Design of an Oil Spill Model Using Modern Software Design Principles & Associated Field Studies

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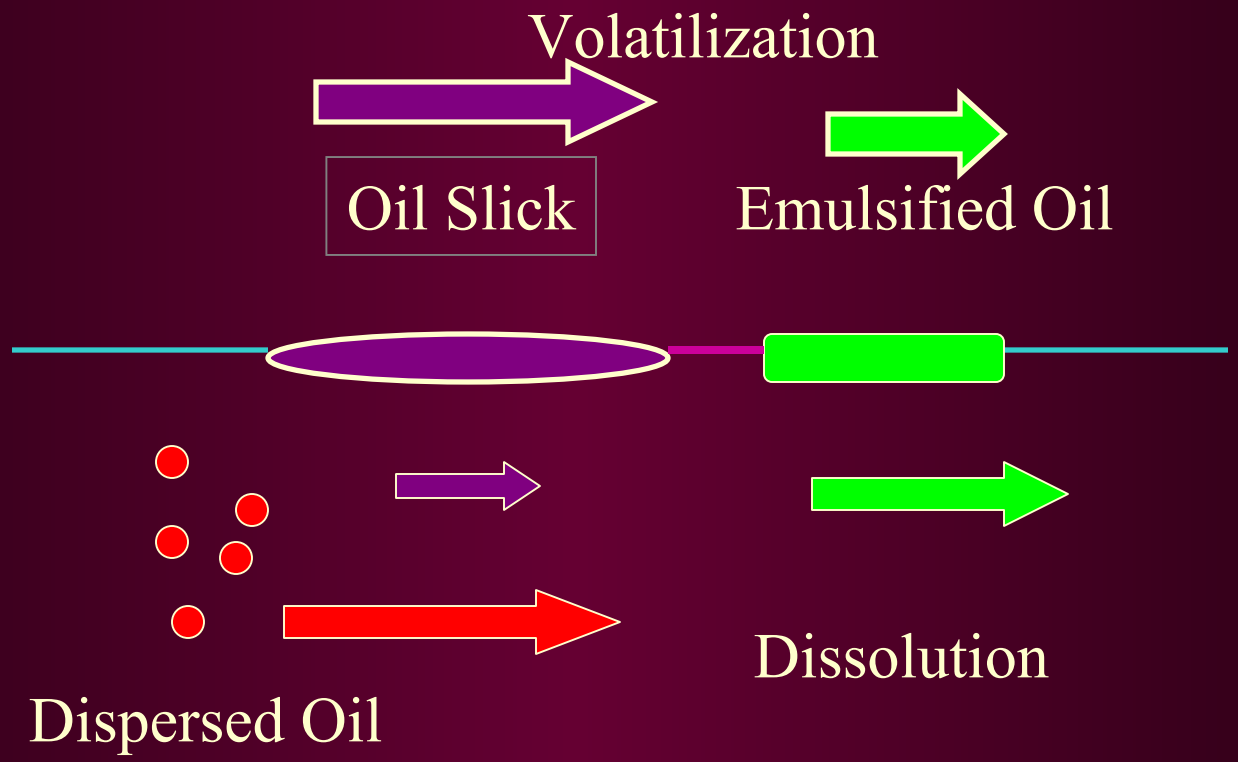
Outline

- Model Design--Software Concepts
- 2001-2002 Field Studies at the Lock Lake tidal marsh
  - Significant Flow and Transport Features
  - Preliminary Simulations of Lock Lake
- Conclusions

