Controls on Sediment/POC Flux and Burial on the Gulf of Mexico Continental Margin (with special emphasis on the Mississippi-Atchafalaya system)

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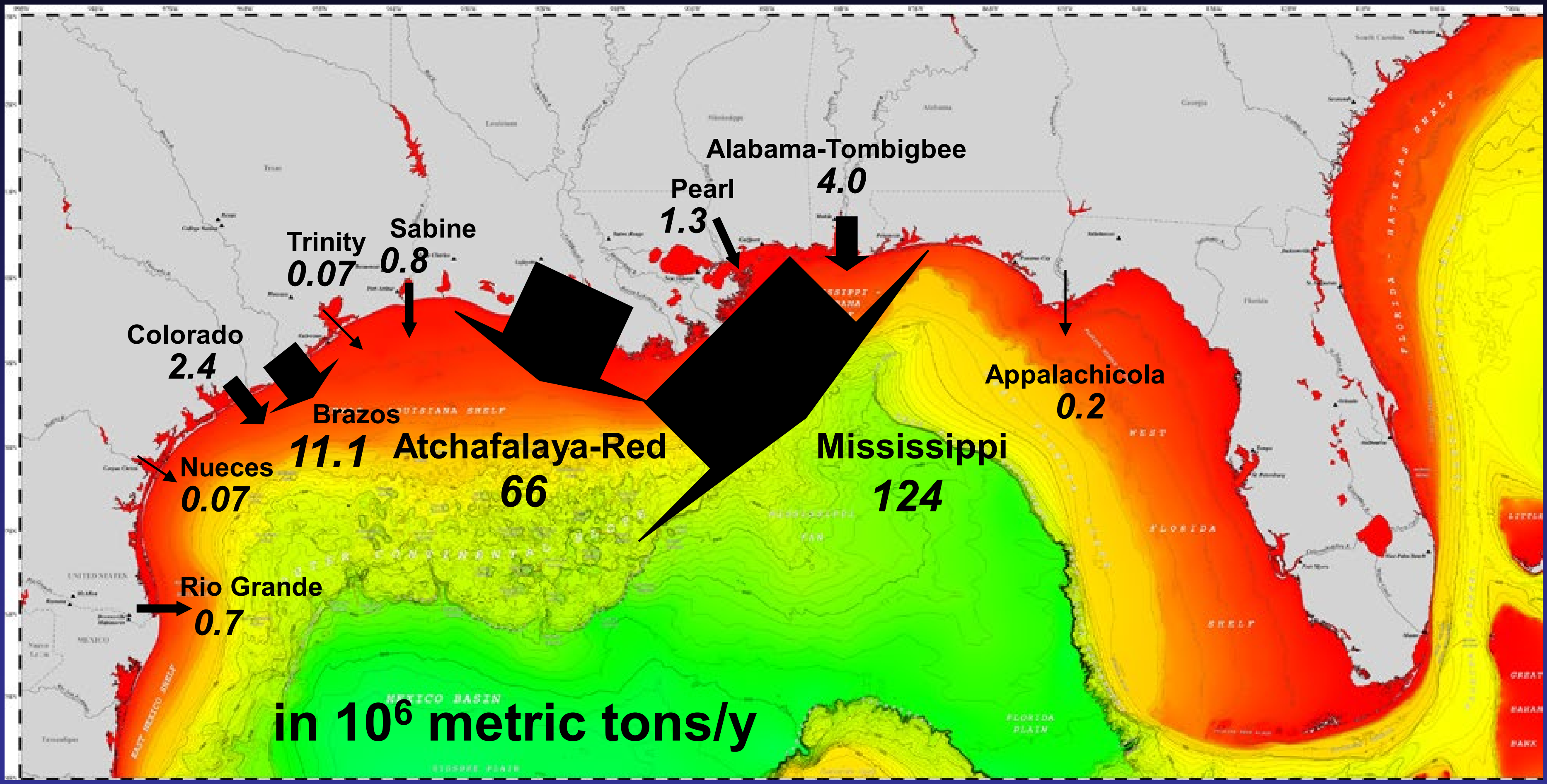
OBJECTIVES

Role of:

1. Riverine Inputs
2. Estuarine/Tidal Zone Alteration of Inputs
3. Wetland Inputs from Storms
4. Shelf Sediment Burial
5. Inner Shelf Dynamics
6. Hurricanes and the Shelf (Lili/Katrina/Rita)
7. Relative Sea Level Rise

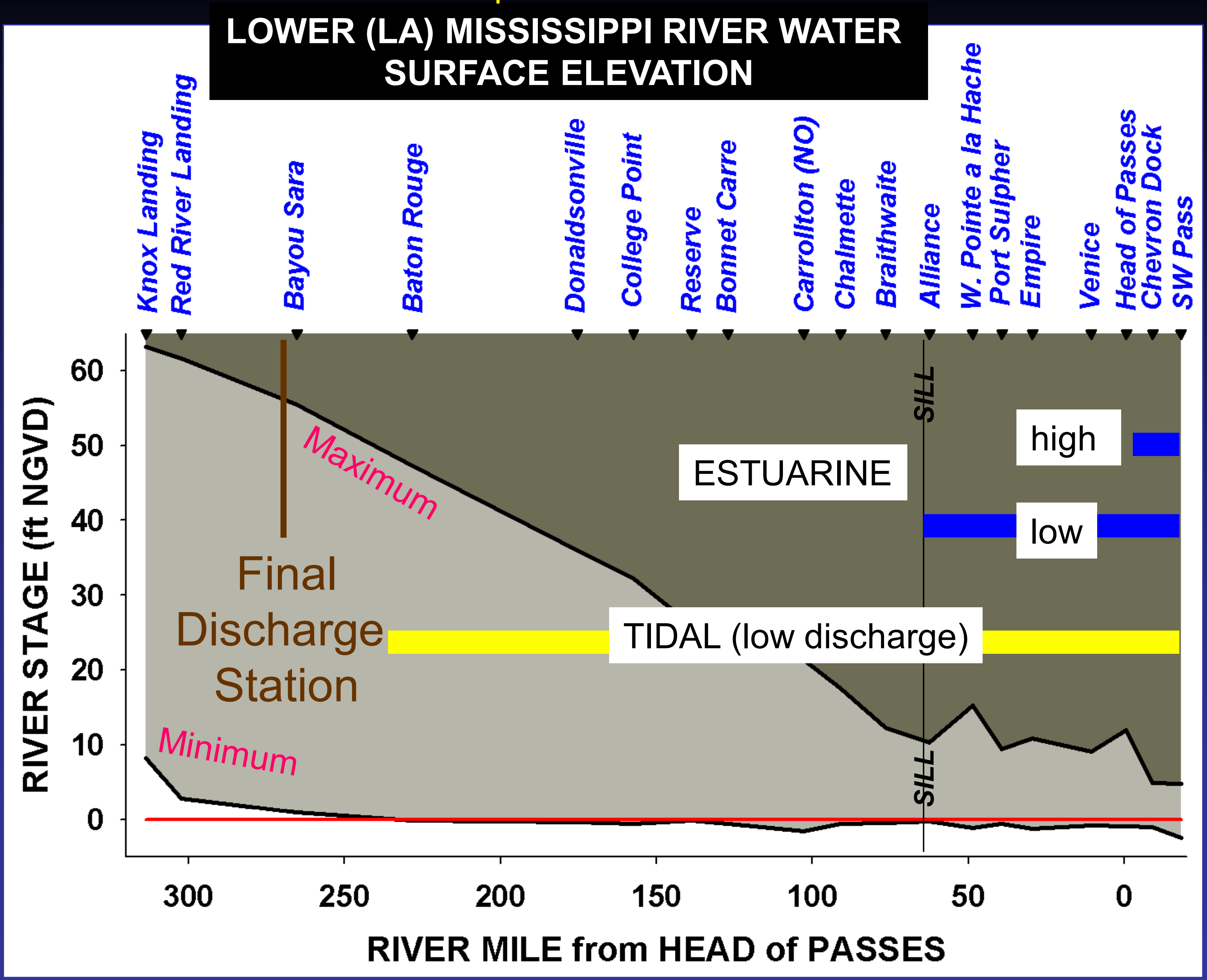
1. Riverine Inputs

Gulf of Mexico Riverine Suspended Sediment Loads



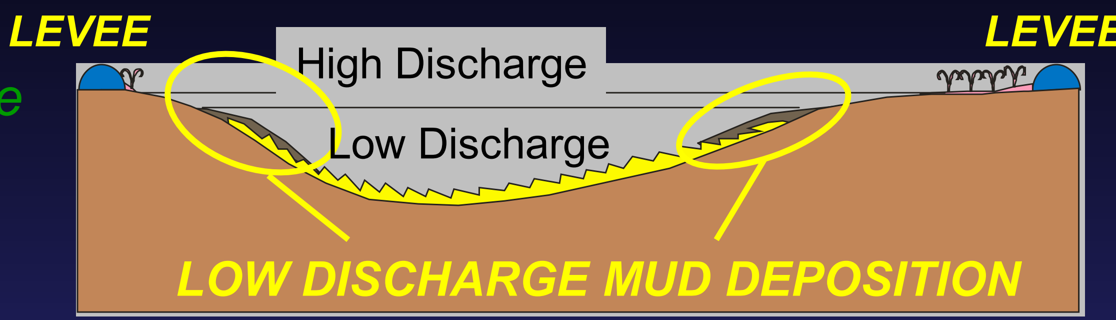
USGS Waterweb, Ryan and Goodell (1972)
Meade and Parker (1985), Meade et al. (1990)
Hudson and Mossa (1997), Horowitz et al., (2001)
Horowitz (2006)

2. Estuarine/Tidal Zone Alteration of Inputs

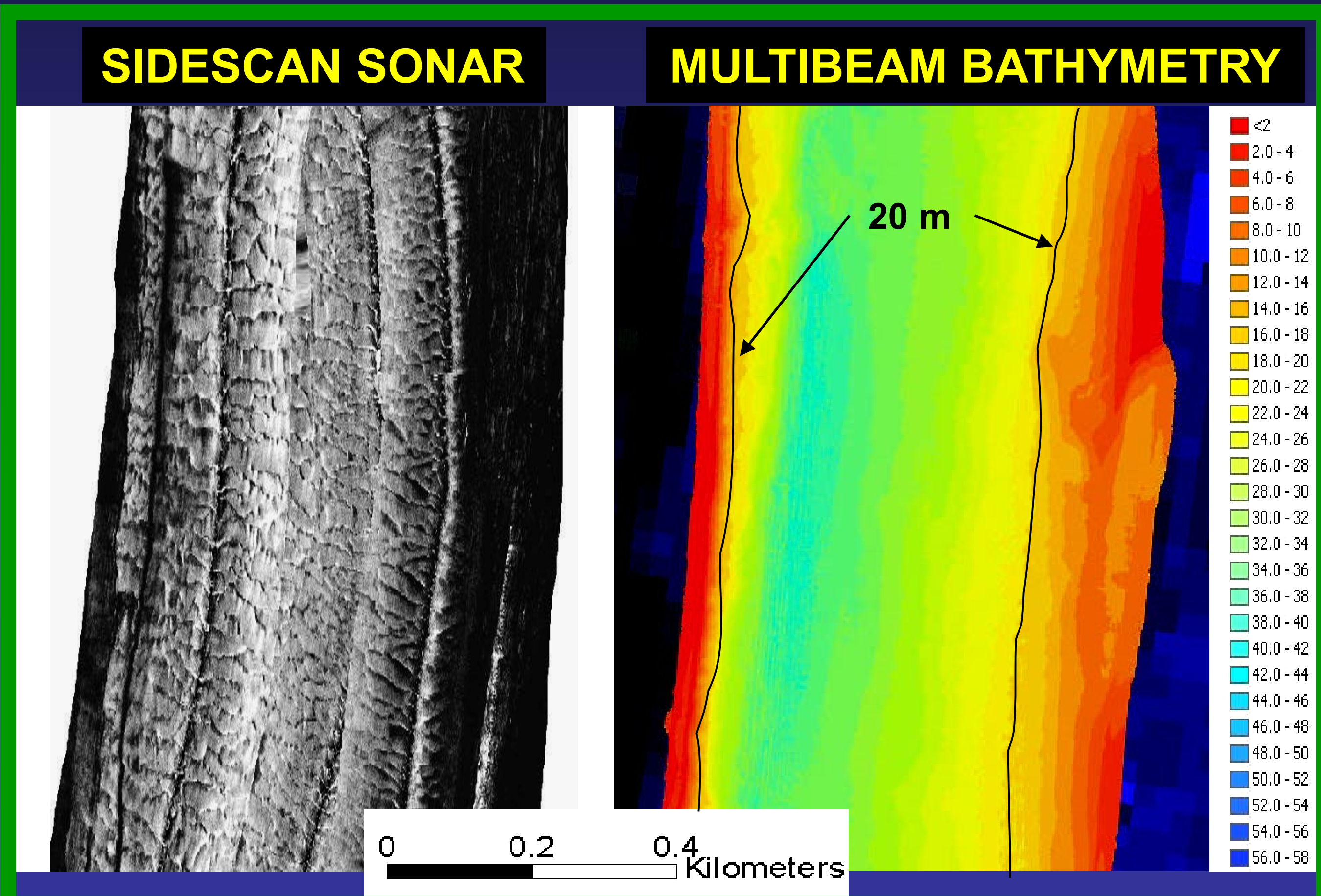


2. Estuarine/Tidal Zone Alteration of Inputs

Low Discharge Mud Storage (1999-2002)



