ATOC 4800: Policy Implications of Climate
ATOC 5000:Critical Issues in Climate and the Environment

Goal of class: Promote critical thinking skills

My role: provide knowledge & facts – particularly forefront research – & promote you to think deeply;

Your role: think hard & be open minded

Guest lecture: Dr. Fahey from NOAA – ozone depletion

Guest lecture: Anthropogenic land use/climate

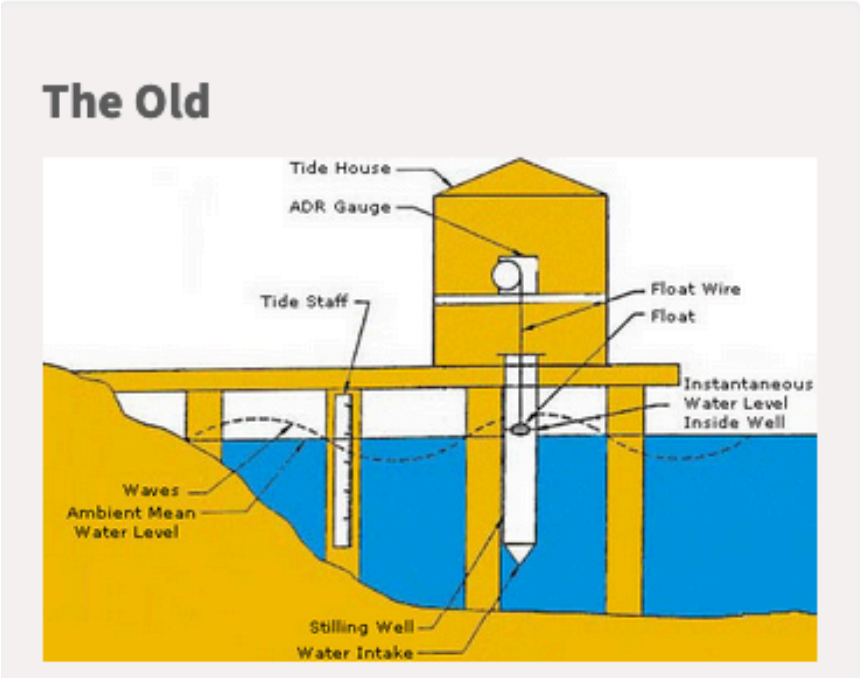
(lectures confirmed but dates uncertain)

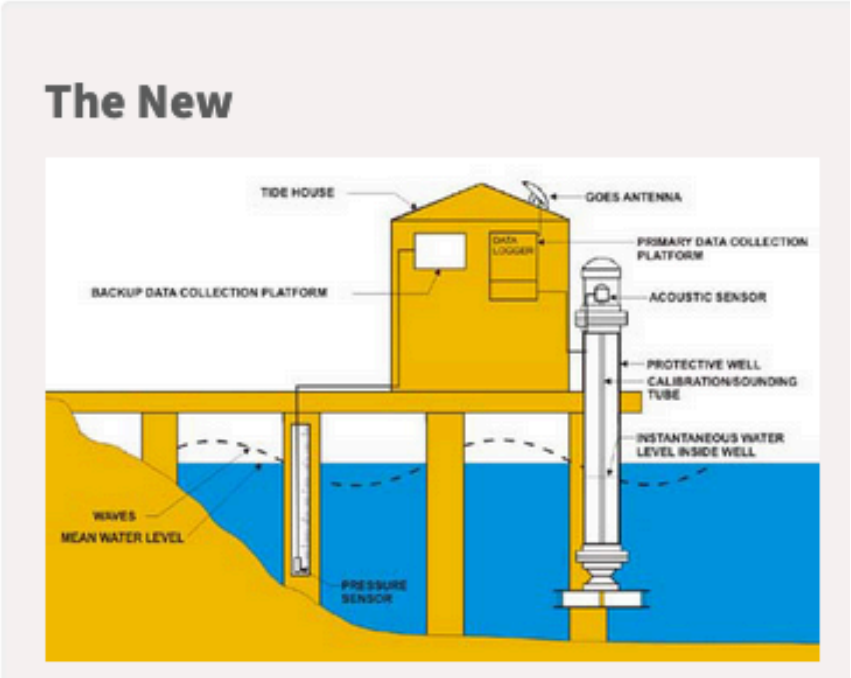
HW grading: usually return in 1 week; exceptions (e.g., meetings, deadlines)

Tide gauge measurements: Relative Sea Level (RSL)

https://oceanservice.noaa.gov/facts/tide-gauge.html

The rise and fall of the tides play an important role in the natural world and can have a marked effect on maritime-related activities. The image aboves shows the NOAA San Francisco Tide Station, in operation for more than 150 years.





