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Climate Change Up Close and Personal: Impacts on Hampton Roads Region

Russell De Young
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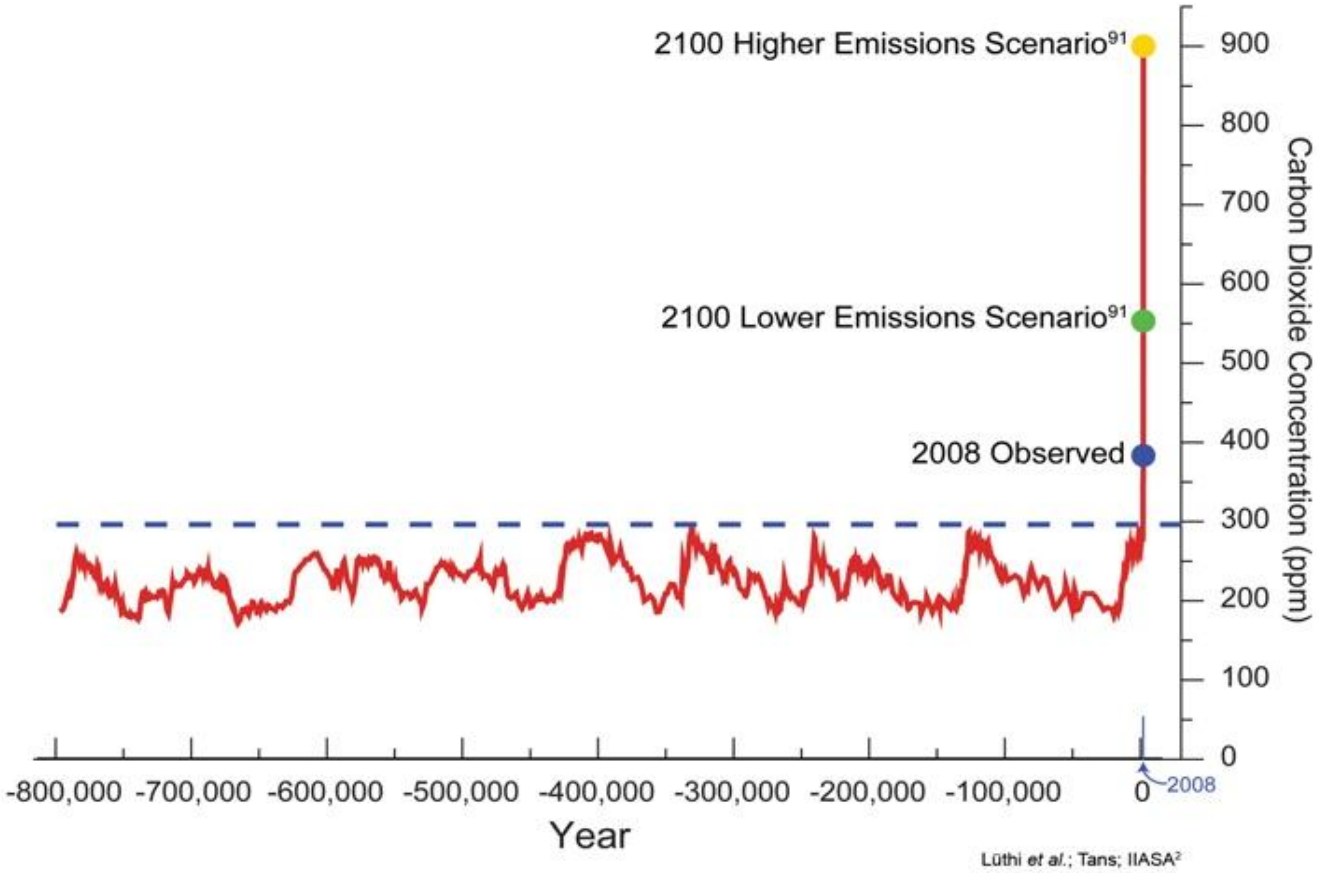
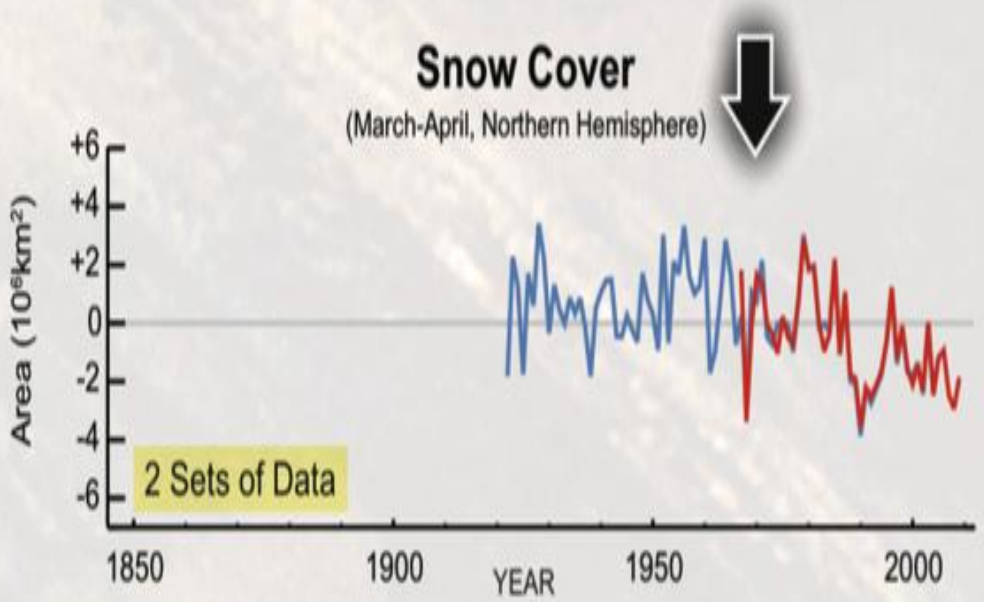
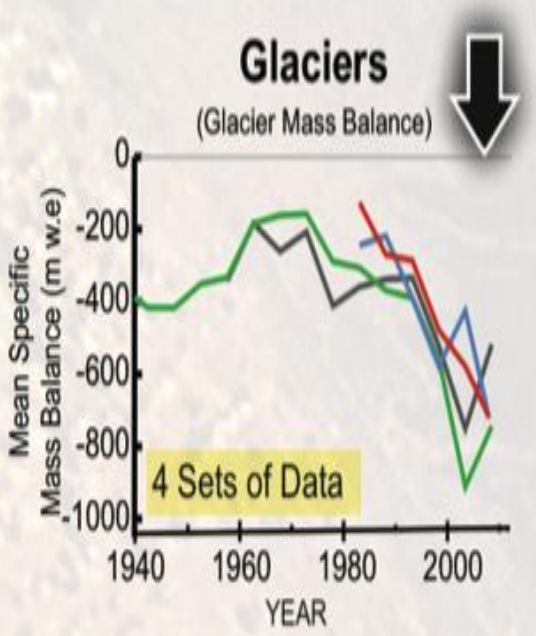
Atmospheric Carbon Dioxide over the Past 800,000 Years

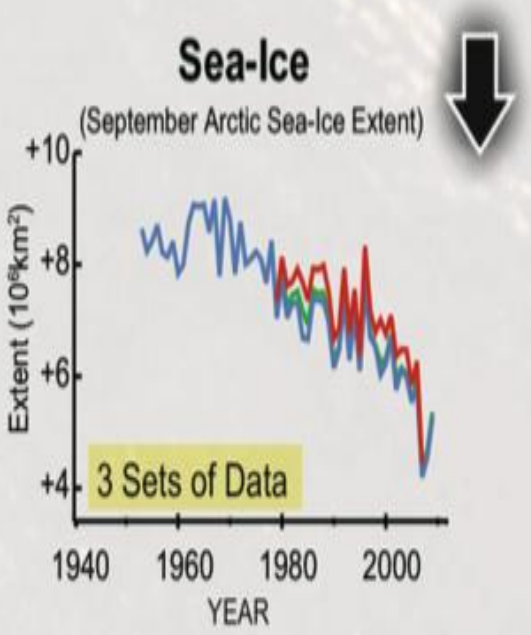


Analysis of air bubbles trapped in an Antarctic ice core extending back 800,000 years documents the Earth's changing carbon dioxide concentration. Over this long period, natural factors have caused the atmospheric carbon dioxide concentration to vary within a range of about 170 to 300 parts per million (ppm). Temperature-related data make clear that these variations have played a central role in determining the global climate. As a result of human activities, the present carbon dioxide concentration of about 385 ppm is about 30 percent above its highest level over at least the last 800,000 years. In the absence of strong control measures, emissions projected for this century would result in the carbon dioxide concentration increasing to a level that is roughly 2 to 3 times the highest level occurring over the glacial-interglacial era that spans the last 800,000 or more years.