TIDAL REACH

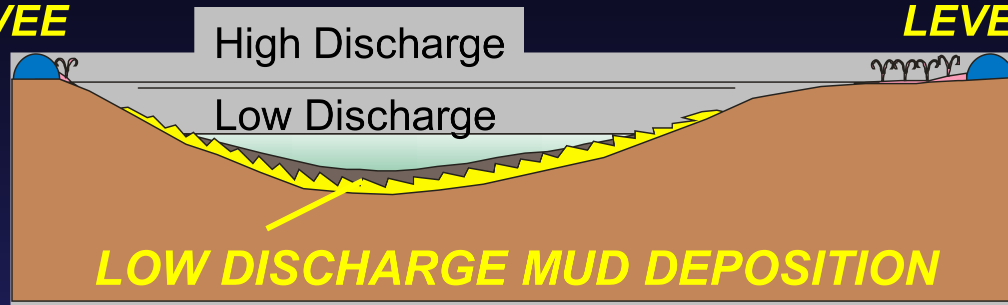


14 MT
(RM181-13)

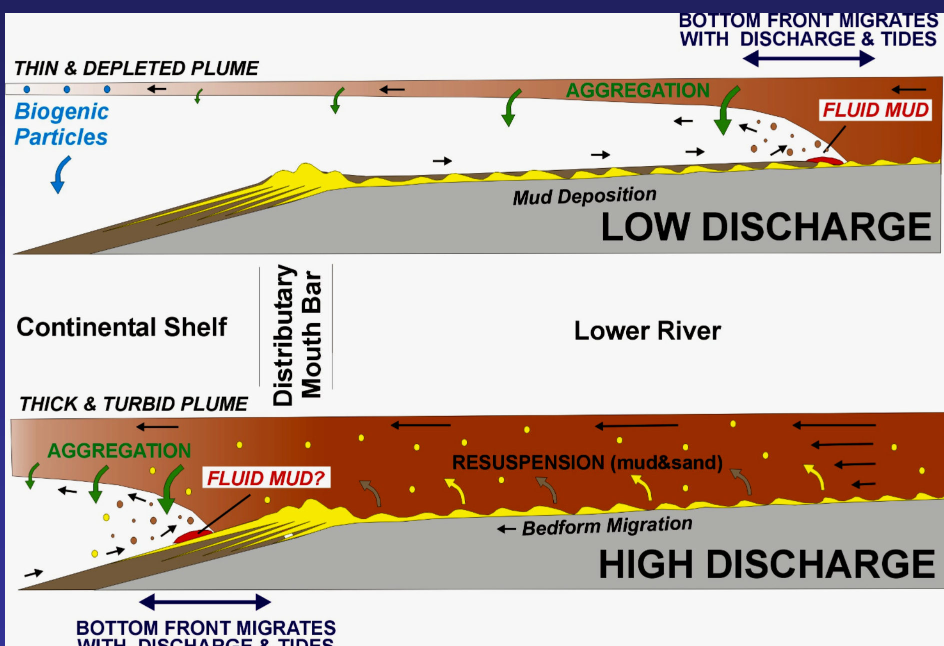
124 MT
Post-1993
(Horowitz et al., 2001)

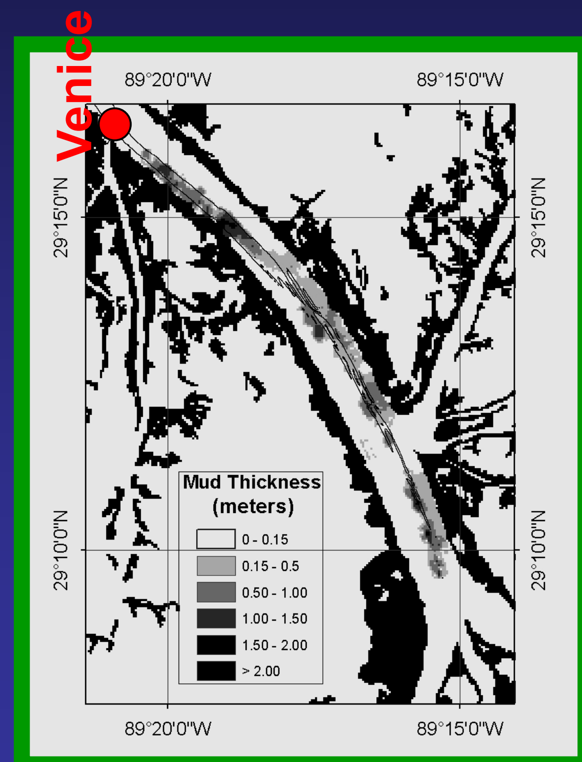
2. Estuarine/Tidal Zone Alteration of Inputs

Low Discharge Mud Storage (1999-2002)



ESTUARINE REACH



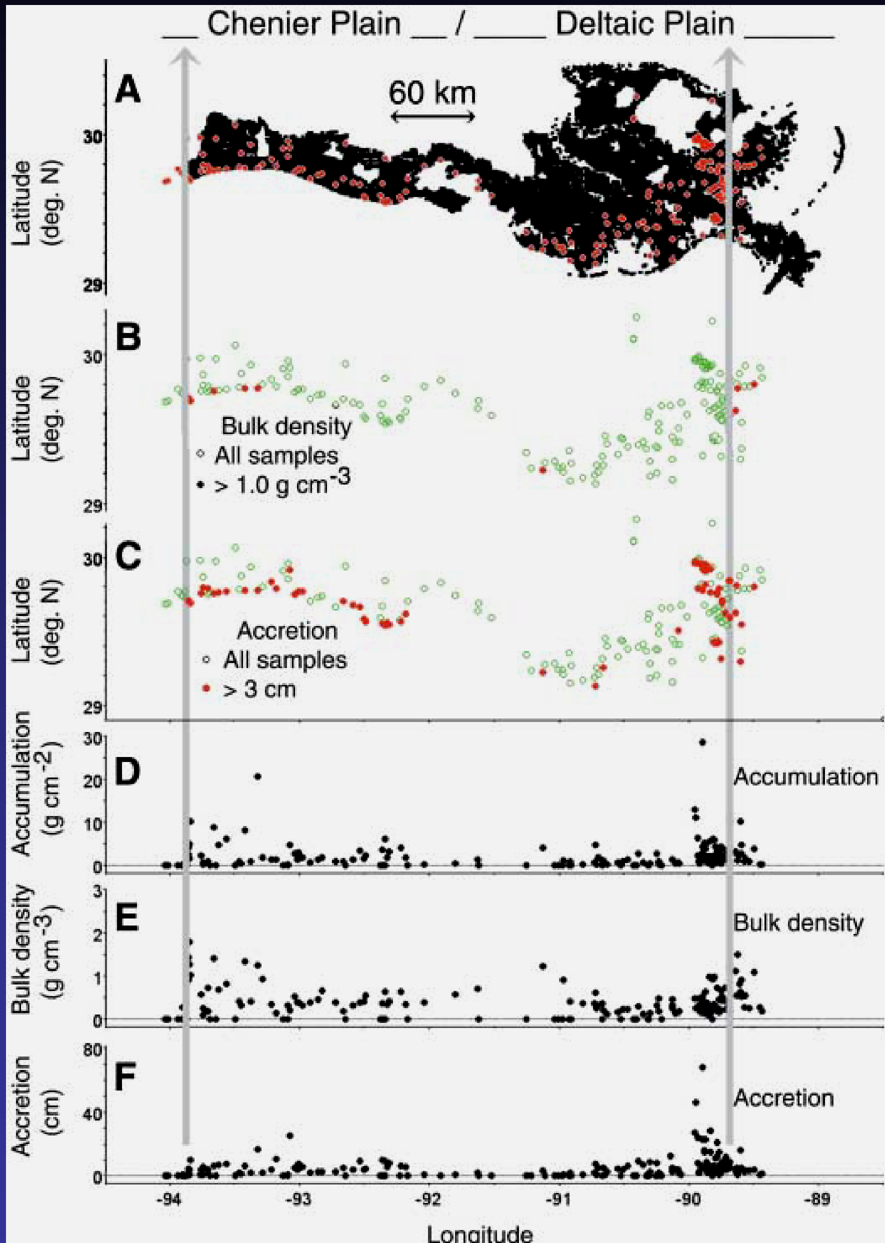


10 MT
(RM13-Passes)

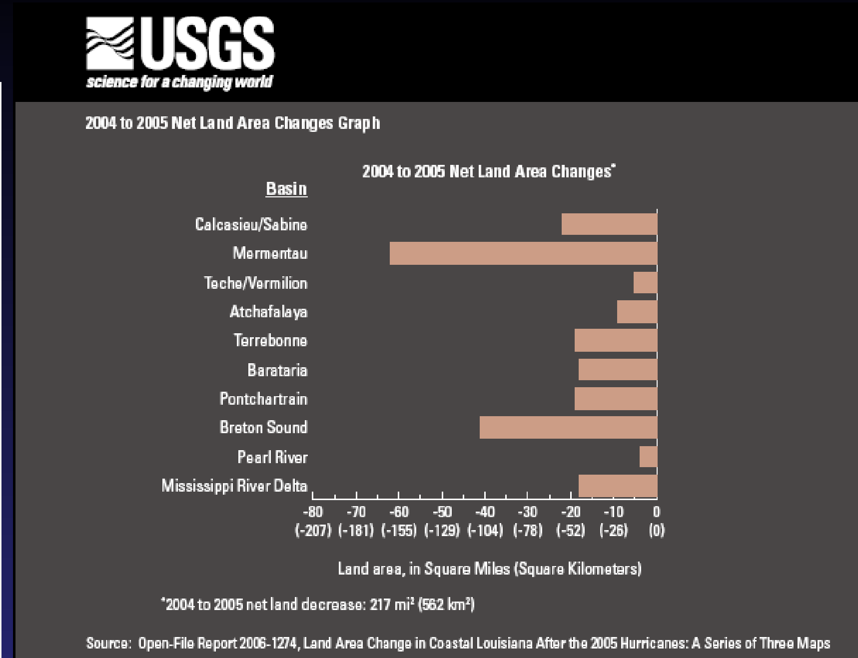
124 MT
Post-1993
(Horowitz et al., 2001)

