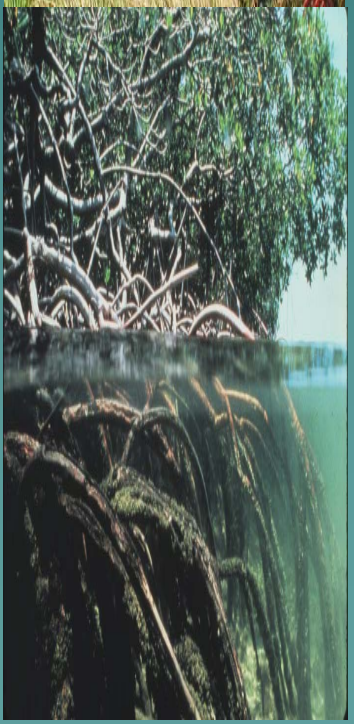

A NEW MODEL OF WETLAND LOSS AND SEA-LEVEL RISE

Modelling the impact of sea-level rise on broad-scale wetland response

Loraine Mc Fadden, Tom Spencer and Robert Nicholls

CCRU

University of Southampton

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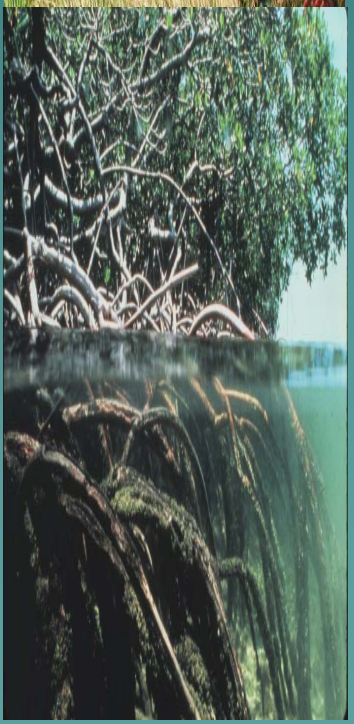

DIVA Wetland Change Model

- Provides a dynamic assessment of wetland loss and transitions between vegetated wetland types and open water
- Range of scenarios of sea-level rise and social sensitivity
- EU DINAS-COAST Project (Dynamic and Interactive Assessment of National, Regional and Global Vulnerability of Coastal Zones to Climate Change and Sea-Level Rise)

Structure of presentation

1. Broad-scale modelling of wetland behaviour: the context
2. The conceptual framework
3. Preliminary results

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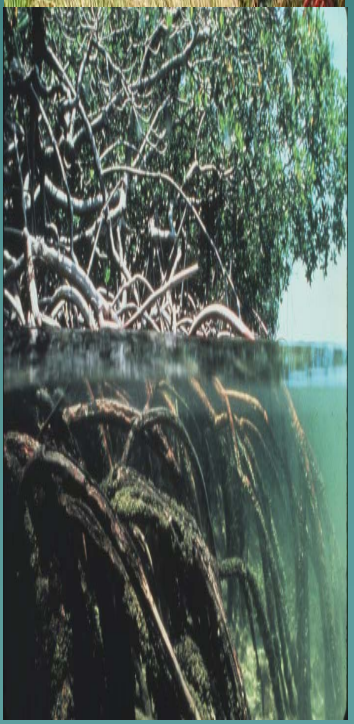

Global Estimates

GVA (Global Vulnerability Assessment)

(Hoozemans et al., 1993)

Detailed Studies

Mass-balance models focusing on vertical adjustment e.g.

