Determining Elevation in Wetland Ecosystems –

Changes in the collection of elevation data over the years

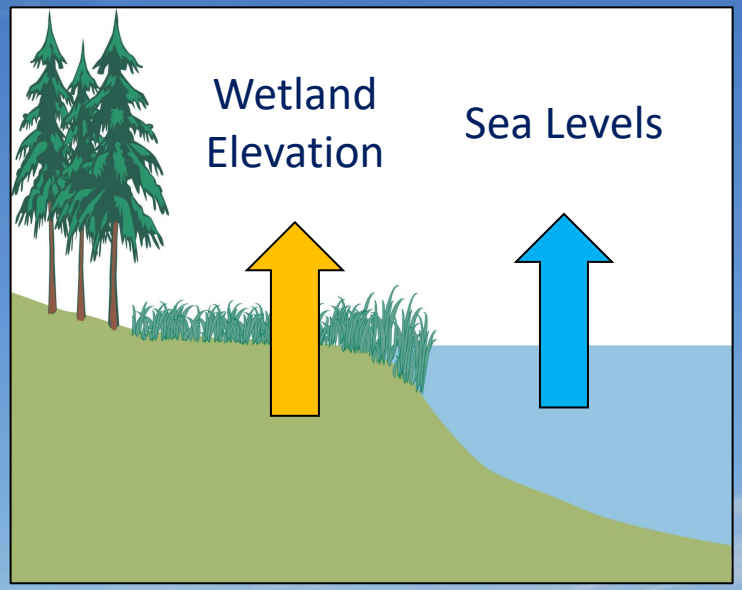
James C. Lynch
National Park Service

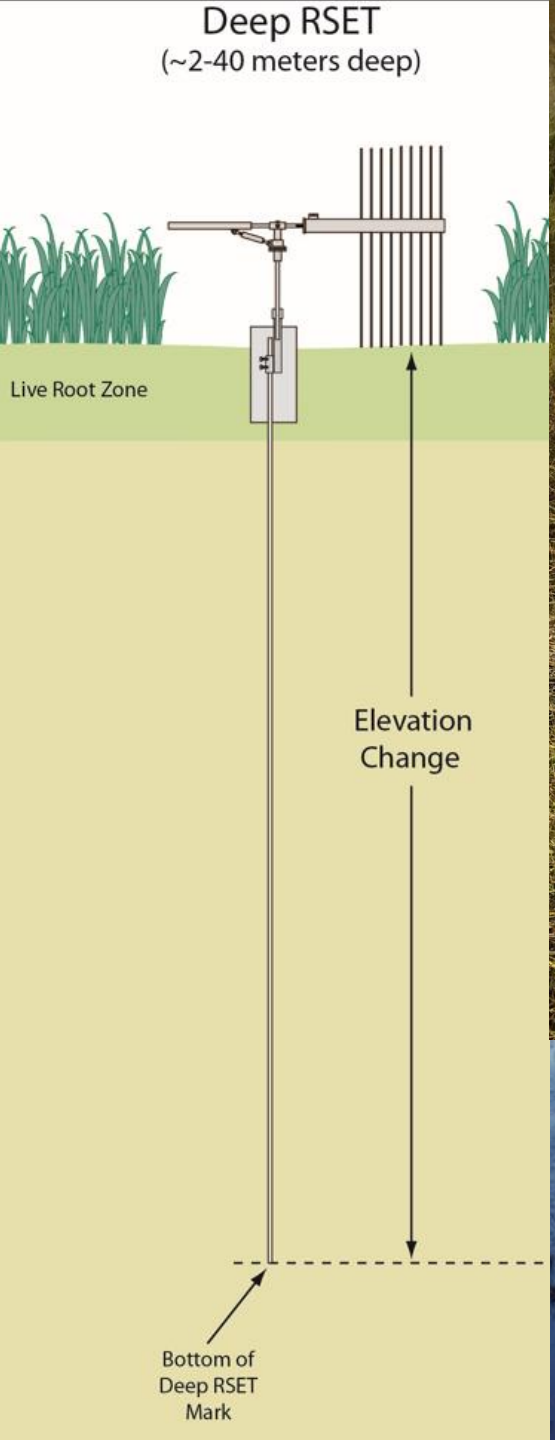
James C. Lynch – National Park Service

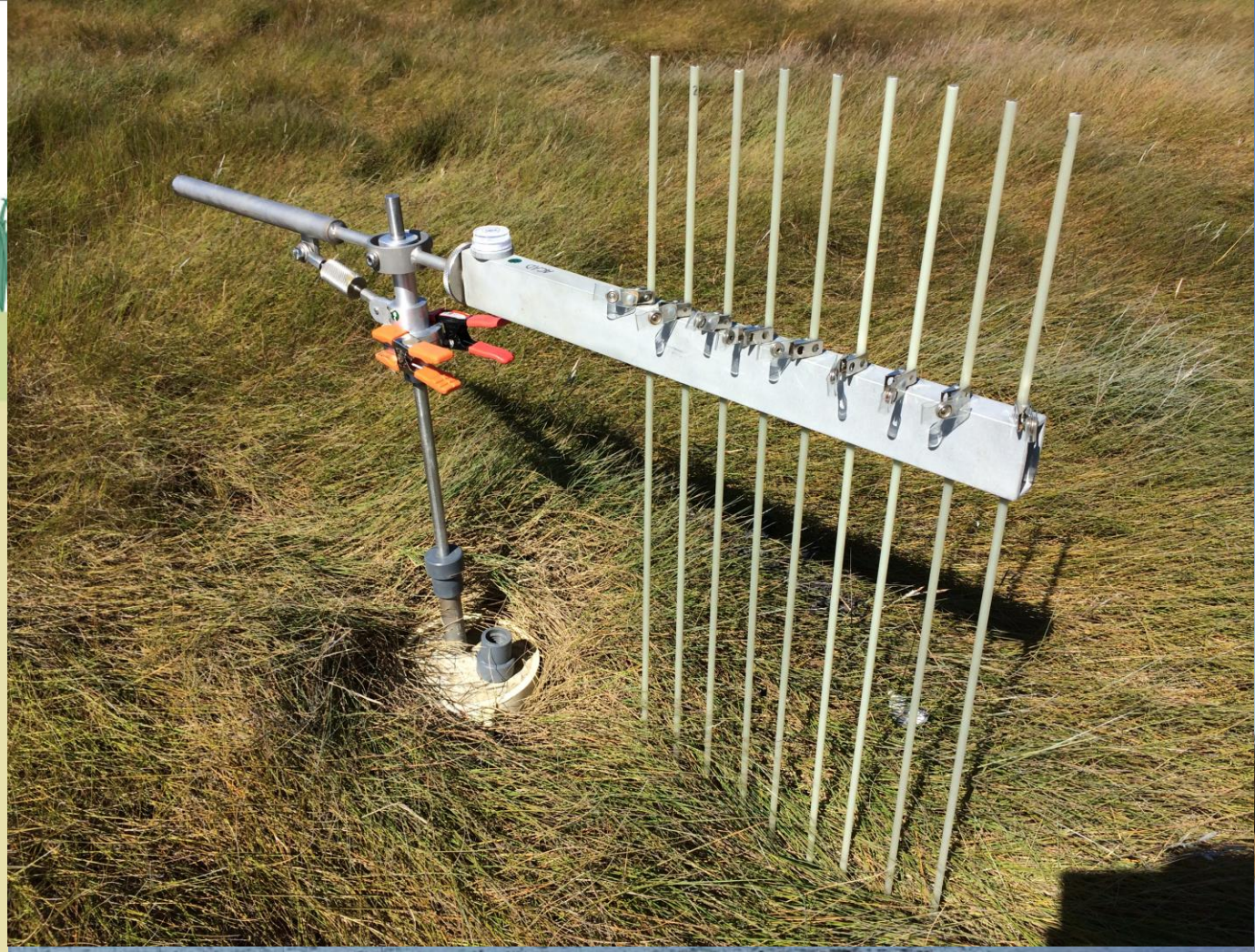
- Biologist / Wetland Ecologist in the Department of Interior since the early 1990's
  - USFWS
  - NBS
  - USGS
  - NPS
- Work focuses on the measurement of elevation change in wetland ecosystems

Wetlands grow vertically in response to sea level rise (SLR). The change is very small from year to year (mm) and a simple mechanical instrument, called the Surface Elevation Table (SET), was developed in early 1990's to monitor these small changes.

The NPS and other government agencies have been using this method to help assess the resilience of wetland habitats to climate change. The SET method is now used throughout the U.S. and in over 35 countries.



