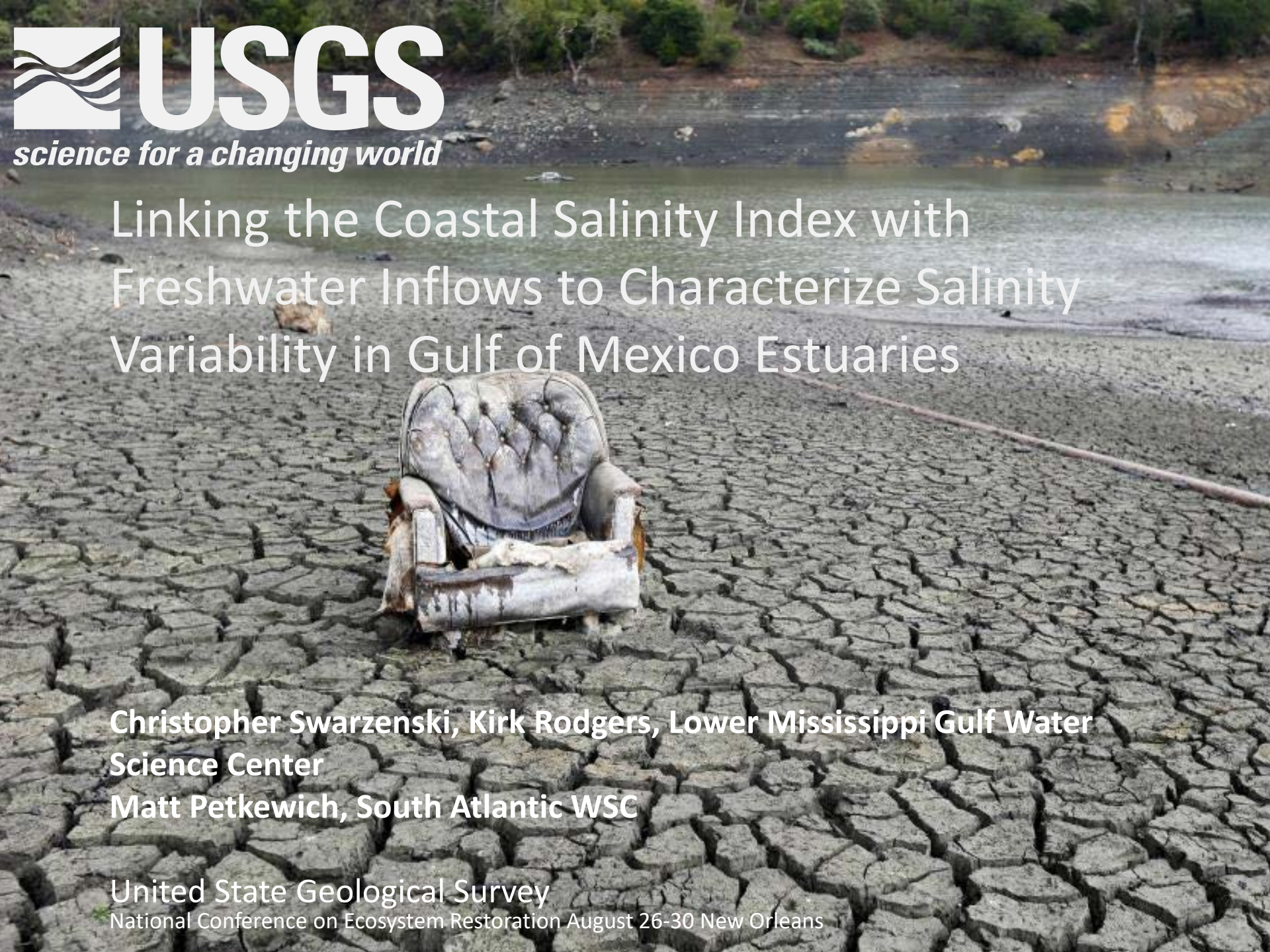


USGS
science for a changing world

Linking the Coastal Salinity Index with Freshwater Inflows to Characterize Salinity Variability in Gulf of Mexico Estuaries

Christopher Swarzenski, Kirk Rodgers, Lower Mississippi Gulf Water Science Center
Matt Petkewich, South Atlantic WSC

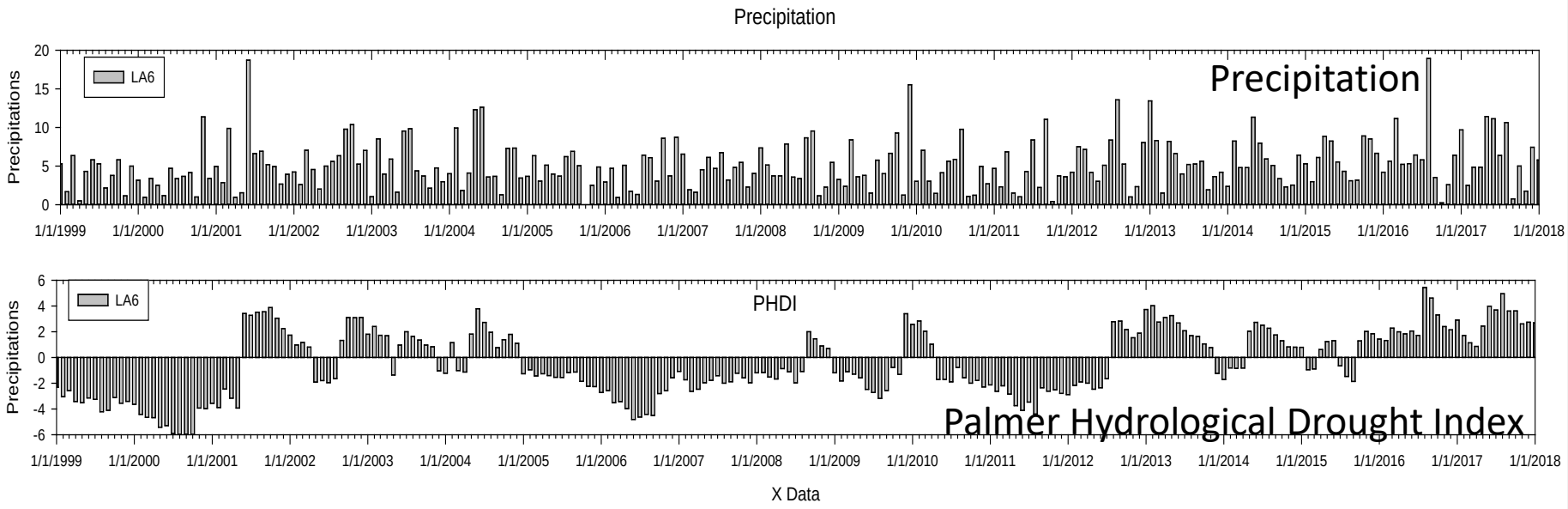
United State Geological Survey
National Conference on Ecosystem Restoration August 26-30 New Orleans

COASTAL SALINITY INDEX: a measure of the departure from long-term average salinity conditions (PAUL CONRADS, SAWSC)

- Is salinity fresher or saltier than long-term averages

- Specific to the measurement location

- An analog to Drought Indices (eg Palmer Hydrological Drought Index)



