Role of elevation, relative sea level history & land cover conversions in determining carbon distributions in *Spartina alterniflora* dominated salt marshes in Galveston, Texas

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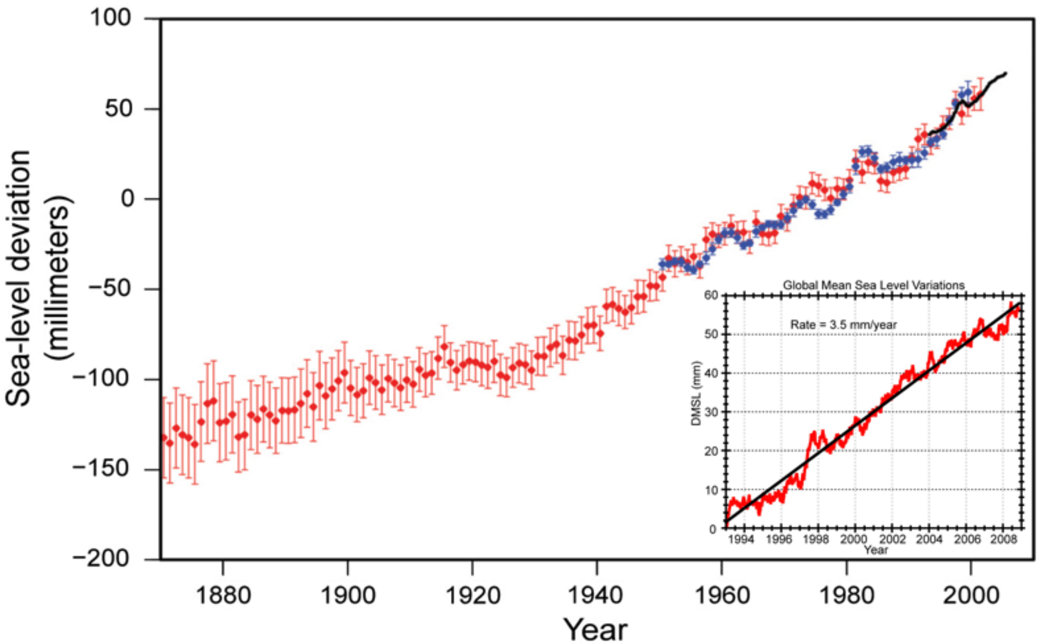
Background

Coastal Salt marshes

- Cover less than 1% of the Earth's surface, yet comprise ~ 25% of the global soil carbon sink
- Rates of carbon sequestration are an order of magnitude higher than that of comparably-sized rainforests
- Serve as major terrestrial carbon sinks

Background

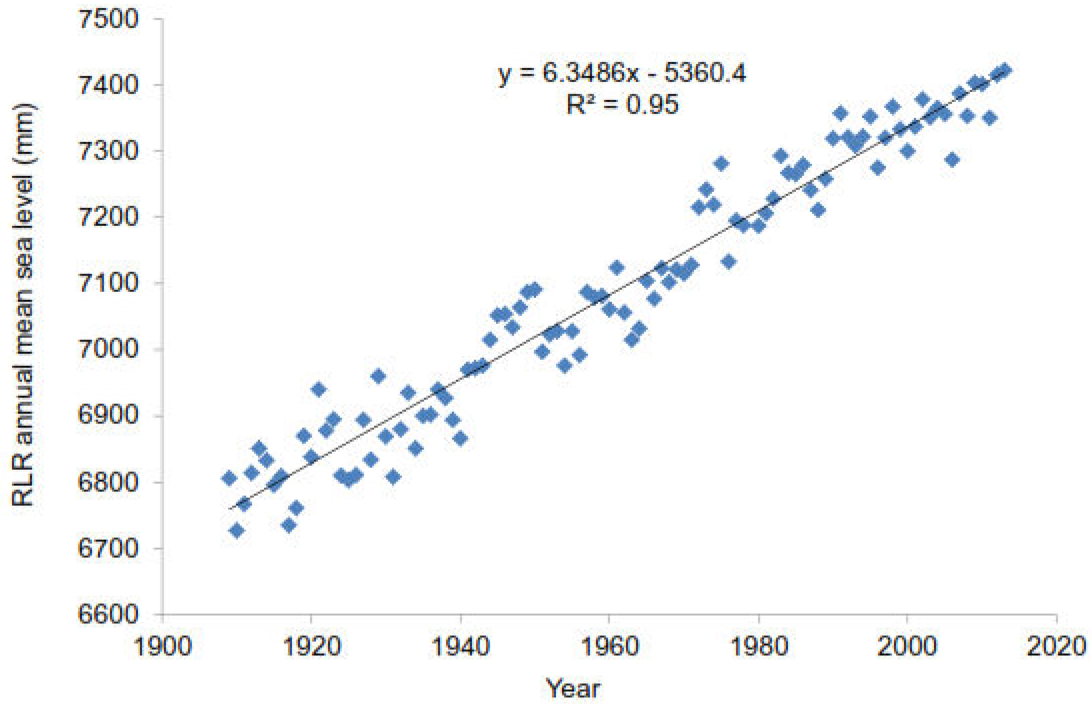
- Global warming and rising sea levels create increasing threats for the wetland ecosystems
- They are highly productive and must be preserved as future carbon sinks
  - “Estuarine wetlands sequester carbon at a rate of about 10-fold higher on an area basis than any other wetland ecosystem” - Brigham et al. (2006)”



Annual averages of global sea level
(Red: sea-level since 1870;
Blue: tide gauge data;
Black: based on satellite observations.
The inset shows global mean sea level rise since 1993 - a period over which sea level rise has accelerated)

Background

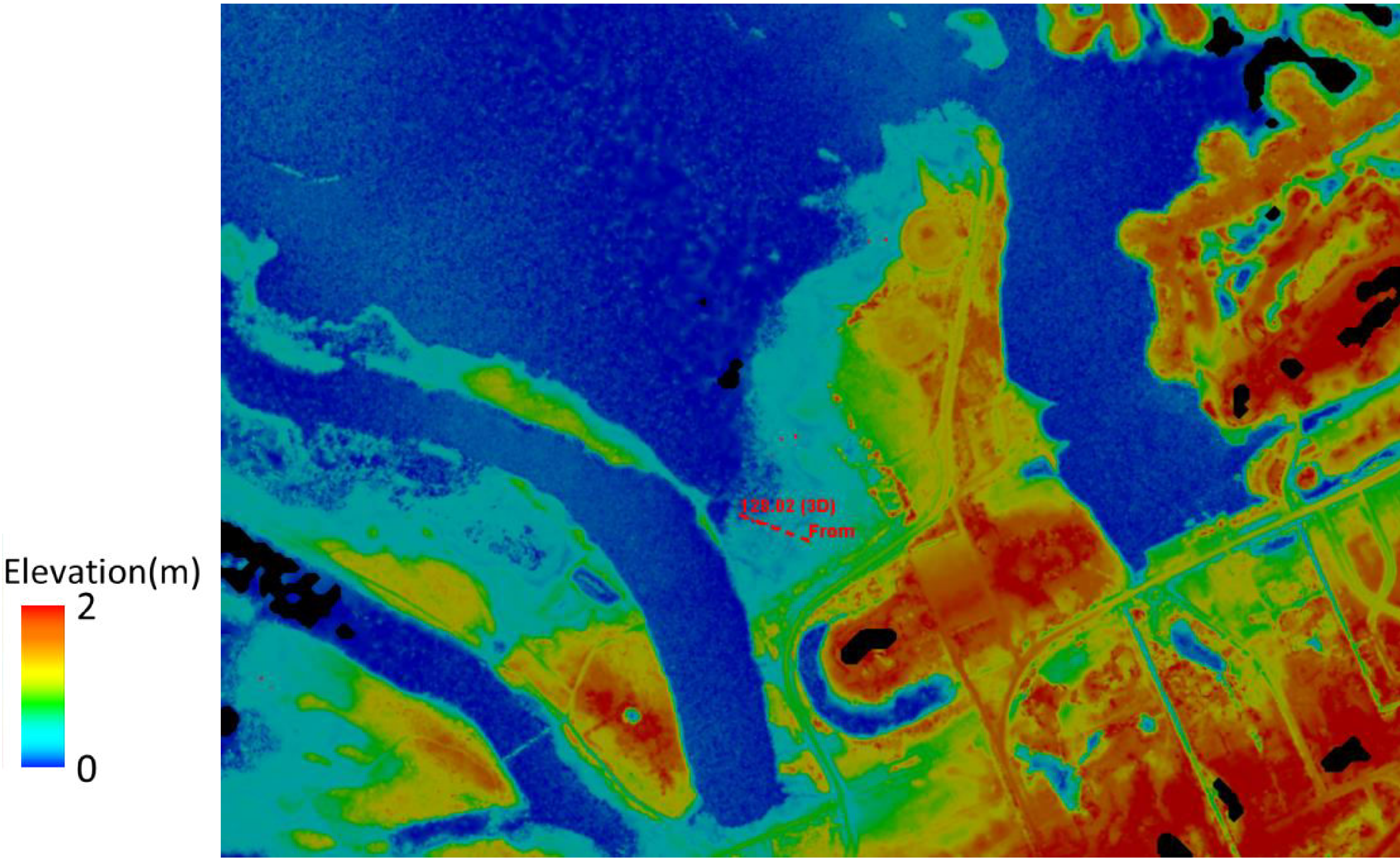
- Local sea level rise rates for the study area



