

# Coupling Paleoecological Data and Model-Produced Hydrology to Estimate Circa 1900 CE Conditions in Freshwater Marshes and Marl Prairies within Everglades National Park (ENP)

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## Introduction

Paleoecological data from three sediment cores collected from freshwater marshes and marl prairies in ENP were interpreted by the USGS and coupled with model-produced water level data to estimate the pre-drainage hydrologic regimes in the Everglades within ENP.

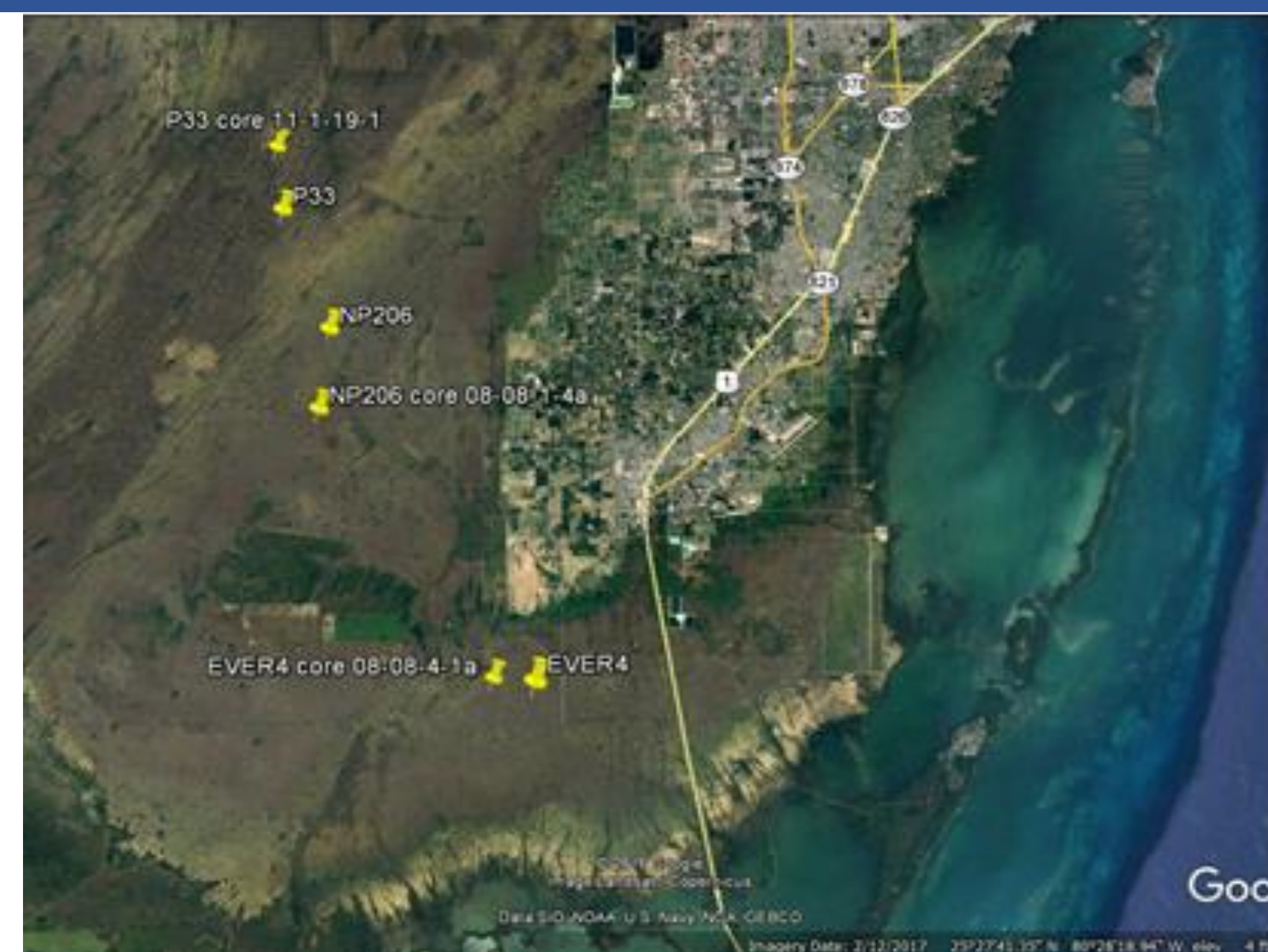
Each sediment core was located relatively close to an existing ENP stage monitoring station. The proximity of the stations facilitated the use of statistical and numeric models coupled with the paleoecological data to produce time series simulations of the pre-drainage water levels in Shark River Slough marsh (P33), in the marl prairie east of Shark River Slough, and the coastal marl prairie community east of Taylor Slough.

