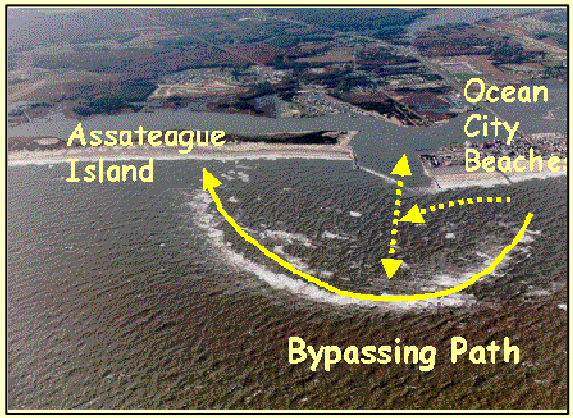
Cascade

Regional Model for Calculating Coastal Morphology Change and Sand Bypassing

Presented at 12th LICA Conference, Stony Brook, April 5, 2007

Regional Applications

Engineering Activities



Long-term Morphology Response

Julie Dean Rosati
Nicholas C. Kraus
Kenneth J. Connell
Magnus Larson

CIRP
Mission Support
Technology Transfer
Research & Development

System-Wide Water
SWWRP
Resources Program

What is Cascade?

Regional longshore transport and beach change model that incorporates:

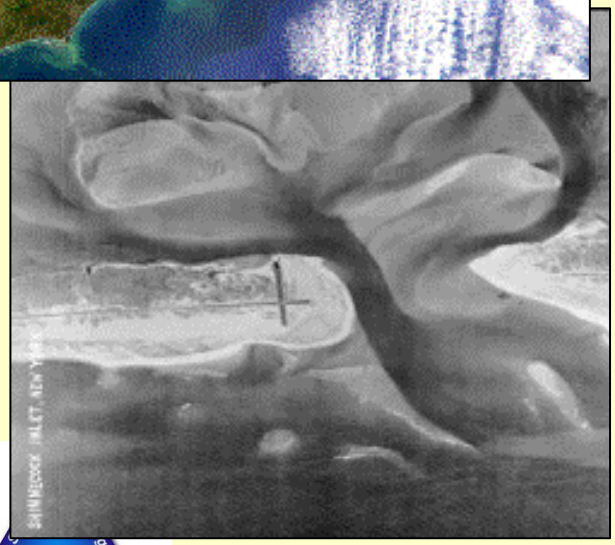
- Regional trends
- Multiple, interacting projects
- Inlet sediment storage and transfer
- Sources and sinks (beach nourishment, washover, breaching, wind-blown sand, cliff erosion, etc.)
- Jetty construction (impoundment, bypassing)
- Navigation channel maintenance
- Large-scale gradients in forcing; long-term trends (e.g., relative sea level rise, increased storminess)

Why is the model called "Cascade"?

- **Sediment transport & coastal evolution occur at many different scales:**
  - ***Near-term (months to years) and local;***
  - ***Mid-term (years to decades) and project scale;***
  - ***Long-term (decades to centuries) and regional-scale; cumulative project response.***
- **Interaction between coastal evolution at different scales may be described through a <u>cascading approach</u>**

Cascade --Able to leap across multiple inlets, channels, river mouths, beaches, barrier islands, etc., in a single (& fast) bound

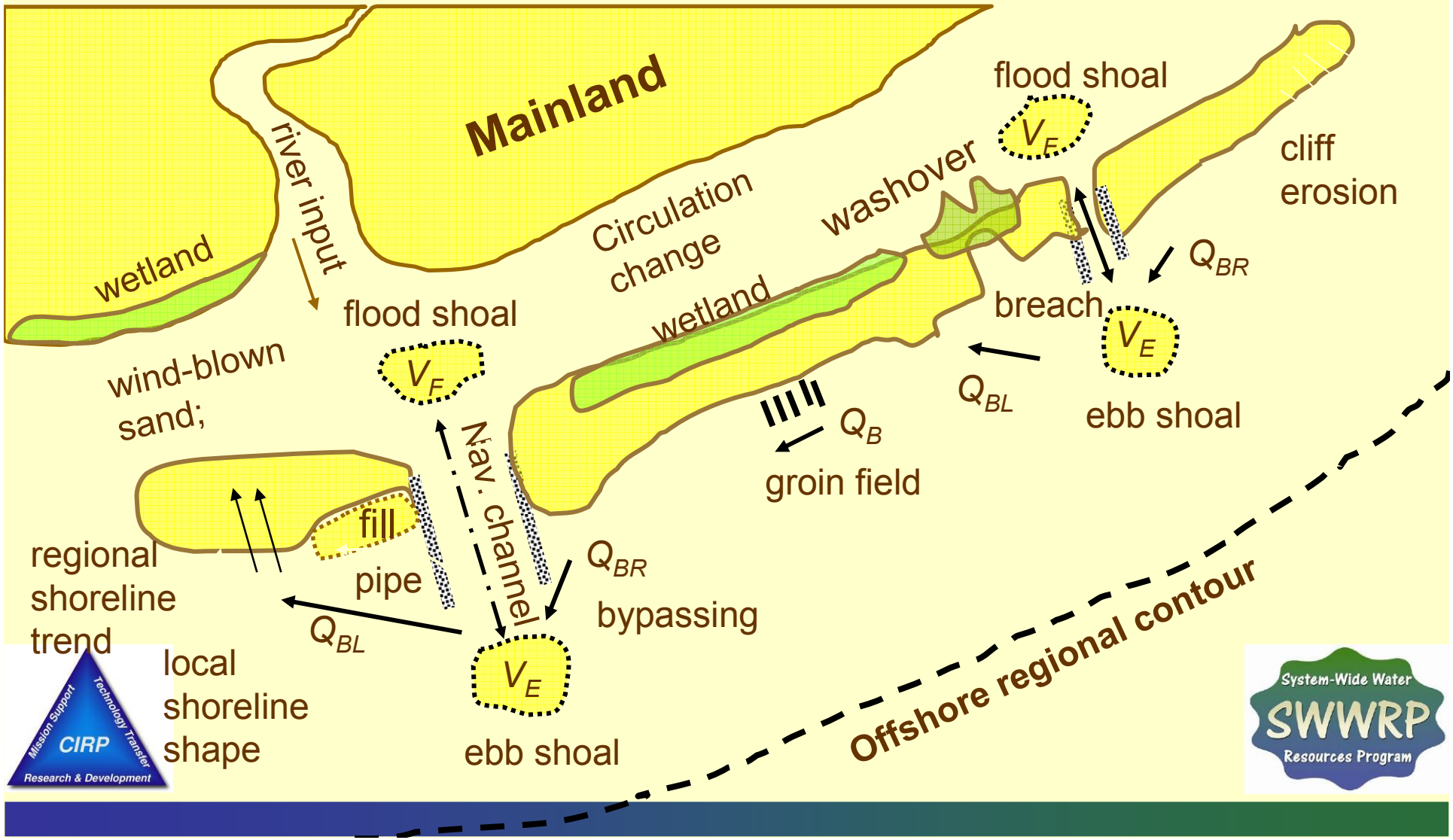
Morphological features that can be described in Cascade



