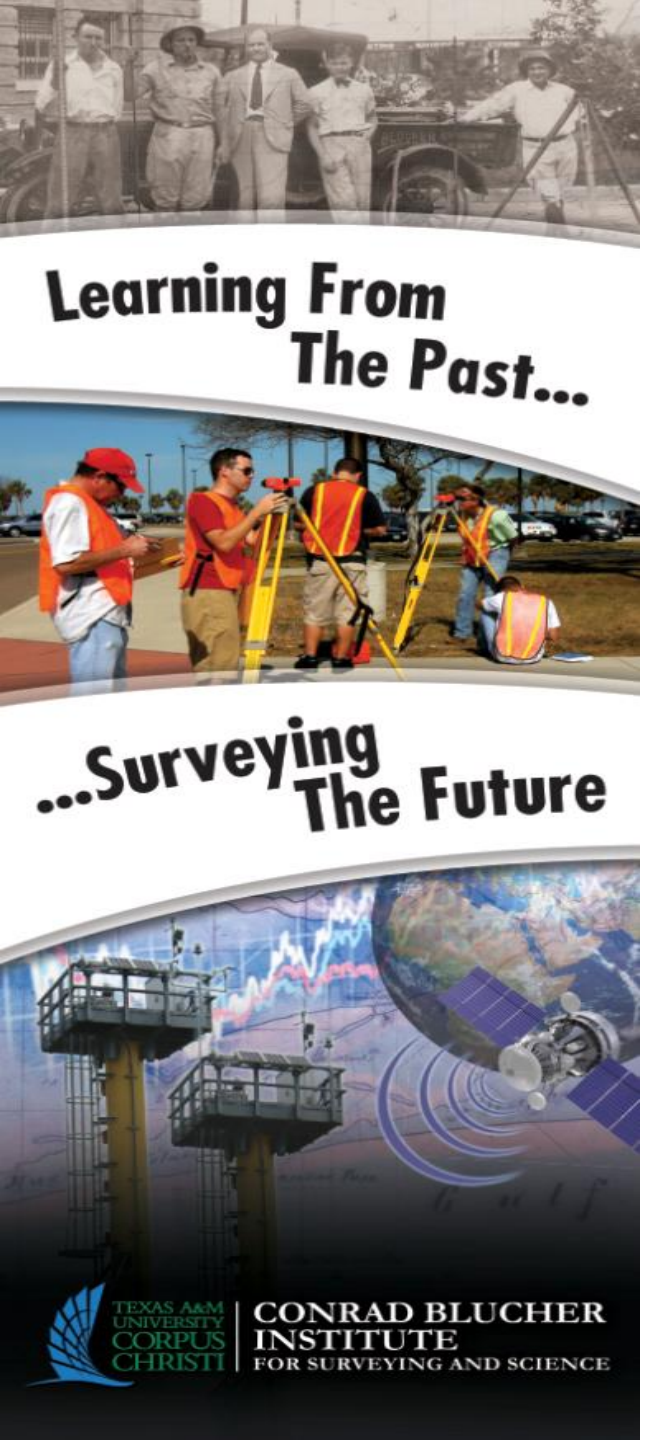


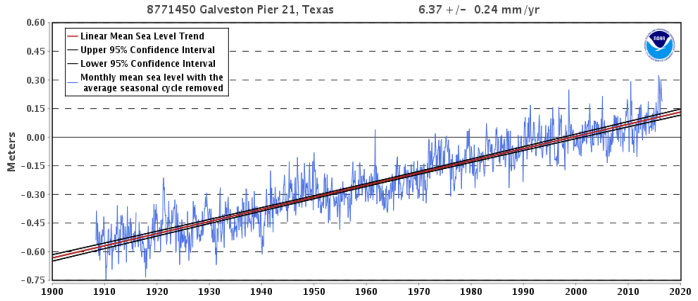
SLR: Spatial variability and interpreting data based on local and regional contexts

Philippe Tissot
Conrad Blucher Institute
Anthony Reisinger & Mark Besonen
Harte Research Institute
Texas A&M University-Corpus Christi

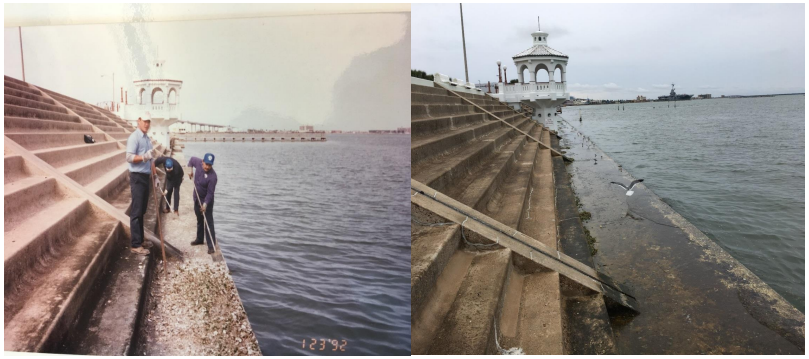
Resilient Texas: Planning for Sea Level Rise
August 8, 2017

Take Home Messages

Measurements

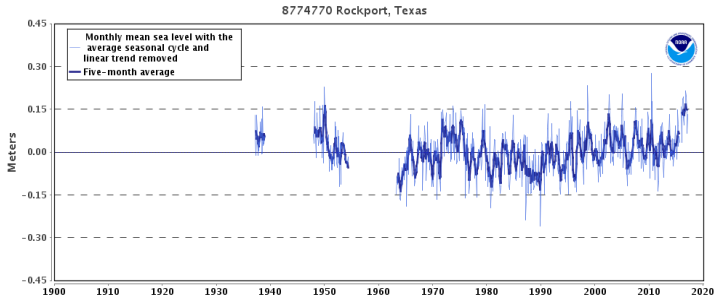


Relative Sea Level Rise



Variability:

Location – Season - Year



Sea Levels: Temporal Variability

Long Term Sea Level Rise: 24K years

Recently sea level rise has been very moderate

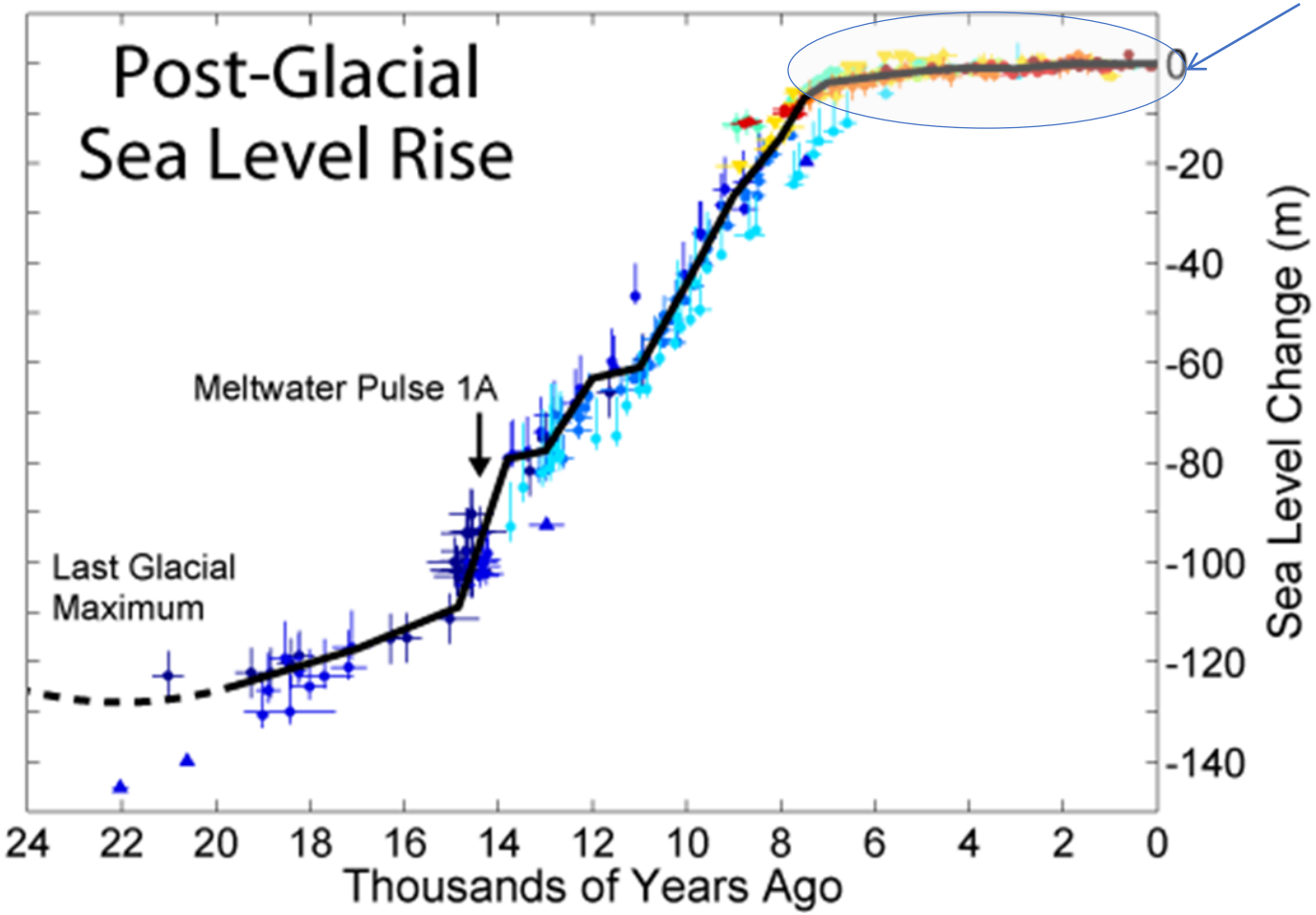
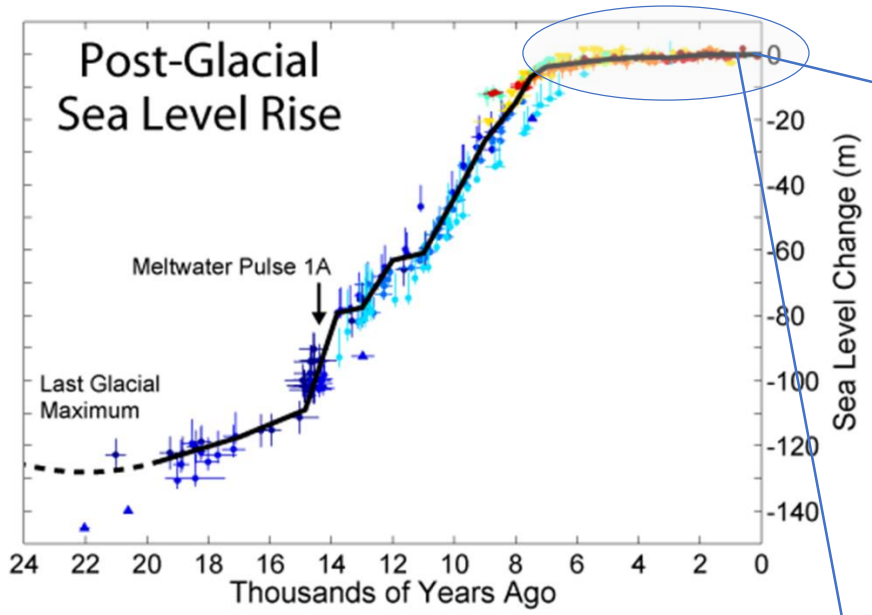


