Louisiana Blue Carbon Science Highlights, Landscape-Scale Carbon & Additional Research Needs?

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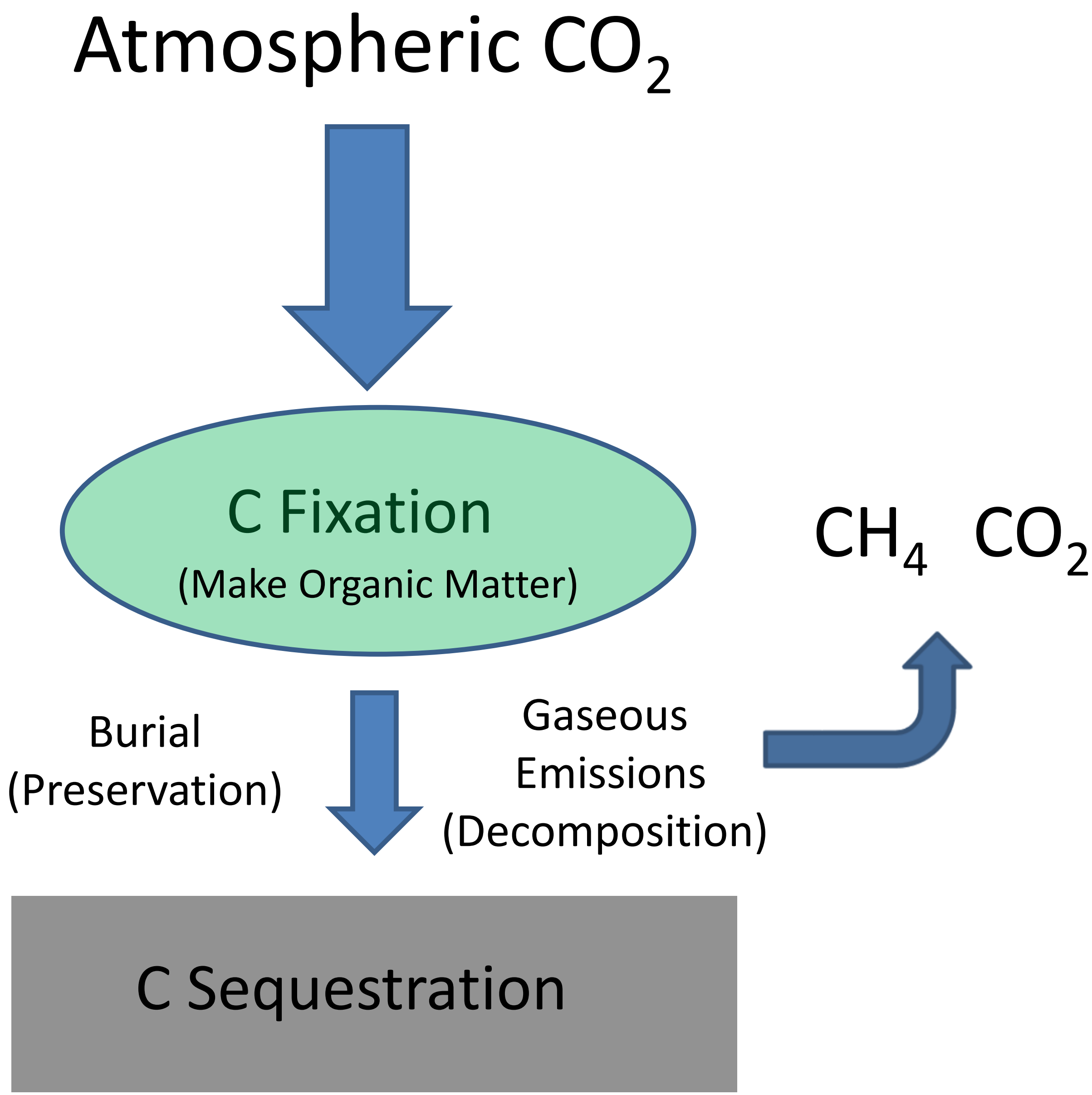
Louisiana State University



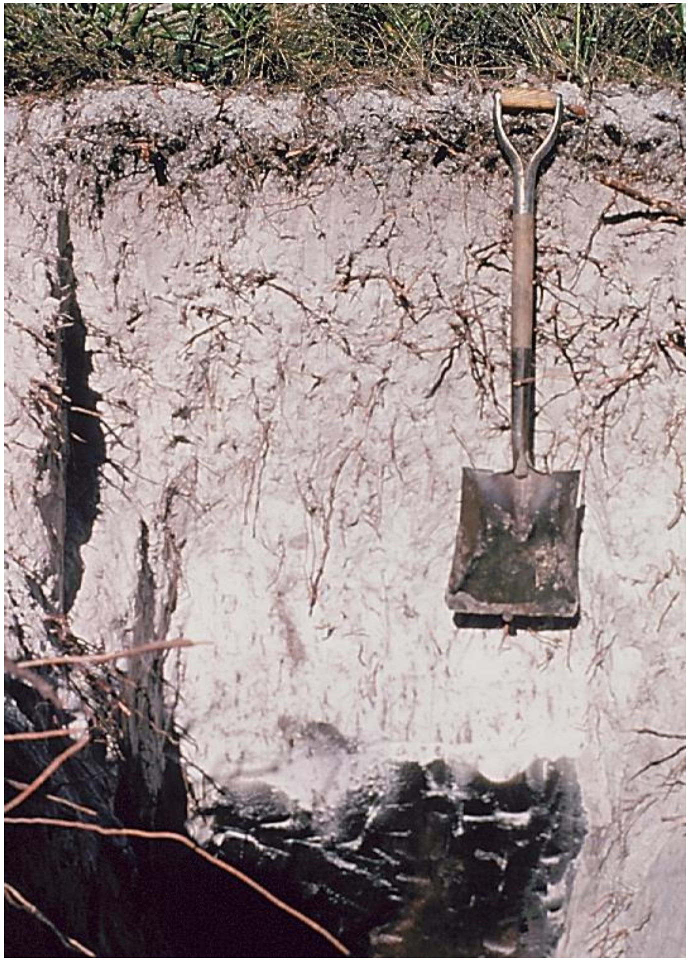
Atmospheric CO_2
C Fixation
(Make Organic Matter)
CH_4 CO_2
Burial
(Preservation)
Gaseous
Emissions
(Decomposition)
C Sequestration

Global Carbon Reservoirs [10^{14} kg]

• Atmospheric CO_2	7
• Biomass	4.8
• Fresh water	2.5
• Marine	5-8
• Soil organic matter	30-50

Reddy and DeLaune, 2008

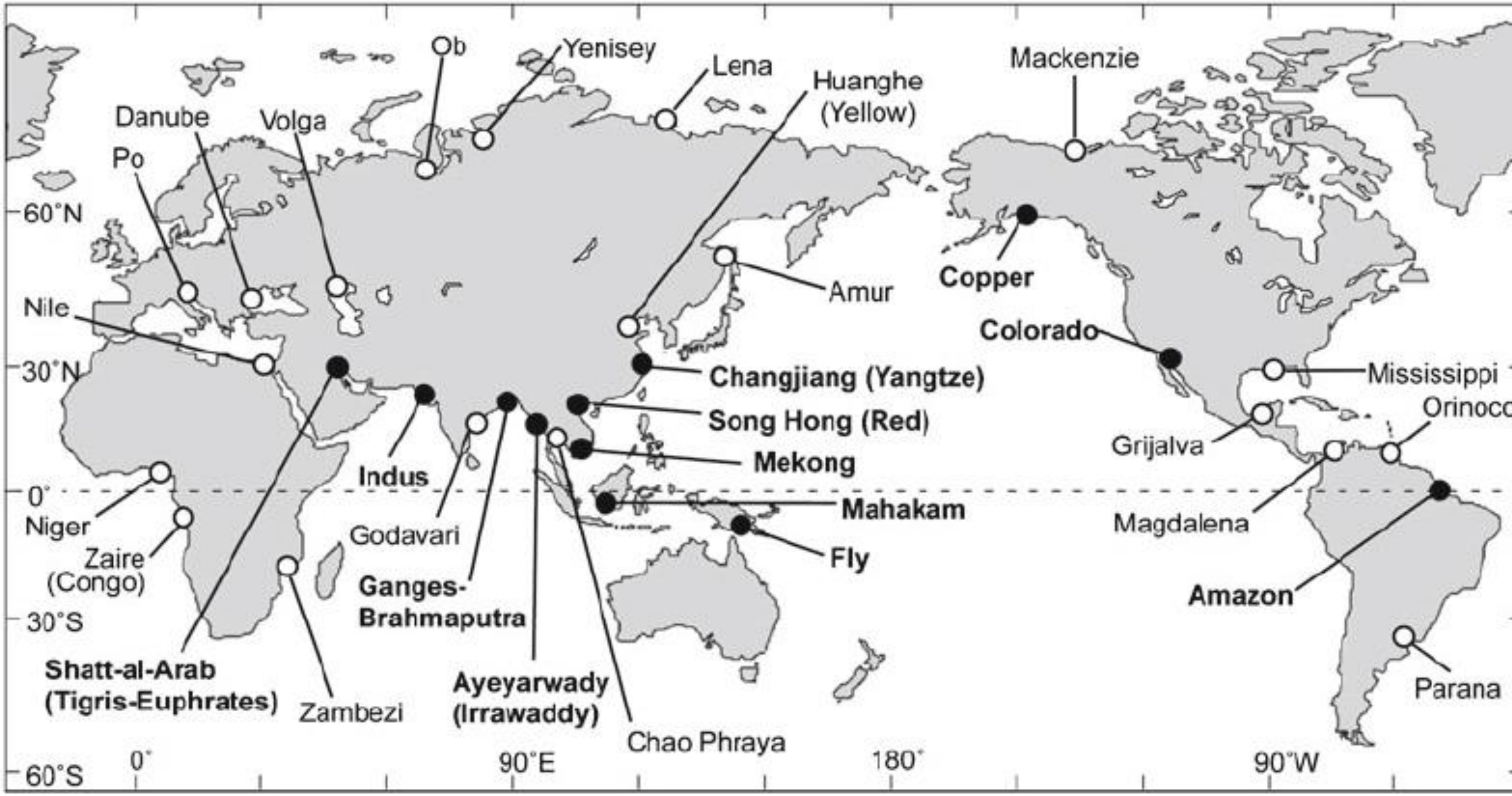
Will Any Soil Do ?