North Norfolk Coast UK (French, 1993)

Louisiana, USA (Koch et al., 1990)

Venice Lagoon (Day et al., 1999)

Plus landward retreat of saltmarshes e.g. Essex, UK (Reed, 1988)

Landscape Simulation Models

e.g. Mississippi delta Reyes et al. (2000), Martin et al. (2002)

DIVA WETLAND CHANGE MODEL

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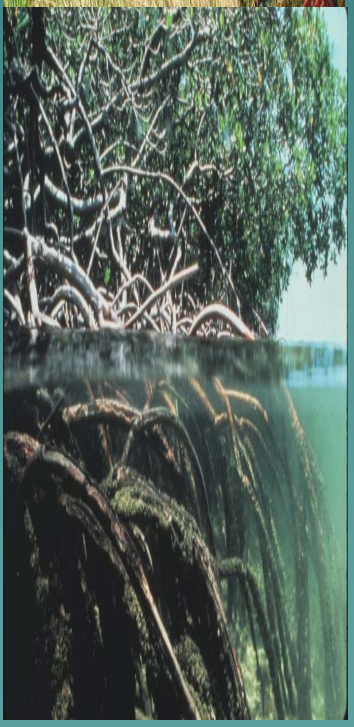

1. Environmental Forcing Factors

RSLR Tidal Range

Sediment Supply

Accommodation Space

Unconstrained horizontal and vertical response

No loss

Constrained horizontal and vertical response

Calibration Landscape Modelling & Field Observations

2.Ecological Response Lags

WETLAND VULNERABILITY SCORE

Behavioural Curves

ECOLOGICAL SENSITIVITY SCORES per wetland type

Model of Wetland Transition

Habitat sucessional changes and loss to open water

3. Differentiation of wetland loss by wetland type

NEW WETLAND AREAS

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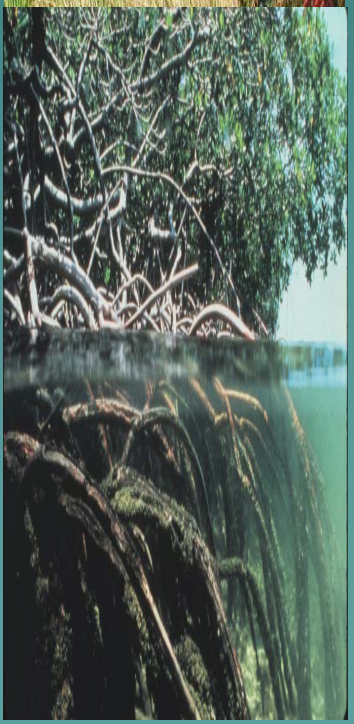
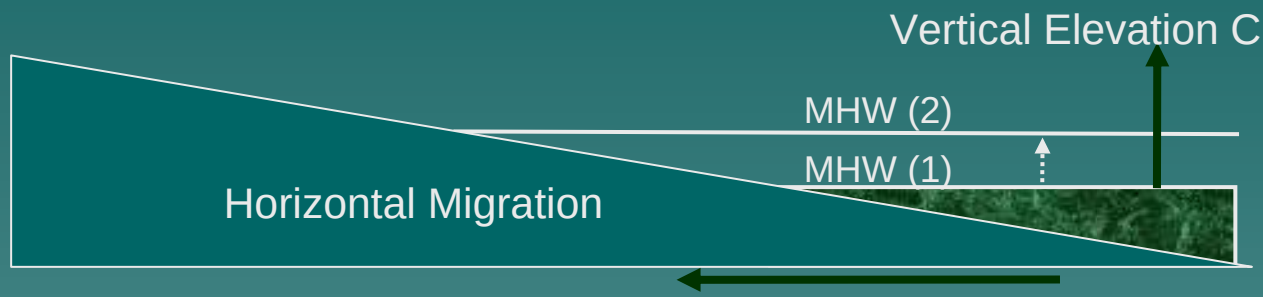
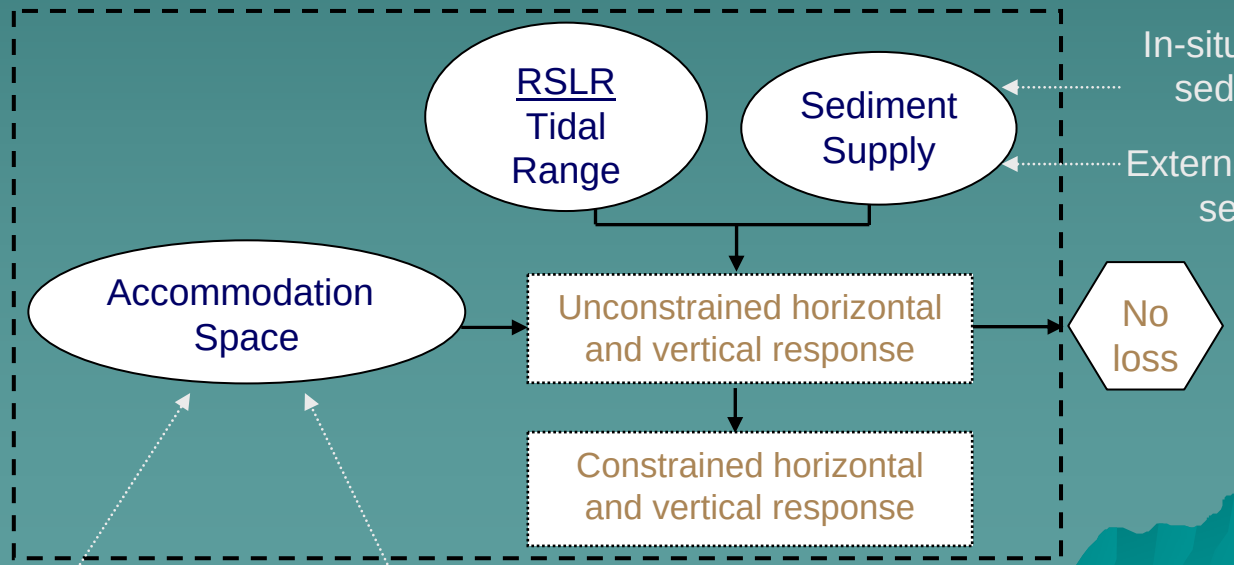