These indicators all decrease in a warming world

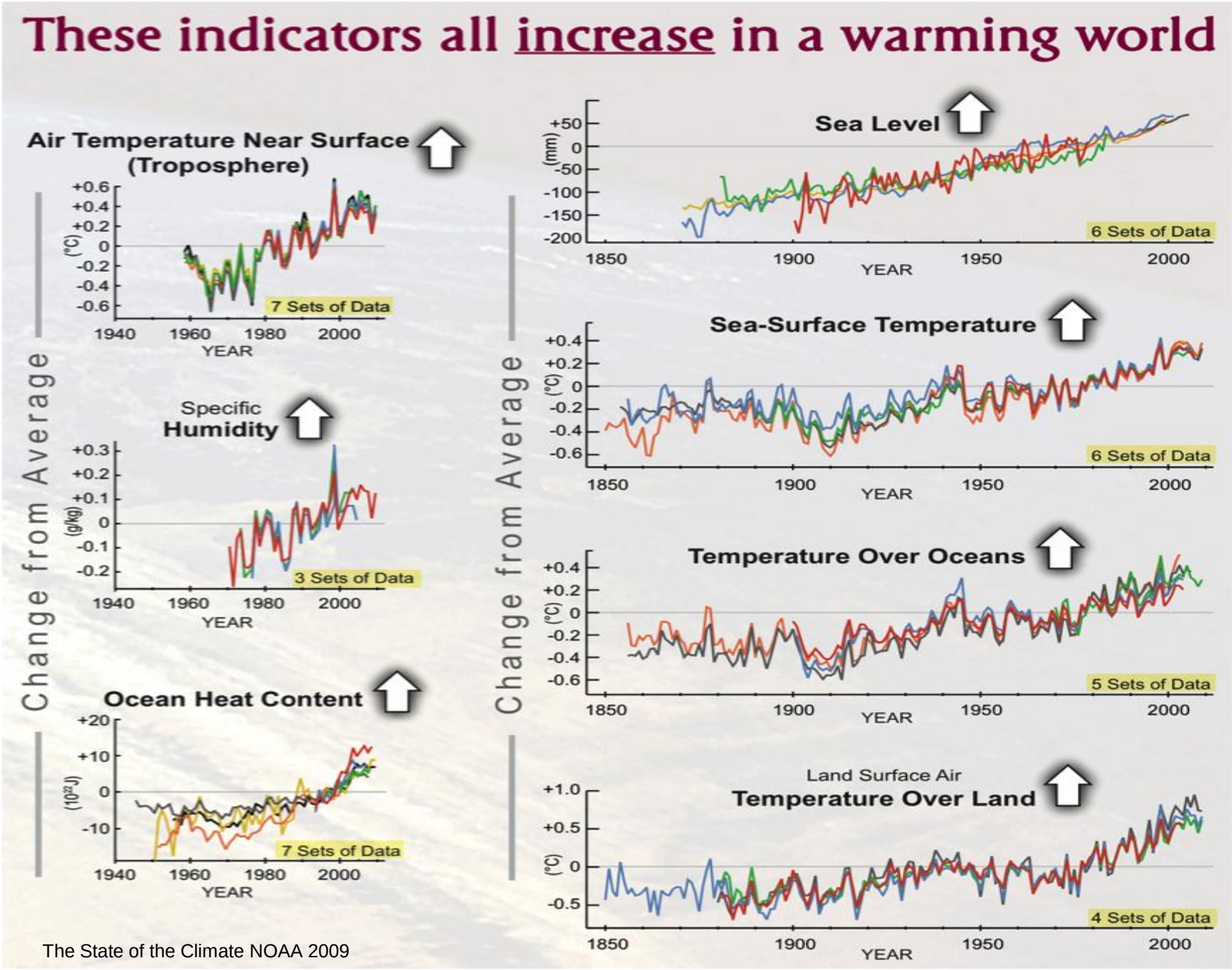






The State of the Climate NOAA 2009

These indicators all increase in a warming world



The State of the Climate NOAA 2009

We know very well:

i) Earth is warming due to increased concentrations of atmospheric heat-trapping gases especially carbon dioxide.

(ii) Most of the increase in heat-trapping gases over the last century is due to human activities, especially burning fossil fuels and deforestation.

(iii) Natural causes always play a role in changing Earth's climate, but are now being overwhelmed by human-induced changes.

(iv) Warming will cause many other climatic patterns to change at speeds unprecedented in modern times, including increasing rates of sea-level rise and alterations in the water cycle. Rising concentrations of carbon dioxide are making the oceans more acidic.

(v) The combination of these complex climate changes threatens coastal communities, our food and water supplies, marine and freshwater ecosystems, forests, high mountain environments, and more.

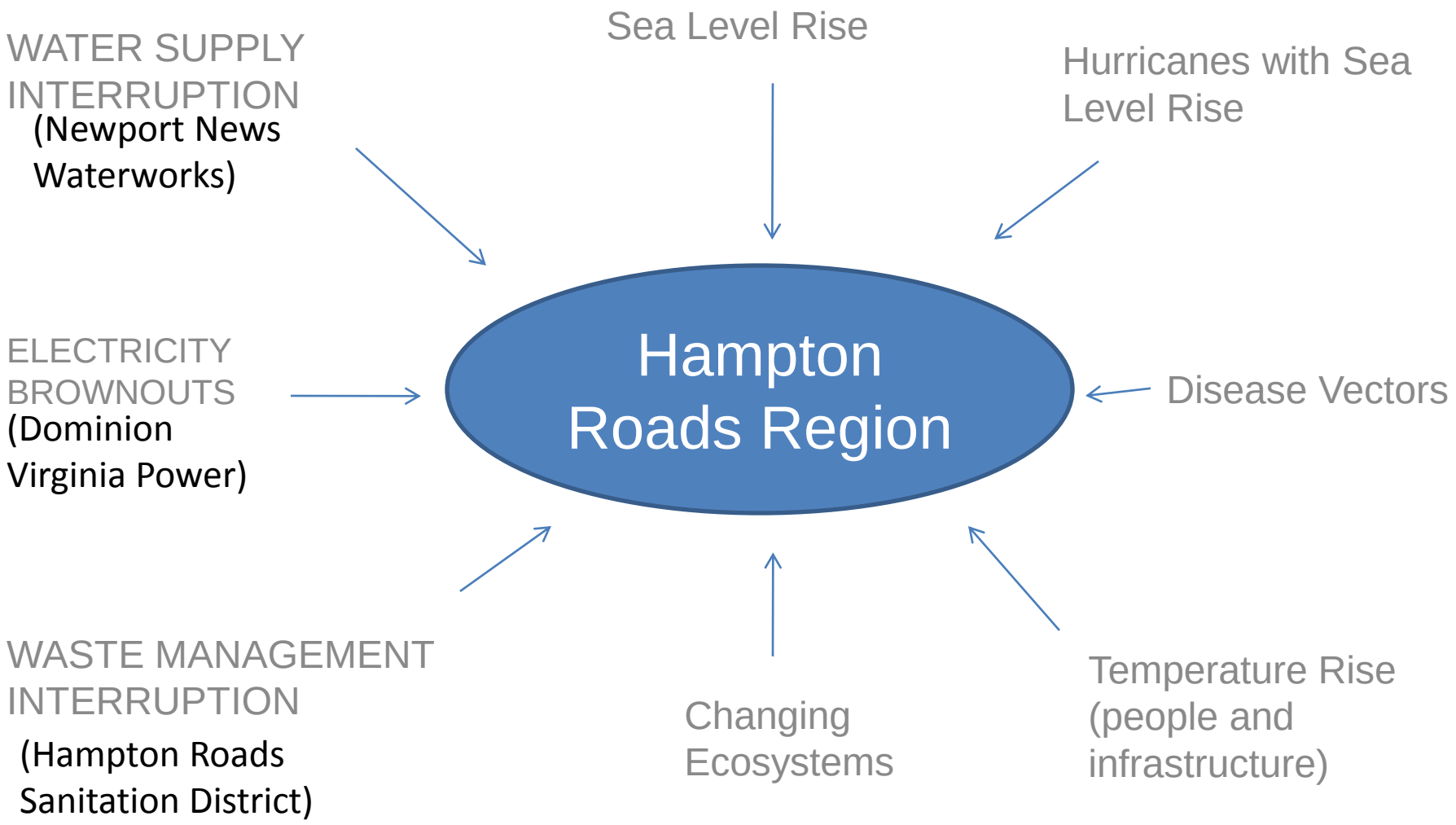
http://www.sciencemag.org/cgi/content/full/328/5979/689

Addressing Climate Change Risk

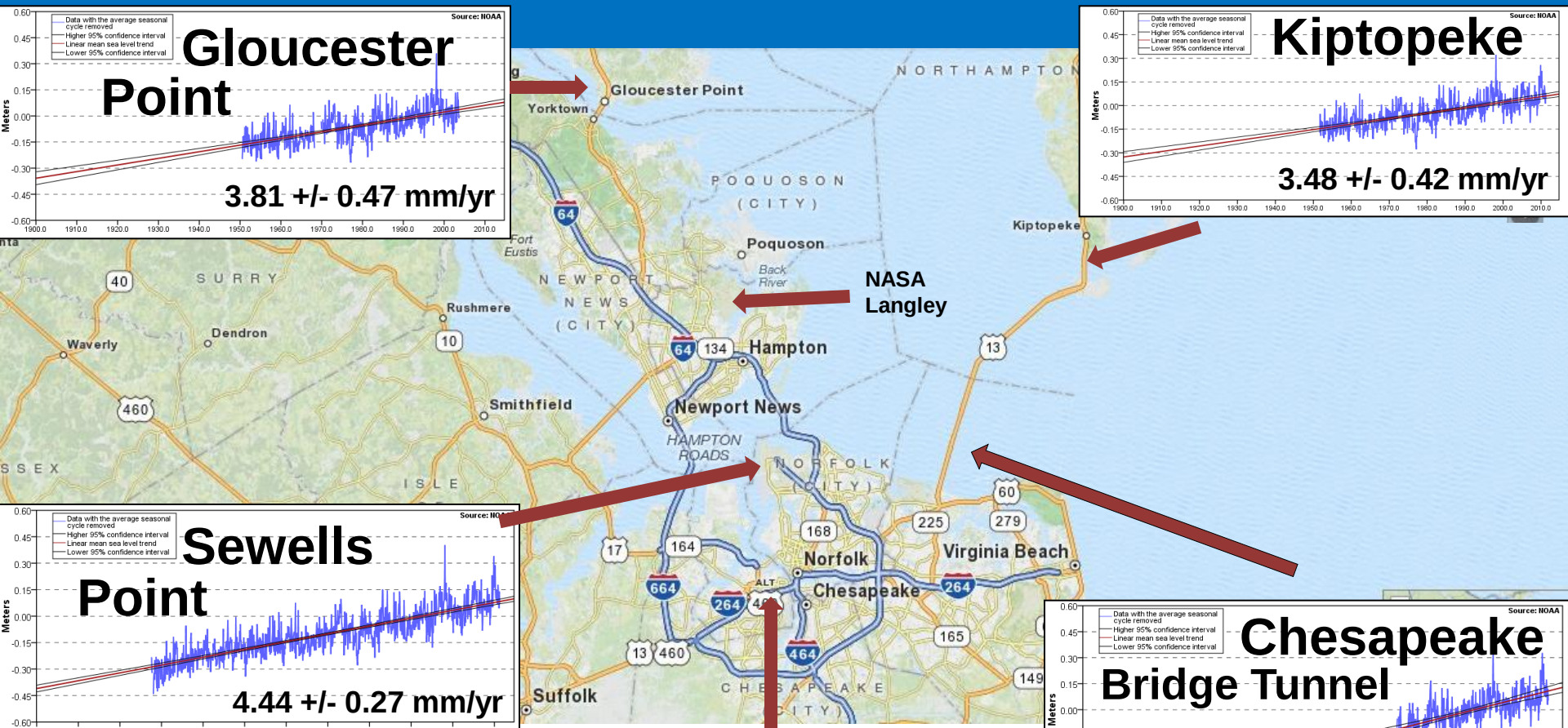
- Adaptation: Adapting to climate change risk such that risk will not negatively impact quality of life.

