Hydrology of Florida's coastal dune lakes

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CBA
CHOCTAWHATCHEE BASIN ALLIANCE
OWC

Project motivation

- Is water quality in dune lakes deteriorating?
- If so, where are the contaminant sources, and what are their relative contributions?

- Water and nutrient budgets
  - Instrument three lakes: Draper, and 2 of the following 4: Campbell, Camp Creek, or Eastern. UF staff installed wells and stage recorders at each lake
  - Water quality sample collection by CBA staff and volunteers, analysis by Lakewatch.
  - Budgets: Change in storage = in - out
  - Water quality
    - N and P concentrations may be increasing
    - Are there ecological consequences?
  - Are other management issues more pressing (interesting?)

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Project extended impacts

- UF grant from US EPA P3 program (2007 –2008)
  - national sustainable design competition for students
    - *how to address lake issues?*
    - integrated education campaign
  - National Sustainable Design Expo - Washington DC
- UF course "Florida Lake Management"
  - graduate/undergraduate
  - inaugural year (2007) focus on dune lakes, including 2-day field trip
  - now taught annually

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Campbell Lake
Draper Lake
Gulf of Mexico
Camp Creek Lake

Data Collection: Hydrology

- April 2007: Water level recorders placed in Campbell and Draper Lakes.
- October 2007: Water level recorder placed in Camp Creek Lake.
- May 2008: Recorders replaced by units capable of measuring WL, temperature and conductivity.

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Data Collection: Water Quality

- April 2007: Groundwater wells installed at Campbell, Camp Creek and Draper Lakes.
- May 2007: Begin monthly collection of groundwater samples by Lakewatch volunteers
- Samples analyzed for TP, TN, and color.

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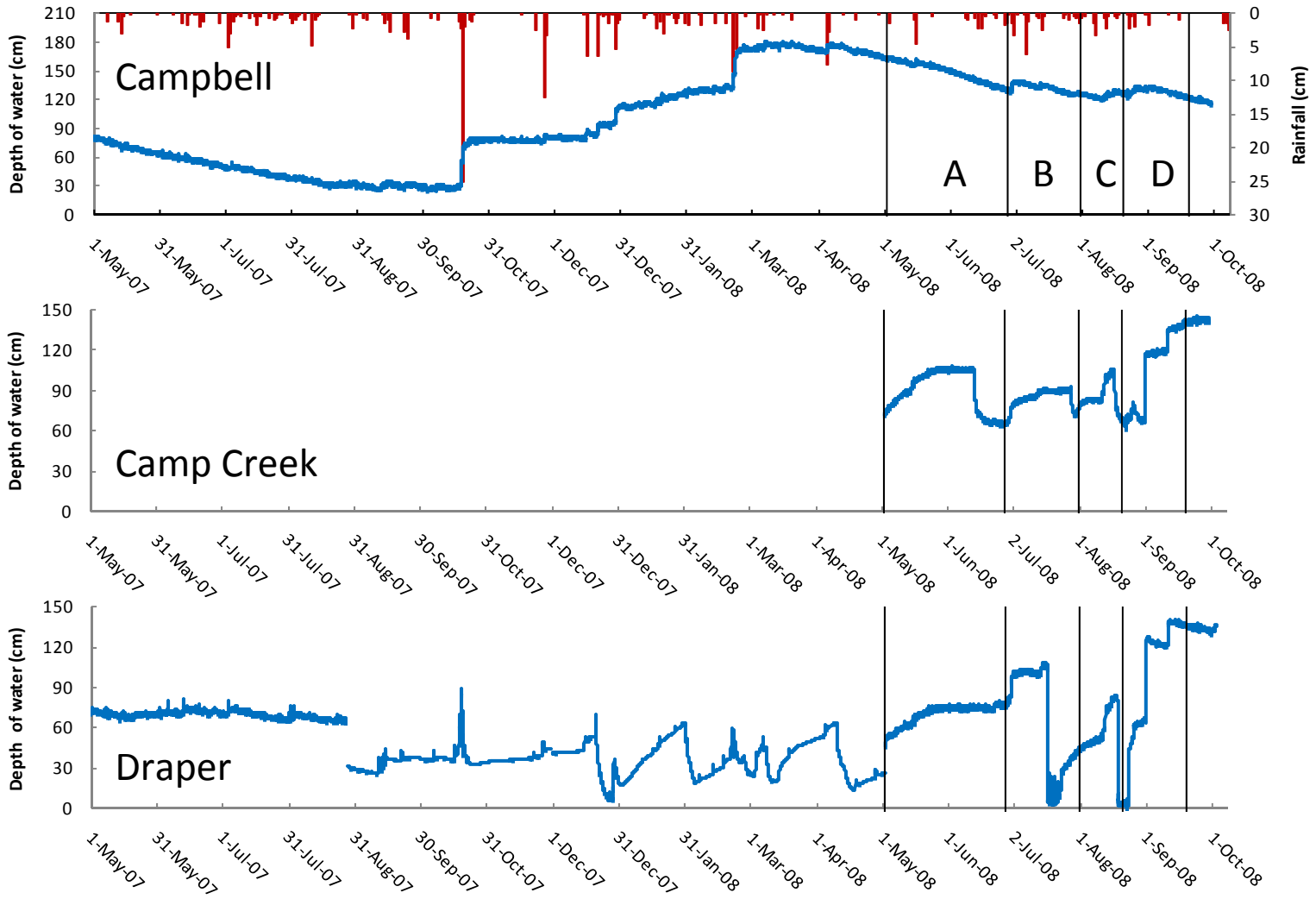
Hydrologic Dynamics