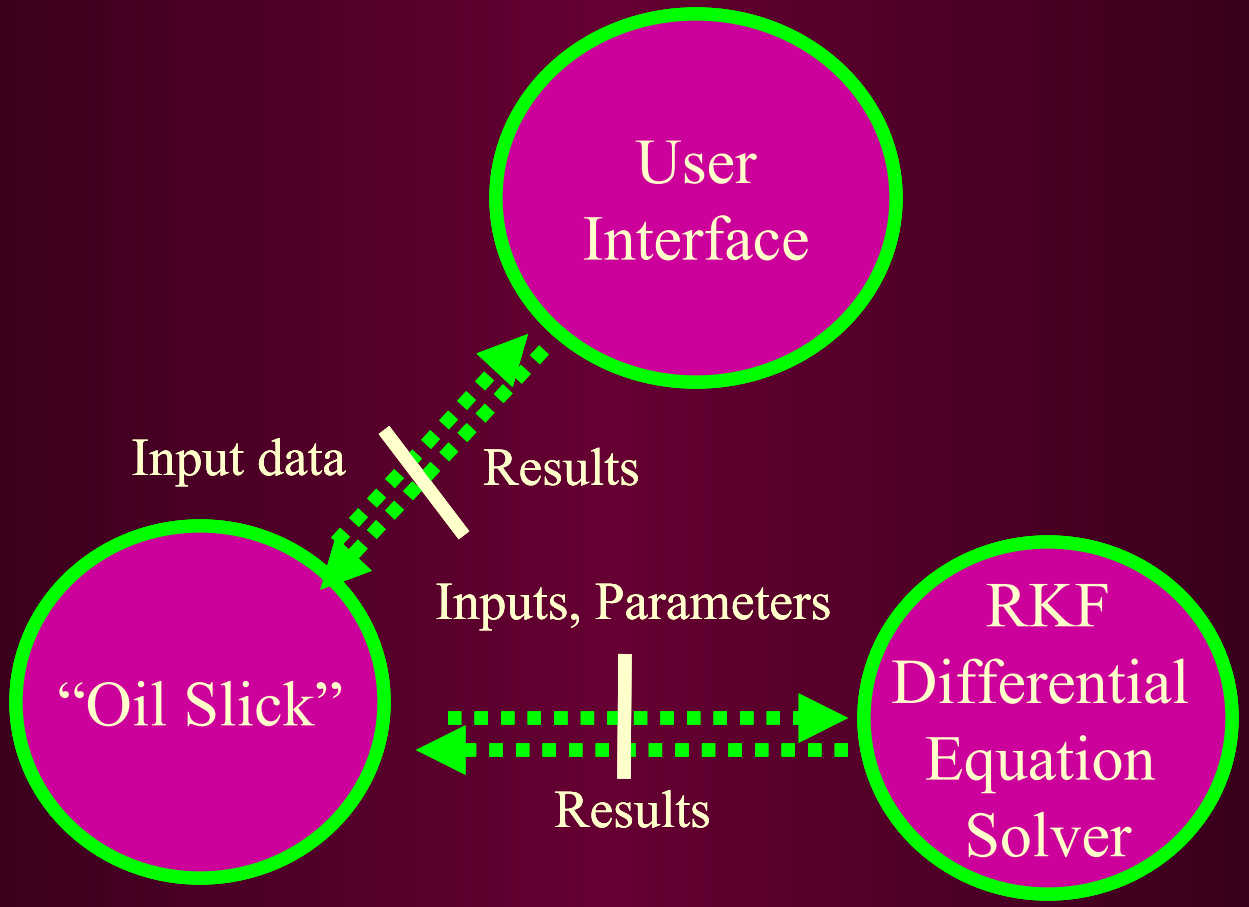
Oil Spill

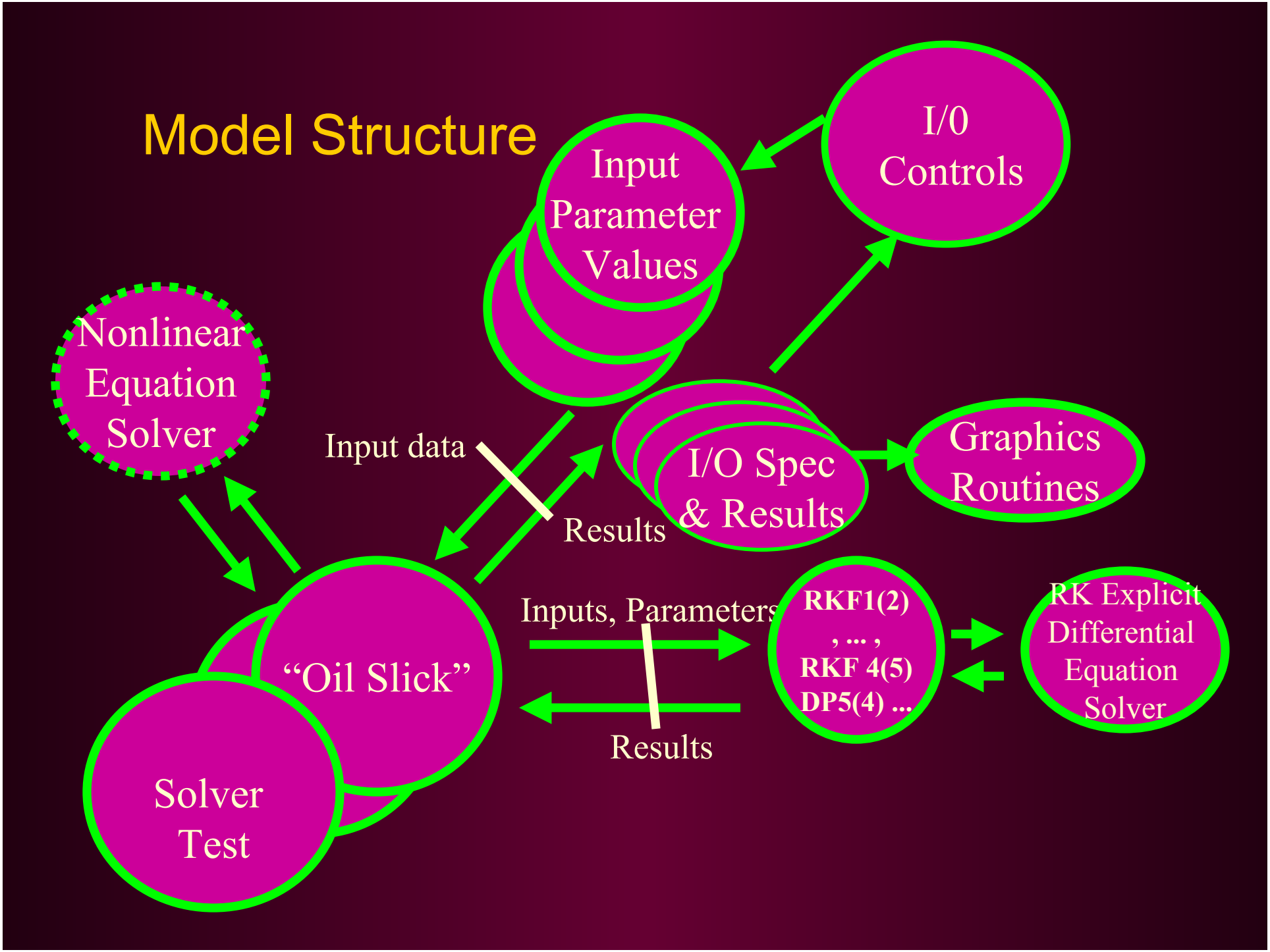


Object Oriented Structure

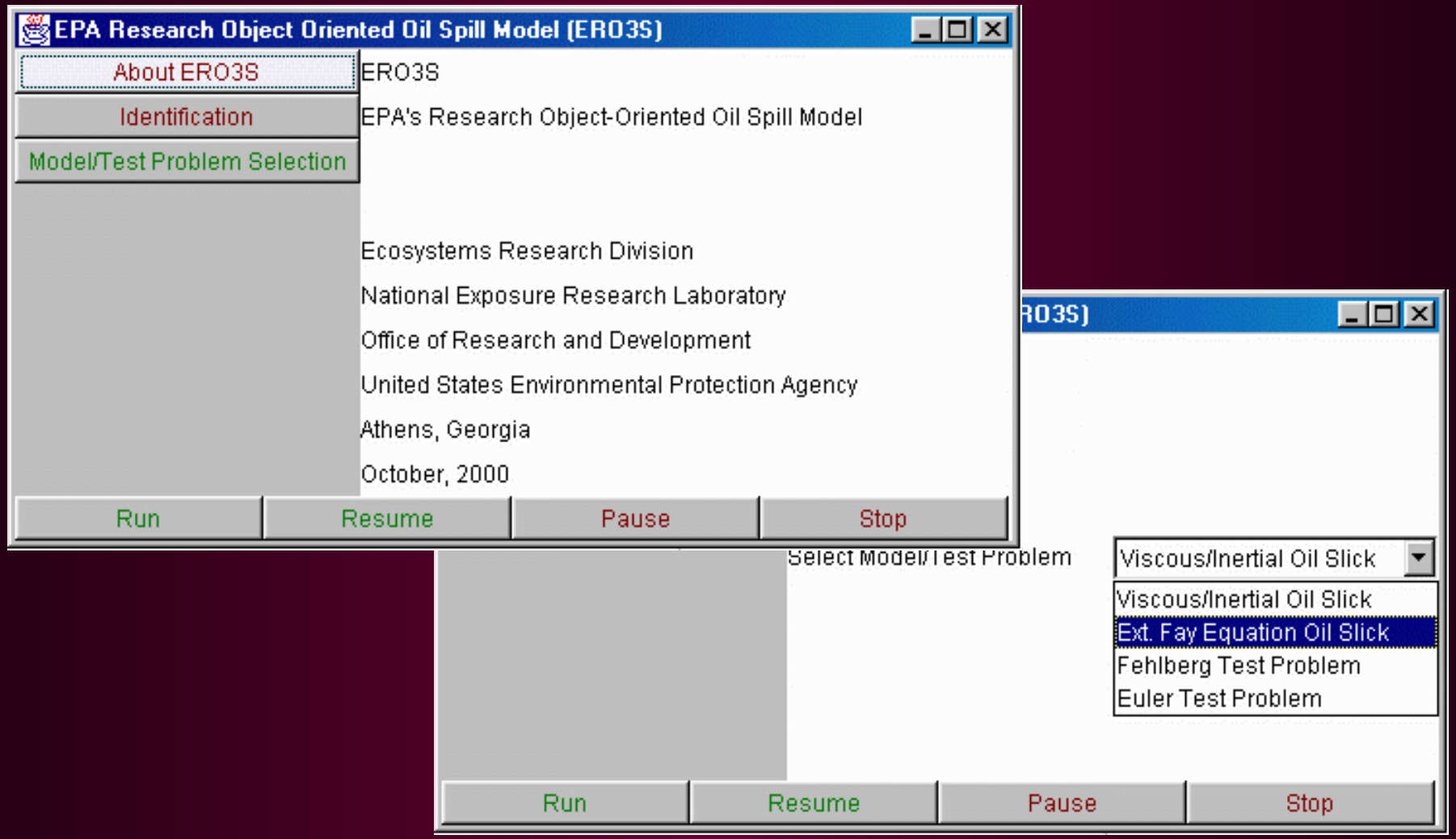
- Natural alignment with Problem Definition
  - Polymorphism: Slicks vs. droplets
  - Inheritance: Multiple droplets, e.g.
- *Vast* improvement over serial languages:
    - Flexibility
    - maintainability
    - testing
    - QA/QC
    - Cost is in Additional Design Time

