NUMERICAL MODEL OPTIMIZATION OF SURFACE-WATER INFLOWS TO ACHIEVE RESTORATION SALINITY PERFORMANCE MEASURES

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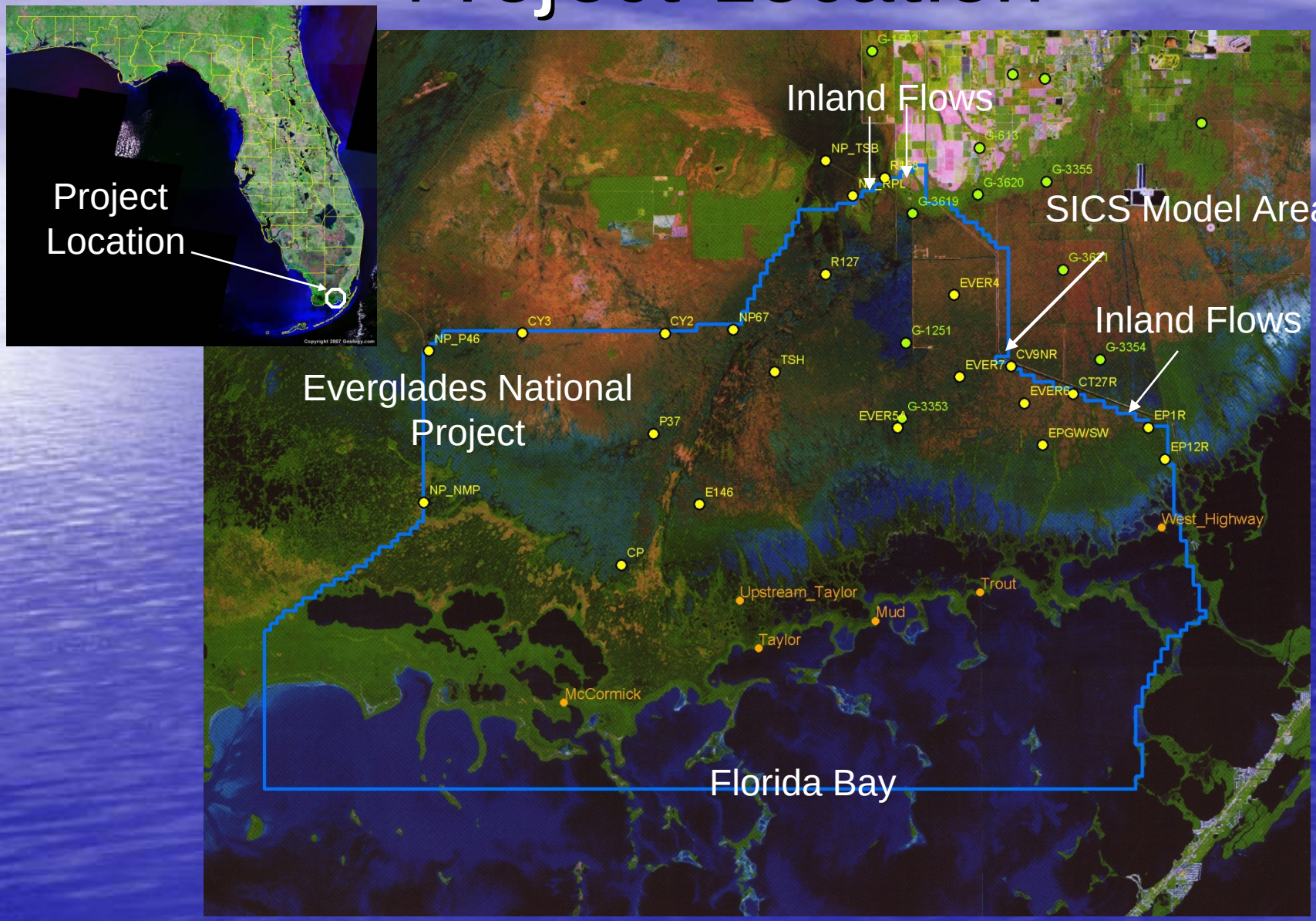
PROJECT STRATEGY

- To use inverse techniques on a numerical model to determine methods of achieving desired hydrologic objectives

- Using model simulations to analyze how specific water-management practices affect factors such as water levels, flows, and salinities.