Time scales

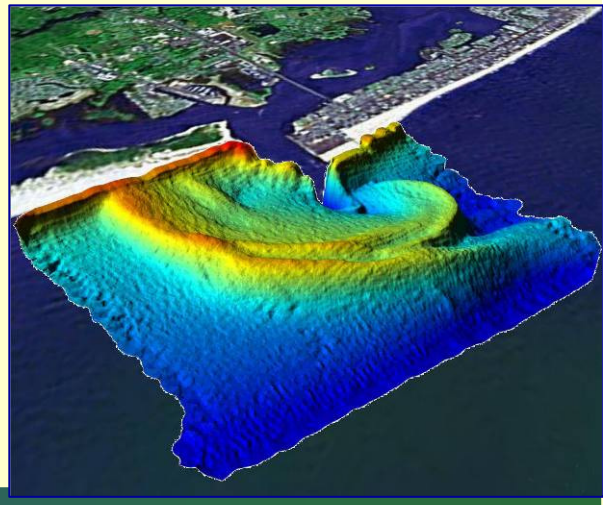
Space scales

Components of Cascade

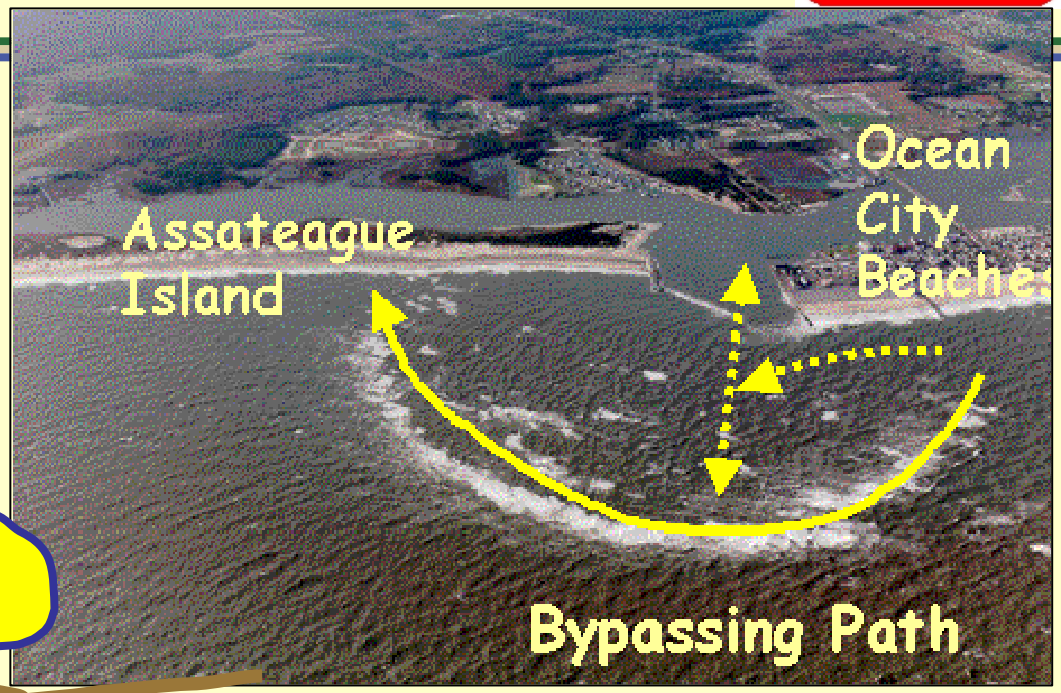


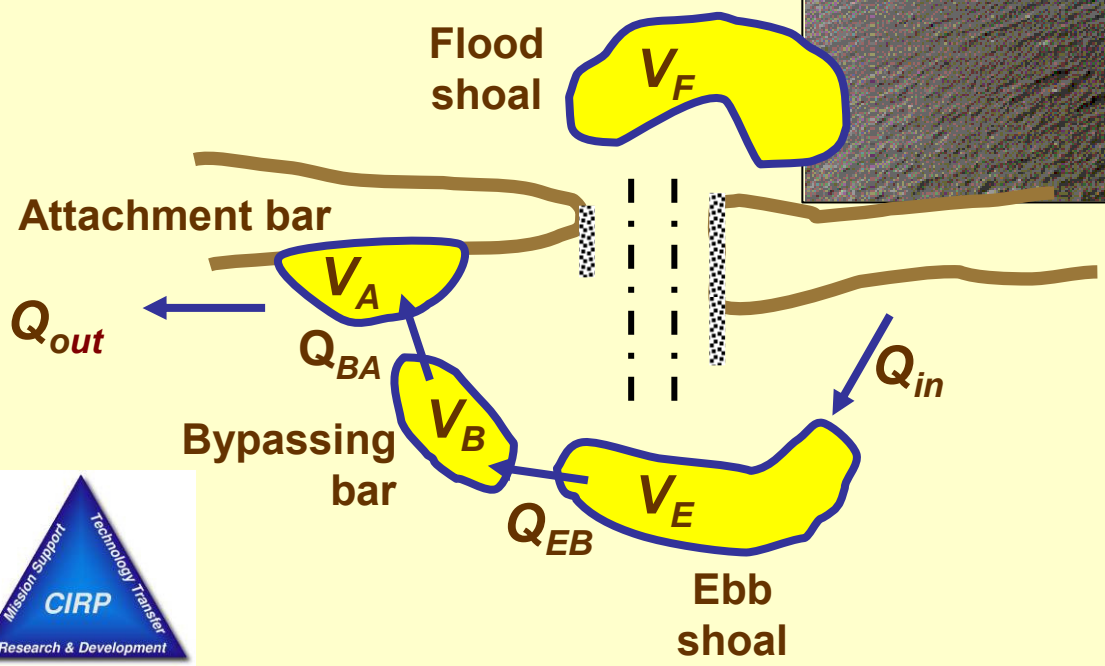
Modules in Cascade

- Wave transformation
- Longshore current & sediment transport
- Inlet sediment storage & pathways
- Jetty bypassing
- Sediment sources and sinks
  - nourishment, dredged material placement
- Sediment volume conservation



Simulation of Shoal and Bar Volumes





What are the differences between Cascade and GENESIS?