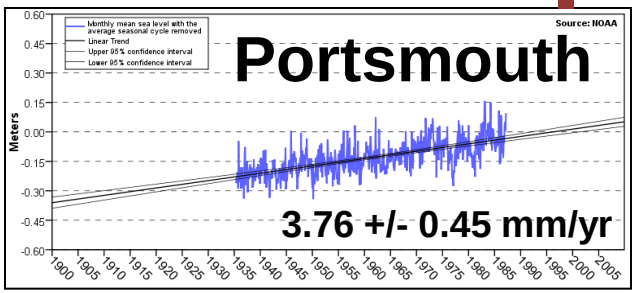
- Mitigation: Developing programs and procedures to reduce our carbon footprint thus reducing climate change impacts.

Langley Research Center Climate Change Risk

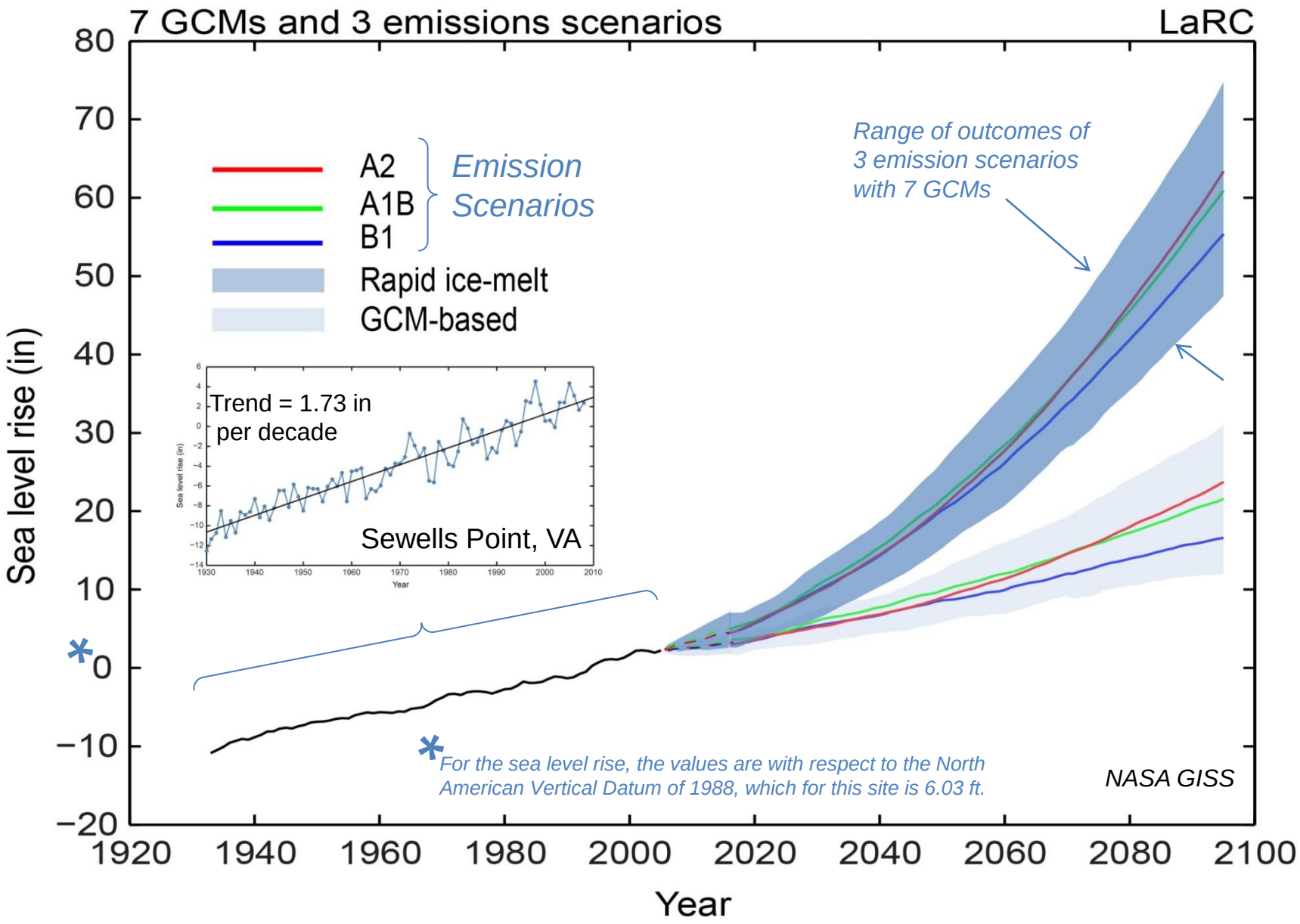


HAMPTON ROADS NOAA TIDE GAUGES

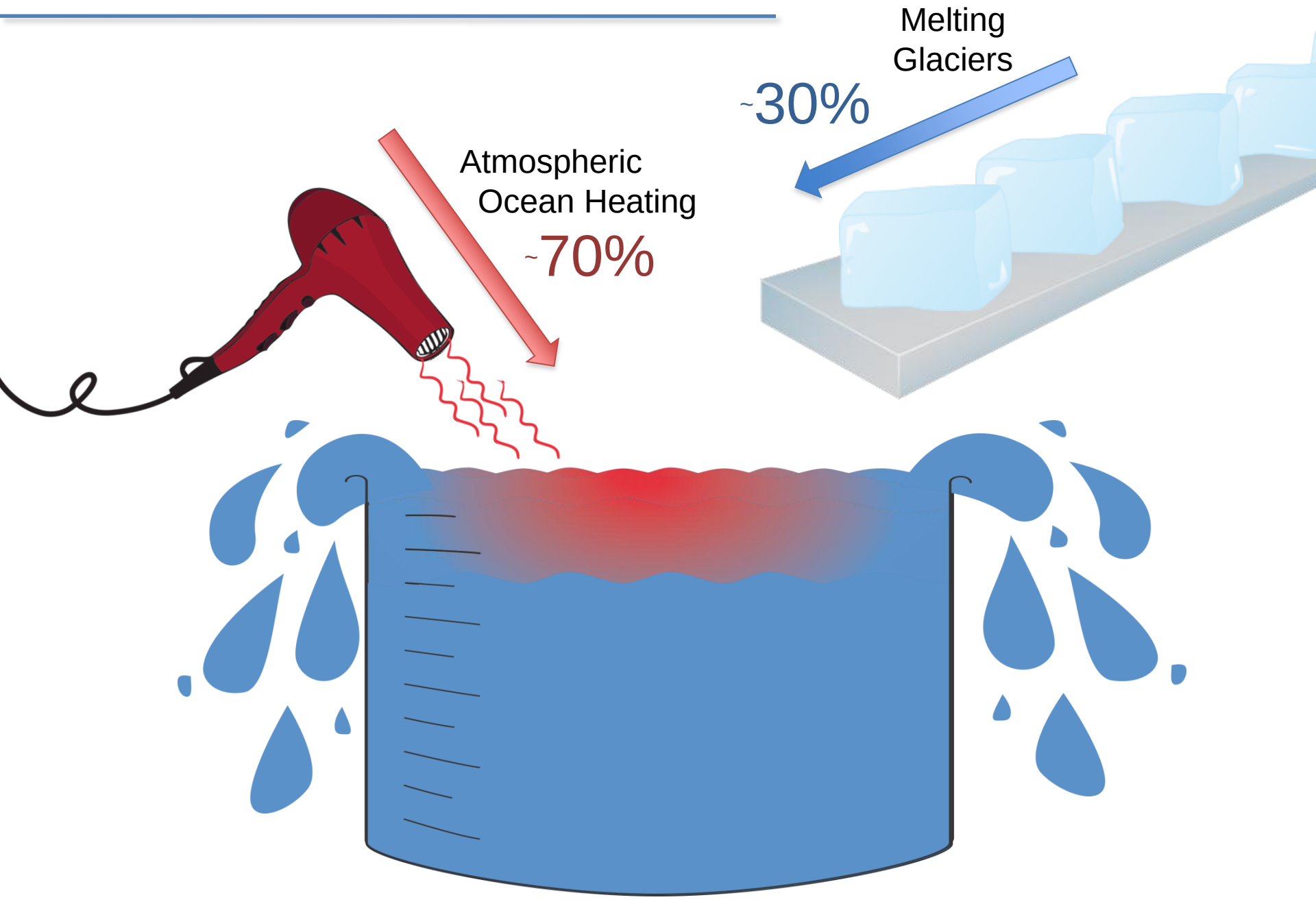




SEA LEVEL RISE SEWELLS POINT, VA



Cause of Sea Level Rise

