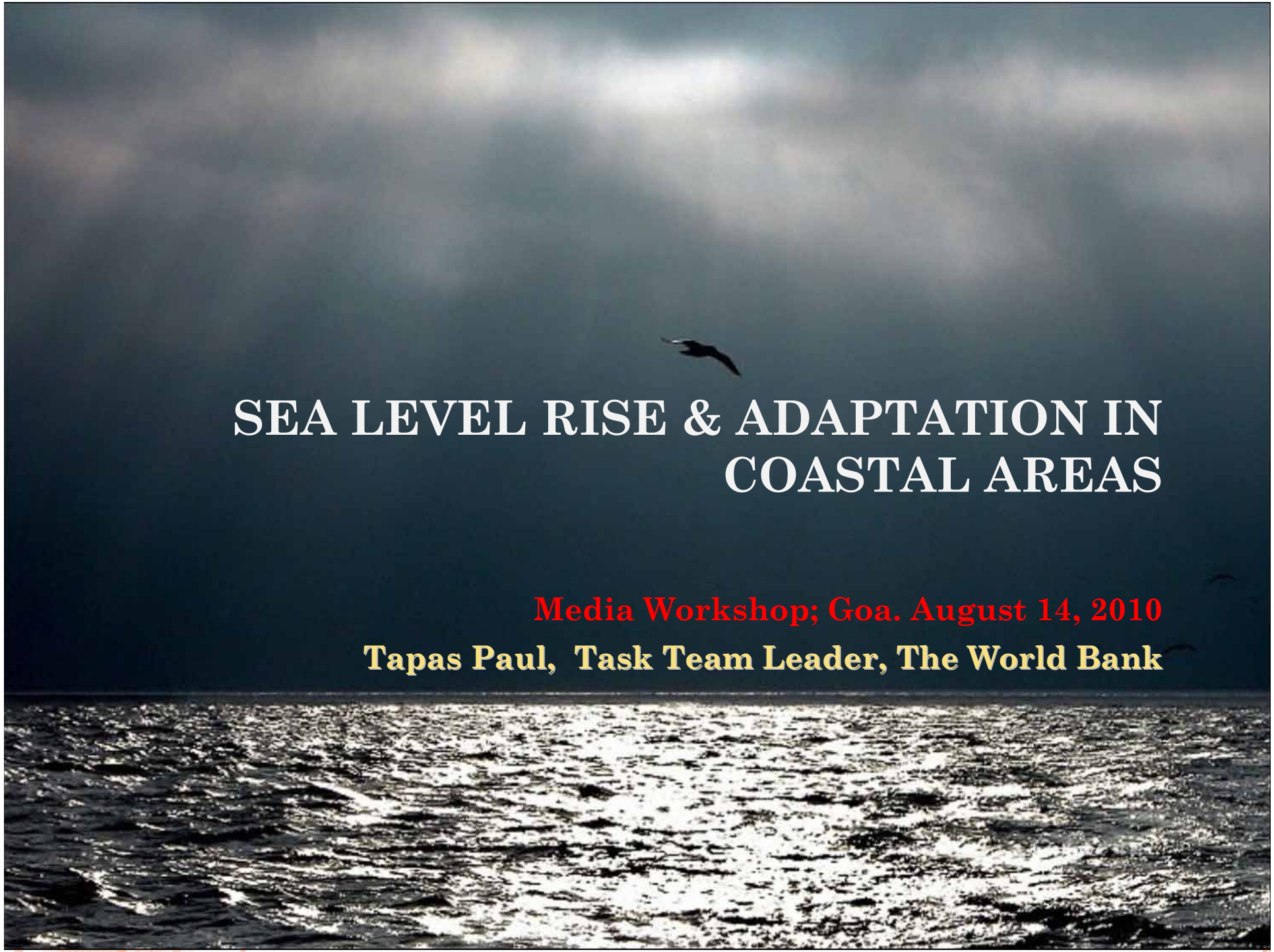
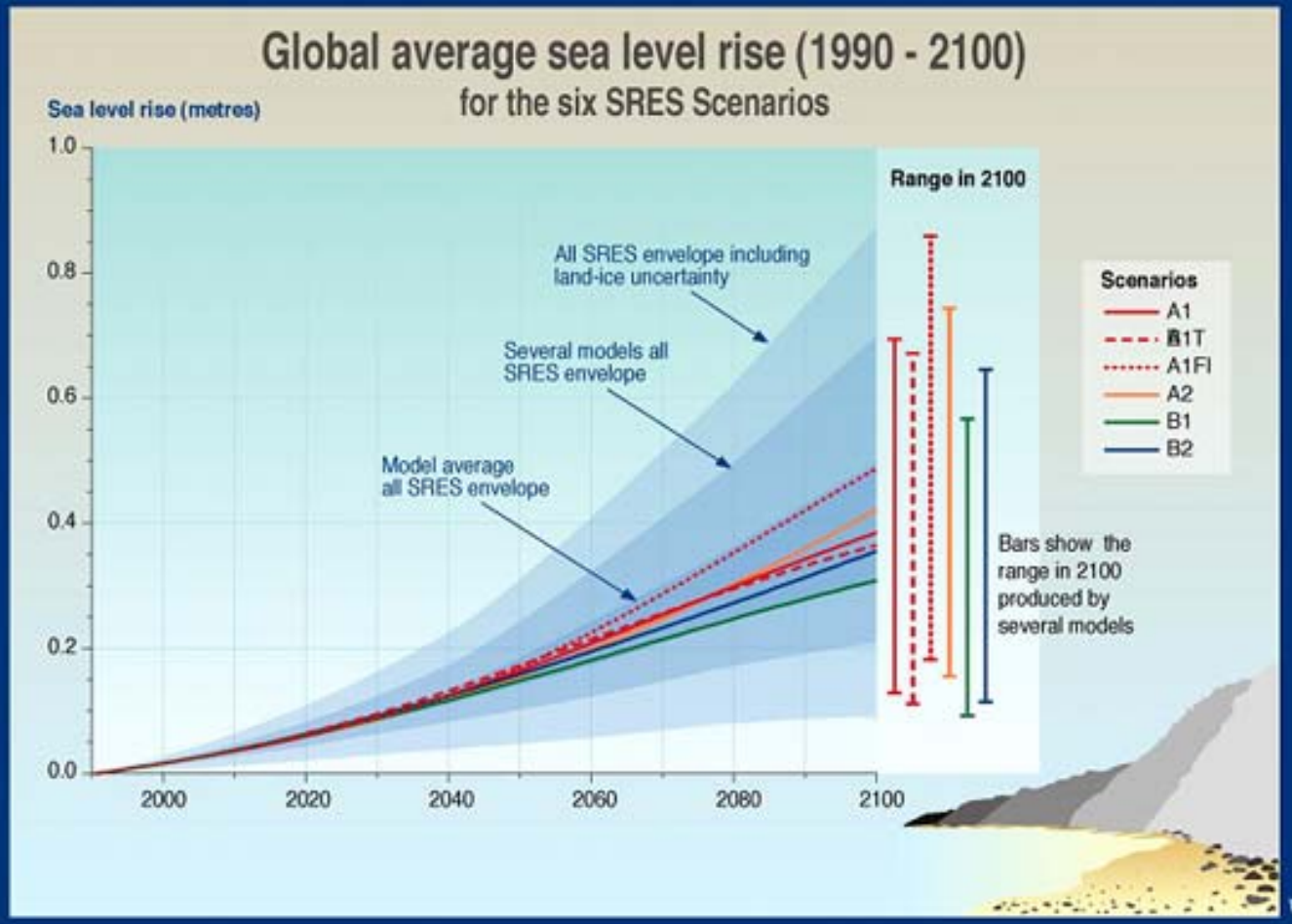


SEA LEVEL RISE & ADAPTATION IN COASTAL AREAS

Media Workshop; Goa. August 14, 2010

Tapas Paul, Task Team Leader, The World Bank

IPCC Forecast (2000)



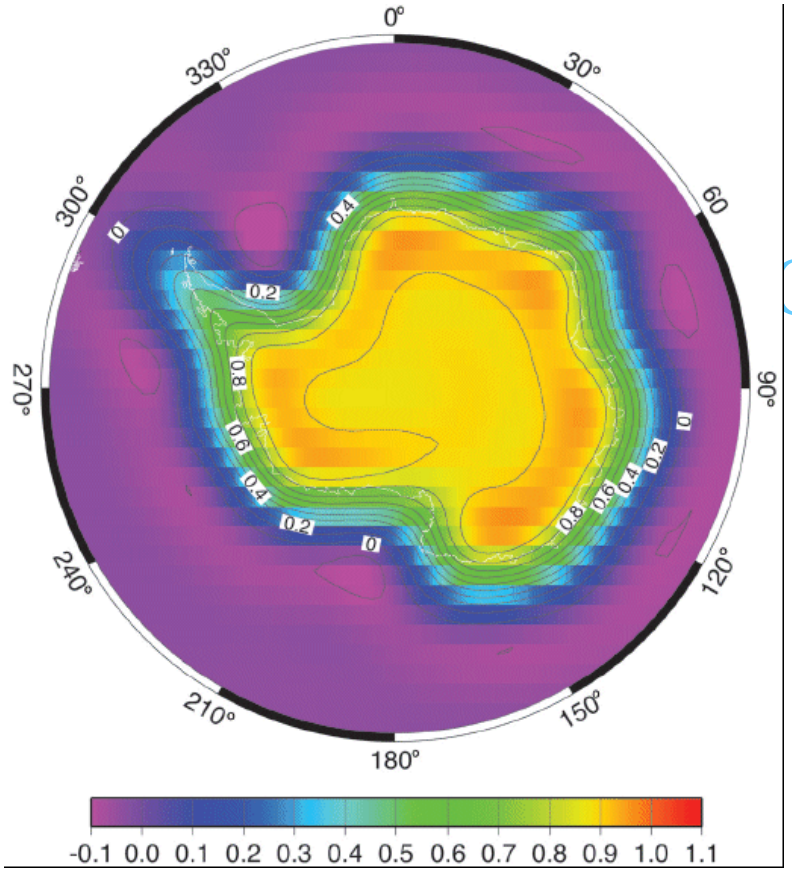
ICE SHEET MELT AND SEA LEVEL RISE

"Paleoclimate information supports that the warmth of the last half century is unusual in at-least the previous 1300 years. The last time the polar regions were significantly warmer than present for an extended period (about 125,000 years ago), reductions in polar ice volume led to 4-6 meters of sea level rise". **- IPCC, 2007**

1979 SSMI Composite Data

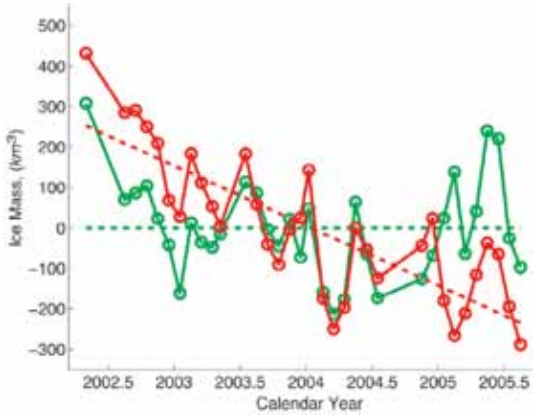
2003 SSMI Composite Data

WEST ANTARCTIC ICE SHEET AND SEA LEVEL RISE



Melting instead of stable, as previously thought

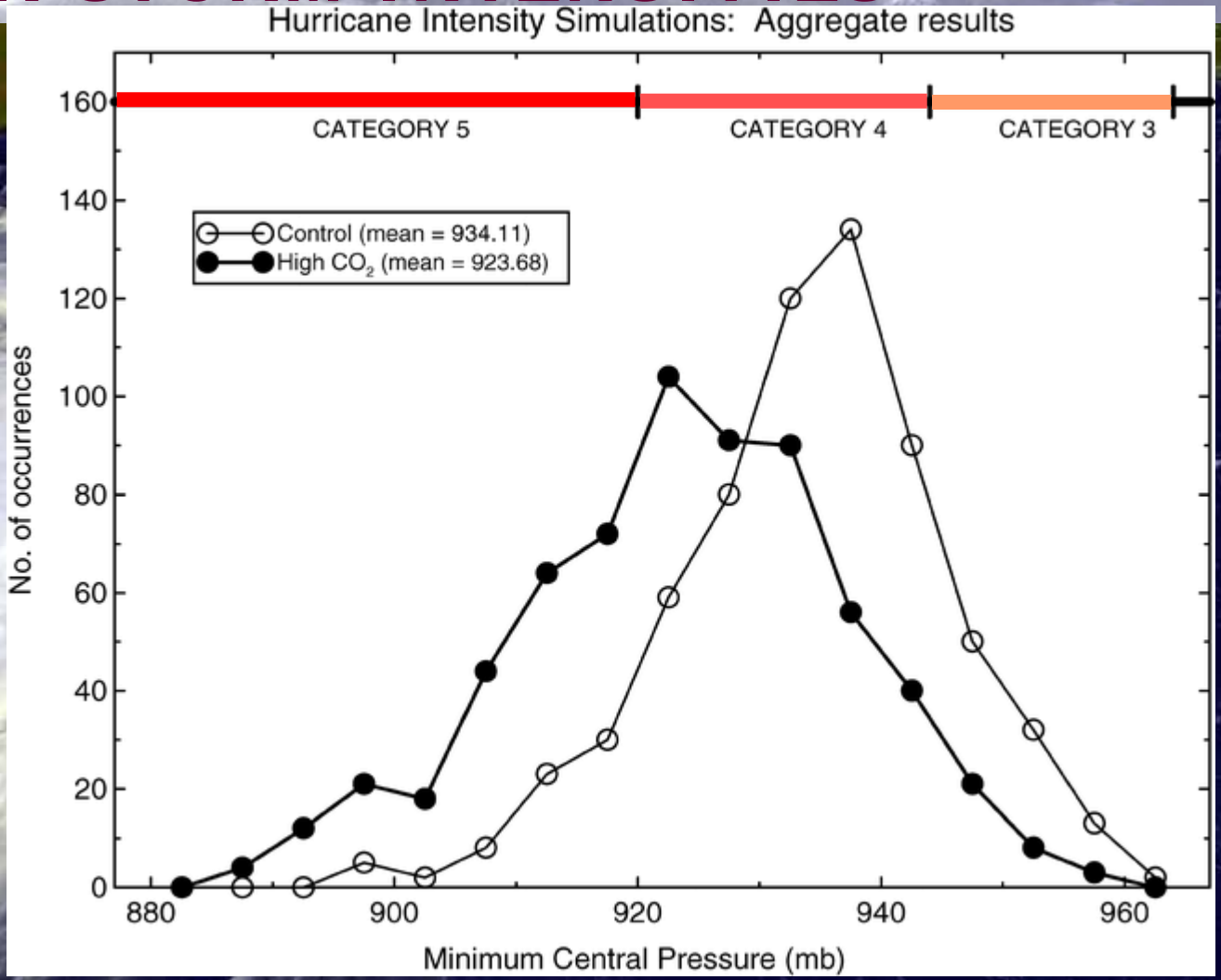
Current Antarctic loss rate: 152 ± 80 km^3 / yr.



Ice Mass Changes, 2002-2005

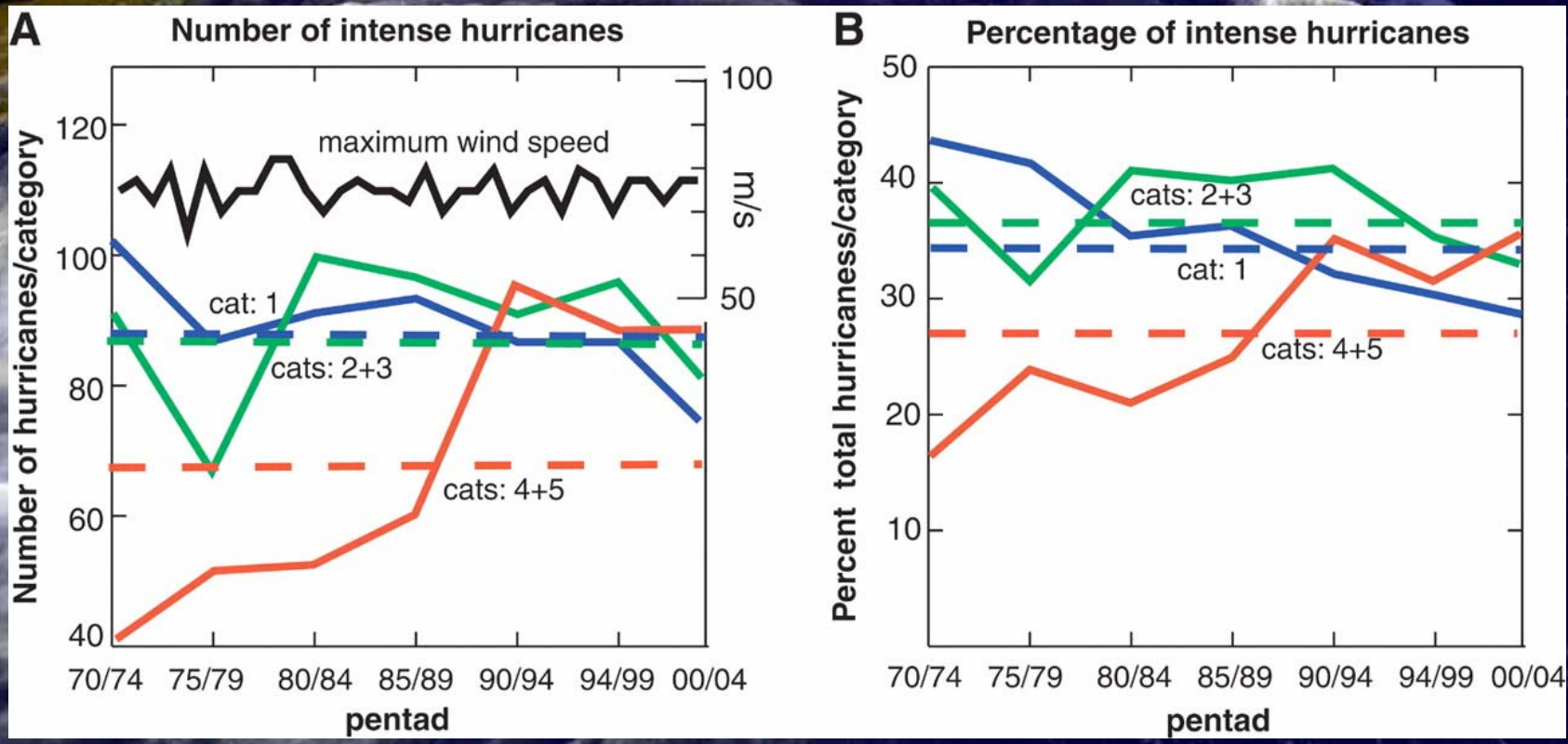
Source: Science Express, March 2, 2006: Measurements of Time-Variable Gravity Show Mass Loss in Antarctica, Isabella Velicogna and John Wahr

GLOBAL WARMING: INCREASE IN STORM INTENSITIES



Thomas R. Knutson and Robert E. Tuleya at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL)
http://www.gfdl.noaa.gov/~tk/glob_warm_hurr.html

GLOBAL WARMING:
INCREASE IN STORM INTENSITIES



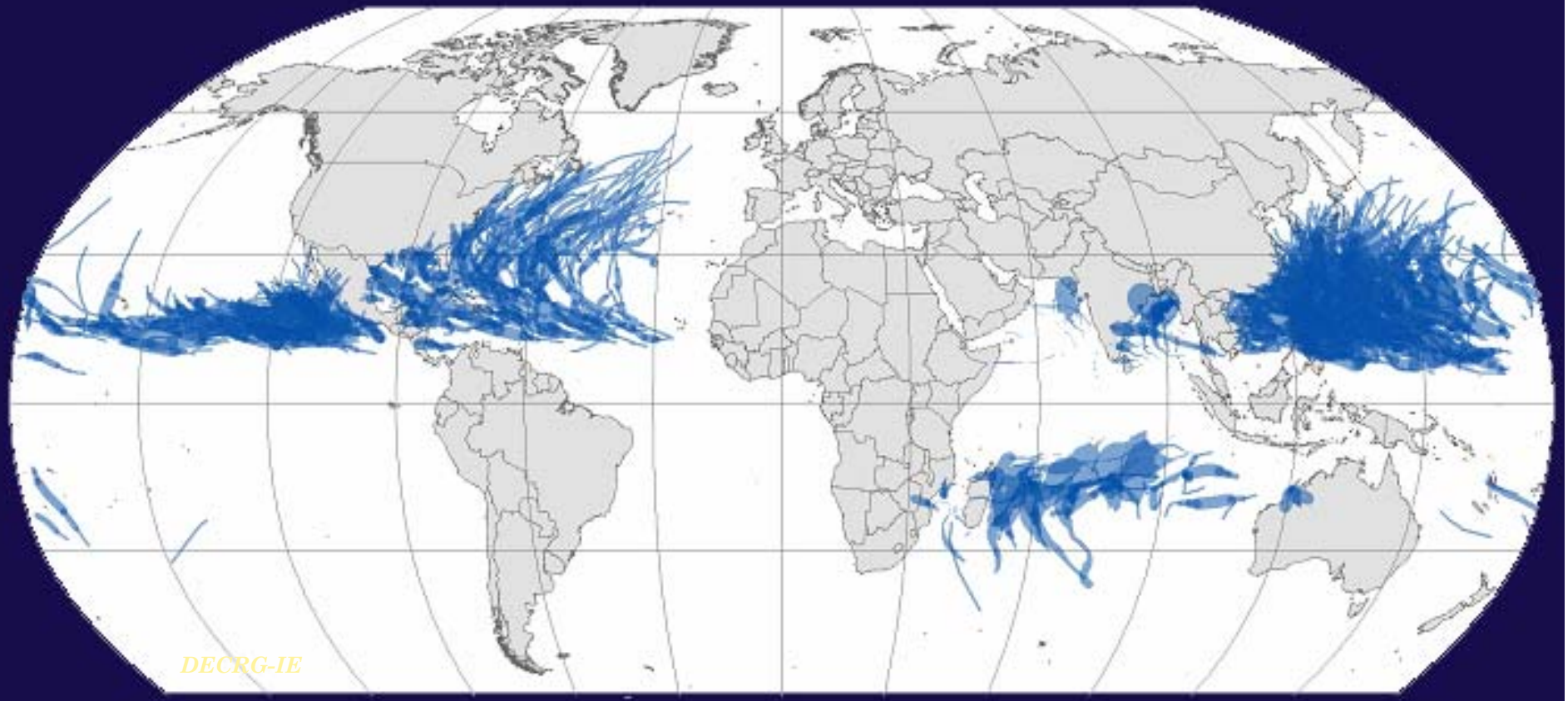
Thomas R. Knutson and Robert E. Tuleya at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL)
http://www.gfdl.noaa.gov/~tk/glob_warm_hurr.html

Natural Disaster Impacts 1980 – 2006 (Feb)

Natural disaster type	Number of events	Killed	Injured	Total affected	Total damages (000's USD)
Drought	530	558,982	-	1,612,692,798	55,508,146
Earthquake	644	291,508	797,887	81,098,546	289,991,179
Wind Storm	1934	268,581	498,270	578,524,479	445,749,972
Famine	68	232,299	-	70,396,301	93,399
Wave / Surge	29	229,159	42,490	2,494,524	7,713,397
Flood	2309	177,716	1,146,462	2,559,035,967	327,488,468
Epidemic	874	165,225	80,086	18,011,472	4,692
Extreme Temperature	272	70,237	1,820,526	11,411,723	21,591,447
Volcano	116	25,180	6,778	3,283,198	3,638,967
Landslide & avalanche	375	19,351	7,937	5,976,677	4,482,381
Wild Fire	263	1,203	2,551	3,975,366	28,243,643
Insect Infestation	75	-	-	2,200	229,200

Source: EM-DAT: The OFDA/CRED International Disaster Database
www.em-dat.net - Université Catholique de Louvain - Brussels - Belgium

Severe Storms, 1981 - 2000



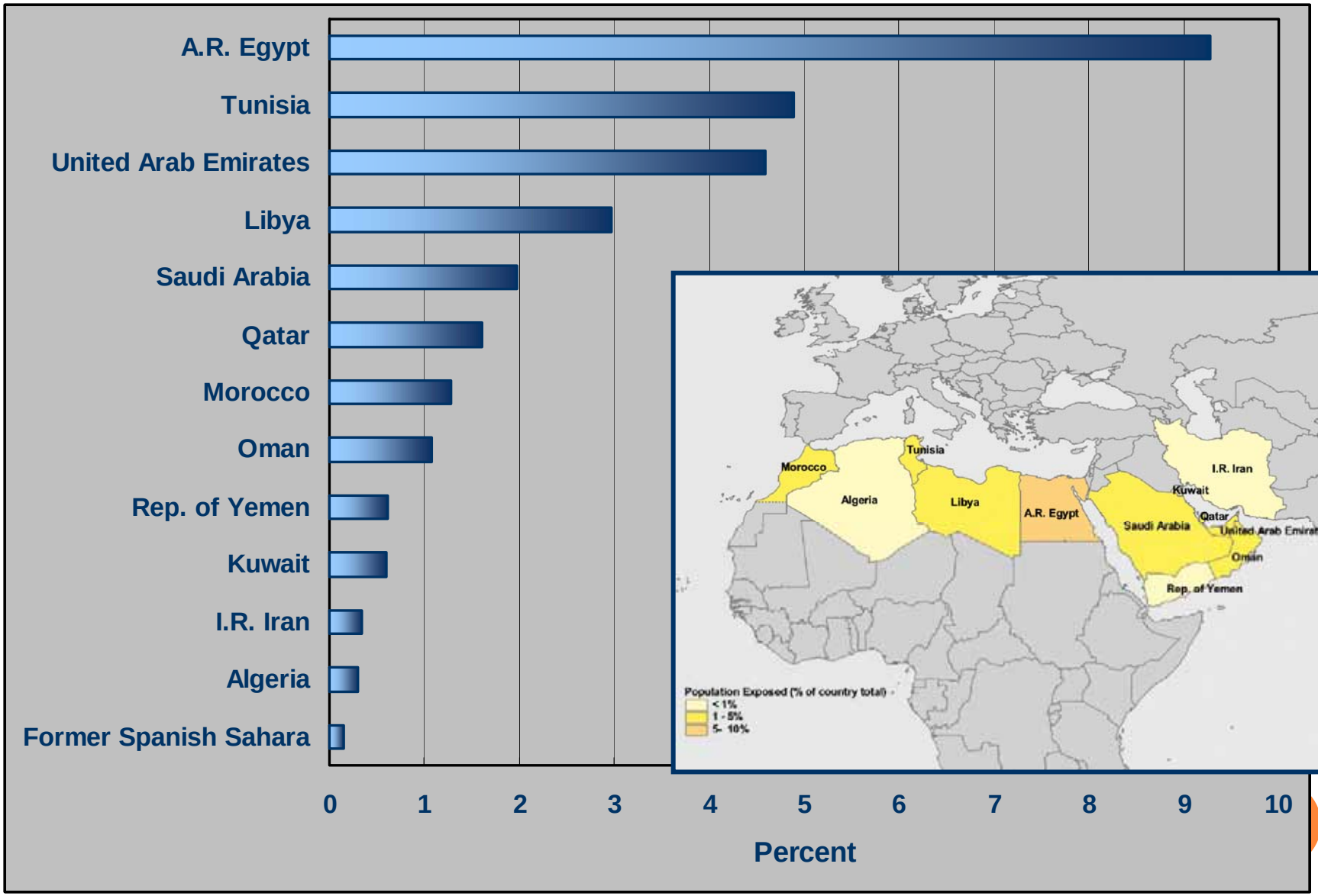
World Bank/Columbia University: Natural Disaster Hotspots Study 2005
based on strom track data compiled by UNEP-GRID Geneva

IMPACT : TOTAL POPULATION

1 Meter Sea Level Rise

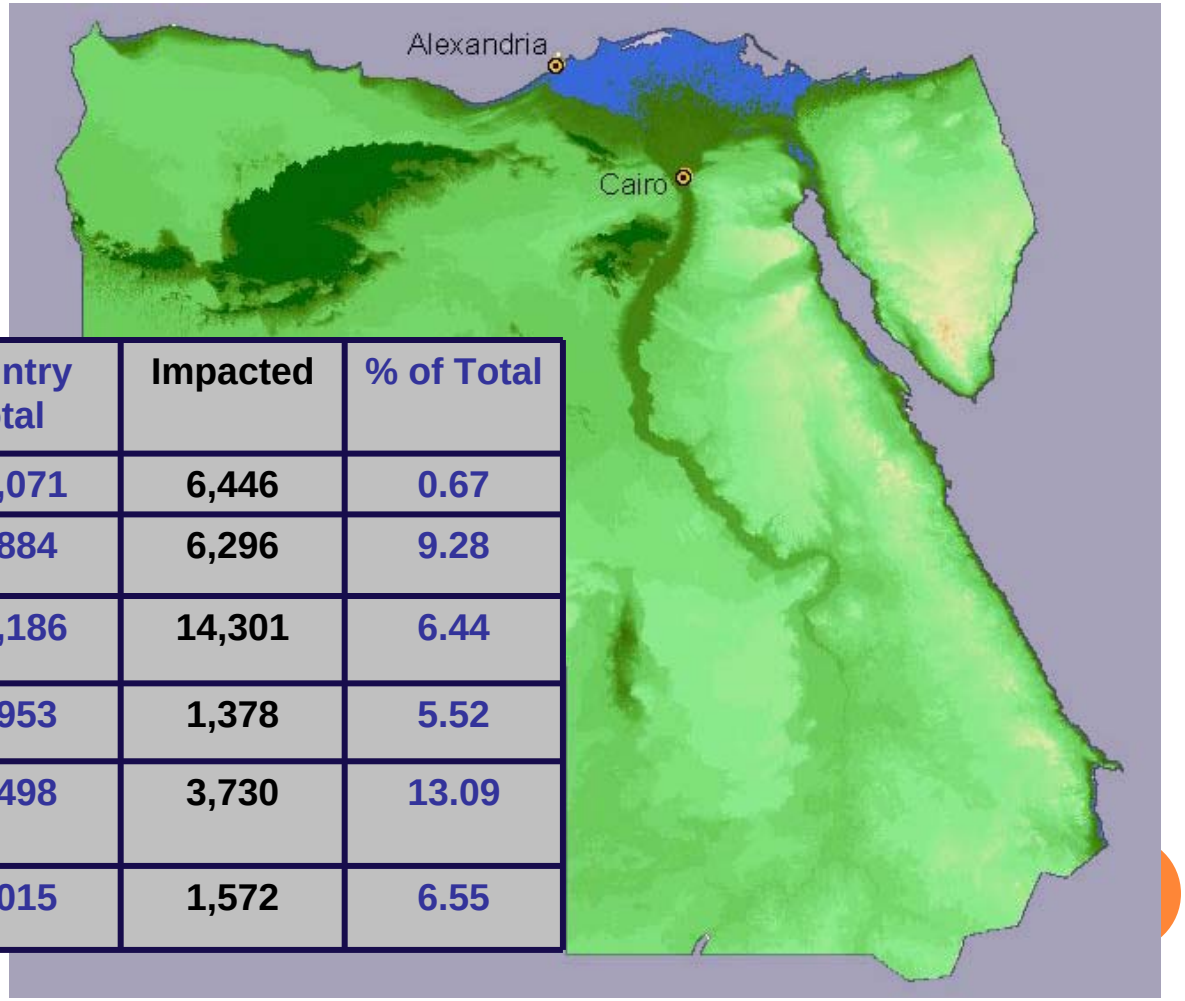
East Asia & Pacific	37.2 million
Middle East & North Africa	8.3 million
South Asia	5.9 million
Latin America & Caribbean	2.9 million
Sub-Saharan Africa	2.1 million
Total	56.4 million

