Factsheet # 15

Coastal Wetlands: Monitoring Estuarine Topographic Change with Terrestrial Laser Scanning (TLS)

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UW

Understanding multiscale dynamics of landscape change through the application of remote sensing & GIS

Remote **S**ensing & **G**eospatial **A**nalysis **L**aboratory

Background

Submerged Aquatic Vegetation is highly sensitive to water depth and degree of tidal inundation, and coastal wetlands are subject to sediment erosion and accumulation. Understanding the rates of theses processes is critical to understanding how these ecosystems will respond to predicted sea level rise. The traditional method for monitoring integrated sediment erosion/accumulation, the Sediment Elevation Table (SET), provides millimeter-scale precision with an extent of approximately $1m^2$ per instrument. Terrestrial Laser Scanning (TLS) may offer similar precision over a much larger extent.

Our Approach

This study will compare concurrent monitoring results from a SET and at TLS at a single SET over time. TLS scans will be georeferenced by a combination of kinematic GPS and scanning the fixed SET monument.

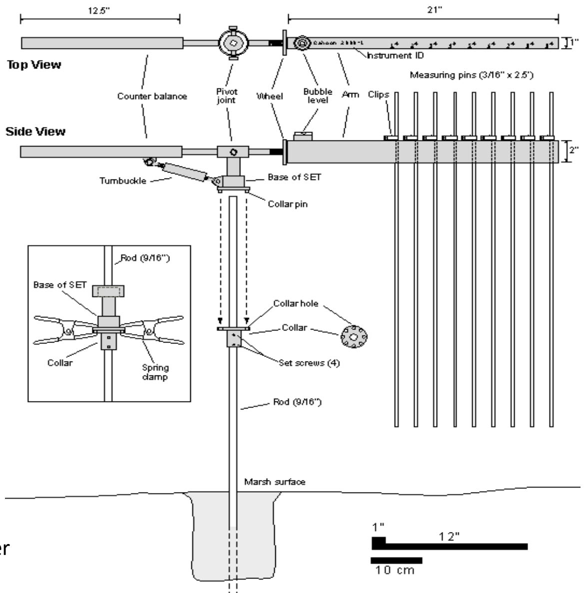

Figure 1. Diagram of Sediment Elevation Table (http://www.pwrc.usgs.gov/set/SET/rod.html)

What are the traditional methods for monitoring sediment dynamics?

The SET consists of a permanent monument to which a rotating leveling arm may be attached. When leveled, the arm remains a constant height above the monument. Rods are lowered from the arm until the reach the sediment surface in order to measure sediment elevation at that point. The arm is rotated to multiple preset angles and these measurements repeated.

Why use Terrestrial Laser Scanning?

Because the measurement extent of a single SET instrument is less than 1.5 m^2, multiple SET sites are needed to overcome small scale heterogeneity in sediment erosion and accumulation rates. The measurement extent of a TLS may be greater than $5000m^2$, meaning fewer monitoring sites may be necessary. Furthermore TLS can truly map topography, and topographic change within a scanned area allowing for novel investigations that incorporate the spatial patterns of change.

