Near Term Sea Level Change on Sediment Retention in Estuaries

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RSL = Eustatic Levels + Isostatic Loads + Local Controls

Eustatic Level = Changes in the global ocean volume:

- i) changes in the surface layer temperature of the ocean;
- ii) changes in the water volume of the ocean;

iii) changes in the shape of the ocean basins



Since 1961, sea level has been rising at 1.8 mm/y: all data sources Since 1990, sea level has been rising at 3 mm/y: Satellite altimetry (IPCC 2007)



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Isostatic Loads = significant regional load changes to the crust of the earth

- i) growth/shrinkage of large ice masses (glacio-isostasy)
- ii) Sediment added to a delta
- iii) Coastal water added/subtracted with fluctuations in sea level: hydro-isostasy
- iv) Fault-controlled uplift/subsidence & thermal subsidence

Flexural Response of the crust:

- Relaxation time occurs over thousands of years because the viscous asthenosphere has to flow out of the way before the lithosphere can deflect (as influenced by mantle viscosity). E-folding is 2500 years, thus a 30 m displacement will reach 75% or 22.5 m in 5000 years.
- ii) Extends over a region much larger than the area directly affected by the load change (as influenced by the regional elastic thickness of the lithosphere).



Holocene SL rise (hydro-isostasy) is still affecting the world's coastlines.



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Each location has a unique isostatic subsidence signature depending on the distance to the ever changing coastline concomitant with sea level rise, and the present and former deposition centers. Present day isostatic subsidence rates vary from 0.3 mm/y (B) to 3.6 mm/y (C).



Natural RSL = Eustatic Levels + Isostatic Loads + Compaction

Compaction = change in soil void ratio (e.g. dewatering + degassing) 80% of rates 0.7 to 2.2 mm/y (Meckel et al., 2007)

Natural RSL rates = (0.1 to 3 mm/y) + (0.3 to 3.8 mm/y) + (0.7 to 2.2 mm/y) = 1.1 to 7.8 mm/y



Accelerated compaction = change in sediment void ratio (petroleum & groundwater mining) Po in the 1950's: >60mm/y e.g. Yangtze: 28 to 3 mm/y (after controls) Niger (today): 25 to 125 mm/y Chao Phraya (today): 50 - 100 mm/y