The Conceptual Framework

1. Environmental Forcing Factors





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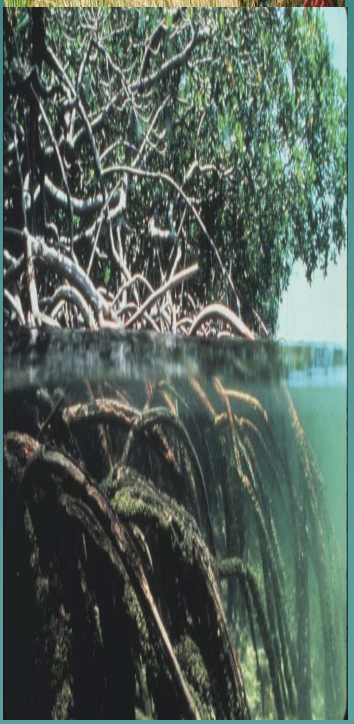
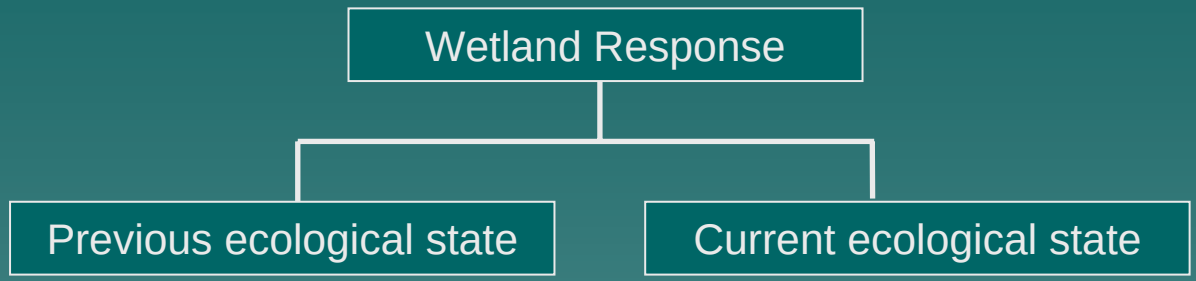