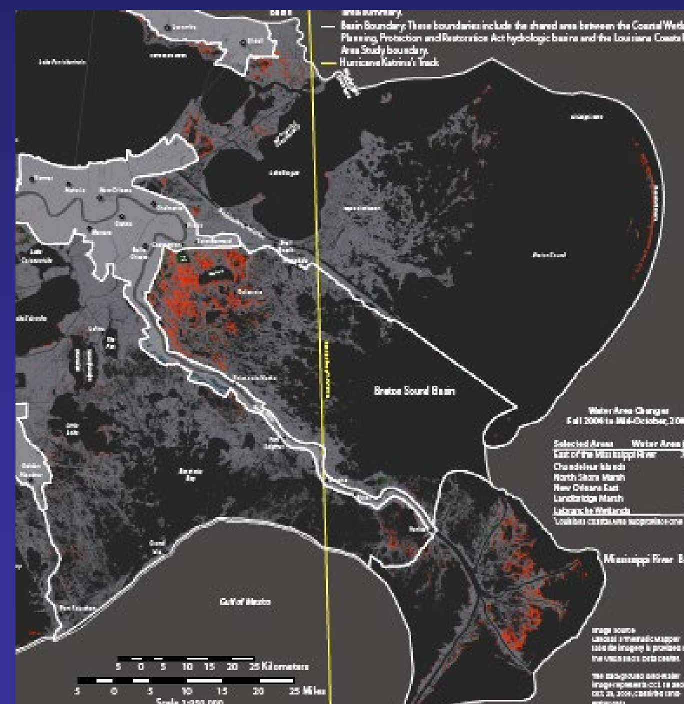
From Galler and Allison, GSA Bull (2008)

3. Wetland Inputs from Storms



from Turner et al., Science (2006)





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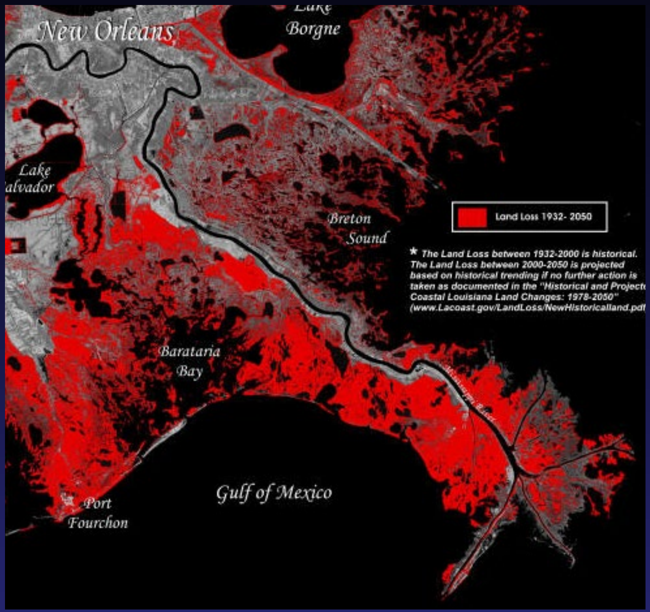
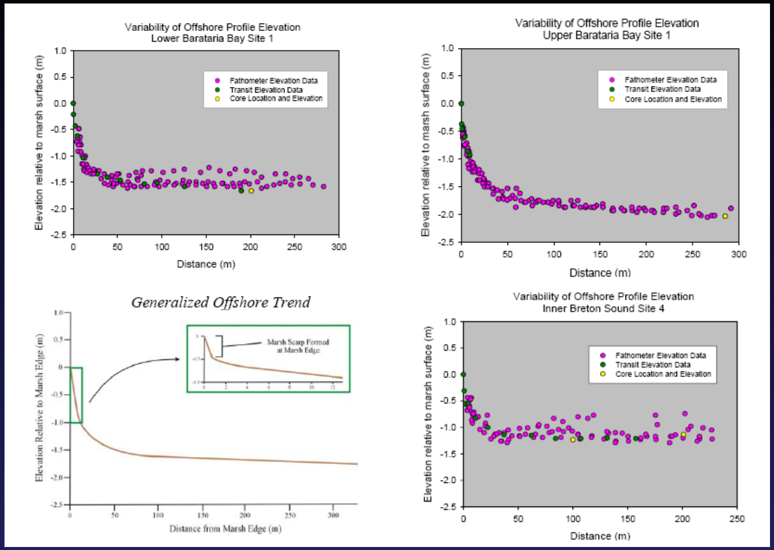
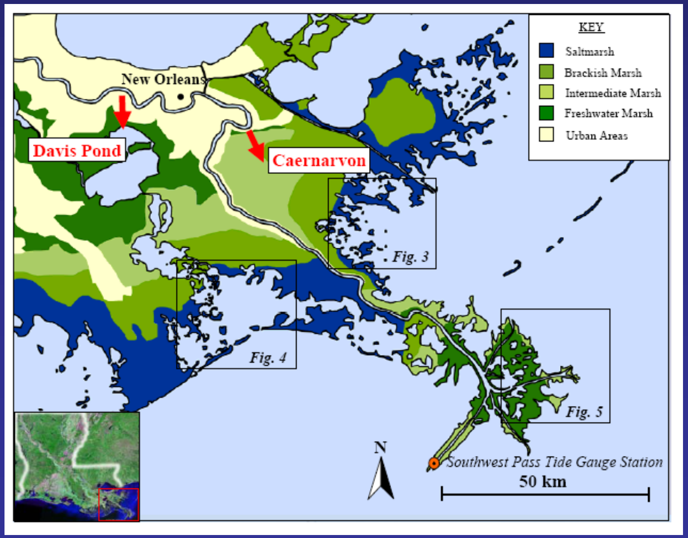
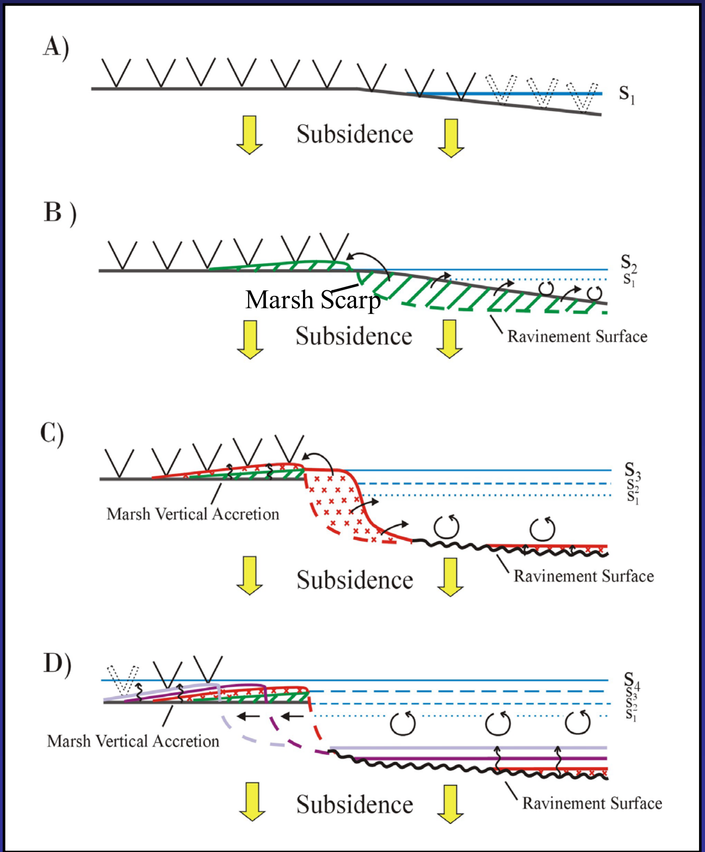








from Wilson and Allison, ECSS (submitted)

3. Wetland Inputs from Storms

Site	Shoreline Retreat Rate[1] (m/yr)	Maximum Depth of Profile (m)	RSLR Rate[2] (m/yr)	Annual Sediment Yield from Translation of Profile (m^3 per m of shoreline)	% Sediment Yield Sequestered by RSLR annually	Corrected Annual Sediment Yield (m^3 per m of shoreline)	Annual Sediment Yield Estimated from Equilibrium Profile (m^3 per m of shoreline)
LBB 1	1.59	1.454	0.0111	2.31	0.4	2.32	2.39
LBB 2.1	1.05	1.415	0.0111	1.49	0.4	1.49	1.57
LBB 2.2	0.83	1.503	0.0111	1.25	0.4	1.244	1.24[4]
UBB 1	1.28	1.839	0.0111	2.35	0.3	2.35	1.92
UBB 2	0.84	1.52	0.0111	1.28	0.4	1.27	1.26
UBB 3	1.02	N/A[3]	0.0111	N/A[3]	N/A[3]	N/A[3]	N/A[3]
IBS 1	0.76	N/A[3]	0.0104	N/A[3]	N/A[3]	N/A[3]	N/A[3]
IBS 2	0.74	1.719	0.0104	1.27	0.3	1.274	1.11[4]
IBS 3	0.66	1.545	0.0104	1.02	0.3	1.024	0.99[4]
IBS 4	0	1.118	0.0104	0	0	0.00	0.00
IBS 5	0.76	1.602	0.0104	1.22	0.3	1.22	1.15

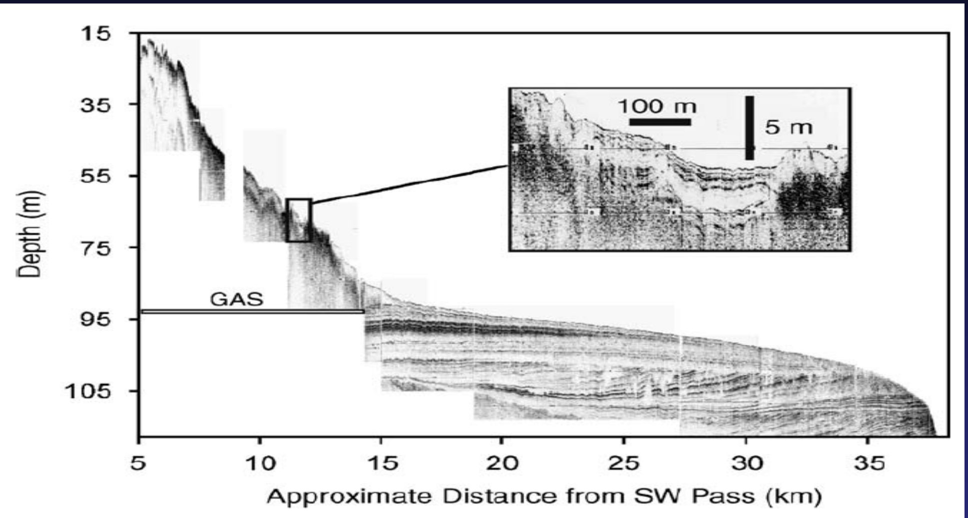
[1]From Penland et al., 2000; [2]From Penland and Ramsey, 1990; [3]Sites adjacent to deep marsh channels were excluded; [4]Marsh accumulation rates not calculated for these sites, so not included in corrected yields

