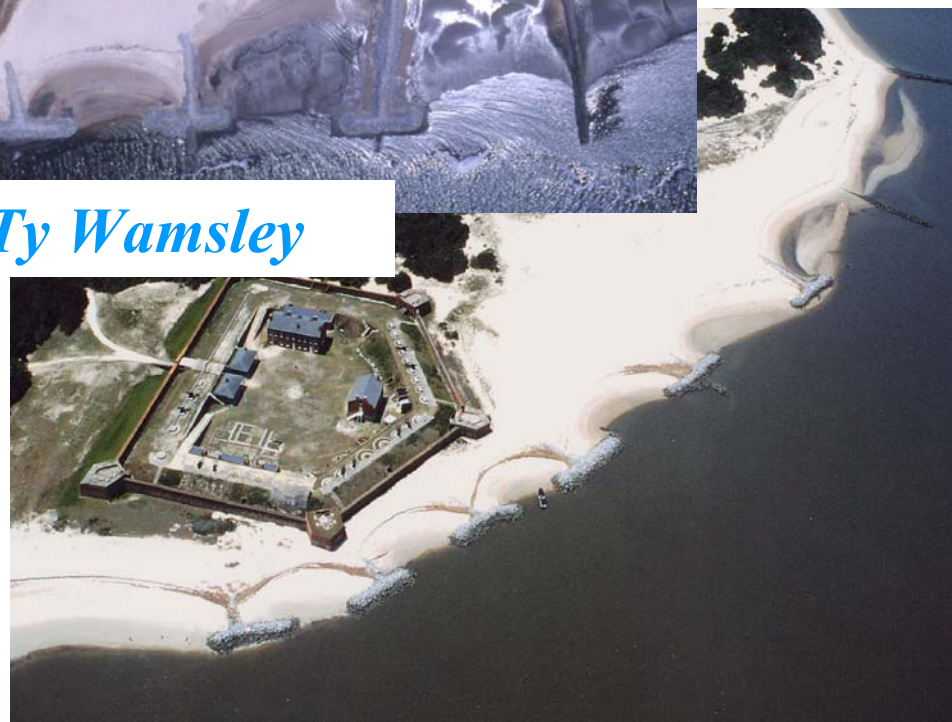
Breakout Session G:
GENESIS-T

Coastal Engineering Design & Analysis System Version 2.01



Instructor Team:
Mark Gravens, Hans Hanson, & Ty Wamsley

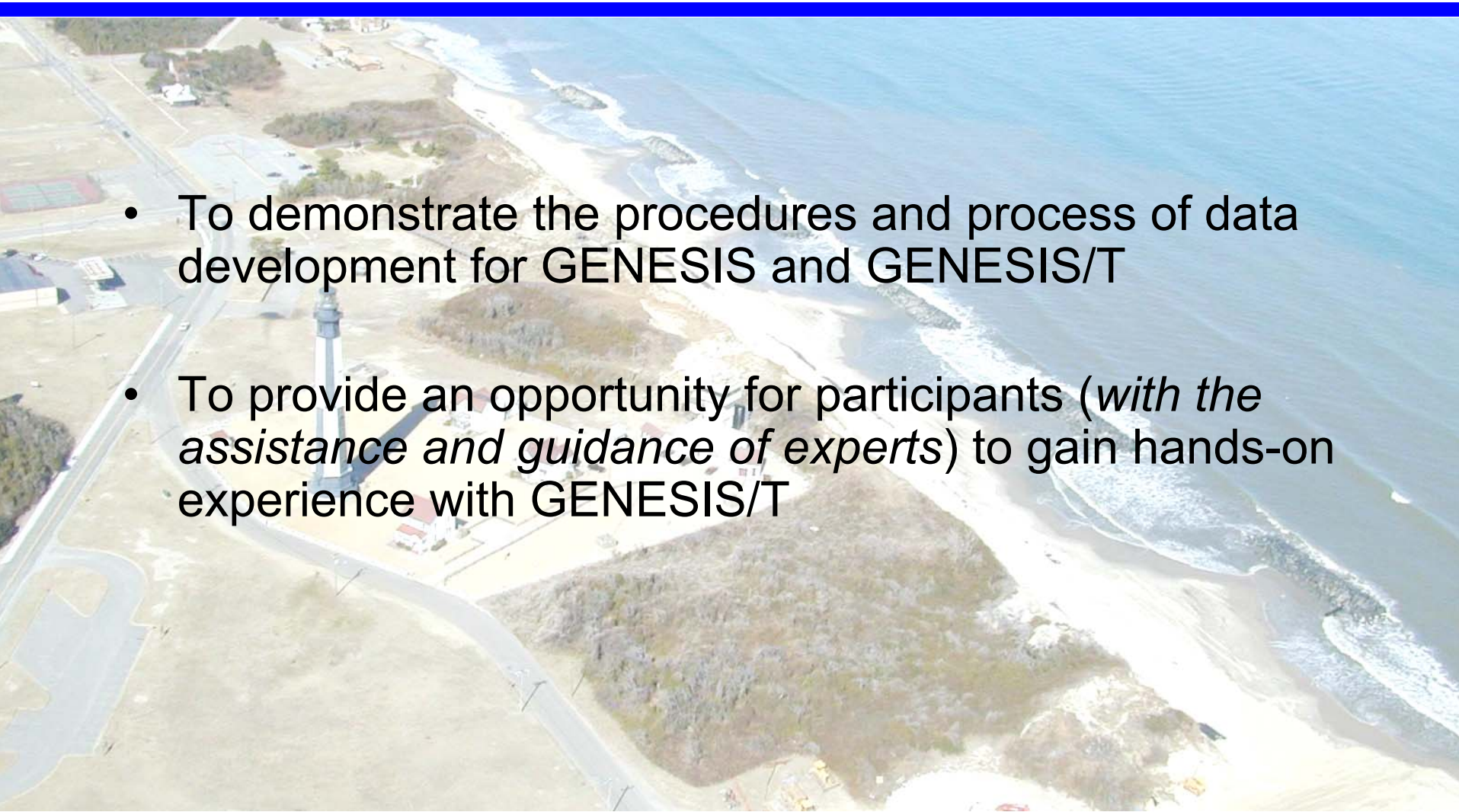
4th Annual CIRP
Technology Transfer Workshop

In cooperation with
2003 National Conference on Beach Preservation Technology

Session Goals

- To provide a broad overview of the CEDAS product with emphasis on the Beach Processes Module
- To detail the formulation of the GENESIS enhancements that constitute GENESIS/T
- To provide instruction as to when and how to apply GENESIS/T with emphasis on the operational/ computational differences between GENESIS and GENESIS/T

Session Goals



- To demonstrate the procedures and process of data development for GENESIS and GENESIS/T
- To provide an opportunity for participants (*with the assistance and guidance of experts*) to gain hands-on experience with GENESIS/T

Presentation Team

Mark Gravens & Ty Wamsley

Research Hydraulic Engineer

Coastal and Hydraulic Laboratory

US Army Engineer Research and Development Center

Hans Hanson

Professor / GENESIS Developer

Department of Water Resources Engineer

University of Lund, Sweden

Agenda

Tuesday morning (8 – noon)

Overview of Session/Introduction to CEDAS & Beach Processes Module

GENESIS/T – formulation of model upgrades

NEMOS System Components & Typical Procedures

Break

GENESIS/T Demonstration

- Offshore waves
- Nearshore waves
  - Grid generation
  - Nearshore stations
  - Input wave conditions
- Structure specification
- Simulation & Visualization

Lunch (provided by FSBPA)

Agenda

Tuesday afternoon (1 – 5 pm)

Orientation to Hands-on Application

- Project Site and Solution Design Concept
- Available Data
- Design Teams / Detailed Design Goals

Hands-on Application

- Offshore waves
- Configuration / Spatial Domain specification

Break

Hands-on Application

- Structural Lay-out & Simulation
- Alternative analysis

Adjourn

Agenda

Wednesday morning (8 – noon)

Review

Hands-on Application

- Alternative analysis / Optimization
- Presentation preparation

Break

Design Team Presentations

Summary / Questions

- Evaluation

Adjourn

CEDAS Overview

Coastal Engineering Design & Analysis System Version 2.01

TOOLBOX

of coastal and hydraulic engineering models

Veri-Tech, Inc.