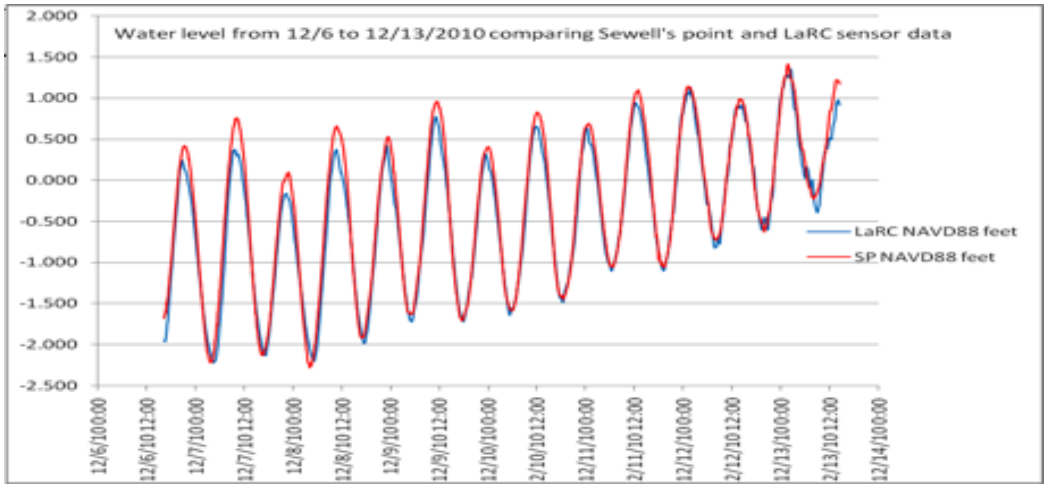


Rapid Glacier Melting and Sea Level Rise

Langley Water Level Gauge Measurement System

Water level data available at:

www.capable.larc.nasa.gov



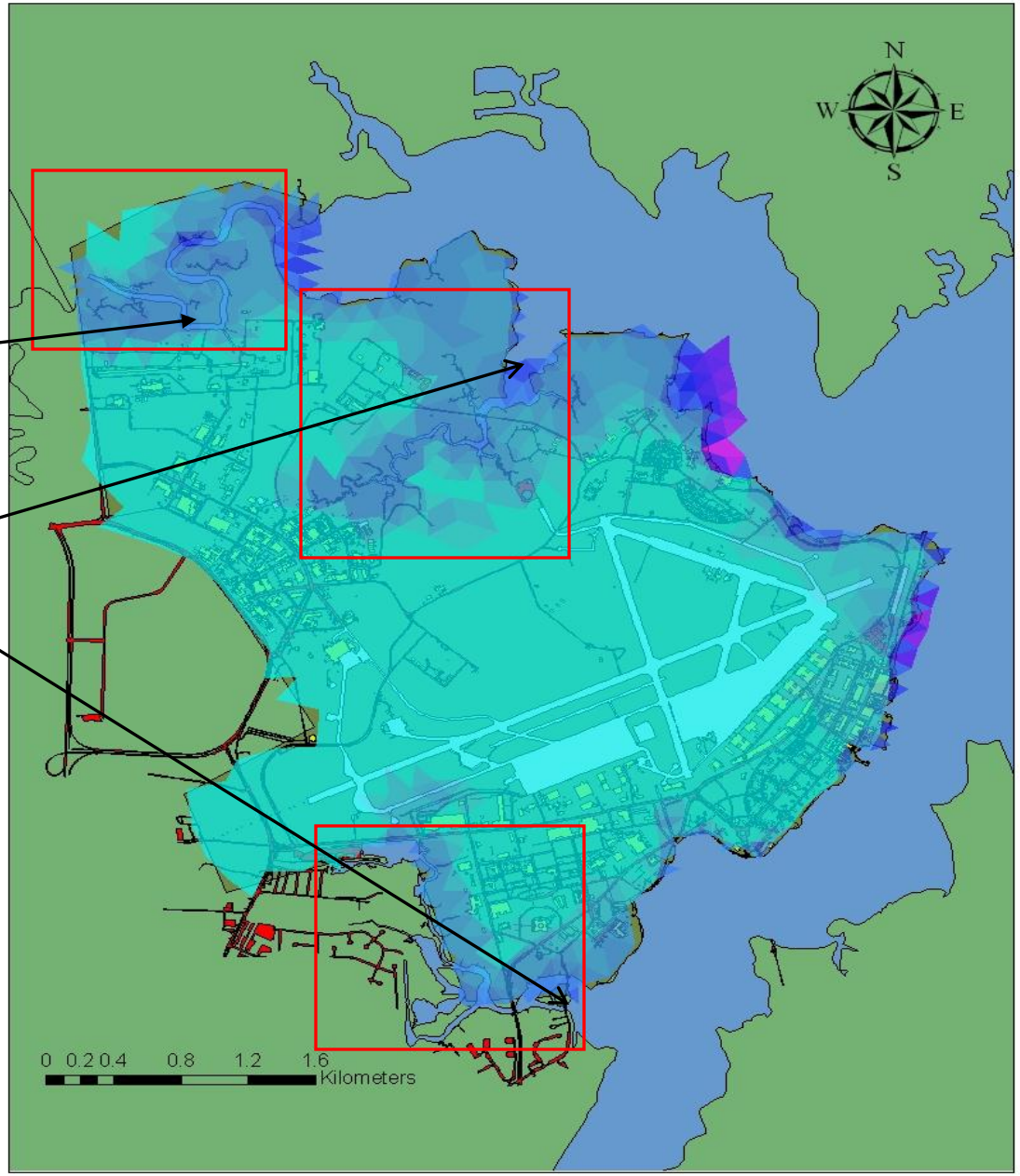
Water Level, feet

Date

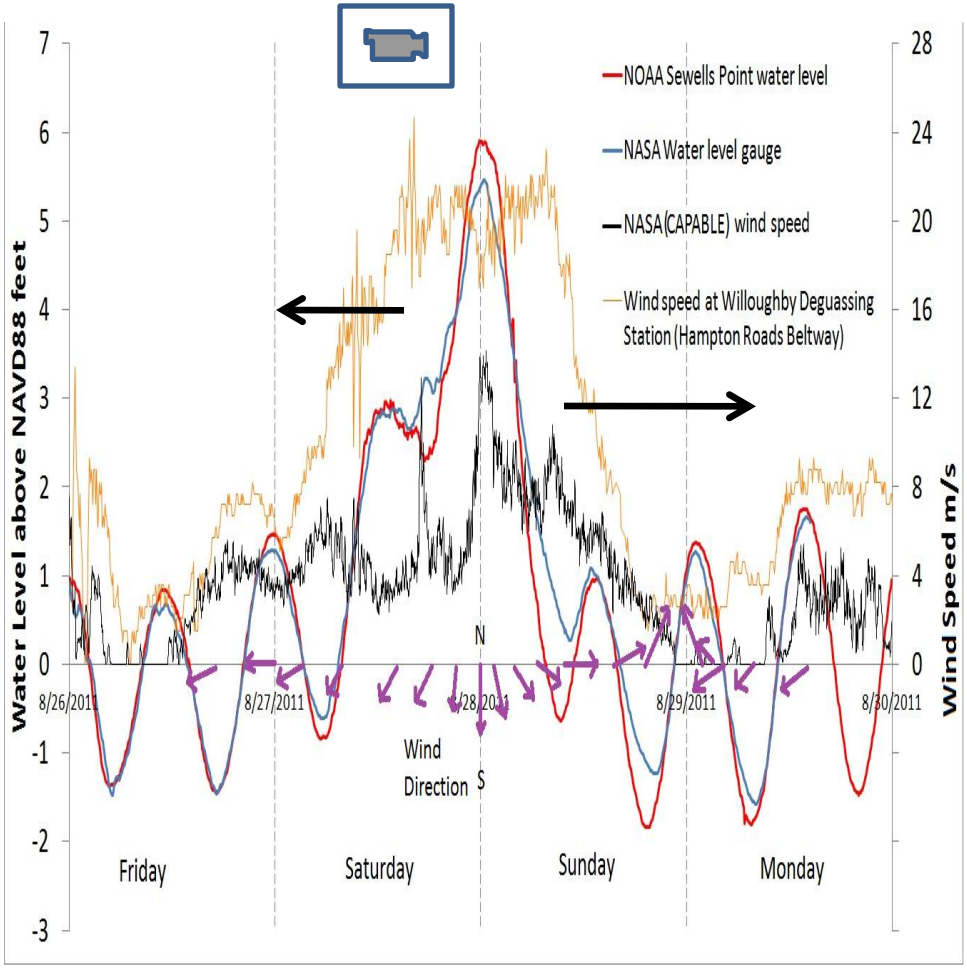
Flood Inundation Maps Made Using VIMS Model For Peak of 2009 November Nor'easter