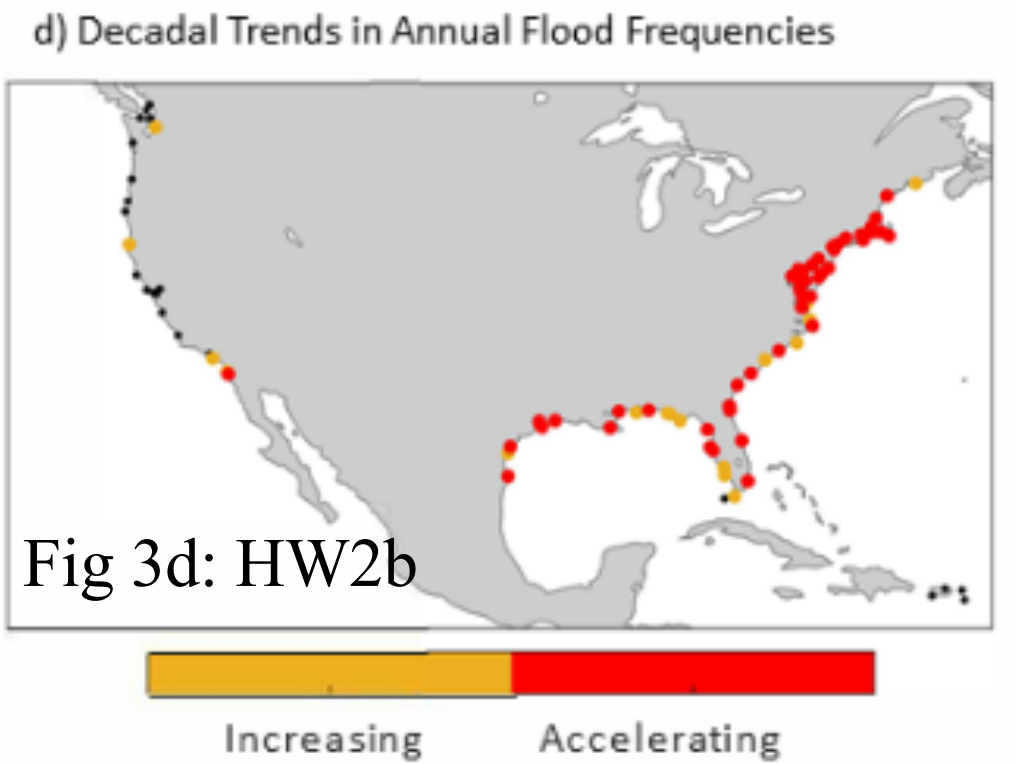
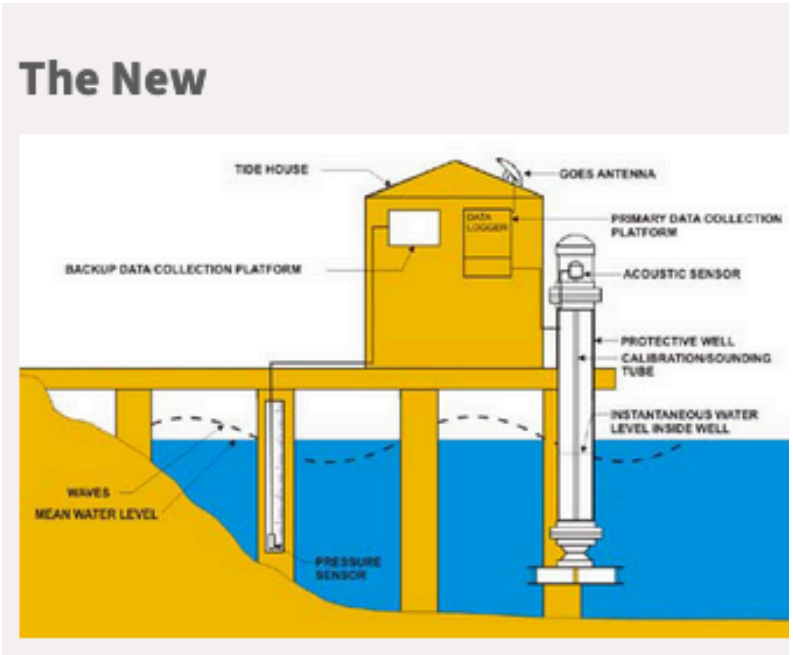


Fig 3d: HW2b



Factors affect sea level change

a) **Thermal expansion due to warming**
b) **Land ice melting – mass input**
c) **Land motion:** e.g., sinking due to ground water extraction
d) **Changes in atmosphere - ocean circulation**