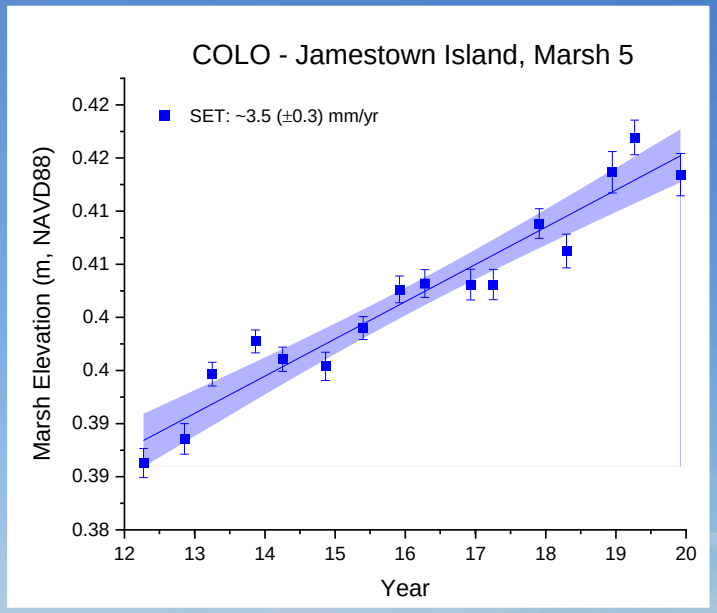


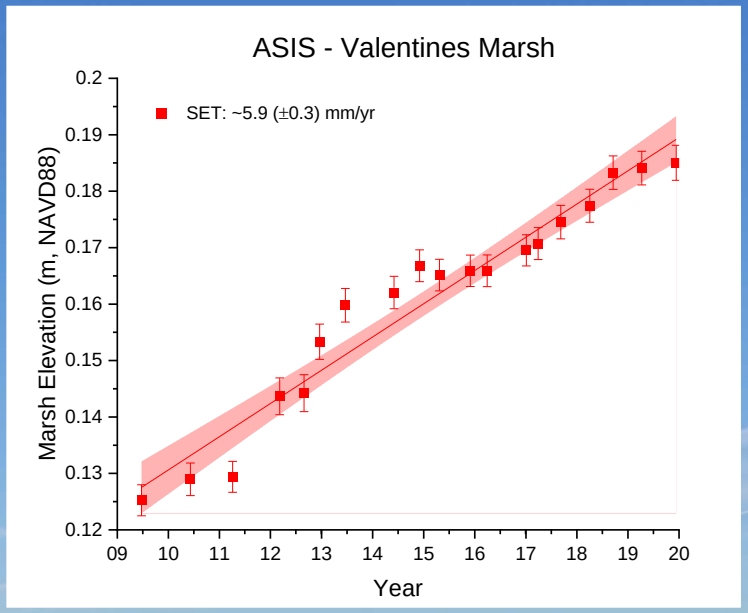


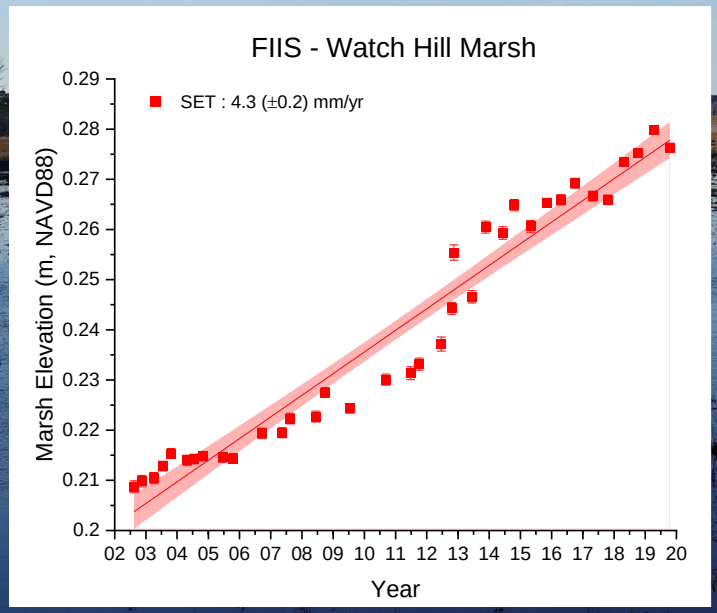
- Surface Elevation Table (SET) – requires the installation of a deep benchmark for vertical control (typically 10-80’ deep).
- SET instrument measures elevation change of the marsh surface over time (mm/year):

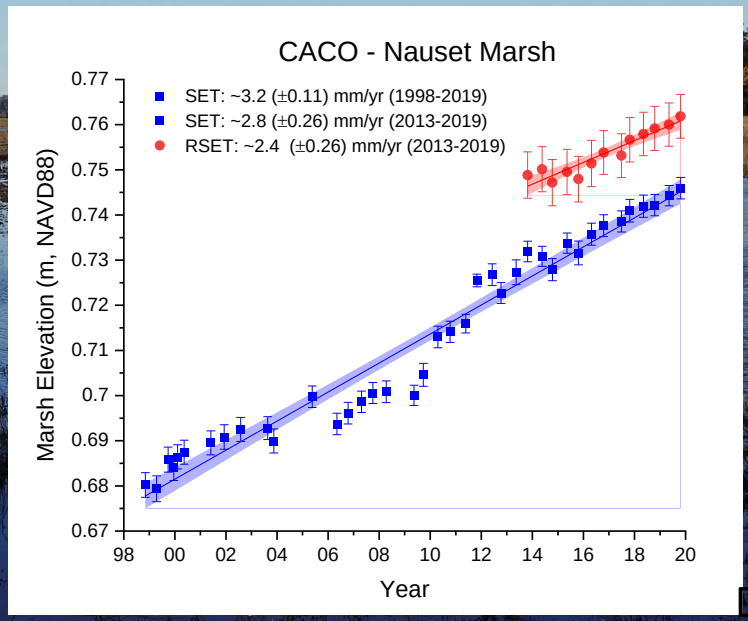
Jamestown Island, VA

Most tidal wetlands increase in elevation over time in response to local hydrologic conditions (Tides & relative Sea Level Rise)



