The Rapidly Evolving Science of Coastal Blue Carbon: What's Known and What Do We Want to Know

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ESA PWA

Blue Carbon, Green Opportunities

Society of Wetlands Scientists / INTECOL
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Ecosystems in focus for climate change mitigation

Forest

Peatland

Mangroves

Tidal Marshes

Seagrass

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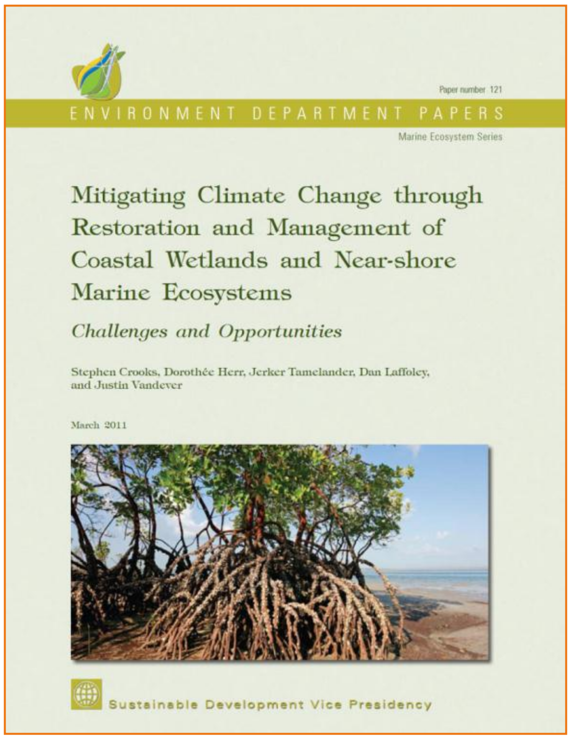
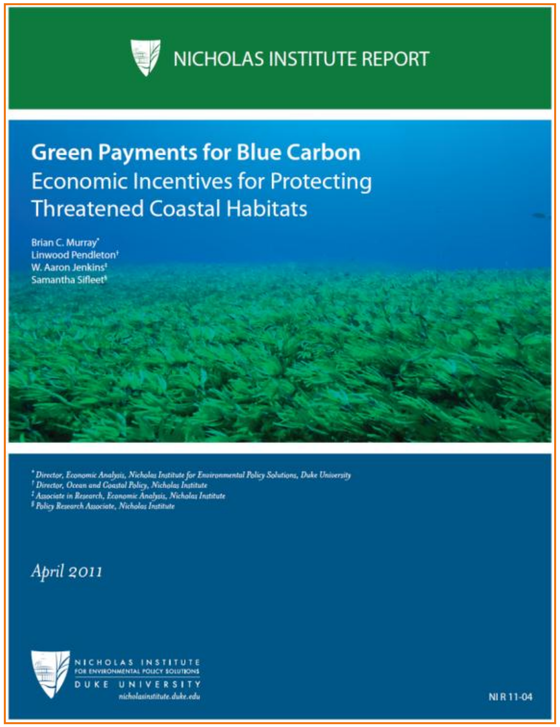
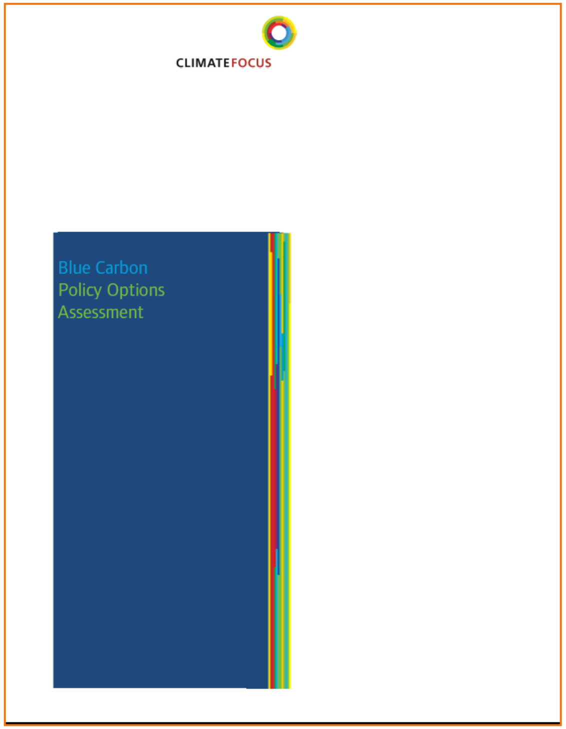
Blue Carbon: Emissions, Economics and Policy



