BLUE CARBON SCIENCE OVERVIEW

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International Blue Carbon Policy Working Group
Washington DC

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Oceans play a vital role in controlling greenhouse gases

Deforestation

+

Fossil Fuels

Atmosphere
46%

Land
29%

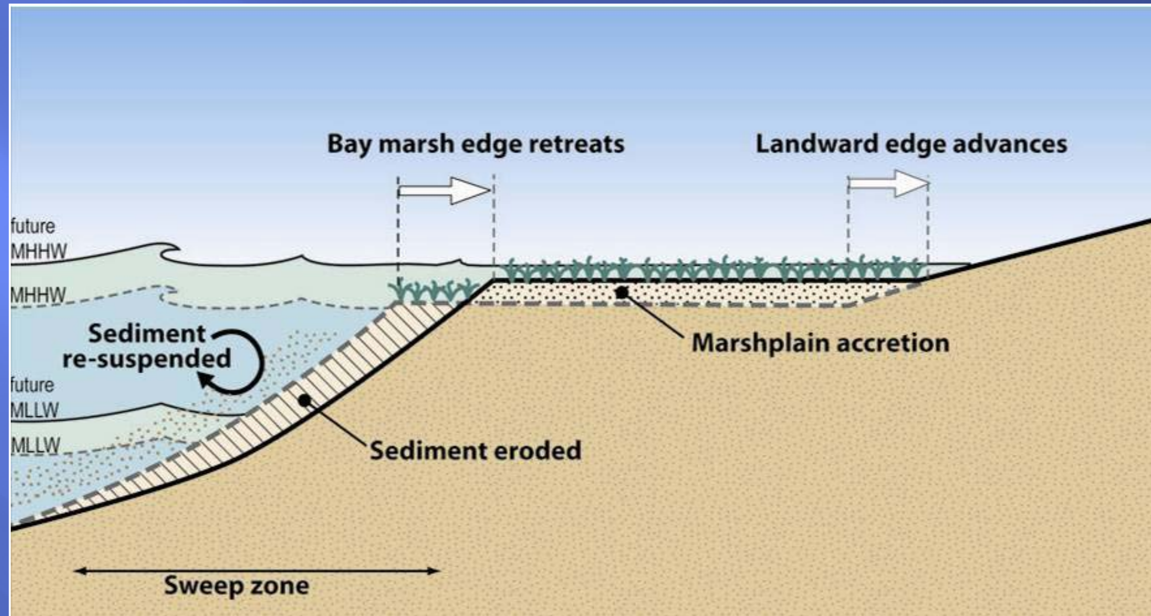
Oceans
26%

Three key ecosystems…

Mangroves

Salt Marshes

Seagrass

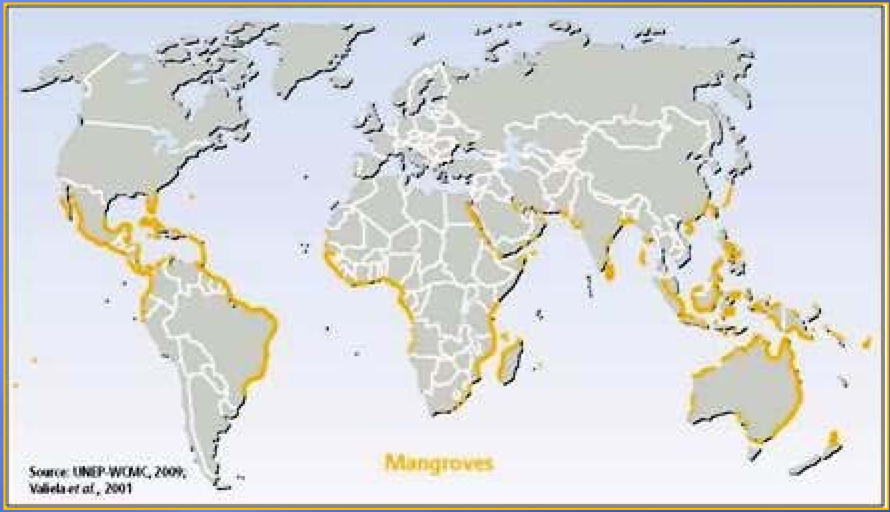


Copper River Delta


Betsiboka River Delta

These ecosystems occur globally

High concentration in the tropics

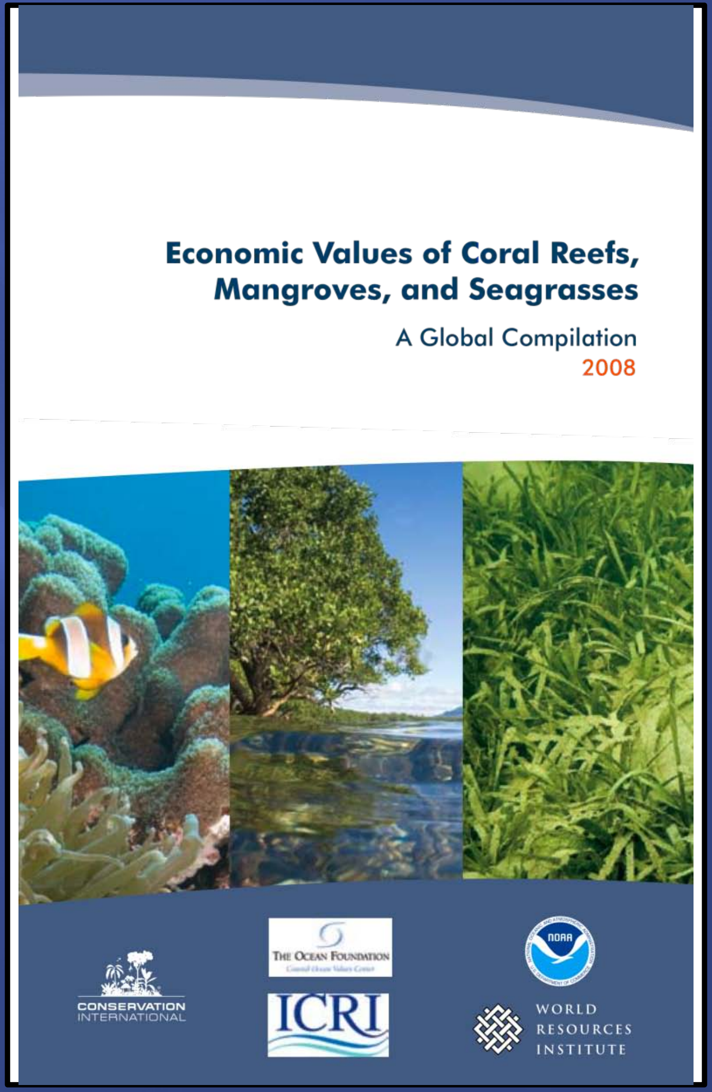


Coastal ecosystems provide essential services

Fisheries
Biodiversity
Coastal Protection
Cultural Values
Tourism

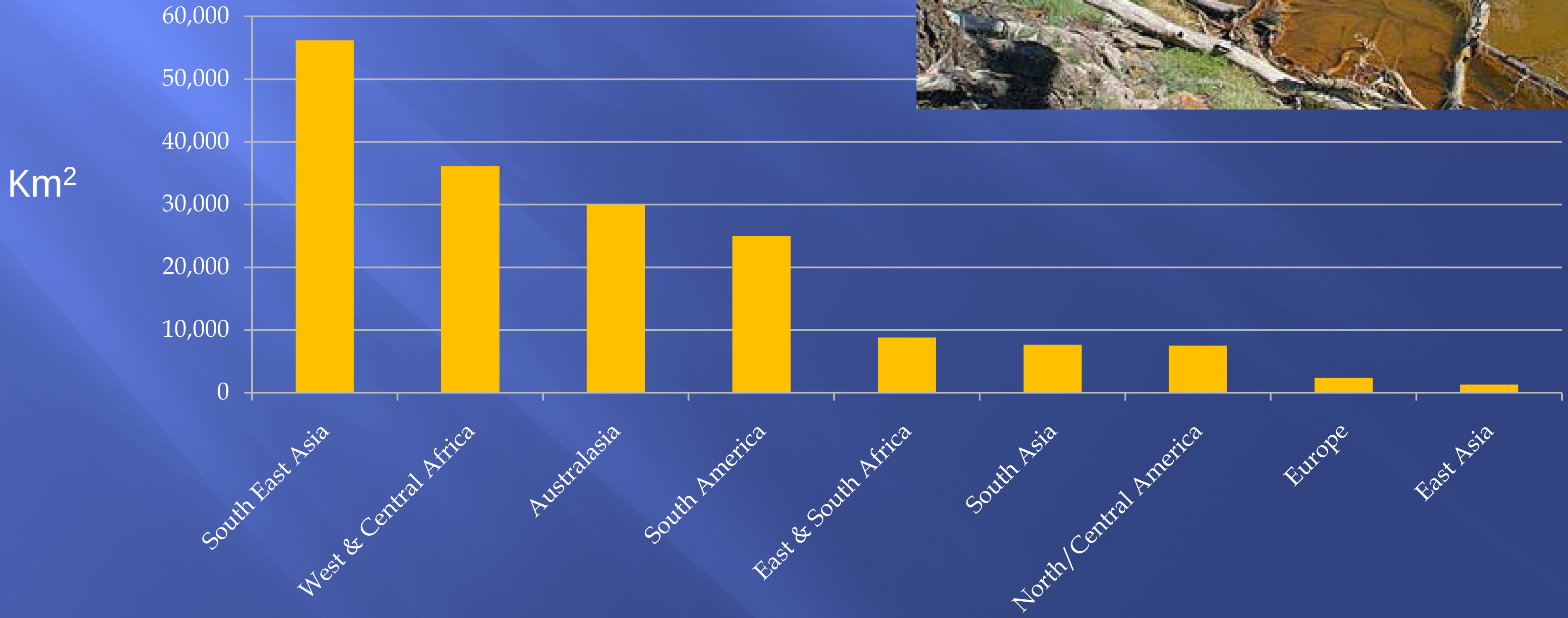
$25,783 billion per year

Total value of ecosystem services and products provided by the world's coastal ecosystems



Destruction can bring acid pollution

- Ecological impacts – e.g. fisheries decline
- Water pollution with heavy metals - As Al
- Reduced agri production and contamination
- Corrosion of infrastructure