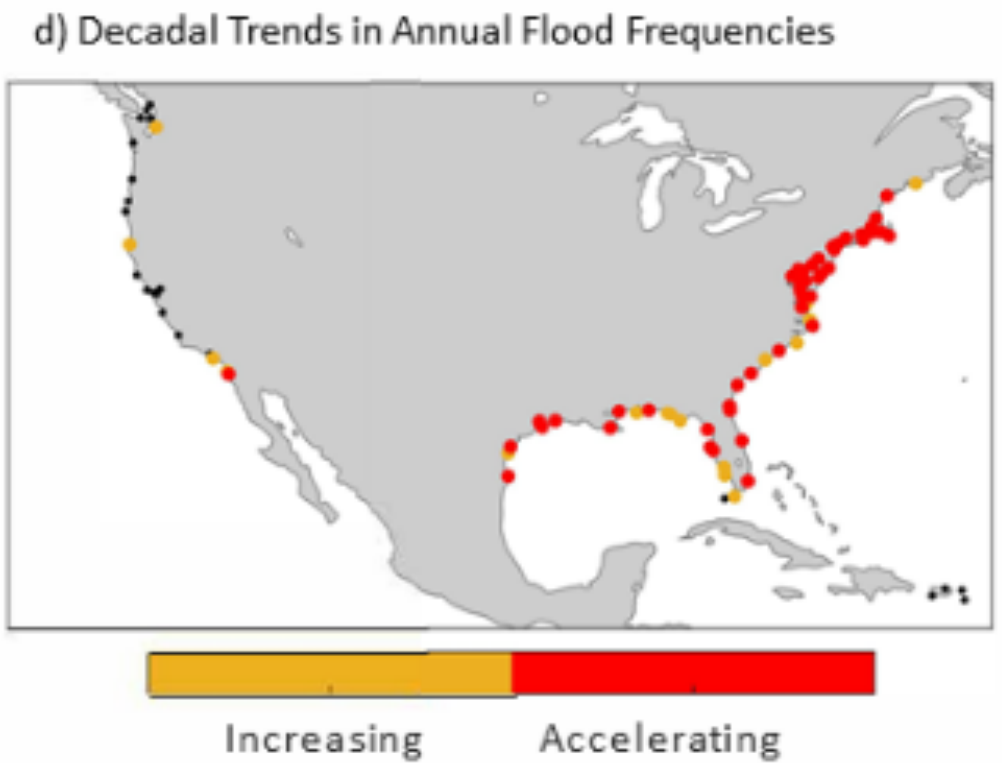
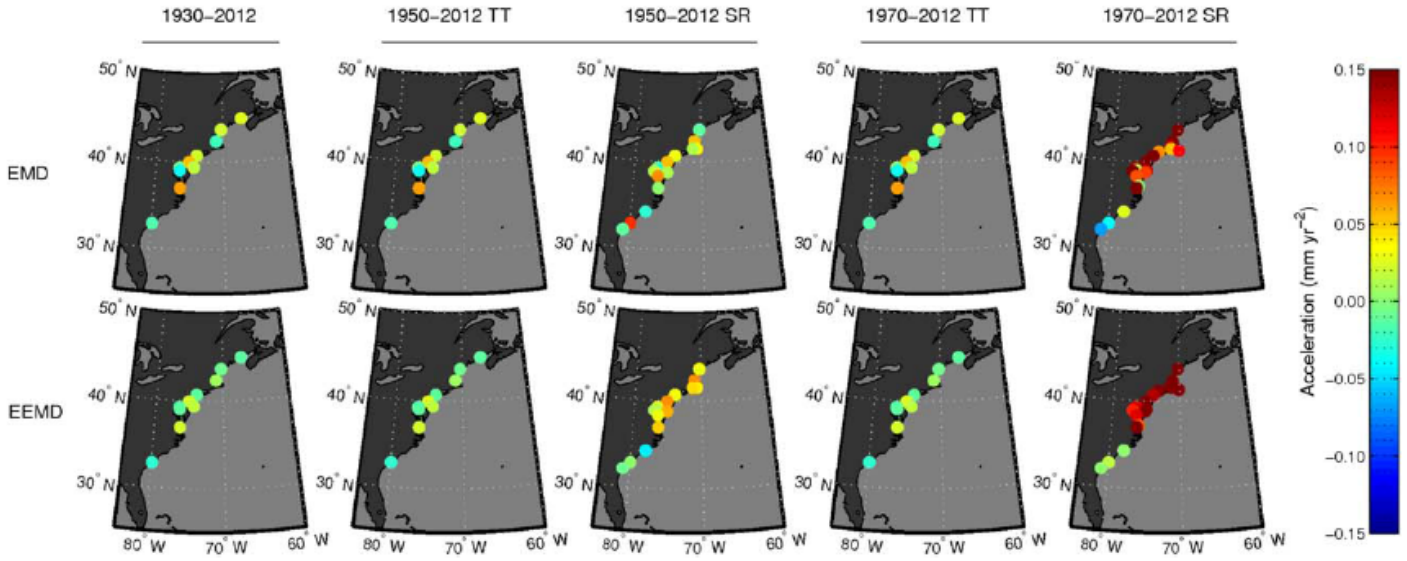
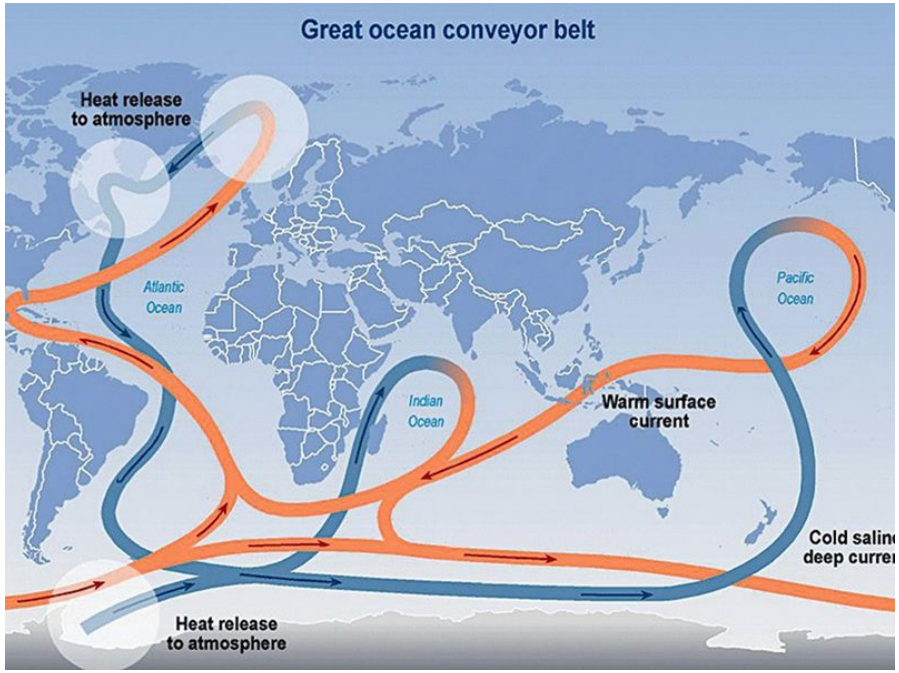


