



Status & Trends – Marine and Estuarine Conditions of Florida Bay, 2009

Erik Stabenau

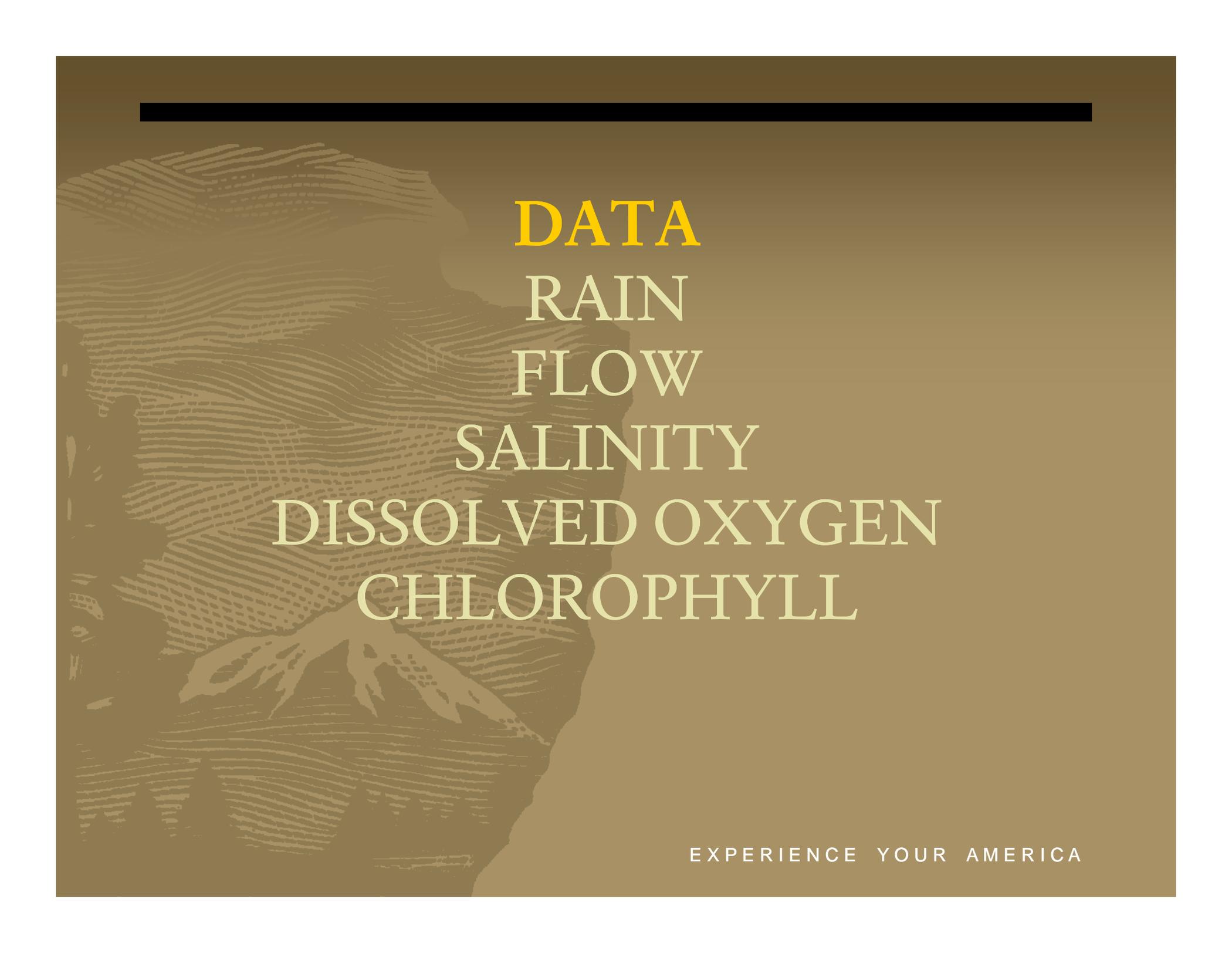
South Florida Natural Resources Center

Everglades National Park, Homestead, FL

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Data Requests: EVER_Data_Request@nps.gov

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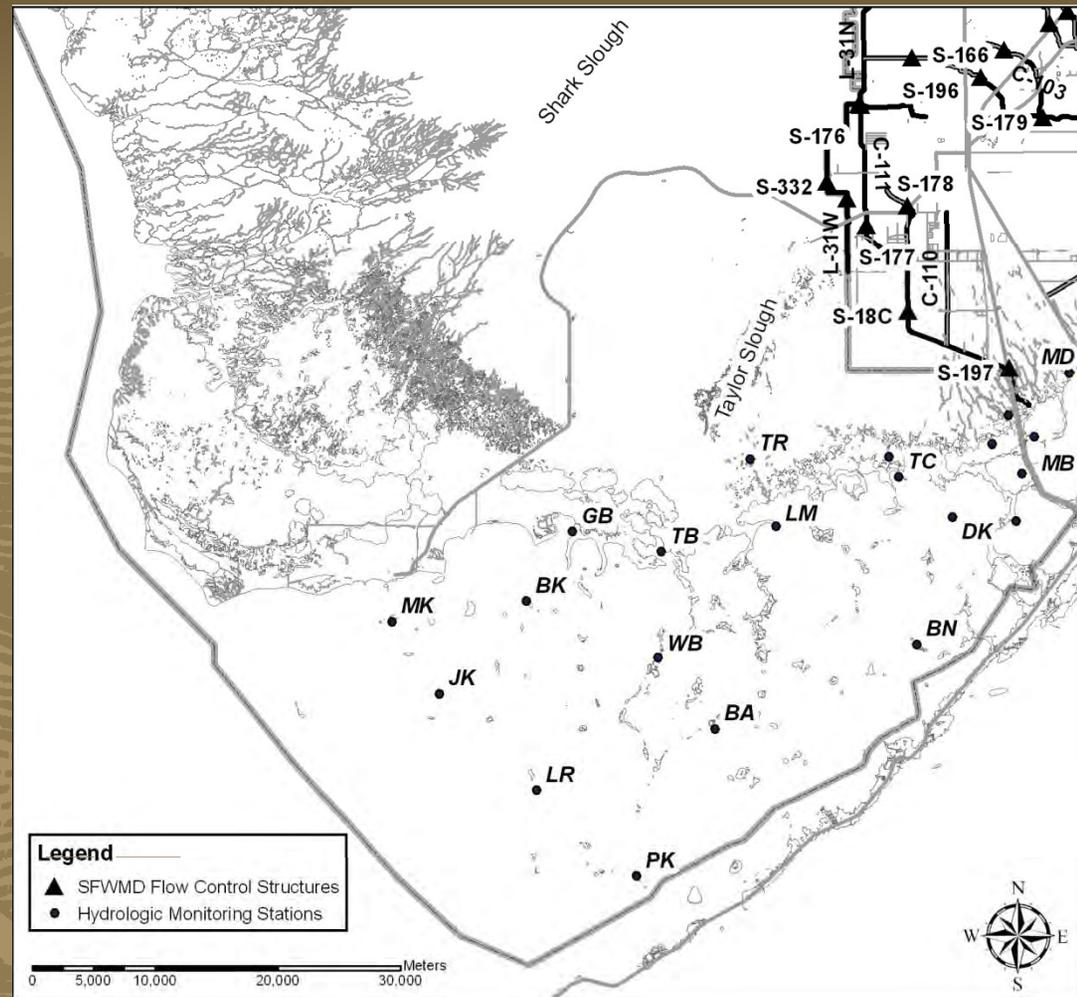


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FLOW
SALINITY
DISSOLVED OXYGEN
CHLOROPHYLL

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Marine Monitoring Network

- 18 Stations monitoring;
 - Hourly salinity (ppt)
 - bottom temperature (C),
 - rain (inches)
 - 6 min. resolution – stage (ft., NGVD29)
- 2 stations with chlorophyll A (mg/l) and turbidity (NTU)
- Upstream information –
 - USGS stream gages in 7 rivers & creeks
 - Marsh monitoring network stations with hourly rain (inches) & stage (ft., NGVD29)



EVER_data_request@nps.gov

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http://www.ndbc.noaa.gov

The screenshot shows a web browser window with the URL <http://www.ndbc.noaa.gov>. The browser tabs include "DataForEVER Hydrology" and "National Data Buoy Center". The page content is divided into several sections:

- Google Maps:** A sidebar on the left with navigation options like "Classic Maps", "Recent", "Historical", "DART@", "MMS ADCP", "Obs Search", "Ship Obs Report", "APEX", "TAO", "DODS", "HF Radar", "OSMC", "Dial-A-Buoy", "RSS Feeds", and "Email Access".
- Station Status:** Options for "NDBC Maintenance", "NDBC Platforms", and "Partner Platforms".
- Program Info:** Links for "About NDBC", "Met/Ocean", "Moored Buoy", "C-MAN", "TAO", "DART@", "VOS", "CSP", "IOOS@Program", and "IOOS@DAC".
- Publications:** Links for "NDBC DQC Handbook", "Hurricane Data Plots", "Mariners Weather", "Log", and "Observing".