USGS
science for a changing world

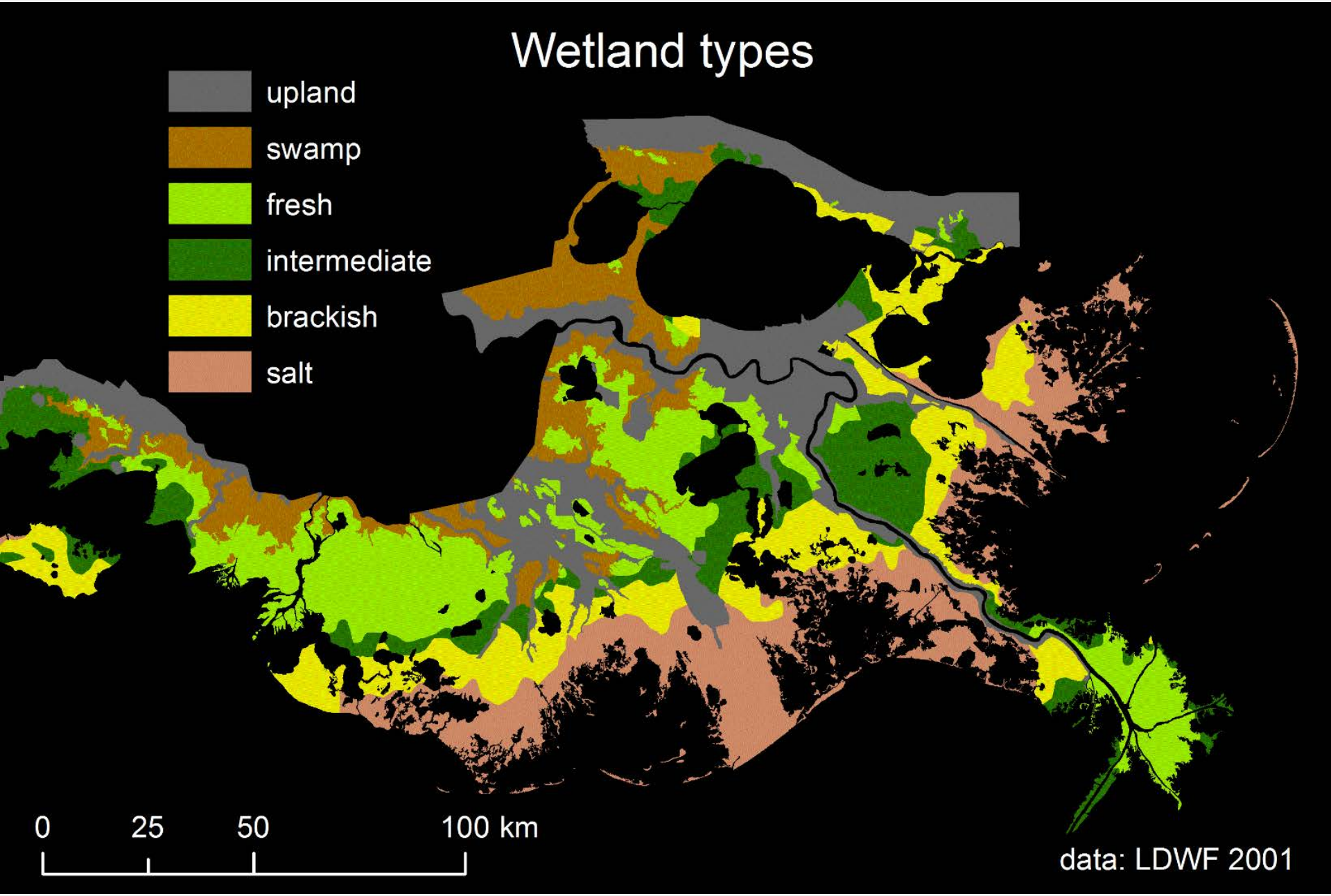
ESTUARINE SALINITY GRADIENT: Mixing of freshwater inflows with marine waters creates an area (estuary) of variable salinity that is very productive biologically

- Living resources are distributed in estuaries based on their salinity tolerance

- Some are mobile (fish) some are sessile (plants, oysters)

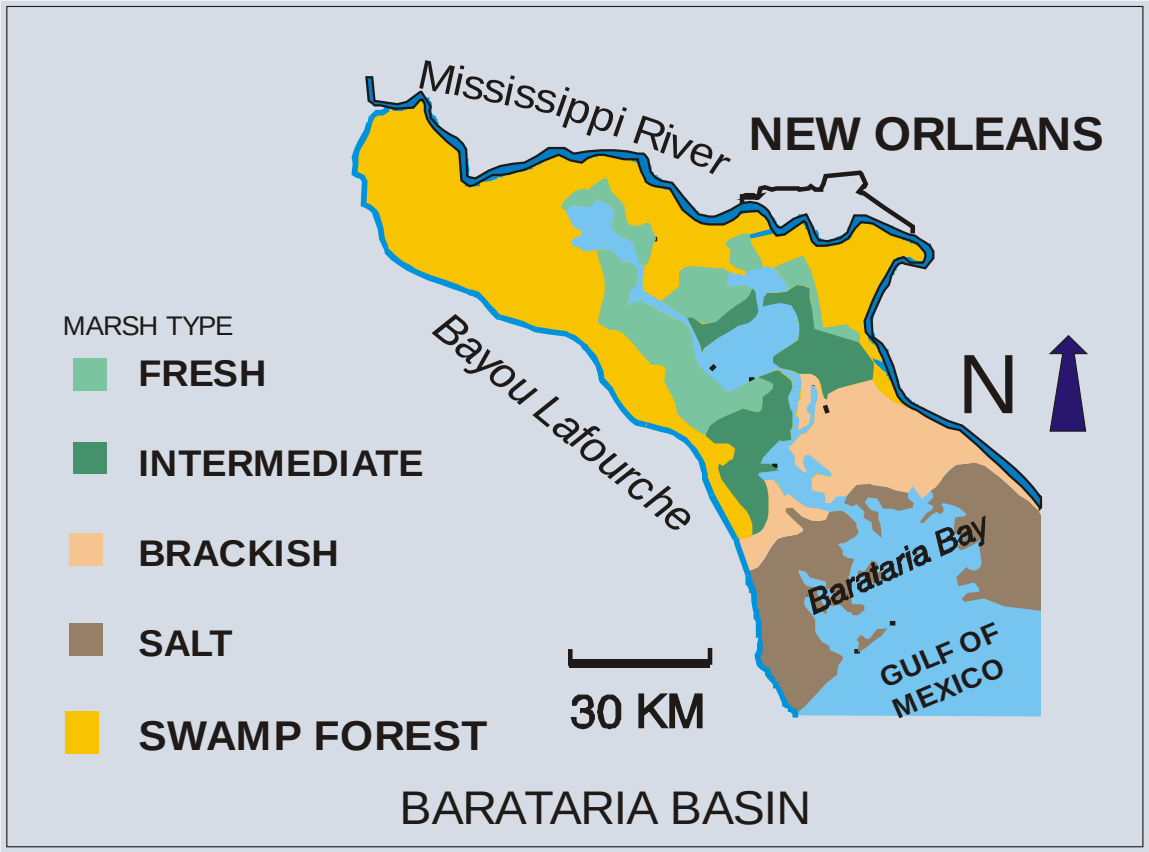
MISSISSIPPI DELTA PLAIN

USGS


Wetland types
upland
swamp
fresh
intermediate
brackish
salt
0
25
50
100 km
data: LDWF 2001