Will Any Soil Do ?   No

- Upland soils typically range in 1- 6 % carbon
- Wetland peat soils range 30-40 % carbon
- Wetland peats on average have more than 10x more carbon stored

World's Coastal Deltas



Formed as sea level slowed ~ 7000 ybp

Exist as fresh water/fresh marsh expanses within the salty coastal zone

World's Coastal Deltas

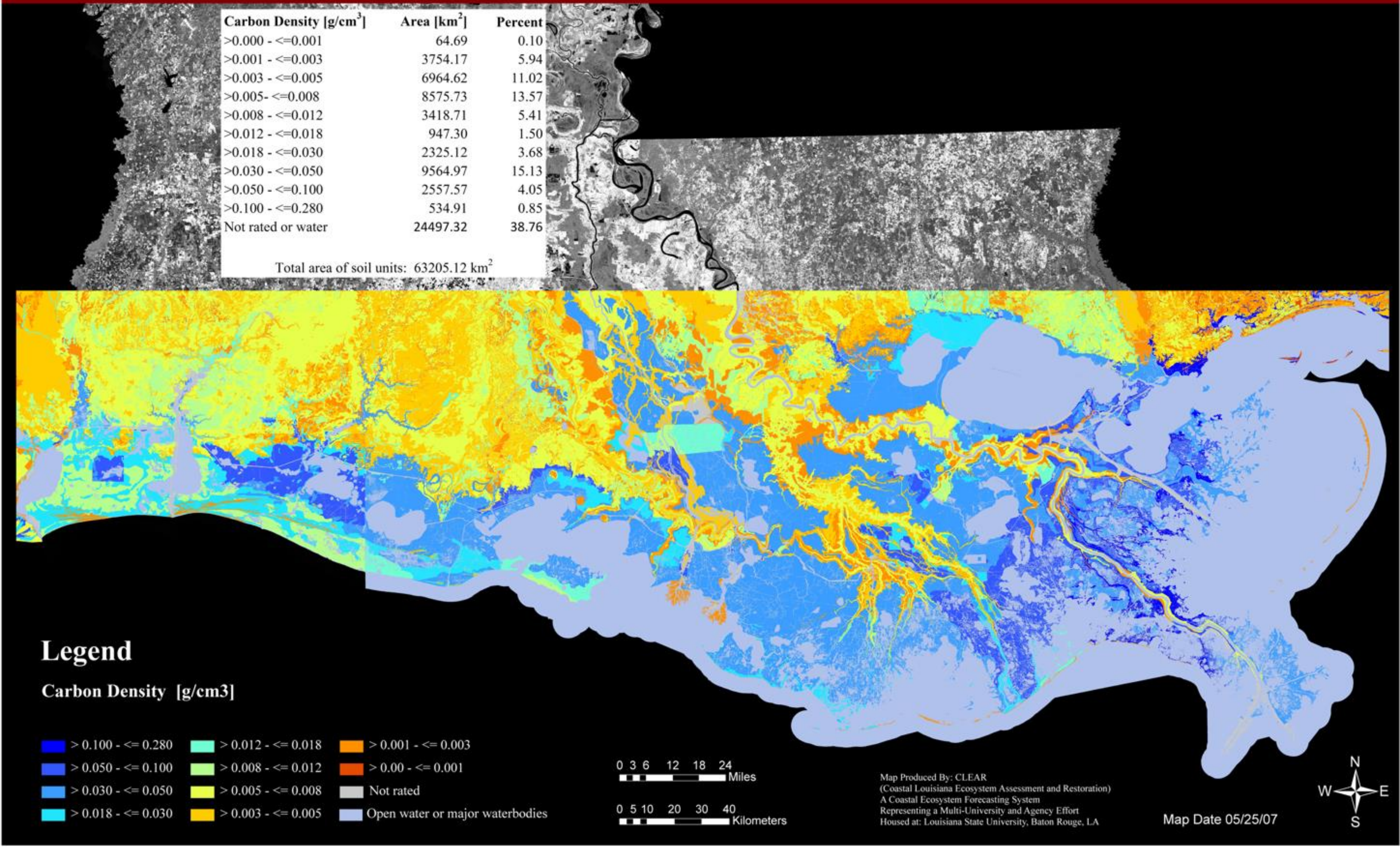
Through coupled processes of subsidence and sea level rise, Deltas can play a substantial role in the global carbon cycle

R.R. Twilley

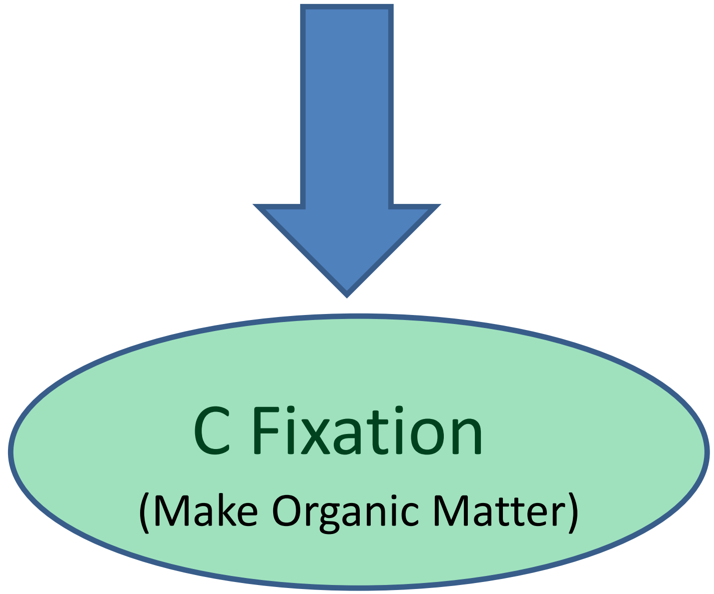
Carbon Density

Carbon Density [g/cm^3]	Area [km^2]	Percent
>0.000 - <=0.001	64.69	0.10
>0.001 - <=0.003	3754.17	5.94
>0.003 - <=0.005	6964.62	11.02
>0.005- <=0.008	8575.73	13.57
>0.008 - <=0.012	3418.71	5.41
>0.012 - <=0.018	947.30	1.50
>0.018 - <=0.030	2325.12	3.68
>0.030 - <=0.050	9564.97	15.13
>0.050 - <=0.100	2557.57	4.05
>0.100 - <=0.280	534.91	0.85
Not rated or water	24497.32	38.76

Total area of soil units: 63205.12 km^2



Atmospheric CO_2

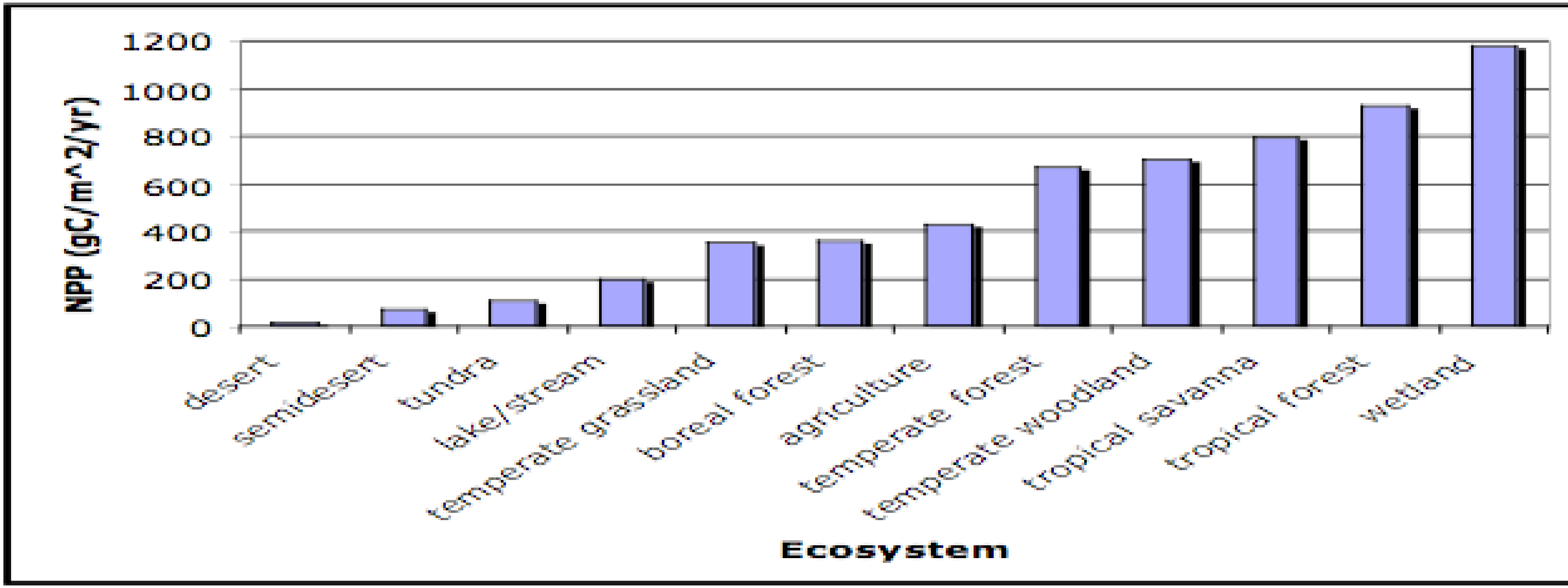


We need plants !

Will Any Plant Do ?

