

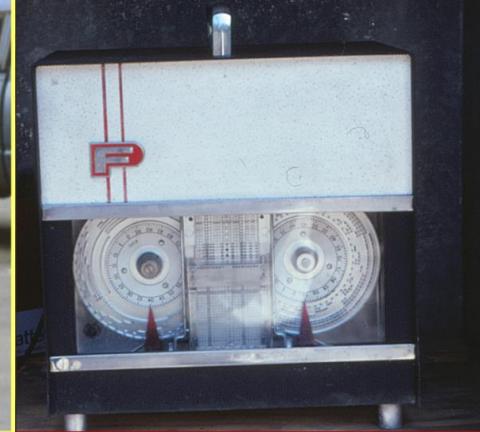
Coastal Gaging – Monitoring the Effects of Riverine and Tidal Forces

South Carolina Department of Natural Resources
Streamflow Monitoring Workshop
February 3, 2016

Presentation Outline

- General comments on USGS gaging along SC Coast
- The unsteady state of the coast
 - Teasing out coastal complexities
 - Flow, salinity, dissolved oxygen examples
- USGS gaging along the coast
 - Convergence of conditions in the 1980s
 - Demographic growth
 - Technology real-time data
 - Water availability

1980s: The Time and Place for Real-time Gaging

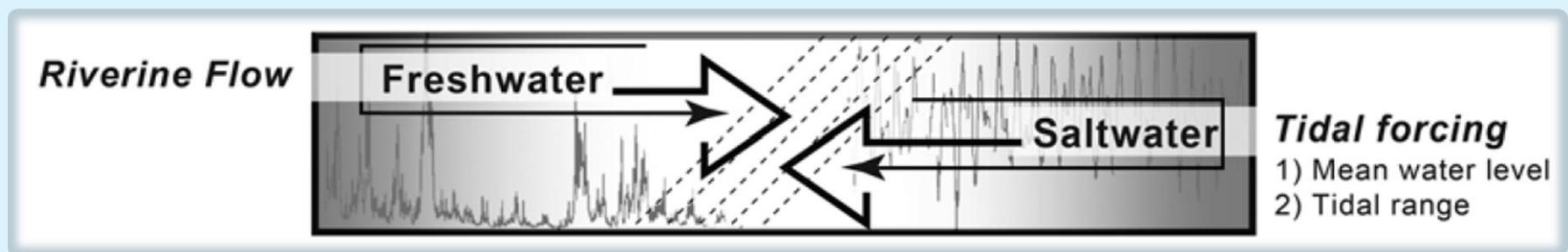


Cooper River Salinity Alert System

- Decreased flows in the Cooper River = increased salinity upstream
- Saltwater-freshwater interface will move upstream to Durham Canal
- Industries need Bushy Park Reservoir protection from salinity intrusion
- Real-time alert system established in 1985



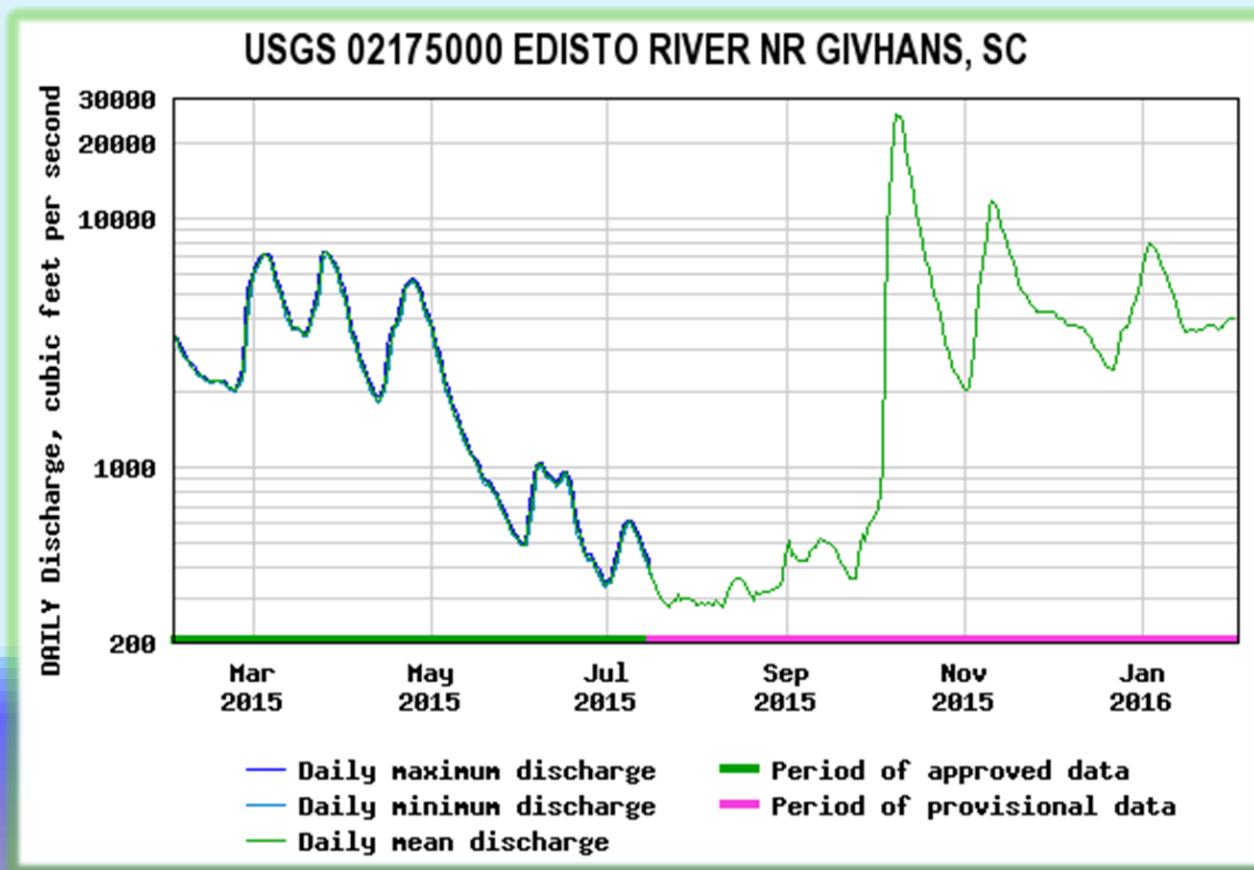
Constant Pushing and Shoving Along the Coast