2. Wetland response timescales:

identifying the sensitivity of each wetland type



….two conceptual developments

a) DIVA WETLAND TYPOLOGY based on a morphological classification

Coastal Forested wetlands
Mangrove
Freshwater wetlands
Saltmarsh
Unvegetated sediment > mean high water springs (sabkas)
Unvegetated sediment < mean high water springs (mud and sand flats)

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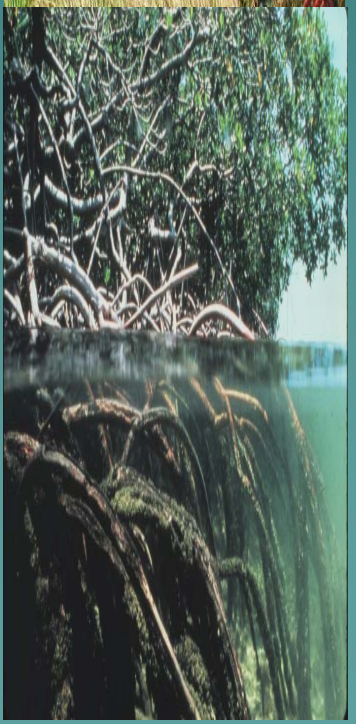
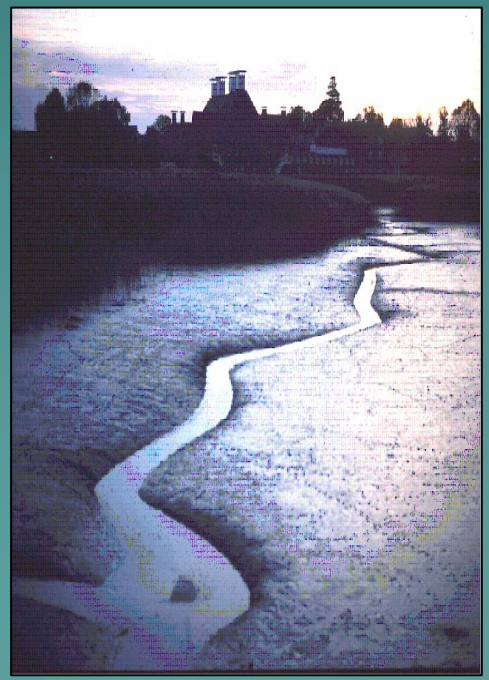