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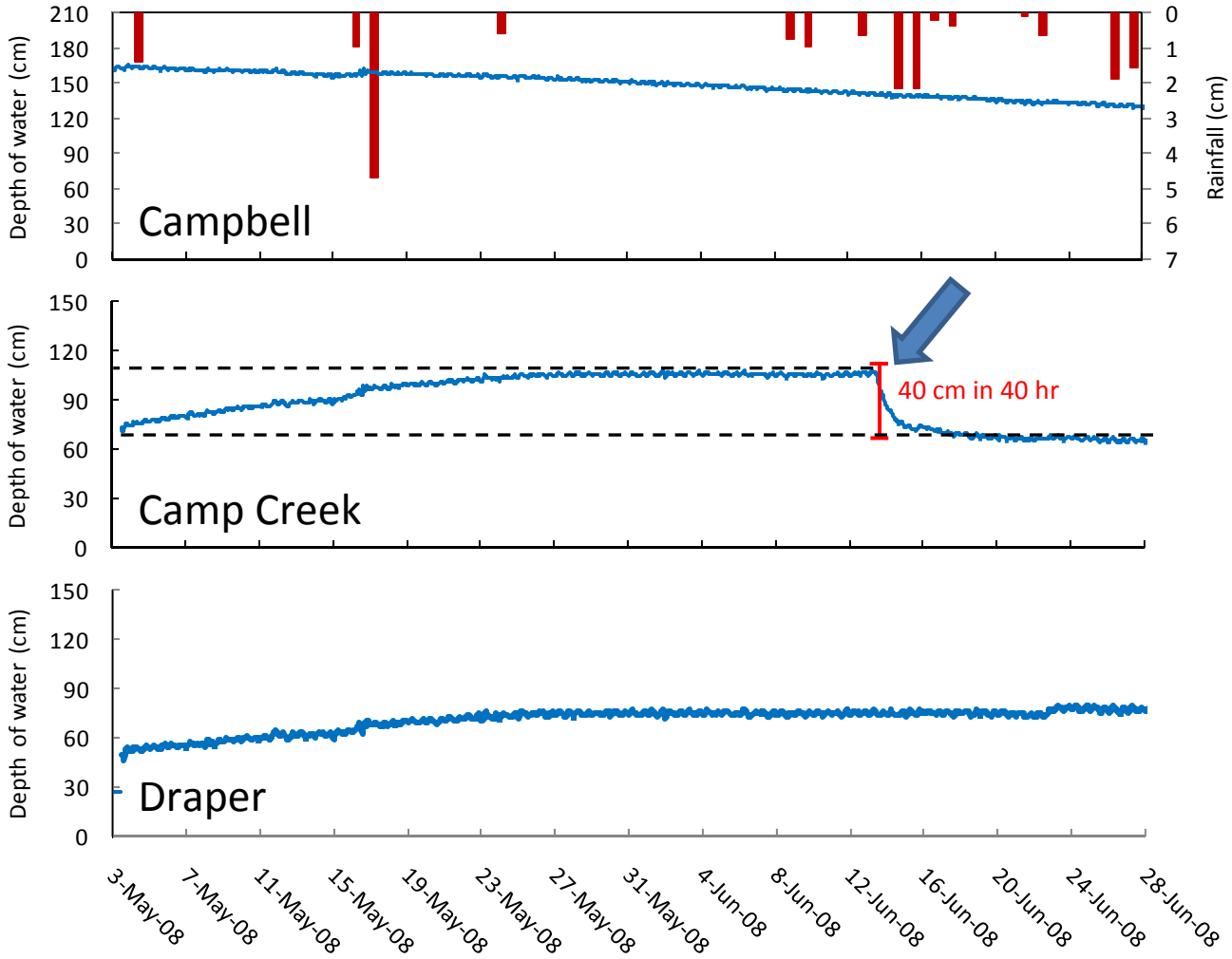
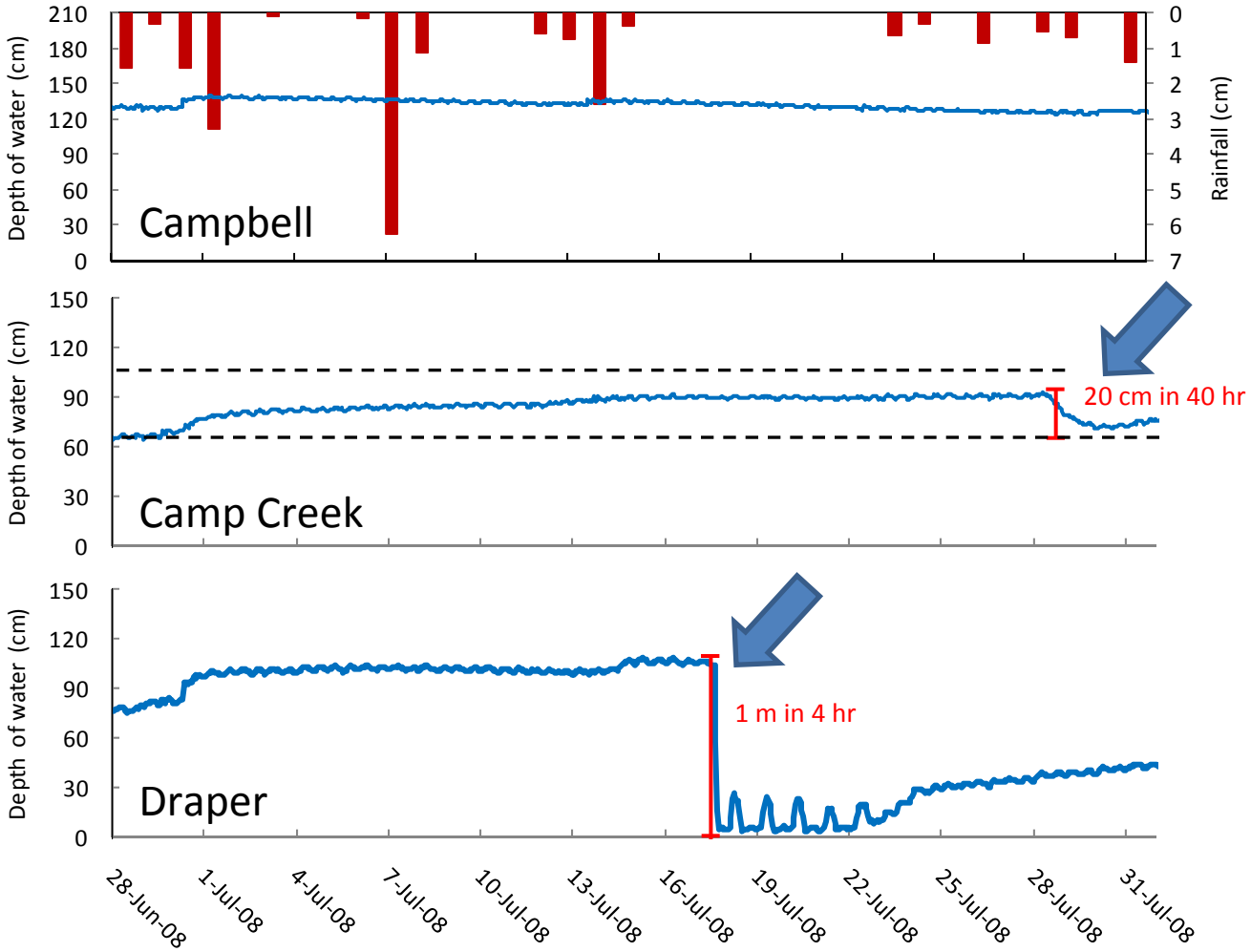
Hydrologic Dynamics: Period A