Sea level trends for the period from 1909 to 2013 at Galveston Pier 21 station.

Background

Current status & future roles of coastal salt marshes as terrestrial C sinks??



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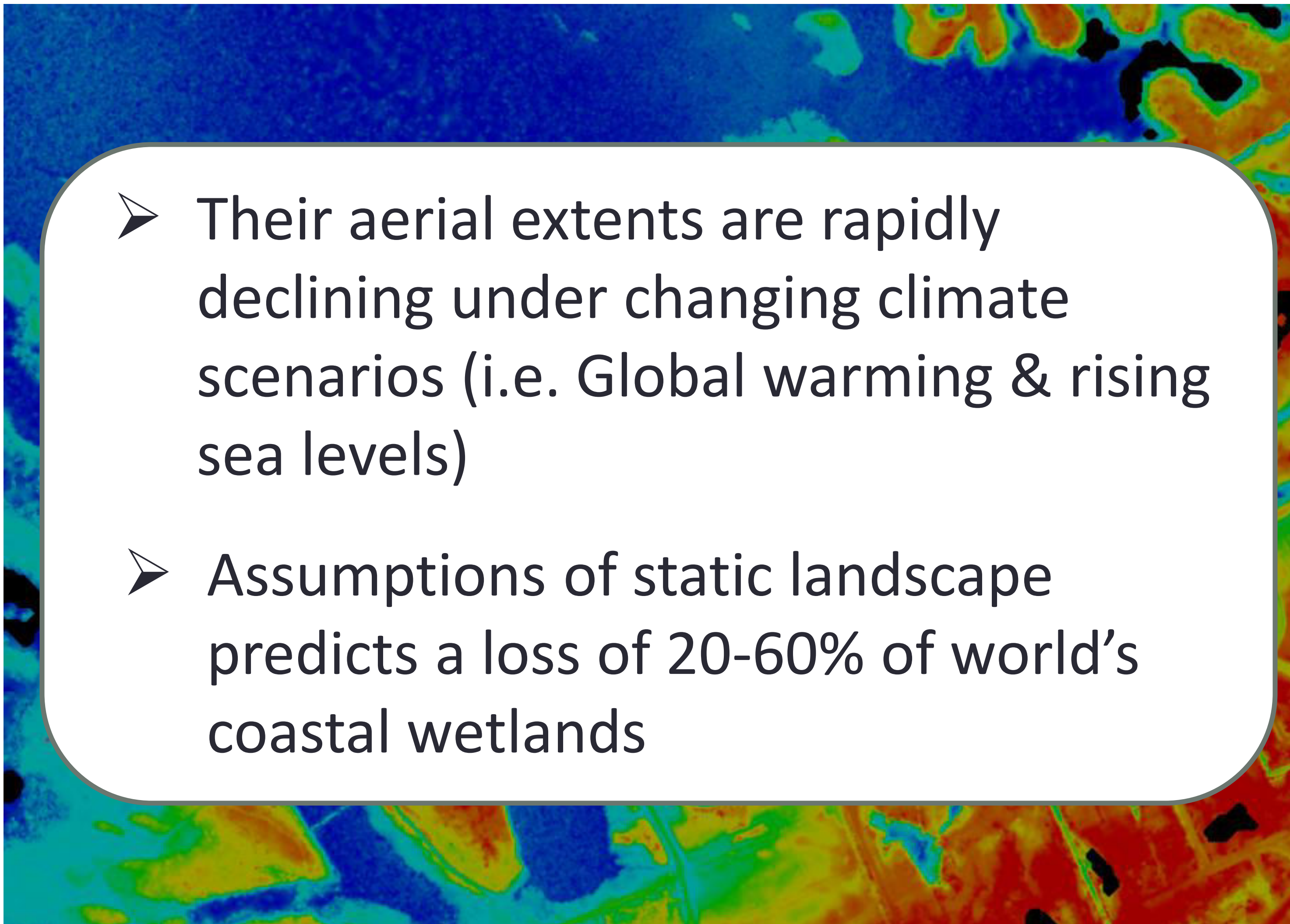
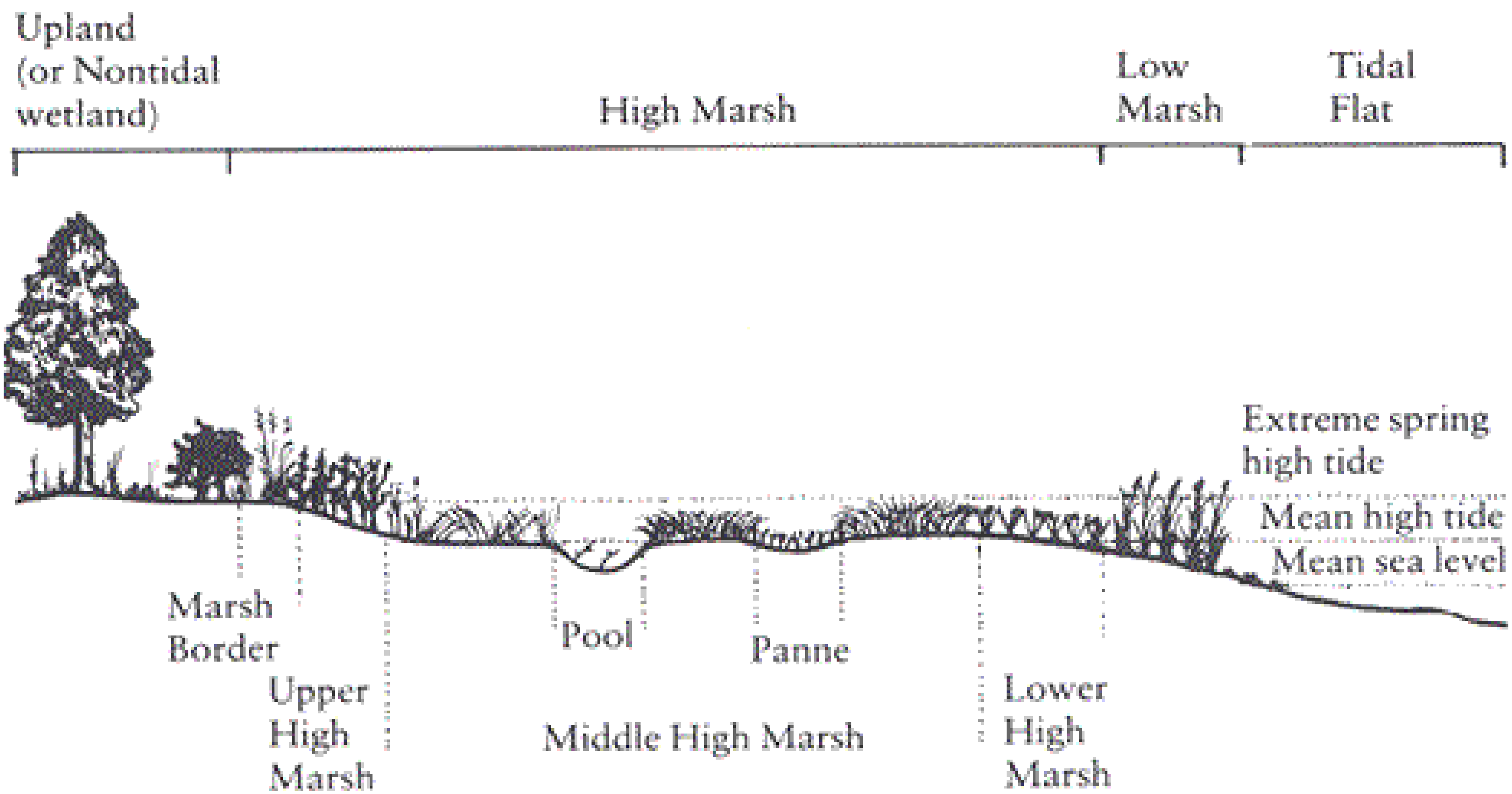
Current status & future roles of coastal salt marshes as terrestrial C sinks??