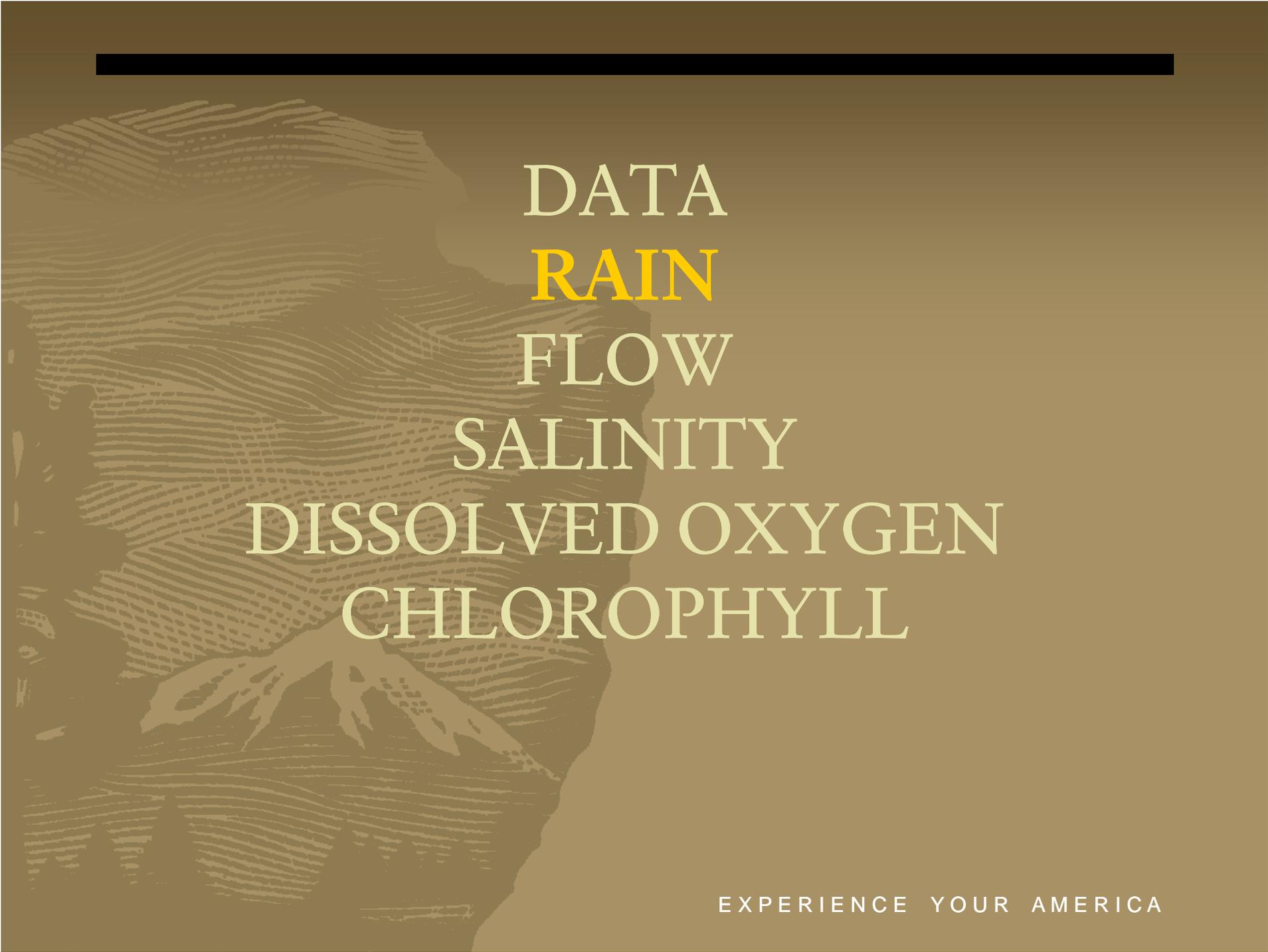
The main content area features a "Program Filter" and an "Owner Filter" section. The "Program Filter" includes checkboxes for "International Partners", "IOOS Partners", and "NDBC Meteorological/Ocean". The "Owner Filter" includes checkboxes for "Environment Canada", "Everglades National Park" (which is checked), and "ExxonMobil".

Below the filters, there is a text box: "To save the current map view, [right click on this link](#) and select either 'Add to Favorites' or 'Bookmark this link'. To view observations, left-click a marker on the map."

The map displays the Everglades National Park area in Florida, with various locations marked by yellow diamonds. A popup window for "Station LBSF1" is open, showing the following information:

- Station LBSF1**
- Everglades National Park**
- Location:** 25.212N 80.433W
- Conditions as of:** Thu, 25 Mar 2010 17:00:00 UTC
- Water Temperature:** 70.9 F
- Tide:** 4.92 ft (above MLLW)
- [View Details](#) and [View History](#) links.

The map interface includes navigation controls (directional arrows, zoom in/out, pan), a scale bar (0 to 20 miles / 0 to 50 kilometers), and map style options (Map, Satellite, Hybrid). A "Mouse Cursor Coordinates:" field is visible at the bottom of the map area.



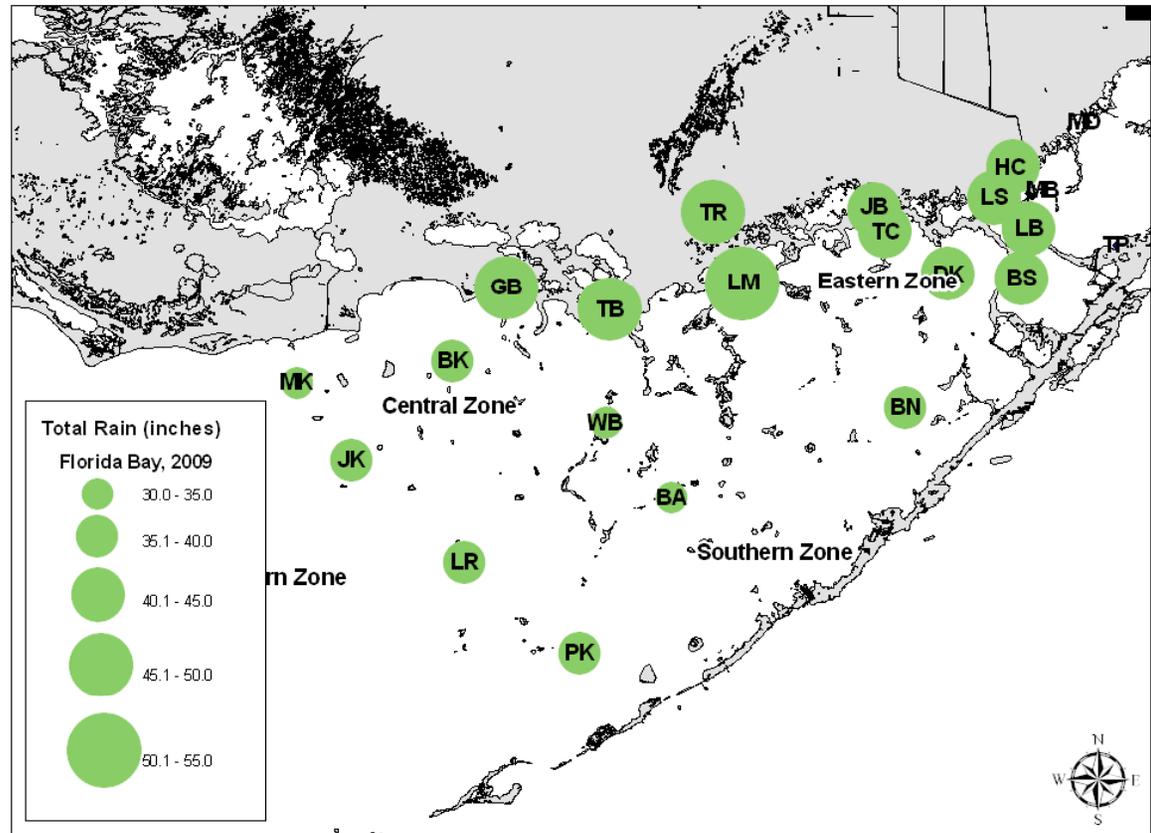
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Precipitation

2009 was an average year for precipitation in the bay, with 40.66"

Bay wide trend with increasing rain to the north and east



Precipitation

2009 wet season rain:

Jun. – Oct. = 23.39”

or event based

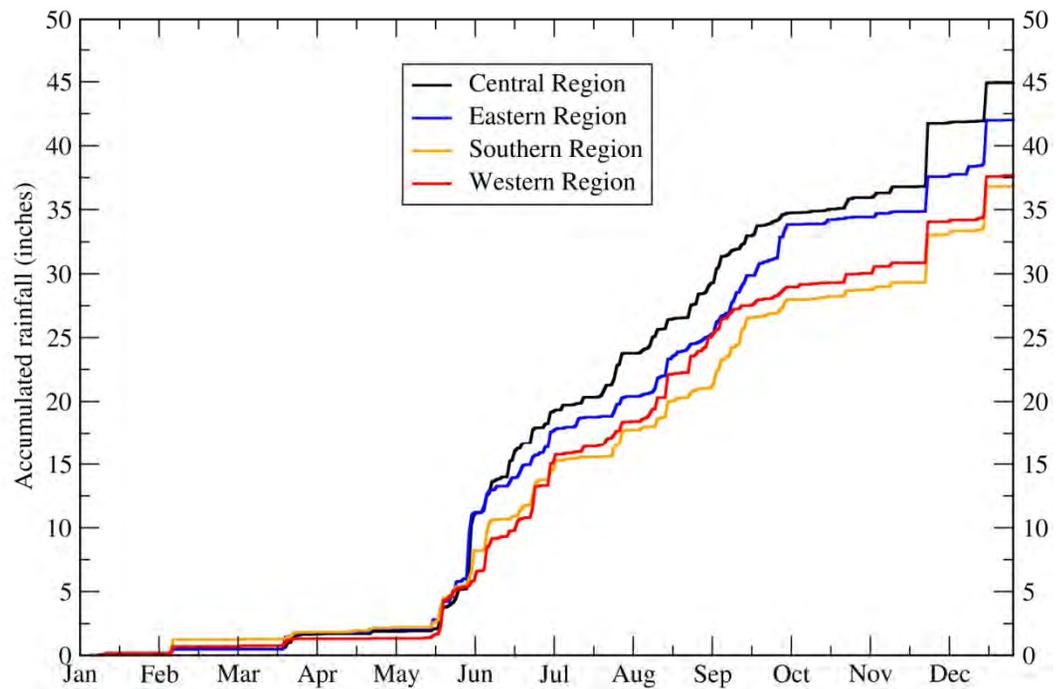
May – Oct. = 31.03”

Average but...