EPA's Research Object-Oriented Oil Spill Model ----ERO^{3}S

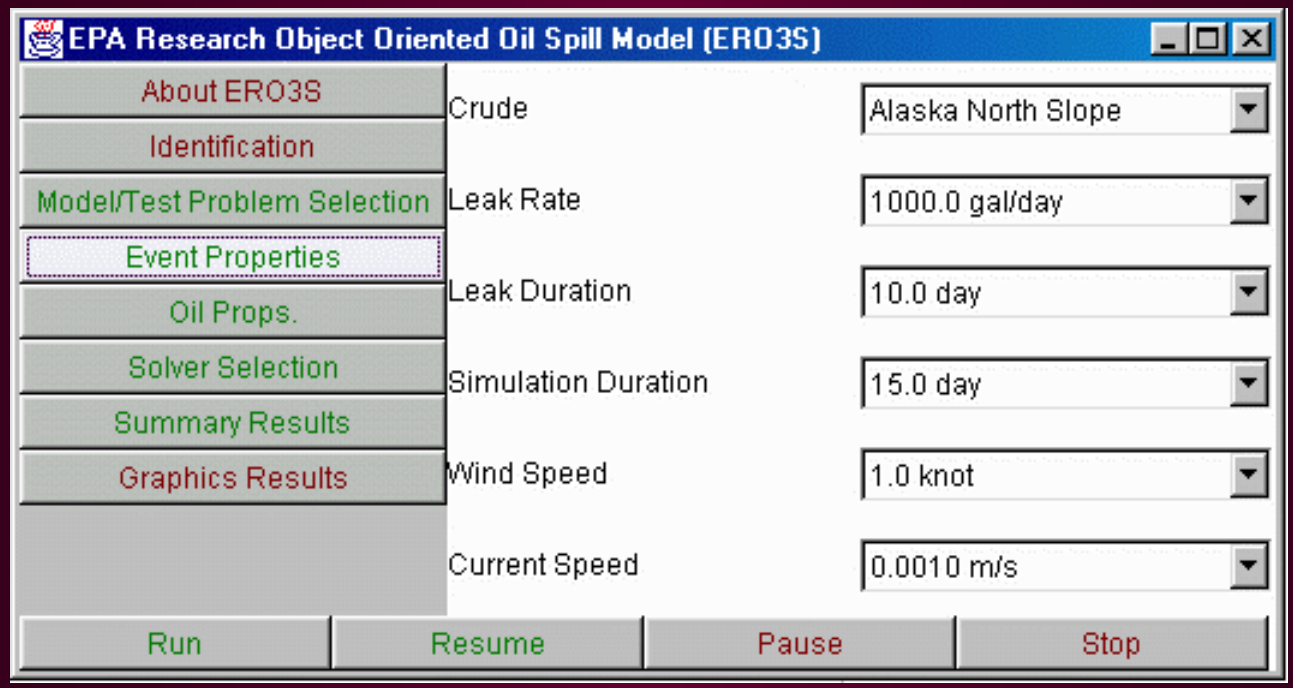




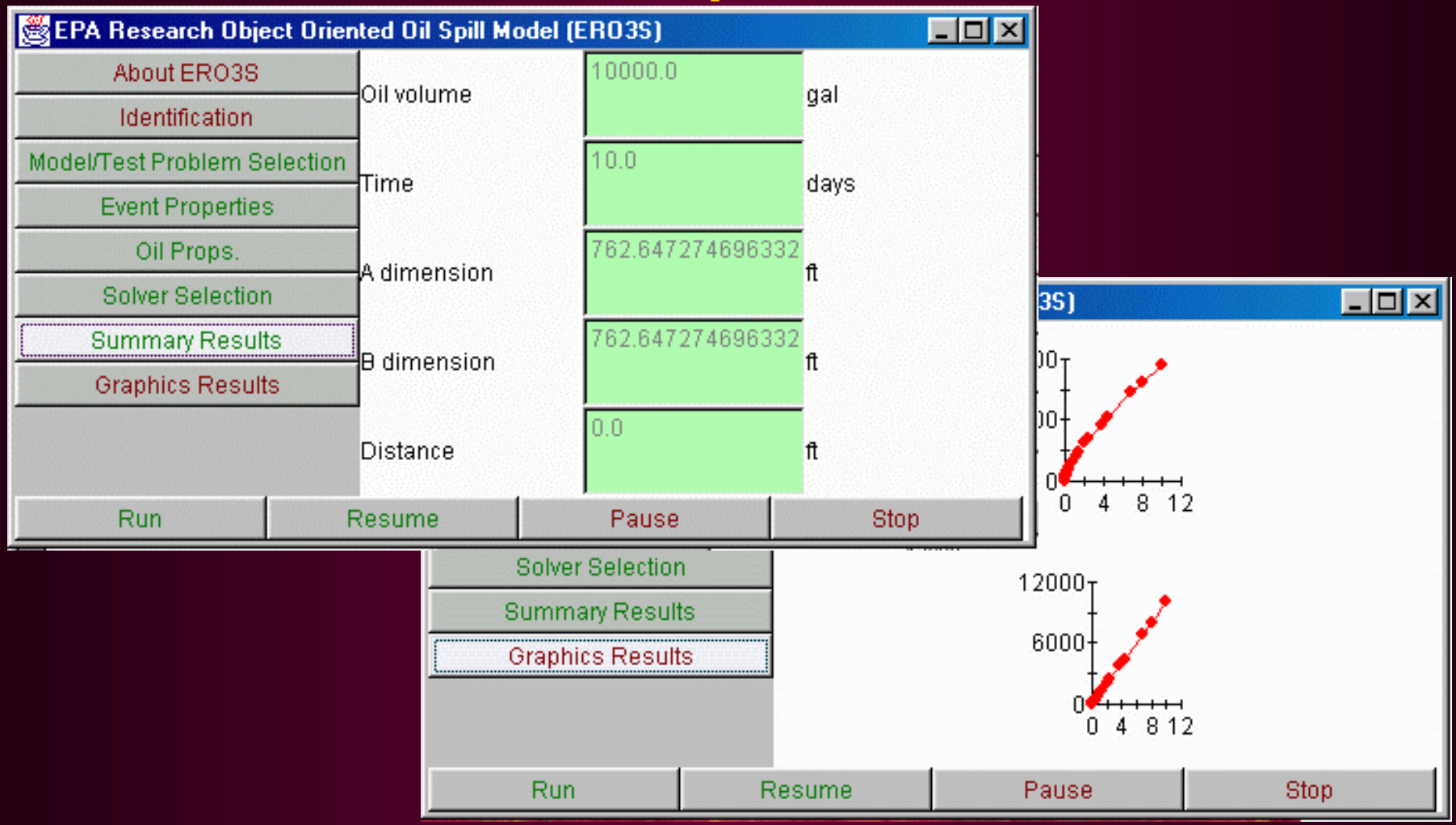
Main Screen



Input



Outputs



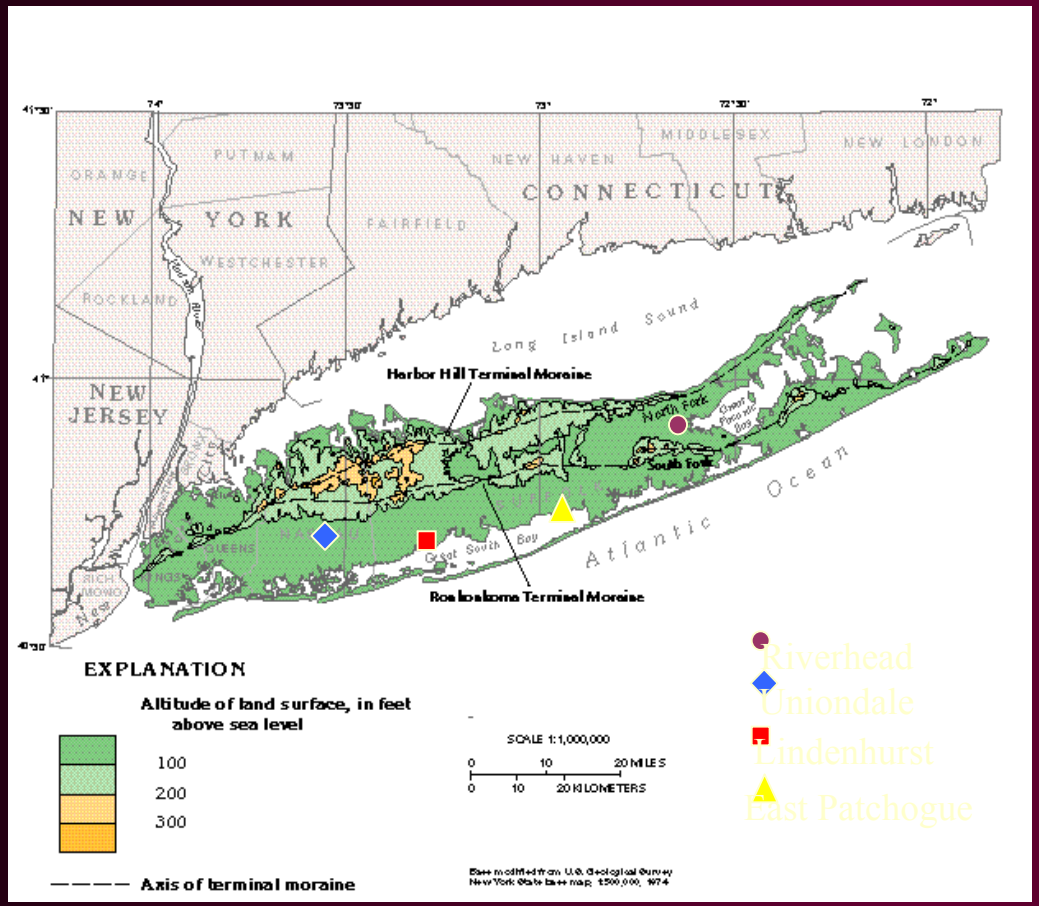
Lock Lake Tidal Marsh Study

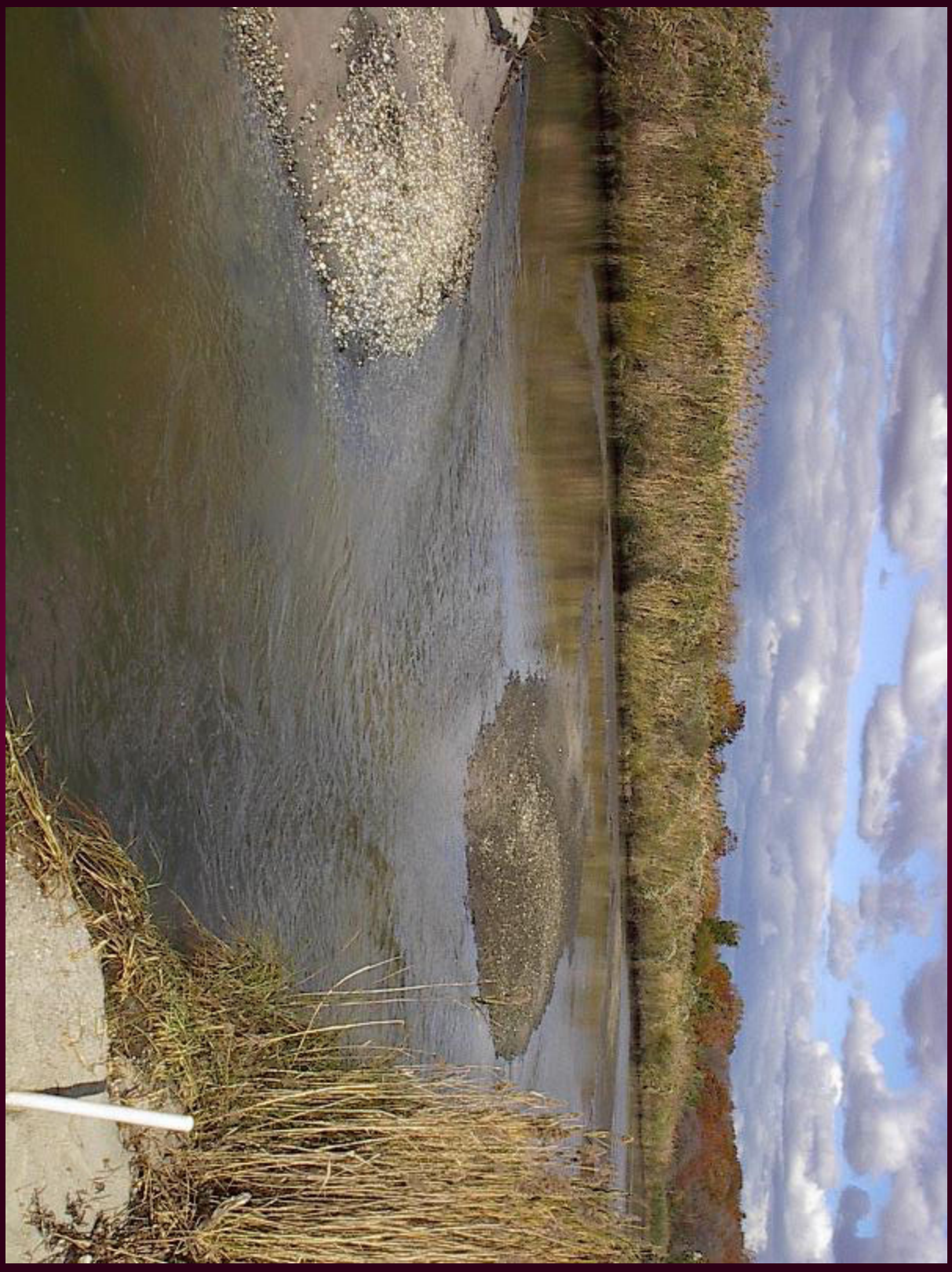
- Gain understanding from studying field site
  - Component of model design
  - We have observed phenomena we could not have guessed
  - What data are critical for model-based studies?
- Test site for hypothesis testing
  - What would be the impact of an oil spill? Emulsified fuel spill?
- Parameter estimation from field studies
  - Measure dispersion coefficients

Lock Lake Tidal Marsh

- Small tidal marsh on south shore of Long Island
- Cooperative study between
  - US EPA, NYSDEC, Temple University
- Study transport in a setting influenced by
  - Tides, ground water discharge, freshwater inflows