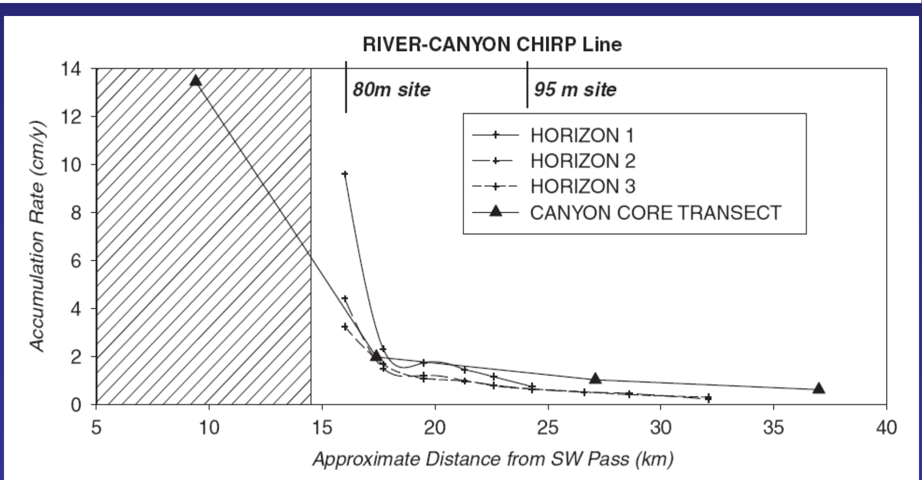
LOCATION	Area of Land Loss in Basin b/t 1932-1990 (m^2)	Equilibrium Profile depth of incision (m)	Corrected Sediment Yield (m^3)	Yield of Organic Material (MT)	Yield of Inorganic Material (MT)	Annual Yield of Organic Material (MT)	Annual Yield of Inorganic Material (MT)
Barataria Bay	58.3×10^6	1.5	80.2×10^6	4.2×10^6	24.7×10^6	7.3×10^4	42.5×10^4
Breton Sound	62.2×10^6	1.5	88.9×10^6	5.3×10^6	25.9×10^6	9.1×10^4	44.7×10^4

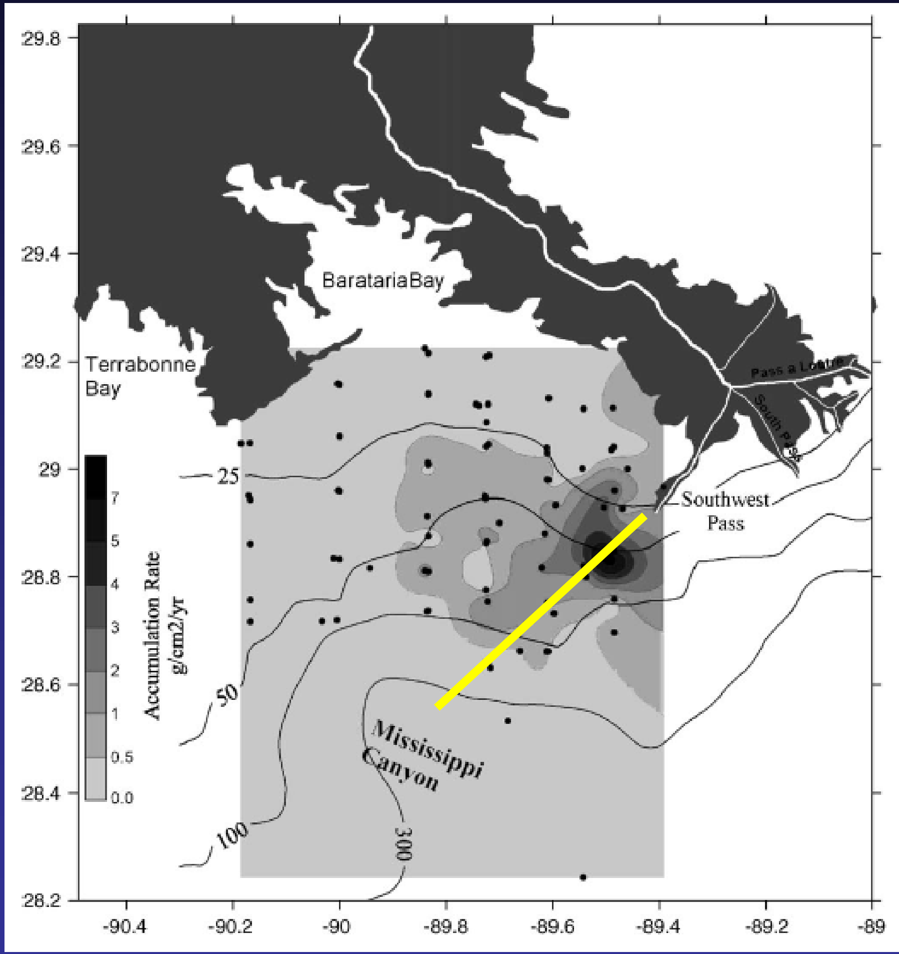
from Wilson and Allison, ECSS (submitted)

4. Shelf Sediment Burial

50-60% of input buried

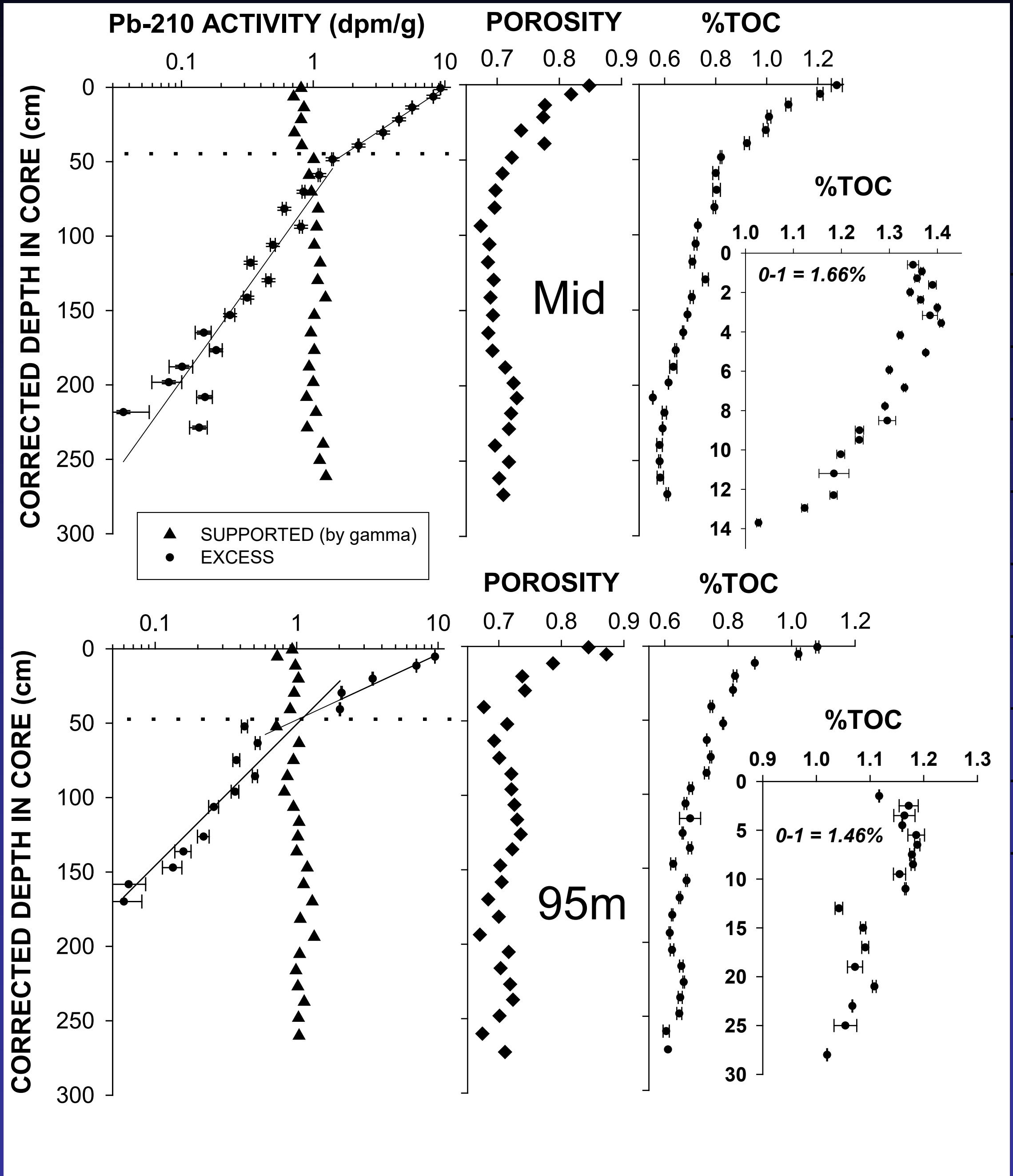


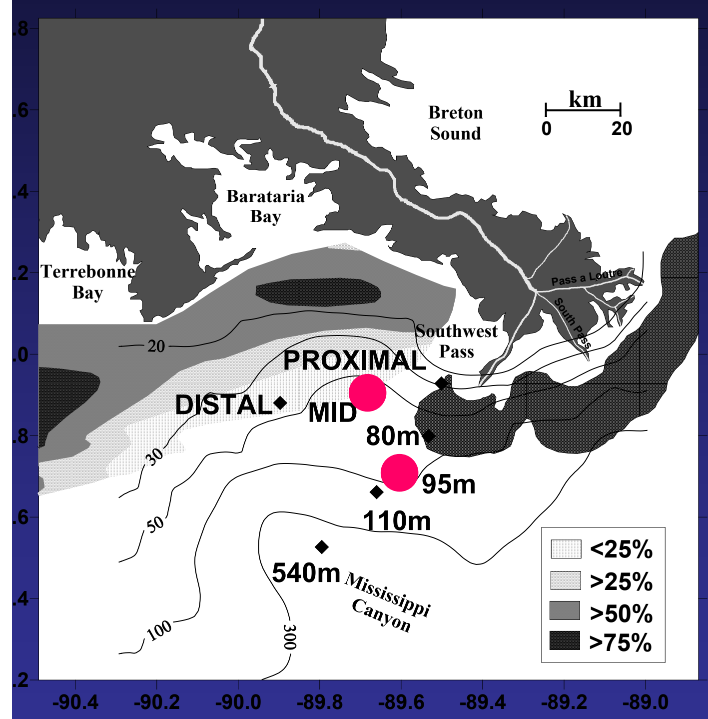




from Corbett, McKee and Allison, CSR (2006)