Late dry season rain:

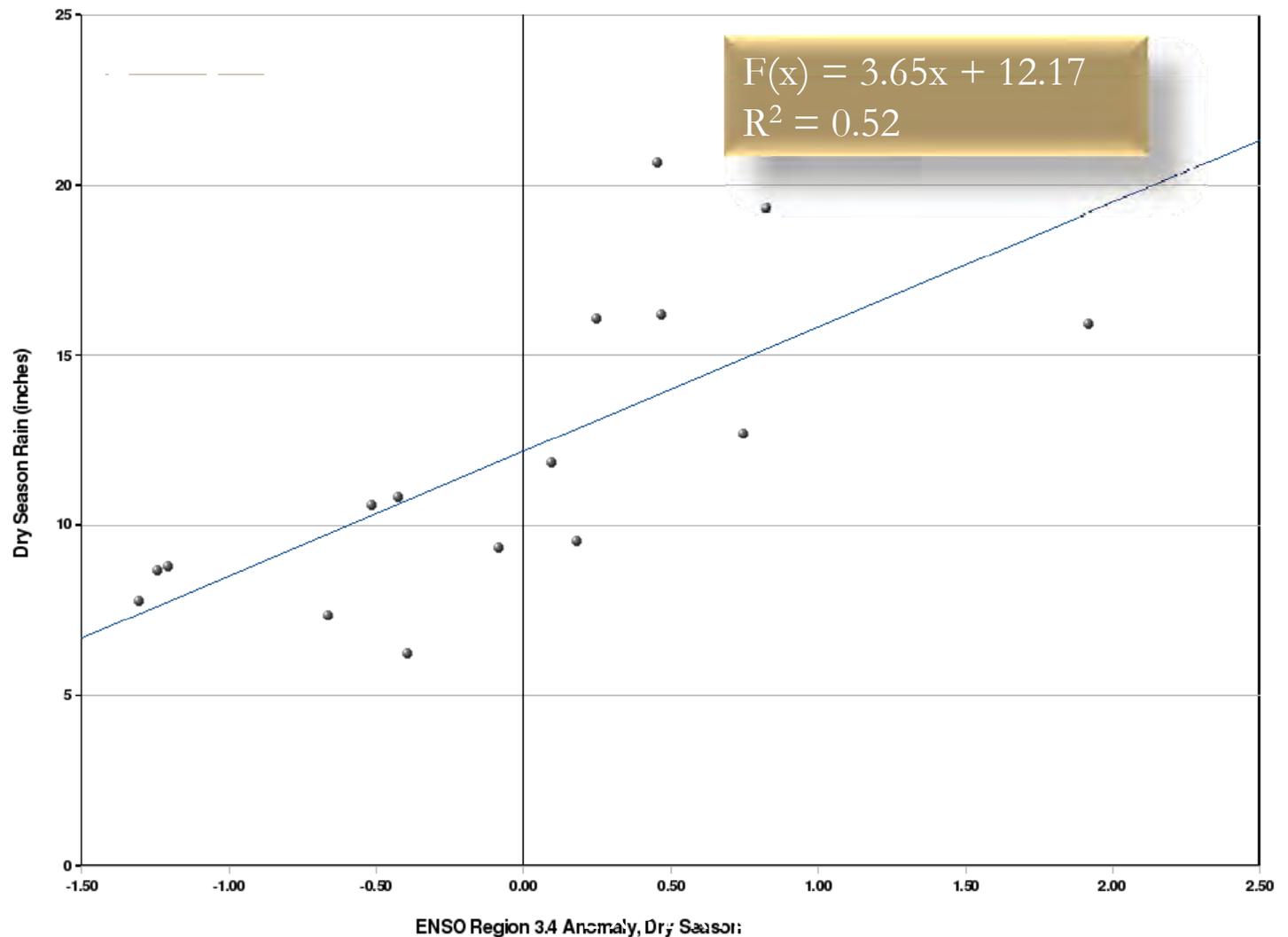
Nov. – Dec. = 7.74”

Mostly in two events



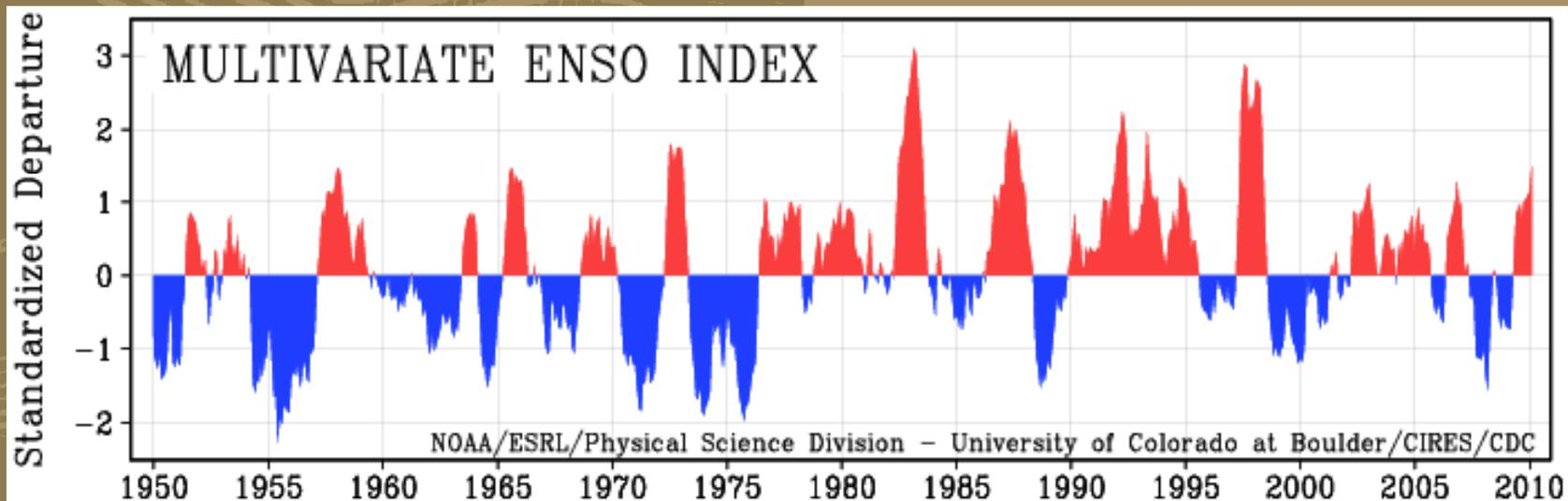
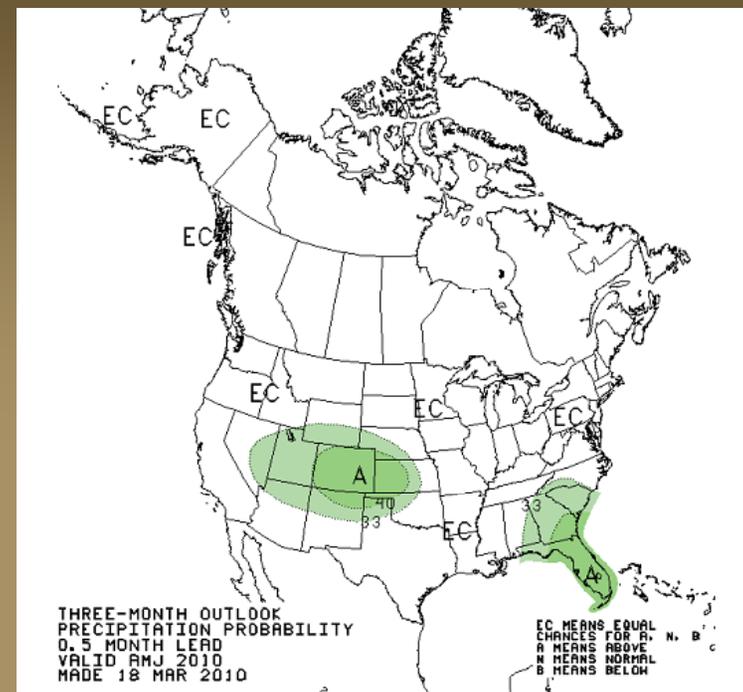
El Nino Southern Oscillation (ENSO)

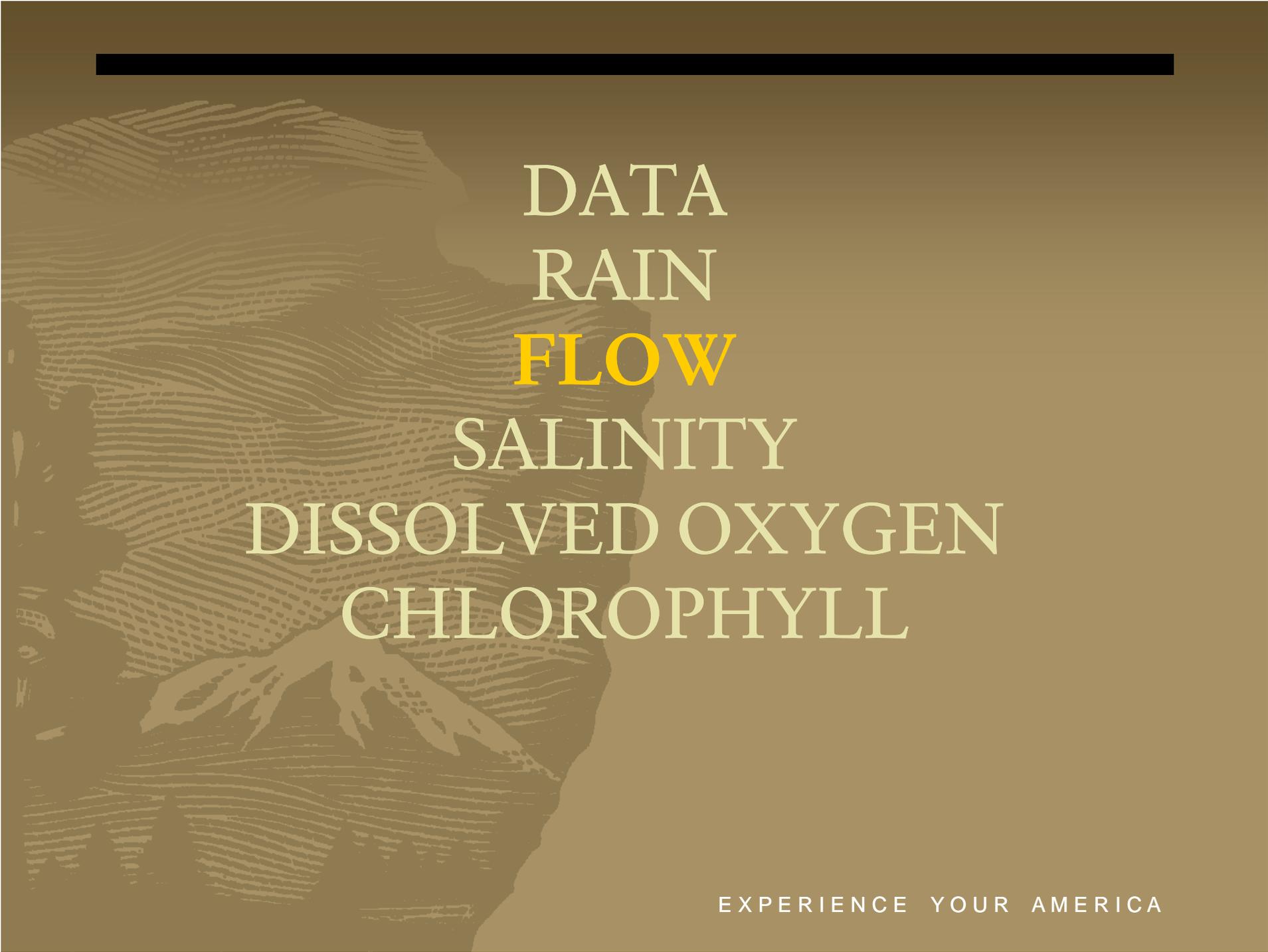
Current positive ENSO phase related to wetter than normal dry season conditions.