Horsfield nursery

Will Any Plant Do ? No



Miami of Ohio

Wetland Area in Louisiana

CO_2 CO_2 CO_2 CO_2 CO_2 CO_2 CO_2

26 % of all wetlands in the contiguous United States

40 % of all coastal wetlands


Area of Coastal Marsh ~ 988,888 ha

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[10^{14} kg]

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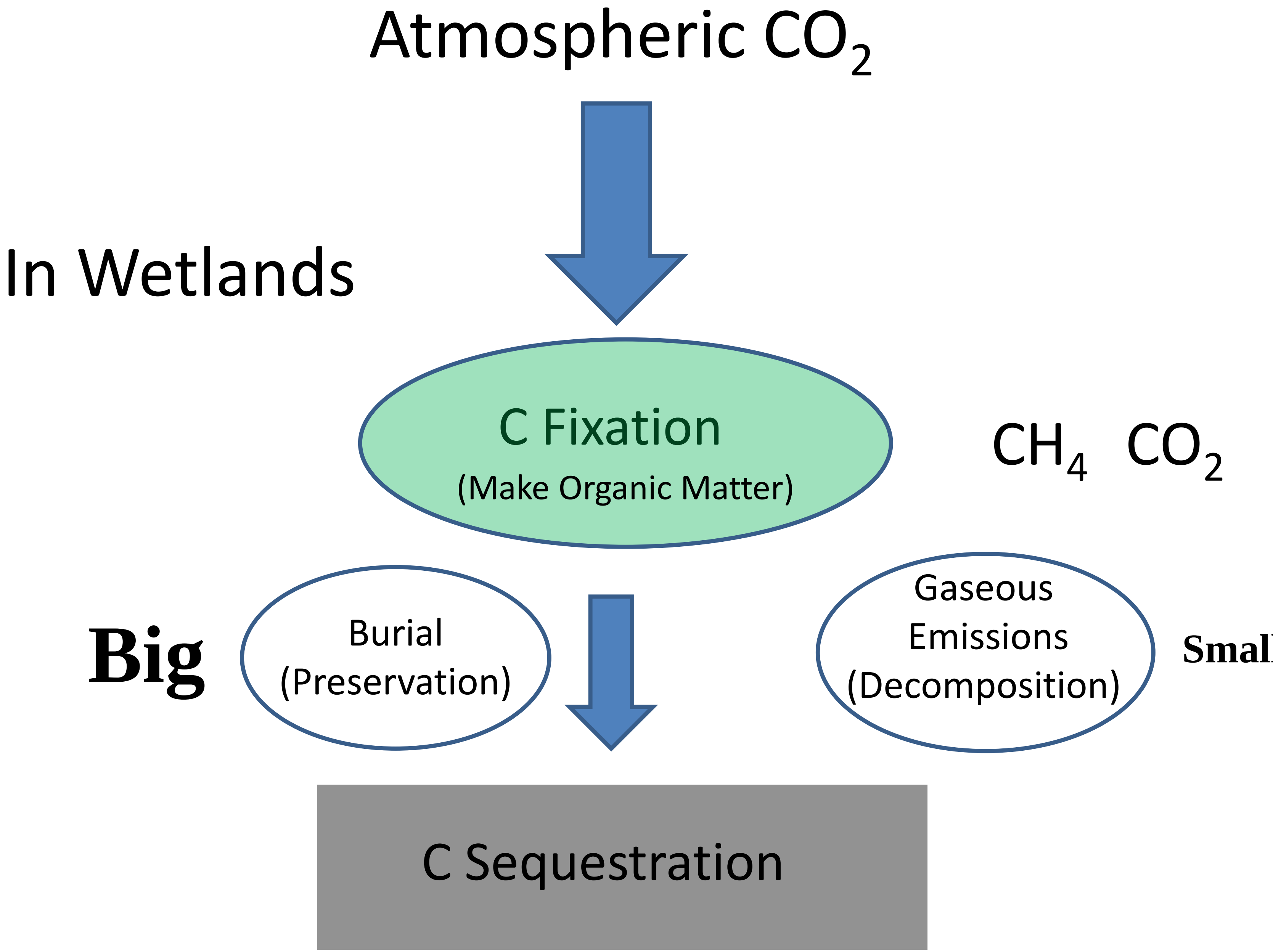
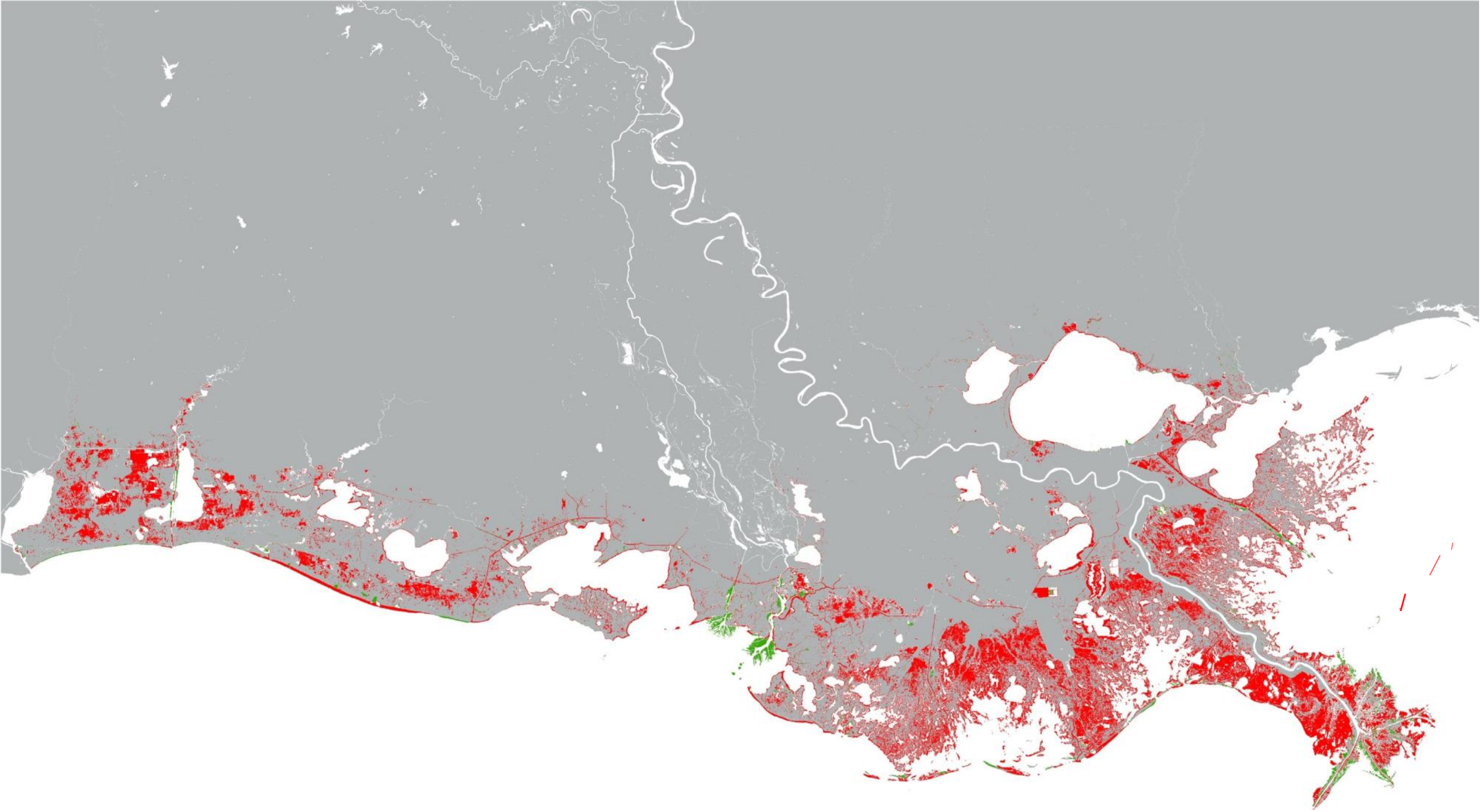
Blue Carbon

- Decomposition of organic matter is driven by oxygen availability
- Oxygen diffuses through water 10,000 times slower than in air
- Wet environments become anaerobic and the rate of decomposition is very slow


Atmospheric CO_2
In Wetlands
C Fixation
(Make Organic Matter)
CH_4 CO_2
Big
Burial
(Preservation)
Gaseous
Emissions
(Decomposition)
Small
C Sequestration

Land 1932



Land change 1932-2010

Land 1932

Land 2010

But Wait, there's more !