Cascade

- Planning-level tool
- Time scales: 1 to ~100 yrs
- Can model multiple inlets and barrier islands; cumulative inpacts
- Fast

GENESIS

- Engineering Design Tool
- Time scales: 2-50 yrs
- Cannot transverse inlets

Cascade can provide boundary conditions for project-scale GENESIS modeling

Test Sites for Cascade Development and Validation

Completed Research Applications

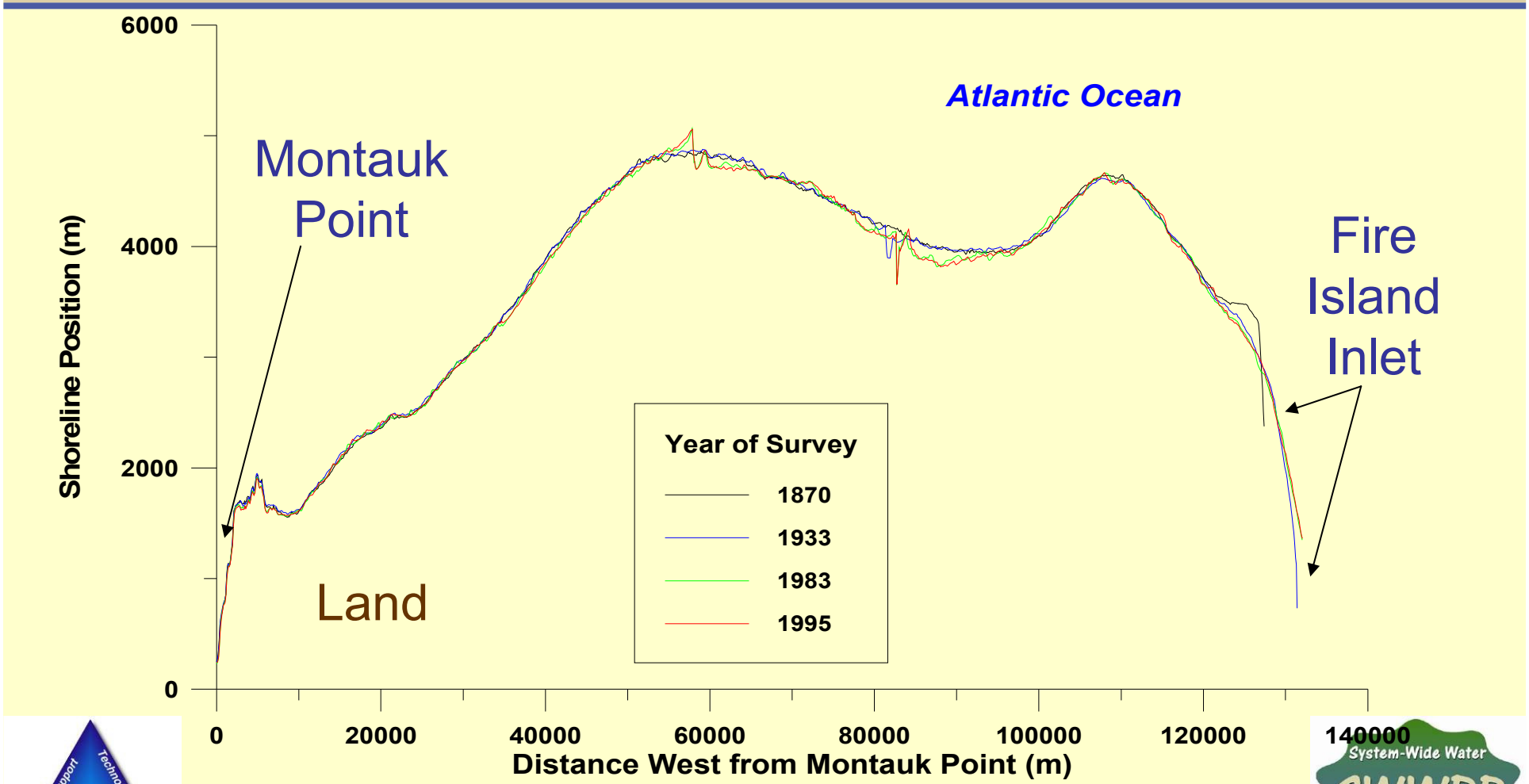
- South Shore of Long Island (Montauk Point to Fire Island Inlet), NY
- Ocean City Inlet with Fenwick and Assateague Island (Cape Henlopen to Chincoteague), Delmarva Peninsula