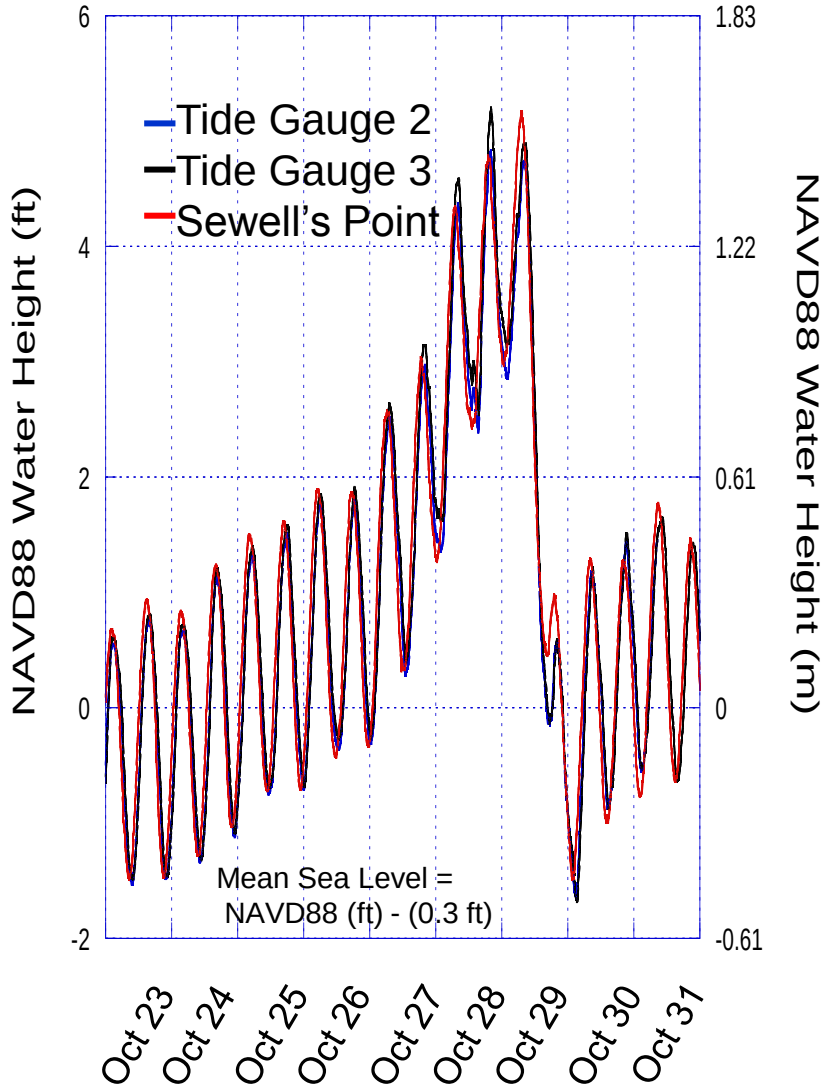
Current Wythe Creek sea level gauge site

Placement of new water level gauges in the Back River tributaries.