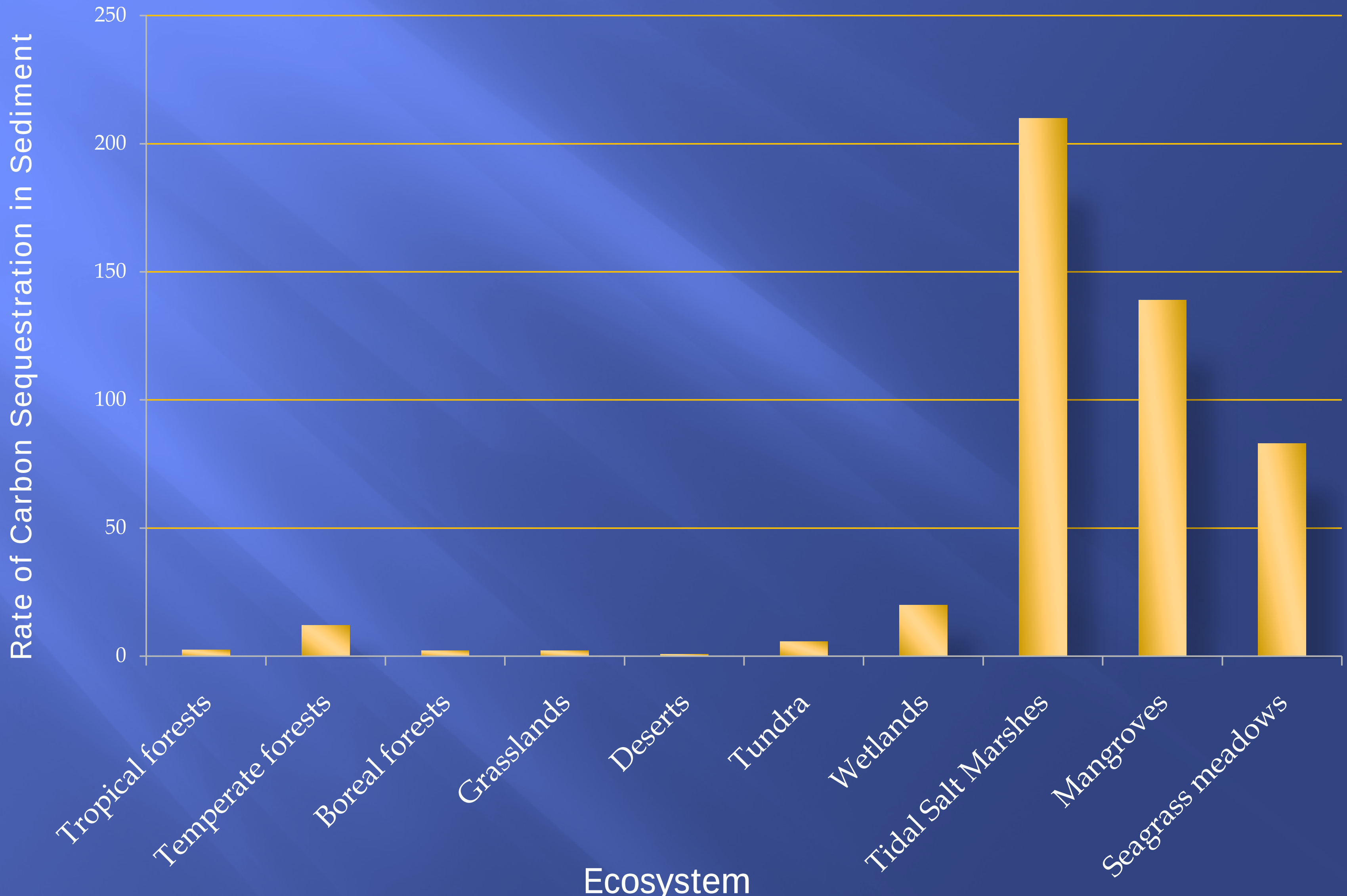


…And provide one critical service to all humanity

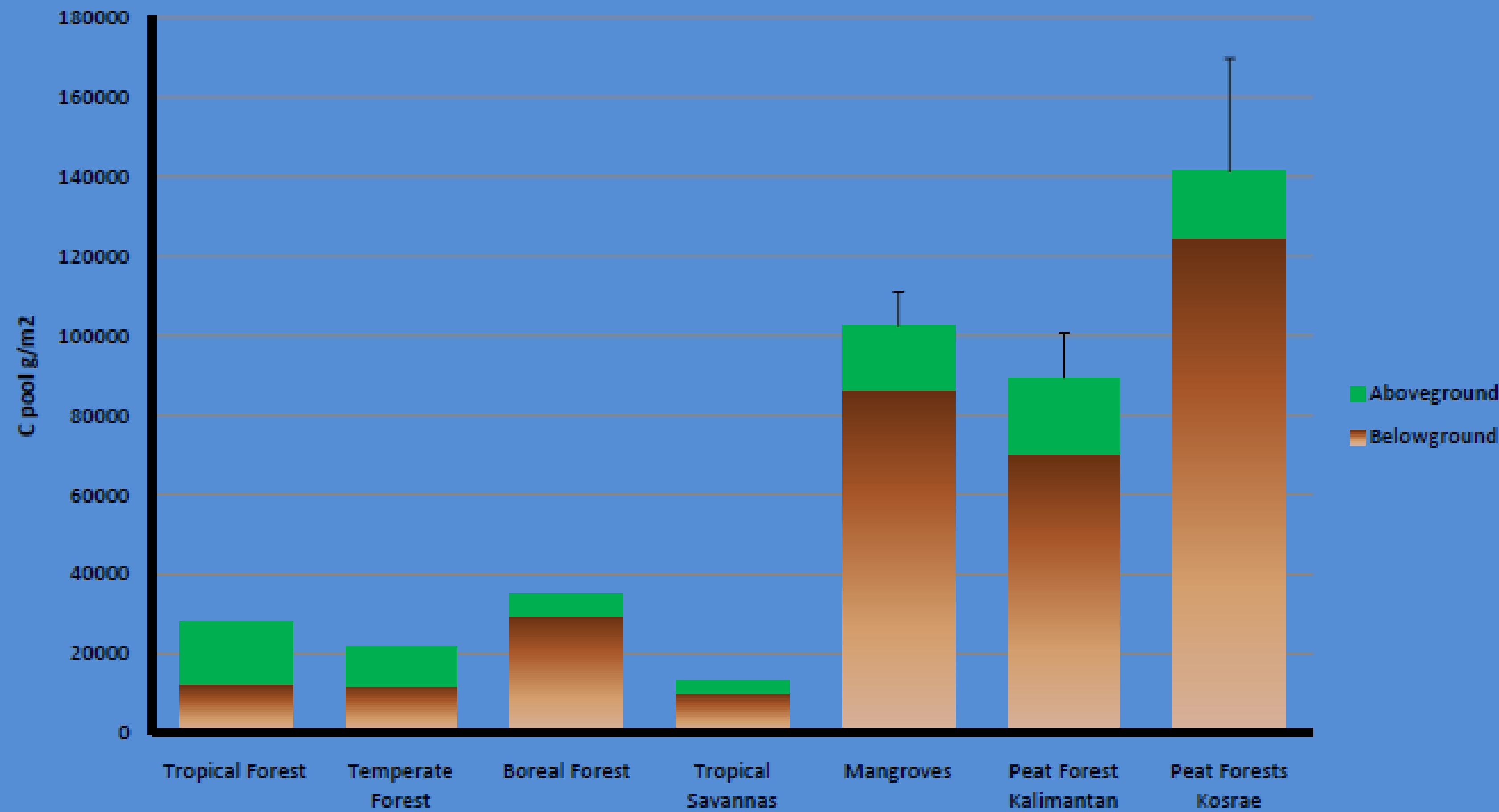
Permanent Carbon Sequestration

Carbon from plants gather in soil and builds up over thousands of years

Coastal ecosystems have very high rates of carbon sequestration (gC / m² / yr).



Ecosystem C pools of selected tropical forests



Data are from:IPCC, 2001: Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change ; Donato et al. (2011. , and this presentation.

They're being destroyed very quickly…

Aquaculture

Agriculture

Development

Pollution

Rates of wetland loss

Ecosystem	Global Extent (km^2)	Annual Rate Of Loss (%)
Tidal Marsh	400,000	1 - 2
Mangrove	160,000	1 - 2
Seagrass	300-600,000	1 - 2