Future applications

- Texas coast
- Other? – searching for partners

Long Island, NY

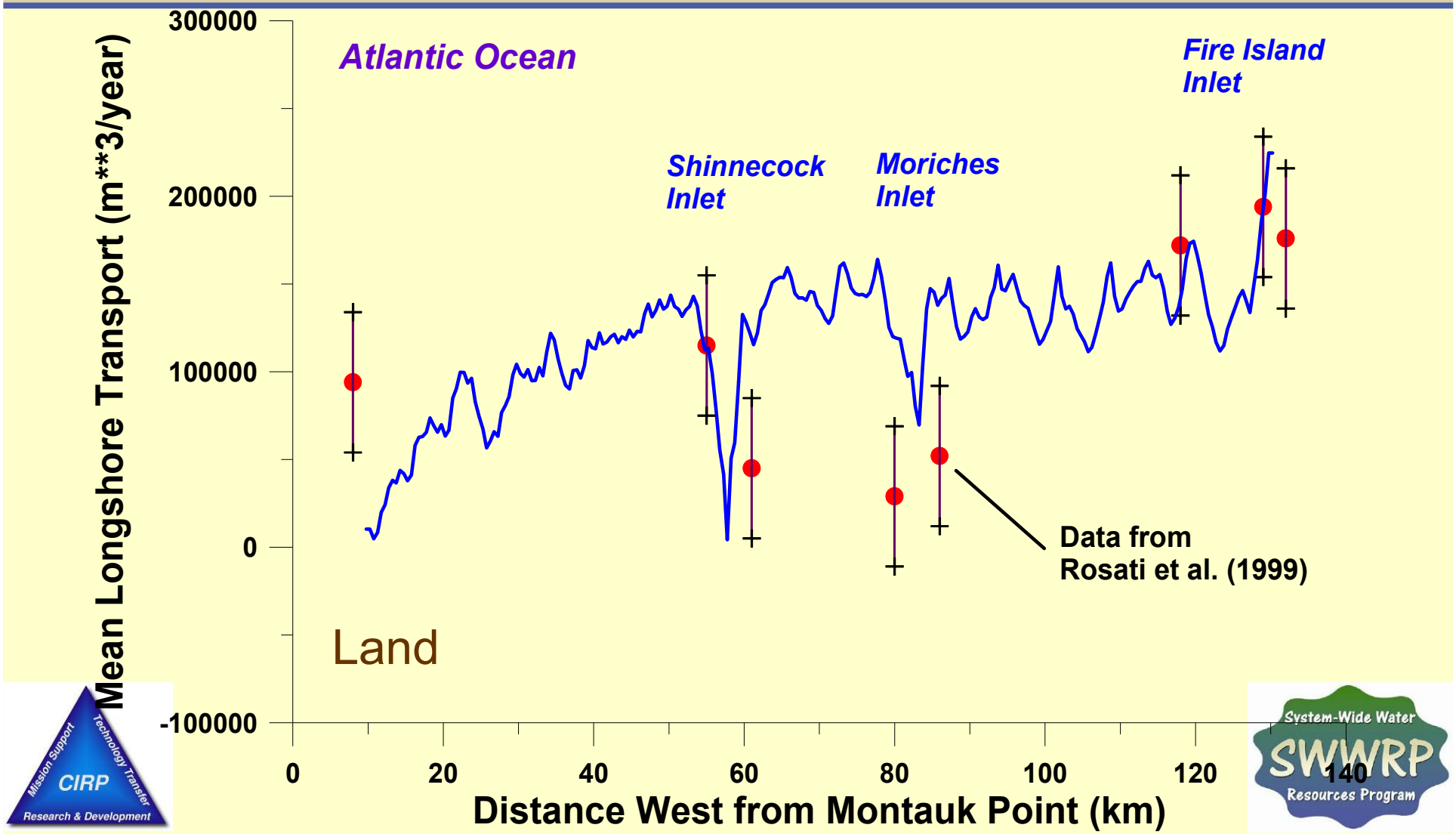
Shoreline Evolution, South Shore of Long Island (125 years)



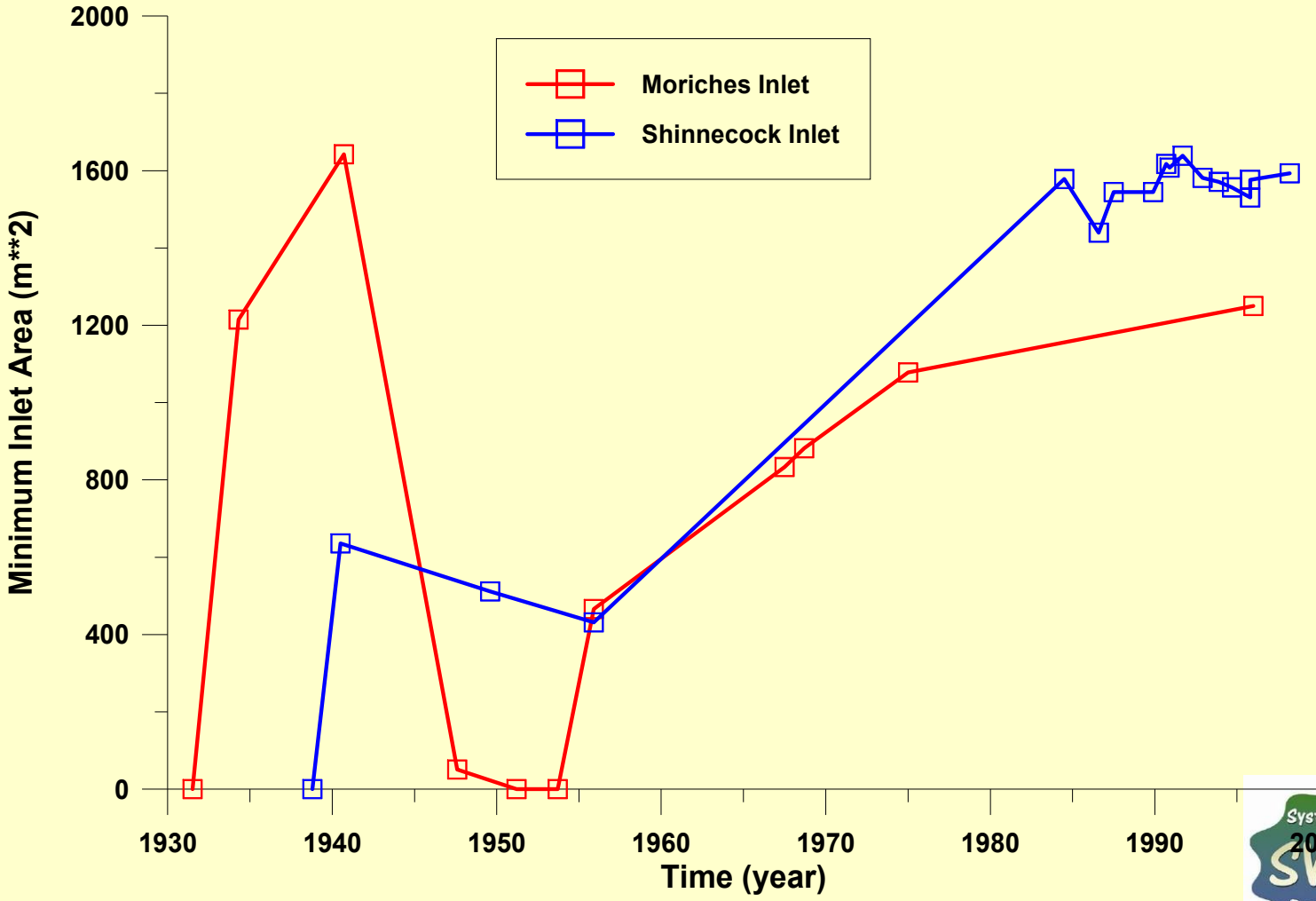
WIS Stations Along Long Island (old WIS)

