Long Term Salt Marsh Monitoring In the Inland Bays

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DELAWARE CENTER FOR THE INLAND BAYS
Research. Educate. Restore.

Why Monitoring Started

- In response to 2006 Sudden Wetland Dieback
- Fears of what sea level rise would mean for wetlands locally
- Are wetlands keeping pace with sea level rise?

2006 aerial flight showing sudden wetland dieback in Rehoboth Bay

Marsh Monitoring

- 3 "representative" marshes outfitted with 3 SET tables each
- Each marsh has 1 table on levee, and 2 interior marsh tables
- Monitored twice annually (October/April)
- Within 5 days of full moon

Angola Neck Site 1
Angola Neck Site 2
Angola Neck Site 3


Slough's Gut 1
Slough's Gut 2
Slough's Gut 3

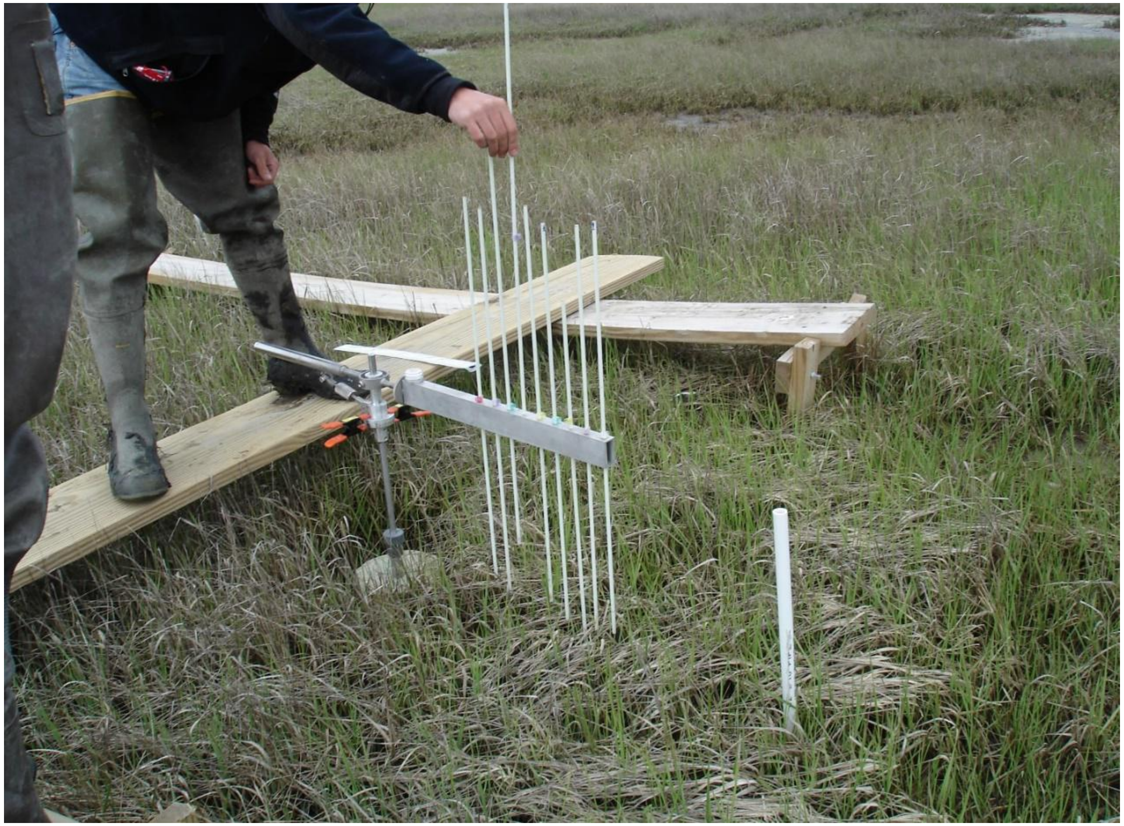

Piney Point 1
Piney Point 2
Piney Point 3

Period of Collection

