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Climate Change in the Gulf of Maine

Charles Tilburg

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Climate Change in the Gulf of Maine

Charles Tilburg

Maine Aquaculture Research, Development & Education Summit

January 17, 2020

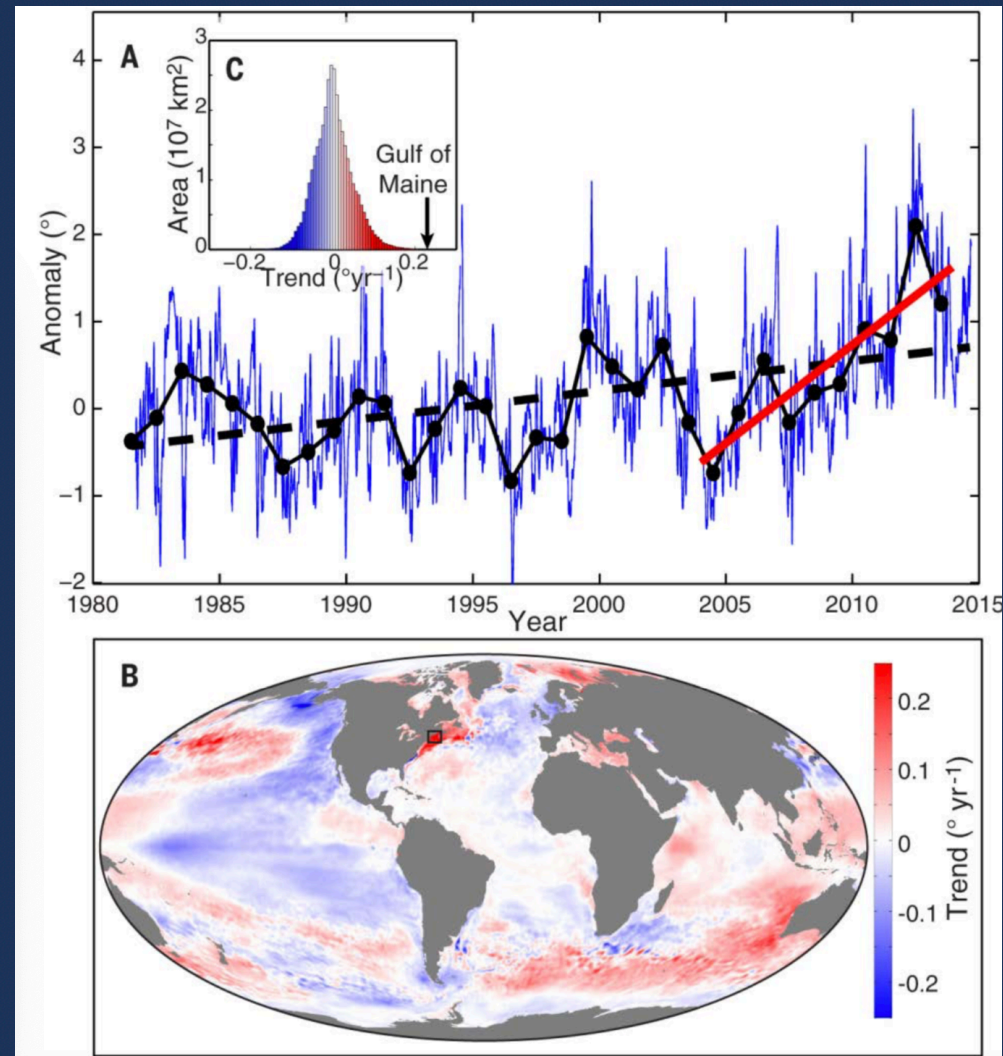
MAINE'S CLIMATE FUTURE

**2015
UPDATE**

Where is this coming from?