Figure: (http://en.wikipedia.org/wiki/Current_sea_level_rise)

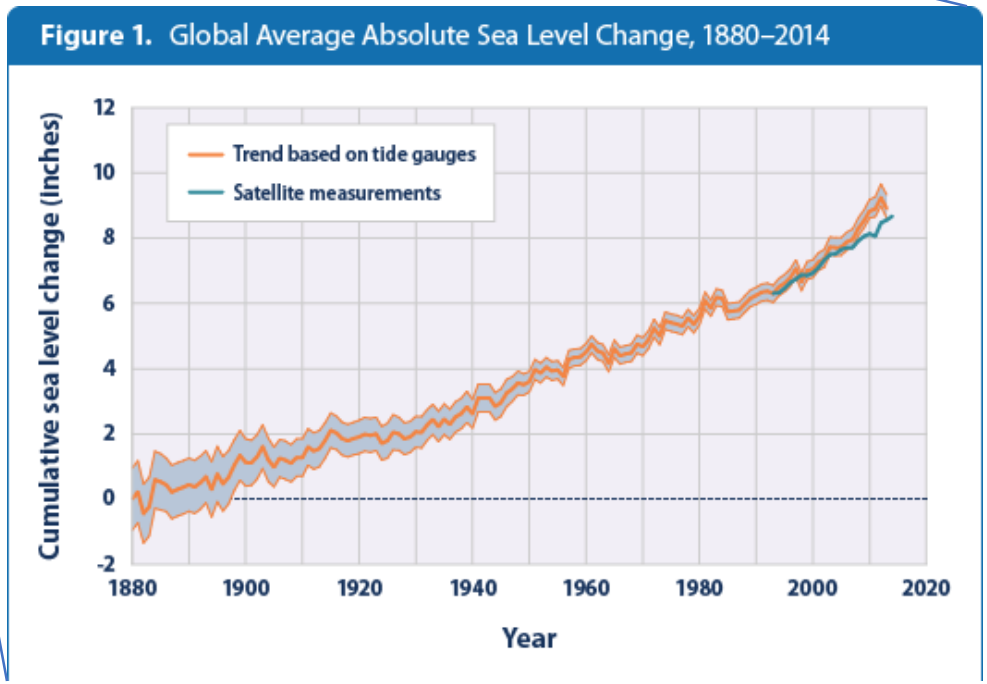
Sea Levels: Temporal Variability



More recent sea level rise:

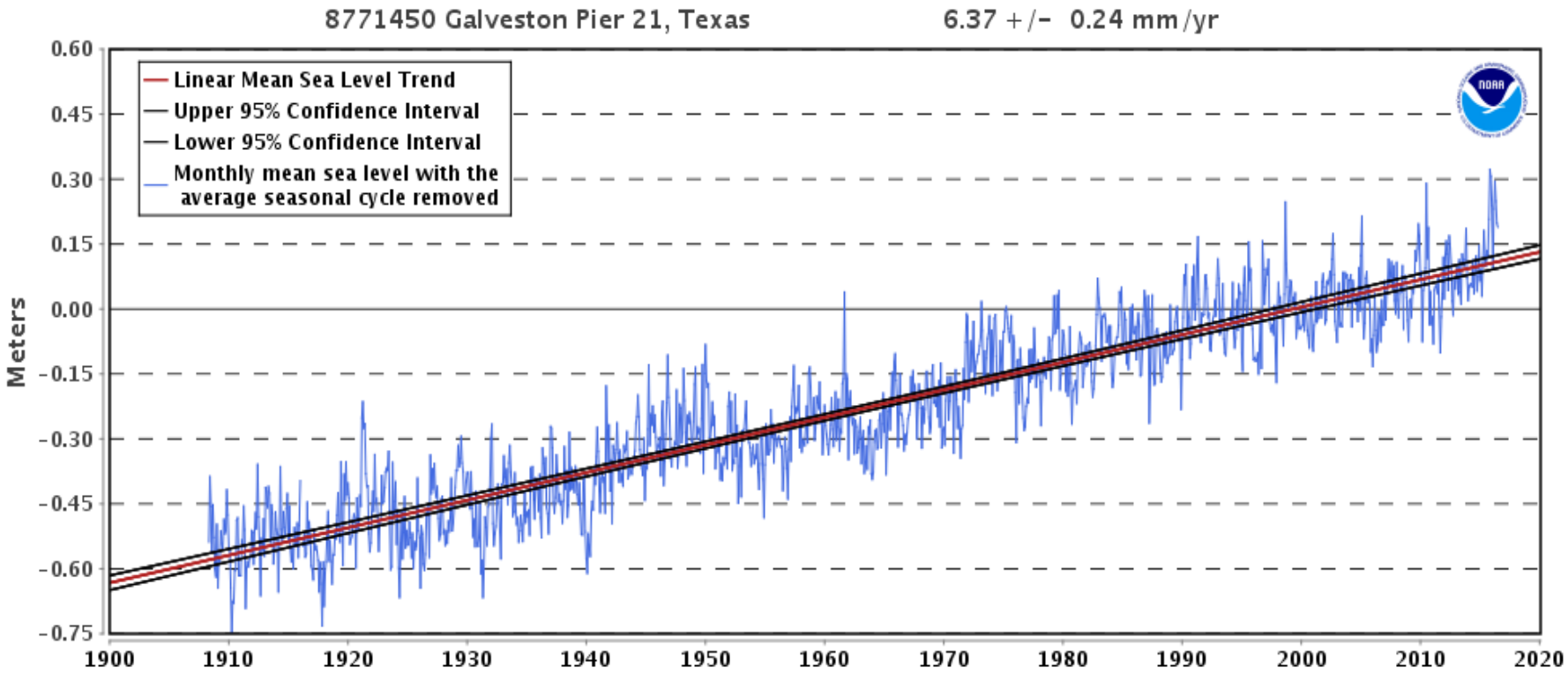
1.7 +/- 0.2 mm/yr (tide gauges)

~ 3.0 +/- 0.4 mm/yr (Satellite 1993-2015)



Top Figure : (http://en.wikipedia.org/wiki/Current_sea_level_rise)
Bottom Figure: (https://www3.epa.gov/climatechange/science/indicators/oceans/sea-level.html)

