Climate change vulnerability assessment and adaptation in mangrove deltas

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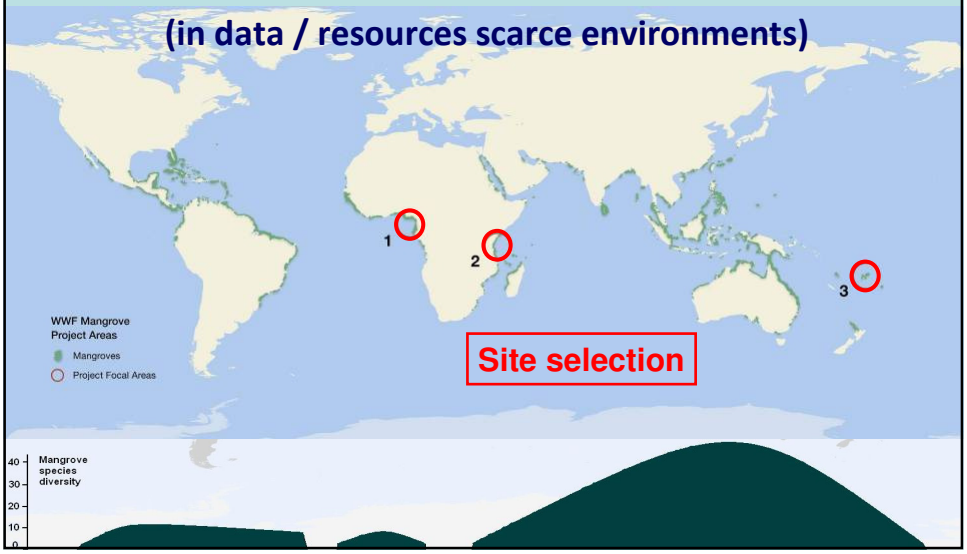
Developing a Generalisable Method for Assessing Mangroves CC Vulnerability and Developing Adaptation Measures

(in data / resources scarce environments)



