Sea-level changes along the Indian coast

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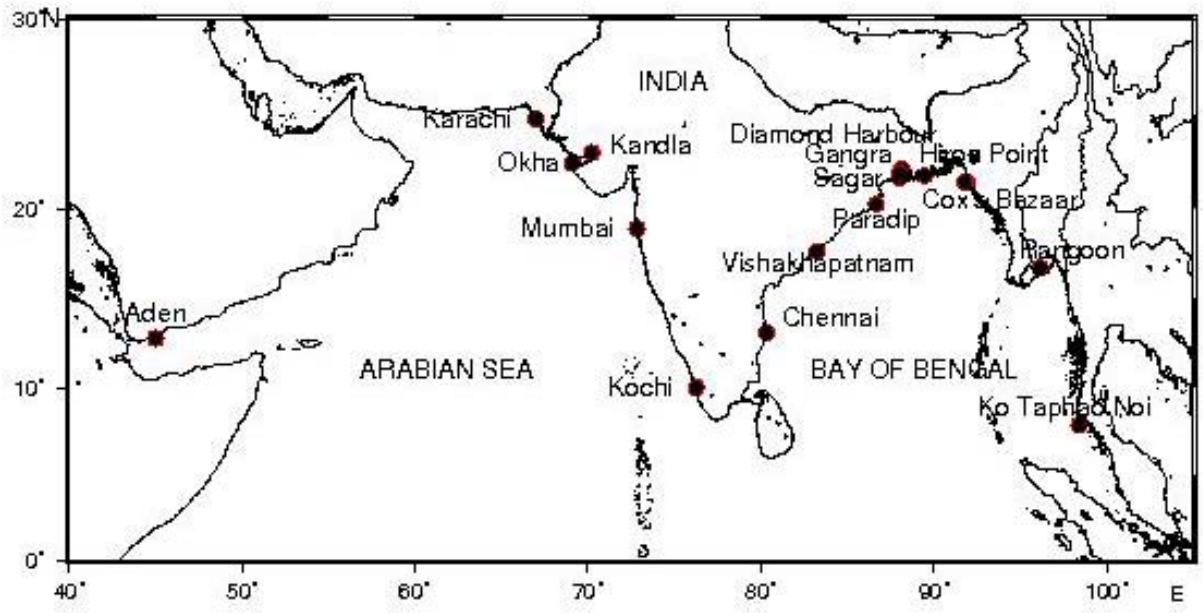
Inputs to INCCA

- Sea-level-rise trends (along the Indian coast) and (global) projections
- Tropical cyclones in the Bay of Bengal
- Storm surges in the Bay of Bengal - projections
- Impact studies at vulnerable locations (Kochi, Nagapattinam and Paradip) – Inundation maps

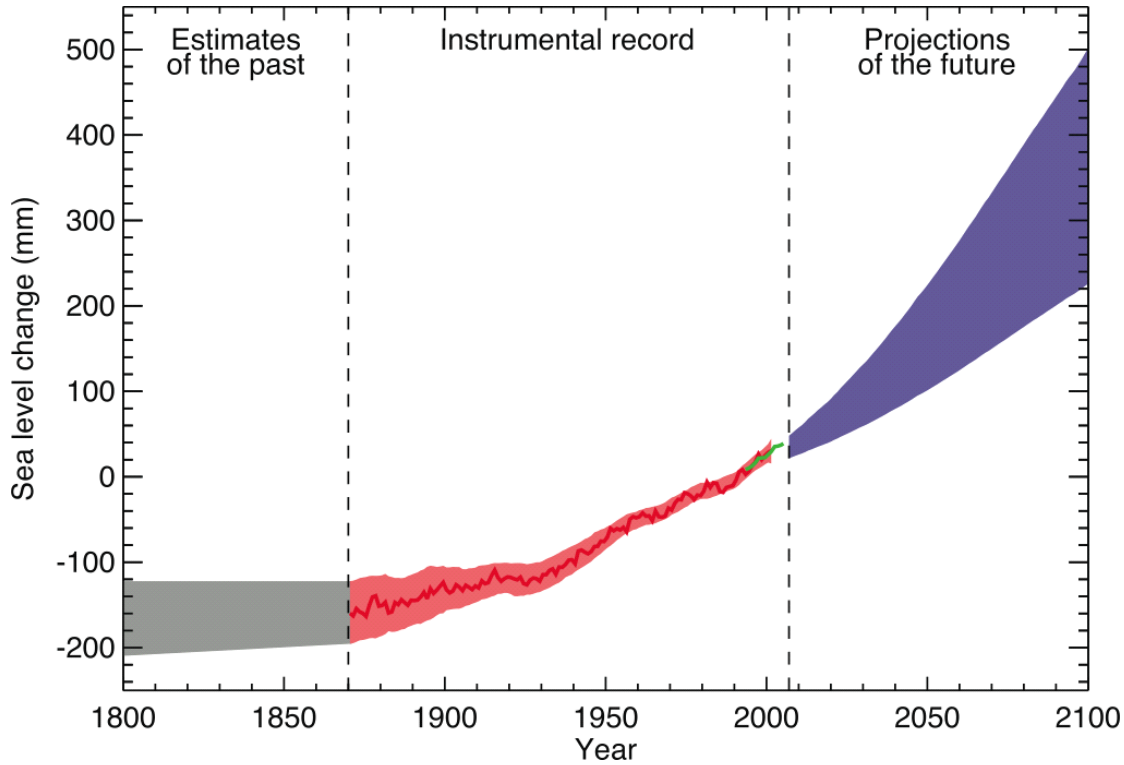
Tide-gauge locations (records > 20 years) along N Indian Ocean coasts