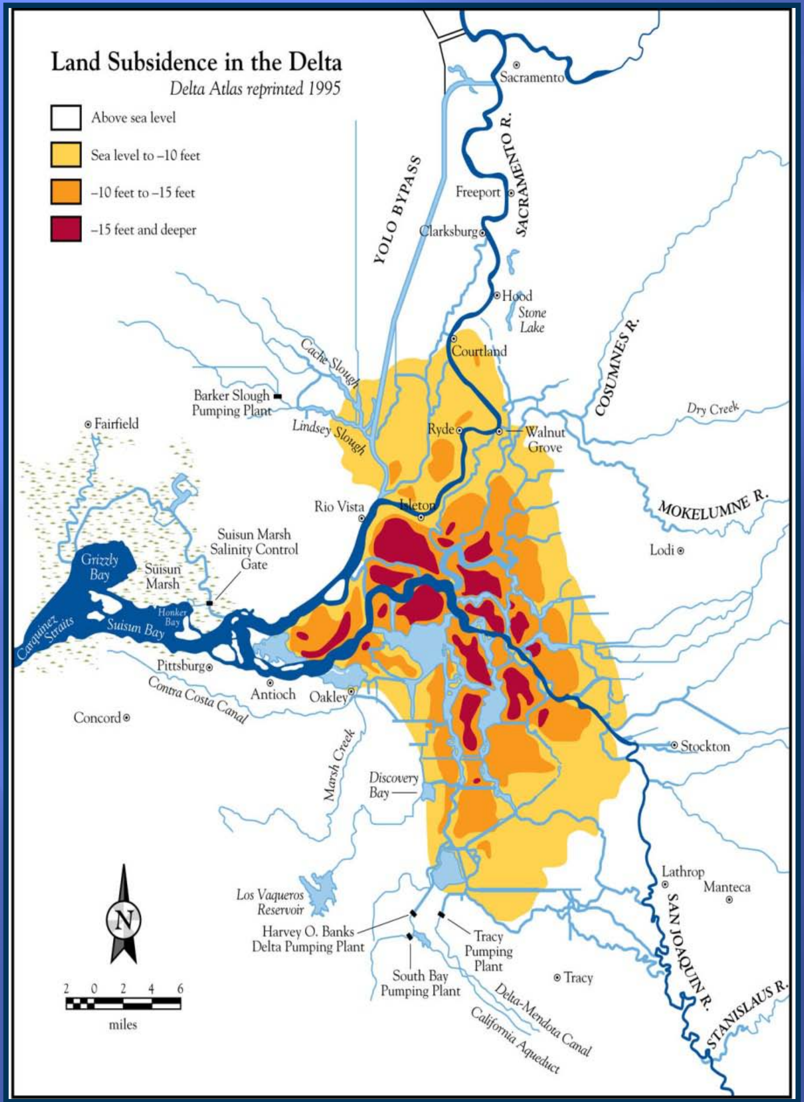
Emissions: 0.1-0.25 $MtCO_2$ / km^2 / meter depth of soil
In peaty wetlands 1 m soils may be lost in >2 decades after drainage

