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A coastal terrestrial and marine ecosystem

ASSESSMENT OF THE HYDROGEOLOGY AND HYDROLOGY OF THE PUNTA CABULLONES AREA, PONCE, PUERTO RICO

BACKGROUND (REASONS FOR THE STUDY)

Acquisition of wetland and associate areas to compensate for the potential negative impact of constructing the Las Americas –Transshipment Port in Ponce

Need by PRDNER and MGP of hydrogeologic and hydrology baseline information to develop a plan for restoration and management of the area

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OBJECTIVES OF THE STUDY

The main objectives of the study were:

- Define the hydrogeology and hydrology of Punta Cabullones
  - -groundwater occurrence and movement
  - -temporal variations in the chemical, isotopic, and physical properties of groundwater and surface water
  - - define relations between sea-level stage (tidal cycle), wetland stage and ground-water levels

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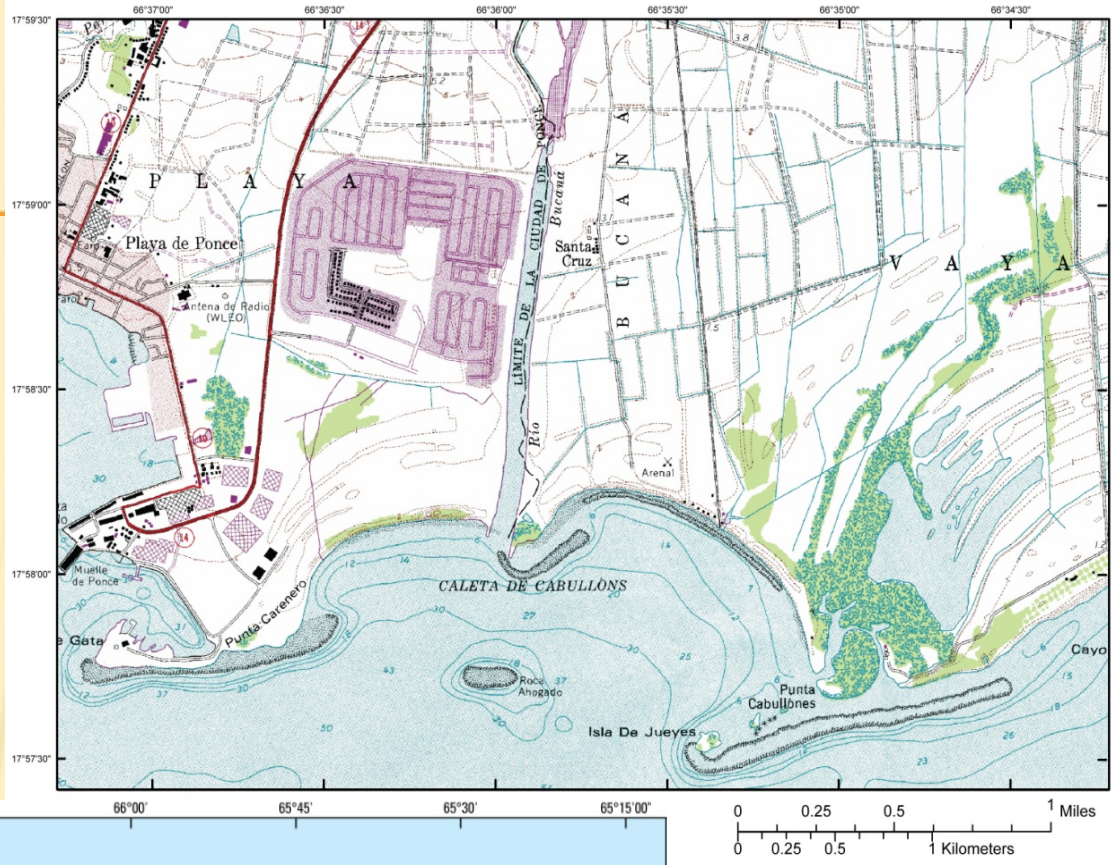
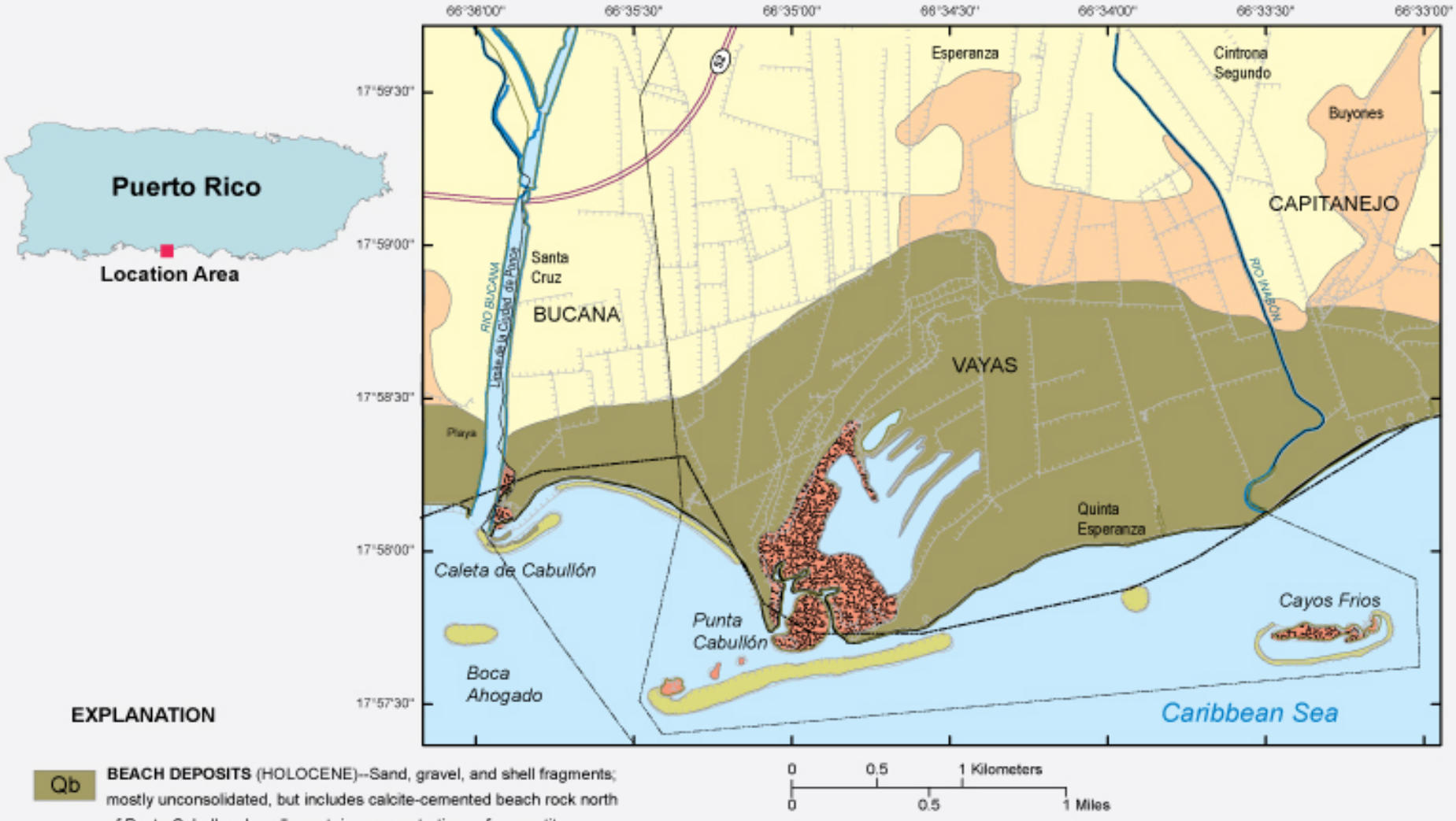
LOCATION OF PUNTA CABULLONES



Base modified from the U.S. Geological Survey digital data



EXPLANATION

Qb — **BEACH DEPOSITS** (HOLOCENE)--Sand, gravel, and shell fragments; mostly unconsolidated, but includes calcite-cemented beach rock north of Punto Cabullon. Locally contains concentrations of magnetite

Qc — **REEFS** (HOLOCENE)--Composed chiefly of coral and coralline algae; partly overlain on the protected or back-reef side by sand composed of coral and coralline algae and by irregularly distributed whole and broken coral heads

Qp / Qps — **PIEDMONT ALLUVIAL PLAIN DEPOSITS** (HOLOCENE AND PLEISTOCENE?)--Sand, silt, and gravel, uncon-solidated, thickness unknown Like Qp, but contains a moderate accumulation of salt

SWAMP DEPOSITS (HOLOCENE)--Clay, silt, and organic material; chiefly covered by mangrove trees