- ➢ Their aerial extents are rapidly declining under changing climate scenarios (i.e. Global warming & rising sea levels)
- ➢ Assumptions of static landscape predicts a loss of 20-60% of world's coastal wetlands

Background

Current status & future roles of coastal salt marshes as terrestrial C sinks??



Vegetation transition over a marsh cross section

Objectives

1. To understand variations in vegetation characteristics and biomass distribution along the elevation gradient

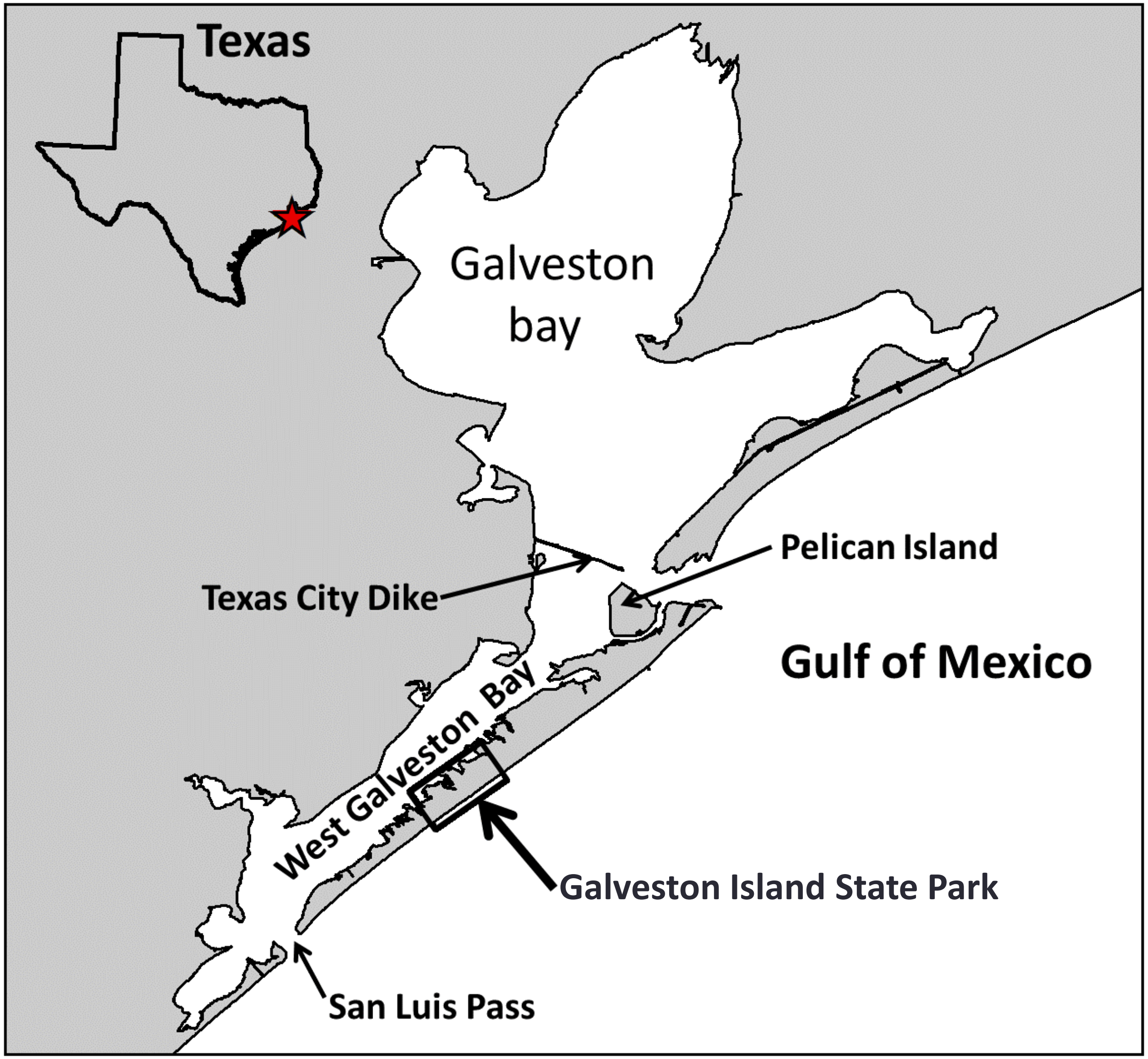
2. To understand variations in soil carbon storage across different depths of the soil profile

3. To evaluate possible linkages between the changes in above ground environment (i.e. vegetation transition as affected by relative sea level history) to the changes in soil carbon storage

