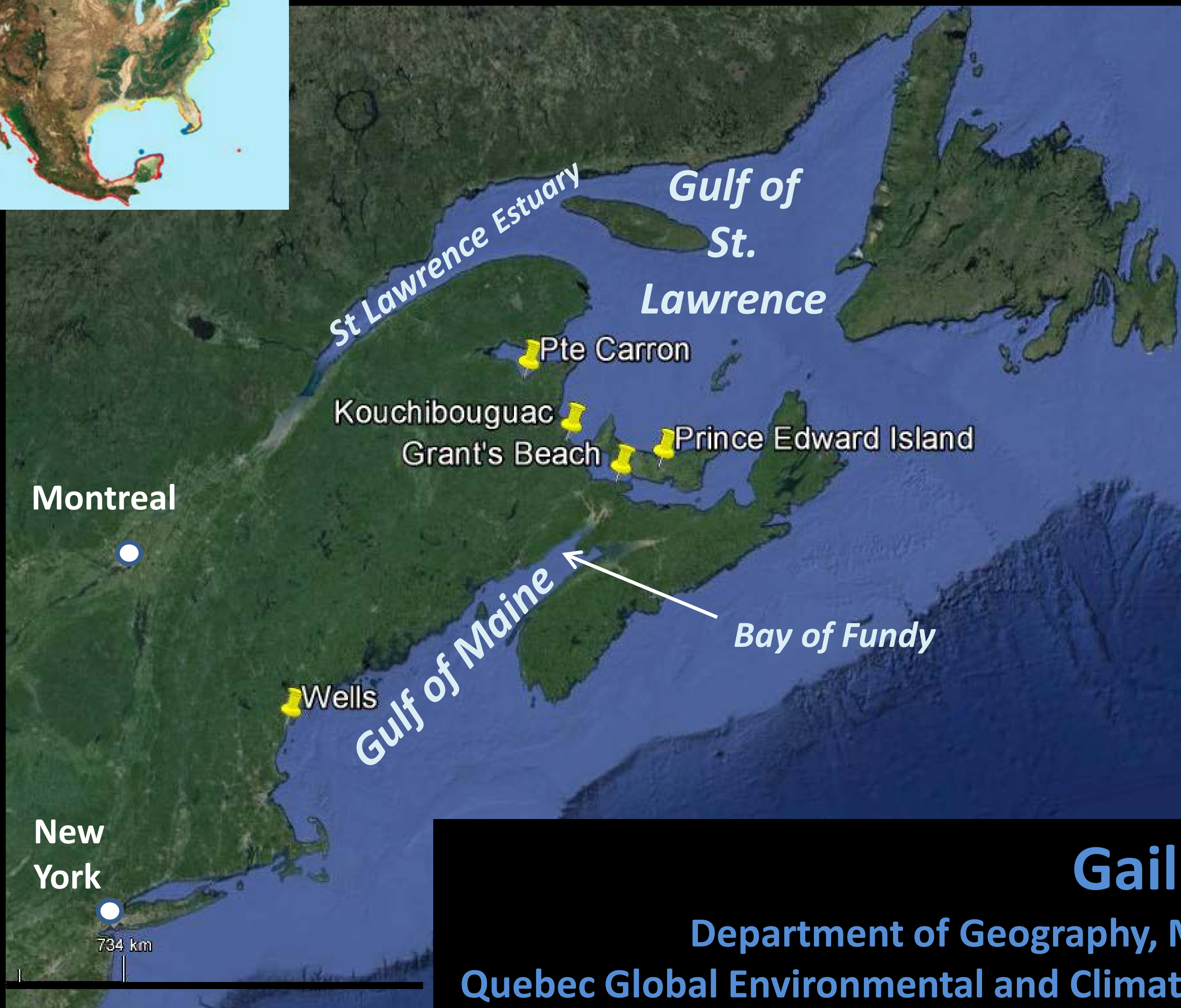
Gulf of St. Lawrence and Gulf of Maine Results of Recent Research and Future Research Needs