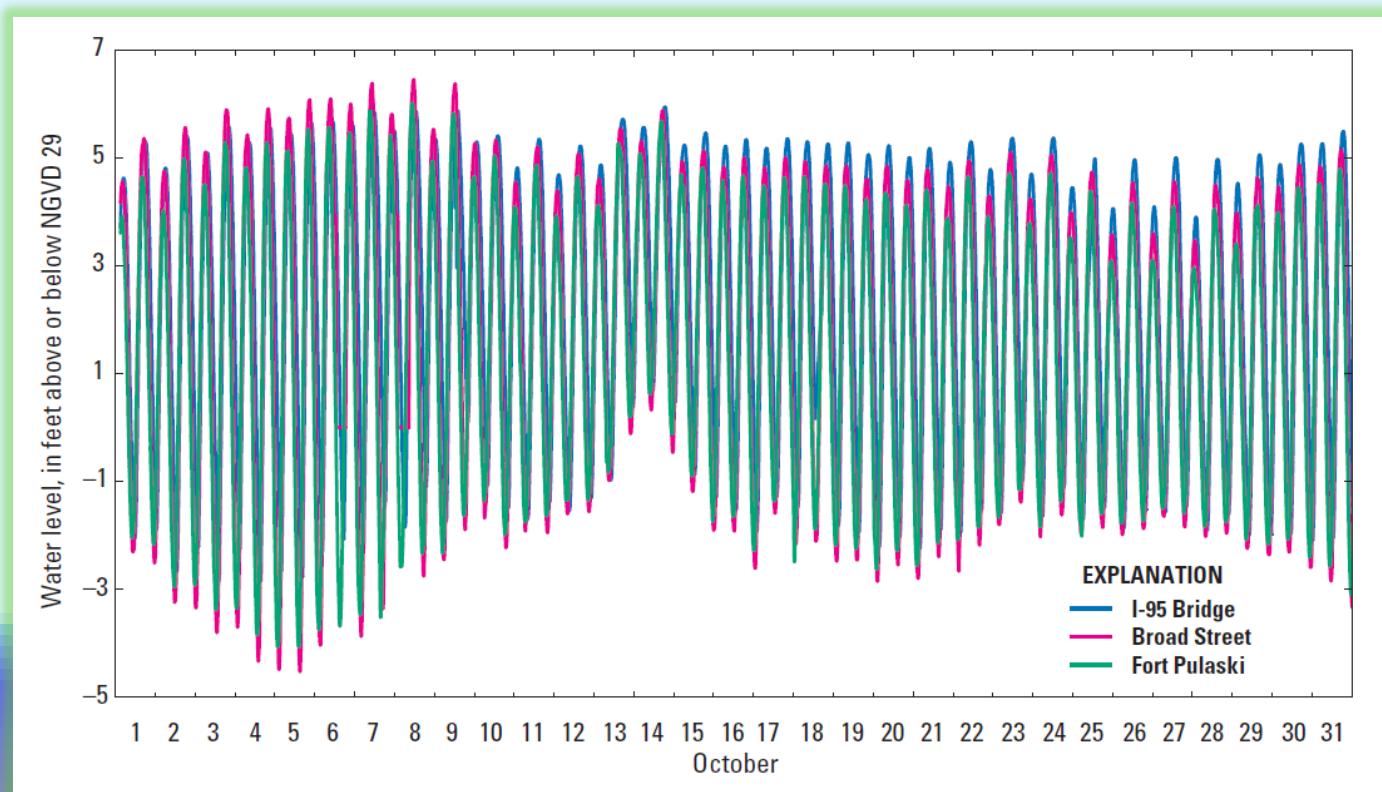
“...estuaries may never really be steady-state systems; they may be trying to reach a balance they never achieve.”