Study Area

S. alterniflora dominated coastal salt marshes of Galveston, Texas

Coastal salt marshes of Galveston, Texas - Location



Galveston Island State Park, Texas – May 2012

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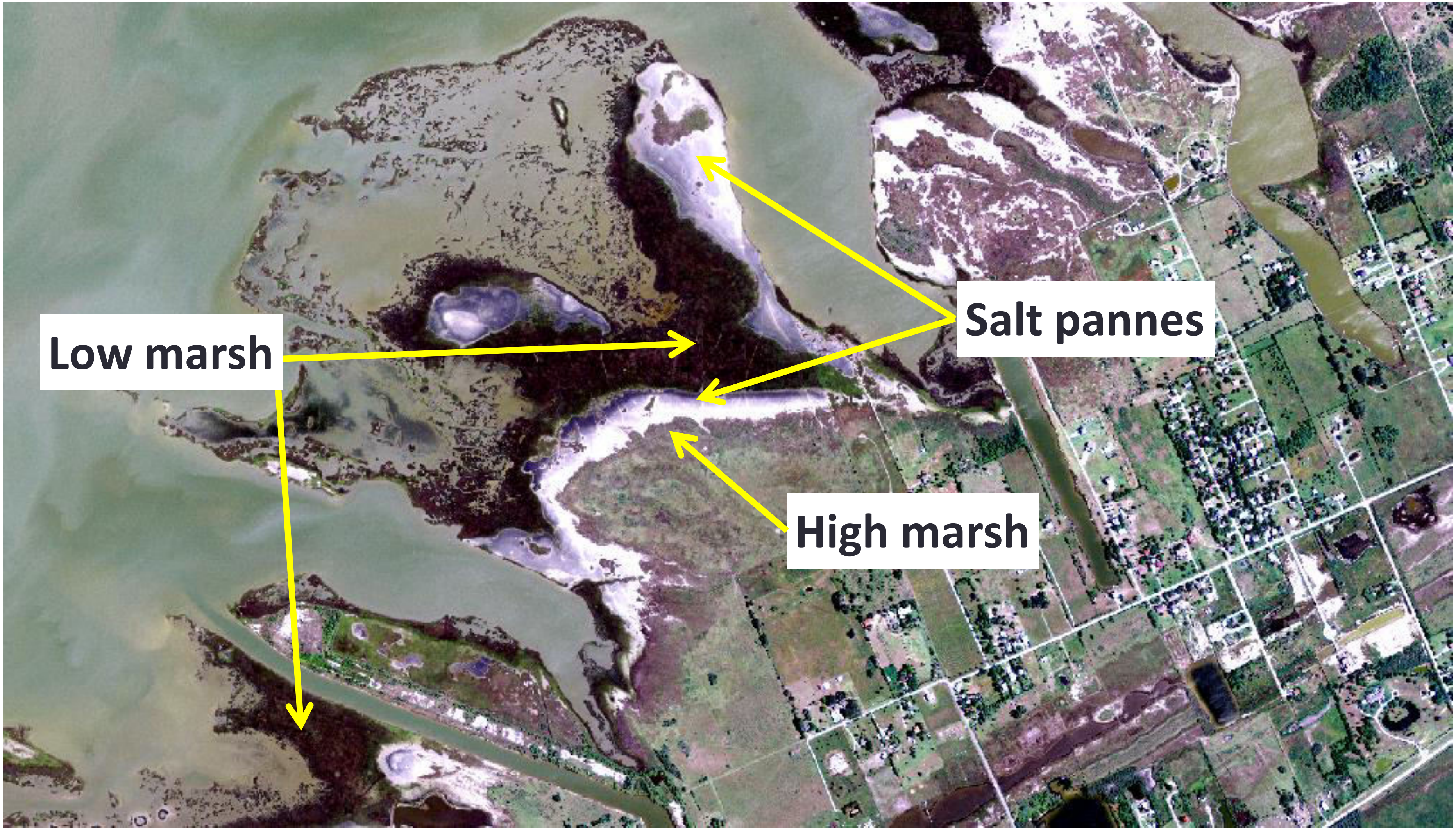

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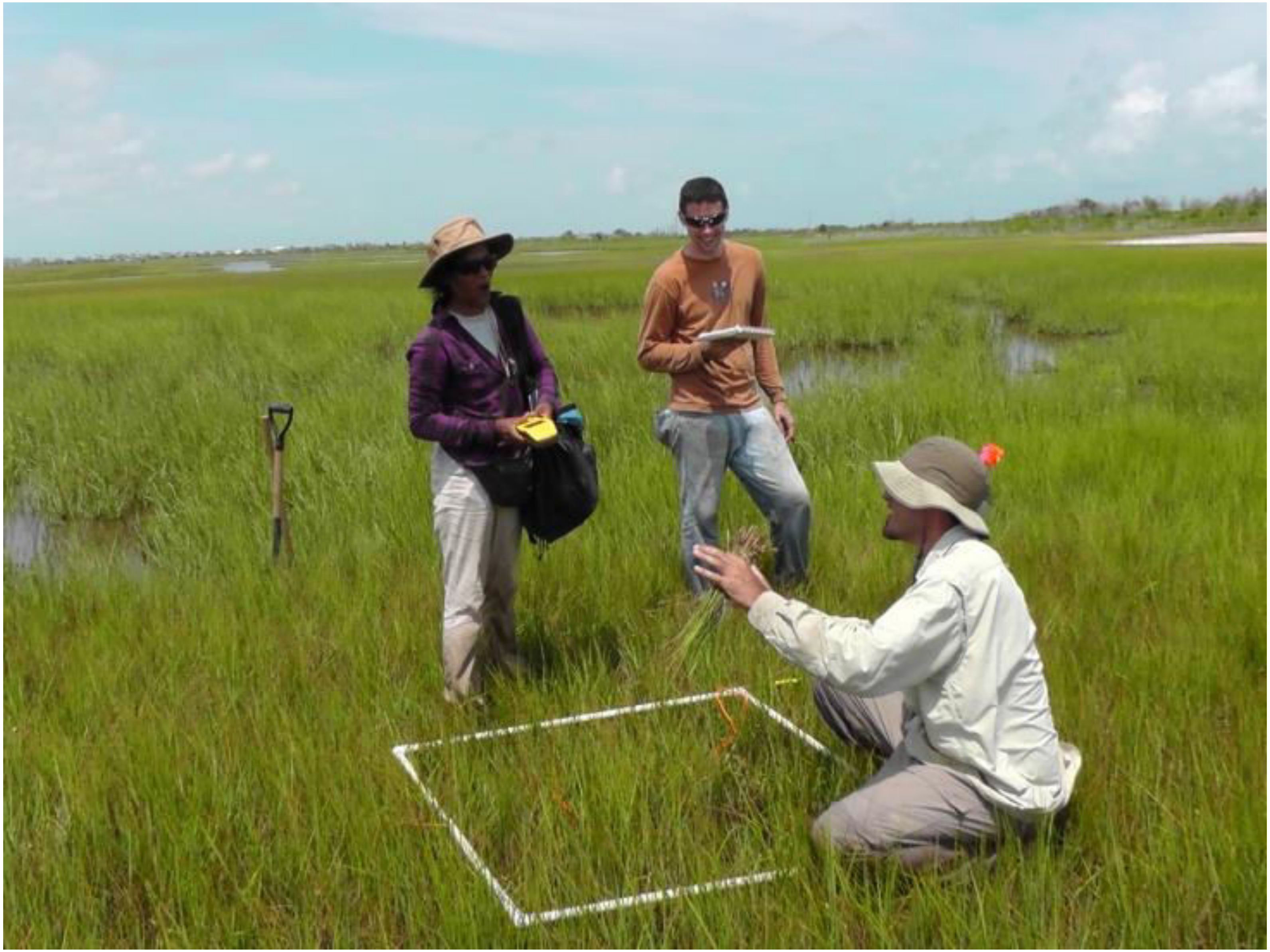