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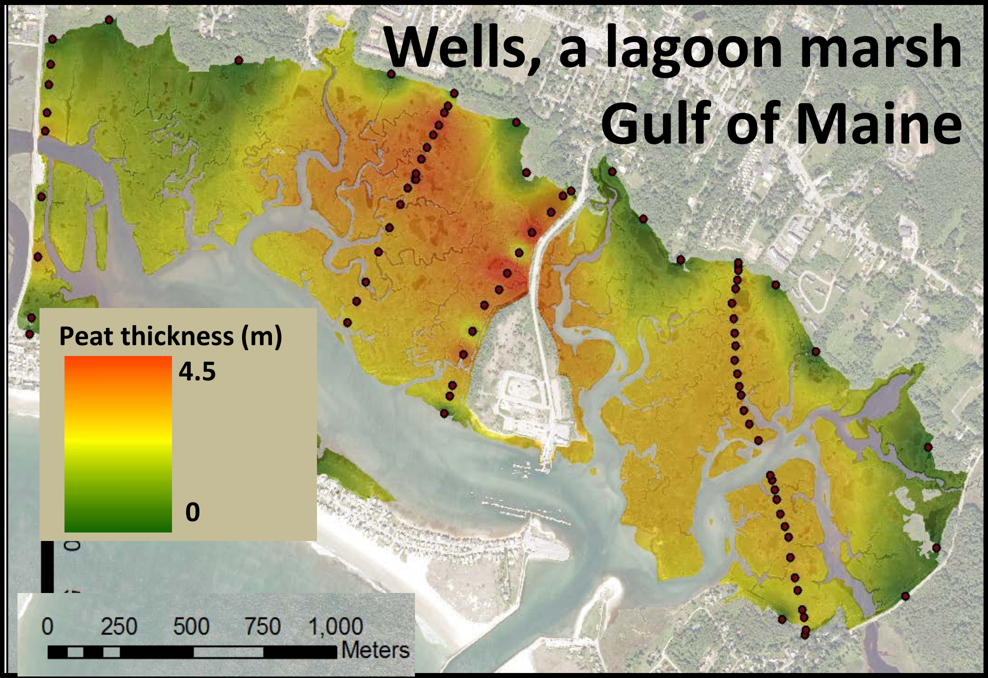
Results of Recent Research and Future Research Needs

Blue Carbon Stocks

- Variability
- Future of Stocks with Sea Level Rise
- Fate of Blue Carbon with Catastrophic Sea Level Rise

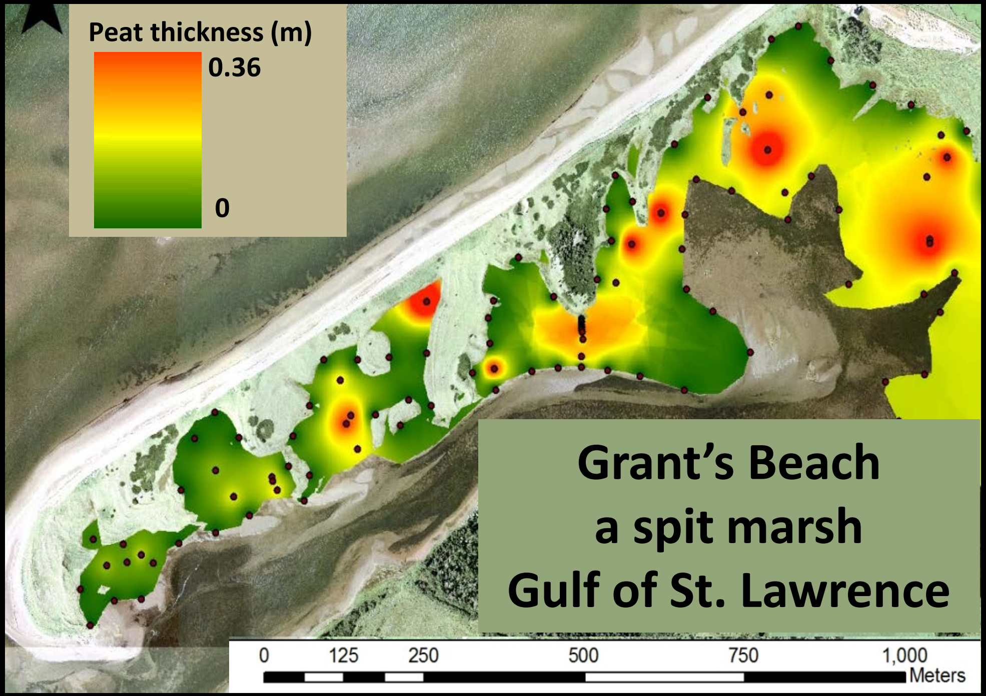
Impact of Excessive Nutrient Input

- Reducing the Mitigation Potential of Blue Carbon through Greenhouse Gas Emissions
  - Eutrophic Estuaries
  - Restoration of Agricultural Marshes?
- Impacts on Blue Carbon storage?
- Threats to Sustainability of the Blue Carbon Sink



Estimates of carbon stocks are based upon the carbon density of the soil (g/cm^3) and the volume of the peat. Volume is based on the area of marsh and thickness of the peat – assumed to be 1 m.