Net sea-level-rise trends from past tide-gauge data

Station	No of years of data	Trends (mm/year)	GIA (Glacial Isostatic Adjustment) corrections	Net sea level rise (mm/yr)
Mumbai	113	0.77	-0.43	1.20
Kochi	54	1.31	-0.44	1.75
Vishakhapatnam	53	0.70	-0.39	1.09
Diamond Harbour (Kolkata)	55	5.22	-0.52	5.74 ← sinking of delta

Sea level changes- past, present and future (Bindoff et al., 2007)

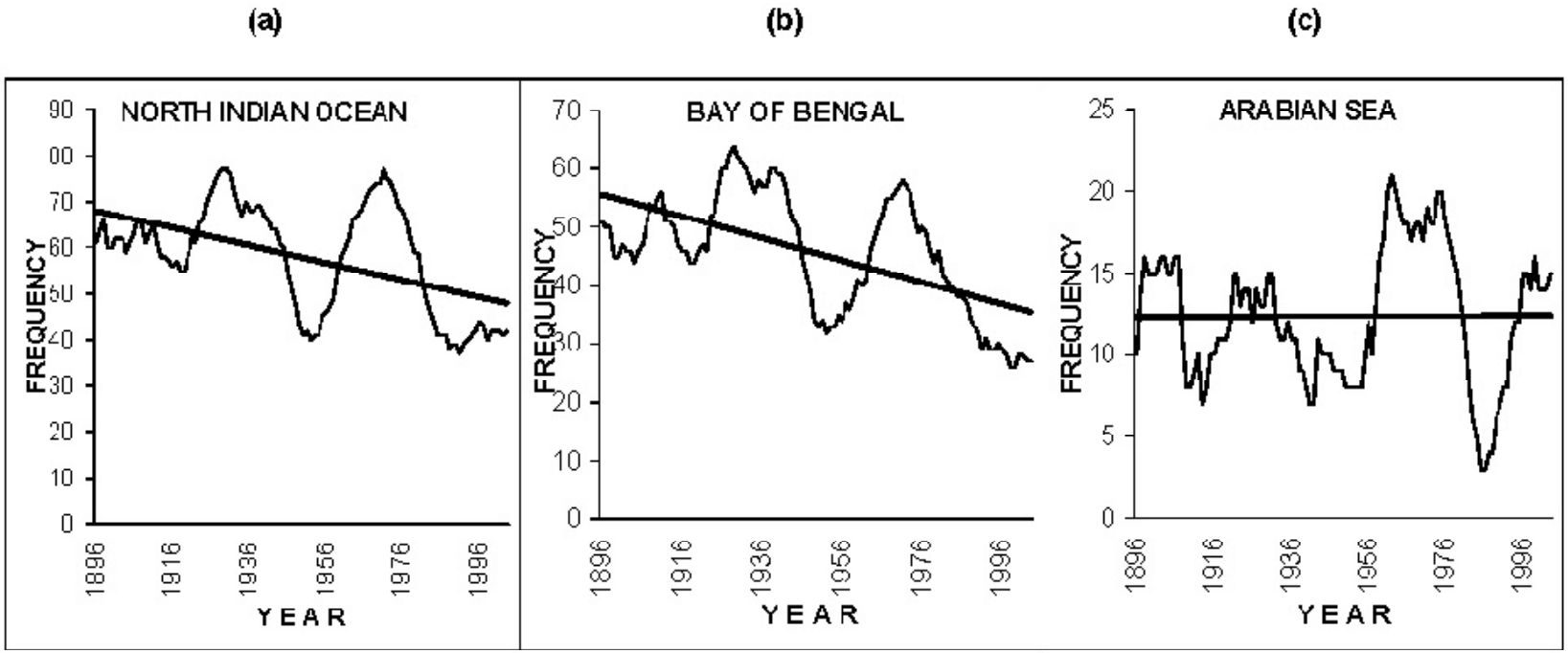


FAQ 5.1, Figure 1

Projections of global sea-level-rise (Meehl et al., 2007 IPCC 2007)

Case	Sea-level rise in m (5 % and 95 % range) in 2090-2099 with respect to 1980-1999
B1 scenario	0.18 - 0.38
A1T scenario	0.20 - 0.45
B2 scenario	0.20 - 0.43
A1B scenario	0.21 - 0.48
A2 scenario	0.23 - 0.51
A1F1 scenario	0.26 - 0.59

Trends in the occurrence of cyclones in the past century (Niyas et al., 2009)



$y = -0.1876x + 68.179$
$R^2 = 0.246$

$y = -0.1879x + 55.816$
$R^2 = 0.3263$

$y = 0.0003x + 12.363$
$R^2 = 0.000005$

Future projections of cyclones and extreme sea level

- Regional Climate model (PRECIS) provided by IITM and storm surge model runs made in NIO