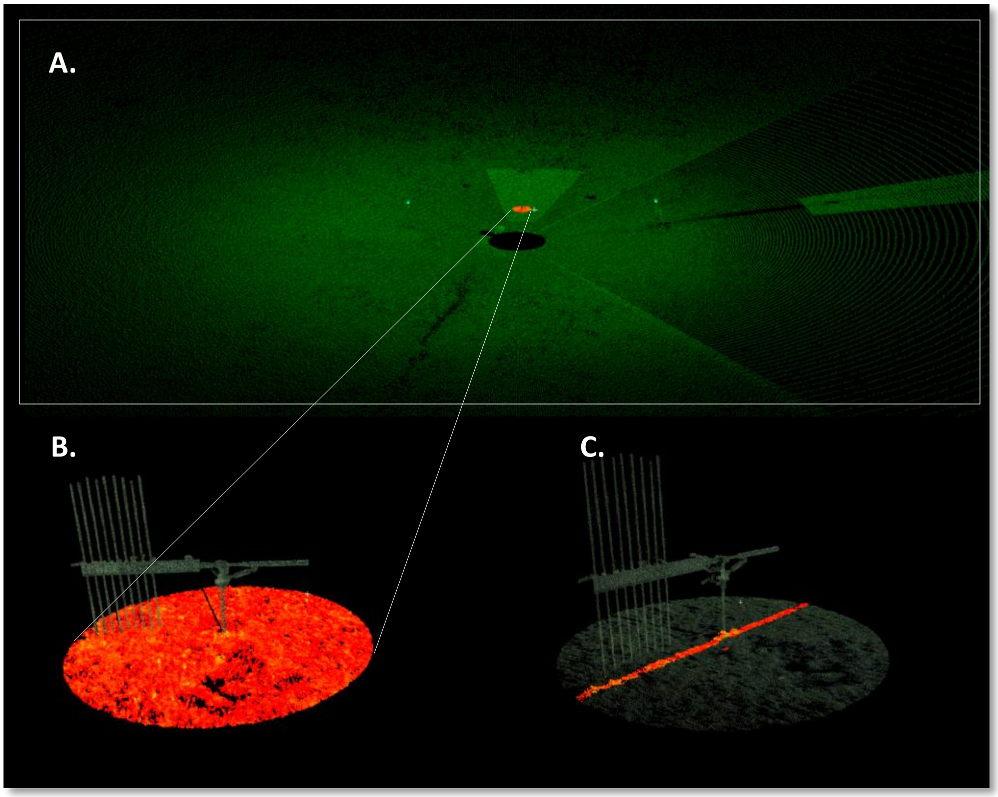

Figure 2. (A) Relative measurement extents of TLS scan (returns colored green) and SET instrument (returns colored orange within SET measurement extent). **(B)** Close-up of SET measuring arm showing measurement extent in orange. **(C)** Slice of TLS scan corresponding to SET measurement axis colored orange.

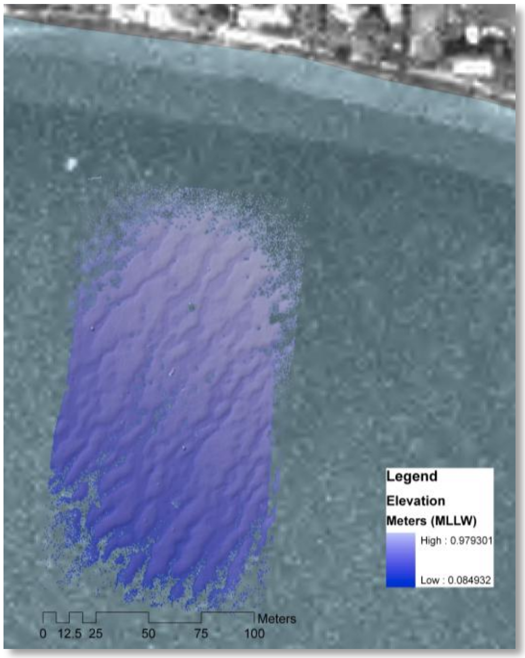

Figure 3. Example of TLS-derived topographic map draped on an aerial photograph.

Challenges

- Tides allow only short work windows in this environment.
- TLS requires more equipment, making measurement of remote sites challenging.
- Standing water or dense vegetation hinder the effectiveness of TLS
- GPS alone may not provide sufficient positional accuracy to achieve the same change detection resolution as a SET

THE ISSUE: Coastal and estuarine ecosystems are vulnerable to climate change induced sea level rise. Understanding the rates of sediment erosion and accretion is crucial to predicting ecosystem response to such change. Terrestrial laser scanning may offer similar precision to current monitoring methods with much higher extent.

THE KEY QUESTION:

Can we monitor estuarine topography with Terrestrial Laser Scanning (TLS)?

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