Fig 3d: HW2b

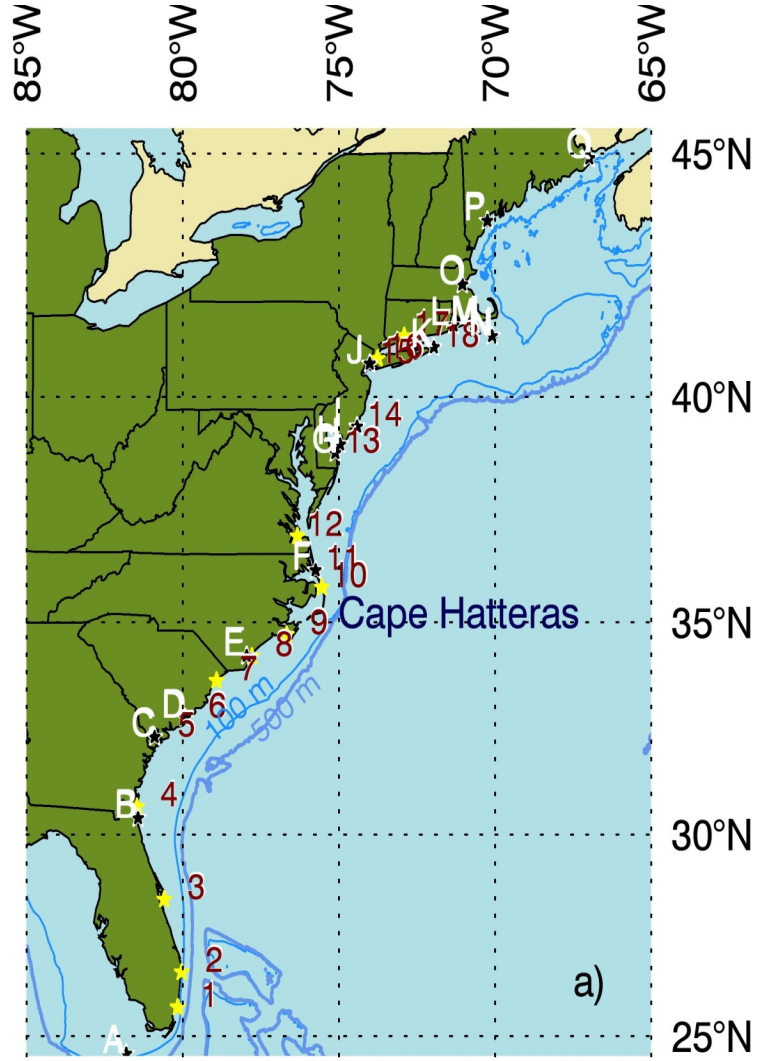
Observed rapid Sea level rise along US Northeast coast during recent decades



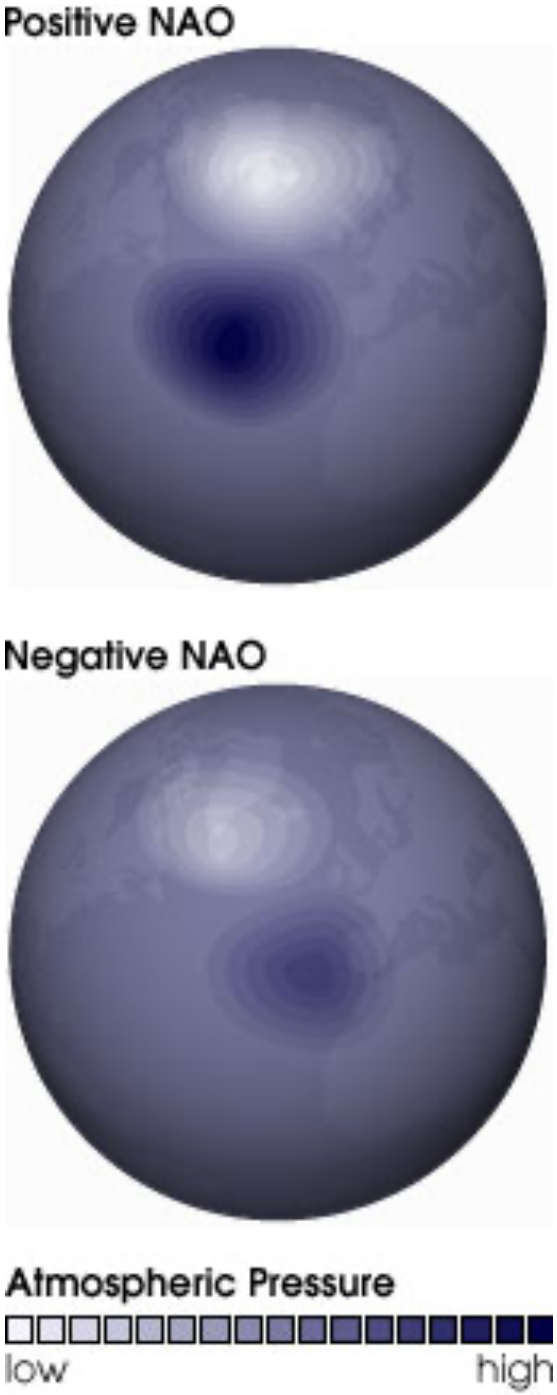
Schematic: **Atlantic Meridional Overturning Circulation (AMOC)**