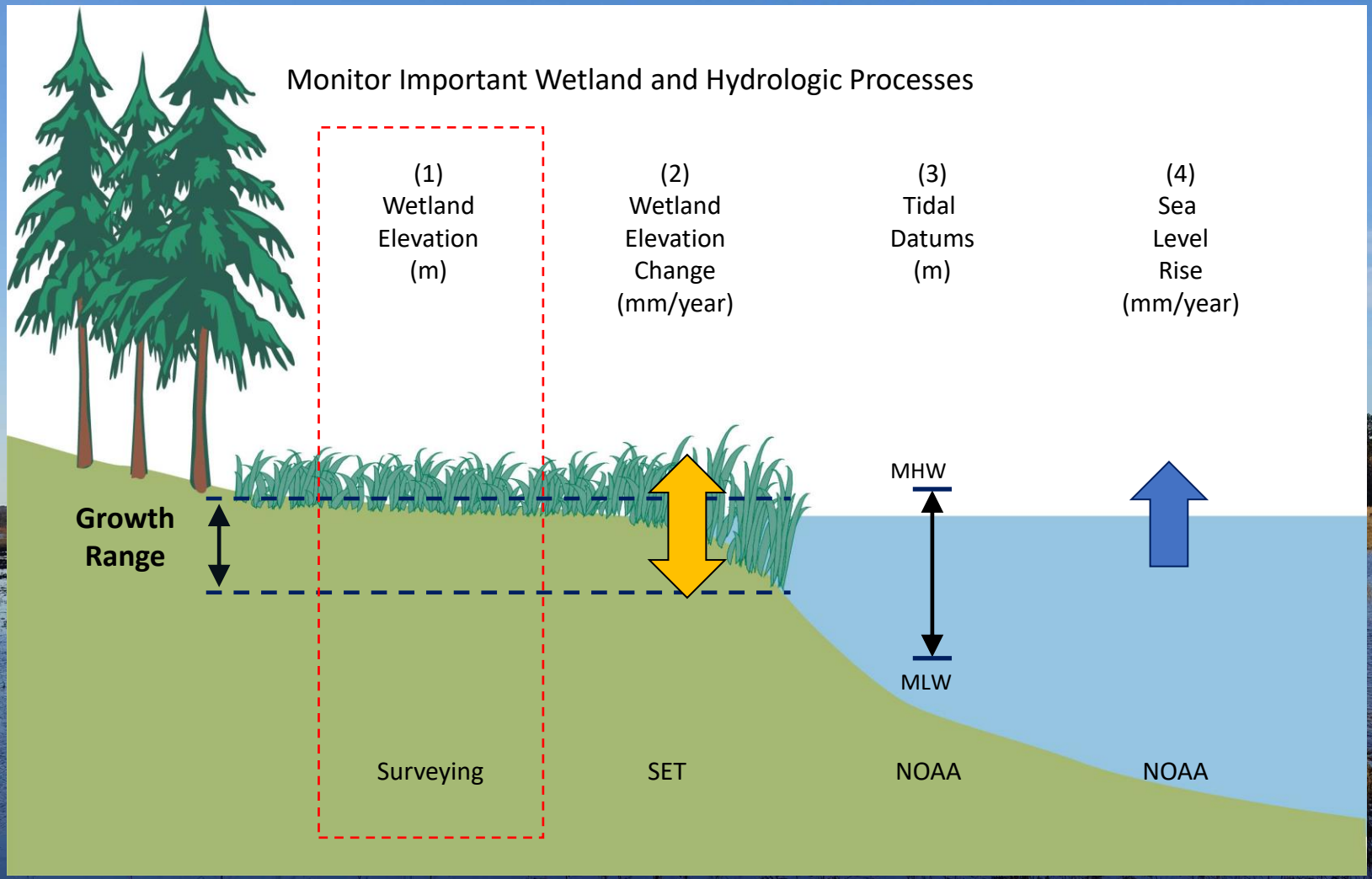






Draft data

Important factors for determining the resilience of a wetland



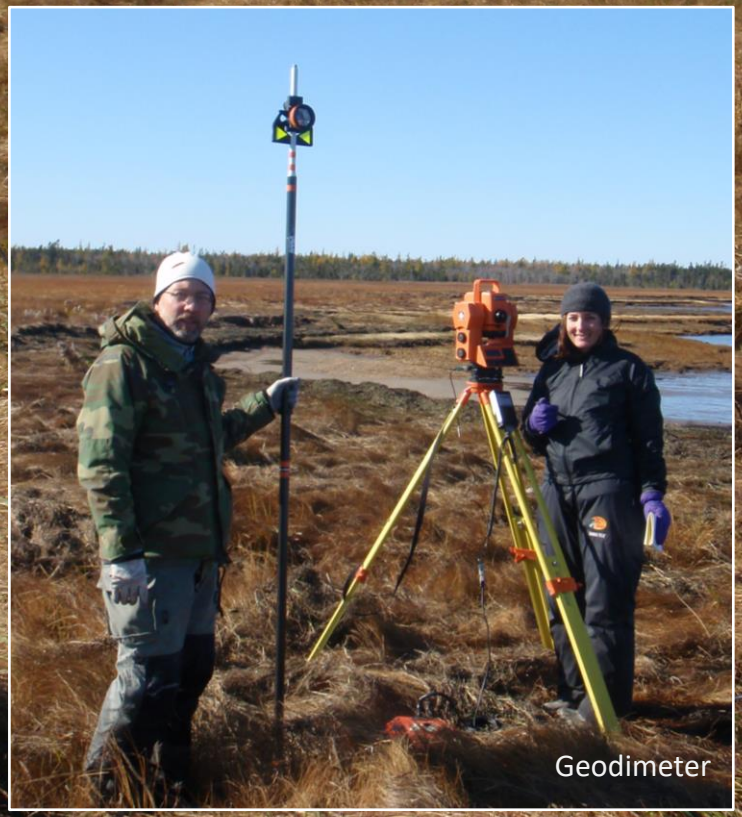
1990's : Established our first vertical control benchmarks at wetland sites (LA). Used for local site levelling. GPS use at this time was primarily for navigation. No orthometric elevation data.