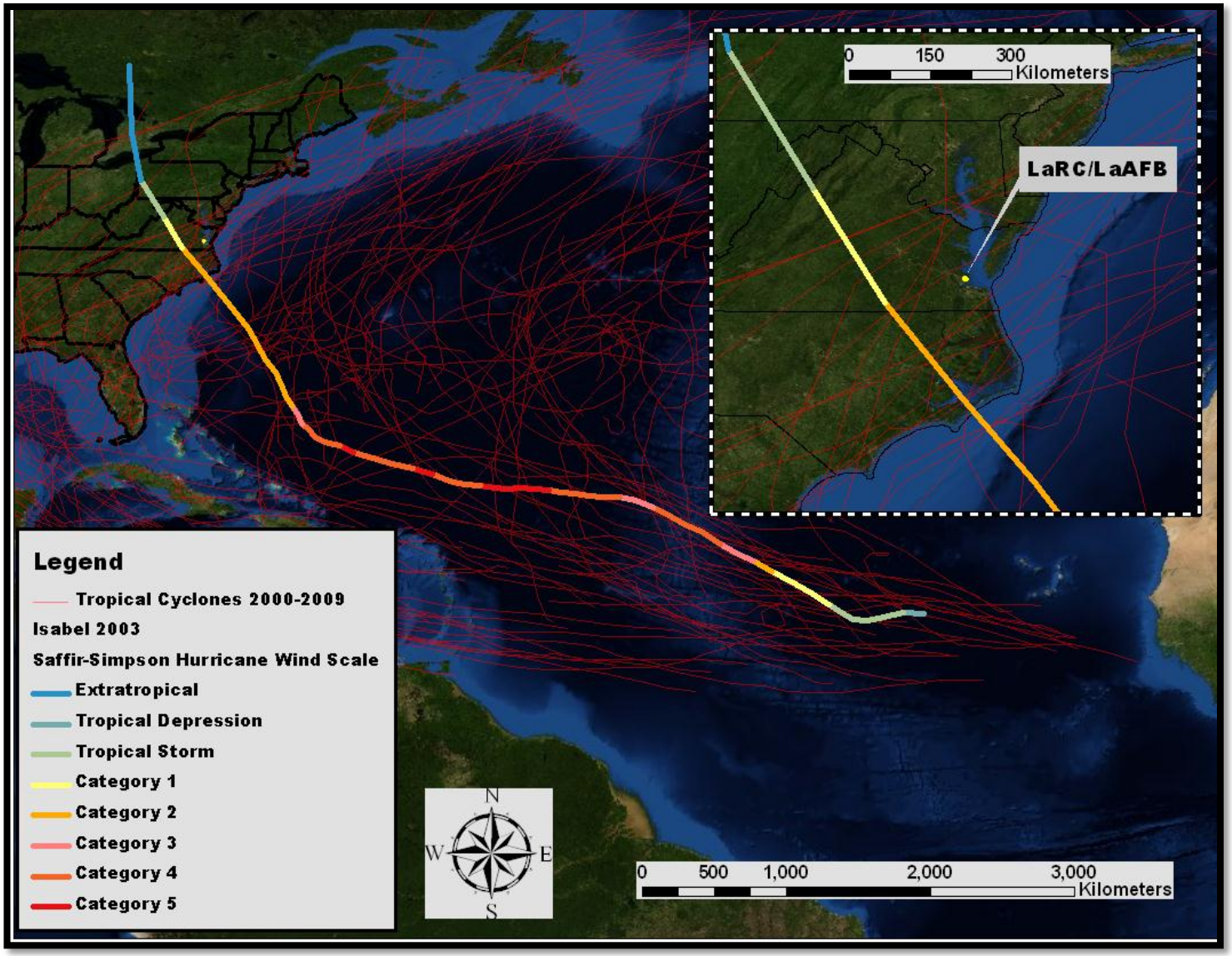


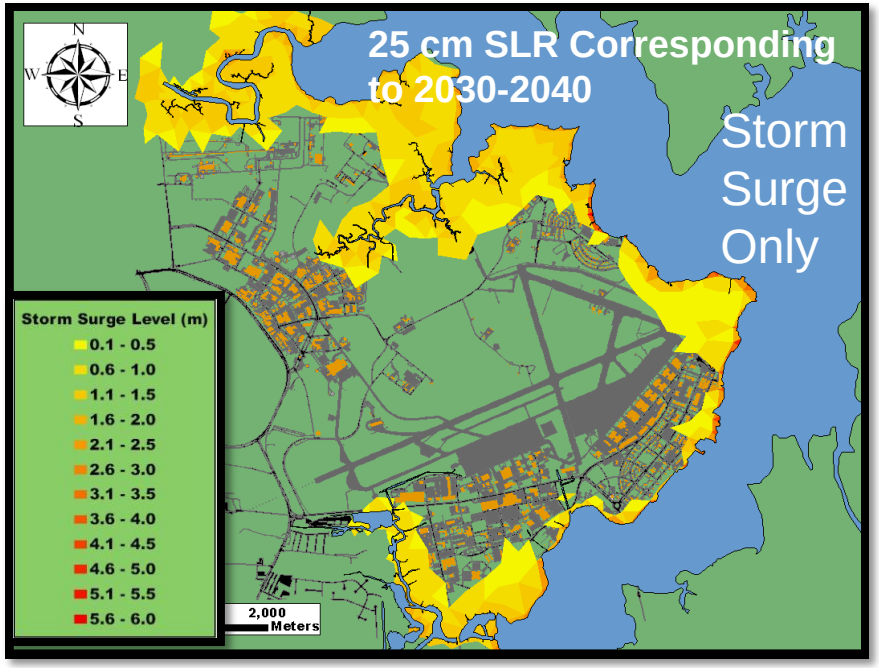
Hurricane Irene and Sandy Flood Surge

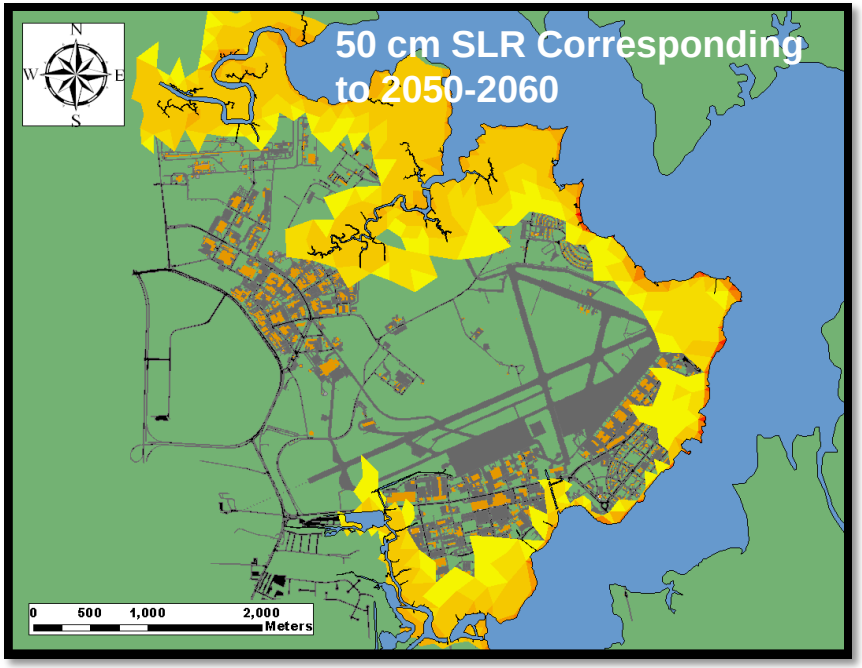


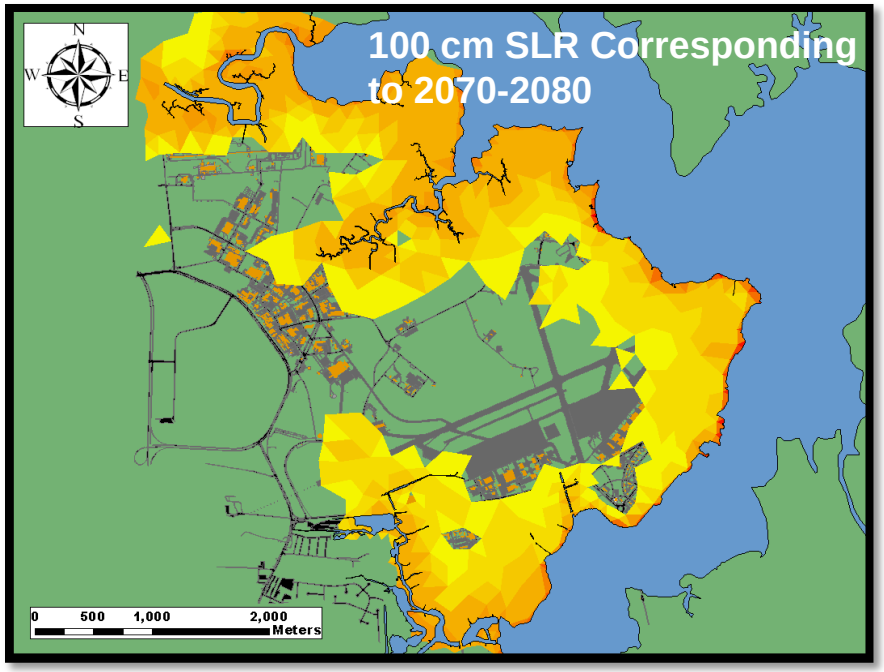


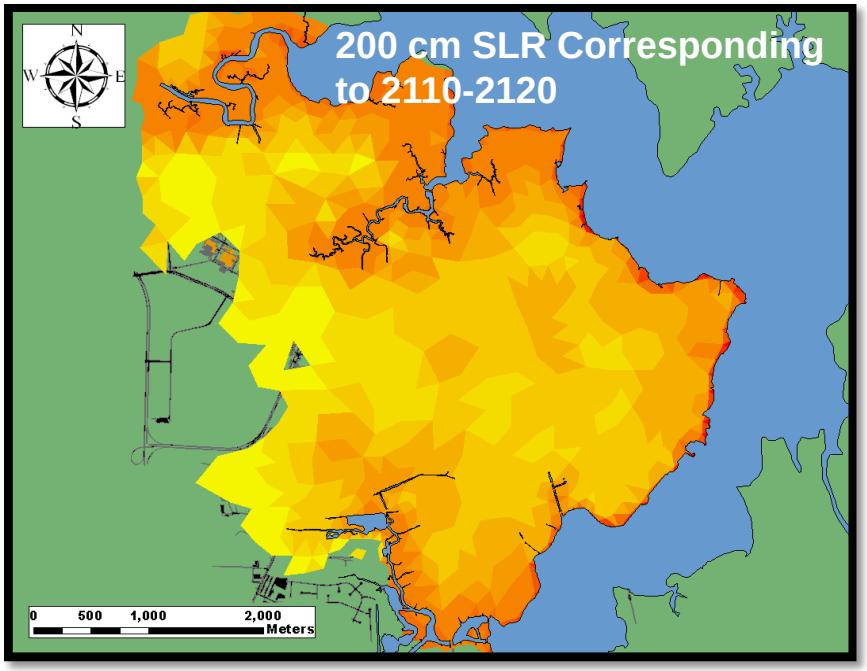
Atlantic Tropical Cyclones 2000-2009 and Hurricane Isabel 2003




25 cm SLR Corresponding to 2030-2040
Storm Surge Only
Storm Surge Level (m)
0.1 - 0.5
0.6 - 1.0
1.1 - 1.5
1.6 - 2.0
2.1 - 2.5
2.6 - 3.0
3.1 - 3.5
3.6 - 4.0
4.1 - 4.5
4.6 - 5.0
5.1 - 5.5
5.6 - 6.0
2,000 Meters