…Causing big CO_2 emissions

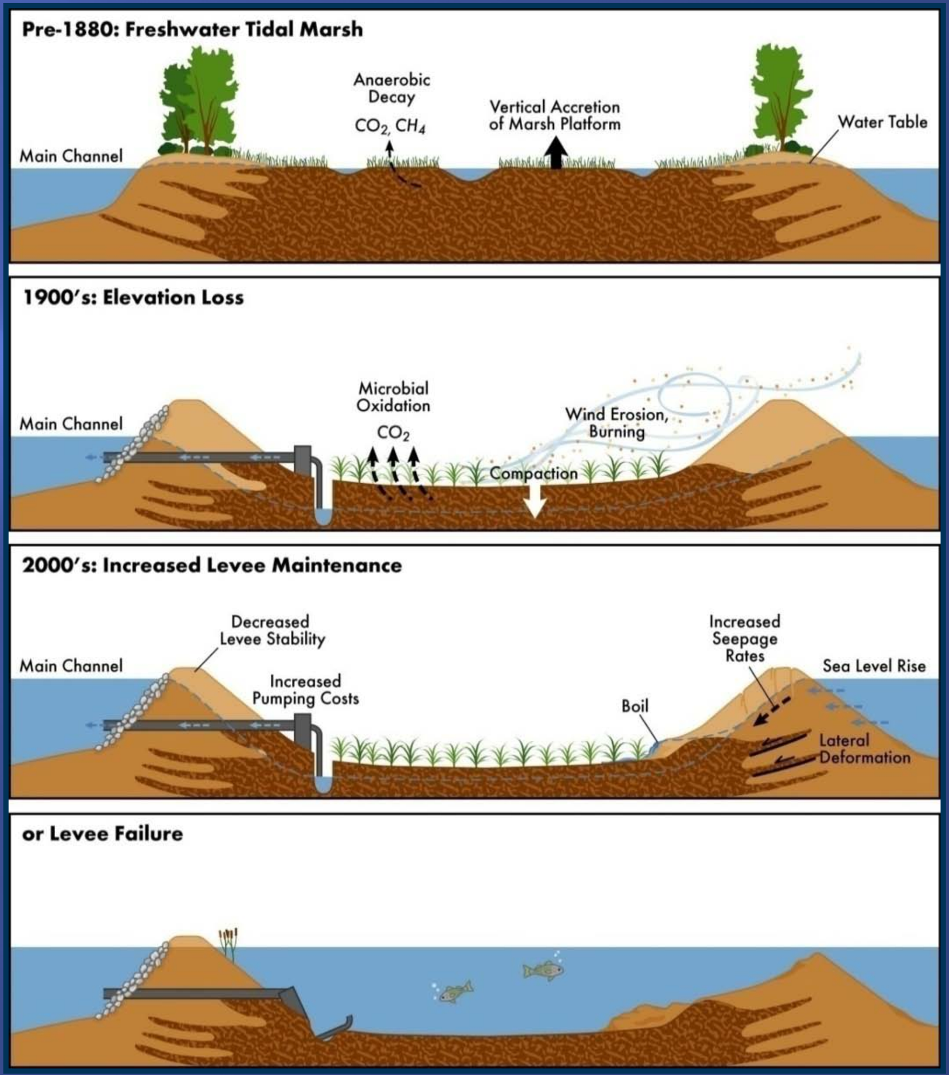
CO_2

Destruction

Drained Wetlands: Very High Emissions



Sacramento - San Joaquin Delta



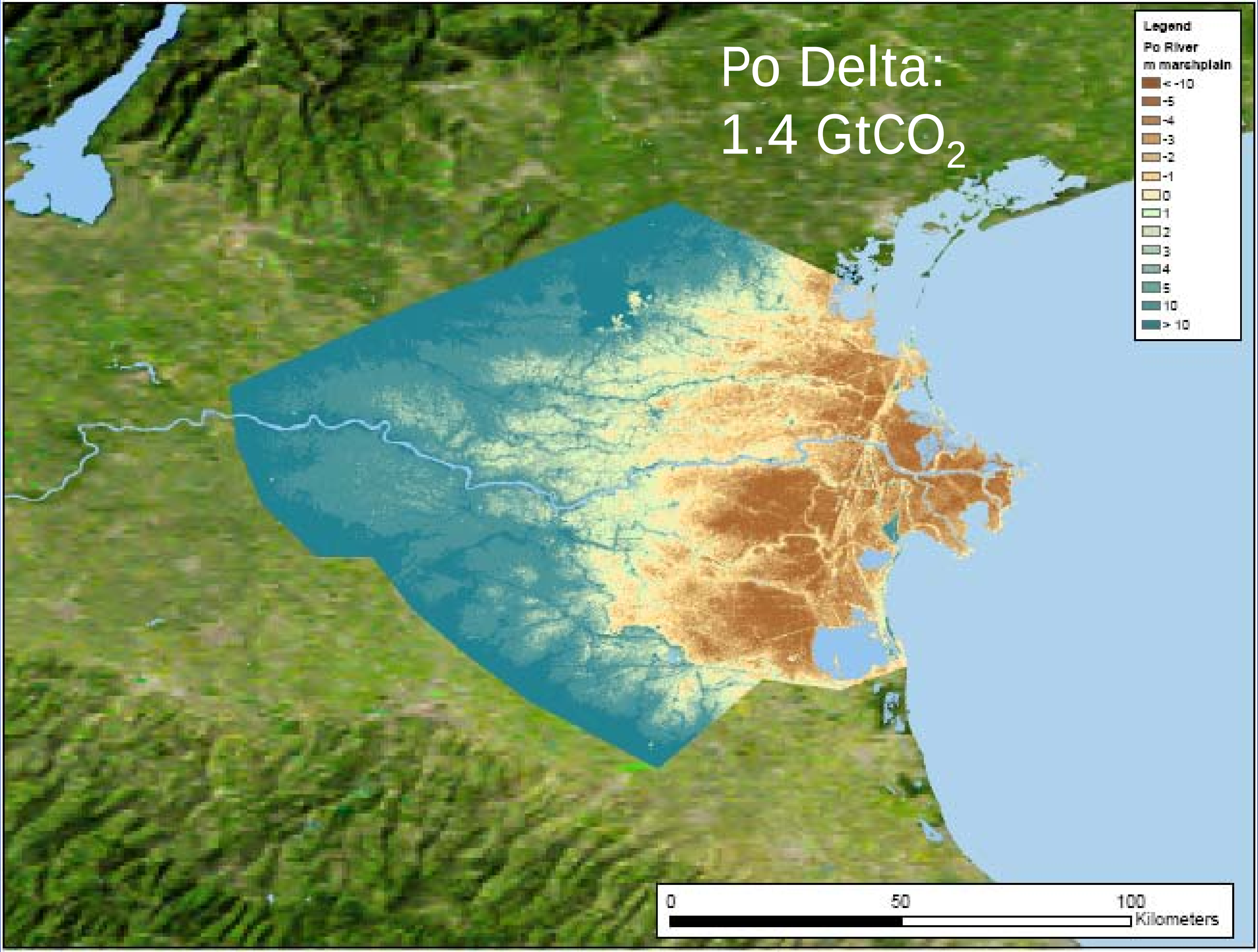
