Carbon and Louisiana Wetlands

Sarah K. Mack, PhD, CFM

Outline

- Background on carbon offsets
- Analysis based upon peer-reviewed data
- Quantification estimates
- Gaps and research needs

What is an Offset?

- An offset represents a reduction, avoidance, or removal of one metric ton of carbon dioxide equivalent emissions resulting from a specific project activity that is used to compensate for an equivalent emission occurring elsewhere.

Offset Criteria

- **Real**
  - It can be accurately measured
  - Can be accomplished without “leakage”
- **Permanent**
  - Will retain stored carbon for the life of the project.
- **Additional,**
  - Occurs outside a regulatory requirement
  - Would not have occurred but for the incentive provided by a GHG market
- **Verifiable**
  - It can be independently verified
- **Enforceable**
  - Its ownership is undisputed
  - No double counting

Terminology

- Carbon Sequestration – The removal of atmospheric CO_2 to mitigate CO_2 released during a project activity elsewhere (fossil fuels).
- Terrestrial sequestration – Capturing and storing carbon in plant and soil structures by modifying the management of forests, rangelands, agriculture lands and wetlands to either remove more CO_2 from the air or reduce CO_2 emissions from these ecosystems.

Louisiana Wetlands Are Unique!

- Coastal wetland (marsh and swamp) restoration provides the greatest potential for carbon offset opportunities.
- Enhanced carbon sequestration is associated with wetland restoration.
- Enhanced above ground biomass (swamps) and greater root production.
- Enhanced organic soil formation below ground.

Louisiana Wetlands Are Unique!

- The Mississippi delta naturally subsides.
- This is compensated by new sediment and organic matter accumulation.
- The result is carbon burial.
- Oxidation of wetland soils during wetland loss releases the carbon stored in soil organic matter.

Carbon Pools in Wetlands

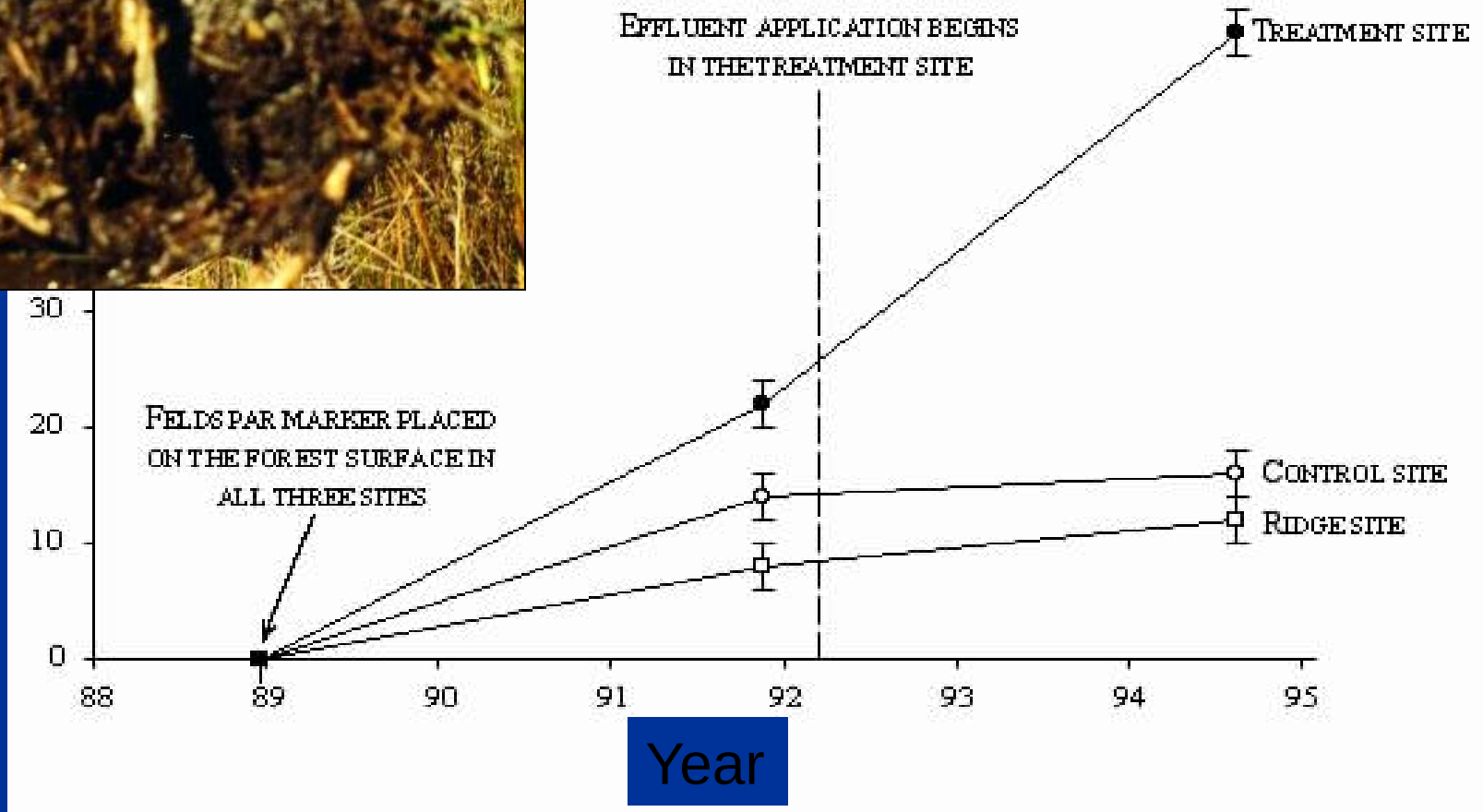
1. Trees
2. Herbaceous vegetation
3. Forrest floor litter
4. Dead wood
5. Soil

