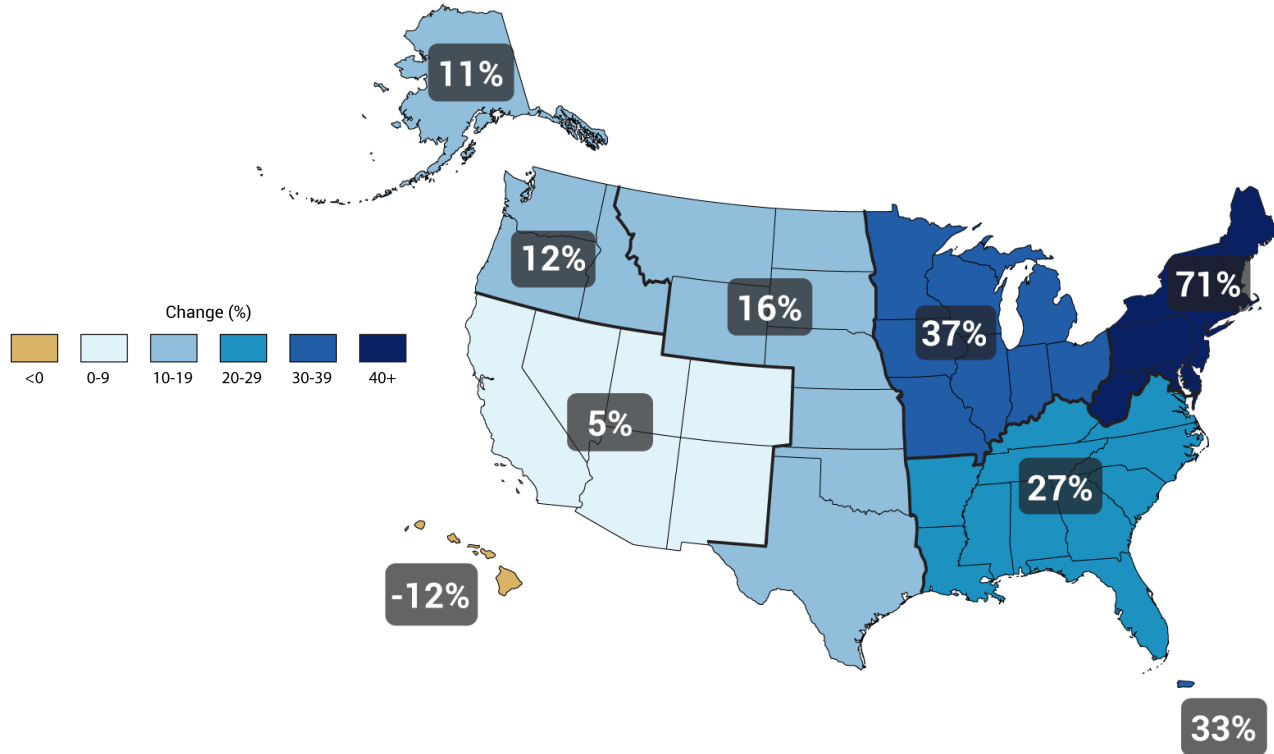
<https://www.climate.gov/news-features/blogs/beyond-data/2017-us-billion-dollar-weather-and-climate-disasters-historic-year>

1980-2017 Year-to-Date United States Billion-Dollar Disaster Event Frequency (CPI-Adjusted)



<https://www.climate.gov/news-features/blogs/beyond-data/2017-us-billion-dollar-weather-and-climate-disasters-historic-year>

OBSERVED CHANGE IN VERY HEAVY PRECIPITATION



WHAT IS RISK?



Hazard has a potential to cause harm



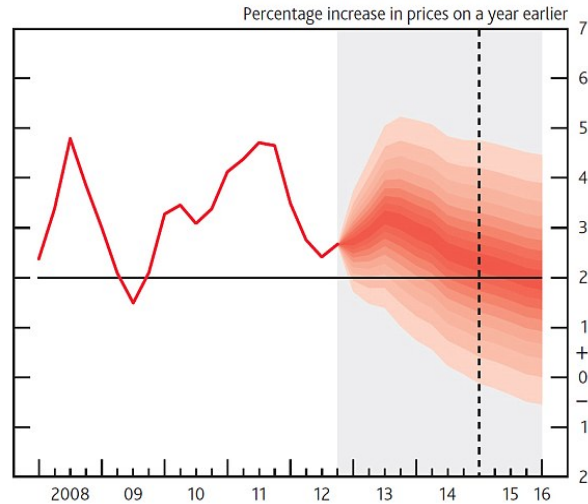
Risk is the potential of the hazard to cause harm