- In lieu of trial and error methods, optimization techniques were employed to more precisely and directly define good water management alternatives.

Project Location



Tools used in experiment

- SICS Model: Coupled surface-water/ ground-water representation of southern Everglades
- UCODE: Parameter estimation code used to optimize target performance measures for physical characteristics in SICS model
- Performance Measures: The desired objectives for ecological restoration, i.e. salinity ranges

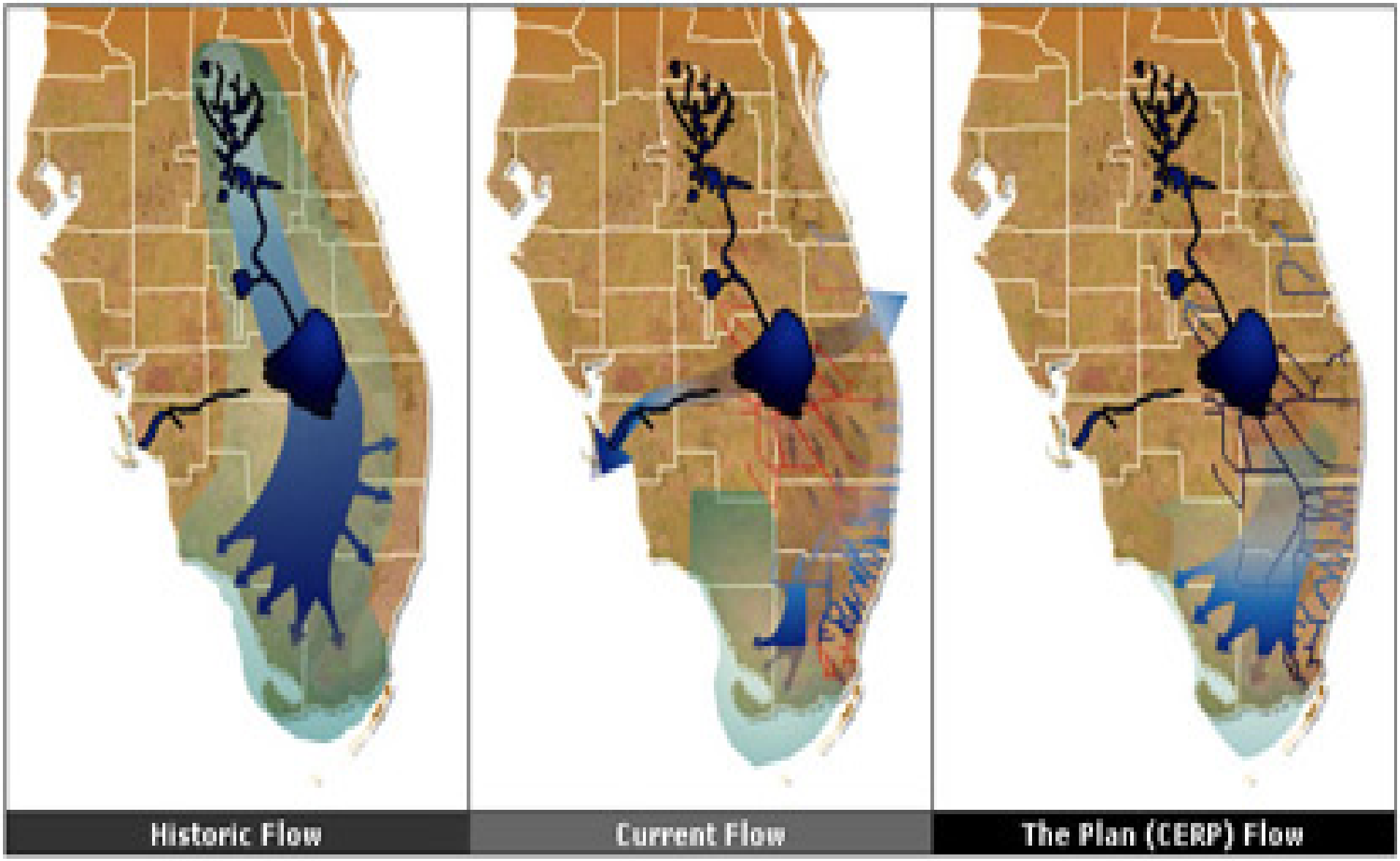
SICS Model Principles

- Uses FTLOADDS coupled hydrodynamic surface water and ground water flow model.
- Salinity transport represented in both ground water, surface water and leakage.
- Applied in several locations in south Florida.

UCODE Parameter Estimation

- Developed to perform inverse modeling for any numerical model
- User defined input and output format
- Varies parameters within allowable ranges
- Background of successful applications