PROJECT TIMELINE

Vulnerability Assessments

2007 2008 2009 2010

Generalized methodology

National planning | Baseline surveys | Other studies | Adaptation planning

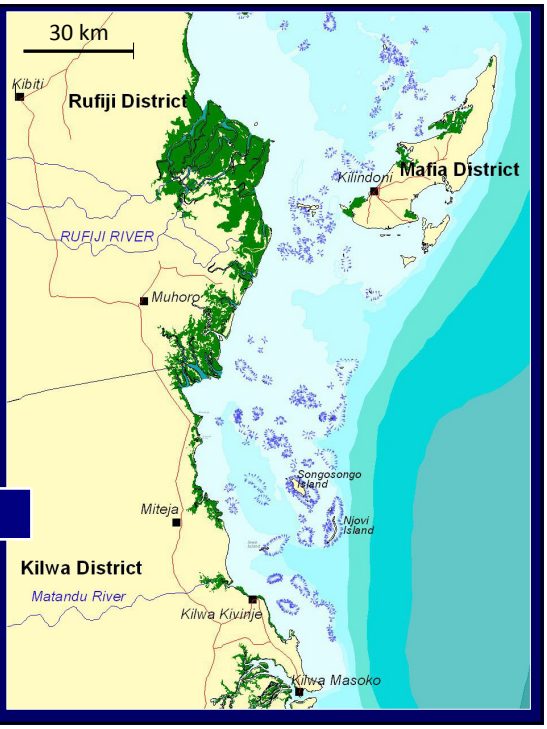
Adaptation Strategies

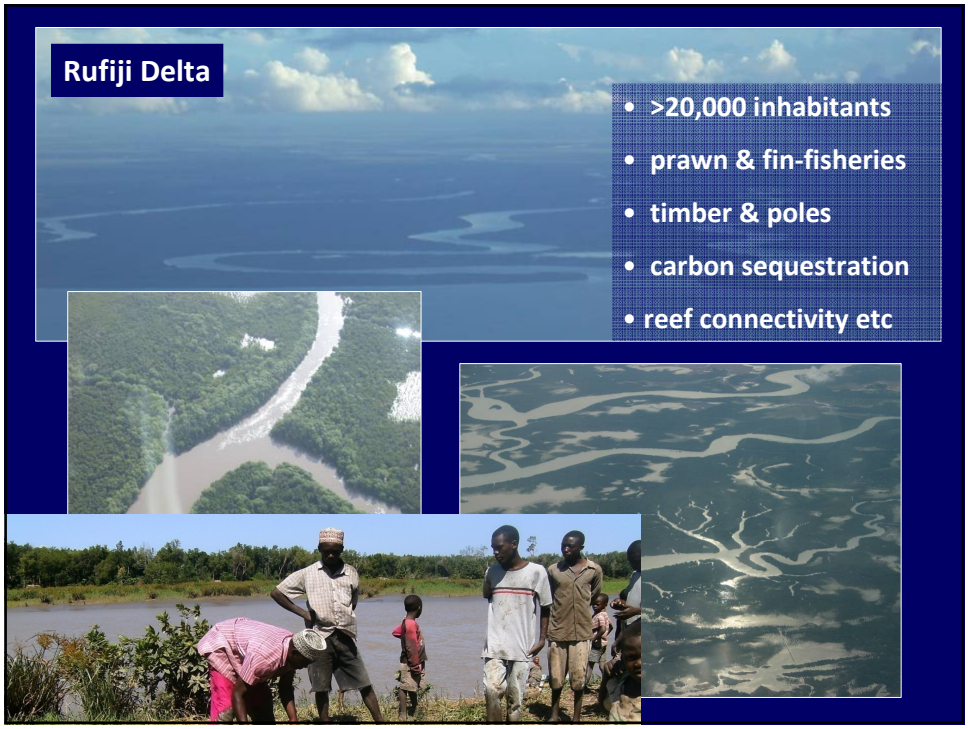
Tanzania project site

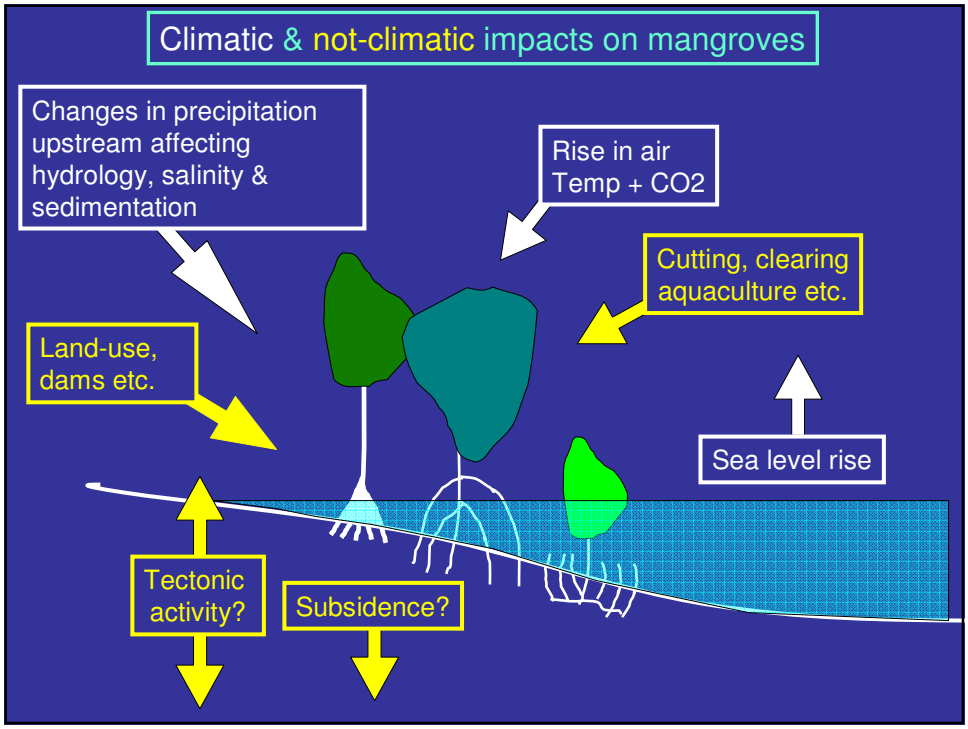
