Development of Sampling Protocols for the Surface Elevation Table

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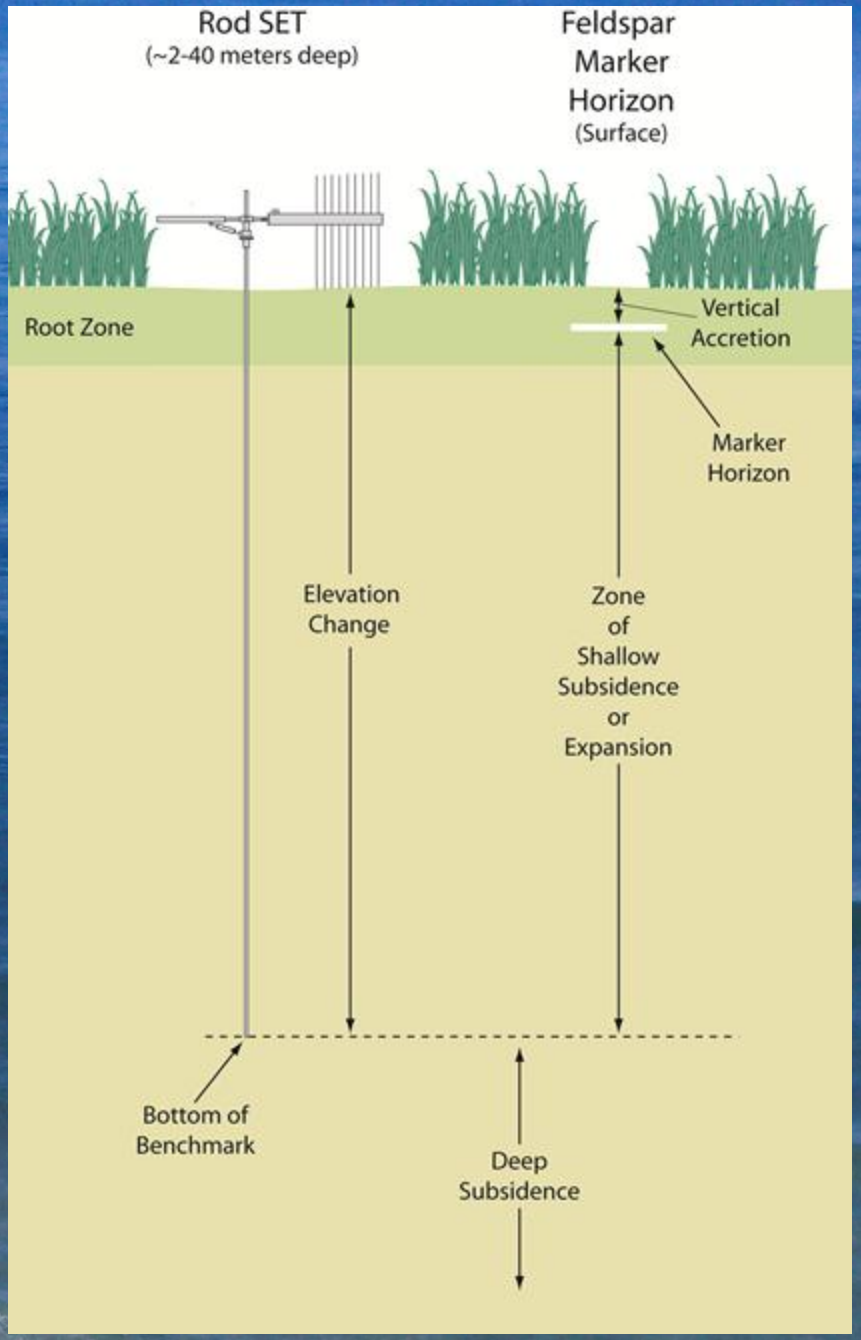
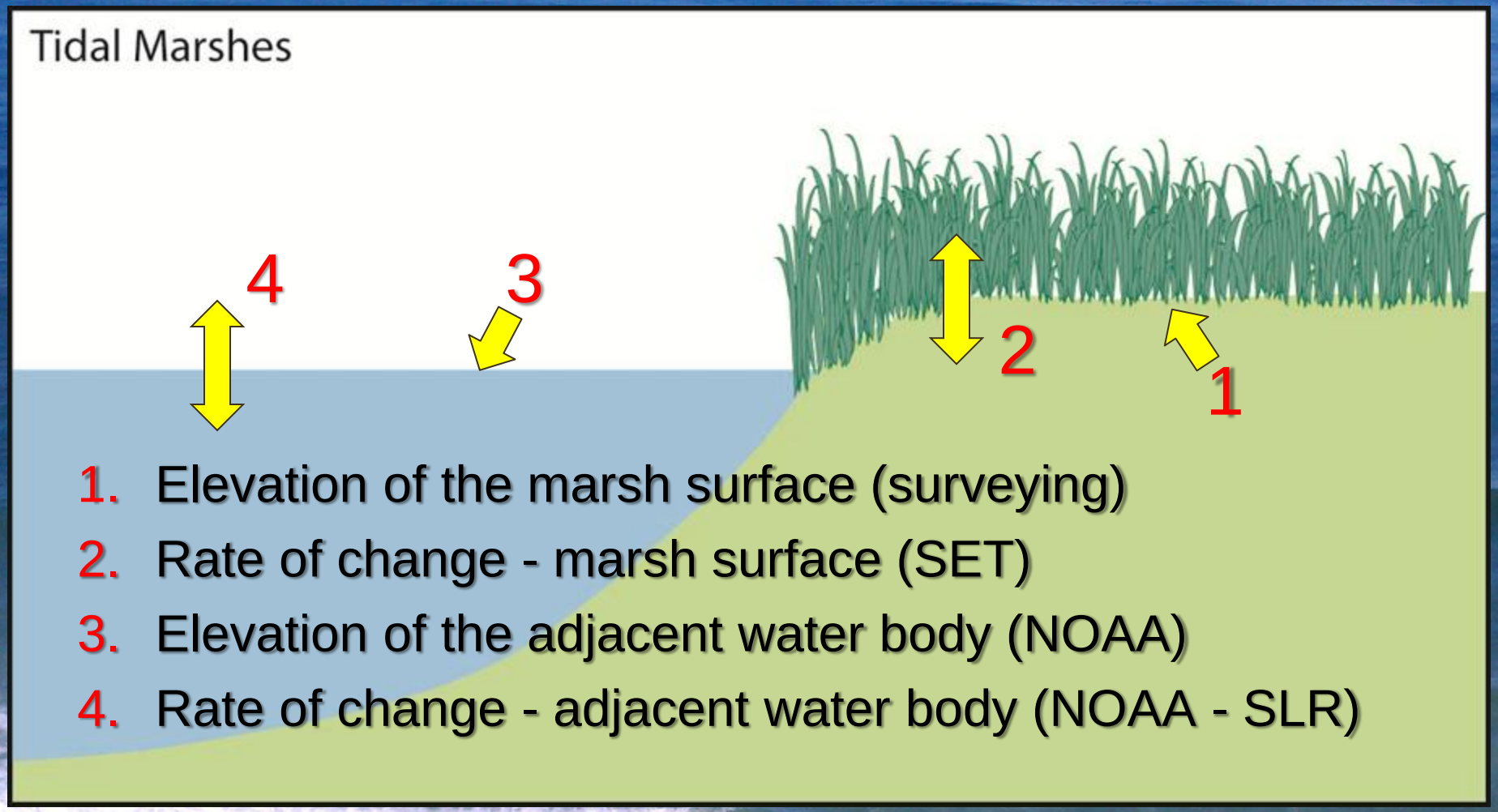
- The SET is unique in that it ties the changes in marsh elevation to a stable reference mark (the deep Rod or Pipe).
- Hard to find stable reference marks in wetland environments.
- This is one of the first methodologies to accurately monitor relative elevation change over time in wetlands.