El Nino Southern Oscillation (ENSO)

Current positive ENSO phase related to wetter than normal dry season conditions.





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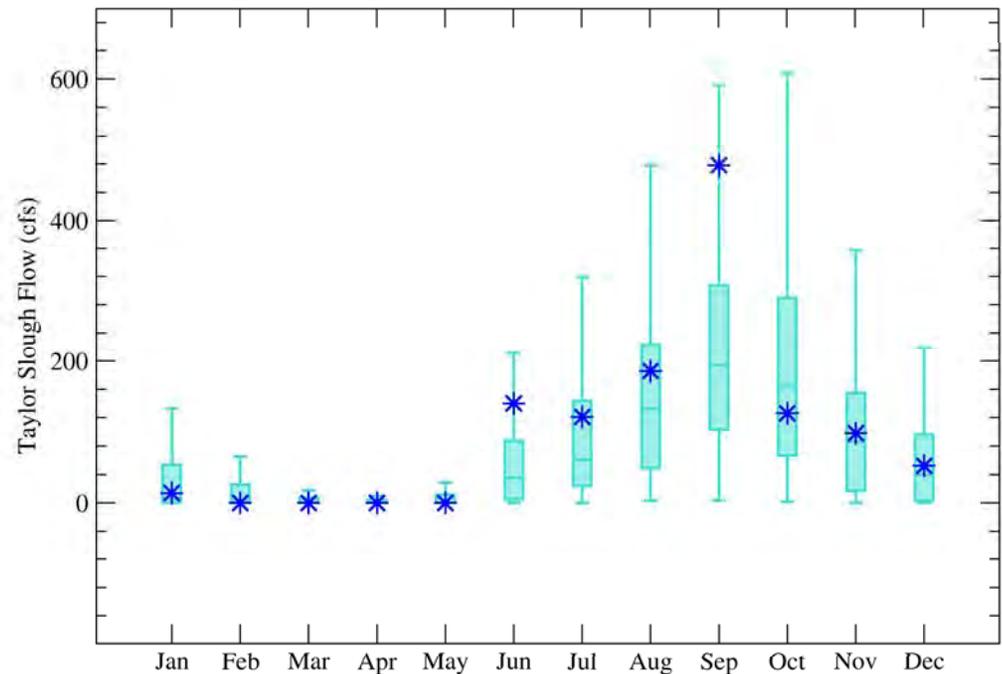
Freshwater Discharge

Taylor Slough flow 2009 compared to period of record

Large event driven flow in Jun. and Sept.

Late dry-season flow appears unaffected by unseasonably large Nov. & Dec. rain events*

Measured at Taylor Slough bridge, relatively 'high' in system



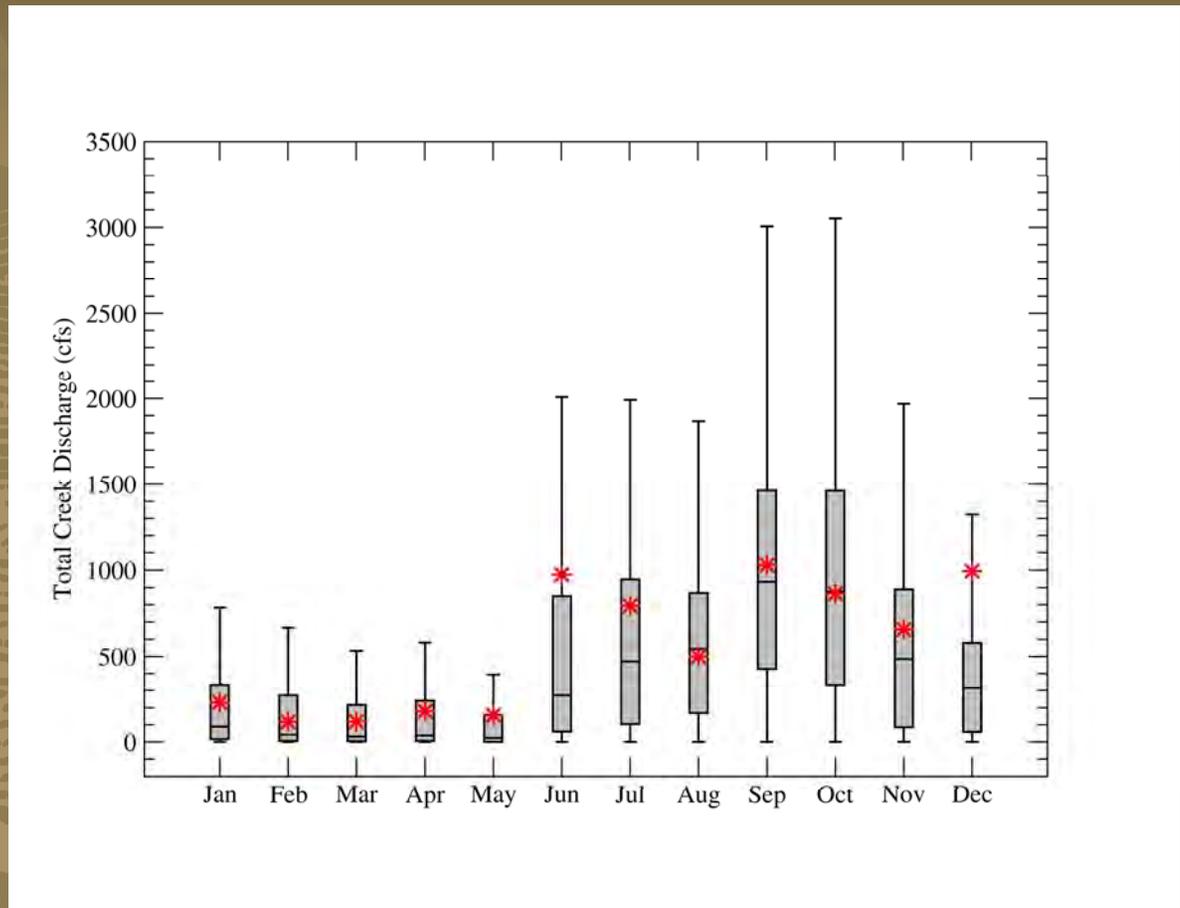
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* Hittle, et Al., USGS Water-Resources Investigation Report 01-4164

Freshwater Discharge

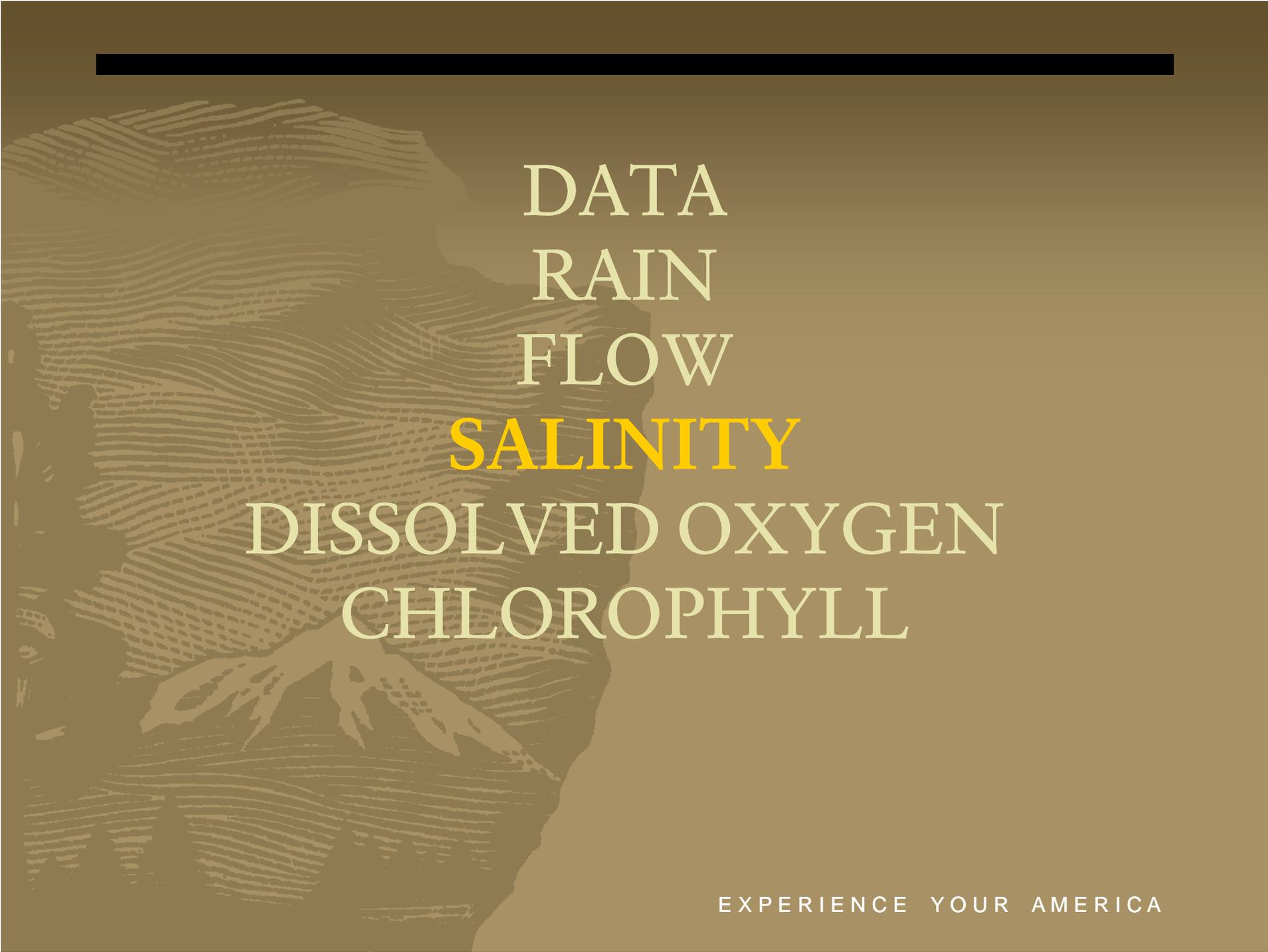
In 1997-98, El Niño increased average dry season discharge of coastal creeks from 8.5 cfs to 55.6 cfs*