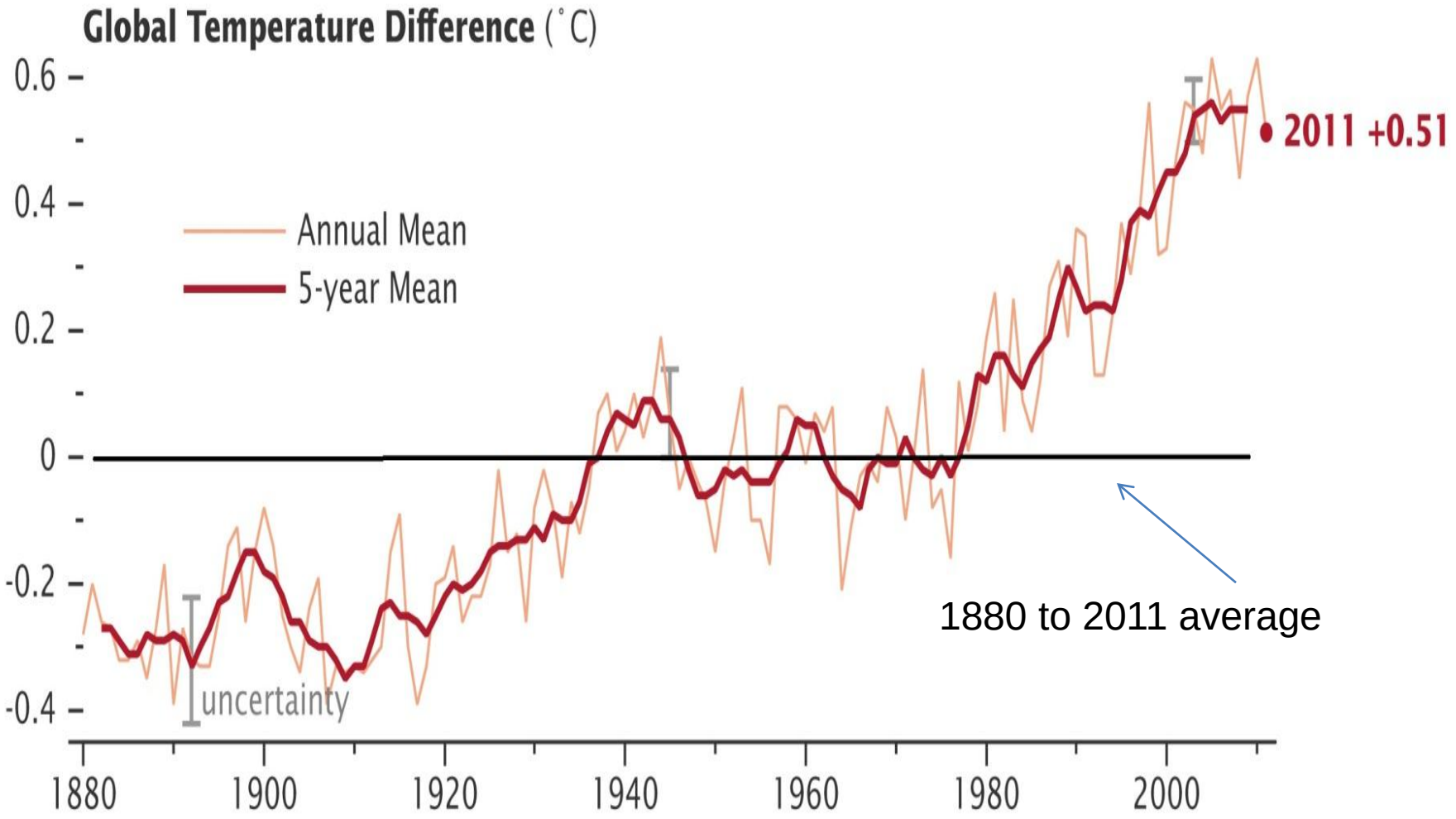

50 cm SLR Corresponding to 2050-2060
0 500 1,000 2,000 Meters


100 cm SLR Corresponding to 2070-2080
0 500 1,000 2,000 Meters

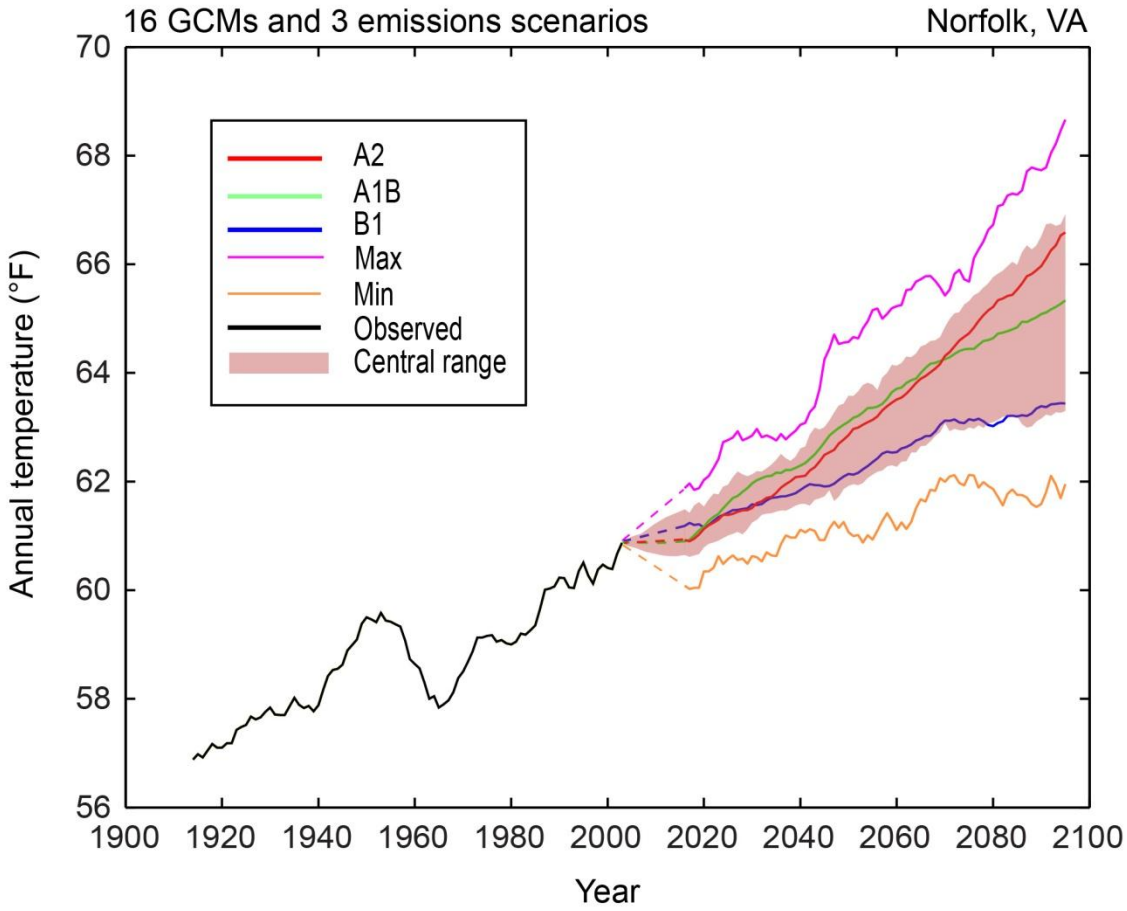

200 cm SLR Corresponding to 2110-2120
0 500 1,000 2,000 Meters

Climate Change and Heat Stress

Global Temperature 1880-2011



Norfolk Temperature Projections



Combined observed (black line) and projected temperature. Projected model changes through time are applied to the observed historical data. The three thick lines (green, red, and blue) show the average for each emissions scenario across the 16 GCMs from the BCSD dataset. Shading shows the central range. The bottom and top lines, respectively, show each year's minimum and maximum projections across the suite of simulations. A ten-year filter has been applied to the observed data and model output. The dotted area between 2004 and 2015 the period that is not covered due to the smoothing procedure.

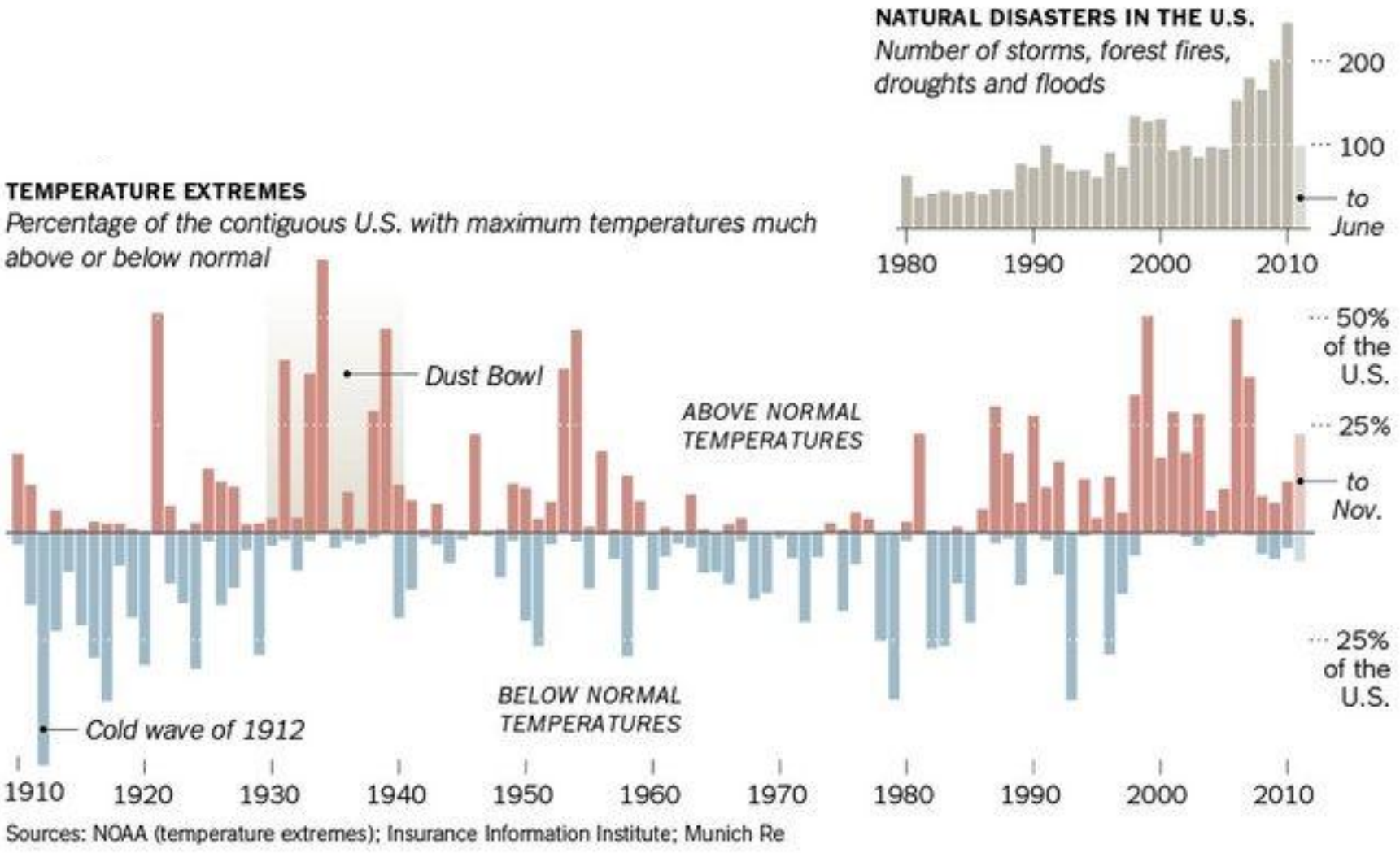
Source: NASA GISS / CCSR

Norfolk Projected Temperature Extreme Days

Daily Temperatures	Baseline	2020s	2050s	2080s
Max temperature **at or above 90°F** (days)	34	40 to 47	49 to 64	55 to 86
Max temperature **at or above 100°F** (days)	0.7	1 to 3	3 to 7	5 to 16
Min temperature **at or below 40°F** (days)	102	83 to 89	71 to 83	59 to 77
Min temperature **at or below 32°F** (days)	48	34 to 39	26 to 34	19 to 30

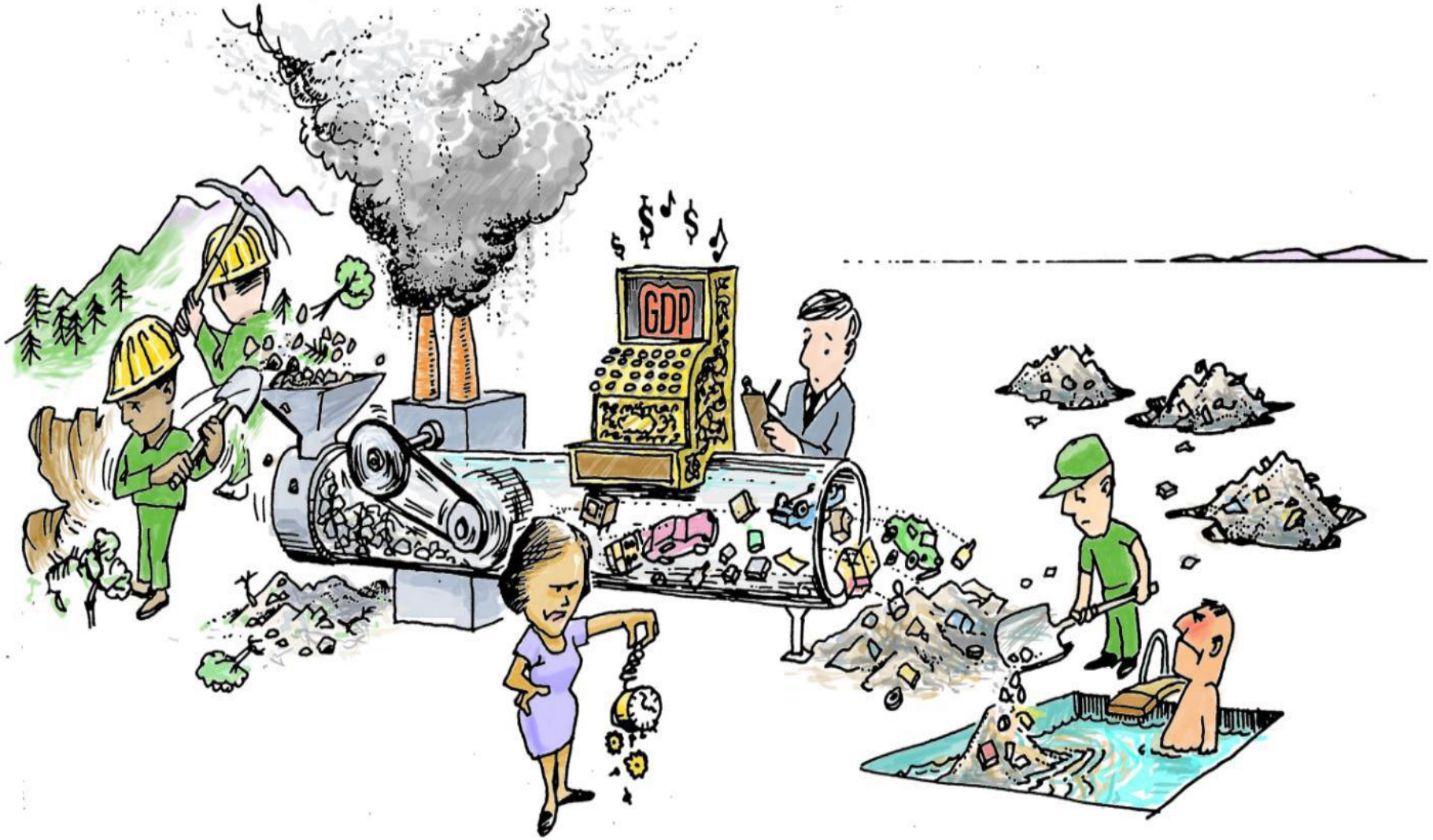
Observed data for Norfolk, Virginia. The baseline data for temperature are for the most complete set of years centered around the 1980s. Shown are the central range (middle 67%) of values from model-based probabilities across the GCMs and greenhouse gas emissions scenarios.