Galveston



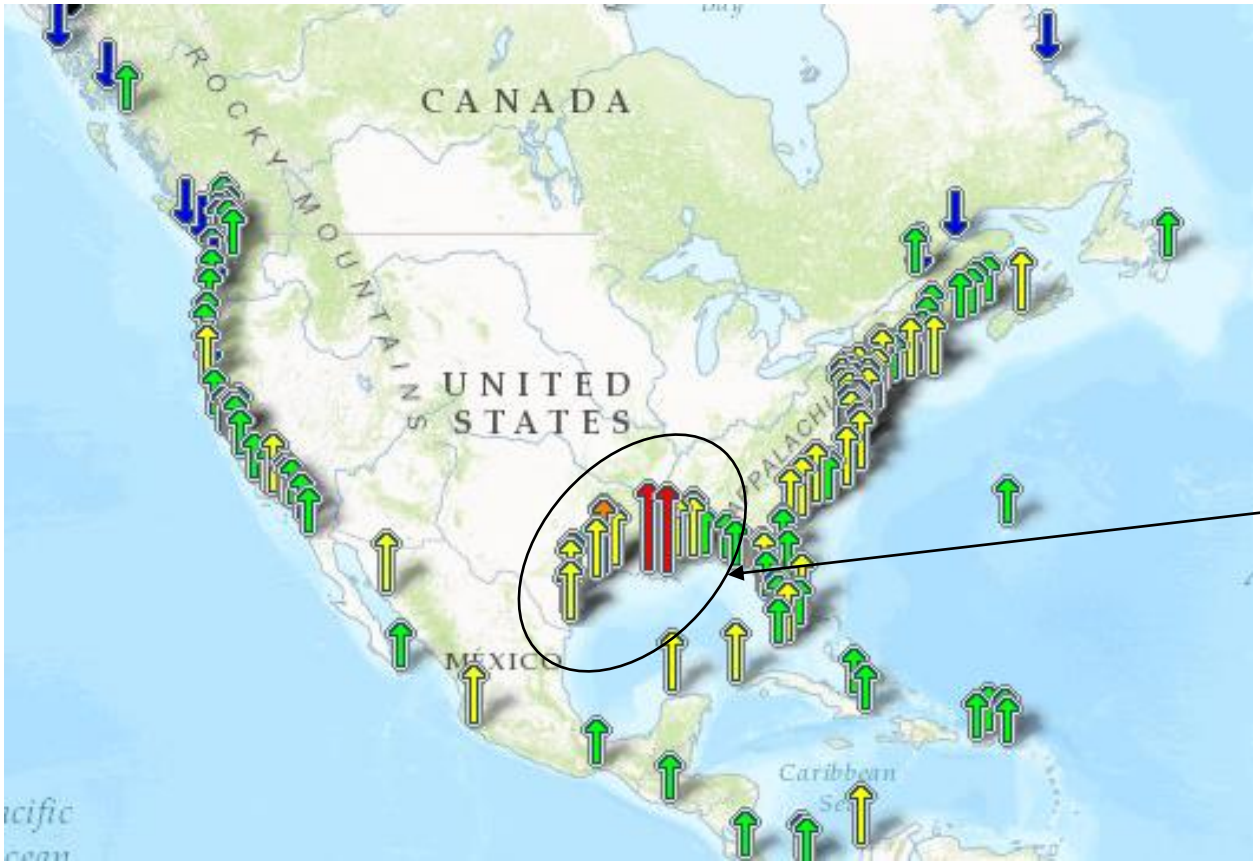
Galveston Pier 21

0.25” / year

100 years = 2.1 ft

TEXAS A&M UNIVERSITY CORPUS CHRISTI | CONRAD BLUCHER INSTITUTE FOR SURVEYING AND SCIENCE

Relative Sea Level Rise in the NW Gulf of Mexico



The Northwest Gulf of Mexico is home to the largest rates of relative sea level rise in the US and 10 of the largest 13 US ports by tonnage (USDOT 2016)

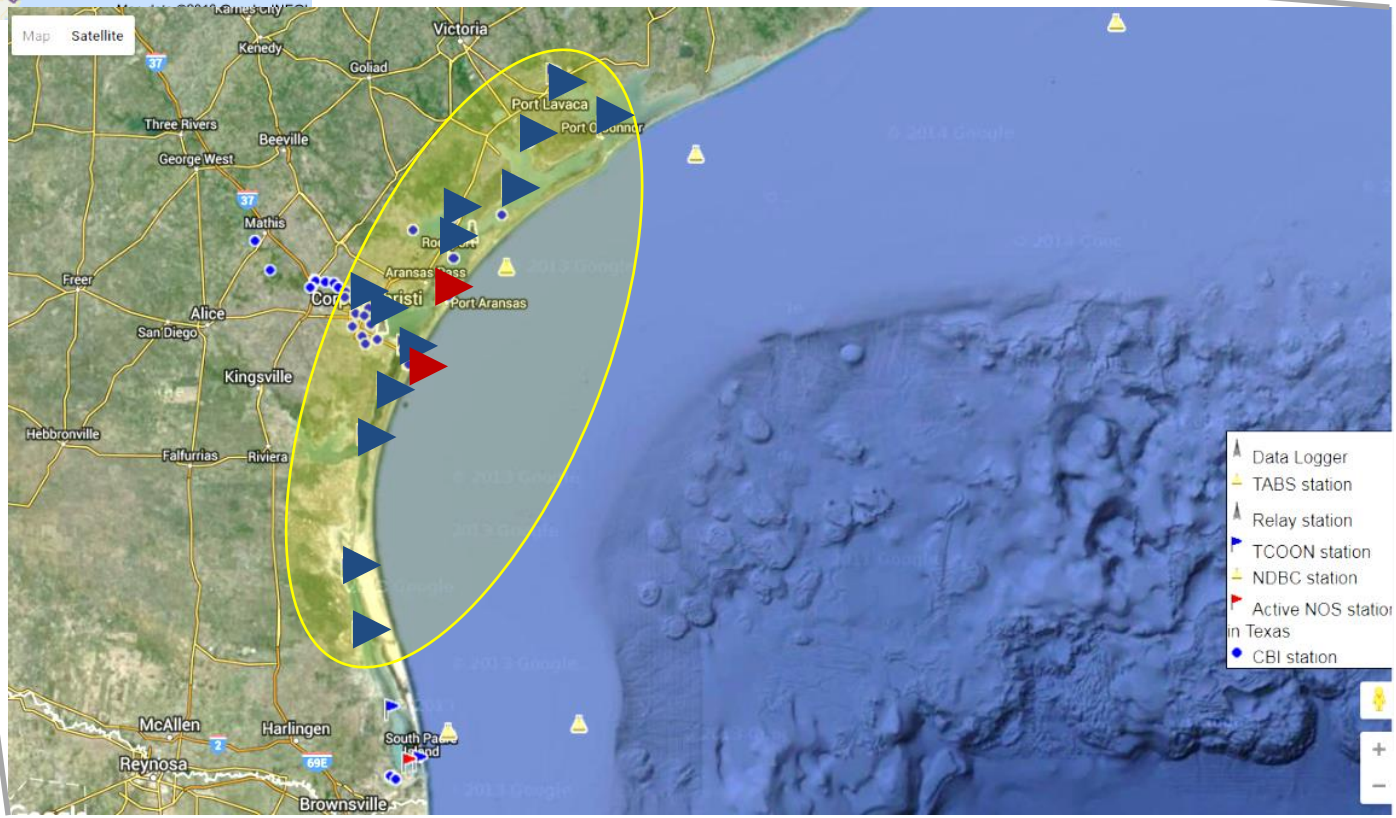
The map above illustrates regional trends in sea level, with arrows representing the direction and magnitude of change. Click on an arrow to access additional information about that station.

Sea Level Trends
mm/yr (feet/century)

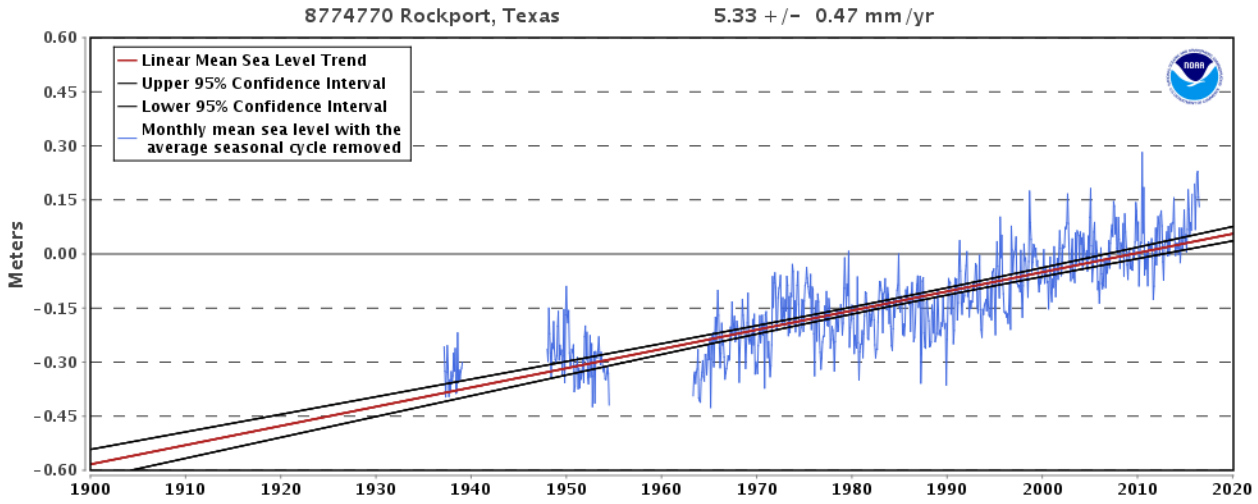
15 to 21 (5 to 7)	6 to 9 (2 to 3)	-3 to 0 (-1 to 0)	-12 to -9 (-4 to -3)
12 to 15 (4 to 5)	3 to 6 (1 to 2)	-6 to -3 (-2 to -1)	-15 to -12 (-5 to -4)
9 to 12 (3 to 4)	0 to 3 (0 to 1)	-9 to -6 (-3 to -2)	-18 to -15 (-6 to -5)

