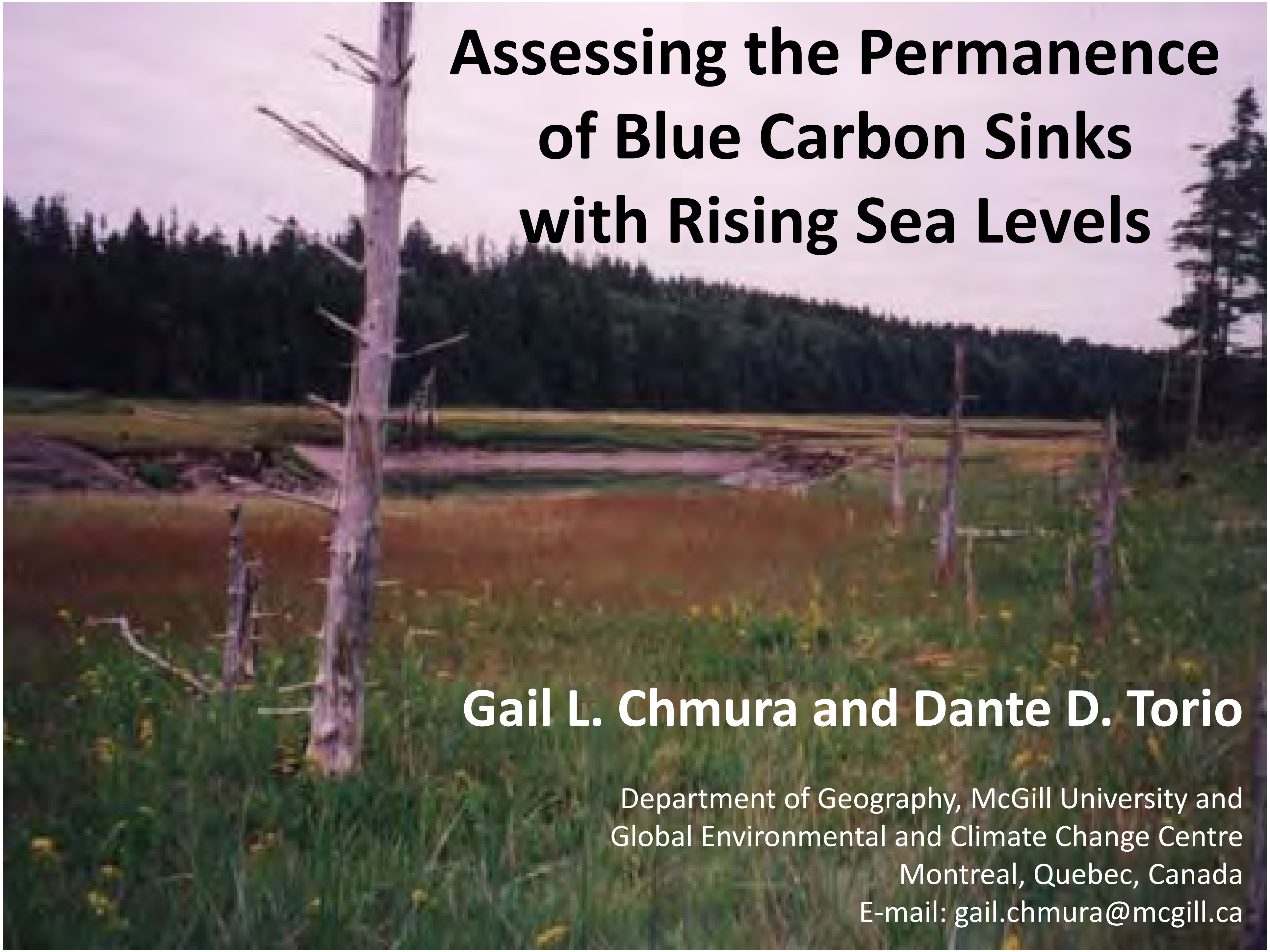

Assessing the Permanence of Blue Carbon Sinks with Rising Sea Levels

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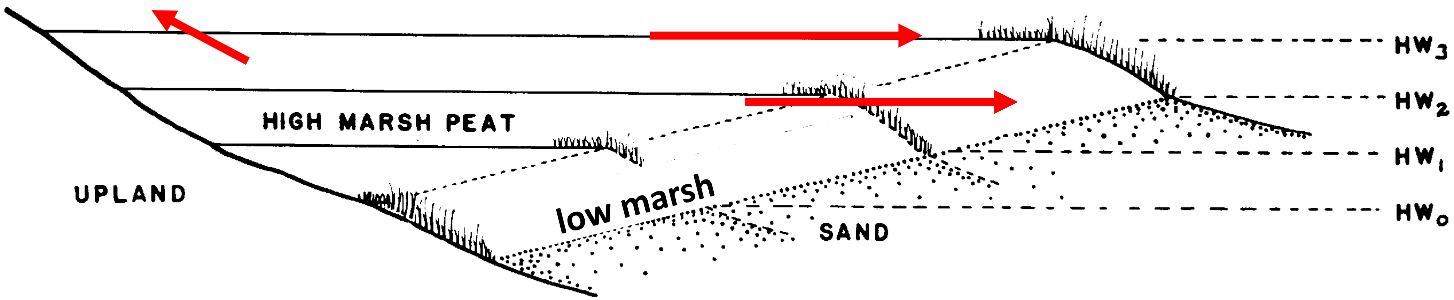
