Numerical Model Development to Address the Effects of Climate Change on Coastal Hydrology and Ecology in Southern Florida

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USGS Modeling and Climate Change

- **Use of USGS Coastal hydrologic models**
  - Represent effects of sea-level rise; simple or too simplistic?
  - Represent effects of mean temperature rise
  - Represent effects of changes in precipitation and ET
  - Provide water level, salinity, and temperature information to ecologic models

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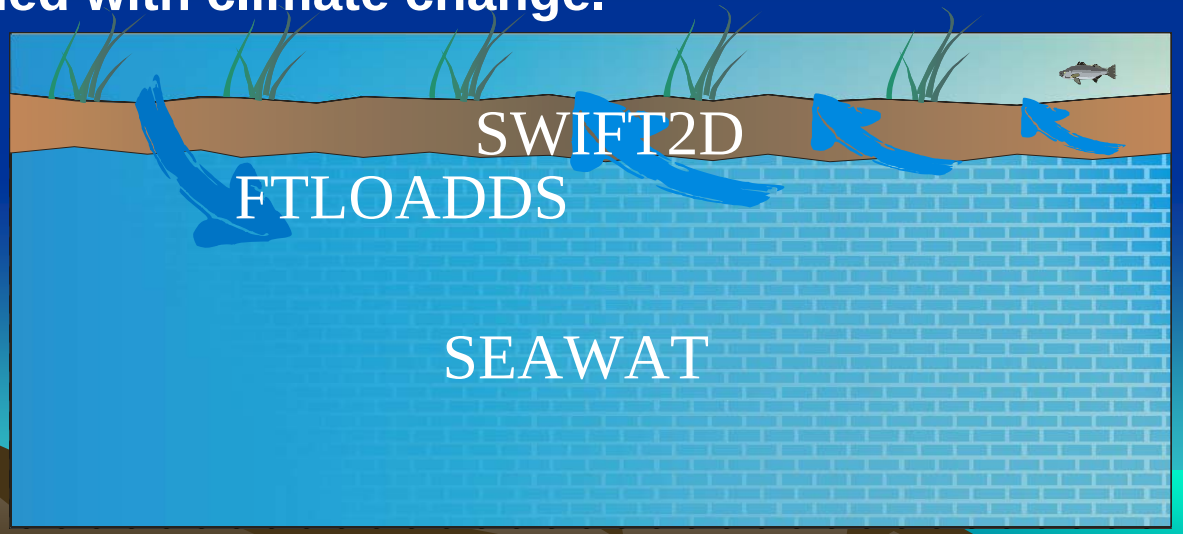
USGS numerical model

- FTLOADDS (Flow and Transport in a Linked Overland/Aquifer Density Dependent System) Useful to look at climate change because:
  - **Surface water dynamics of prime importance**
  - **Ground-water/surface-water exchange affects saltwater intrusion**
  - **Heat and salinity transport are both factors affected by climate change**
  - **Applications representing restoration scenarios can be combined with climate change.**



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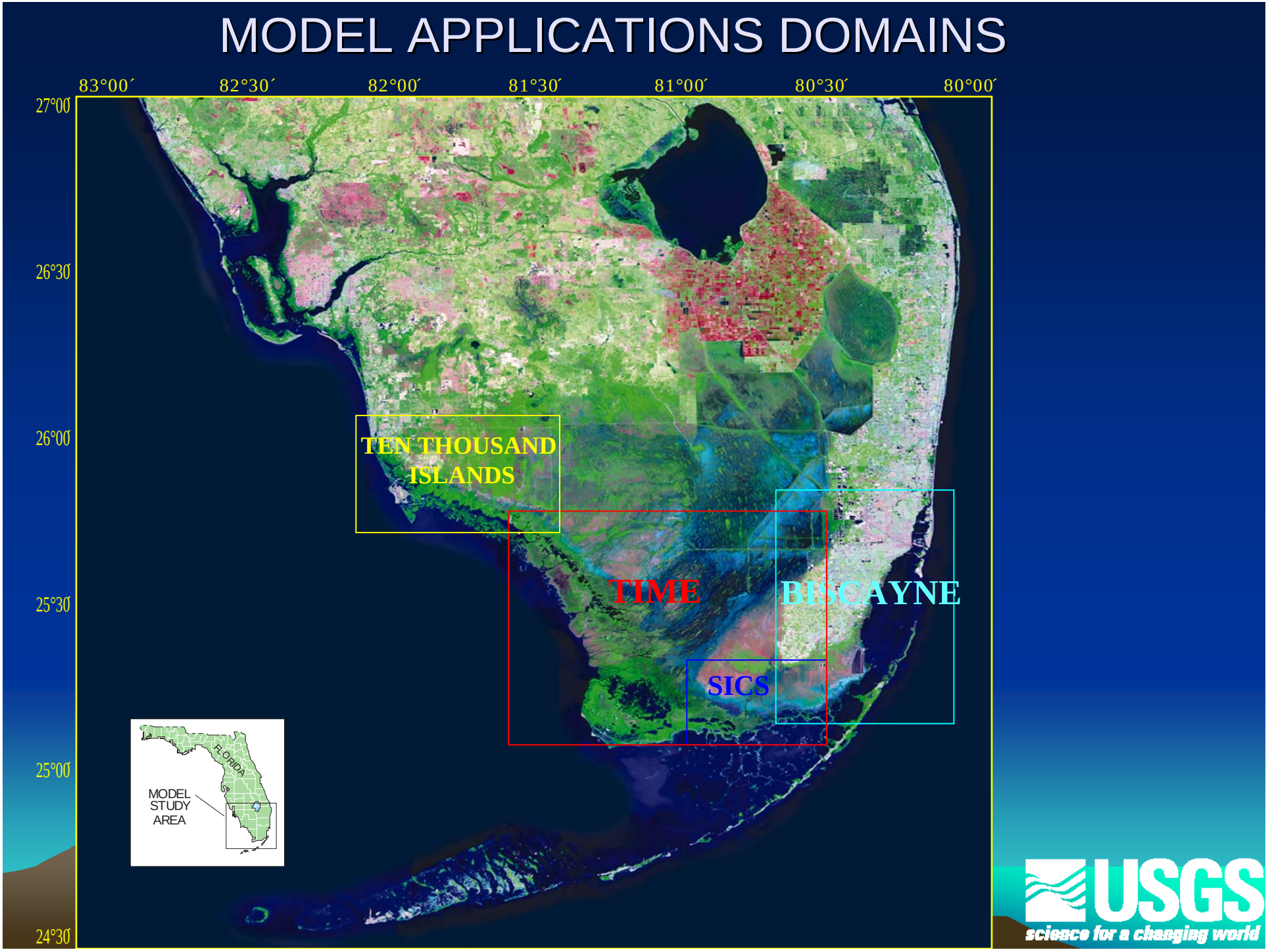
MODEL APPLICATIONS DOMAINS