Texas Coastal Bend Tide Gauges

Study based on 15 tide gauges and 2 CORS station in the Coastal Bend: Port Lavaca to Port Mansfield



RSLR in the Coastal Bend



Rockport

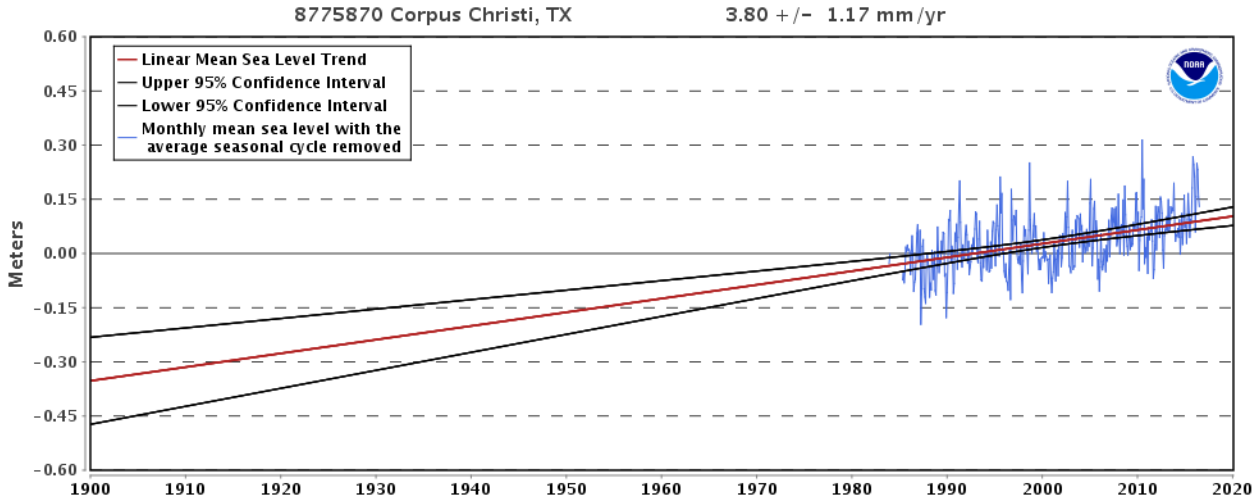
0.21” / year

100 years = 1.8 ft

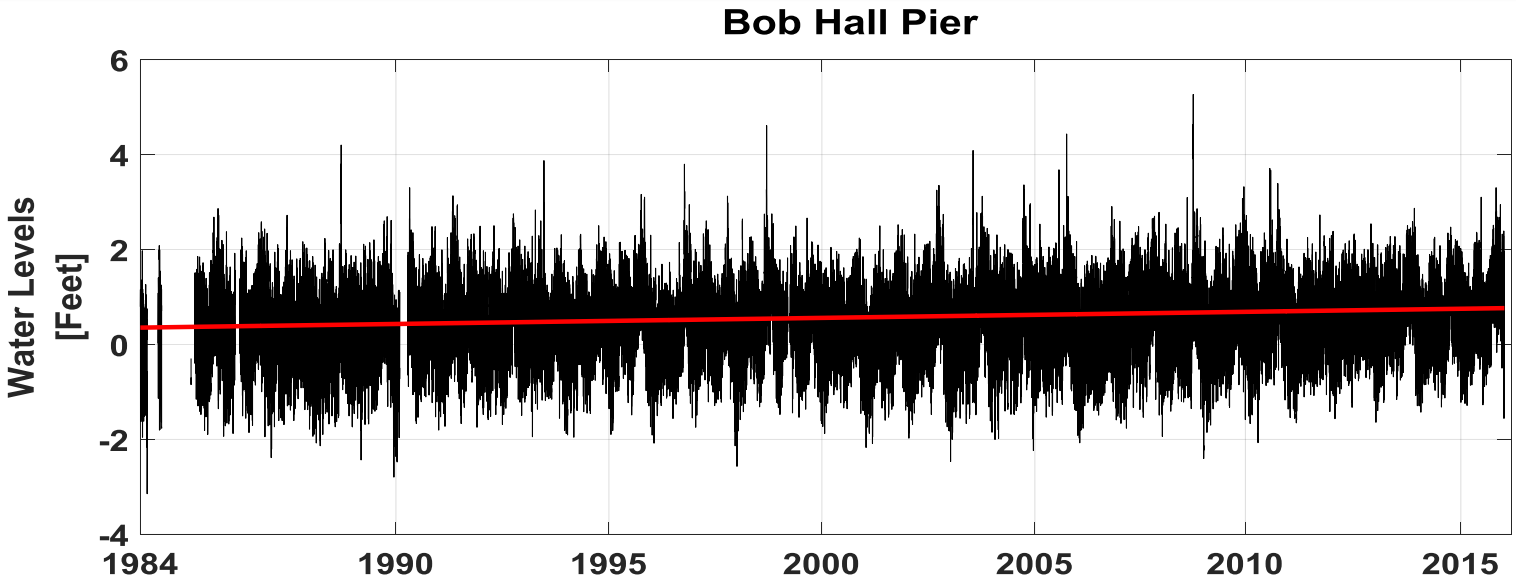
Bob Hall Pier

0.15” / year

100 years = 1.3 ft

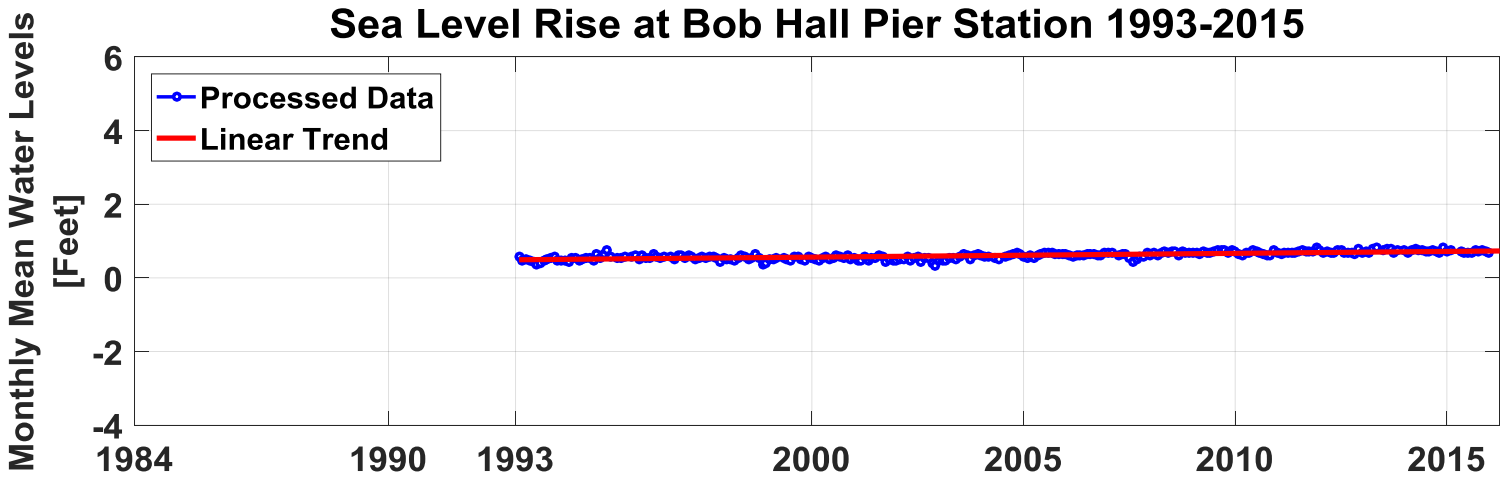


Methods



Trend 3.9 mm/yr

Processing