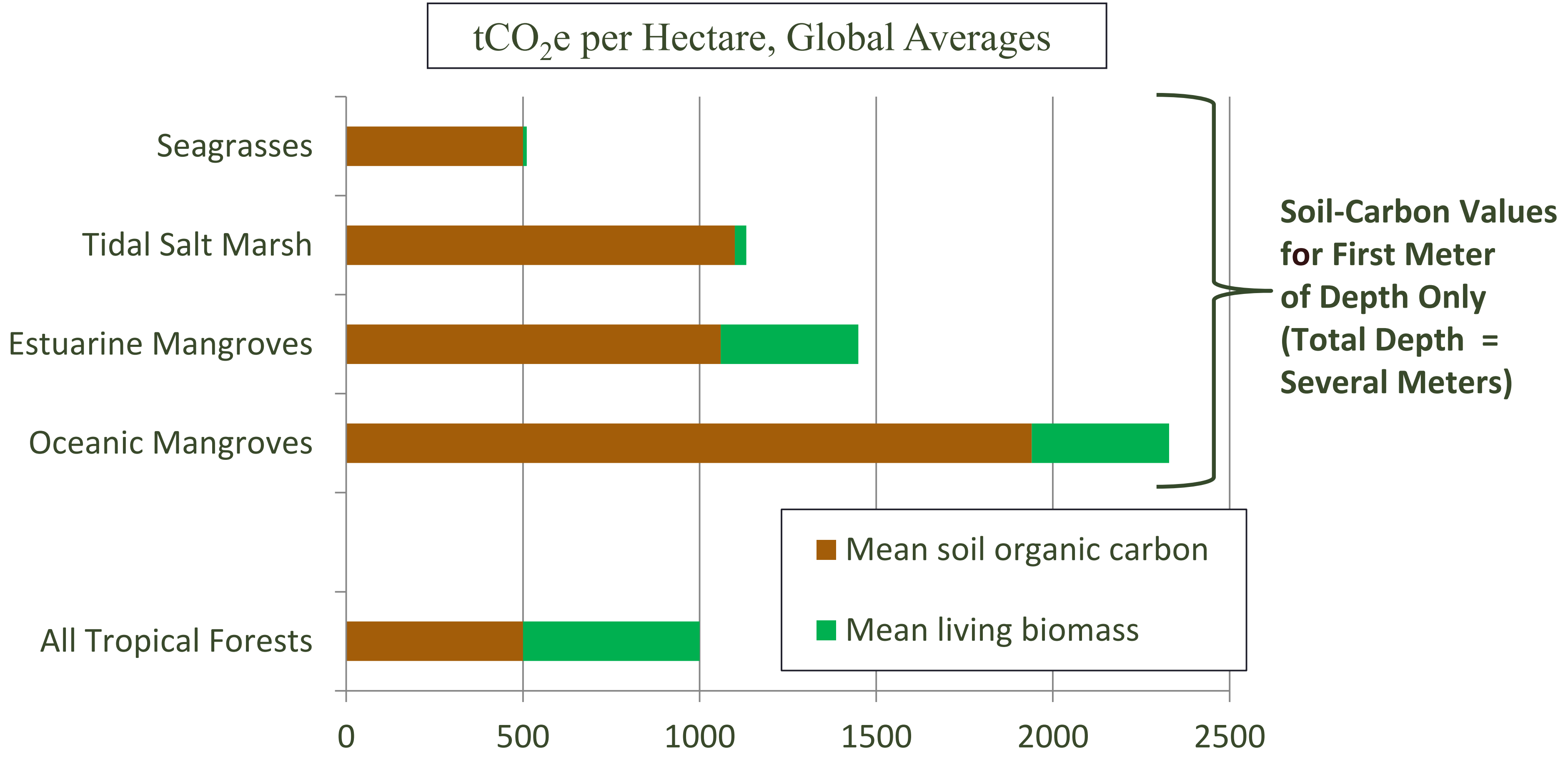




http://estuaries.org/climate-change.html

Coastal ecosystems: long-term carbon sequestration and storage

Distribution of carbon in coastal ecosystems

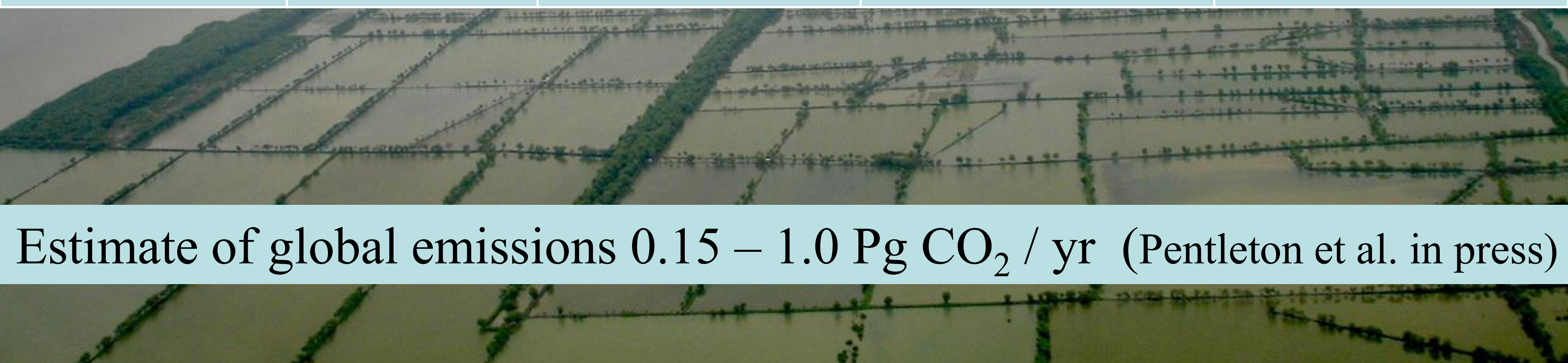


Data summarized in Crooks *et al*., 2011; Murray *et al*., 2011, Donato et al., 2011


