[AV]Past, Present and Future Seal Level, Subsidence and Storm Impact Records Indicate Accelerated Change along the Texas Coast This Century

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Conclusions

- The current consensus is that eustatic sea level will rise between 0.5 and 2.0 meters by the end of this century. There is growing evidence that the overall rise will be punctuated by episodic rises of a few decimeters to a meter in magnitude caused by ice stream collapse.
- The rate of subsidence along the Texas coast over the past 4000 years has been minimal (less than 1 mm/yr).
- Most predictions for coastal change are best case scenarios; they do not account for reduced sediment supply, and they cannot account for storm impact.
- The geological record indicates that Gulf Coast estuaries are extremely vulnerable to changes in sediment supply when the rate of sea-level rise exceeds 4mm/yr.
- The frequency of severe hurricane impact in the Gulf of Mexico during the past 4000 years has been relatively constant, despite high-frequency climate oscillations.

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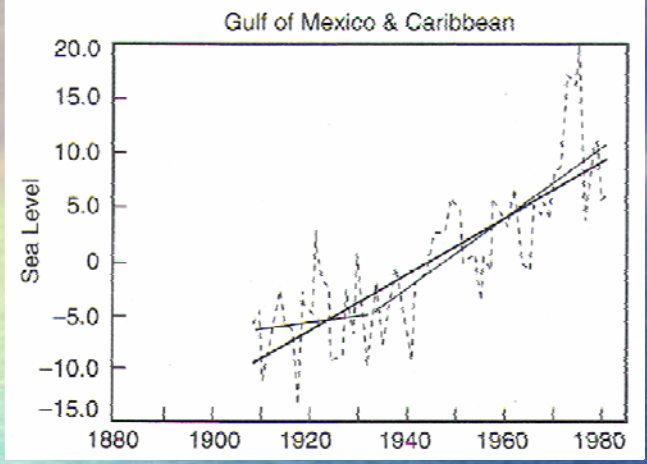
RICE

Global Change Impact on Coastal Systems?

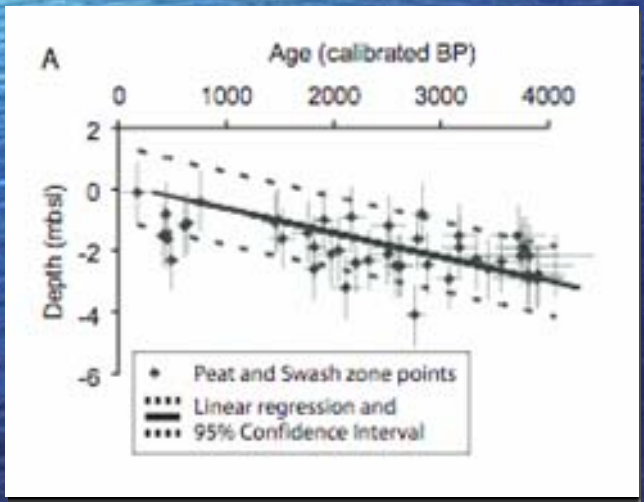
- Increased temperature (1.5 - 5.5 C) and changes in rainfall patterns and river discharge
- Accelerated Sea Level Rise (50 cm to 200 cm by 2100)
- Potential Increase in the Intensity and Frequency of Hurricanes, and possibly steering mechanisms.

Louisiana and Texas will be the most impacted.

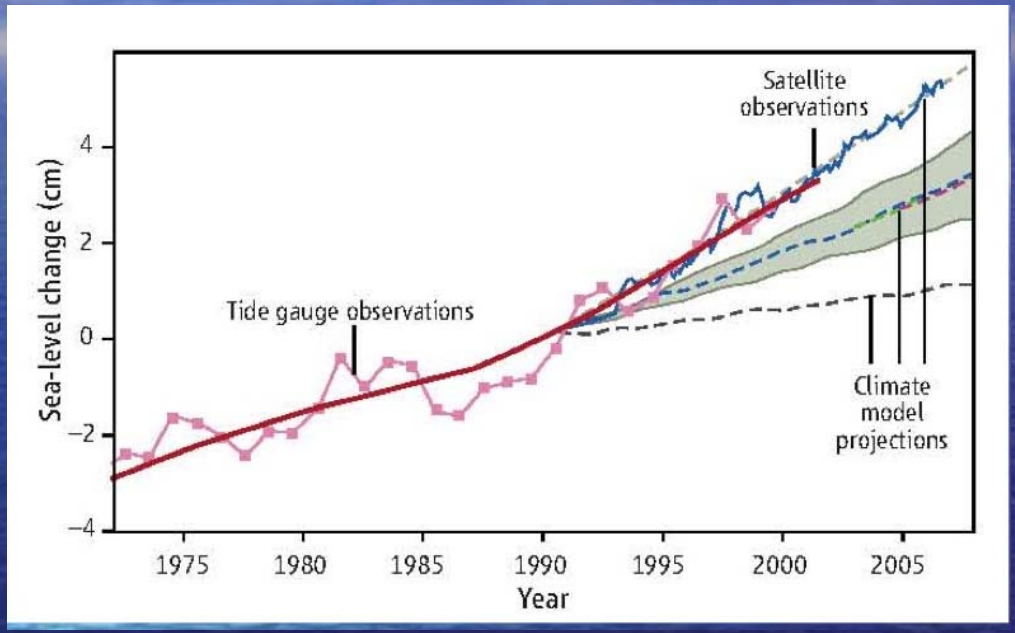
Historical Records indicate increased rate of eustatic rise and minimal subsidence for the upper Texas coast



Historical rate 3.0 mm/yr since WWII
(Gornitz and Lebedeff, 1987)

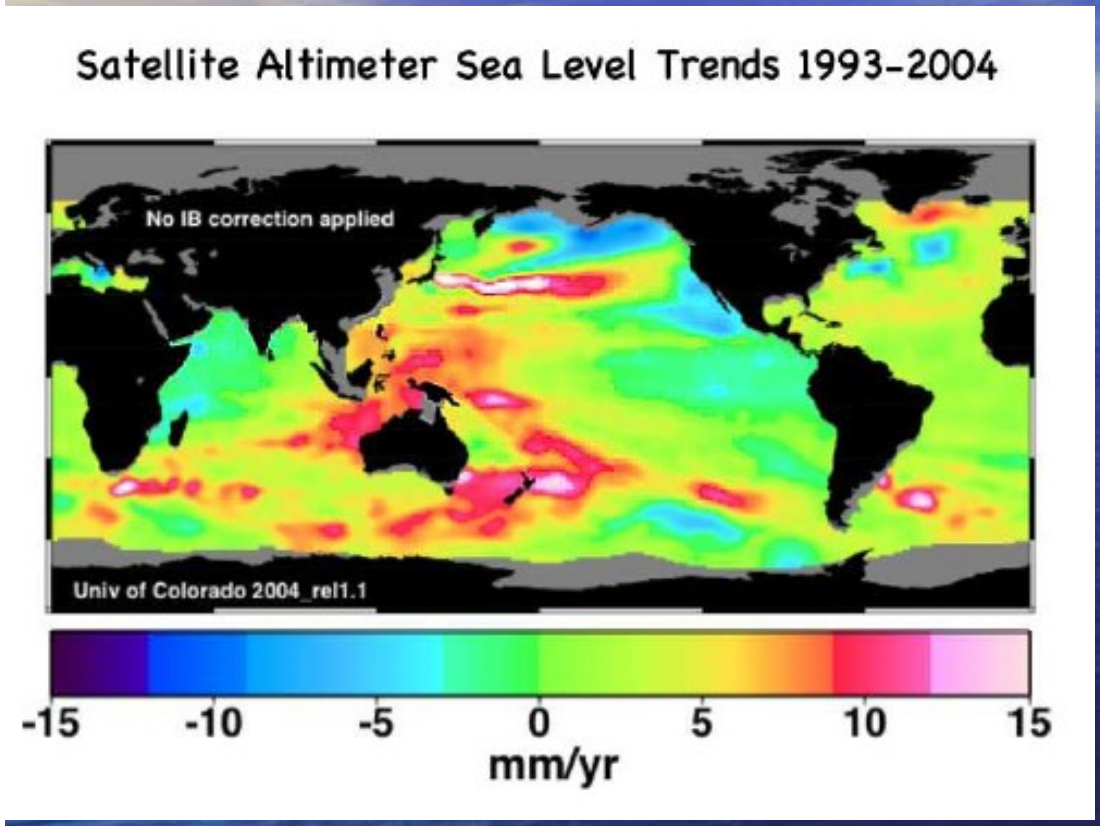


(0.4-0.6 mm/yr)
(Milliken et al., 2008)