RISK AND UNCERTAINTY

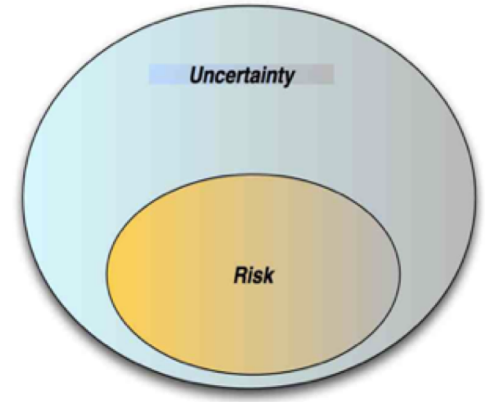


Ignorance

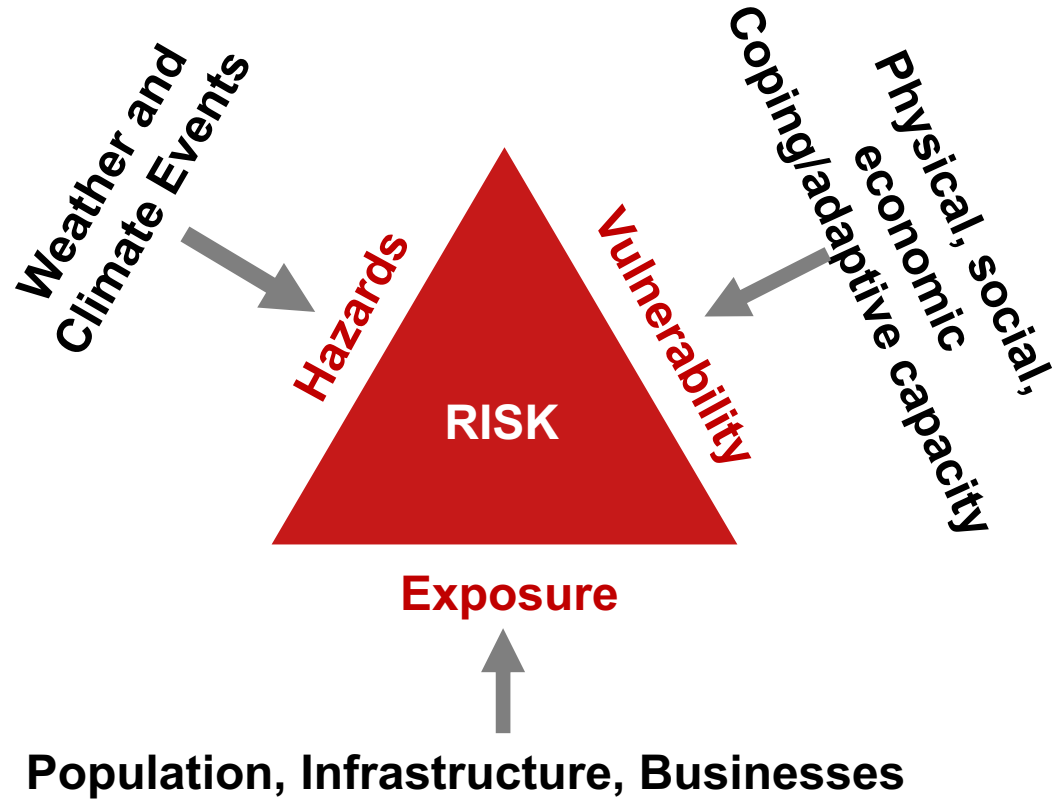
Chart 3 CPI inflation projection based on market interest rate expectations and £375 billion asset purchases



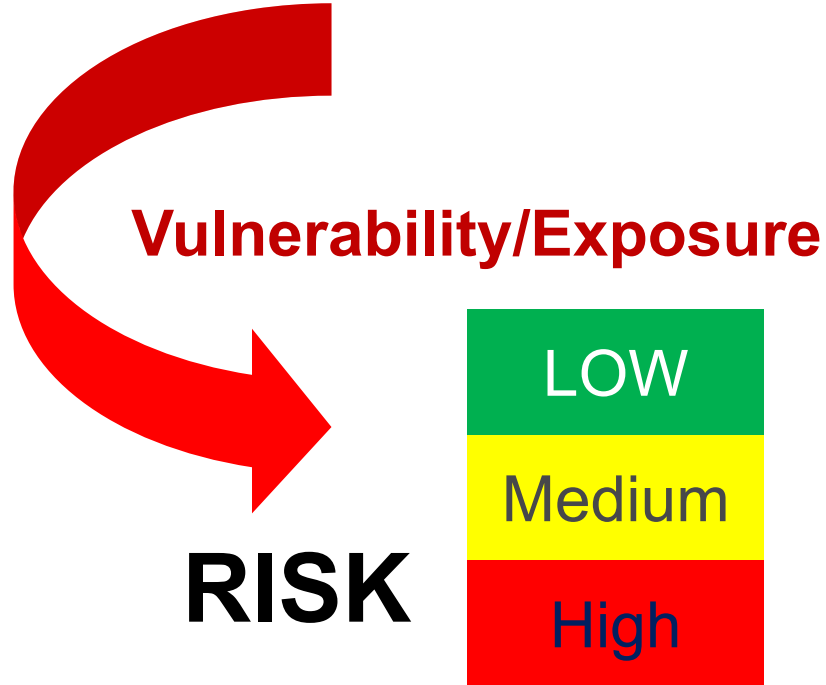
Uncertainty



Risk



WEATHER HAZARD



A futuristic cityscape with a man walking a dog and a futuristic car. The scene is set in a lush green park area with a paved path. A man in a dark tank top and shorts is walking a small dog on a leash. To the right, a sleek, silver, futuristic car is parked on the path. The background features a tall, cylindrical tower with a circular observation deck, surrounded by other modern buildings and flying vehicles in the sky. The overall atmosphere is one of advanced technology and urban development.

HOW CAN WE FORECAST THE CHANGES IN THE TRENDS OF EXTREMES

WEATHER

Tells you what to wear each day



CLIMATE

Tells you what types of clothes to have in your closet



NOAA National Centers for Environmental Information

www.ncei.noaa.gov



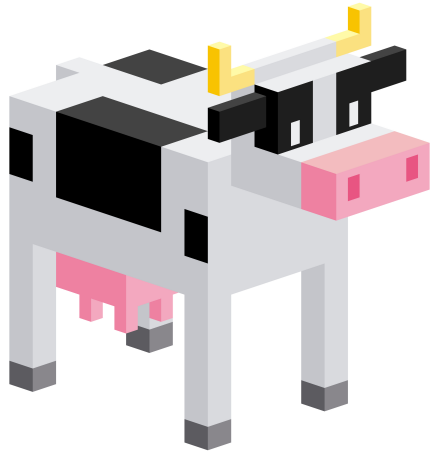
U.S. DEPARTMENT OF
ENERGY

Argonne National Laboratory is a
U.S. Department of Energy laboratory
managed by UChicago Argonne, LLC.