The SET provides important data needed for assessing tidal marsh health:



1. Elevation of the marsh surface (surveying)
2. Rate of change - marsh surface (SET)
3. Elevation of the adjacent water body (NOAA)
4. Rate of change - adjacent water body (NOAA - SLR)

SET has been in use for over 20 years

The Surface Elevation Table: History

Original Design: Used for about 10-15 years (1989 - early 2000's)

- First used in Louisiana by LSU graduate student Roel Boumans.
- SET design – large and somewhat heavy
- Installation -– 15-25 feet deep benchmark. Stable?

Original SET : Big!

Original SET : Benchmark Installation

Major Points:

1) Somewhat difficult to install.
2) Benchmark was not very deep - <25 feet (8 meters)

SET Today:
multiple instrument designs

“SUPER” ROD SET – SERC, MD – P. Megonigal design

SET Today – Benchmark Installation

The Surface Elevation Table:

Today:

- Used in 25 U.S. States – mainly on the coast.
- Used in 25 Countries – possibly two in Africa (?).
- Multiple improved designs of the instrument.
- Multiple installation options – benchmarks are much deeper than original design. There is also a Shallow benchmark option (4 legged platform).
- Used in all types of wetland environments - mangroves, salt marshes, brackish marshes, freshwater marshes.
- All types of users.

The SET has become a standard tool used to monitor elevation change in wetlands.

SET Protocol:

The National Park Service in collaboration with colleagues in the USGS and NOAA are writing this protocol to provide detailed guidelines on the installation and use of SET's in wetland environments.

This document is being published by the National Park Service but is intended for use by all groups interested in using the SET for research and monitoring.

SET Protocol:

Major topics covered in this document are:

A. SET study design

B. Installation & sampling

C. Data processing -

SET website:
www.pwrc.usgs.gov/set/

A) Study Design.

This section will address some commonly asked questions about SET installations;

A. Where do I put my SET's? – Random location

B. How many SET's do I install? - Sample Size

C. How often do I sample? - Sampling frequency

D. Do I measure Accretion? Is it required?

Sampling Design:
Monitoring and Hypothesis testing:

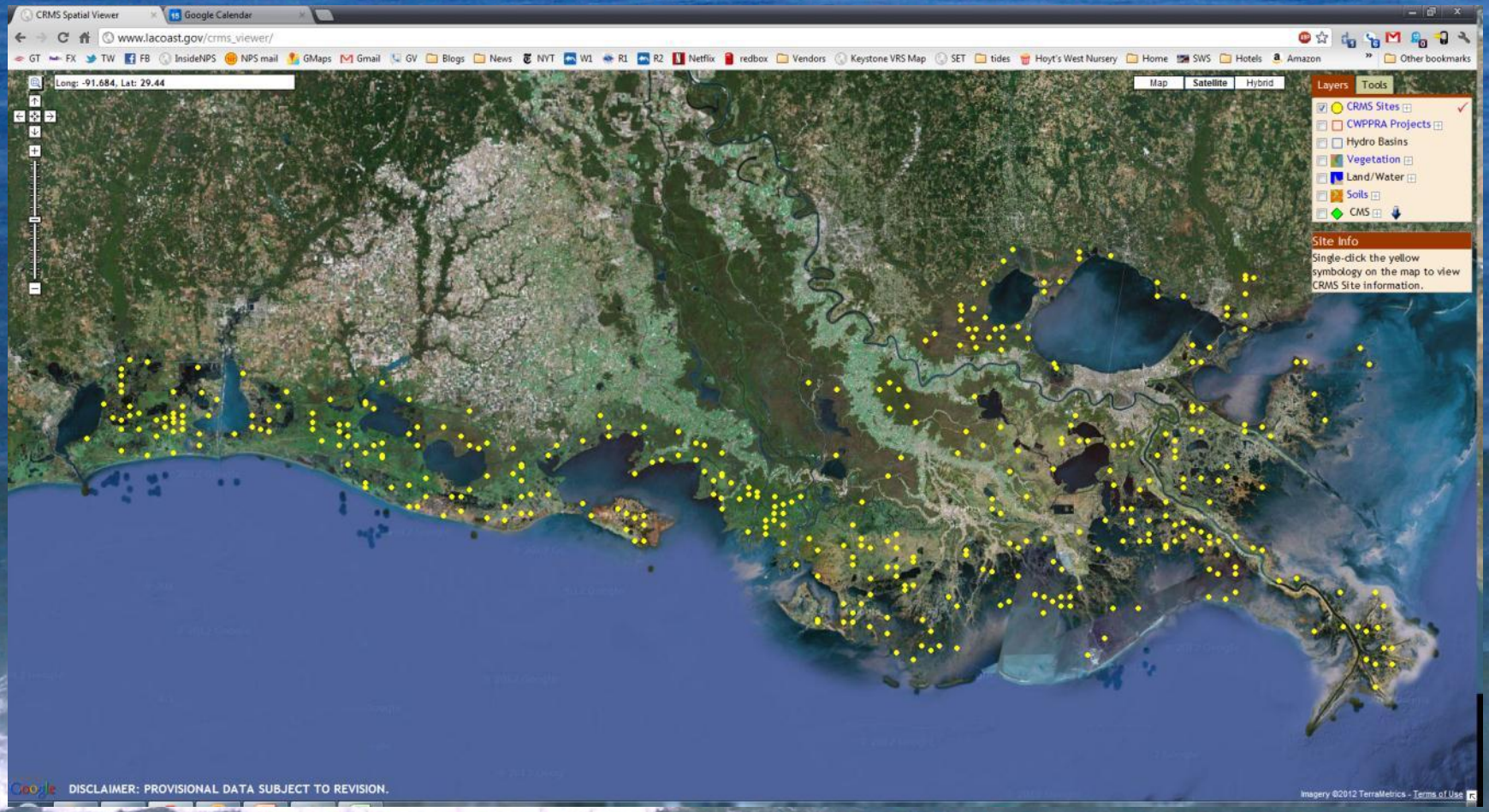
1. General considerations
2. Sampling for monitoring
    1. Representative vs. random sampling
    2. Restricted randomization and controlling variables
    3. Monitoring examples
3. Sampling for hypothesis testing
    1. Statistical Power
    2. Experimental unit
    3. Statistical sampling theory
    4. Representation and independence
    5. Distributional requirements
    6. Statistical models & their influence on sampling design
    7. Hypothesis testing examples