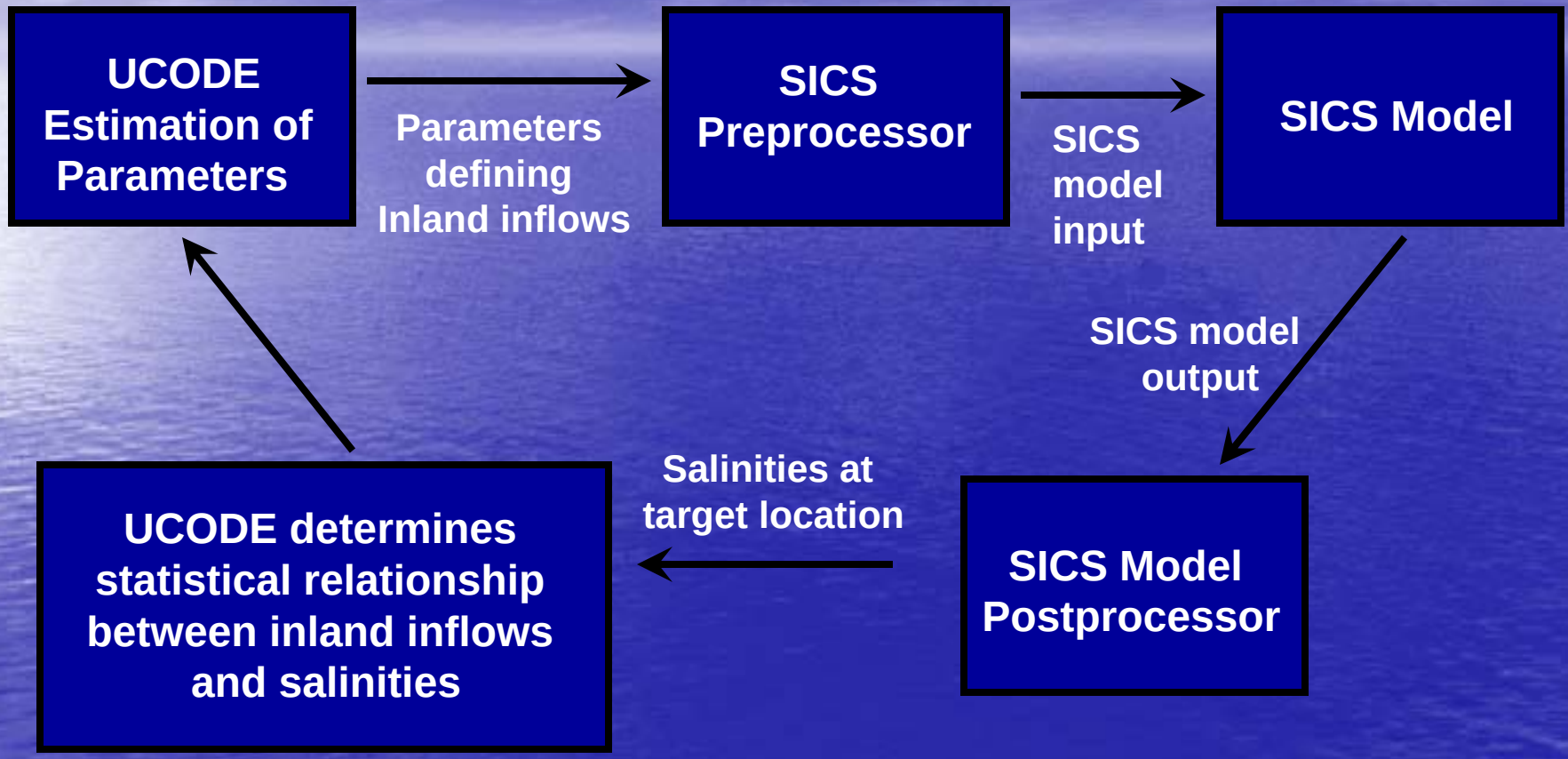
Performance Measure Strategy



METHODS

- SICS represents the coastal salinity response to changing inland flows
- UCODE adjusts the boundary condition inland flows in the SICS model based on SICS output salinities
- UCODE and SICS interact iteratively to determine the inland flows that induce the desired salinity value.