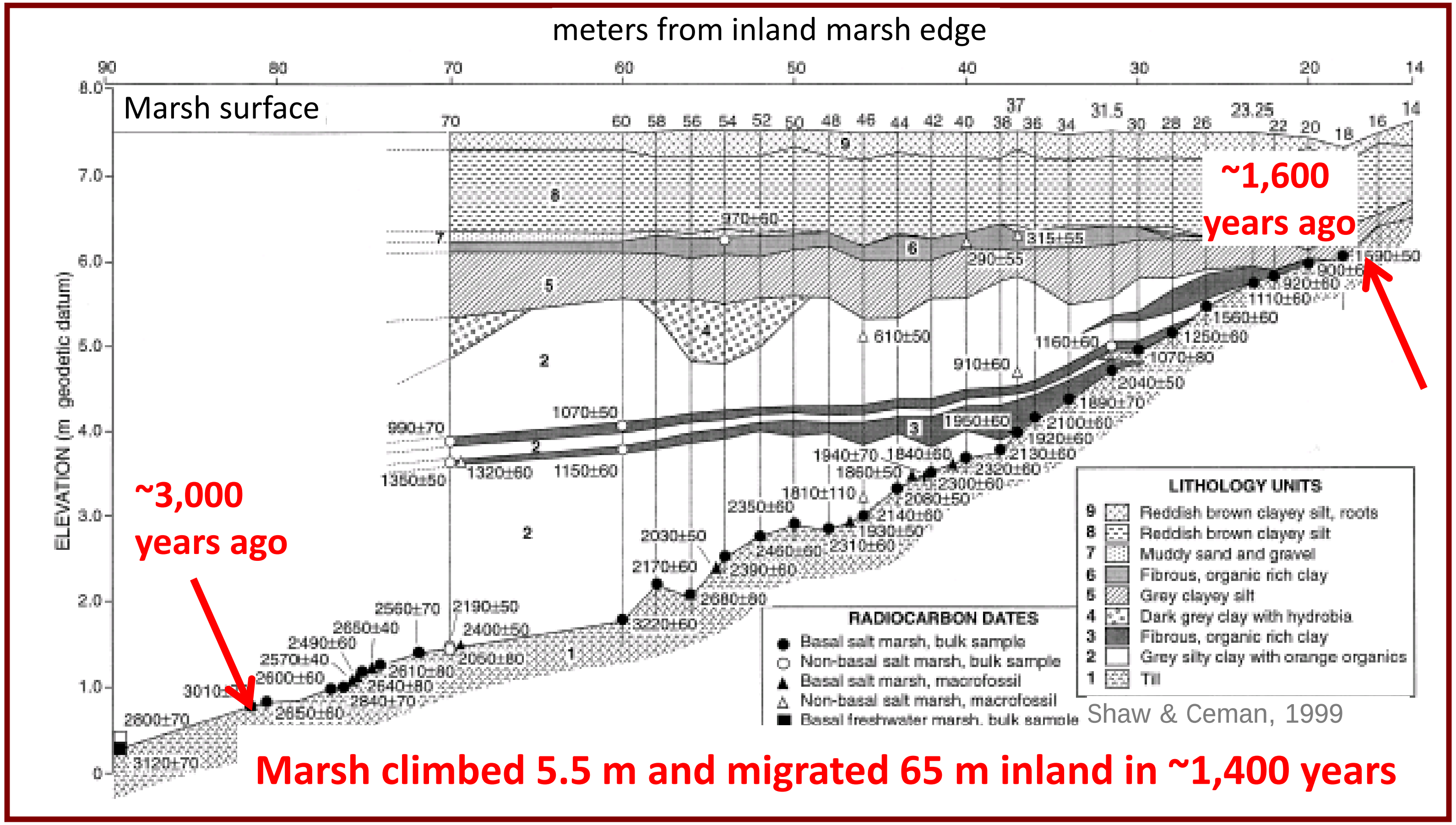
Over millenia salt marshes & mangroves have vertically accumulated soil and, at the same time, expanded laterally both seaward and inland.