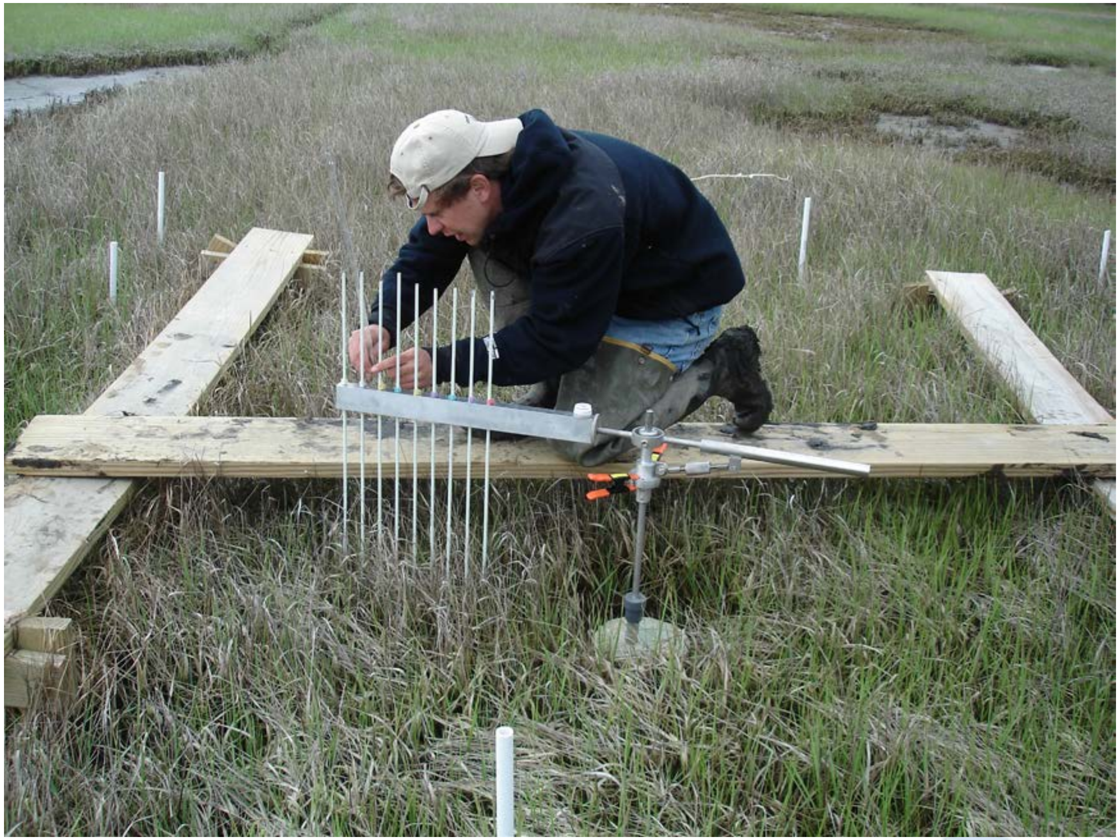
SET Table	Type	Date of Install	Number of Readings
Angola Neck 1 Deep	Interior	8/25/2008	10
Angola Neck 1 Shallow	Interior	4/29/2009	9
Angola Neck 2 Deep	Levee	8/25/2008	10
Angola Neck 2 Shallow	Levee	4/29/2009	9
Angola Neck 3 Deep	Interior	8/25/2008	10
Angola Neck 3 Shallow	Interior	4/29/2009	9
Slough's Gut 1 Deep	Levee	5/27/2011	5
Slough's Gut 1 Shallow	Levee	5/27/2011	5
Slough's Gut 2 Deep	Interior	5/27/2011	5
Slough's Gut 2 Shallow	Interior	5/27/2011	5
Slough's Gut 3 Deep	Interior	5/27/2011	5
Slough's Gut 3 Shallow	Interior	5/27/2011	5
Piney Point 1 Deep	Levee	5/11/2010	6
Piney Point 1 Shallow	Levee	5/11/2010	6
Piney Point 2 Deep	Interior	4/26/2011	5
Piney Point 2 Shallow	Interior	5/11/2010	6
Piney Point 3 Deep	Interior	4/26/2011	5
Piney Point 3 Shallow	Interior	5/11/2010	6

