JULY 30, 2018

Argonne NATIONAL LABORATORY

NAVIGATING CHANGING RISK FROM EXTREME EVENTS

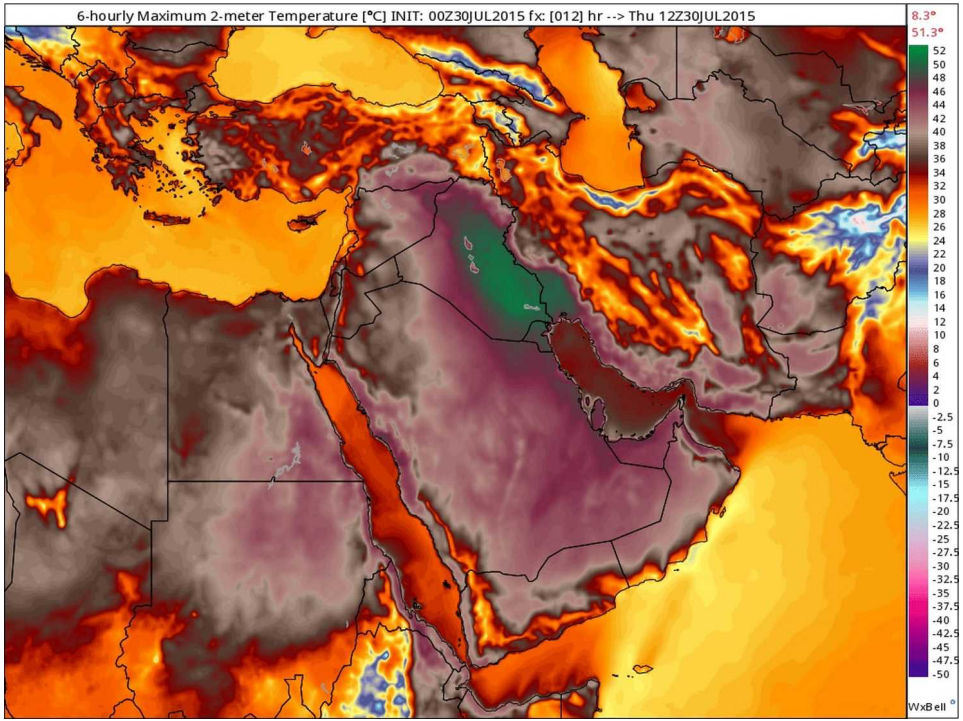
RAO KOTAMARTHI
Atmospheric Scientist

WHAT ARE WEATHER EXTREMES?

Coastal Flooding (Hurricane Sandy, NYC)

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

EXTREME HEAT

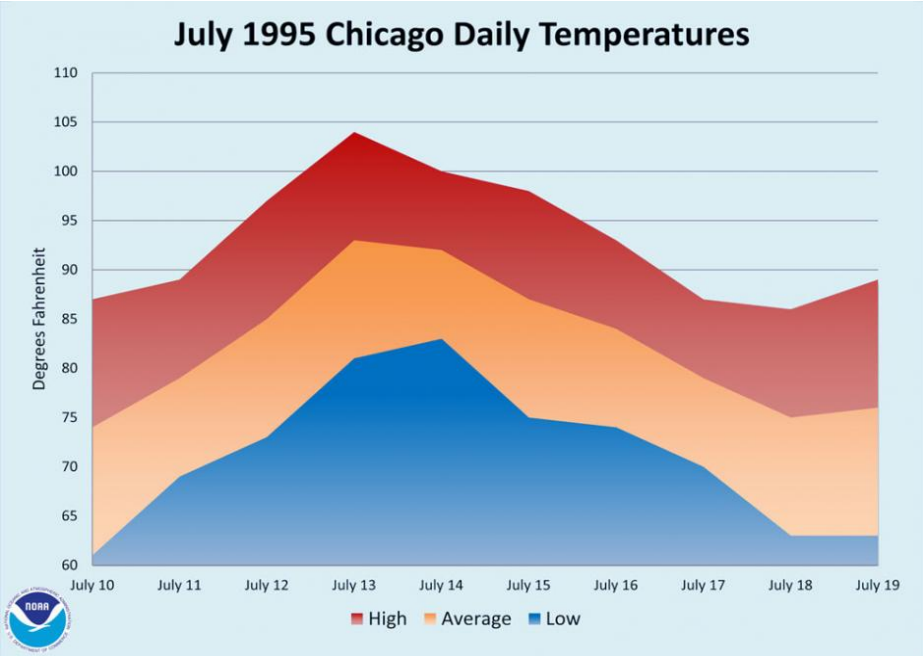


Bandar Mahshar, Iran

165º F (feels like temp)