WIS stations along Long Island

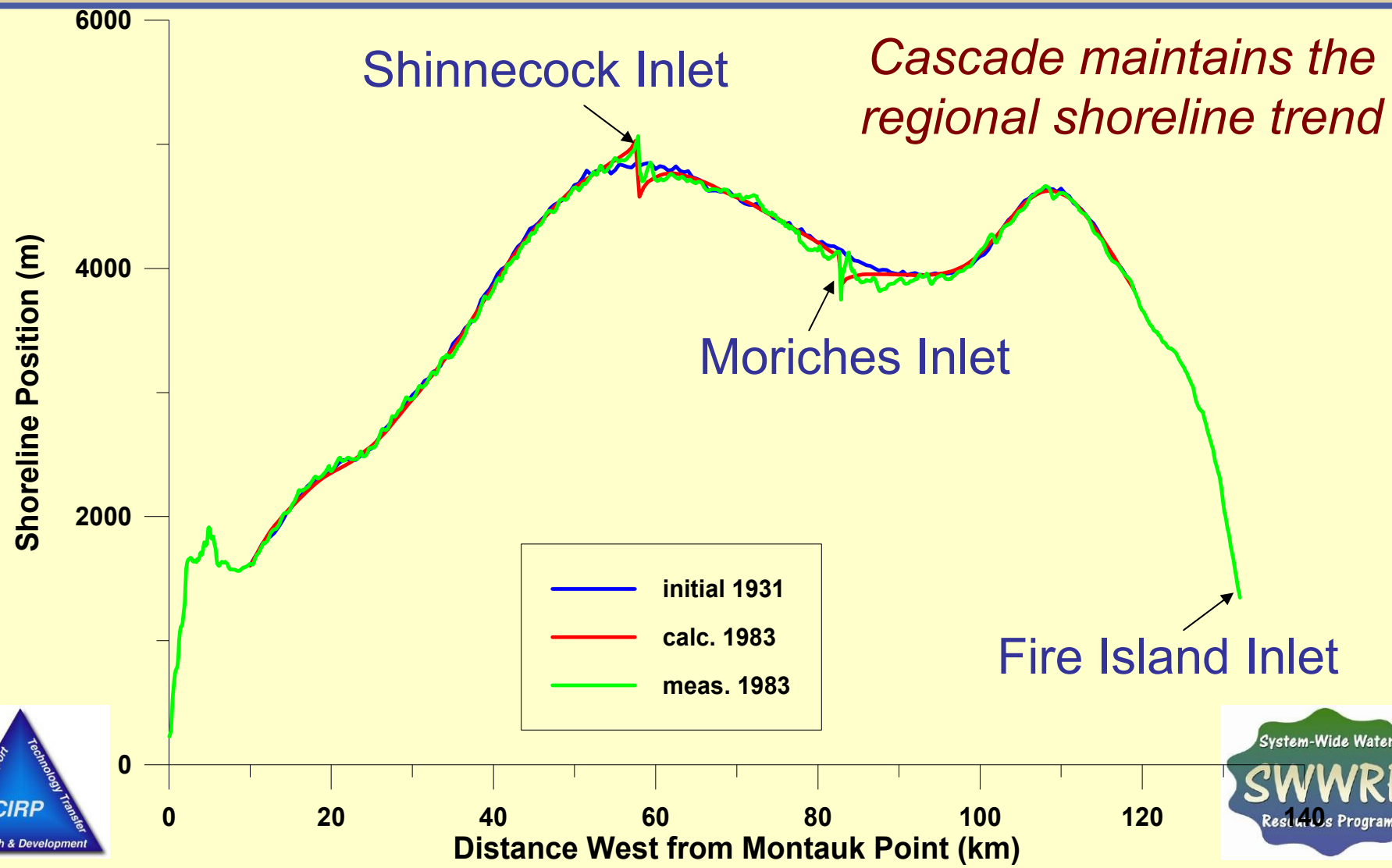
Calculated Net Longshore Sediment Transport Along the South Shore of Long Island



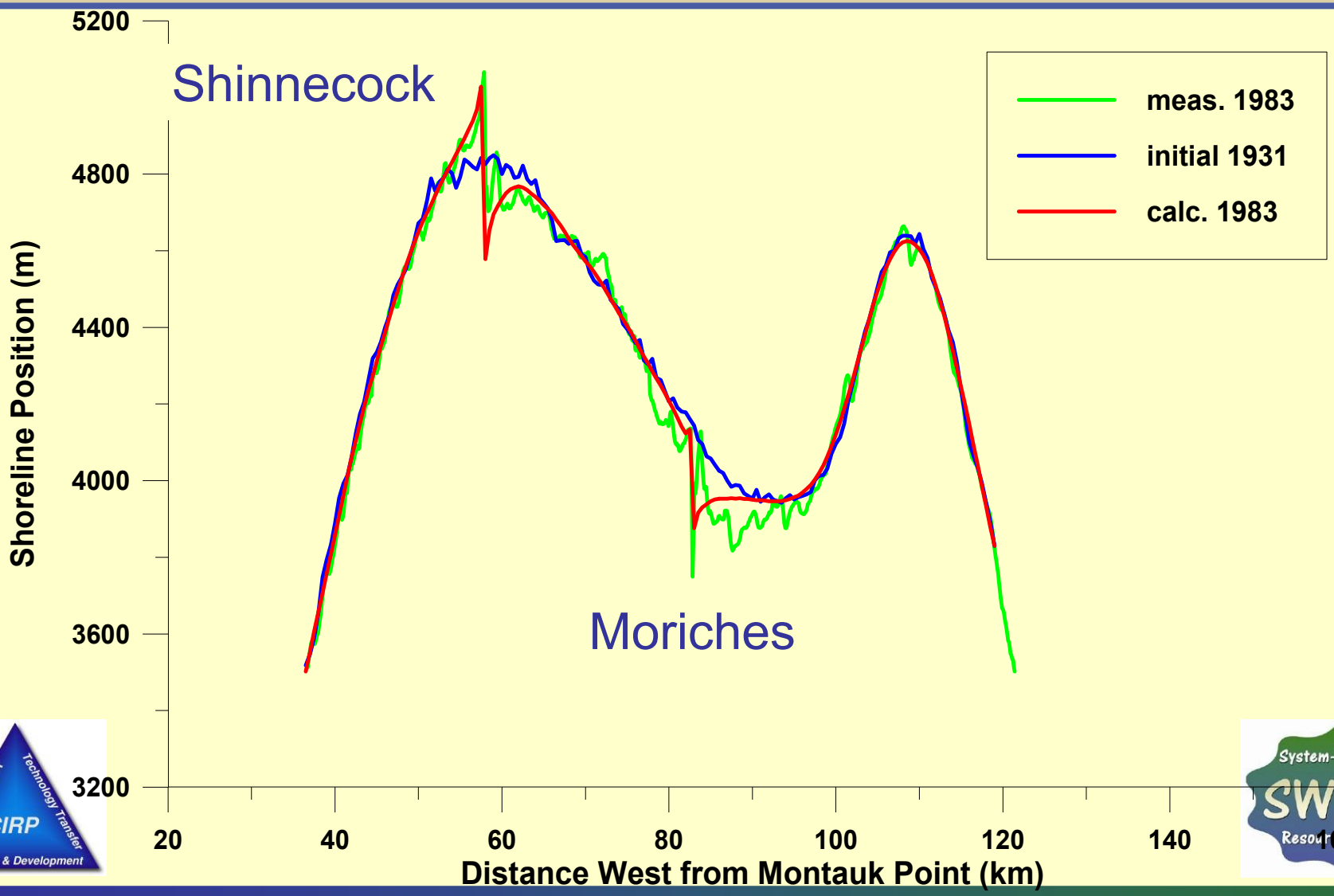
Recorded Changes in Inlet Cross-Sectional Area at Shinnecock Inlet and Moriches Inlet