Optimization Procedure



SICS Model Area and Water Delivery Inflows

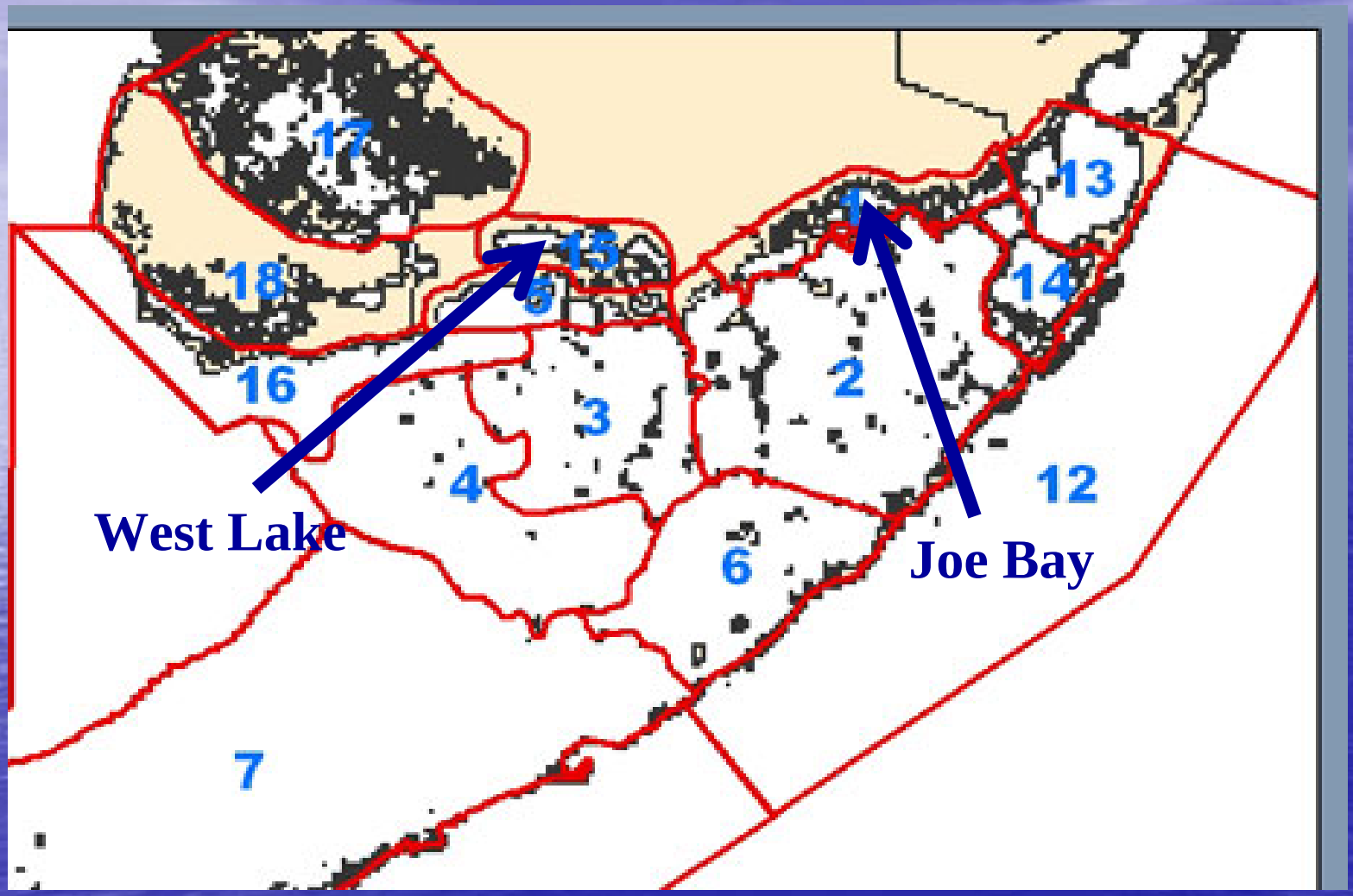
METHODS- continued

- Six Parameter Method: Two multipliers for each discharge inflow locations; one for higher than average flows and one for lower than average flows.

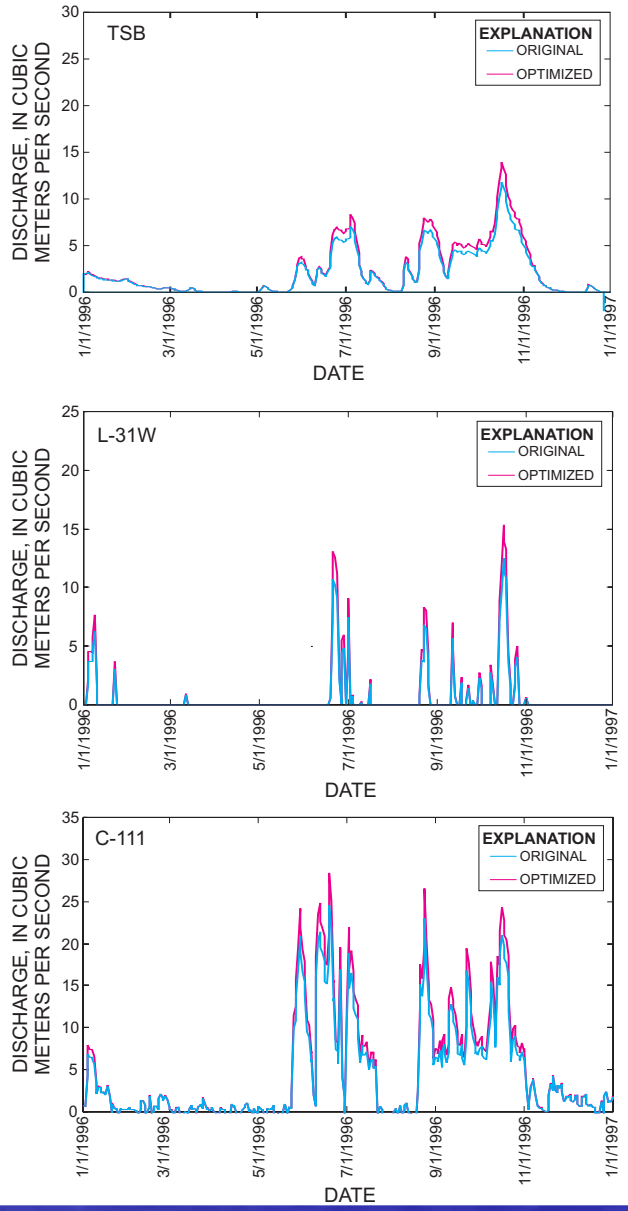
- Two Parameter Method A: Two multipliers for TSB discharge, one for higher than average flows and one for lower than average flows. Discharges at the other two inflow points are set in the proportional to TSB as existing. More computationally efficient than six parameter method.