From USGS Report by Barras et al. 2004

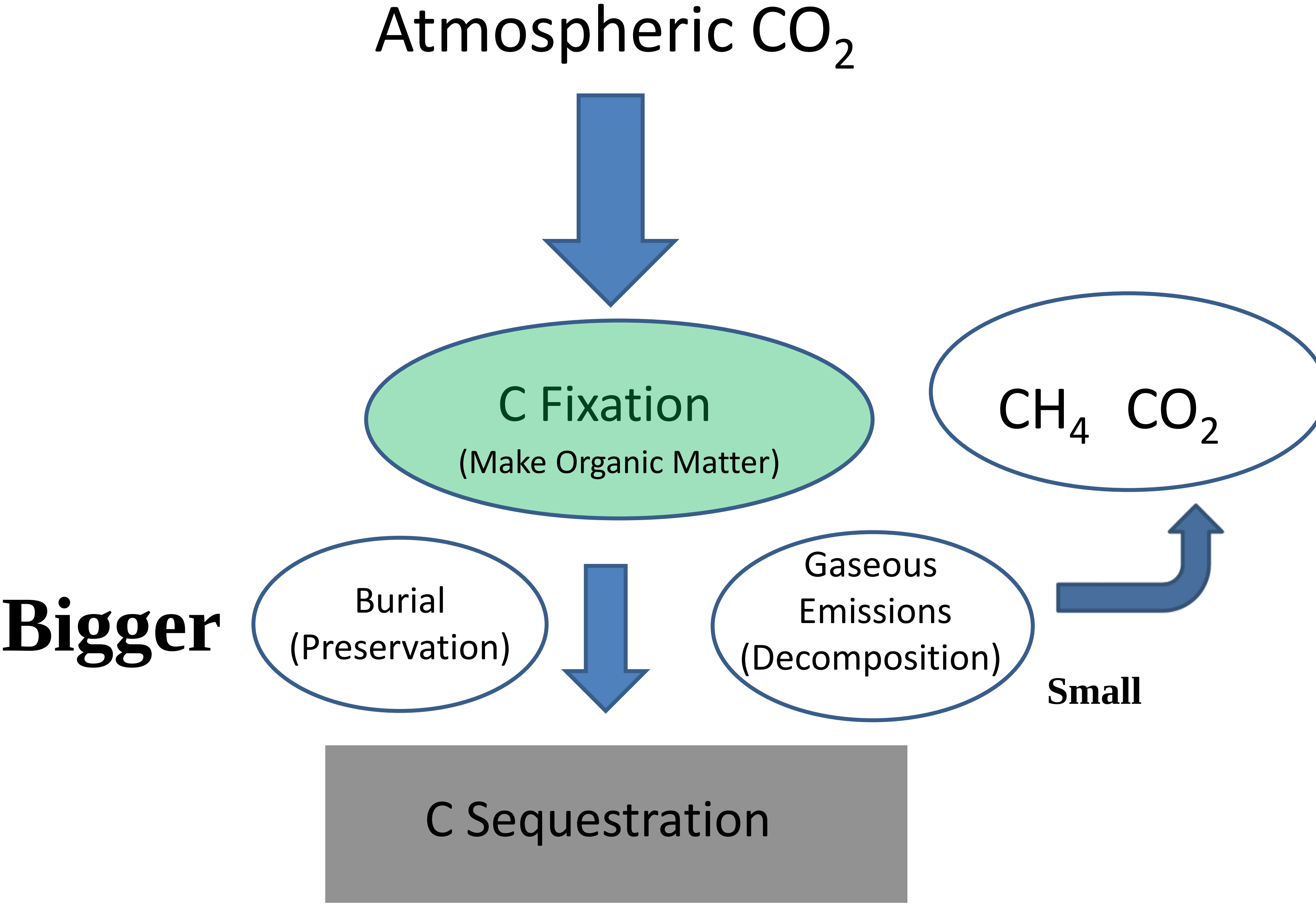
Combined Effects of Global Eustatic Sea Level Rise and Coastal Subsidence

Eustatic Sea Level Rise Rate = 2-3 mm y^{-1}

Mean Subsidence Rate = 9 mm y^{-1}

Greater C Sequestration with faster rising sea level (keeps the C wet)

Coastal wetlands can only accrete C as fast as sea level rises



Atmospheric CO_2
C Fixation
(Make Organic Matter)
CH_4 CO_2
Bigger
Burial
(Preservation)
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Emissions
(Decomposition)
Small
C Sequestration

Peat Mining in Ireland –Release of Carbon Stores

Peat Mining in the Netherlands –Release of Carbon Stores

Annual Carbon Sequestration Assessment For Louisiana Coastal Marshes

Mean of 3 metric tons of C ha^{-1} yr^{-1}

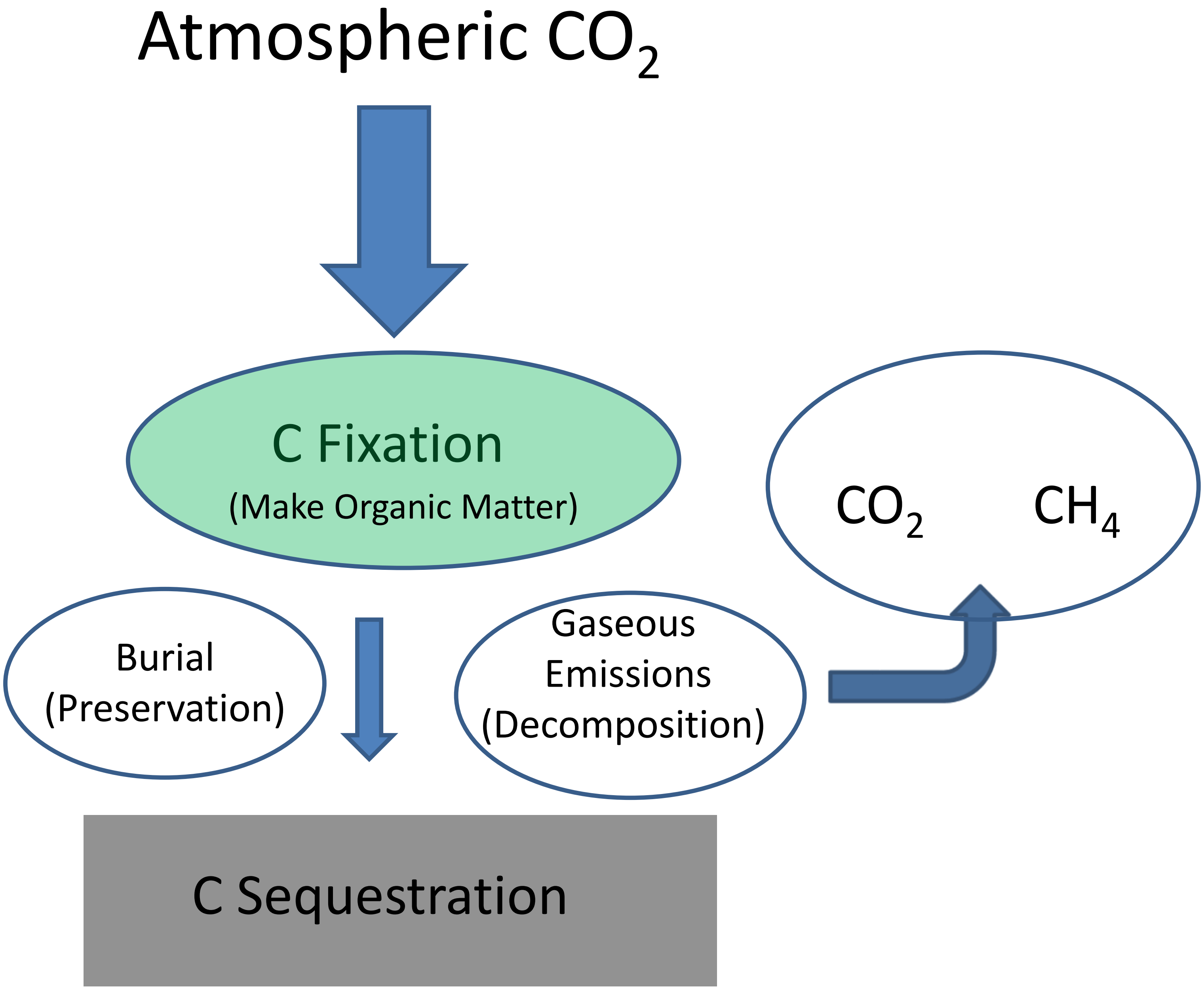
- Freshwater Tidal
- Brackish
- Salt Marsh

Area of Coastal Marsh ~ 988,888 ha

DeLaune, R.D. and J.R. White. 2012. Will coastal wetlands continue to sequester carbon in response to increase in global sea level? A case study of the rapidly subsiding Mississippi River deltaic plain. Climatic Change. 110:297-314

Annual sequestration coast wide:
~ 2,966,664 metric tons/yr

At $15 per ton; $44,499,960/yr



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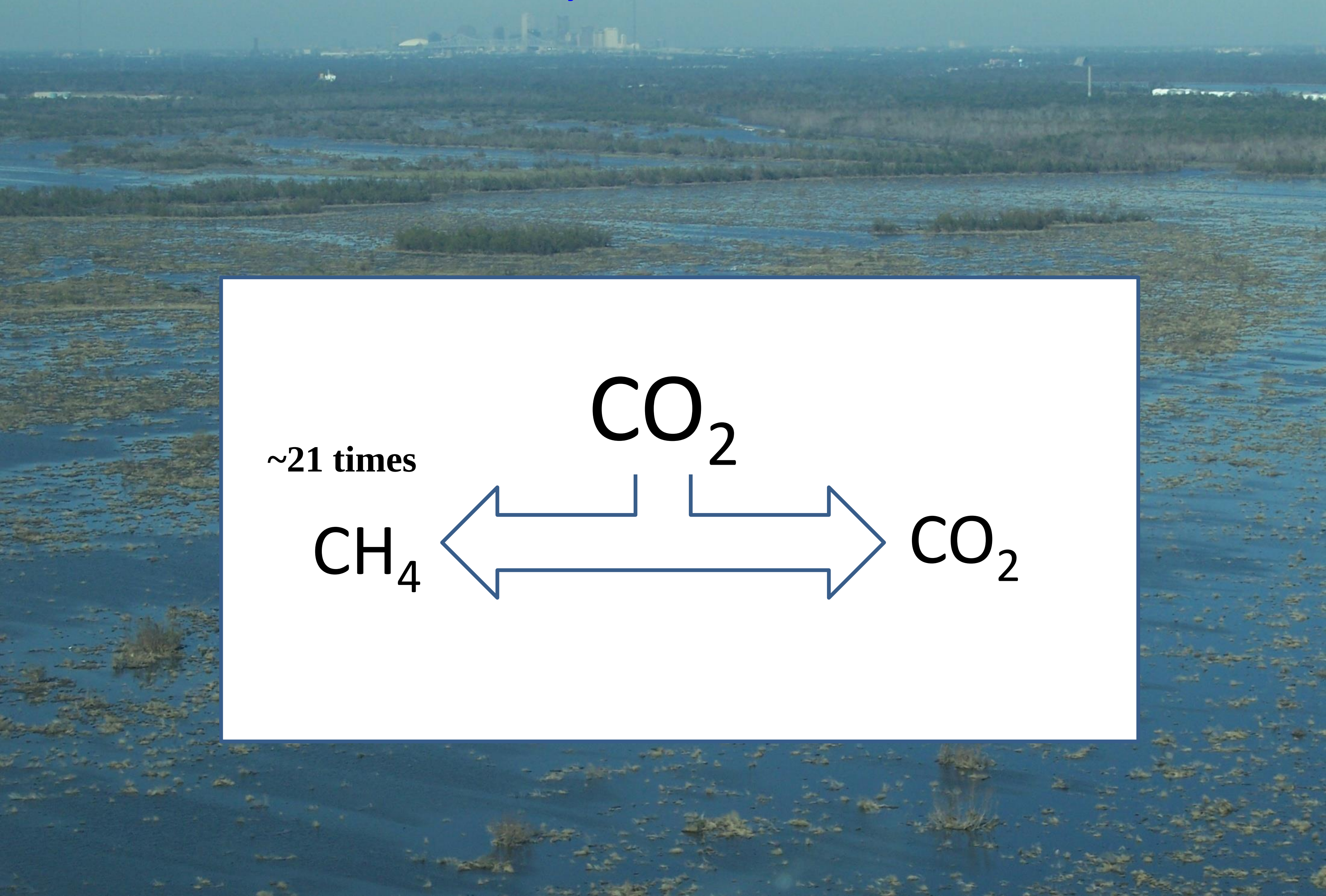