Photo by Cath Lovelock

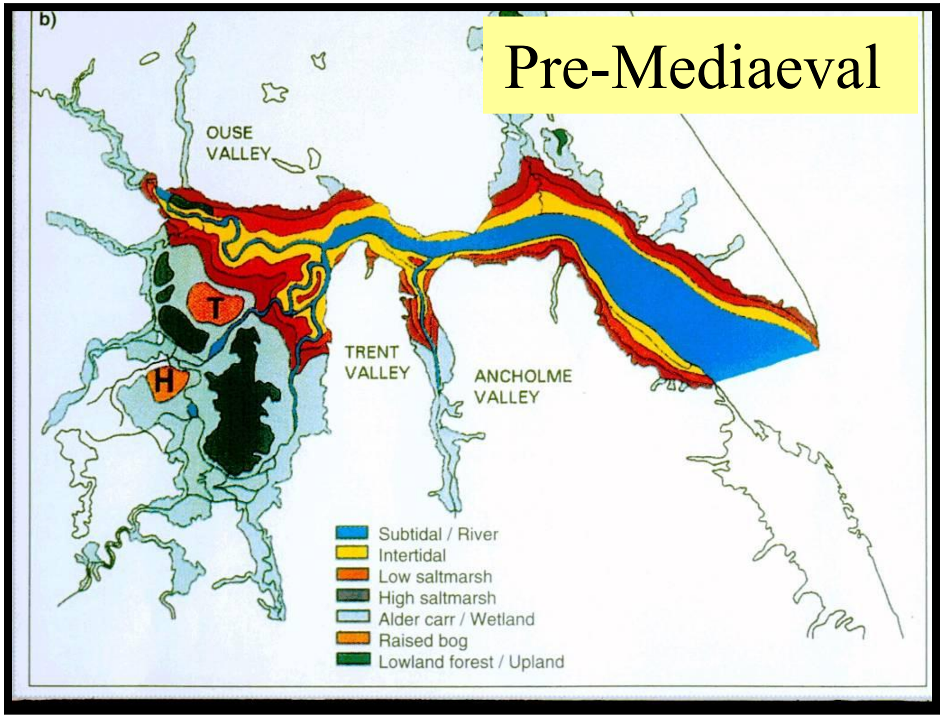
Rates of Wetland Loss

Ecosystem	Global Extent (km^2)	Annual Rate Of Loss (%)	Total Stock (top meter) Pg C	Reference (stock estimates)
Tidal Marsh	400,000?	1 - 2	?	
Mangrove	160,000	1 - 2	14.7 - 73.0	Donato et al 2011
Seagrass	300-600,000?	1 - 2	15.4 - 30.8	Fourqurean et al. 2012



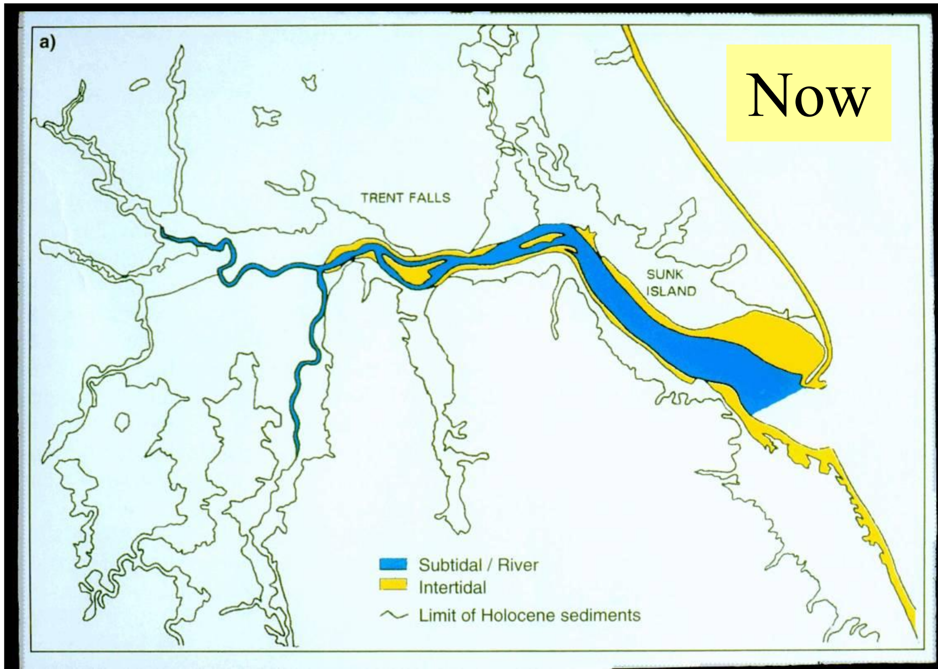
Estimate of global emissions 0.15 – 1.0 Pg CO_2 / yr (Pentleton et al. in press)