ECOSYSTEM OF PUNTA CABULLONES

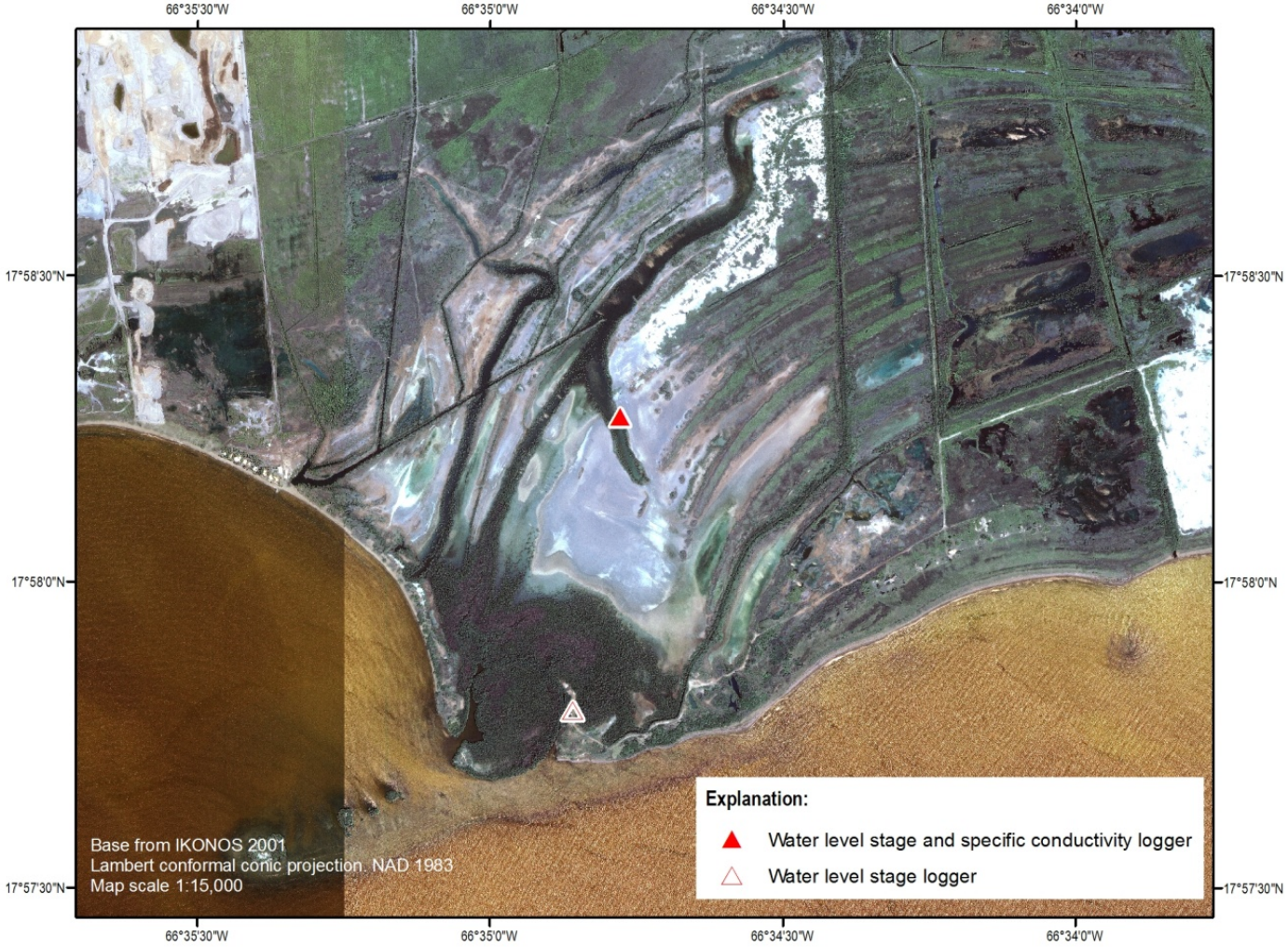
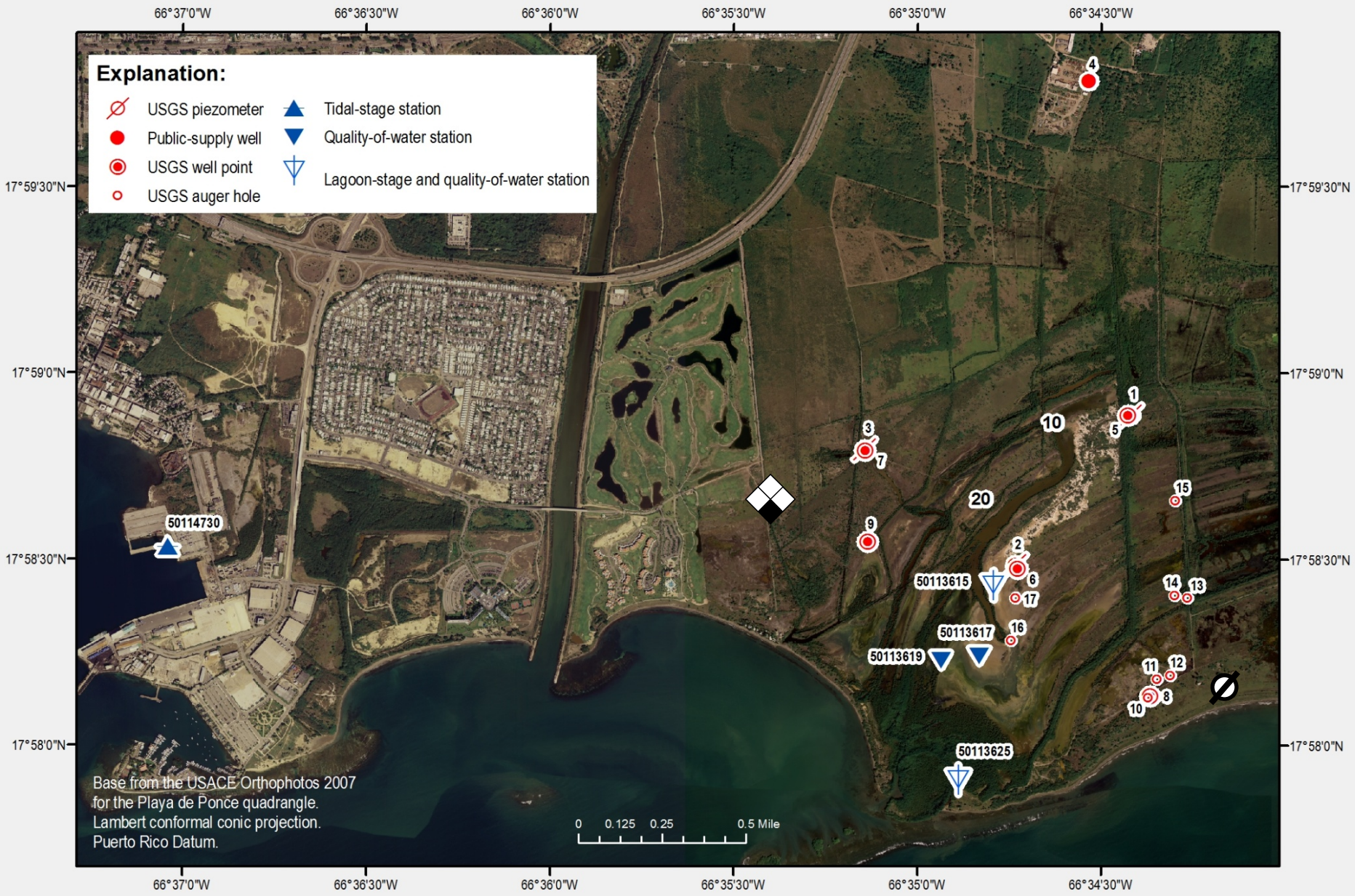


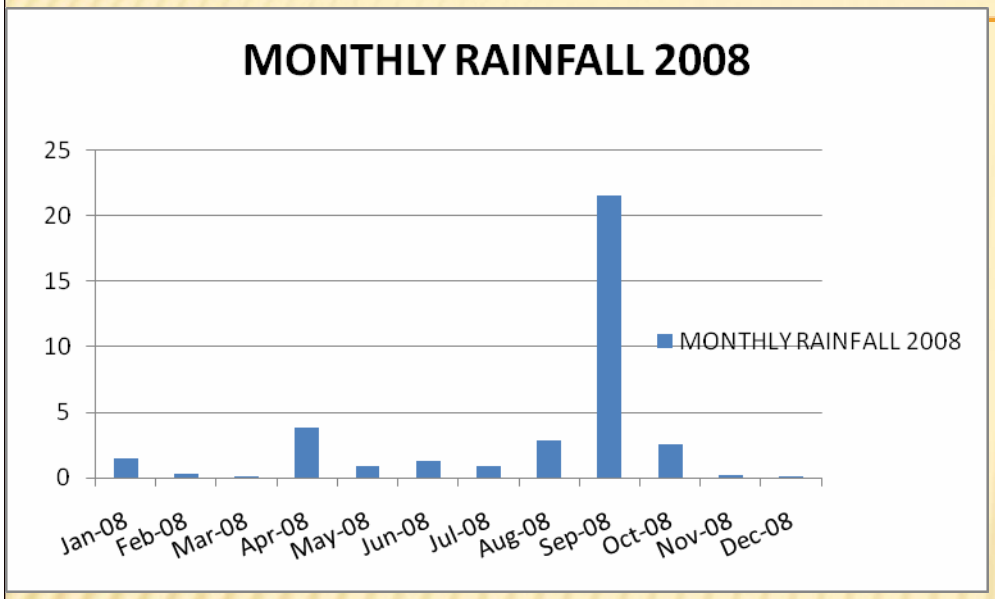
Figure 3 - Expanded view of wetland and outlet channel of punta Cabuyones area