Fernandez, I.J., C.V. Schmitt, S.D. Birkel, E. Stancioff, A.J. Pershing, J.T. Kelley, J.A. Runge, G.L. Jacobson, and P.A. Mayewski. 2015. *Maine's Climate Future: 2015 Update*. Orono, ME: University of Maine. 24pp.
climatechange.umaine.edu/research/publications/climate-future

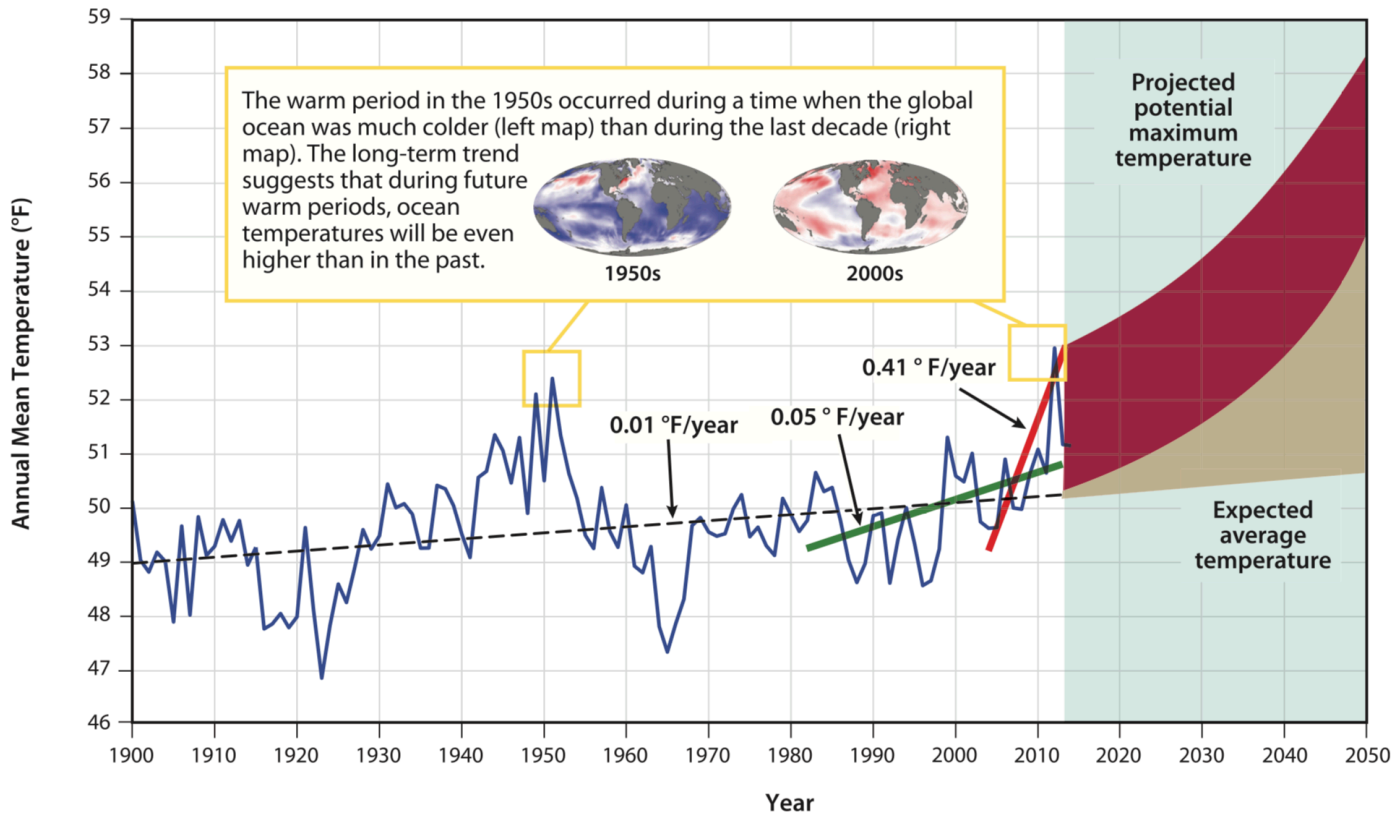
Where did this all start?



Pershing AJ, et al. 2015. Slow adaptation in the face of rapid warming leading collapse of the Gulf of Maine cod fishery. *Science* 350(6262): 809-812.