Lock Lake

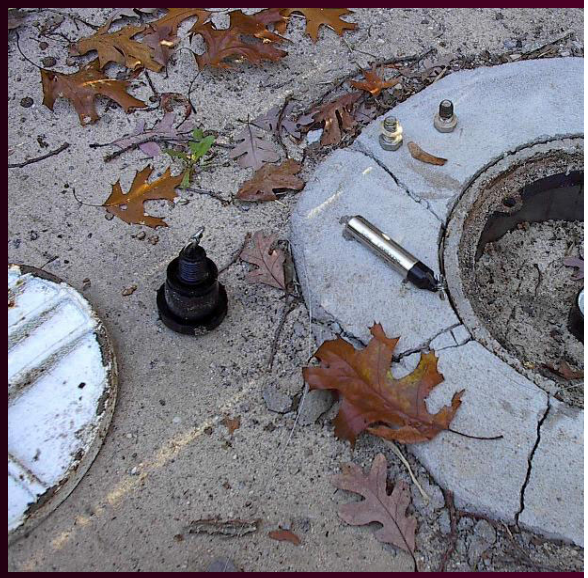


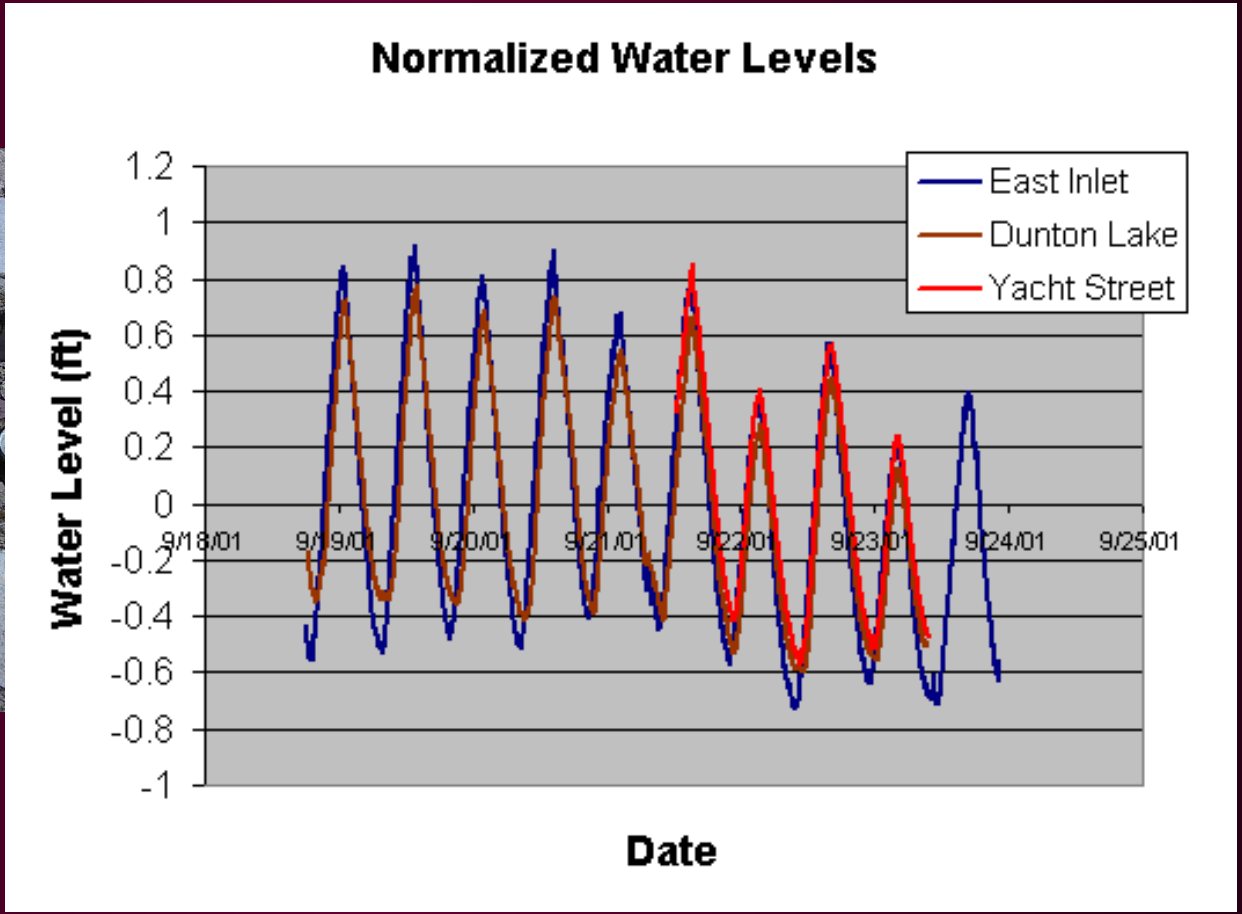


Stilling Well Data

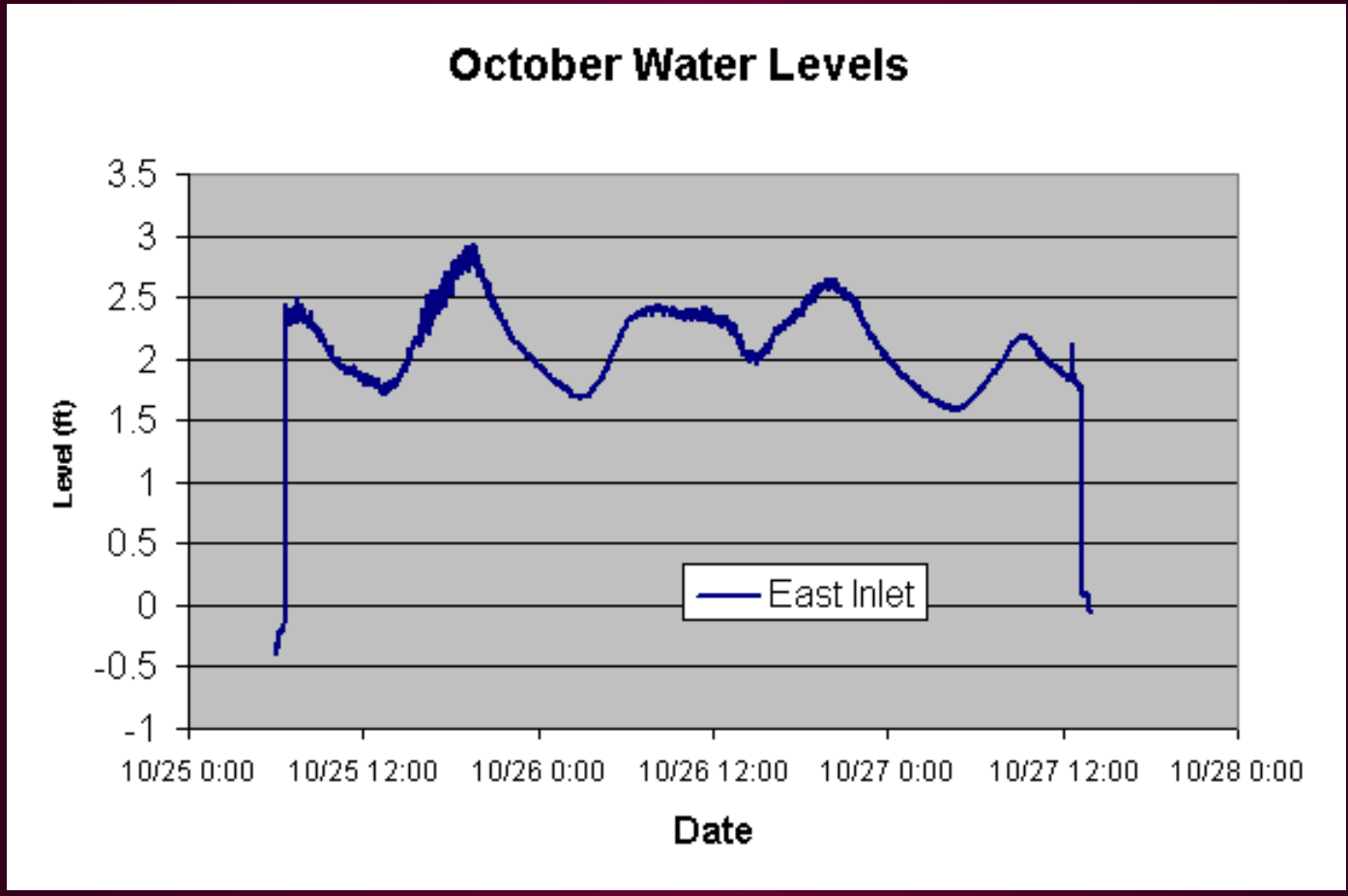
- Do predicted and observed tides match?
  - (Sandy Hook, NJ or Montauk Point, NY + time lag and height correction?)
- How much does response lag in the marsh?
  - Approximately 20 minutes at Dunton Lake
  - Is this data reproduced by the model?