Rufiji-Mafia-Kilwa Seascape

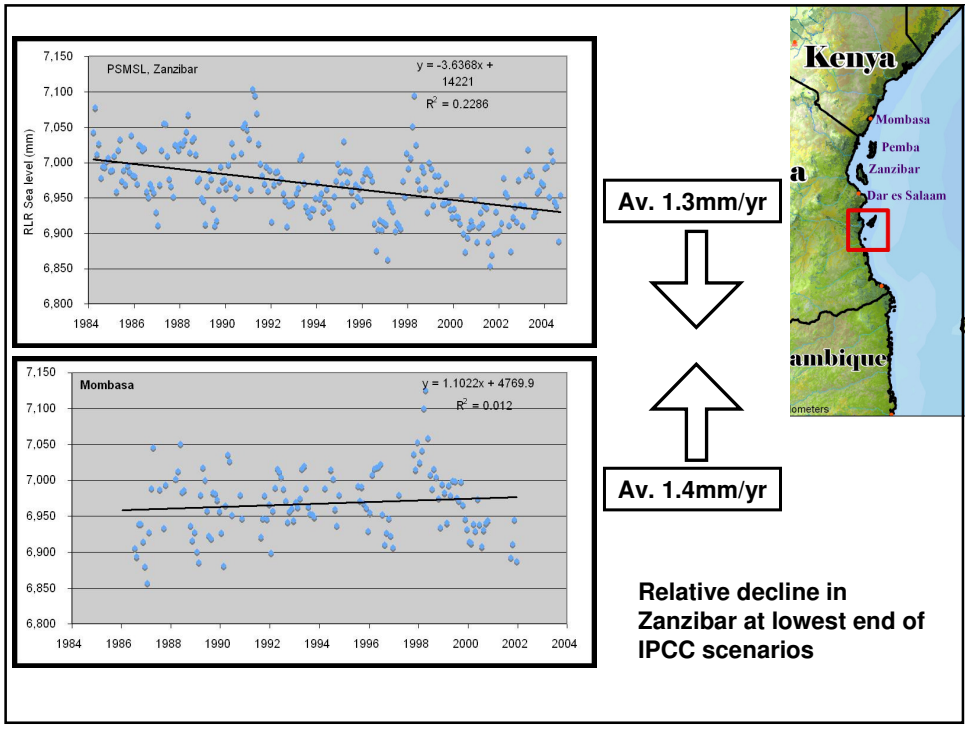
Mangrove area = ~ 73,500 ha

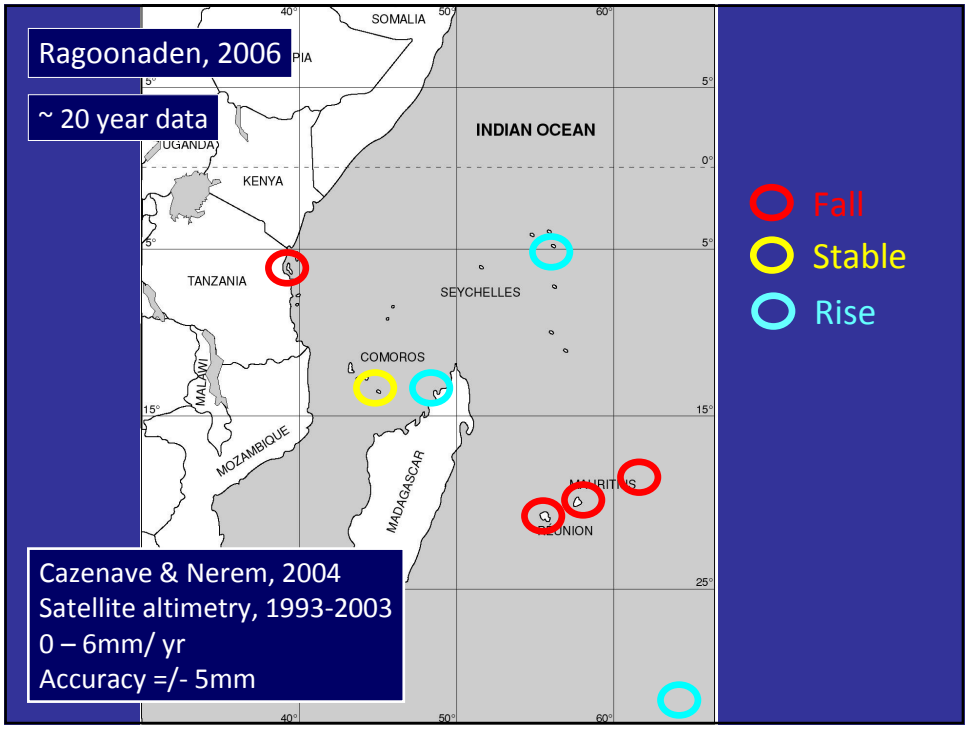
Delta population = ~ 27,000



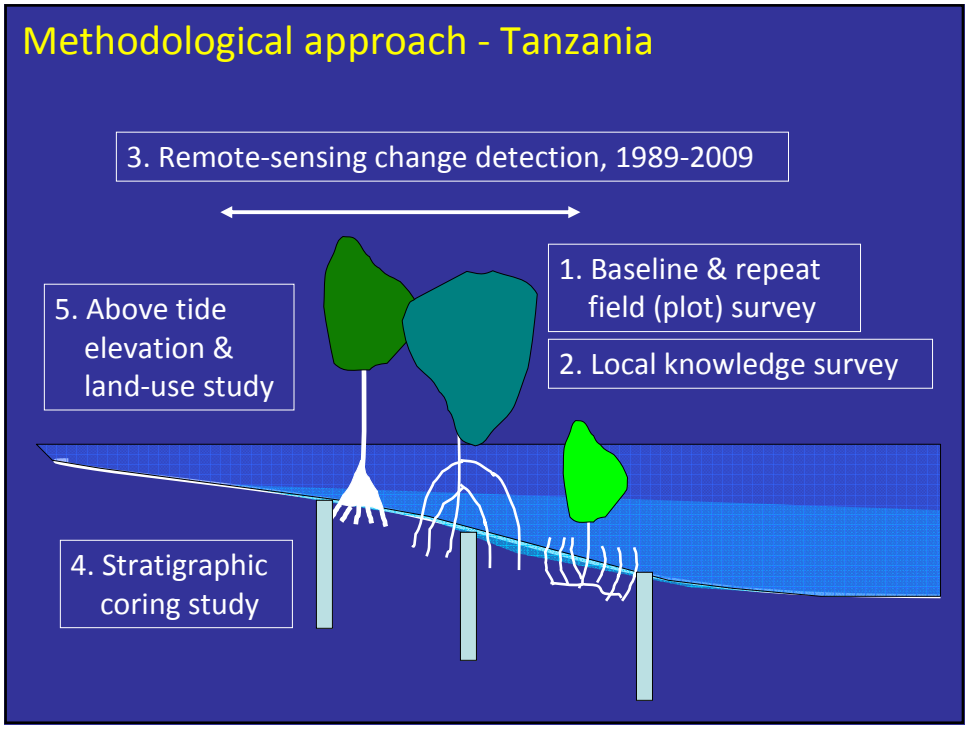

Rufiji Delta
• >20,000 inhabitants
• prawn & fin-fisheries
• timber & poles
• carbon sequestration
• reef connectivity etc