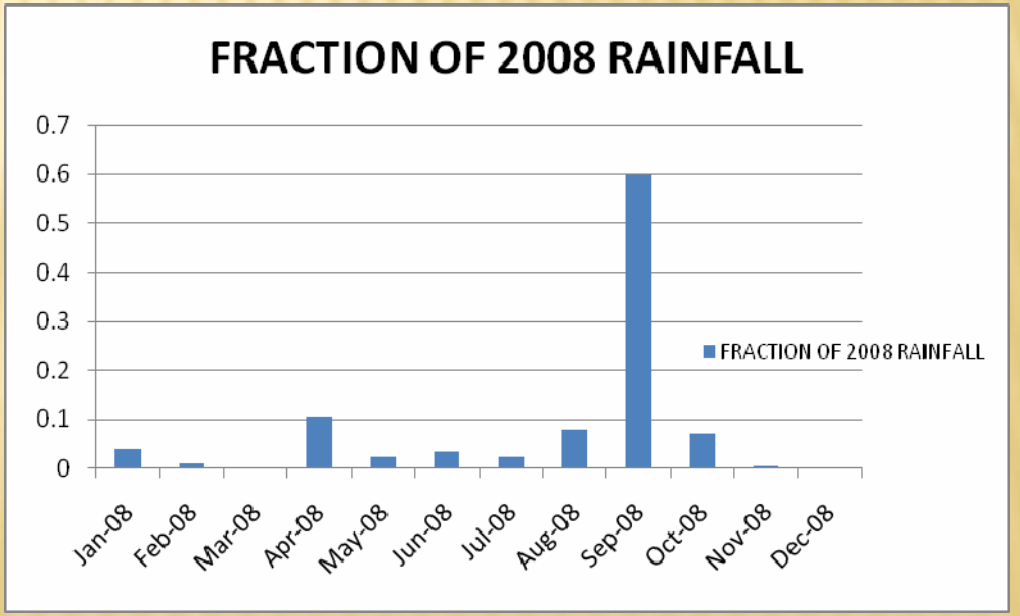
LOW AREAS BETWEEN SUCCESSIVE BEACH RIDGES

WETLAND INTERIOR


Explanation:
USGS piezometer
Public-supply well
USGS well point
USGS auger hole
Tidal-stage station
Quality-of-water station
Lagoon-stage and quality-of-water station
66°37'0"W
66°36'30"W
66°36'0"W
66°35'30"W
66°35'0"W
66°34'30"W
17°59'30"N
17°59'0"N
17°58'30"N
17°58'0"N
50114730
50113615
50113617
50113619
50113625
Base from the USACE Orthophotos 2007
for the Playa de Ponce quadrangle.
Lambert conformal conic projection.
Puerto Rico Datum.
0 0.125 0.25 0.5 Mile

CLIMATE (PRECIPITATION-Cont.)





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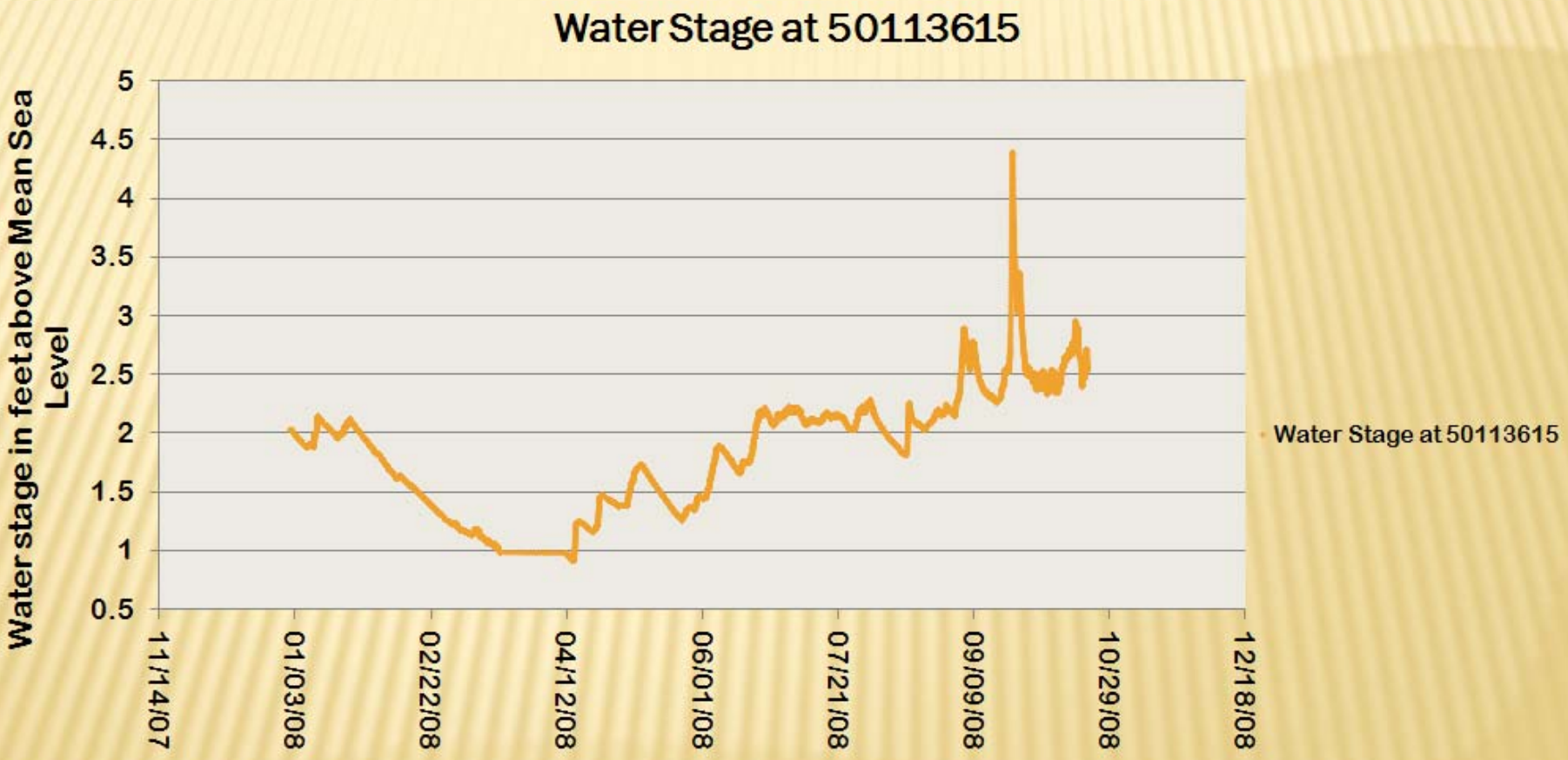
PARTIAL RECORD OF WATER STAGE IN THE WETLAND INTERIOR