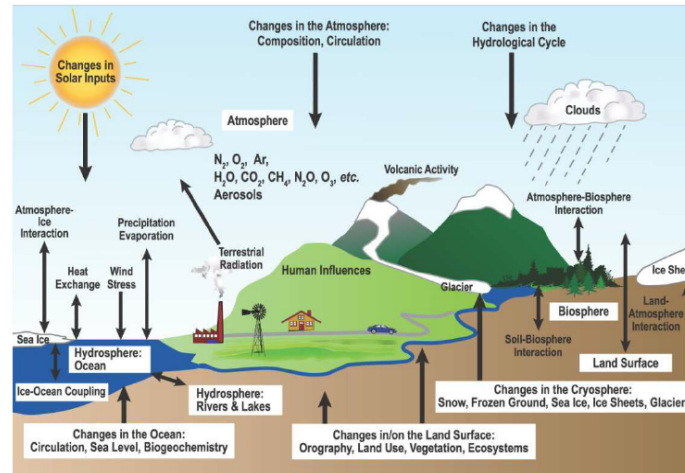
Argonne
NATIONAL LABORATORY

OBJECTIVE FORECASTING

First, we develop a conceptual model

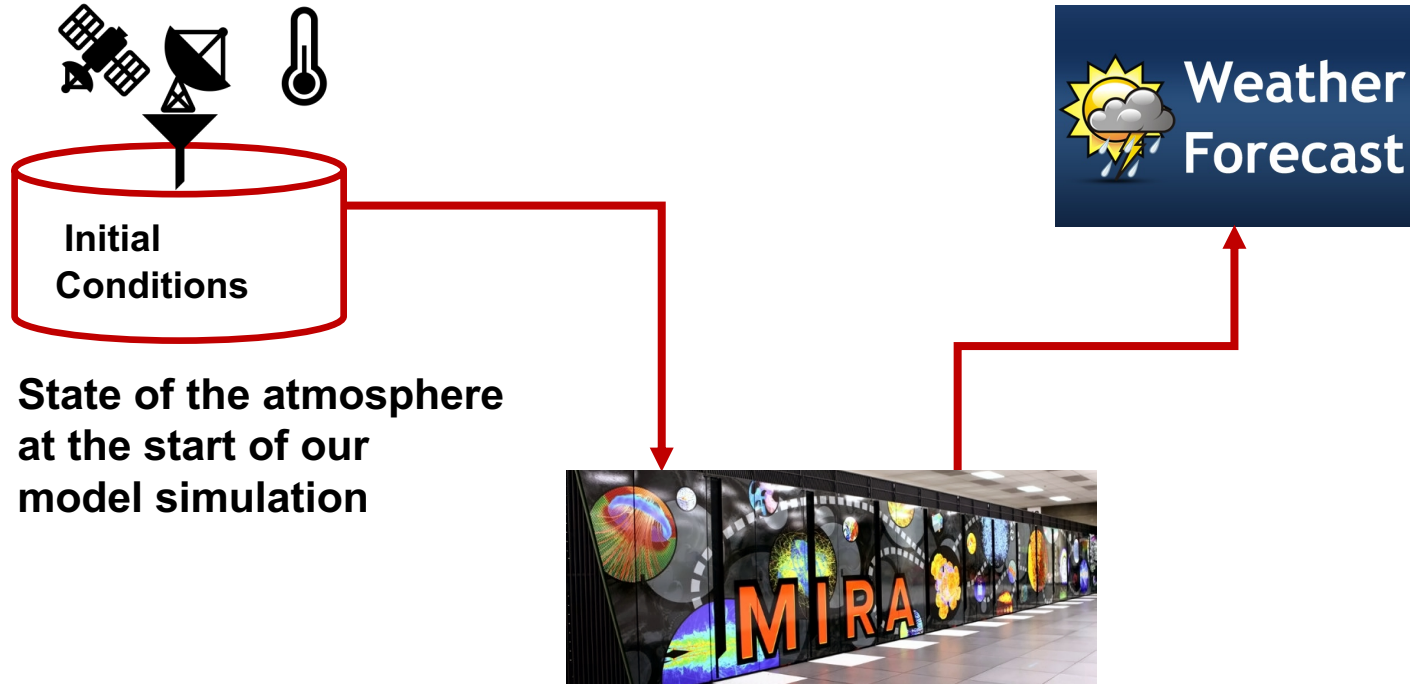


Cow (squared)