Peat thickness varies within and among marshes. Older marshes should have thicker peat deposits and our preliminary field studies confirm this.



van Ardenne, unpublished data

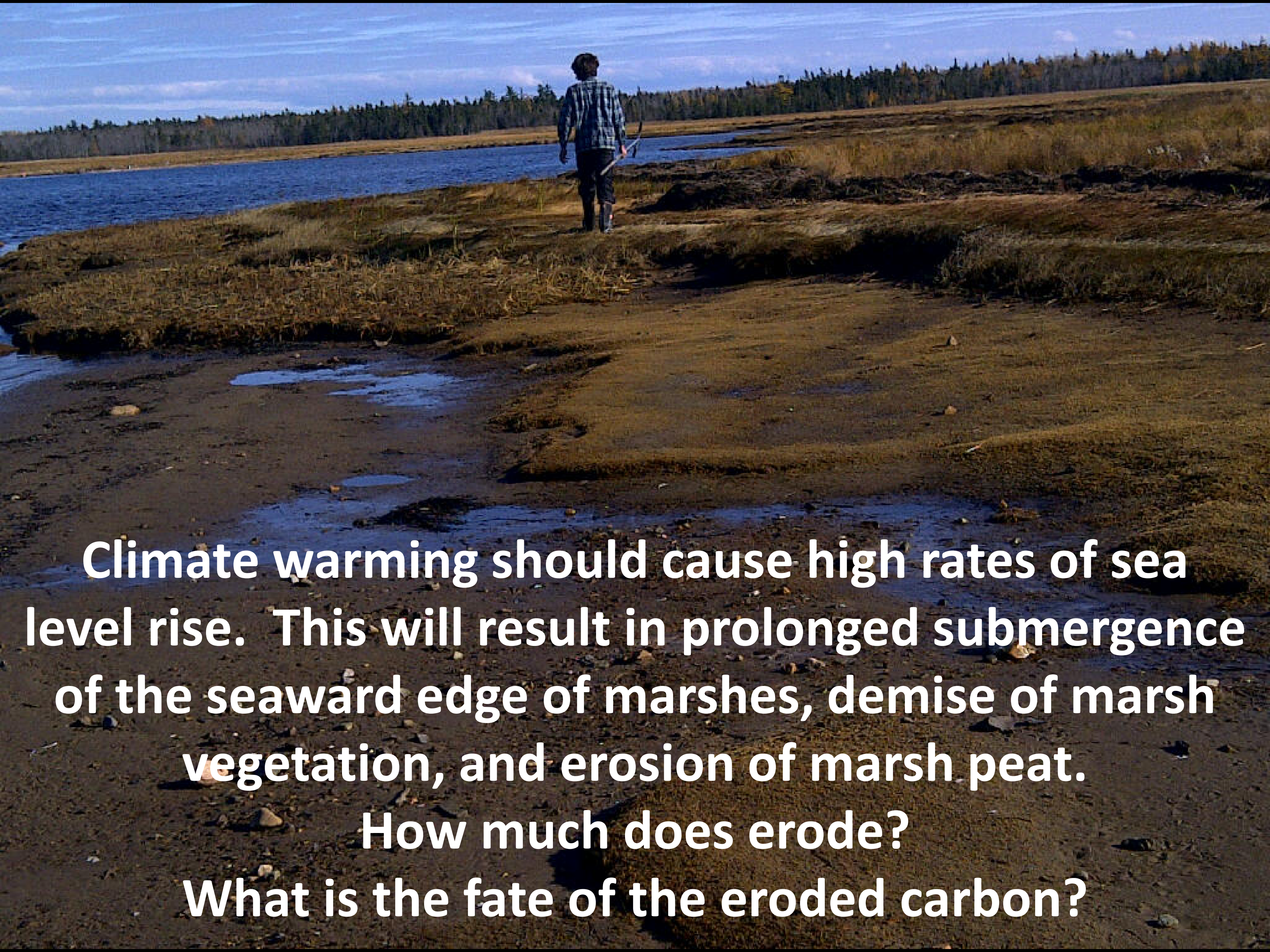
Site	Ratio (Volume/Area)
Spit marshes	
Grants Beach, NB, Gulf of St. Lawrence	0.10
Carron Point, NB, Gulf of St. Lawrence	0.34
Lagoon marshes	
Wells, ME, Gulf of Maine	1.62
Kouchibouguac, NB, Gulf of St. Lawrence	0.39