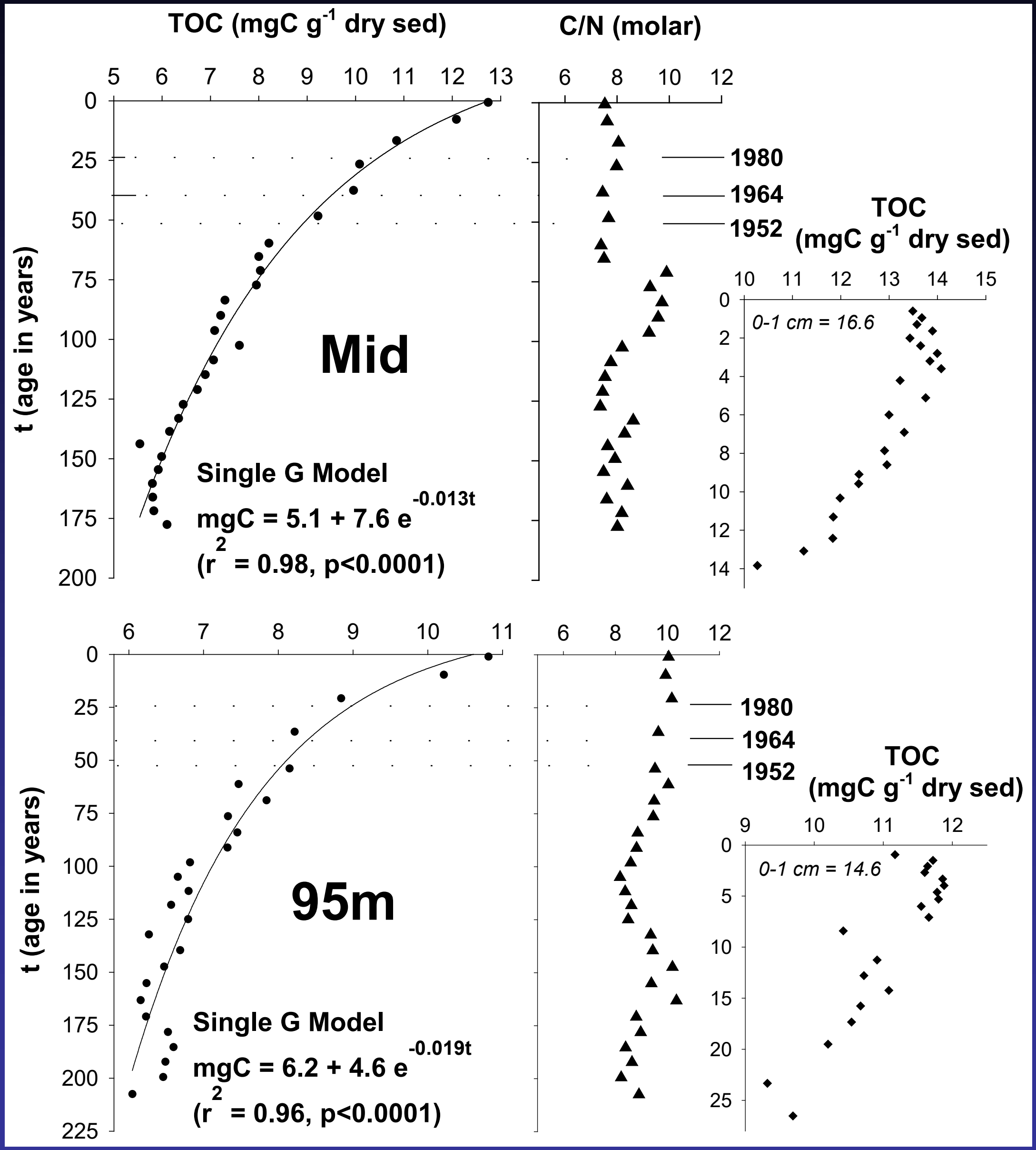
4. Shelf Sediment Burial





Allison et al., GRL (2007)

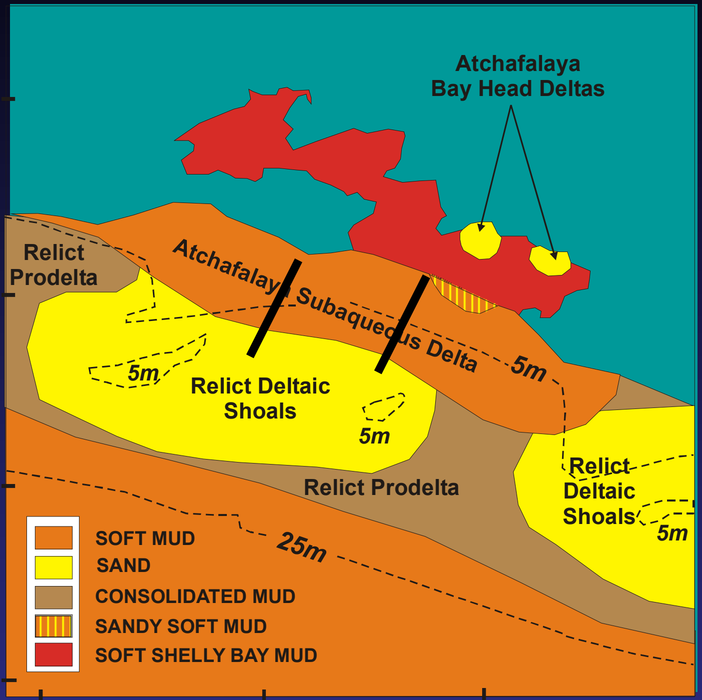
4. Shelf Sediment Burial

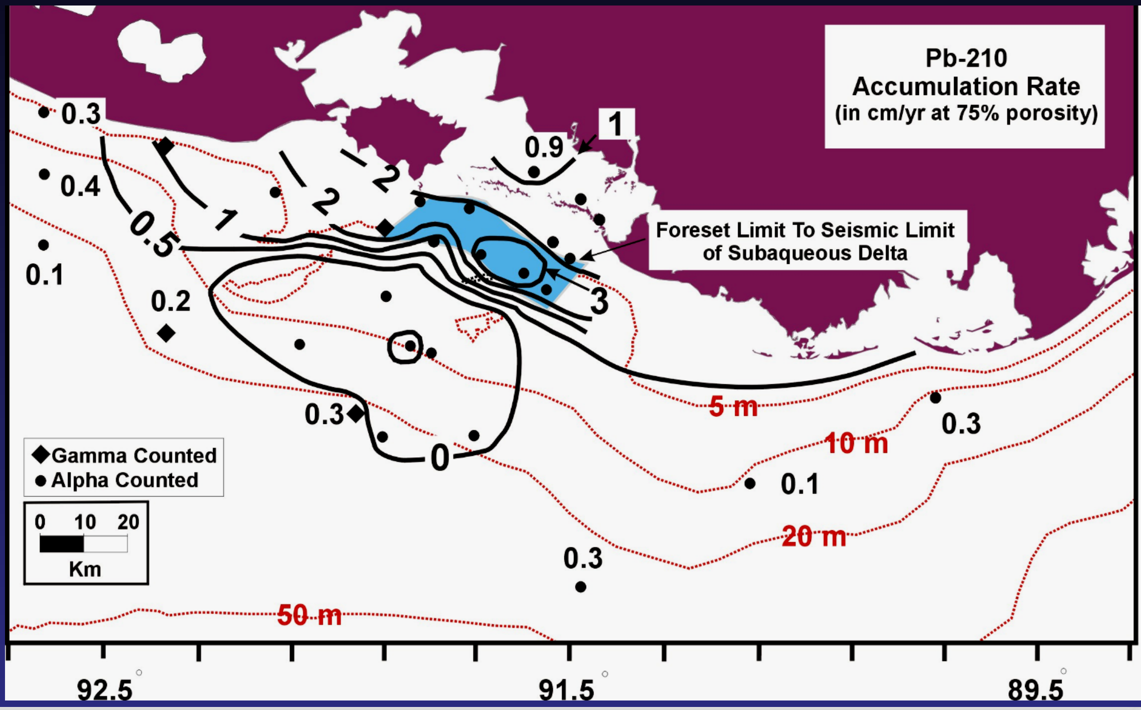


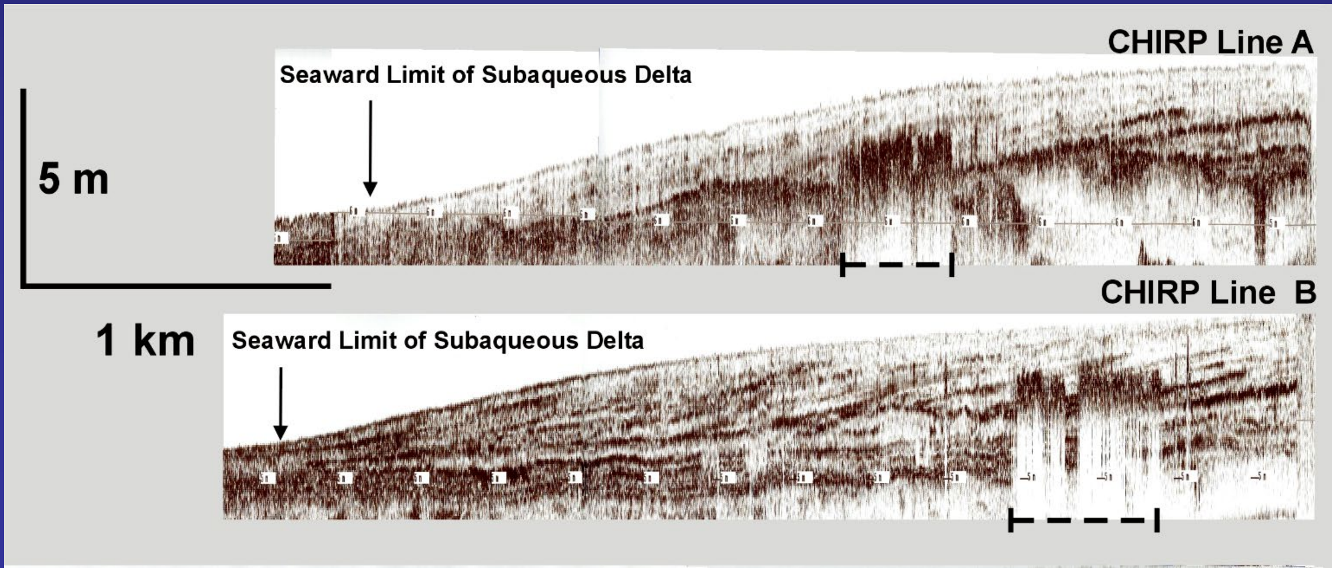
Allison et al., GRL (2007)

4. Shelf Sediment Burial

~61% of input buried (bay/delta/chenier coast)