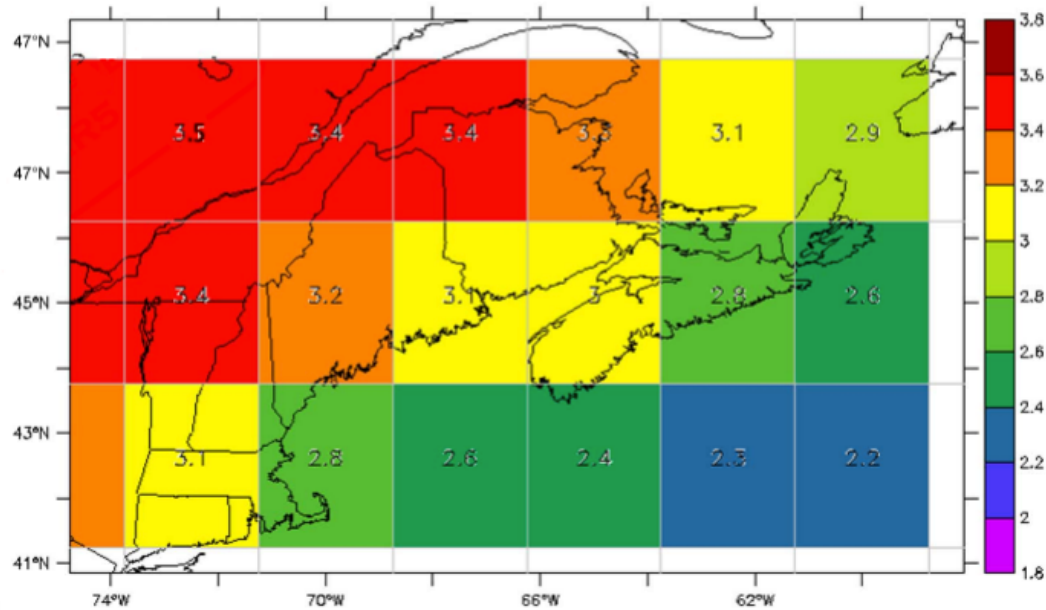
The Gulf of Maine will continue to warm...