Calculation of C stocks over a 1 m depth would result in

- **overestimation by 3-10 fold in the Gulf of St. Lawrence marshes**
- **underestimation of 62% in the Gulf of Maine marsh**

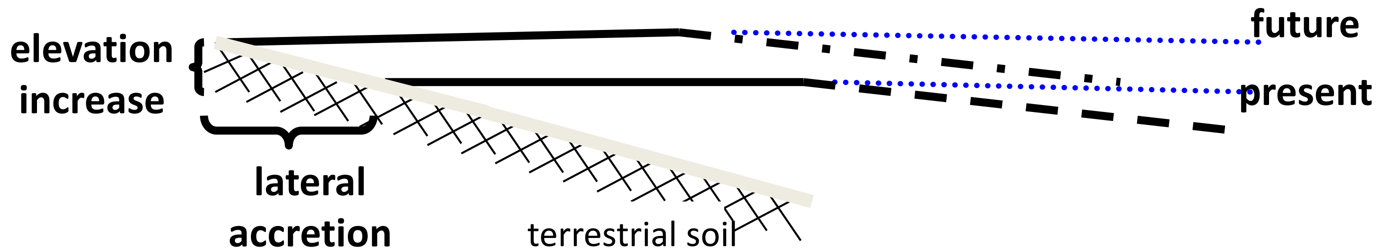
More research will be needed to accurately estimate blue carbon stocks in tidal marshes - examining additional types of marshes of different ages.

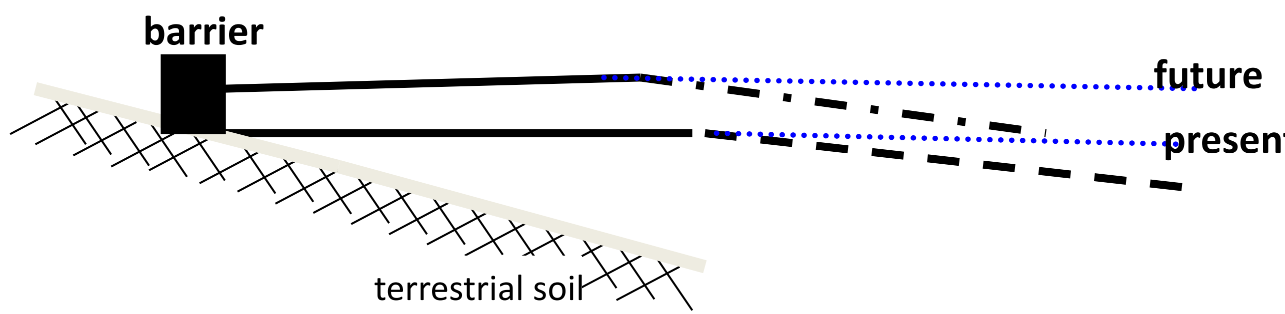
van Ardenne, unpublished data

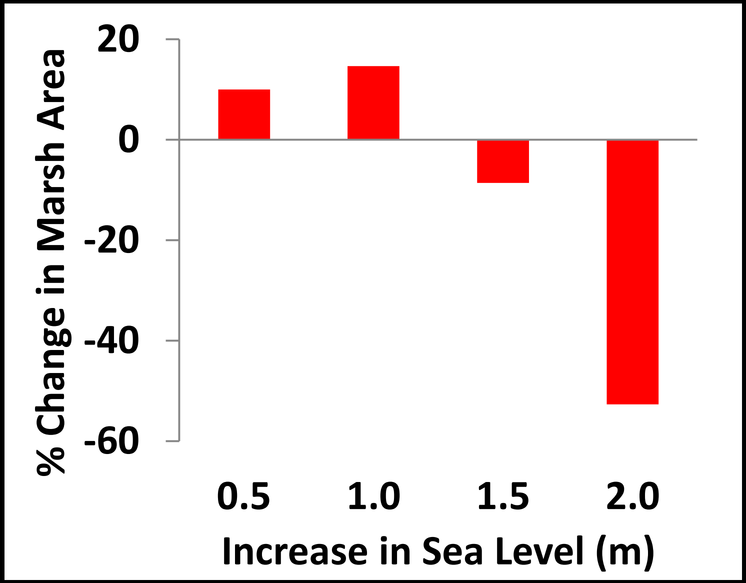

Climate warming should cause high rates of sea level rise. This will result in prolonged submergence of the seaward edge of marshes, demise of marsh vegetation, and erosion of marsh peat.
How much does erode?
What is the fate of the eroded carbon?