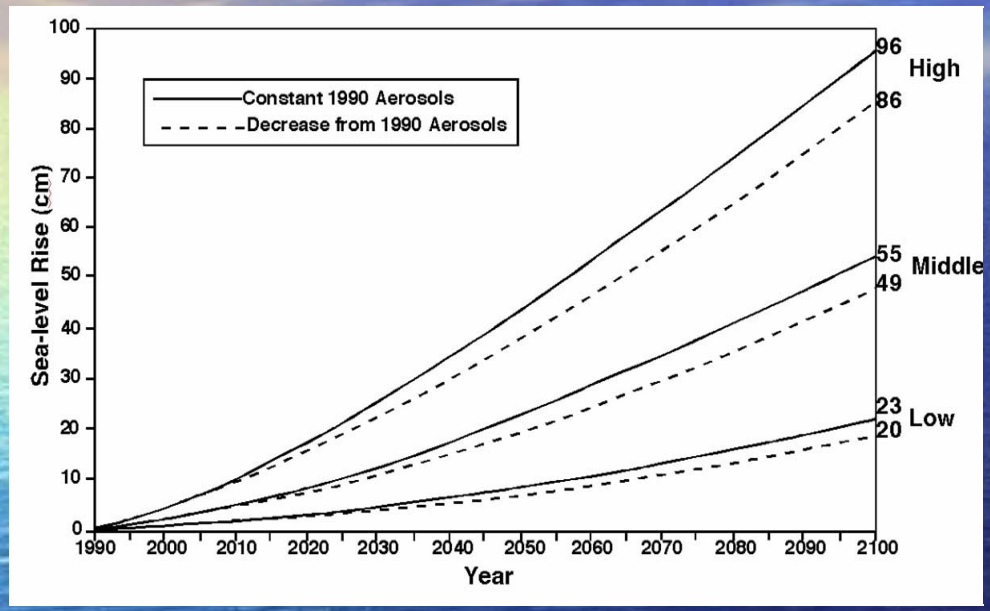


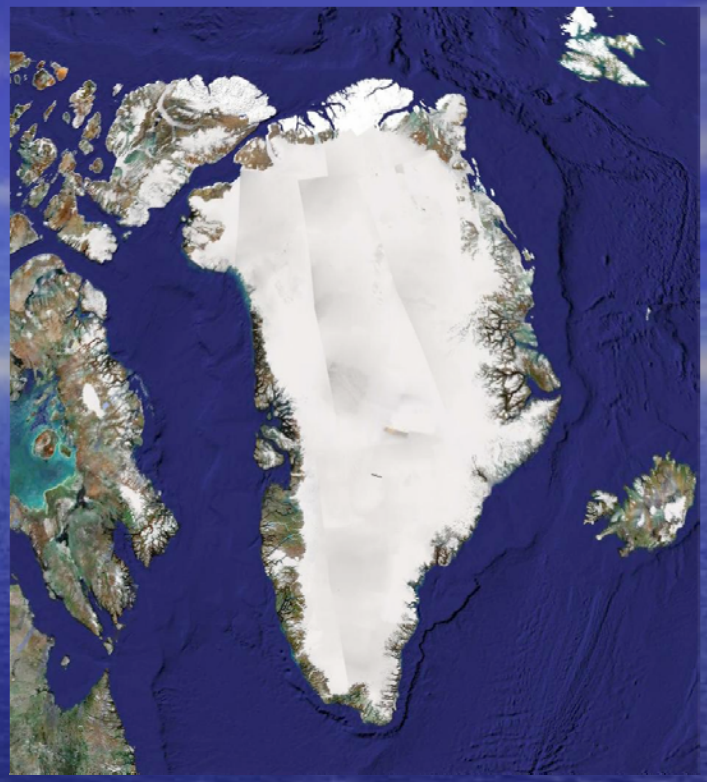
Rahmstorf, 2007

Causes of sea-level rise



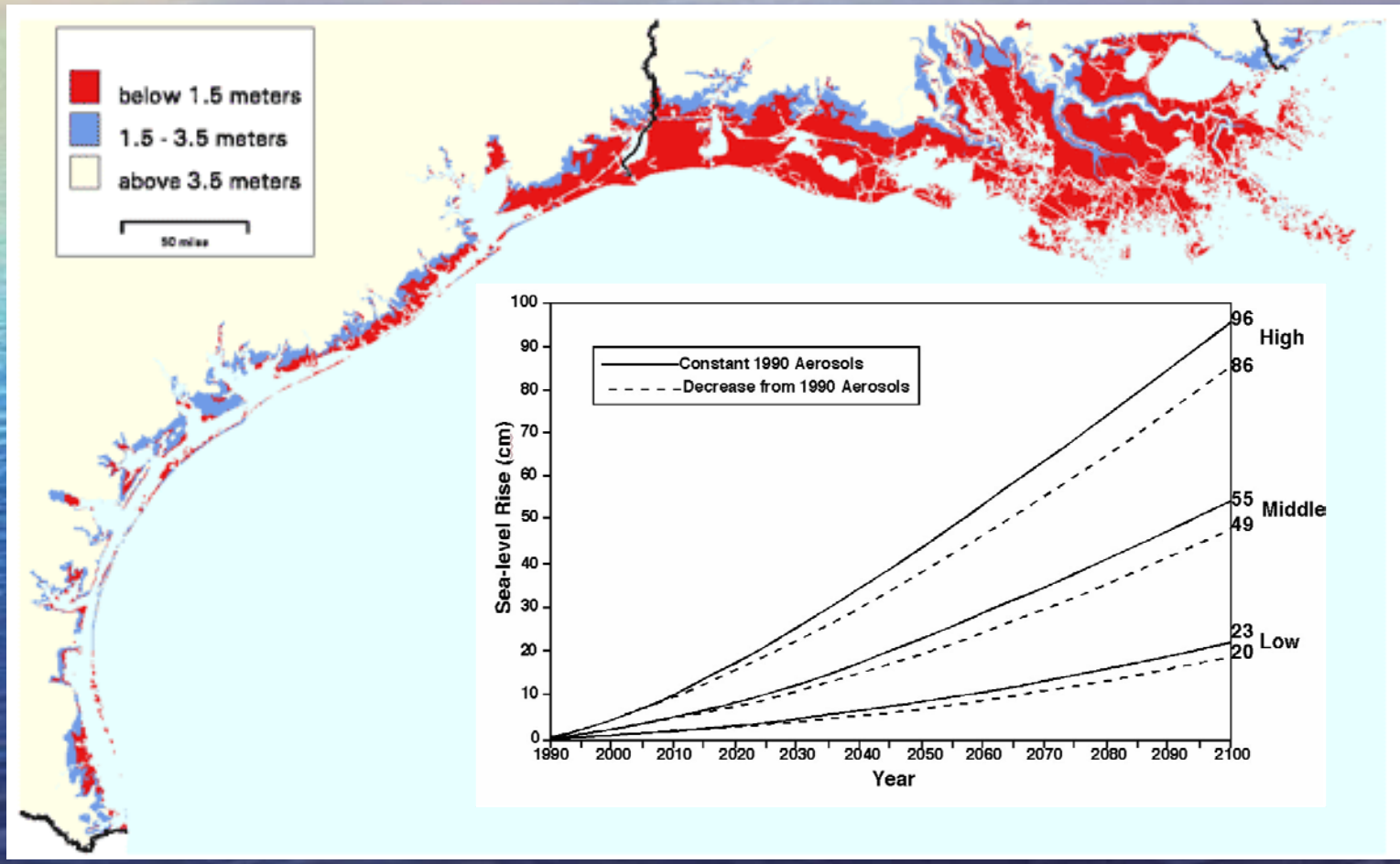
Ice Sheet Contribution Is the Greatest Uncertainty