Rookery Bay NERR, FL


Mississippi Delta, LA


Mississippi Delta, LA

Late 1990's – 2010 : Started using multiple static GPS receivers and a total station. Full day of data collection for one site with >4 hours of static data. A lot of post-processing and one month or more to get finalized position data using STAR*NET. First orthometric elevation data.


Geodimeter

Ashtech Receiver

Kouchibouguac National Park, Canada

Early 2000's, DEM survey –
Prairie Pothole Wetlands, South Dakota

- Established our own network of benchmarks.
- Static occupations while collecting DEM data.
- One full week of data collection
- Post processed - Over 3 months to see final products.

Late 2000's: First experience with internet based RTN – Keystone precision rental. Not widely used by our program until the 2020's.

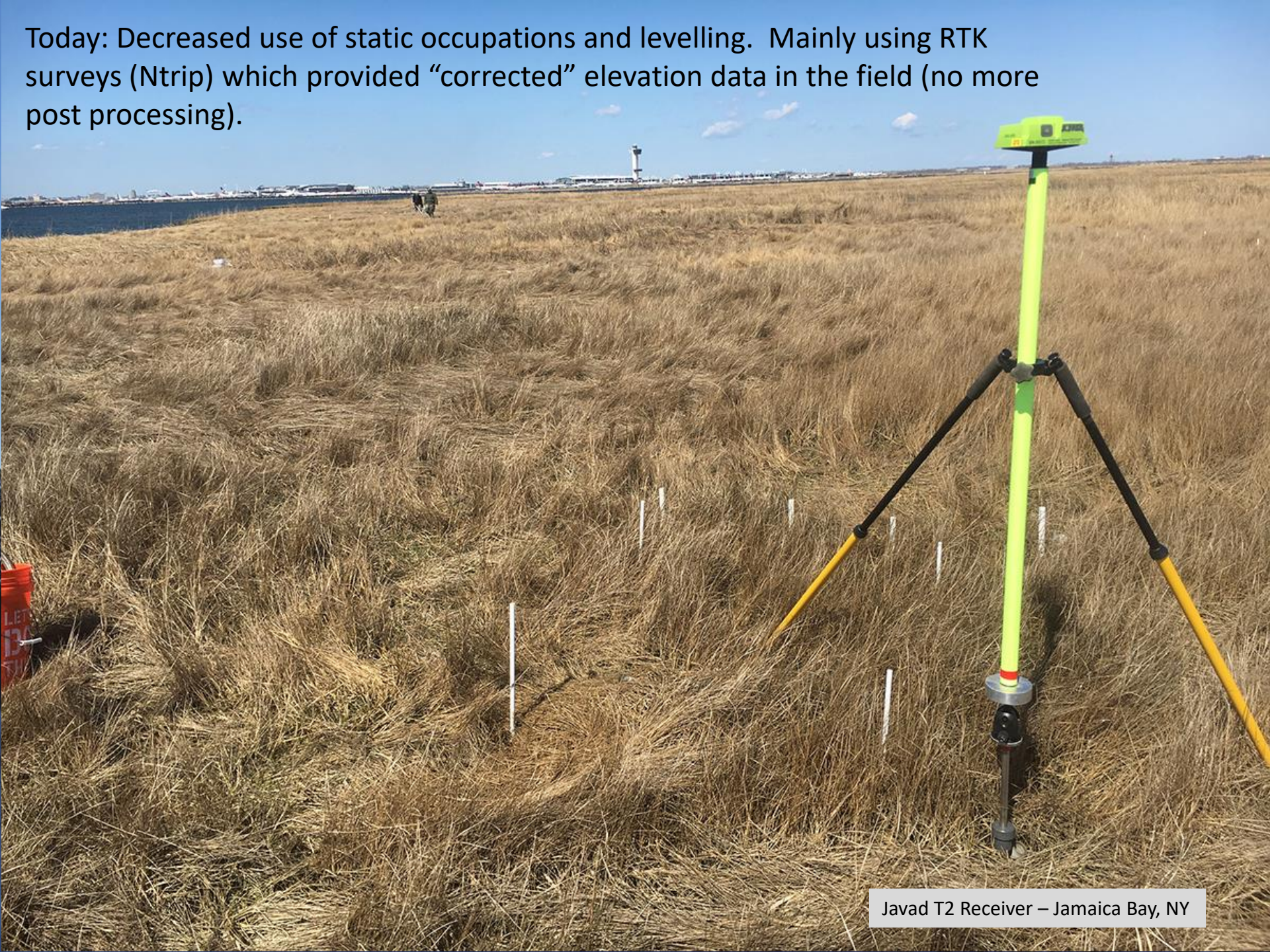
2010 to present : Static occupations used in combination with Real Time Kinematic elevation surveys – Post processed in OPUS and Trimble Business Center. Started using OPUS projects. Still takes a few weeks to get final position data.