Distribution of major marsh types along the estuarine salinity gradient (based on salt tolerance of plant communities)

MarshType	Salinity (ppt)
Fresh	< 1
Intermediate	0.5 – 4
Brackish	4 -15
Salt	11- 30



USGS science for a changing world

FRESH AND INTERMEDIATE MARSHES: HIGH DIVERSITY > 50 spp LARGE CONTIGUOS EXPANSES WITH CLEAR ZONATION BASED ON SHARP SALINITY GRADIENTS

USGS
science for a changing world

SALT MARSH LANDSCAPE: MONOTYPIC (1-3 species), BISECTED BY NUMEROUS TIDAL CREEKS, LARGE SALINITY VARIABILITY

USGS
science for a changing world

SALINITY VARIABILITY IN ESTUARIES

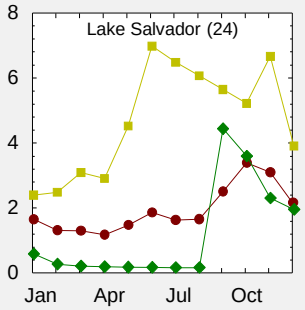
- Freshwater inflows (streamflow, precipitation)
- Storm surge (hurricanes, frontal passages)
- Seasonal and annual variations in mean sea level

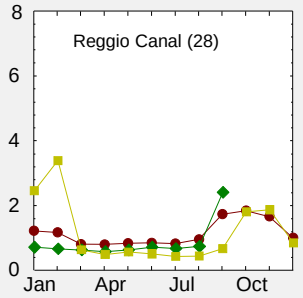
Unique spatial and temporal salinity patterns result from interactions among these factors

BARATARIA BASIN
West of river

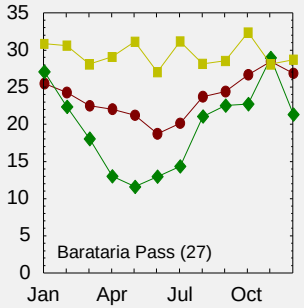
BRETON SOUND
East of river

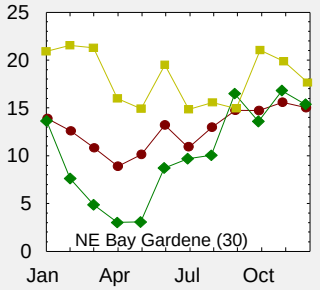
Intermediate Marsh





Salt Marsh





Prolonged Drought (2000)

Long-term average

Peak River flood (2008)

USGS
science for a changing world

Monthly mean salinity (1998-2013) at upper and lower parts of an estuary

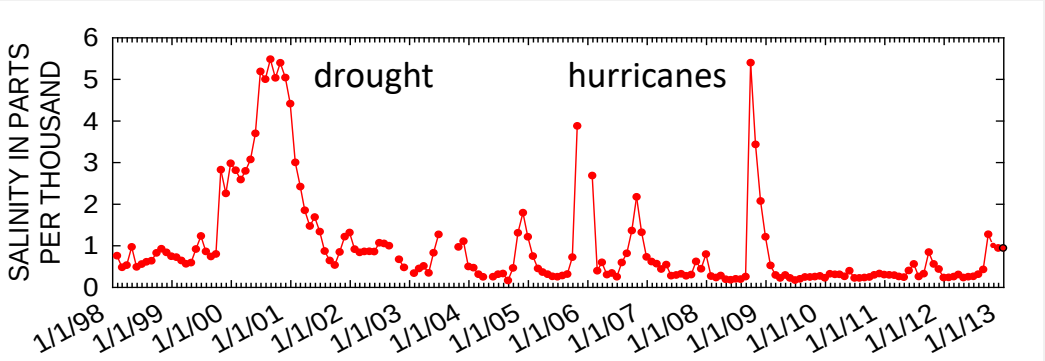
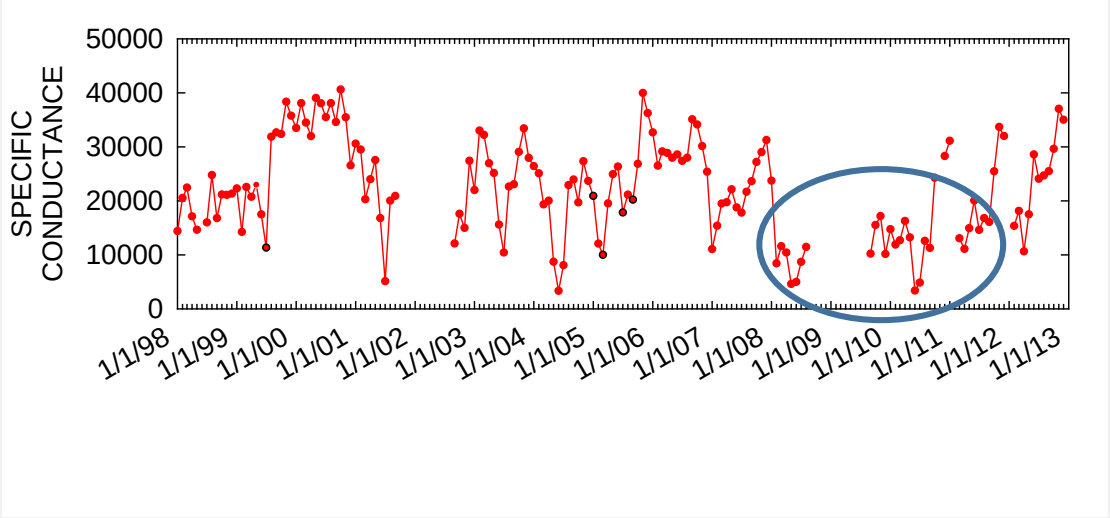