Temperature 115º F
Dew Point 90º F

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



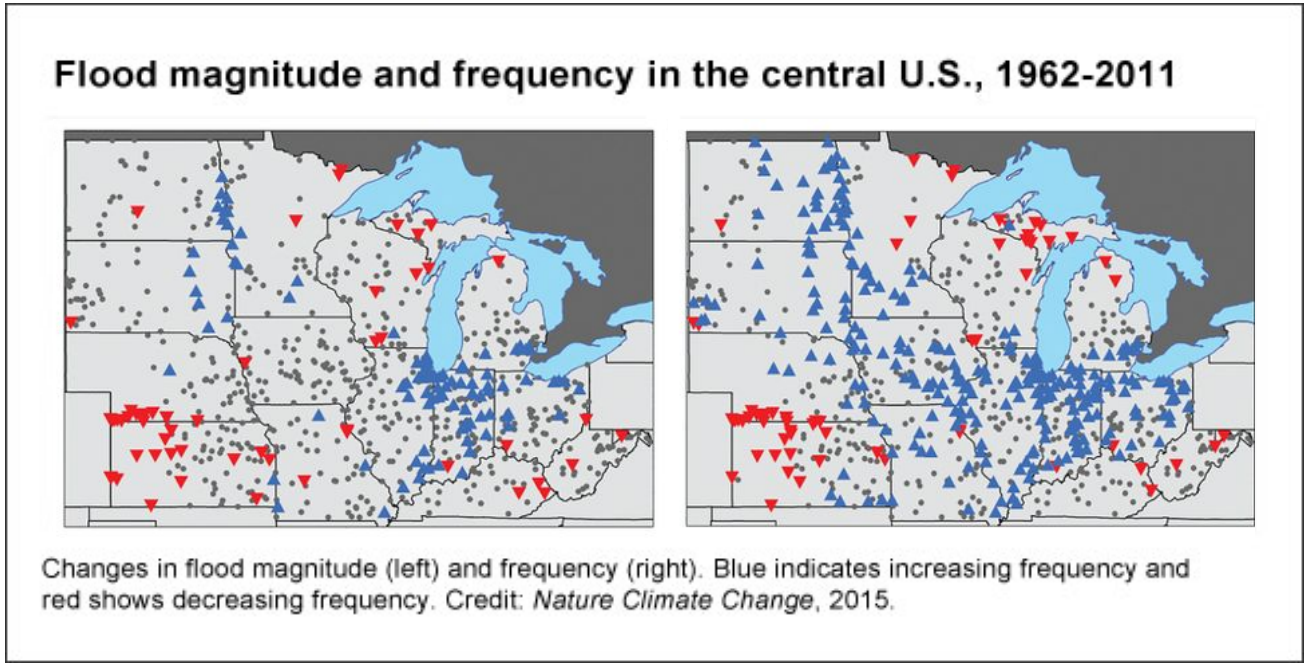
Heat Index at Midway was 125º F

Average temperatures were 20º F above normal

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

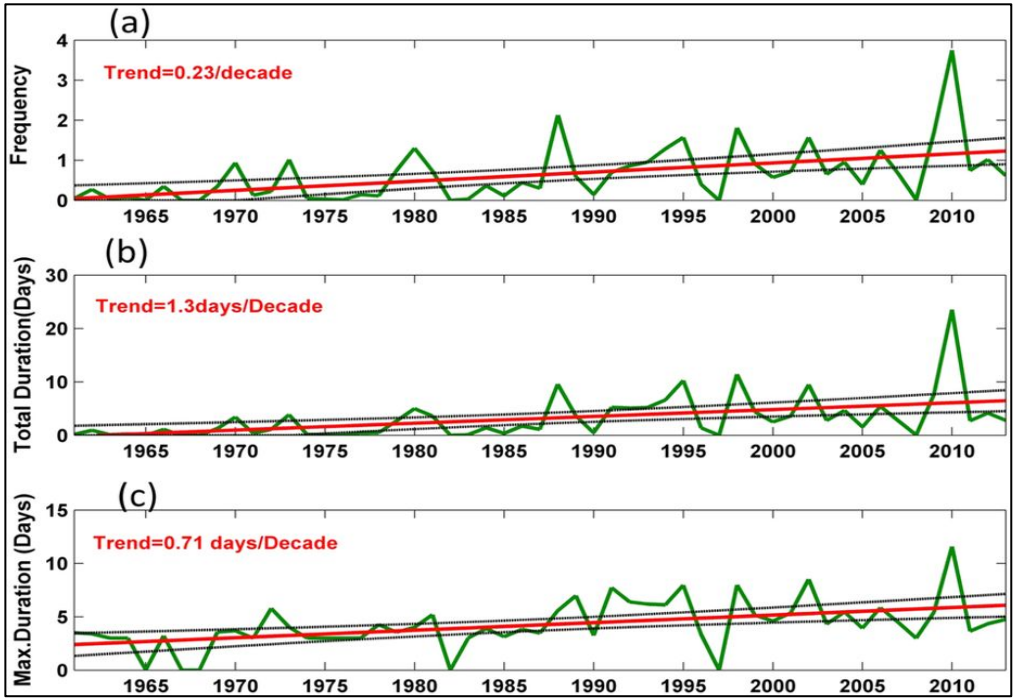
WEATHER EXTREME TRENDS ARE CHANGING

FREQUENCY OF EVENTS



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

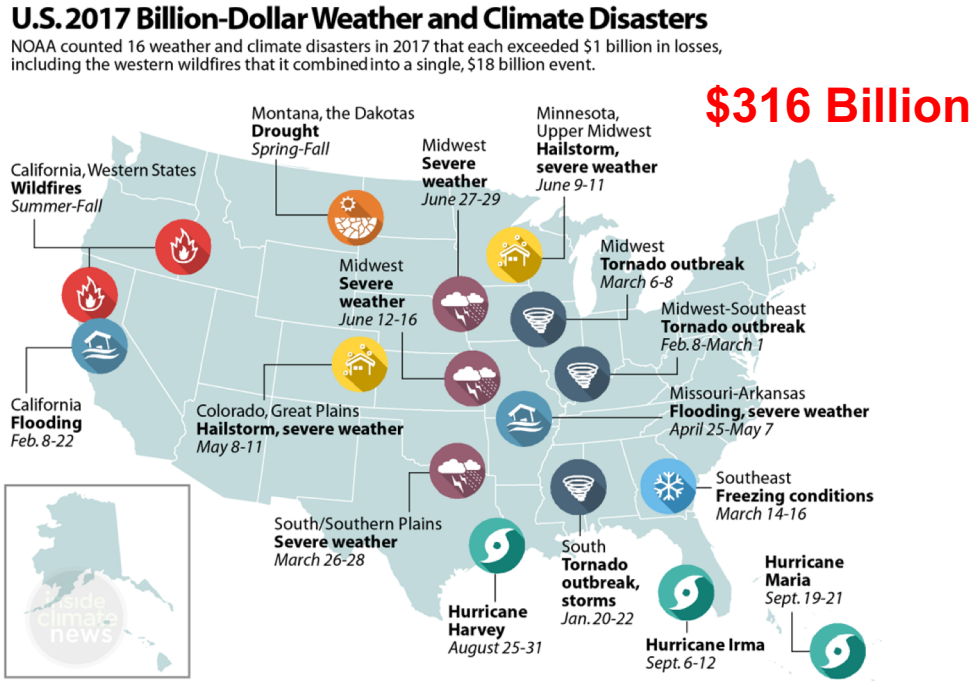
DURATION



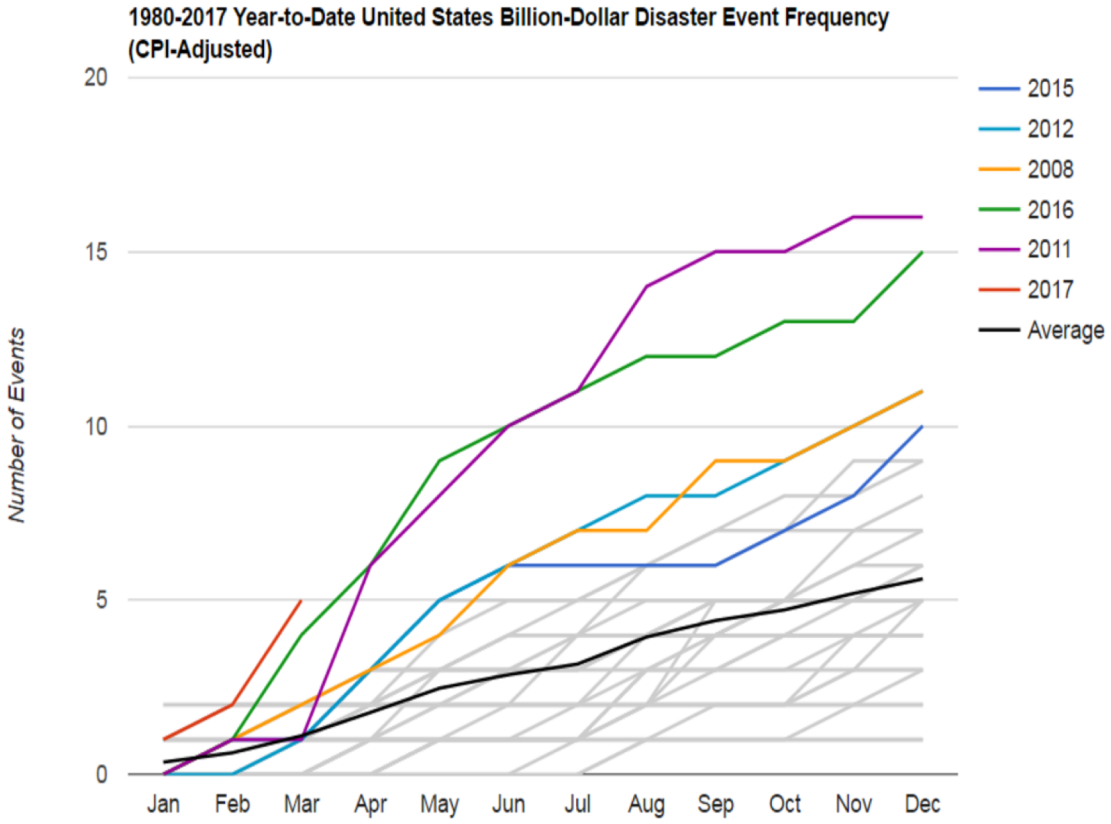
Heat Waves in India

Scientific Reports **volume 6**, Article number: 26153 (2016)

WHAT IS THE CURRENT RISK FOR WEATHER EVENTS?