Trimble R8 Receiver

Trimble 5700 Receiver – Acadia National Park, ME

Static Occupations of SET benchmarks – Boston Harbor Island.

Today: Decreased use of static occupations and levelling. Mainly using RTK surveys (Ntrip) which provided “corrected” elevation data in the field (no more post processing).



Javad T2 Receiver – Jamaica Bay, NY

RTK (Ntrip) Surveys:
up to 180 second occupations

Trimble R10 Receiver – Fire Island, NY

RTK (Ntrip) Surveys:
Up to 180 second occupations

ica GG04 – Fire Island, NY

Trimble R12i – Jamestown Island,

Today: There are a wealth of options for obtaining elevations in wetland ecosystems..

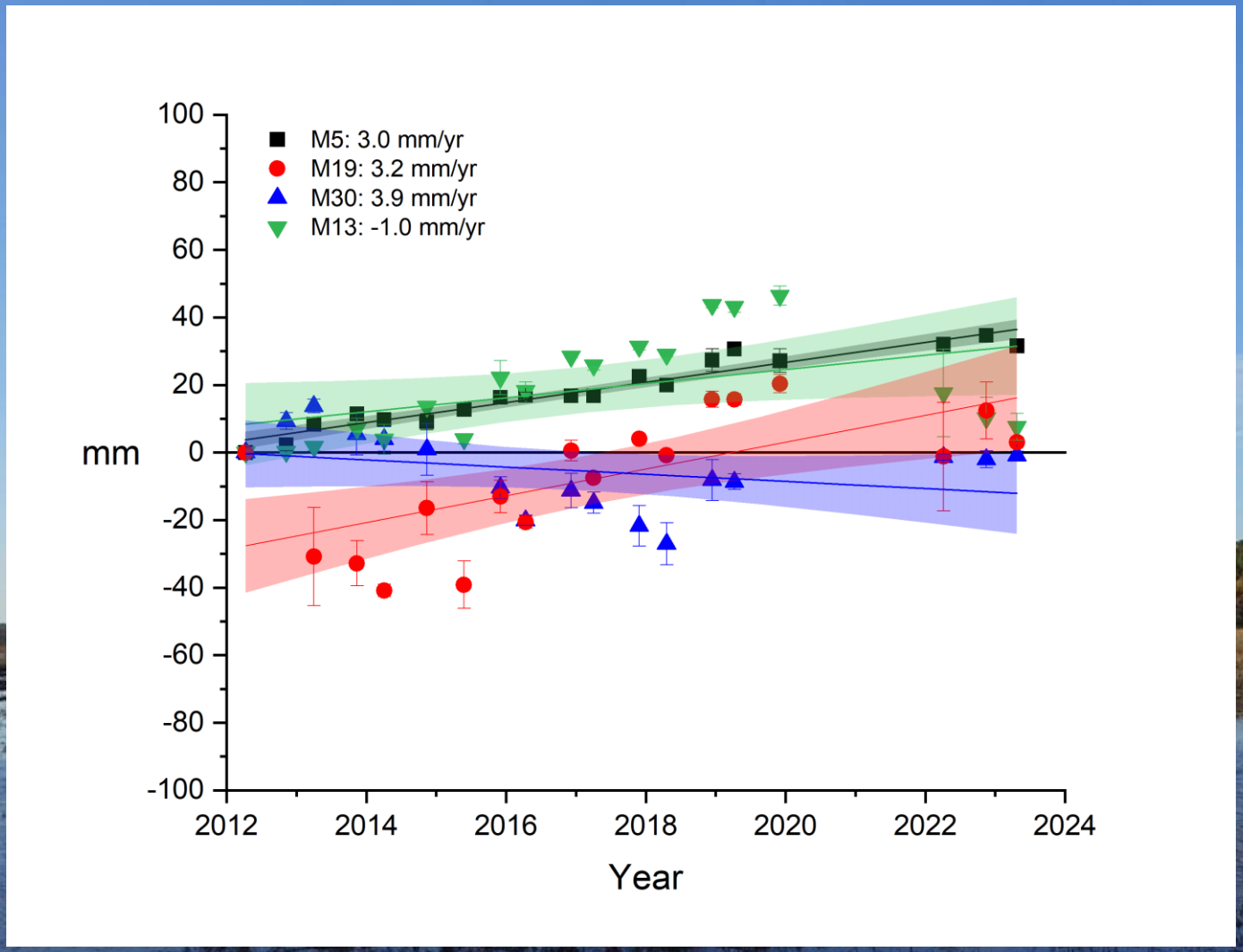
Many more options for collecting elevation data, but it has become more complicated.