Gulf of Maine Sea Surface Temperature



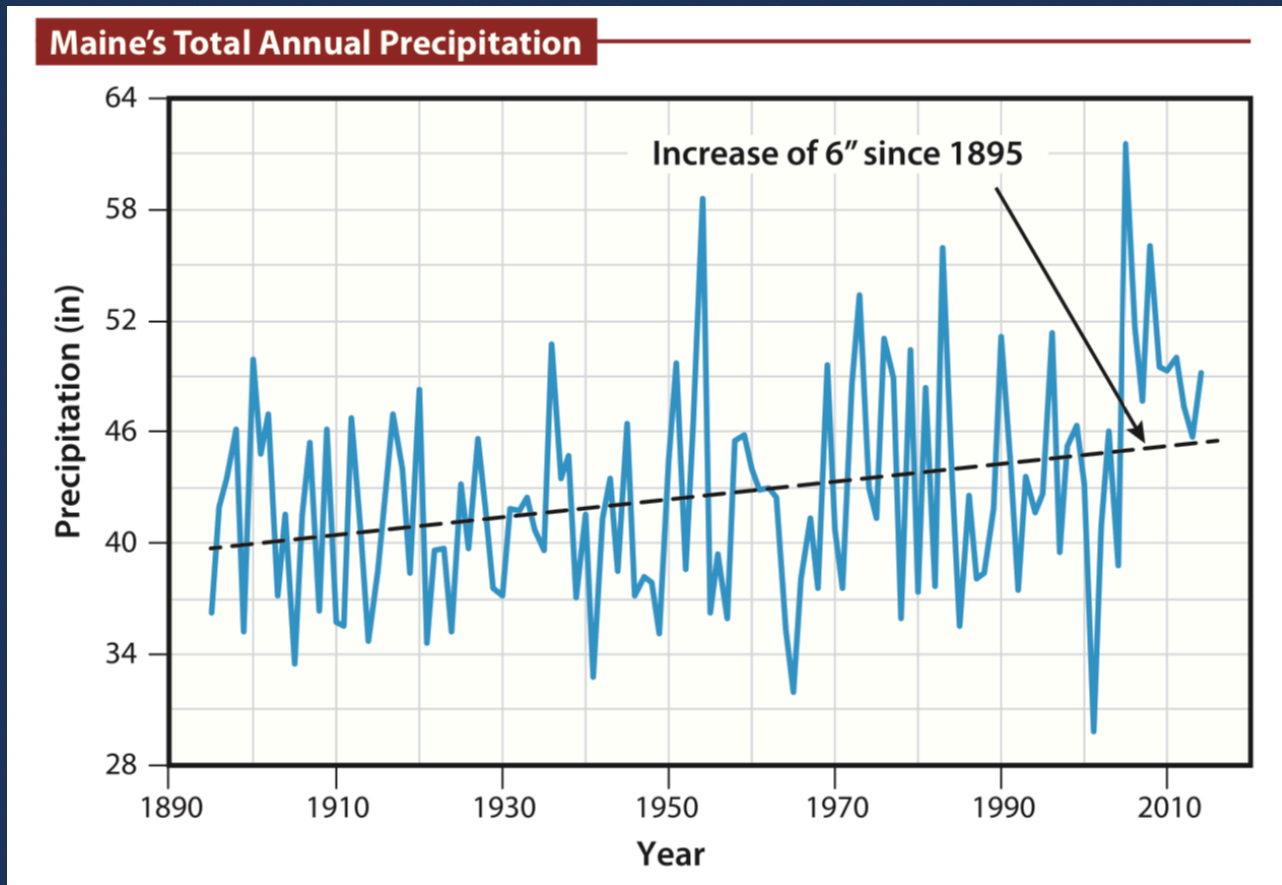
...but it will warm unevenly

Temperature change in 2050 from 1981-2000 average



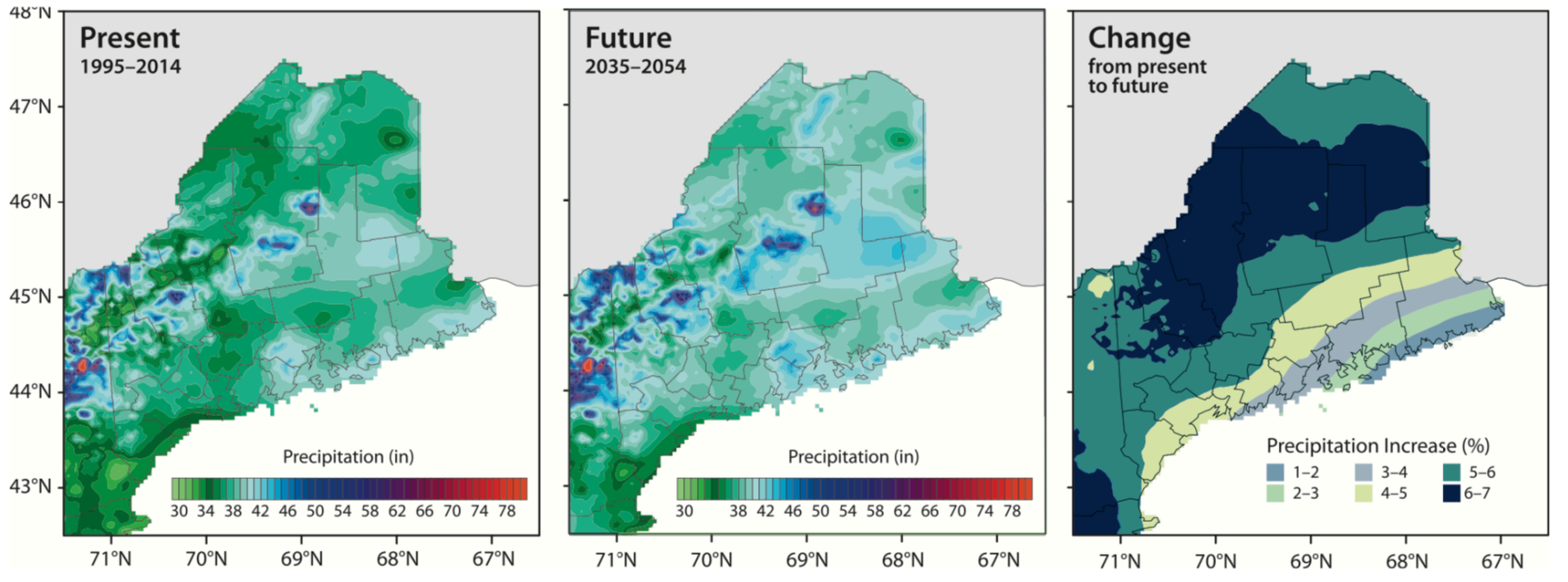
(modified from Dr. Adam Fenech, UPEI Climate Lab)