Percentage Impact

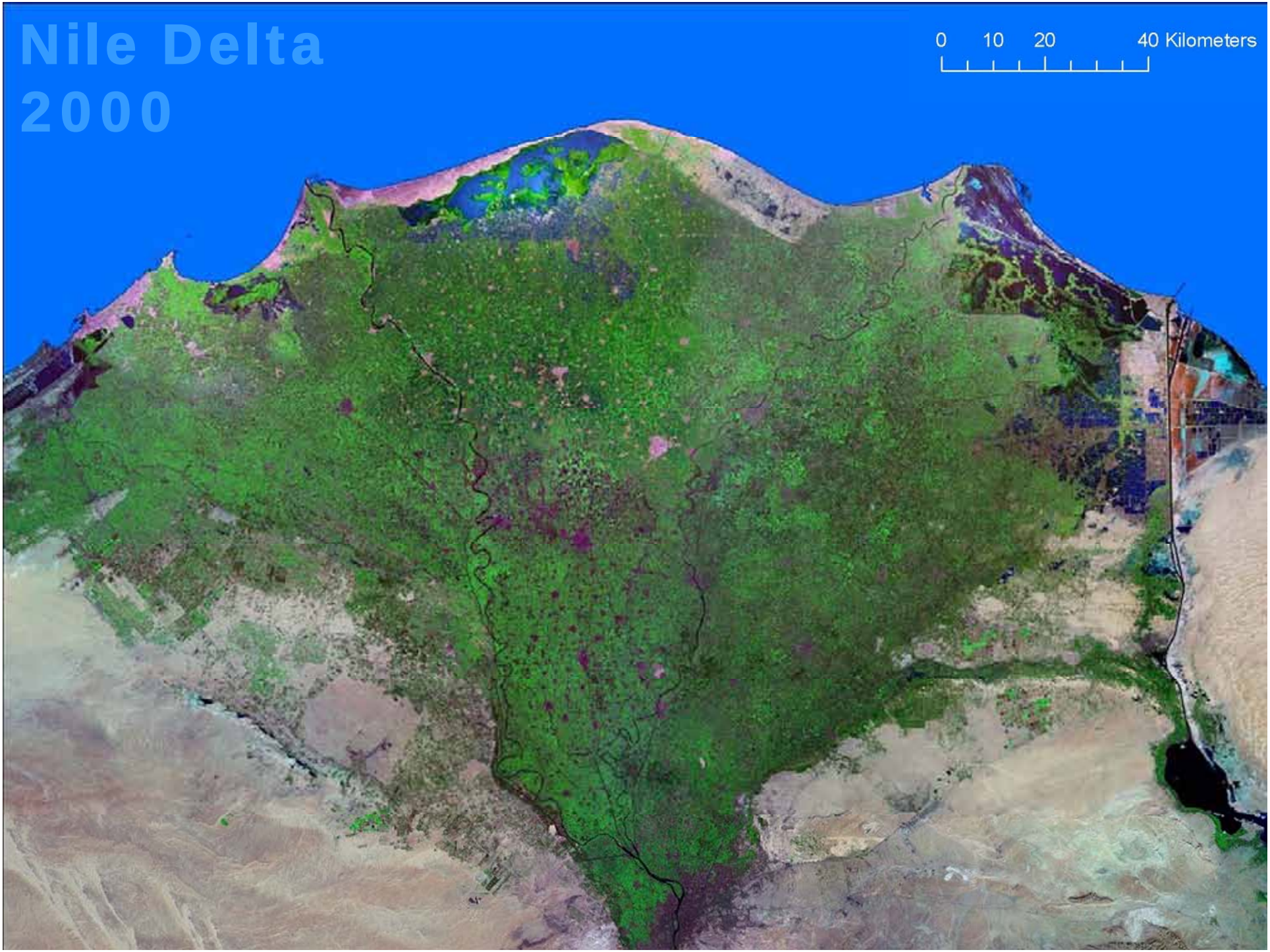


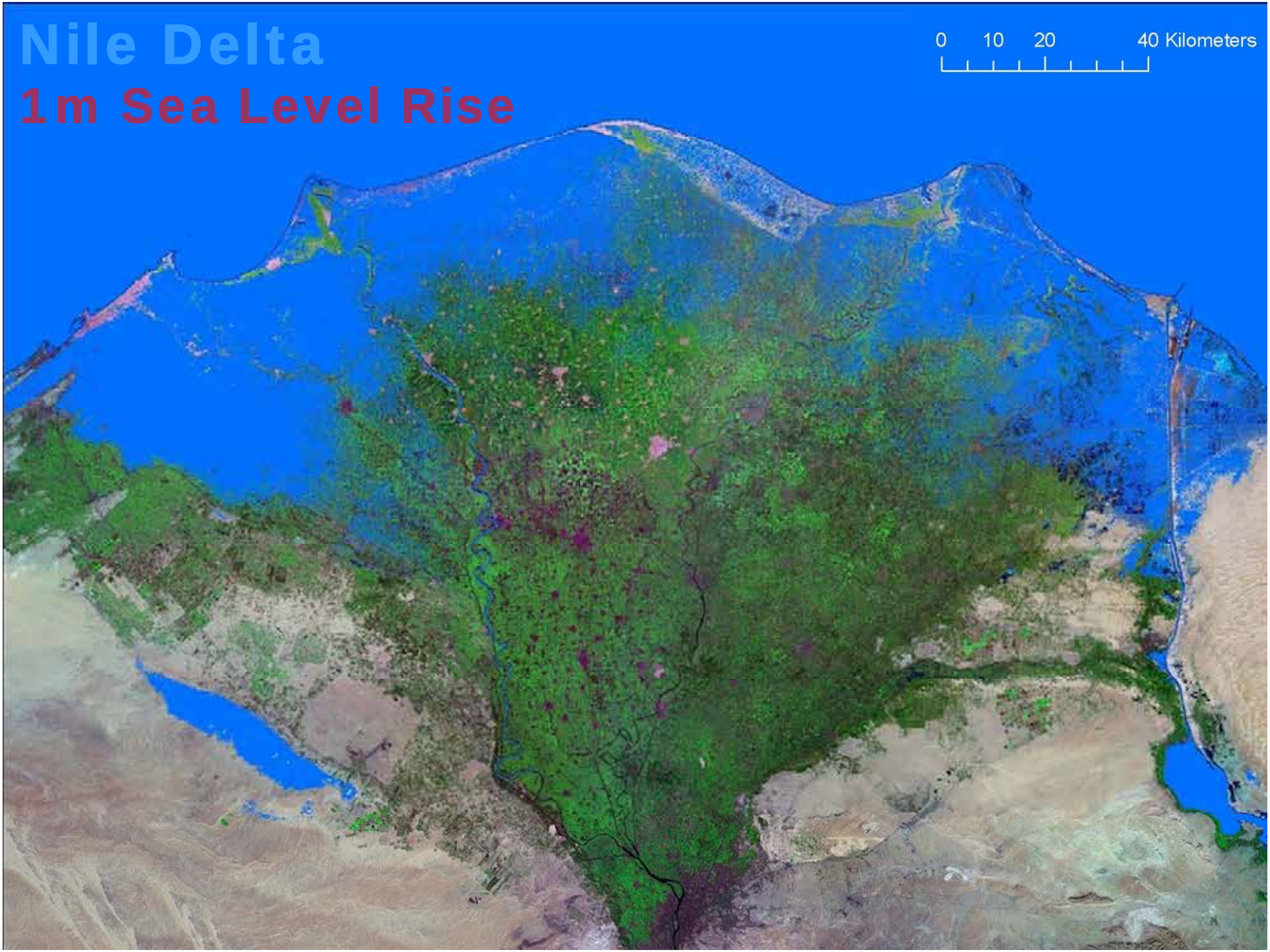
Egypt

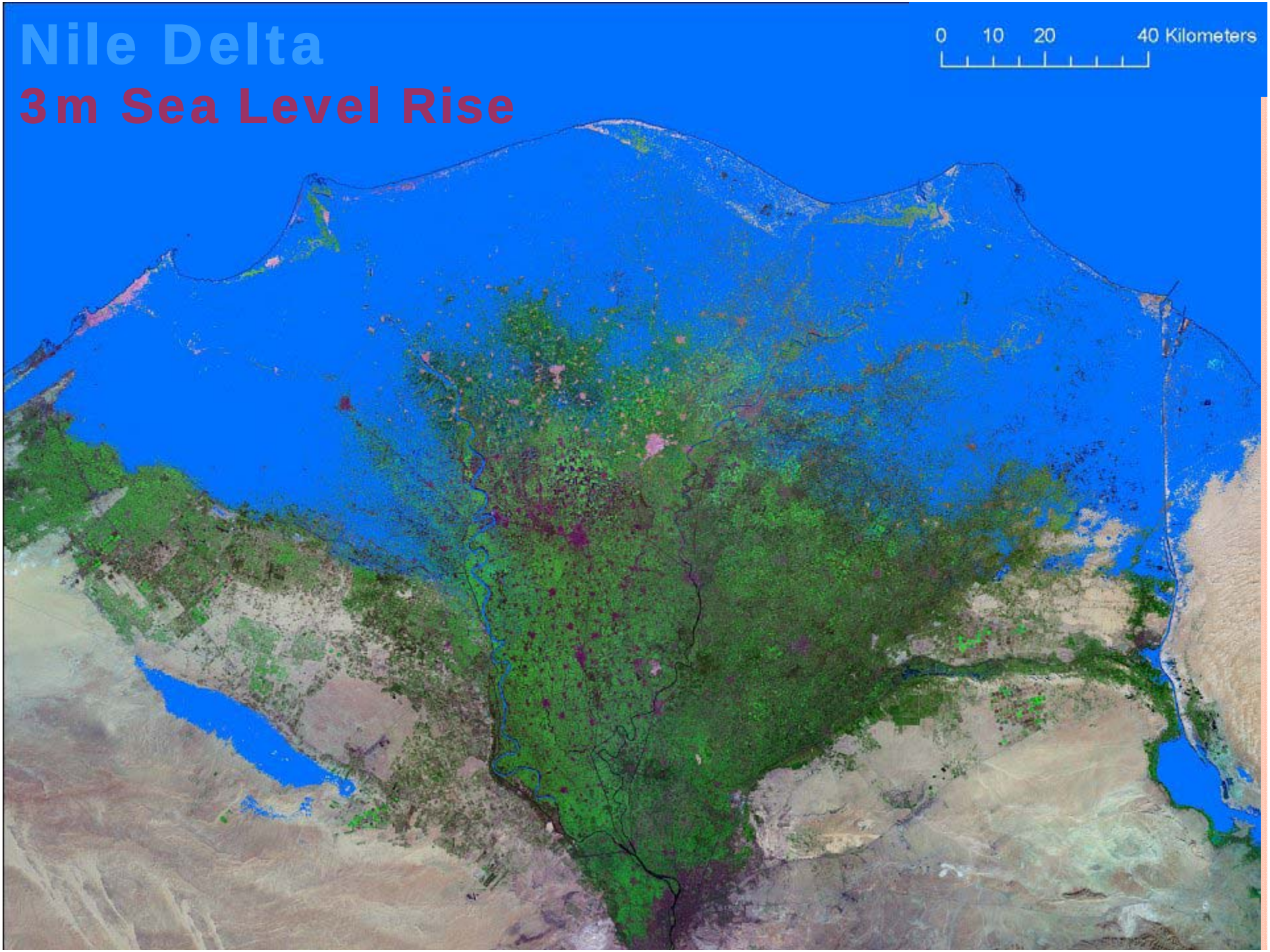
1 Meter Sea Level Rise

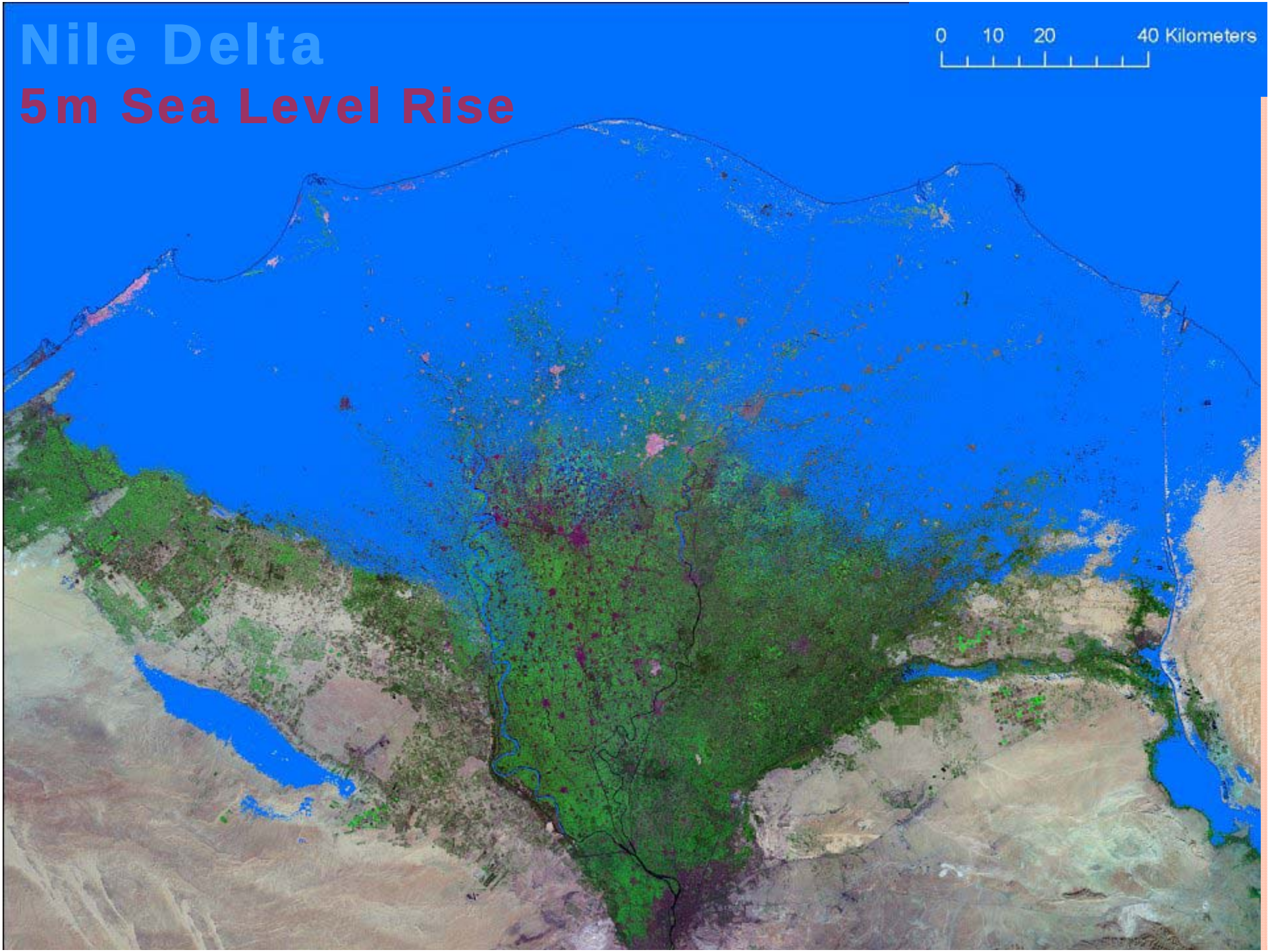


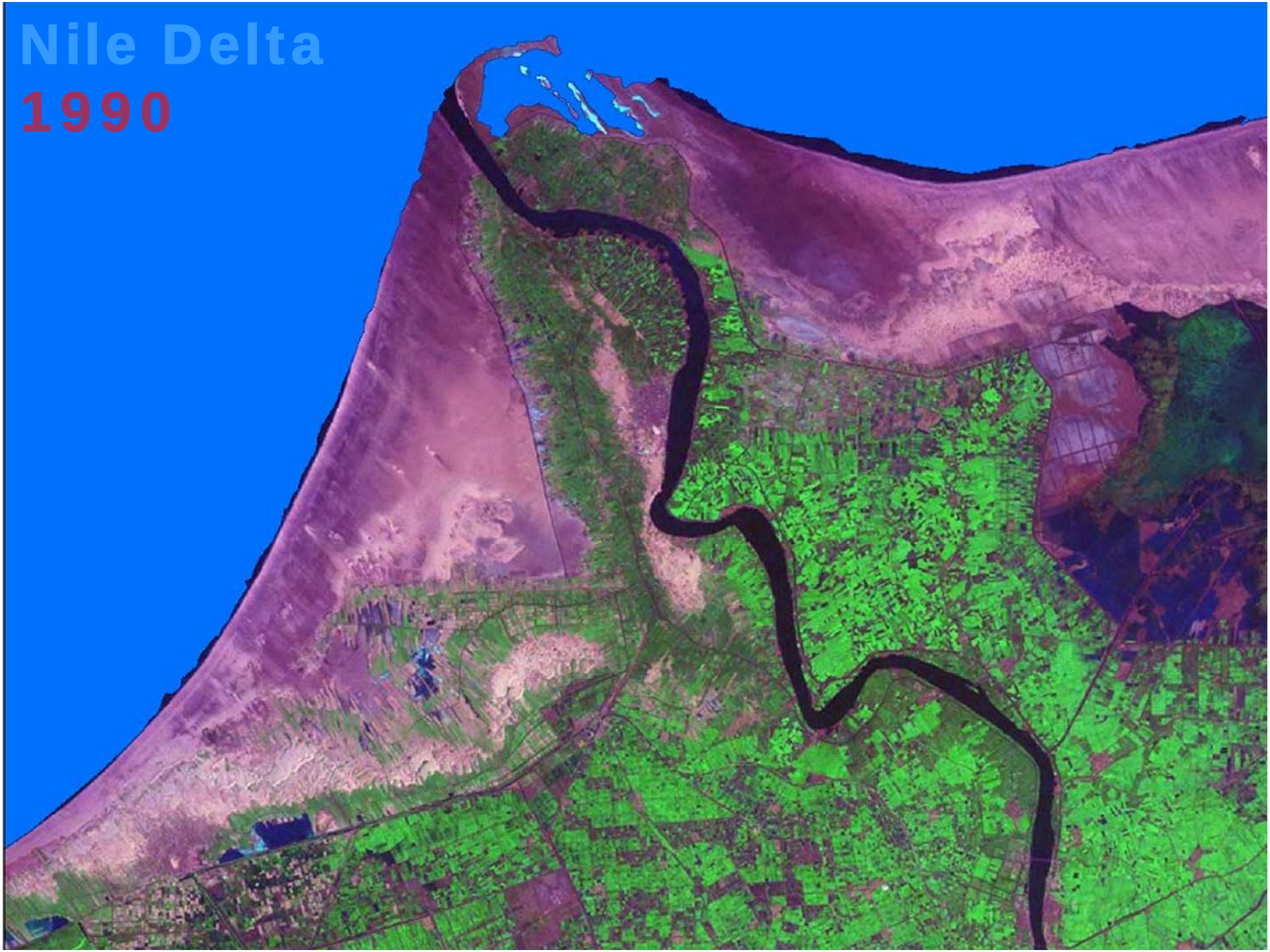
	Country Total	Impacted	% of Total
Area (km^2)	968,071	6,446	0.67
Population (10^3)	67,884	6,296	9.28
GDP (10^6 US$)	222,186	14,301	6.44
Urban Areas (km^2)	24,953	1,378	5.52
Agricultural Land (km^2)	28,498	3,730	13.09
Wetlands (km^2)	24,015	1,572	6.55


Nile Delta
2000
0 10 20 40 Kilometers

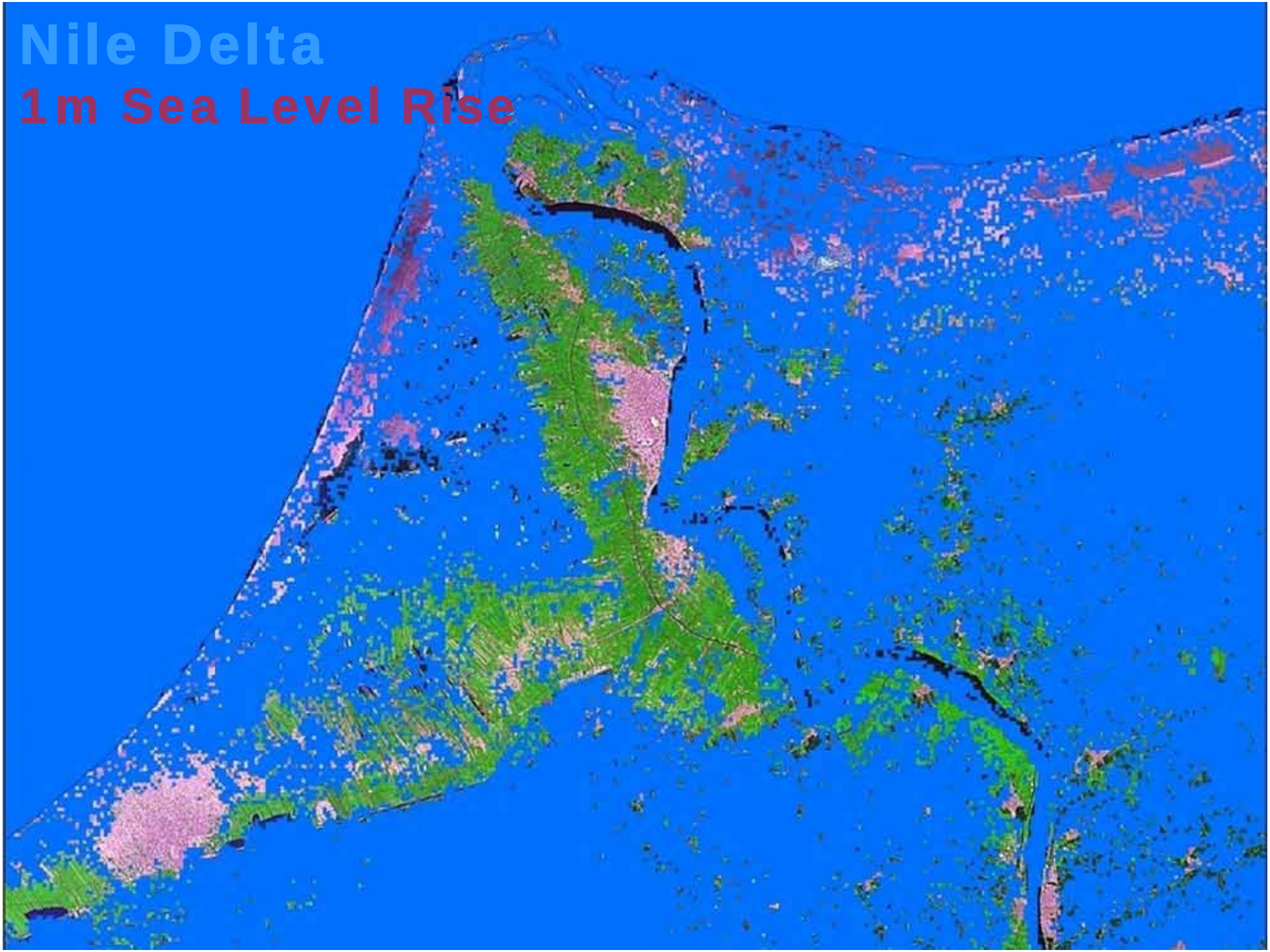

Nile Delta
1m Sea Level Rise
0 10 20 40 Kilometers


Nile Delta
3m Sea Level Rise
0 10 20 40 Kilometers


Nile Delta
5m Sea Level Rise
0 10 20 40 Kilometers

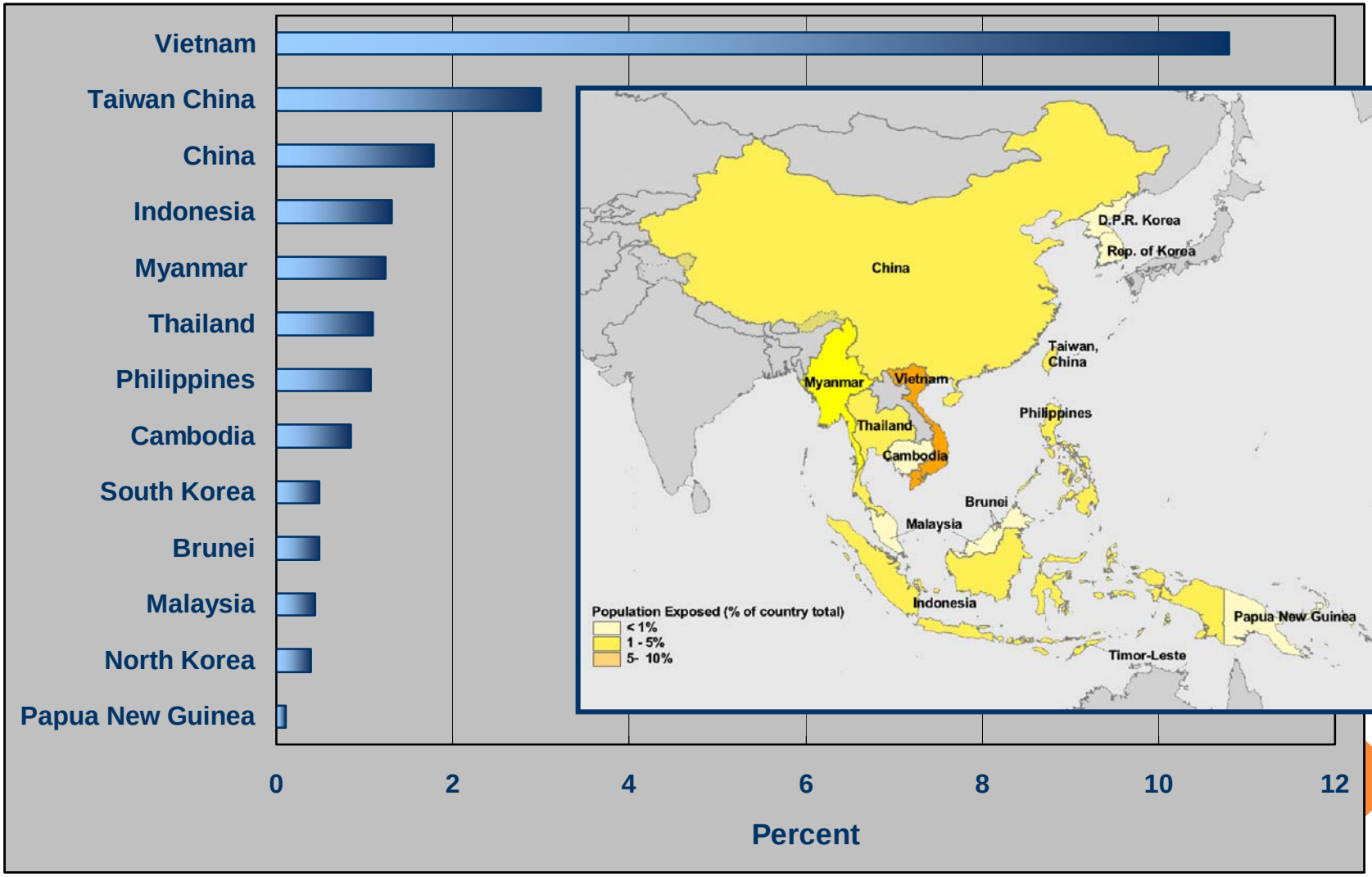

Nile Delta
1990


Nile Delta
2000


Nile Delta
1m Sea Level Rise

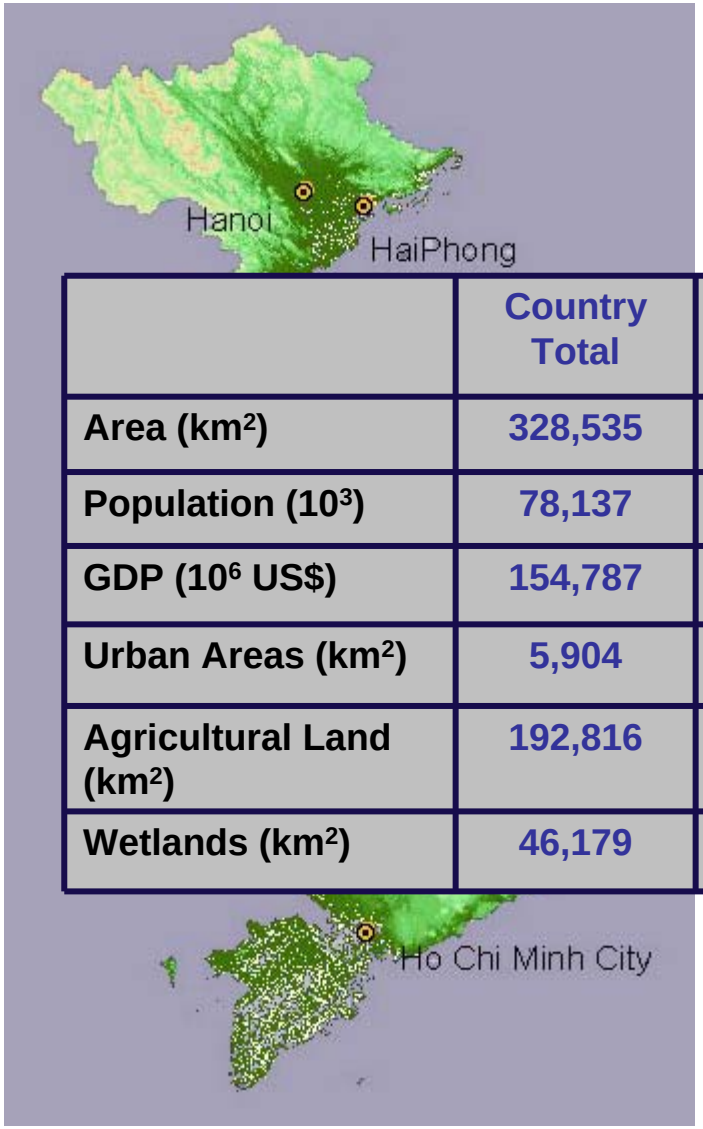
Percentage Impact

East Asia & Pacific : Population



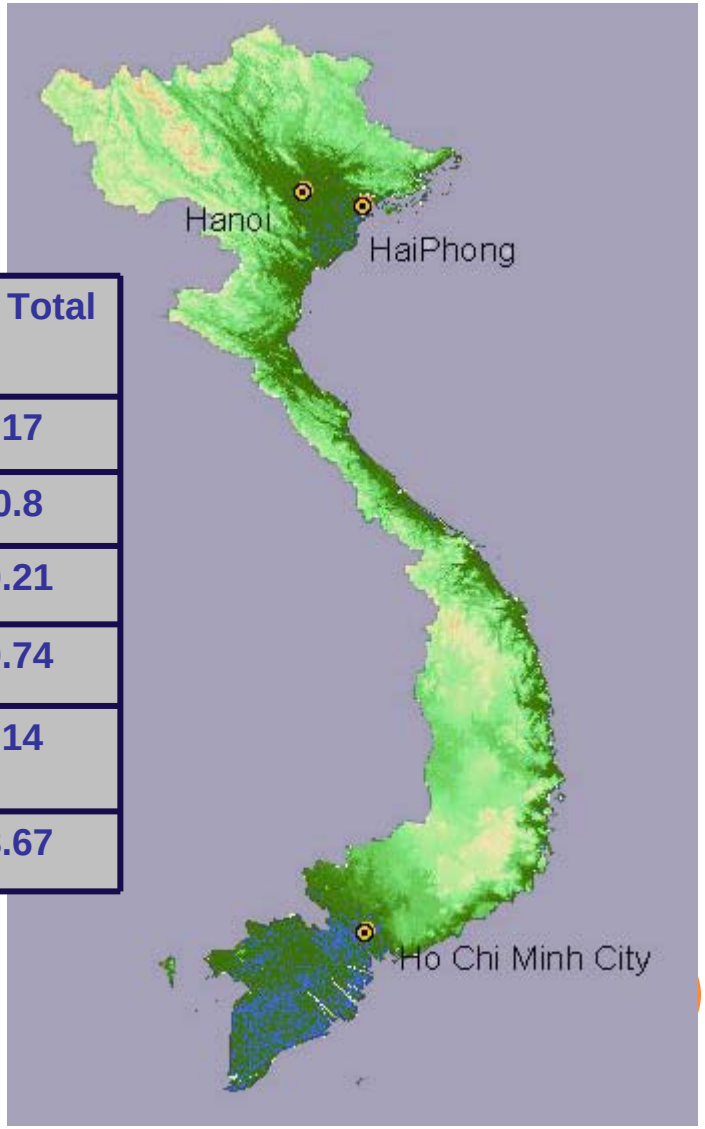
Vietnam

At Present



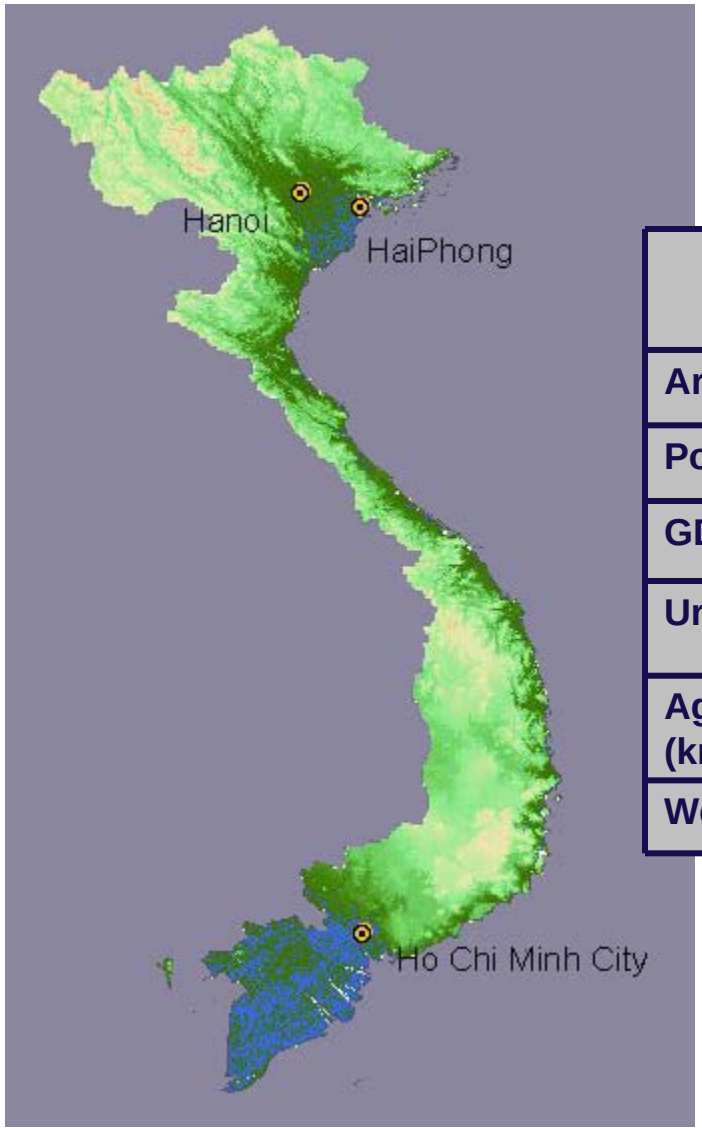
	Country Total	Impacted	% of Total
Area (km^2)	328,535	16,977	5.17
Population (10^3)	78,137	8,437	10.8
GDP (10^6 US$)	154,787	15,805	10.21
Urban Areas (km^2)	5,904	634	10.74
Agricultural Land (km^2)	192,816	13,773	7.14
Wetlands (km^2)	46,179	13,241	28.67