SETs

- Sediment Elevation Tables
- Measure changes in marsh height to the nearest half millimeter
- Same spots on marsh measured year after year



Measuring SETs



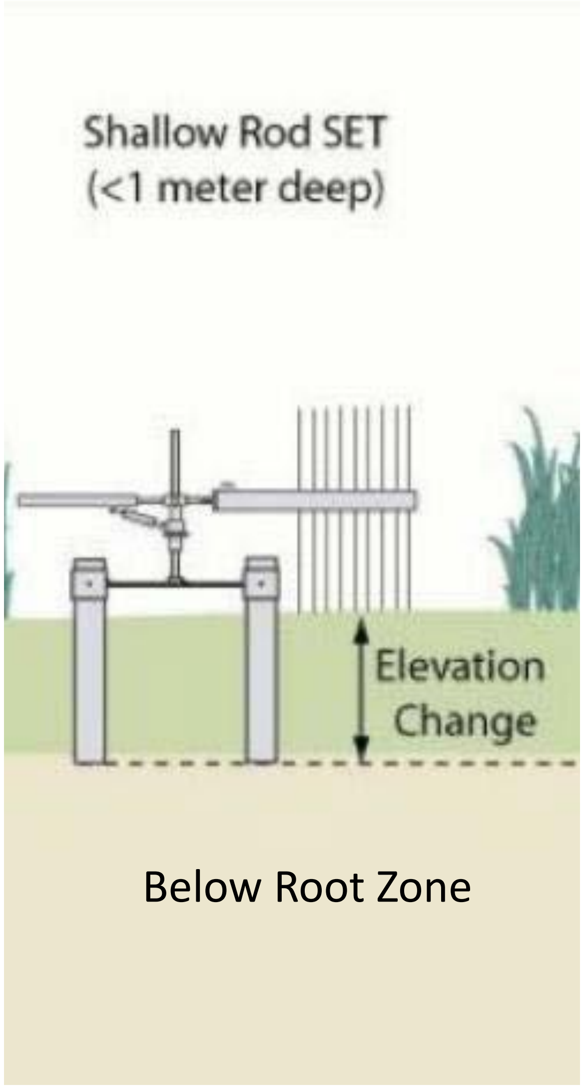
SETs

Shallow SET

Deep SET

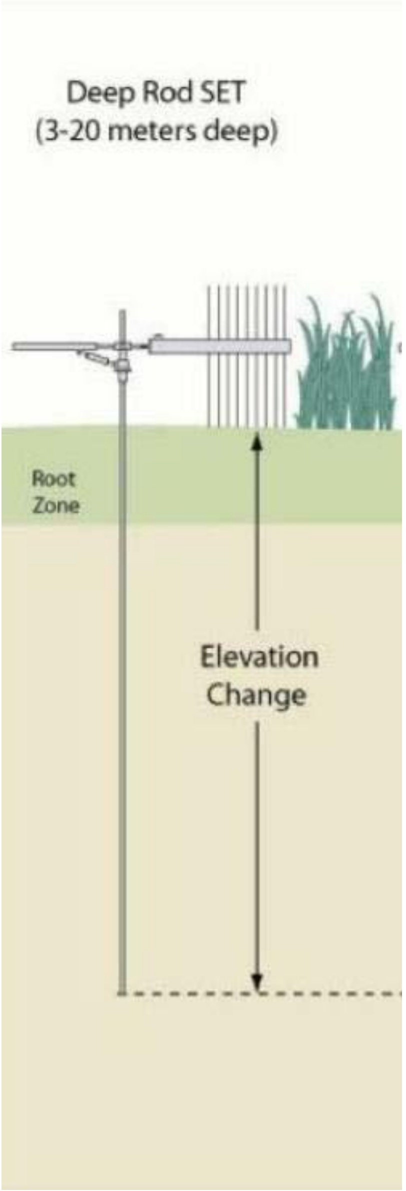
Shallow SET

- Measures changes in root zone/surface layer
- Root zone expansion/compaction, accretion, erosion