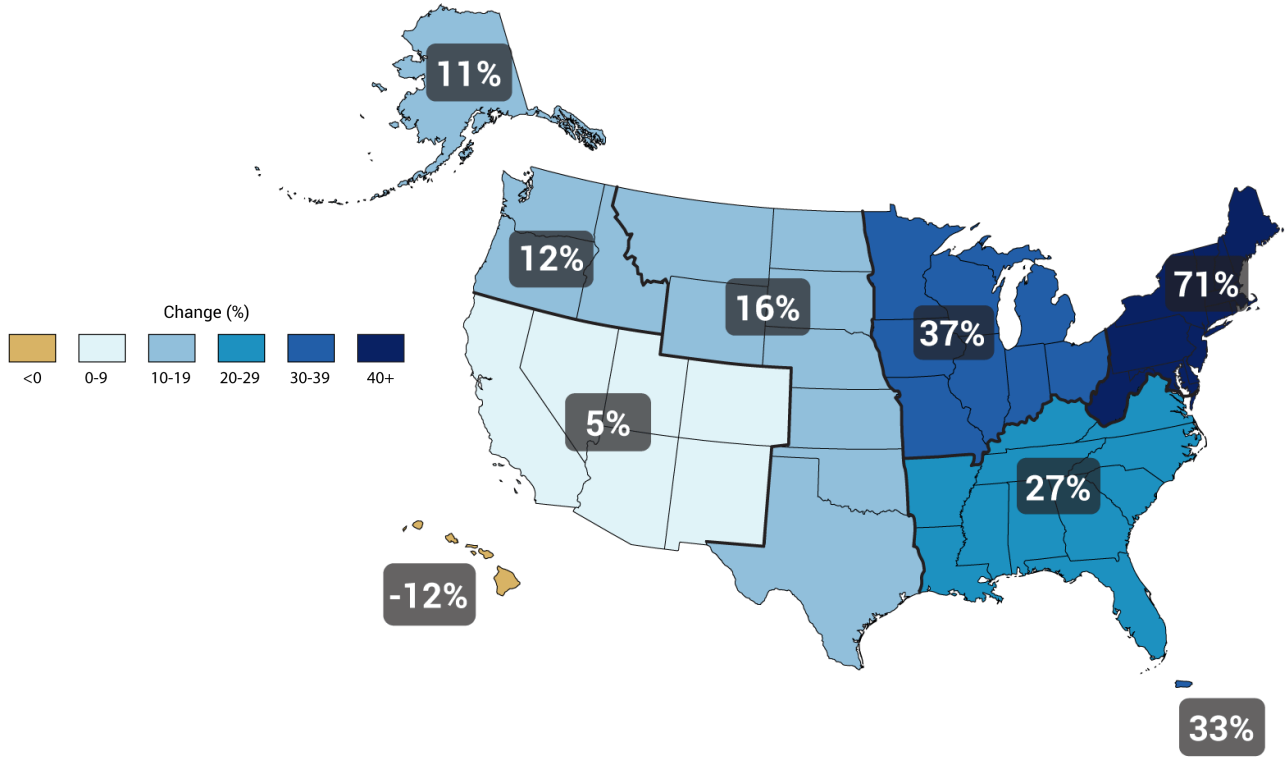


https://www.climate.gov/news-features/blogs/beyond-data/2017-us-billion-dollar-weather-and-climate-disasters-historic-year



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?

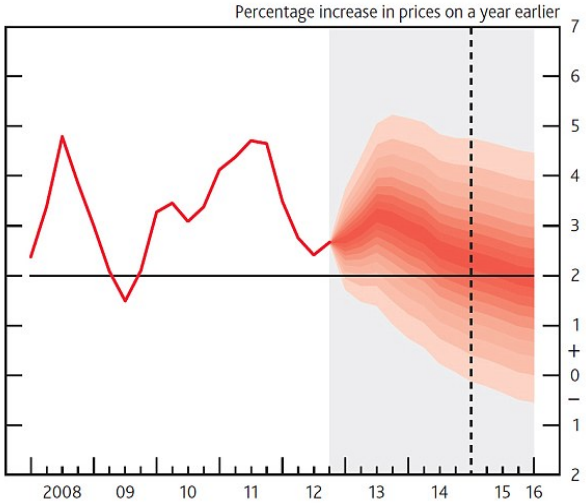
Hazard has a potential to cause harm

Risk is the potential of the hazard to cause harm

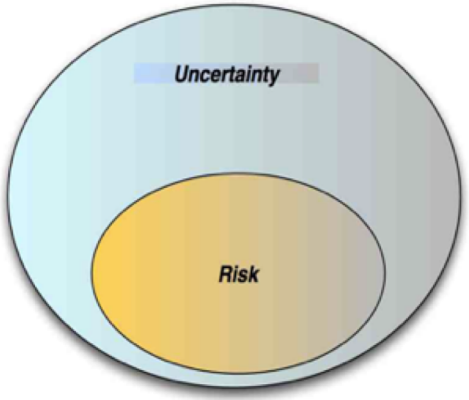
RISK AND UNCERTAINTY

Ignorance

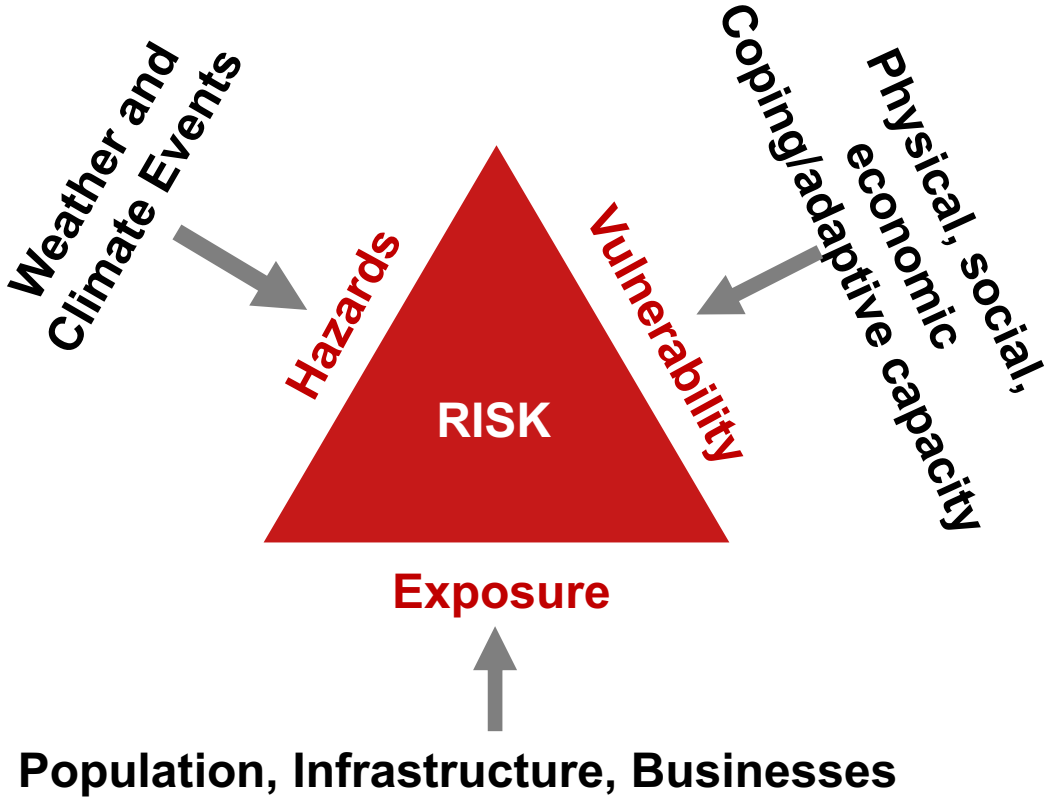
Chart 3 CPI inflation projection based on market interest rate expectations and £375 billion asset purchases