Redfield 1972

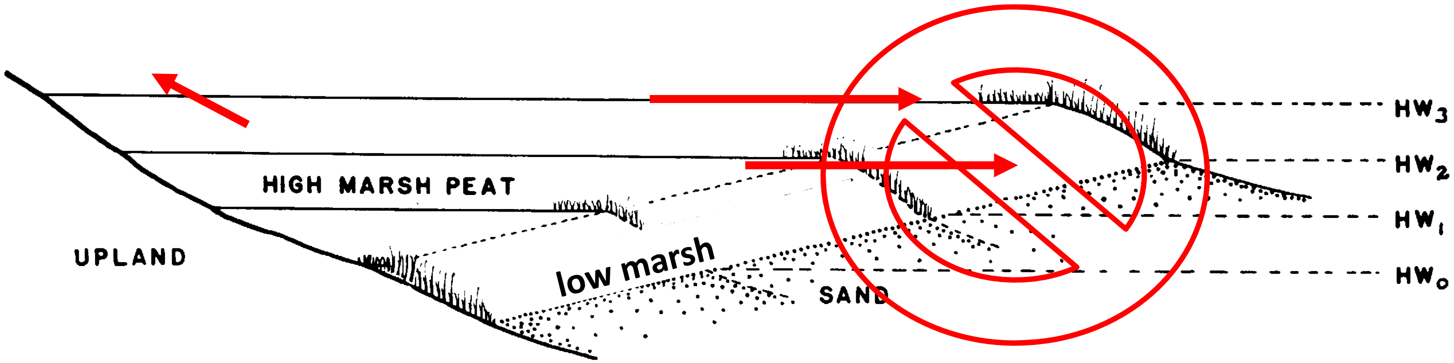
For decades we have known that salt marshes & mangroves vertically accumulated soil and at the same time expanded laterally both seaward and inland.



Rate of vertical accretion ~4 mm/yr

Rate of lateral accretion ~5 cm/yr on an 8.5% slope

This was possible under past, slower rates, but vegetation on the seaward edge may not be able to tolerate increased periods of submergence associated with higher rates of rise – resulting in loss of the active carbon sink there.