Big Redfish Lake
photosFlorida.com

Hydrologic Dynamics: Period B



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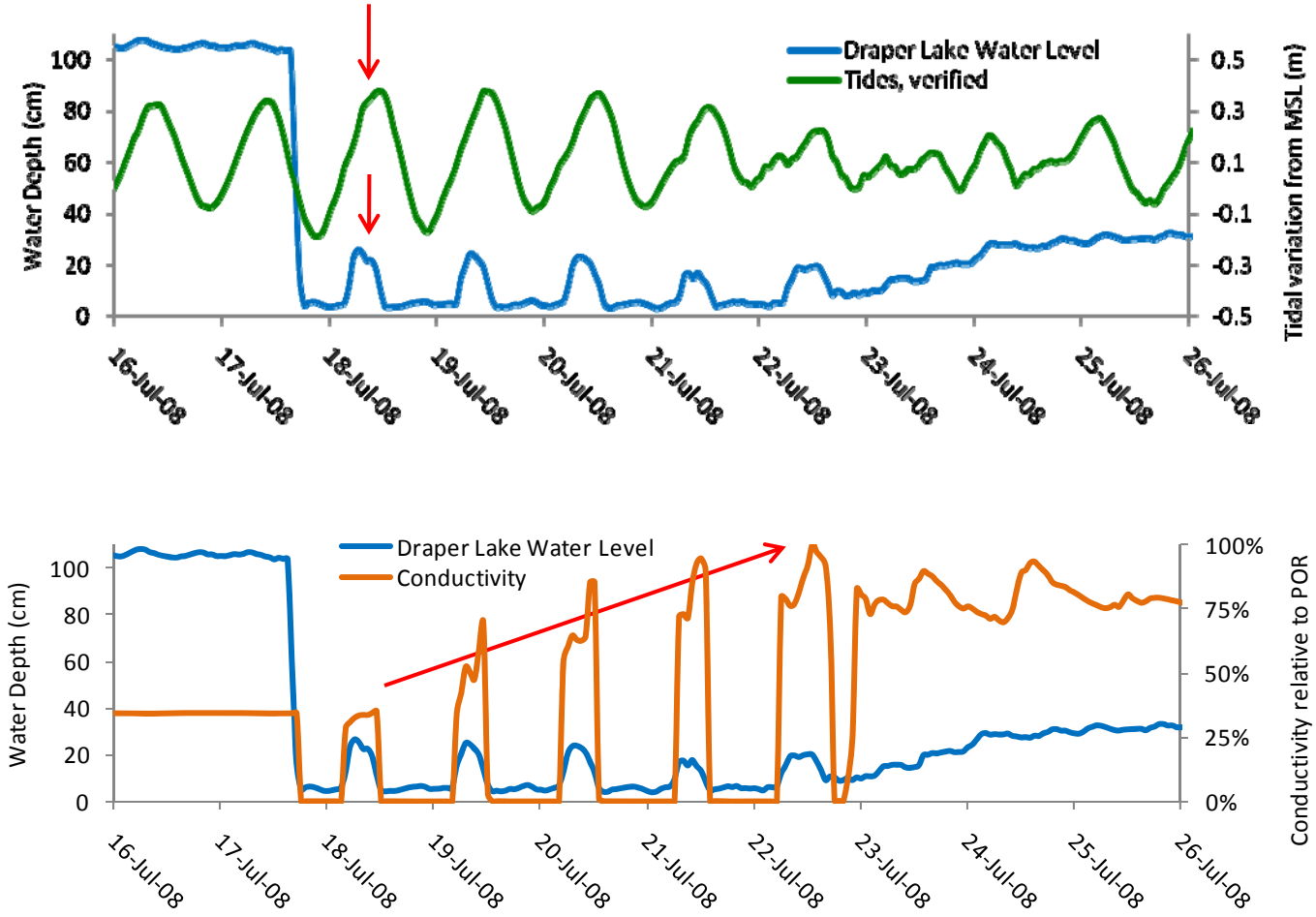
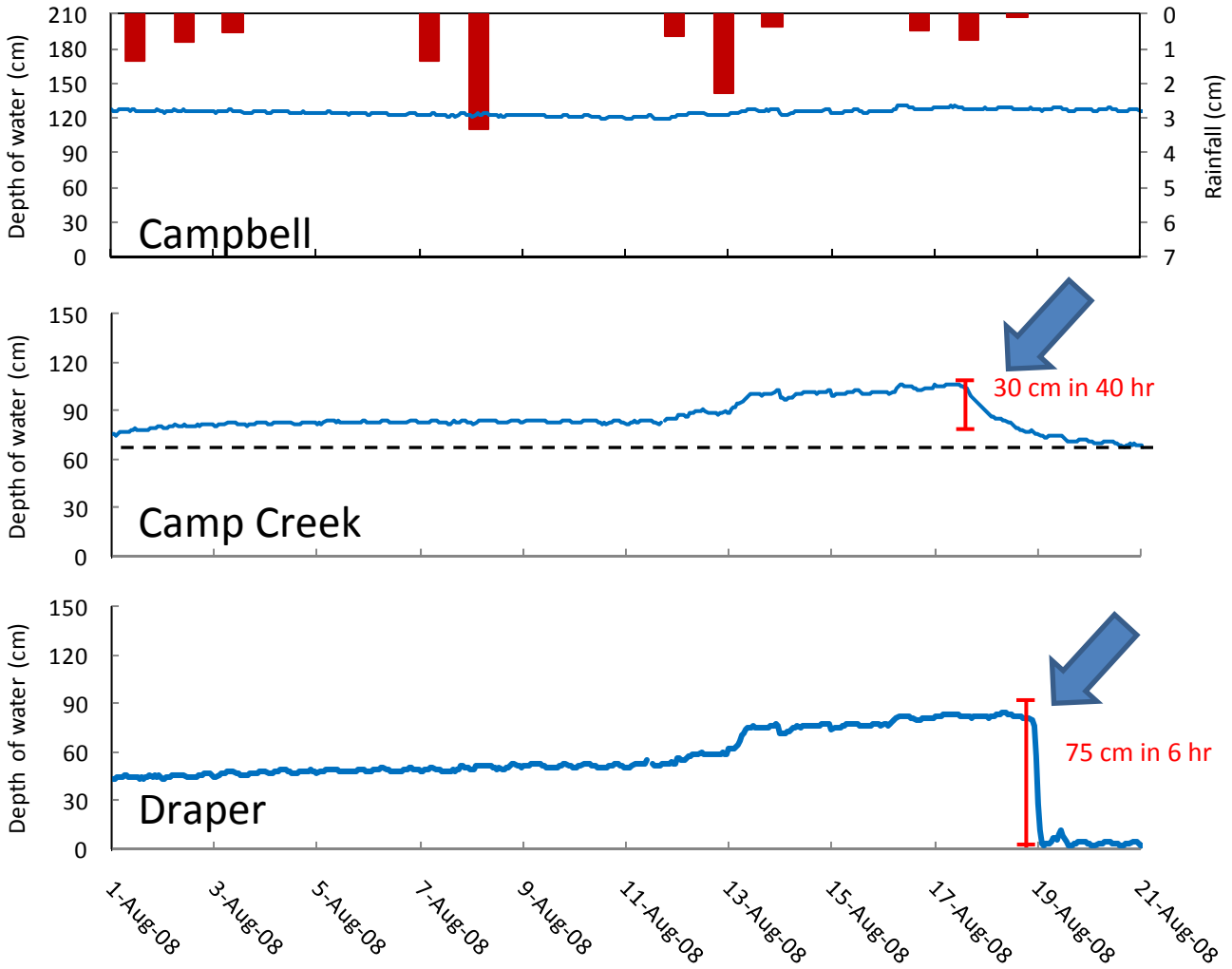
Anatomy of a blow-out: Draper Lake