El Niño 2009-10 related increase in dry season flow visible here



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* Hittle, et Al., USGS Water-Resources Investigation Report 01-4164



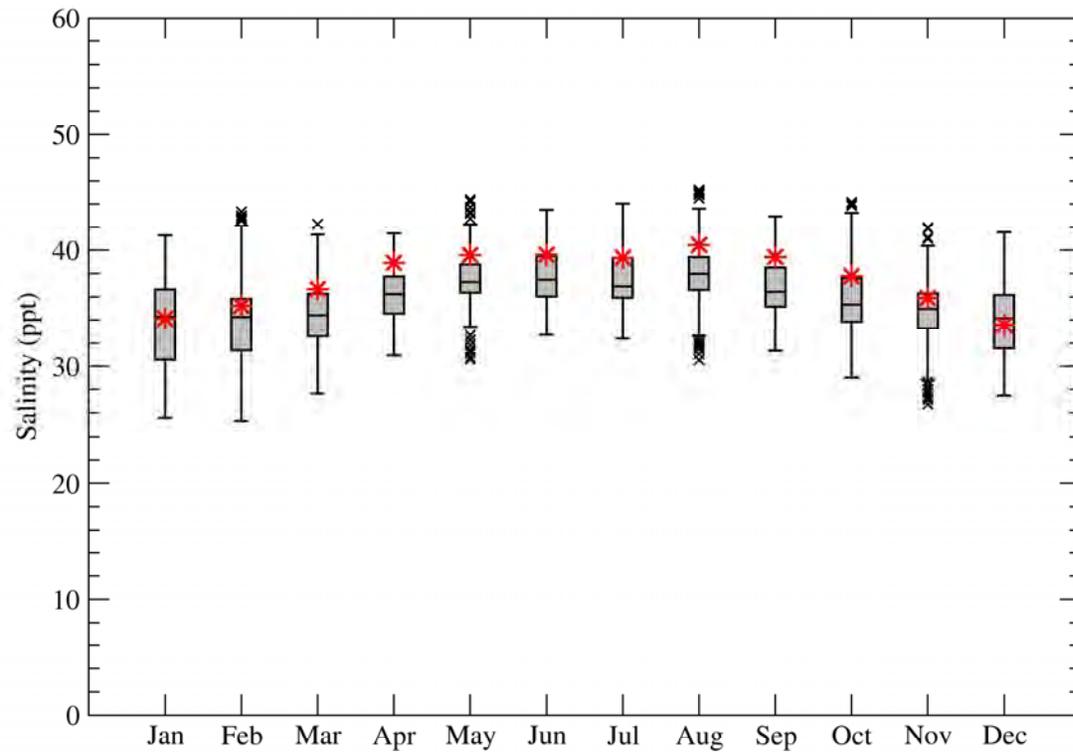
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Salinity – Southern Region

Narrow salinity range

At or above historic mean throughout year

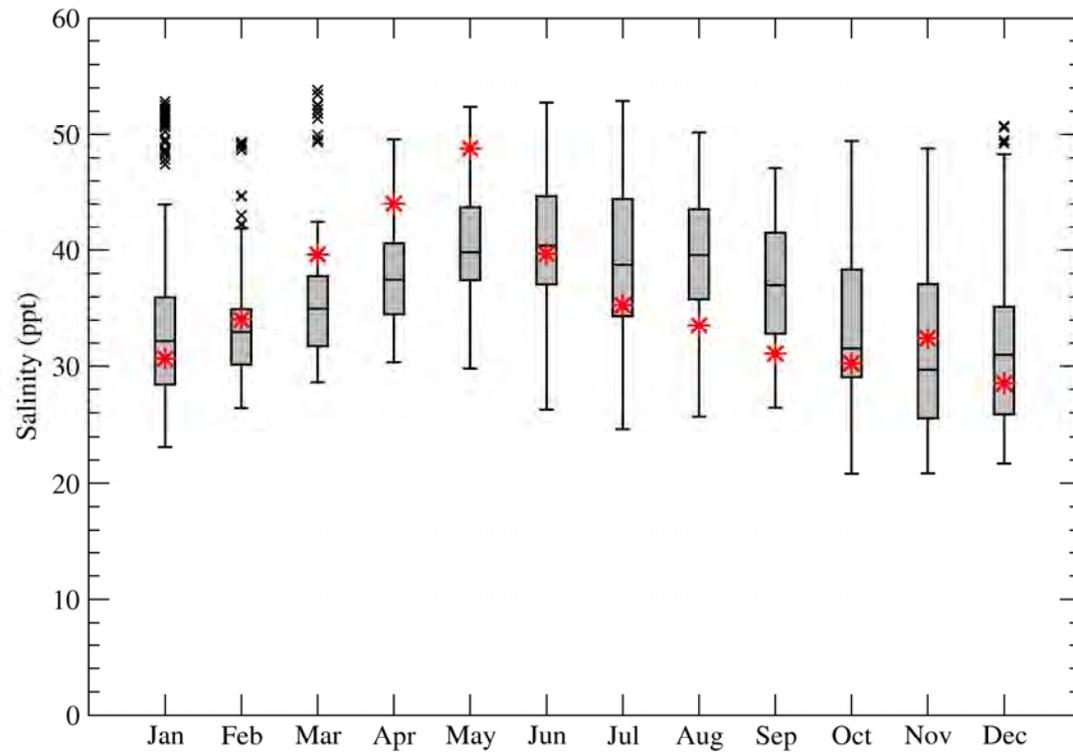


Salinity – Central Region

Long residence time so slower changes in a given year.