Galveston Island State Park, Texas – May 2012

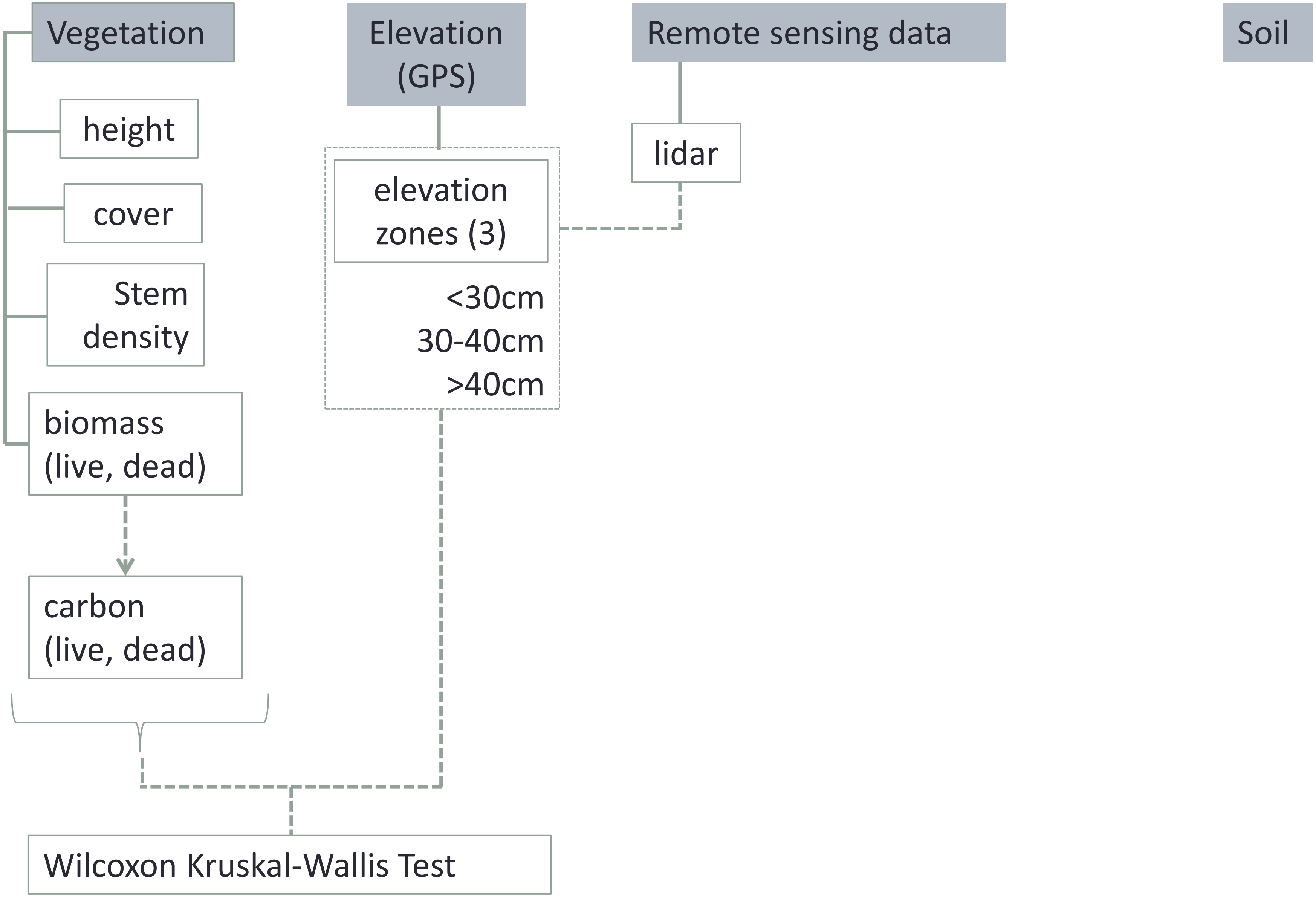
Data, Methods & Results

1. Variations in the above ground environment – plant characteristics, biomass and Carbon storage

2. Variations in the soil profile – across different depths

3. Sea level history, land cover change and the changes in the soil profile

Data, data processing and analyses



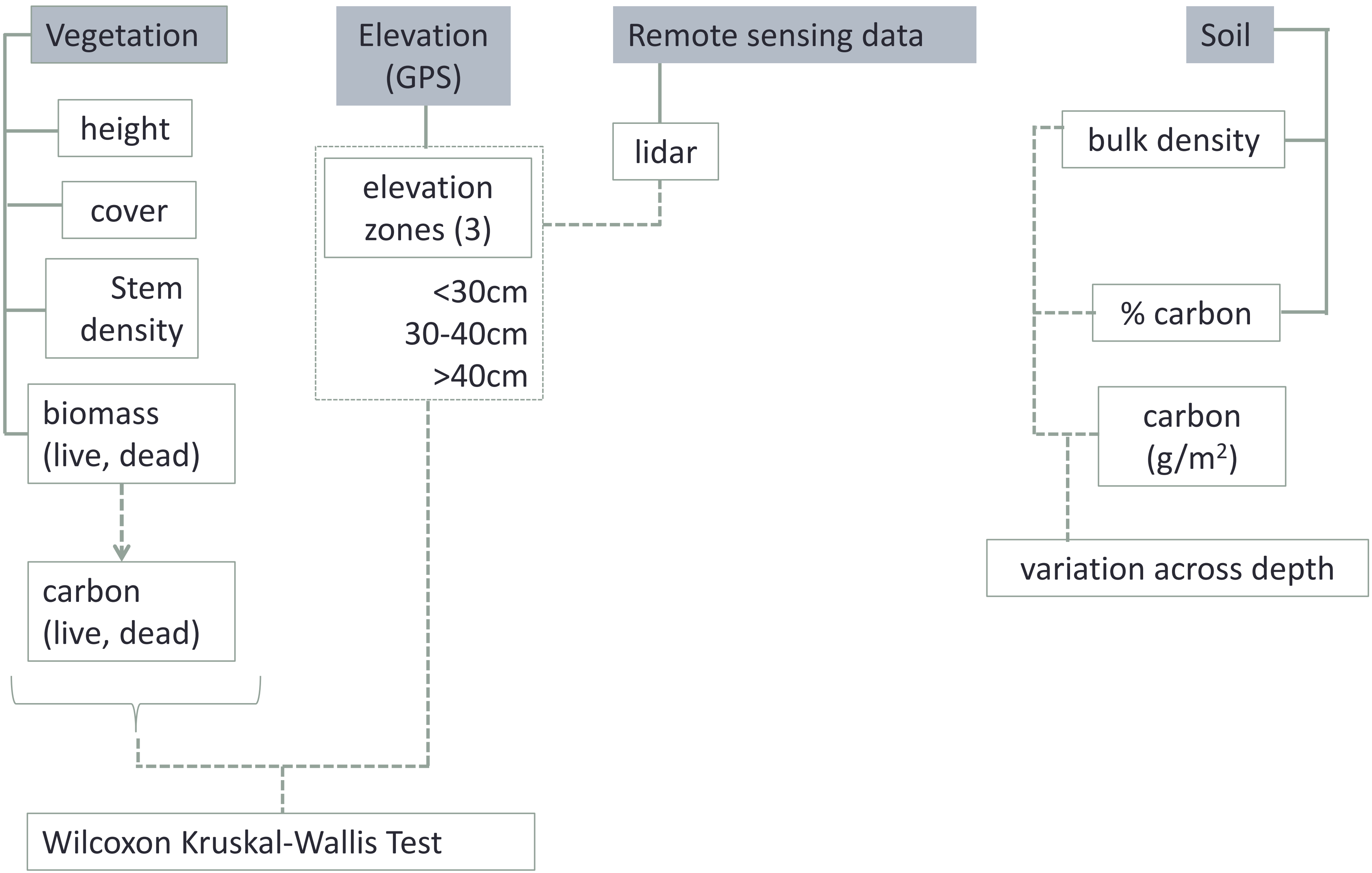
- Spatial variations along the elevation gradient – Spatial patterns of vegetation characteristics

	Elevation (cm)			$Pr>\chi^2$
	<30	30-40	>40	
Plant height mean (cm)	48	44	43	0.008
Culm height mean (cm)	14	12	8	<0.0001
% Cover	82	81	93	0.009
Stem density (#/m^2)	351	360	344	0.68