Climatic & not-climatic impacts on mangroves
Changes in precipitation upstream affecting hydrology, salinity & sedimentation
Rise in air Temp + CO2
Cutting, clearing aquaculture etc.
Land-use, dams etc.
Sea level rise
Tectonic activity?
Subsidence?


PSMSL, Zanzibar
y = -3.6368x + 14221
R² = 0.2286
RLR Sea level (mm)
7,150
7,100
7,050
7,000
6,950
6,900
6,850
6,800
1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004
Mombasa
y = 1.1022x + 4769.9
R² = 0.012
Av. 1.3mm/yr
Av. 1.4mm/yr
Kenya
Mombasa
Pemba
Zanzibar
Dar es Salaam
Relative decline in Zanzibar at lowest end of IPCC scenarios

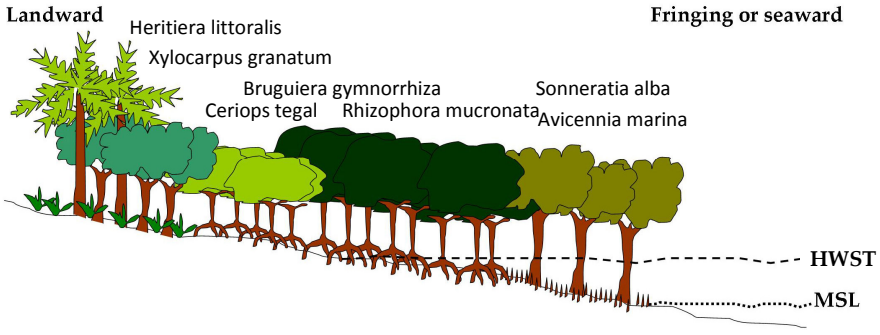

Ragoonaden, 2006
~ 20 year data
SOMALIA
INDIAN OCEAN
UGANDA
KENYA
TANZANIA
SEYCHELLES
COMOROS
MALAWI
MOZAMBIQUE
MADAGASCAR
REUNION
Fall
Stable
Rise
Cazenave & Nerem, 2004
Satellite altimetry, 1993-2003
0 – 6mm/ yr
Accuracy =/- 5mm