- Platform moves with the root zone



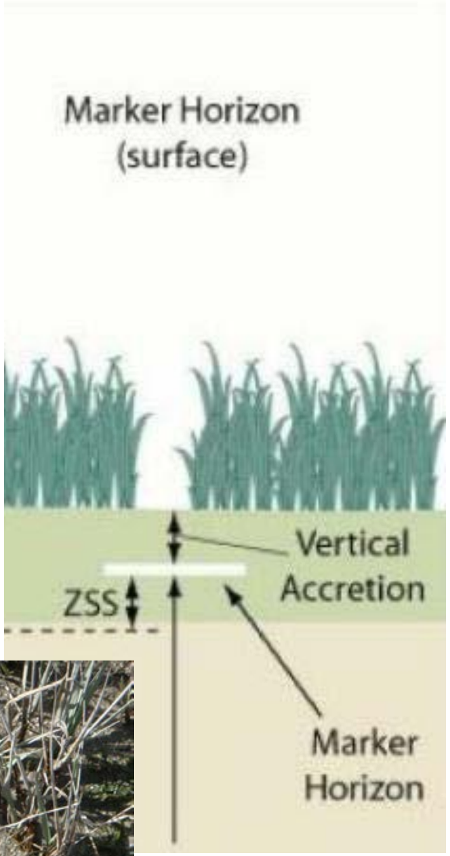
Deep SET

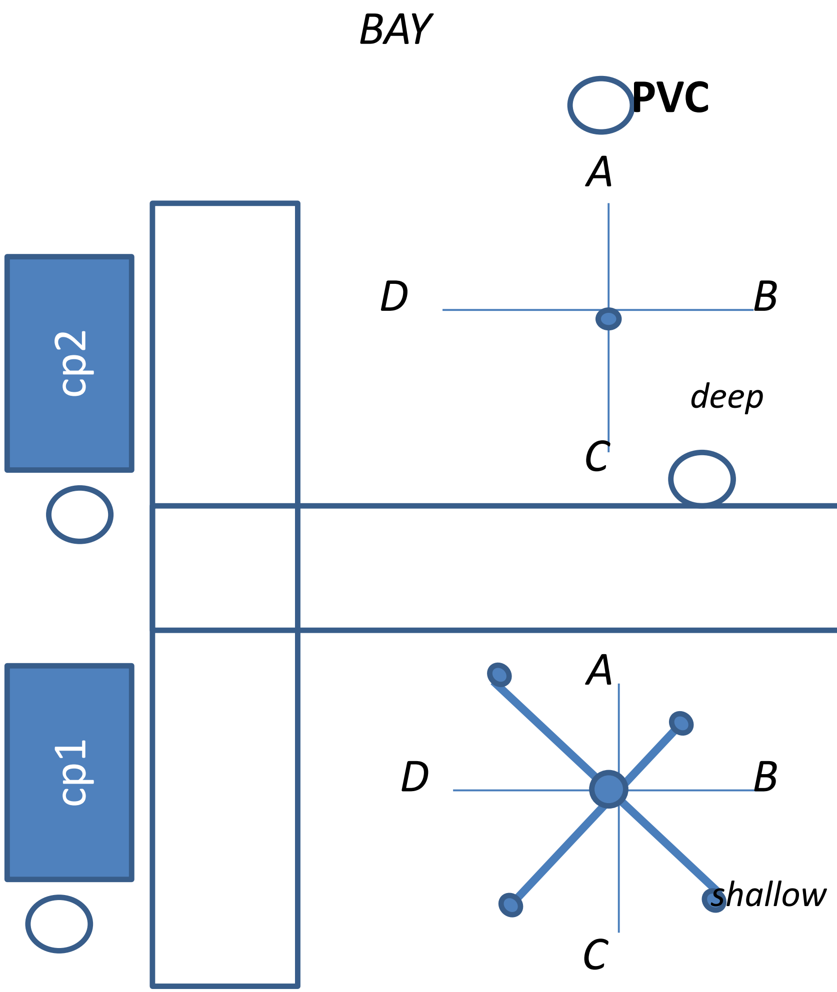
- Platform does not move relative to accretion or subsidence above the base of the rod
- Rod installed to point of refusal, covers a large portion of marsh geology
- Captures all changes in marsh height above end of rod (overall marsh change over time)



