Vulnerability of coastlines - How do environmental changes affect coastlines and river deltas?

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Coastal changes have occurred through geological time due to tectonic and isostatic processes as well as sea level changes induced (primarily) by climatic changes. During the Quaternary, one of the main controls on coastal evolution over the past several millennia was the exchange of mass between ice sheets and oceans. However, local and regional changes are superimposed on the global picture. These local/regional changes become more important as the temporal scale resolution increases, producing substantial spatial and temporal variability in sea-level changes, even when localities close to each other. This becomes even more complex as humans occupied the coastal zone (e.g. Syvitski, this issue). Furthermore, it seems that the overall warming and sea-level rise of the Holocene was punctuated by climatic events and, apparently, impacted the coastal evolution. In fact, a correlation between monsoonal changes and rapid climatic changes (RCCs) in the Delaware Bay has been established at a millennial scale. The result is an ever-increasing reliance on engineering structures to protect infrastructure (e.g. cities, industry, transportation facilities, agriculture) that is found everywhere. These engineering structures can be overwhelmed with devastating consequences, as in the case of Hurricane Katrina and the Sendai Tsunamis. Human activity has also led to the formation of many coastal features: for example, the deltas of rivers such as the Po River and Rhône were formed due to anthropogenic acceleration of soil erosion by deforestation and farming activities. The deltas were inherently unstable. When soil erosion was reduced or sediment delivery was reduced with the proliferation of dams, these unstable deltas were the first to enter the destructive phase affecting much of the world’s coastlines. A combination of modern and historical perspectives can help us understand the global footprint of humans on our world’s coastlines. This can help us develop effective policies and protocols for learning to live in such transient environments.

Selected references

- NSF (OCE-1130843); MICINN (CGL2009-08840), FCT/PTD/CICT/03798/2010, ICFP Project No. 588.

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Figure 1: A map of the Pamlico estuarine system in North Carolina showing the location of the main active inlet. B Faulkner geomorphological analysis of the Pamlico Sound region (ca. 750-950 AD).