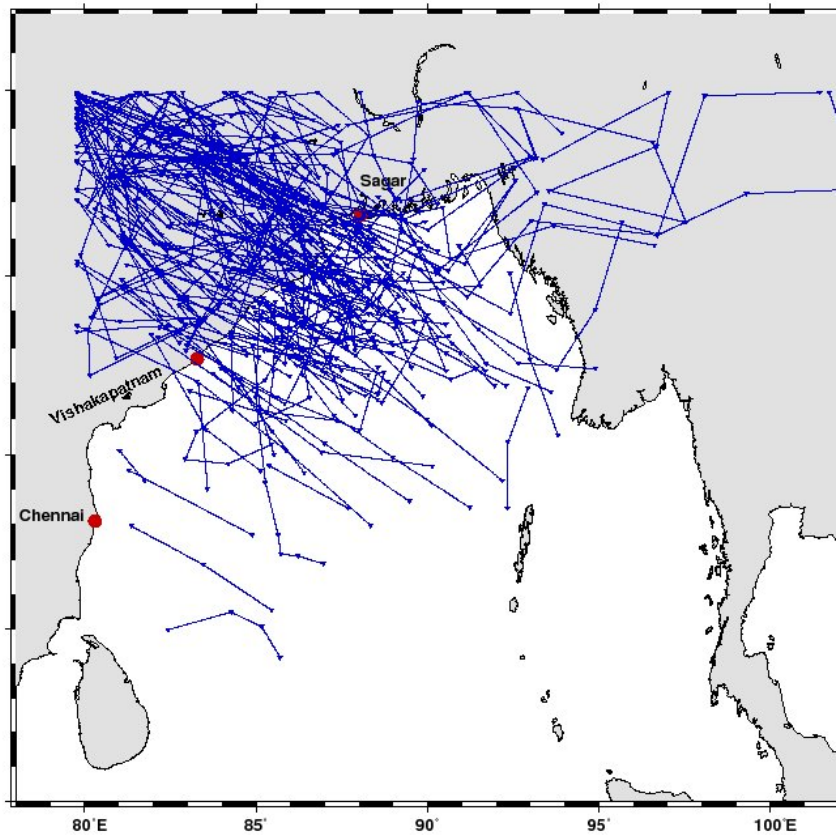
Analysis of PRECIS model runs

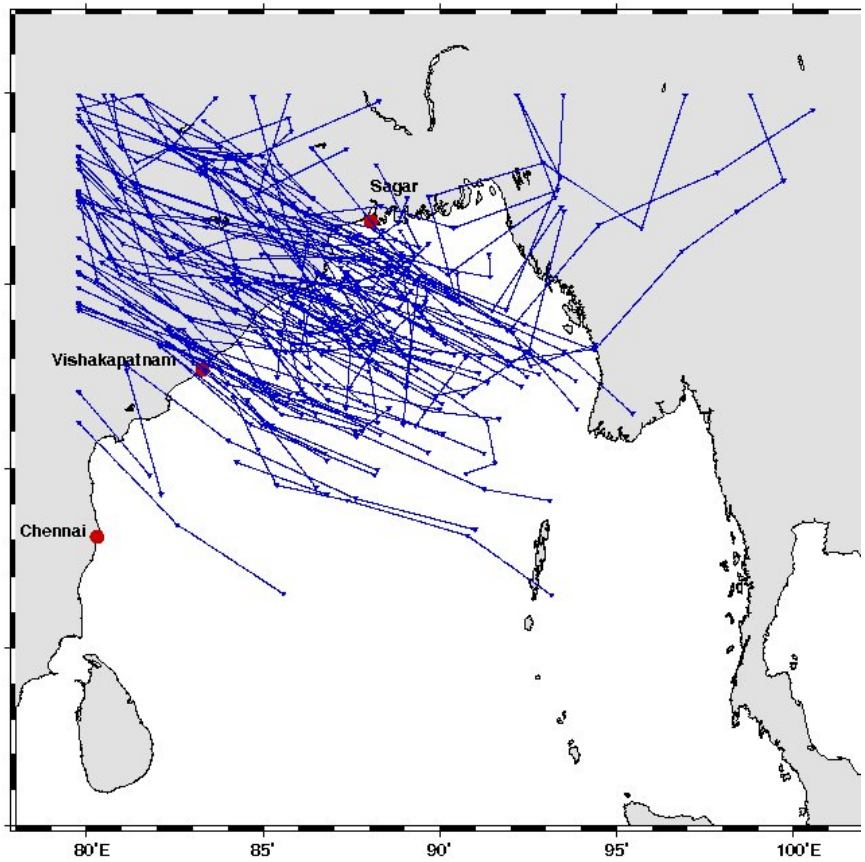
- Wind fields (10 m) and surface atmospheric pressure fields for baseline (1961-1990) and A2 (2071-2100) scenarios