Many groups are using the SET for monitoring.

- USFWS - Incorporating the SET into many coastal refuges
- NPS - Incorporating the SET into coastal parks in NE and SE regions of the US
- NOAA - SET is part of the National Estuarine Research Reserve (NERR) monitoring program
- Louisiana - is using the SET as part of a large scale monitoring program.

Louisiana – Coast-wide Reference Monitoring System

390 monitoring sites



Assateague Island National Seashore
Berlin, Maryland USA.

16 SET's – Where to put them?

a) Randomly across the entire site?
b) Randomly located with randomly located marsh units?

Constraints:
Horses
Marsh Type
Proximity to Bay
Logistics – site access
Etc….

We're not advocating one design over the other in this example. The point is that there are a lot of issues that have to be considered when choosing SET sites.

B) Installation and Sampling:

- How much does an SET installation cost?
- How do I install the deep benchmarks?
- How often do I make measurements?
- Who takes the measurements?
- Accretion plots – installation/sampling.
- Surveying options

B) Installation and Sampling:

SOP # 1 – Project Planning [Checklist or flow chart]

Installation:

SOP # 2 – Choosing SET site location
SOP # 3 – Establishing sampling plots and platforms
SOP # 4 – SET benchmark Installation (& datasheet)
SOP # 5 – Establishing Marker Horizons