b) Establishing relative response times for each type

Coastal Forested wetlands
Mangrove
Freshmarsh/Saltmarsh
Unvegetated sediment

INCREASING RESPONSE LAG



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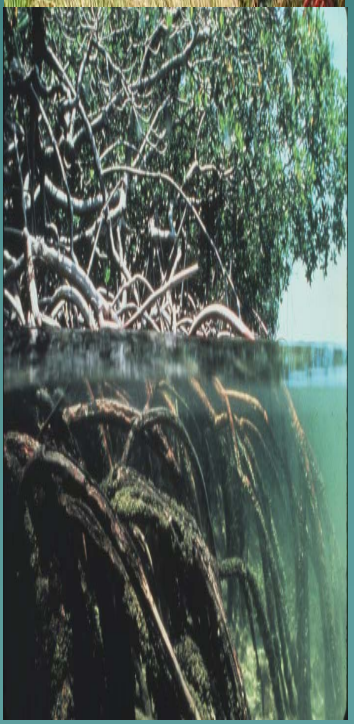
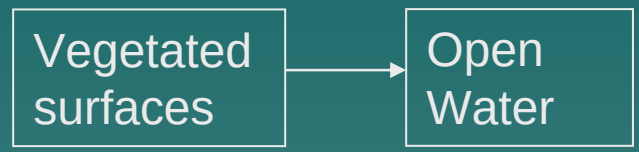
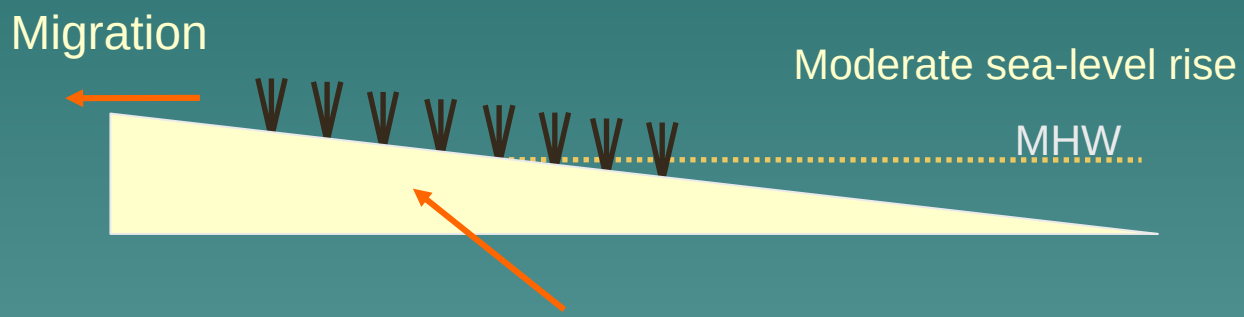


3. Differentiation of wetland loss by wetland type



Total Loss



Adequate sediment supply

(inorganic sediment and accumulation of organic sediment)

DIVA Wetland Change Model:

1. Net wetland losses (conversion to open water)
2. Transitions to other wetland types

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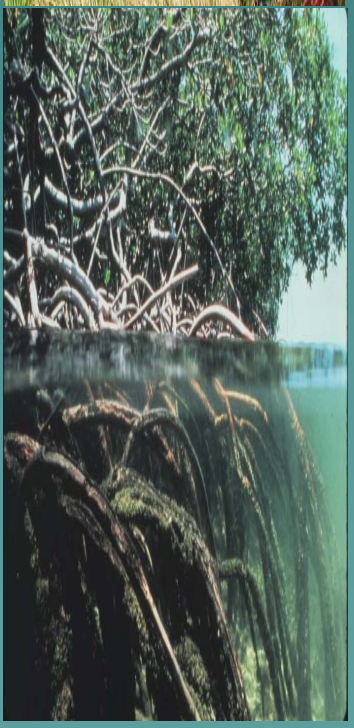