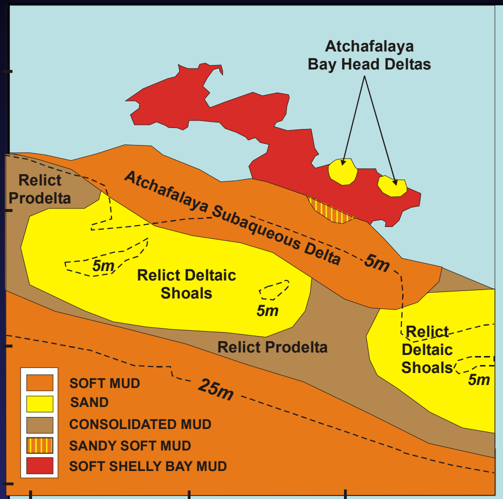


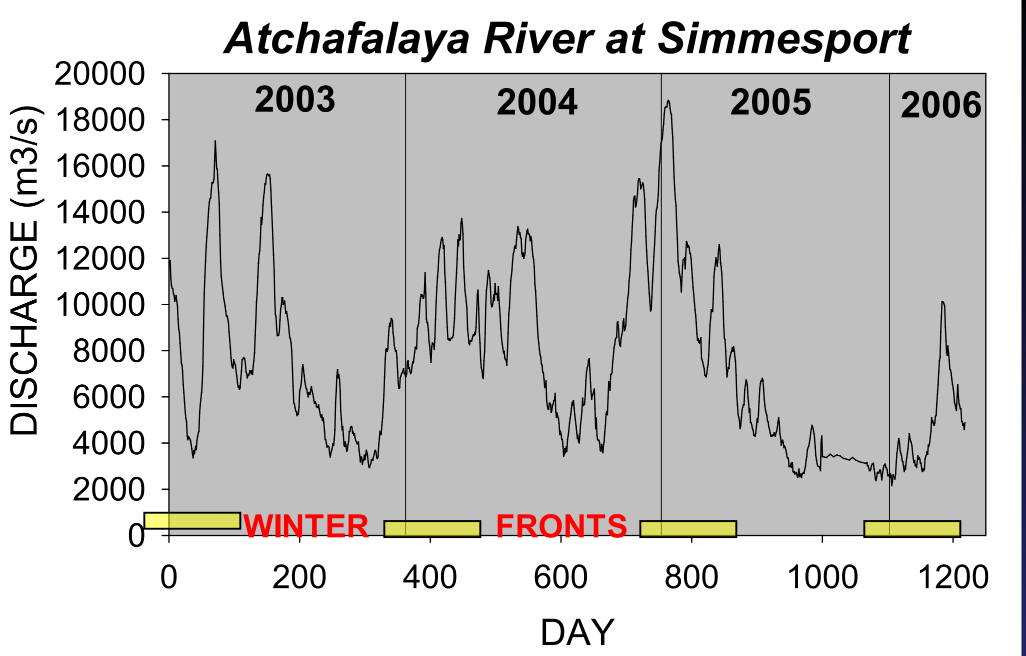


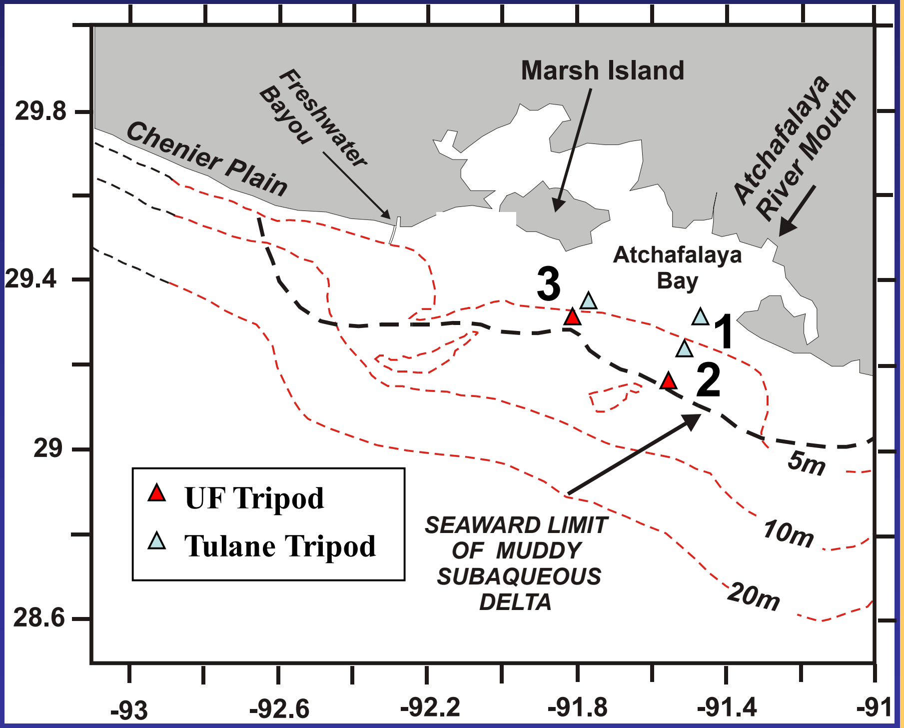


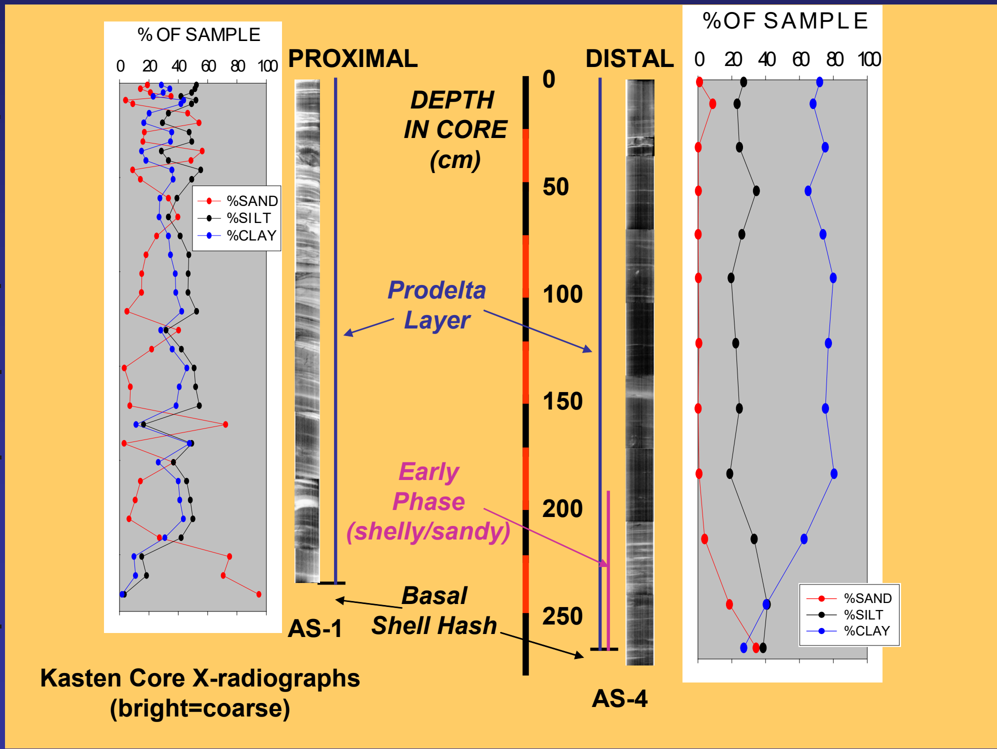
Neill and Allison, MG (2005)

5. Inner Shelf Dynamics









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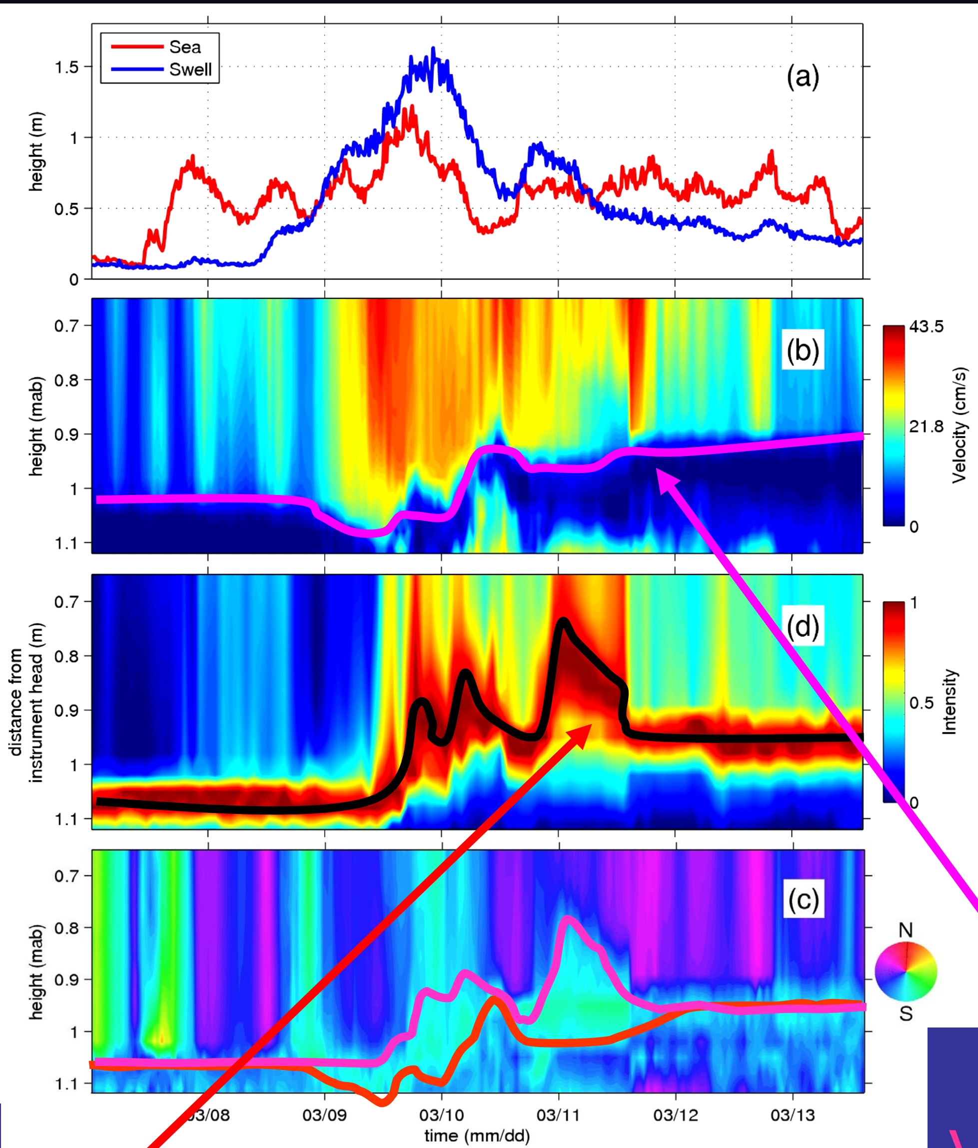
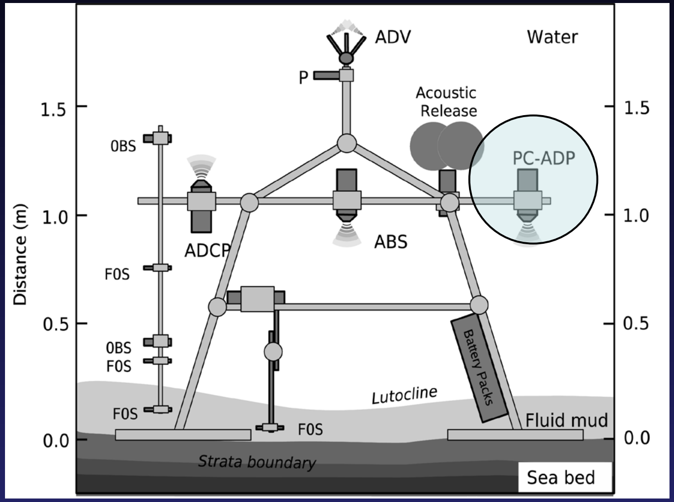
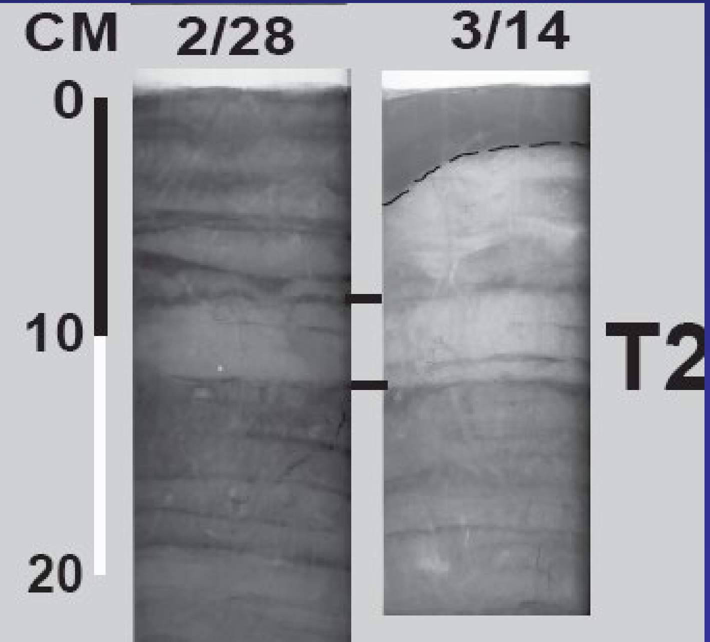