Clay Plots

- Each platform outfitted with 3 feldspar clay plots
- Measure accretion on surface layer




BAY
PVC
A
D
B
C
deep
cp2
cp3
A
D
B
C
shallow
cp1

Separating Marsh Zones

- Δ deep set = changes in overall marsh height
- Δ shallow set = changes in root zone/surface layer
- Δ clay plots = changes in surface layer

- Δ deep set - Δ shallow set = Changes only below root zone
- Δ shallow set - Δ clay plots = Changes only in root zone

Sea Level Rise Calculations

- Following National Park Service Protocol (Lynch et al. 2015)
- Current sea level rise rate (3.40 mm/yr, 2016) from NOAA Lewes Station
- Only deep set measurements used
- Slope for each of the 9 pins calculated at all positions (A,B,C,D) with linear regression (total of 36 slopes)
- Slopes averaged together for average change in height over time
- Compared to sea level rise rate (3.40 mm/yr) with lower tailed t-test
- Can also aggregate by marsh (average of 108 slopes)

Separating Marsh Zones

- Same procedure repeated for shallow sets (36 slopes averaged)
- Shallow set average subtracted from deep set average (below root zone changes are the result)
- Accretion rate (average change in height over difference in days from three clay plots) subtracted from shallow set slope (root zone changes are the result)

Results

- Two tables have sig less elevation change than sea level rise (Piney Point Slough's Gut interior sites)

Results

- 7 out of 9 SETs keeping pace!
- All 3 marshes are keeping pace with sea level rise (3.40 mm/yr)