- Two Parameter Method B: Same as method A, save multipliers are selected for higher than average **salinities** and lower than average **salinities**

FBFKFS Zones for Defining Performance Measures

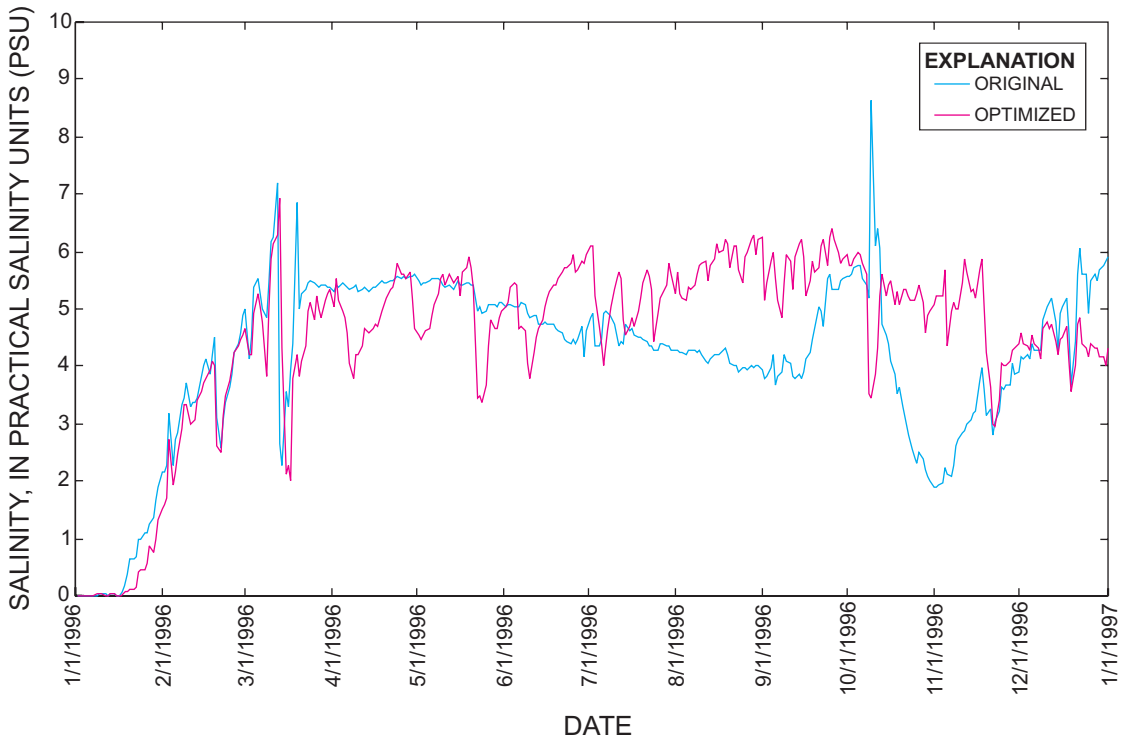


RESULTS



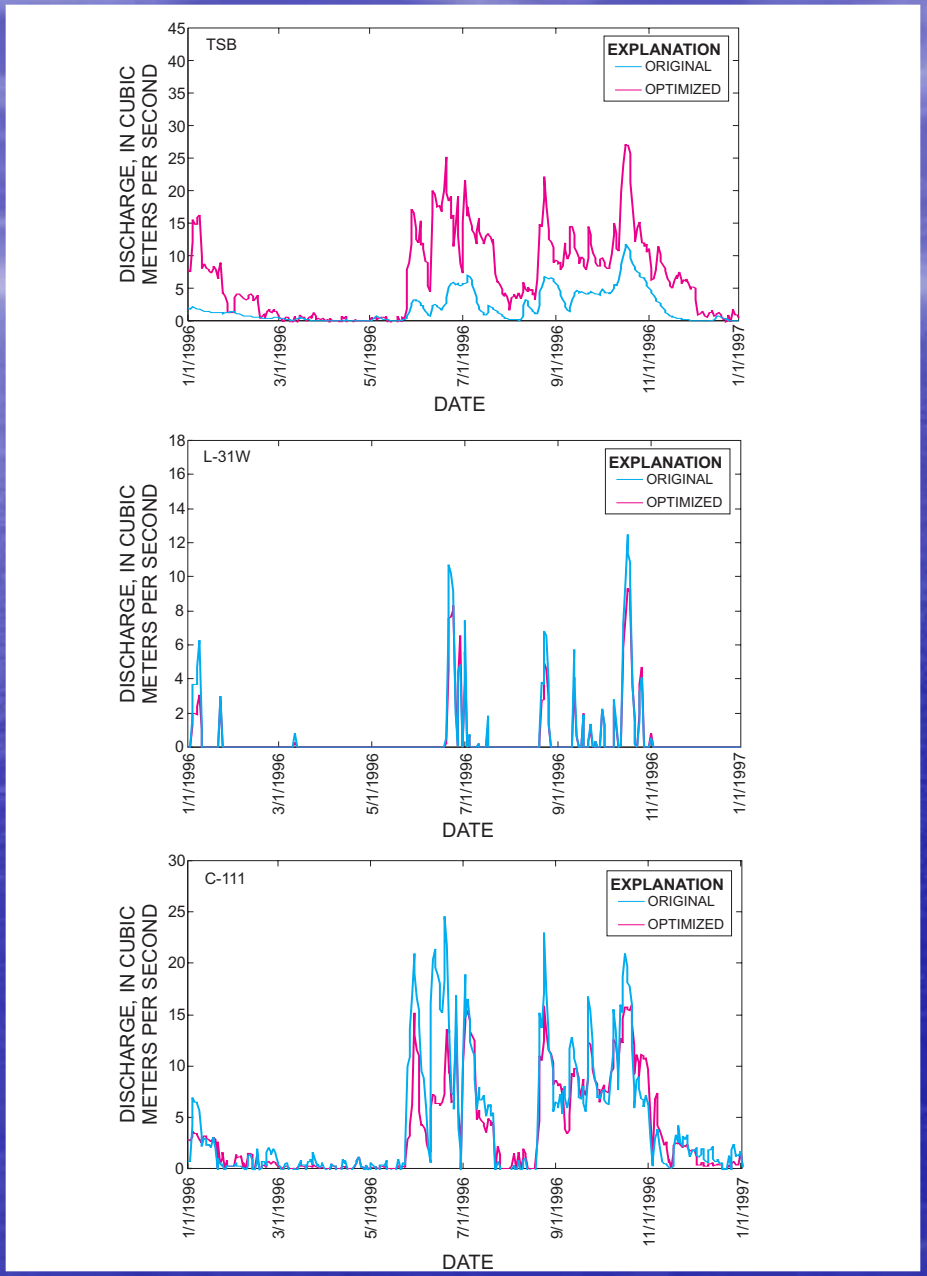
Original and optimized model inflows for six-parameter method