Below median for most of rainy season

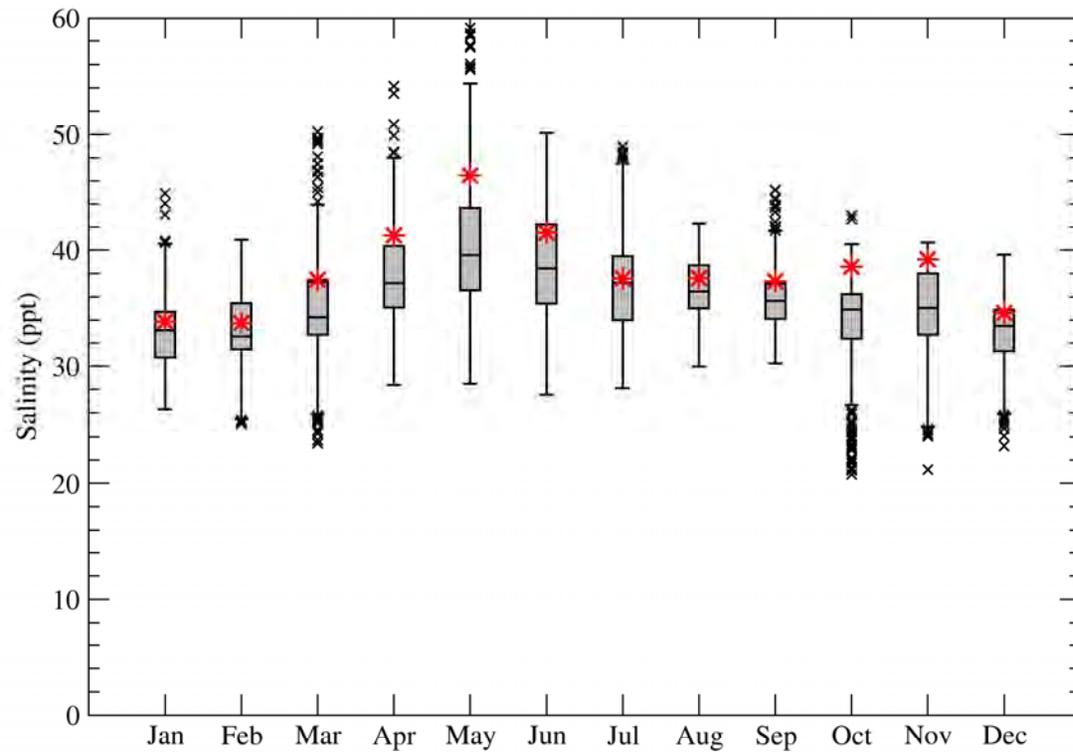
Late-dry season rain affects



Salinity – Western Region

Narrow range

Trending above median, occasionally above 75th percentile

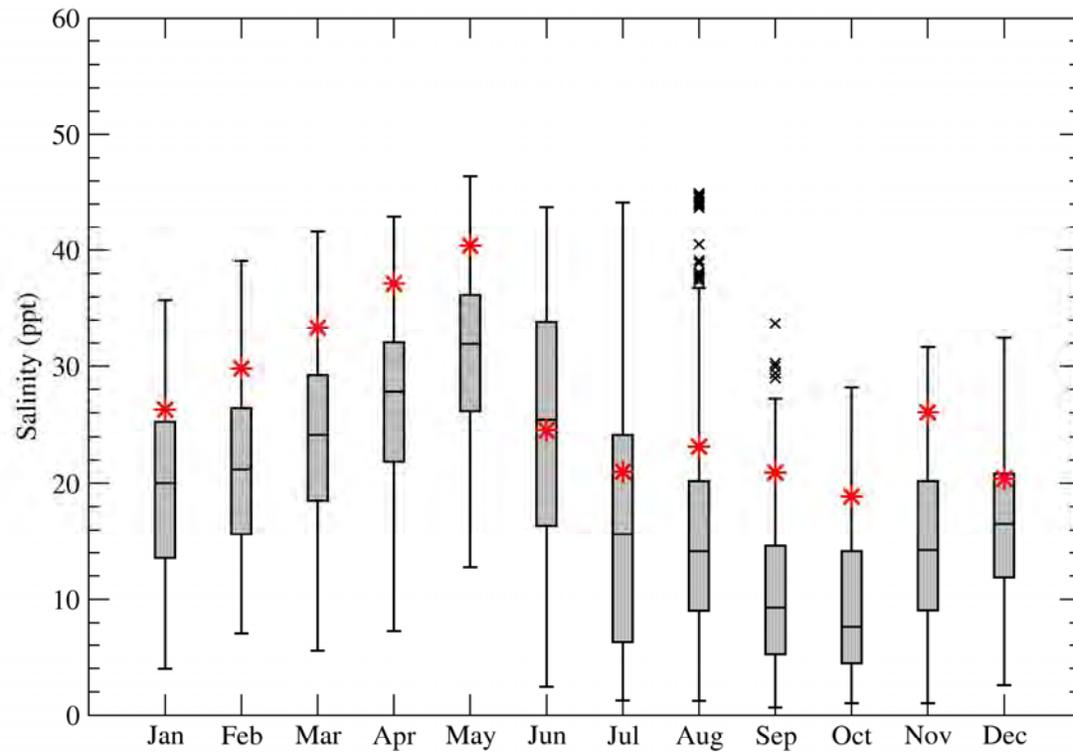


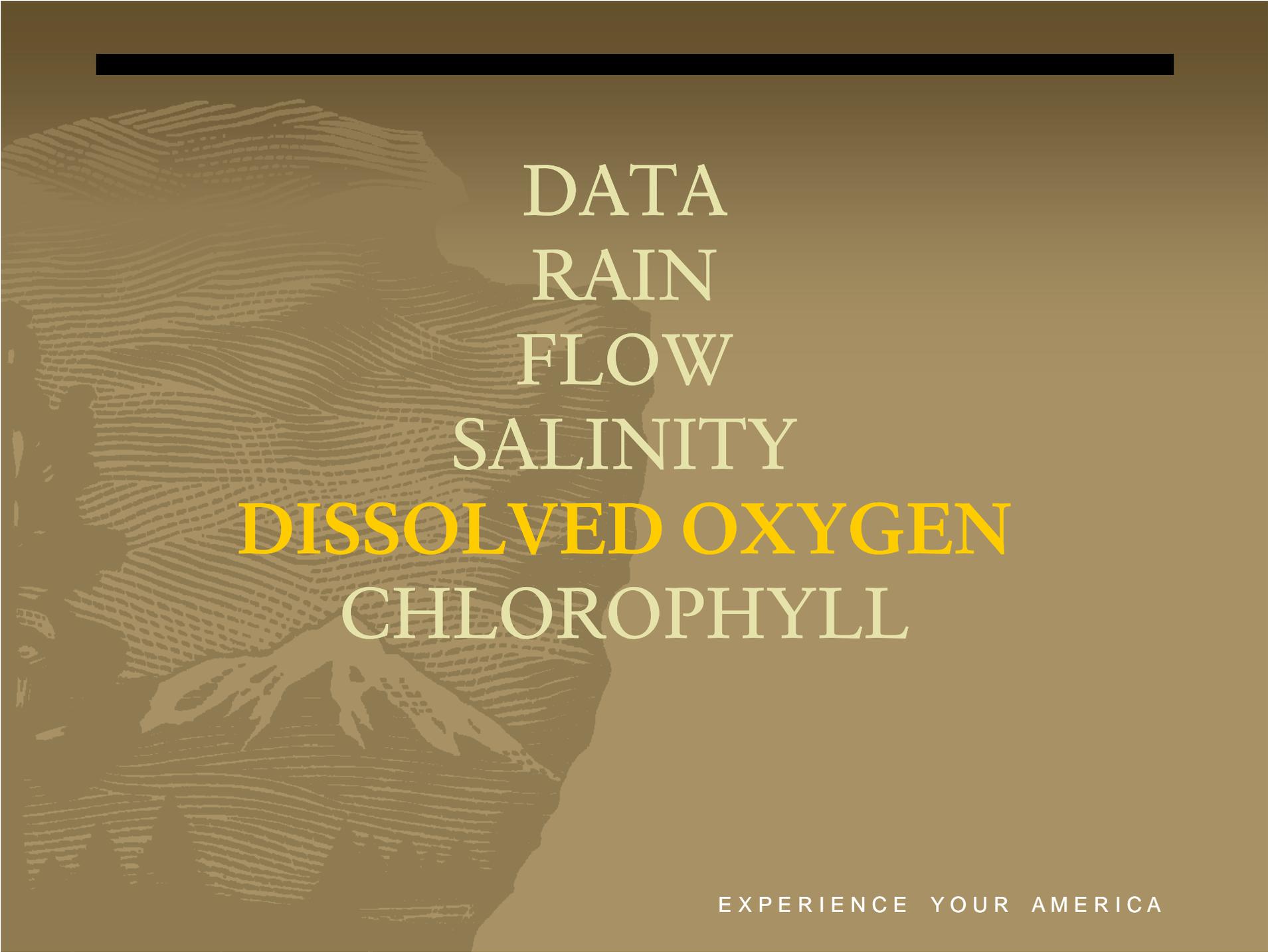
Salinity – Eastern Region

Broad range

Strong influence from discharge and rain events

Above 75 percentile through early dry season and again in late wet season





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Dissolved Oxygen

Running calculation of solubility limit based on hourly salinity and temperature.

*from Garcia & Gordon, *Oxygen solubility in seawater: Better fitting equations*, L&O, 1992.

$$\begin{aligned} \ln C_o^* = & A_0 + A_1 T_s + A_2 T_s^2 + A_3 T_s^2 \\ & + A_3 T_s^3 + A_4 T_s^4 + A_5 T_s^5 \\ & + S(B_0 + B_1 T_s + B_2 T_s^2 + B_3 T_s^3) \\ & + C_0 S^2 \end{aligned} \quad (8)$$

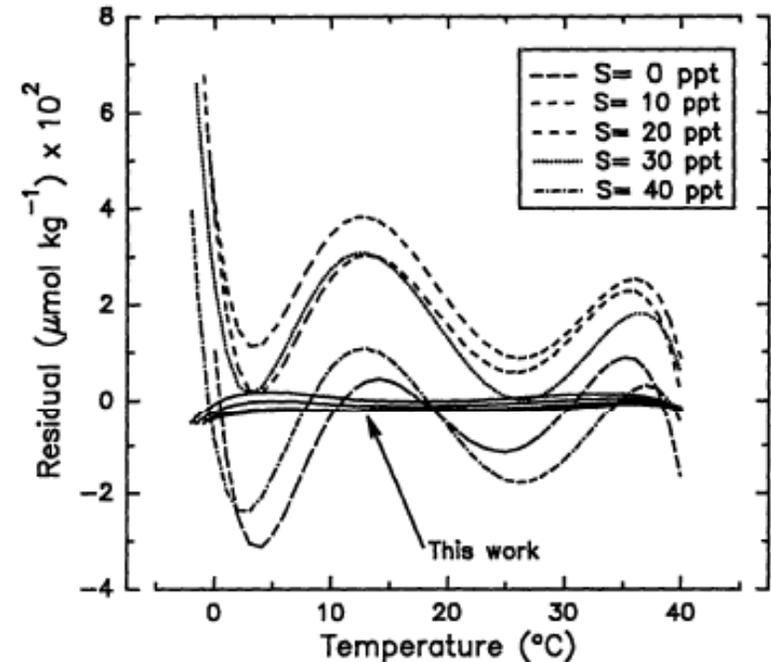


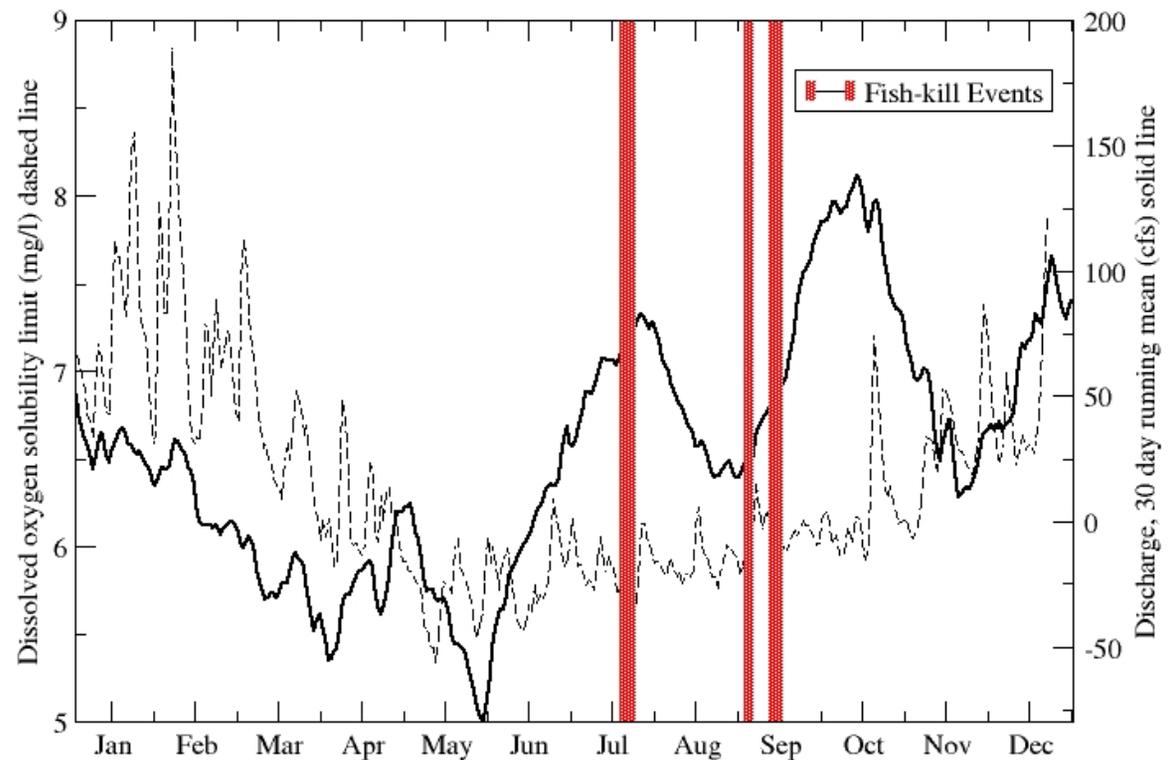
Fig. 3. Residual difference ($\mu\text{mol kg}^{-1}$) between the C_o^* (at STP, real gas) values from Eq. 4 of Benson and Krause (1984) and their fit with Eq. 5 and our fit with Eq. 8 using coefficients in Table 1 in the range ($t_F \geq t \geq 40^\circ\text{C}$; $0 \geq S \geq 40\text{‰}$). Solid lines represent the residual of our fit in the same range of t and S .