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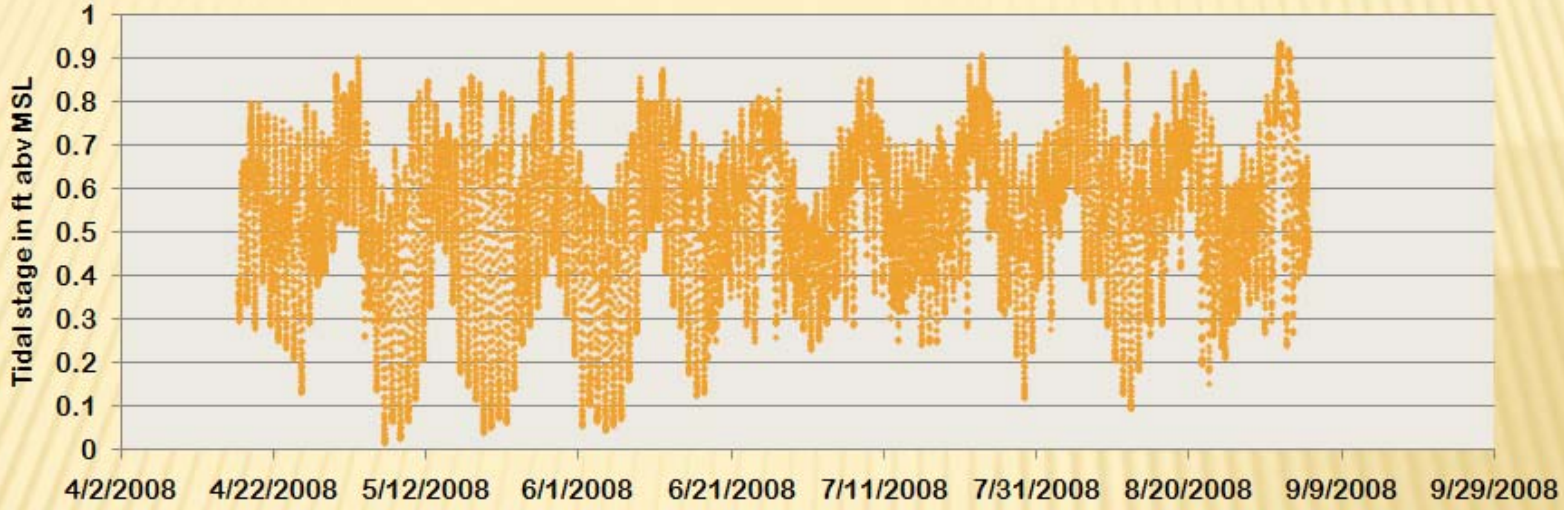
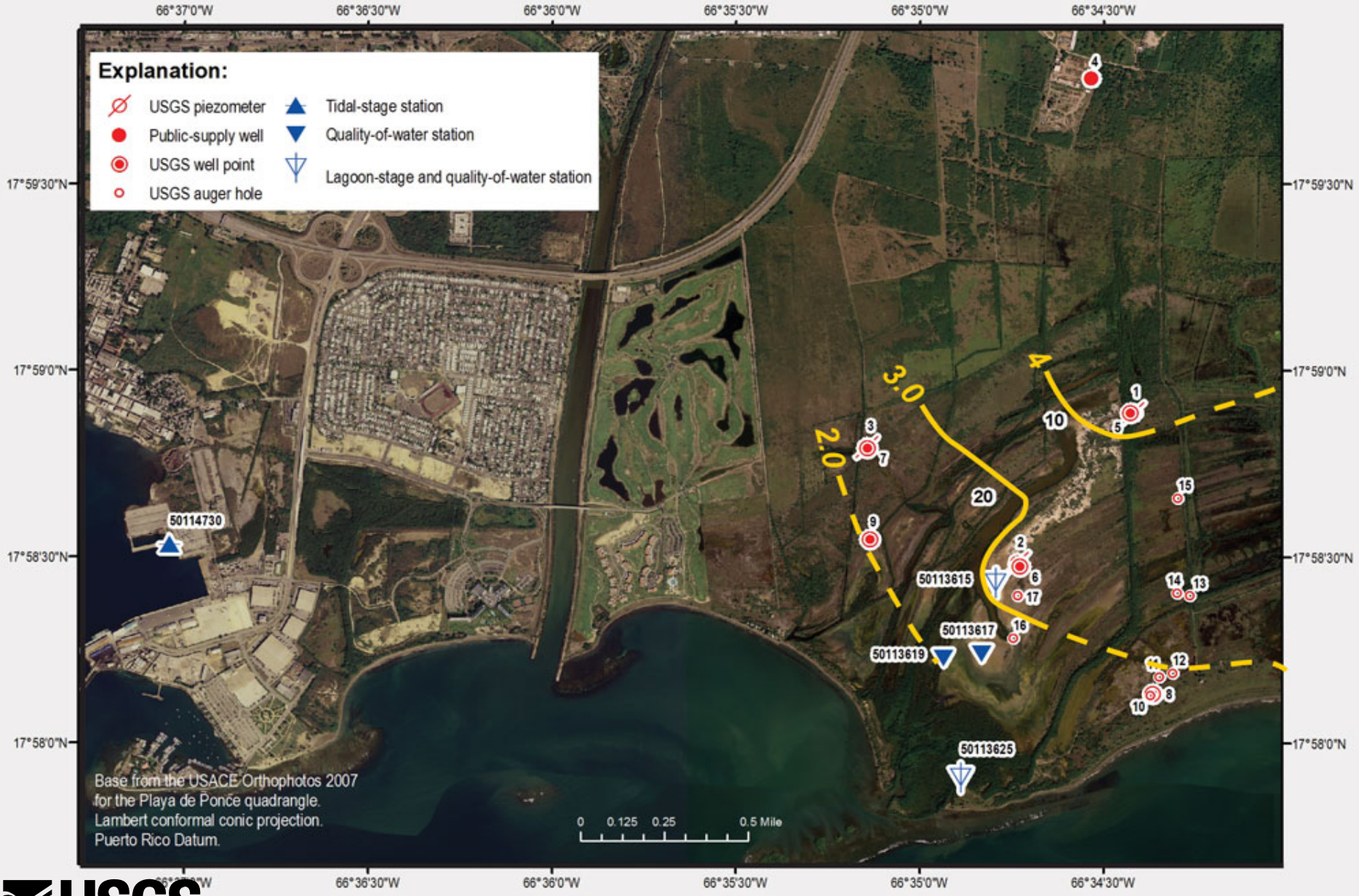
Ponce Harbor Tidal Cycle



Ponce Harbor Tidal Cycle (3 days)



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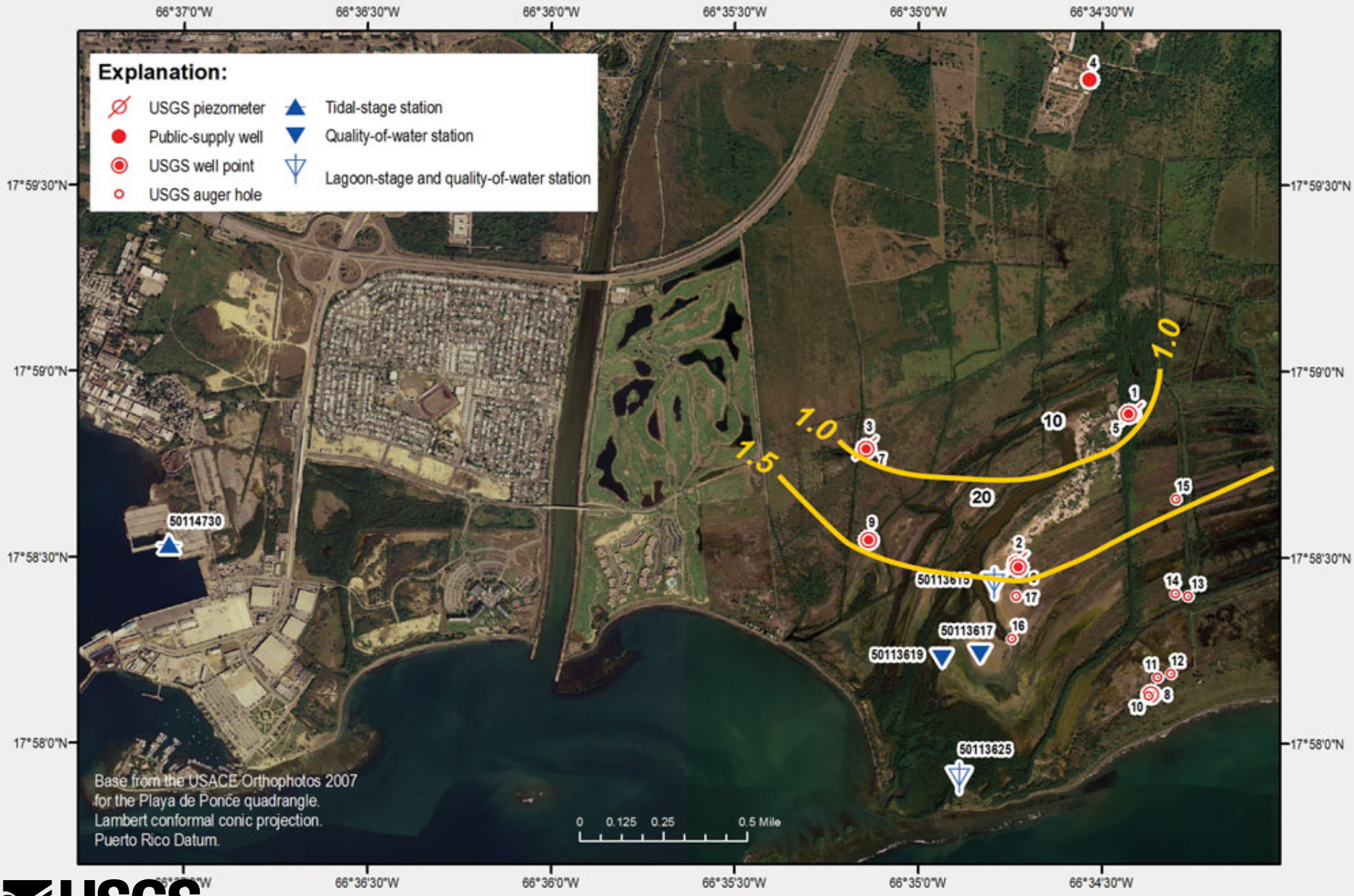
Depth to GW level in ft during March 26-28, 2008



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General depth to GW level in ft bls from Sep 07-Jan 08

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Average salinity in parts per thousand 20 ft below land surface (shallow piezometers and well points) between March 26 and April 29, 08