Precipitation has been increasing since 1895...

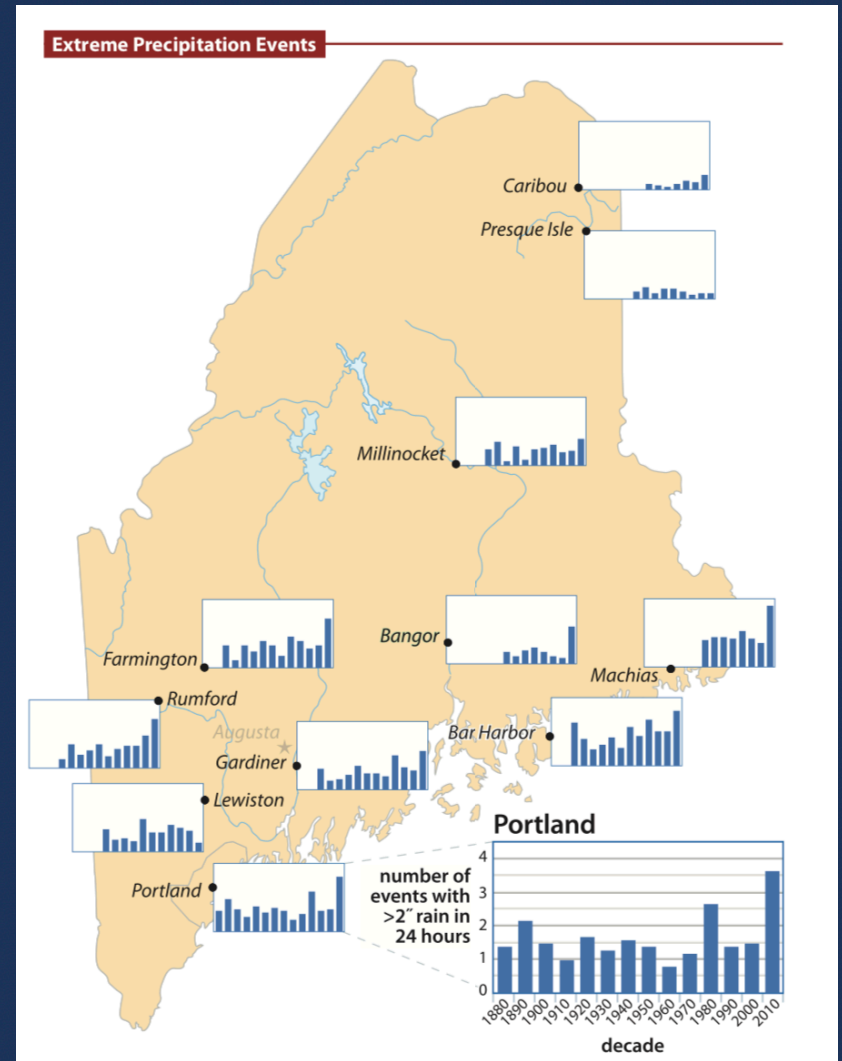


..and will continue to increase..