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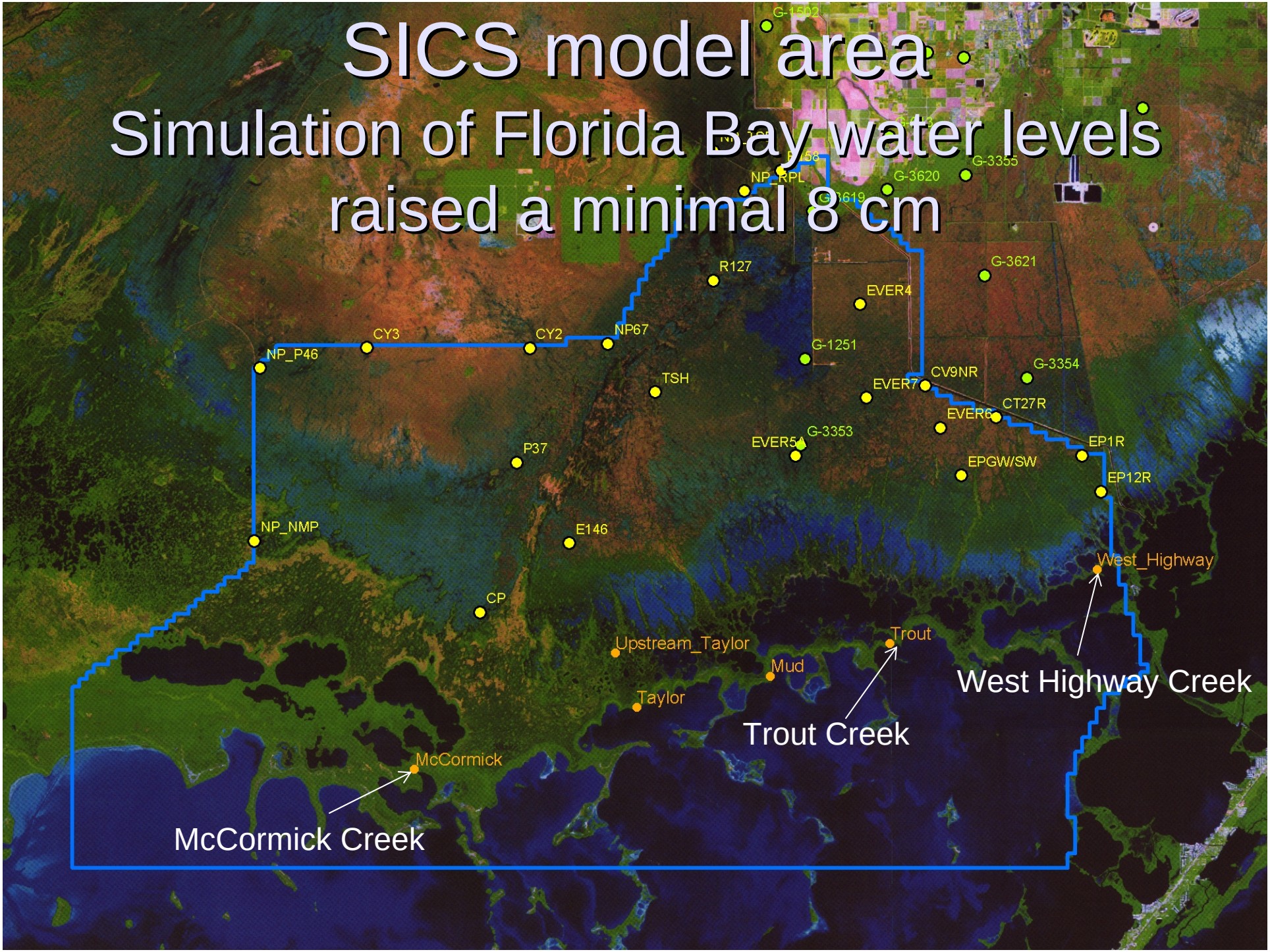