Carbon Dioxide Emissions

Marsh Type	mg C m^{-2} d^{-1}
Fresh marsh	900-4400
Brackish Marsh	245-4950
Salt Marsh	125- 940

>10 measurements over year

DeLaune and White 2012

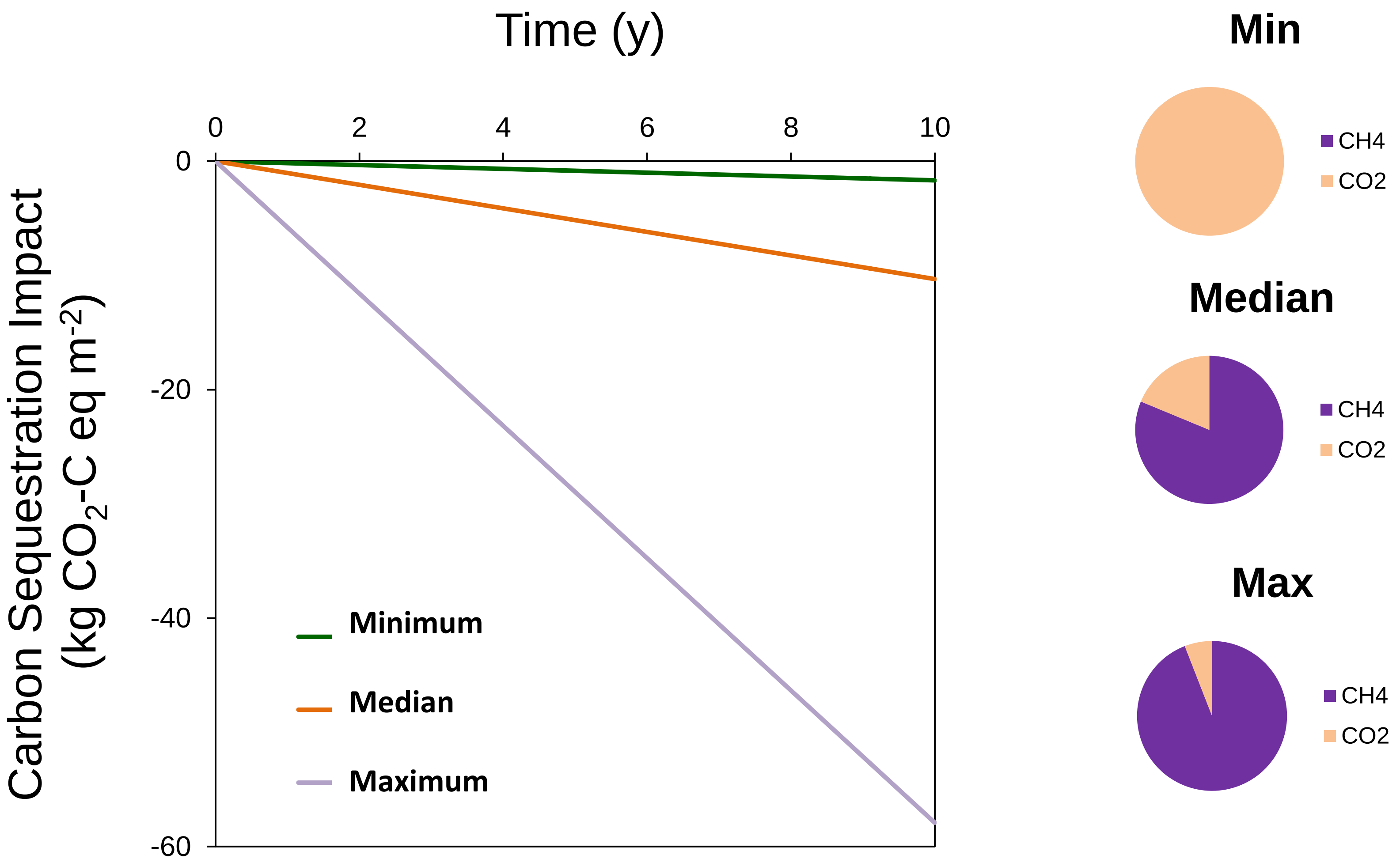
Methane Emissions

Marsh Type	mg C m^{-2} d^{-1}
Fresh marsh	0 - 1950
Brackish Marsh	2 - 1035
Salt Marsh	1 - 37