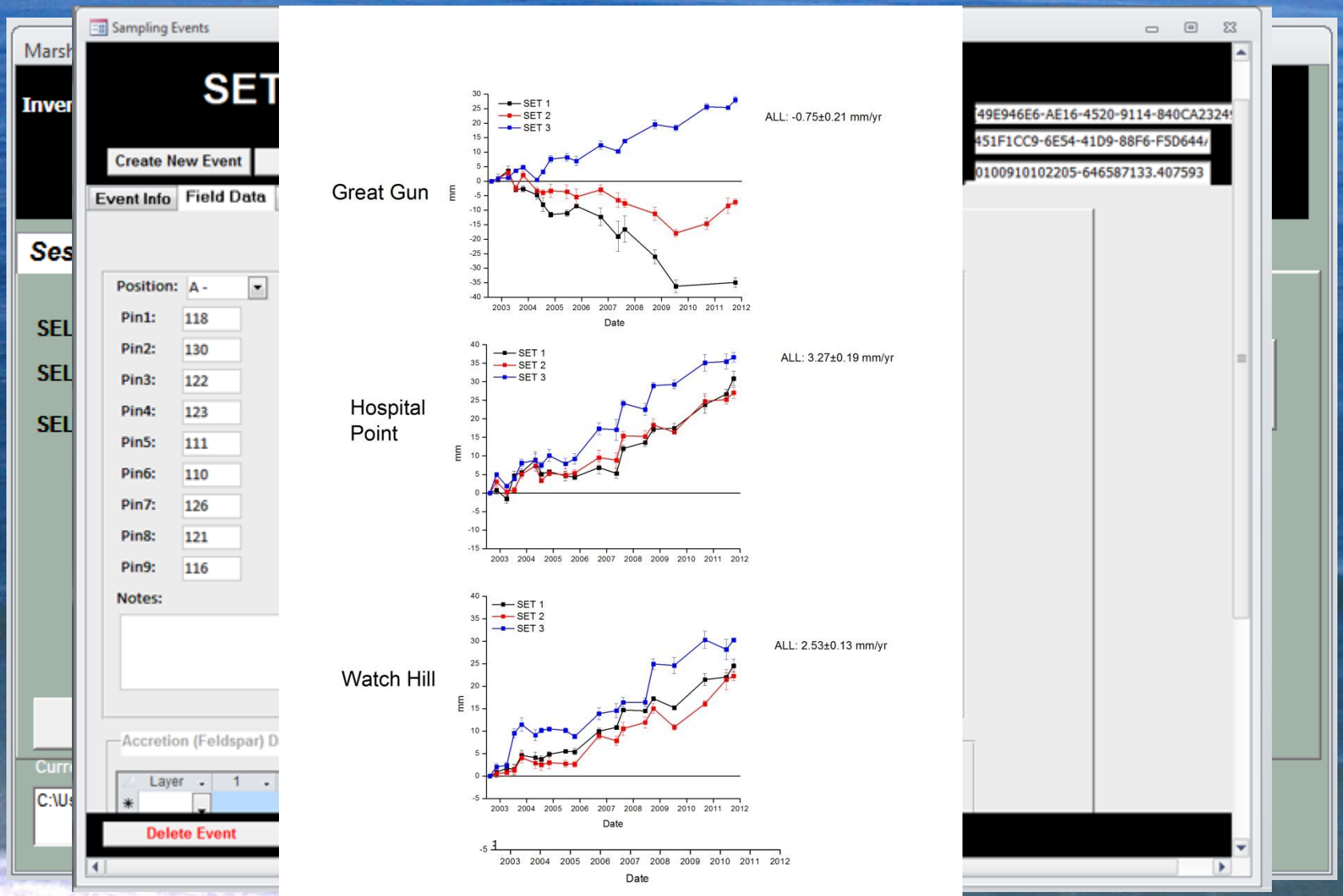
SET and marker horizon sampling:

SOP # 6 – Sampling SET plots – Datasheets
SOP # 7 – Sampling Marker Horizons plots
SOP # 8 – Safety

Surveying:

SOP # 9 – GPS elevation surveying of SET sites
SOP # 10 – Leveling the SET's – stability of SET marks

C) Data processing:



SET Protocol Document – draft text finished by later this year.

Please note that the protocol is only a guideline! End users will ultimately have to determine the design of their particular study based on the constraints that exist for their particular site.

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Issues with the randomly locating SET's

Sample Design	Financial Constraints	Logistical Constraints	Prior Knowledge of Site	Spatial Coverage / Inference	Analysis	Data Outcome	Example
Single SET in sample space A (analogous to a tide gauge)	Low	Low	High	Low / Minimal	Regression: single point over time	Single point trend; low site-specific knowledge; No variance estimate for space A; no variance estimate for sites	Theoretical; depends on definition of sample space
Multiple SETs randomly distributed over sample space A	High	High	Low	High / High	Regression; ANCOVA w/ spatial & other covariates	High spatial coverage; low site-specific knowledge; best variance estimate for space A; no site variance	CRMS, soon Texas Coastal Monitoring
Multiple sites randomly distributed over sample space A; SETs randomly distributed within each sample site (e.g. 1)	High	Moderate	Moderate	Moderate / Moderate	Regression ANOVA ANCOVA w/ covariates	Moderate spatial coverage; high site-specific knowledge; some variance estimate for space A; best estimate of variance for sites	Assateague, Fire Island, others