Earth System

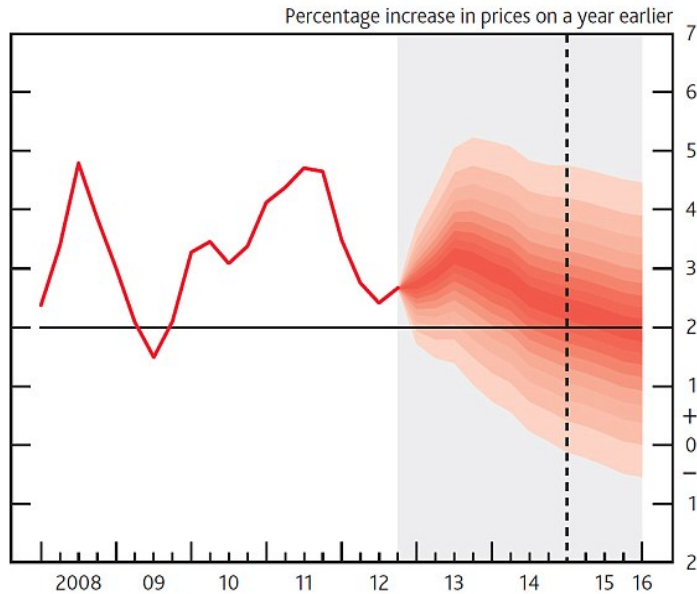
SIMULATIONS OF THE CONCEPTUAL MODEL PERFORMED ON LARGE COMPUTERS



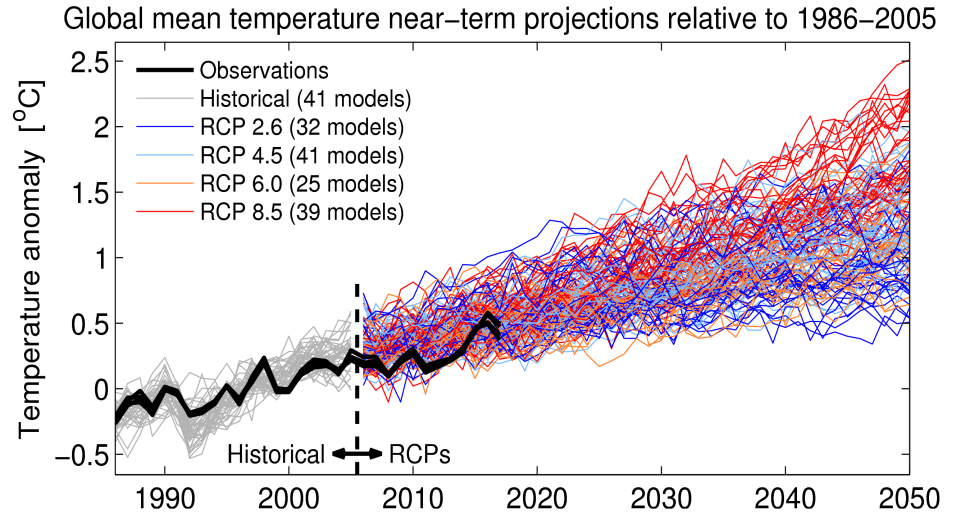
The background is a deep blue color with several white question marks scattered across it. At the bottom, there are white, fluffy cloud-like shapes. The text is centered and written in a bold, white, sans-serif font.

**Uncertainty in going from a known
(the present) to a future-inevitable –
The challenge is to define the extent
of this uncertainty**

FORECAST UNCERTAINTY

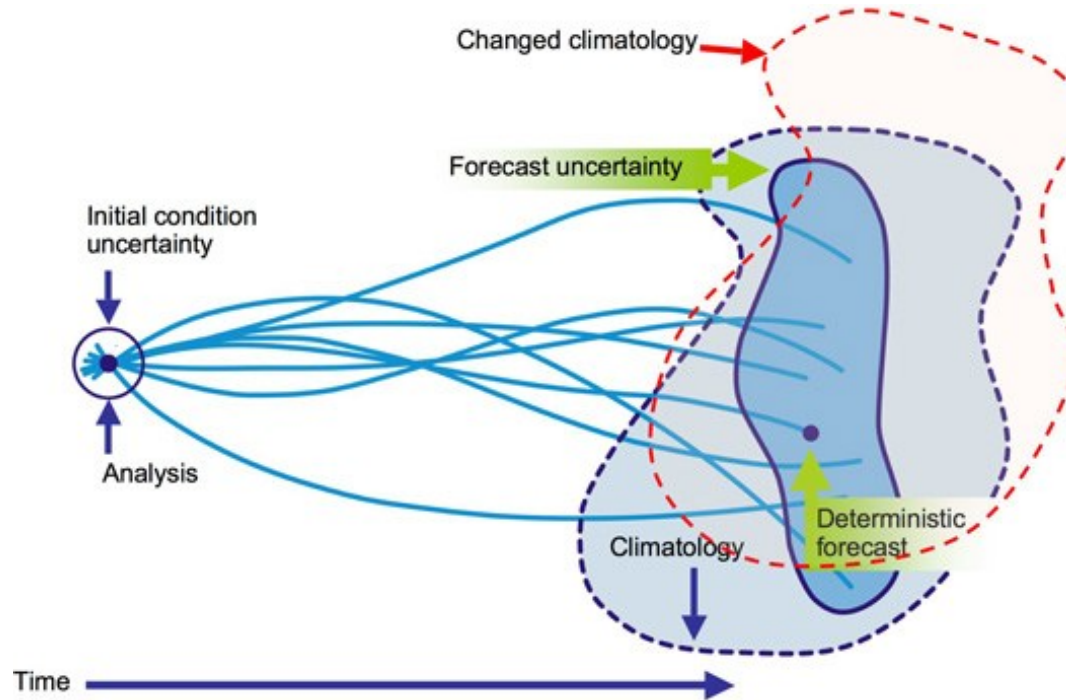


Interest Rate Forecast by the UK Federal Reserve



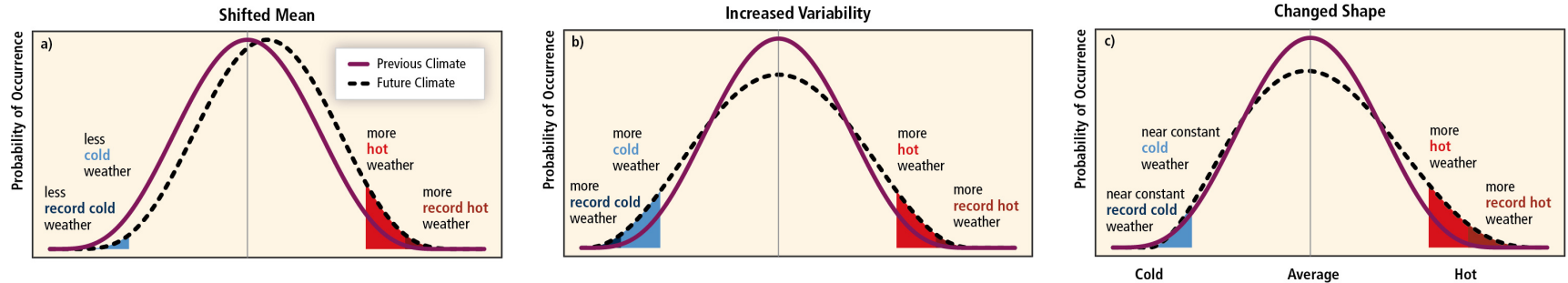
Global Temperatures Projection (IPCC AR-5)