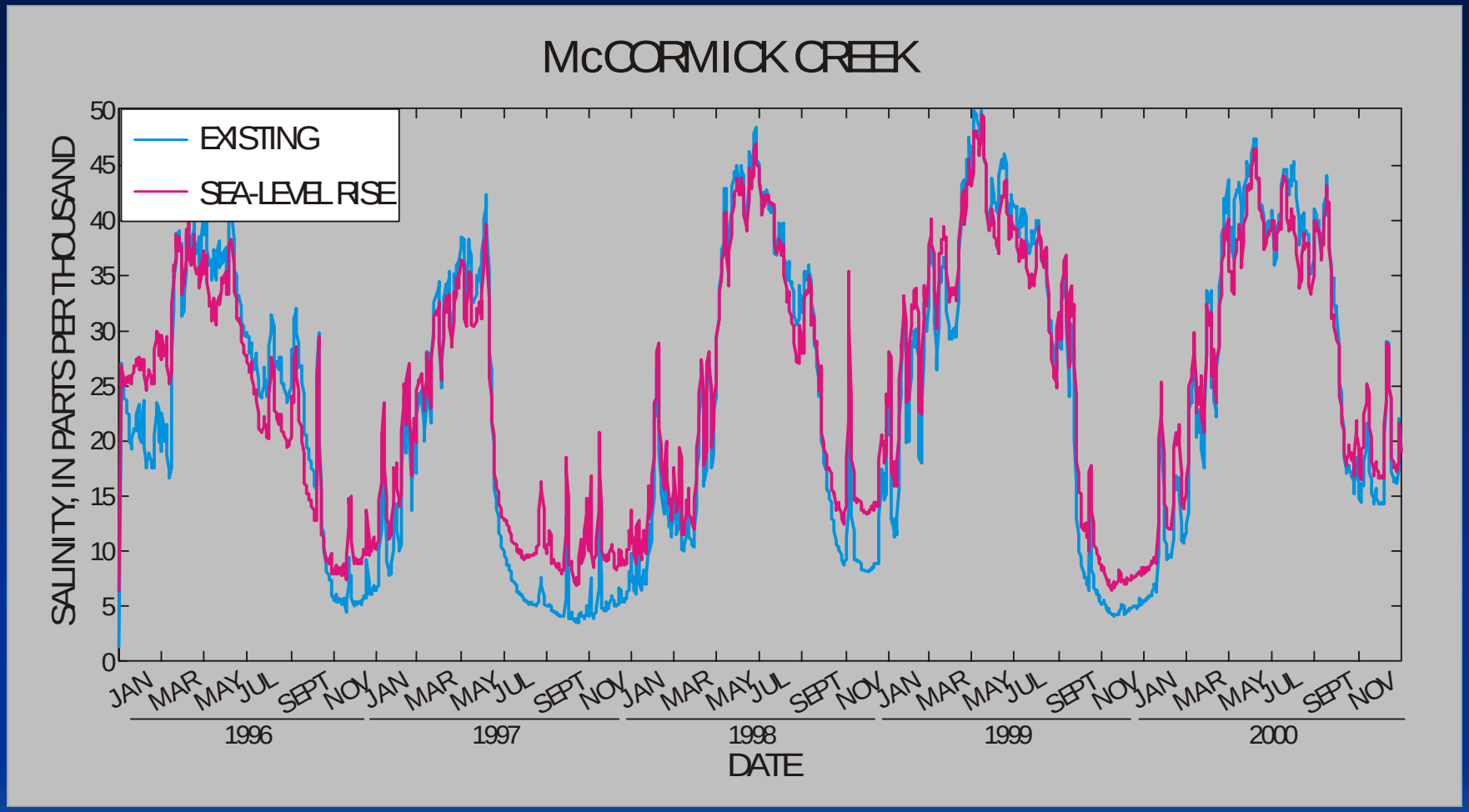
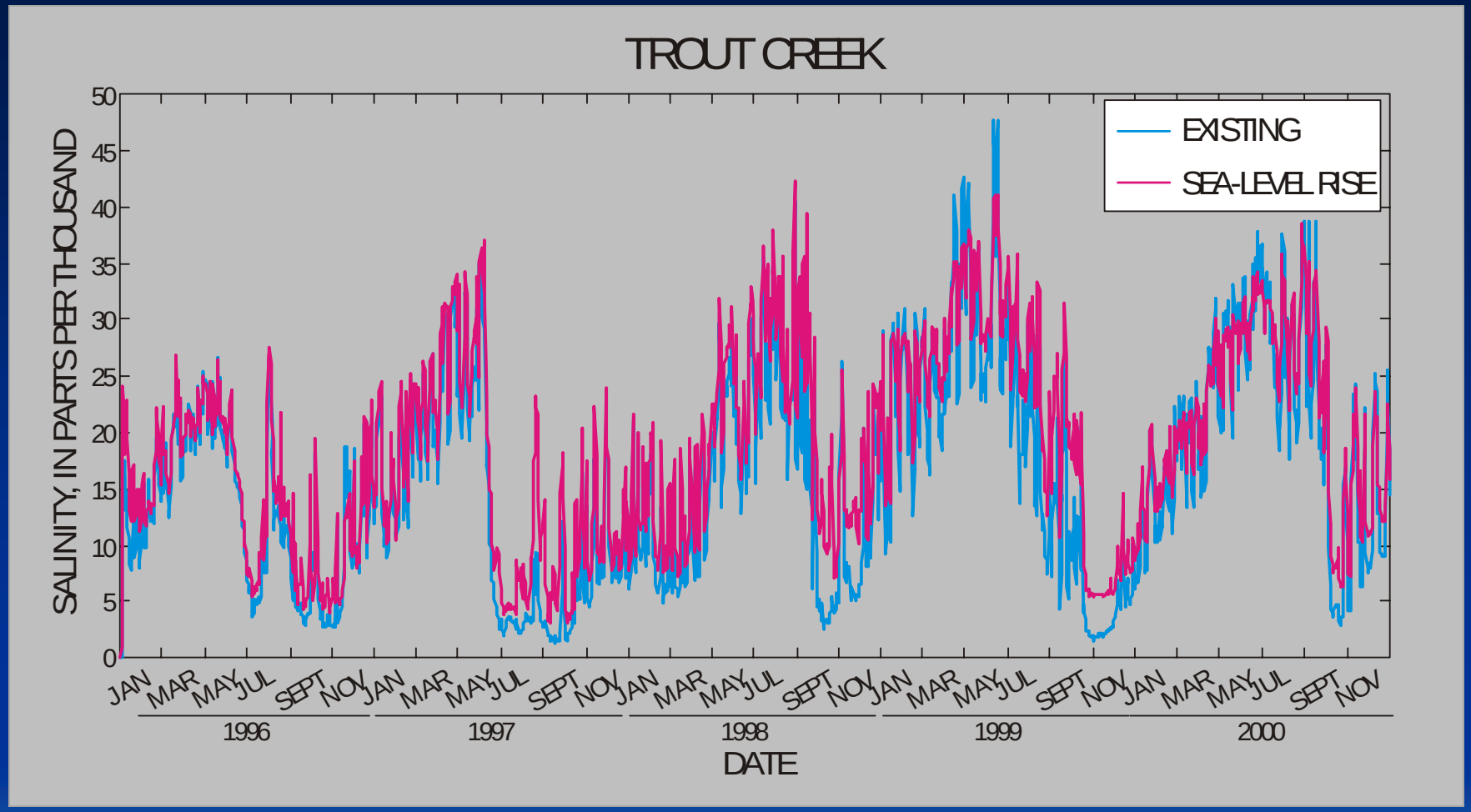
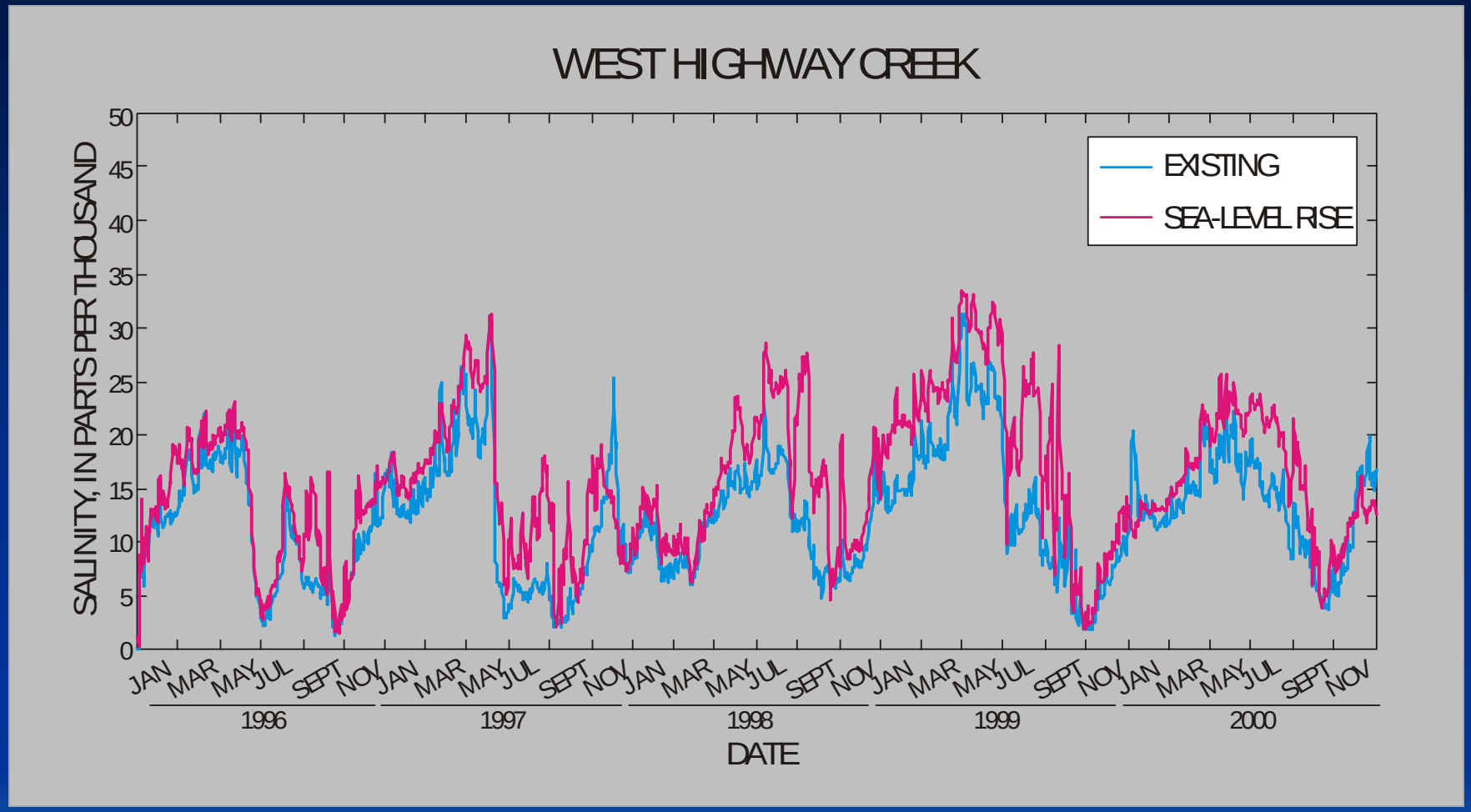