1m Sea Level Rise



Vietnam

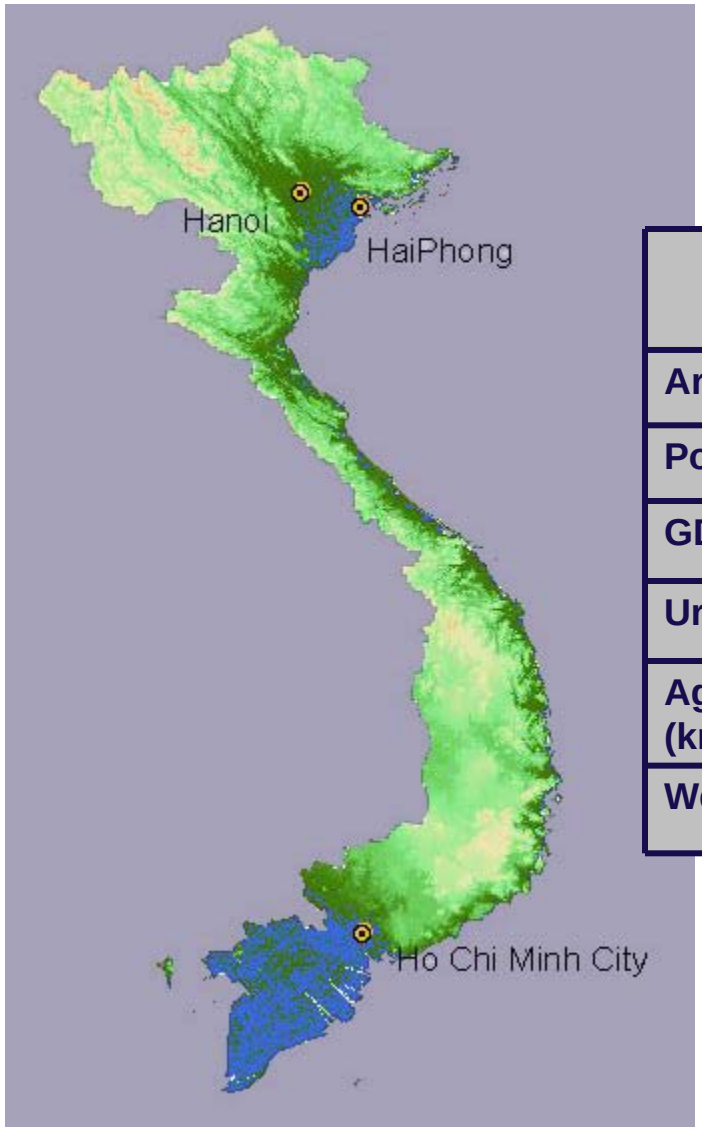
2 Meter Sea Level Rise



	Country Total	Exposed	% of Total
Area (km^2)	328,535	28,090	8.55
Population (10^3)	78,137	14,036	17.96
GDP (10^6 US$)	154,787	25,522	16.49
Urban Areas (km^2)	5,904	1,095	18.55
Agricultural Land (km^2)	192,816	23,641	12.26
Wetlands (km^2)	46,179	22,527	48.78

Vietnam

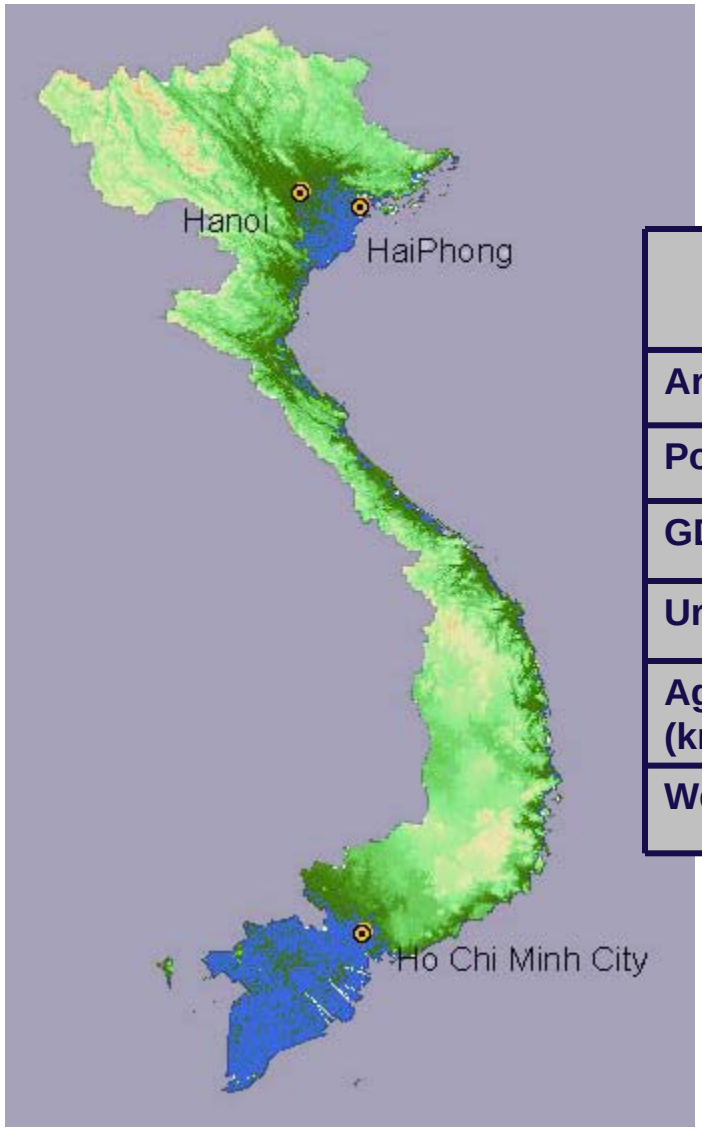
3 Meter Sea Level Rise



	Country Total	Exposed	% of Total
Area (km^2)	328,535	28,860	11.83
Population (10^3)	78,137	2,003	25.60
GDP (10^6 US$)	154,787	37,419	24.17
Urban Areas (km^2)	5,904	1,584	26.83
Agricultural Land (km^2)	192,816	33,064	17.15
Wetlands (km^2)	46,179	31,094	67.33

Vietnam

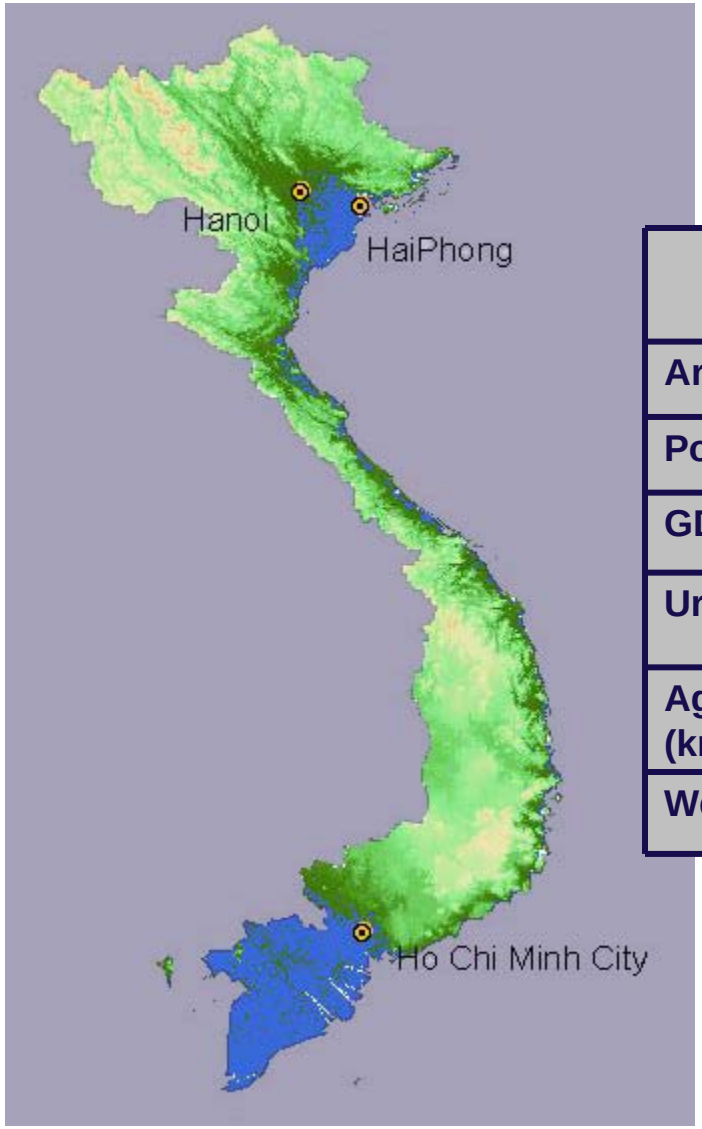
4 Meter Sea Level Rise



	Country Total	Exposed	% of Total
Area (km^2)	328,535	47,080	14.33
Population (10^3)	78,137	25,390	32.49
GDP (10^6 US$)	154,787	47,509	30.69
Urban Areas (km^2)	5,904	2,046	34.65
Agricultural Land (km^2)	192,816	40,207	20.85
Wetlands (km^2)	46,179	38,631	79.76

Vietnam

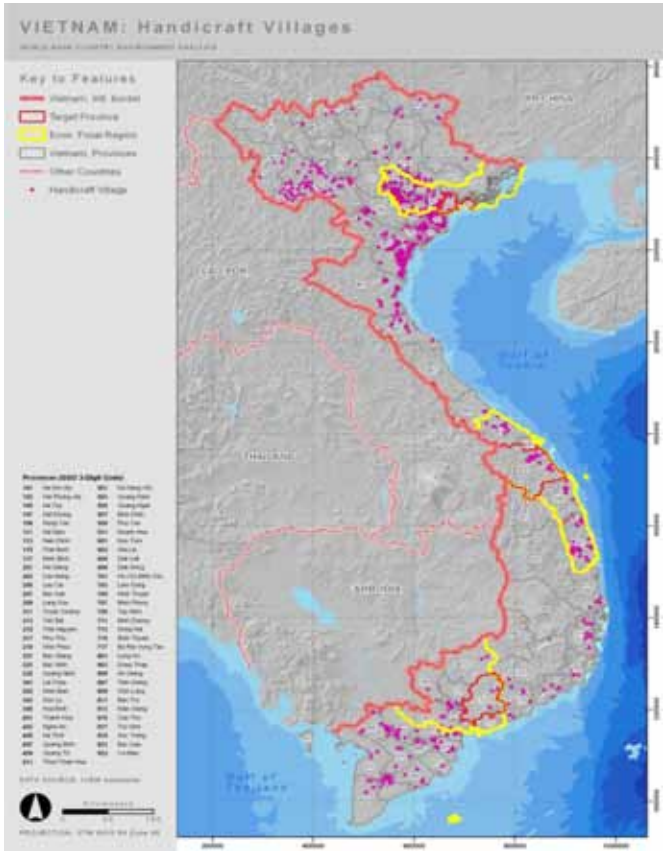
5 Meter Sea Level Rise

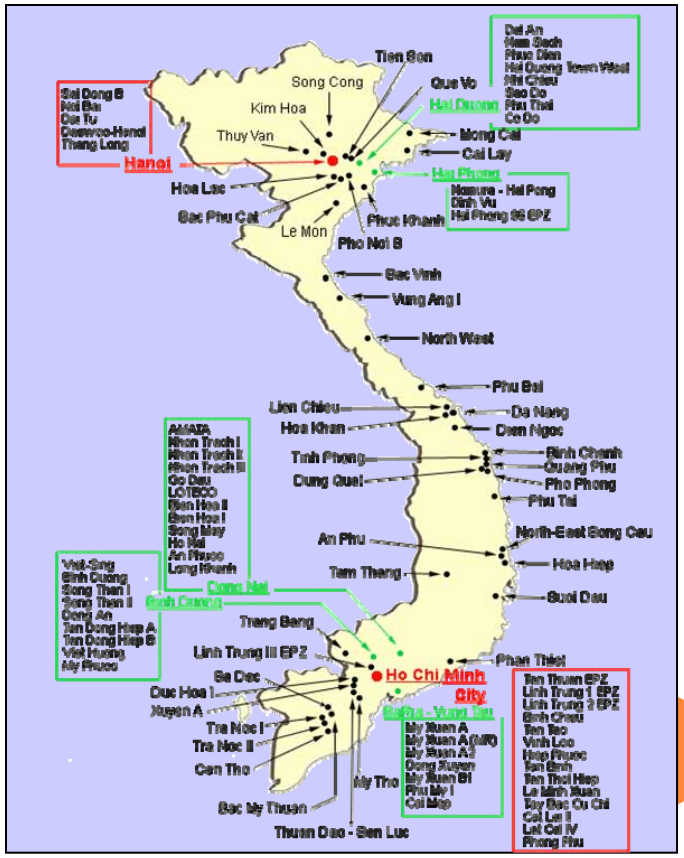


	Country Total	Exposed	% of Total
Area (km^2)	328,535	52,926	16.11
Population (10^3)	78,137	29,836	38.18
GDP (10^6 US$)	154,787	56,035	36.20
Urban Areas (km^2)	5,904	2,431	41.18
Agricultural Land (km^2)	192,816	45,181	23.43
Wetlands (km^2)	46,179	40,091	86.82

Impact : Industry

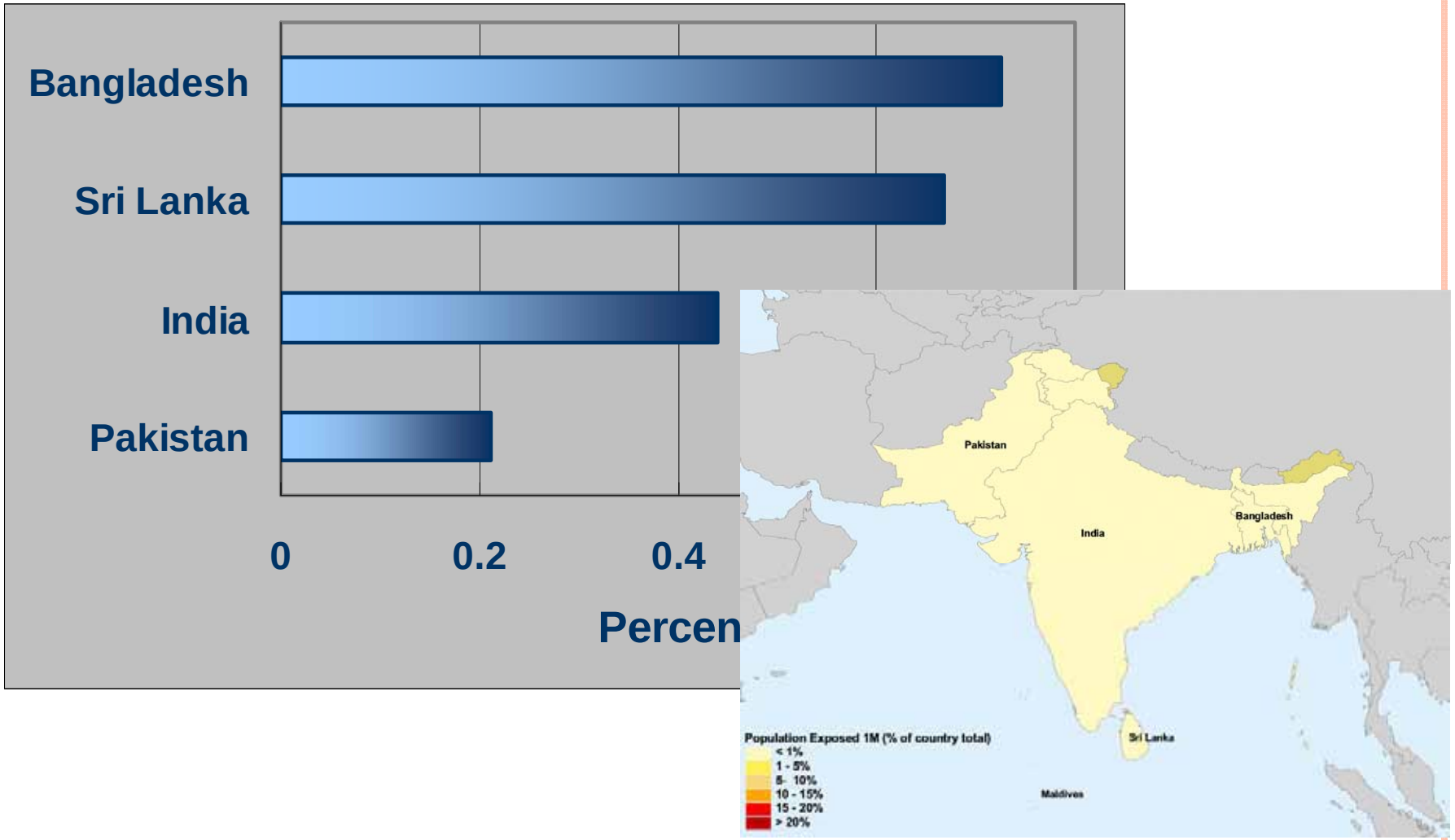
Almost all industrial parks in the South and a significant portion of handicraft villages in the North would go under water.





Percentage Impact

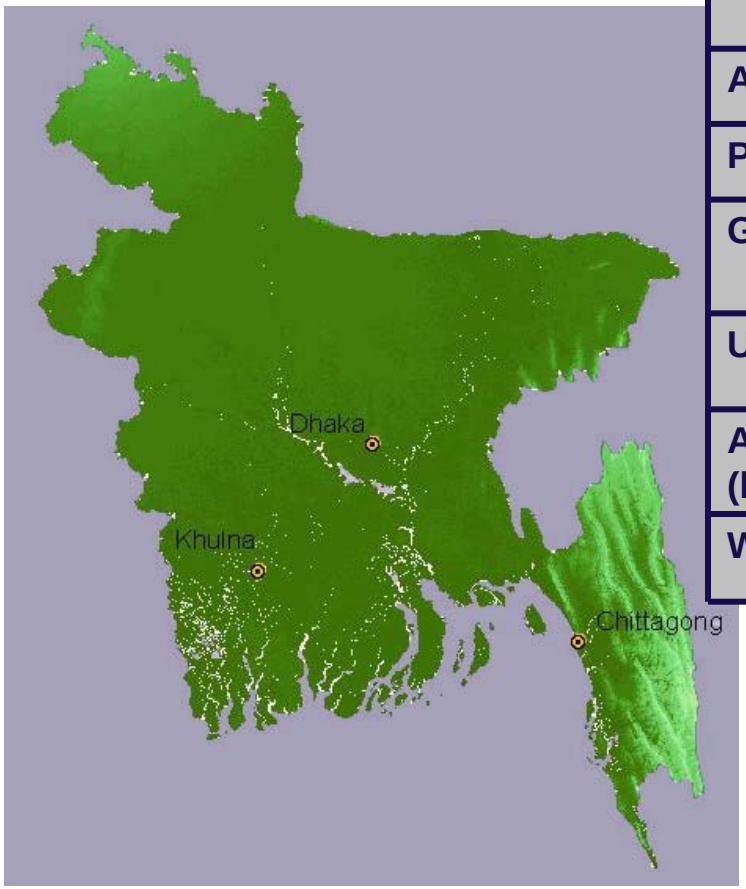
South Asia : Population



Bangladesh

1 m Sea Level Rise

At Present



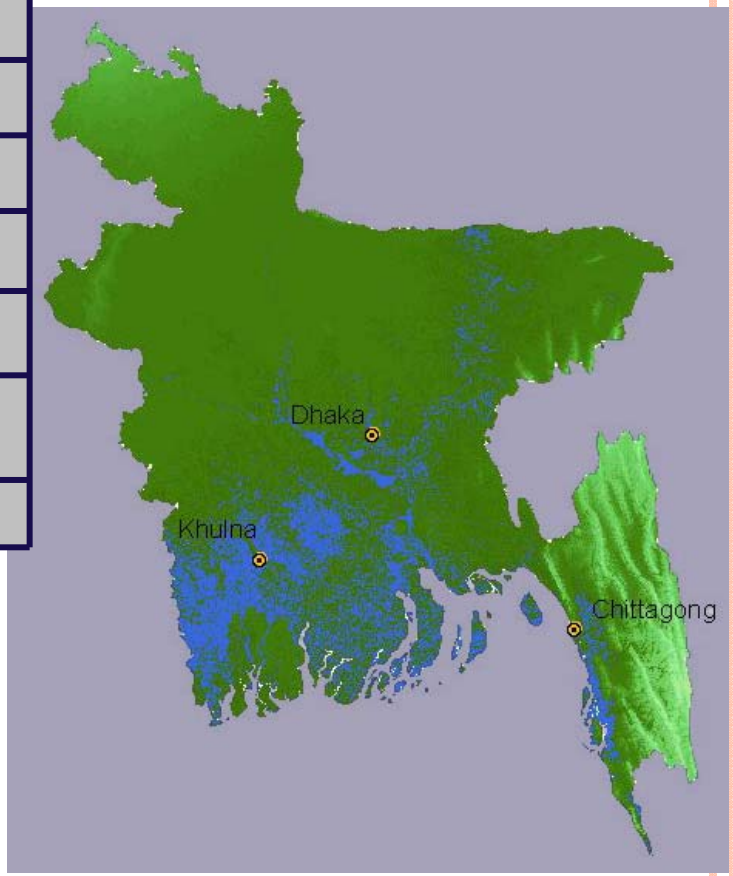
	Country Total	Exposed	% of Total
Area (km^2)	136,305	1,532	1.12
Population (10^3)	137,439	998	0.73
GDP (10^6 US$)	202,087	1,266	0.63
Urban Areas $(km)^2$	10,153	73	0.72
Agricultural Land (km^2)	104,389	679	0.65
Wetlands (km^2)	105,971	999	0.94

Bangladesh

Percent Impact

	1 meter	3 meter	5 meter
Area (km^2)	1.12	3.98	10.88
Population (10^3)	0.73	3.14	9.14
GDP (10^6 US$)	0.63	3.33	8.86
Urban Areas (km^2)	0.72	3.53	9.74
Agricultural Land (km^2)	0.65	3.33	10.03
Wetlands (km^2)	0.94	3.74	11.77

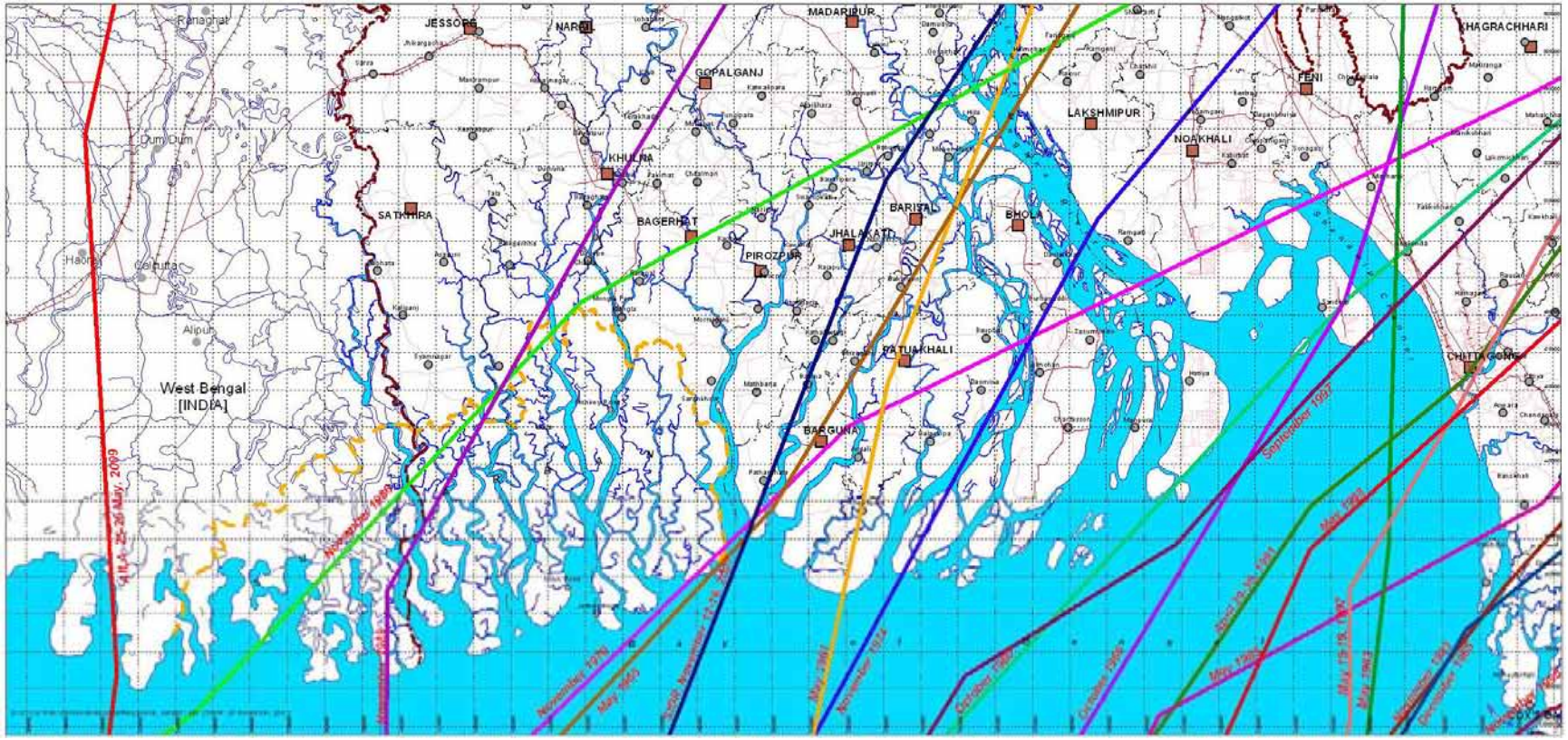
5m Sea Level Rise



BANGLADESH: TROPICAL CYCLONE HOTSPOT

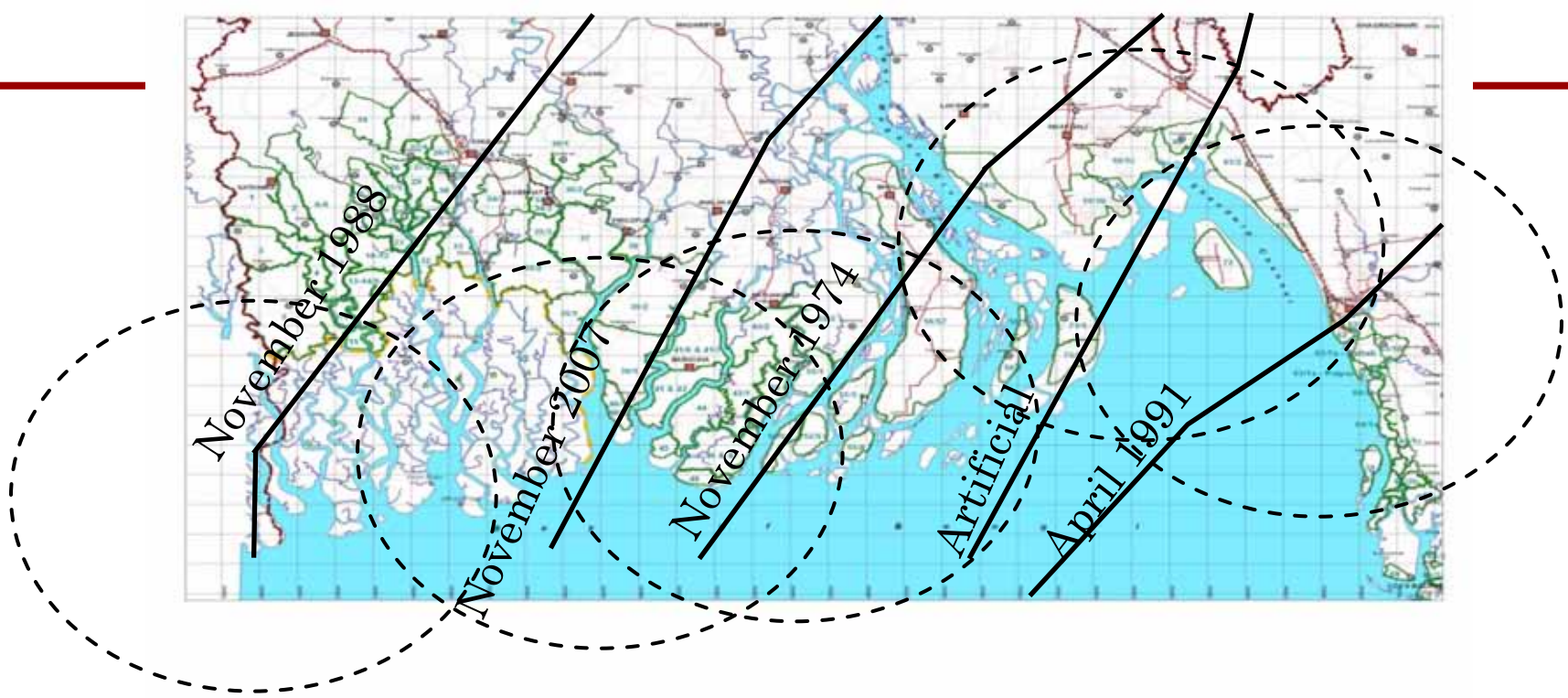
- Cyclones hit the coastal regions of Bangladesh every year, in early summer (April/ May) or late rainy season (October/ November).
- Bangladesh was hit by 154 cyclones during 1877 – 1995, and 5 severe cyclones since 1995.
- History of cyclones in Bangladesh indicates that each year, probability of a Super cyclonic storm (wind speed greater than 220 km/hour), a Very Severe cyclonic storm (wind speed of 119-220 km /hour), and a Severe cyclonic storms (wind speed of 90-119 km/hour) are at least 10%, 20% and 30% respectively.
- Historical range of storm surge height: 1.5 m – 9 m.