ENSEMBLE FORECAST



<https://www.metoffice.gov.uk/research/weather/ensemble-forecasting/what-is-an-ensemble-forecast>

ROLE OF CLIMATE ANALYSES IS TO STUDY PHENOMENA THAT RESULTS IN SHIFTING STATISTICS



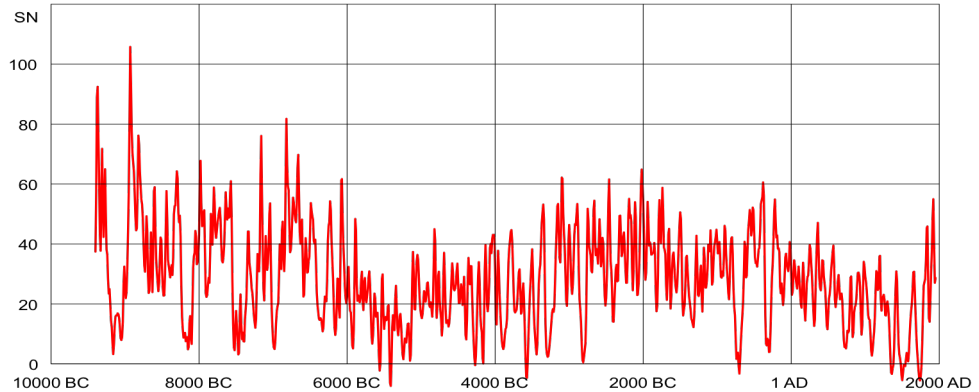
IPCC AR-5

FORECASTING CLIMATE IS DIFFERENT FROM A WEATHER FORECAST

The climate change is driven by three external factors:

- a) Sun
- b) Emissions of greenhouse gases
- c) Large natural events like volcanic activity

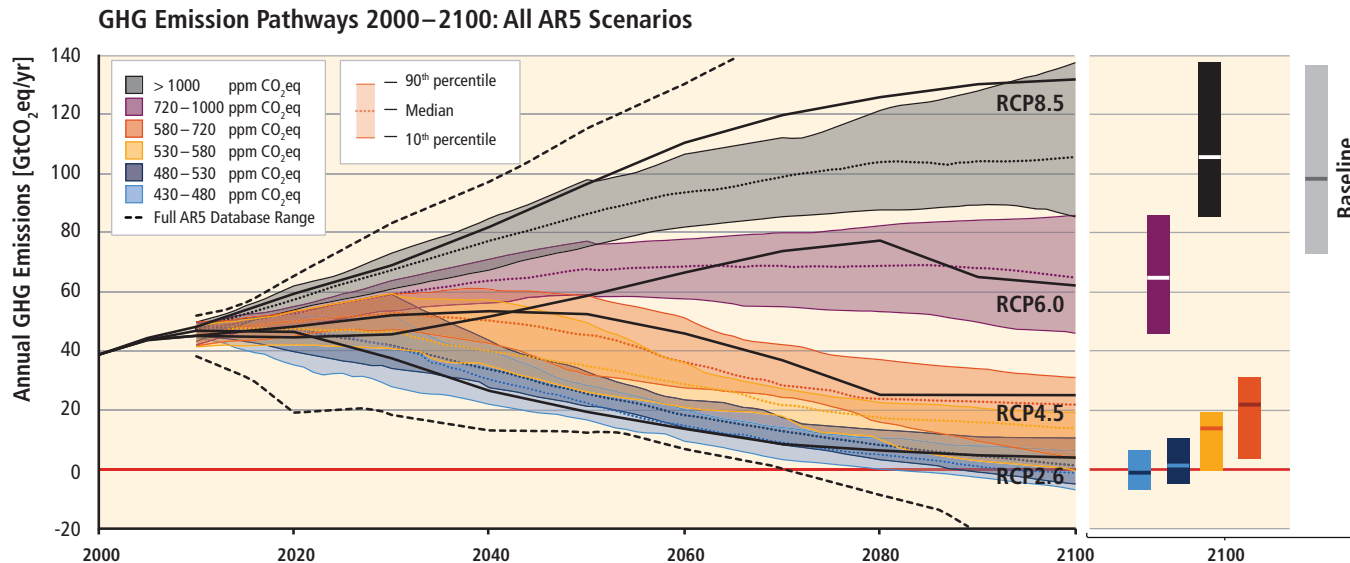
We have no control over (c) and (a) hasn't varied much in thousands of years



Solanki, S.K., et al. 2005.