SICS model area
Simulation of Florida Bay water levels raised a minimal 8 cm
G-1502
G-3355
NP_RPL
G-3620
G-3621
R127
EVER4
CY3
CY2
NP67
NP_P46
G-1251
G-3354
TSH
CV9NR
EVER7
CT27R
EVER6
G-3353
EVER5
EP1R
P37
EPGW/SW
EP12R
NP_NMP
E146
West_Highway
CP
Upstream_Taylor
Trout
Mud
Taylor
McCormick
West Highway Creek
Trout Creek
McCormick Creek



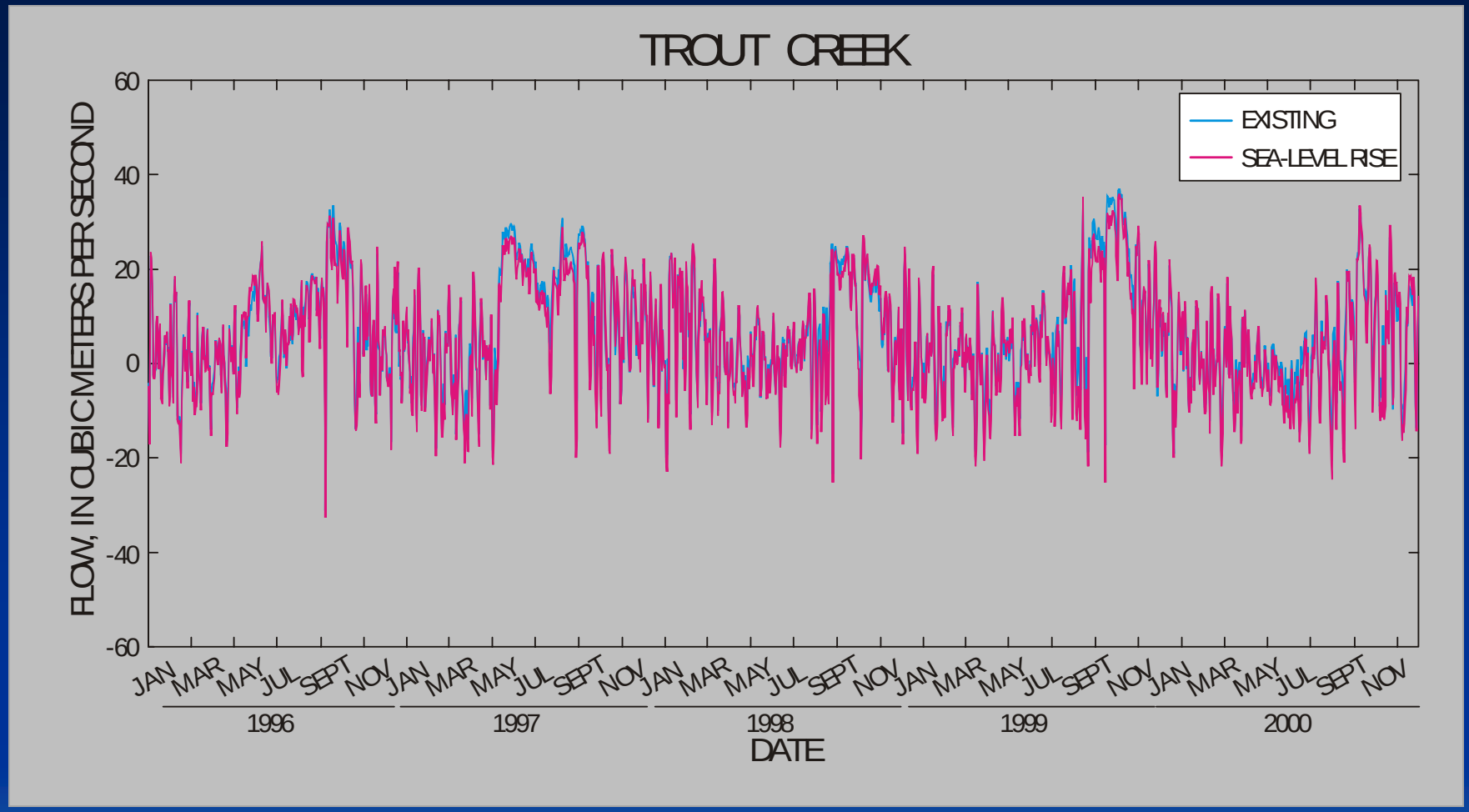
Observation – at high-salinity/low-flow times, the sea-level rise simulation salinity can occasionly be lower ?????



And occasionally here too.



Not as much here, but some.



Discharge fluctuations release “backed up” water.
Inland boundary inflows are set the same as existing.

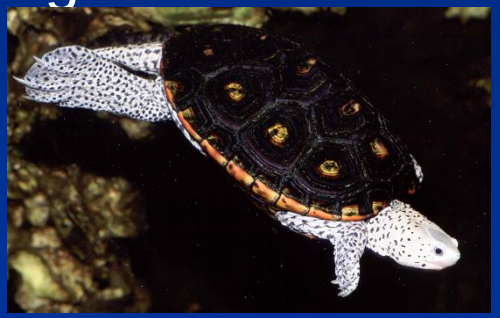
Concerns

- Maintaining the same inland inflows when sea level rises may induce significant error.
- Possible that simulated release of “backed up” water would not occur or occur less with corrected inland inflow boundaries.
- Difficult to ascertain magnitude of change in inland boundary inflows due to sea-level rise.

Heat Transport Model and Species Habitat Use

Collaborative Effort with Hydrology and Biology

- Coastal hydrology model:
  - water temperature and salinity fluctuations that determine habitat suitability
- Model which can be used for research and management of many organisms and communities
  - Manatees
  - Oysters
  - Sharks
  - Many species of fish
  - Diamond Back Terrapins
  - Invasive Species