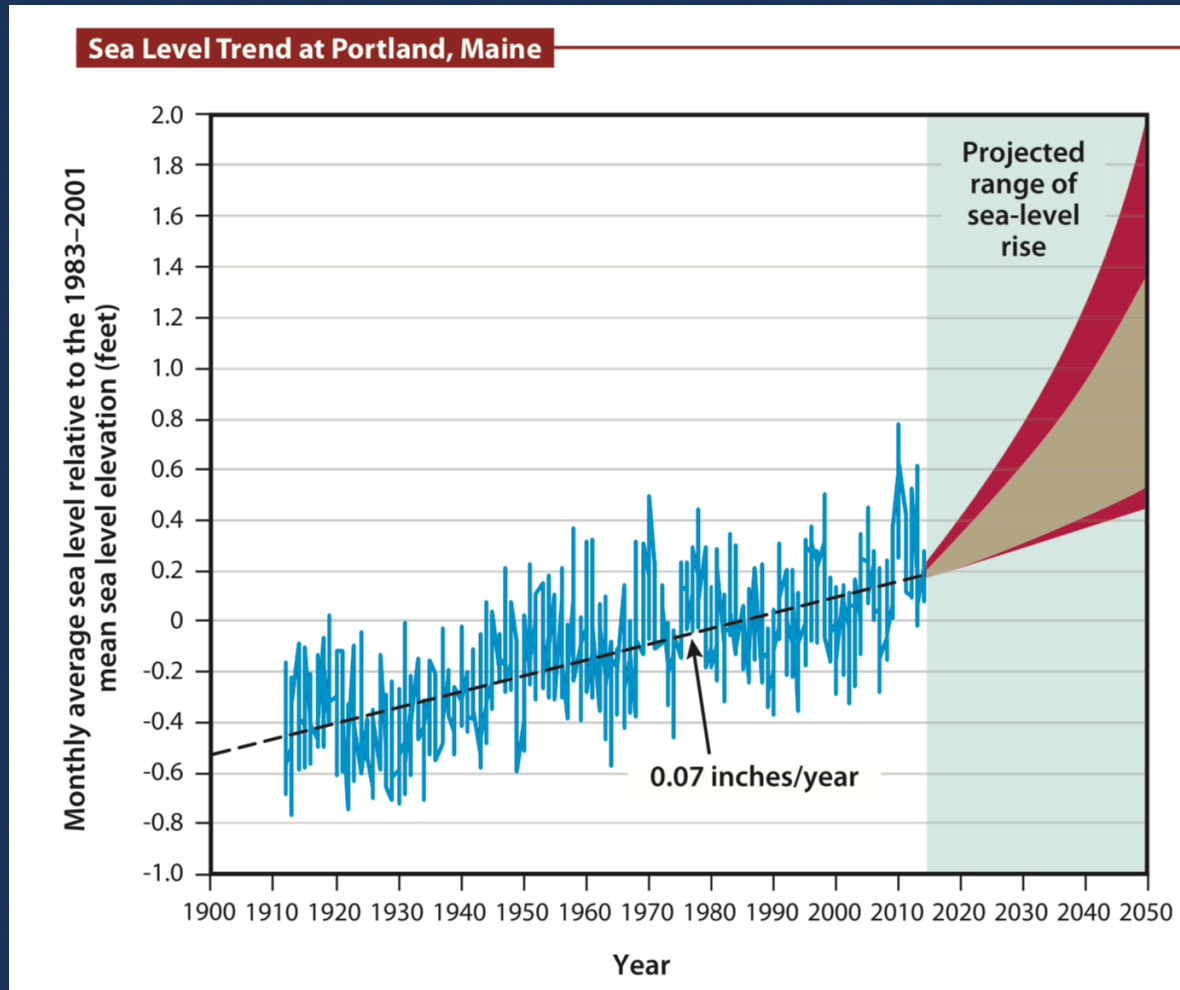
Maine's Annual Precipitation Present and Future