- Storm surge model, driven by winds from PRECSI, for the Bay of Bengal

Composite track of cyclones (PRECIS) in the Bay of Bengal

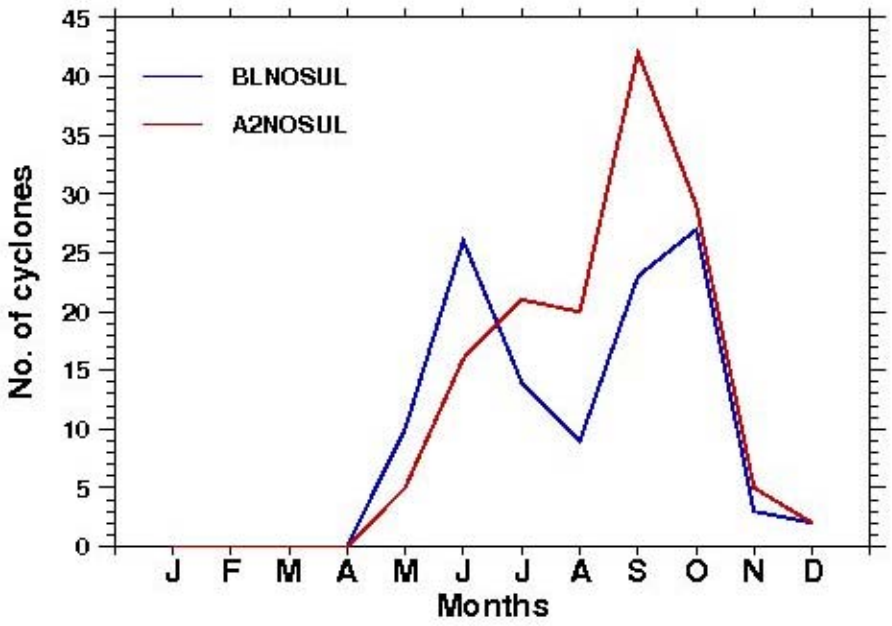
- baseline (1961-1990) A2 (2071-2100)