Fig. Monthly average salinity at BA1-02, 1999-2012



USGS
science for a changing world

Monthly (1998-2012) and daily salinity in upper reaches of Barataria Basin

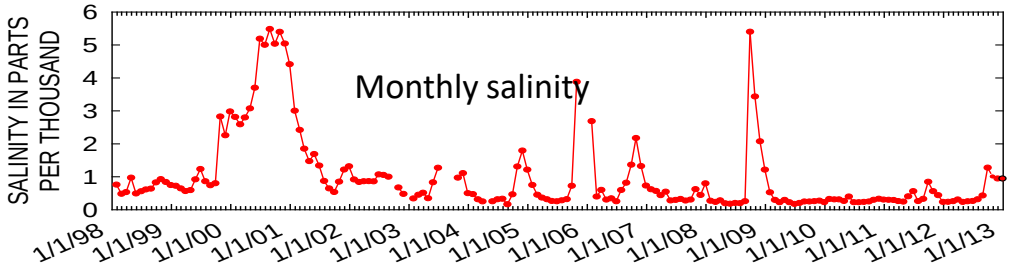
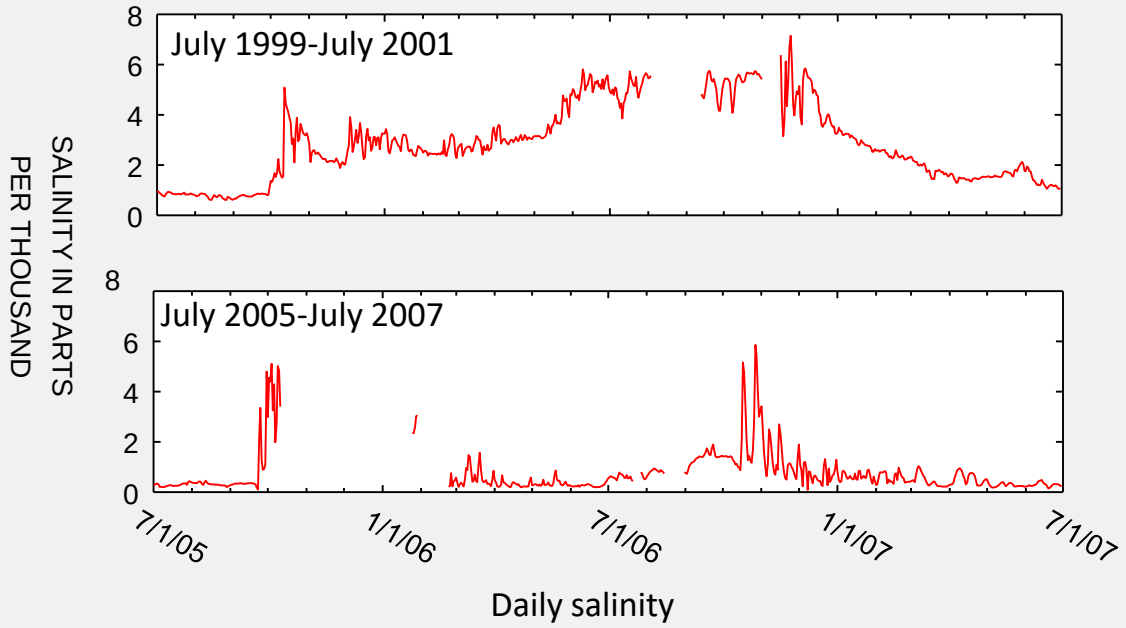


Fig. Monthly average salinity at BA1-02, 1999-2012



USGS science for a changing world

SALINITY VARIABILITY IN ESTUARIES

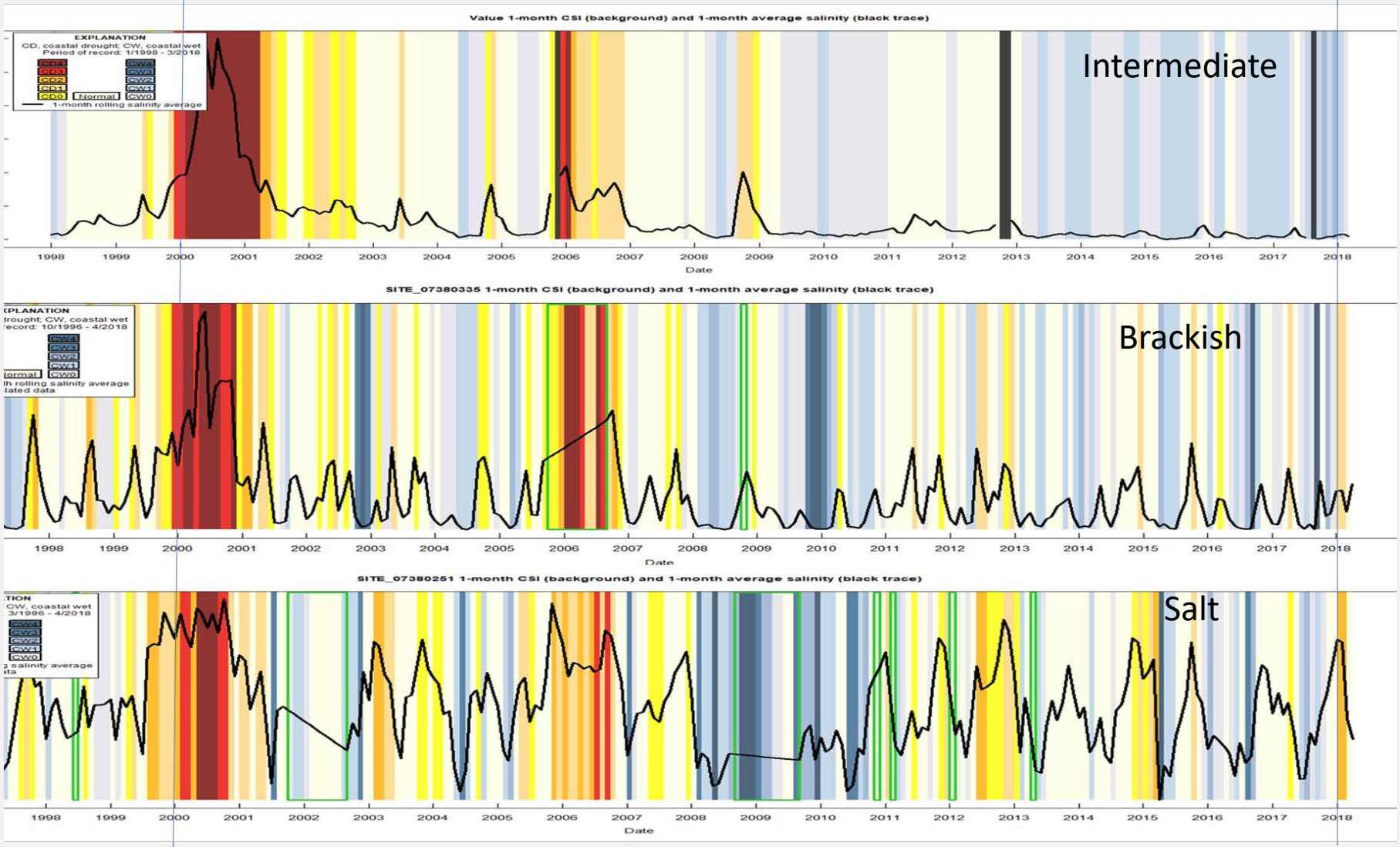
- Freshwater inflows (streamflow, precipitation)
- Storm surge (hurricanes, frontal passages)
- Seasonal and annual variations in mean sea level

CLIMATE EVENTS IN COASTAL LOUISIANA 1998-2018

- Prolonged droughts (1999/2000 and 2006)
- Hurricanes Katrina and Rita (2005), Gustave and Ike (2008)
- Mississippi River record floods (2008 and 2011)
- Extreme precipitation (2016)