Hydrologic Dynamics: Period C



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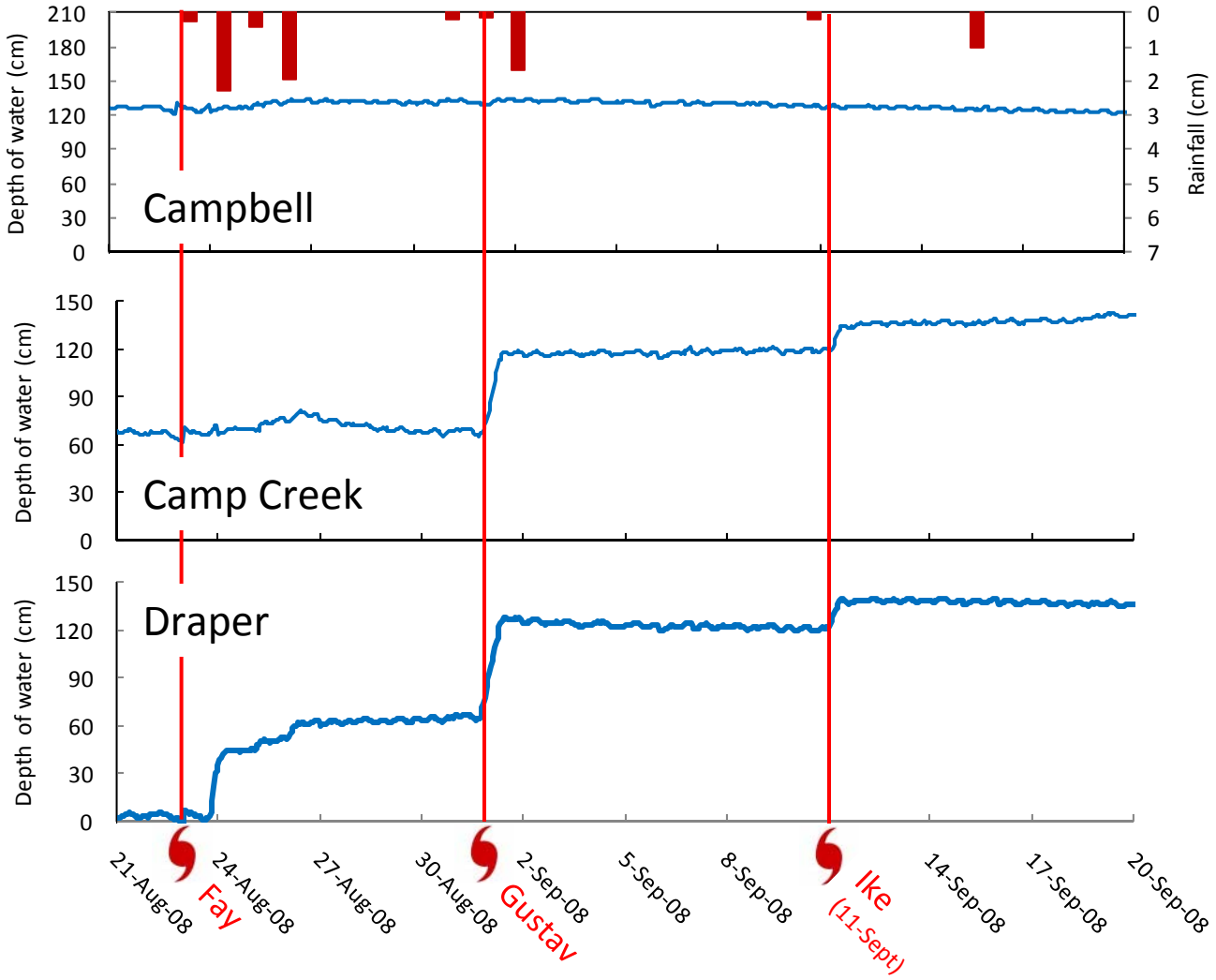
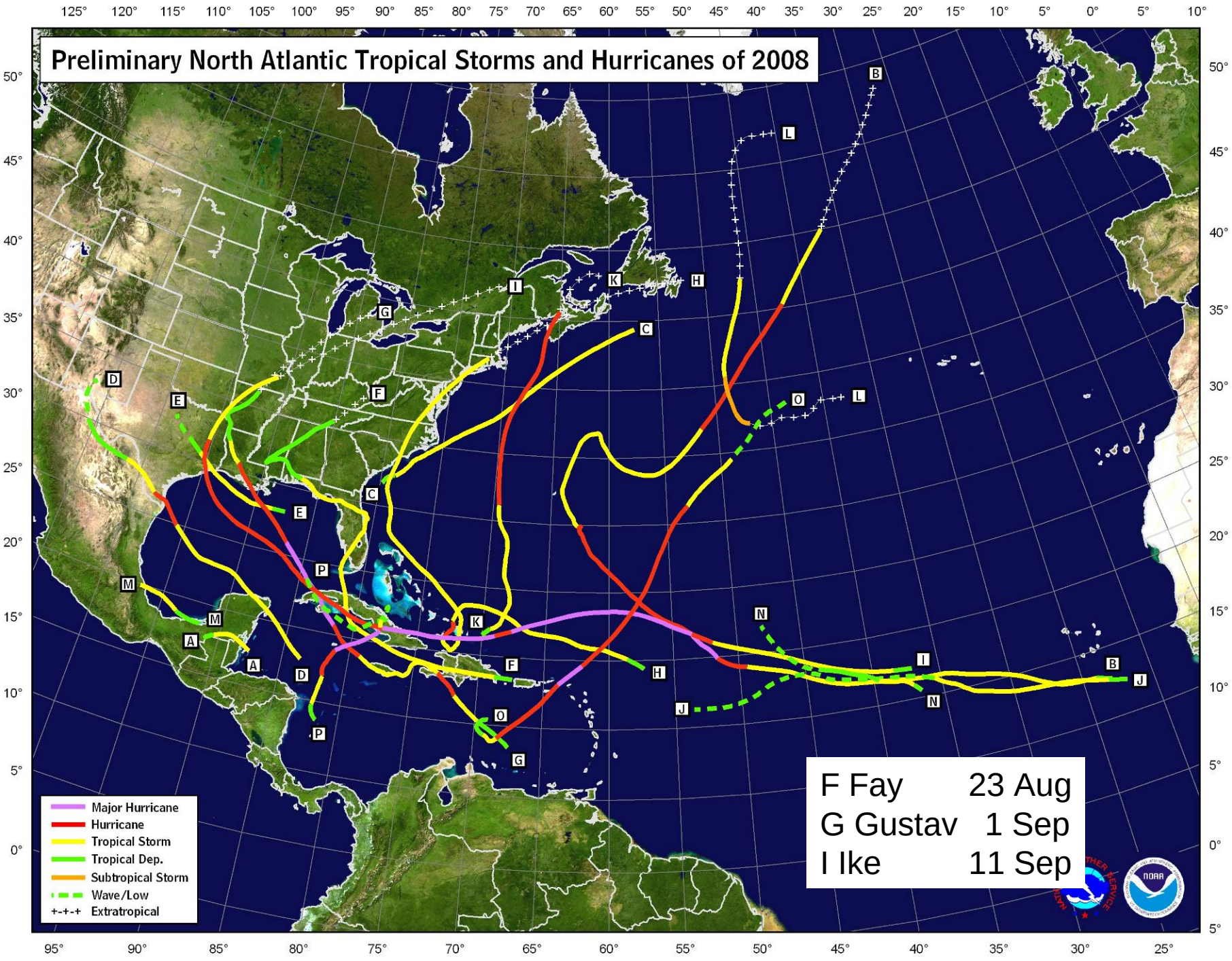
Hydrologic Dynamics: Period D