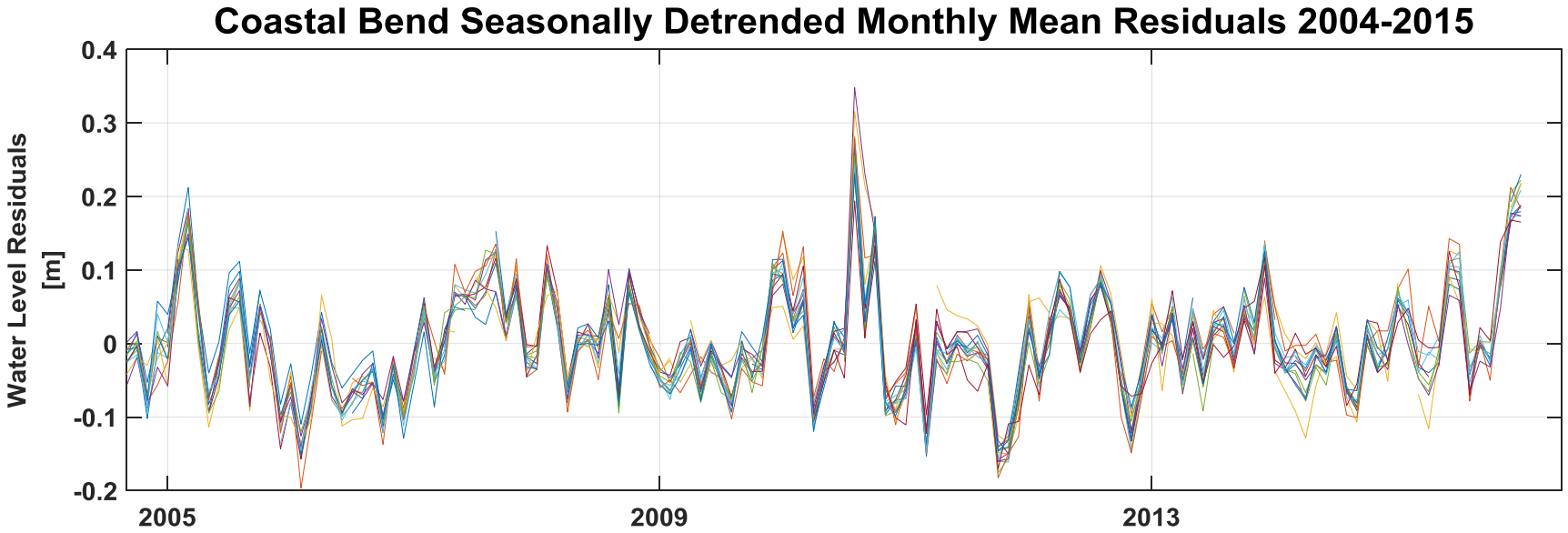


Trend 4.0 mm/yr

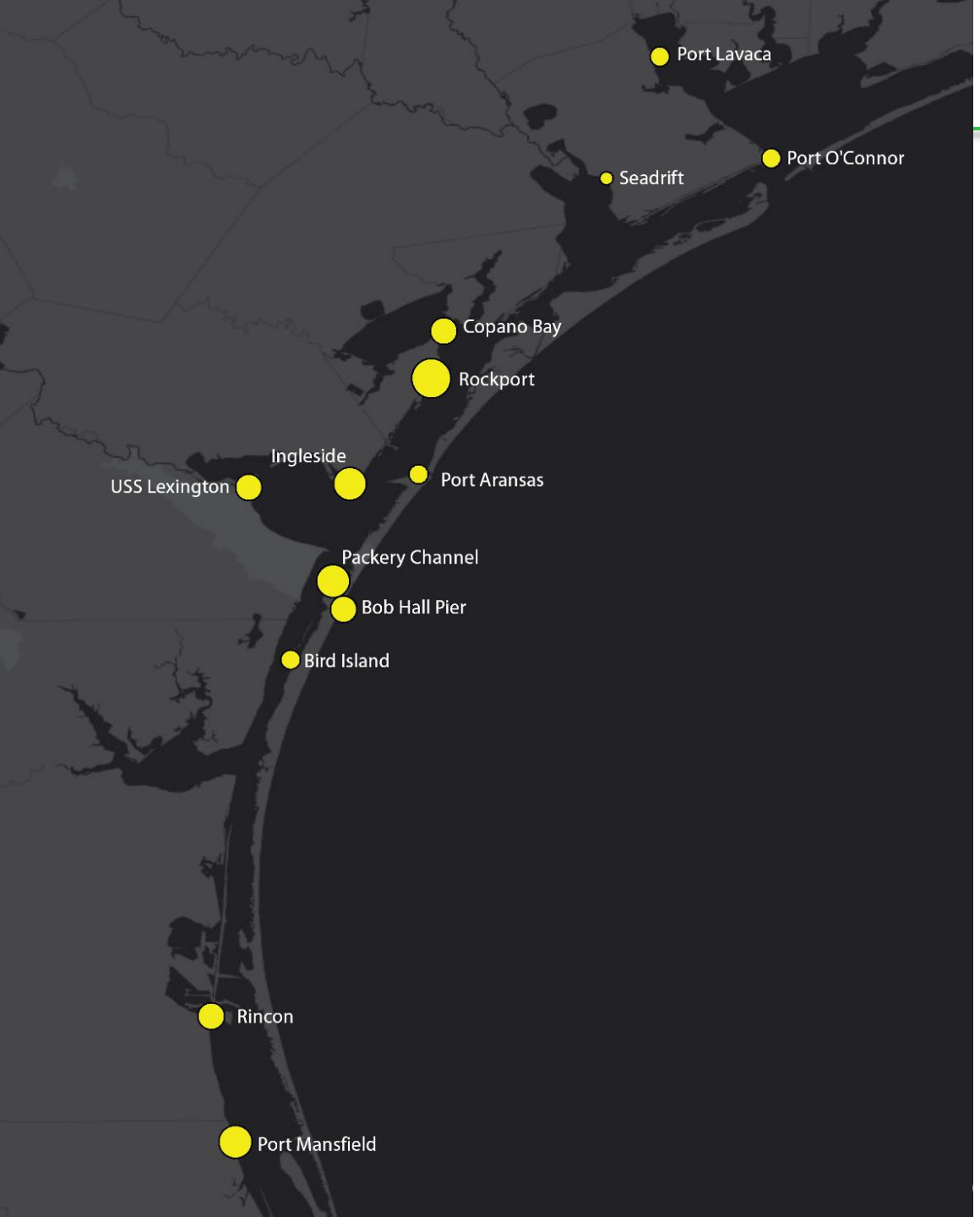
Regional Steric Variability

All 15 tide stations studied are influenced by similar coastal oceanography conditions

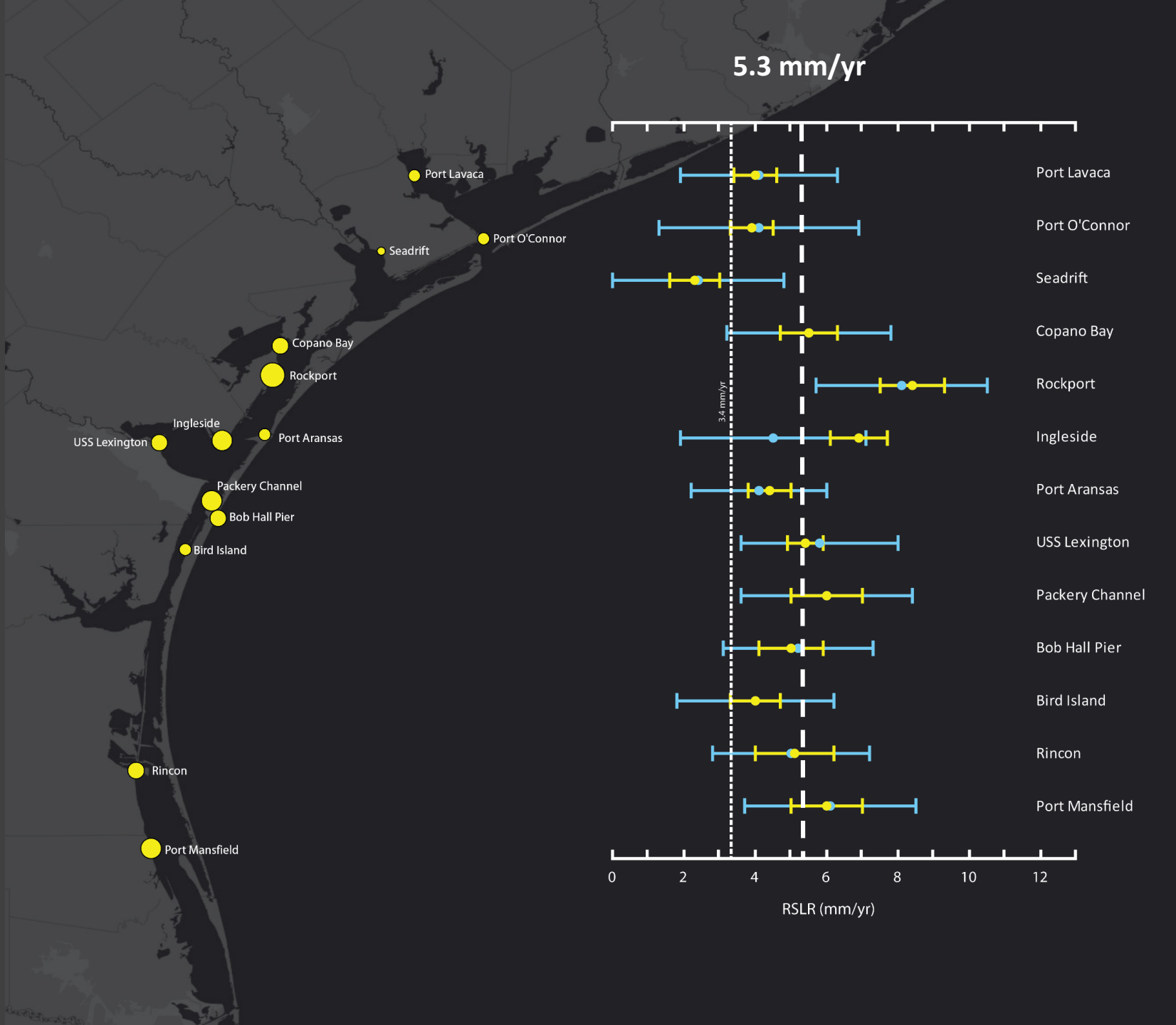
- Three main inlets: Corpus Christi, Mansfield and Matagorda passes
- Coastal currents (e.g. influence of loop current)
- Wind & wave set-up
- Other steric forcings (temperature, salinity)