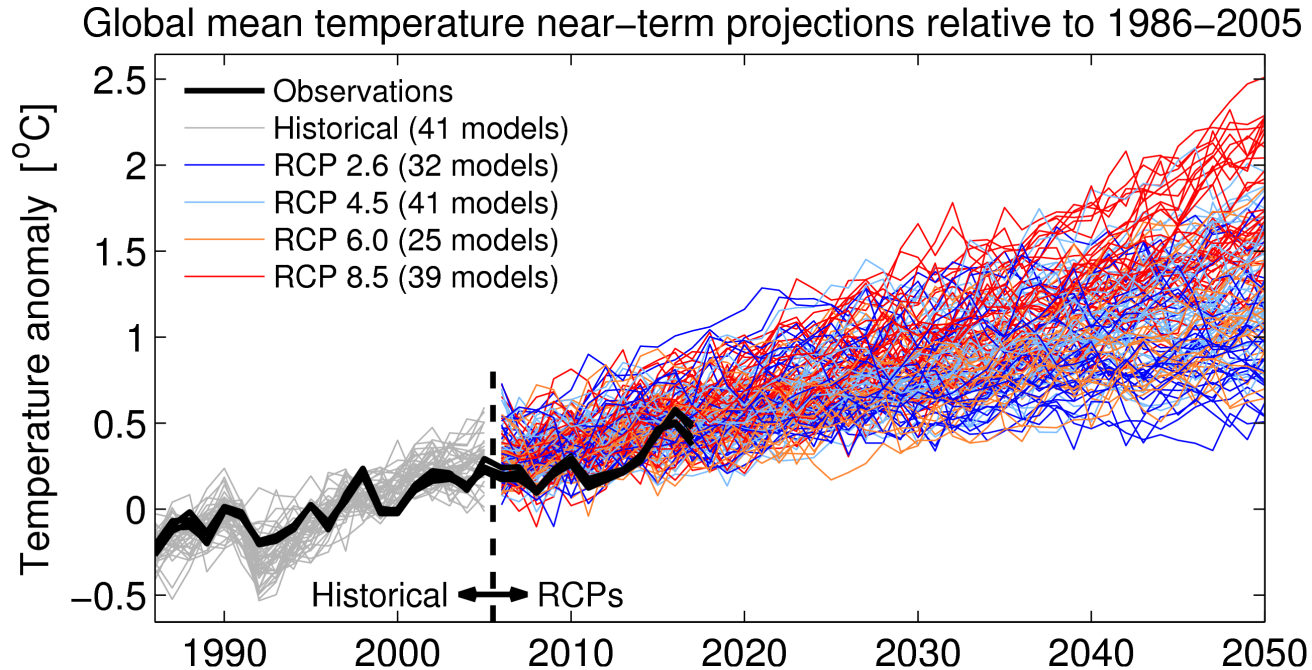
THAT BRINGS US TO PEOPLE

The biggest uncertainty is that we don't know what people will do.