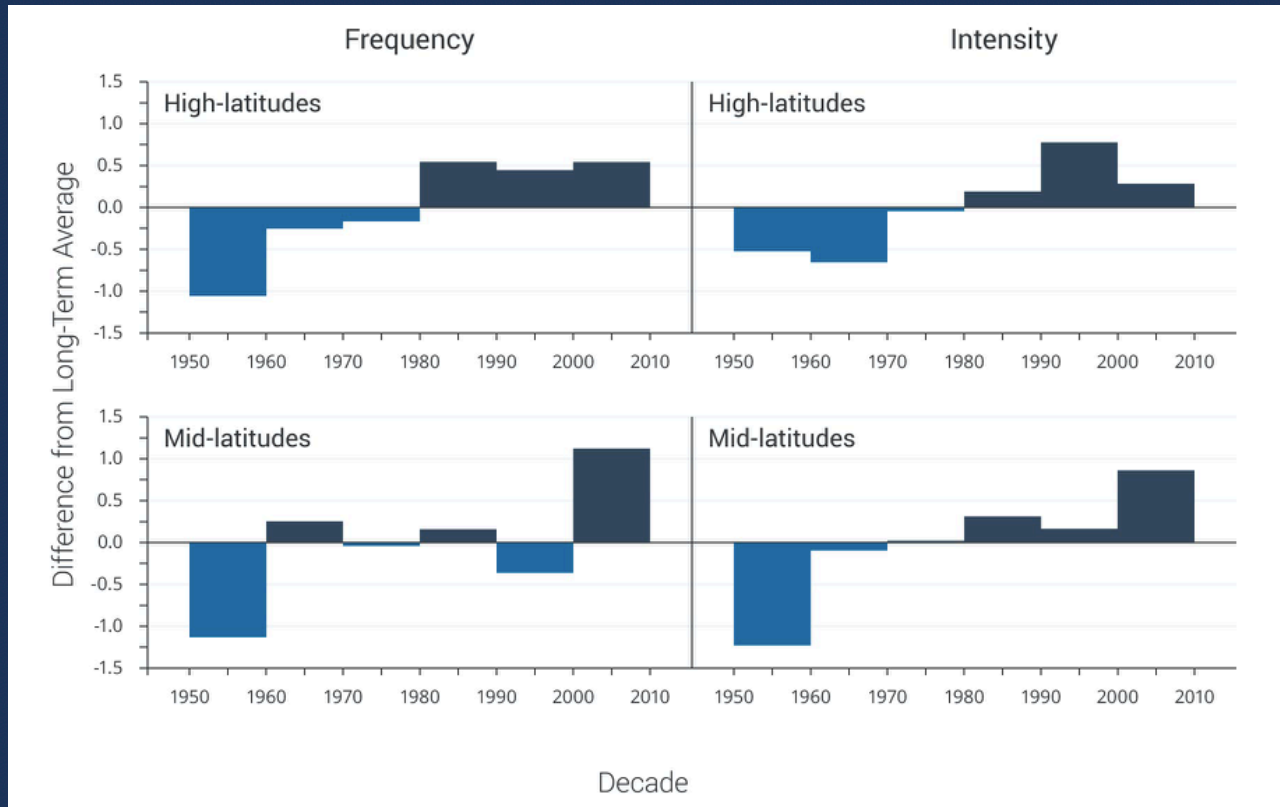
...resulting in more extreme precipitation events.