Extreme Weather Events

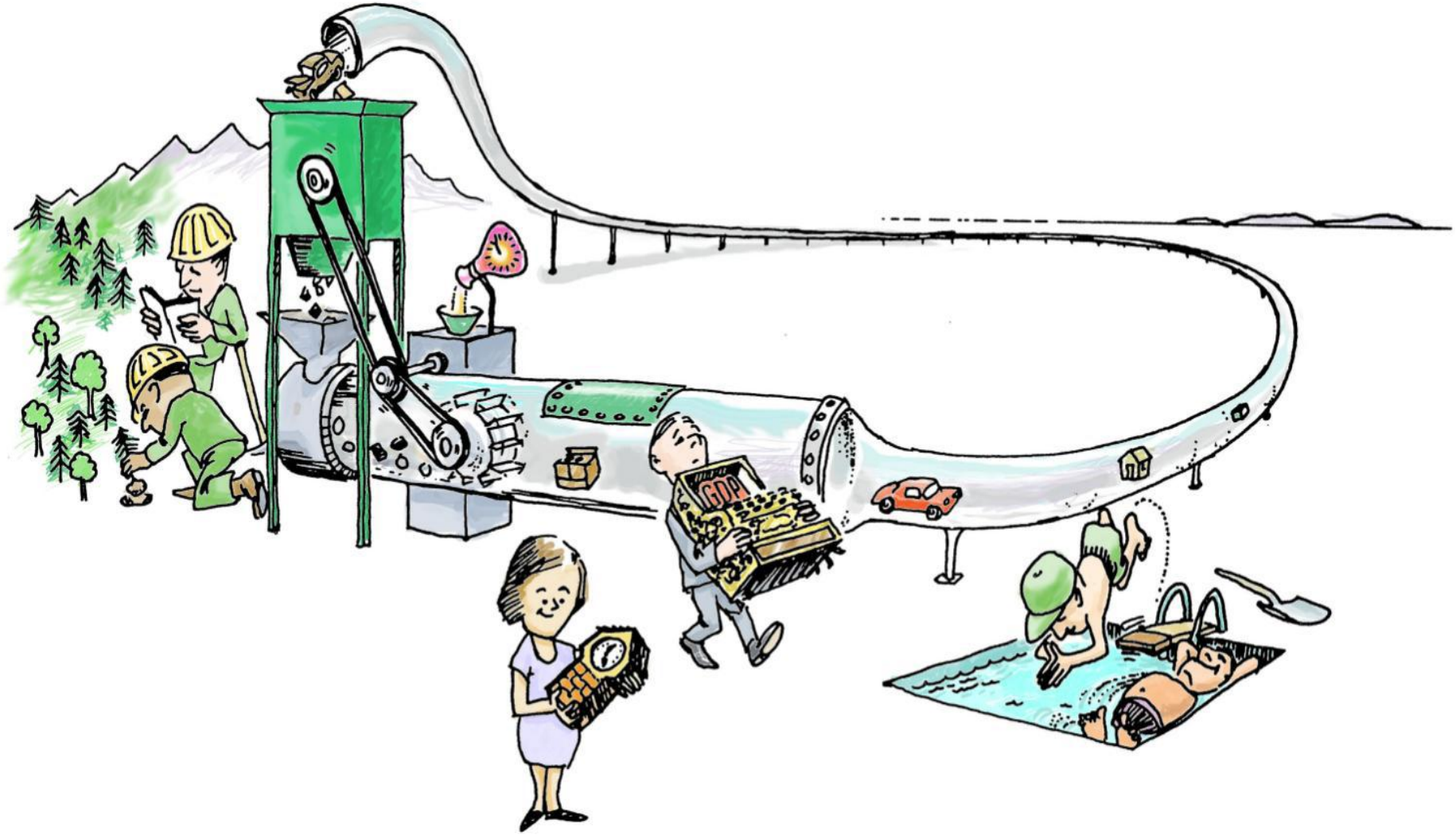


Sources: NOAA (temperature extremes); Insurance Information Institute; Munich Re

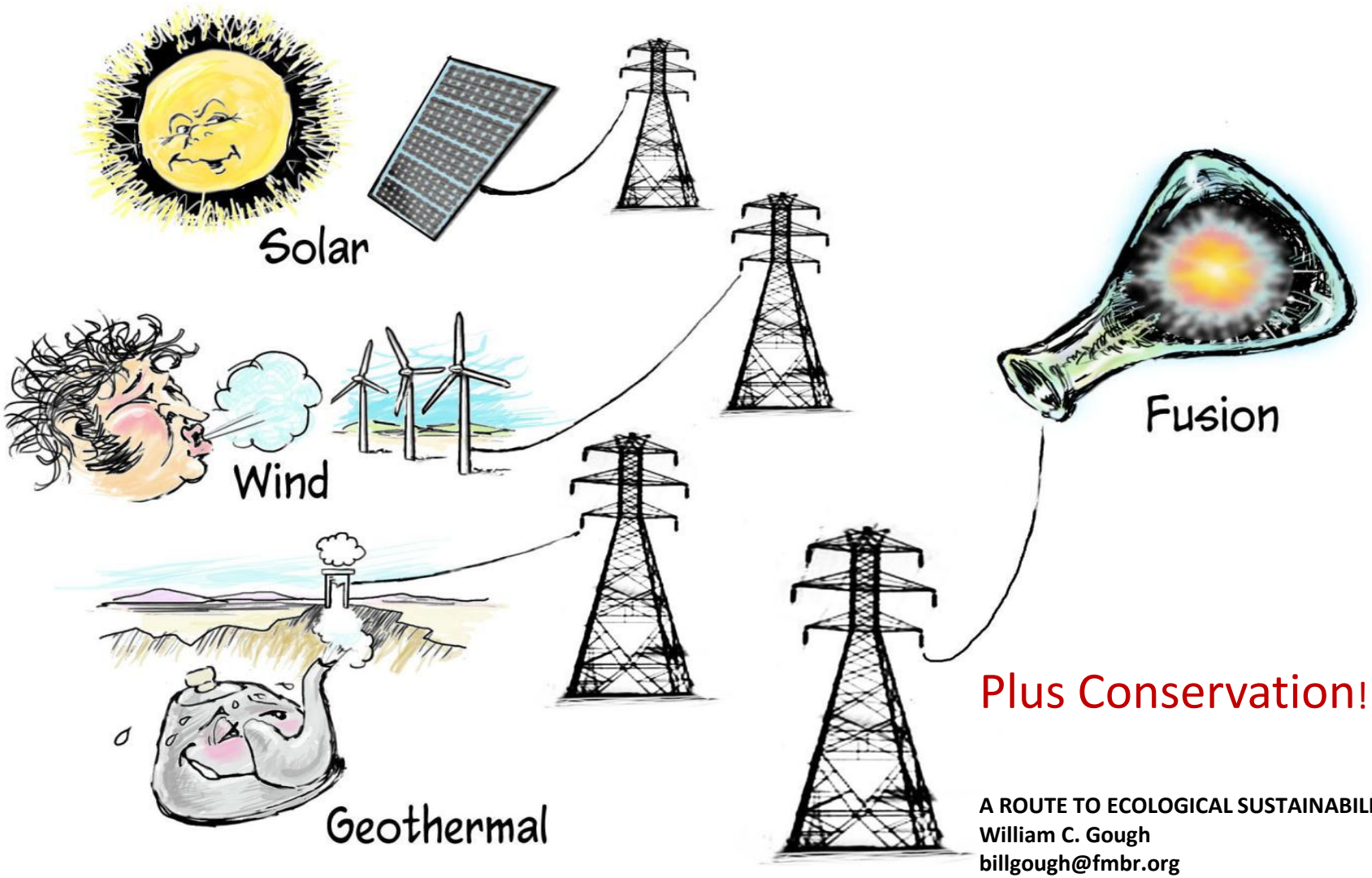
The current economic system is unsustainable



We must transition to a renewable economic system



Some renewable energy solutions



Plus Conservation!

A ROUTE TO ECOLOGICAL SUSTAINABILITY
William C. Gough
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Conclusion

- Climate change will impact all life on Earth.
- Hampton Roads will experience increased sea level rise and increased risk from hurricanes.
- Local, state, federal and global governments will need coordinated policies to address climate change.
- Local governments are starting to initiate programs to help constituents reduce their carbon footprint.
- Both adaptation and mitigation will be necessary to reduce the risk associated with future climate change.