MAJOR CYCLONES IN BANGLADESH (1960-2009)



- Risk spans the entire coastline.
- Damage from the most recent major cyclone SIDR in 2007 is more than $1.7 billion.

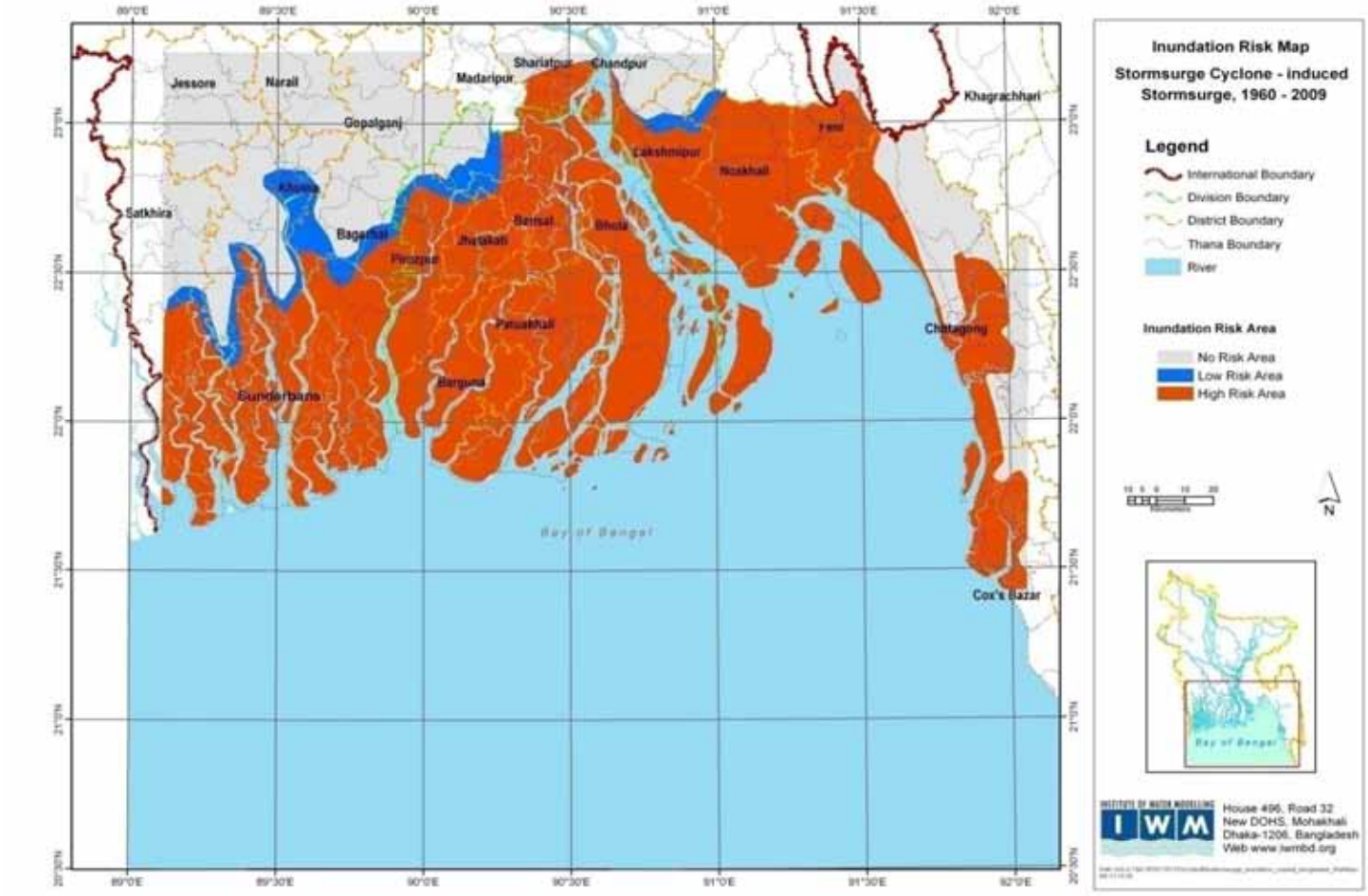
DEMARCATION OF VULNERABLE ZONE



Baseline Scenario: 19 historical cyclone tracks with actual observed meteorological parameters (*Maximum wind speed; radius of influence, cyclone tracks, forward speed and direction and central and neutral pressure*).

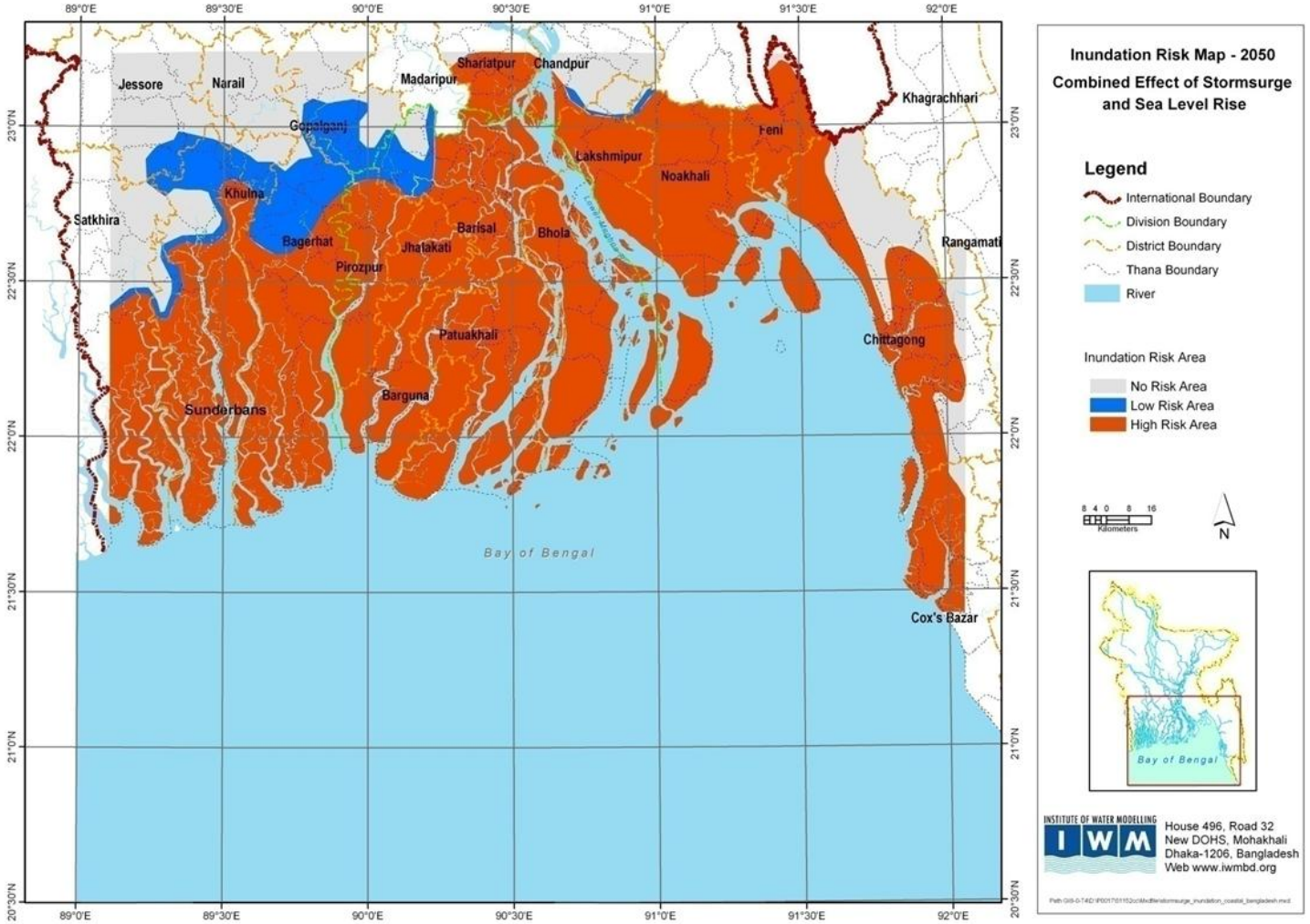
Climate Change Scenario: Five cyclone tracks to span the coast line, meteorological parameters as Sidr for the artificial track, 10% increase in wind speed, 27 cm sea level rise, Land fall at high tide.

STORM SURGE INUNDATION AREA UNDER BASELINE (2050 WITHOUT CLIMATE CHANGE)

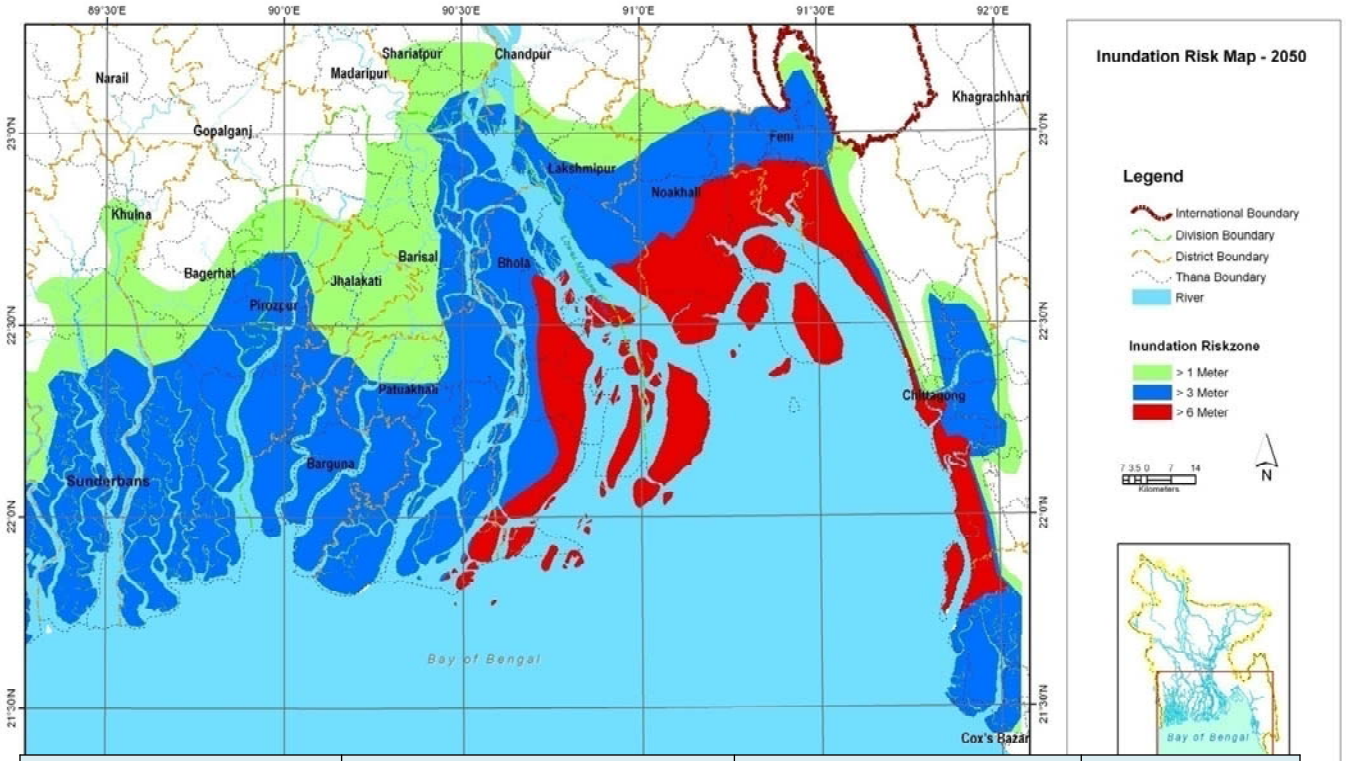


- Bay of Bengal model based on MIKE 21 Hydrodynamic modeling system has been used.

AREA (2050 IN A CHANGING CLIMATE)

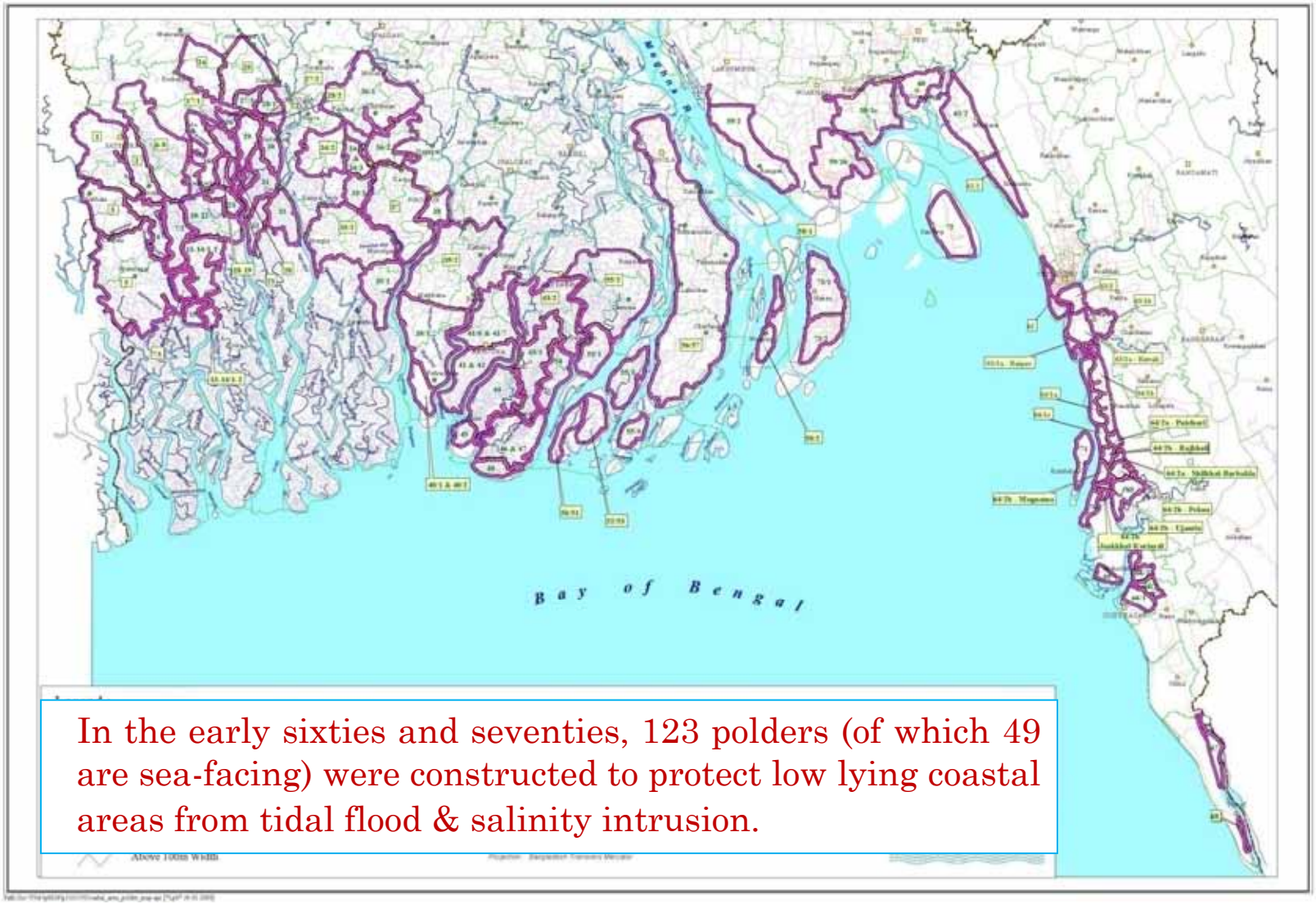


HIGH RISK AREA IN A CHANGING CLIMATE 2050



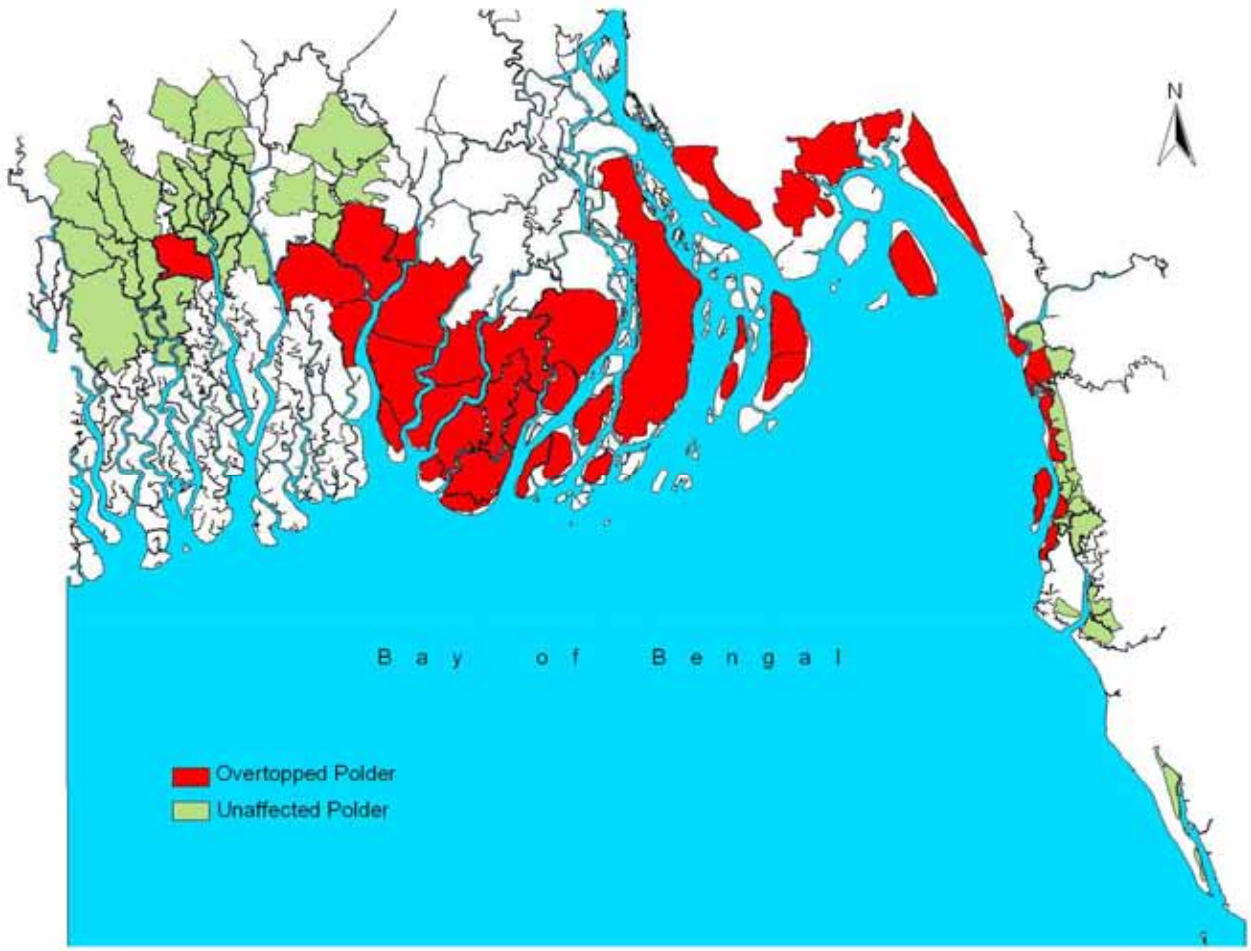
Inundation Depth (m)	2050 without Climate Change	2050 in a Changing Climate	Change
1 m – 3 m	20,876 m^2	23,764 m^2	**+14 %**
More than 3 m	10,163 m^2	17,193 m^2	**+69 %**

COASTAL POLDERS IN BANGLADESH

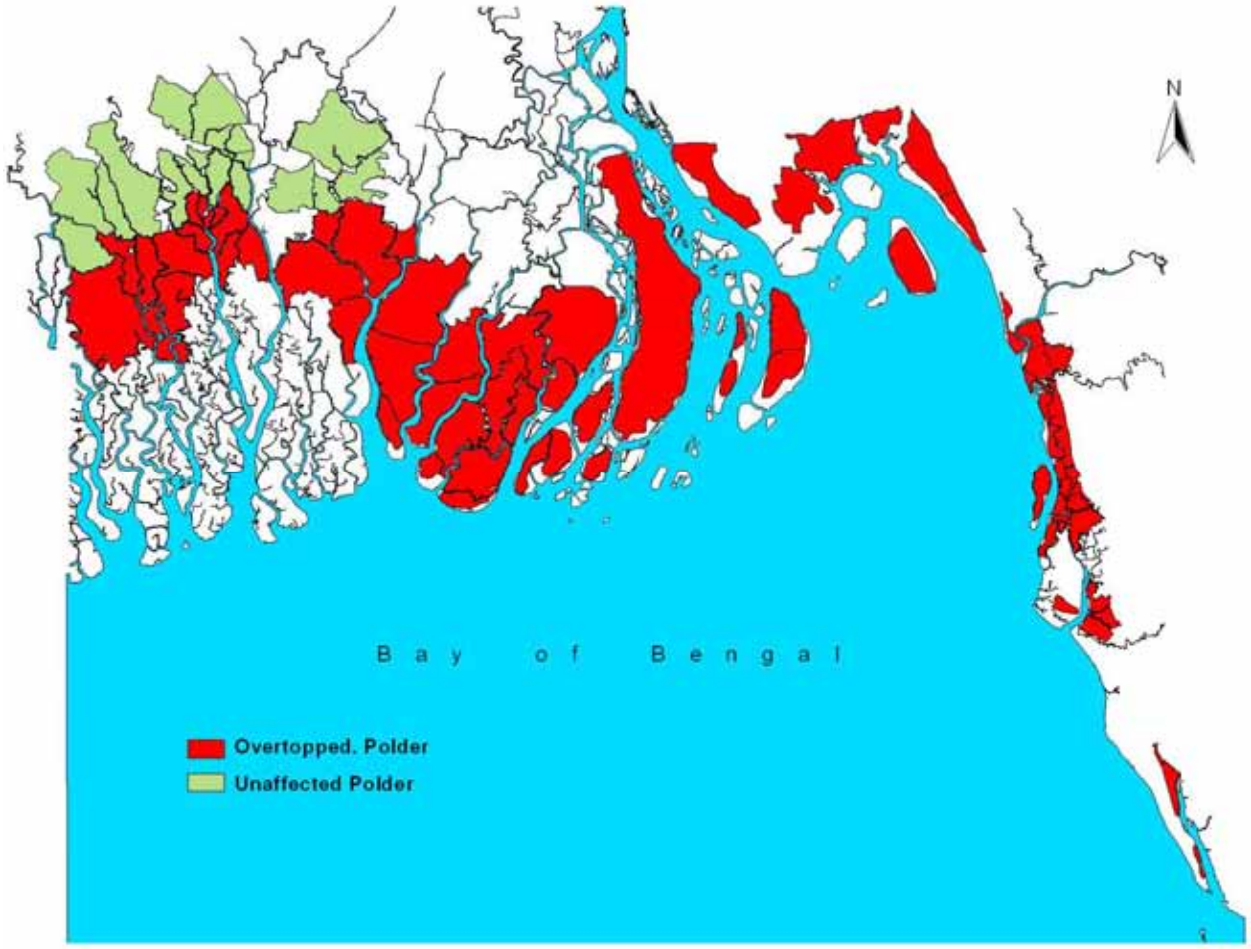


In the early sixties and seventies, 123 polders (of which 49 are sea-facing) were constructed to protect low lying coastal areas from tidal flood & salinity intrusion.

COASTAL POLDERS AT RISK OF OVERTOPPING (2050 WITHOUT CLIMATE CHANGE)



COASTAL POLDERS AT RISK OF OVERTOPPING (2050 IN A CHANGING CLIMATE)



- 33 sea-facing polders and 26 interior polders are likely to be overtopped.

VULNERABLE POPULATION ESTIMATES (MILLION)

Inundation Depth	(a) At Present	(b) 2050 without Climate Change	Percent Change between (a) and (b)	(c) 2050 in a Changing Climate	Percent Change between (b) and (c)
1m – 3m	16.83	28.27	+ 68%	35.33	+25%
More than 3m	8.06	13.54	+68%	22.64	+67%

DEATH & INJURY FROM STORM SURGES - 2050

	2050 without Climate Change	Addition due to Climate Change	2050 in a Changing Climate
Deaths	5,274	4,637	9,911
Injury	85,609	75,268	160,877

- Additional damage from increased number of lives at-risk: $ 1.03 billion.
- Conservative cost of treatment of injuries : $ 0.352 million.

Projection based on

1. Risk of Fatality and Risk of Injury same as Sidr (2007);
2. World Bank estimate of VSL in Bangladesh (Taka 2008): 15.5 million;
3. WHO estimate of cost per outpatient visit at a secondary hospital in Bangladesh: $4.86

ADDITIONAL POTENTIAL DAMAGE & LOSS IN CHANGING CLIMATE OUT TO 2050 (10-YEAR RETURN PERIOD CYCLONE)

	Estimated Damage (Million $)	Estimated Loss (Million $)
Housing	1,947.3	-
Education Infrastructure	9.0	0.8
Agriculture	75.4	835.4
Non-Agriculture Productive Sectors	87.9	1,084
Roads	239.5	52.7
Power	60.2	150.0
Coastal Protection	17.3	
Others	-	-
Total	2,436.6 million	2,122.9

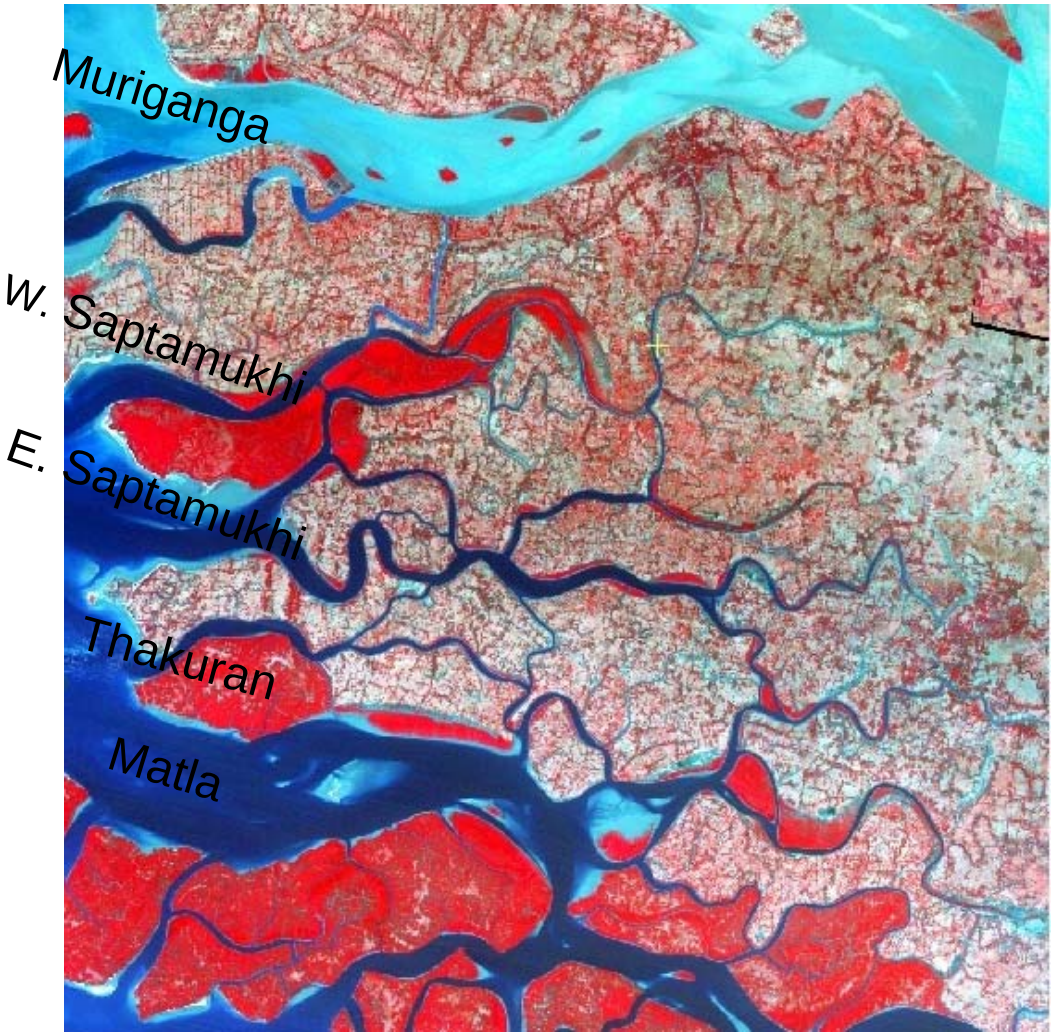
ADAPTATION COST (INVESTMENT COST & RECURRENT COST)

	Without Climate Change	Additional Cost with Climate Change	
	Investment Cost	Adaptation Option	Annual Recurrent Cost
Polders	2.462 billion	893 million	18 million
Foreshore afforestation		75 million	
Cyclone Shelters		1.2 billion	24 million
Cyclone Resistant Housing		200 million	
Strengthening of Early Warning & Evacuation System		39 million	8 + million
Total	2.462 billion	2.407 billion	50 million +