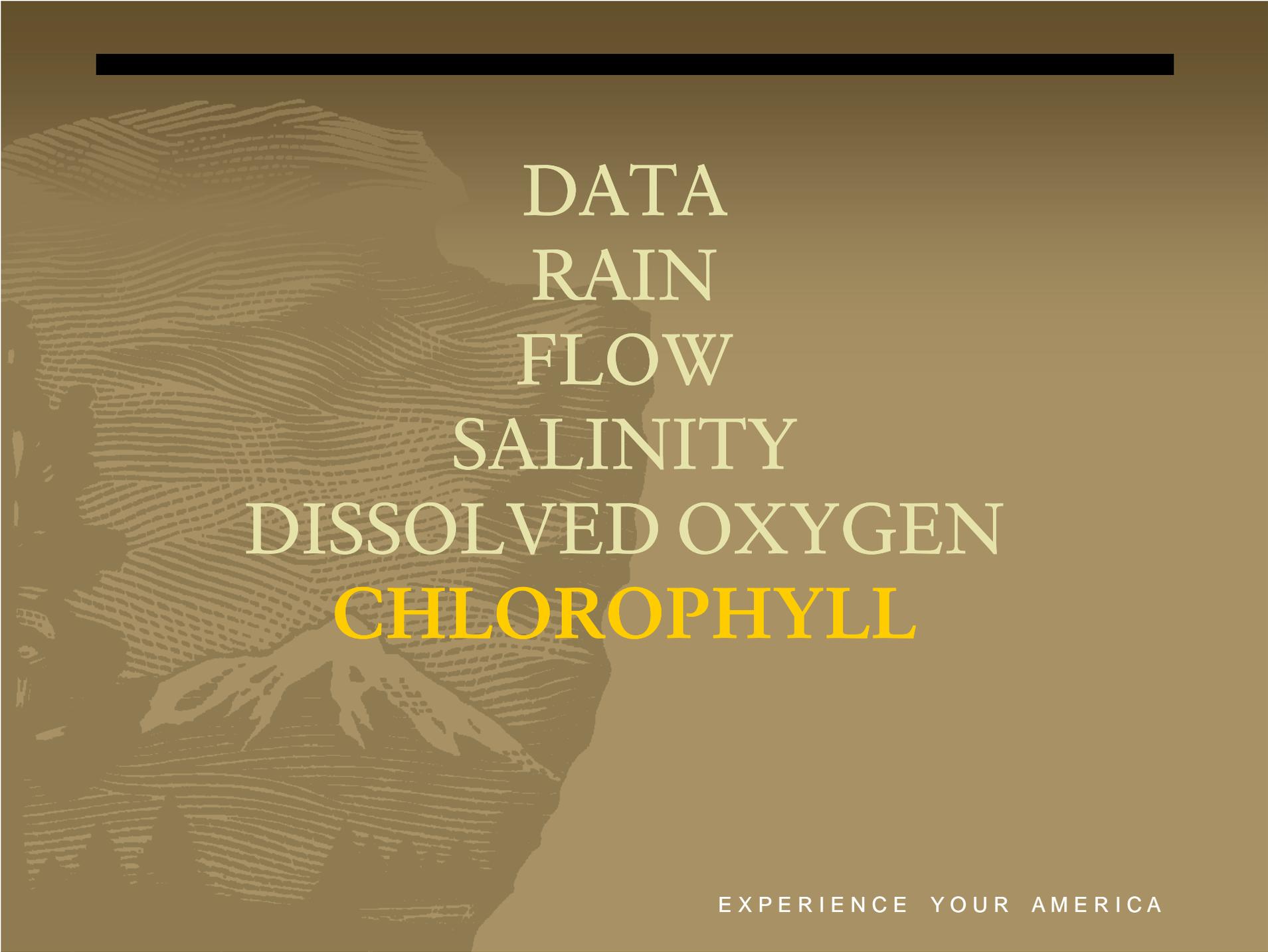
Dissolved Oxygen

Sample from TB with 2009 fish die-off events highlighted

- No biological component in calculation
- Seasonal lower carrying capacity for O_2 in summer months