Progressive change of our coastlines



The Humber Estuary

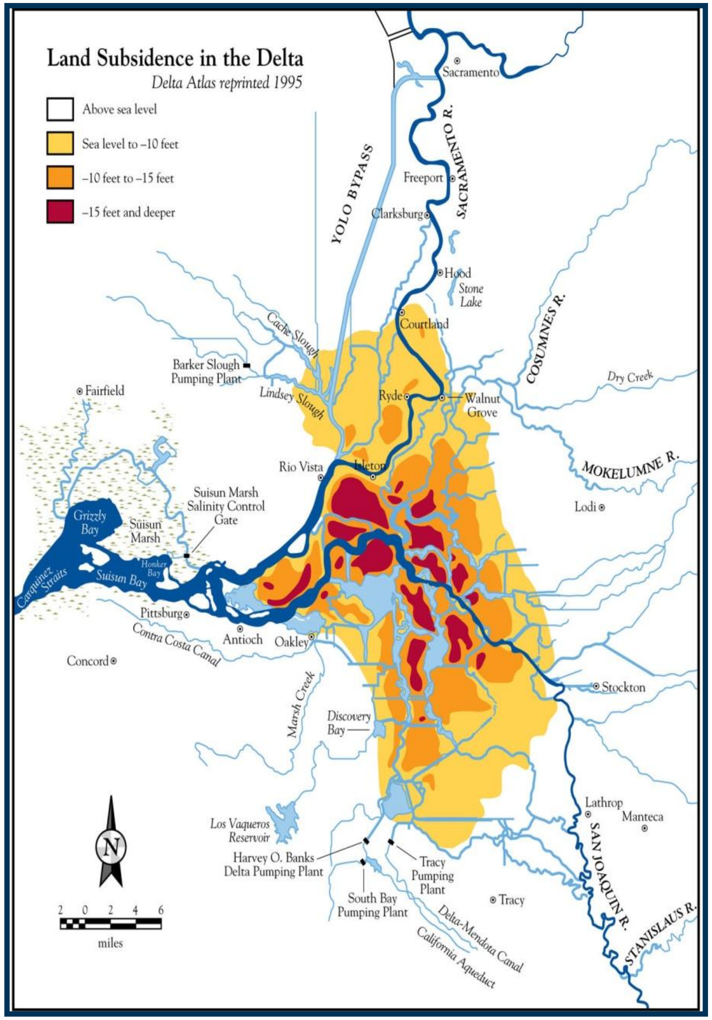
Extensive diked wetlands
Post industrial estuary
Agricultural run-off



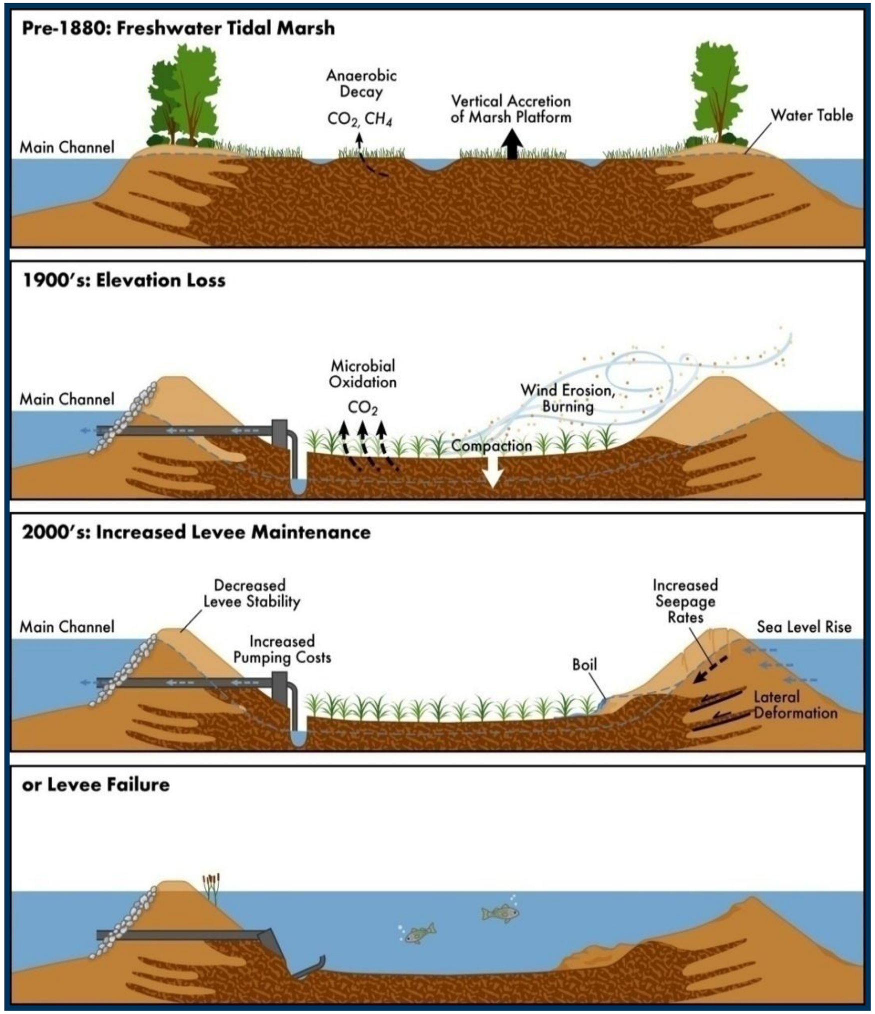
405 km of levees
870 km^2 of drained wetlands