Keith Dyer, 1997

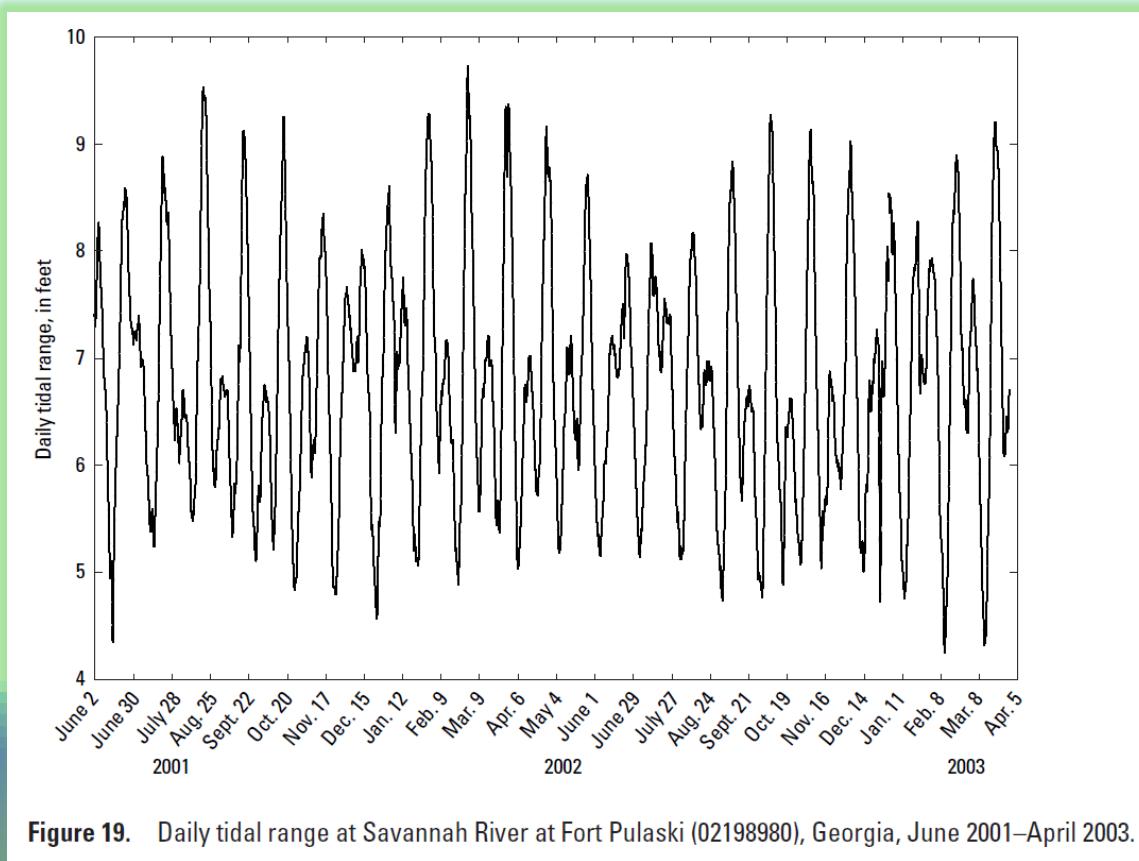
Upland Forces - Flow



Coastal Forces – Tides

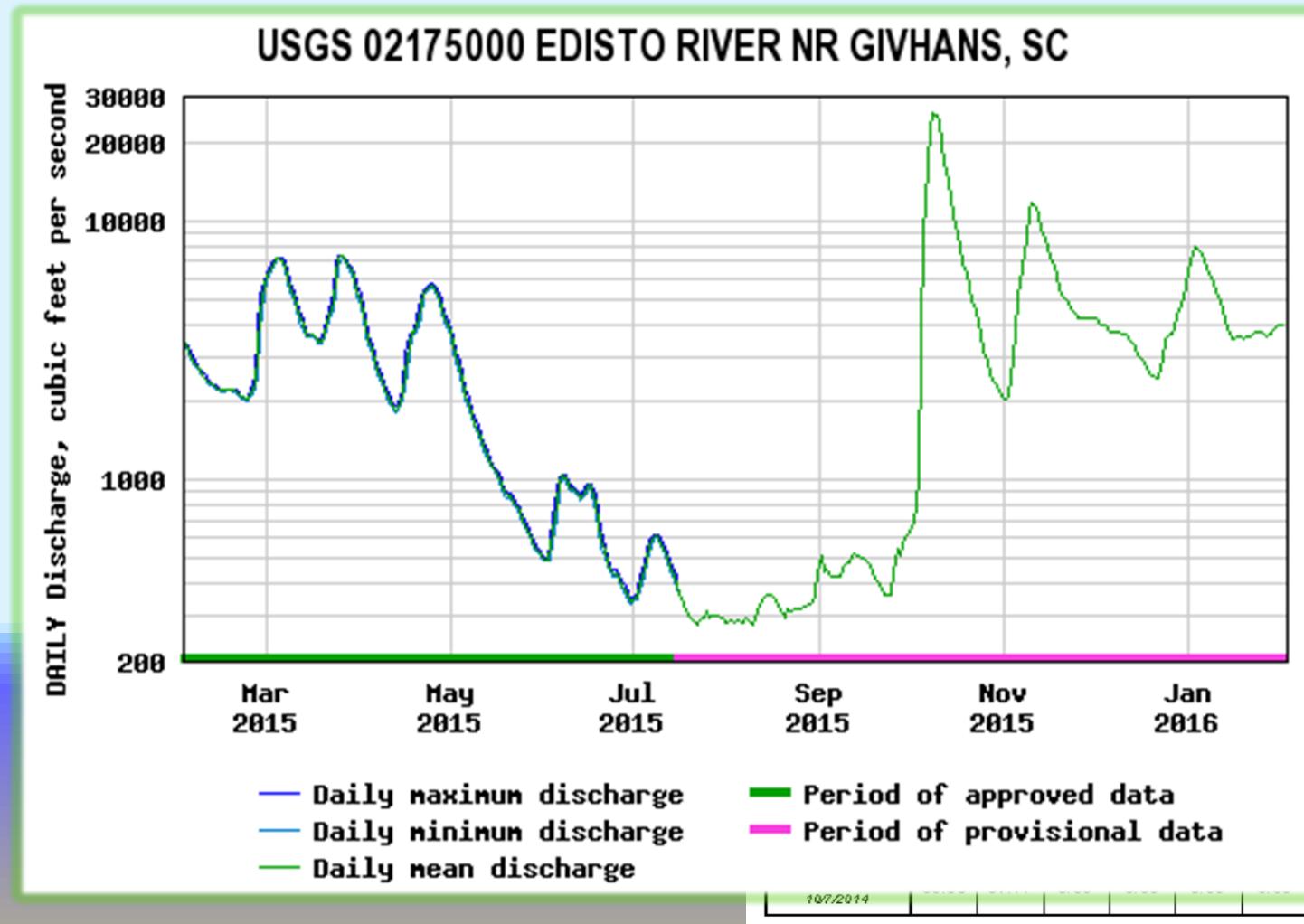


Coastal Forces – Tidal Range



Salinity – Natural Conservative Tracer

Mixing of upland flows and coastal salinity

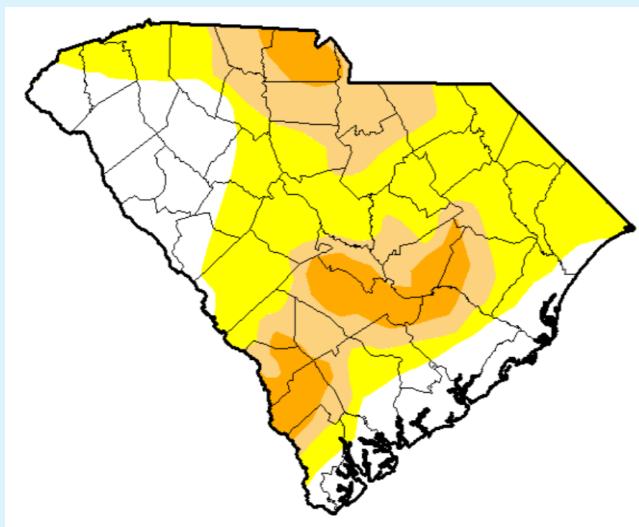


Salinity – Natural Conservative Tracer

Drought maps before and after October flood

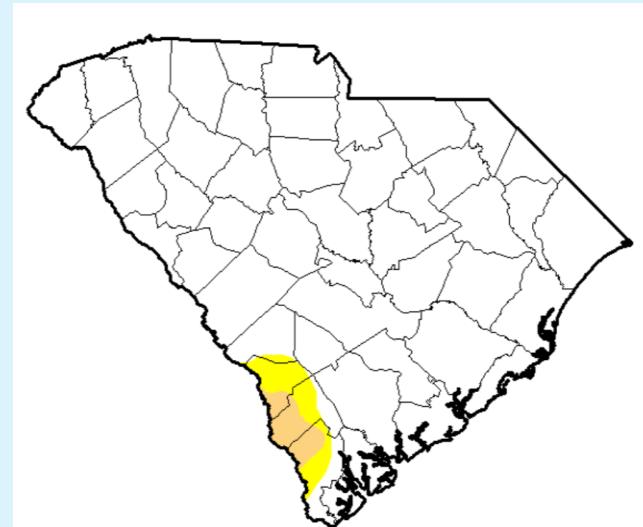
September 29, 2015

October 6, 2015



Intensity:

Yellow	D0 Abnormally Dry
Brown	D1 Moderate Drought
Orange	D2 Severe Drought
Red	D3 Extreme Drought
Dark Brown	D4 Exceptional Drought

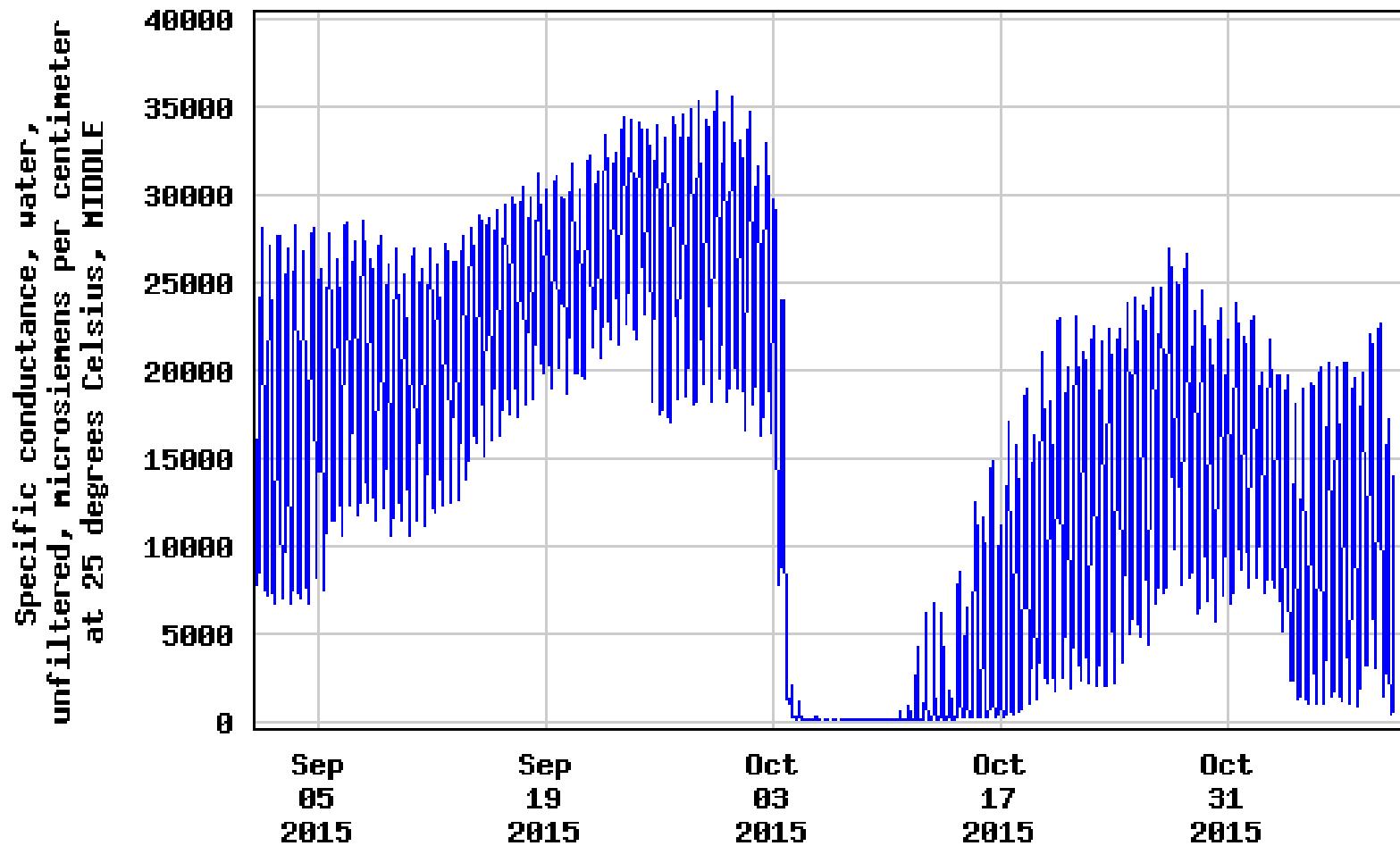


Drought Conditions (Percent Area)