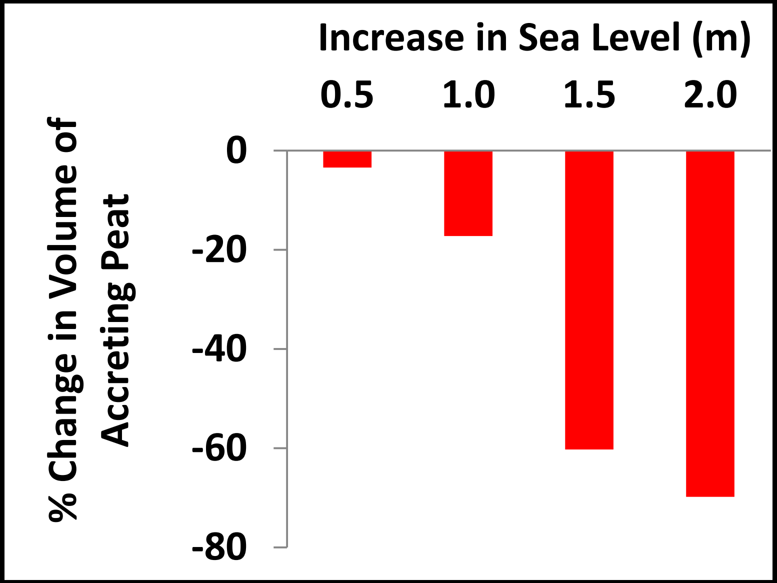
Sustainability of tidal marshes and mangroves may require that they shift inland with rising sea level.

This only will be possible if inland barriers do not pose a "coastal squeeze"









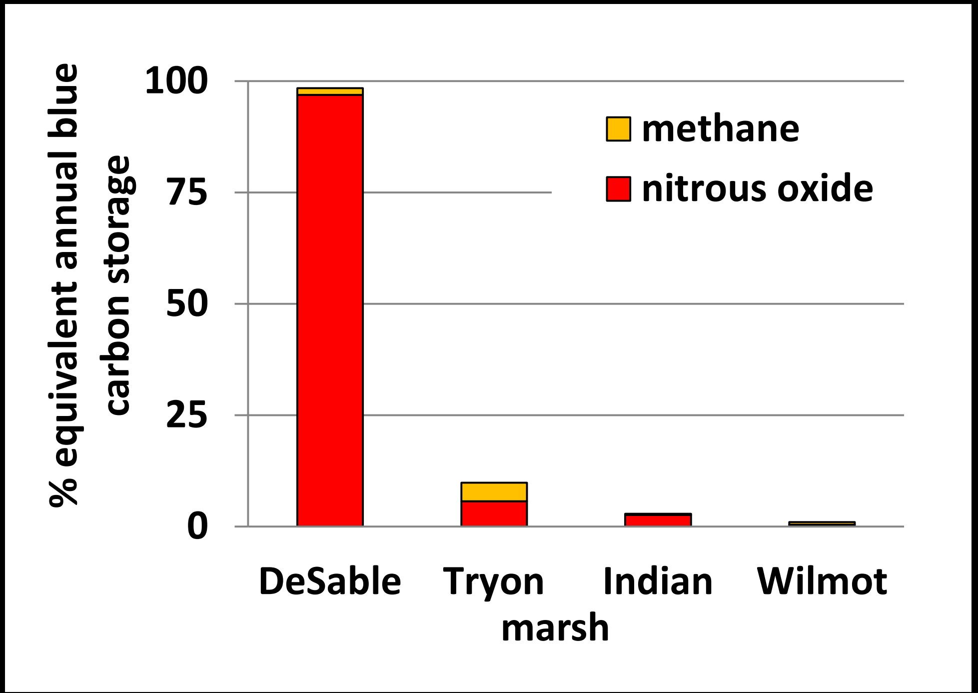
Models of mesotidal Wells marsh indicate an increase in marsh area with moderate levels of sea level rise (by 2100) through inland migration.