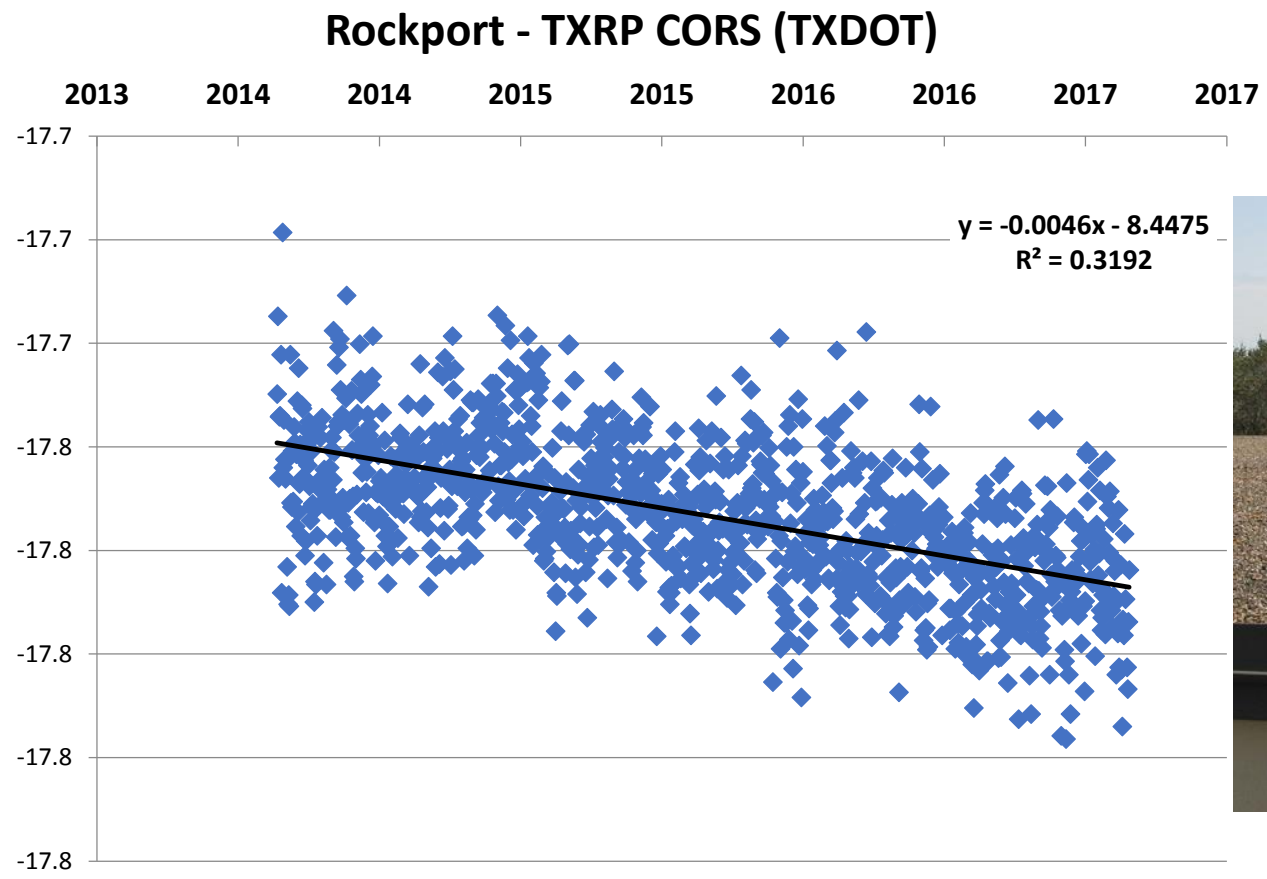
Construct a "***steric index time series***" by averaging the time series residuals of all 15 stations.



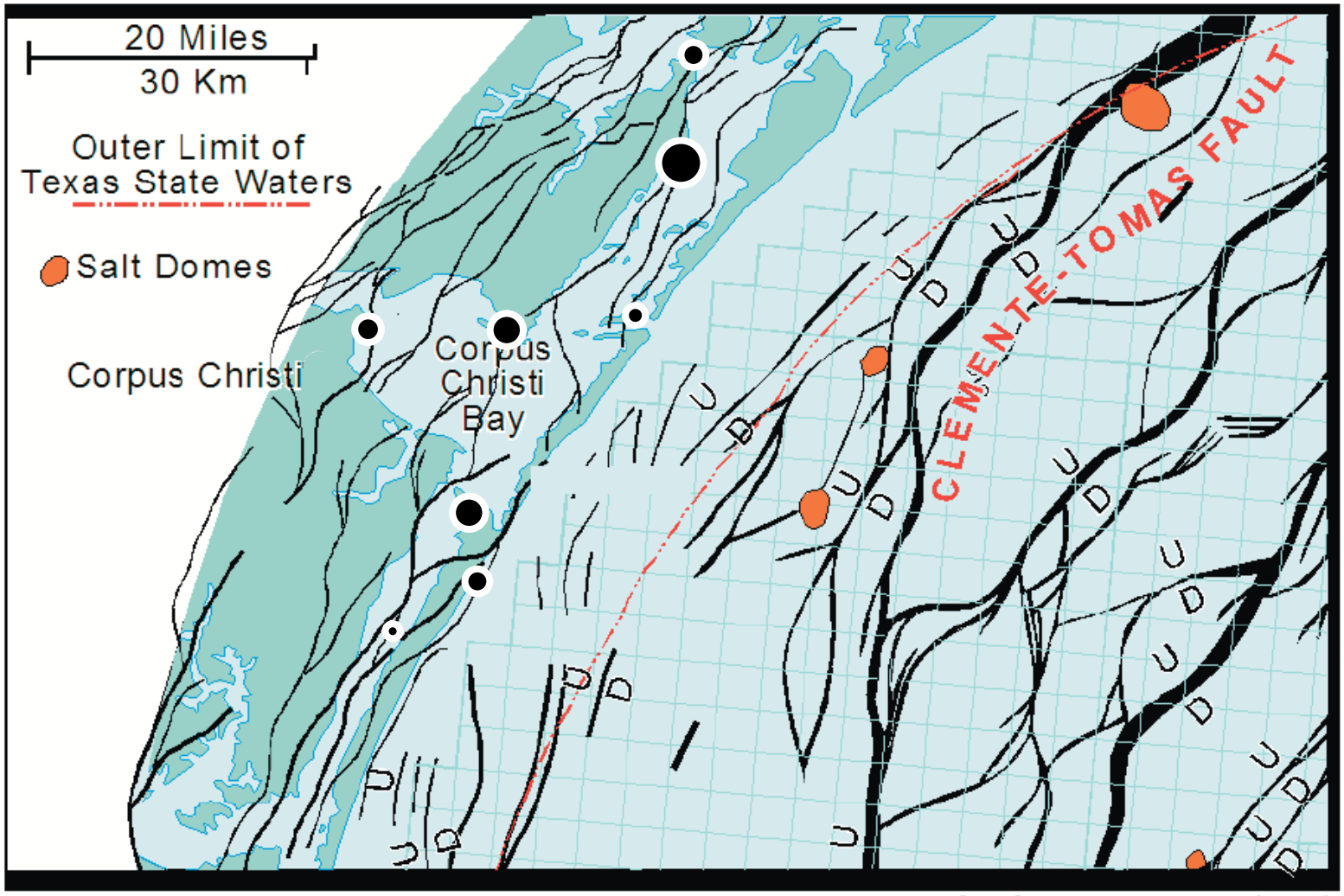
Coastal Bend Relative Sea Leve Rise Variability


5.3 mm/yr
Port Lavaca
Port O'Connor
Seadrift
Copano Bay
Rockport
Ingleside
USS Lexington
Port Aransas
Packery Channel
Bob Hall Pier
Bird Island
Rincon
Port Mansfield
3.4 mm/yr
0
2
4
6
8
10
12
RSLR (mm/yr)