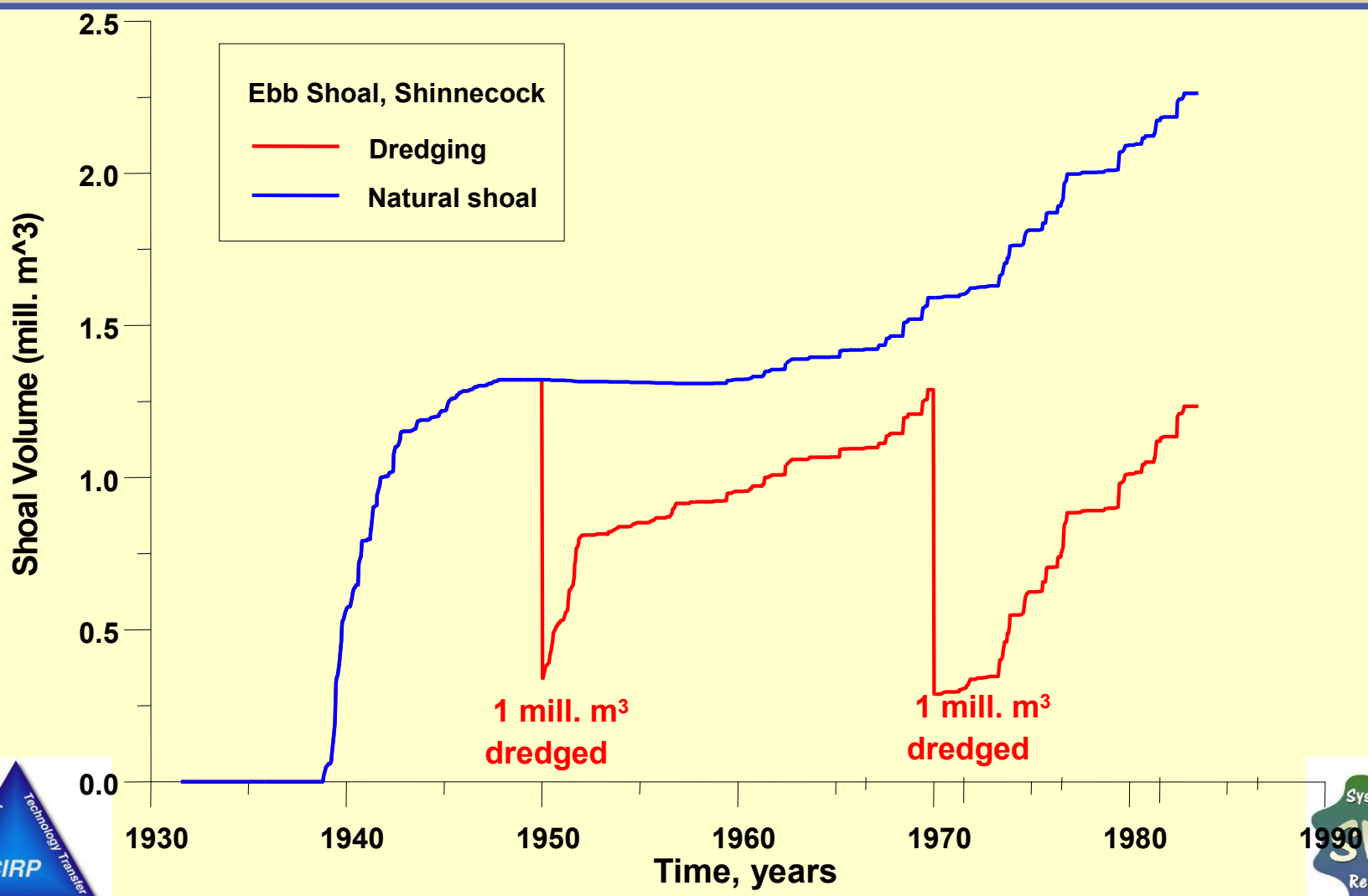
Simulation of Shoreline Evolution
Long Island, 1931-1983