Uncertainty



Risk


Weather and Climate Events
Hazards
RISK
Vulnerability
Physical, social, economic Coping/adaptive capacity
Exposure
Population, Infrastructure, Businesses

WEATHER HAZARD

Vulnerability/Exposure

RISK


HOW CAN WE FORECAST
THE CHANGES IN THE
TRENDS OF EXTREMES

WEATHER

Tells you what to wear each day

CLIMATE

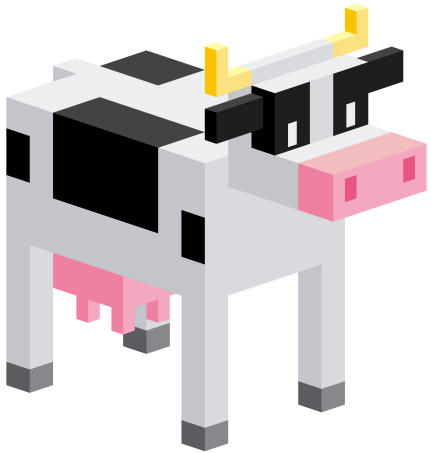
Tells you what types of clothes to have in your closet

NOAA National Centers for Environmental Information

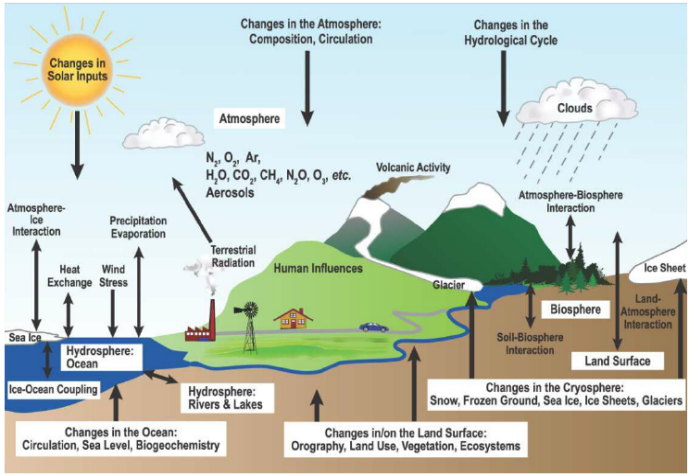
www.ncei.noaa.gov

OBJECTIVE FORECASTING

First, we develop a conceptual model

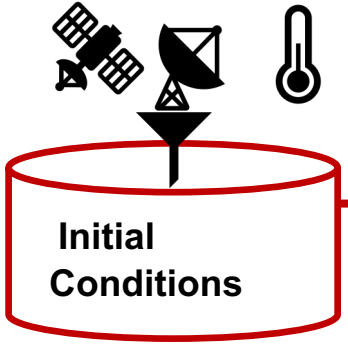


Cow (squared)