Methodological approach - Tanzania

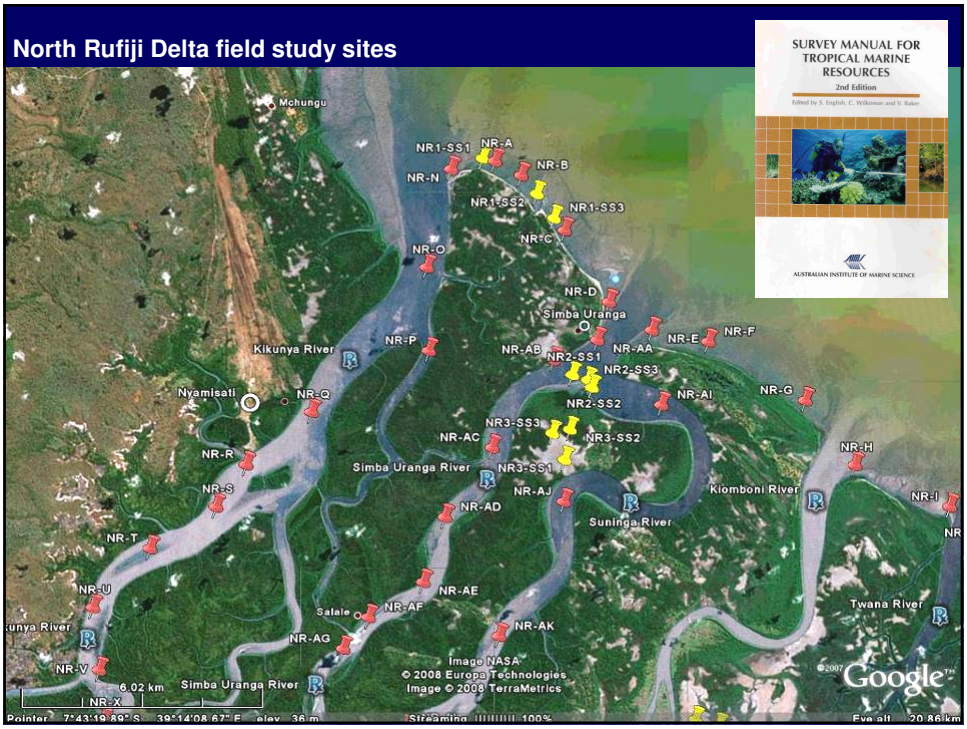


Mangrove zonation in Rufiji Delta

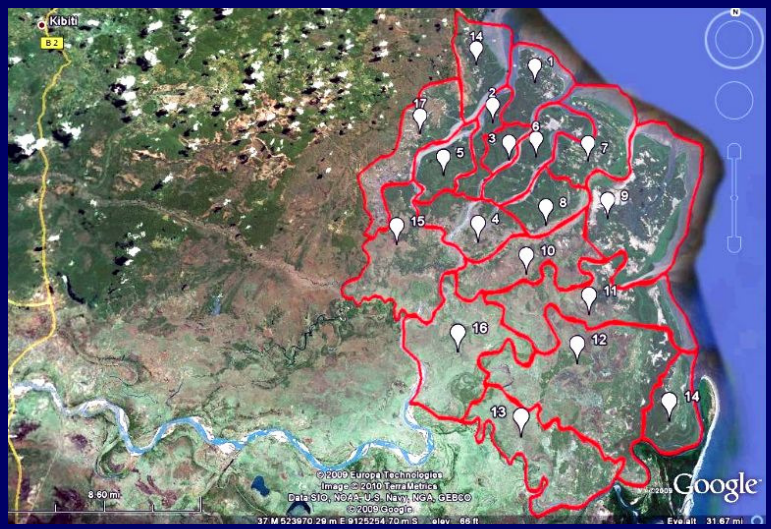
Nine mangrove species present Tanzania (Kathiresan and Rajendran, 2005 and Wang *et al.,* 2003), show distinct zonation (Taylor *et al.*, 2003) with respect to tide levels.



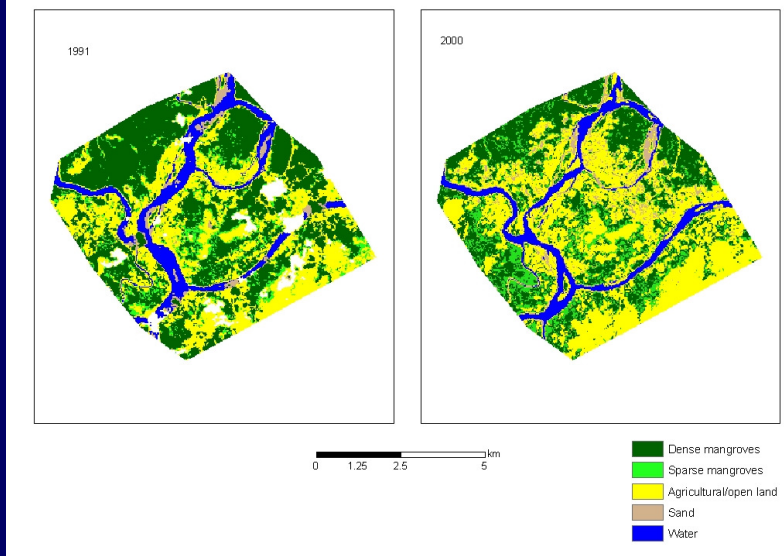
North Rufiji Delta field study sites



Unit blocks for remote sensing analysis - Tanzania



Vegetation change, Mawanda, Rufiji
Landsat May 1991 and June 2000



Example of zone transition: Rhizophora (background)/ Bruguiera (fore).

At Lomawai (Fiji) seaward edge, dead mature Bruguiera and young thriving Rhizophora, indicating sea level rise.

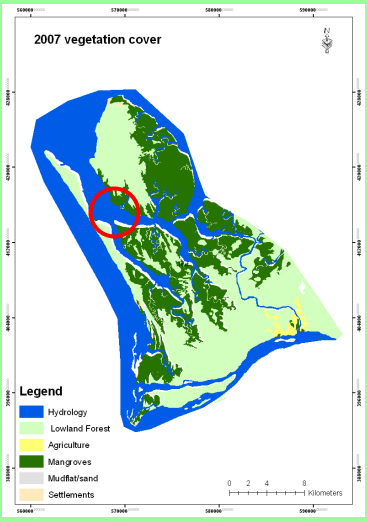
Community knowledge & perceptions

- Major shift of outflow patterns from south delta to north delta during 1960s and again 1978
- Major die-off of Heritiera during el Nino rains, 1998

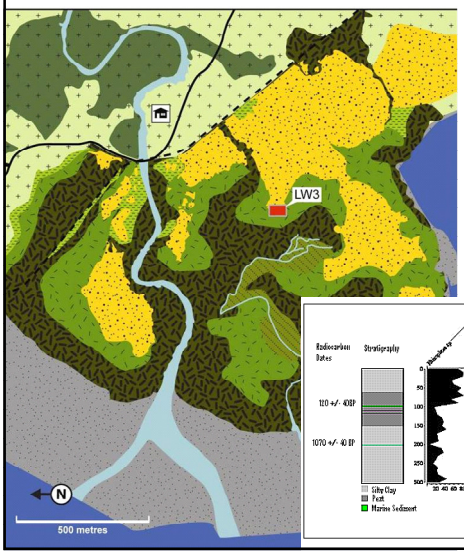
- Getting hotter
- Humidity decreasing.
- Rainfall decreasing and more irregular
- Aware of sites of erosion and accretion but not of trends in sea levels