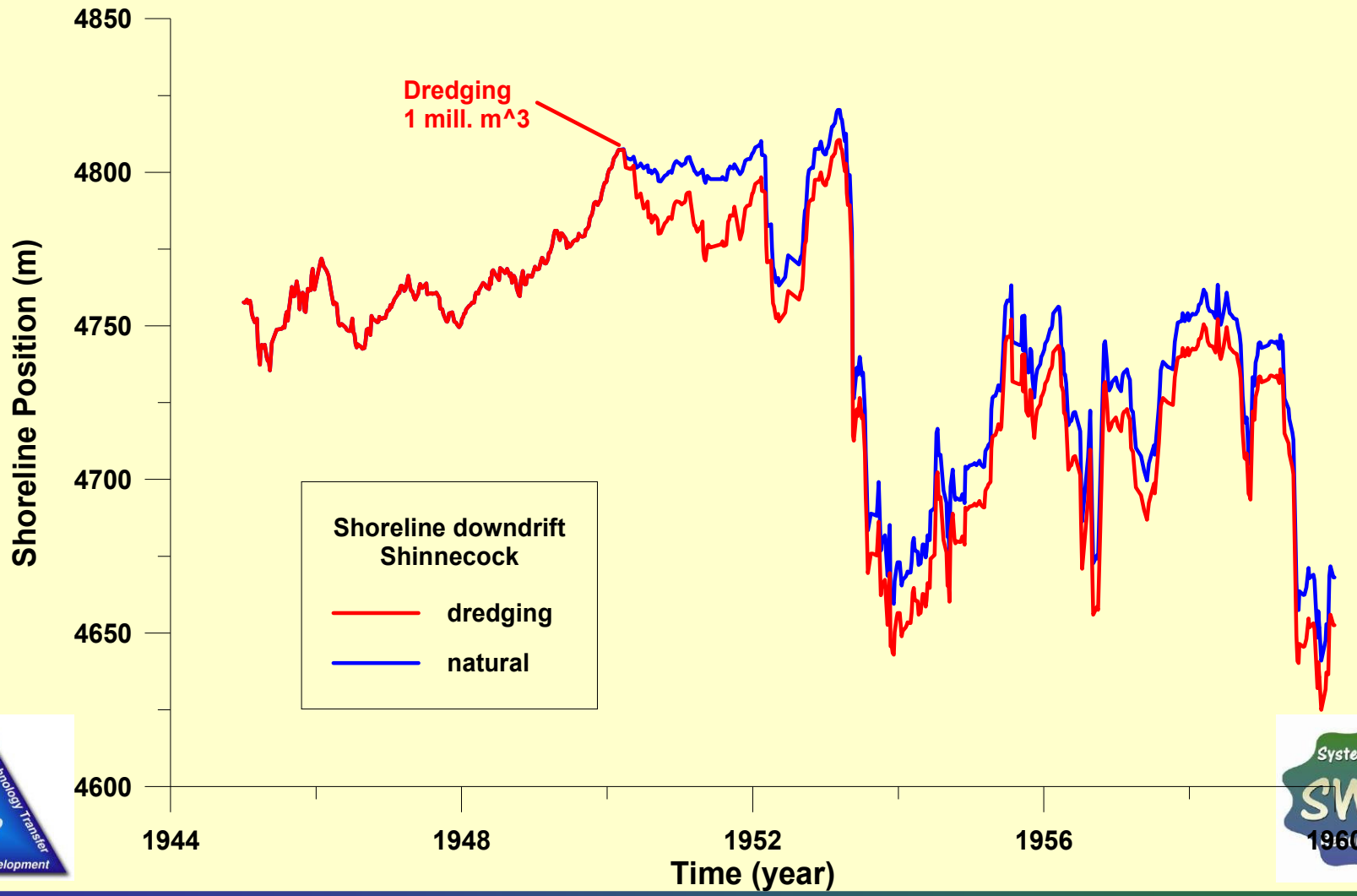
Simulation of Shoreline Evolution at Long Island, 1931-1983 (detail)



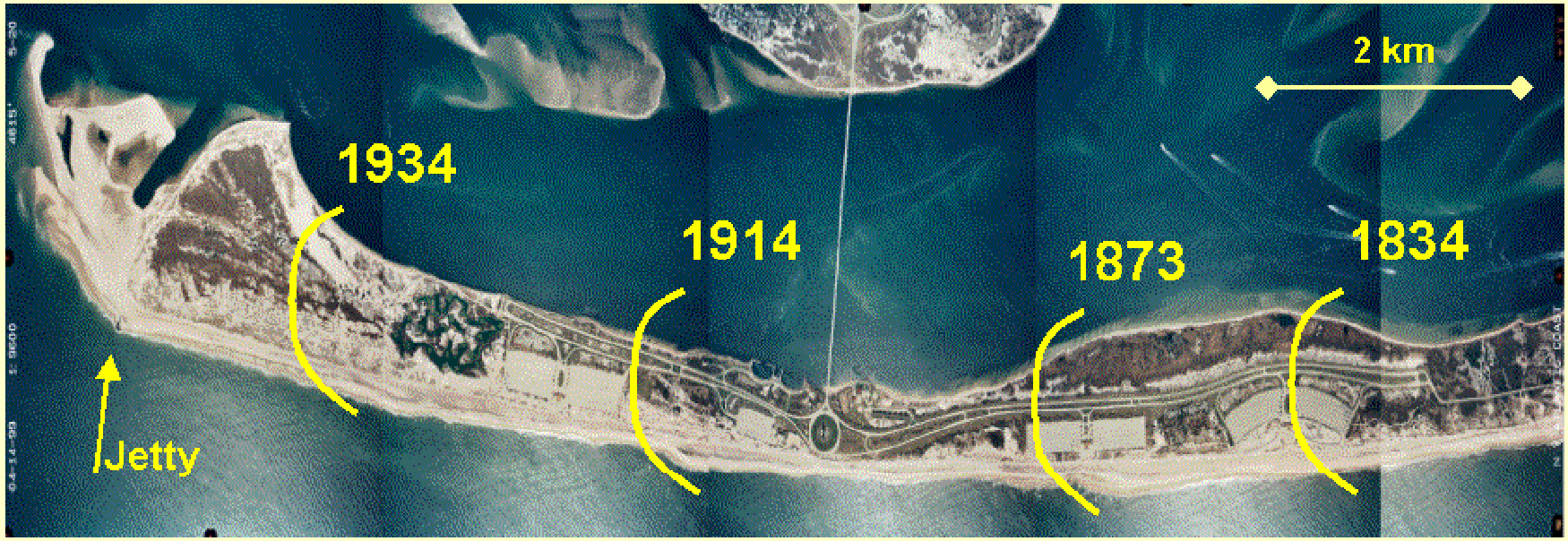
Simulation of Ebb Shoal Dredging, Shinnecock Inlet