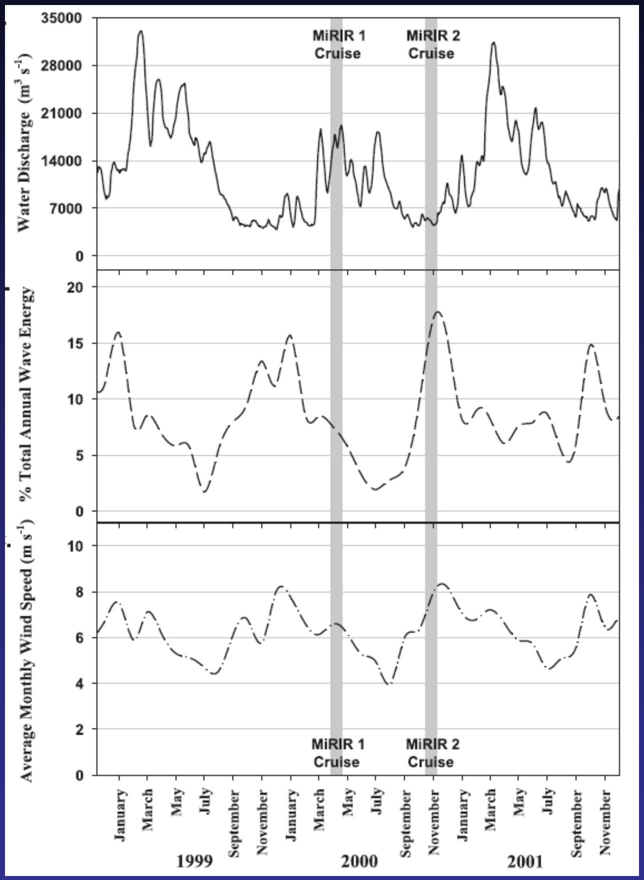


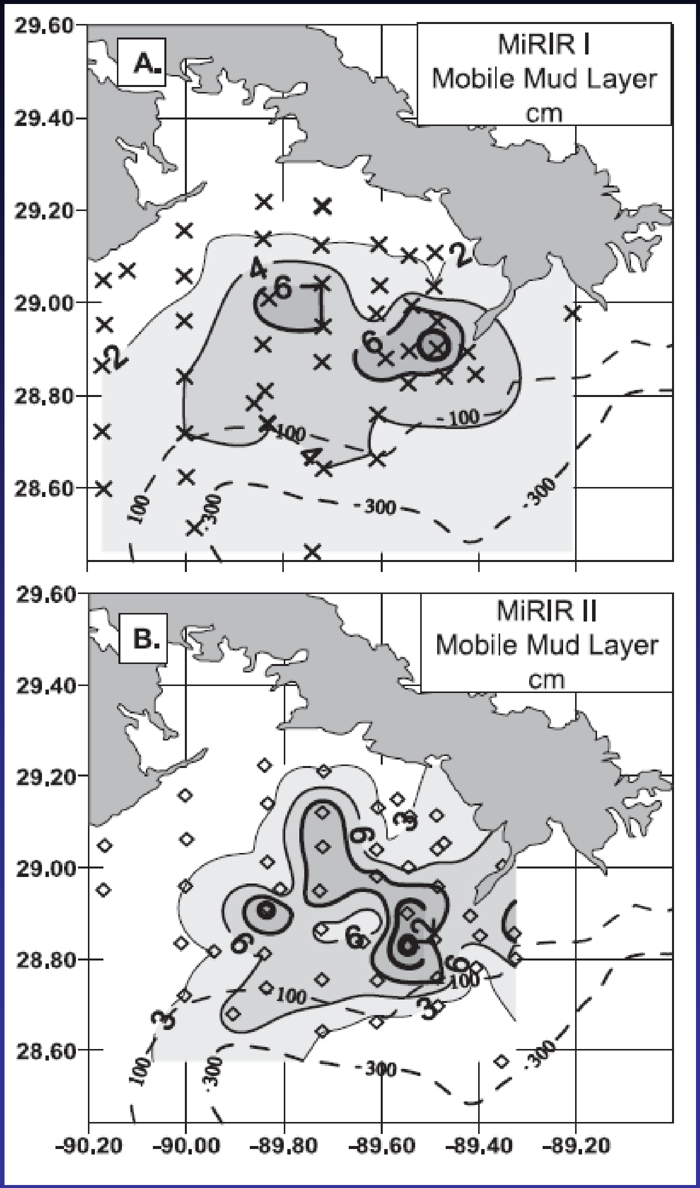
Zero Velocity

Maximum Backscatter Intensity

Jaramillo et al., JGR (submitted)

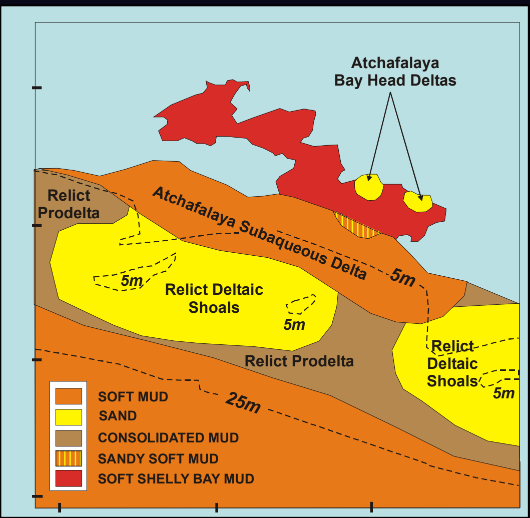
5. Inner Shelf Dynamics

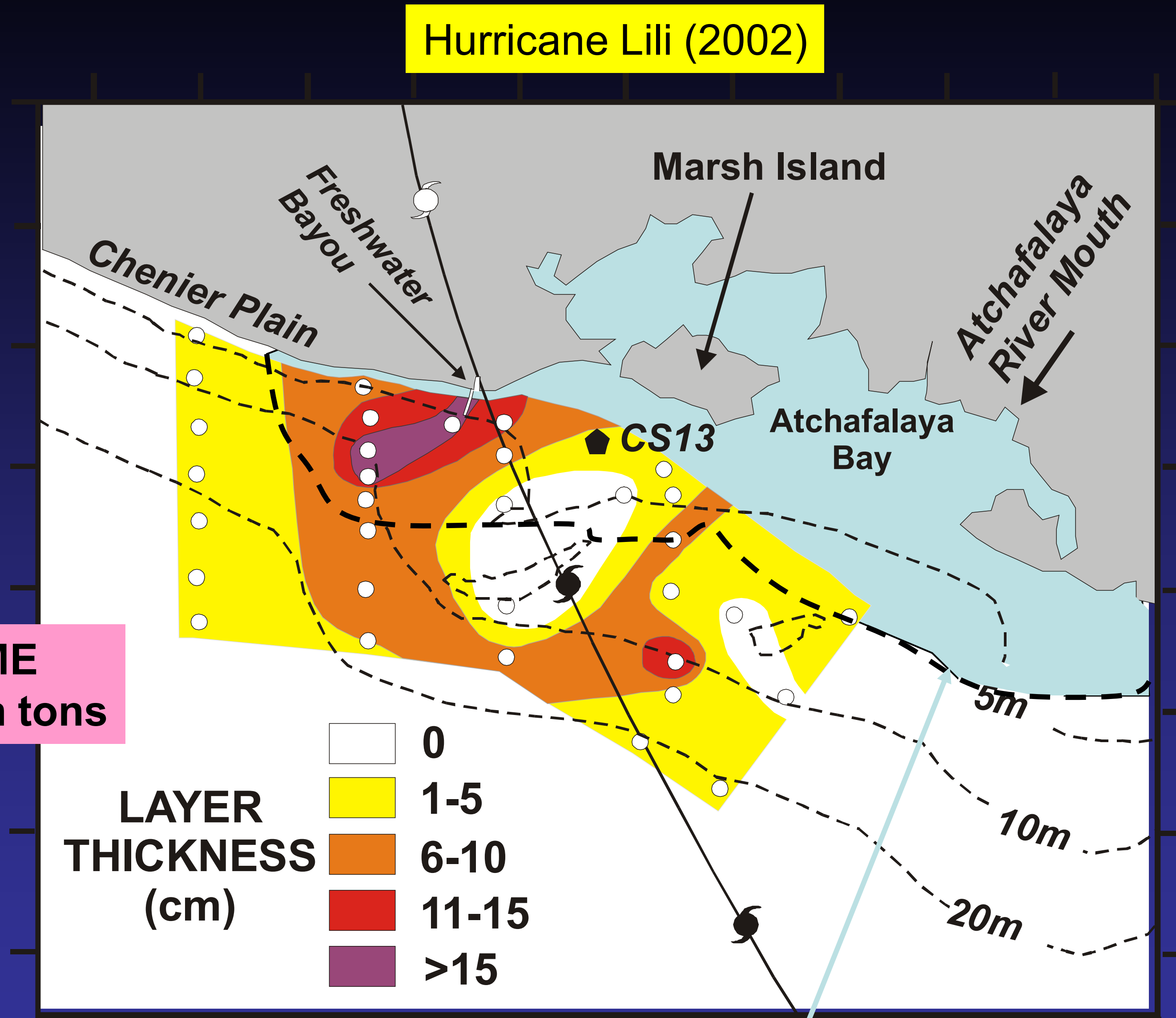




Corbett et al., CSR (2004)

6. Hurricanes and the Shelf





VOLUME
160 million tons

Allison et al., CSR (2005)

Seismic Limit of Subaqueous Delta

6. Hurricanes and the Shelf

Hurricane Katrina/Rita (2005)

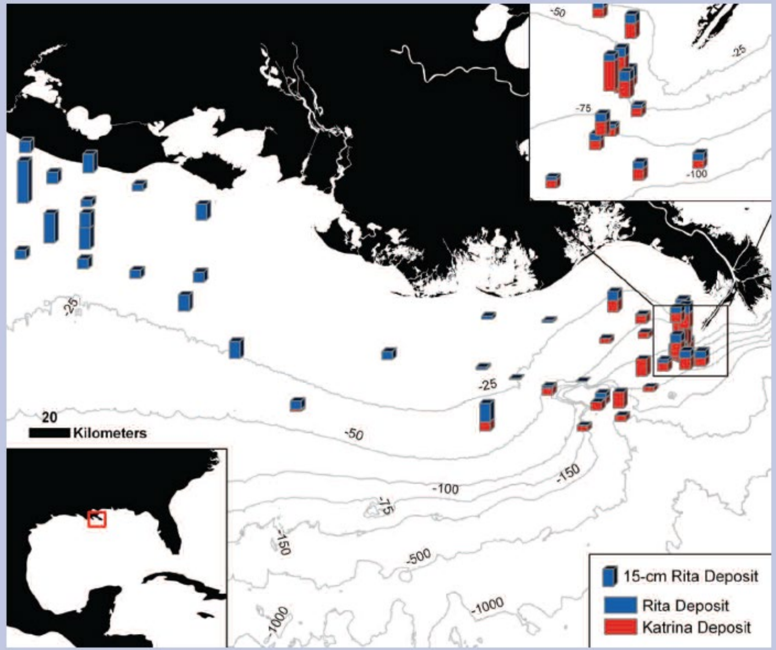


Figure 2. Map illustrating the thickness of sediment deposits associated with Hurricanes Katrina and Rita.

Table 1. Estimates of total mass accumulation of sediment, organic carbon and nitrogen on the seabed due to the combined Rita and Katrina events in contrast to annual inputs by rivers and regional primary production.