C deposition >99% decrease
Release of historic carbon
Andrews et al., 2000, 2006

Long-term release of carbon from organic soils



Sacramento - San Joaquin Delta



Emissions from One Drained Wetland: Sacramento-San Joaquin Delta

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

5 million tCO_2/yr
released from Delta

1 $GtCO_2$ release in c.150 years
4000 years of carbon emitted
Equiv. carbon held in 25% of
California's forests

Accommodation space: 3 billion m^3

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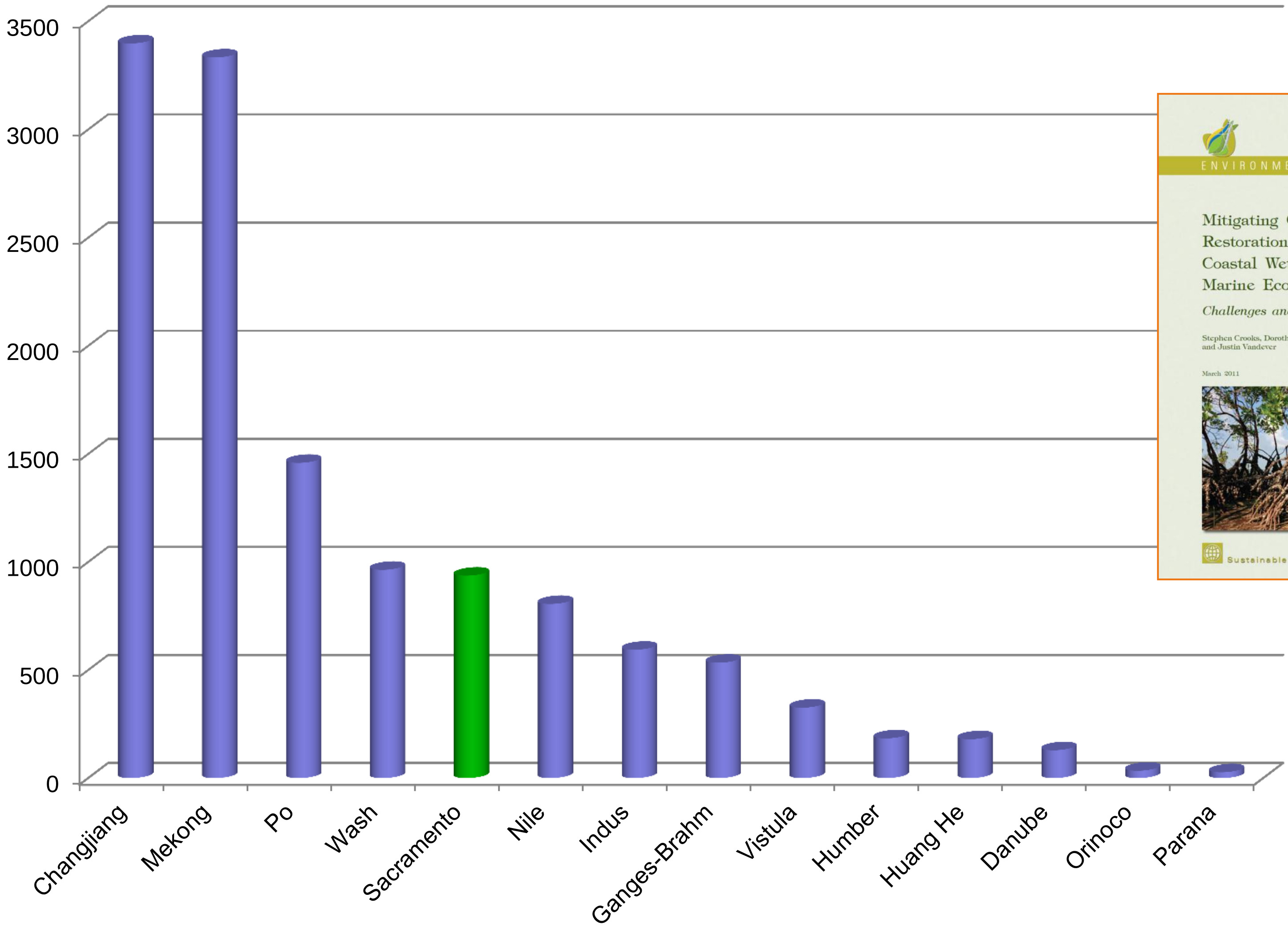
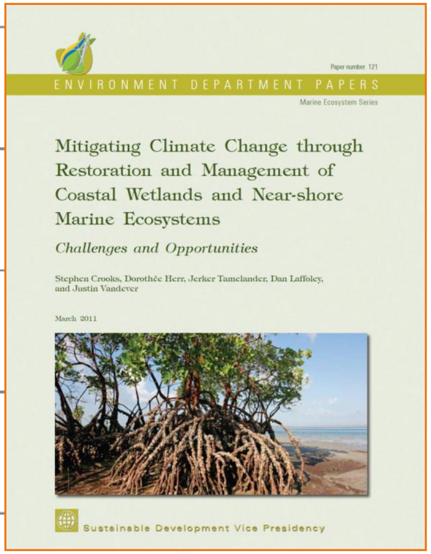
CO_2 Emissions from drained coastal wetlands (million tons)