Emissions from One Drained Wetland

Area under agriculture	**180,000 ha**
Rate of subsidence (in)	1 inch

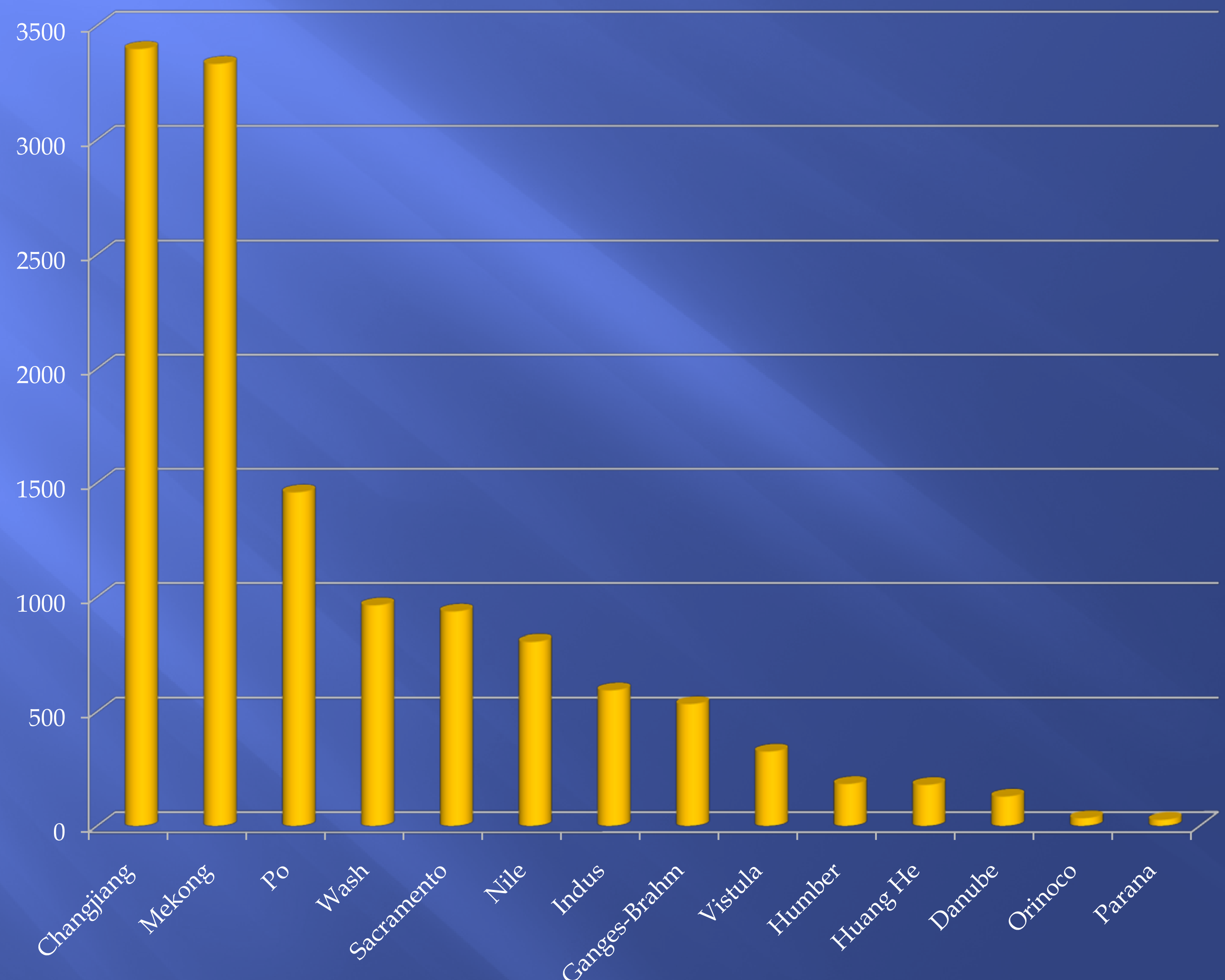
5 to 7.5 million tCO_2/yr
released from Delta