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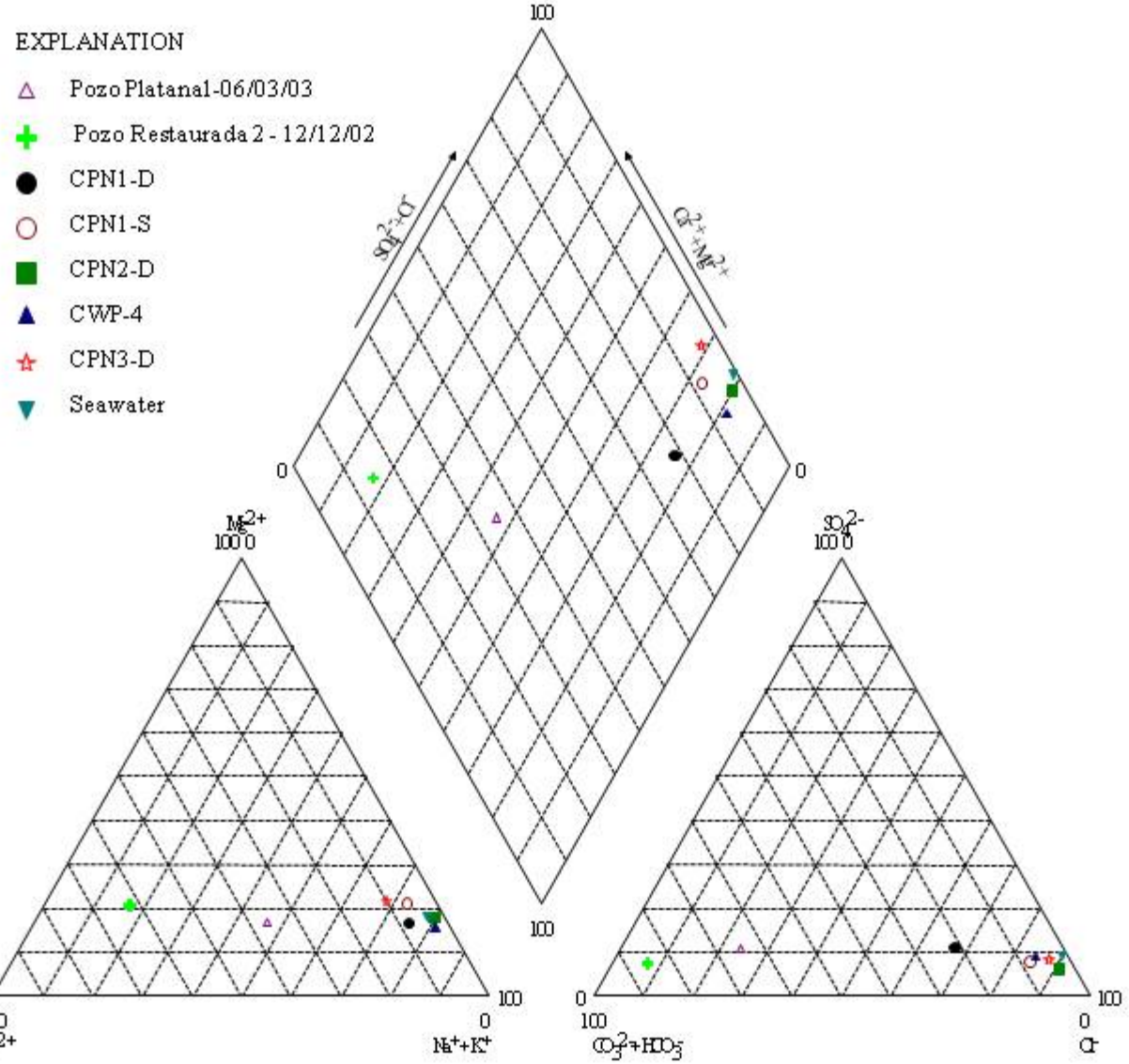
Figure 17 (b) Average spatial Salinity distribution within the Punta Cabullones study area at depths between 20 and 100 ft below land surface during the dry period between March 26 thru April 29, 2008.

Piper diagrams of ground-waters amples collected from selected wells in the Punta Cabullón area



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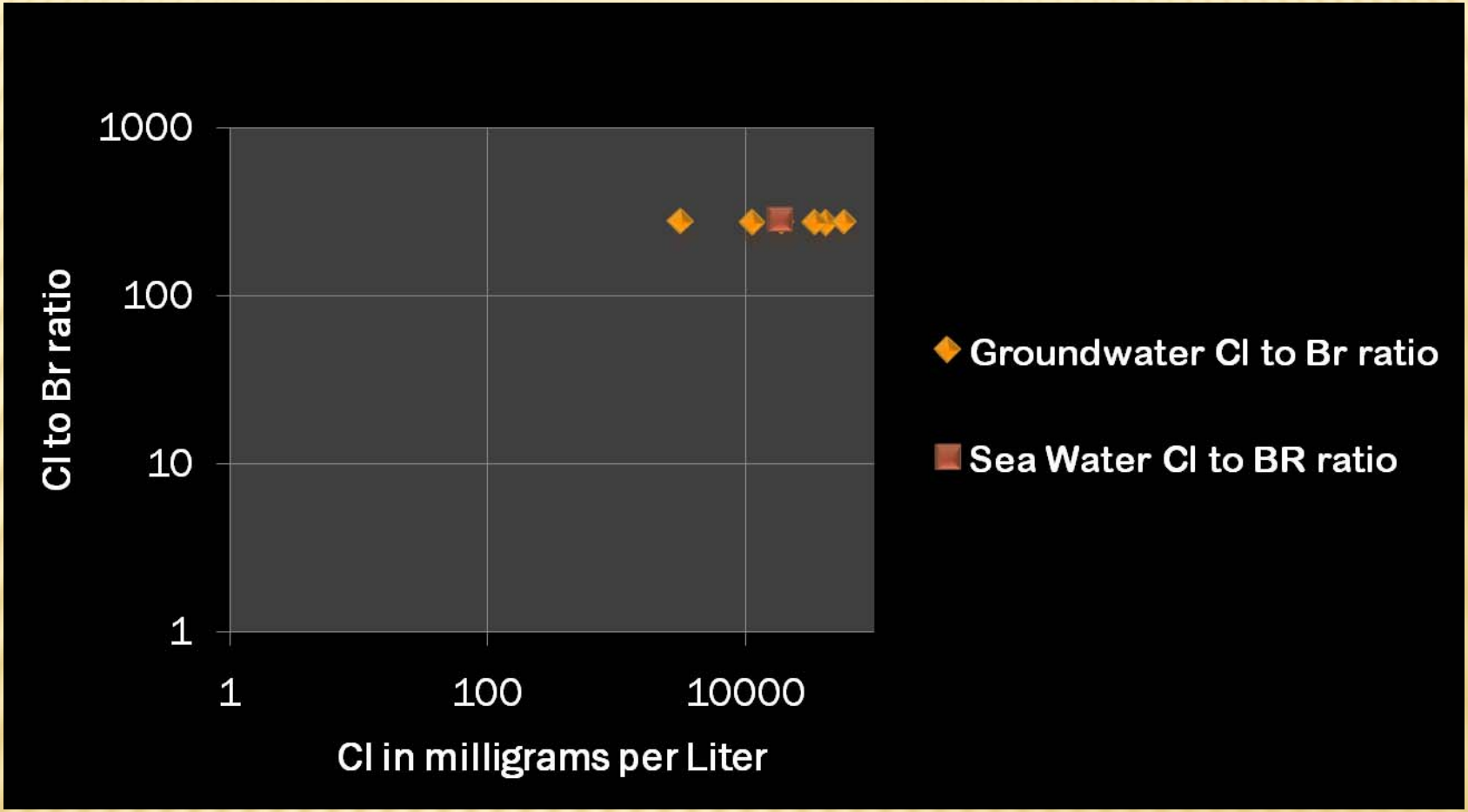