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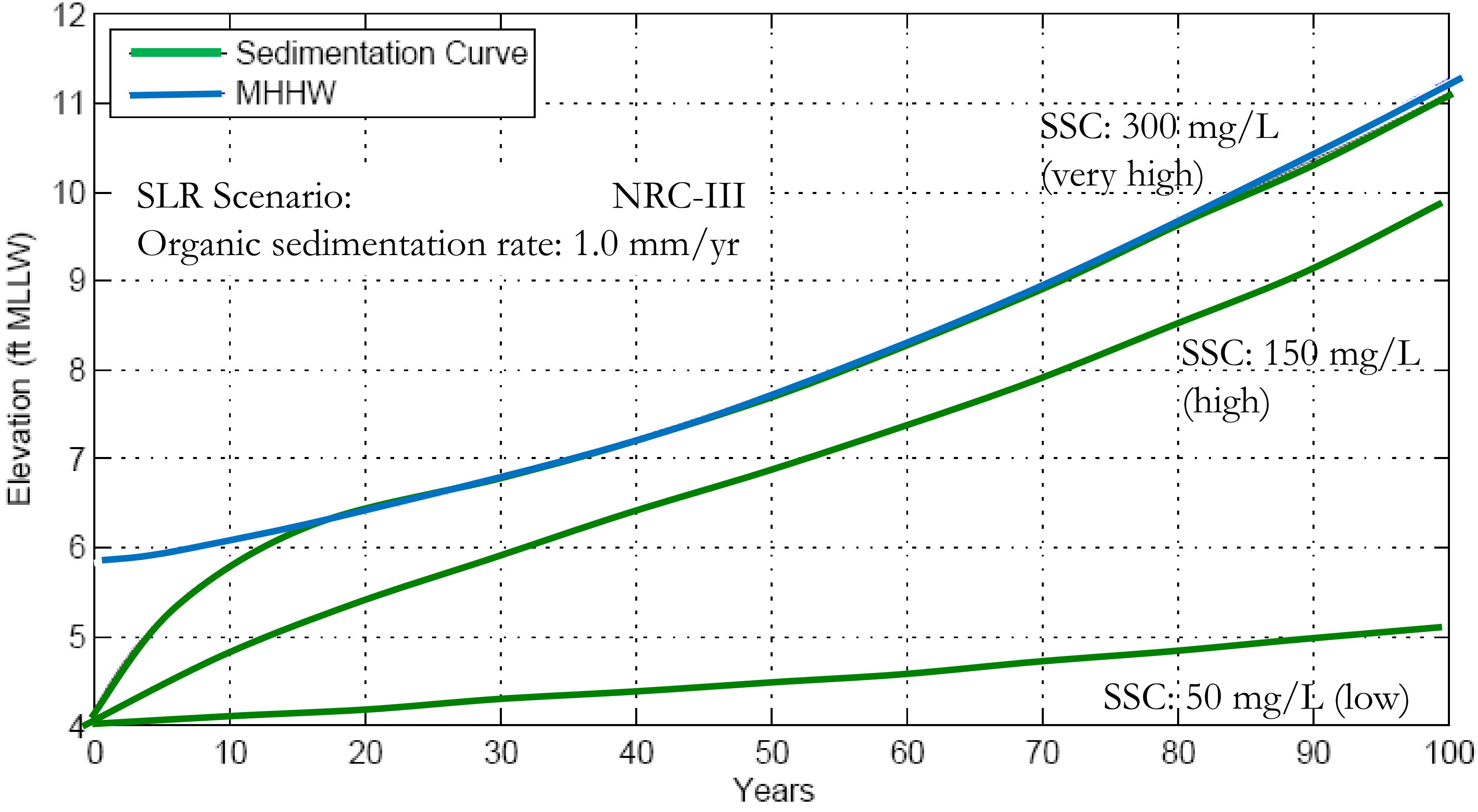
Emissions from drained wetlands organic soils