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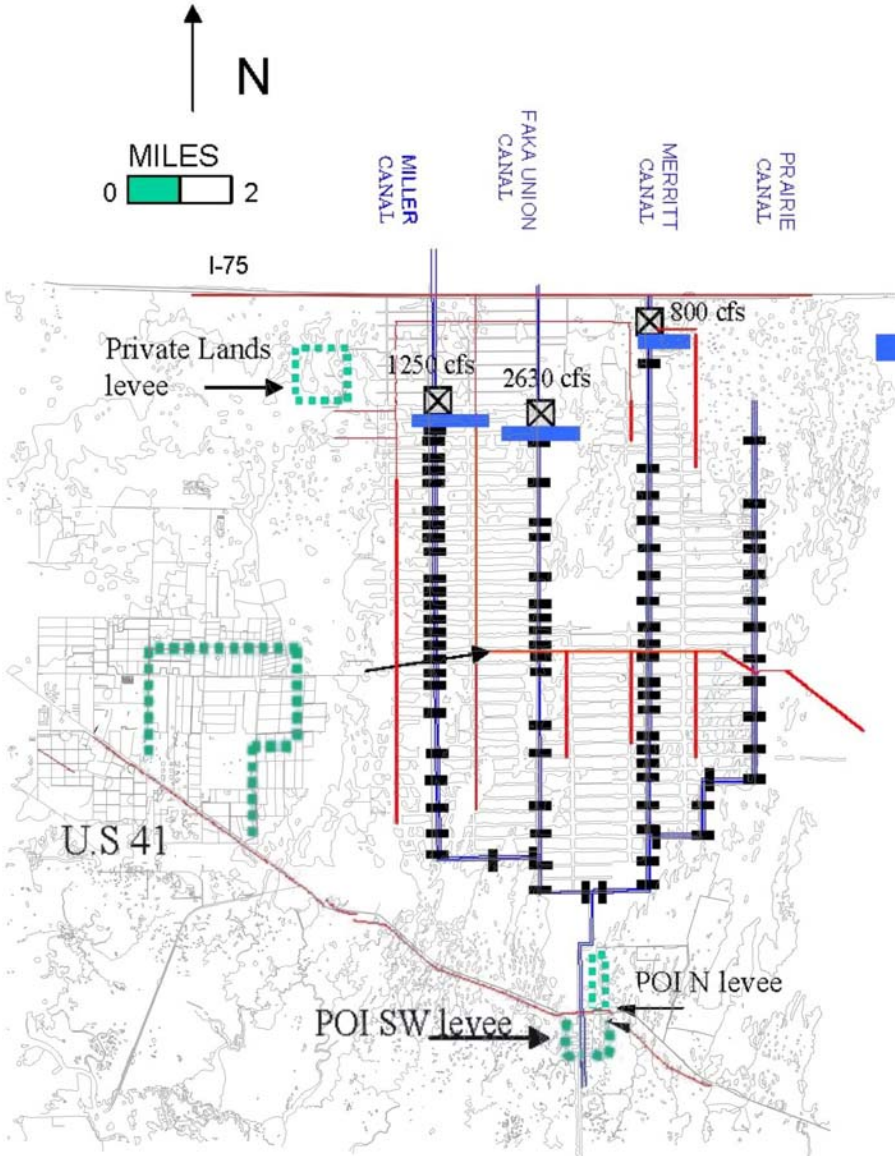
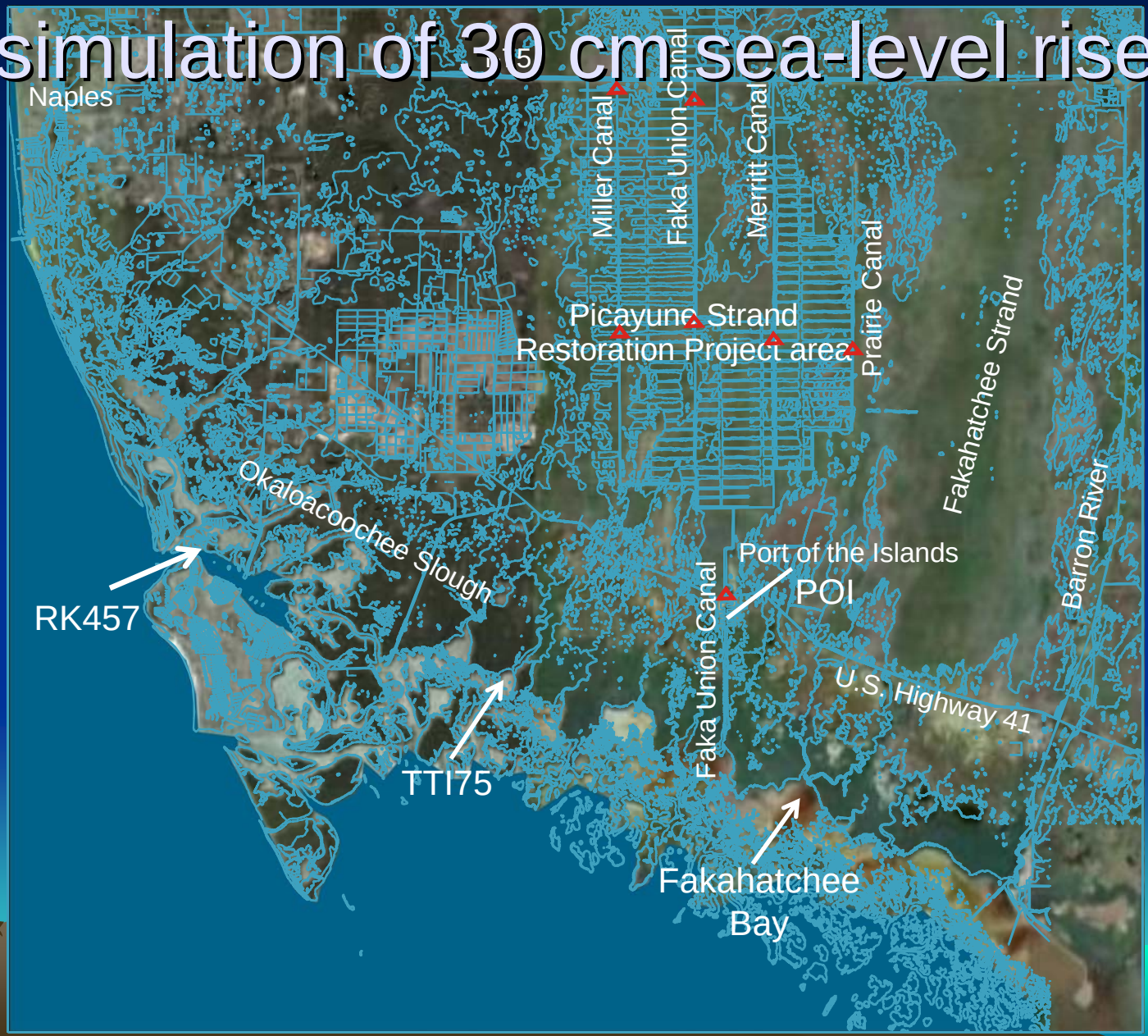
Picayune Strand Restoration Project

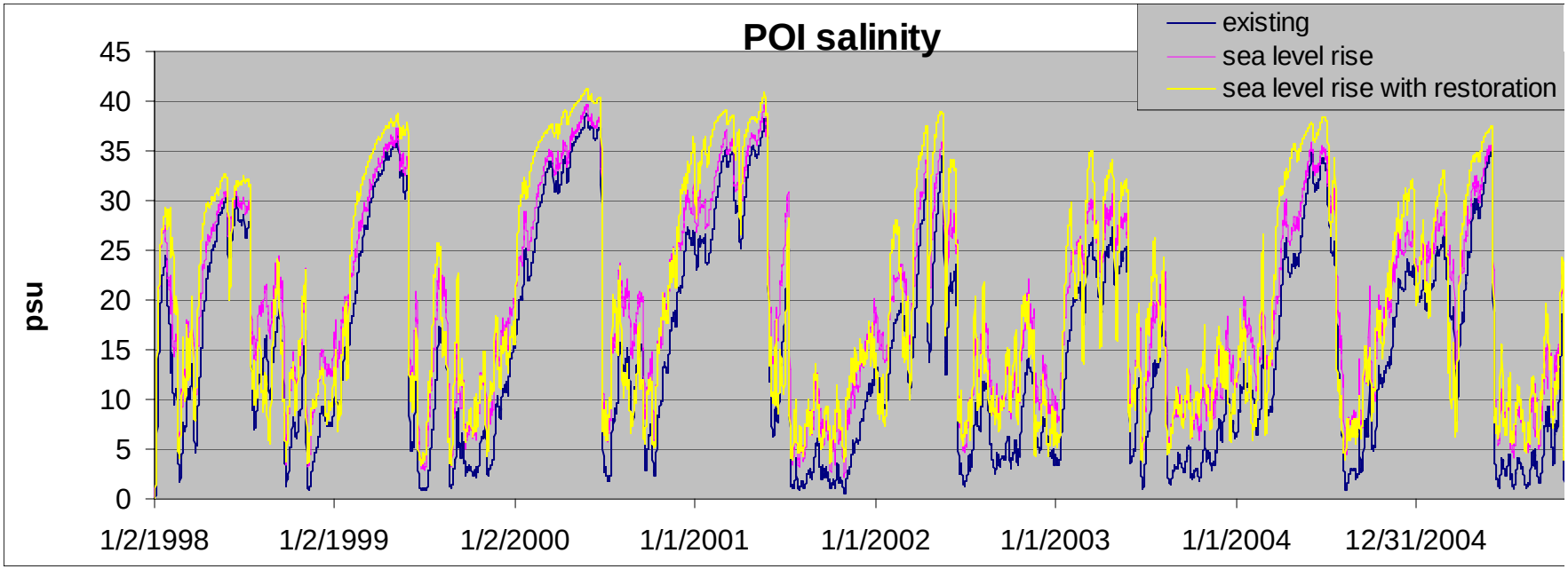


Elements

- 3 Spreaders
- 3 Pump Stations
- 83 Canal Plugs
- -227 miles of Road Removed
- Flood Protection Levees