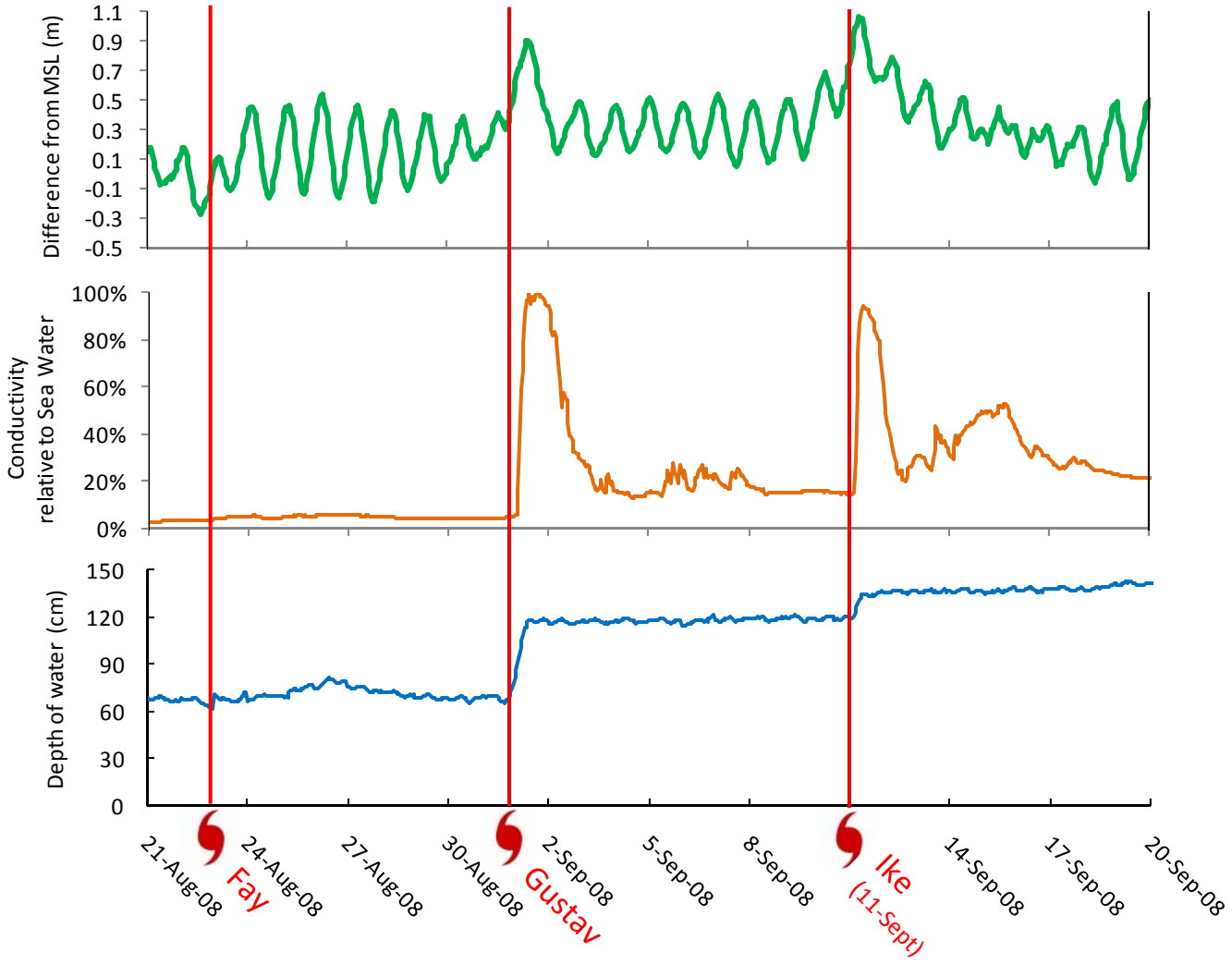

Preliminary North Atlantic Tropical Storms and Hurricanes of 2008
Major Hurricane
Hurricane
Tropical Storm
Tropical Dep.
Subtropical Storm
Wave/Low
Extratropical
F Fay 23 Aug
G Gustav 1 Sep
I Ike 11 Sep

Hurricane Impacts: Blow-in at Camp Creek

Tide

Conductivity

Water Level



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Conclusions: Hydrology

- From May to Oct 2008, Draper and Camp Creek blew-out 2 and 3 times, respectively. This may translate to 3-5 opening events per year.
- Water level decline during blow-outs averaged 90 cm in Draper and 30 cm in Camp Creek.
- Magnitude and rate of water loss depends on:
  - Lake morphology (e.g. compartmentalization of Camp Creek)
  - Outflow channel morphology
  - Antecedent water level
- Current datasets do not allow prediction of blow-outs or firm reconstruction of hydraulic events.