Ecosystem	Modification	CO_2 efflux t/ ha / a	Method	Reference
Mangrove (Belize)	Cleared	29	CO_2 efflux	Lovelock et al. 2011
Mangrove (Honduras)	Forest damaged by hurricane	15	Inferred from peat collapse	Cahoon et al. 2003
Mangrove (Australia)	Drained for agriculture	32	Peat collapse and CO_2 efflux	Couwenburg et al. 2010
FWT marsh (California)	Drained for agriculture	6-40	Peat collapse and CO_2 efflux	Rojstaczer & Deverel 1993; Deverel & Leighton 2010; Hatala et al. 2011
FWT marsh (Po Delta)	Drained for agriculture	92 ± 55	Peat collapse and CO_2 efflux	Camporese et al. 2008; Zanello et al.2011

What about remaining wetlands?

Low Marsh Response to SLR for Ranging Sediment Availability



Modeled with Marsh98

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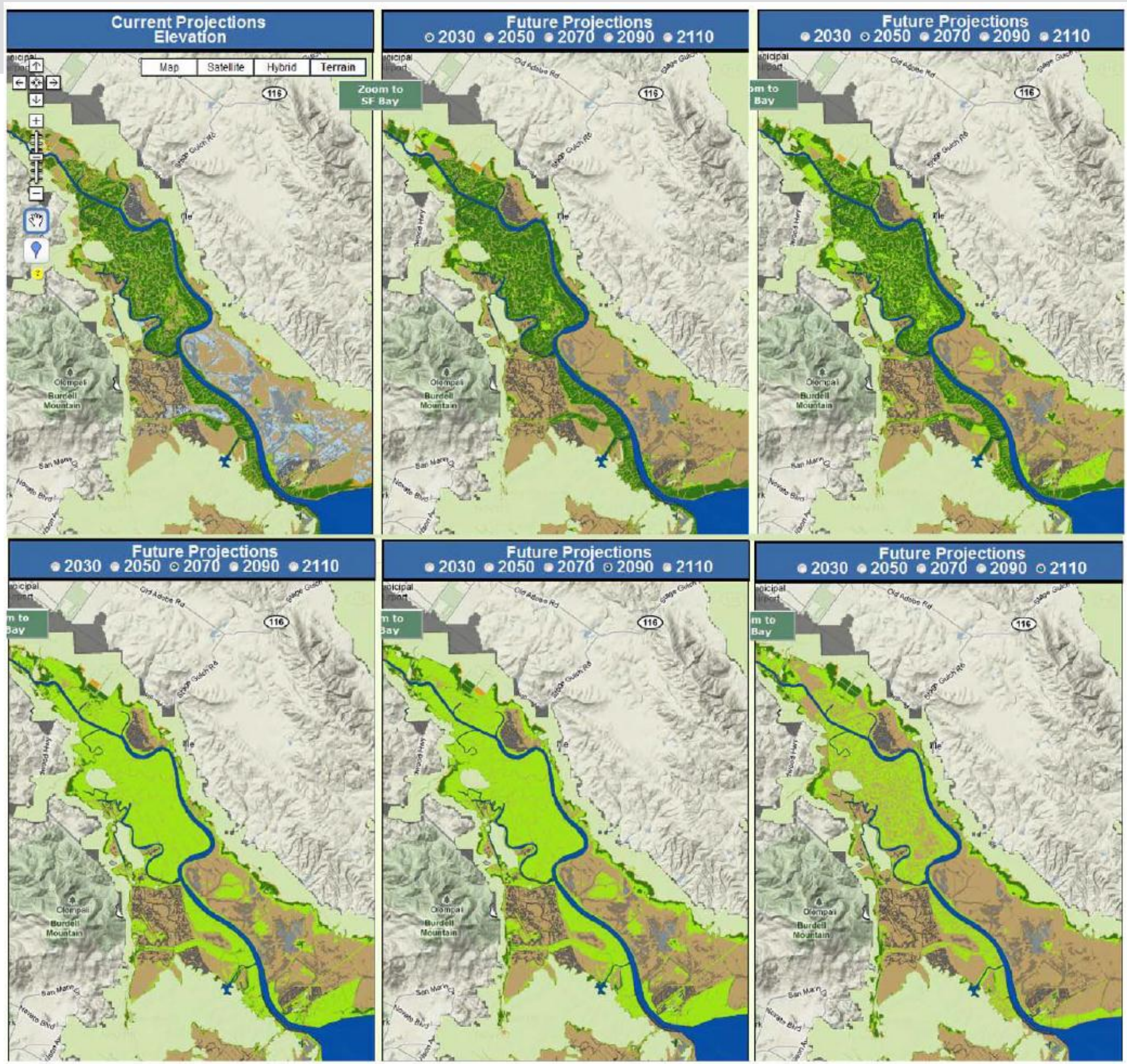