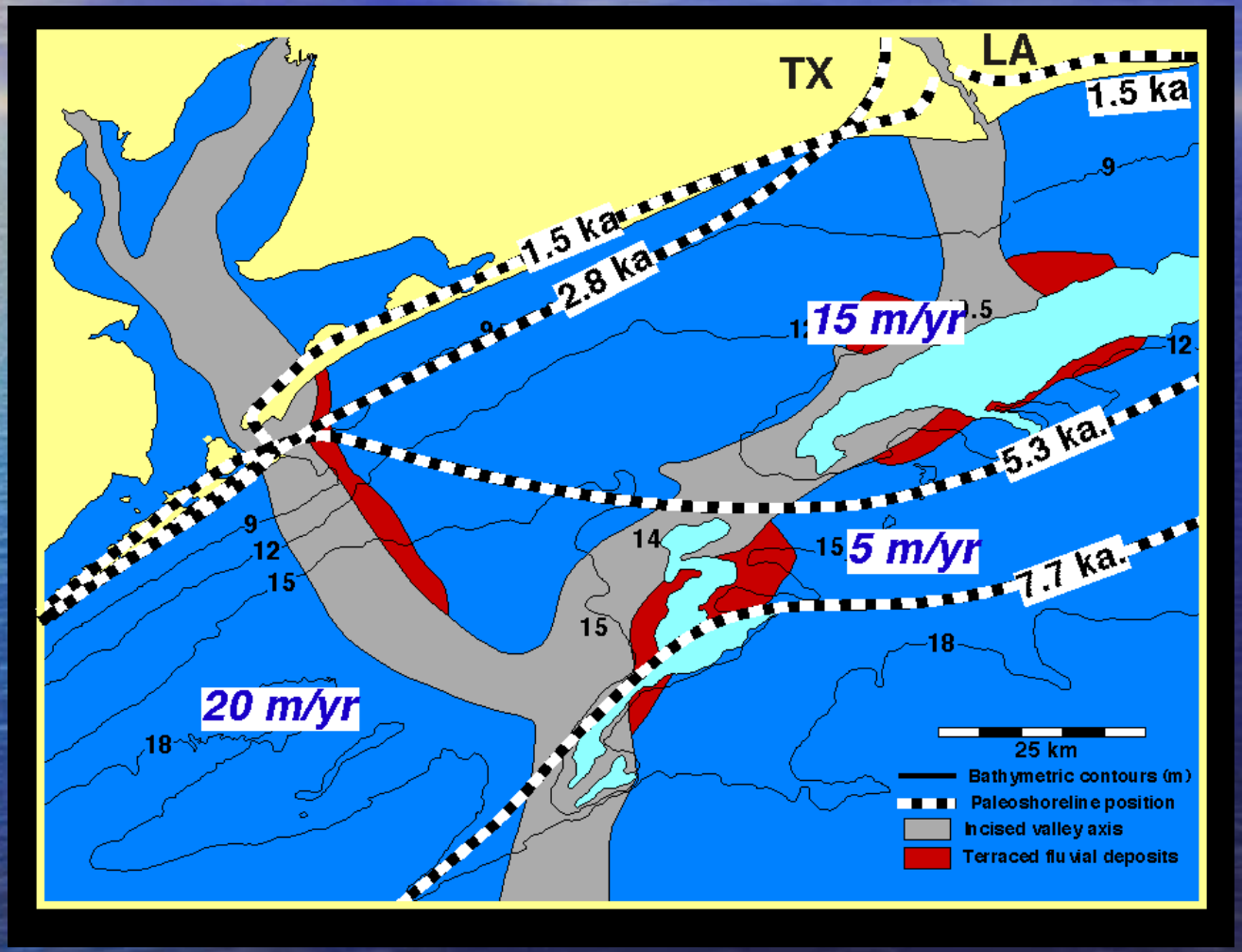


Pffefer et al. 2008 Science, 80-200 cm
(Analysis of ice mass dynamics)
Rohling et al. 2008 Nature Geoscience,
(analysis of Holocene sea level rise, ~50 cm)
Rignot et al., 2008, Nature Geoscience, 50 cm
(West Antarctic Ice Sheet contribution)

Inundation models like this likely underestimate coastal change this century because they do not take into account variable subsidence, hurricanes, changes in sediment supply (both natural and anthropogenic) and other factors