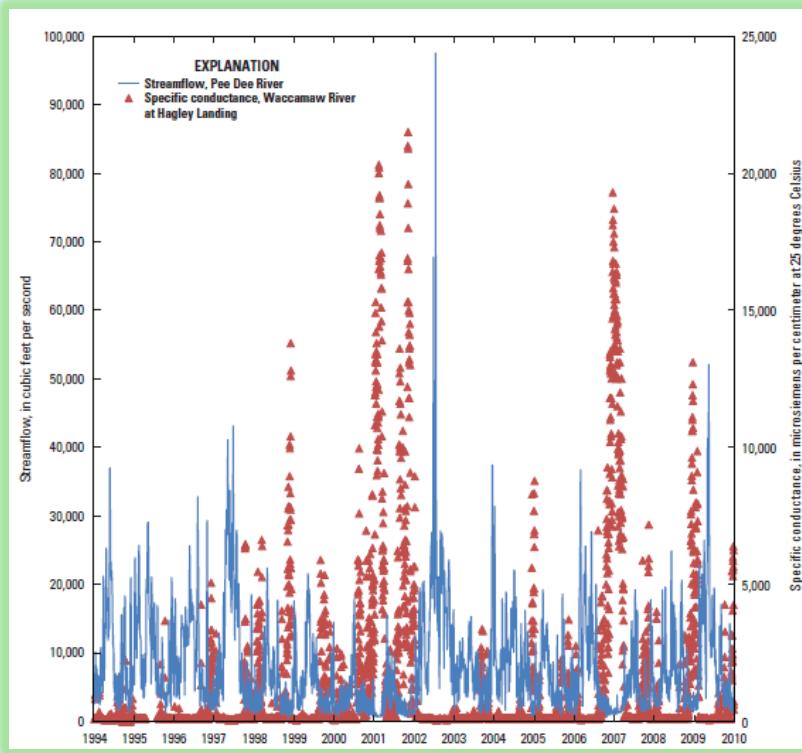
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	95.93	4.07	1.72	0.00	0.00	0.00
Last Week 9/29/2015	26.80	73.20	31.76	10.91	0.00	0.00
3 Months Ago 7/7/2015	33.06	66.94	38.43	0.00	0.00	0.00
Start of Calendar Year 12/31/2014	96.63	3.37	0.00	0.00	0.00	0.00
Start of Water Year 9/29/2015	26.80	73.20	31.76	10.91	0.00	0.00
One Year Ago 10/7/2014	68.83	31.17	0.00	0.00	0.00	0.00

Salinity – Natural Conservative Tracer

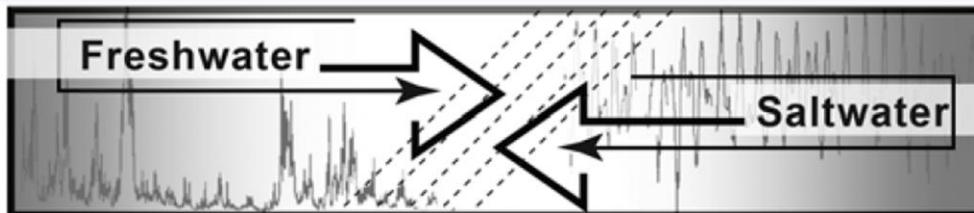
USGS 021720869 ASHLEY RIVER NEAR NORTH CHARLESTON, SC



Convergence of Conditions



Riverine Flow

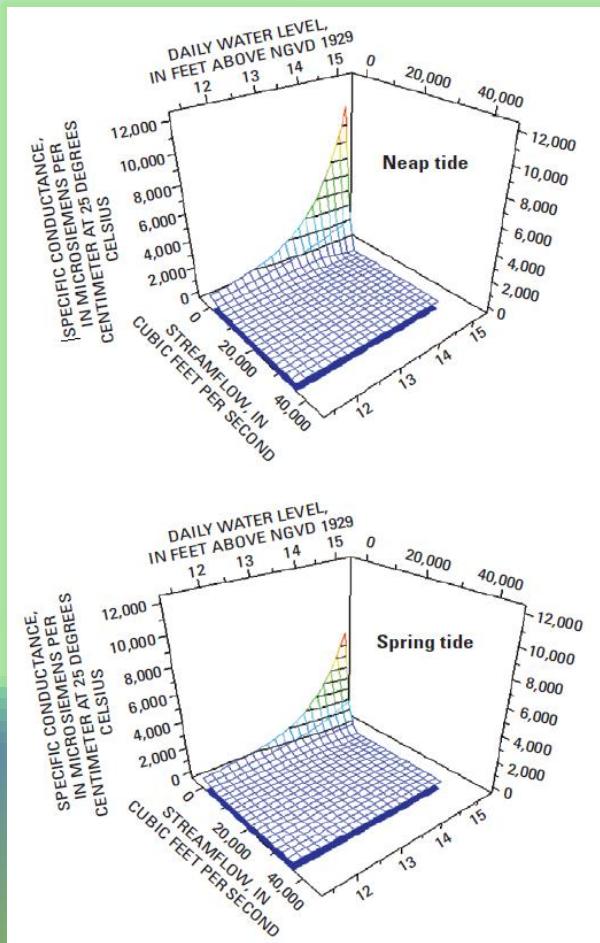


Tidal forcing

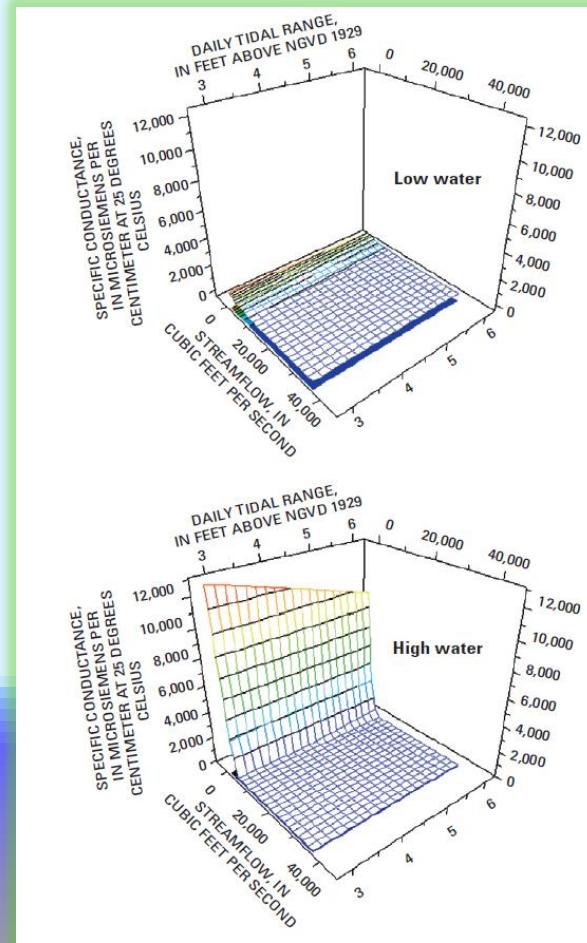
- 1) Mean water level
- 2) Tidal range

Interaction of Flow, Tidal Range, and Water Level

Spring Tides or Neap Tides?