However, overall, the volume of peat, & Blue Carbon stock will decrease. How will marshes with lower (microtidal) and higher (macrotidal) amplitudes respond?

Torio, unpublished data

On Prince Edward Island nitrogen leaching from agricultural fields is causing severe eutrophication of many estuaries.

As a result, marshes on some estuaries are emitting high levels of N_2O, a greenhouse gas 298 times more potent than CO_2. What is the cause of the variability?



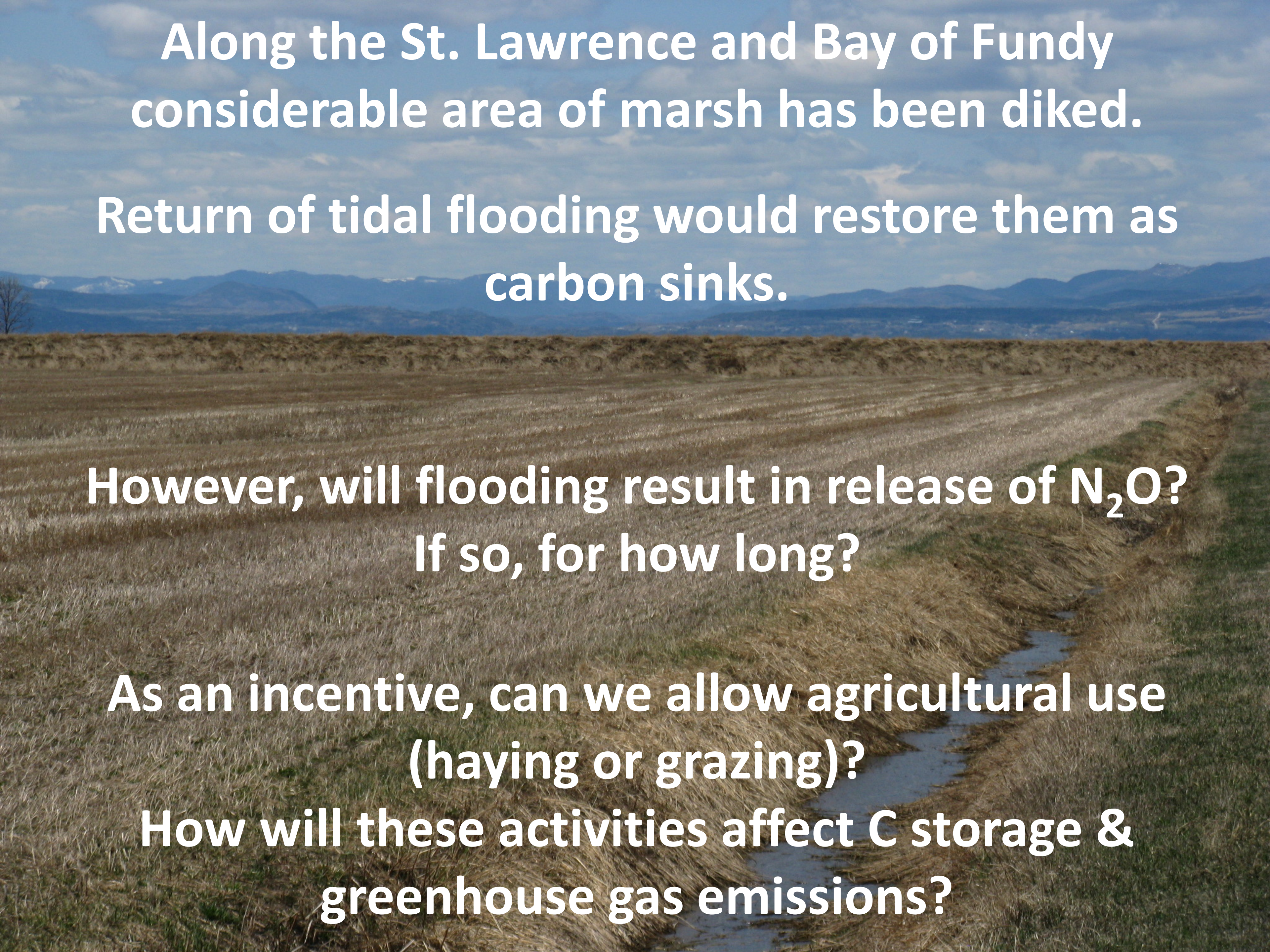
Roughan, Kellman, Smith & Chmura under review *Science*

Studies have shown that added N results in reduced root production and integrity of the marsh substrate.