RESULTS- CONTINUED



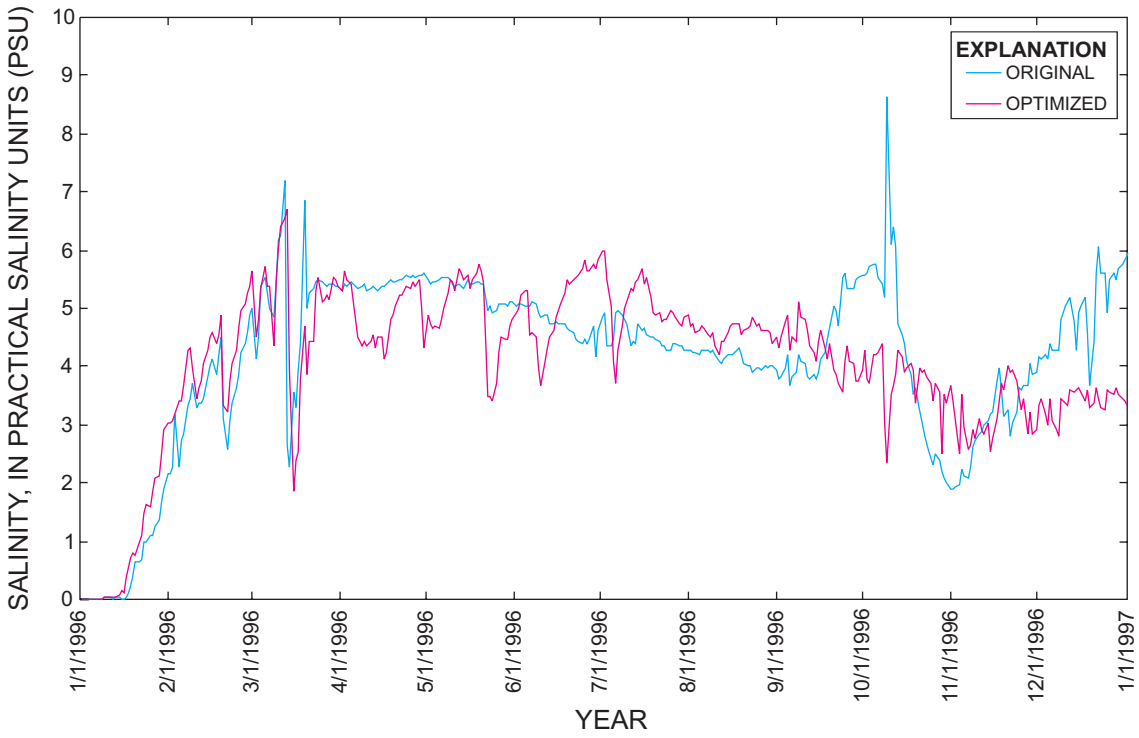
Zone 1 original and optimized salinities for six parameter method.

RESULTS- Continued



Original and optimized model inflows for two-parameter method, flow criteria.

RESULTS- CONTINUED



Zone 1 original and optimized salinities for two parameter method, flow criteria.

Disadvantages in UCODE application

1. In order to bound the simulated inflows, a parameter transformation was necessary.
2. By matching to a synthetic timeseries, possible alternate solutions are not considered.
3. The SICS model inflow boundary conditions depend on conditions outside the model domain, so model-produced values may not be realistic.

Advantages of Using UCODE

- This method creates water management scenarios rather than using the standard method of trial and error simulations of proposed scenarios.
- Optimizing the decision making process rather than a subjective approach.
- UCODES output statistics define uncertainty in the system.

Alternative Applications

- Numerical model output can be used to define a statistic which would be minimized or maximized by UCODE; such as total variance, difference with optimal value, or hydroperiods

- Management model – Use larger-scale model instead of SICS so hydraulic structure operations can be optimized for a more realistic and useful solution.


QUESTIONS?