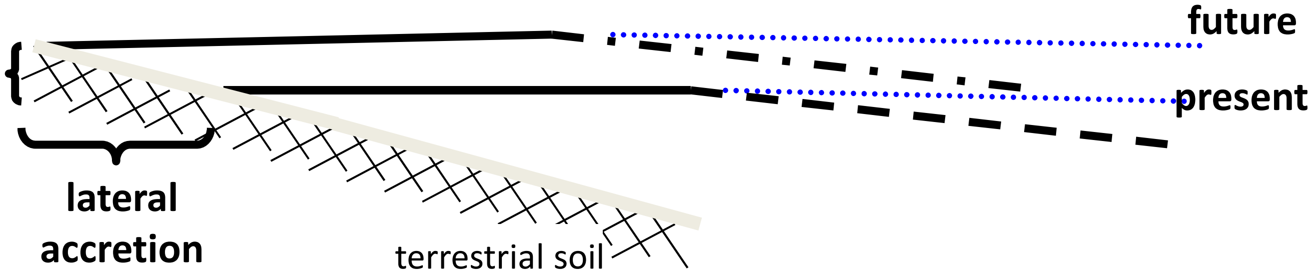
Redfield 1972

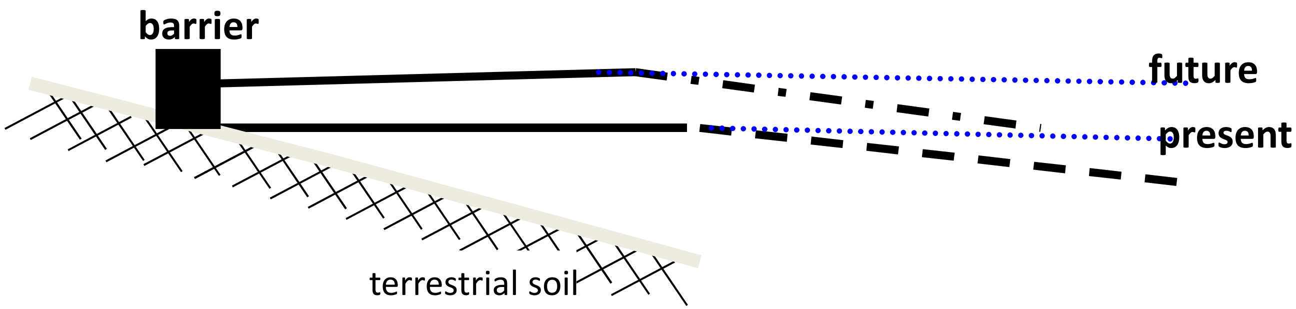
Predictions of increased sea level in 100 years:

40 cm	from paleo-example
59 cm	IPCC : Bindoff et al. 2007
190 cm	Vermeer & Rahmstorf 2009
224 cm	Grinsted et al. 2010

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"





The narrow vertical elevation range of tidal wetlands requires that elevation models used to predict response to sea level rise have *fine* vertical resolution…

Tidal amplitudes and elevation range of vegetation in selected salt marshes

country	coast	tidal amplitude (m)	elevation range of vegetation (m)	source
Italy	Venice Lagoon	0.7	0.2	Silvestri et al. 2005
USA	Palo Alto, California	2.6	1.2	Hinde 1954
Spain	Ortigueira & Ldrido Rivers	3.6	2.4	Sánchez et al. 1996
Canada	Bay of Fundy	6.0	>3.0	Chmura et al. 1997

Contour intervals of topographic maps are 3-10 m

Vertical resolution of LIDAR can be as fine as 0.05 m

LIDAR (Light Detection and Ranging Systems)
How it works:

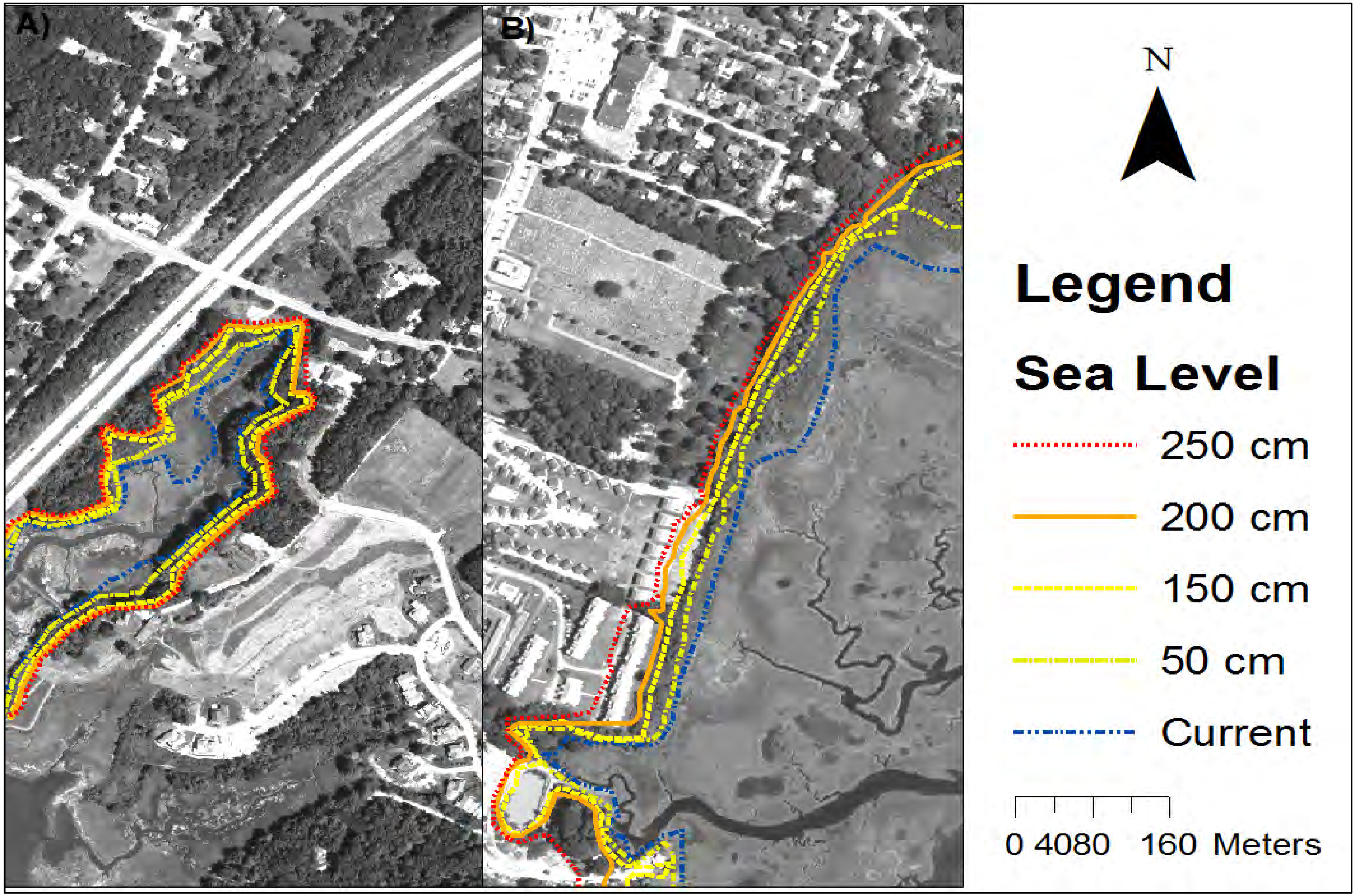
- Pulses sent down from a laser mounted in a plane
- ...along with a GPS, an inertial measurement unit, and a computer
- Receiver unit in the plane collects the returning energy
- A series of filters must be employed to isolate the vegetation surface from the ground surface
- *Contract a specialized firm to fly and collect the LIDAR, and tell them to fly at LOW TIDE!*
- Post processing can be contracted to the same firm or done by research collaborators (recommended – involve them from the beginning)

Comparison of costs of obtaining Lidar data vs. collecting field data with a real time kinematic Geographical Positioning System (RTK GPS), based upon US $ in 2005 (Rogers et al. 2007).