To what degree does it decrease C stocks?

How do we best manage agricultural activities to reduce eutrophication?

Deegan et al. (2012) *Nature*



Along the St. Lawrence and Bay of Fundy considerable area of marsh has been diked.

Return of tidal flooding would restore them as carbon sinks.

However, will flooding result in release of N_2O?
If so, for how long?

As an incentive, can we allow agricultural use (haying or grazing)?
How will these activities affect C storage & greenhouse gas emissions?

Acknowledgements

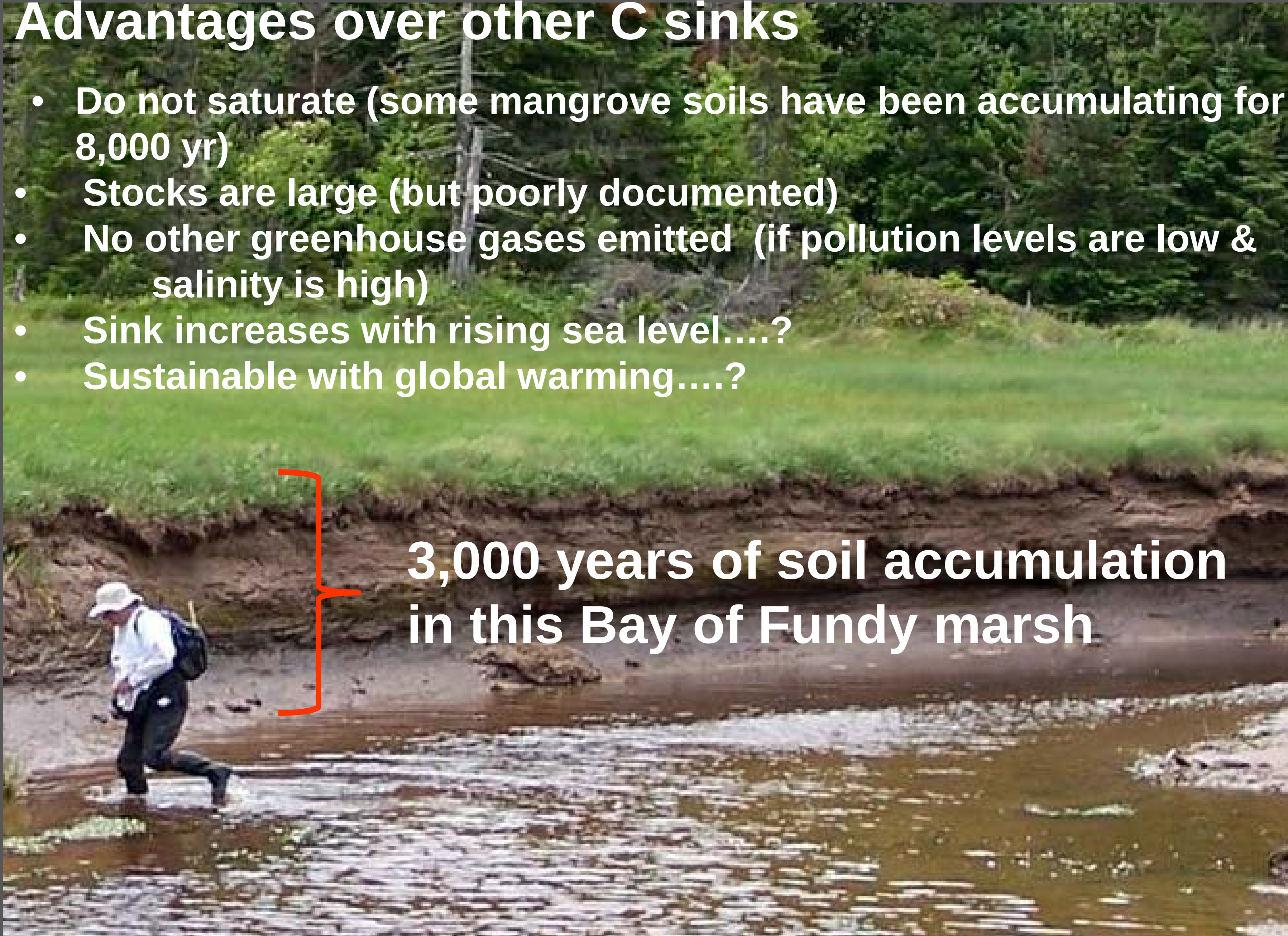
Research of my grad students:
Dante Torio & Lee van Ardenne (McGill University, QC)
Brittney Roughan (St. Francis Xavier University, NS)