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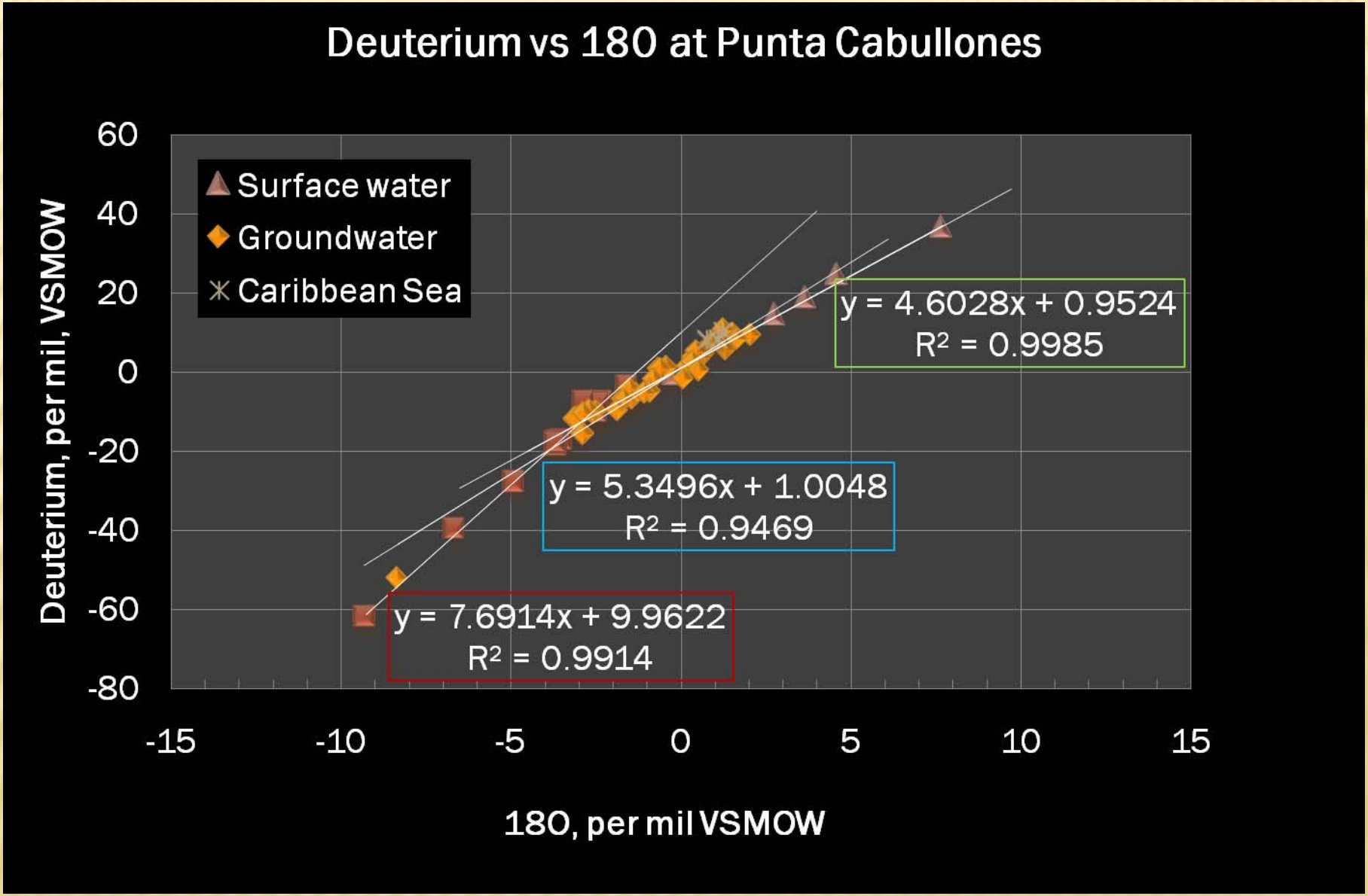
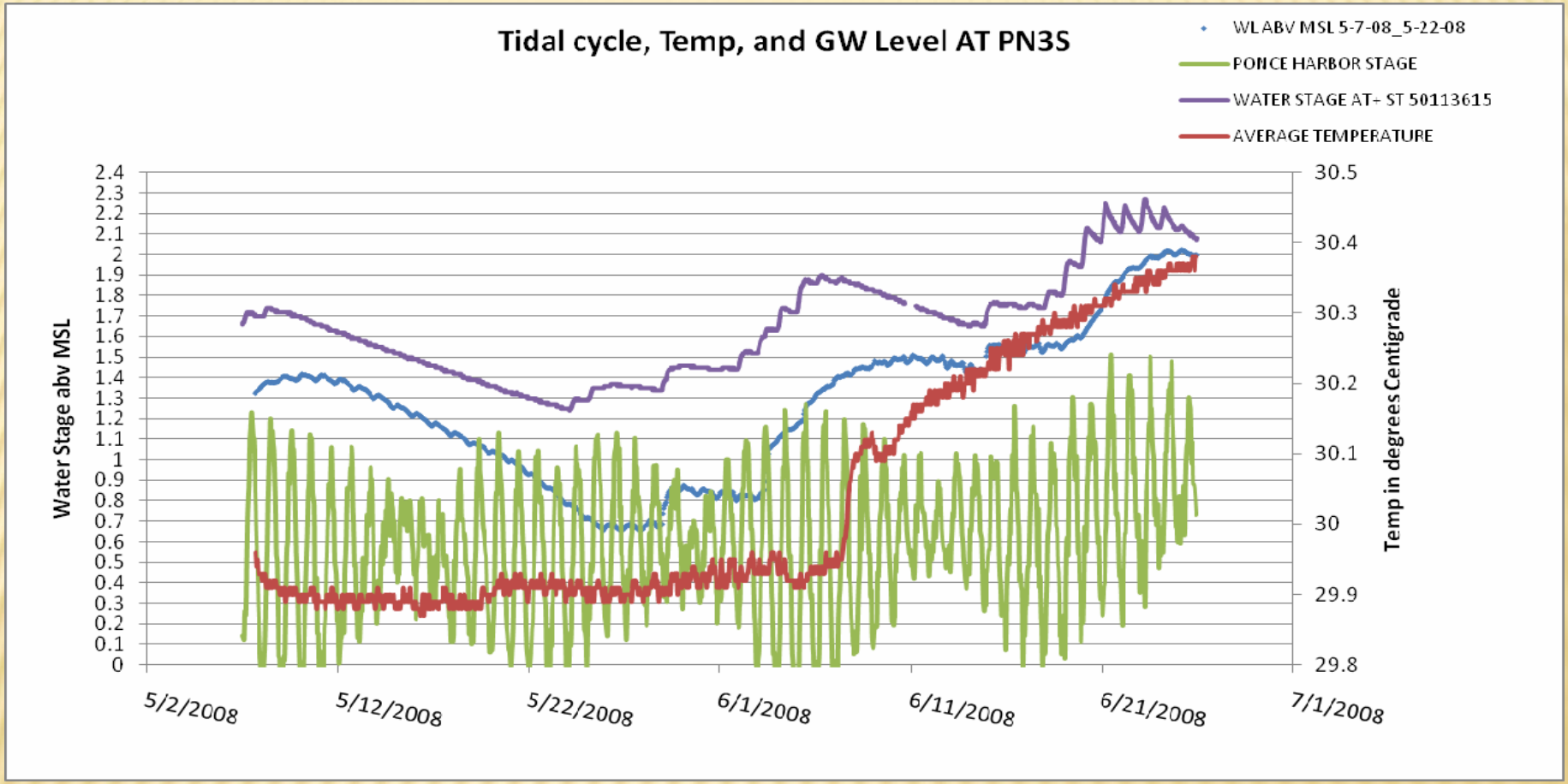

Deuterium vs 180 at Punta Cabullones
Surface water
Groundwater
Caribbean Sea
y = 4.6028x + 0.9524
R² = 0.9985
y = 5.3496x + 1.0048
R² = 0.9469
y = 7.6914x + 9.9622
R² = 0.9914
Deuterium, per mil, VSMOW
60
40
20
0
-20
-40
-60
-80
-15
-10
-5
0
5
10
15
180, per mil VSMOW