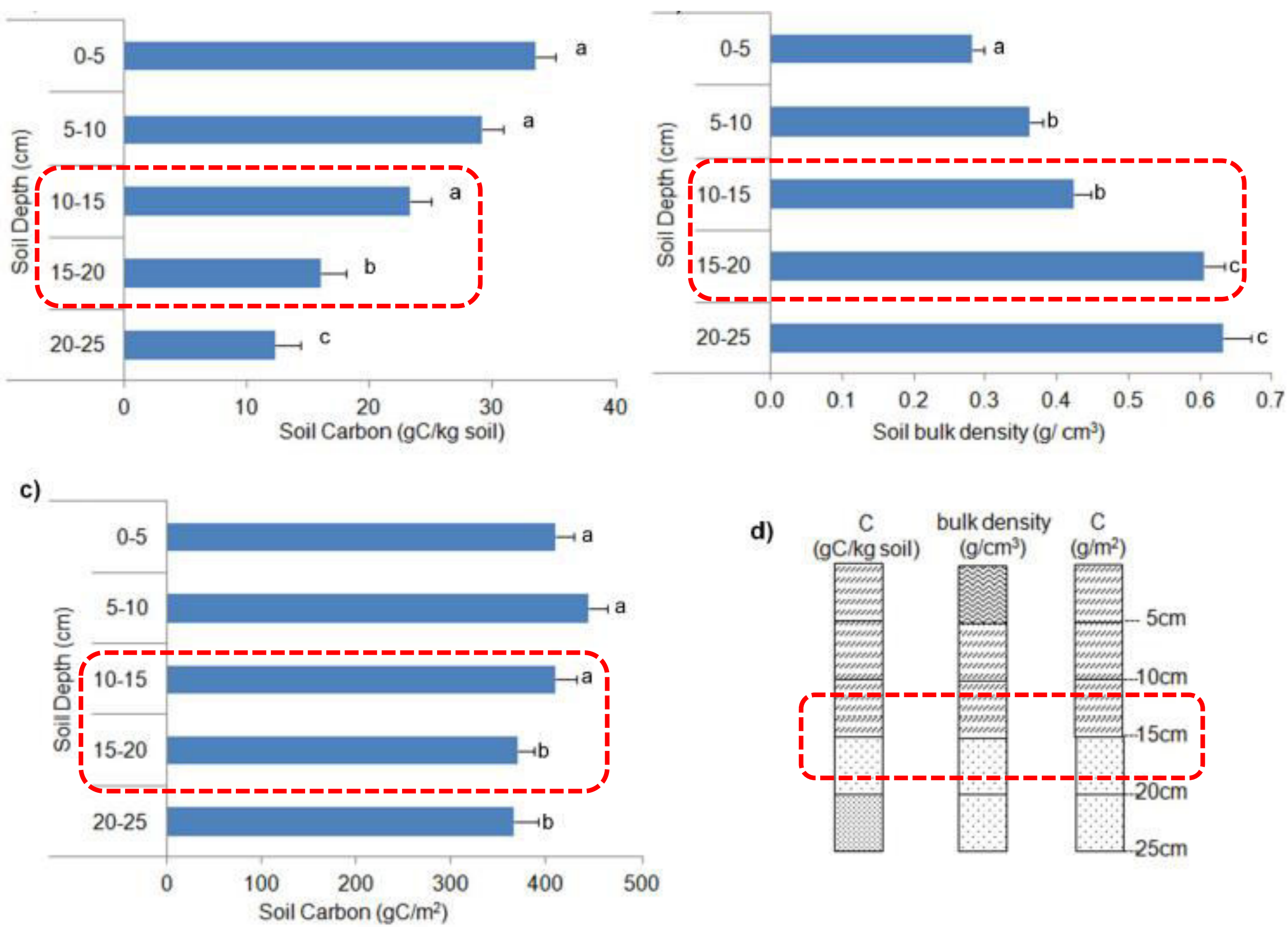
- Spatial variations along the elevation gradient – Distribution of above-ground C quantities

Above-ground C (g/m^2)	Elevation (cm)			$Pr>\chi^2$
	<30	30-40	>40	
Live	251	222	200	0.04
Dead	80	88	168	0.0004
Total	331	310	367	0.18