>10 measurements over year

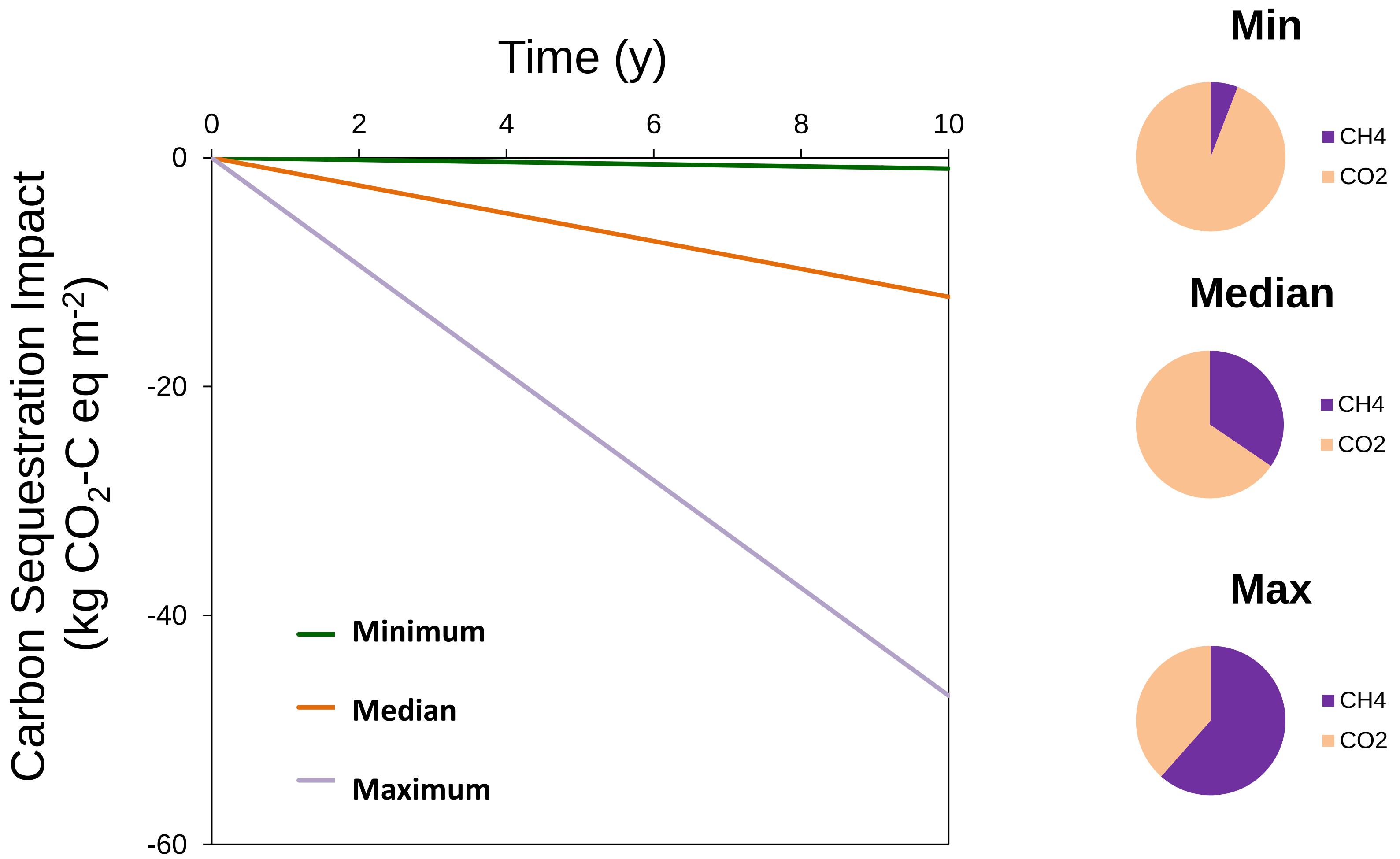
DeLaune and White 2012

Fresh Marsh

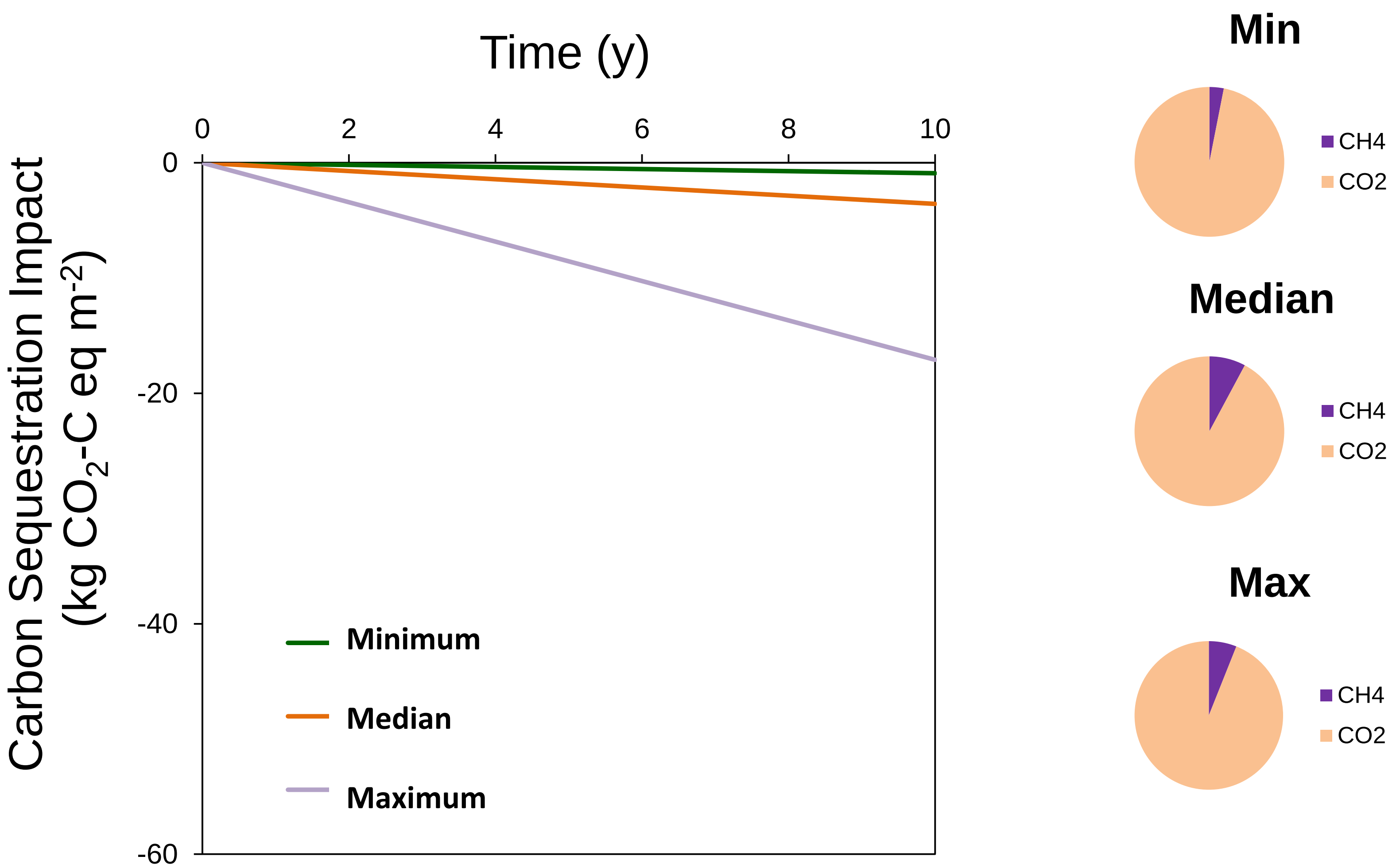


Time (y)
0
2
4
6
8
10
0
-20
-40
-60
Carbon Sequestration Impact
(kg CO2-C eq m-2)
Minimum
Median
Maximum
Min
CH4
CO2
Median
CH4
CO2
Max
CH4
CO2

Brackish Marsh



Salt Marsh



Time (y)
0
2
4
6
8
10
0
-20
-40
-60
Carbon Sequestration Impact
(kg CO_2-C eq m^{-2})
Minimum
Median
Maximum
Min
CH4
CO2
Median
CH4
CO2
Max
CH4
CO2

Wetland Type

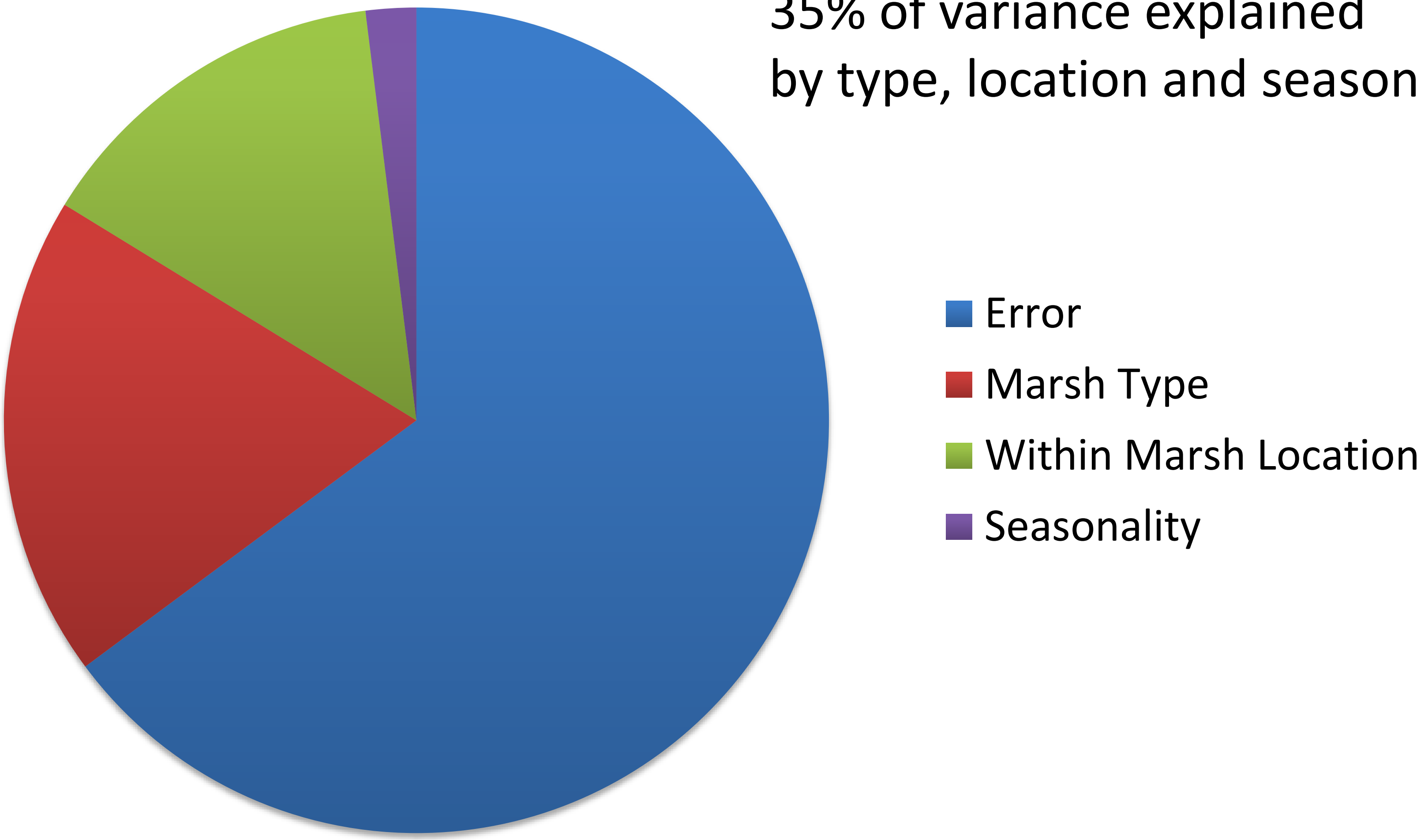
- Salt Marshes have Lowest Methane Emissions
  - Trading a CO_2 sequestered with CO_2 released
  - Louisiana has very large tracts of salt marsh
  - Most of the losses of salt marsh are in Louisiana