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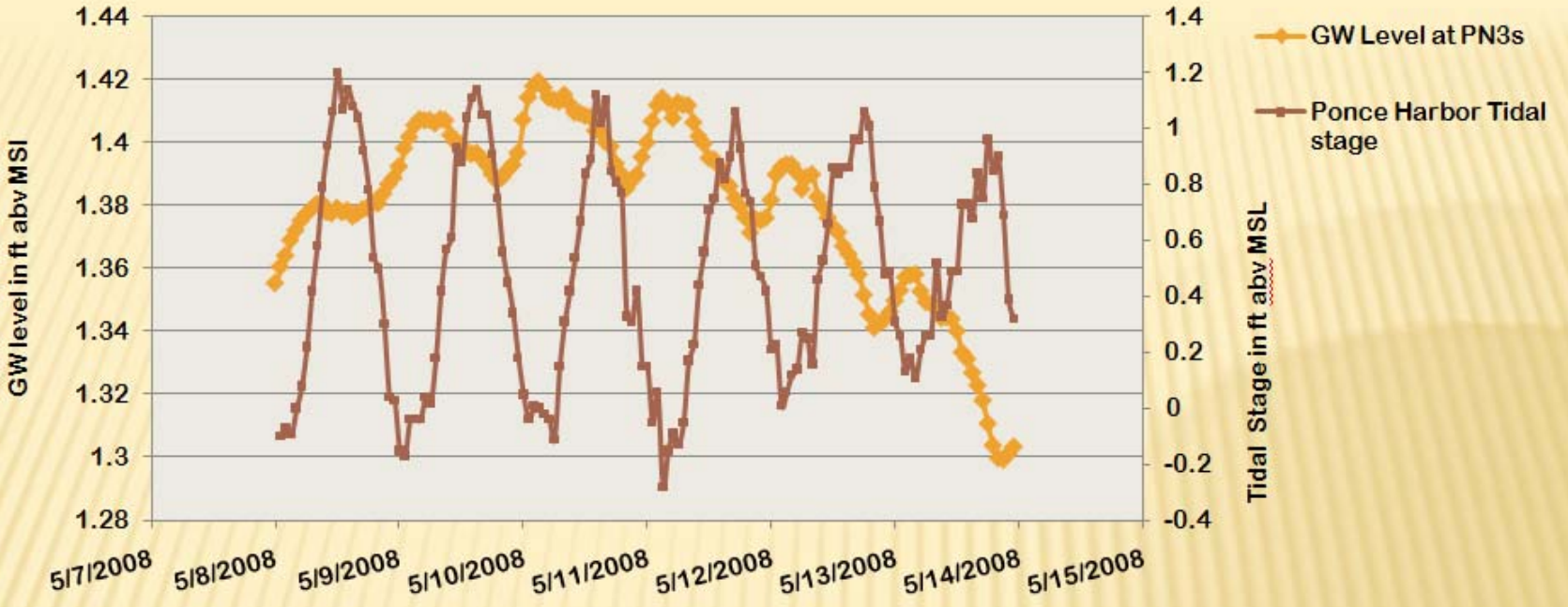
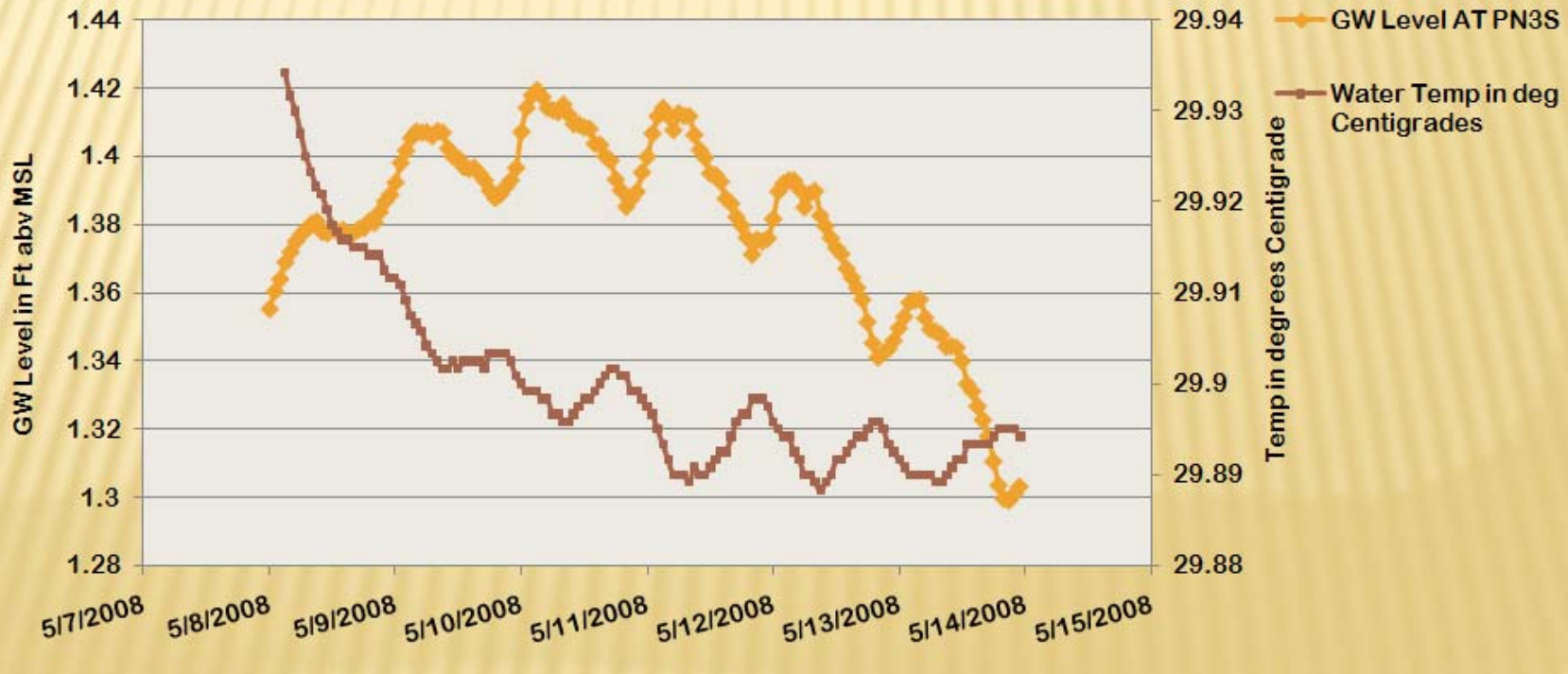

GW level in ft abv MSL
Tidal Stage in ft abv MSL
GW Level at PN3s
Ponce Harbor Tidal stage
1.44
1.42
1.4
1.38
1.36
1.34
1.32
1.3
1.28
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
5/7/2008
5/8/2008
5/9/2008
5/10/2008
5/11/2008
5/12/2008
5/13/2008
5/14/2008
5/15/2008


GW Level in Ft abv MSL
Temp in degrees Centigrade
GW Level AT PN3S
Water Temp in deg Centigrades
1.44
1.42
1.4
1.38
1.36
1.34
1.32
1.3
1.28
29.94
29.93
29.92
29.91
29.9
29.89
29.88
5/7/2008
5/8/2008
5/9/2008
5/10/2008
5/11/2008
5/12/2008
5/13/2008
5/14/2008
5/15/2008

WATER BUDGET

- Various ET rates used according to land use:

  - Healthy mangrove swamps-0.017 mt/d-(Twilley and Chen, 1998)
    - Areas partially connected to the sea- (sea water to hypersaline)-0.0075 mt/d; Kokya and Kokya, 2005)
    - - Areas with thin saltflats-0.0039 mt/d (Kampf and others, 2005)

- Input-2020 ac-ft/yr
  - groundwater inflow from north of the study area-1541 ac-ft/yr (assuming that pumpage by public supply wells does not affect regional gw to the study area-total pumpage is 2240 ac-ft/yr; Bennet, 1972))

  - recharge from direct precipitation in study area of 32 in/yr -479 ac-ft/yr (10% of precipitation)

- Output- 8254 ac-ft
  - -due entirely to ET
  - difference between input and output satisfied by seawater-storm surges?