Assistance and Access Permission from:
Wells US National Estuarine Research Reserve
Eric Tremblay, Kouchibouguac National Park & Parks Canada
Dominique Bérubé, New Brunswick Dept. Energy and Mines Geological Surveys Branch
John Deane, Gabriel Lambert-Rivest, Elisabeth Lefevre (McGill)
Jobst Wagner – Access to Grants Beach
Arthur Ronalds – Access to Carron Point

Funding from:
Commission for Environmental Cooperation
Natural Sciences and Engineering Research Council of Canada (Discovery Grants to GLC & L. Kellman, fellowships to L. van Ardenne and G. Lambert-Rivest, CREATE grant to B. Roughan)

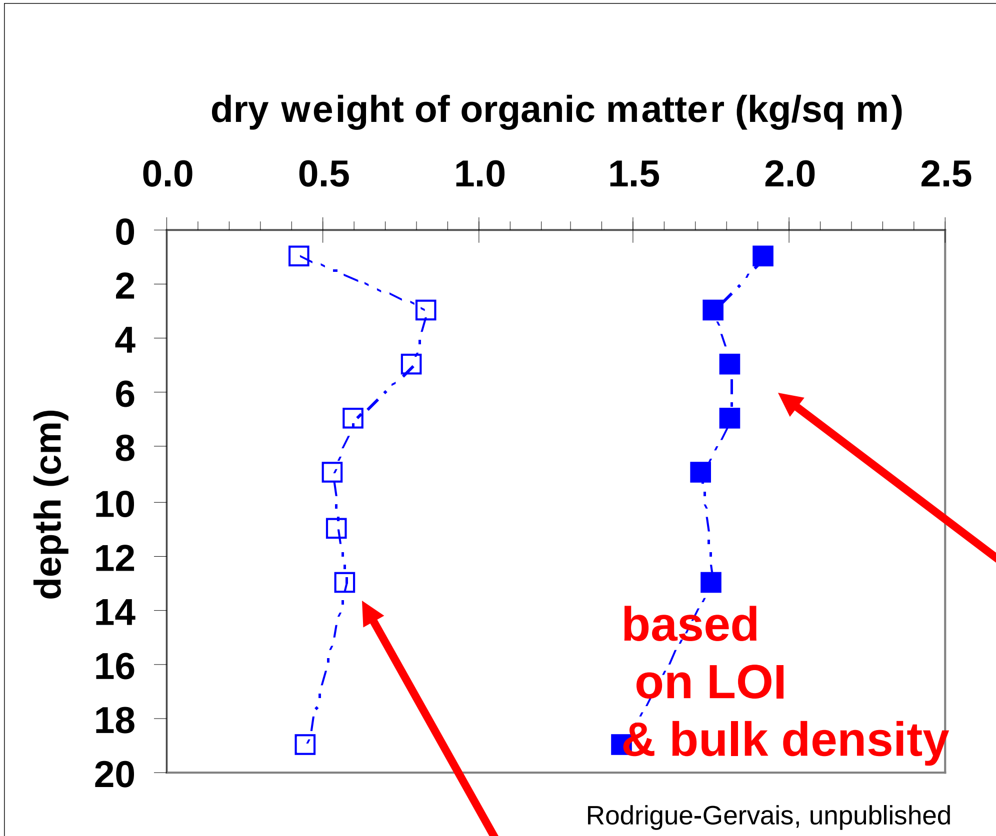
Advantages over other C sinks

- Do not saturate (some mangrove soils have been accumulating for 8,000 yr)
- Stocks are large (but poorly documented)
- No other greenhouse gases emitted (if pollution levels are low & salinity is high)
- Sink increases with rising sea level….?
- Sustainable with global warming….?



Tidal salt marsh and mangrove soils, and even seagrass beds accumulate through sediment deposition and accumulation of primarily roots and rhizomes. It is difficult to assess the contribution of litter.

5 years of sediment accumulation



but also degraded OM, root exudates, and most importantly (?) carbon from micro-flora

macro-organics, >1mm (e.g., roots & rhizomes)

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