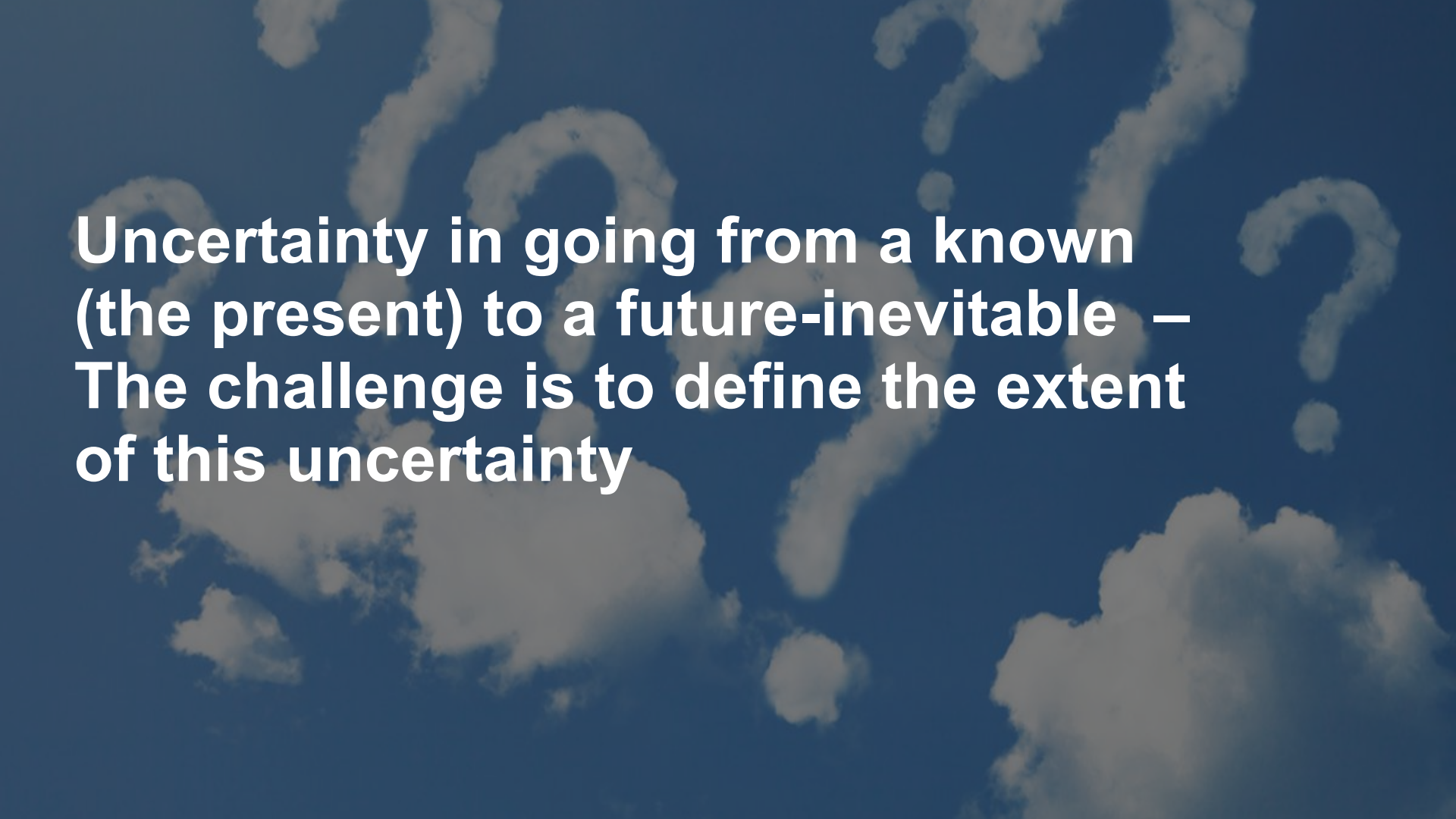


Earth System

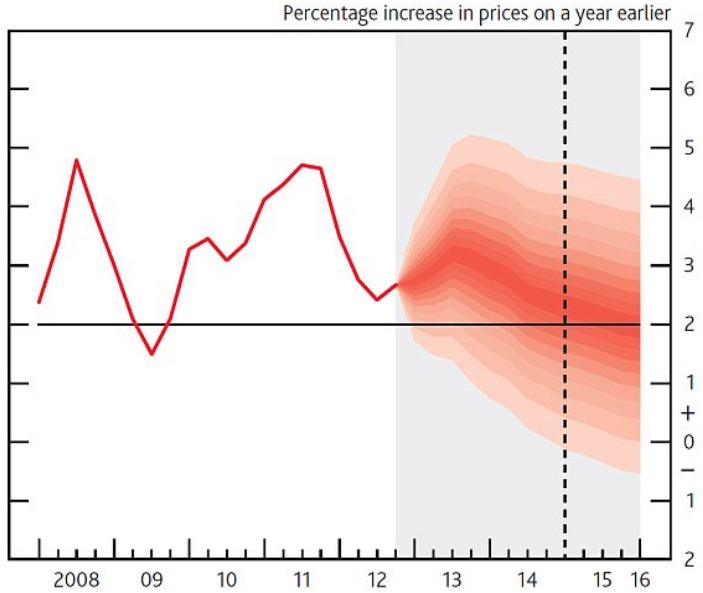
SIMULATIONS OF THE CONCEPTUAL MODEL PERFORMED ON LARGE COMPUTERS



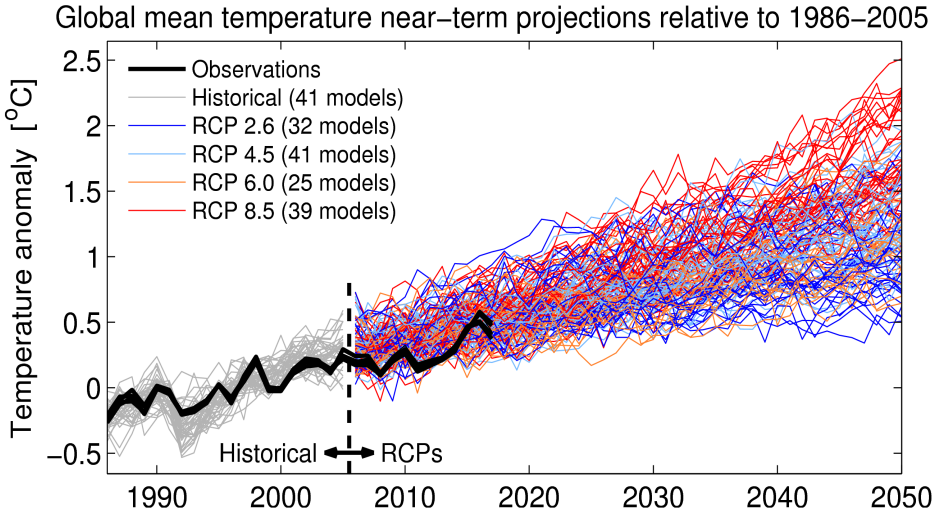
State of the atmosphere at the start of our model simulation


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

FORECAST UNCERTAINTY

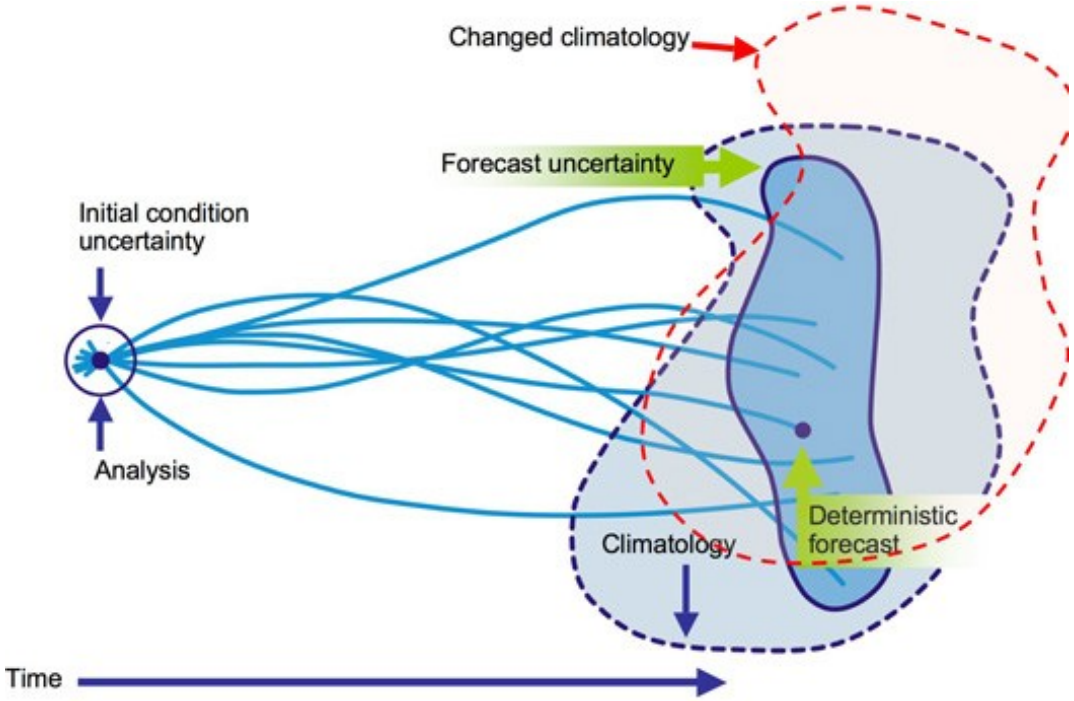


Interest Rate Forecast by the UK Federal Reserve



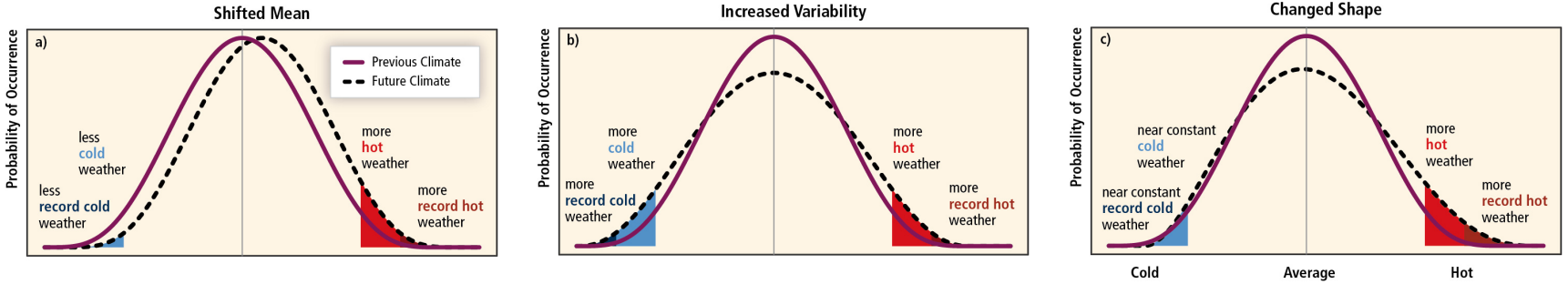
Global Temperatures Projection (IPCC AR-5)