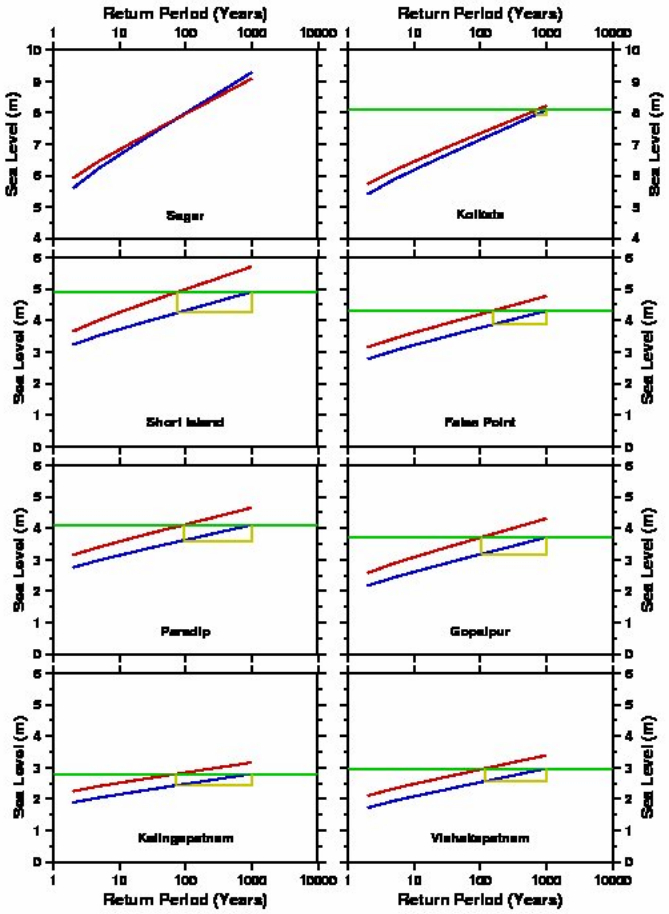
Frequency distribution of cyclones (PRECIS) in the Bay of Bengal

- Increase in post-monsoon cyclones in the Bay during A2 (2071-2100) scenario, when compared to the baseline (1961-1990) scenario



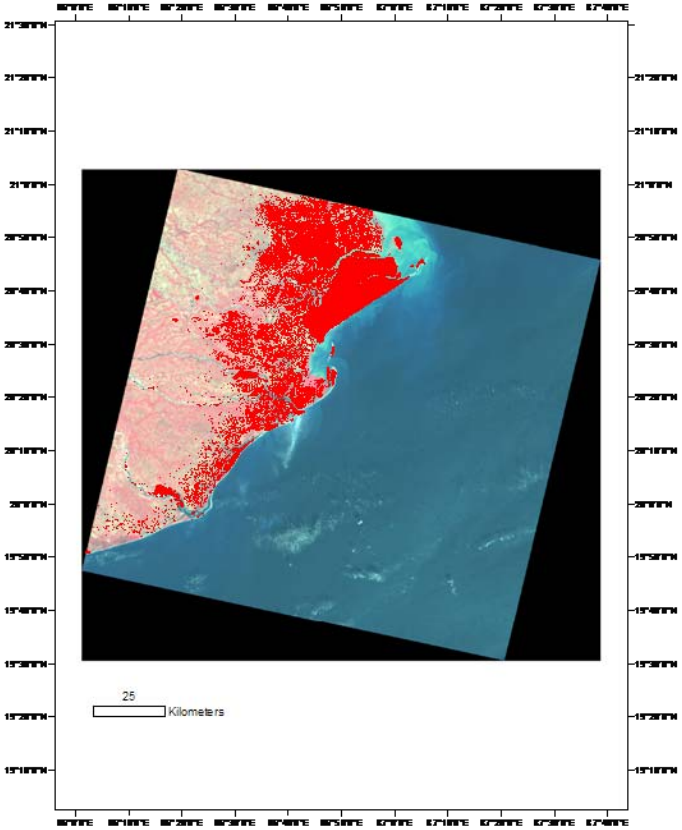
Changes in Return levels for increased sea-level rise

- Storm surge
- model for the Bay
- of Bengal, forced
- by winds from PRECIS (baseline and A2 scenarios) and projected sea-level rise for the A2 scenario
- Blue (1961-1990)
- Red (2071-2100)