    Perfect marsh type to target for restoration

There is Some Uncertainty

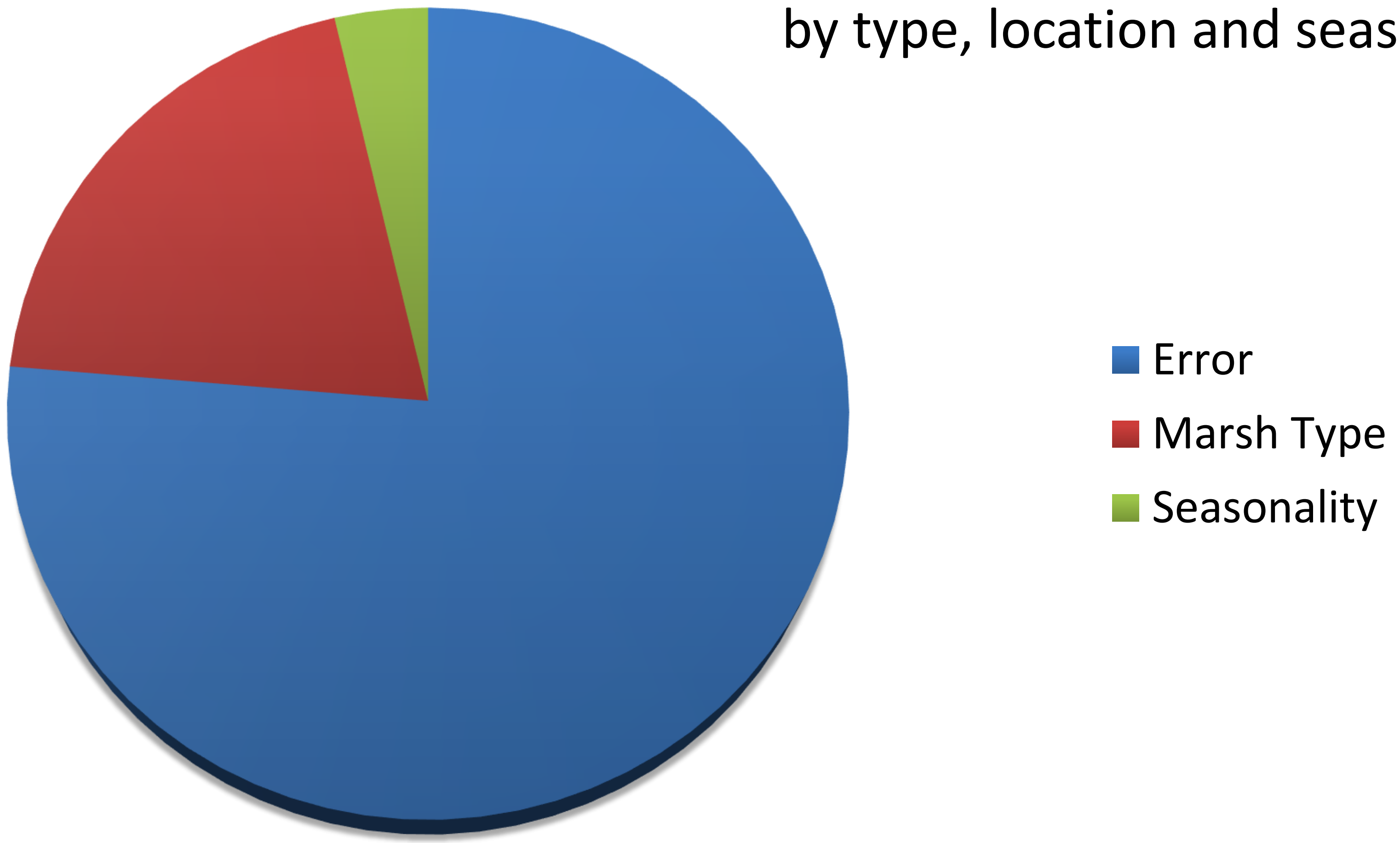
Carbon Dioxide

35% of variance explained by type, location and season



Methane

24% of variance explained by type, location and season



Large Error Term

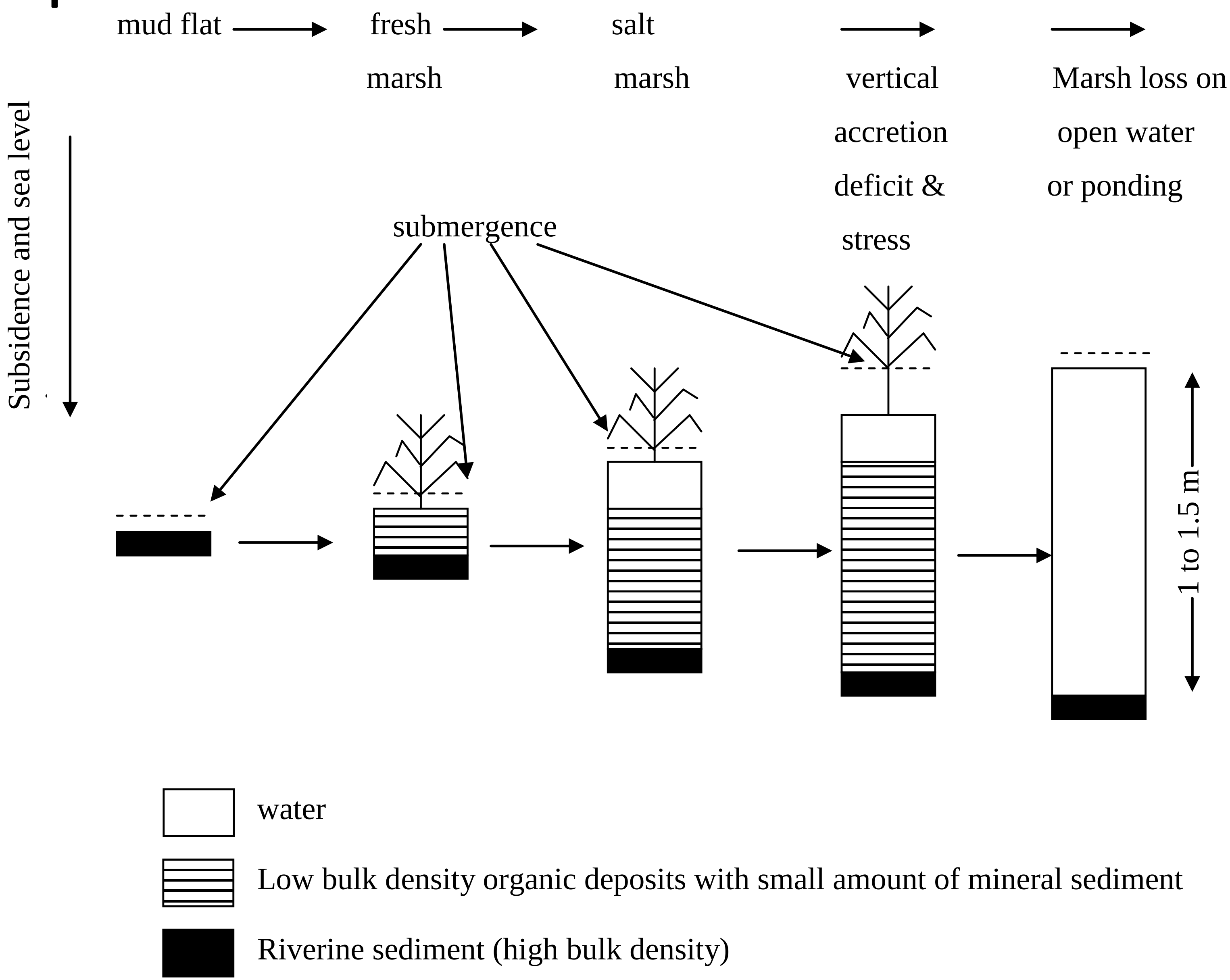
- Spatially not well described
  - Presence of vegetation
  - Flooding

- Temporally
  - Season
  - No data on fine scale (Over 24 hours)

More Work (measurements) needs to be done

Any More Credit in Subsiding Salt Marshes?

Peat Collapse



DeLaune and Nyman

Restoration in Context of C Credit

46,000 ha preserved by river re-introduction

2.07 Million US Dollars per year
as a restoration benefit

Plus
Prevented loss of a meter of stored C
Which has a value of 207 Million US Dollars

Conservation Projects

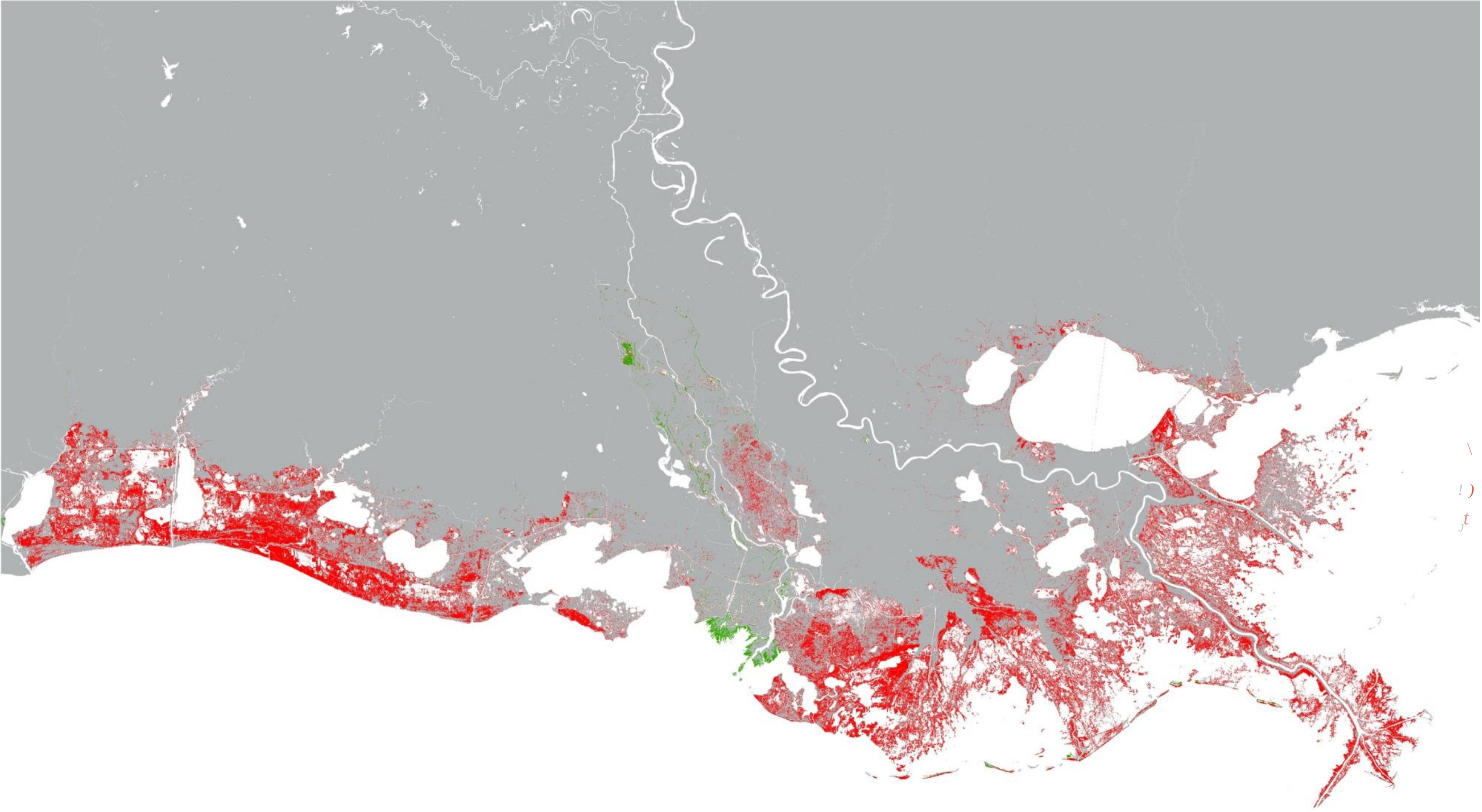
Uncertainty

Where does the Carbon go in Eroding Coastal wetlands?