IPCC AR-5

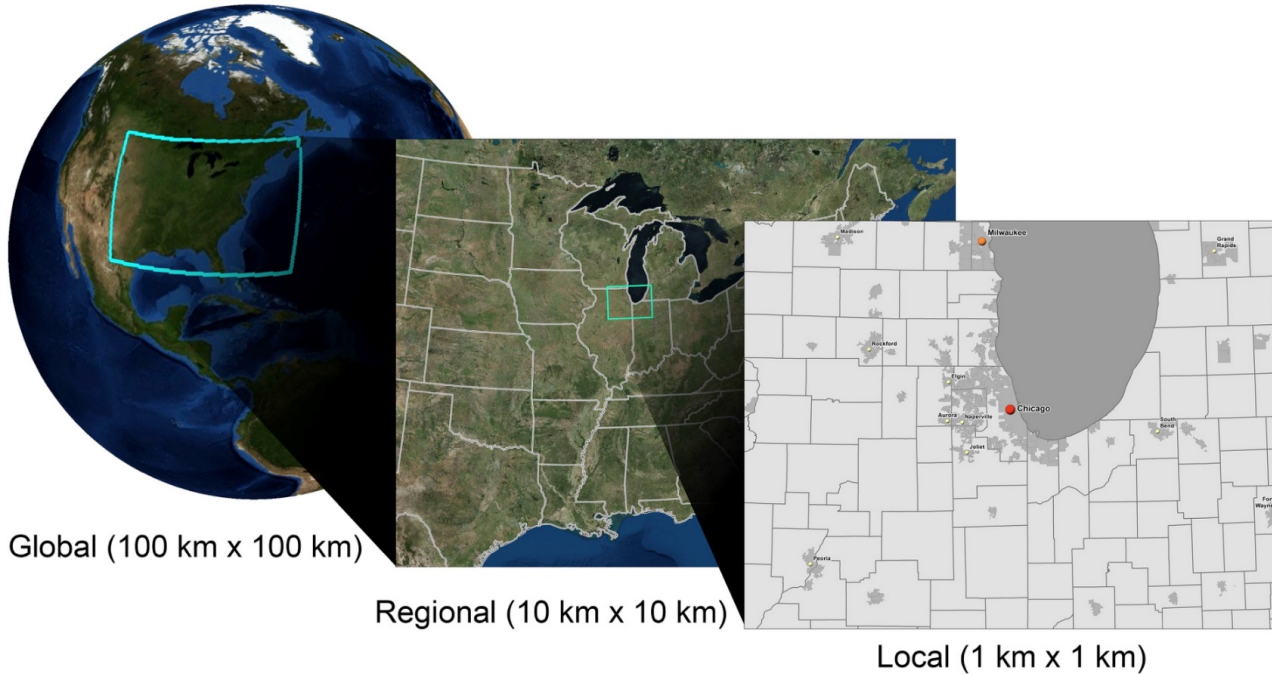
ENSEMBLE OF SIMULATIONS GIVE A SENSE OF THE UNCERTAINTY IN THE FORECAST





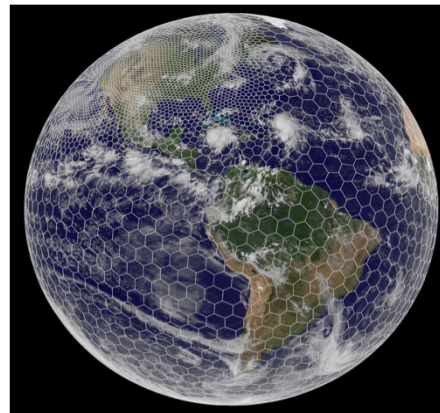
WHAT WE DO AT ARGONNE

CLIMATE SIMULATIONS

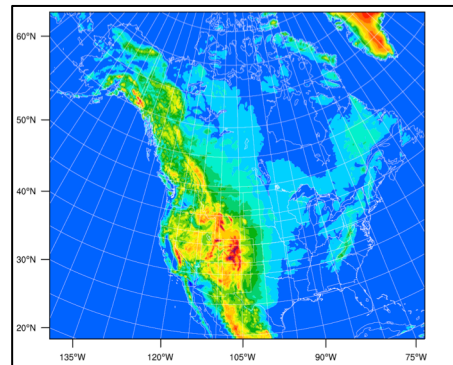




Argonne
Supercomputers



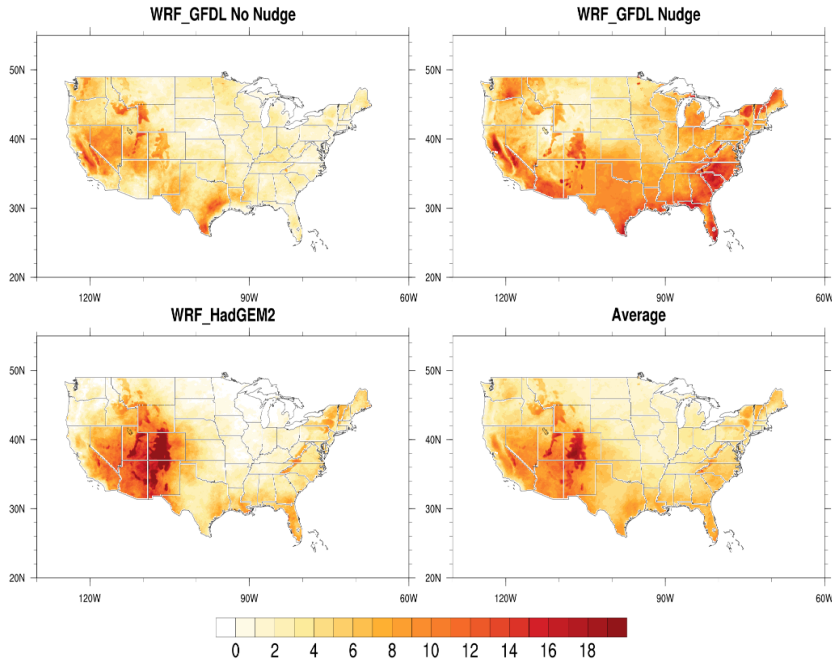
Develop Global Models



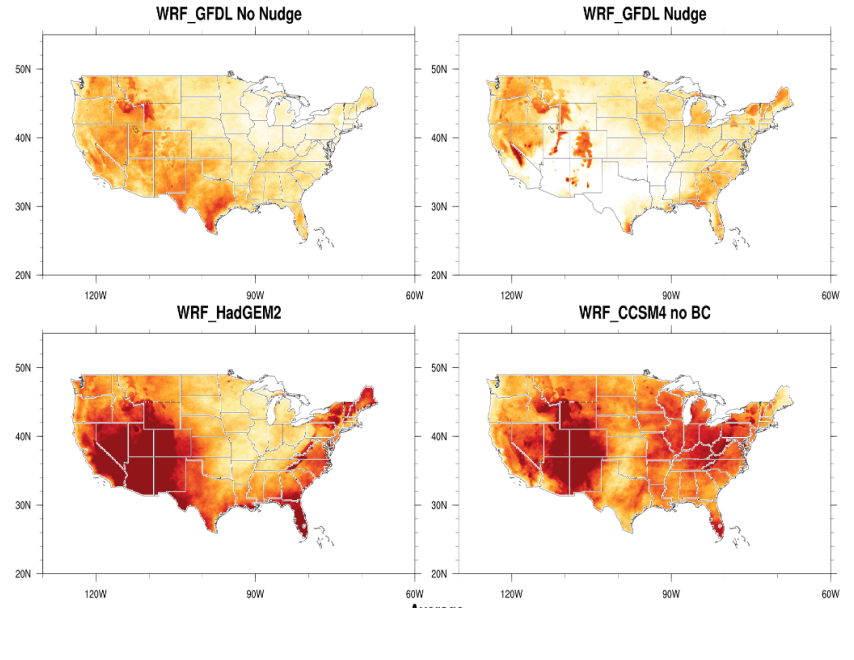
Focus on North America

PROJECTIONS: HEAT WAVE PROJECTIONS

3-day Heat Waves that exceed 95% historical threshold (2045-2054 - 1995-2004)

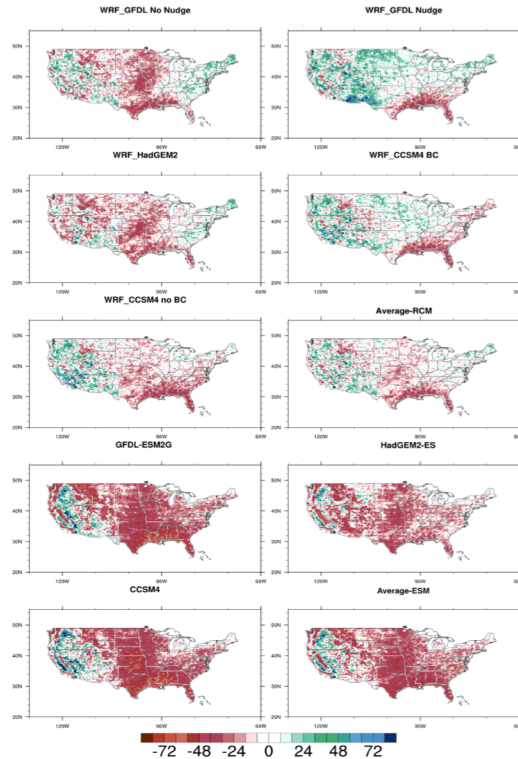


3-day Heat Waves that exceed 95% historical threshold (2085-2094 - 1995-2004)