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



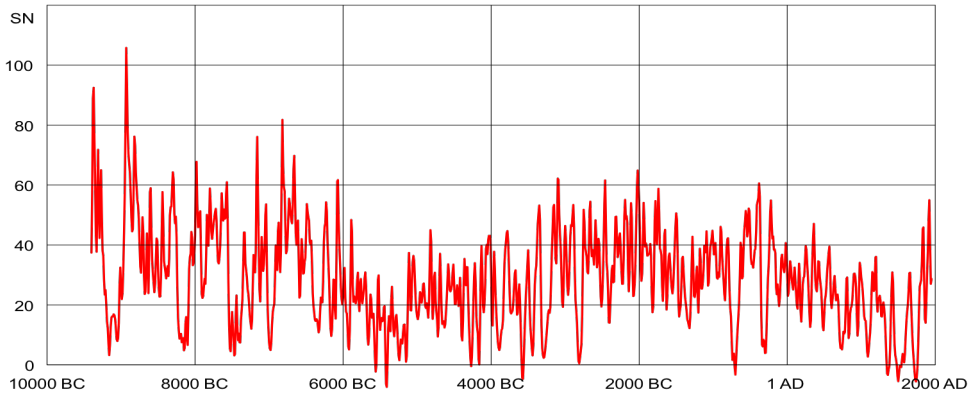
IPCC AR-5

FORECASTING CLIMATE IS DIFFERENT FROM A WEATHER FORECAST

The climate change is driven by three external factors:

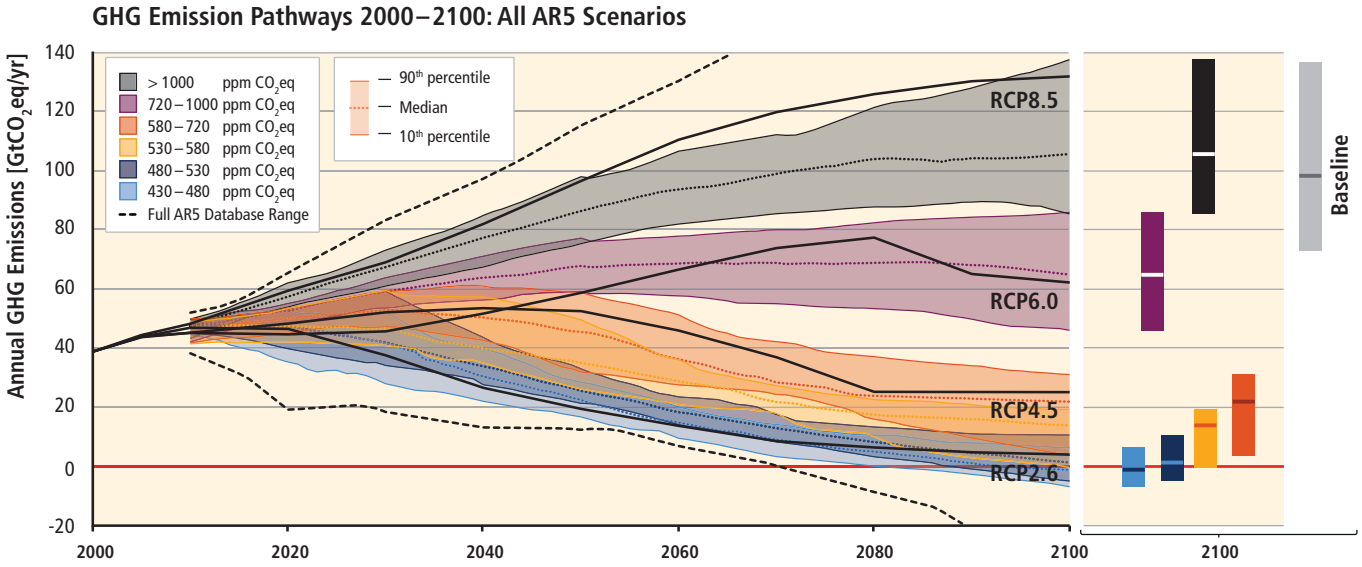
a) Sun
b) Emissions of greenhouse gases
c) Large natural events like volcanic activity

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



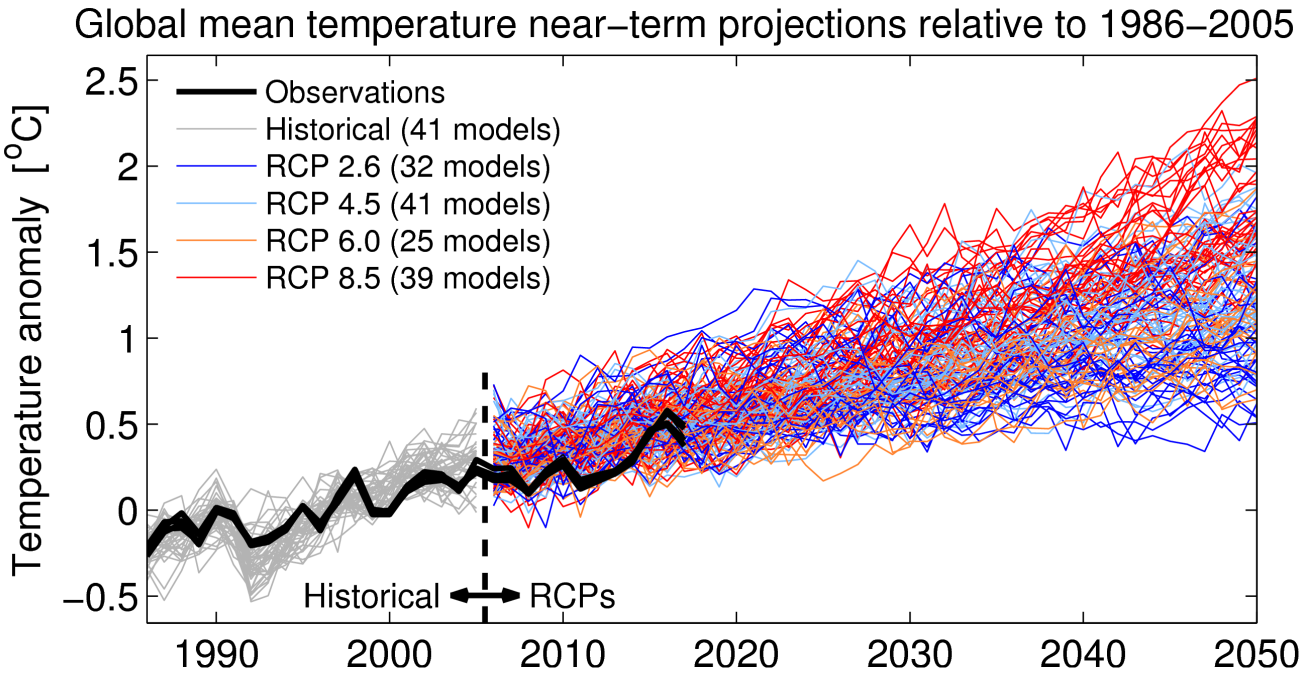
Solanki, S.K., et al. 2005.

THAT BRINGS US TO PEOPLE
The biggest uncertainty is that we don't know what people will do.