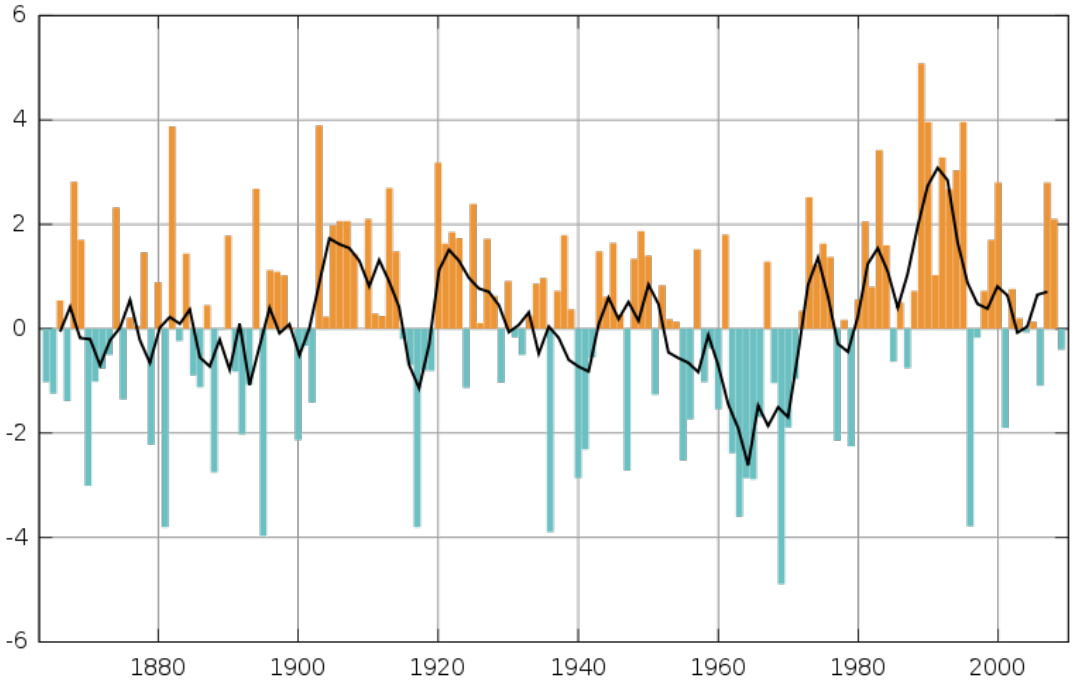
Gulf stream: separarate from the coast near Cape hatteras



Review: The North Atlantic Oscillation



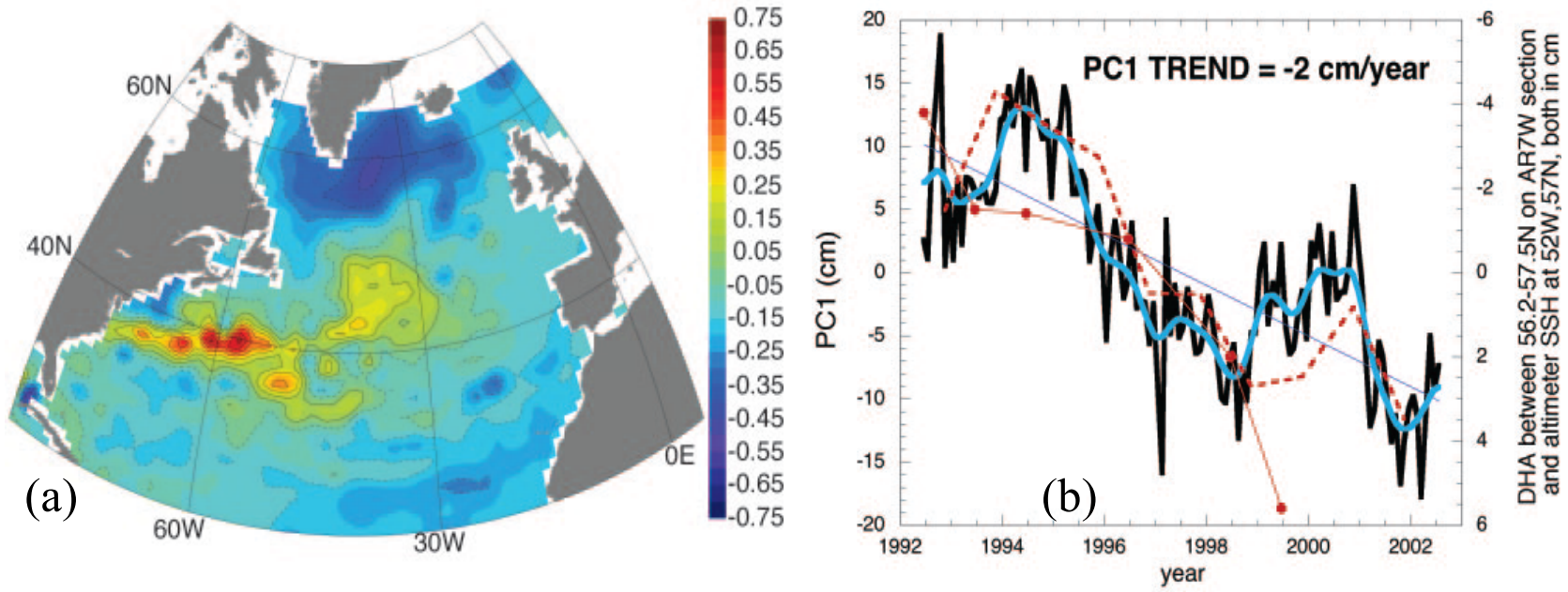
Sea Level Pressure: Oscillation between Icelandic low and Azores high; part of Arctic Oscillation, with interannual-decadal timescale Oscillation (no preferred timescale)