Sequestration Range:
0.8 – 26 tons CO_2e/ac/yr

Emissions During Loss:
206 tons CO_2e/ac/yr
(top 50 cm of wetland soil horizon)

Tierra

Enhanced Accretion



(Rybczyk et al. 2002)

Wetland Restoration for Carbon Credits

- How much carbon is sequestered by wetlands?
- Timeframe?
- Emissions from wetland loss?
- Analysis based on peer-reviewed literature.
- 50 year timeframe.

Four Scenarios

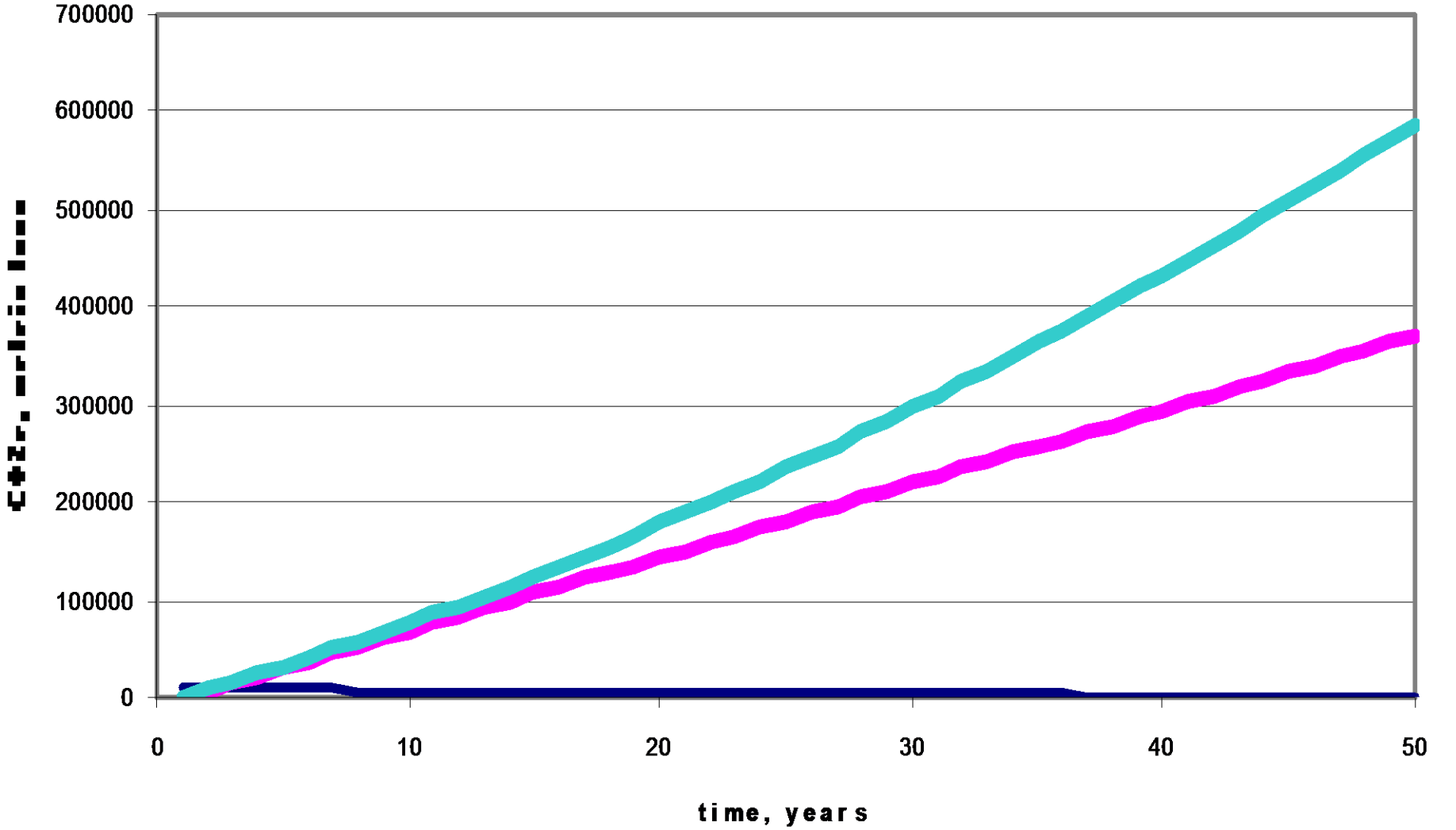
- Central Wetland Unit Wetland Assimilation
- Caernarvon River Diversion
- Hypothetical Large Scale Diversion
  - Current submergence rate
  - Climate change submergence rate
- Various Rates of Wetland Loss