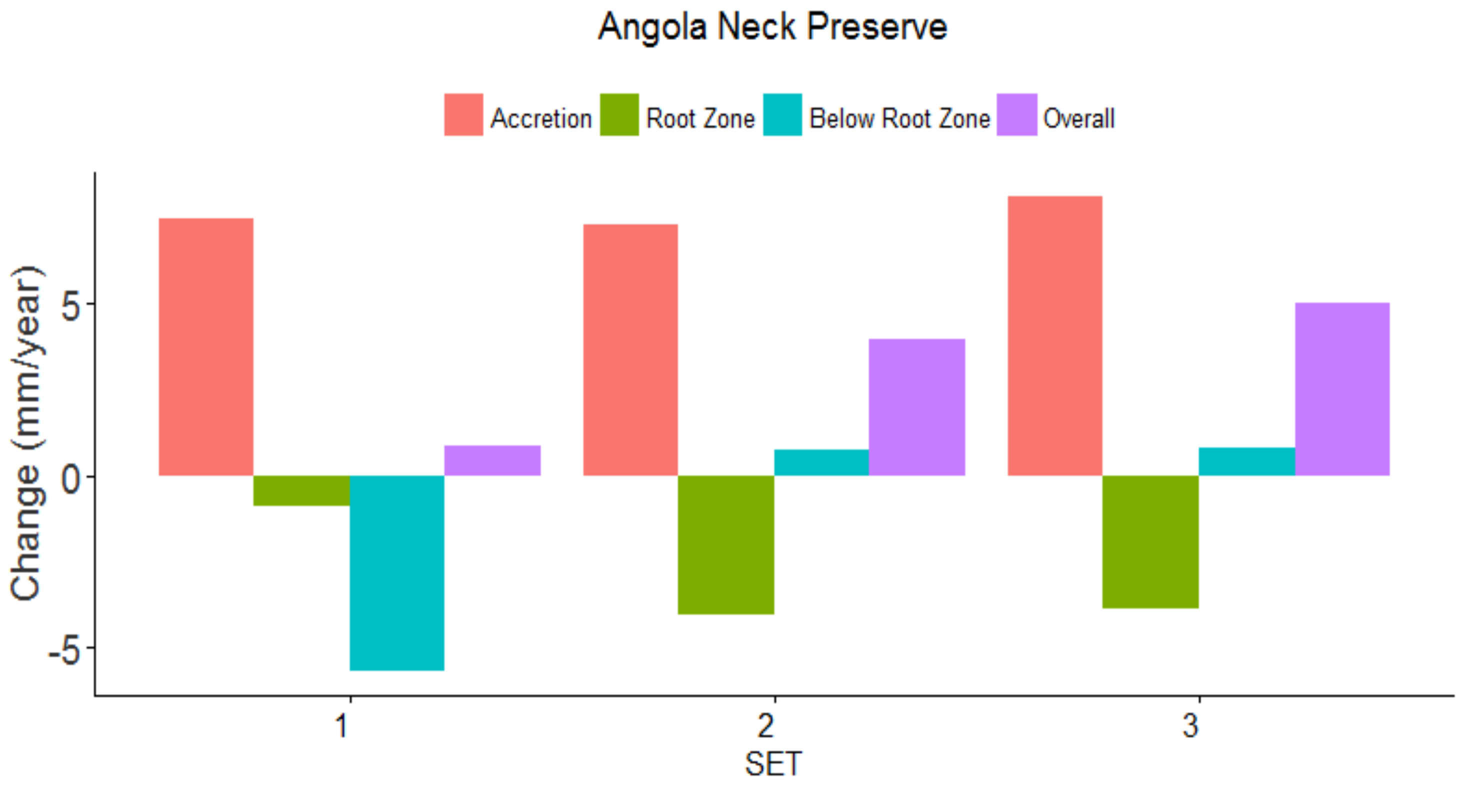
Site	Average Slope	Standard Deviation	Standard Error	t statistic	t critical	p value
Angola Neck	3.281286855	2.500261315	0.240667057	-0.49316	-2.92	0.335364
Piney Point	5.13741807	9.309511515	0.896908332	1.937147	-2.92	0.903834
Sloughs Gut	6.128851145	7.790707825	0.750431569	3.636409	-2.92	0.966