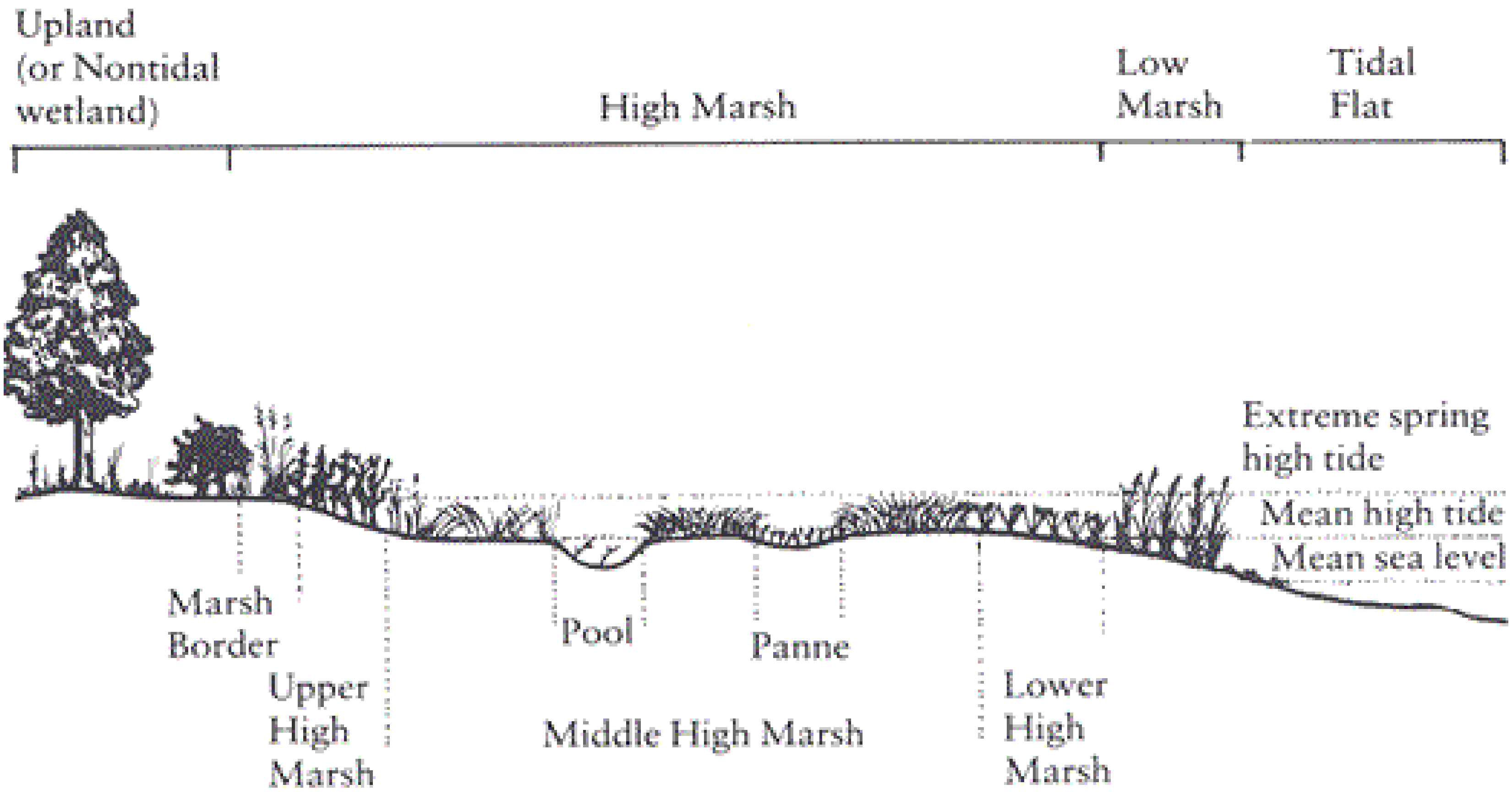
Data, data processing and analyses



- Temporal changes: Soil carbon storage



- Vegetation transition over a marsh cross section



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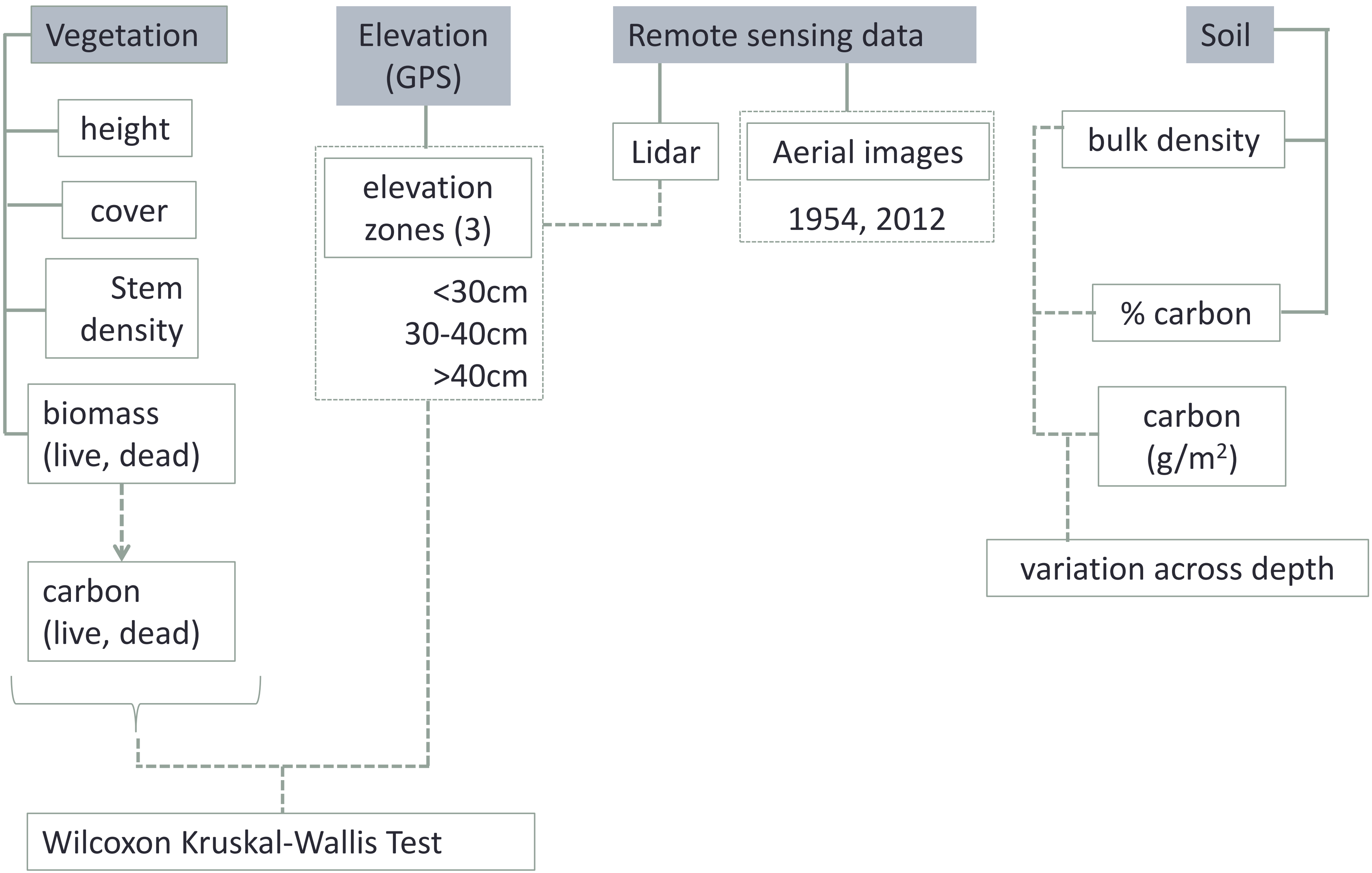

- Temporal changes: Relative sea level history and vegetation transition

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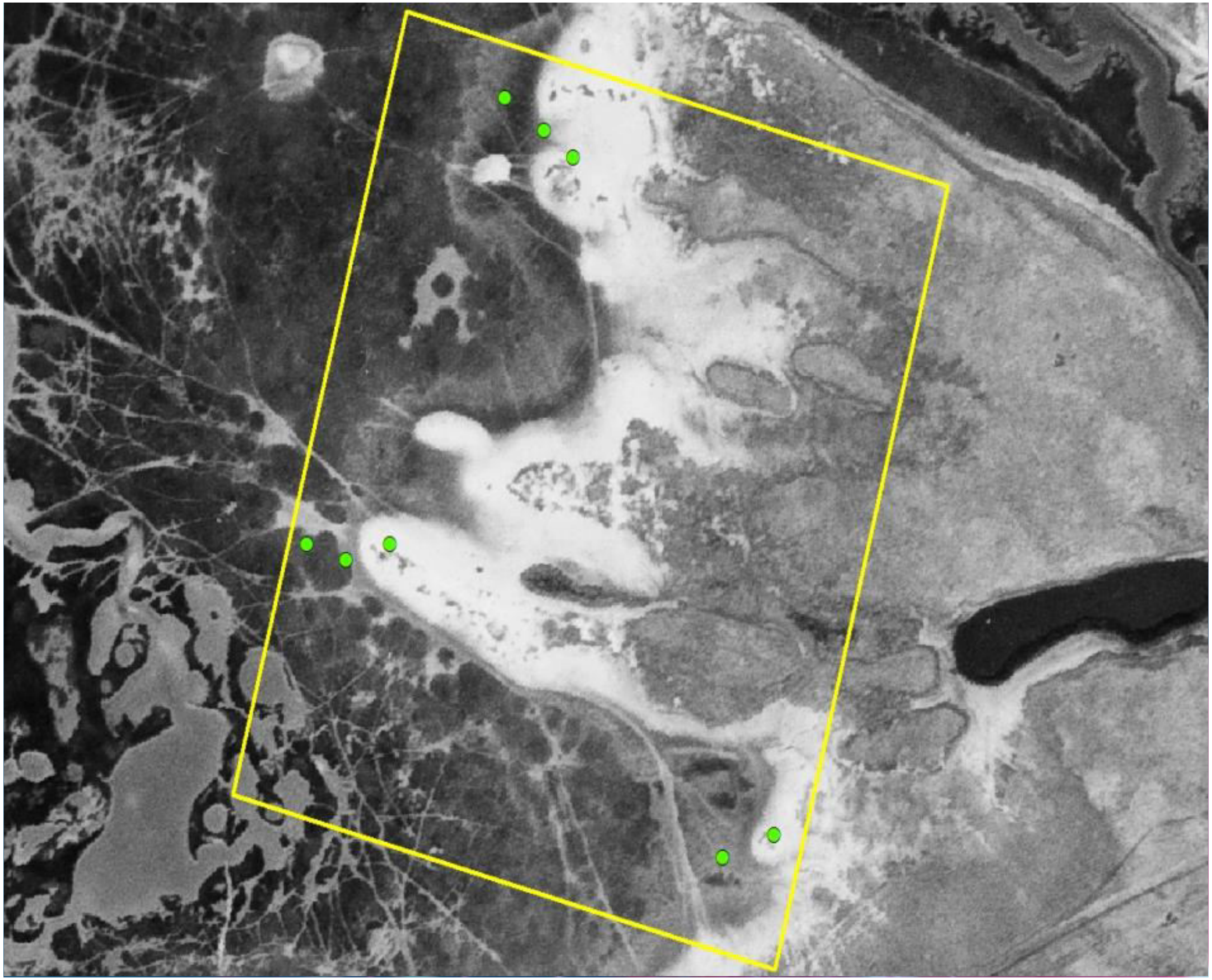
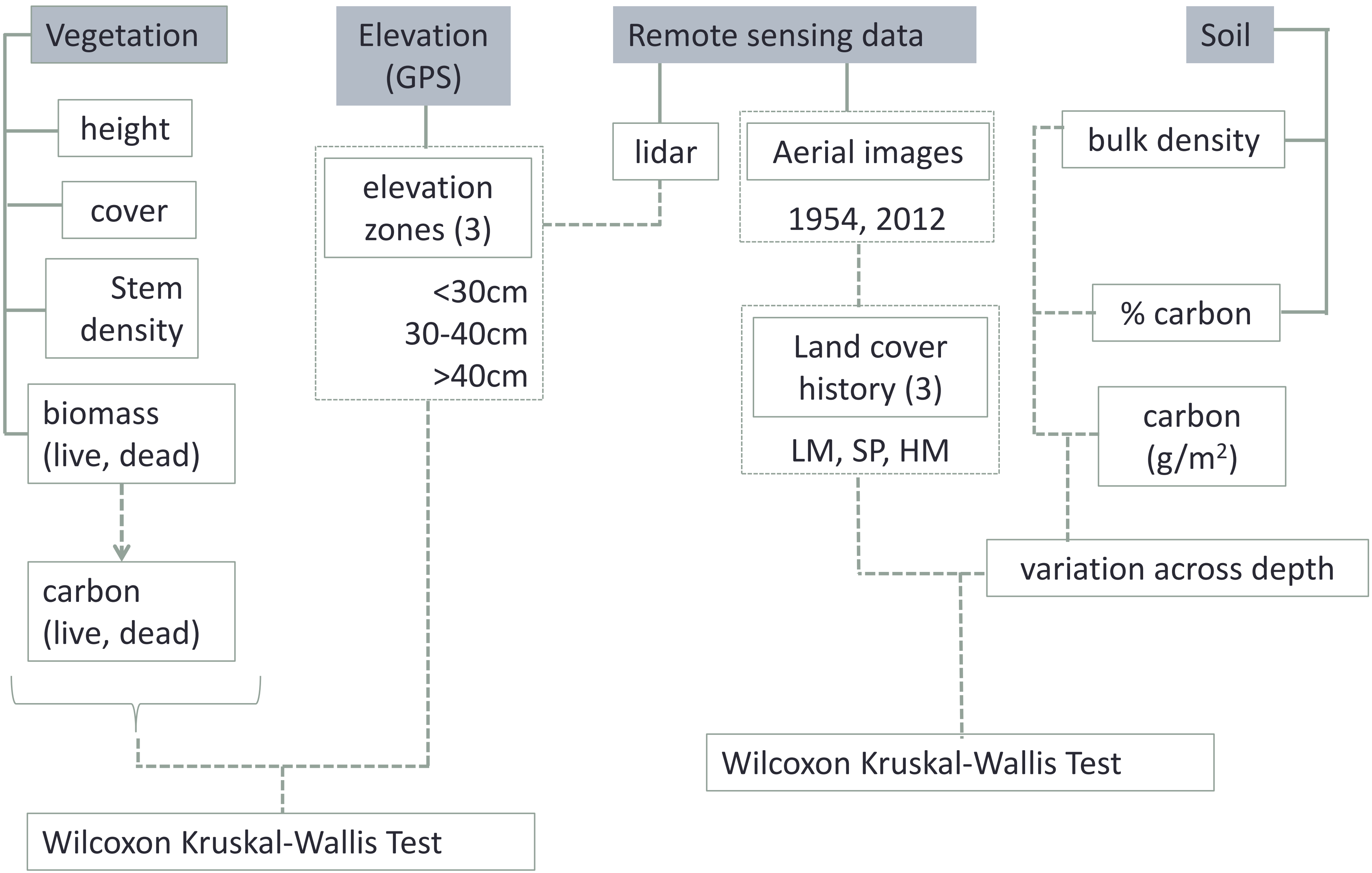
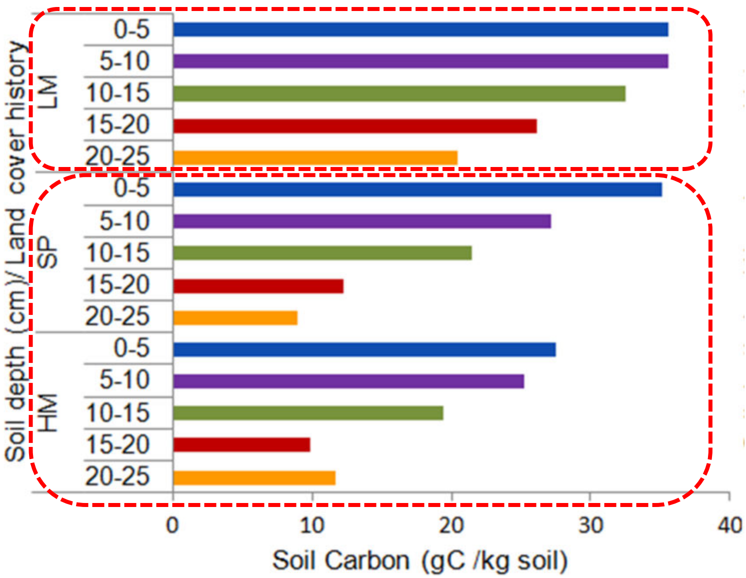
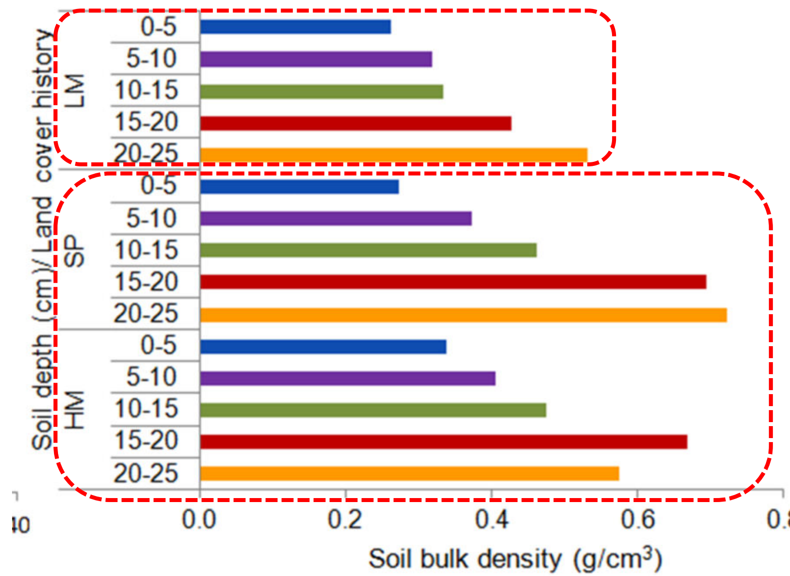