1 $GtCO_2$ release in c.100 years
4000 years of carbon emitted

Equiv. carbon held in 25% of California's forests


Po Delta:
1.4 GtCO2
Legend
Po River
m marshplain
< -10
-5
-4
-3
-2
-1
0
1
2
3
4
5
10
> 10
0
50
100
Kilometers

CO_2 Emissions from Drained Wetlands (million tons)



How Big is Blue Carbon?

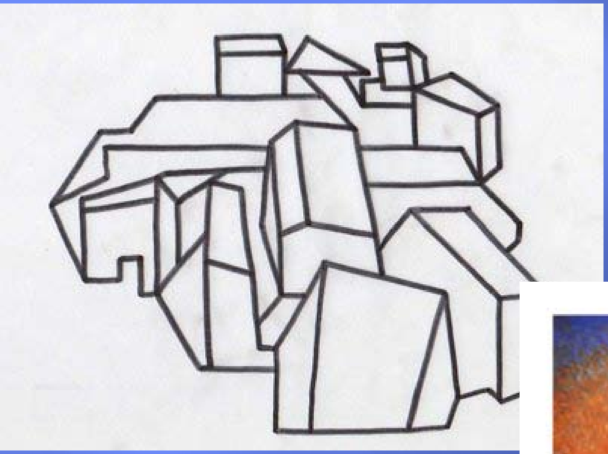
GLOBALLY:
~10-20% AS BIG AS REDD

NATIONALLY:
POTENTIALLY MORE IN
COASTAL TROPICAL COUNTRIES

	CO_2 Emissions (Mt/year)
REDD	~4,000
Peat	~2,000
Blue Carbon	~300-900

Mangroves are very rich in Blue Carbon

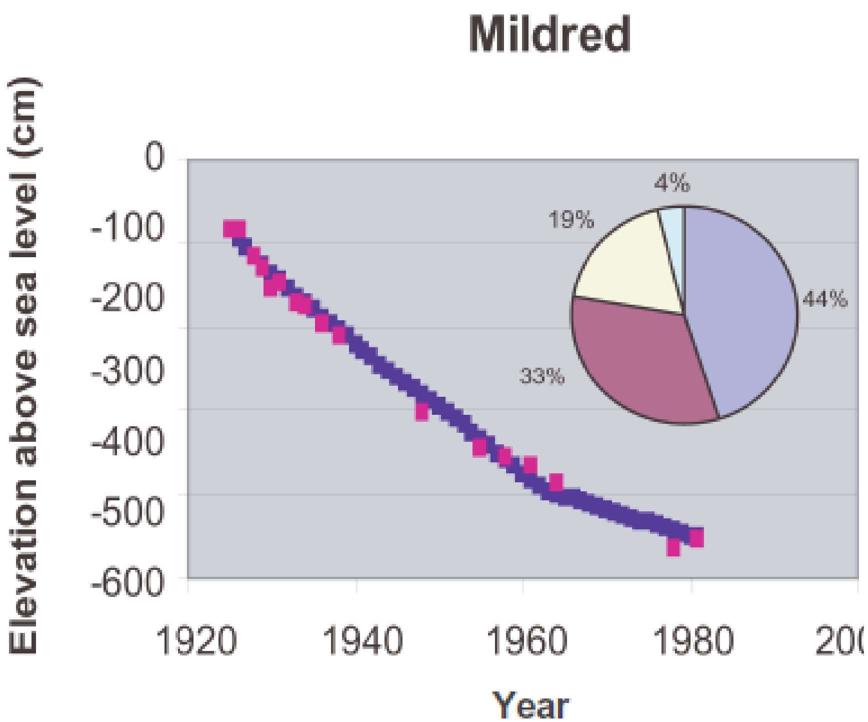
Data Resolution

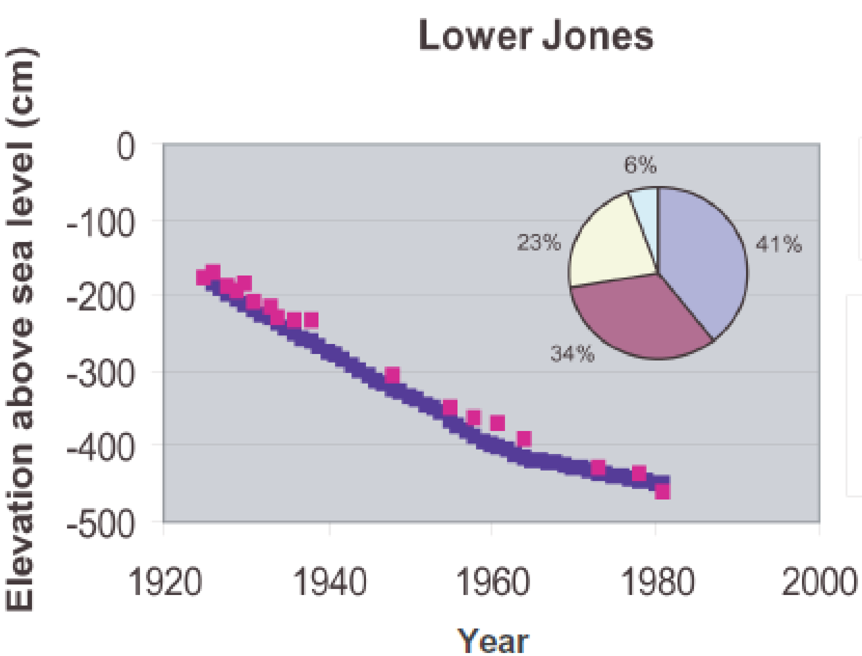


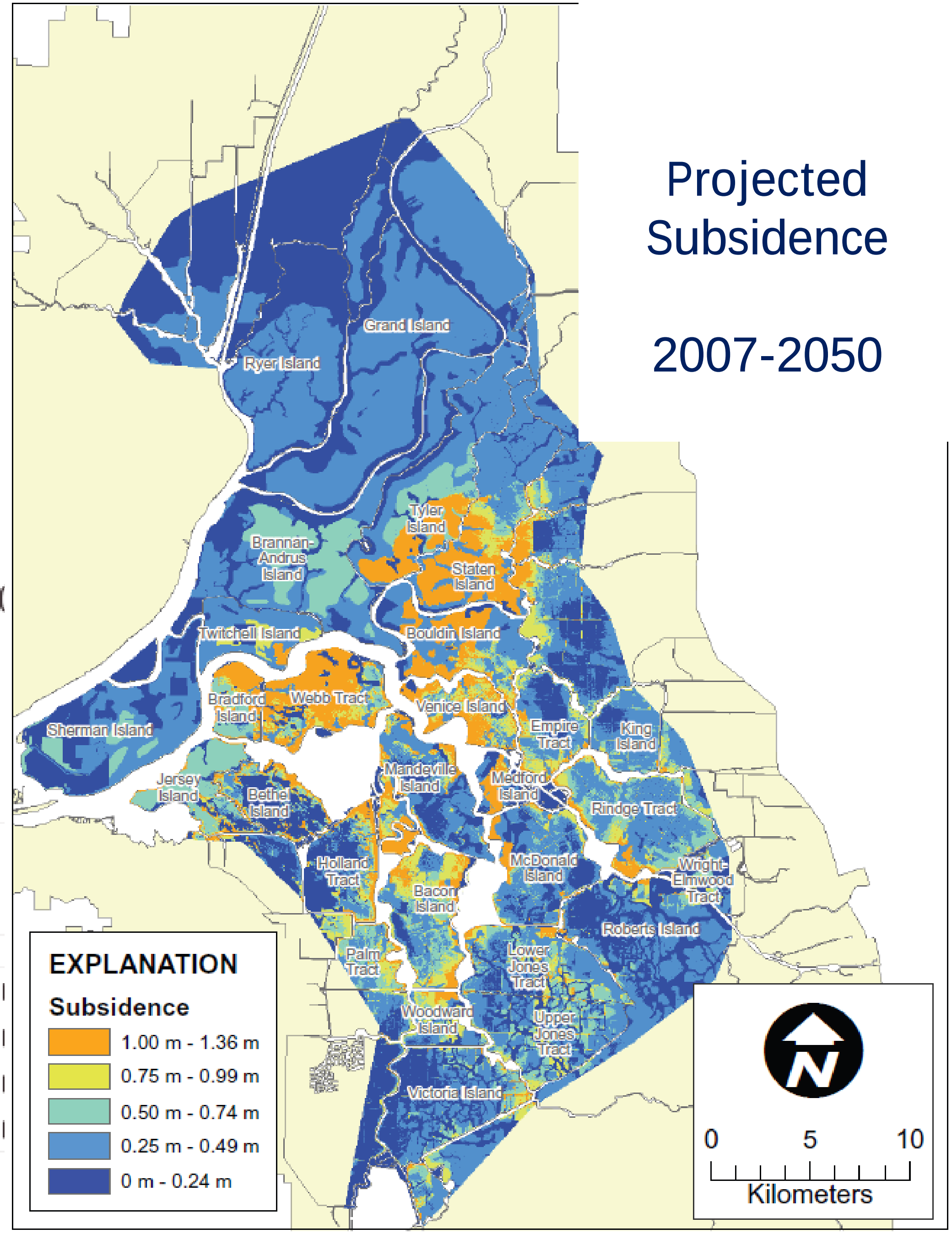
Picasso

Monet

Canaletto



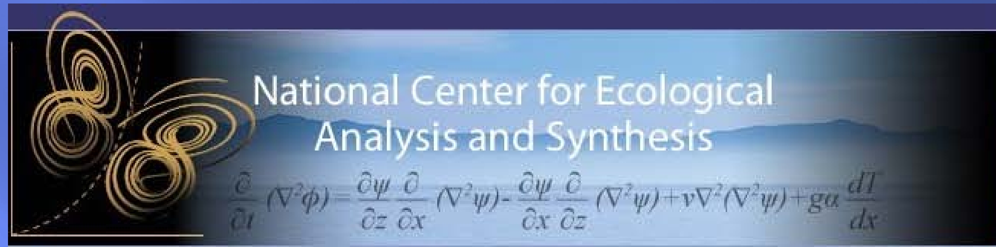




Projected Subsidence

2007-2050

Deverel and Leighton 2010



MEM 2.21

Run Simulation | Restore Inputs

Options

- Simulate Restoration
- Use my biomass profile

Physical Inputs

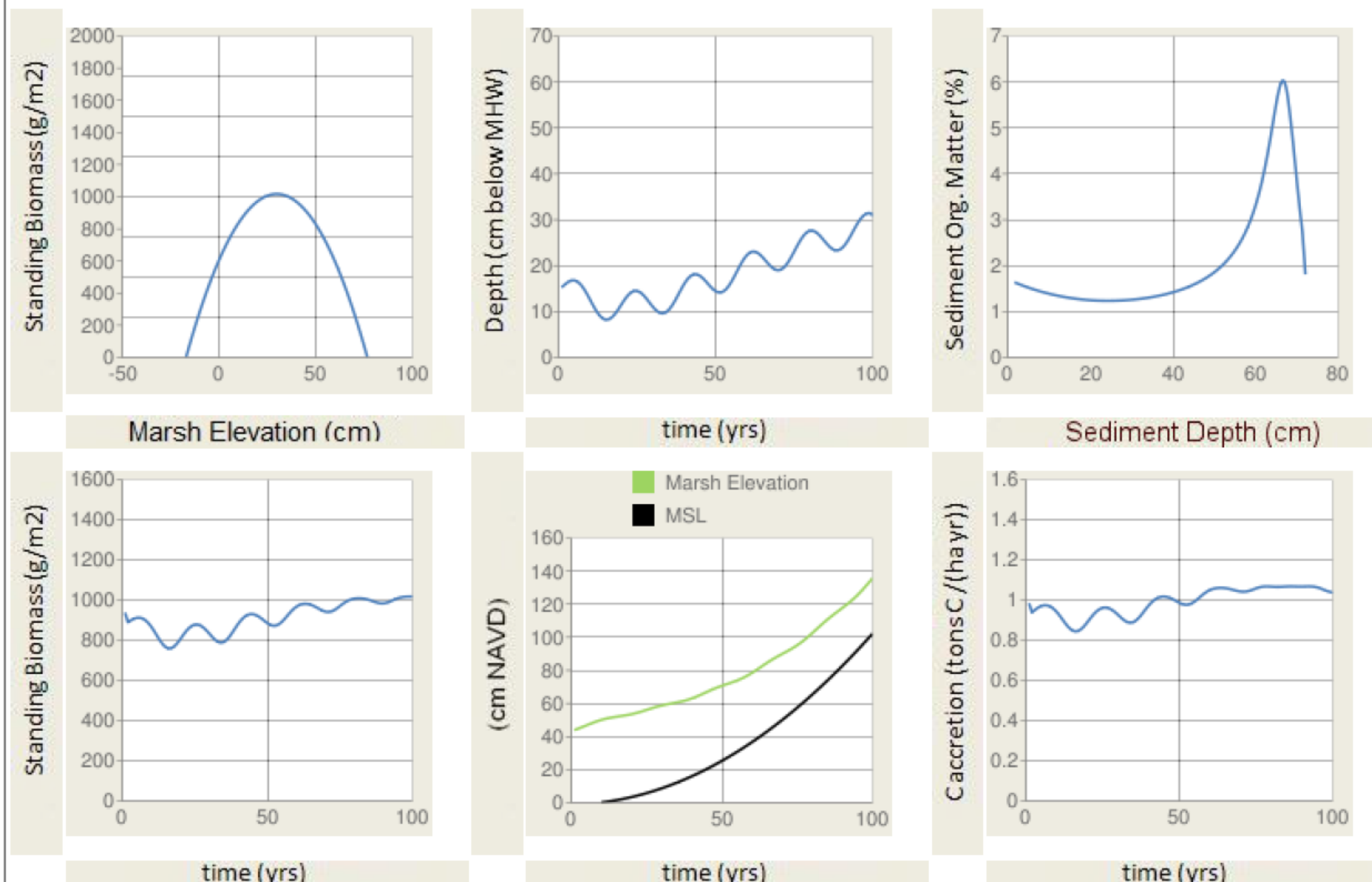