## Objectives

The objectives of this research were:

1. Use paleoecological methods to estimate the pre-drainage freshwater wetland water levels at each of 3 core sites
2. Couple that information with hydrologic model output to estimate pre-drainage water levels throughout Everglades National Park
3. Use other statistical models to estimate the salinity conditions in Florida Bay. (work in progress)

## Study Area and Sediment Core Locations



## Methods

Step 1: Pollen assemblages in sediment cores were analyzed by the USGS to estimate the approximate 1900 CE seasonal average water depth at each sediment core location

Step 2: Use of distributional statistics on Natural System Model (NSM) output to estimate needed NSM correction that matches sediment core results

Step 3: Adjust NSM using bias-based correction

Step 4: Use uni- and multi-variate linear regression models to simulate the paleo-adjusted NSM stage at monitoring station locations in the freshwater wetlands of ENP

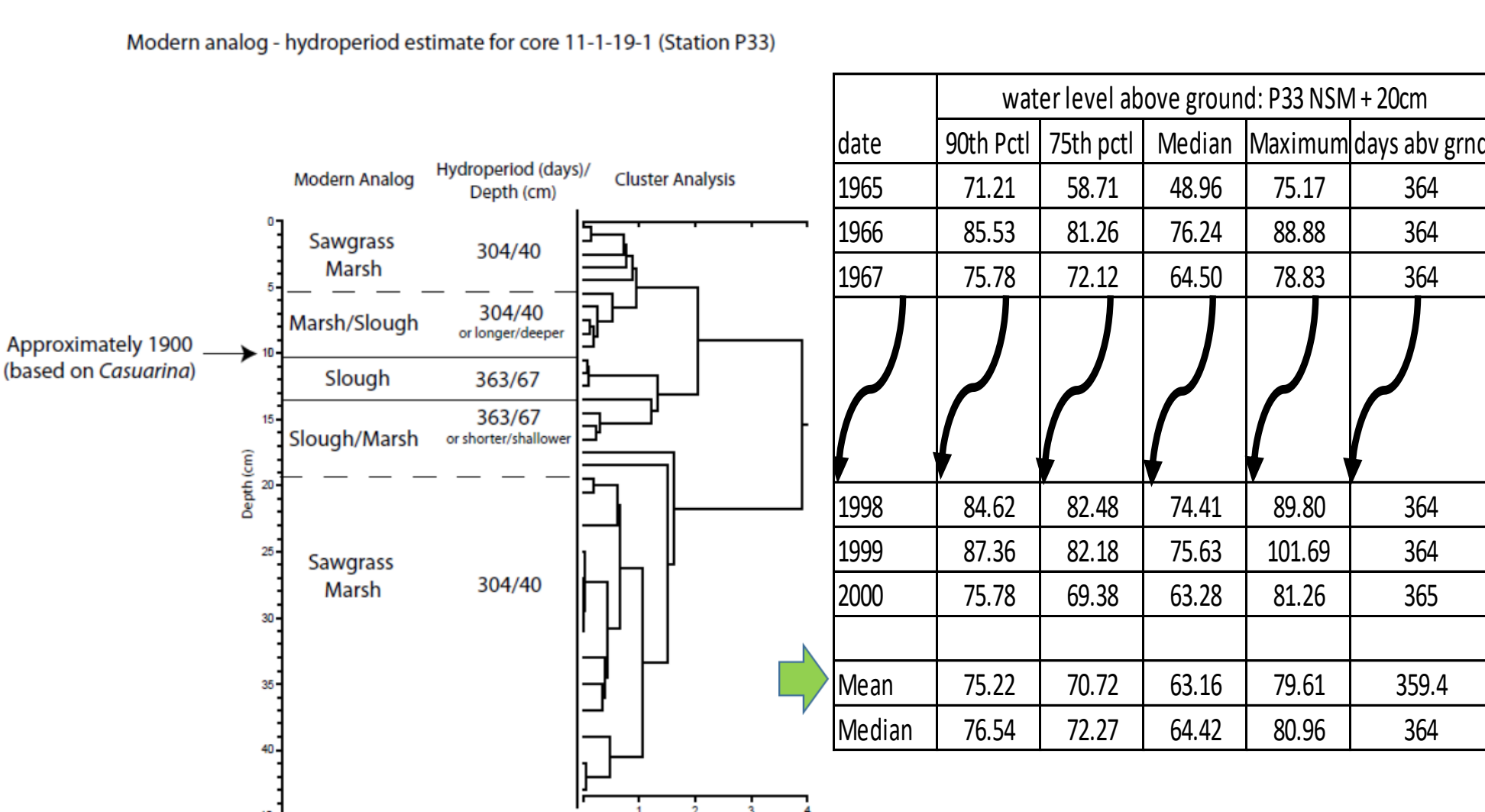
Step 5: (work underway) Estimate the resulting pre-drainage salinity conditions in Florida Bay using multi-variate linear regression salinity models