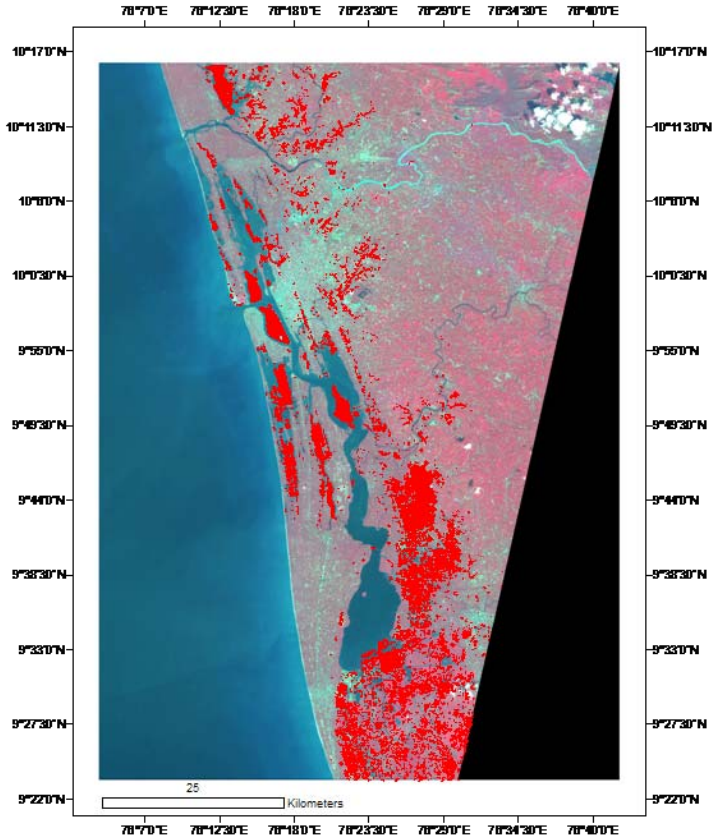
Inundation map of area surrounding Paradip for a sea-level rise of 1m

- Region characterised
- By frequent occurrence
- of cyclones and
- Storms surges



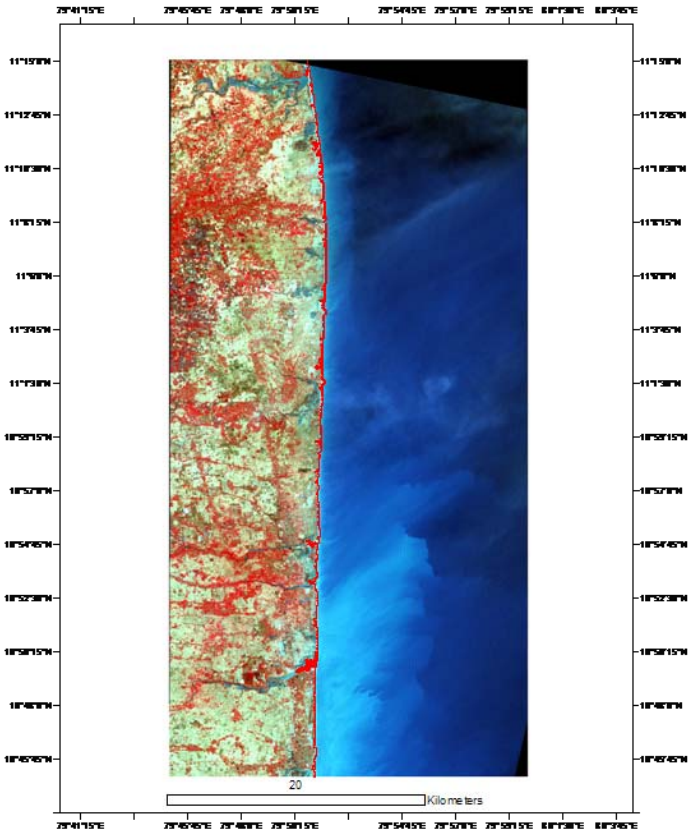
Inundation map of area surrounding Kochi for a sea-level rise of 1m