Ten Thousand Islands model simulation of 30 cm sea-level rise




POI salinity
existing
sea level rise
sea level rise with restoration
psu
45
40
35
30
25
20
15
10
5
0
1/2/1998
1/2/1999
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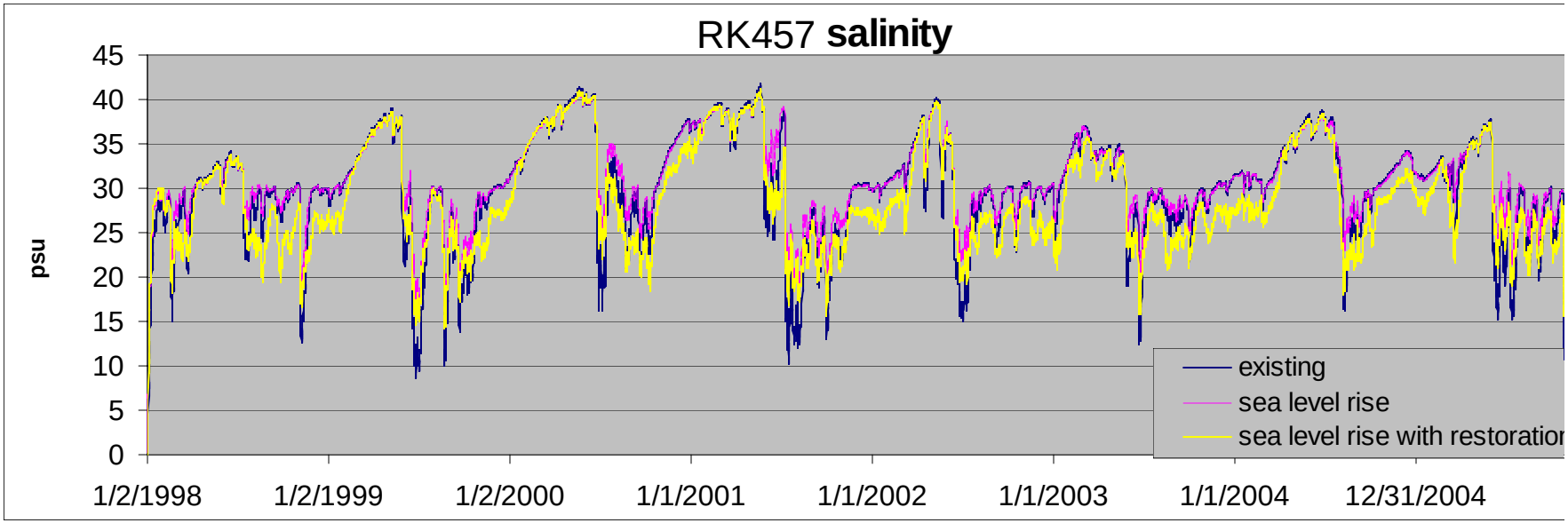
1/1/2002
1/1/2003
1/1/2004
12/31/2004


RK457 salinity
psu
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existing
sea level rise
sea level rise with restoration
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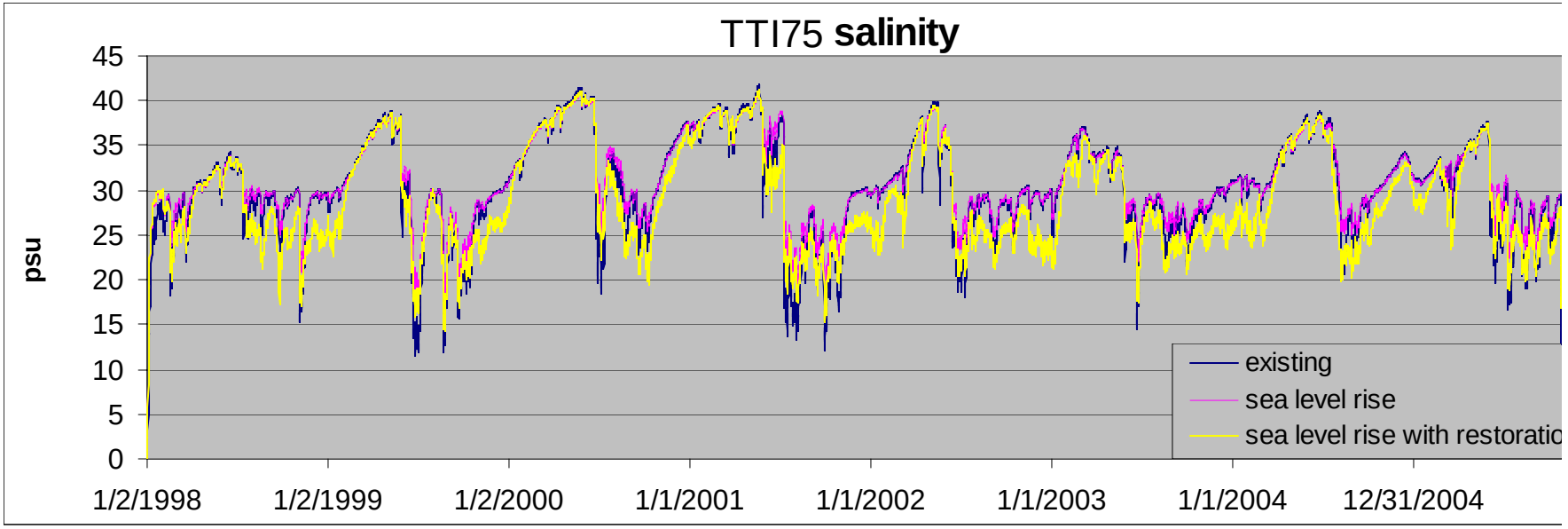
12/31/2004