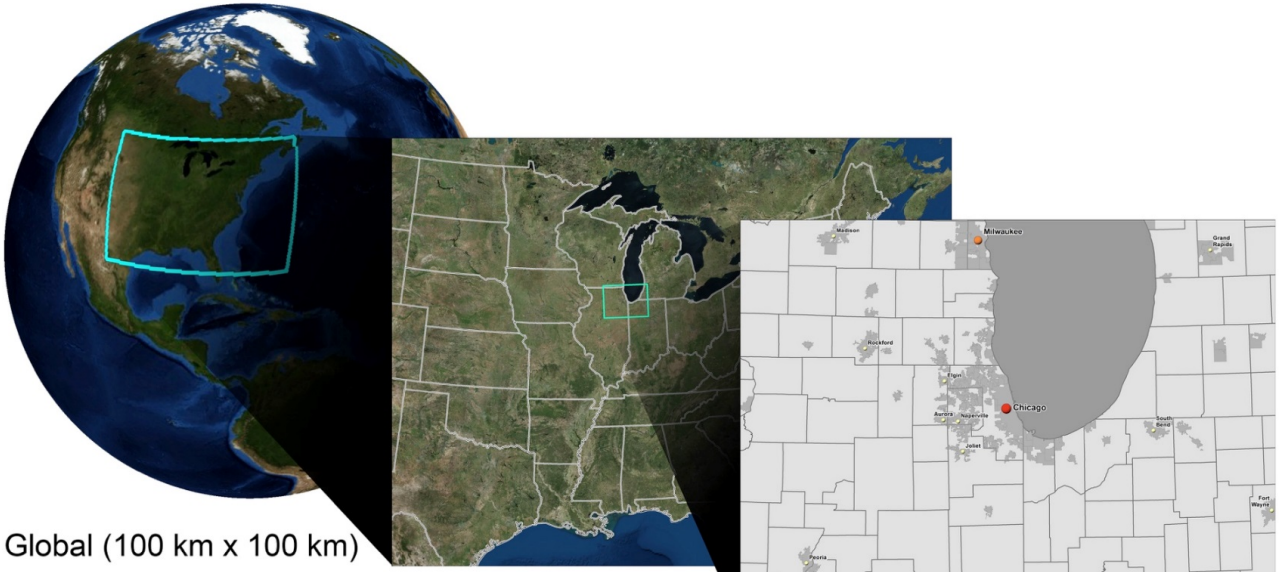
IPCC AR-5

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

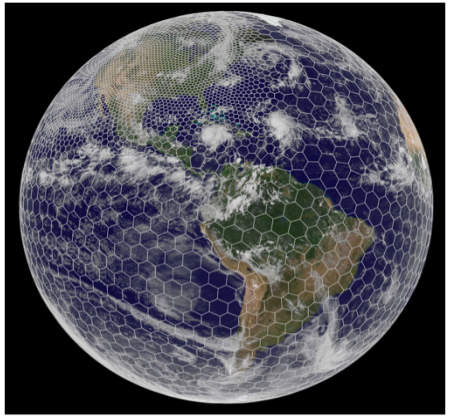


WHAT WE DO AT ARGONNE

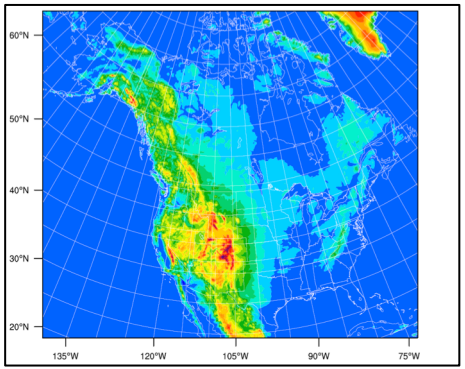
CLIMATE SIMULATIONS



Argonne Supercomputers



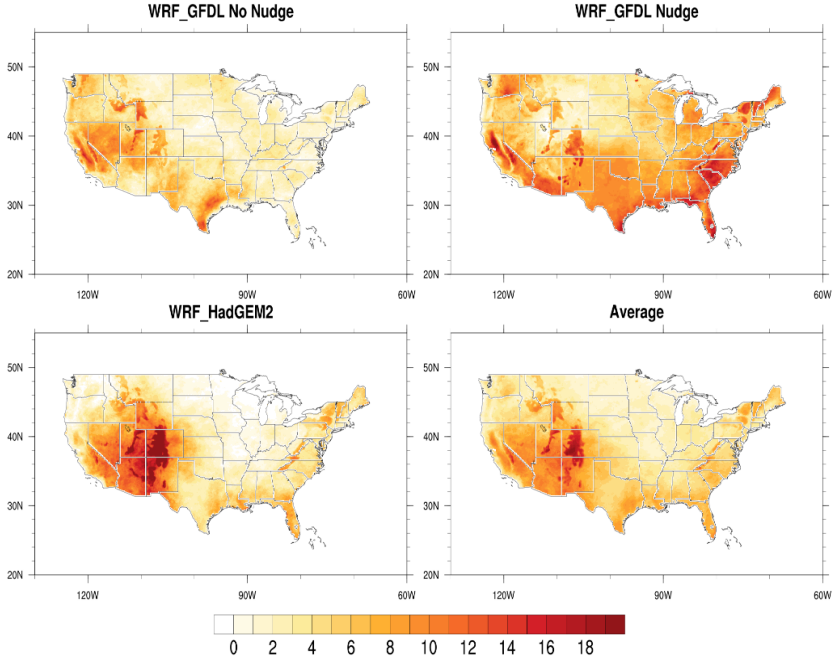
Develop Global Models



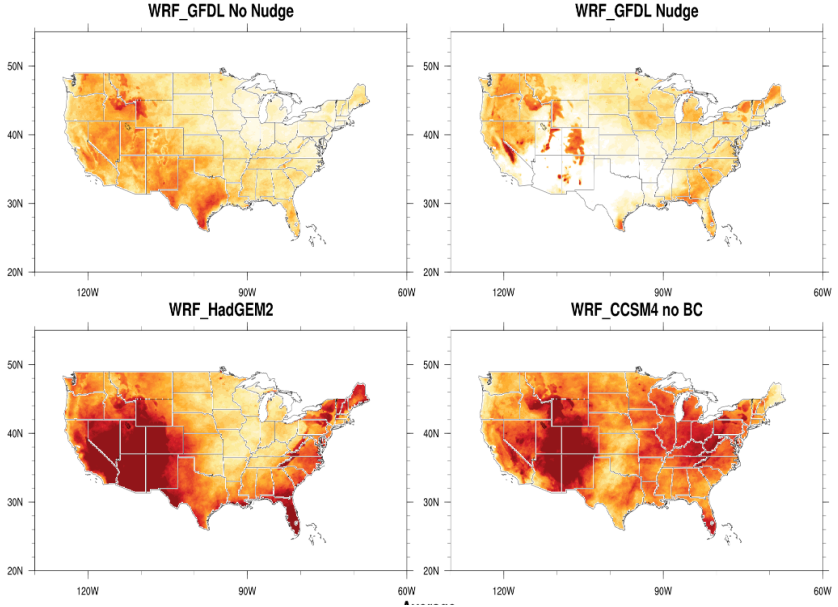
Focus on North America

PROJECTIONS: HEAT WAVE PROJECTIONS

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

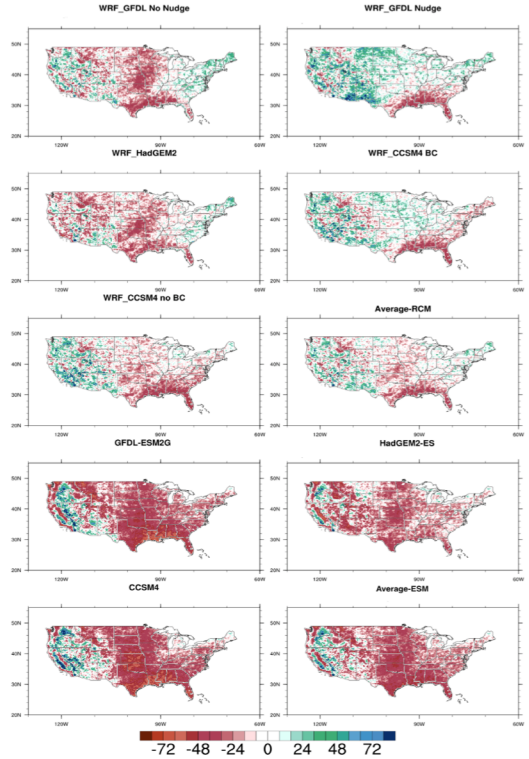


3-day Heat Waves that exceed 95% historical threshold (2085-2094 - 1995-2004)