ANALYTICAL WORK ON THE INDIAN SUNDARBAN

SUNDARBAN ESTUARIES

Think estuaries not islands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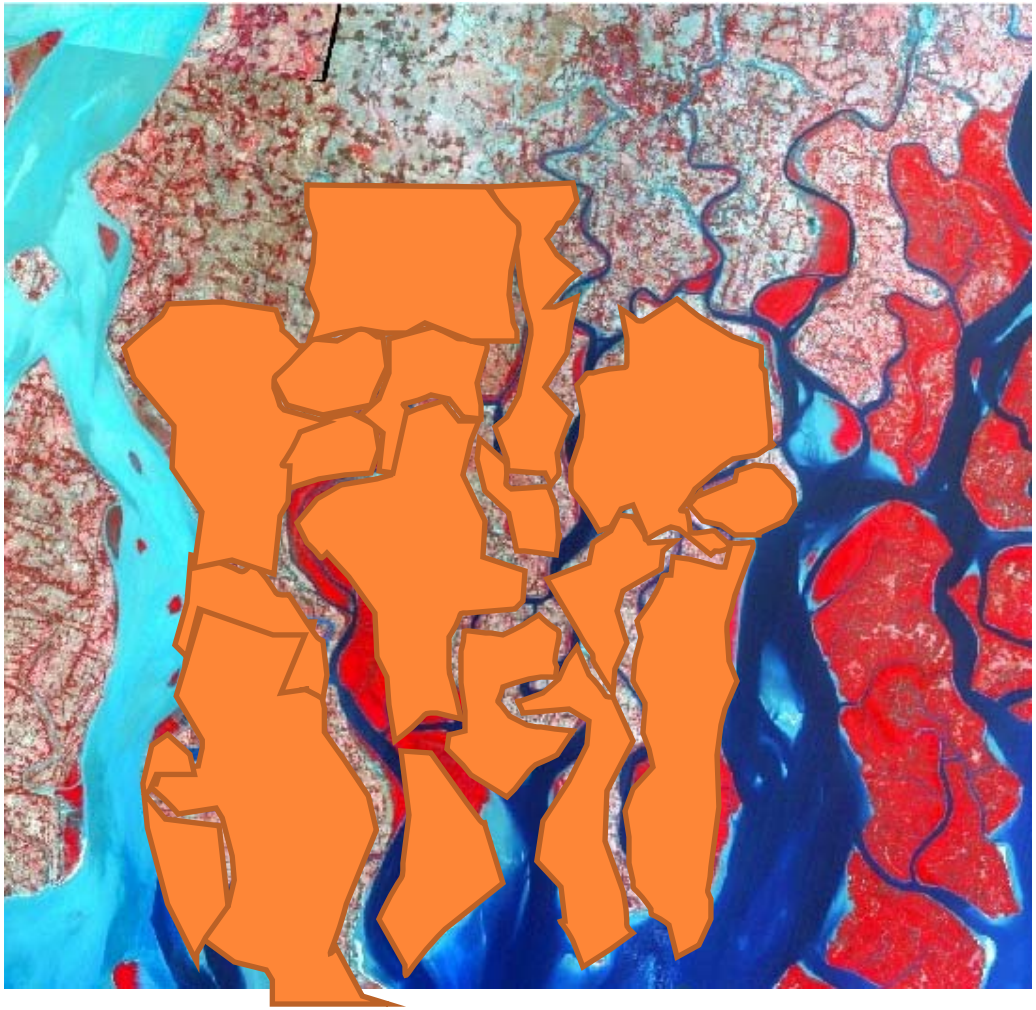
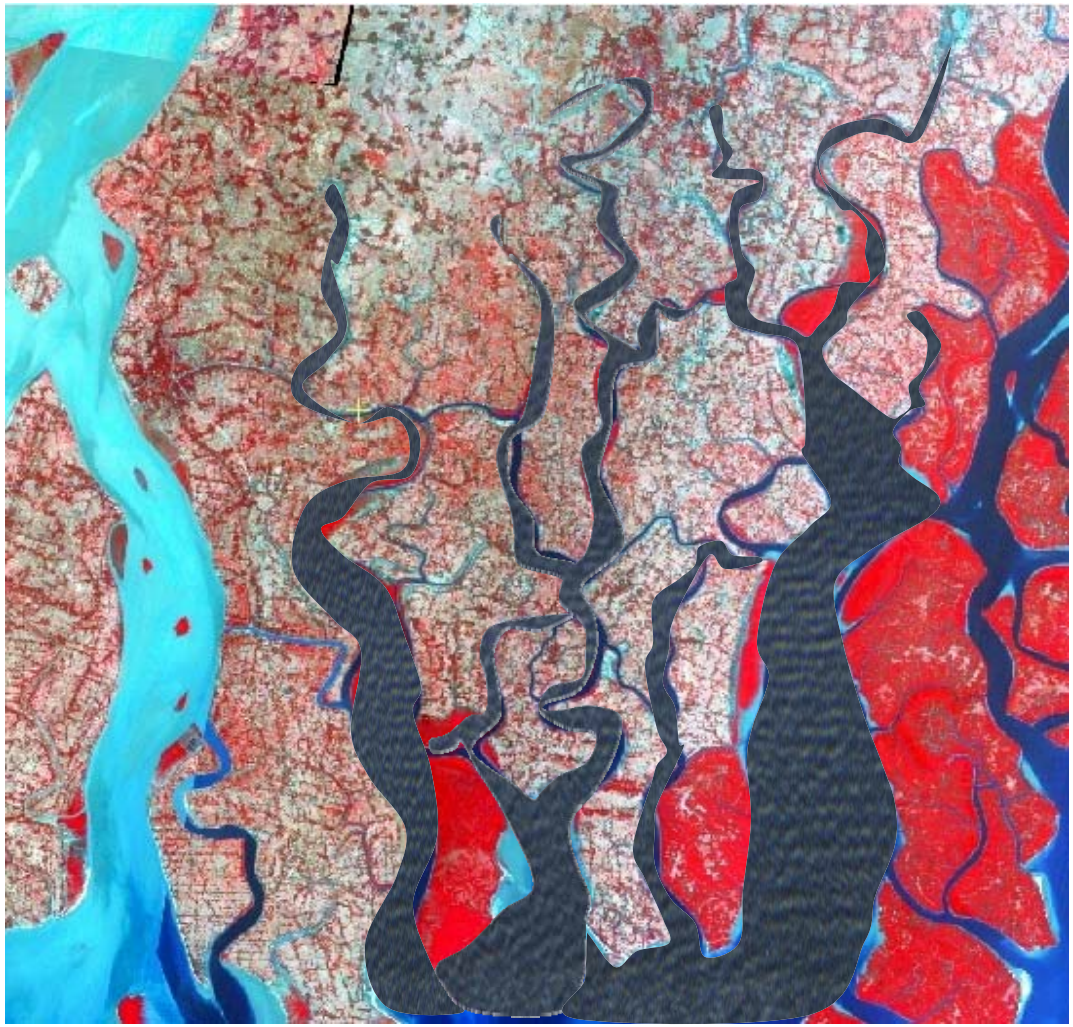
W. Saptamukhi
E. Saptamukhi
Thakuran
Matla

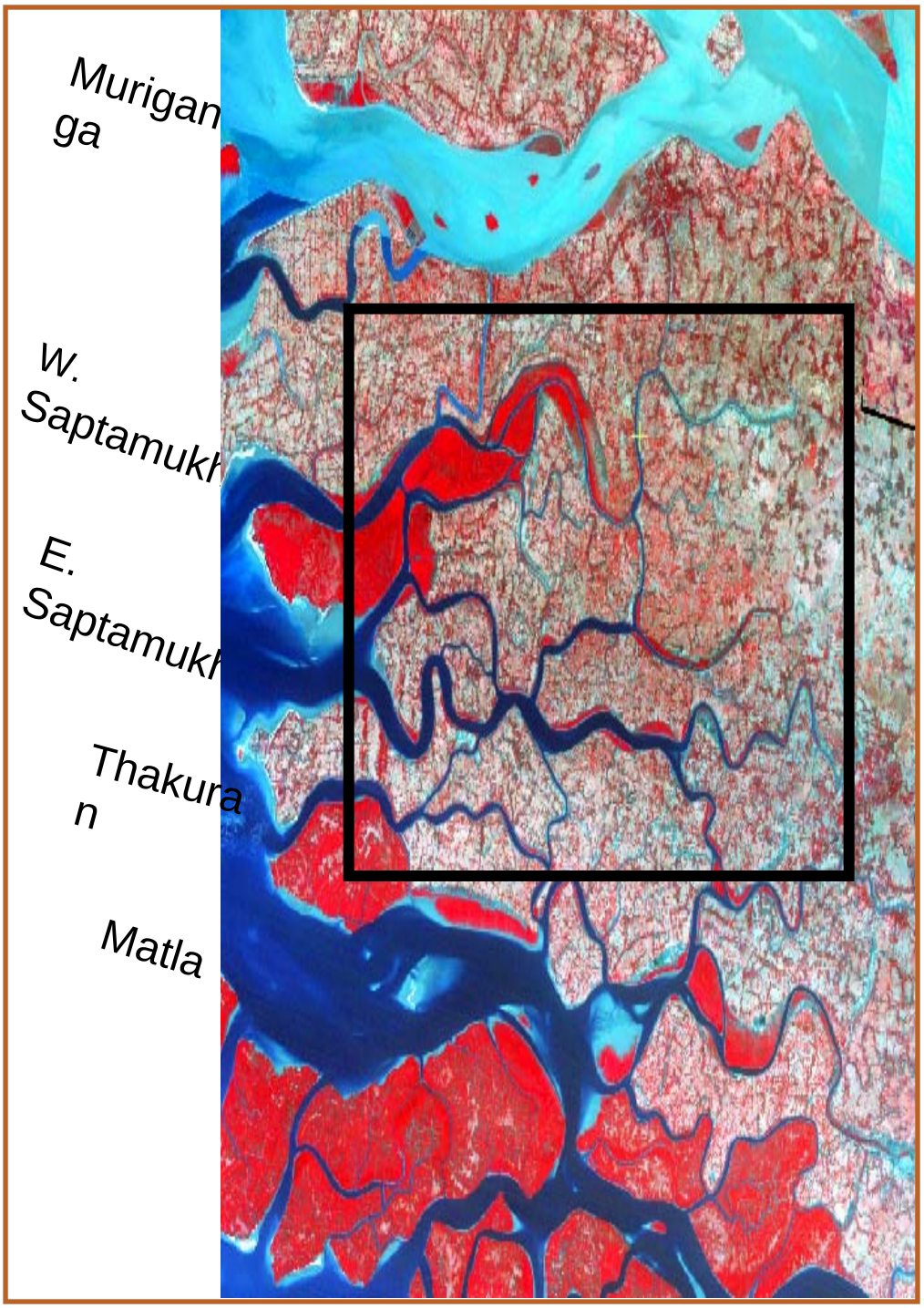


The jigsaw puzzle of islands are formed – and modified - by estuary processes. All islands are thus interconnected



The estuary channels provide the processes shaping the Sundarban and mean that large scale interactions are dominant

Management must focus on the channels in order to protect the islands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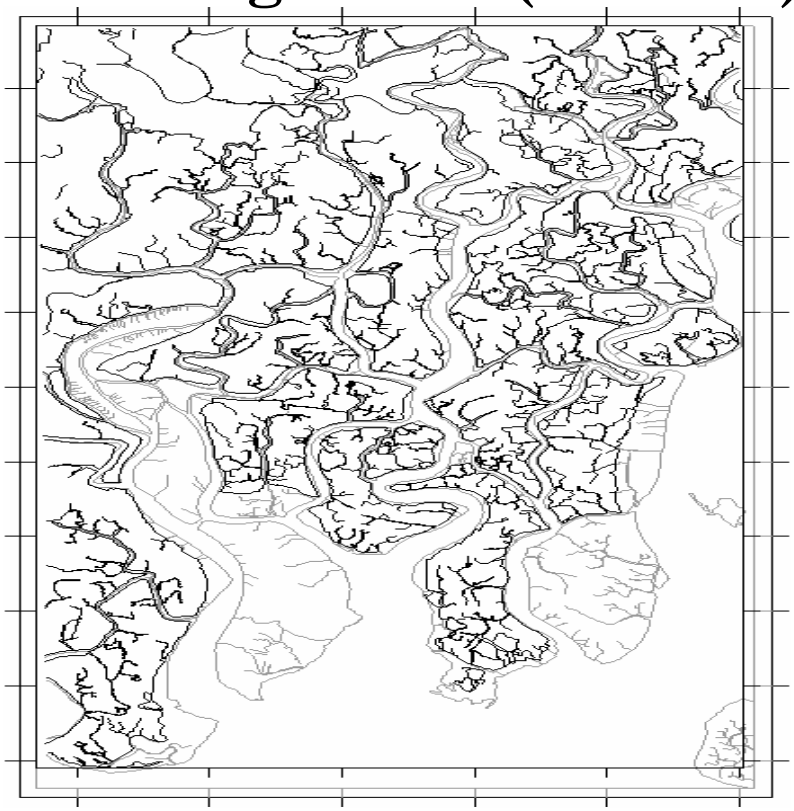
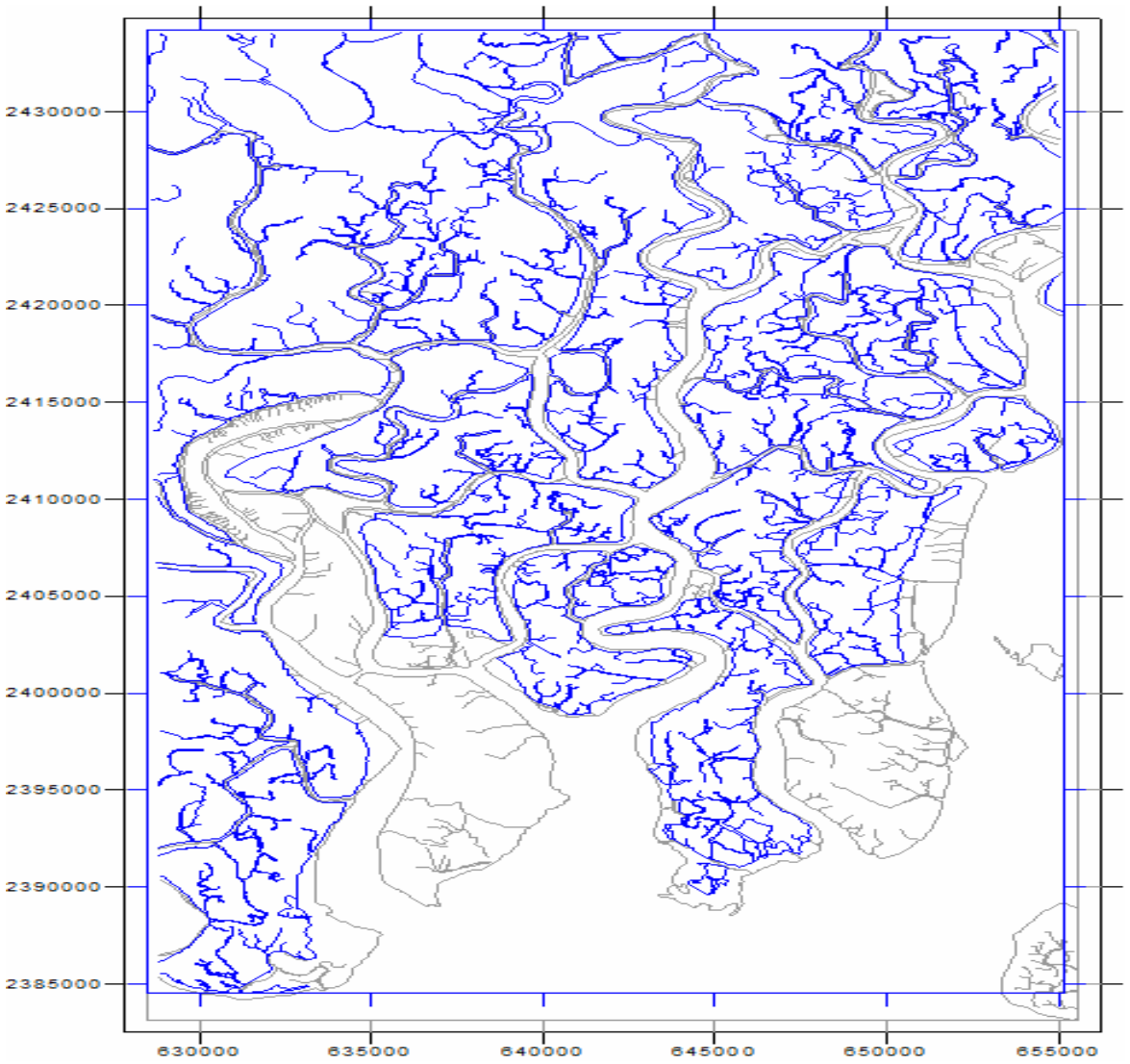
Digitised map from Institute of Environmental Studies & Wetland Management (IESWM)



Satellite image: Linear Imaging Self Scanning Sensor (LISS-III)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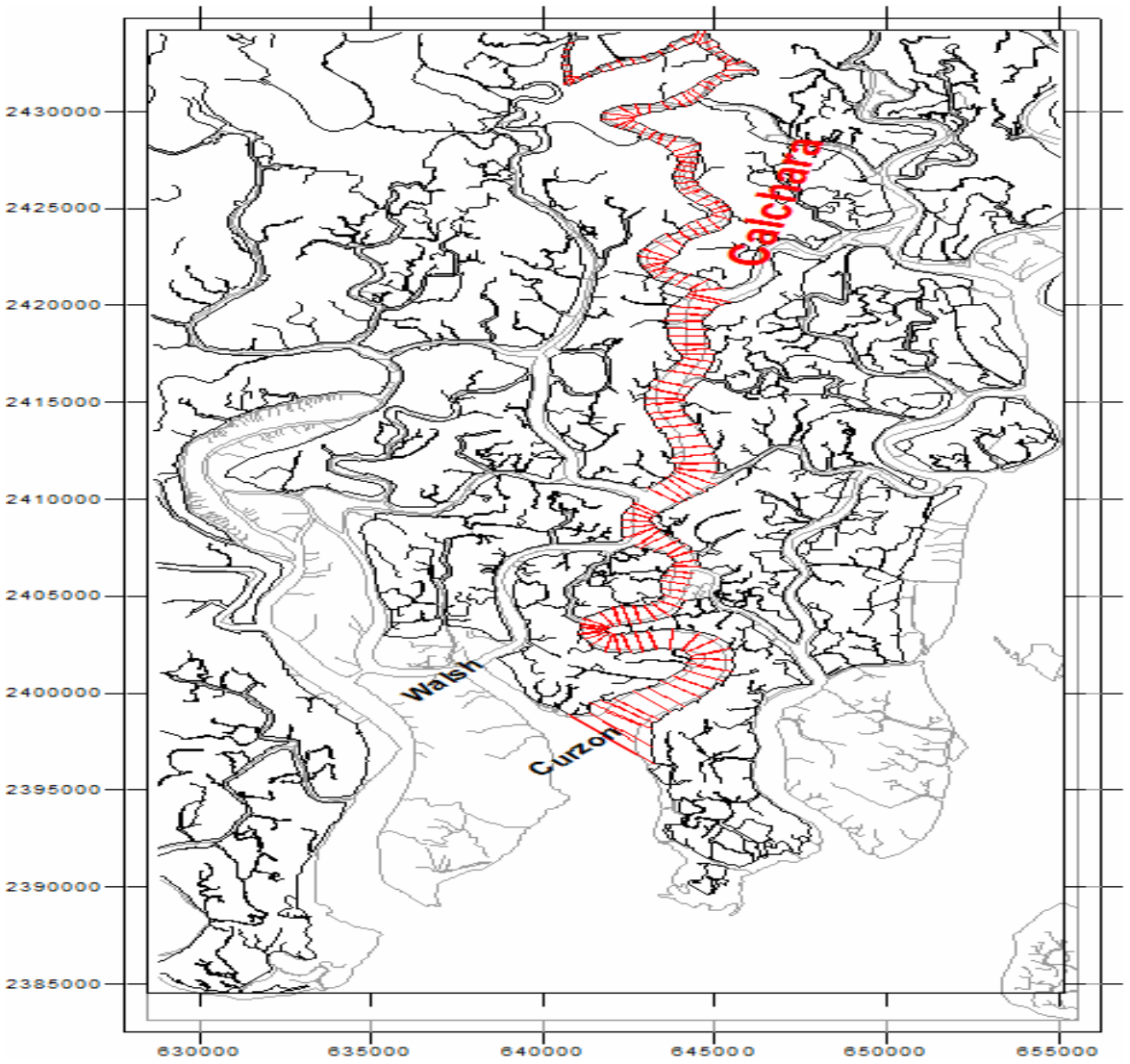
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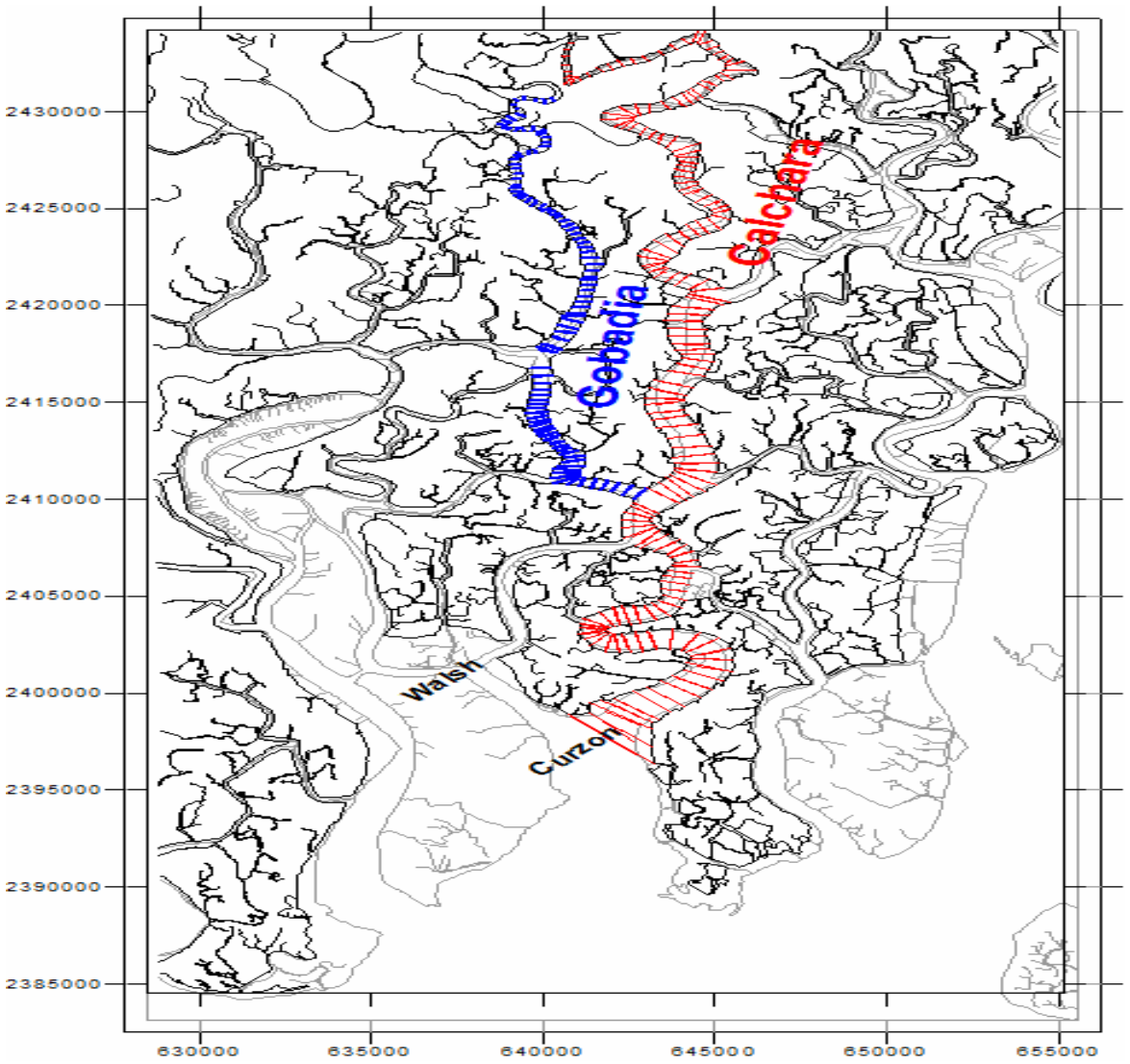
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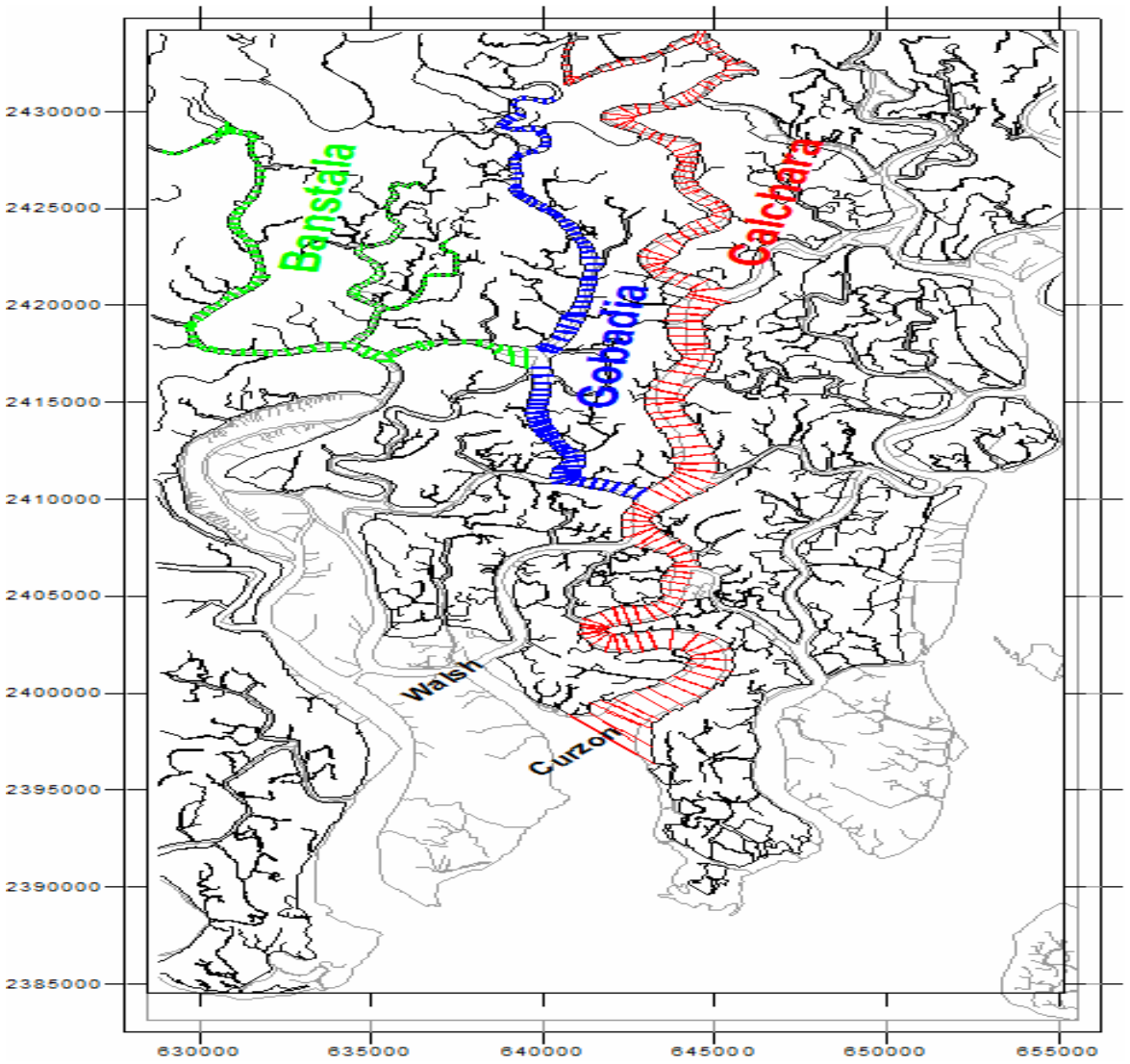
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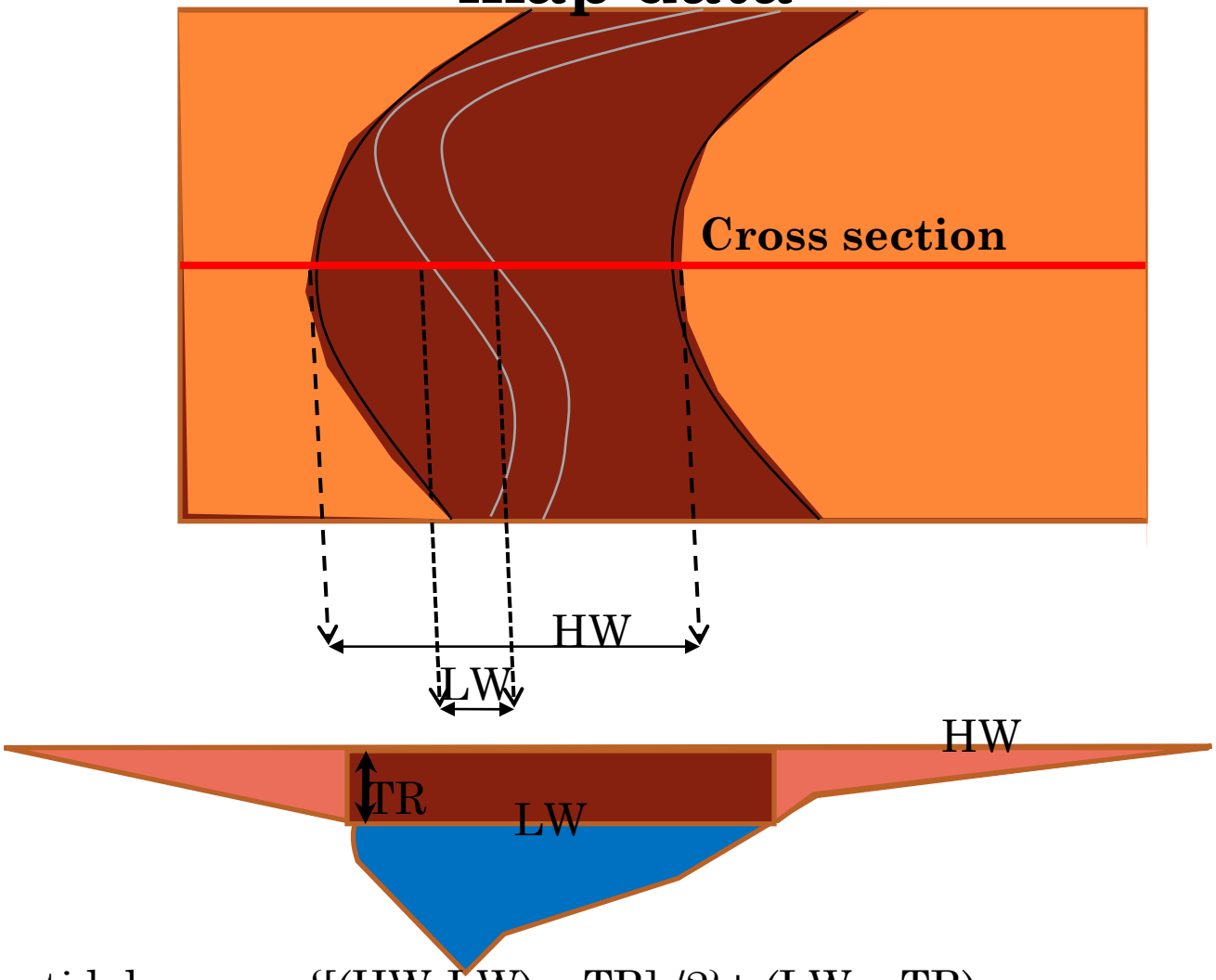
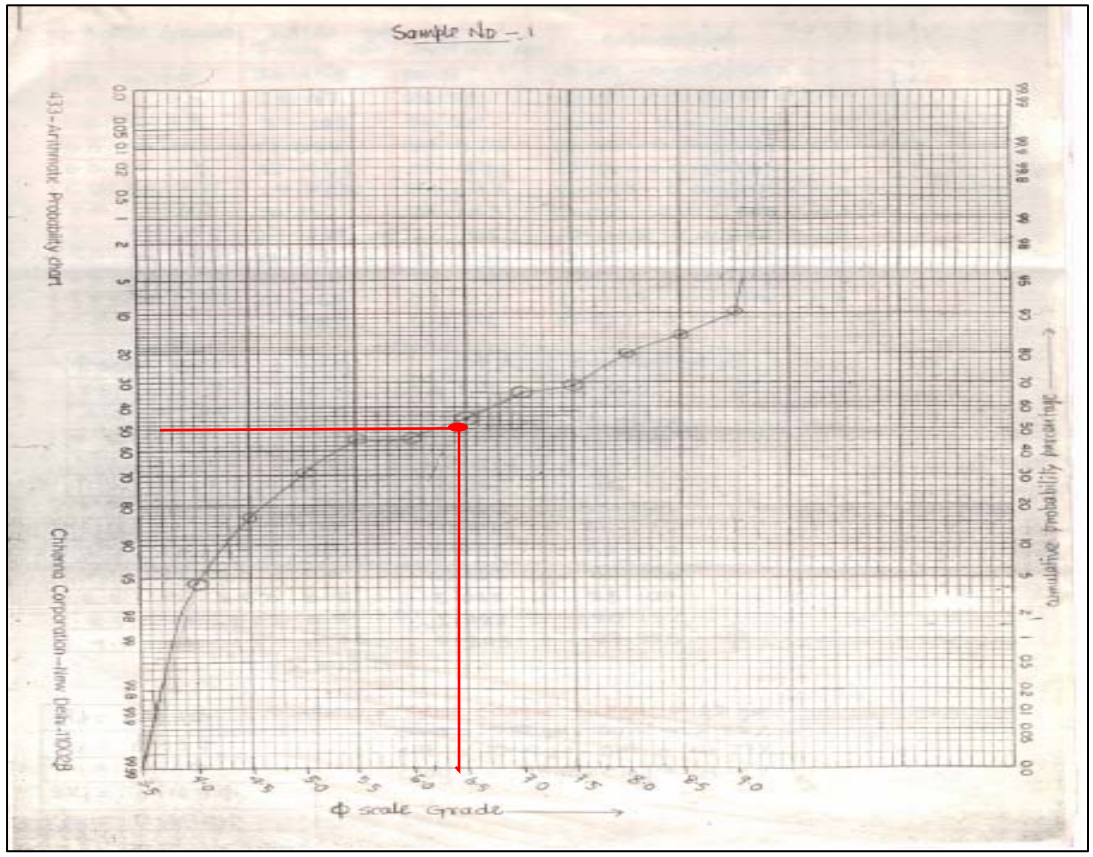
Tidal prism derivation from map data