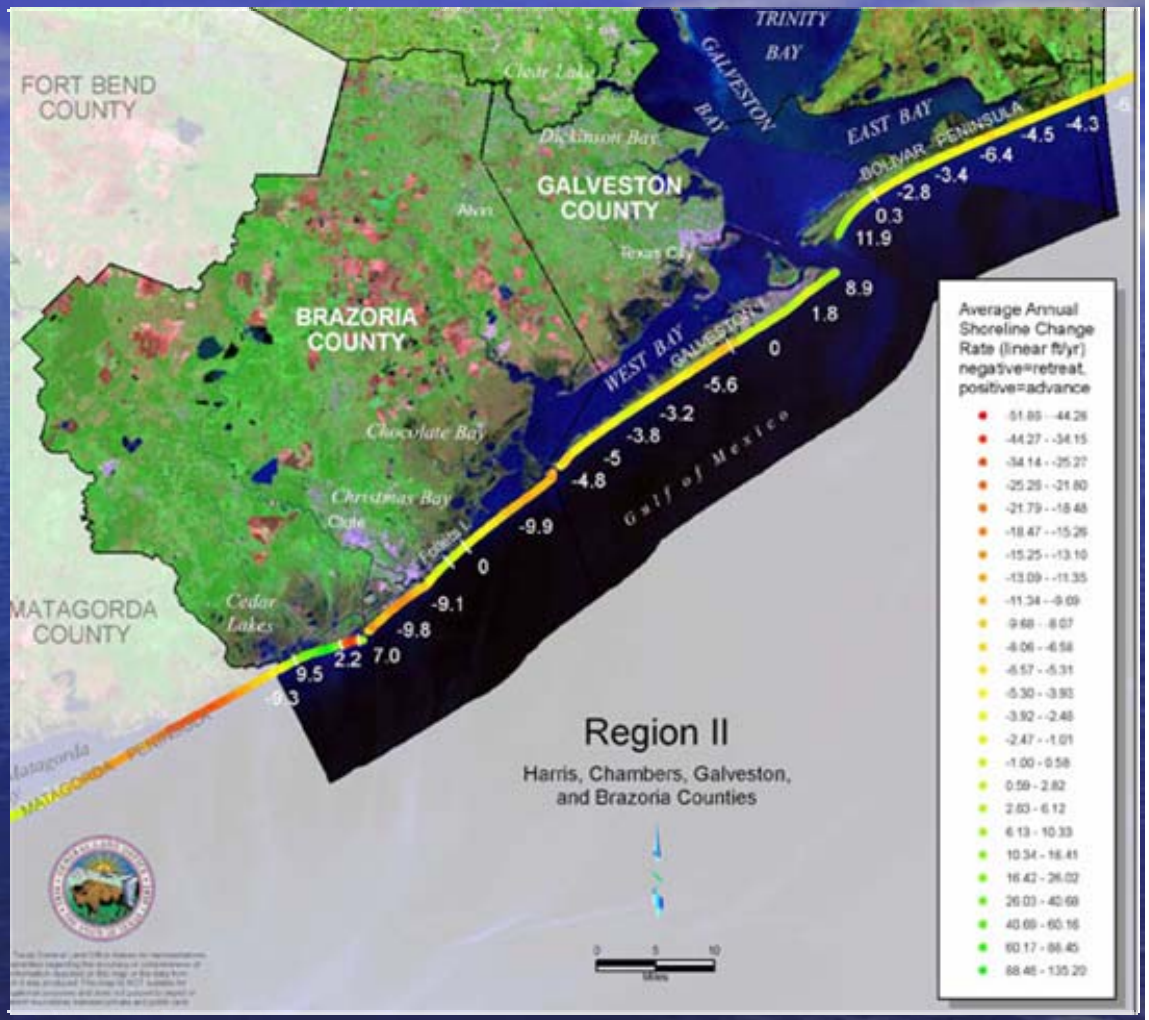


The response of coastal environments to sea-level rise has not been one of simple inundation. Shoreline retreat occurs in step-like fashion.



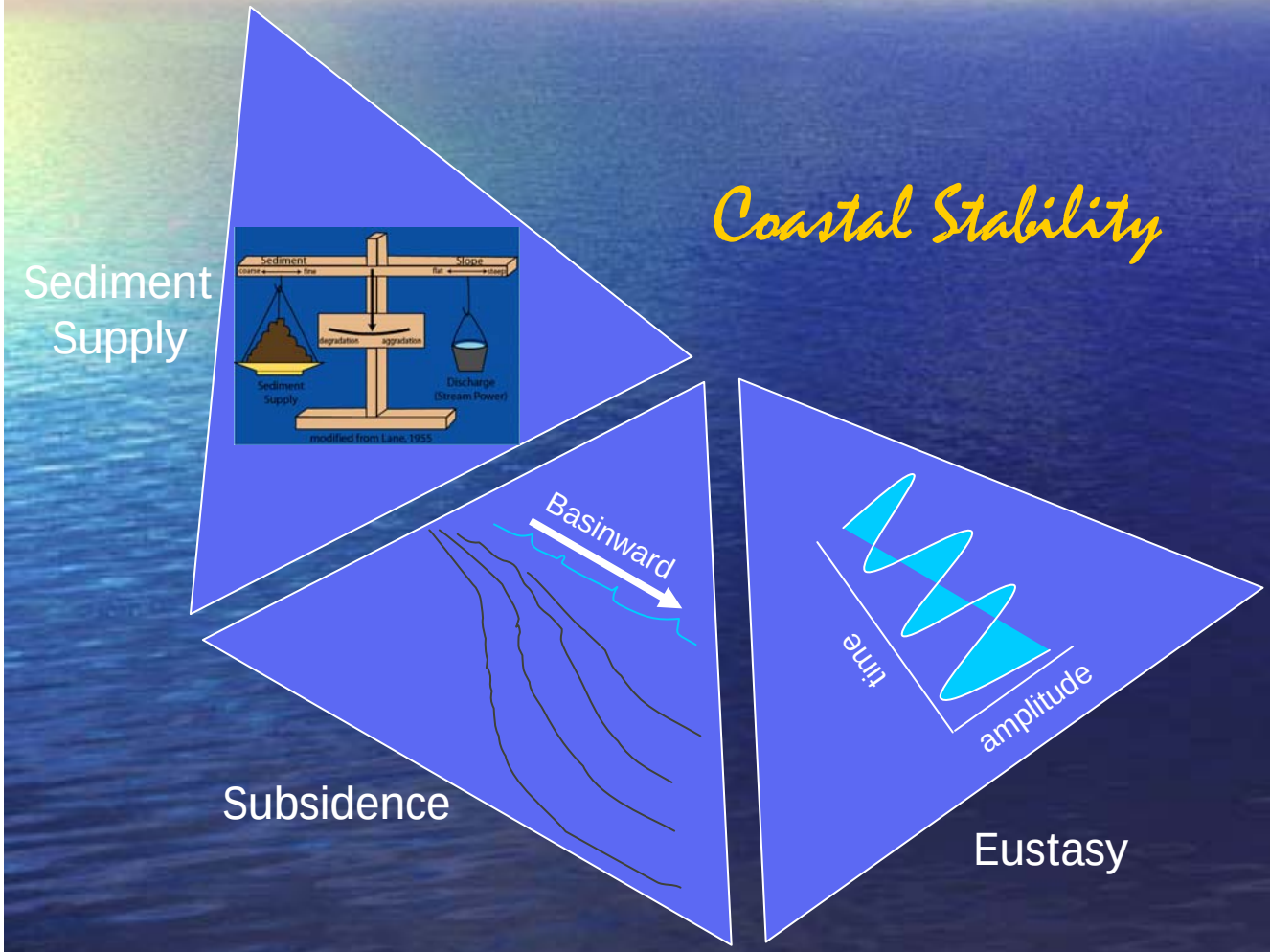
Rodriguez et. al. 2004

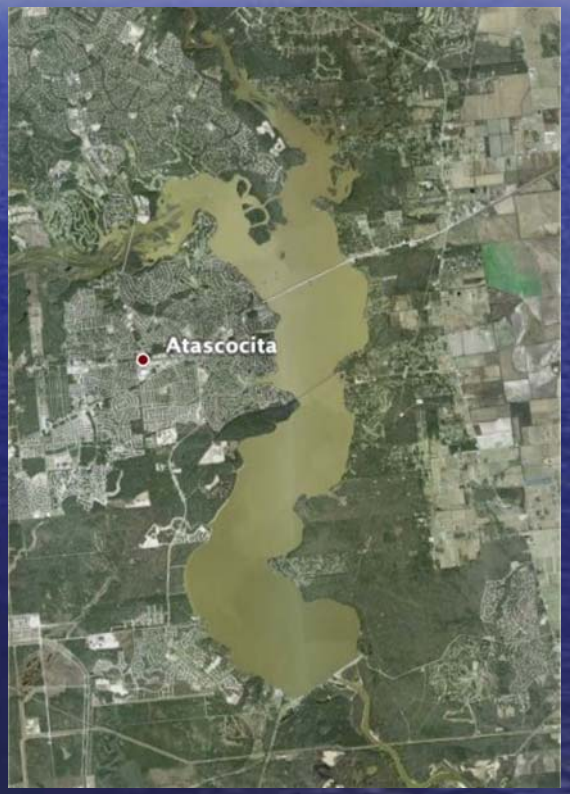
The Texas Bureau of Economic Geology has been monitoring coastal erosion rates for decades. Current rates are approximately twice the rate of the past 1800 years. Prior to that time the barriers were growing.