- Methods for collecting elevation data
  - Levelling
  - Static GNSS Surveys
  - Traditional RTK (Base / Rover).
  - Internet based RTK
- Can't always compare old data to new data.
- Orthometric elevations - Geoid issues
- Reference frames
- CORS stations (OPUS/OPUS projects)
- using GPS or multi-GNSS.

There are so many choices that it can be difficult deciding which is the best method to use. We currently tend toward collecting elevation data using RTK (NTRIP).

SET trend data (mm/year) – Jamestown Island, Virginia

4 Sites (3 SETs per site)



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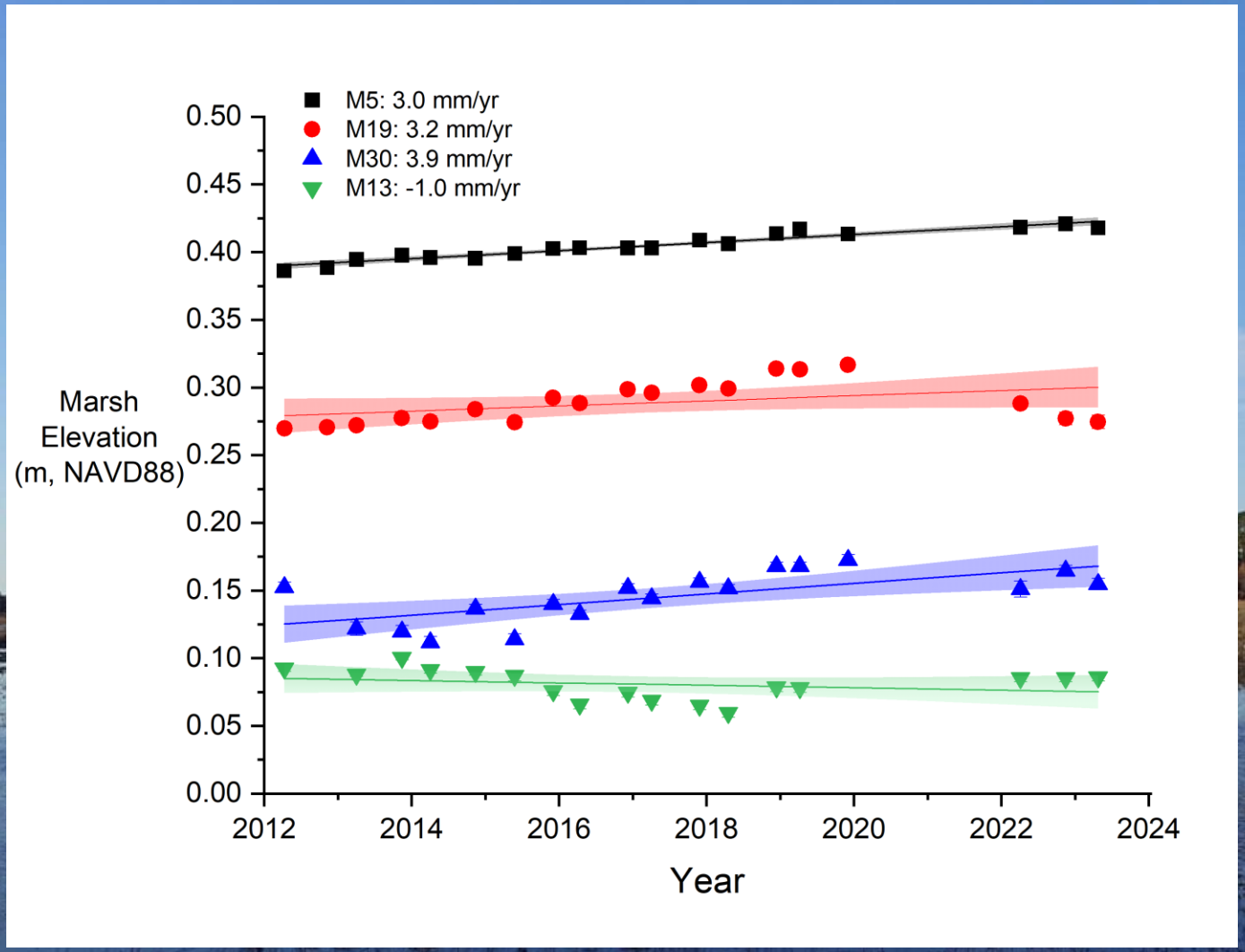