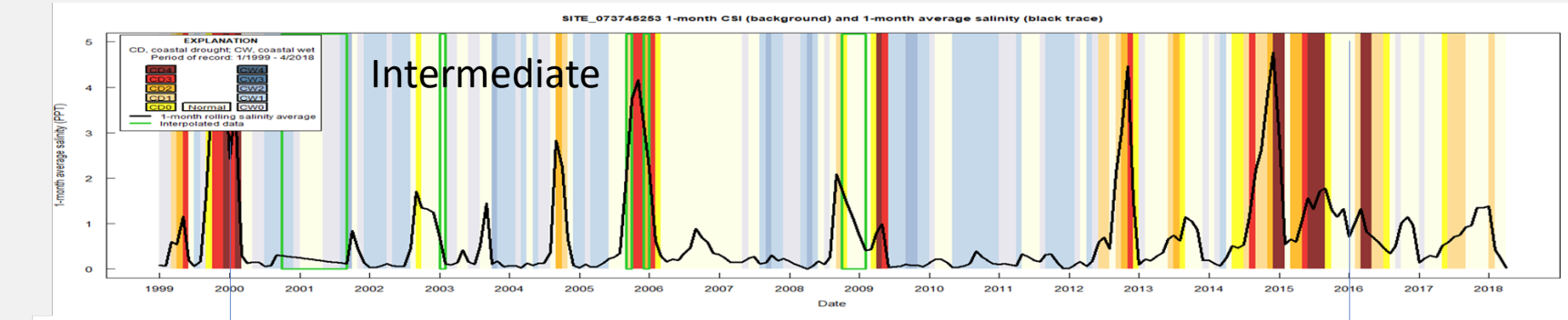

ESTUARINE SALINITY GRADIENT
Breton Sound
Barataria
Transect
USGS
science for a changing world

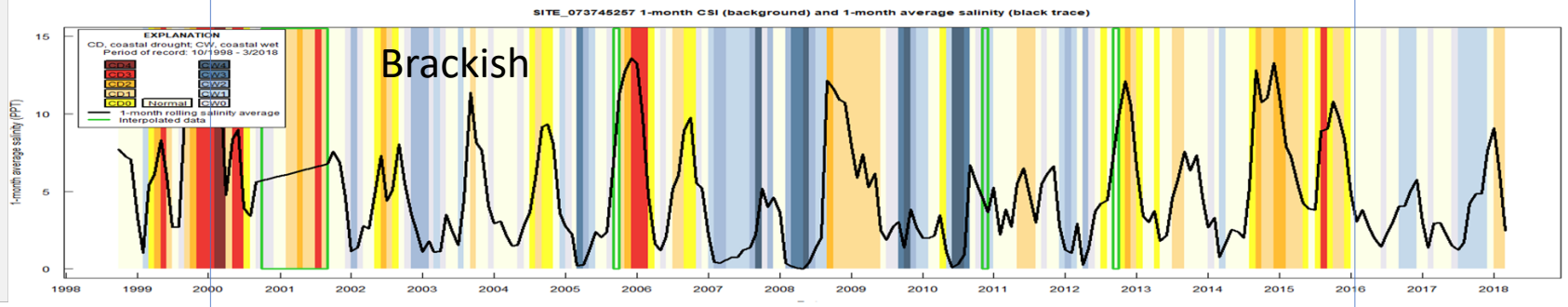
BARATARIA BASIN CSI (monthly 1998-2018)

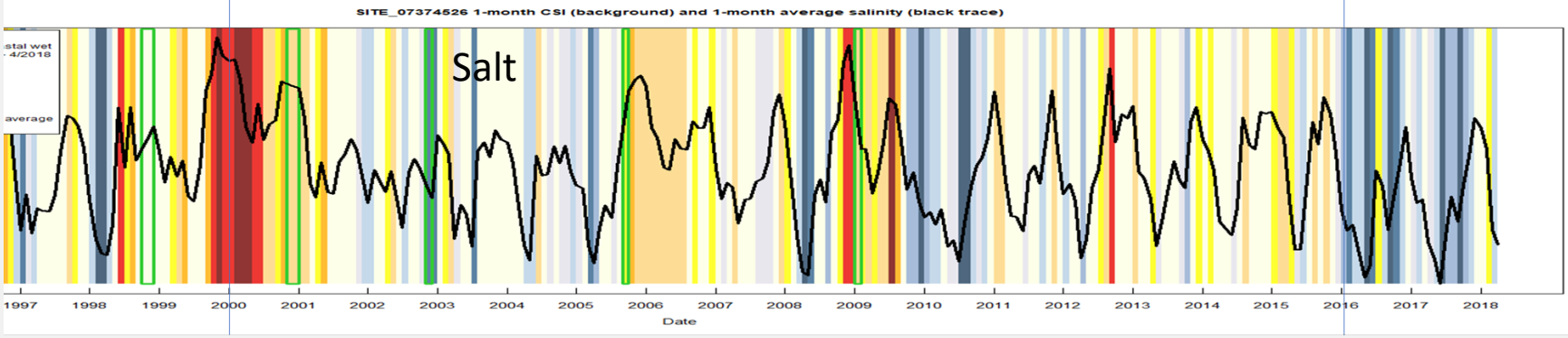


USGS
science for a changing world

Breton Sound CSI (monthly 1998-2018)