- Angola Neck is the most vulnerable

Results

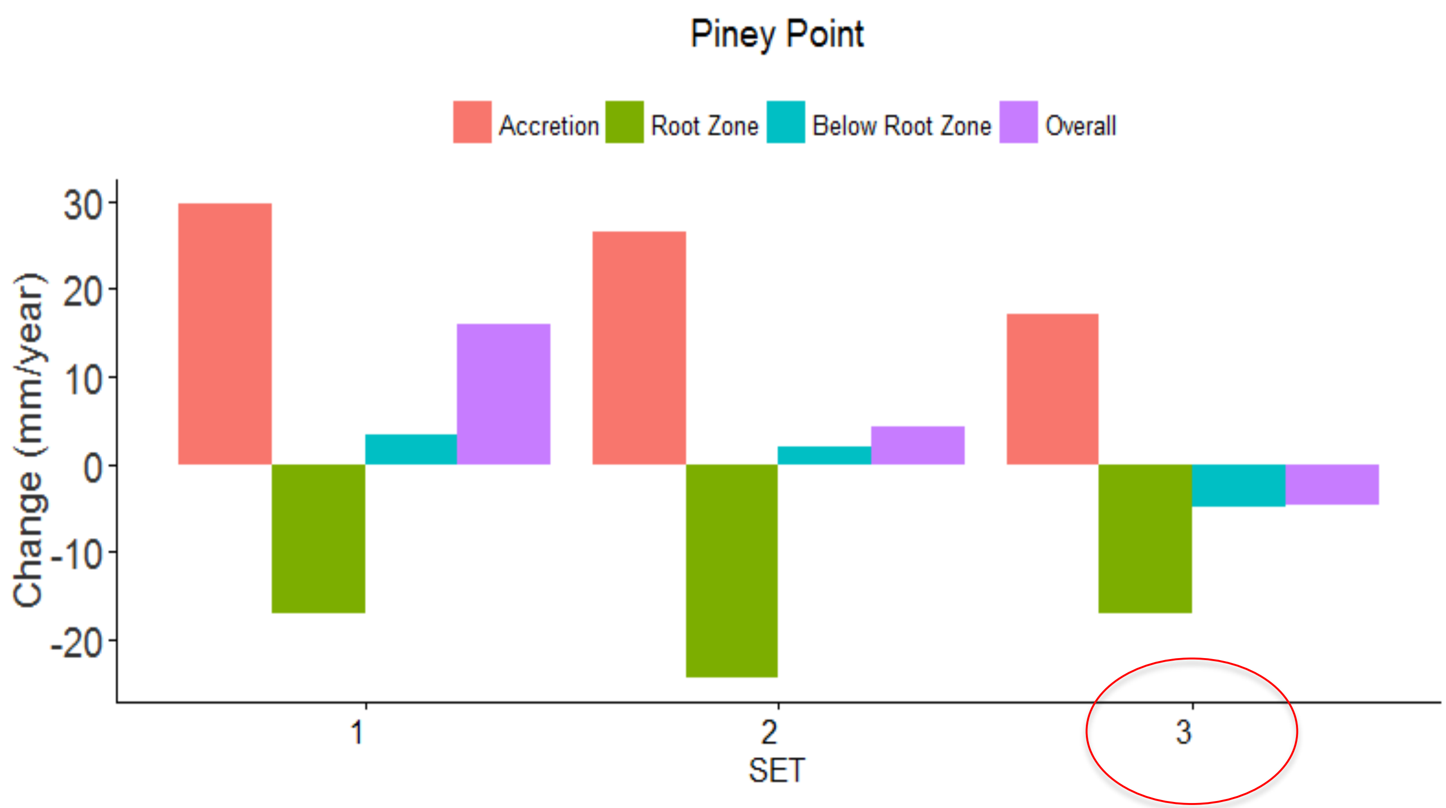
- If we compare current rates against DNREC sea level rise projections (5 mm/yr, 10 mm/yr, 15 mm/yr)
- Angola Neck does not keep pace with 5 mm/yr
- No marsh keeps pace with 10 mm/yr or 15 mm/yr

Marsh Zone Results



Processes show variability, important to note that changes are small (~5 mm)

Marsh Zone Results



Similar to Angola. SET 3 has both root zone and below root zone losses. Changes are much greater than Angola Neck

Marsh Zone Results

Processes show variability, dissimilar to Angola or Piney Point. Changes are less than Piney but greater than Angola.

Conclusions

- At current rate, marshes keeping pace (Does not mean marsh is healthy!)

- At accelerated rates marshes do not keep pace

- Angola Neck is most vulnerable (smallest changes occurring here)

Acknowledgements

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Thank You
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