TTI75 salinity
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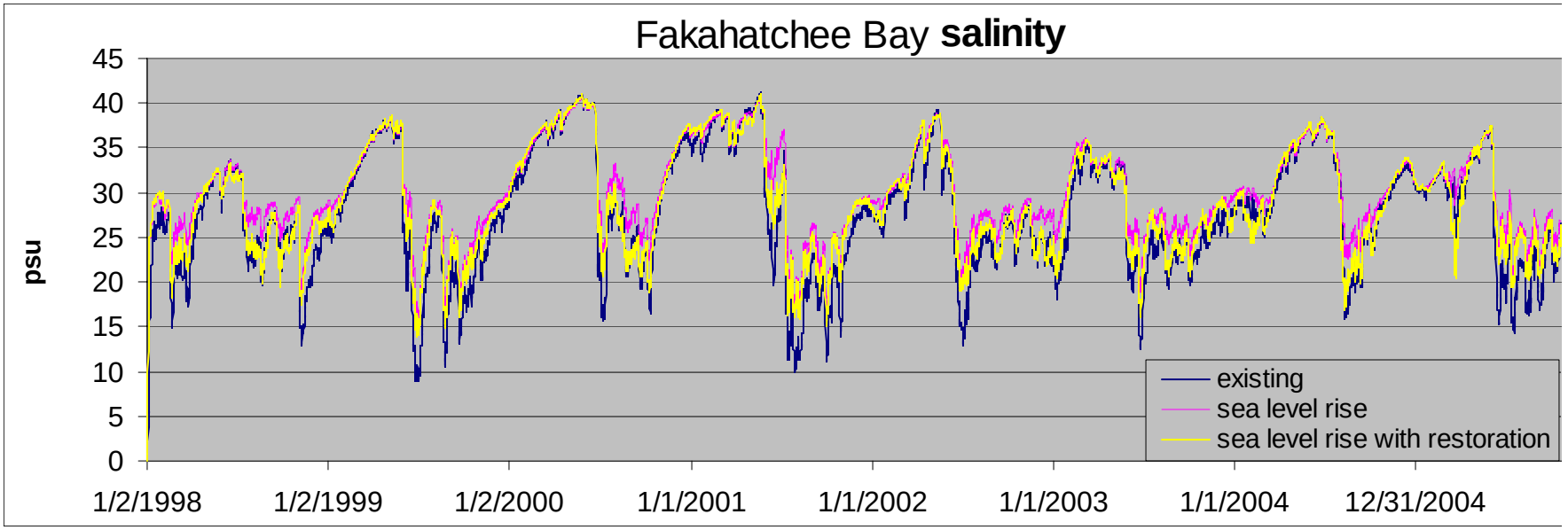
existing
sea level rise
sea level rise with restoratio


Fakahatchee Bay salinity
psu
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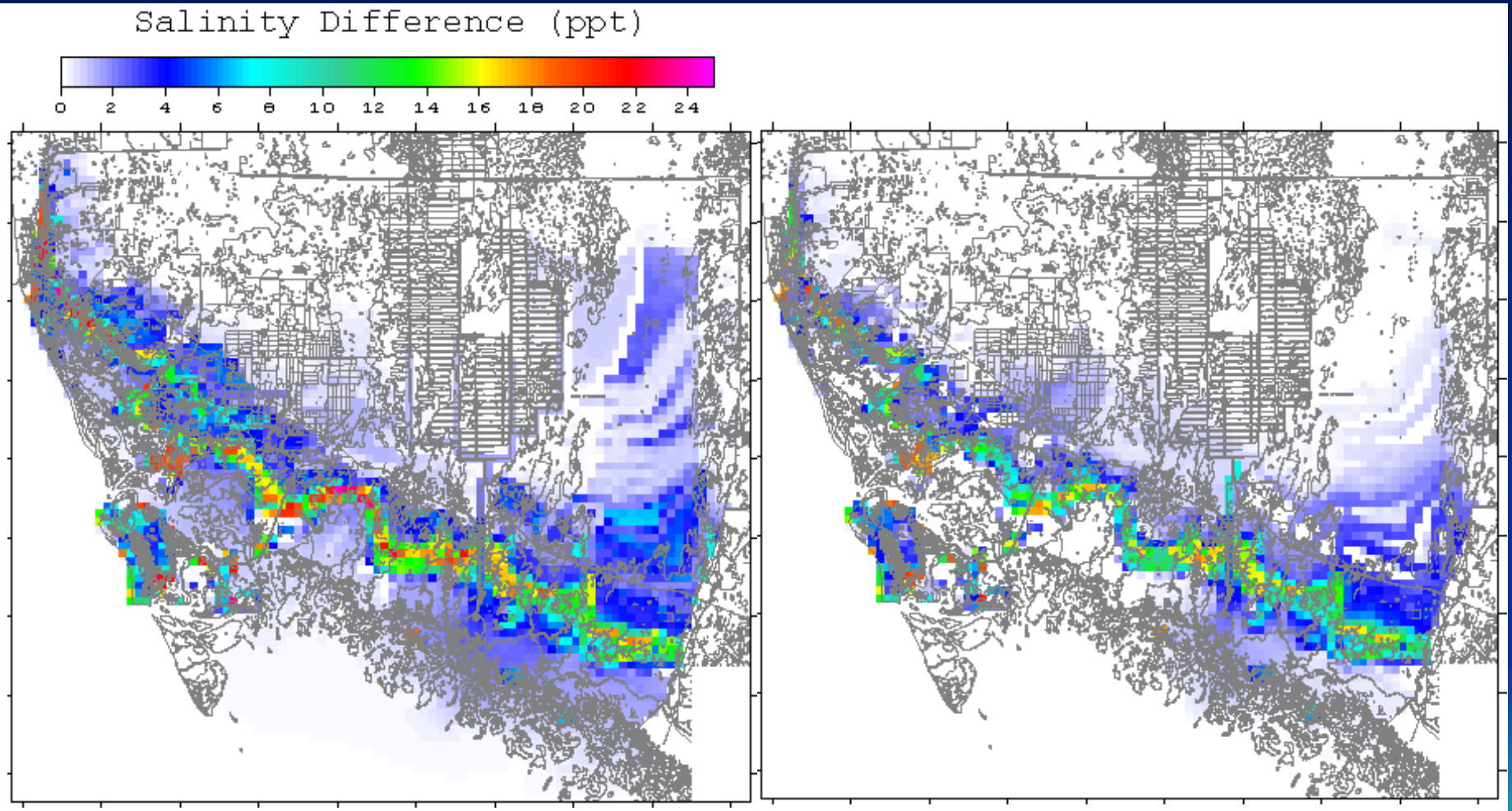
1/2/1998
1/2/1999
1/2/2000
1/1/2001
1/1/2002
1/1/2003
1/1/2004
12/31/2004
existing
sea level rise
sea level rise with restoration