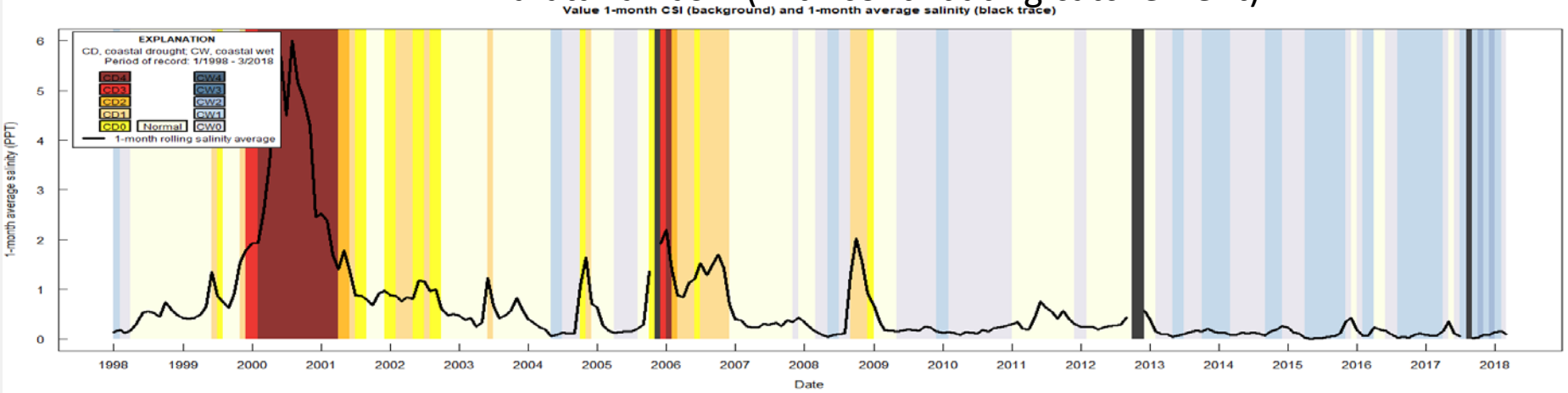


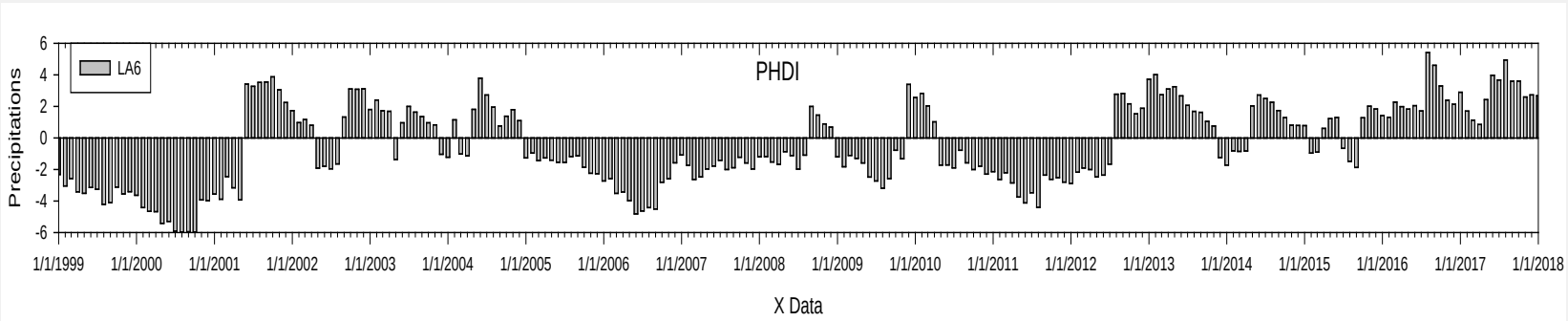


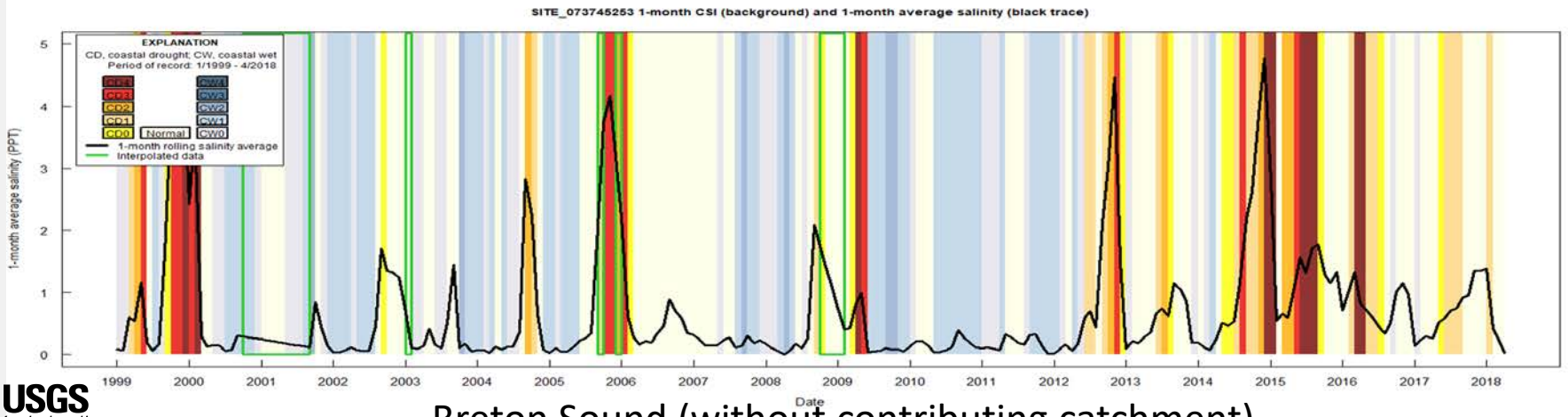
USGS
science for a changing world

INTERMEDIATE MARSH

Barataria Basin (with contributing catchement)