Marsh Water Levels (9-2001)

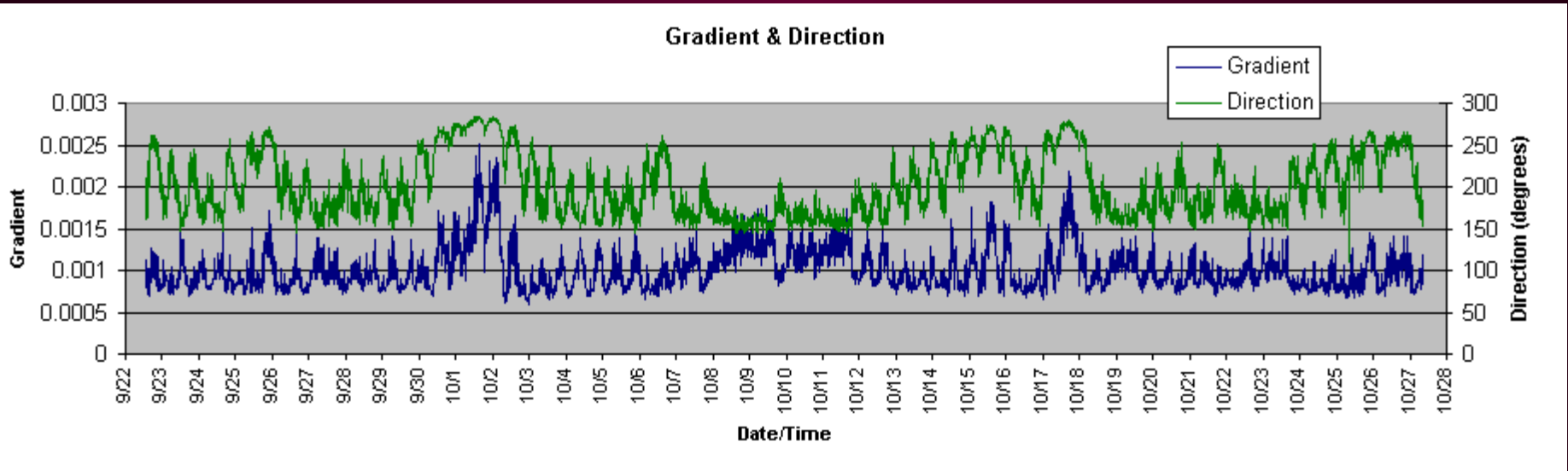


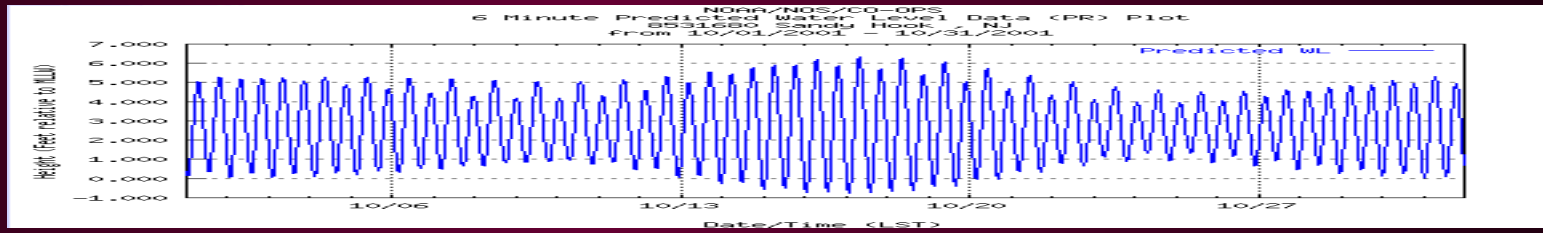


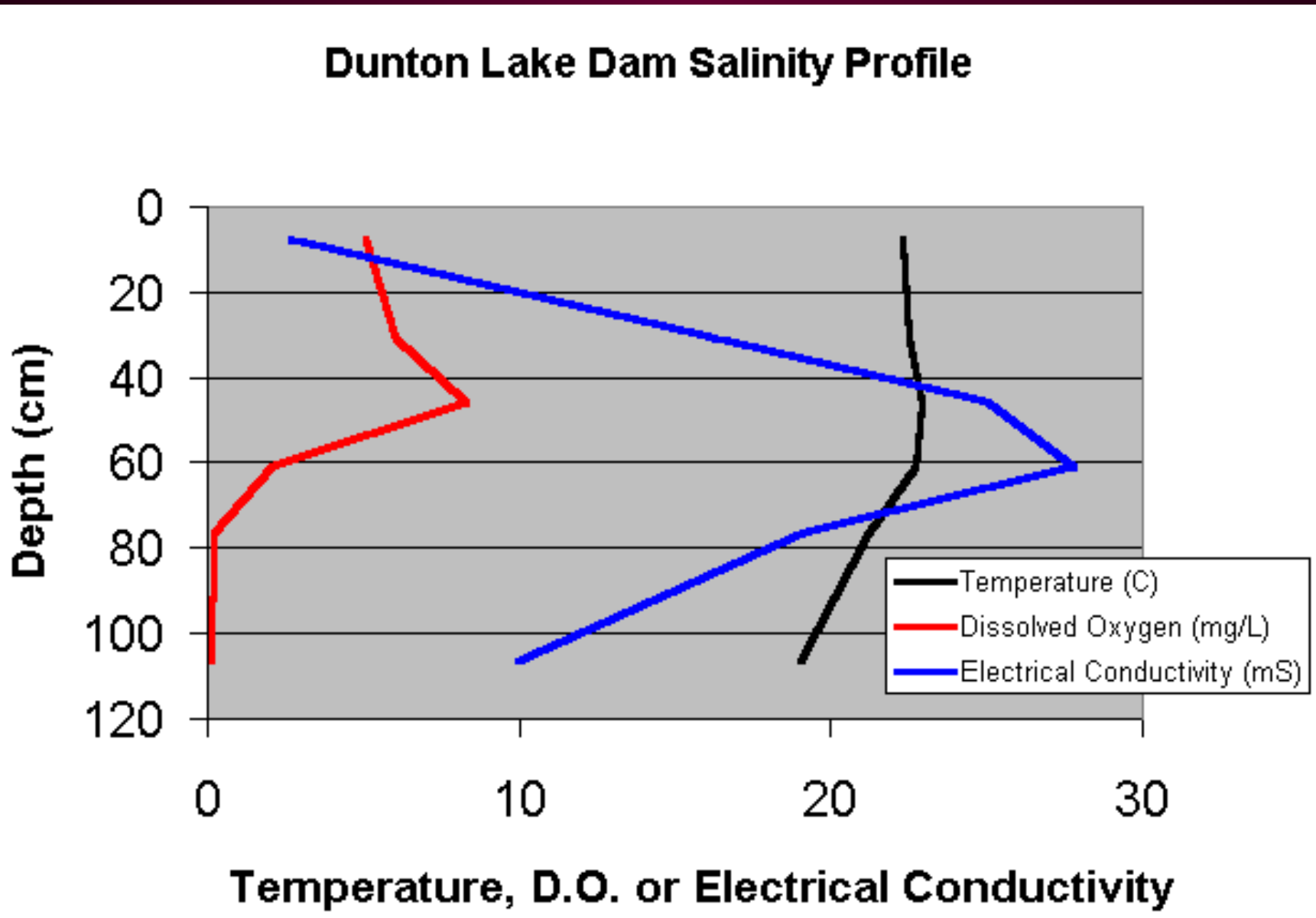
Marsh Water Levels (10-2001)