Wintertime NAO index (temporal variability)

Climatic impacts: large impacts on US & European climate, including sea level rise of the Atlantic Ocean

Sea level variability pattern associated with NAO

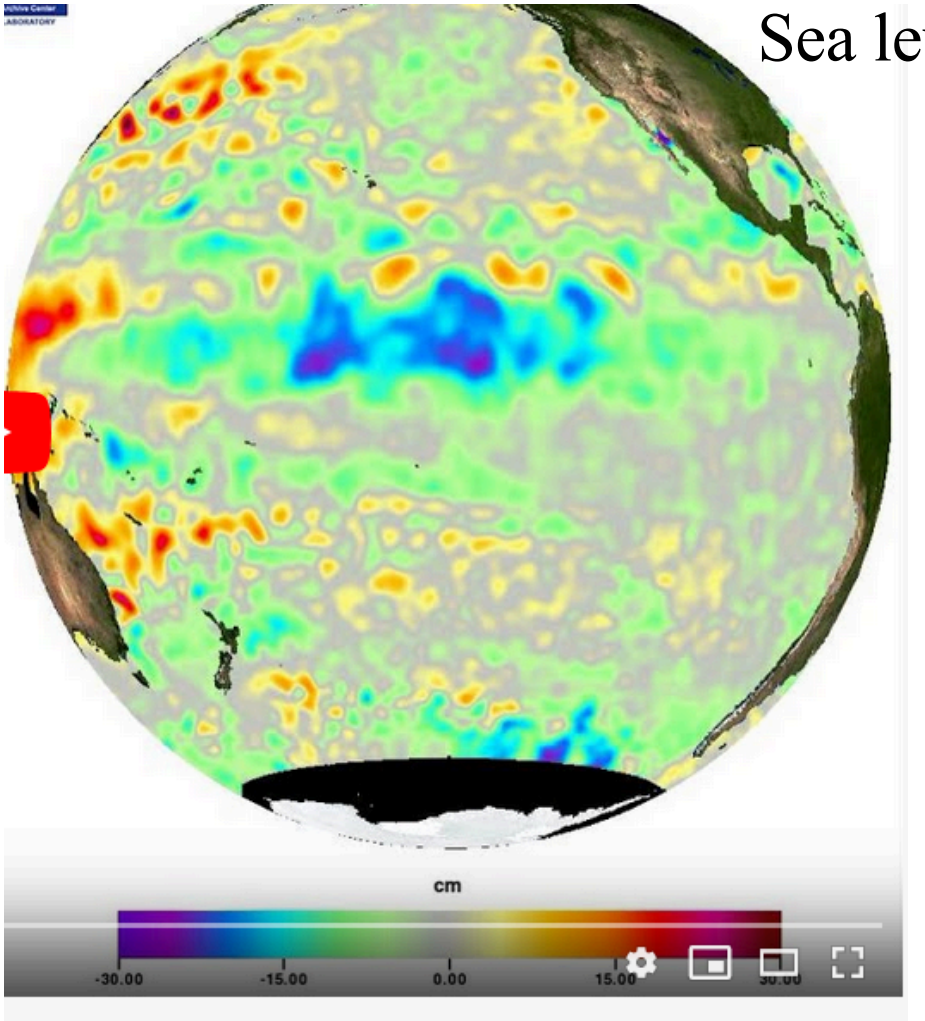


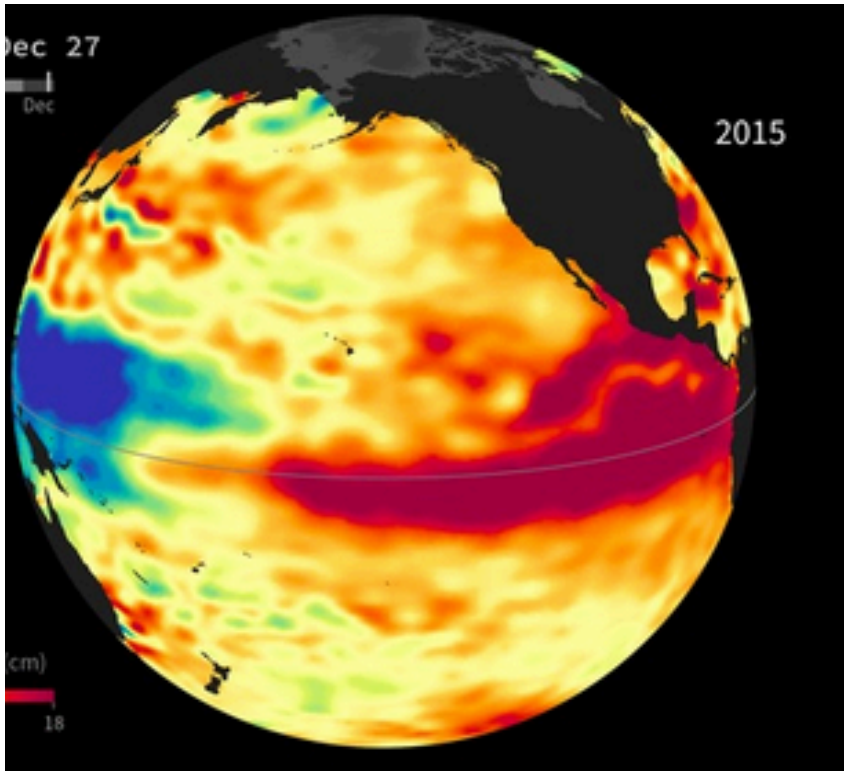
(Left) EOF1 of altimeter SSH and (right) its PC1 (black curve). The blue curve is the binomially smoothed PC1. The dynamic height anomaly (DHA; in solid red; dots denote data points of the time series) computed in the central Labrador Sea (average from 56.2° to 57.5° N along the WOCE AR7/W section across the Labrador Sea from Newfoundland to Greenland) is shown in the right panel with its axis on right. The altimeter SSHa at 52° W, 57° N (12-month May-to-April average) is shown in dashed red curve. Adapted from *Hakkinen and Rhines* [2004]. *From Han et al. (2017): Review of climate modes on spatial distribution of sea level variability.*