cGPS Comparison



RSLR & Regional Growth Faults

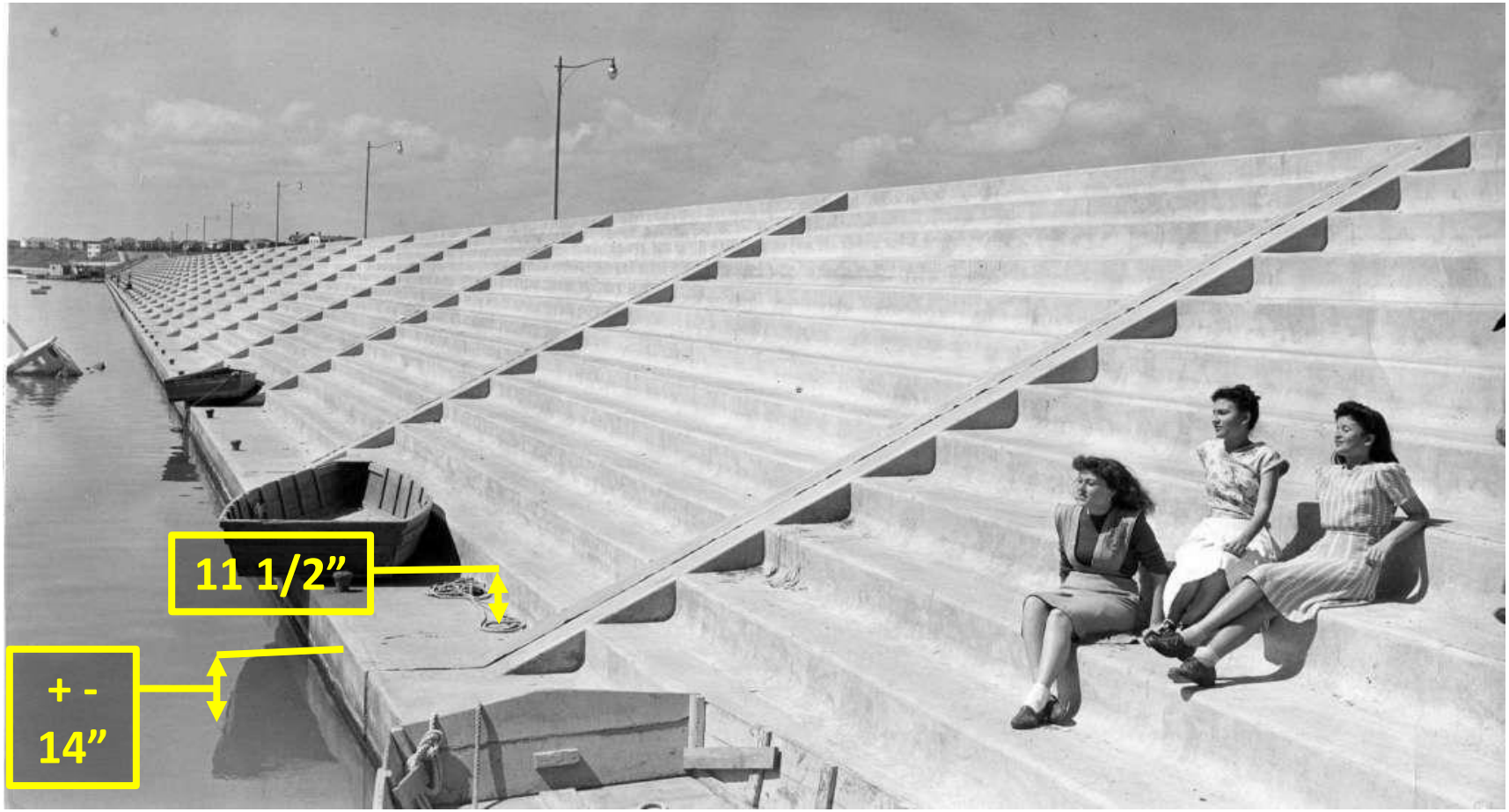


modified from Trevino et al. (2003)

Figure from: Hammes, U., et al. "Structural setting and sequence architecture of a growth-faulted lowstand subbasin, Frio Formation, South Texas." Gulf Coast Association of Geological Societies Transactions, Vol. 54, 2004.

Courtesy Peter Davidson, CC Marina

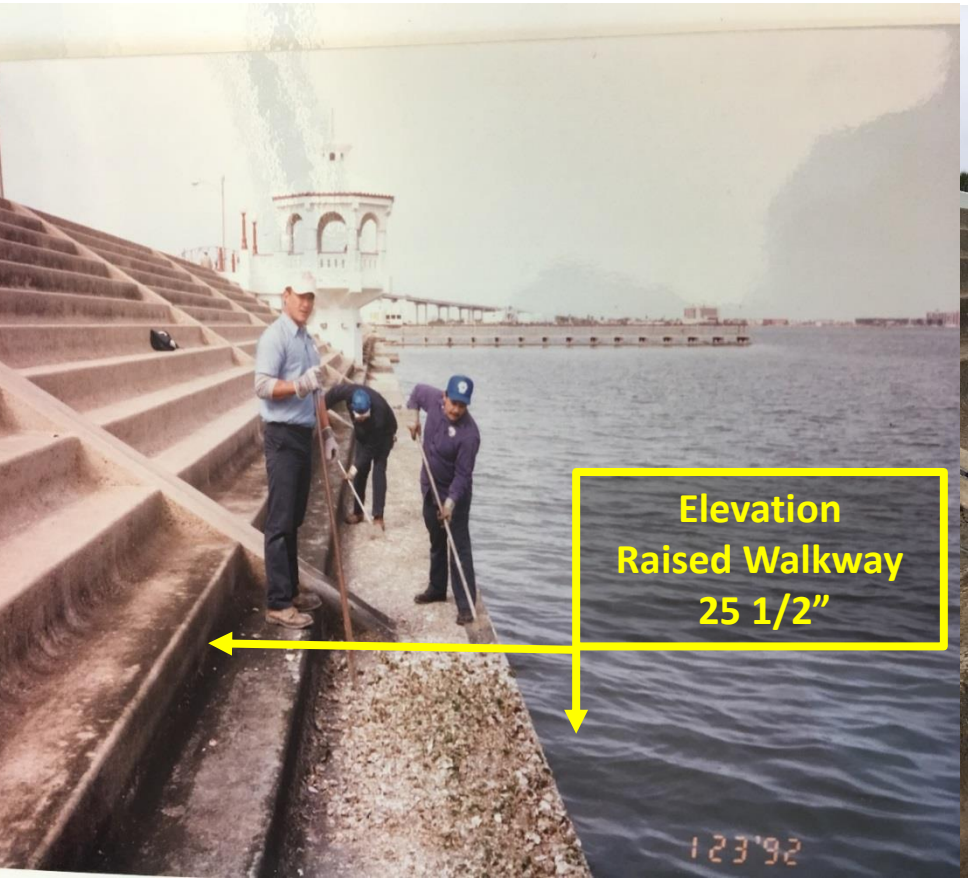
1941 Original Seawall Upon Completion
Note Bottom Walkway Related to Water Level



Courtesy Peter Davidson, CC Marina

24 YEARS, SEAWALL 1992 – 2016

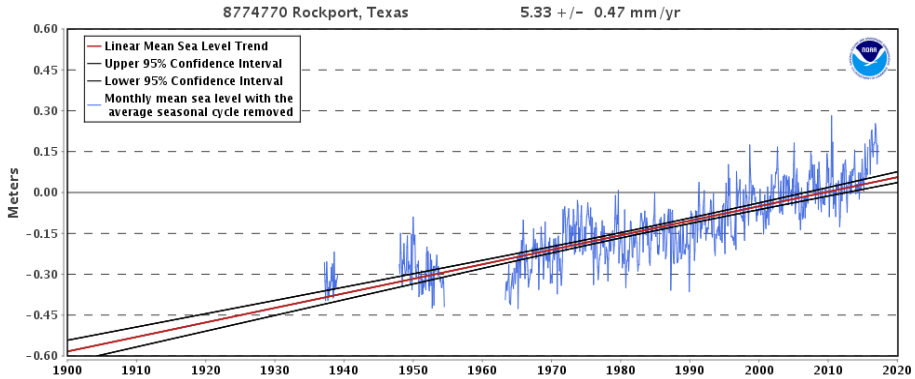
Removing Oyster Shells From Bottom Step of Walkway 12-3-1992 Low Tide



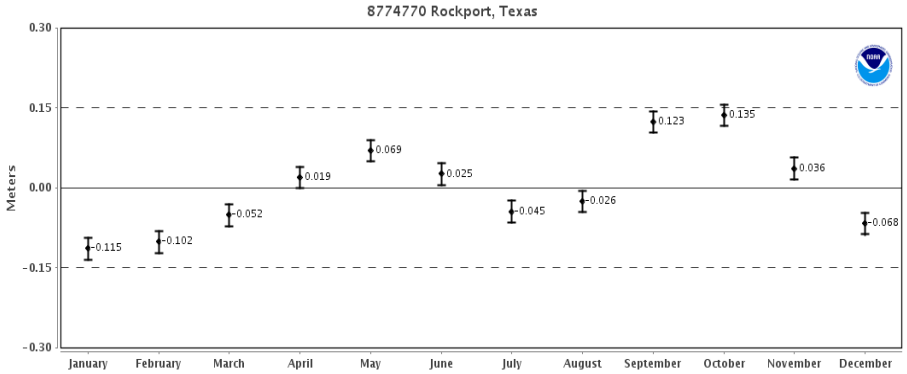
After Seawall Reconstruction (2005) New Marine Growth at Same Location 11-10-2016 High Tide

Courtesy Peter Davidson, CC Marina

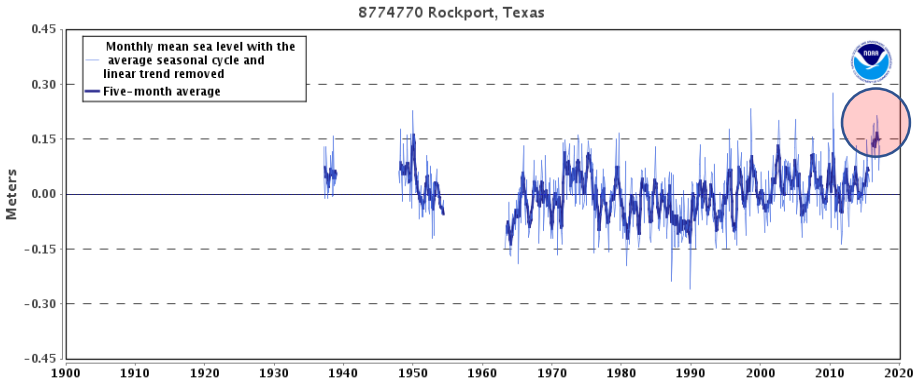
Water Level Variability: Rockport



Long term relative sea level rise:
5.3 +/-0.5 mm/yr (1.7 ft/100 yr)