- A region characterised
- by the presence
- of backwaters



Inundation map of area surrounding Nagapattinam for a sea-level rise of 1m

- A region characterised by a flat onshore topog--raphy



Impacts & Vulnerability of sea-level rise along the coastline

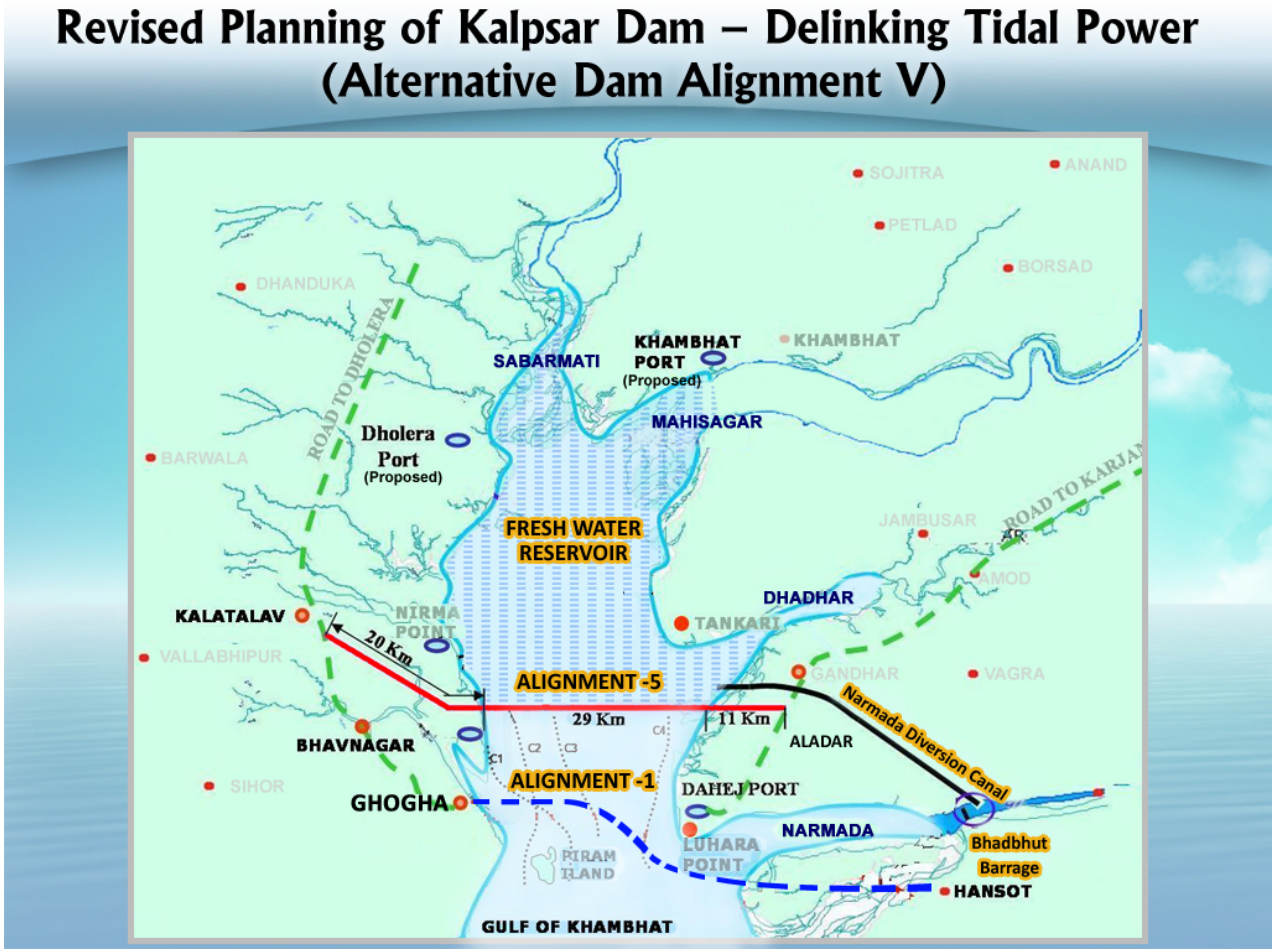
- Impacts on Coastal Ecosystem (mangroves)

- Infrastructure development

Vulnerability of the mangroves to sea-level rise

Tanaji,et.al, Ambio, 2007

Long-term impacts of sea-level rise



Conclusions

- Mean sea-level-rise trends along the Indian coasts are about 1.30 mm/yr
- Future (global) Projections (global) indicate about 0.48 m (A1B) by the turn of the century
- Return level estimates using storm surge model driven by RCM indicate higher flood risks associated with storm surges along the southern part of the east coast of India, where tidal ranges are low

Next steps….

- We propose to study impacts of climate change on coastal marine ecosystem (project submitted to DST)