- Carbon Credit Potential is greatest in Salt Marsh Systems
- Great temporal and spatial Uncertainty in gas flux rates
- Preservation of Coastal Marshes may provide superior credits due to the maintenance of the large stores of soil C and low methane flux

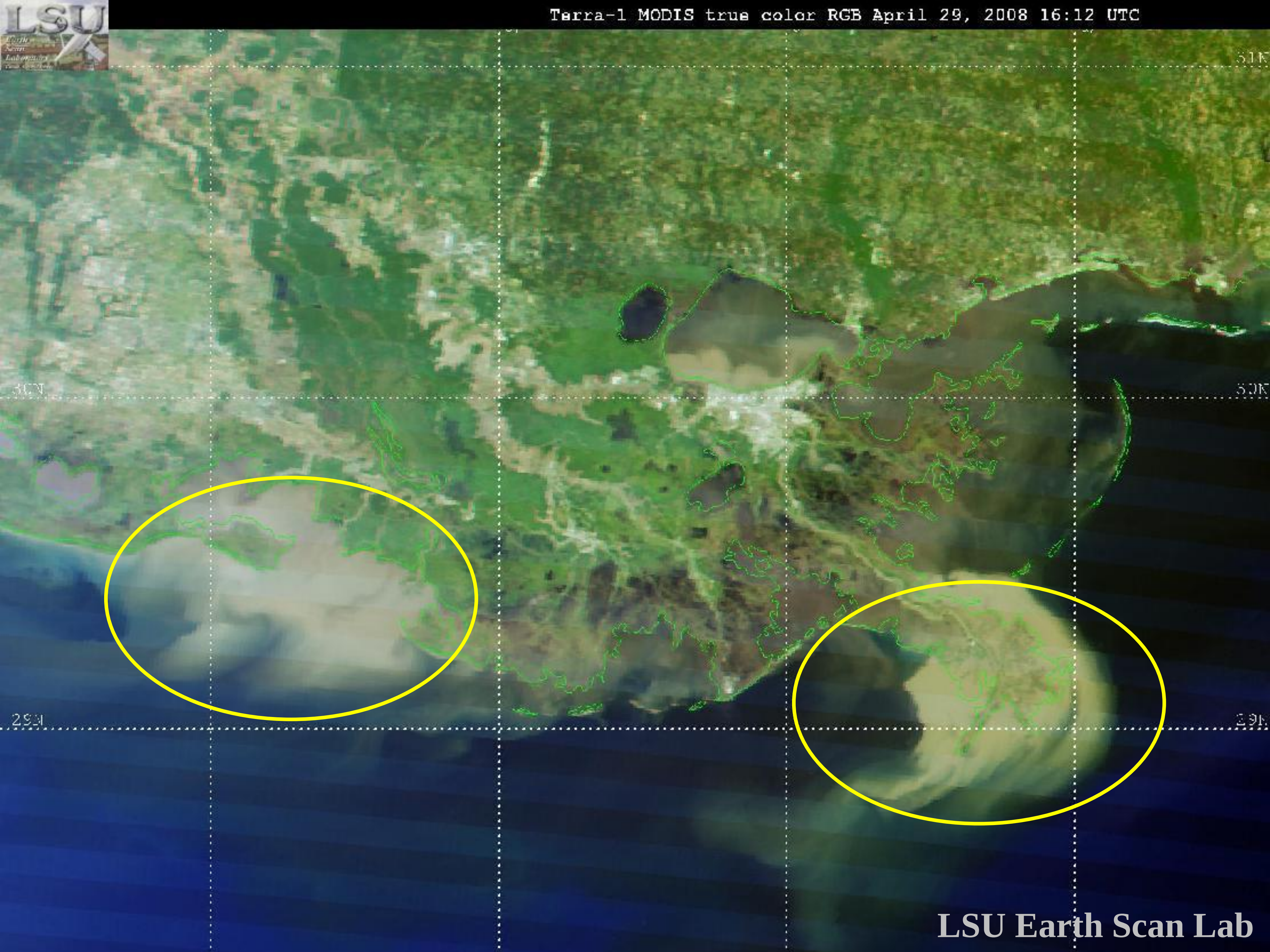
LA DNR

Land 2010



Projected land change 2012-2050
(moderate scenario)

Projected land 2050
(moderate scenario)

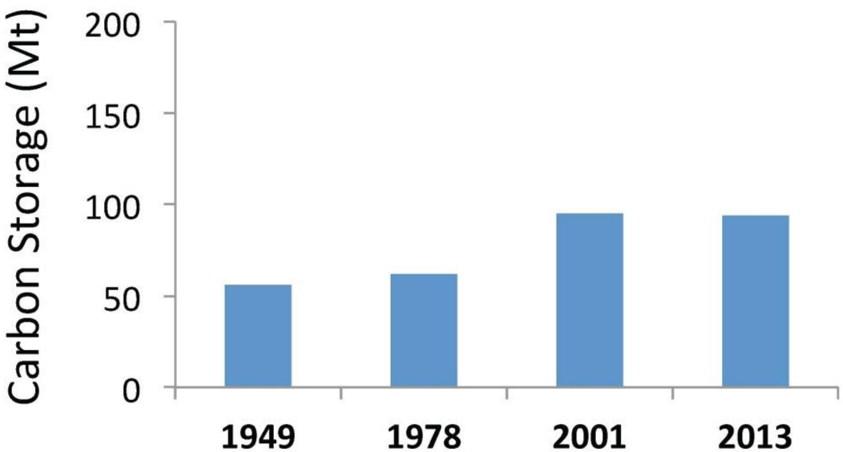


Terra-1 MODIS true color RGB April 29, 2008 16:12 UTC
30N
29N
LSU Earth Scan Lab

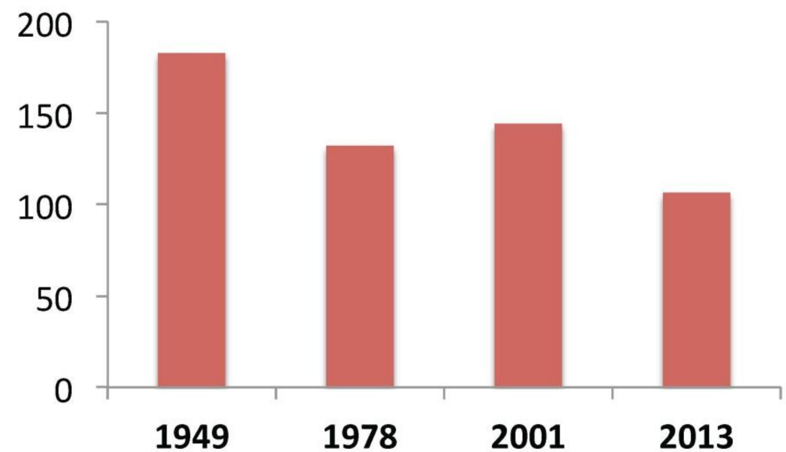
Carbon Storage Capacity Over Time
Using Wetland Vegetation Zone Maps & CRMS Data

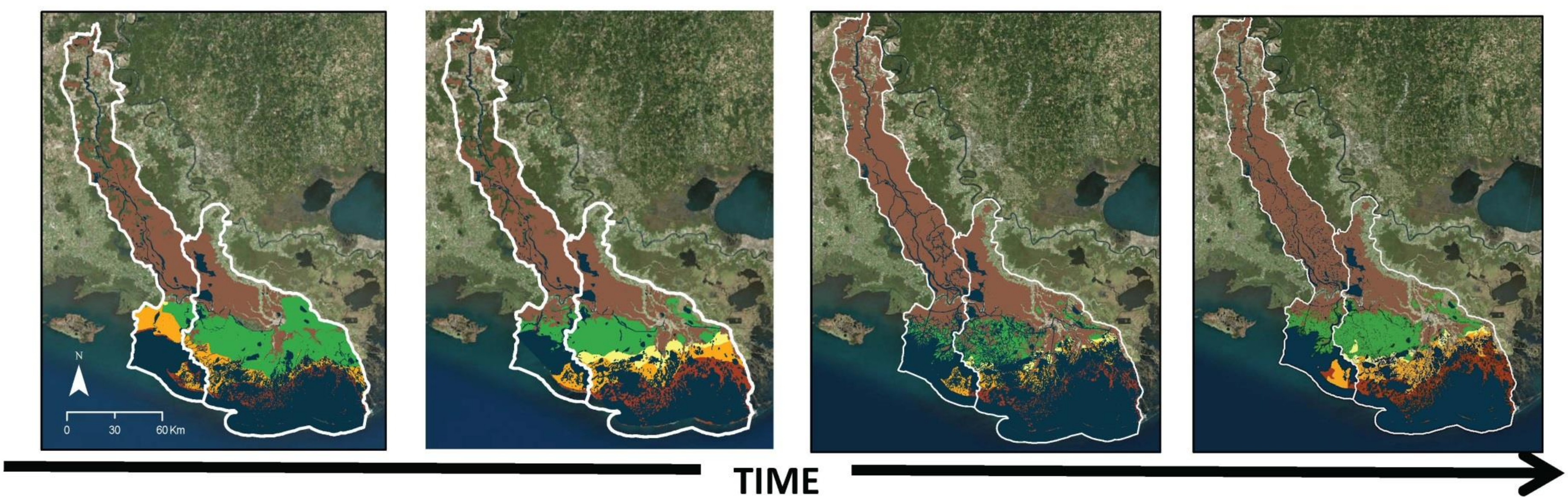
R.R. Twilley

Atchafalaya 47%



Terrebonne 42%





River Re-introduction

Carbon Credits as a Mechanism to Fund Coastal Restoration ?

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