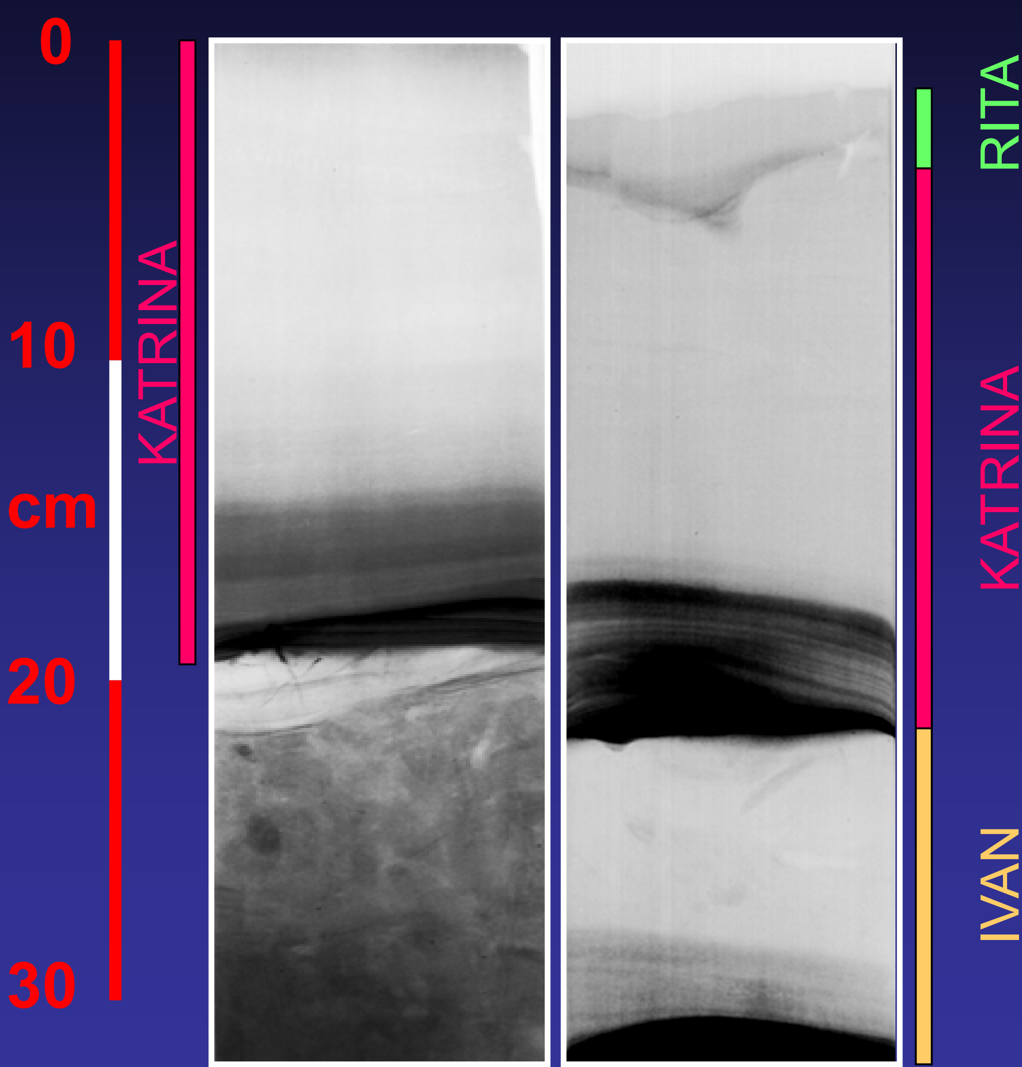
	Sediment	Organic Carbon	Nitrogen
Rita/Katrina Accumulations (g)	$1.16 \times 10^{15} \pm 1.56 \times 10^{14}$	$1.36 \times 10^{13} \pm 2.46 \times 10^{12}$	$1.56 \times 10^{12} \pm 2.5 \times 10^{11}$
Annual Inputs (g/y)			
Combined Mississpi/Atchafalaya Rivers	2.16×10^{14}	3.62×10^{12}	3.96×10^{11}
Regional Net Primary Production		$1.05 \times 10^{13} \pm 3.82 \times 10^{12}$	$1.74 \times 10^{12} \pm 6.36 \times 10^{11}$
Non-Hurricane Accumulations (g/y)	1.18×10^{14}	1.17×10^{12}	1.40×10^{11}

Seabed accumulation rates account for the porosity values measured in storm and non-storm deposits.
Estimates of annual inputs (river discharge and primary productivity) and of non-hurricane accumulations are from Gordon and Goni, 2004.

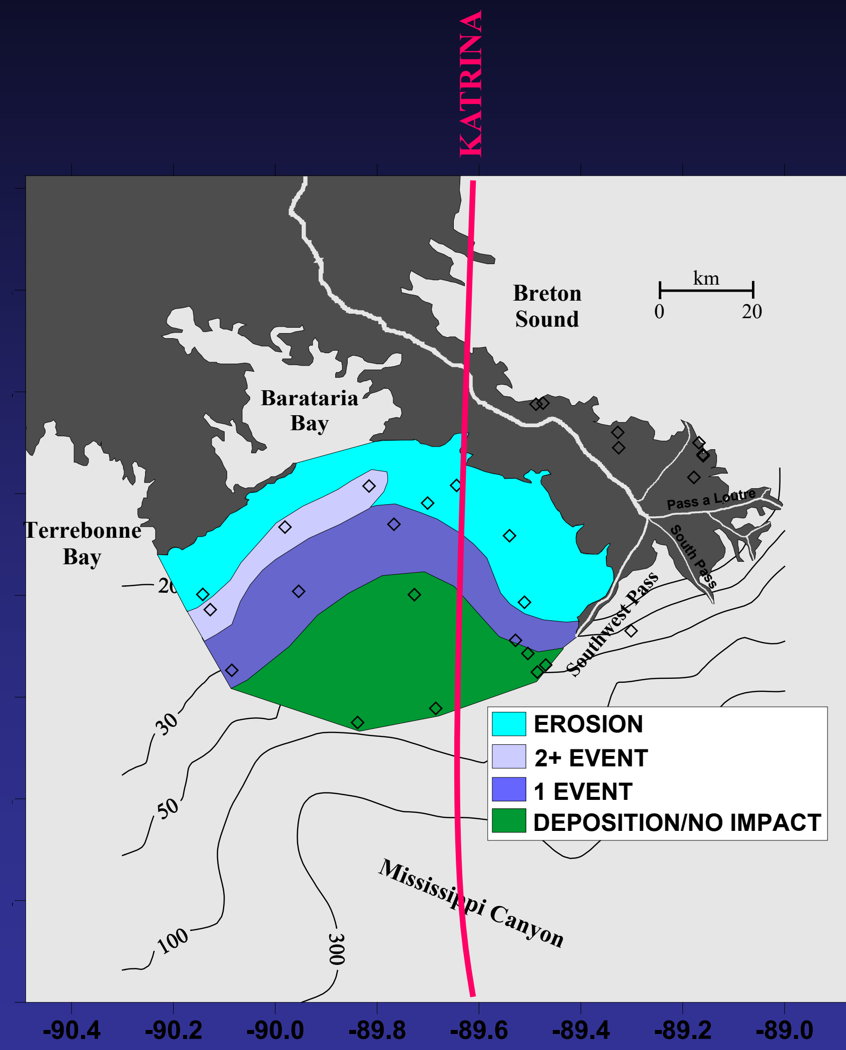
Goni et al. SedRec (2007)

6. Hurricanes and the Shelf

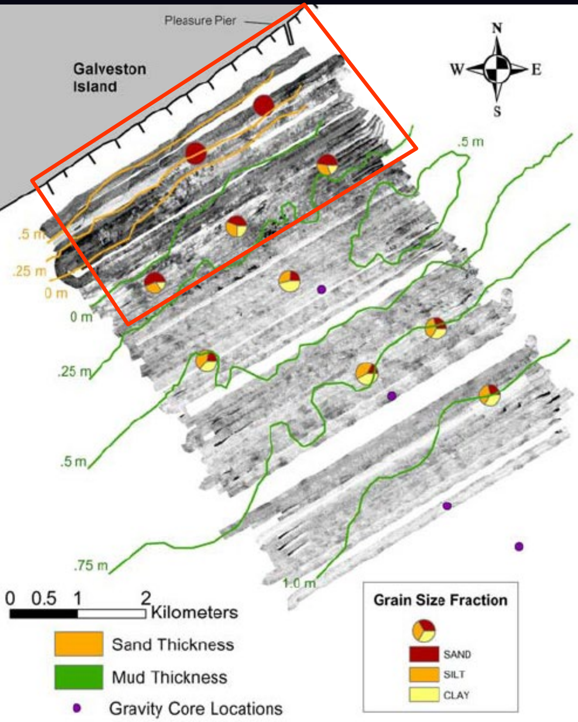
Hurricane Katrina (2005)



DARK=COARSER GRAINED

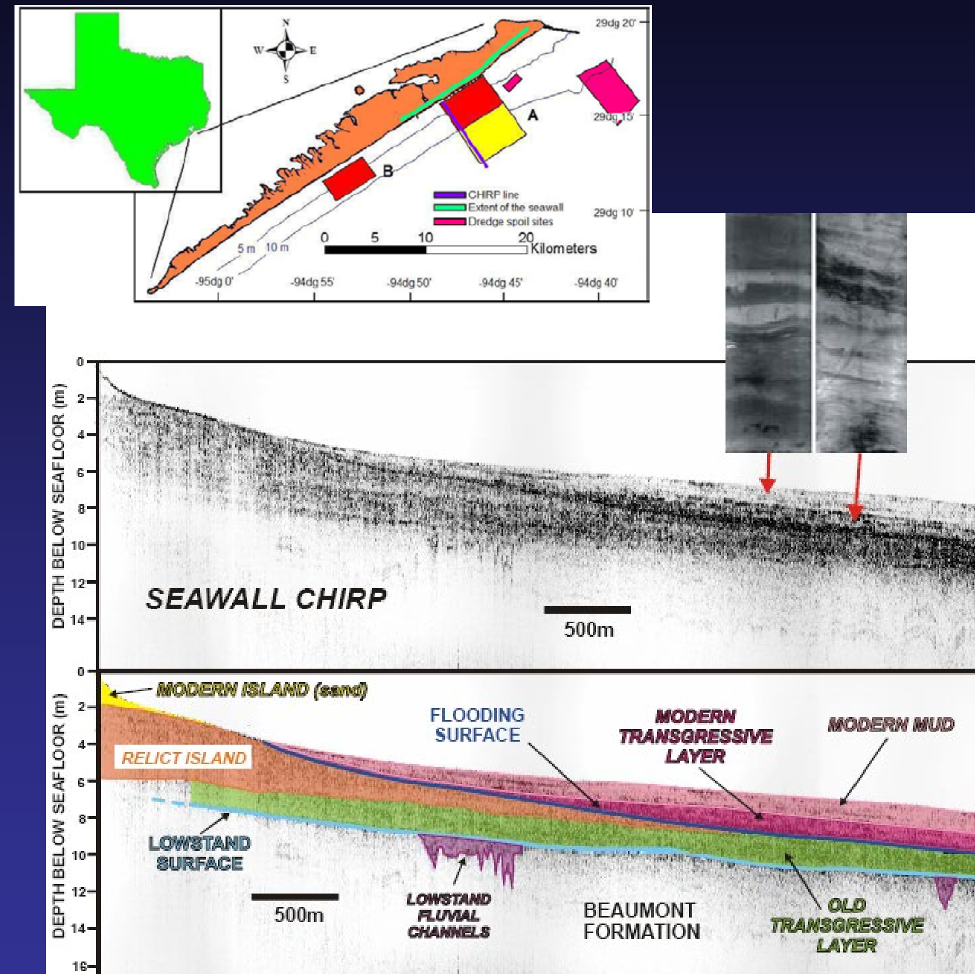


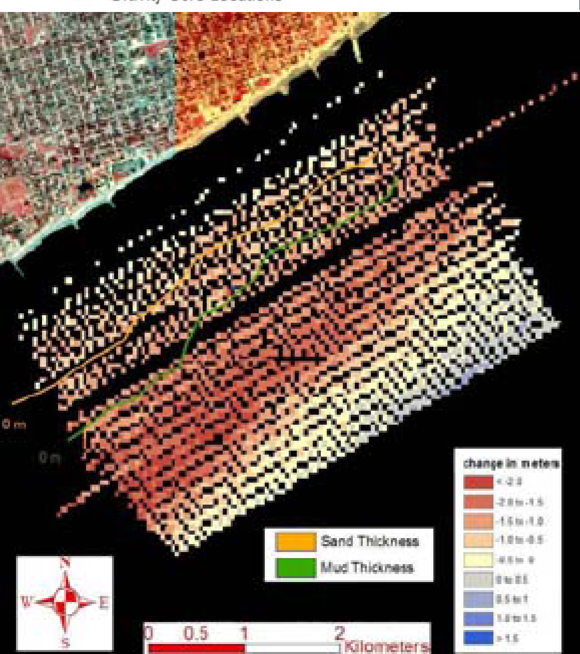
7. Relative Sea Level Rise



Modern Shoreface-Inner Shelf Evolution Galveston Island, Texas

Sidescan & Subbottom Seismic





Bathymetry NOAA (1934) vs. Multibeam (2001)

from Robb, Allison and Dellapenna (2003)