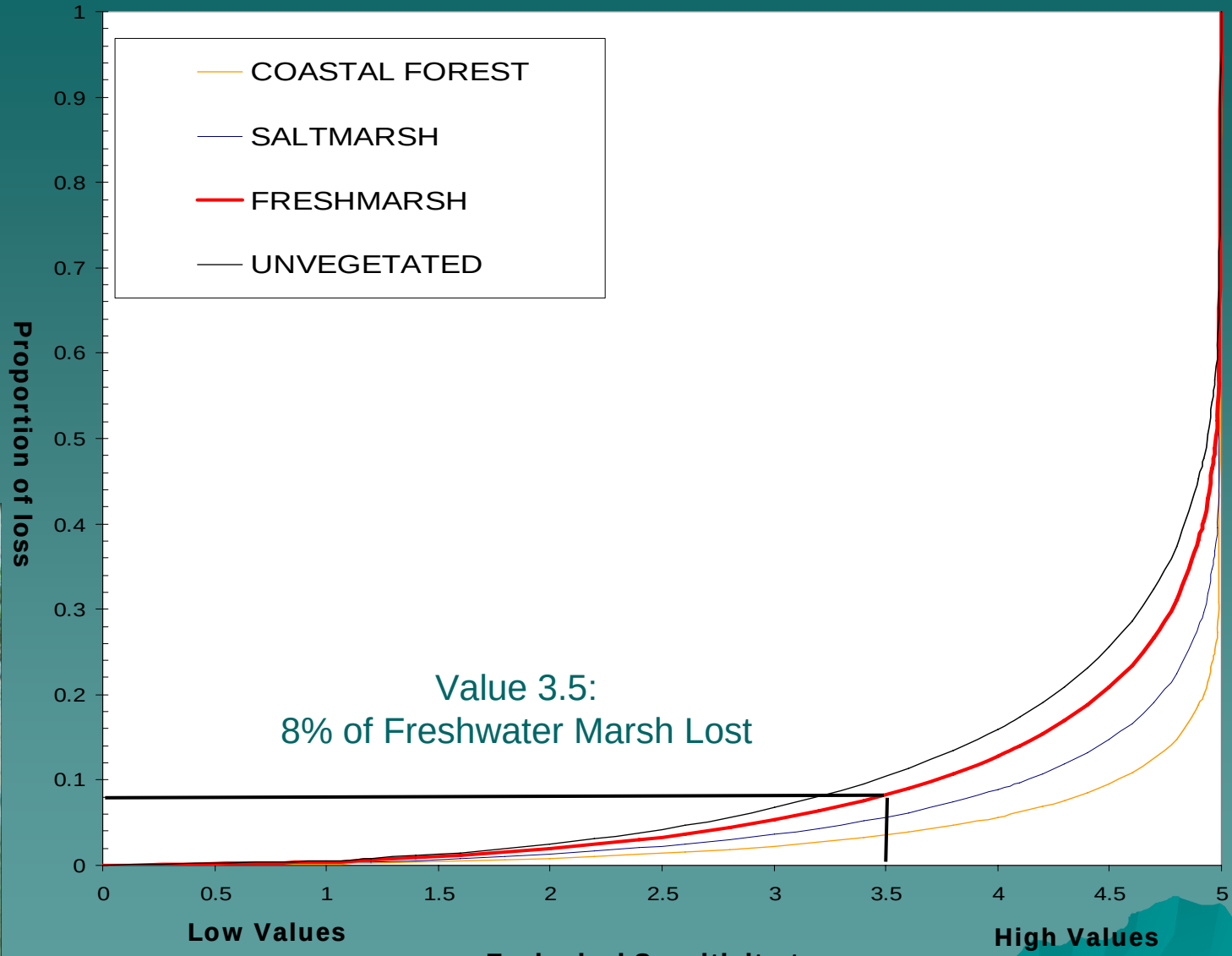

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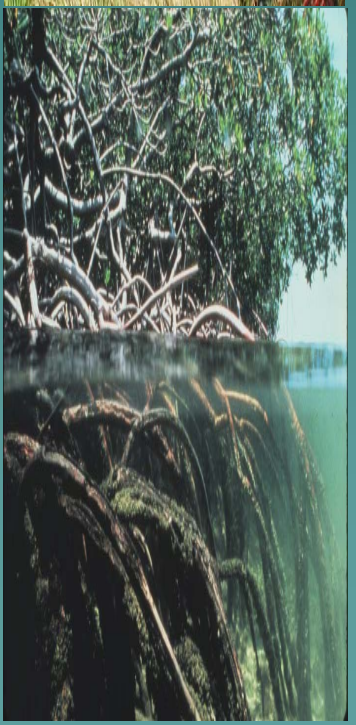
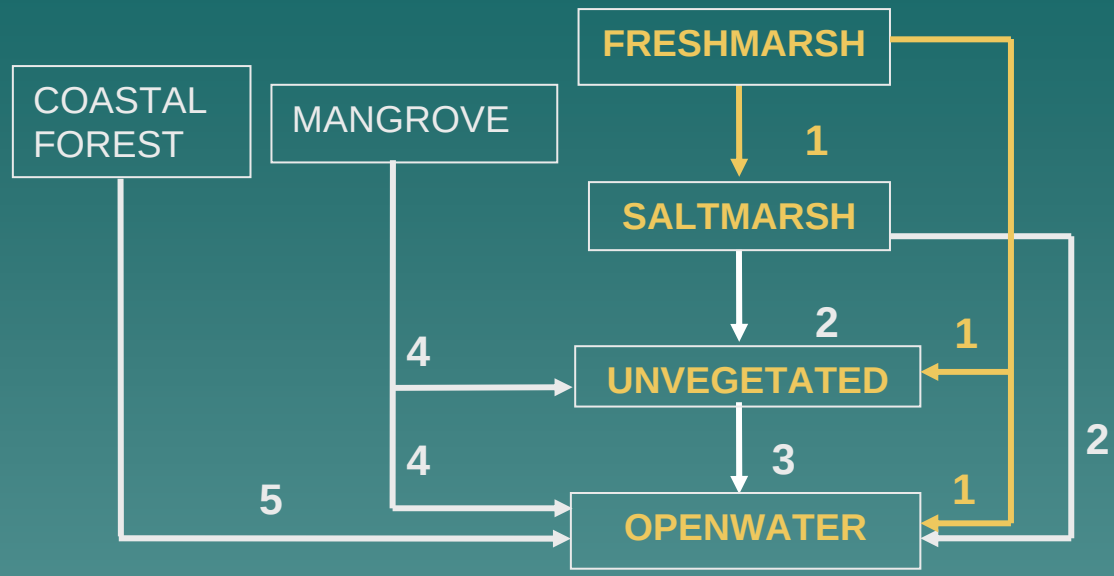


High forcing values
(ecological sensitivity >4)

Coastal Forest
Mangrove
Freshmarsh
Saltmarsh
Unvegetated

Open Water

Low - moderate forcing values
(ecological sensitivity <4)



1	**Freshwater loss to saltmarsh**	**= 33%**
	Freshwater loss to unvegetated	**= 33%**
	Freshwater loss to openwater	**= 33%**
2	Saltmarsh loss to unvegetated	= 50%
	Saltmarsh loss to openwater	= 50%
3	Unvegetated loss to openwater	= 100%