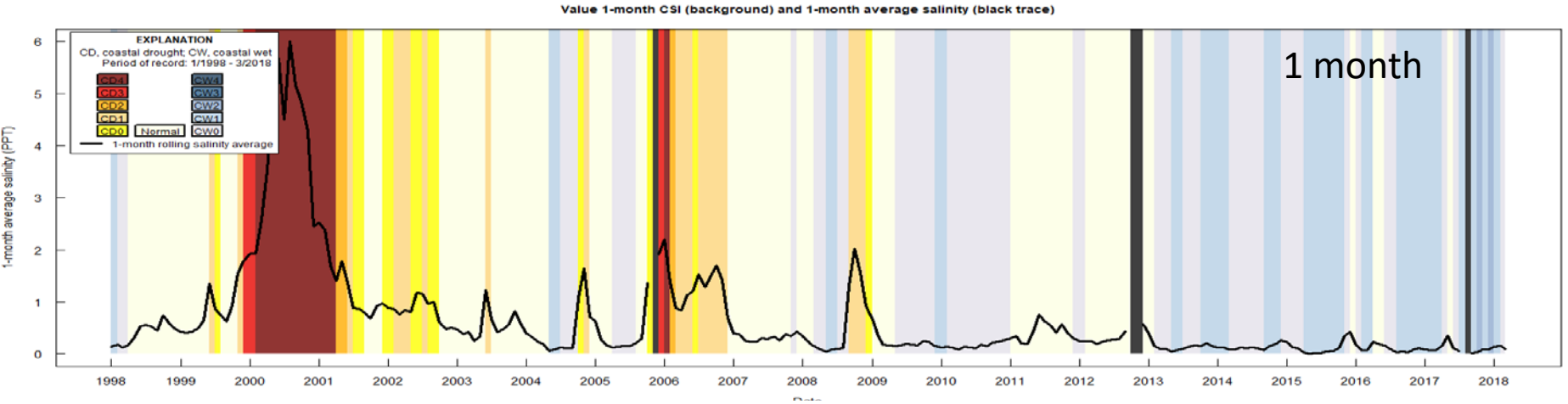


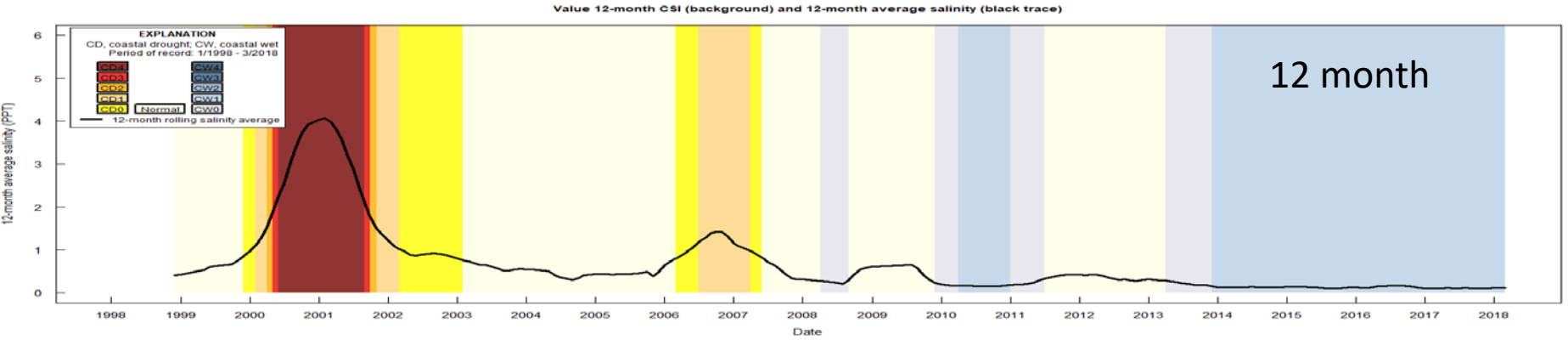
USGS science for a changing world

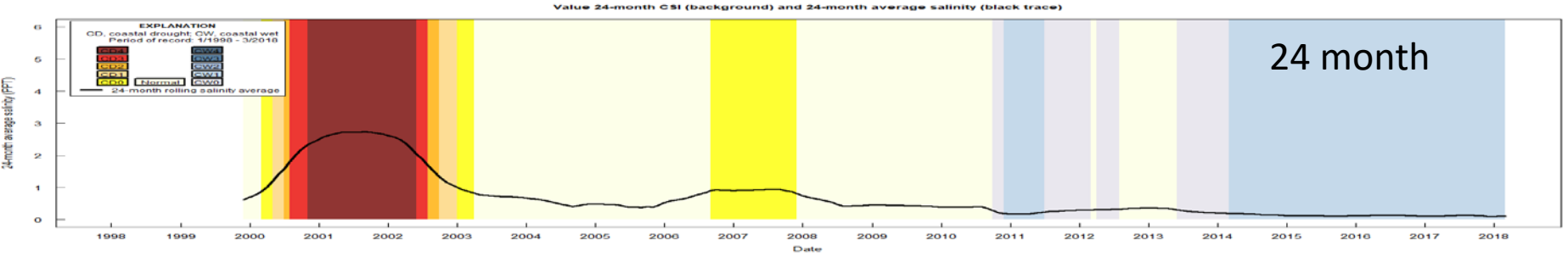
Breton Sound (without contributing catchment)

INTERMEDIATE MARSH

Barataria Basin



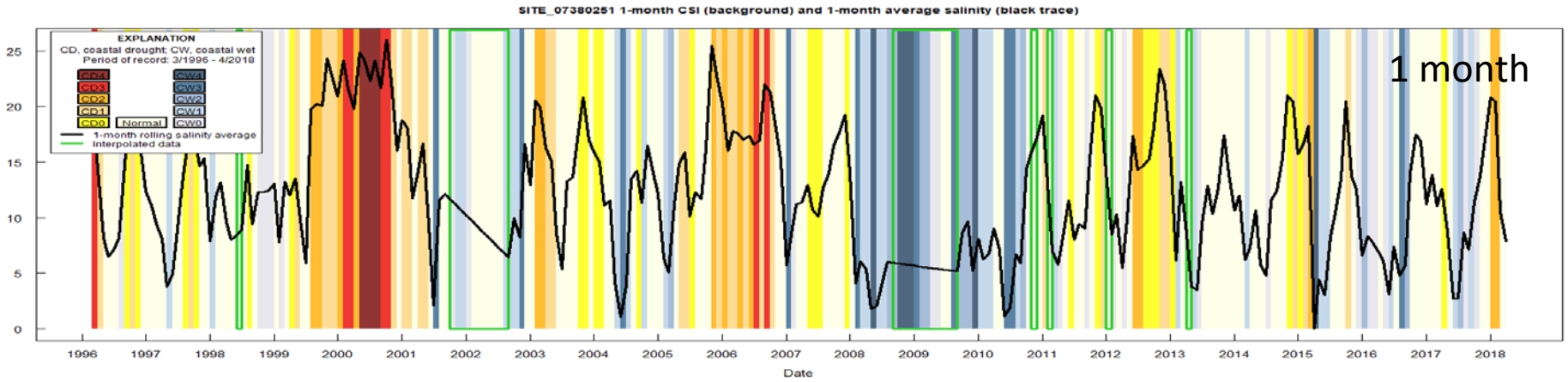


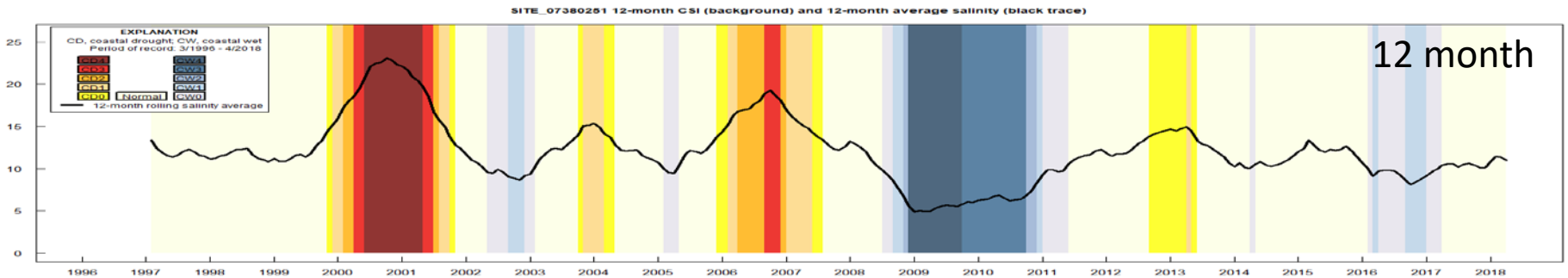


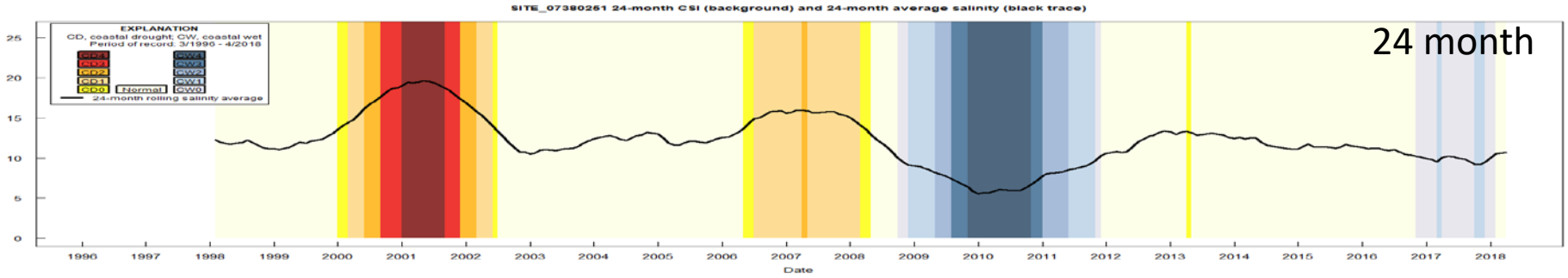
USGS
science for a changing world

SALT MARSH

Barataria Basin







USGS
science for a changing world

LINKING CSI TO SPECIFIC ECOLOGICAL CONSEQUENCES IS DIFFICULT AND MAYBE NOT NEEDED

2000 drought resulted in a shift in plant community at one intermediate marsh but not three other similar marsh types in the vicinity