Station TB (Terrapin Bay) and Taylor River Flow





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Real time Chlorophyll Data

Two sensors in network,
more coming online in
2010

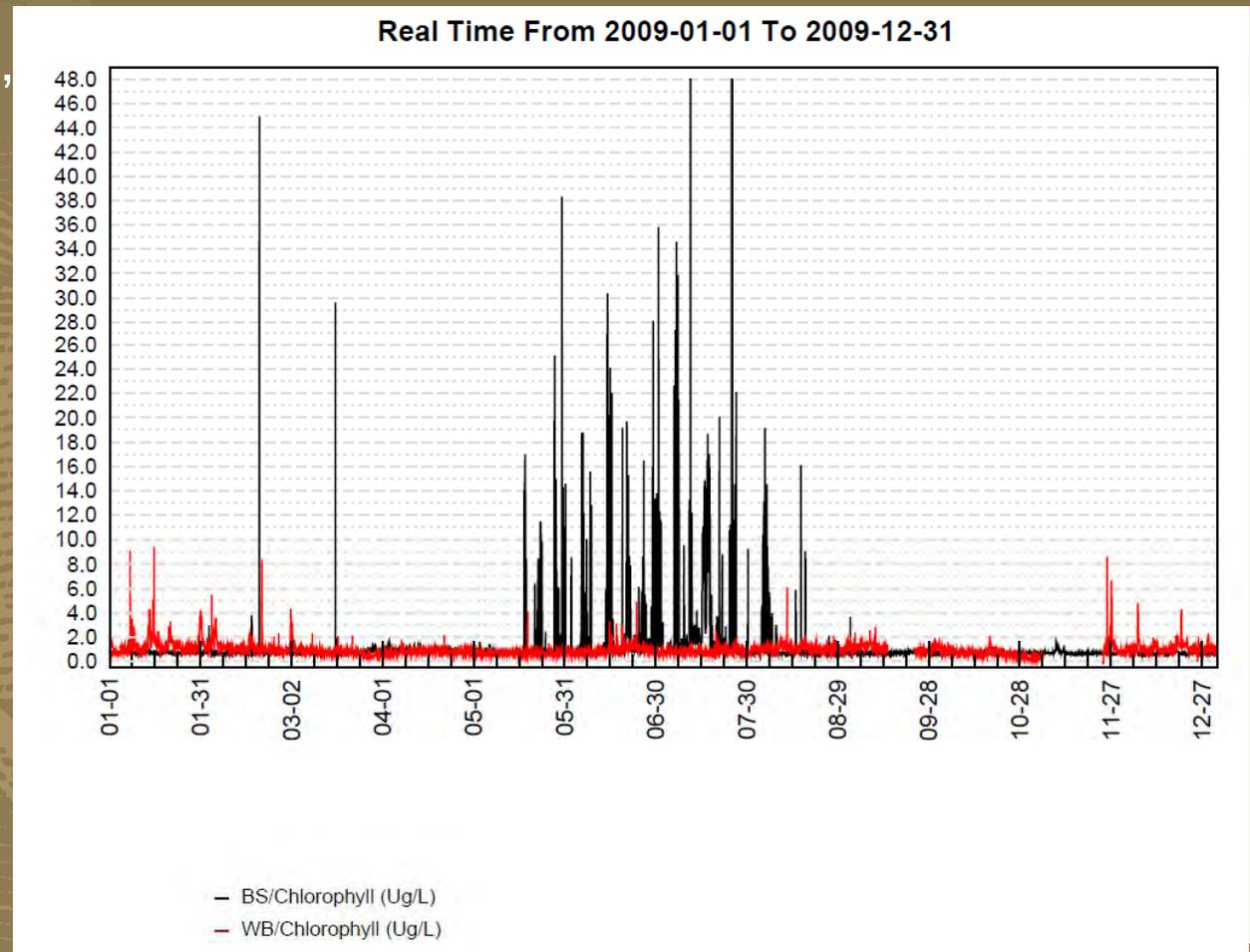
Station WB

$0.95 \pm 0.49 \text{ ug/l}$

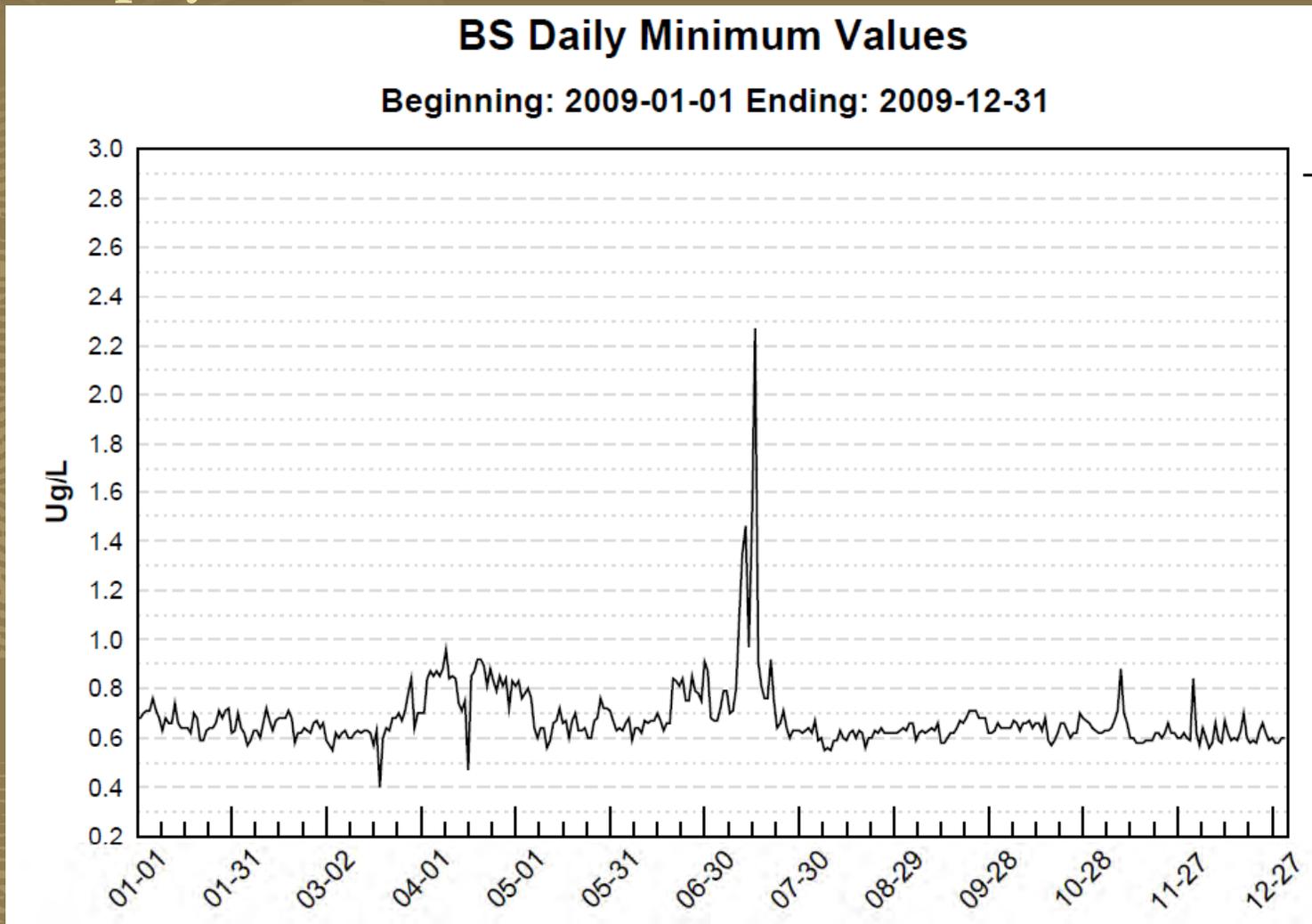
Station BS

$1.14 \pm 2.39 \text{ ug/l}$

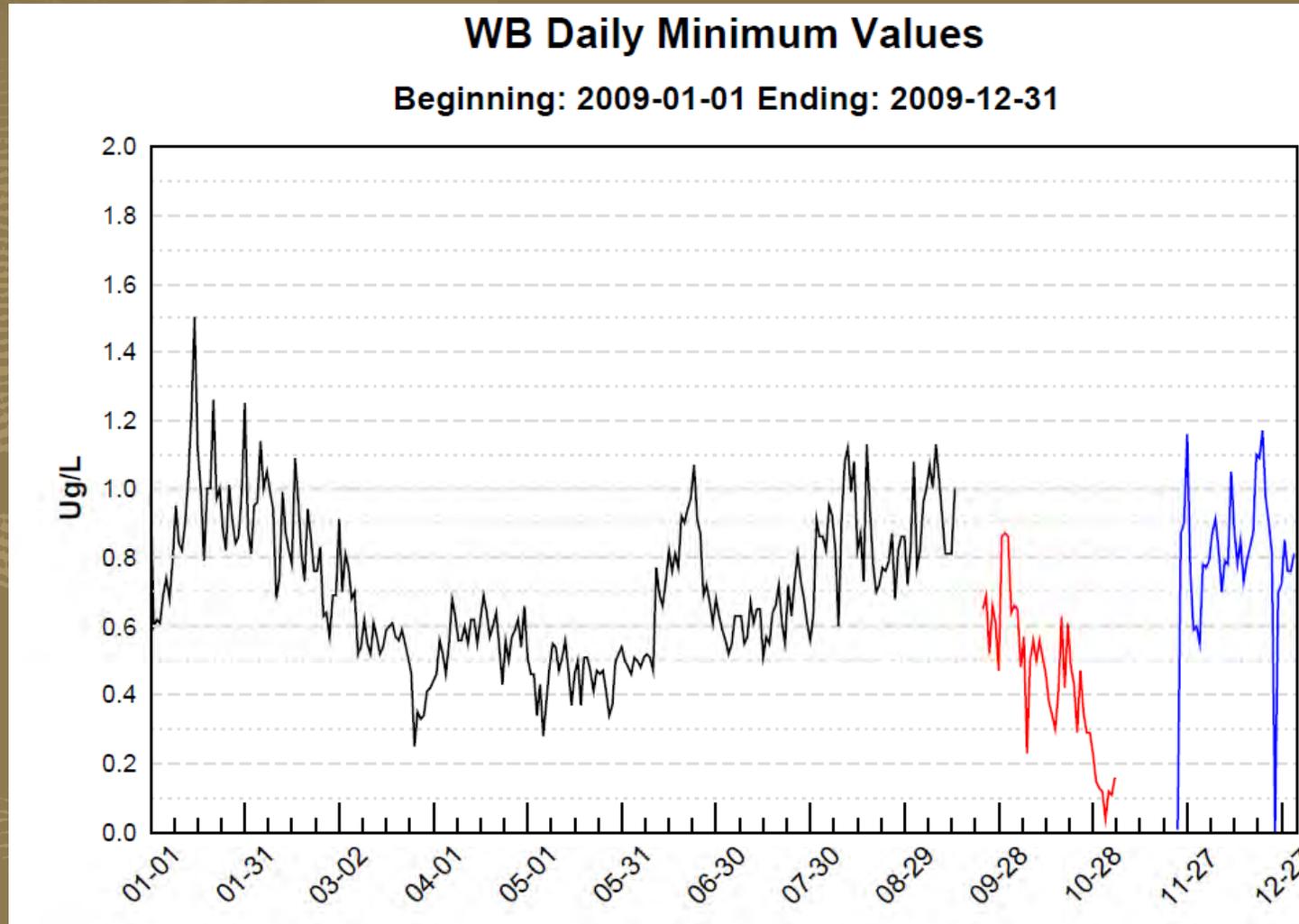
High variability from
seagrass interference,
improvements in place



Filtered Chlorophyll Data



Filtered Chlorophyll Data



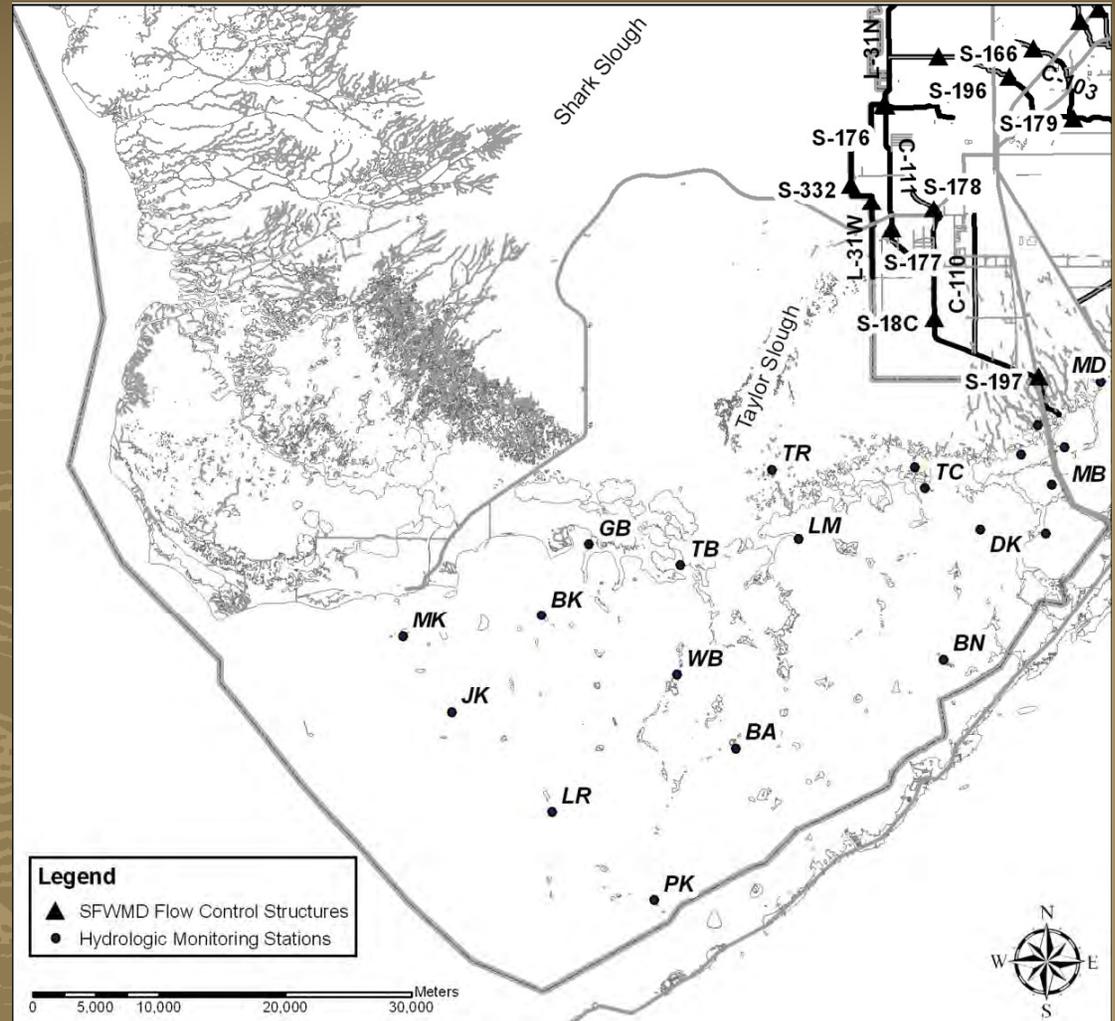
Marine Monitoring Network

FLBAM! Florida Bay Algal Monitoring Network expanding from 2 to 7 stations in 2010

Also adding dissolved oxygen sensors at stations

Partners:

in-house efforts
external with SFWMD



Contact and References

Contact info.: Erik_Stabenau@nps.gov

Data Requests: [EVER Data Request@nps.gov](mailto:EVER_Data_Request@nps.gov)

Hittle, Clinton, Eduardo Patino, and Mark Zucker, *Freshwater Flow from Estuarine Creeks into Northeastern Florida Bay*, U.S. Geological Survey Water Resources Investigations Report 01-4164, 2001.

Garcia, Hernan E. and Louis I. Gordan, *Oxygen solubility in seawater: Better fitting equations*, *Limnology & Oceanography*, 37(6), 1307-1312, 1992.

NOAA Climate Prediction Center historic archive and long range forecasts:

<http://www.esrl.noaa.gov/psd/cnso/enso.current.html#indices>

<http://www.cpc.ncep.noaa.gov/>