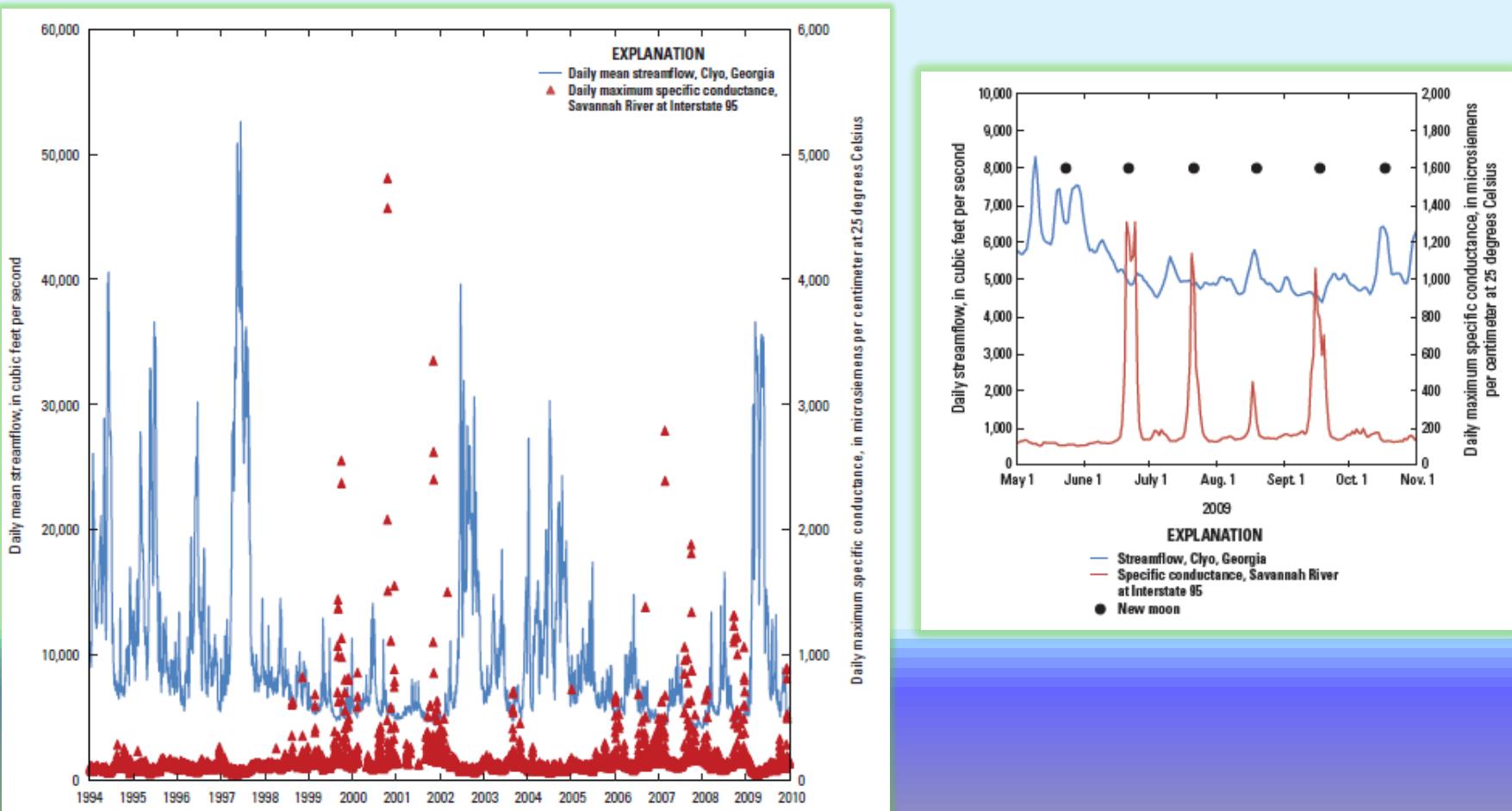


High or Low Water Level ?

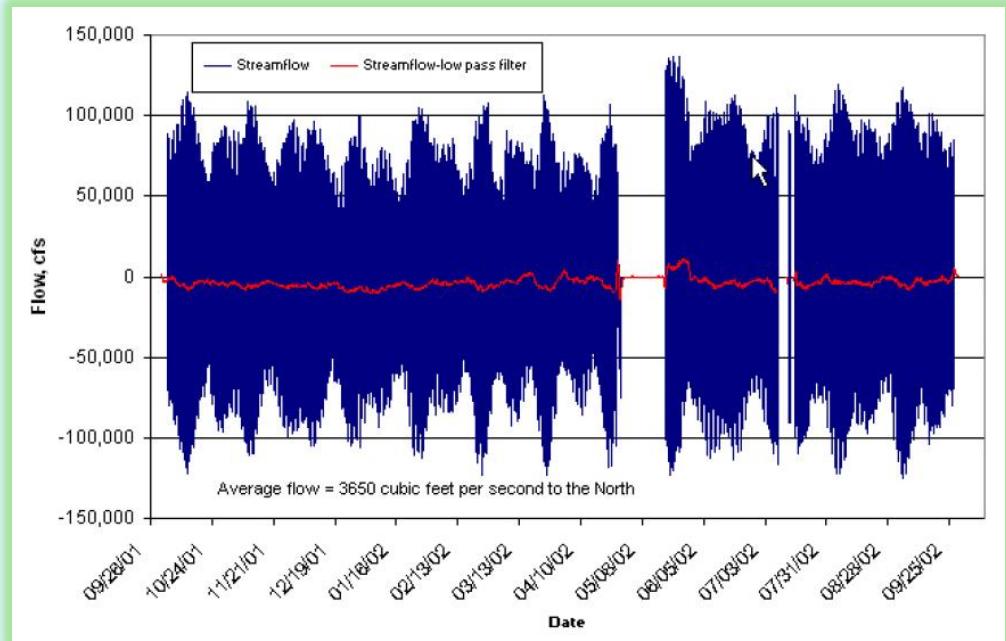
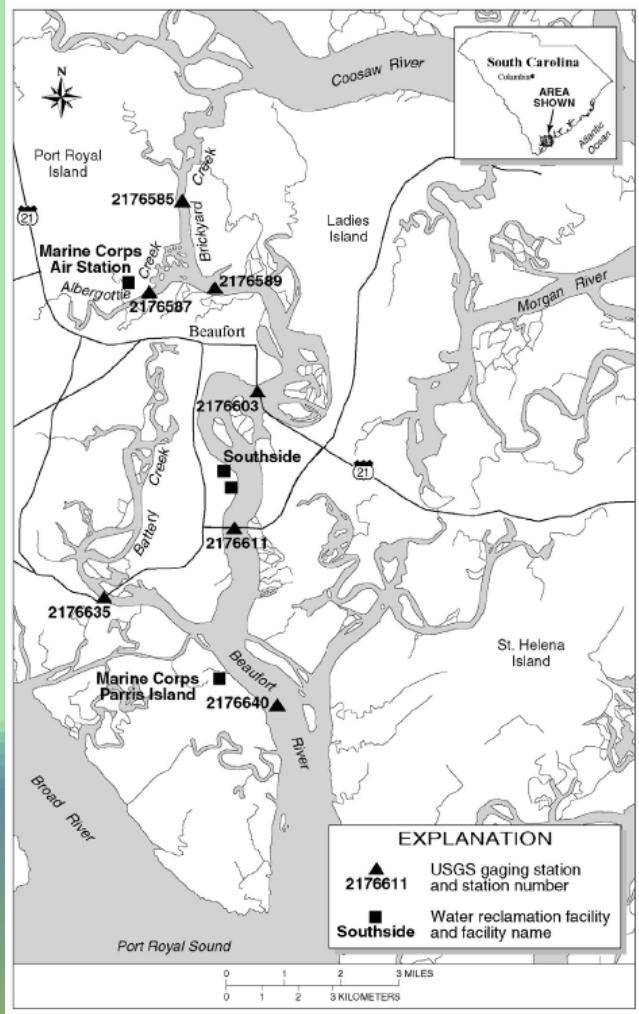