Intertidal area = {[(HW-LW) x TR] /2}+ (LW x TR)

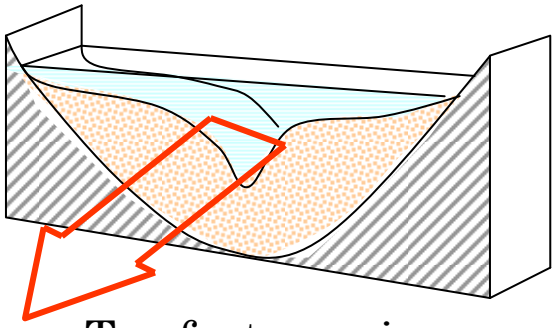
Sediment analysis



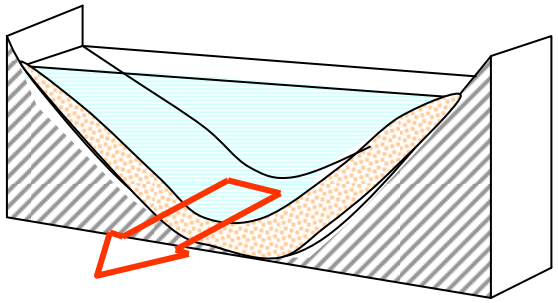
D_{50} = 6.2phi (0.014 mm : Medium Silt)

REGIME MODELLING

- Want to know future width and depth
- Computer model assesses tidal power available and predicts channel size
- Based on the principle that flow through smaller channel is faster giving erosion and vice versa
- An estuary tends to an equilibrium with no erosion or deposition
- Once it achieves this it is said to be in 'Regime'



Too fast: erosion



Too slow: deposition

REGIME

Extensive literature on general relationship between channel sectional area and tidal discharge

Applying and verifying the global relationship developed by Gao & Collins 1994 to the Sundarban estuaries requires bathymetric data

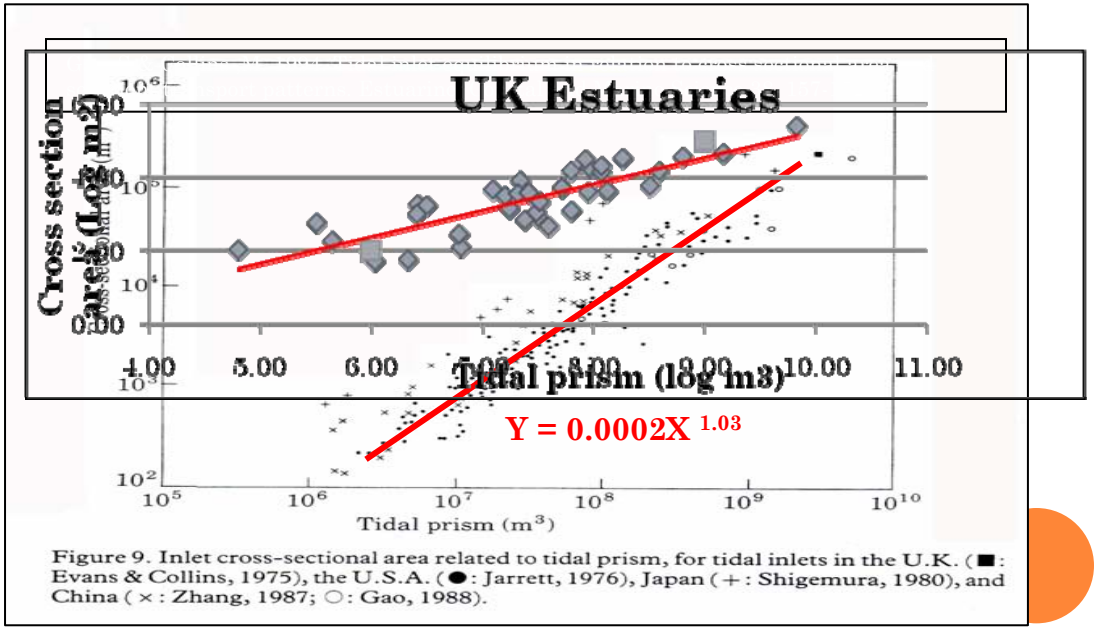


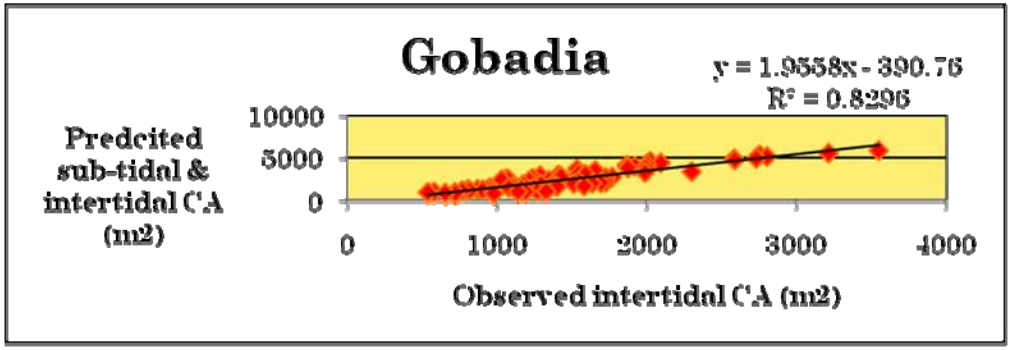
Figure 9. Inlet cross-sectional area related to tidal prism, for tidal inlets in the U.K. (■: Evans & Collins, 1975), the U.S.A. (●: Jarrett, 1976), Japan (+: Shigemura, 1980), and China (×: Zhang, 1987; ○: Gao, 1988).

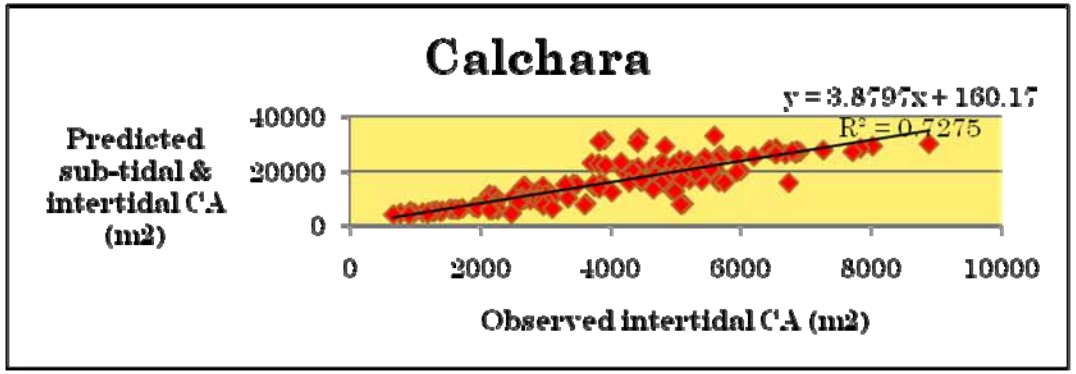
Verification

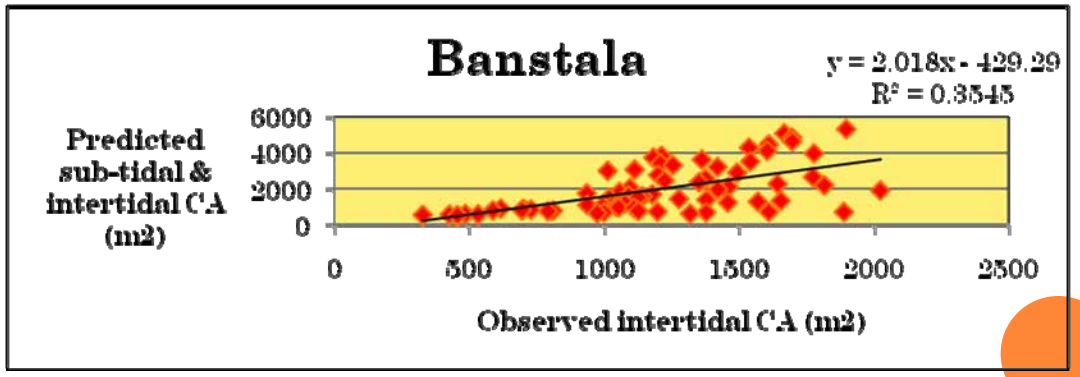
Comparison of calculated cross sectional area (sub-tidal plus intertidal) with data for intertidal area only

All channels show very high statistical significance despite difference in parameters

Although Banstala shows considerable scatter - due to reclamation





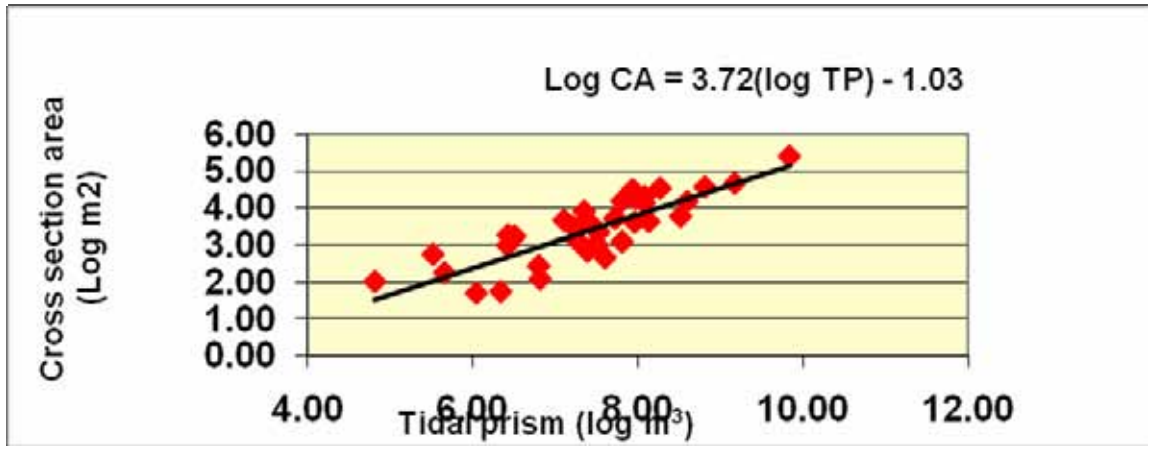


General relationship between tidal prism (TP) and channel sectional area (CA)

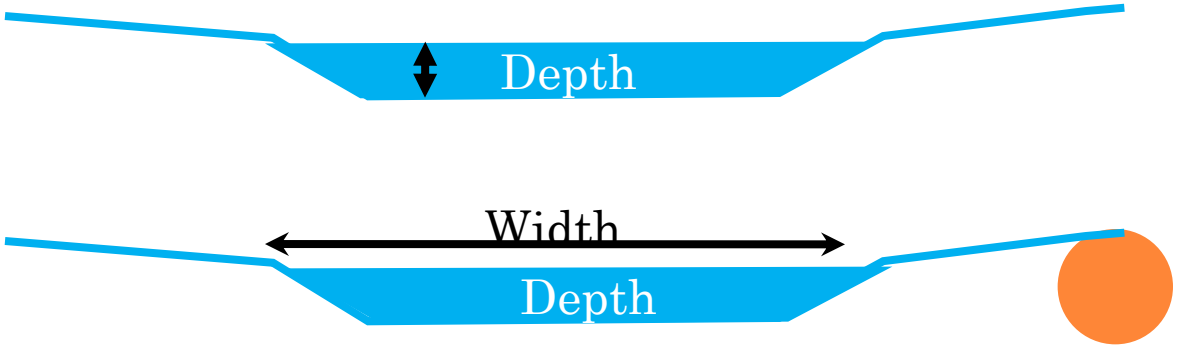
Calculation of CA from TP

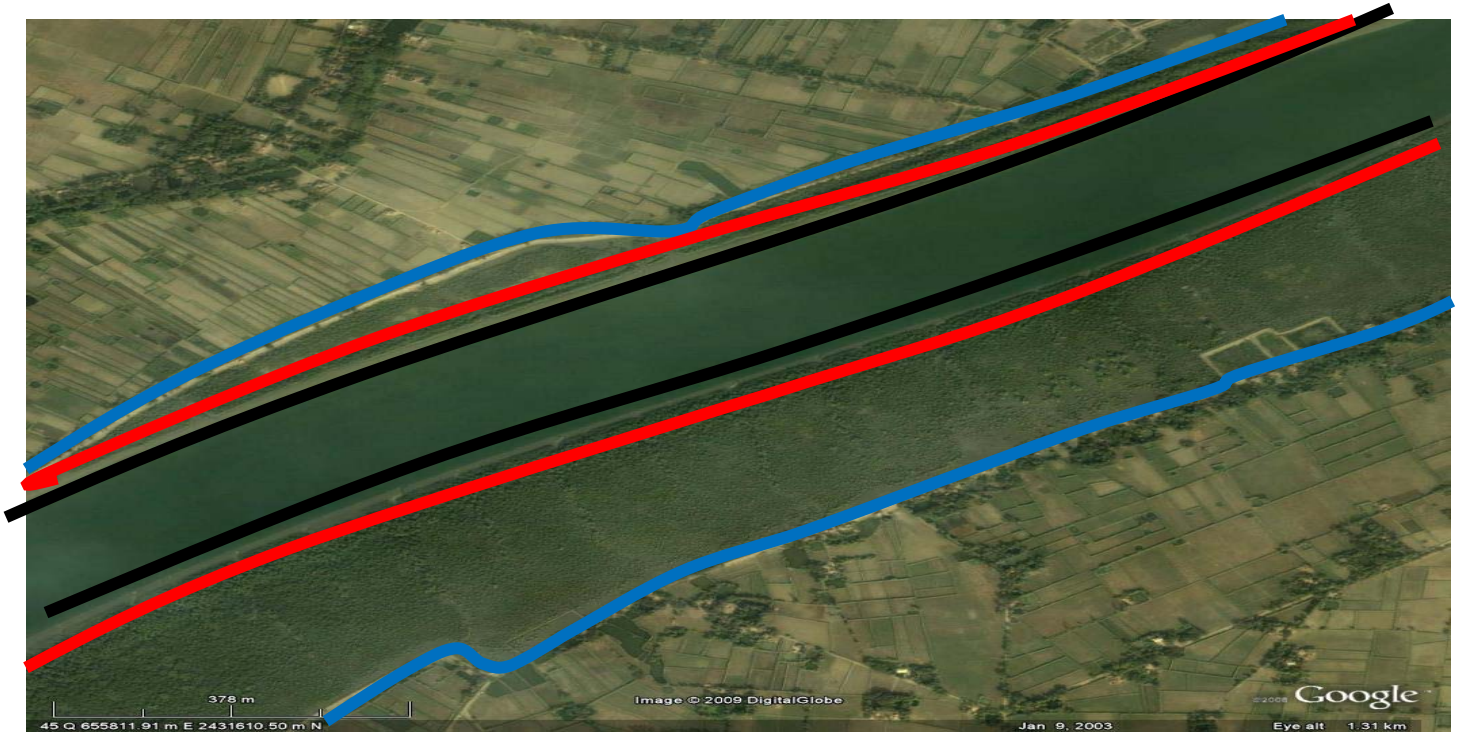
Calculate mean depth from Q and D50

Calculate width from CA/D

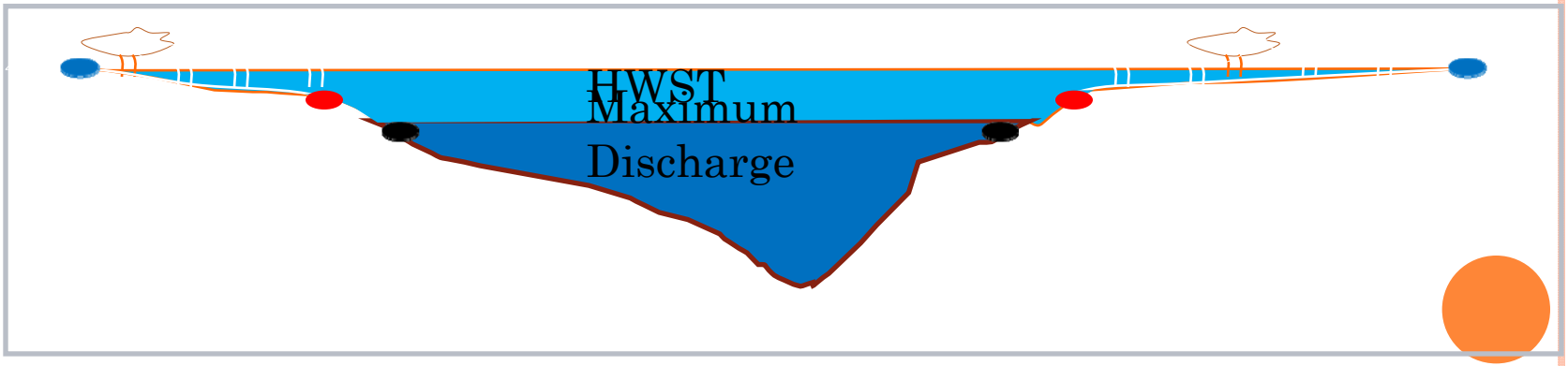


Tidal prism (m3)	Log (TP)	Log(CA	Cross section area (m2)
178,226,812	8.2510	4.7985	62879
175,225,640	8.2436	4.7909	61788
173,249,646	8.2387	4.7858	61071
170,955,850	8.2329	4.7799	60238



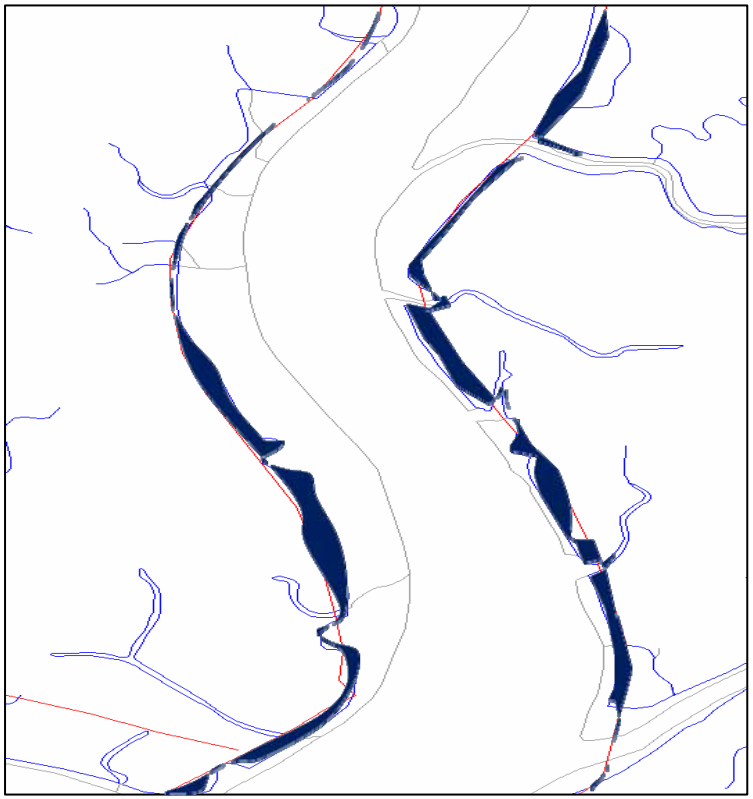


Interpretation: maximum discharge occurs immediately before inundation of marsh/mangrove surface



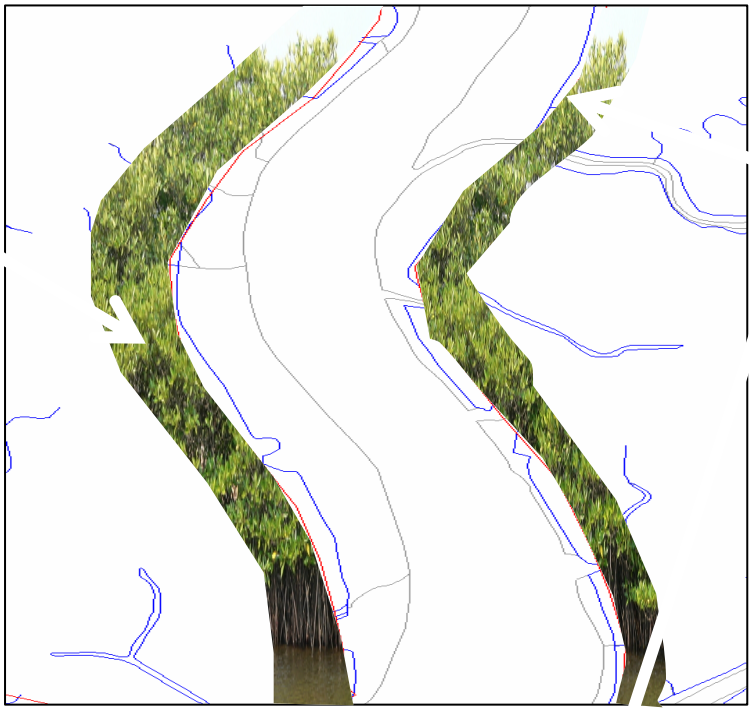
Accretion

Erosion

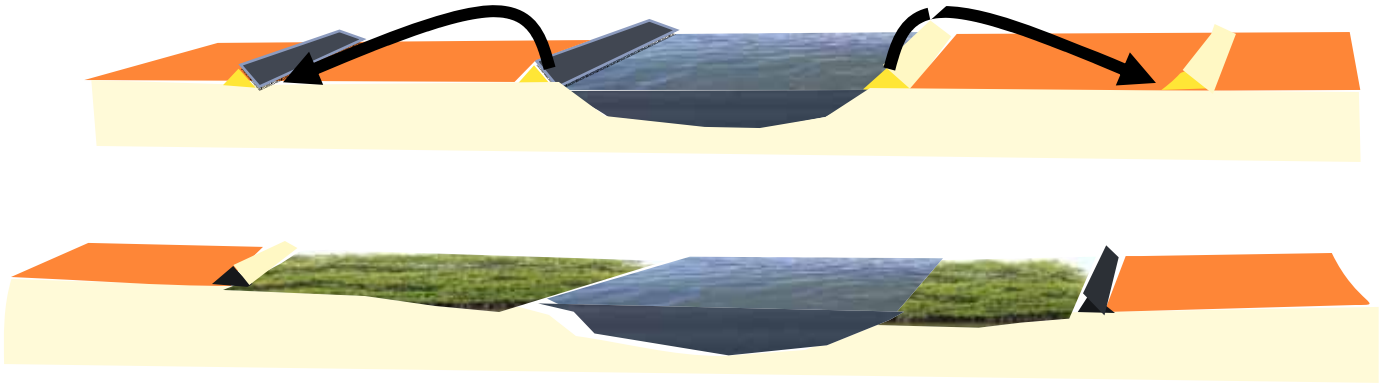


Retreat

Intertidal mangrove width added to channel width to give retreat distance

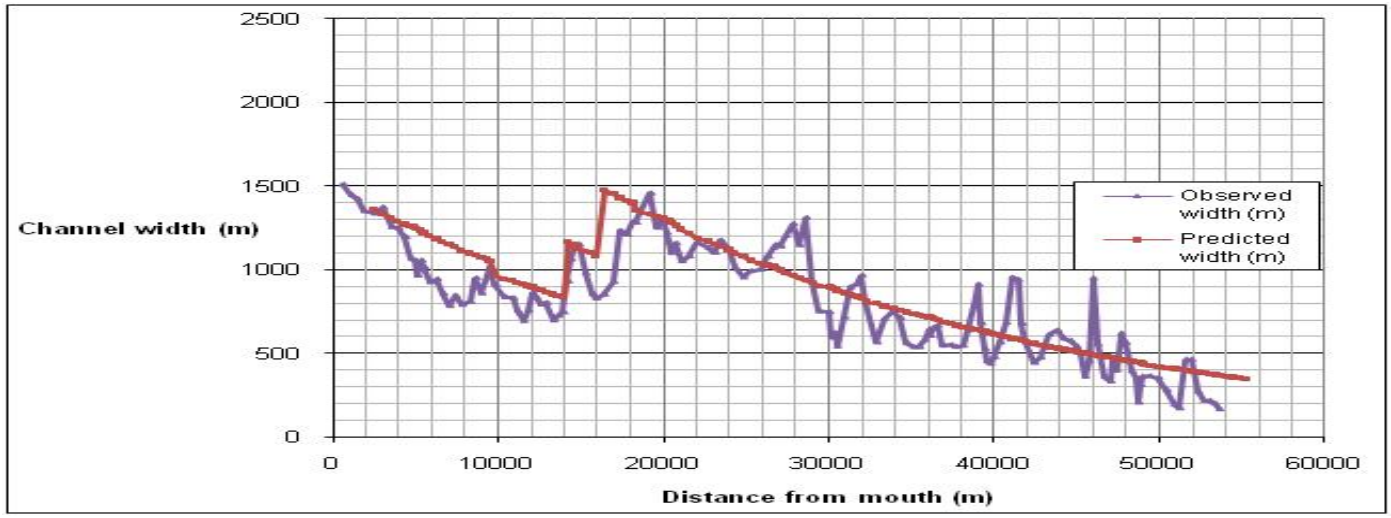


Red line is equilibrium channel without intertidal flats

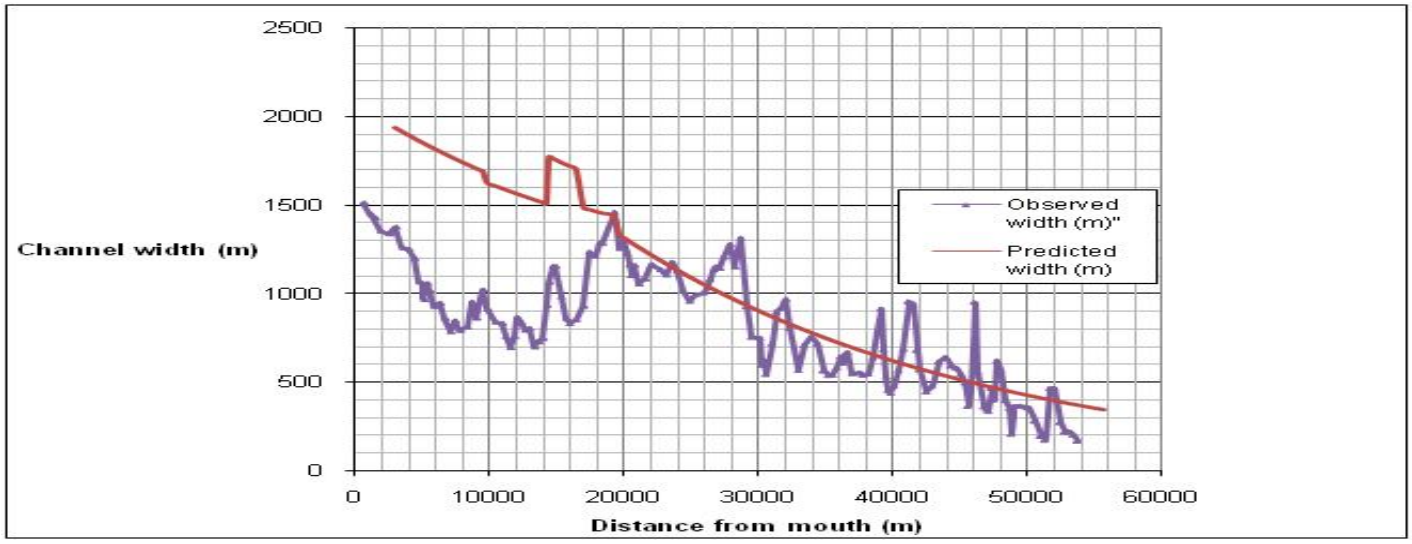


Equilibrium model limit + intertidal width

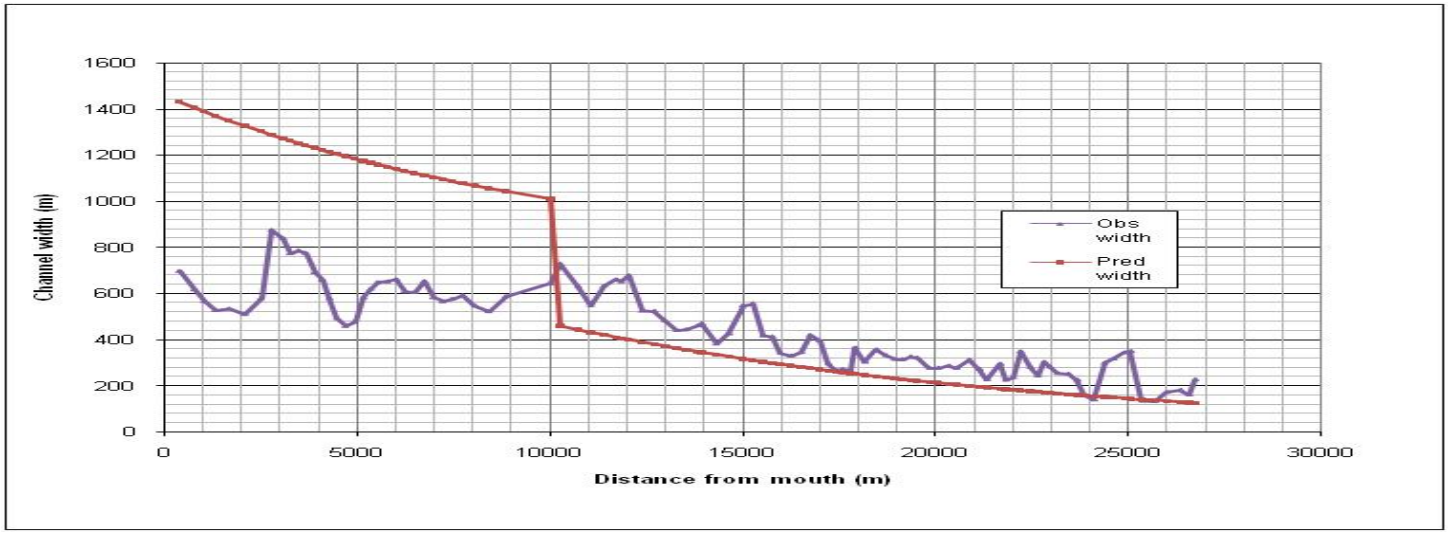
RESULTS



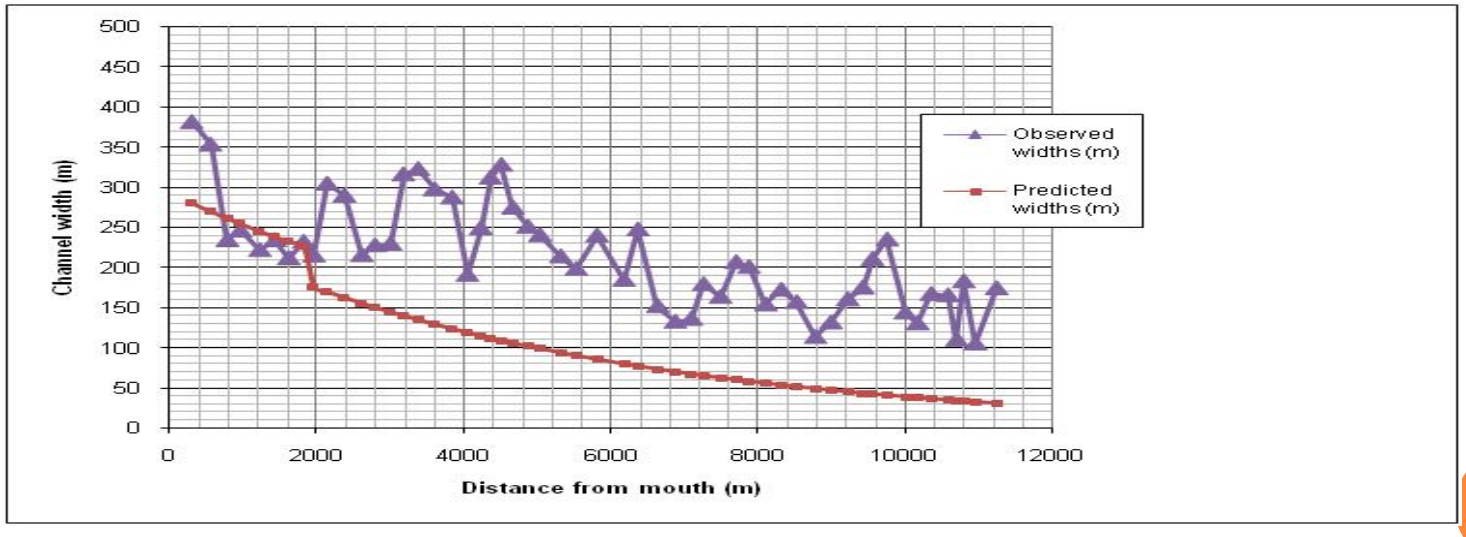
Calchara : no avulsion, no sea level rise



