Exploring the costs of sea level rise: should we focus on ‘means’ or ‘extremes’?

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Change Points in Cat 3-5 Hurricane Numbers (the drivers of major coastal storm surges)

Change points from Jewson and Penzer, 2005

Current high activity started in 1995
Implications of changes in activity of intense Hurricanes on extreme sea levels

30% increase in Cat 3-5 activity

Historical Baseline

5.6m new
4.8m old

100yrRP
Lessons for flood risk zoning
Mississippi Coast

Estimated wind speed of 110-130 mph (Cat 3)

Surge damage

Houses destroyed but outside all designated flood zones

Minor
Moderate
Total

2005 Katrina
Implications of an increase in Hurricane activity

- Unrecognised flood risk & no coverage
- New perspective
- New wind risk
- Old wind risk
- Old flood risk
- New flood risk

Risk cost
In Hancock County (Mississippi) – Nov 2005 - FEMA has admitted risk ‘has increased’ in the coastal Flood zone

- new and replacement buildings will need to be sited up to 10 feet higher
- V zone (high velocity flooding) extends to 12 feet higher

Q. However why haven’t flood zones been expanded along all the hurricane coasts?  
A. Because this is politically unacceptable.
FEMA as a force of adaptation (Grand Isle LA, Feb 07)

- Buildings being raised 1.5m to achieve new FEMA base flood elevation (and therefore be eligible for NFIP)

- However no consideration of increased potential for failure due to hurricane wind loads

- Insurability problems because of dangers of high terraces.
Rates of sea level rise (US Gulf Coast)

- Change in Sea level m (since 1960)
- Year

- Combined (100 year extreme)
- 100 yr extreme
- Mean
Oil refineries around the Gulf Coast were sited during a period of lower hurricane activity and are very hard to relocate.
Many Critical assets are located close to sea level

- Le Blayais Nuclear Power Plant on the Gironde estuary SW France, 50km NW of Bordeaux
- Site protection height of 5.02m
  - Protected by 5.2m dyke in front 4.75m at the side
- Dec 27th 1999 Surge from Windstorm Martin
  - Reached c 5.3m

- Water entered the general gallery at 6-12m$^3$per sec. – total of around 90,000m$^3$ of water – 0.3m deep
- Inundated and disabled the essential service water pumps to Unit 1
- Level 2 onsite emergency Plan put into operation. Reactors all shut down.
- Rising sea levels and storm surge heights will be an increasing problem for coastal Nuclear Power Plants.
Implications of changing hazards on investment horizon

Each horizon gives a different perspective
The future of New Orleans
Subsidence from radar interferometry
Rates of sea level rise (New Orleans)

Year

Change in Sea level m (since 1960)

Combined (100 year extreme)

100 yr extreme

New Orleans subsidence

mean

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The PDF of global exposure value by elevation

For first meter - average cost = $1Bn/mm

However pre-existing safety margins give critical thresholding effects.

Reconstructed from Anthoff et al., (2006)
Top 20 Cities for ‘Exposed Assets’ by 2070s

In Asia we see an 18X increase in exposure, with 8/10 most exposed cities in Asia.
Retreat as a form of Adaptation

Dauphin Island, Alabama
(hit by Ivan, Dennis & Katrina)