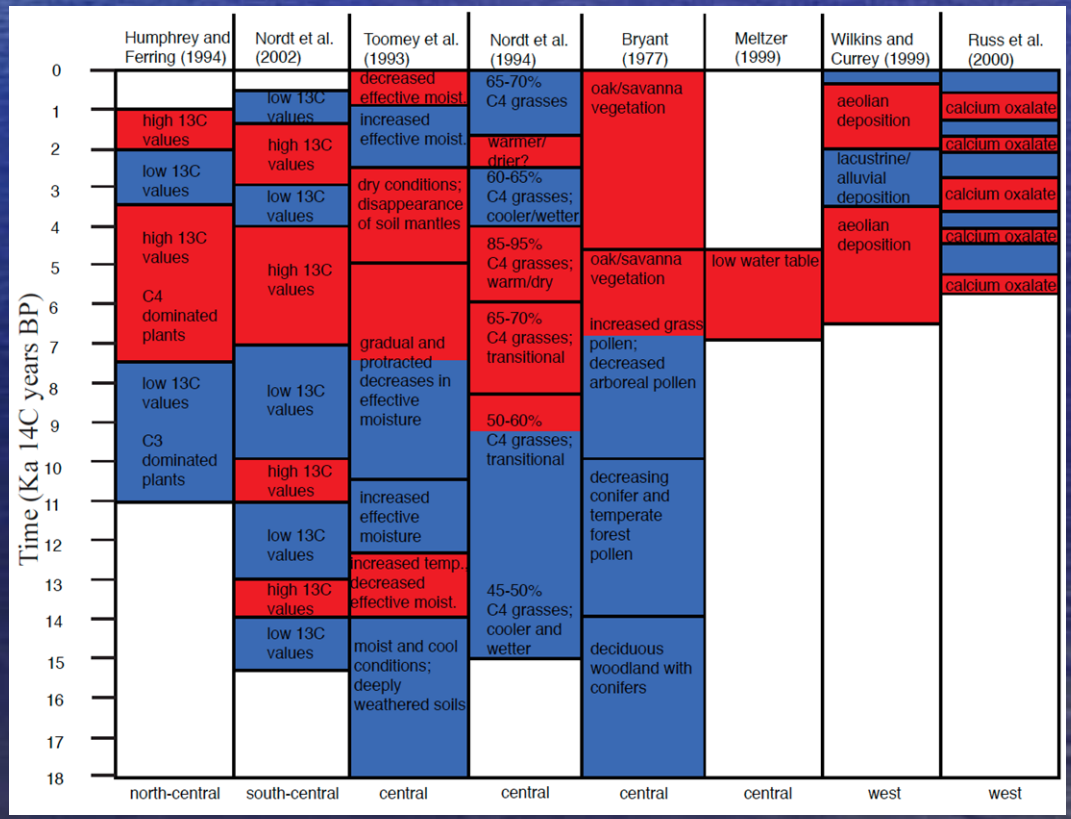
Bureau of Economic Geology

Relative controls on shoreline stability must be quantified before we can predict future coastal change. None of these is well constrained but eustasy and subsidence are best known. More detailed sediment budget analyses are required for predicting the future of our coast. What we do know is that sediment supply is minimal.

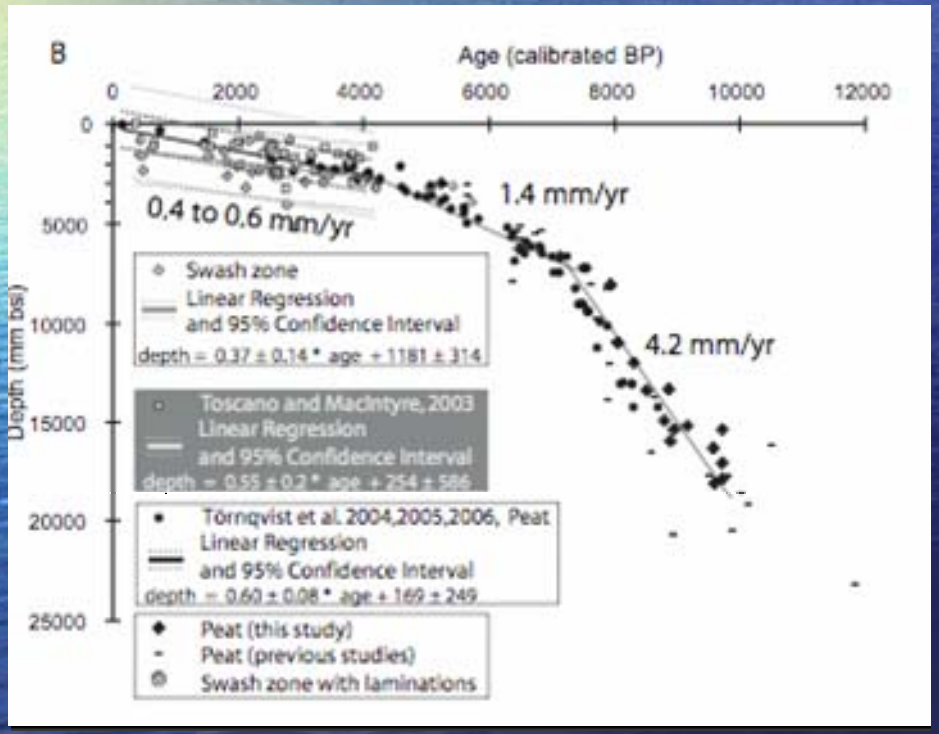




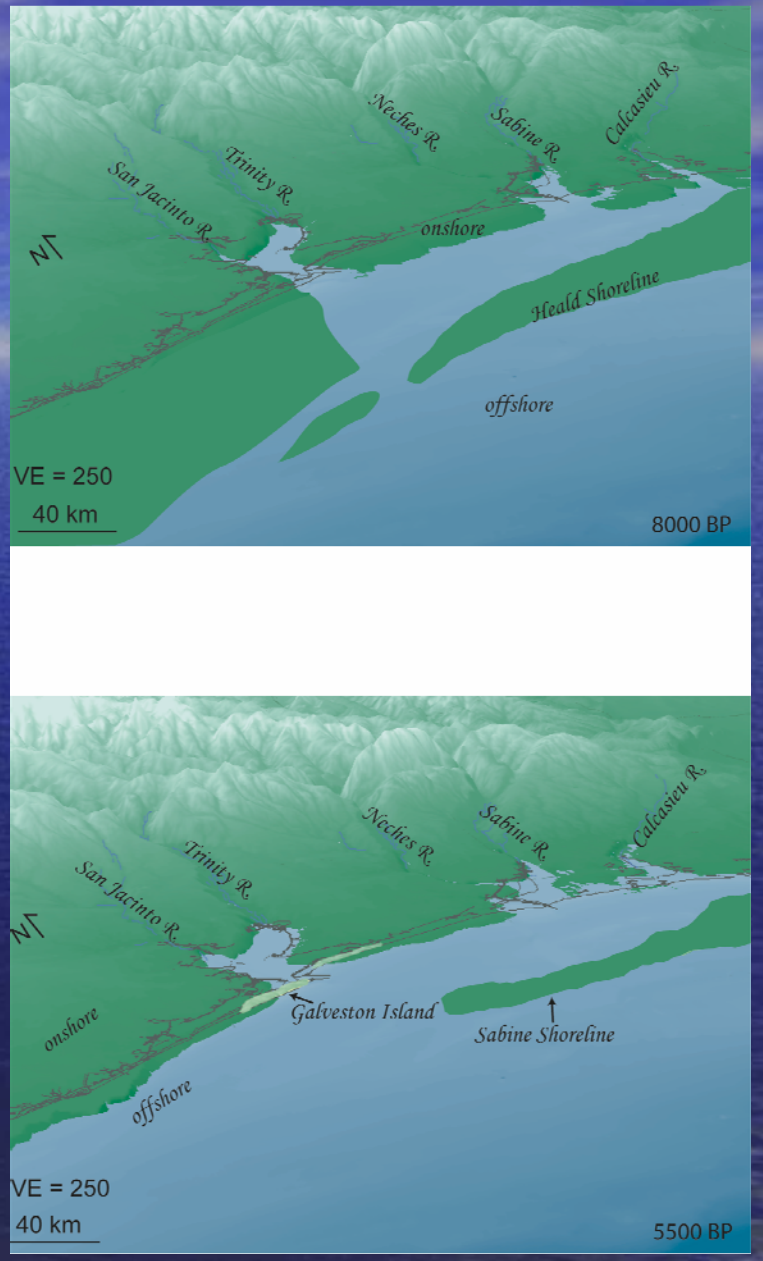
Holocene climate record for Texas reveals an unstable climate that varies across the region. These changes have been linked to changes in sediment supply and coastal change.