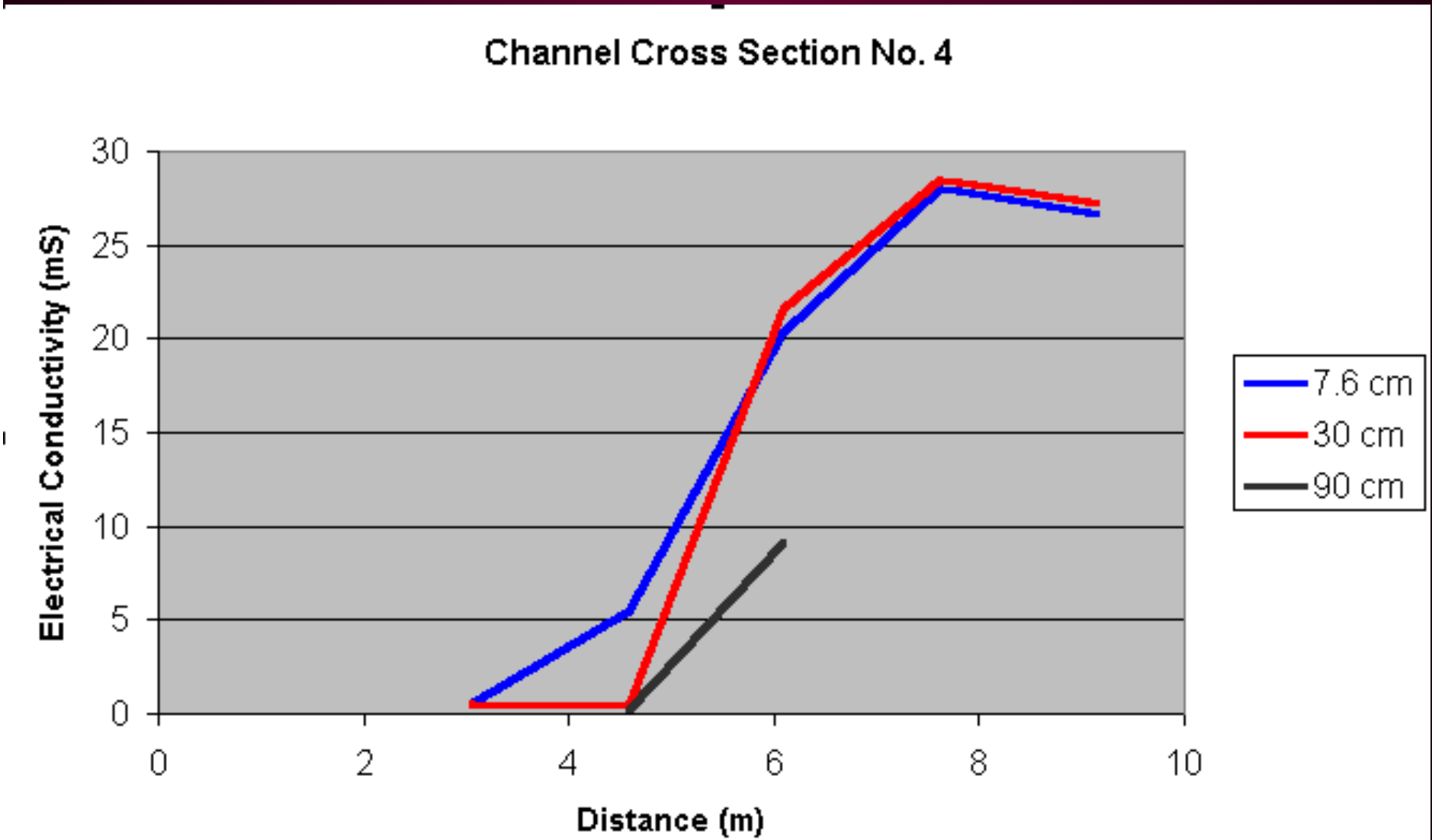


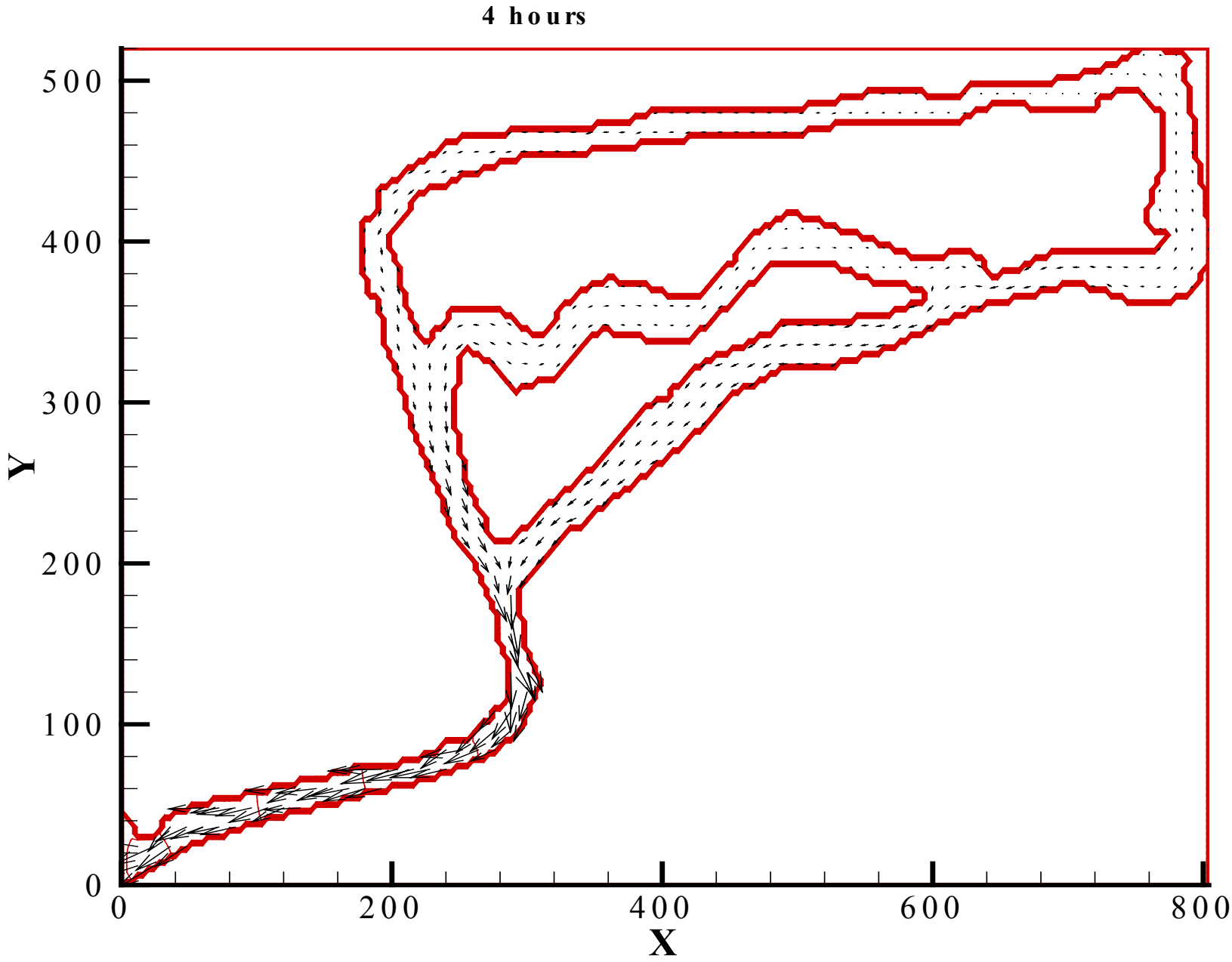
Aquifer Connection

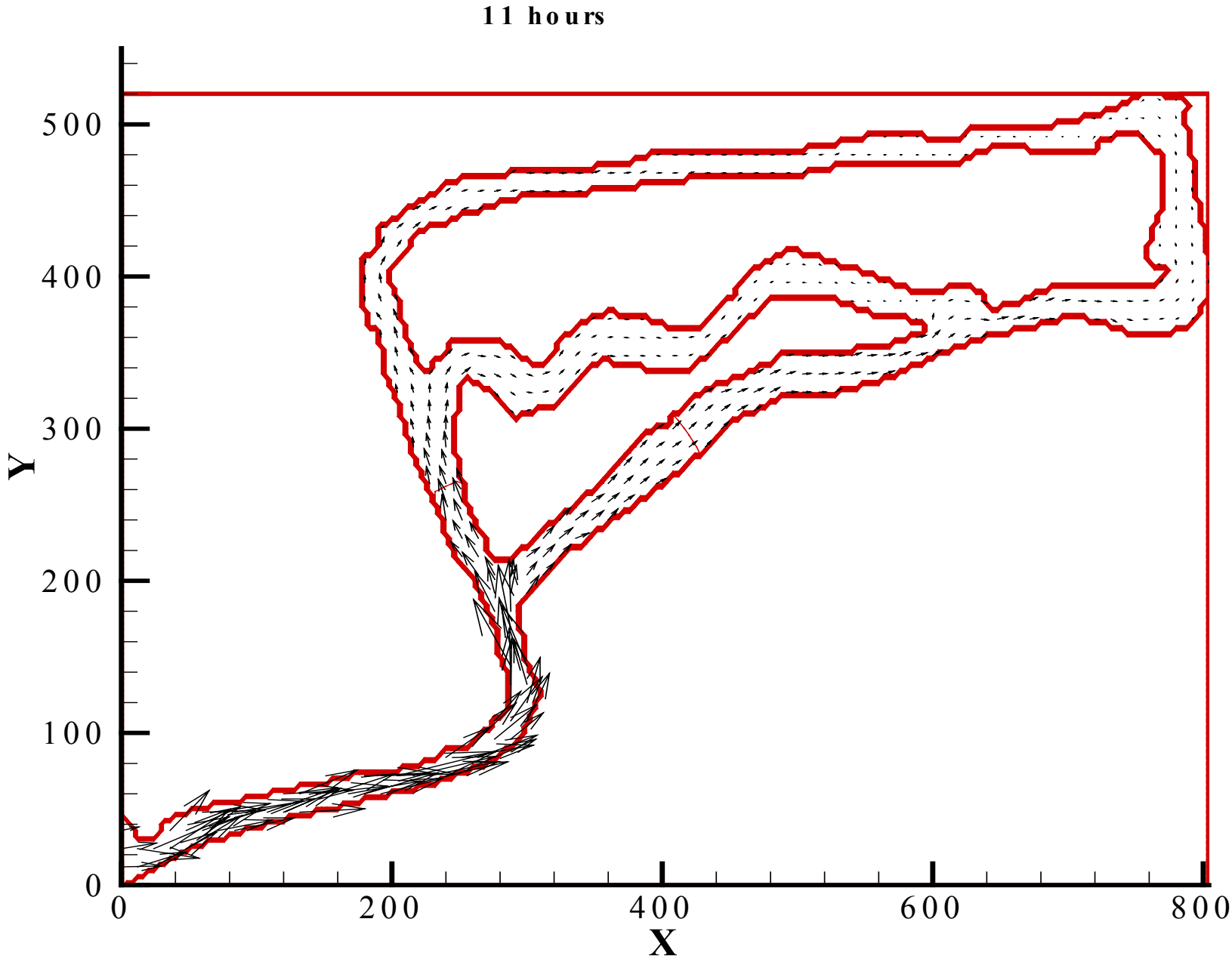




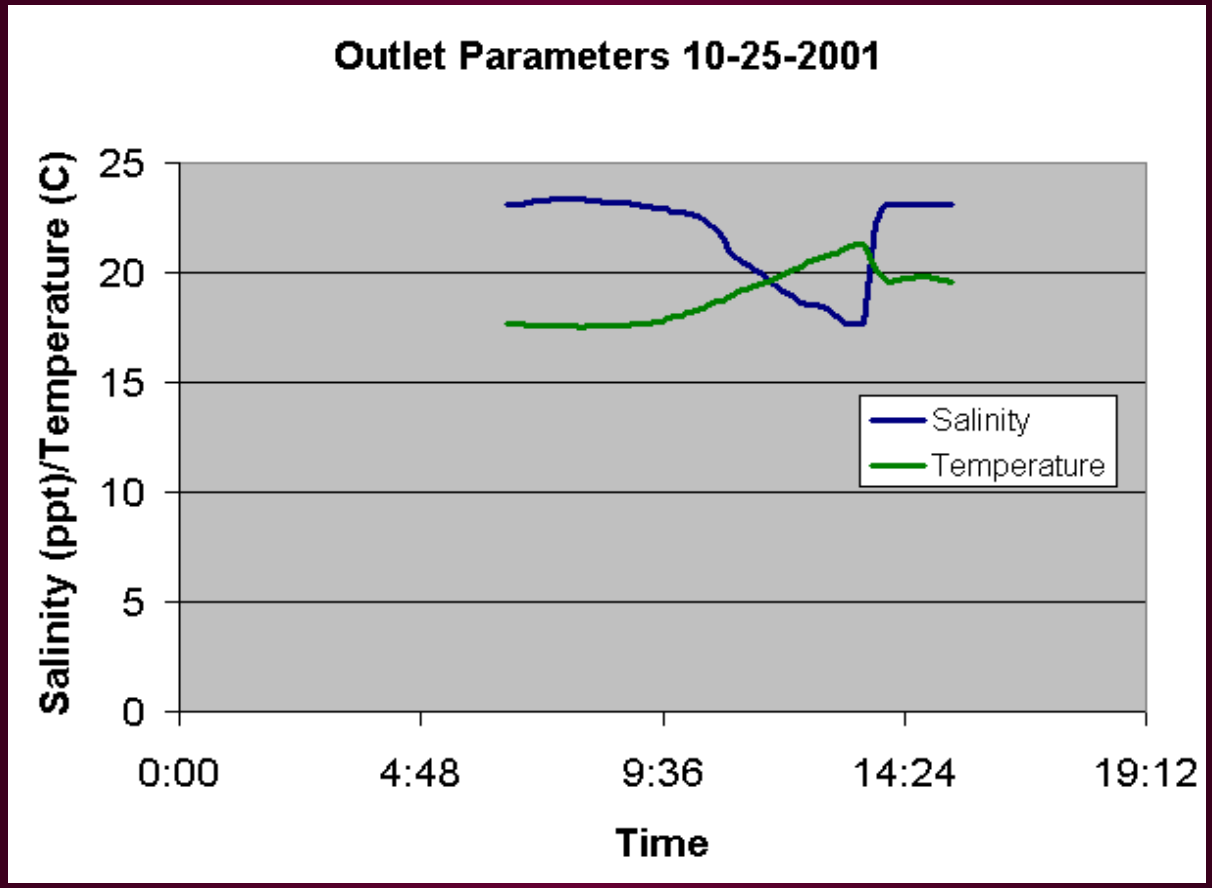

Dunton Lake Dam Salinity Profile
Depth (cm)
0
20
40
60
80
100
120
0
10
20
30
Temperature, D.O. or Electrical Conductivity
Temperature (C)
Dissolved Oxygen (mg/L)
Electrical Conductivity (mS)


Channel Cross Section No. 4
Electrical Conductivity (mS)
30
25
20
15
10
5
0
0
2
4
6
8
10
Distance (m)
7.6 cm
30 cm
90 cm





East Inlet Salinity & Temperature



Conclusions

- Lock Lake field study provides insight into transport behavior and contributes to model design
  - Preliminary Lock Lake data indicate
    - maximum propagation distance into marsh
    - mixing with fresh water
  - Inverted salinity profiles indicate fresh water inflows
  - Spring with abrupt salinity transition

Conclusions

- Preliminary model results correspond to observations
  - limited propagation distance into marsh
  - sensitivity analysis indicates topography controls flow
- Continuing work to link oil slick model to the flow model

2002 Field Work

- Long term logging of water levels, temperature and salinity in marsh
- Tracer study to generate testing data
  - Direct estimates of dispersion coefficients
  - Test data for water level model
  - Verification (or not) of transport hypothesis based on inlet data

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