1997
P.hemitomon

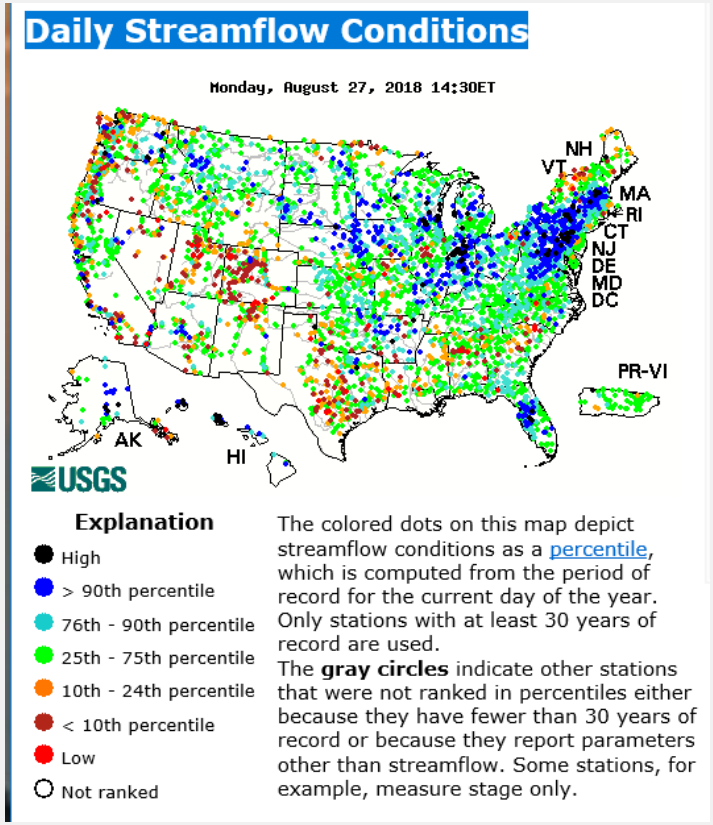
2002
S. falcata

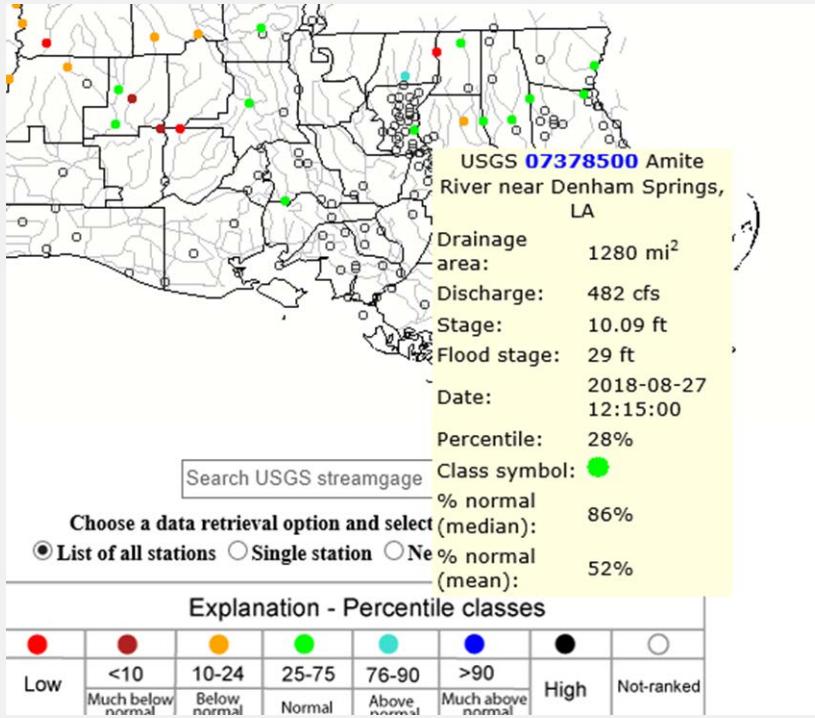
USGS
science for a changing world

Fresh marsh

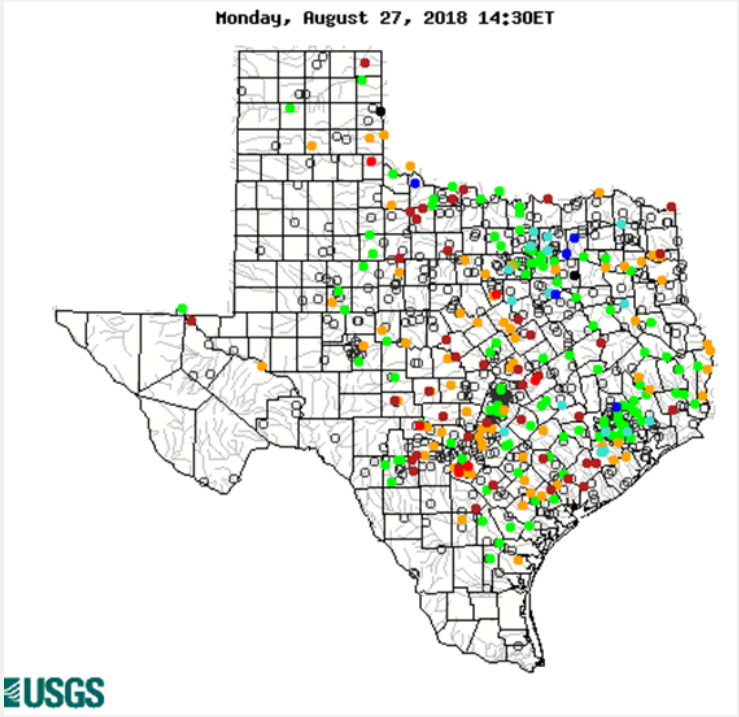
Daily stream flow conditions across the nation

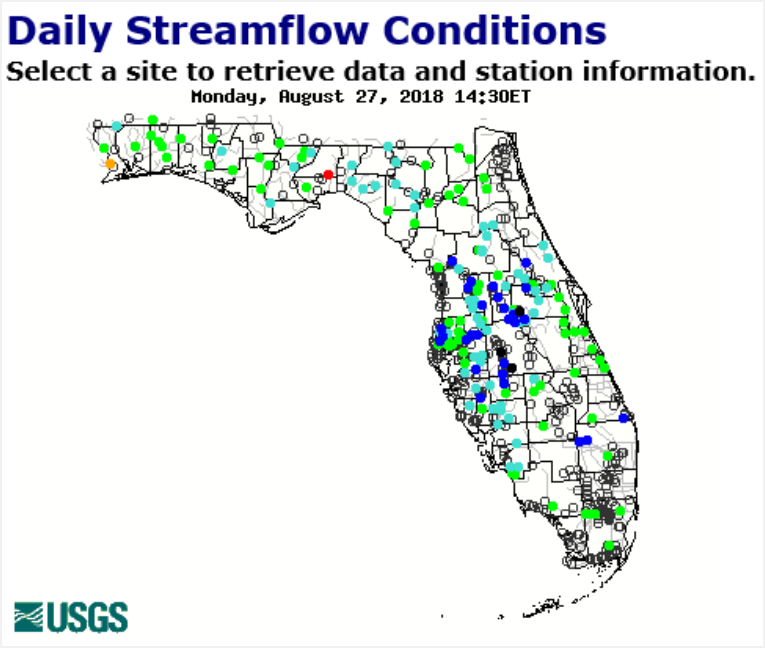
- Color co-ordinated based on at least 30 years of continuous streamflow
- For CSI maybe monthly is a better choice?





https://waterdata.usgs.gov/nwis/rt





Explanation - Percentile classes							
Low	<10 Much below normal	10-24 Below normal	25-75 Normal	76-90 Above normal	>90 Much above normal	High	Not-ranked

https://waterdata.usgs.gov/nwis/rt

USGS
science for a changing world

COASTAL SALINITY INDEX

- Extremely useful to quickly assess how far from normal salinities are at a particular location

- Valuable for understanding both too much and too little freshwater input; in estuaries this is different than drought in farmlands

- Sensitive to local hydrology and basin characteristics within an estuary, showing different responses near the freshwater and saltwater ends to same event, for example

- Getting continuous records of salinity along estuaries and coasts has only gained traction in the last 25 years or so. Getting good records without too frequent interruptions is challenging