To study coastal change at a time when sea level was rising at a rate equal to that predicted for the end of this century we have to go back 7,000 years.

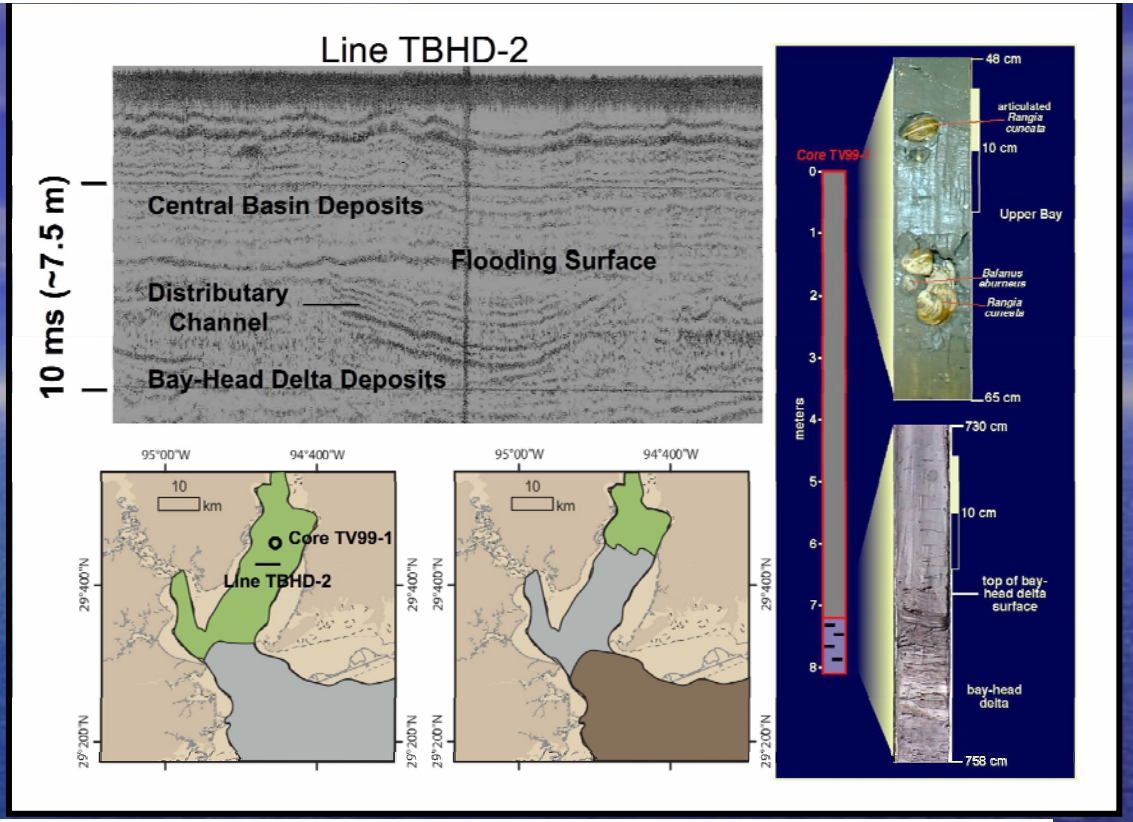


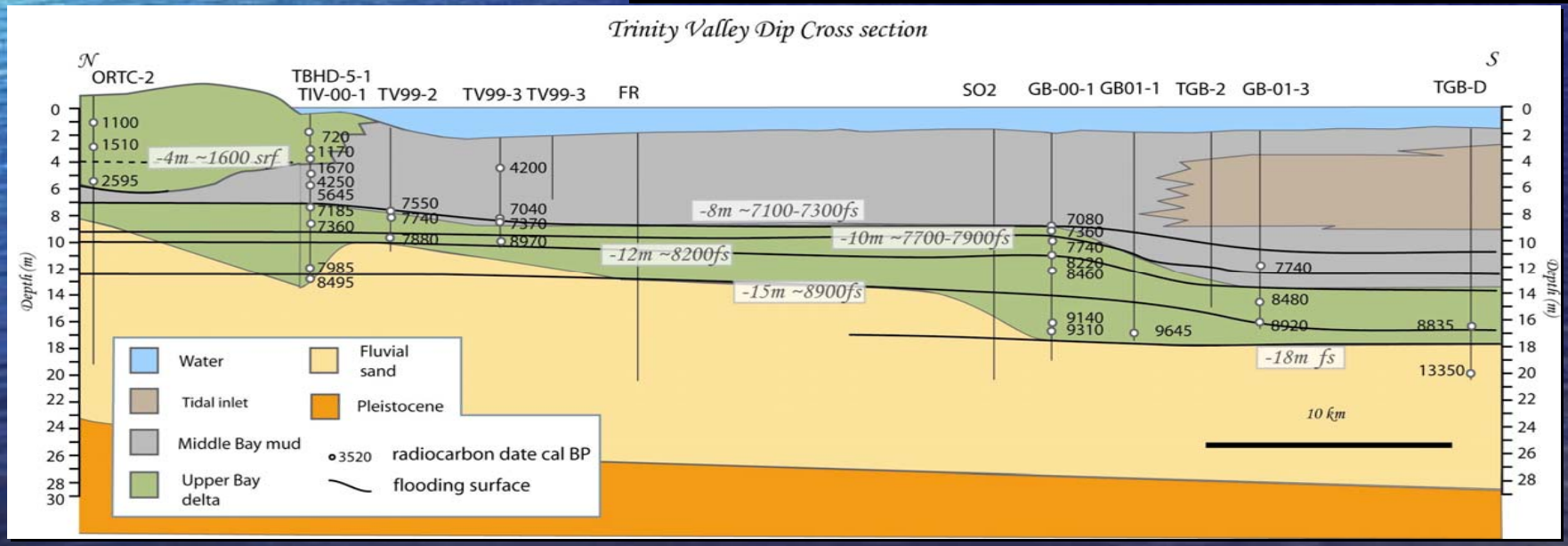
Milliken et al., 2008

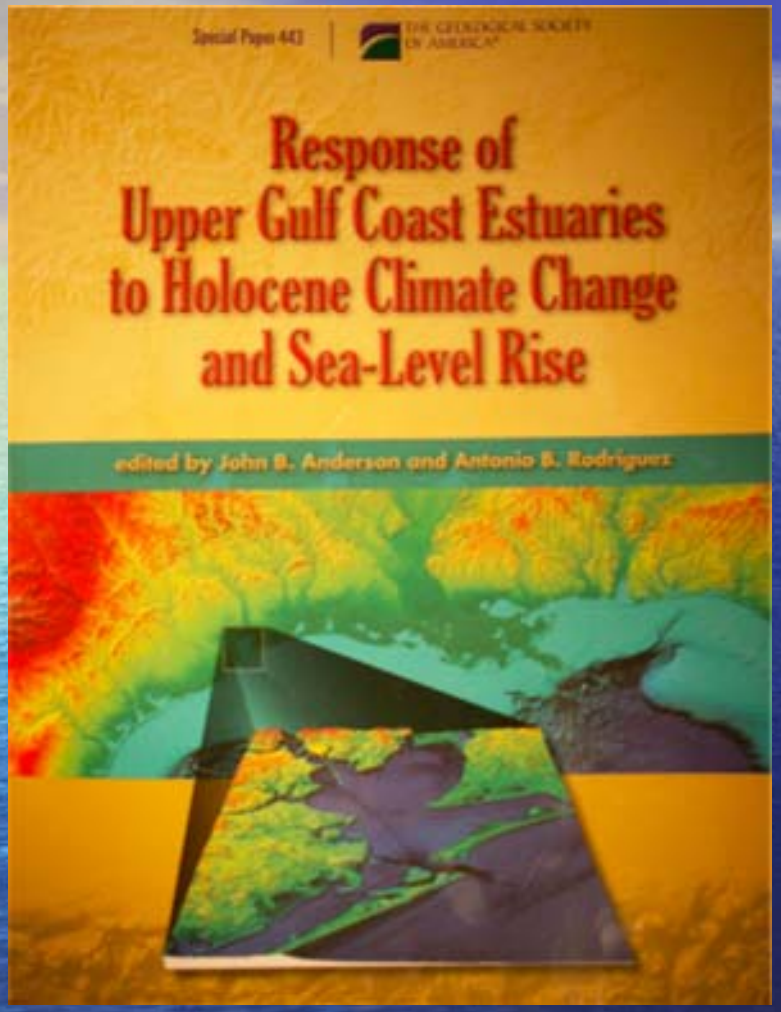


Anderson, 2007