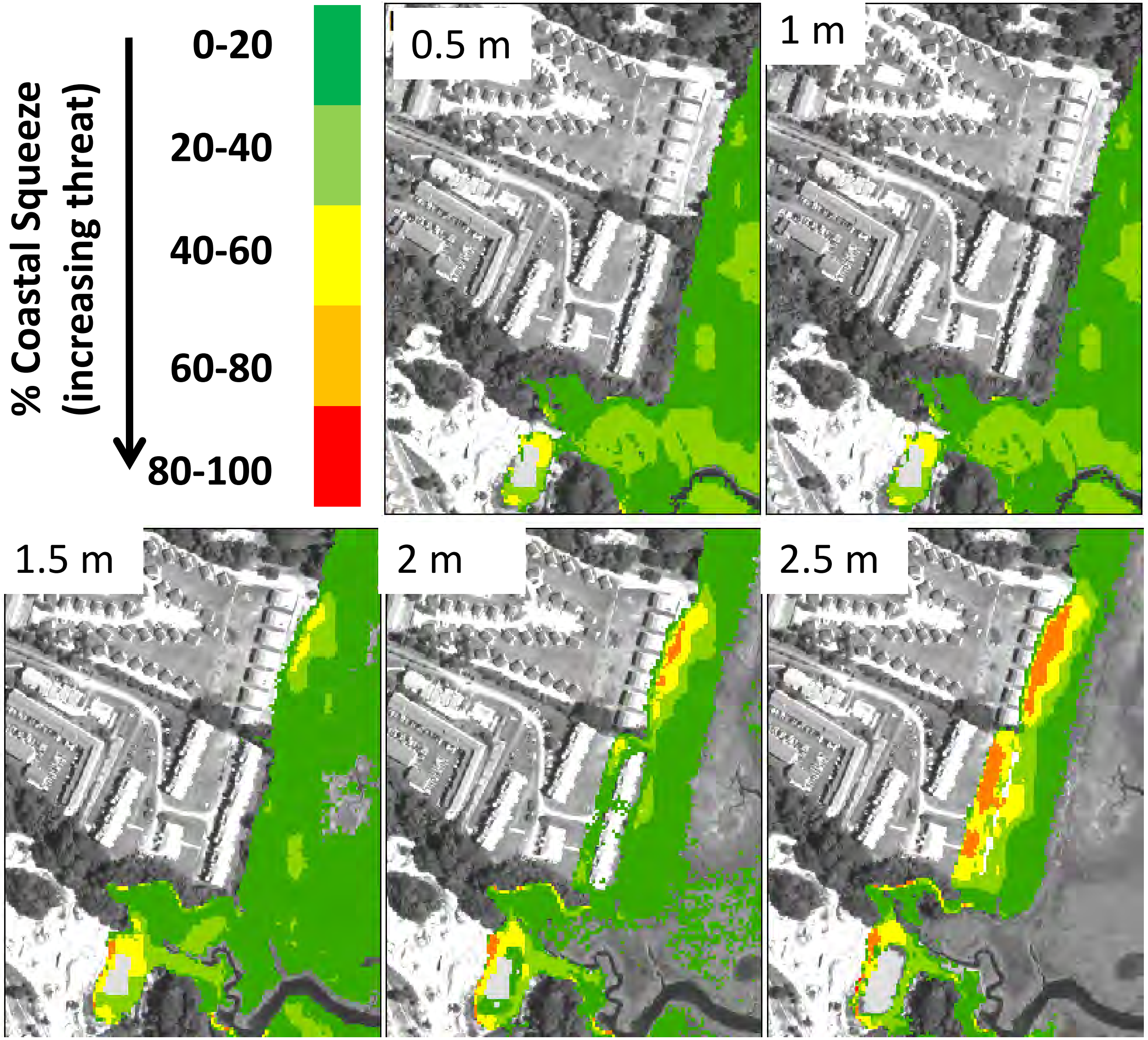
Type	Cost/Acre	Points/Acre	Cost/Point
Lidar	$2.34	1396	$0.00
RTK GPS	$287.00	62.69	$5.44

Dante using RTK GPS

The RTK GPS is labour-intensive, requires specialized equipment and post-processing to relate field data to an appropriate datum.