Procedure modified from estuarine paleoecological methodologies for Florida Bay (Marshall et al., 2009).

## Results – Sediment Cores Analyses

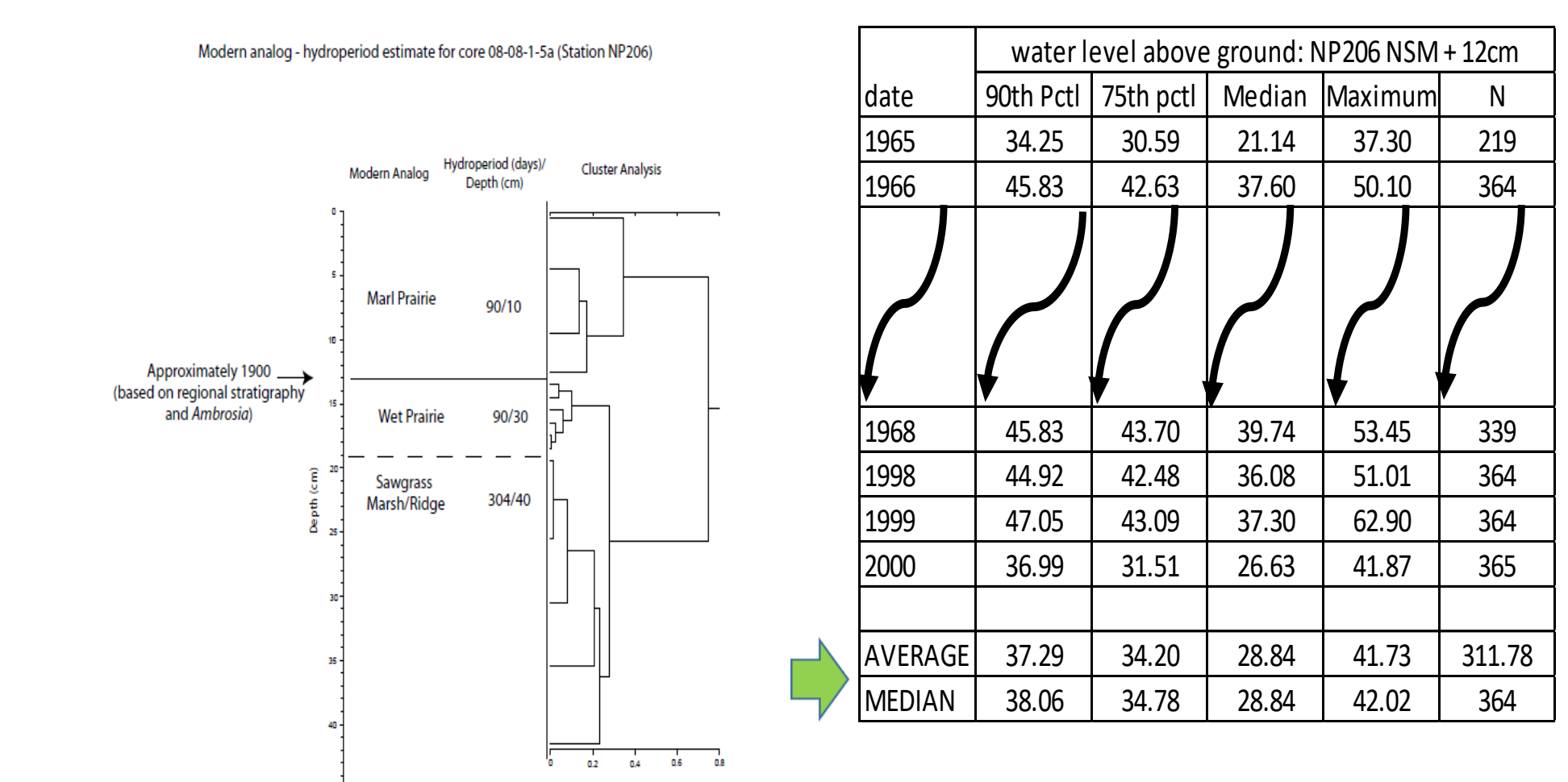
Results of Steps 1, 2, and 3:

- a. Pre-drainage conditions including water depths and hydroperiod for each dated segment of sediment core
- b. Distributional statistics on Natural System Model (NSM) output and needed NSM correction to match sediment core results (step 1)
- c. 36-year paleo-adjusted NSM time series of water levels with distributional statistics that approximate results of sediment core analysis



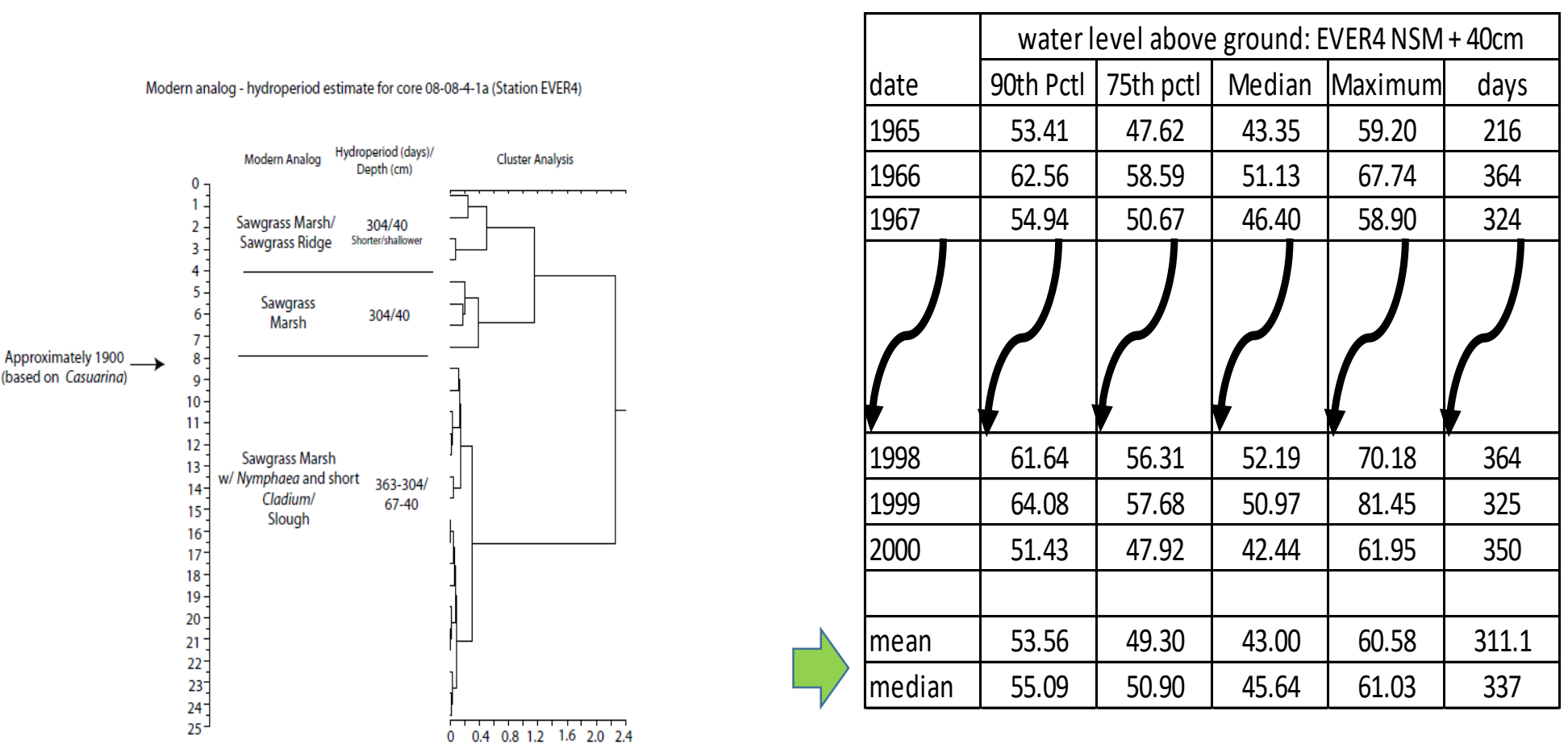
### P33 Core / NSM Interpretation

Sediment core results: pre-drainage hydroperiod ~ 353 days, ~67 cm depth  
NSM with + 20 cm adjustment: median = 64.42 cm, hydroperiod = 364 days