Calchara : avulsion, no sea level rise



Gobadia : avulsion, no sea level rise



Banstala : avulsion, no sea level rise

Calchara channel reach	Existing average widths (m)	Sea level rise		
		1m	2m	3m
		Predicted average width (m)		
0-20km	1009.76	1181.12	1216.84	1252.11
20-40km	1056.86	1055.24	1087.16	1118.67
40-60km	528.86	553.60	570.34	586.87
		Difference from existing width(m)		
0-20km		-171.36	-207.08	-242.35
20-40km		1.61	-30.30	-61.81
40-60km		-24.74	-41.49	-58.02

Gobadia channel reach	Existing average widths (m)	Sea level rise		
		1m	2m	3m
		Predicted average width (m)		
0-10km	621.70	750.86	785.30	819.10
10-20km	434.98	330.93	346.12	361.01
20-25km	250.32	175.55	183.61	191.51
		Difference from existing width(m)		
0-10km		-129.15	-163.60	-197.40
10-20km		104.05	88.87	73.97
20-25km		74.77	66.72	58.81

Banstala channel reach	Existing average widths (m)	Sea level rise		
		1m	2m	3m
		Predicted average width (m)		
0-7km	377.55	362.67	387.05	409.30
7-15km	292.49	242.74	254.12	265.29
15-25km	225.48	123.76	129.57	135.26
		Difference from existing width(m)		
0-7km		14.88	-9.50	-31.75
7-15km		49.74	38.36	27.20
15-25km		101.72	95.91	90.22

RETREAT DISTANCES

Equilibrium retreat for: 1m sea level rise; 30m wide intertidal mangrove belt

River Name	Reach length	Existing average width (m)	Retreat distance. 1m sea level rise; + mangrove
Kalchara Gang			
	0-20km	1037	**-200**
	20-40km	664	**-28**
	40-60km	422	**-55**
Gobadia Gang			
	0-10km	622	**-160**
	10-20km	435	**0**
	20-25km	250	**0**
Ghughudanga Gang			
	0-7km	321	**-26**
	7-15km	302	**0**
	15-25km	252	**0**

RETREAT DISTANCES

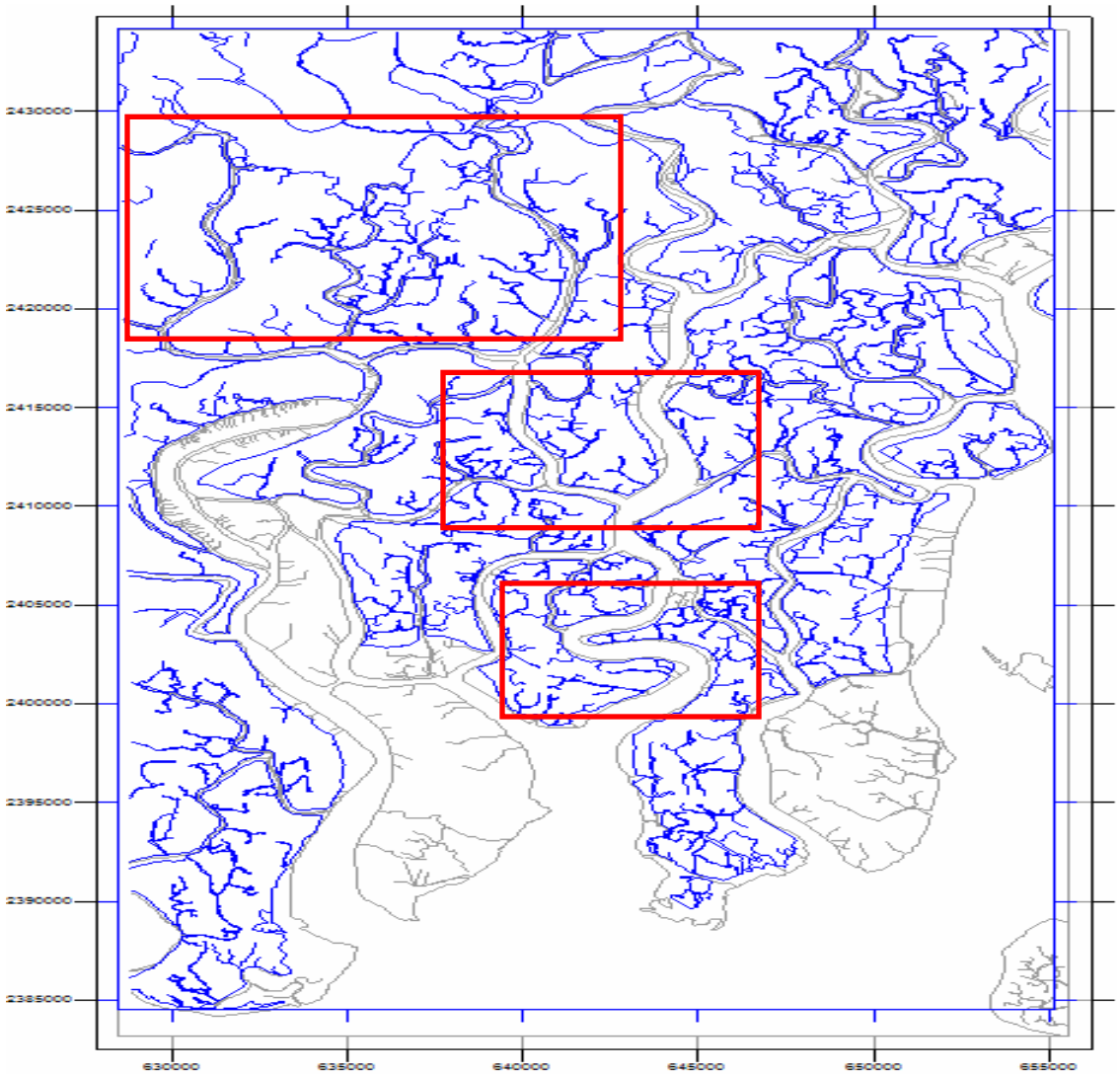
Equilibrium retreat for: 1m 3m sea level rise; 30m wide intertidal mangrove belt

River Name	Reach length	Existing average width (m)	Retreat distance. 1m sea level rise; + mangrove
Kalchara Gang			
	0-20km	1037	**-270**
	20-40km	664	**-91**
	40-60km	422	**-88**
Gobadia Gang			
	0-10km	622	**-230**
	10-20km	435	**0**
	20-25km	250	**0**
Ghughudanga Gang			
	0-7km	321	**-81**
	7-15km	302	**-3**
	15-25km	252	**0**

RETREAT DISTANCES

Equilibrium retreat for: 1m 1m sea level rise; river capture adjustment; 30m wide intertidal mangrove belt

River Name	Reach length	Existing average width (m)	Retreat distance. 1m sea level rise; + river capture; + mangrove
Kalchara Gang			
	0-20km	1037	**-750**
	20-40km	664	**-28**
	40-60km	422	**-55**
Gobadia Gang			
	0-10km	622	**-670**
	10-20km	435	**0**
	20-25km	250	**0**
Ghughudanga Gang			
	0-7km	321	**-425**
	7-15km	302	**-60**
	15-25km	252	**0**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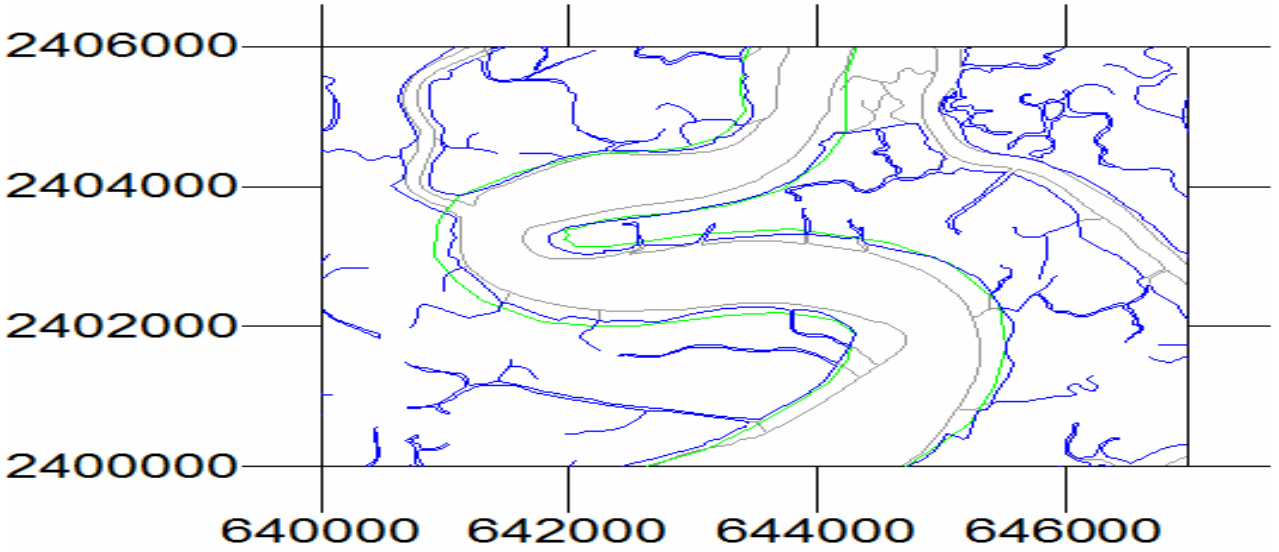
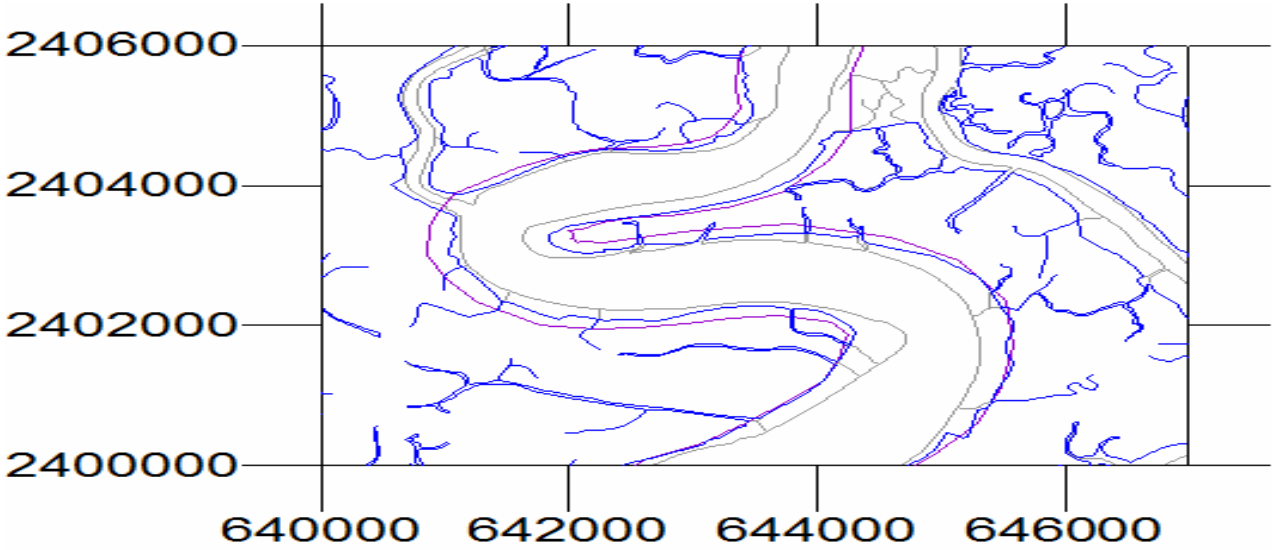
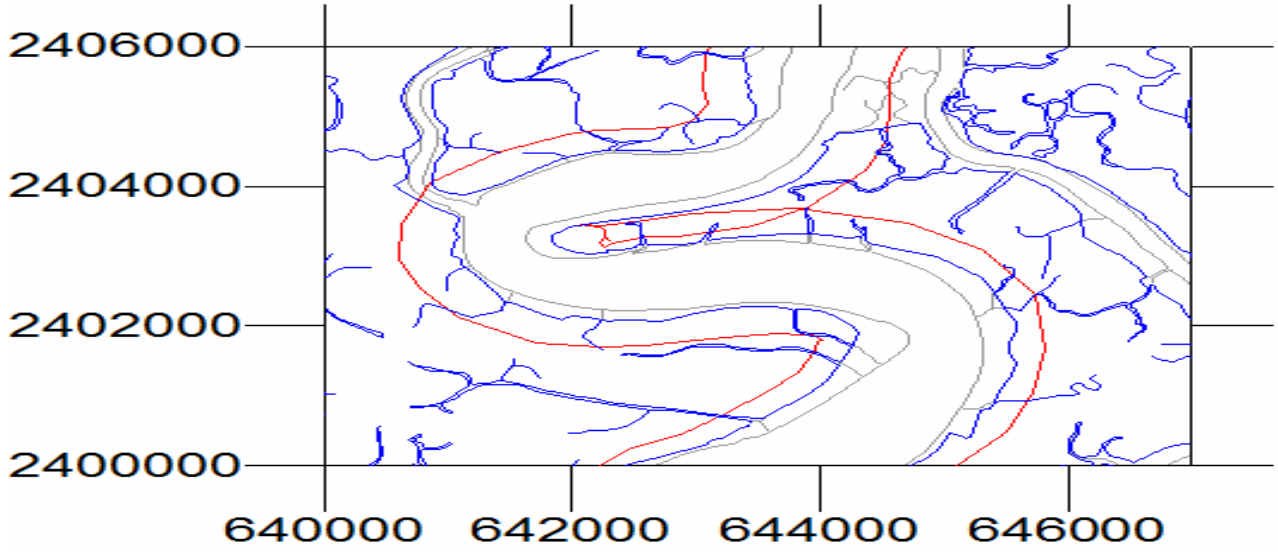