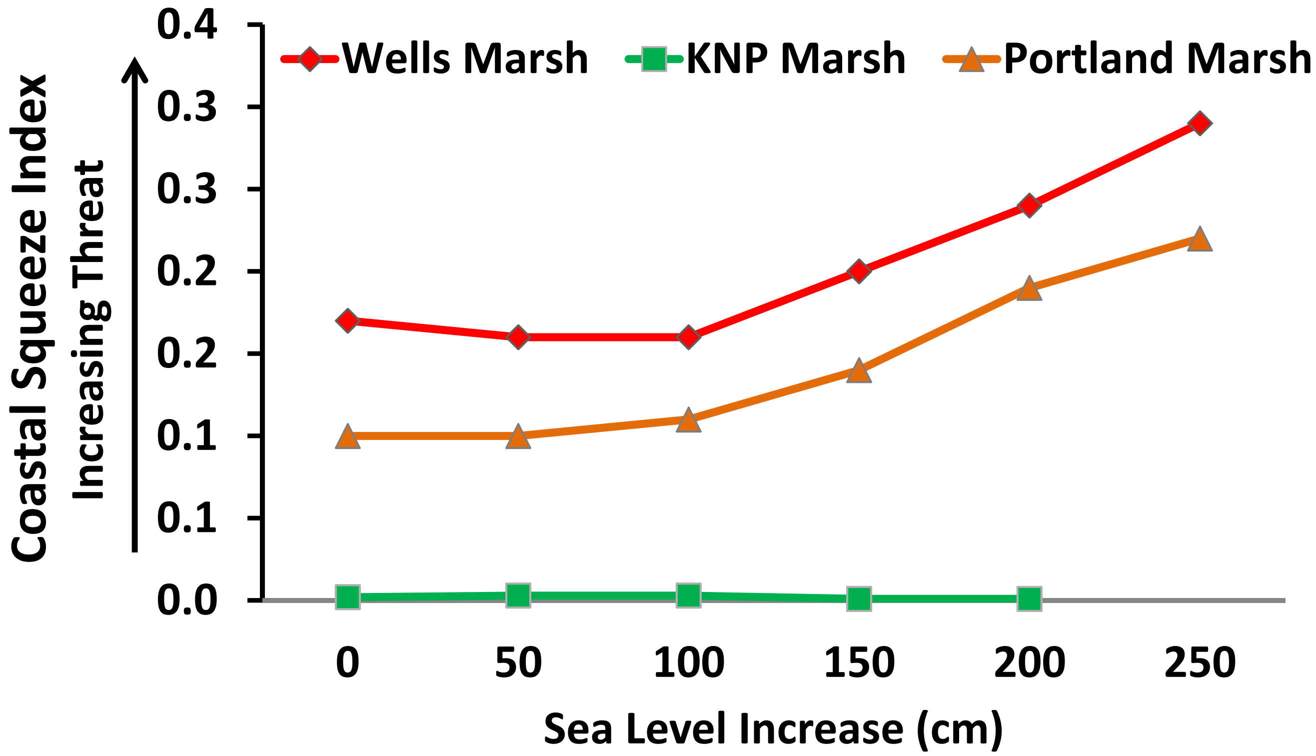
Here Dante has used LIDAR to create a digital elevation model & predict future "tidal floodplains" under varied scenarios of sea level rise. This is useful for many types of planning.



Combined with remotely sensed data, that reveals characteristics such as impervious surfaces, we can determine how intensity of squeeze will vary around a wetland under different sea level rise scenarios.

Dante has incorporated measurements of slope and imperviousness (proxy for development) to create a “Coastal Squeeze Index” that can be applied to any tidal wetland.

With LIDAR available we not only can assess the permanence of a blue carbon sink under varied sea level threats, but use the Coastal Squeeze Index to compare sites and prioritize targets for preservation, restoration, and best investments in carbon offsets.



The LIDAR digital elevation model can also be used to assess loss at the seaward edge if we know local accretion rates.

Only LIDAR has the required resolution

It is expensive, but valuable for many planning purposes to:

- **Assess flooding risk**
- **Assess increased exposure to coastal erosion**
- **Determine which portions of infrastructure and which sectors of coastal communities are threatened**
- **Reach stakeholders, as mapping scale can fit property boundaries**


Thank-you!
Questions?
(This is the "techy" half of the team, Dante Torio.)