Sea level rise will accelerate in the future

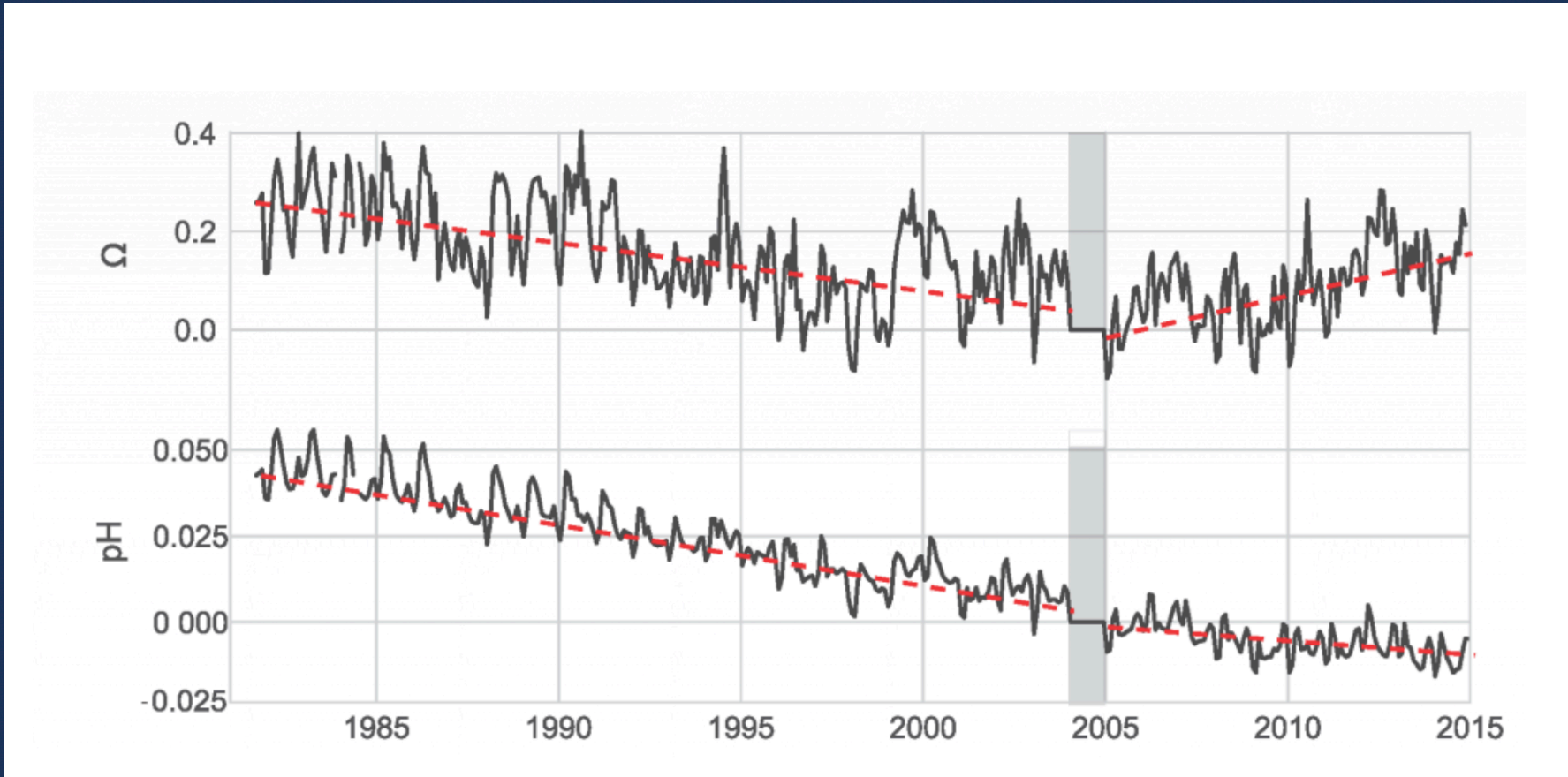


Winter storms are increasing in frequency



CCSP, 2008: *Weather and Climate Extremes in a Changing Climate - Regions of Focus - North America, Hawaii, Caribbean, and U.S. Pacific Islands. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Vol. 3.3*. R. Karl, G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray, Eds. Department of Commerce, NOAA's National Climatic Data Center, 164 pp.

Ocean Acidification has slowed due to the increase in temperature



Salisbury, J.E., Jönsson, B.F. Rapid warming and salinity changes in the Gulf of Maine alter surface ocean carbonate parameters and hide ocean acidification. *Biogeochemistry* **141**, 401–418 (2018) doi:10.1007/s10533-018-0505-3

Take Home Messages

- **The Gulf of Maine is getting hotter.**
 - Since 2004, the rate of warming has been 0.41 °F (0.23 °C) per year
 - IPCC models project that temperature will increase by 2-10 °F (2-6 °C) by 2050
- **The Gulf of Maine is getting wetter.**
 - Since 1895, total annual precipitation has increased by about six inches (or 13%)
 - Annual precipitation will increase across the Northeast by 2-5 inches (5–10%) by 2050
- **Storms are increasing in frequency.**
- **Sea level is rising.**
 - Since 1912, sea level in the Gulf of Maine has increased about 7 inches.
 - Sea level will increase by 5-24 inches by 2050.
- **The extent of ocean acidification is limited by the increase in ocean temperatures.**
 - pH decreased by 0.035 from 1982 to 2004
 - pH decreased by 0.010 from 2005 to 2015