### NP206 Core / NSM Interpretation

Sediment core results: pre-drainage hydroperiod ~ 90 days, ~30cm depth  
NSM with +12 cm adjustment: median=28.84 cm, hydroperiod = 364 days



### EVER4 Core / NSM Interpretation

Sediment core results: pre-drainage hydroperiod ~ 363-304 days, ~67-40cm depth  
NSM with +40 cm adjustment: median=45.64 cm, hydroperiod = 337 days

## Outputs – Freshwater Paleo-based Estimates of Stage throughout ENP

Results of Step 4: Paleo-based estimates of stage at ENP monitoring stations and comparison to stage estimates inferred from FL Bay sediment core analyses

Legend: within range (green), < 0.2 ft out-of-range (yellow), out-of-range > 0.2 ft (red). OFR range is inferred stage from estuarine sediment cores; see USGS Open File Report 2012-1054

Independent Variable Stage Station	N	Mean Observed Stage (ft NGVD29)	Paleo-based stage from P33 core = P33_NSM+20cm (ft NGVD29)	OFR Range (ft NGVD29)
CP	7614	1.20	2.24	1.5-2.5
E146	2336	1.30	2.23	1.8-2.1
EVER4	2524	2.18	3.06	2.8-3.0
EVER6	3036	2.05	2.92	2.7-2.9
EVER7	2944	2.25	3.06	2.7-2.9
NP206	8831	5.15	7.57	6.3-7.3
NP62	9956	2.38	4.16	2.9-4.0
P33paleo	12748	6.04	7.53	6.7-7.5
P35	12905	1.63	2.64	2.1-2.6

Independent Variable Stage Station	N	Mean Observed Stage (ft NGVD29)	Paleo-based stage from NP206 core = NP206_NSM+12cm (ft NGVD29)	OFR Range (ft NGVD29)
CP	7614	1.20	1.72	1.5-2.5
E146	2336	1.30	1.79	1.8-2.1
EVER4	2524	2.18	2.69	2.8-3.0
EVER6	3036	2.05	2.58	2.7-2.9
EVER7	2944	2.25	2.74	2.7-2.9
NP206	8831	5.15	6.69	6.3-7.3
NP62	9956	2.38	3.39	2.9-4.0
P33	12748	6.04	6.77	6.7-7.5
P35	12905	1.63	2.14	2.1-2.6

Independent Variable Stage Station	N	Mean Observed Stage (ft NGVD29)	Paleo-based stage from EVER4 core = EVER4_NSM+40cm (ft NGVD29)	OFR Range (ft NGVD29)
CP	7614	1.20	2.17	1.5-2.5
E146	2336	1.30	2.29	1.8-2.1
EVER4	2524	2.18	3.25	2.8-3.0
EVER6	3036	2.05	3.05	2.7-2.9
EVER7	2944	2.25	3.25	2.7-2.9
NP206	8831	5.15	7.18	6.3-7.3
NP62	9956	2.38	3.83	2.9-4.0
P33	12748	6.04	7.08	6.7-7.5
P35	12905	1.63	1.72	2.1-2.6

## Conclusions – Three Sediment Cores

1. Based on P33 sediment core results a +20cm adjustment to P33\_NSM was required.
2. Based on NP206 sediment core results a +12cm adjustment to NP206\_NSM was required.
3. Based on EVER4 sediment core results a +40cm adjustment to EVER4\_NSM was required.
4. The paleo-adjusted NSM time series for P33, NP206, and EVER4 were used with regression models to estimate the paleo-based stage throughout the ENP freshwater wetlands. The outputs correspond well with estimates of pre-drainage stage inferred from estuarine sediment cores.
5. These results can be used for Everglades restoration performance measure target-setting and for calibrating pre-drainage hydrologic models (NSM and NSRSM).

Citations:

Marshall, F.E., G.L. Wingard, and P. Pitts. 2009. A simulation of historic hydrology and salinity in Everglades National Park: coupling paleoecologic assemblage data with statistical models. Estuaries and Coasts 32: 37-53.

Marshall, F.E., and Wingard, G.L. 2012. Florida Bay salinity and Everglades wetlands hydrology circa 1900 CE: A compilation of paleoecology-Based statistical modeling analyses: US Geological Survey, Open-File Report 2012-1054.