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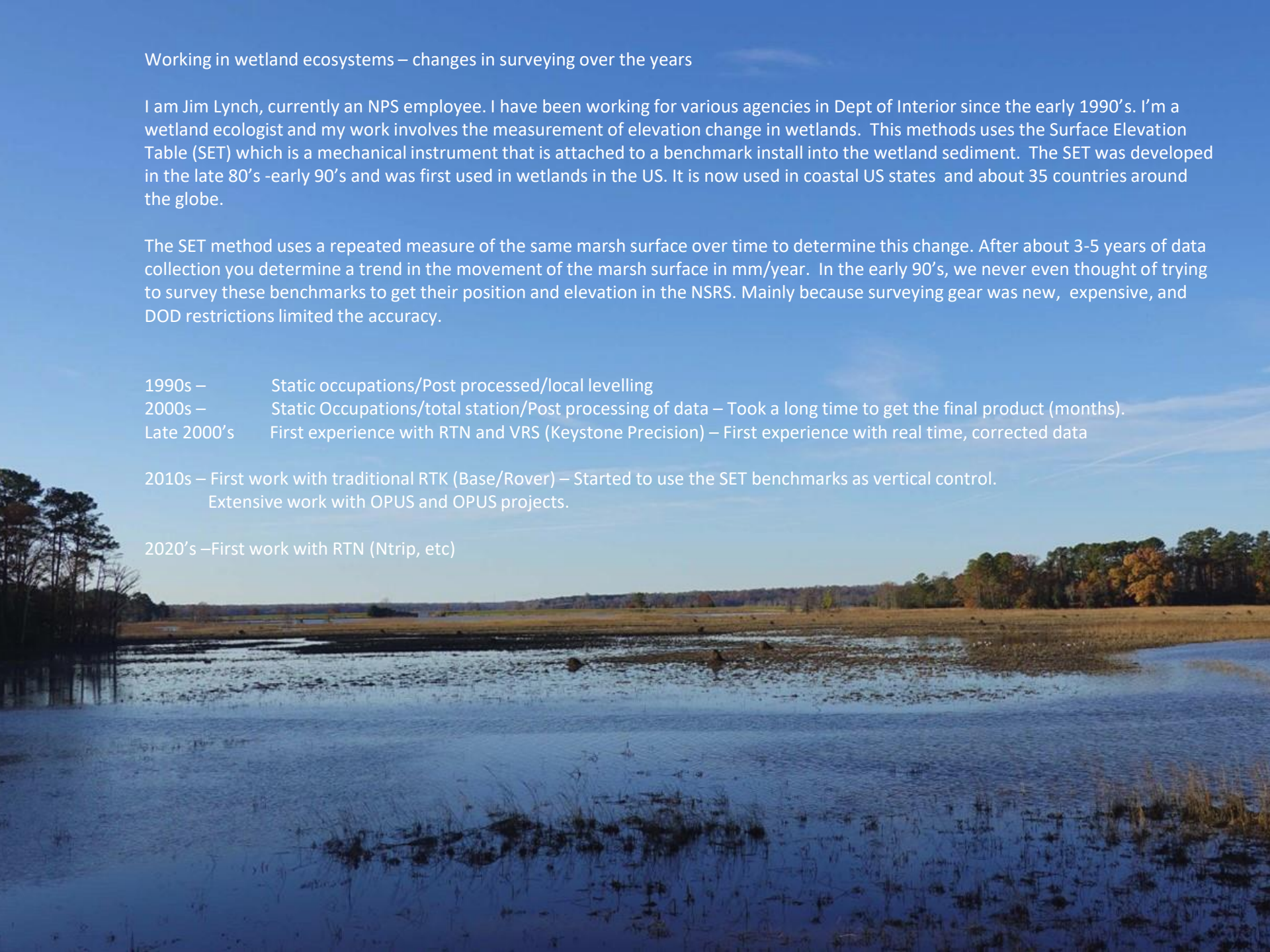

Working in wetland ecosystems – changes in surveying over the years

I am Jim Lynch, currently an NPS employee. I have been working for various agencies in Dept of Interior since the early 1990's. I'm a wetland ecologist and my work involves the measurement of elevation change in wetlands. This methods uses the Surface Elevation Table (SET) which is a mechanical instrument that is attached to a benchmark install into the wetland sediment. The SET was developed in the late 80's -early 90's and was first used in wetlands in the US. It is now used in coastal US states and about 35 countries around the globe.

The SET method uses a repeated measure of the same marsh surface over time to determine this change. After about 3-5 years of data collection you determine a trend in the movement of the marsh surface in mm/year. In the early 90's, we never even thought of trying to survey these benchmarks to get their position and elevation in the NSRS. Mainly because surveying gear was new, expensive, and DOD restrictions limited the accuracy.

1990s – Static occupations/Post processed/local levelling
2000s – Static Occupations/total station/Post processing of data – Took a long time to get the final product (months).
Late 2000's First experience with RTN and VRS (Keystone Precision) – First experience with real time, corrected data

2010s – First work with traditional RTK (Base/Rover) – Started to use the SET benchmarks as vertical control.
Extensive work with OPUS and OPUS projects.

2020's –First work with RTN (Ntrip, etc)