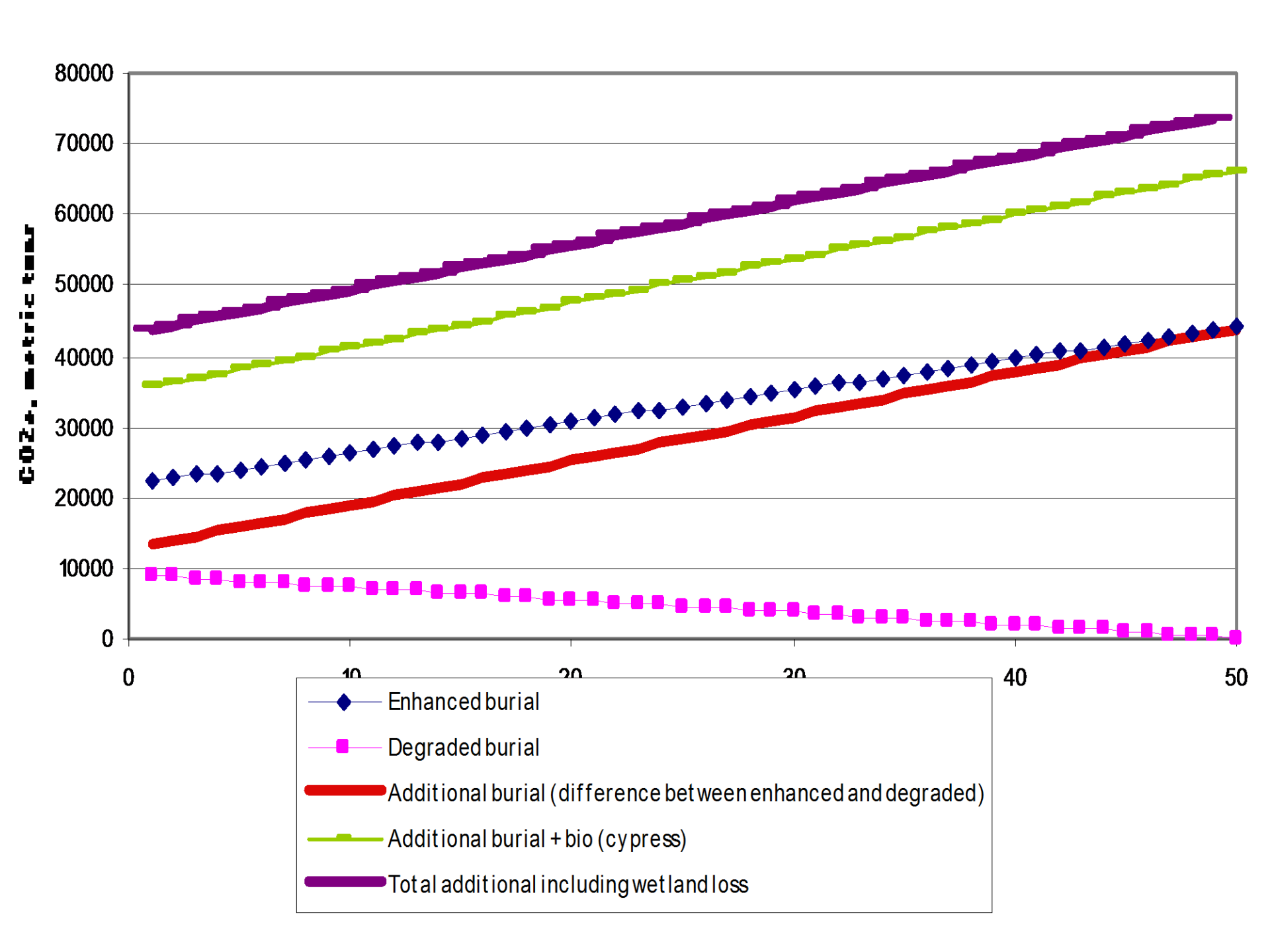
Primary Carbon Mechanisms

- C emitted during wetland loss
  - 13,911 g C/m^2 in the top 50cm of soil
    - 75% and 50% oxidation
- Burial = organic soil formation (roots)
  - 150 g C/m^2yr^{-1} and 450 g C/m^2yr^{-1}
- Biosequestration = above ground wood
  - 750 g C/m^2yr^{-1}

Cypress Restoration of Bayou Bienvenue Central Wetland Unit

Business As Usual




80000
70000
60000
50000
40000
30000
20000
10000
0
0
10
20
30
40
50
Enhanced burial
Degraded burial
Additional burial (difference between enhanced and degraded)
Additional burial + bio (cypress)
Total additional including wetland loss