ENSO: Pacific Sea Surface Temperature (SST), winds, precipitation, etc. anomalies (impacts global climate**) – global influence**

Cold phase ***Warm phase***

Sea level





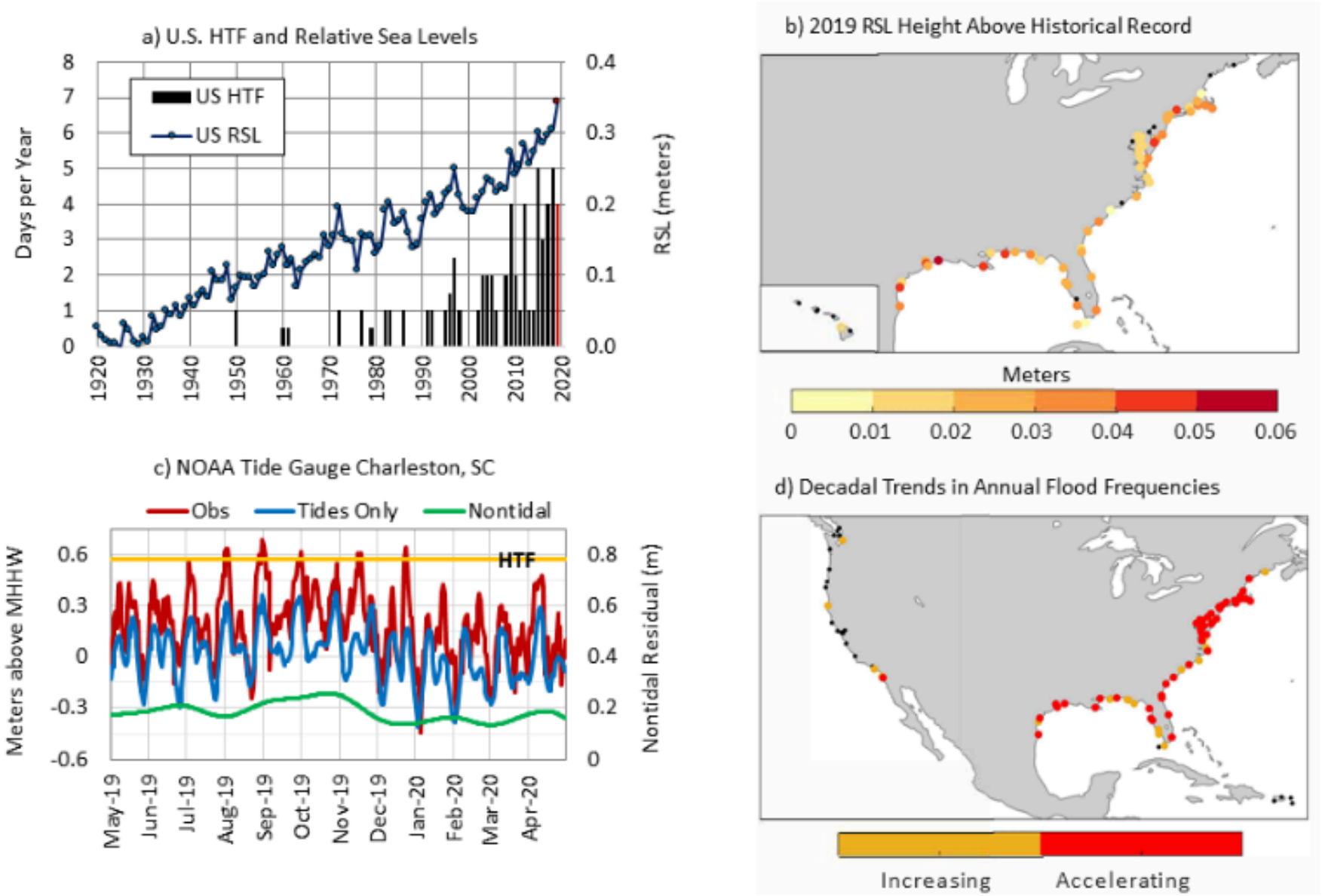
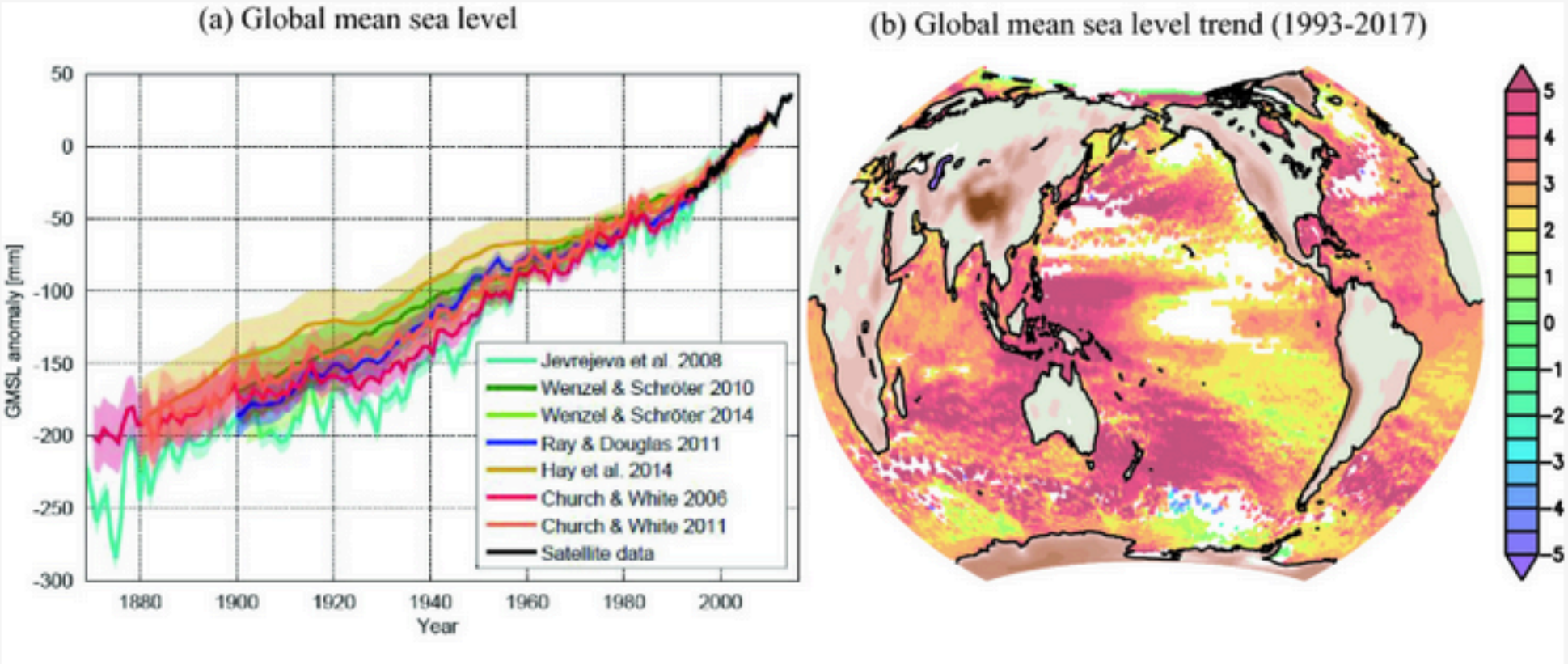