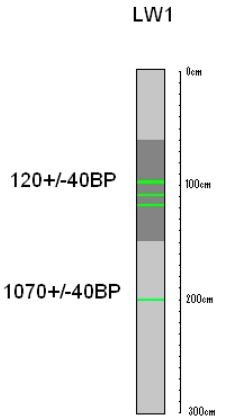
Cameroon Estuary GIS analysis of change

Kwekwele Island retracted from 39,000 m2 (1975) to 4,000 m2 (2009)



Lomawai, Viti Levu relative sea-level reconstruction (Fiji)
(Ellison & Strickland, 2010)

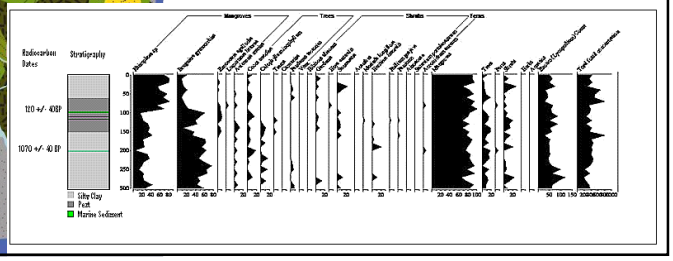




Current mangroves in top 50 cm of core.

80% of pollen = mangrove down to 3m

Site is tectonically subsiding so total future sea level rise > global projections



Cameroon Estuary relative sea-level reconstruction
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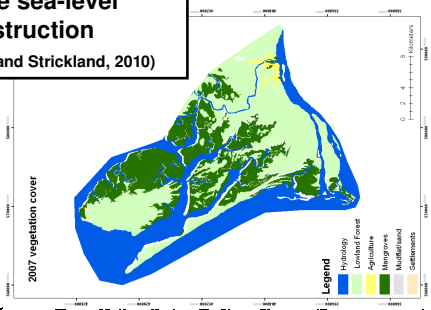
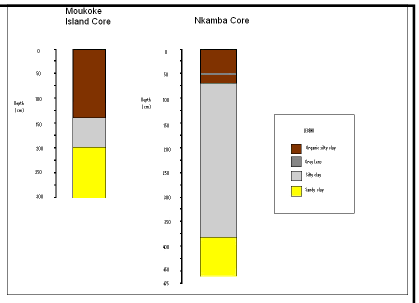
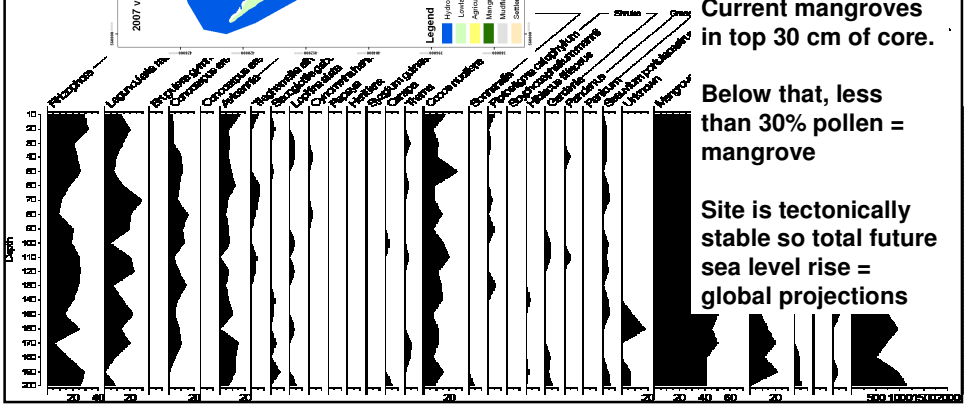