Response of Downdrift Shoreline Position in Response to Dredging, Shinnecock Inlet



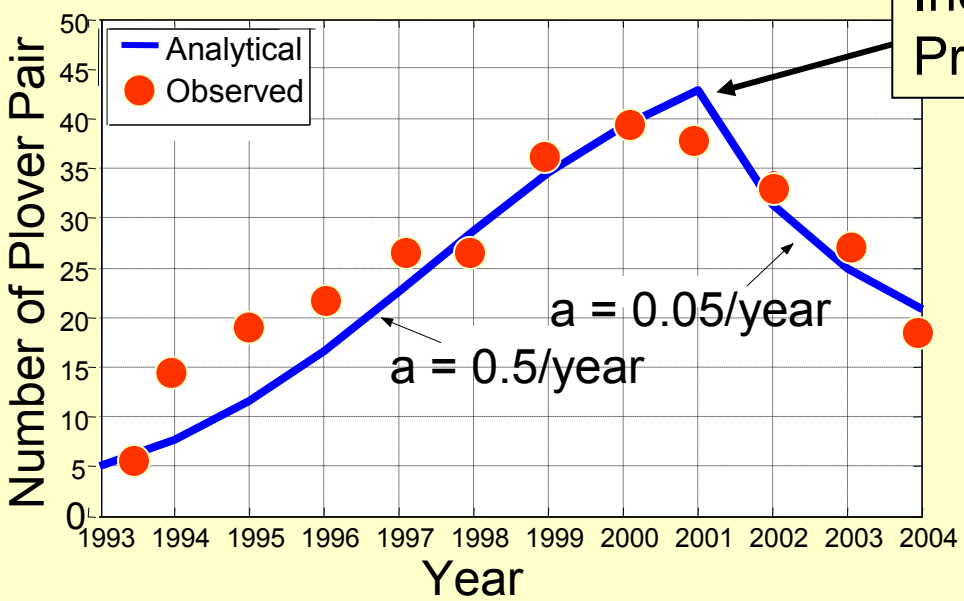
Upcoming effort: Spit BC in Cascade



Fire Island Inlet, Long Island
-- is the terminus of a long barrier chain

Cascade Ecological Sub-Module
in Development

Piping Plover Habitat & Population Dynamics

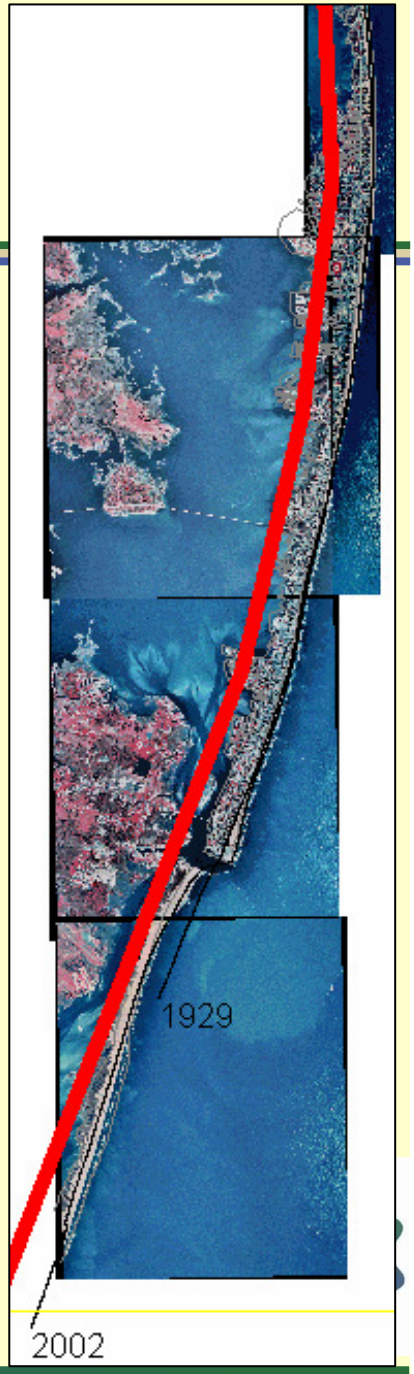


Increased Predation?

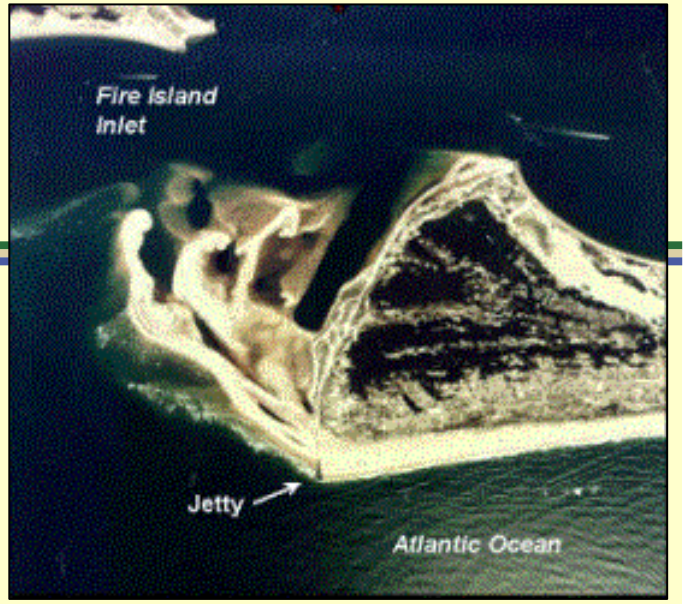
Westhampton Dunes, NY

Cascade: Conclusions

- Sediment transport & coastal evolution occur at many different scales with implications for modeling – need <u>Cascading approach</u>
- Engineering projects require considerations at regional scale, → dictating need for modeling processes & controls at this scale
- Cascade can simulate coastal evolution within complex regional trends, including inlet sediment storage & transfer, engineering activities, & structures



Cascade: Future Development



- Inlet module modifications
  - -modify downdrift sediment release (attachment bar)
- Spit evolution
- Barrier island migration (washover)
- Transport relationships
  - - regional sediment transport
  - - wind-blown sand transport
  - - cliff erosion
- Sediment exchange with offshore
- Long-term forcing
  - - relative sea level change
  - - consolidation of substrate