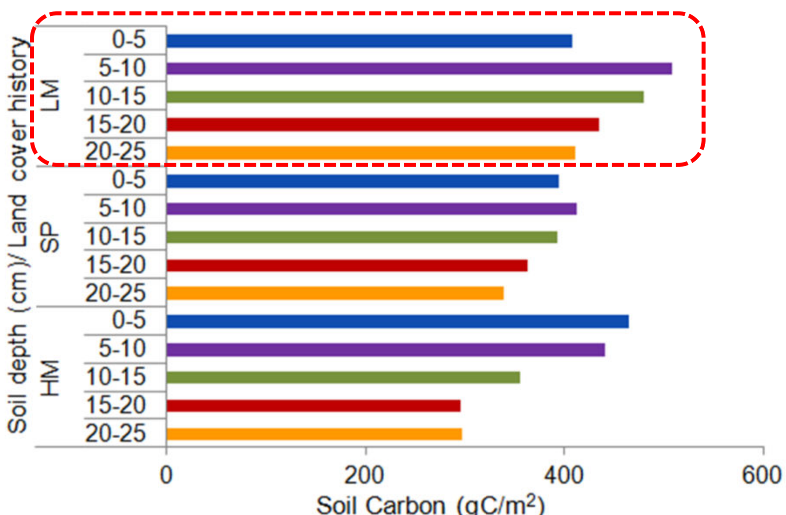
Data, data processing and analyses



- Temporal changes: Relative sea level history, vegetation transition and soil carbon storage







- Average accretion rates for this area - 0.25cm/ year
- Corresponds to the marsh build up over 58 year period

Conclusions

- Terrain characteristics (i.e. elevation gradient) play a key role in determining the vegetation distribution and thus carbon storage in the above ground environment
- Variations in soil properties along the soil depth were linked to the temporal changes in sediment deposition on the marsh surface, relative sea level history, and resulting vegetation transitions
- Amounts of soil carbon stored in recently established marshes were significantly lower than those that have remained in situ for a longer period of time
- Status of the salt marsh as a carbon sink varies as a function of both **space and time**

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  - Dr. Ricardo Colon-Rivera & Trevor Pattillo
- Jackson State University (JSU)
  - NOAA Environmental Corporative Science Center (NOAA ECSC)
  - Research Centers for Minority Institutions (RCMI)
  - Department of Biology

Questions???

Read for more information

Kulawardhana R. W., Feagin R. A., Popescu S. C., Boutton T. W., Yeager K. & Bianchi T. S. (**2015**)

– Estuarine Coastal and Shelf Sciences

http://www.sciencedirect.com/science/article/pii/S0272771414004119

Kulawardhana R. W., Popescu S. C. & Feagin R. A. (**2014**)

- Remote Sens. of Environment (Special Issue)

http://www.sciencedirect.com/science/article/pii/S0034425714000959

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