Seasonal variability: **~ 1 ft**



Interannual variability: **~ 1 ft**

Questions/Discussion

Acknowledgements: Florence Tissot, James Rizzo, John Adams, Dan Prouty, Maclovio Perez, Jim Gibeaut, Steve Hilla, NOAA NGS and CBI Coastal Dynamics Laboratory staffs for their feedback and suggestions

Regional Sea Level Changes and Coastal Impacts
10-14 July 2017, Columbia University, New-York (NY) - USA

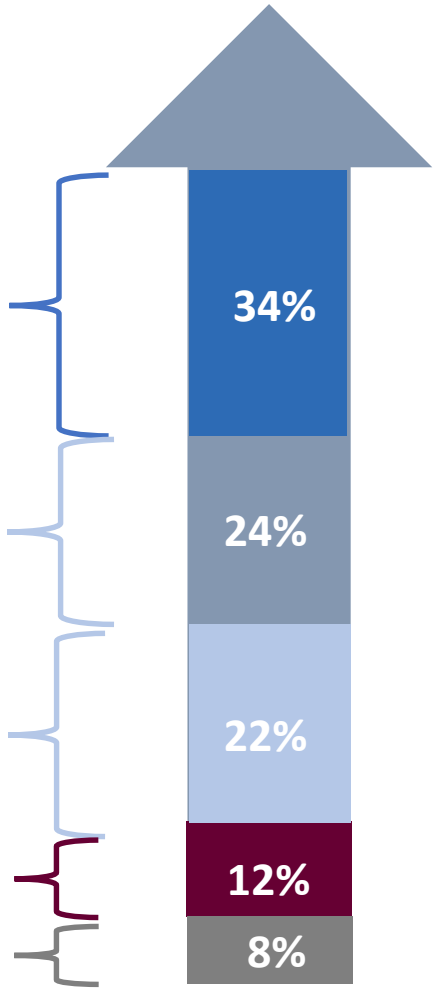
Conference Sessions:

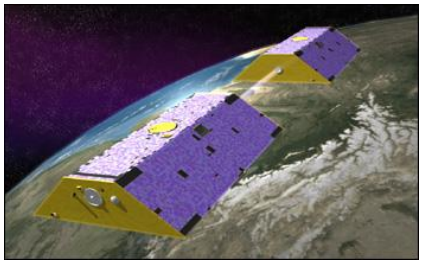
- Paleo sea level data and GIA modeling
- Millennial-scale ice sheet and sea level interactions
- Contemporary contributions from ice sheets and glaciers
- Contemporary sea level change
- Coastal zone
- Sea level rise adaptation in greater New York: the response to Sandy and beyond
- Projections

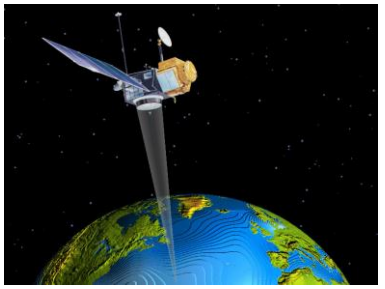
Causes for Global Sea Level Rise

Components to Global Sea Level rise (IPCC AR5, 2013)

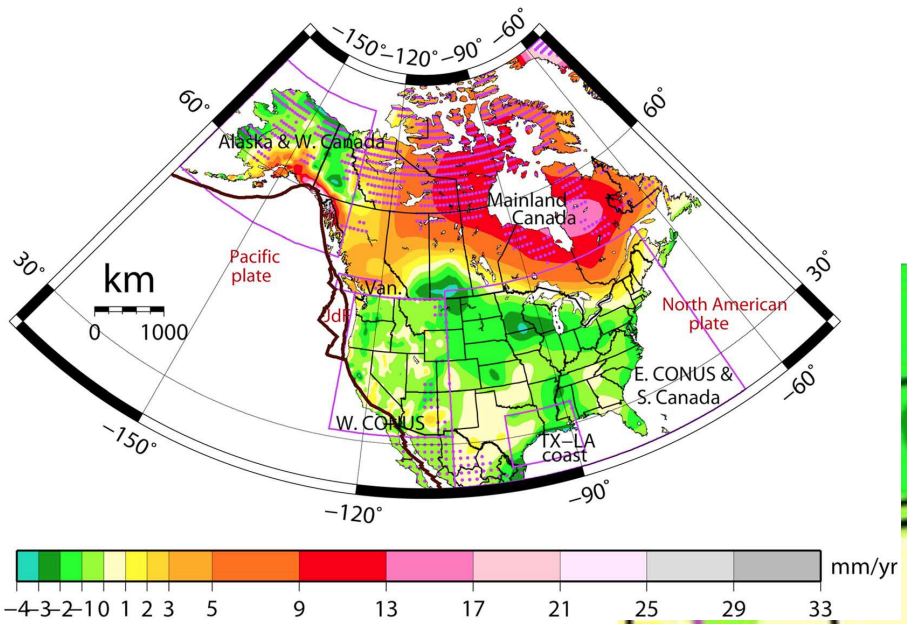
(1993-2010)



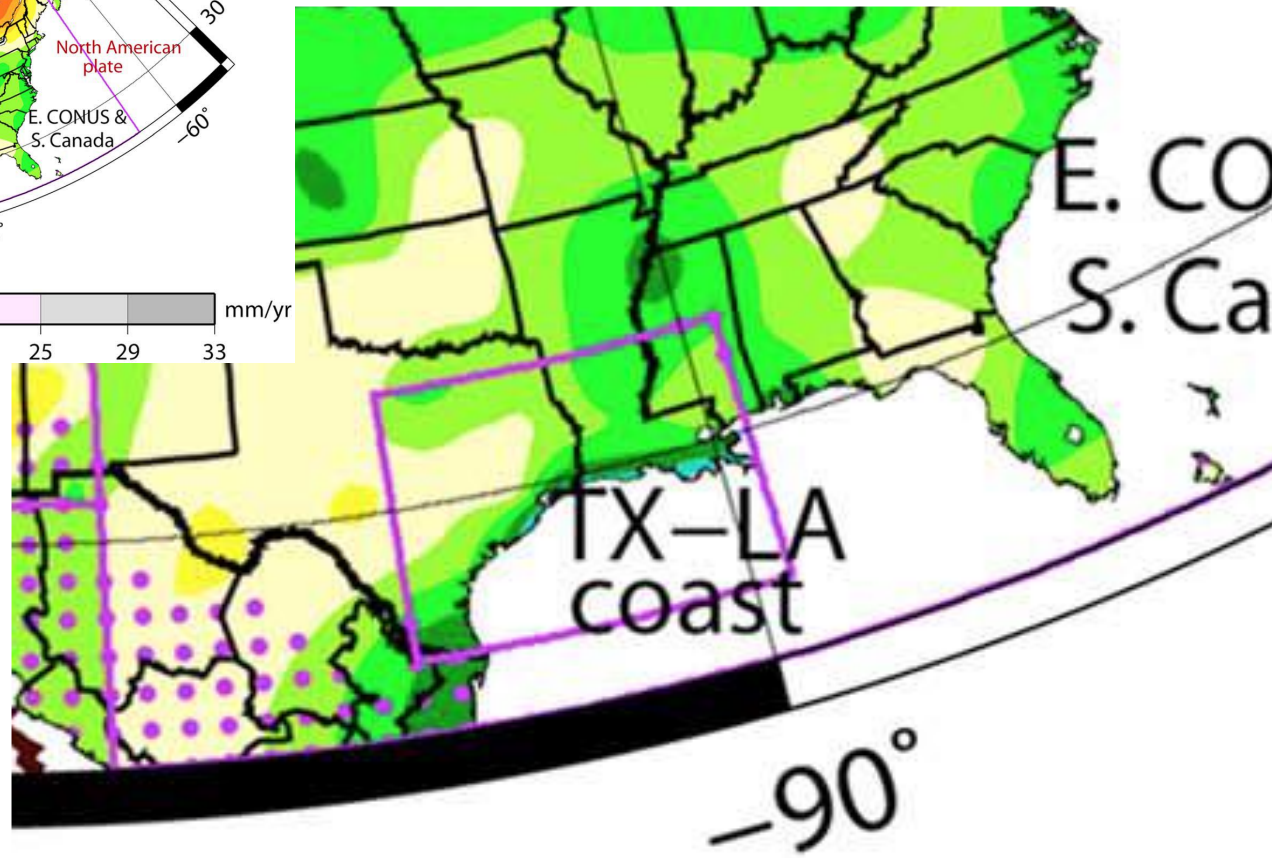




Crustal Velocity: Vertical Component



Coastal Bend IGS08 estimated 3-D crustal velocities: ~-1mm/yr



IGS08 estimated 3-D crustal velocities (Snay et al., 2016).
Models broad vertical motion, tectonics and glacial isostatic adjustment.

Snay et al. (2016) Modeling 3-D Crustal Velocities in the United States and Canada, JGR.
Estimated IGS08 vertical velocities. Purple dots are located within areas where vertical velocities have standard deviations exceeding 2mm/yr. Purple line segments denote regional boundaries, and dark brown line segments denote plate boundaries.