4	Mangrove to unvegetated	= 50%
	Mangrove to openwater	= 50%
5	Forest to openwater	= 100%

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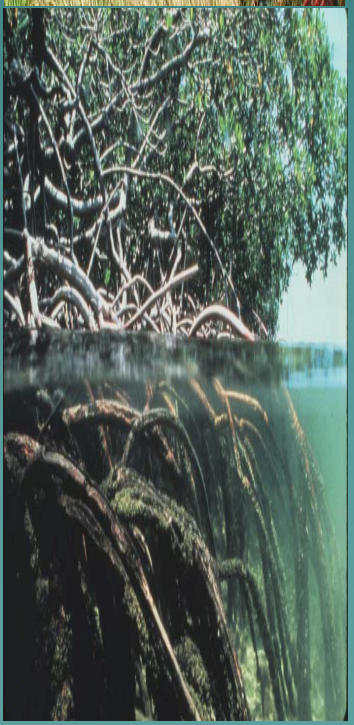

Calibrating provisional estimates of wetland loss

1. Forecasting of changing wetland and open water areas in the Barataria and Terrebonne basins of SE Louisianna, USA from a basis of historical data collected by the United States Fisheries and Wildlife Service (USFWS) (DJ Reed, pers. comm., 2003)

2. Predictions of wetland type transitions produced by large-scale landscape modelling in the same region (Reyes et al., 2000)