Estuaries are the most vulnerable to changes in sea-level rise and sediment supply



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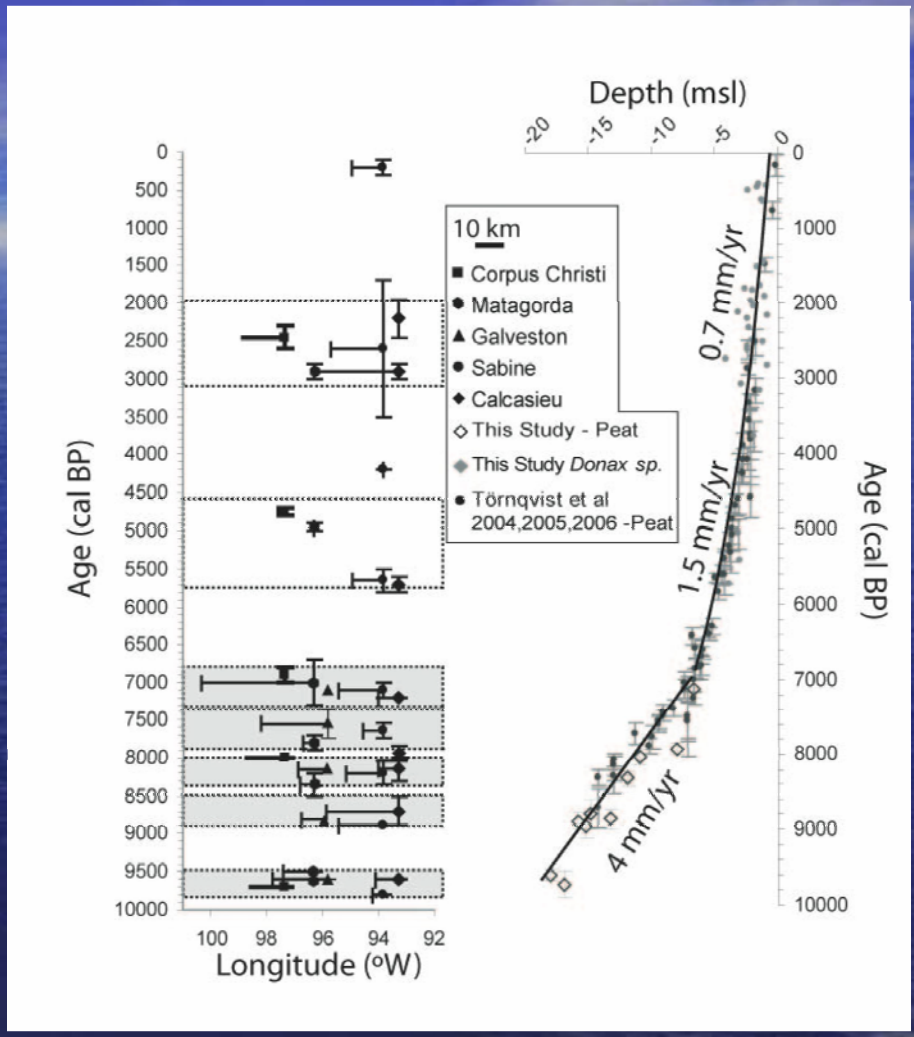
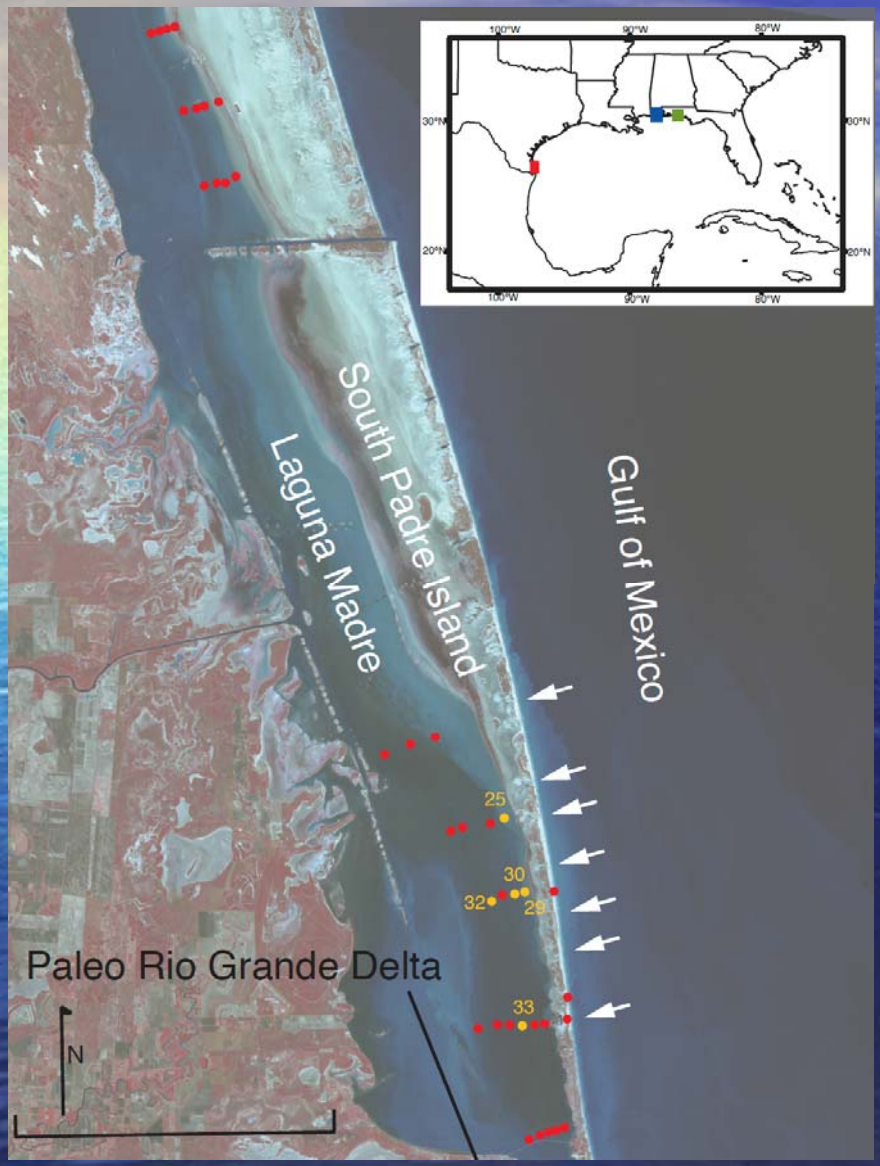
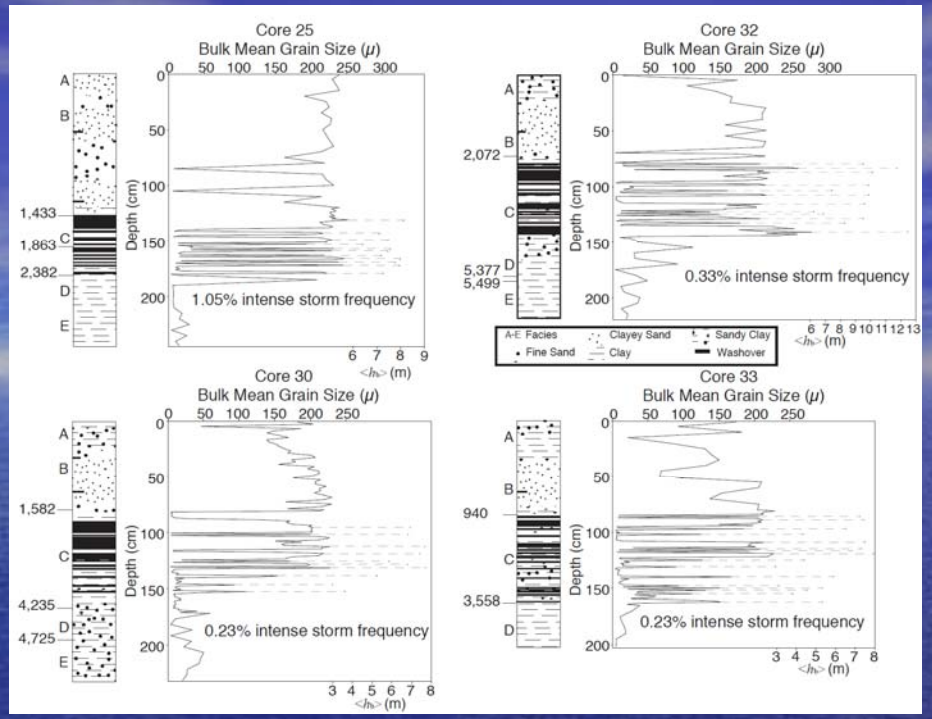
edited by John B. Anderson and Antonio B. Rodriguez