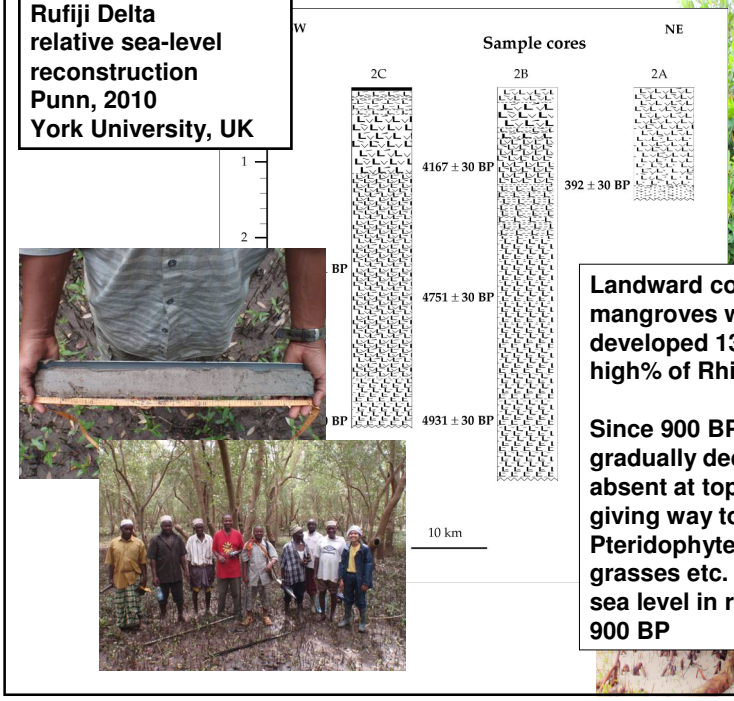


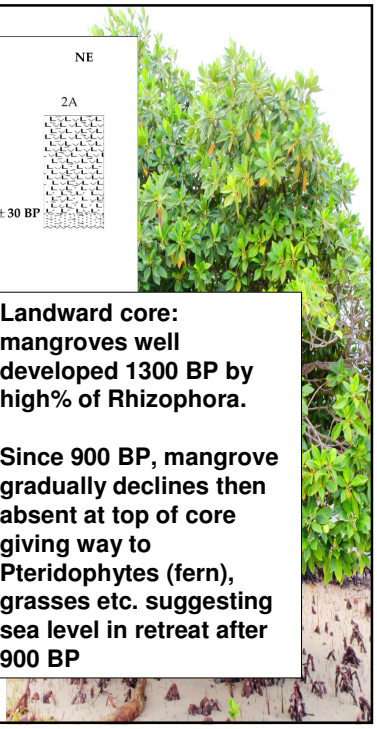
Current mangroves in top 30 cm of core.