Start	1991	year
Century Sea Level Rise	100	cm
Mean High Water	61.7	cm rel MSL
Mean Sea Level	-2	cm NAVD
Lunar Nodal Amp	3.1	cm
Initial Rate SLR	0.24	cm/yr
Suspended Sed. Conc.	100	mg/l
Marsh Elevation	43	cm NAVD

Biological Inputs

Max Veg Elev	76.7	cm
Min Veg Elev	-17	cm
Max Peak Biomass	1017	g/m^2
OM Decay rate	-0.2	1/time
BG Input Mult	2.5	g/g
kr	0.1	g/g

Trapping Coef & Settling Velocity

ks	3.27E-02	$cm^{-1}\ yr^{-1}$
q	2.85E-03	$g\ cm^{-2}\ yr^{-1}$



Model Instructions

Model Output

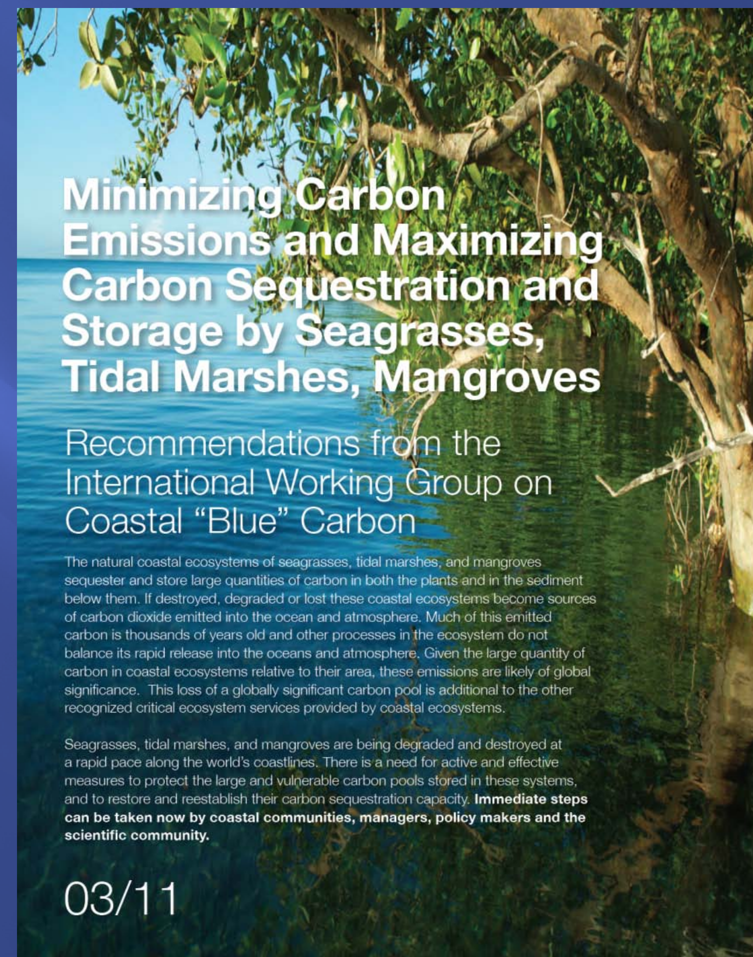
JT Morris 6-9-10

International Blue Carbon Science Working Group

Second Meeting – July 2011

Guidance: National Accounting of Stocks and Emissions

Global Coastal Carbon Data Archive



Needed Data – GHG Emissions

Estimates of CO_2 efflux from mangroves and similar systems with peat soils

Habitat	Modification	CO_2 efflux tonnes km^{-2} $year^{-1}$	Method	Reference
Mangrove, Belize	Cleared	2900	CO_2 efflux	THIS STUDY
Mangrove, Honduras	Forest damaged by hurricane	1500	Inferred from peat collapse	Cahoon et al. 2003
Mangrove, Australia	Shrimp pond	1750 (220-5000)	CO_2 efflux	Burford and Longmore 2001
Rainforest, Indonesia	Drained for agriculture	3200	Inferred from peat collapse and measured as CO_2 efflux	Couwenburg et al. 2010 and references therein
Tundra, Alaska	Thawed	150-430	CO_2 efflux	Schuur et al. 2009

Lovelock et al., 2011

Conclusions

Coastal wetlands hold large stocks of carbon that are vulnerable to release

Conservation is the most effective mechanisms to manage coastal blue carbon

Restoration can halt and reverse emissions

We can readily quantity emissions and avoided emissions– data collection needed

Science would be stimulated if policies were developed

Just as there is a very strong case for protecting forests and peatlands,
there is a very strong case for protecting coastal wetlands for their carbon resources and broader ecosystem goods and services