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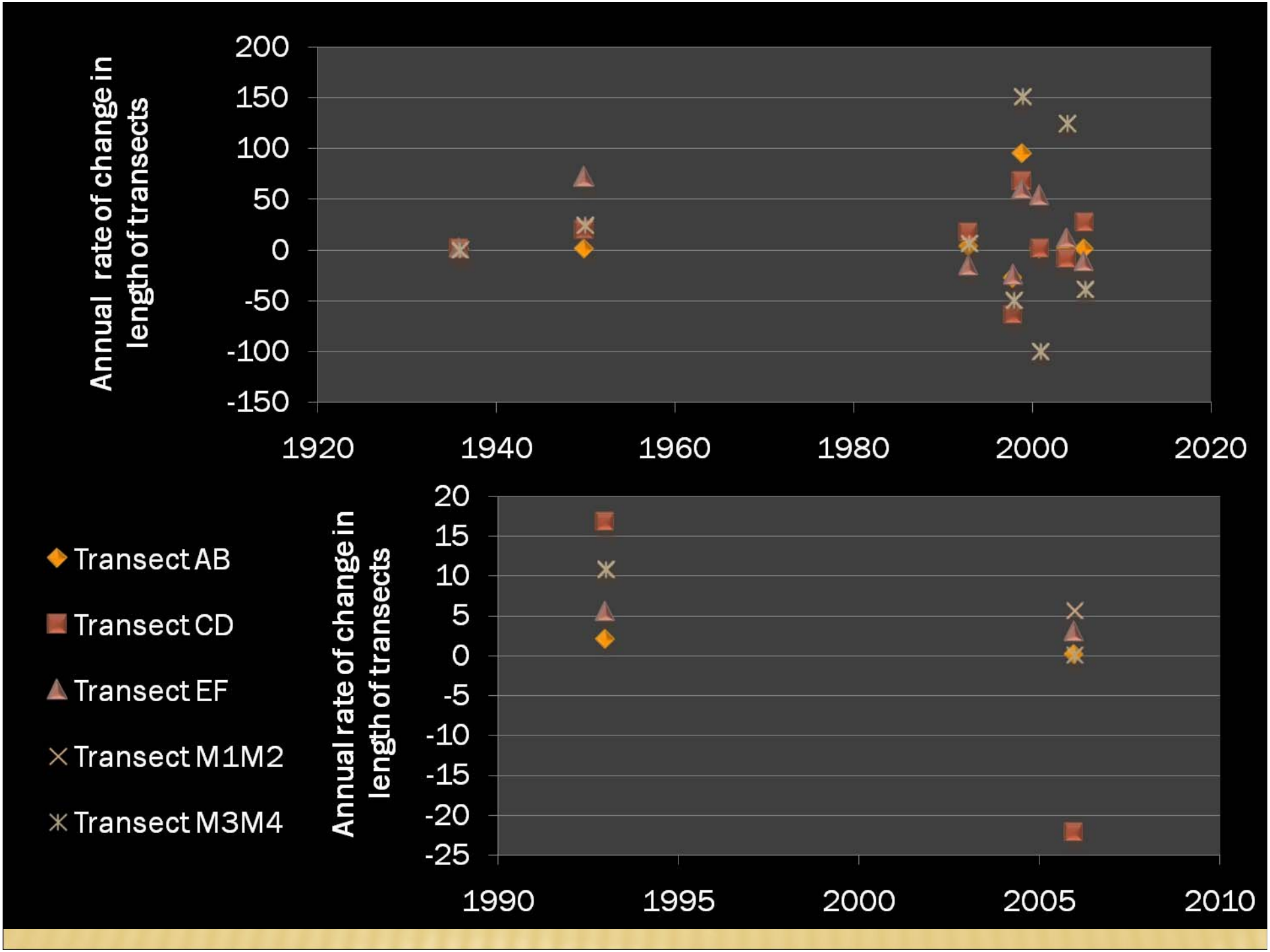
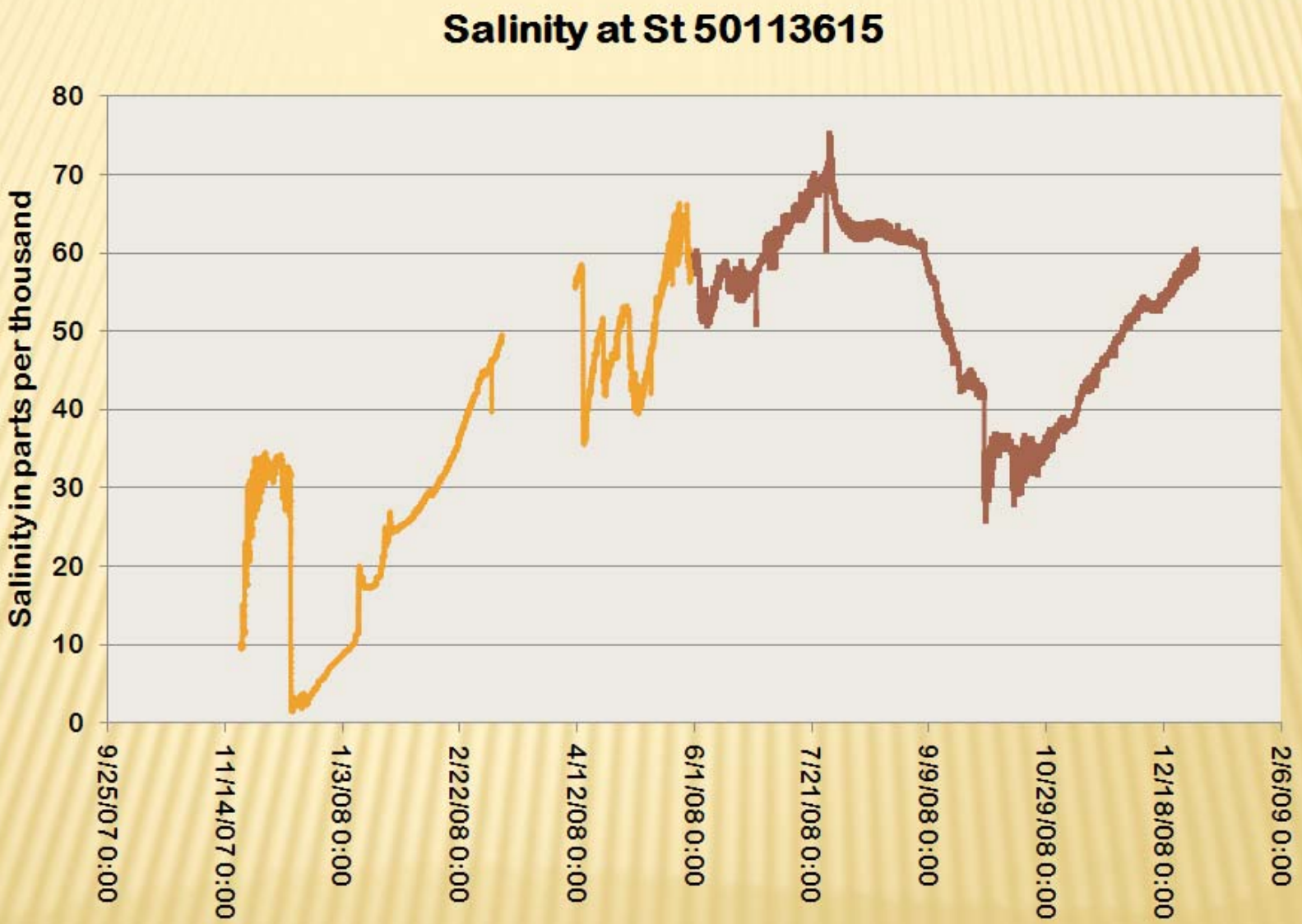

Annual rate of change in length of transects
200
150
100
50
0
-50
-100
-150
1920
1940
1960
1980
2000
2020
Transect AB
Transect CD
Transect EF
Transect M1M2
Transect M3M4
Annual rate of change in length of transects
20
15
10
5
0
-5
-10
-15
-20
-25
1990
1995
2000
2005
2010



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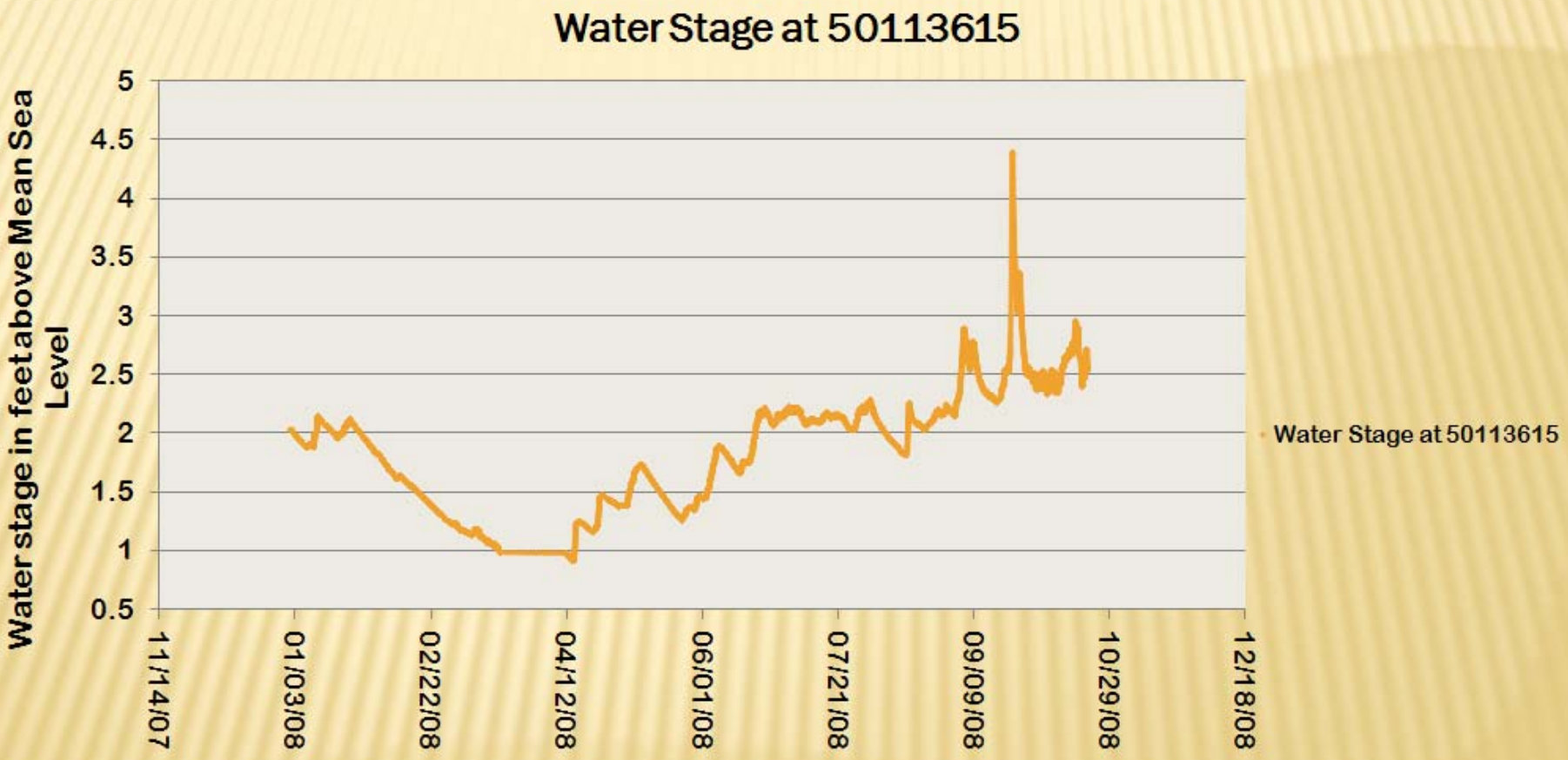

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