WETLAND ASSIMILATION

Sequestration rate = prevented wetland loss and planted cypress

22 tons CO2e/ac/yr

Central Wetland Unit 30,000 acres over 50 years

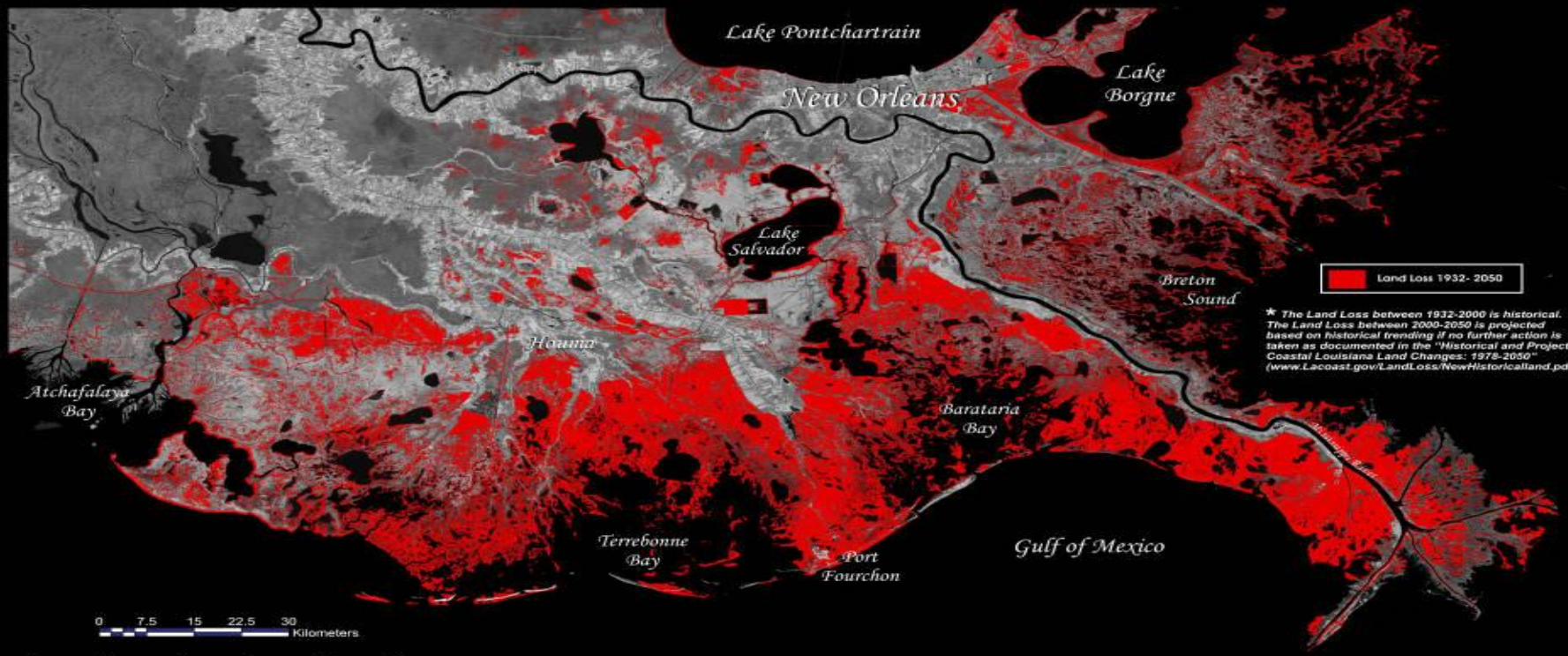
32,951,000-34,468,000 tons CO2e

Annual emissions of six million cars

Tierra

Southeast Louisiana Land Loss

*Historical and Projected Land Loss in the Deltaic Plain



Coastal Louisiana has lost an average of 34 square miles of land, primarily marsh, per year for the last 50 years. From 1932 to 2000, coastal Louisiana lost 1,900 square miles of land, roughly an area the size of the state of Delaware. If nothing more is done to stop this land loss, Louisiana could potentially lose approximately 700 additional square miles of land, or an area about equal to the size of the greater Washington D.C.- Baltimore area, in the next 50 years.

For more information about the land loss analysis or to see an animated time series of wetland change, visit www.LaCoast.gov/LandLoss

BTNEP USGS

Data Sources:
1932-1956 Land Change Analysis
U.S. Army Corps of Engineers, New Orleans

1956-1990 Land Change Analysis
1978-2050 Land Change Analysis
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, LA

Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, LA

Map ID: USGS-NWRC 2005-16-0001
Map Date: December 6, 2004

LOUISIANA WETLAND LOSS

Carbon oxidized during wetland loss and lost degraded carbon sequestration capacity

1900 square miles 1932-2000

282 million tons of CO_2e

24 square miles continue to be lost each year
700 square miles of marsh loss by 2050

91 million tons of CO_2e

Tierra

Wetlands and Climate Change

Wetland restoration measures that help wetlands to accrete at a rate to counter submergence due to sea level rise and subsidence will have increased rates of carbon sequestration.

Assumptions

- Extrapolations from peer reviewed studies
- CH_4 and N_2O have not been included in the model yet.
- Carbon sequestration is highly dependent upon the health and productivity of the wetland!