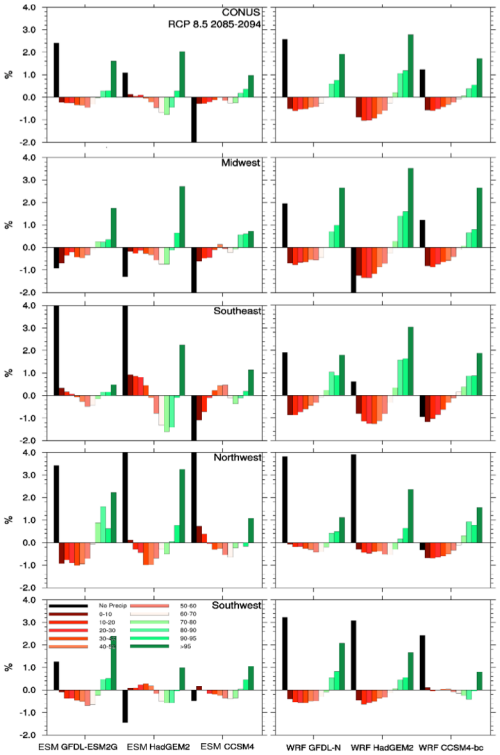


PROJECTIONS: EXTREME PRECIPITATION

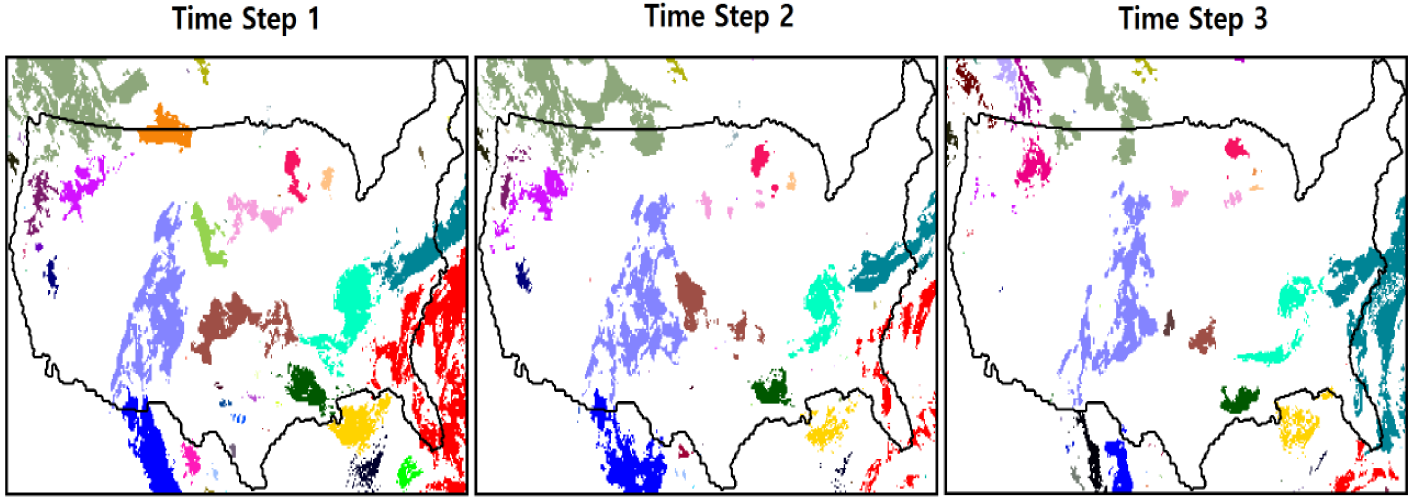
Precipitation Difference from Observed 95th Percentile



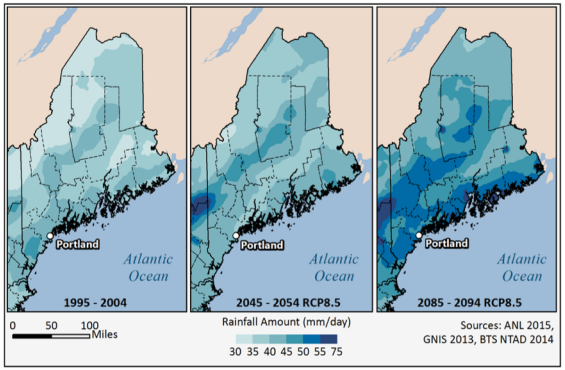
Regional Percentile Difference

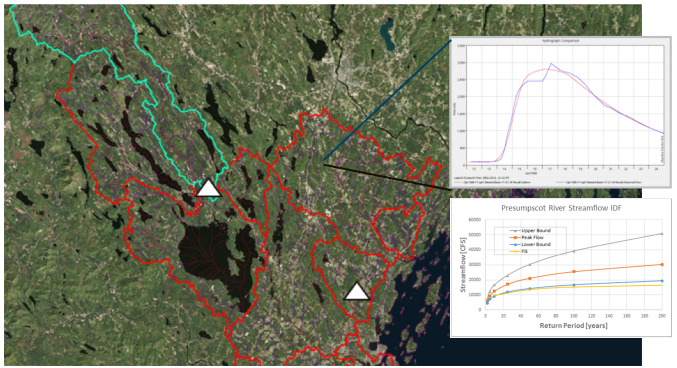


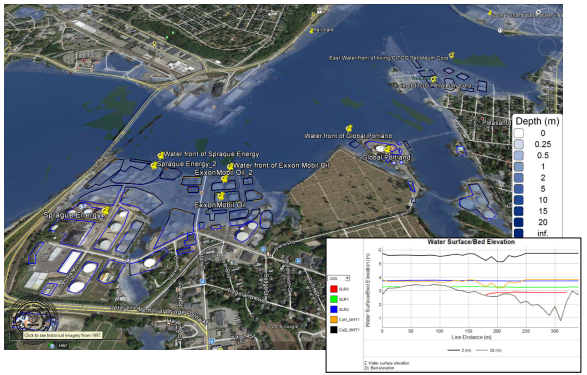
TRACKING RAIN STORM- TIME AND SIZE

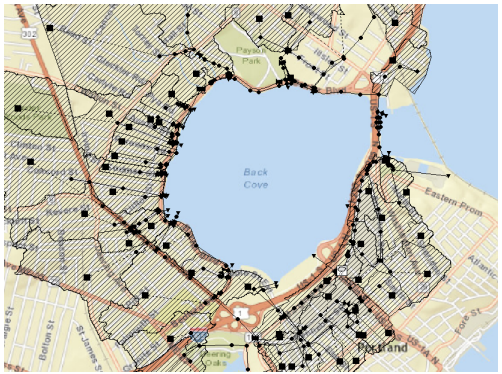


CHANGES IN RISK TO INFRASTRUCTURE









WORK WITH COMMUNITIES TO DEVELOP A RISK DECISION FRAMEWORK