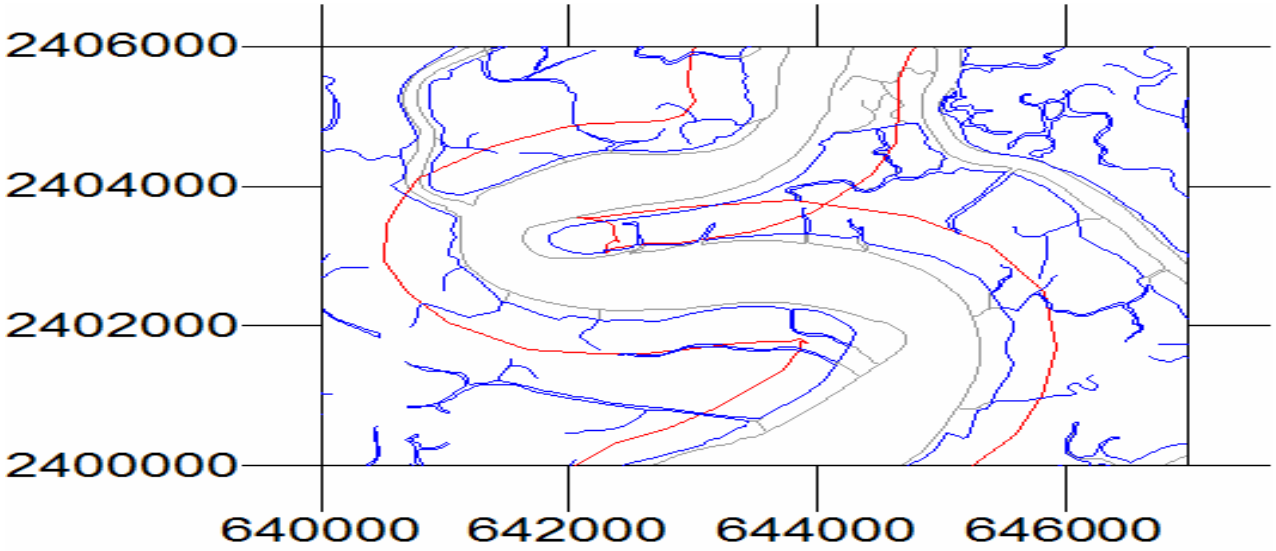
Equilibrium: no sea level rise



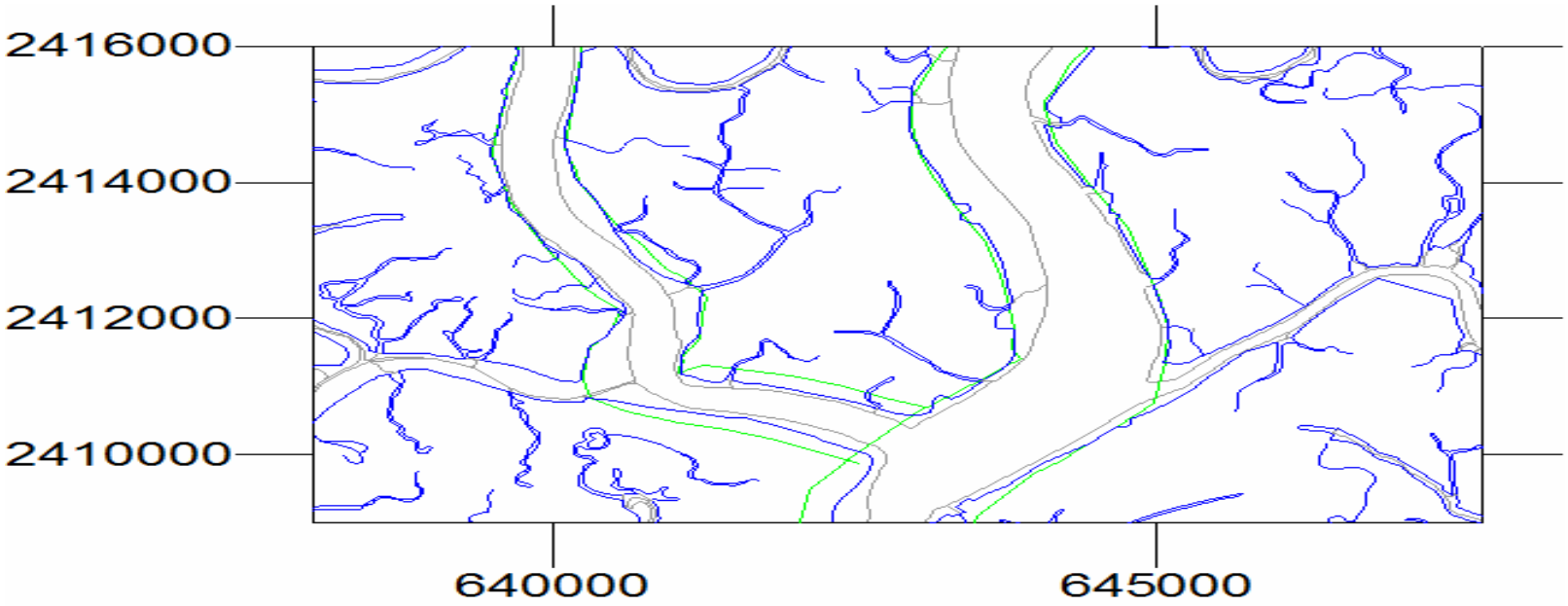
3m sea level rise



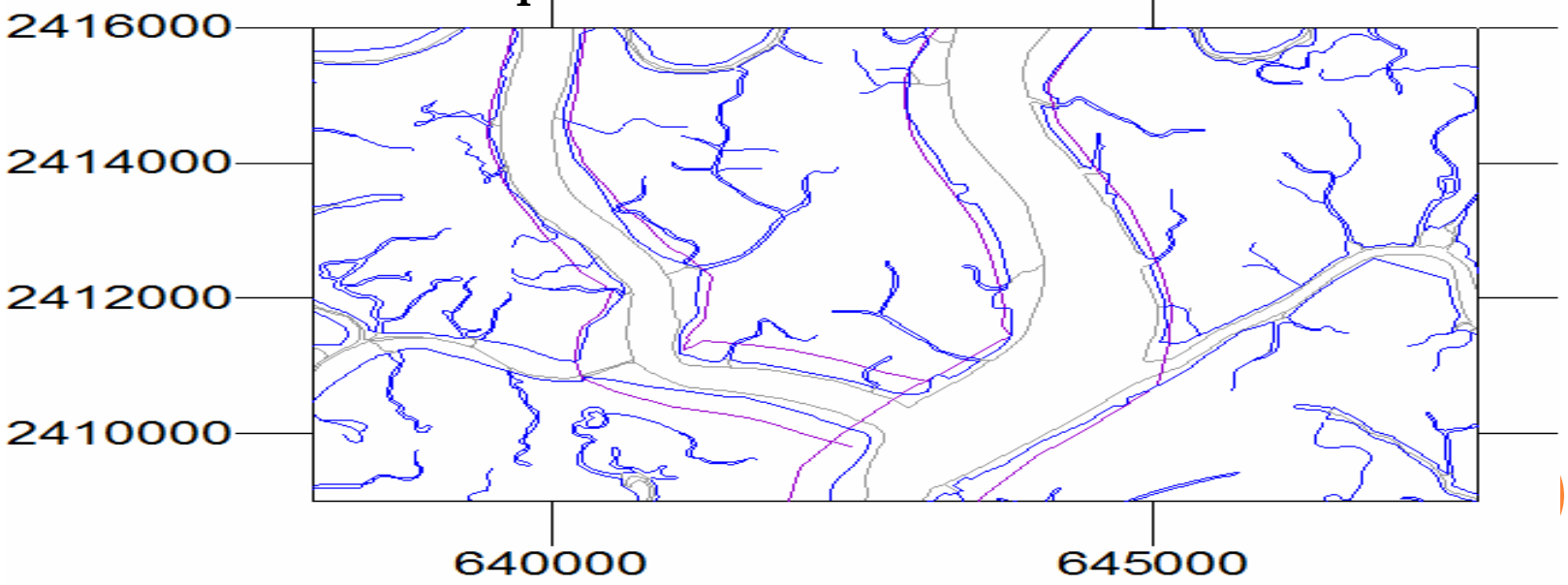
Channel avulsion



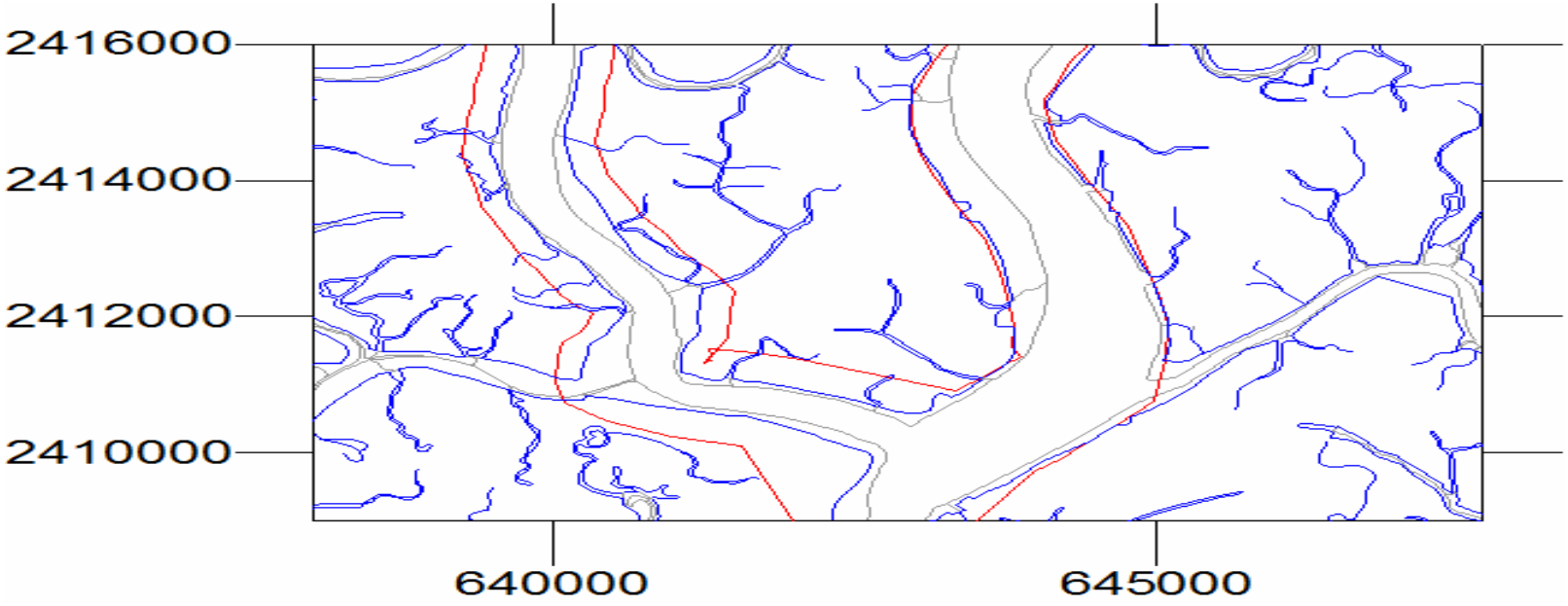
Channel avulsion plus 3m sea level rise



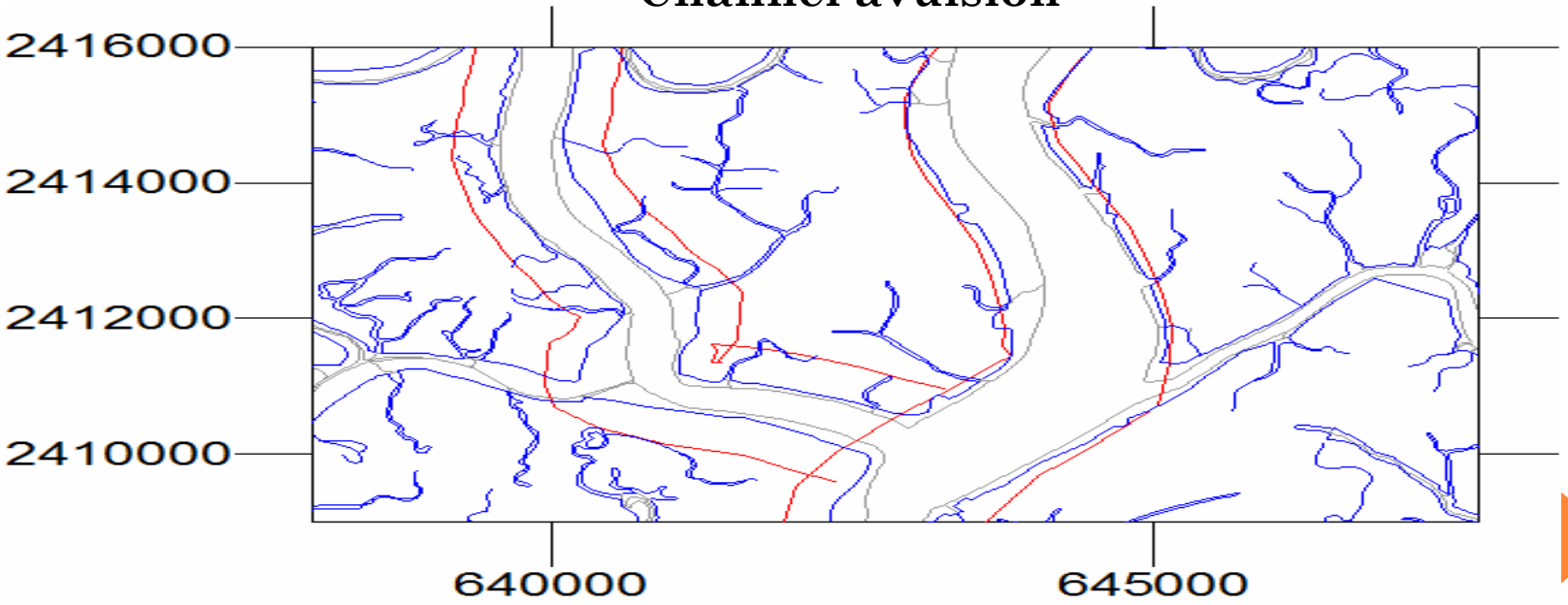
Equilibrium: no sea level rise



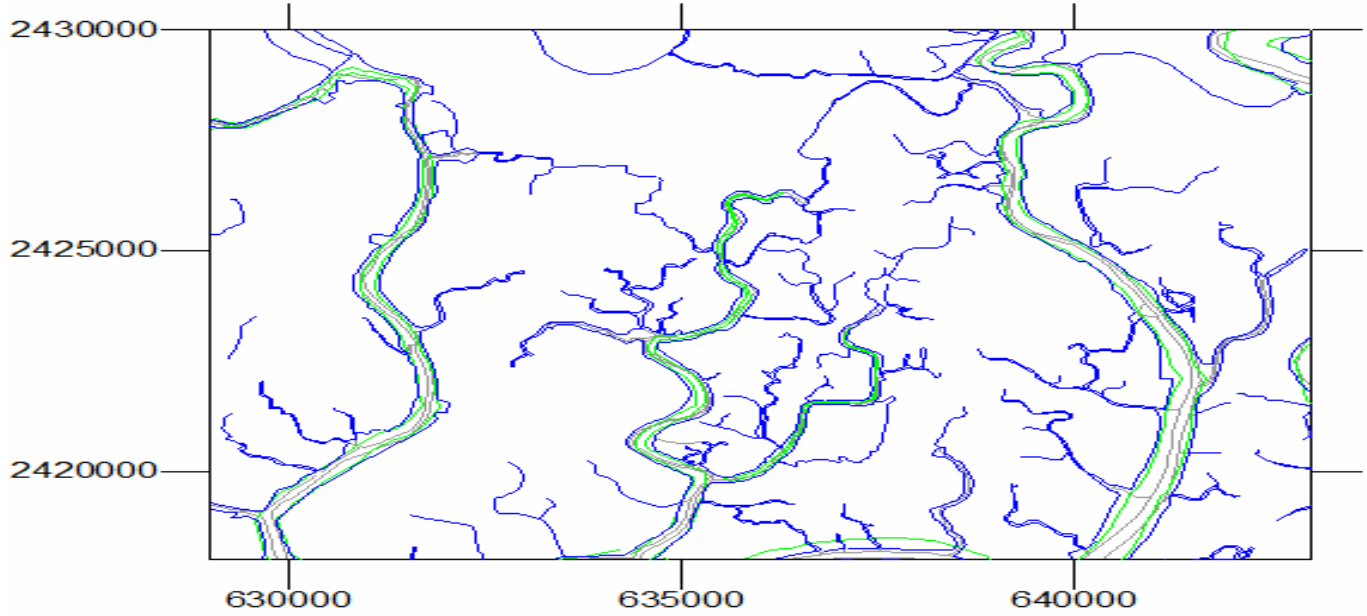
3m sea level rise



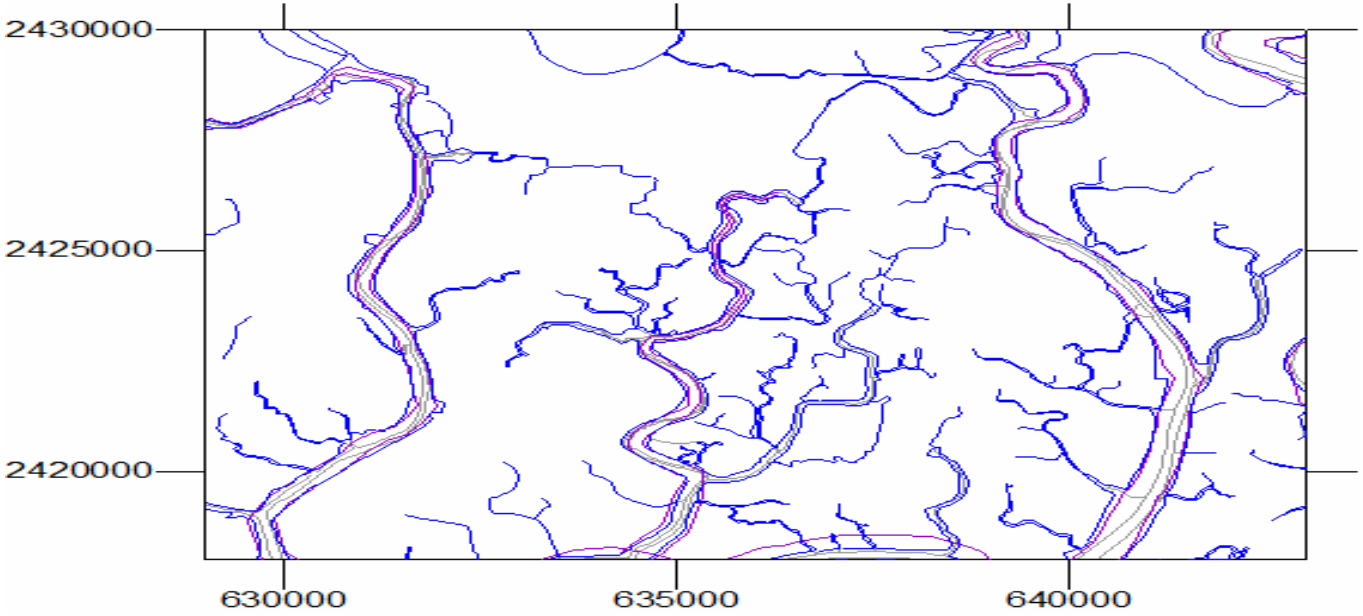
Channel avulsion



Channel avulsion plus 3m sea level rise

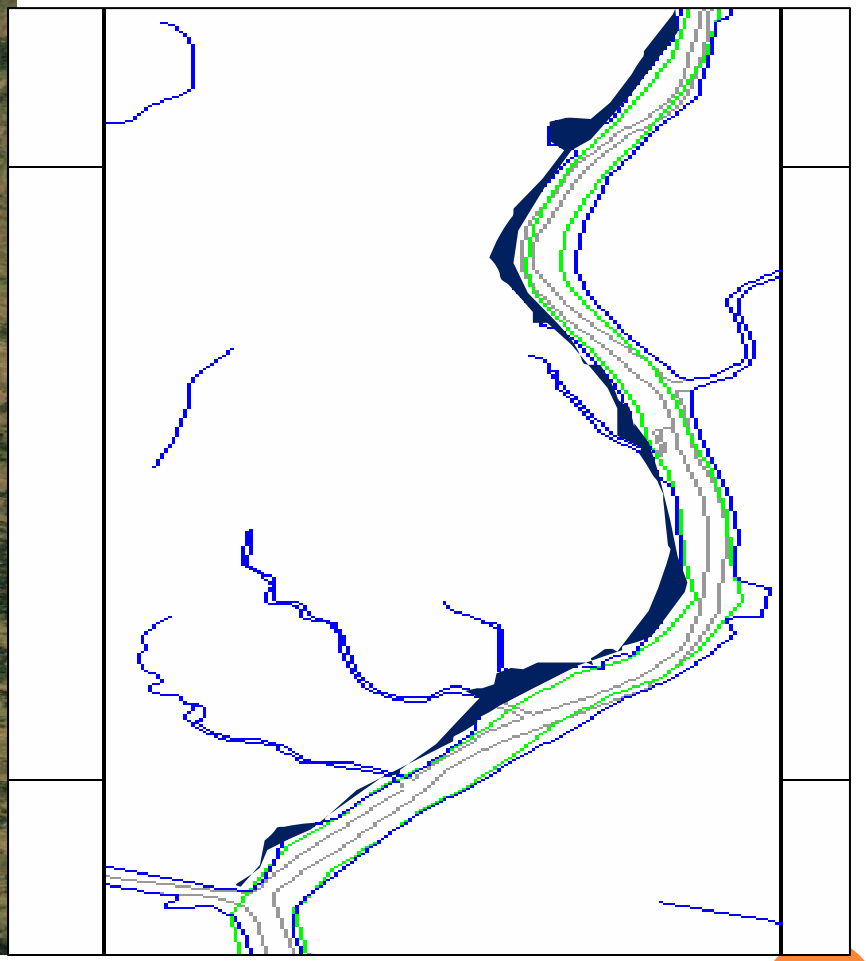


Equilibrium: no sea level rise

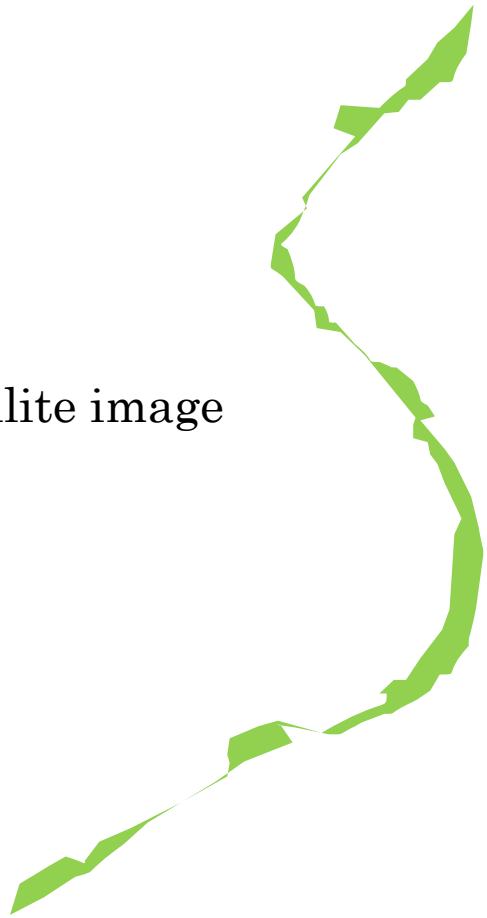


3m sea level rise

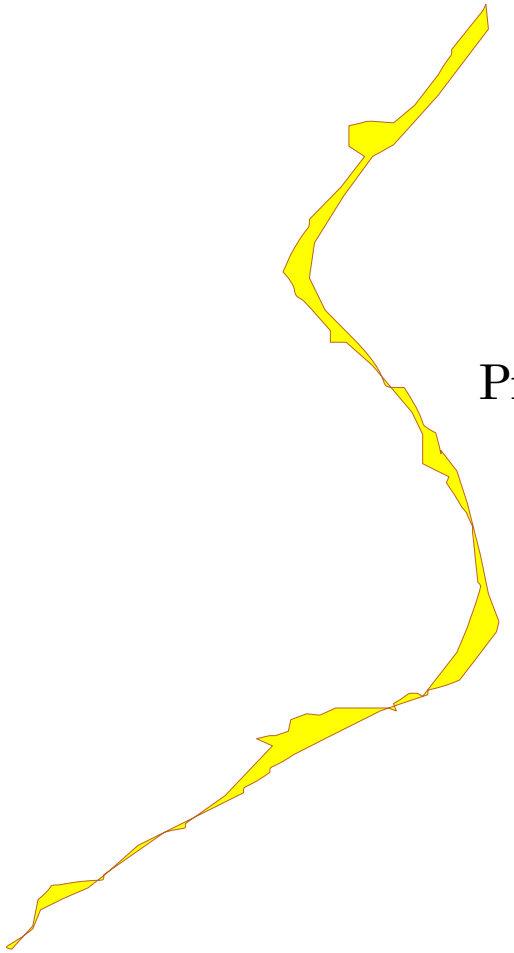
Ghughudanga Gang : predicted equilibrium mangrove colonisation compared to satellite image

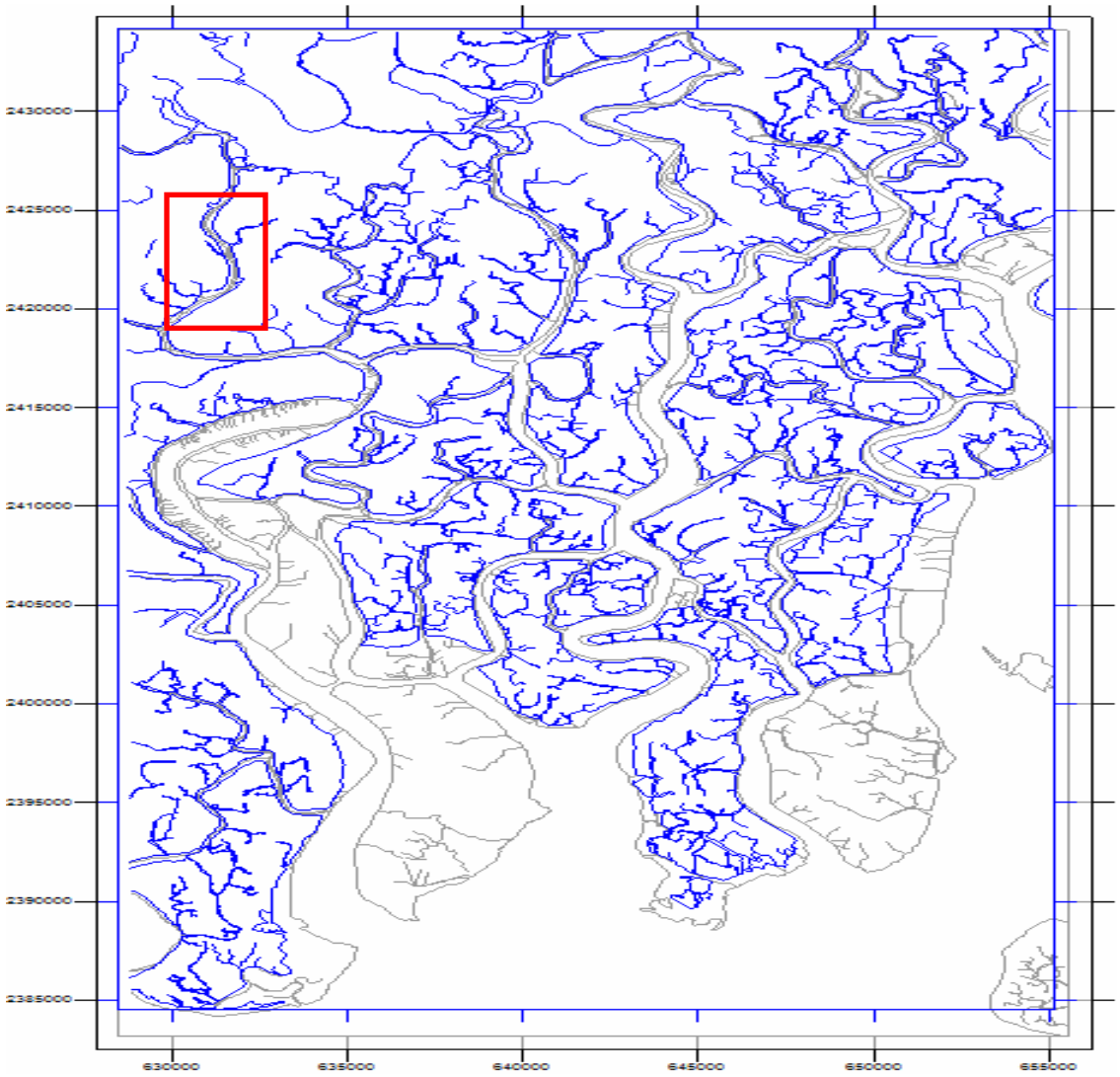


Satellite image



Predicted

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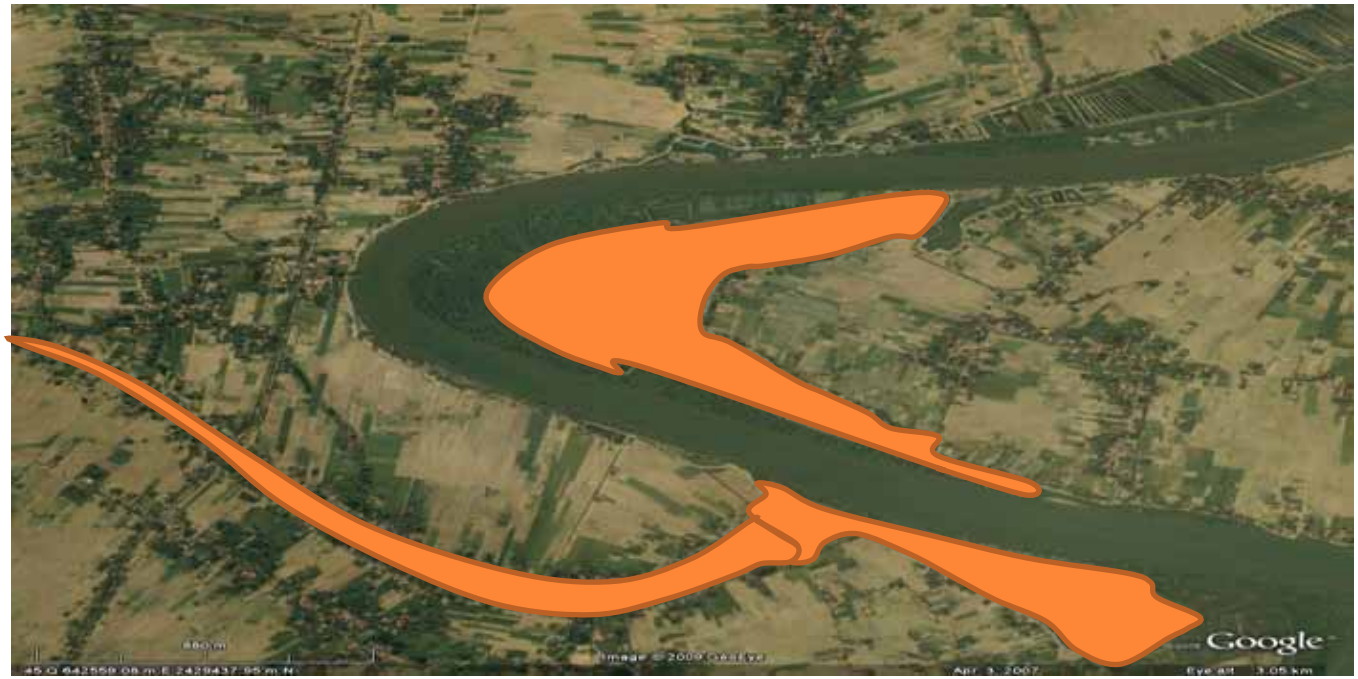
CHANNEL AVULSION

Reclamation and creek dams



Reclamation removes 180ha of tidal area = 1.8 million cubic metres of tidal prism

Avulsion in the Eastern Saptamukhi Estuary

Potential avulsion in the Mehta Estuary

SUMMARY OF RELATIVE IMPACTS

Example impacts for 20km lower Kalchara channel	Metres
Retreat: metres bank erosion per 100m width over 20km stretch	-13.00
Reclaim metres accretion per 100ha	+10.00
Sea level rise 1m: erosion in metres	-96.00
Sea level rise 3m: erosion in metres	-190.00
Channel switching: West to East Saptamukhi. Erosion in metres	-526.00

Results of computer modelling for the Saptamukhi estuary

INDIA: INTEGRATED COASTAL ZONE MANAGEMENT PROJECT

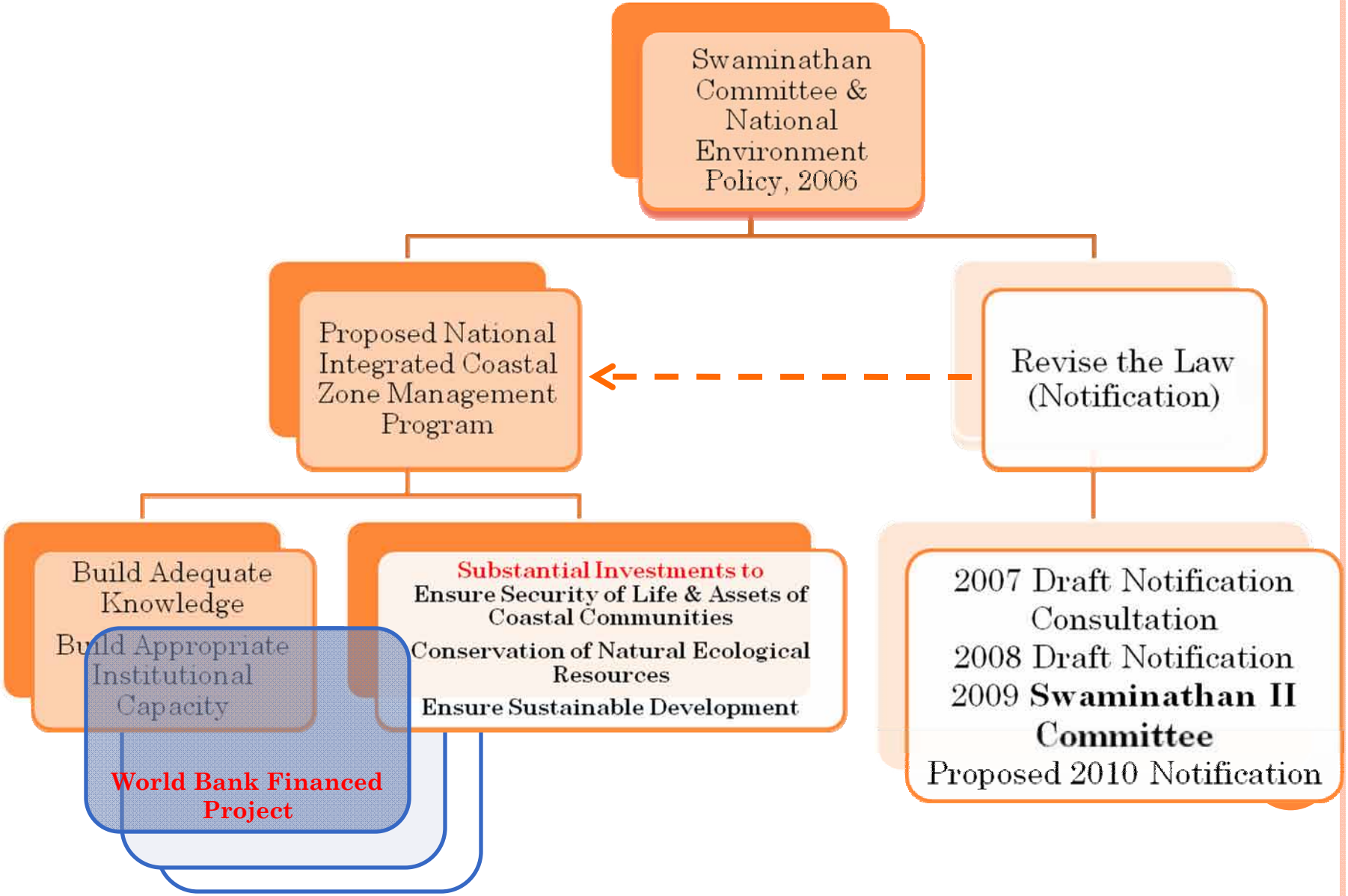
Media Workshop; Goa. August 14, 2010

Tapas Paul, Task Team Leader, The World Bank

GENESIS

- Concern over protection of Coastal Environment
  - 1981 Directive from PM
  - 1991 Coastal Regulation Zone Notification
    - 1996 Supreme Court Order
    - 26 Amendments – some rejected by Supreme Court
    - Supreme Court recommended Comprehensive Review
      - **Expert Committees** - 1992, 1993, 1996, 1997, 2000
- 2004 Directive to MOEF by PM (~ Tsunami)
  - 2006 Prof. Swaminathan Committee
    - "Adopt ICZM Approaches for (i) security of life and assets; (ii) security of inter-generational ecological and cultural security: (iii) livelihood improvement of coastal community; and (iv) sustainable development"
  - 2006 National Environment Policy
  - 2007 – request for Bank support

G.O.I. PROCESS & THE PROJECT



WHAT GOI WANTS FROM THE BANK

- Support to implementation of GOI conservation and livelihood security agenda
  - By supporting activities that will enable decentralized ICZM plan preparation and management
- National level Capacity and Knowledge building
  - Hazard line – definition, mapping & delineation
  - Coastal Sediment Cell (Sub-Cell) – definition & mapping
  - E. S. A. (beyond the currently protected areas) - definition, mapping & delineation
  - Setting up and functioning of a Knowledge Institute
- By supporting preparation of a few ICZM plans
  - That will demonstrate how integrated plans lead to better results; and achieve agreements of differing stakeholder groups
- Supporting State & local level Institutional Capacity Building
- Bringing in international knowledge and expertise
  - From North America, Western Europe, Japan, Brazil, New Zealand, South Africa

PDO & OUTCOMES

- To assist GOI in building national capacity for implementation of the new integrated management approach for India's coastal zones, and piloting the integrated coastal zone management approach in 3 states (Gujarat, Orissa, and West Bengal)
- Outcomes
  - National Capacity Built for guiding and coordinating ICZM
  - Coastal Management Areas Demarcated and Verified (and publicly disseminated + used for planning)
  - (Gujarat + Orissa + West Bengal) state and stakeholder capacity built in implementing ICZM approaches
    - ICZM Plan Preparation (with full participation of all stakeholders) & Adoption
    - Demonstration of integration (joint action + area based integration + integration of purpose) in "local pilots".

PROJECT COMPONENTS

- National capacity building - $97 million
  - Hazard line – mapping, delineation, demarcation ($27m)
  - Coastal sediment cell – mapping
  - ESAs – mapping, delineation, demarcation ($5m)
  - Knowledge institute – setting up and operation ($22m)
  - MOEF medium term capacity building ($3 m)
  - Project management ($8 m)
- 3 state components (Gujarat, Orissa, W Bengal) – $175 m
  - State level capacity building ($ 44 m)
  - Preparation of select ICZM plans ($ 15 m)
  - Local pilots ($ 113 m)
    - Conservation and protection of coastal resources
    - Environment and pollution management
    - Livelihood security of coastal communities
  - Project management ($22 m)

HIGHLIGHTS

- The project is supporting capacity and institution building, with limited demonstration investments
  - Local pilots are complementary to the ICZM plan & other capacity building activities at state levels → test approach and scaling-up options
    - $113 million is for all the local investments in all 3 states.
    - $169 million is for capacity and institution building
  - Local Pilots are necessary – to ensure that the capacity and institution building is sustainable & for demonstration effect
    - Lessons learnt – Bank projects, projects in India, ICZM projects in EU and Africa
- This project is the first of a series of projects
  - Additional Financing & Repeaters based on performance
    - A $3 million TA for Replication in other states [QER Recommendation]
  - Many States have started initial internal discussions

IMPLEMENTATION READINESS

- Detailed project reports drafted
  - 25 local investments (more than 1 sector agency involved for each)
    - Only 4 cases involved consultants; remaining prepared by government departments (with some handholding)
  - 11 capacity building proposals
  - About 250 government staff took part in these
- All Reports (+EA & SA) already in Public Domain
- Substantial consultative process
- Launch Workshops
  - Orissa (Bhubaneswar), Gujarat (Dandi)
  - National & West Bengal – Tentatively September 2010
- Some procurement of consultancies, works and goods initiated
  - SOI has started initial activities of hazard mapping
  - National Institute – Launched; Partnership Agreement with 13 State Institutes signed

HAZARD LINE FOR THE MAINLAND COAST

- To reflect effects of recurrent coastal hazards
- Finalized methods and tools for hazard mapping
  - A very substantial task – included a large number of workshops and consultation
  - Consensus among scientists, experts, state level managers
- Mapping based on landward composite of
  - Coastal 100 year flood lines (+ SLR impacts) + 100 year predicted erosion lines.
- Delineation by ground markers (for entire country)
  - To address the current non-conformity between local revenue maps and standard topographical maps; and misinterpretation / uncertainty
- Full public dissemination of maps + ground markers
  - Obviate the repeated investment in physical surveys
  - Uniform interpretation to comply with coastal regulations.

ECOLOGICALLY SENSITIVE AREAS

- Finalized definition of ESAs + methods of mapping
  - Mangroves, coral reefs, sea grass and sea weed beds, littoral forests, sea beaches, sand dunes, rocky cliffs, mud flats, lagoons, salt marshes, estuaries, and habitats of critical species
- Included consultation with expert institutions across the country; NGOs
  - Two expert consultations (13+28); Direct communication (200); regional workshops at Chennai & Ahmedabad (25 + 17); National Workshop (28)
- To be mapped & boundary delineated by NGOs
  - Current protected areas + unprotected ESAs
  - Capacity of NGOs + Specialized NG Institutions – assessed
  - Includes social assessment + public consultation
- ESAs to be managed by MOEF
  - For conservation of resources; otherwise only protects traditional + customary rights

SEDIMENT CELLS & SUB-CELLS

- First training on coastal sediment cells
  - Prepared training module;
  - Training to a group of 30 geologists and coastal geomorphologists
- Manual on mapping sediment cells
- To be undertaken by NCCM, Chennai
  - Work will start by November 2010
  - Cell mapping to be followed by mapping of sub-cells
- To be substantiated by a Study on Regional Coastal Process in Orissa
  - Berhampur University; to be completed by 2012
- To be replicated all over the mainland and the islands
  - To be completed by 2013-14, and updated thereafter

STATE COMPONENTS - GUJARAT

- ICZM Plan – Gulf of Kachchh
- Capacity Building
  - CZ Conservation, Monitoring of Water Quality & Enforcement; Research capacity in coastal ecology; R&D regeneration of coral reefs, GIS-enabled decision support tools
- **Pilot investments**
  - Conservation and protection of the coastal resources – (i) mangrove plantation, (ii) coral reef regeneration, (iii) shelterbelt plantation, and (iv) marine research and conservation information centre at Dwarka
  - Environment and pollution management – (i) completing the sewerage system of Jamnagar.
  - Livelihood security of coastal communities – (i) livelihood improvement activities in the non-forest villages, (ii) ecotourism and related livelihood improvement activities for villages within the protected areas

STATE COMPONENTS - ORISSA

- ICZM Plan – Gopalpur-Chilika + Paradip-Dhamra
- Capacity Building
  - CZ Conservation, Monitoring of water quality & enforcement; Species and wetland research; Regional coastal process study
- **Pilot investments**
  - Conservation and protection of coastal resources – (i) protection of olive ridley turtle and other aquatic wildlife, (ii) mangrove plantation, (iii) conservation of archaeological heritage, and (iv) pilot work in shoreline protection for village Pentha
  - Environment and pollution management – (i) solid waste management at Paradip
  - Livelihood security of the coastal communities – (i) livelihood improvement support in 60 fishing villages at Chilika and Gahirmatha, (ii) support to fisher-people groups in developing small-scale tourism, (iii) support to fishing communities in developing small-scale industrial and marketing activities, and (iv) provision of cyclone shelters in the 14 remaining coastal villages

STATE COMPONENTS – WEST BENGAL

- ICZM Plan – 3 sectors of the coast
- Capacity Building
  - CZ Conservation; documentation of microbial diversity; geomorphologic and wetland research; and completion of a Sundarban resources interpretation centre
- **Pilot investments**
  - Conservation and protection of coastal resources – (i) mangrove plantation, (ii) a pilot work in shoreline protection for Digha beach, (iii) multi-purpose cyclone shelters and (iv) rehabilitation of the marine aquarium at Digha.
  - Environment and pollution management – (i) completing the sewerage system of Digha, (ii) solid waste management at Digha, (iii) cleaning and environmental improvement of the Digha beach, (iv) improvement of the fish auction centre at Digha, and (iv) distribution of grid electricity in Sagar Island (replaces diesel generation, prevents serious soil and water pollution)
  - Livelihood security of the coastal communities – In Sagar Island (i) improvement in fishery based livelihood systems, and (ii) livelihood improvement and market access, (iii) afforestation-based livelihood improvement, and (iv) local small-scale tourism and ecotourism activities

STATE COMPONENTS – SELECTION OF PILOT INVESTMENTS

- The pilot investments would expectedly be part of any eventual ICZM plan prepared
  - But, not any investment that can potentially jeopardize quality of the ICZM plan itself is avoided (e.g., a seawall)
- Located only in the coastal stretches for which ICZM plans would be prepared
- Each pilot investment is to ensure the sectoral departments participate in the ICZM plan process.
- Each of the pilot investments is expected to demonstrate benefits of either of the following:
  - Inter-departmental integration
  - Integration of purpose
  - Geographic integration
  - Mainstreaming Women's issues

CONSULTATION DURING PROJECT PREPARATION

- Stakeholders consultations
  - For priority investments in the 3 States - revolving
  - For hazard mapping methodology
  - For ESA mapping methodology
  - For designing the National Institute + Skill & Capacity Analysis
  - By MOEF Communication Consultants
    - Including repeat consultation with stakeholders of the pilot investments at local/village levels
  - By EA & SA Consultants
- Additional 122 non-government agencies or community organizations were consulted
  - 86 at national level, 22 in Gujarat, 14 in Orissa, 18 in West Bengal
- Altogether 118 expert consultation sessions organized
- Will continue during Implementation
  - All progress reports, Social Audit and M&E reports will be publicly disseminated