Set Your Clocks

Savannah River



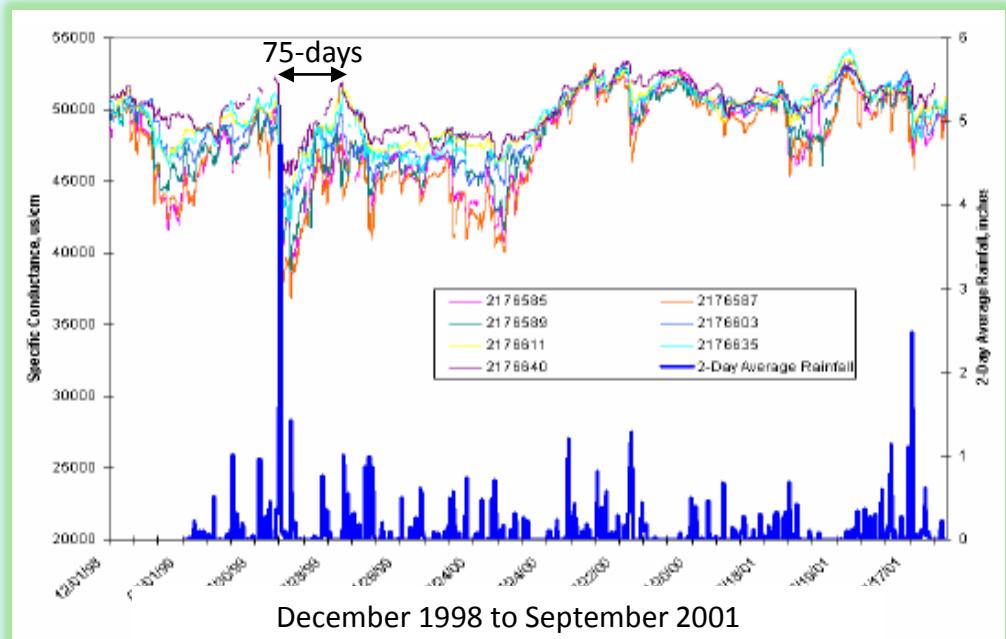
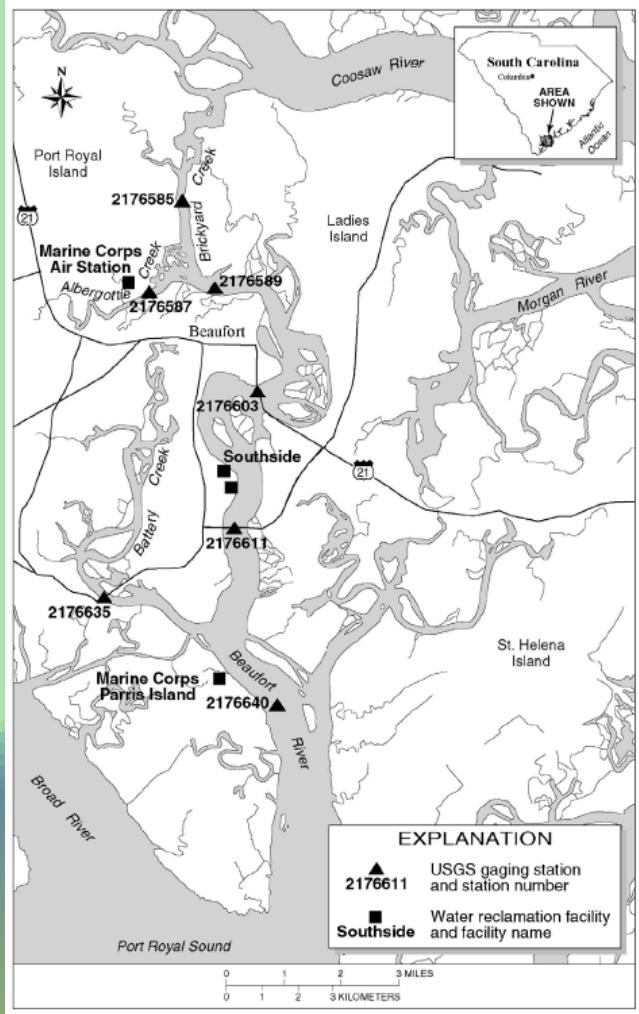
Beaufort River



Hourly and Filtered Flows

Conrads et al., 2003

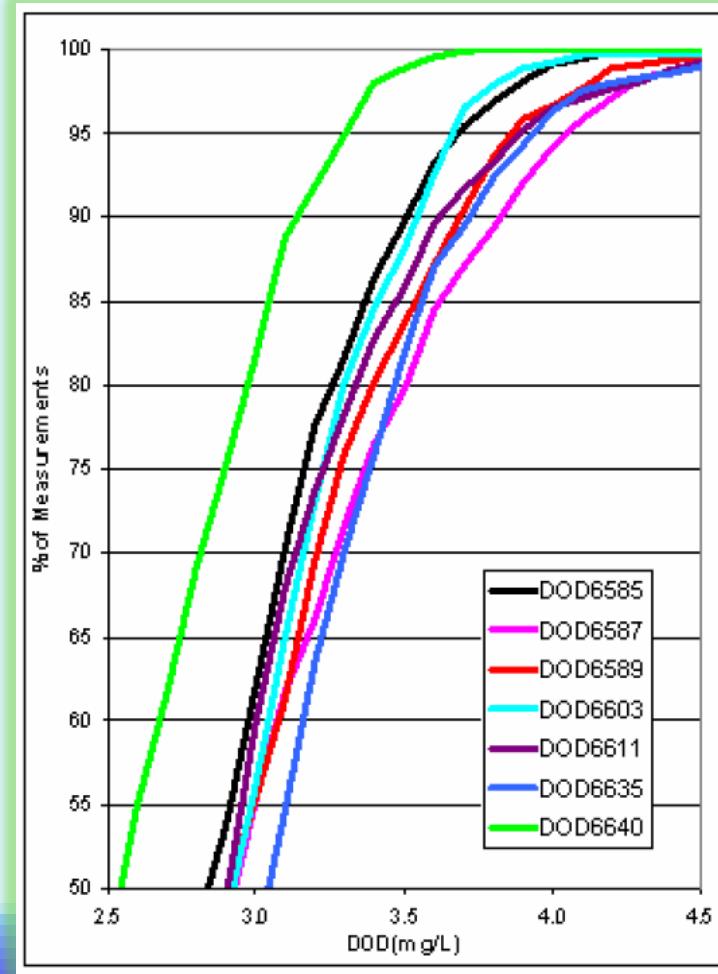
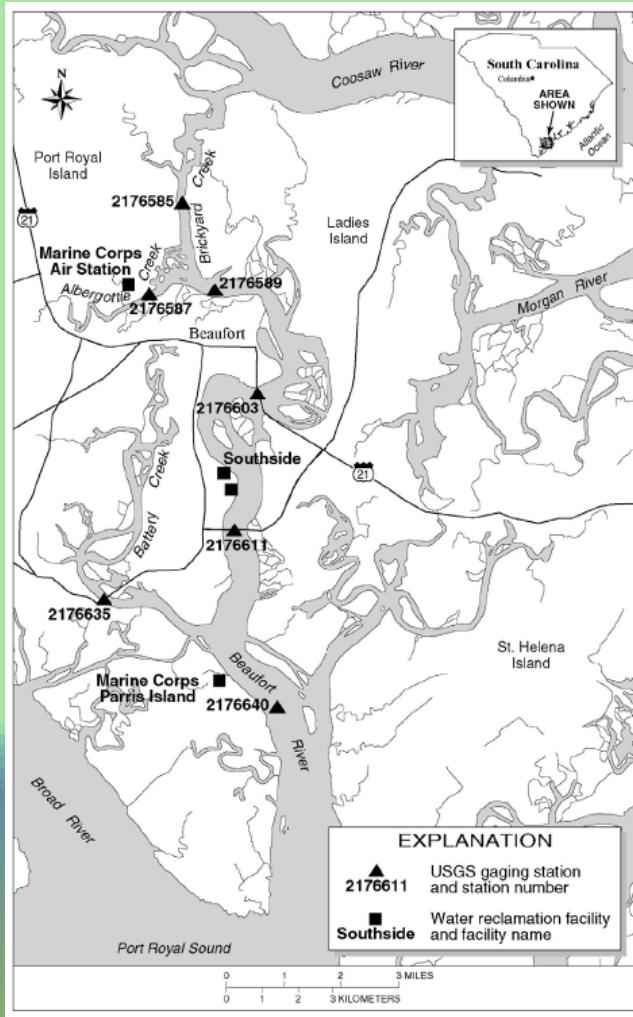
Beaufort River