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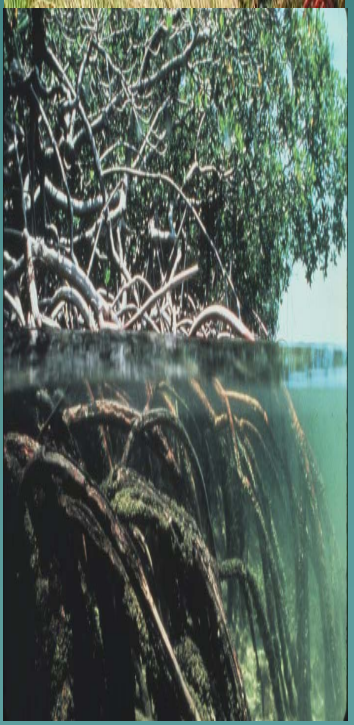

Preliminary Results

Rate of increase in open water:
useful and readily definable summary measure

	DIVA WETLAND CHANGE MODEL				REED (pers. comm., 2003)	
	DIVA Administrative Units (Digital Chart of the World, ESRI, 2002)				Barataria	Terrebonne
	Texas	Louisiana	Alabama	Florida		
Increase in open water 2000 - 2060	**37%**	**26%**	**26%**	**32%**	**35%**	**23%**

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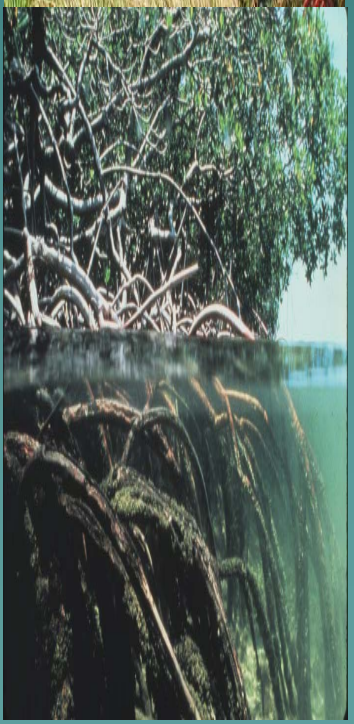

Nicholls et al. (1999) 22% of world's wetlands could be lost by 2080 given a global rise of sea level of 38cm

DIVA Model – Total Global Wetland Loss

Low forcing scores for sediment supply and accommodation space

Global mean SLR 0.5m (1990-2100)	**Proportion of global wetlands lost, 2000 - 2080**
2020	0.10
2050	0.22
2080	0.32
Global mean SLR 1m (1990-2100)	
2020	0.17
2050	0.32
2080	0.44

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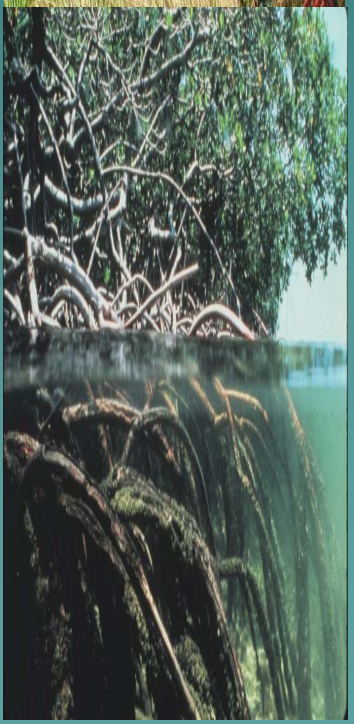

Conclusions

- Improved broad-scale model of loss and transition of coastal wetlands under sea-level rise
- Major Challenge: Validation. Development of more systematic national to regional scale assessments of wetland behaviour
- Next steps….. modelling the impact of changes in storminess and tidal range, which are likely to accompany changes in mean sea-level: regional models based on tidal energy i.e. a micro-tidal versus macro-tidal model

Whilst challenges exist, the approach has the potential to identify regional patterns of vulnerability to different sea-level rise and human intervention scenarios

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