Below that, less than 30% pollen = mangrove

Site is tectonically stable so total future sea level rise = global projections

Rufiji Delta relative sea-level reconstruction Punn, 2010 York University, UK

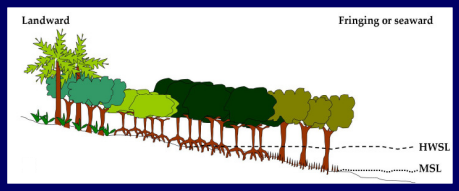


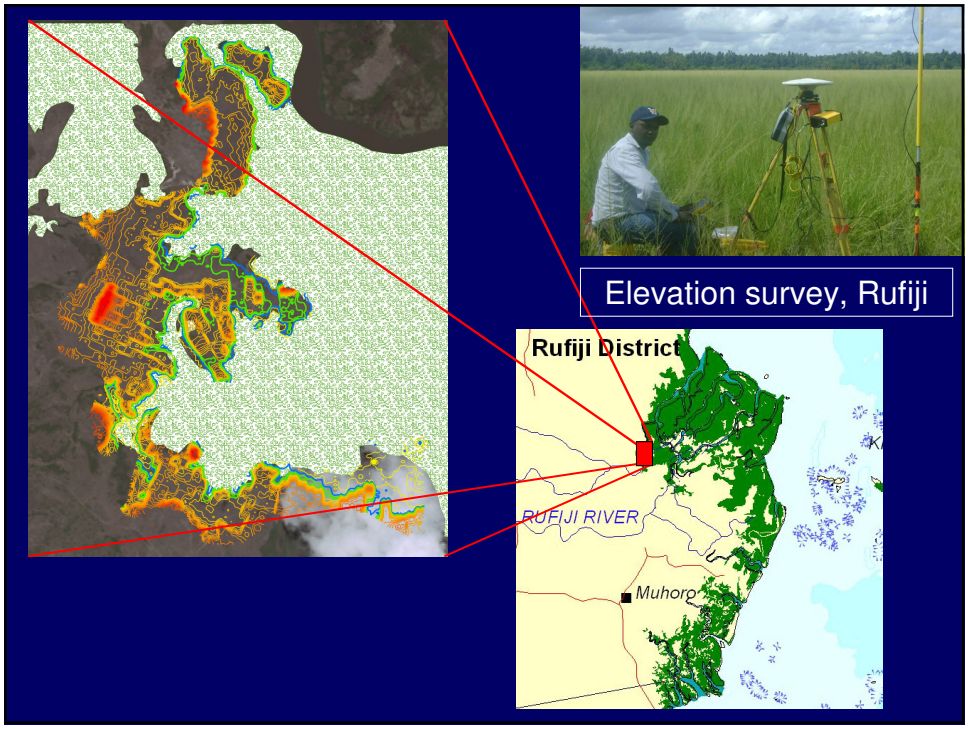


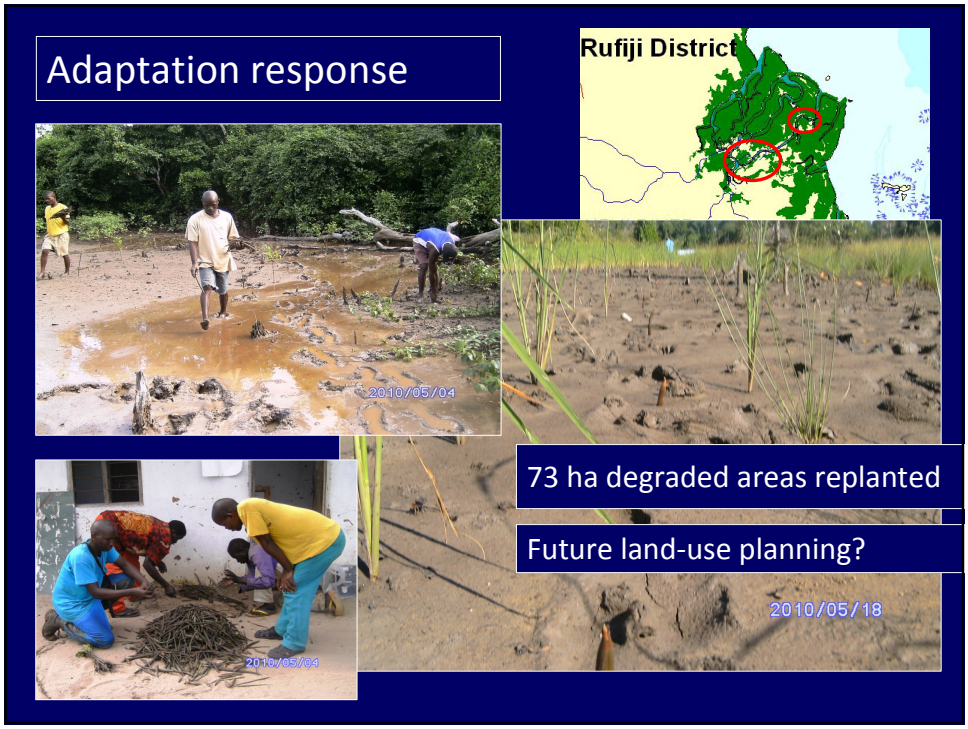
Landward core: mangroves well developed 1300 BP by high% of Rhizophora.

Since 900 BP, mangrove gradually declines then absent at top of core giving way to Pteridophytes (fern), grasses etc. suggesting sea level in retreat after 900 BP

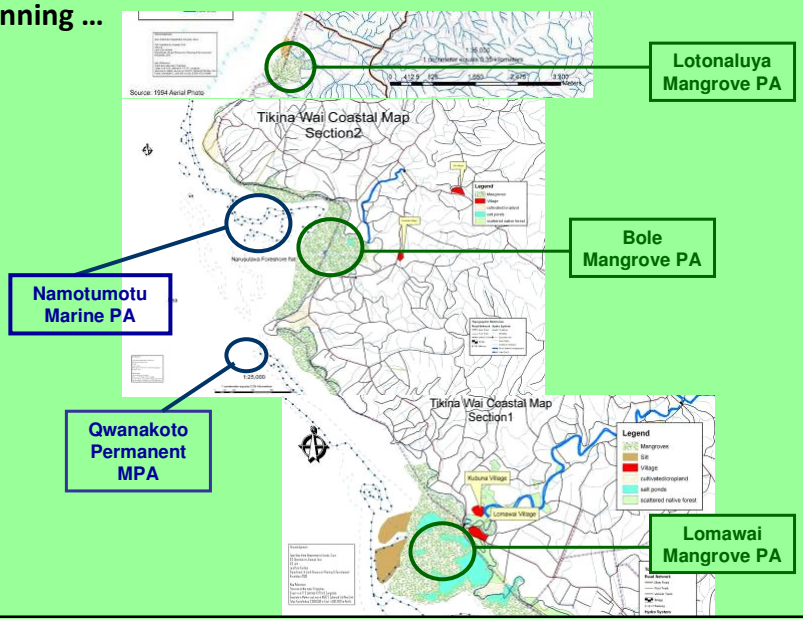
Landward colonisation & land-use in Rufiji




Elevation survey, Rufiji
Rufiji District
RUFIJI RIVER
Muhoro

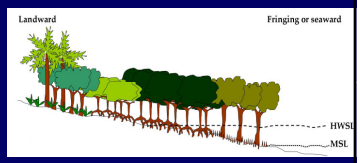

Adaptation response
Rufiji District
2010/05/04
73 ha degraded areas replanted
Future land-use planning?
2010/05/18

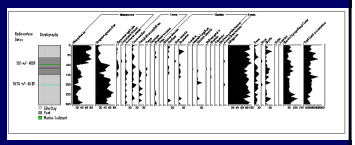
FIJI – vulnerability assessment results inform marine protected area planning …



CONCLUDING POINTS …

- Mangrove vegetation change can = proxy indicator of local sea level trends in absence of tide gauge data, but interpet with care
- Stratigraphic reconstruction provides important local context for global sea level projections
- BUT important to complement with downscale modeling of precipitation in river basin & sediment budgets
- Extreme precipitation events be game-changing. Deltas are dynamic & unpredictable.
- Challenge to reconcile time-scales of CC impacts & livelihood concerns





acknowledgements:

Partners:
York University, UK
Sokoine University, Tanzania
University of Dar es Salaam, Tanzania
CORDIO East Africa
British Institute in East Africa