- Each site is specific and will require testing.

Other Greenhouse Gases

- The generation of methane and nitrous oxide can offset benefits (23 times and 310 times more powerful than carbon dioxide).
- The proportional release is variable and dependent upon many factors.
- Monitoring is required to quantify other GHG above background.
- Wetland restoration projects can be operated in a way that minimizes methane and nitrous oxide.

Tierra

Features That Can be Controlled to Maximize Benefits

- Water levels
- Salinity (sulfate)
- Pulsing
- Nutrient form and loading rates
- Tree or plant species
- Available iron (precipitates sulfides and reduce N_2O) (River and ferrate disinfection)
- Nutria control

Tierra

Value of Carbon Credits

- US 2-6 dollars per ton 2010-2015
- Up to 30 dollars a ton by 2020 (legislation)
- Central Wetland Unit Value Over 50 Years
  - 34,000,000 tons CO_2e
    - 68-200 Million Current Market
      - 1 Billion Potential Market
        - Other GHGs?

Tierra

FUTURE SCIENCE NEEDS

Explain carbon pool interactions.

Quantify carbon mechanisms in wetlands.

Quantify the generation of other GHG.

Quantify avoided release due to alternative management strategies.

- Fate and transport of C during wetland loss
- Pulsing regimes
- Chemical form of the nutrient
- Loading rate
- Salinity (sulfate)

Tierra

CHALLENGES

Wetland offsets are not official: Wetlands restoration activities alone are not considered as an option for carbon offsets in domestic or international mitigation regimes. No existing protocols or "route to market".

Barriers to entry:

- **Regulatory in nature**
- **Psychological: land use based carbon sequestration perceived as not permanent**
- **Scientific: science to support the volume of carbon sequestered is limited.**

Acknowledgements

Dr. John W. Day

Dr. Rob Lane

Environmental Defense Fund

Entergy

Tierra

sarahmack@tierraresourcesllc.com

(504)339-4547