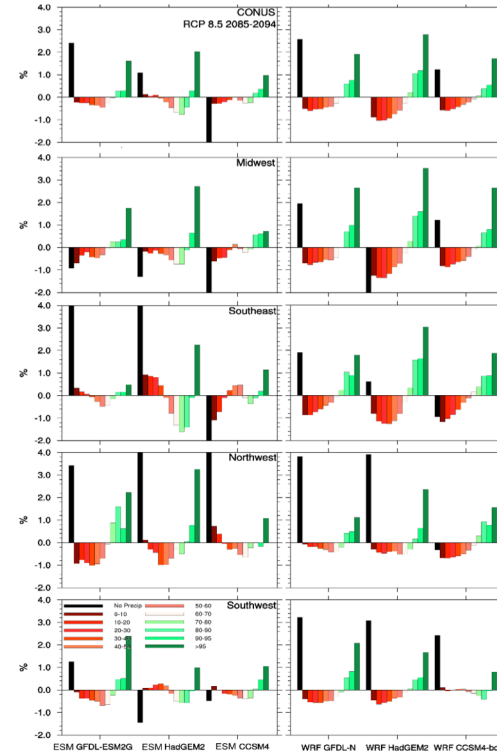


PROJECTIONS: EXTREME PRECIPITATION

Precipitation Difference from Observed 95th Percentile

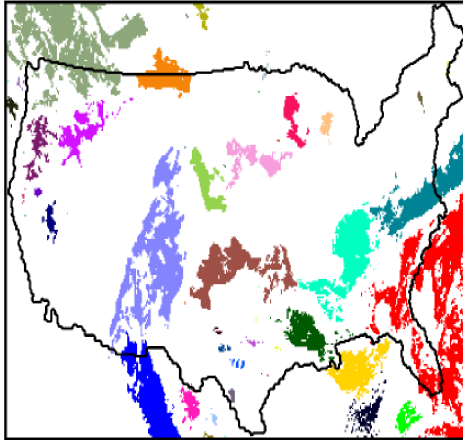


Regional Percentile Difference

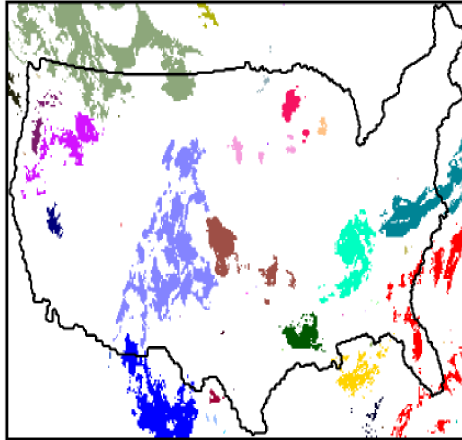


TRACKING RAIN STORM- TIME AND SIZE

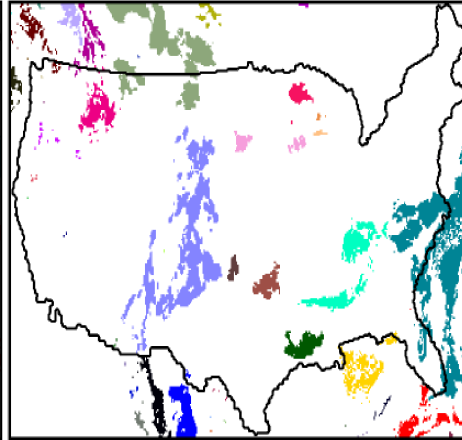
Time Step 1



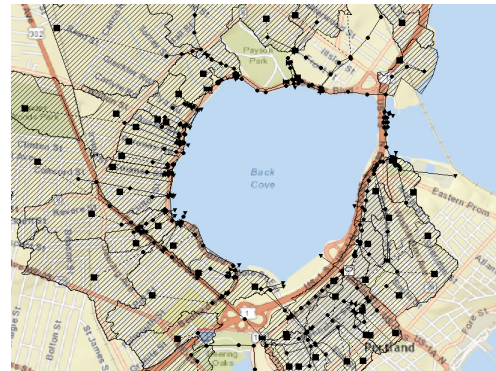
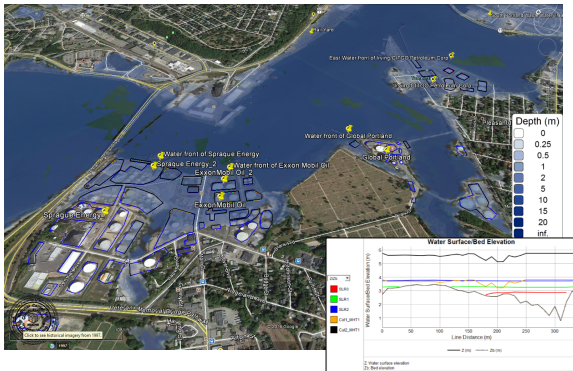
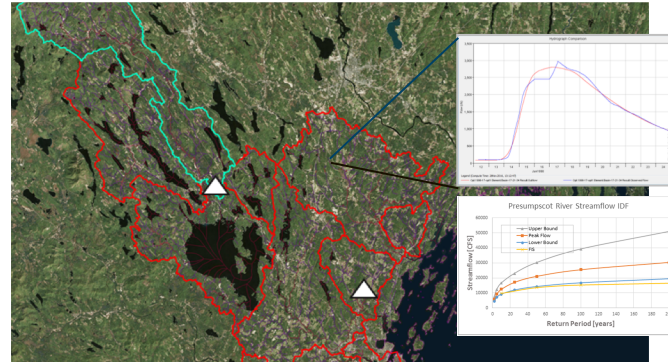
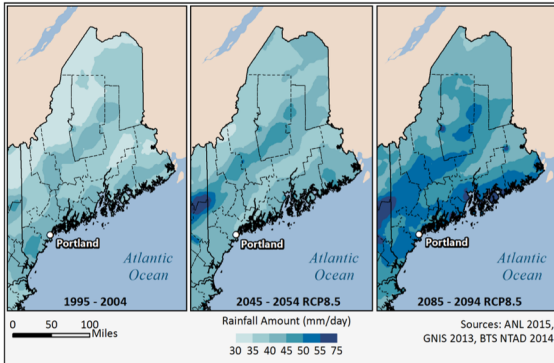
Time Step 2



Time Step 3



CHANGES IN RISK TO INFRASTRUCTURE



WORK WITH COMMUNITIES TO DEVELOP A RISK DECISION FRAMEWORK