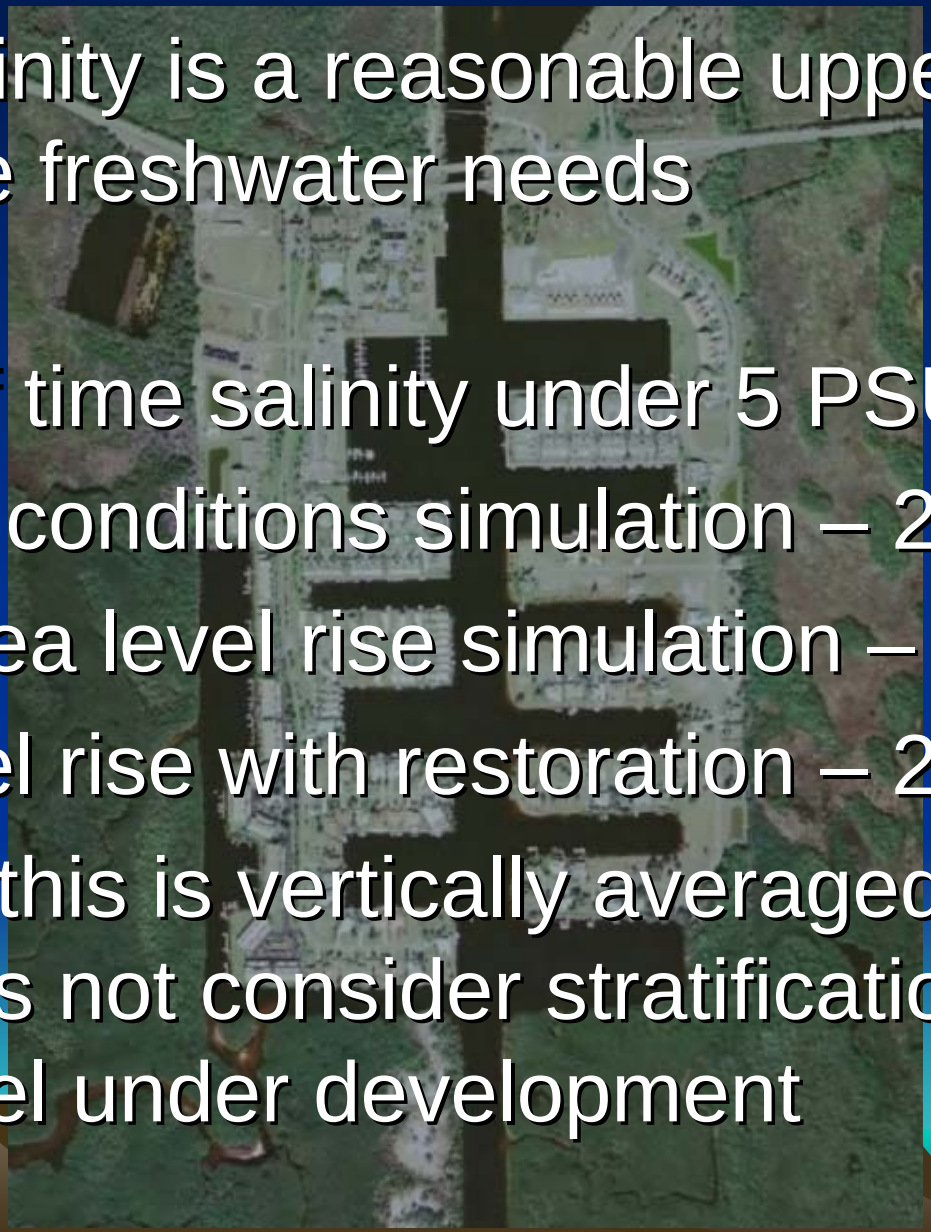
Change in average salinity with 30 cm sea level rise



no restoration

with restoration

Port of the Islands



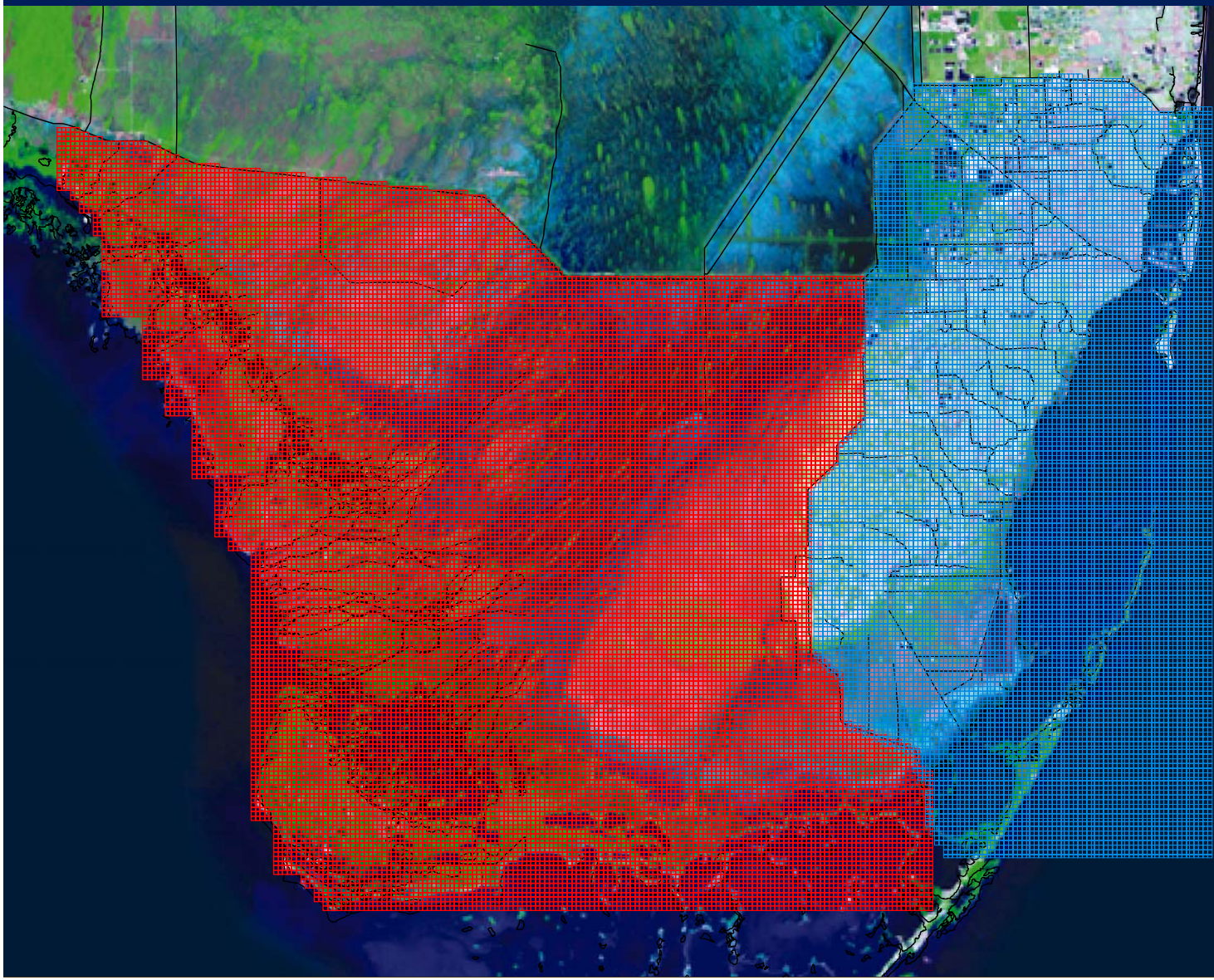
5 PSU salinity is a reasonable upper limit for manatee freshwater needs

Percent of time salinity under 5 PSU

- Existing conditions simulation – 23.4 percent
- 30 cm sea level rise simulation – 3.2 percent
- Sea level rise with restoration – 2.8 percent

However, this is vertically averaged salinity and does not consider stratification as in the 3D model under development

FUTURE CLIMATE-CHANGE SIMULATIONS
BISECT - LINKAGE OF TIME AND BISCAYNE MODELS



- Simulate climate change effects on the southern coast of Florida

A tool to evaluate CERP restoration scenarios with sea level rise in both ENP and BNP

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CLIMATE CHANGE AND NUMERICAL MODELING

- **Understanding climate change and effects on ecology**
  - *Sea level rise*
  - *Temperature increases*
  - *Precipitation changes*
  - *Interaction with restoration initiatives*
- **Representation of sea level rise**
  - *Realistic range of possible rise values*
  - *Consideration of inland boundary changes*
- **Representation of other climate change factors**
  - *Simulate higher offshore and atmospheric temperatures and effects on evapotranspiration*
  - *Effects of predicted changes in precipitation*
  - *Storm event frequency and intensity effects*

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QUESTIONS?