Specific Conductance and Rainfall

Conrads et al., 2003

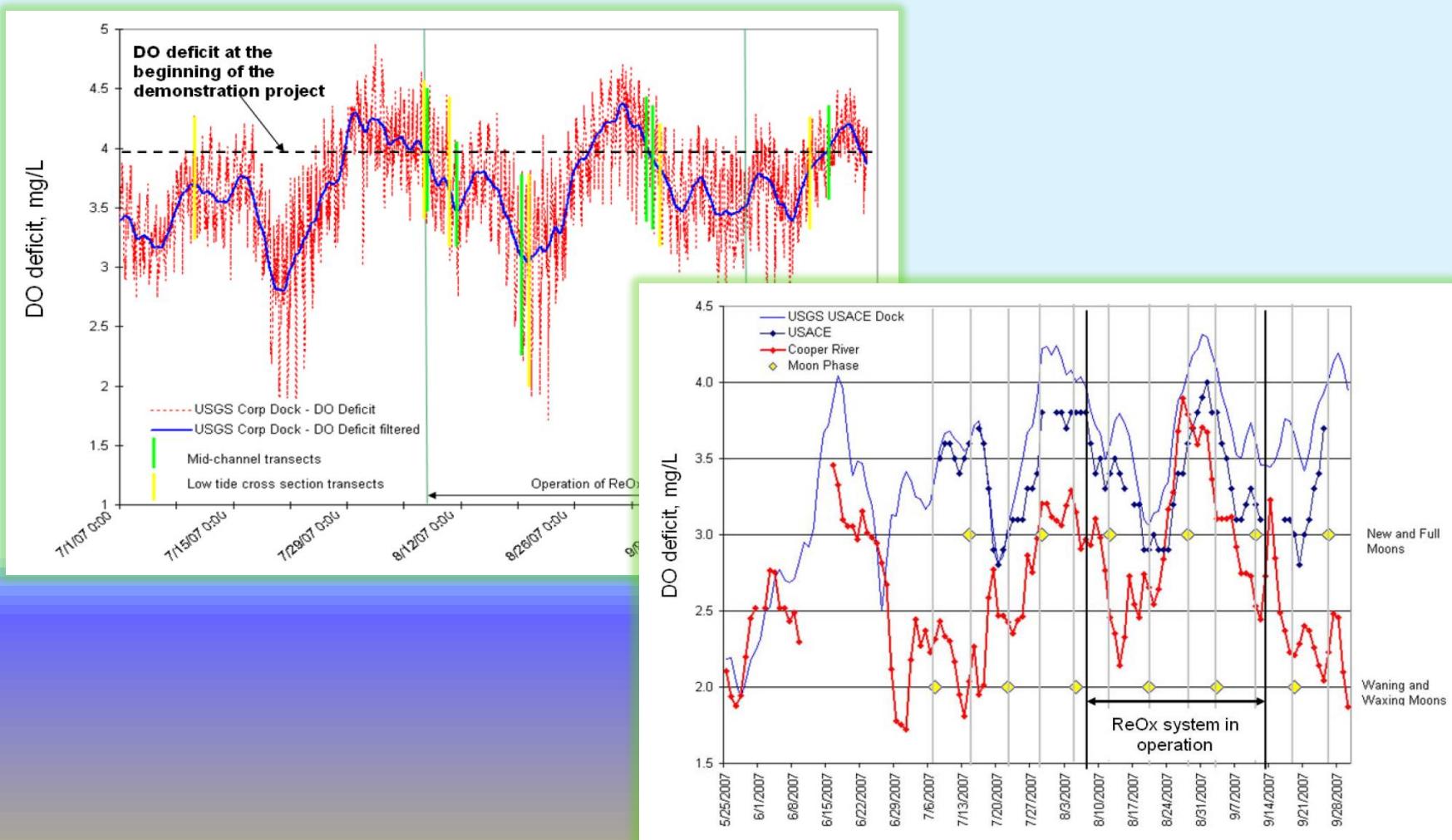
Beaufort River



Frequency Distribution of Dissolved Oxygen Deficit

Conrads et al., 2003

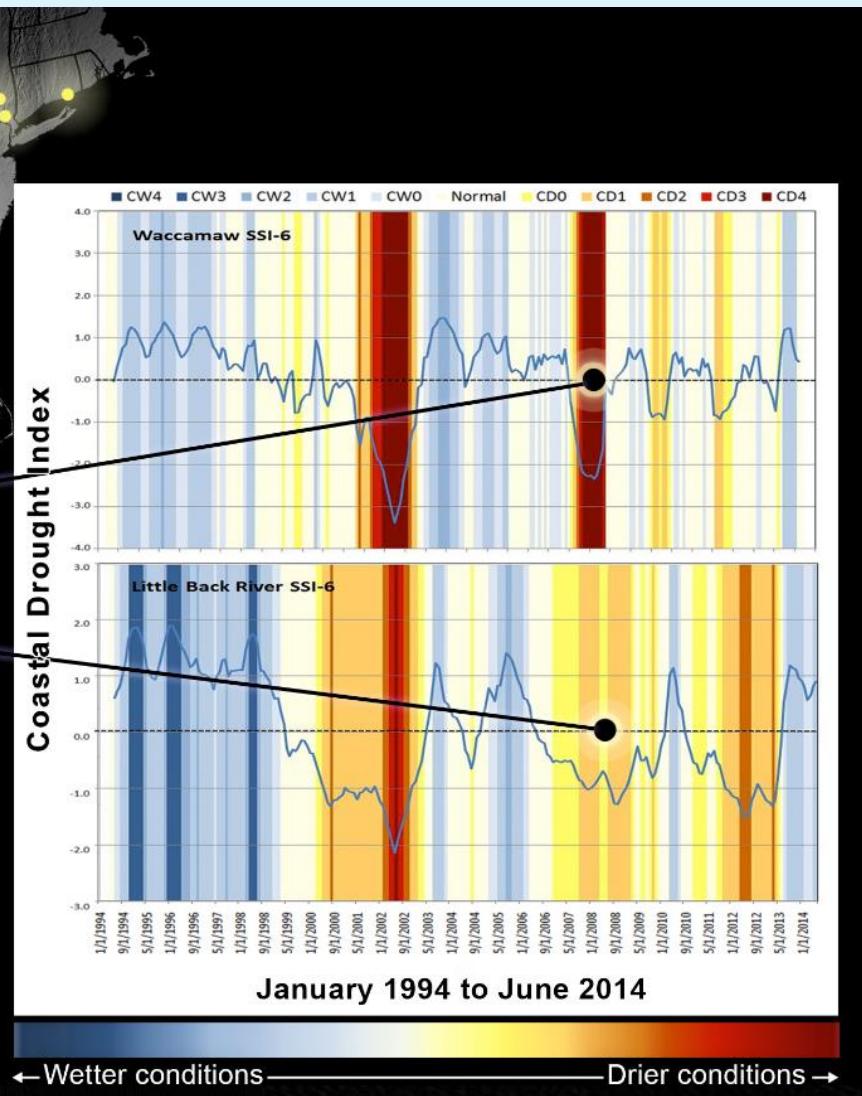
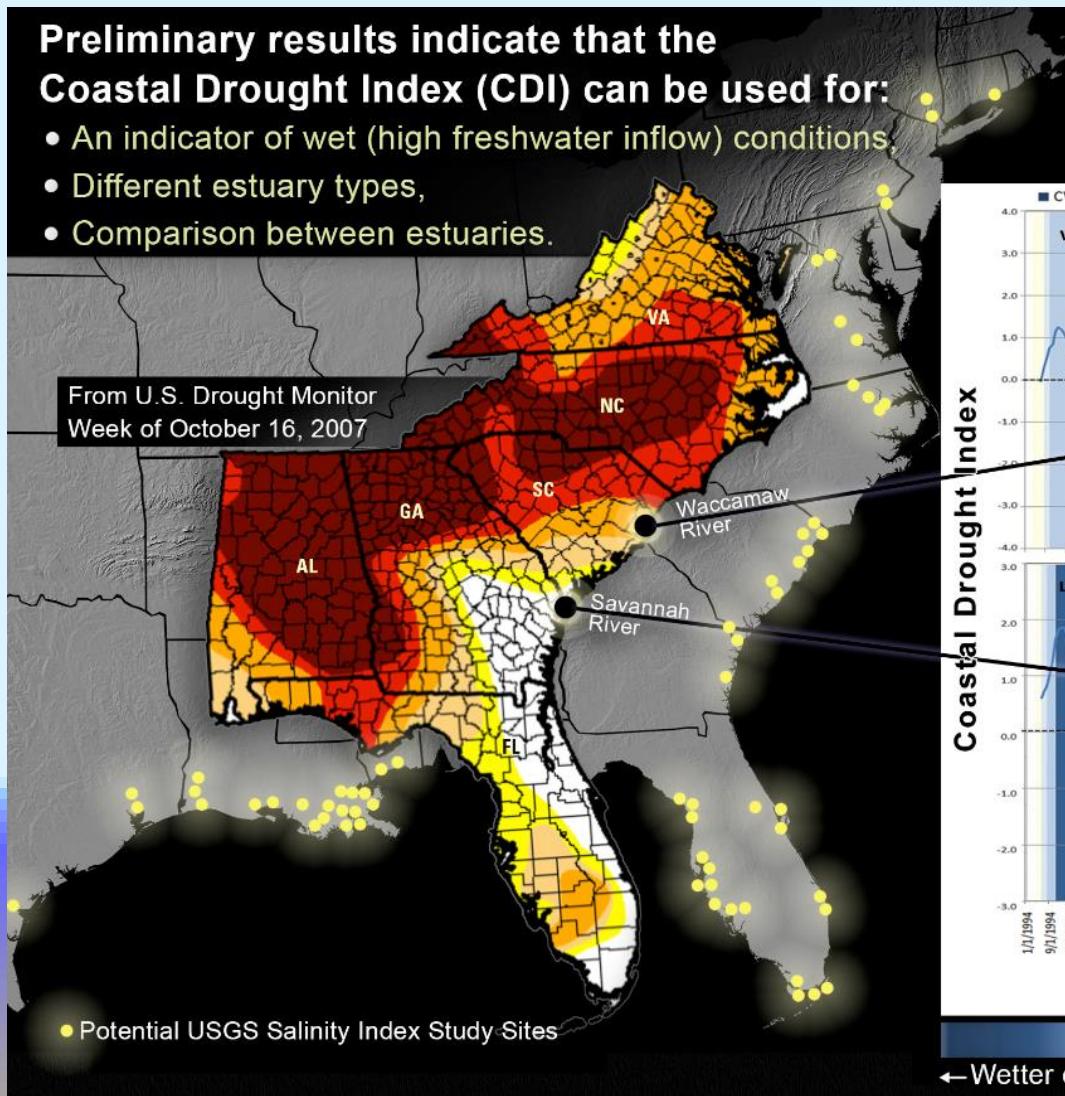
Savannah Harbor: Re-oxygenation Demonstration Project