Figure 3. a) Median HTFs per year (black bars) from 1920–2019 with the annual-median rise in RSL (blue line). 2019 sea level and flood frequency values are shown in red. In b) are the individual tide gauge locations that broke historical RSL records in 2019. In c) is a time series of 2019 daily highest water level observation (red line) and its tide component only (blue line) with monthly average nontidal residual levels (green line: observations – tide only) at the NOAA tide gauge in Charleston, S.C. In d) is the characterization of the trends in annual HTF frequencies, with 49 locations now accelerating and 19 increasing linearly. Trends are significant at the 90% level (p value <0.1) or higher.


(a) Global mean sea level
GMSL anomaly [mm]
50
0
-50
-100
-150
-200
-250
-300
1880
1900
1920
1940
1960
1980
2000
Year
Jevrejeva et al. 2008
Wenzel & Schröter 2010
Wenzel & Schröter 2014
Ray & Douglas 2011
Hay et al. 2014
Church & White 2006
Church & White 2011
Satellite data
(b) Global mean sea level trend (1993-2017)
5
4
3
2
1
0
-1
-2
-3
-4
-5

Rapid sea level rise along the US Northeast coast during recent decades: natural cycle or anthropogenic forcing?

(1) The state of our knowledge: scientific understanding of the issue;

Effects of global warming versus natural internal variability

15 minutes discussion

G1: Ben Stasny

G2: Sydney Walker

(2) If you're a policy maker of an US west coast state, what specific information do you want to know from scientists, to make decisions on coastal development plans for 10yr, 30yr and 50yrs?

5-10 min discussion

(3) With the current science knowledge, as a scientist, how would you communicate with policy makers about sea level rise (SLR) along US west coasts? ~10minutes

(4) With the current science knowledge, how to communicate with public regarding effect of global climate change & natural internal variability on US east coast & west coast SLR?

5-10min discussion

(5) Climate science communication: role play

G1: Scientists: how should we communicate – should we emphasize on or ignore uncertainties?

G2: Policy makers:

Considering public/personal properties, infrastructure, economy & tourists, with the current state of knowledge, how to make informed decisions?