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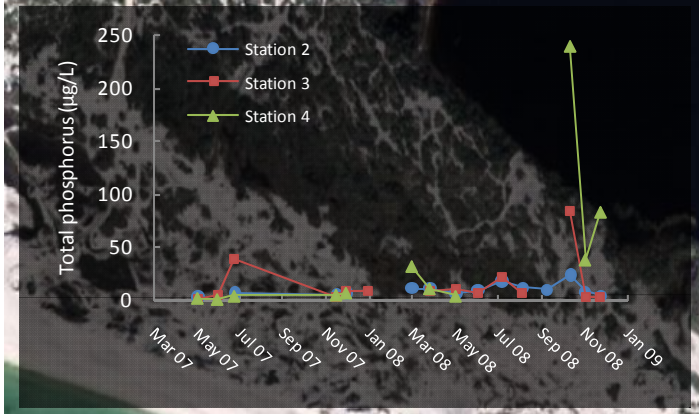
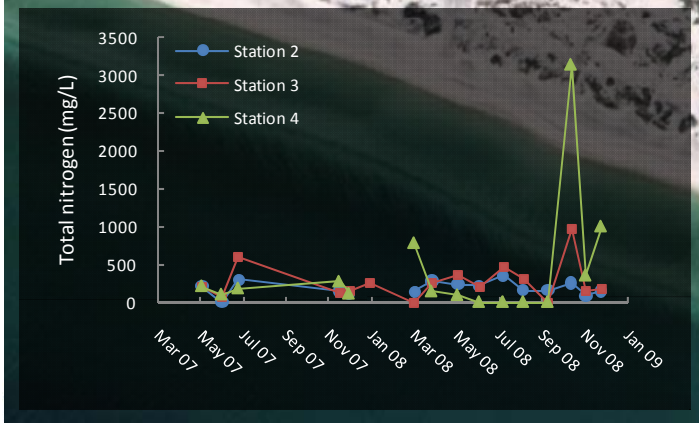
Water Quality: Campbell





Station 4

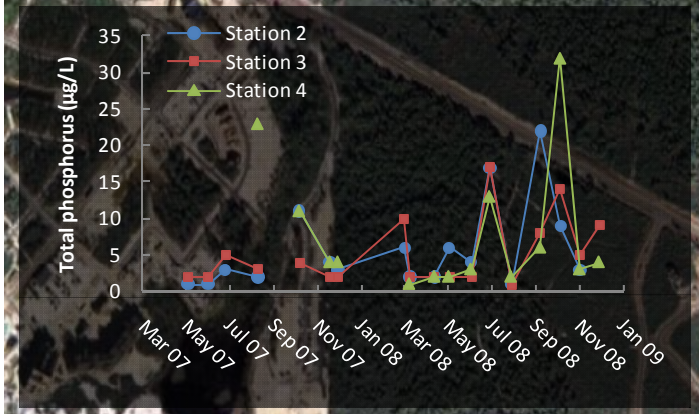
Station 3

Campbell Lake

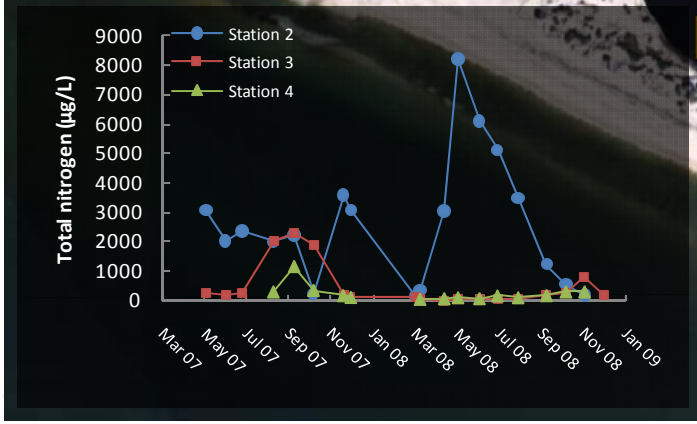
Station 2

Station	Land Use	TP (µg/L)	TN (µg/L)
2	Forested; St. Park	9.7	200
3	Forested; St. Park	14.8	310
4	Forested; St. Park	38.7	580

Water Quality: Camp Creek



Station	Land Use	TP (µg/L)	TN (µg/L)
2	Residential	5.7	260
3	Forested	5.1	40
4	Residential; plotted, not built	7.9	20