Coastal Drought

Preliminary results indicate that the Coastal Drought Index (CDI) can be used for:

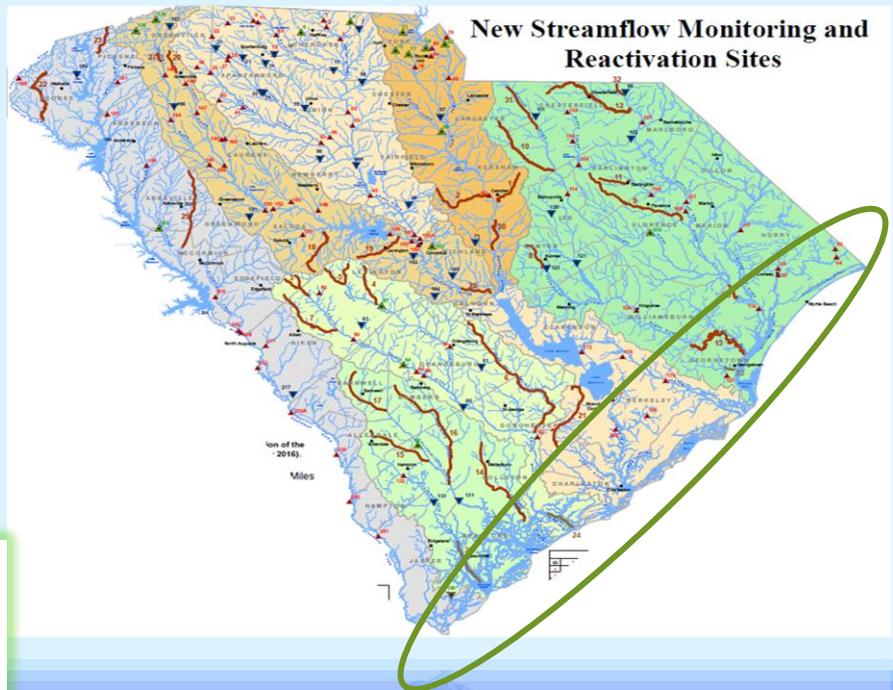
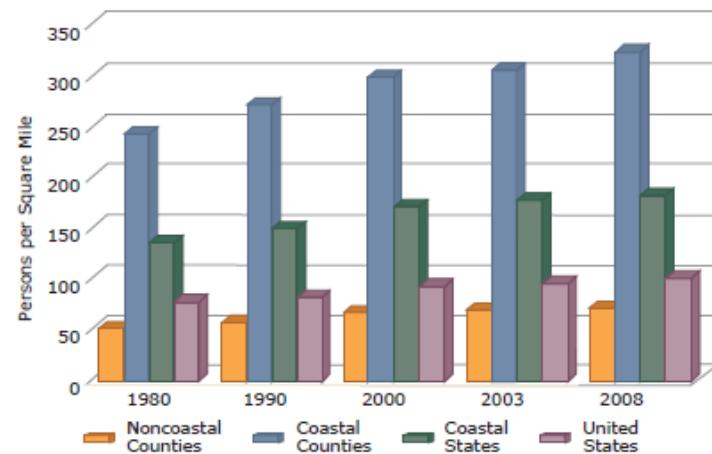
- An indicator of wet (high freshwater inflow) conditions,
- Different estuary types,
- Comparison between estuaries.



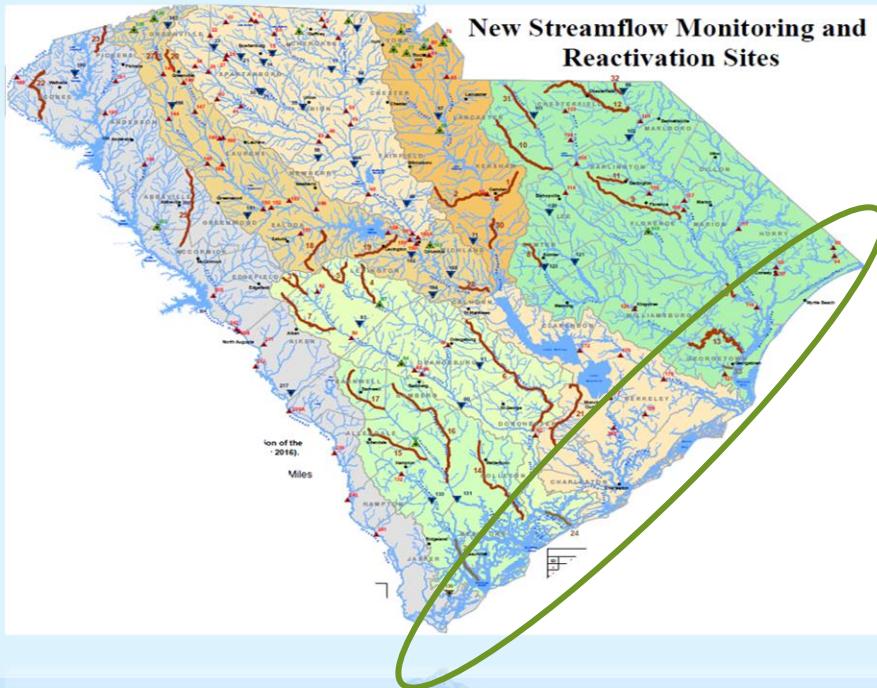
USGS Gaging along SC Coast

- Convergence of conditions in the 1980s

- Demographic growth
- Water availability Issues
- Technology real-time data



History of USGS along SC Coast



1980s

- Charleston – salinity alert
- Grand Strand – freshwater availability

1990s

- Grand Strand – DO TMDL
- Charleston – start of 10+ year DO TMDL development

2000s

- Beaufort – DO TMDL
- Savannah Harbor Deepening

2010s

- Charleston Harbor Deepening
- Savannah Harbor Deepening
- Climate Change

Concluding thoughts

- Over the last 30 years, the USGS coastal network has played an important data and information role in major water-resources decisions along the coast.
- The network has been centered around urban centers. Few gages along undeveloped stretches of the coast.
- Data used by many to address various issues
- Difficult to anticipate how data will be used in the future



Questions?

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