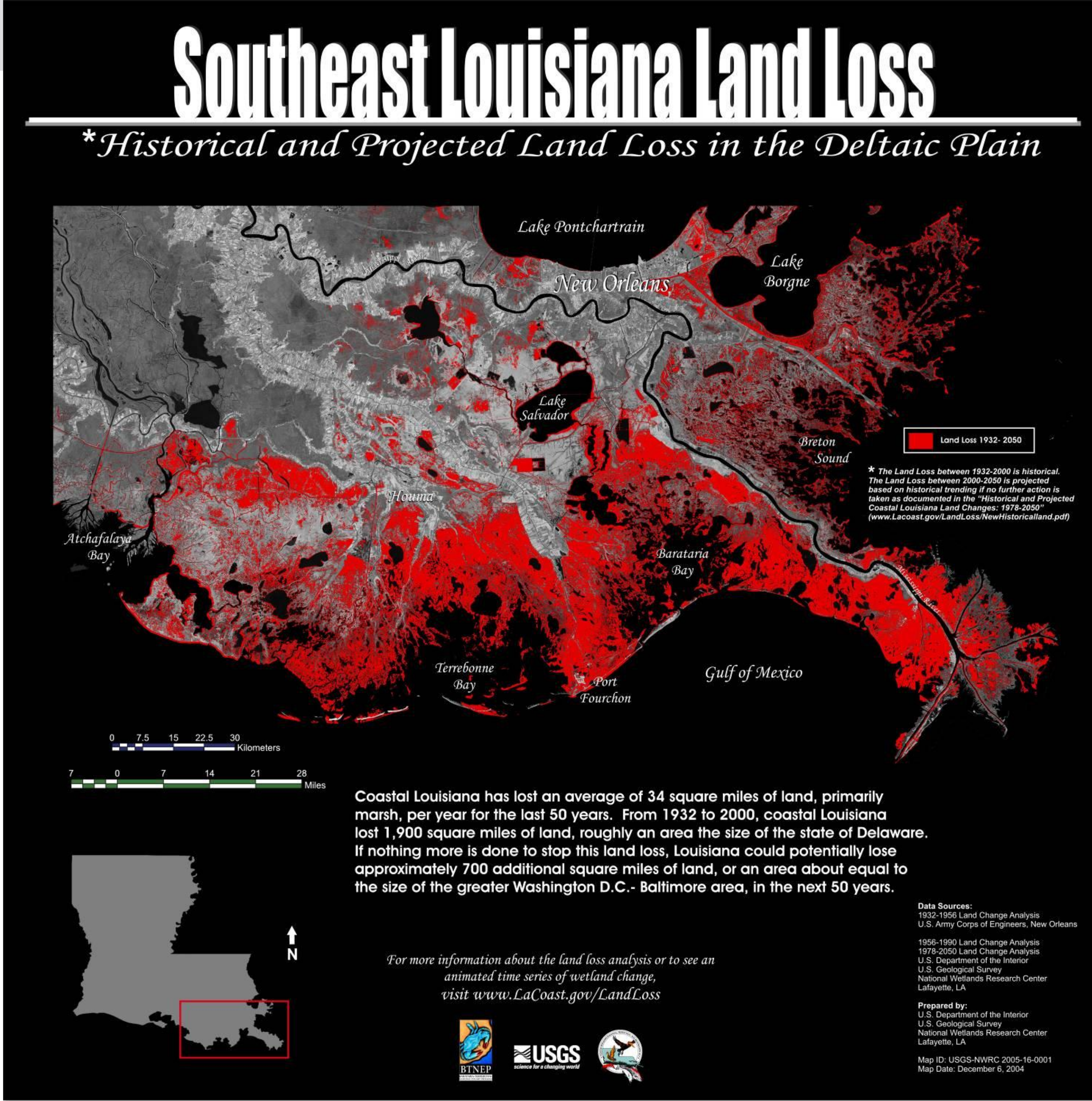
Stralsburg et al. 2011

Large-scale Emissions, or not?

Wetland loss:
100 km^2 /yr

If top 50 cm erodes then 27.5TgCO_2
Released in to circulation

But what is its fate???



Information needs - quantification

- CO_2, CH_4 and N_2O fluxes in wetlands across salinity gradients and under ranging conditions of nitrogen loading.
- GHG fluxes for undisturbed, **converted** and restoring wetlands
- Wetland carbon stocks - better global coverage
- Fate of C & N released from eroding wetlands
- Contribution of DOC to global warming

Information needs - models

- GHG emissions / reductions with landscape change – wetland migration, conversion.
- Process-based models to understand science of C&N cycling (e.g. DNDC)
- Simplified monitoring approaches / indicators
- Default factors of emissions and removals with activities.

Information needs - mapping

- Intact and degraded salt marsh and seagrasses
- Subclasses of coastal wetlands (can we connect to cover to geomorphology and below ground processes?)
- Drained wetlands, soil classification (C%)

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Information needs - technology

- Near surface atmospheric GHG monitoring
- High resolution surface elevation mapping
- Less costly monitoring equipment

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