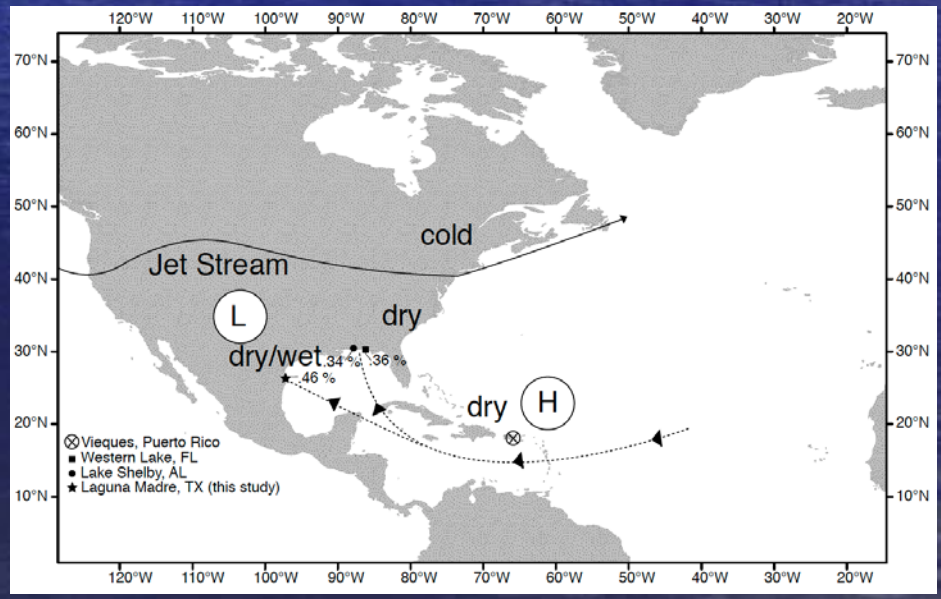

Depth (msl)
-20
-15
-10
-5
0
10 km
Corpus Christi
Matagorda
Galveston
Sabine
Calcasieu
This Study - Peat
This Study Donax sp.
Törnqvist et al 2004,2005,2006 -Peat
0.7 mm/yr
1.5 mm/yr
4 mm/yr
Age (cal BP)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500
9000
9500
10000
Longitude (°W)
100
98
96
94
92

Hurricane impact is the greatest uncertainty in predicting coastal change. Some scientists have argued that the number of large hurricanes striking our coasts will increase this century. Little is known about the impact of global warming on tropical storm steering mechanisms

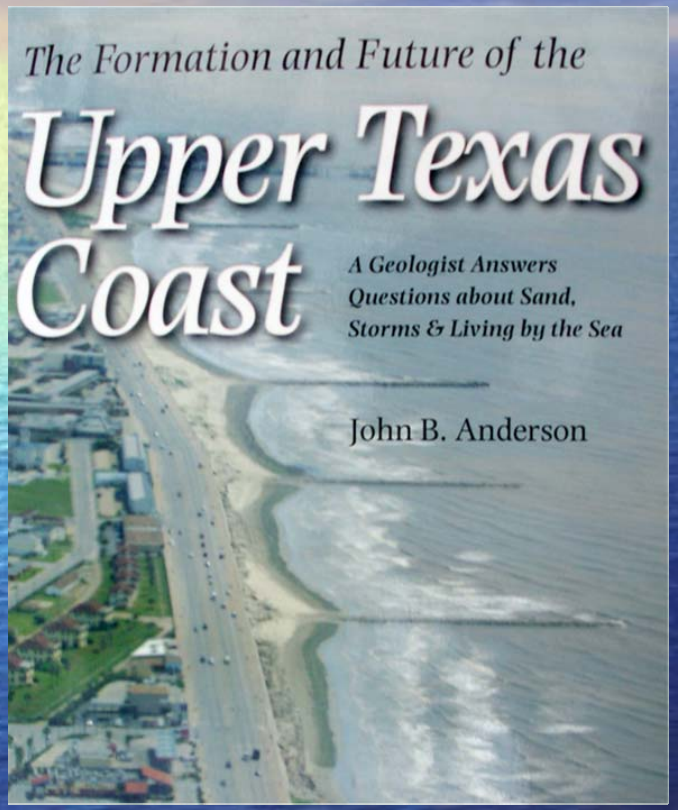
Record of Hurricane Impact







CONCLUSIONS



Learn More

- The current consensus is that eustatic sea level will rise between 0.5 and 2.0 meters by the end of this century. There is growing evidence that the overall rise will be punctuated by episodic rises of a few decimeters to a meter in magnitude caused by ice stream collapse
- The rate of subsidence along the Texas coast over the past 4000 years has been minimal (less than 1 mm/yr)
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