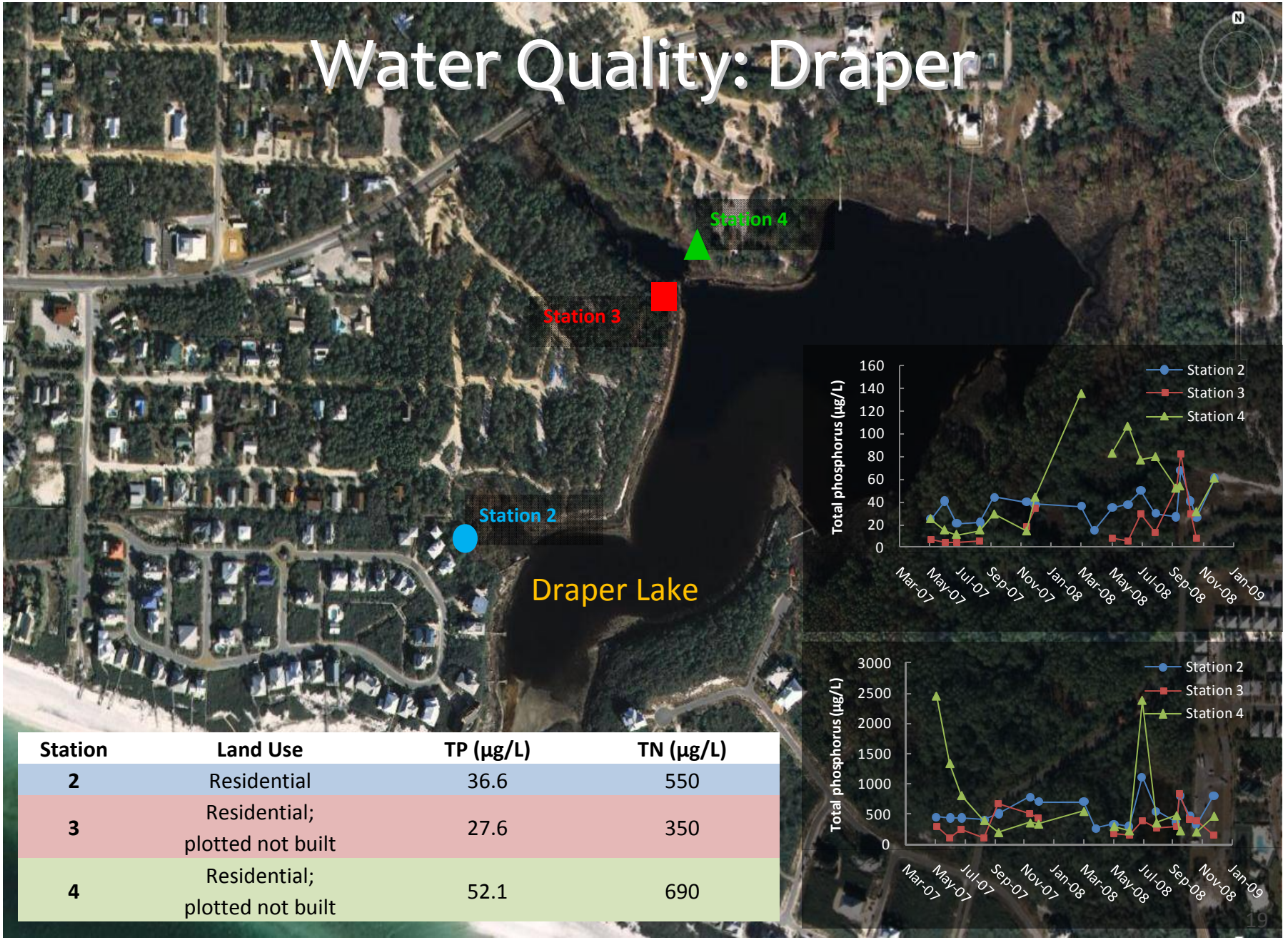
Station 3

Station 4

Station 2

Camp Creek Lake

Water Quality: Draper



Station	Land Use	TP (µg/L)	TN (µg/L)
2	Residential	36.6	550
3	Residential; plotted not built	27.6	350
4	Residential; plotted not built	52.1	690

Water Quality Across Lakes

	Campbell		Camp Creek		Draper	
	Median	Mean ± St Dev	Median	Mean ± St Dev	Median	Mean ± St Dev
TP	10	19 ± 28	4	6 ± 5	**40**	**39** ± 21
TN	227	331 ± 332	**1104**	**1080** ± 725	470	520 ± 275
Color	7	7 ± 3	4	9 ± 13	**66**	**69** ± 39

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Conclusions: Water Quality

- Surrounding land use did not predict TP or TN for lakes or stations.
- Changes in groundwater quality were unrelated to changes in lake hydrology (i.e. spikes in nutrient concentration did not coincide with notable lake events, such as blow-outs)
- Groundwater TP and TN are likely controlled by local events (e.g. fertilizer application, building construction)

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National Sustainable Design Expo, sponsored by USEPA, Washington, DC
20-22 April (Earth Day) 2008

What is US EPA P3 ?

- People, Prosperity, & the Planet
- Student Design Competition for Sustainability
- Mutual goals of economic prosperity while providing a higher quality of life and protecting the planet

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Florida Dune Lakes

Water and Salt

Salinity is a measure of how much salt is in water. It is measured in parts per thousand (ppt).

Rain has a salinity of 0 ppt, so it is "fresh"

Sea water, like the water in the Gulf, has a salinity of 35 ppt

0-0.5 ppt	0.5-5 ppt	5-18 ppt	18-30 ppt	35 ppt
freshwater	oligohaline	mesohaline	polyhaline	seawater

New Words

Haline means salt

Oligo- means "a little"

Meso- means "middle"

Poly- means "a lot"

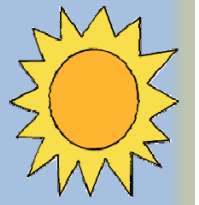
What does polyhaline mean?

Dune Lakes are Unique

The salinity in a Dune Lake is not always the same, but can go up and down.

Rain can lower the salinity in a Dune Lake because it is fresh water

Hot weather can increase the salinity in a dune lake by evaporating water and leaving the salt behind



BLOWOUT!

When water in a dune lake gets high enough or there is a strong storm, the lake can connect to the Gulf of Mexico. This is called a "blowout."

Will a blowout raise or lower salinity?

Visit from USACE Deputy Commanding General Temple and entourage

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Welcome to
Dune Lake
Country