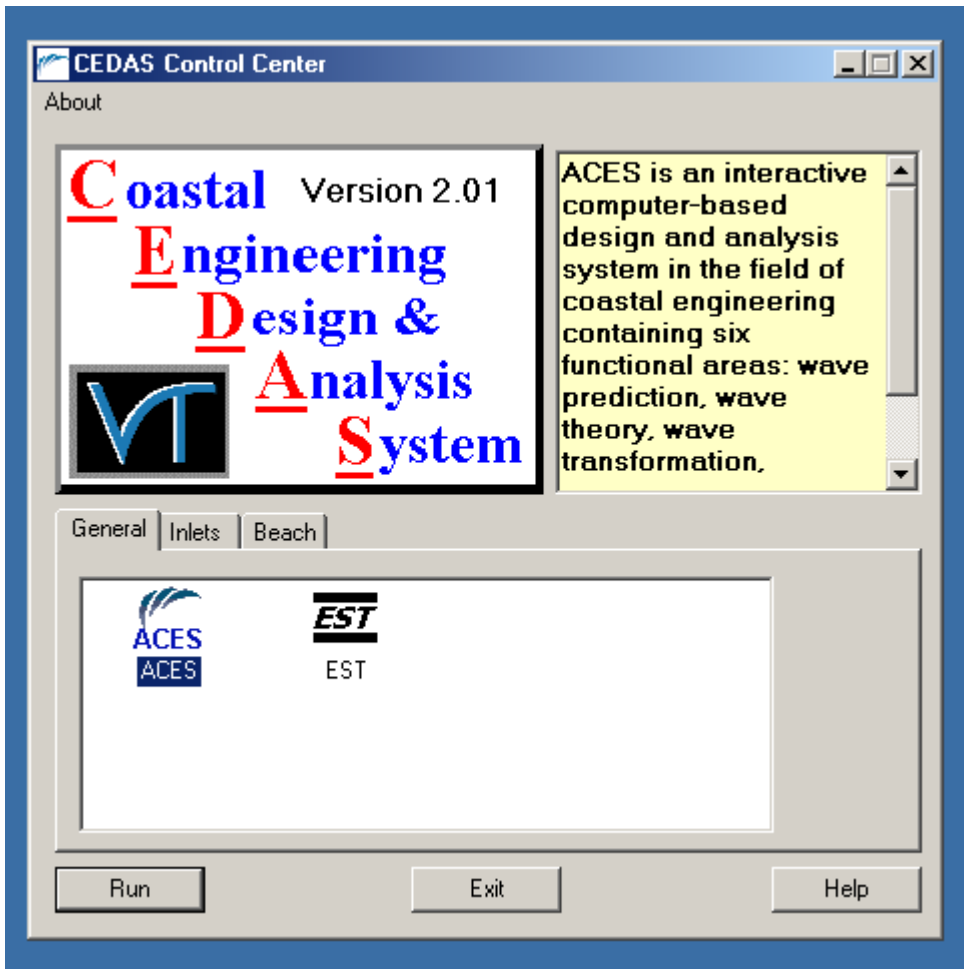
Providing Proven Technology

CEDAS Overview

Partnership between Veri-Tech and ERDC

- Cooperative Research & Development Agreement (CRDA) signed 9/11/1997
- Enhance / commercialize model and technical manual technology
- Product agreements to date:
  - → StreamBank Stabilization Handbook
  - → CEDAS
  - → CEM
  - → CEES

CEDAS Overview



CEDAS Control Center permits access to Modules and Models

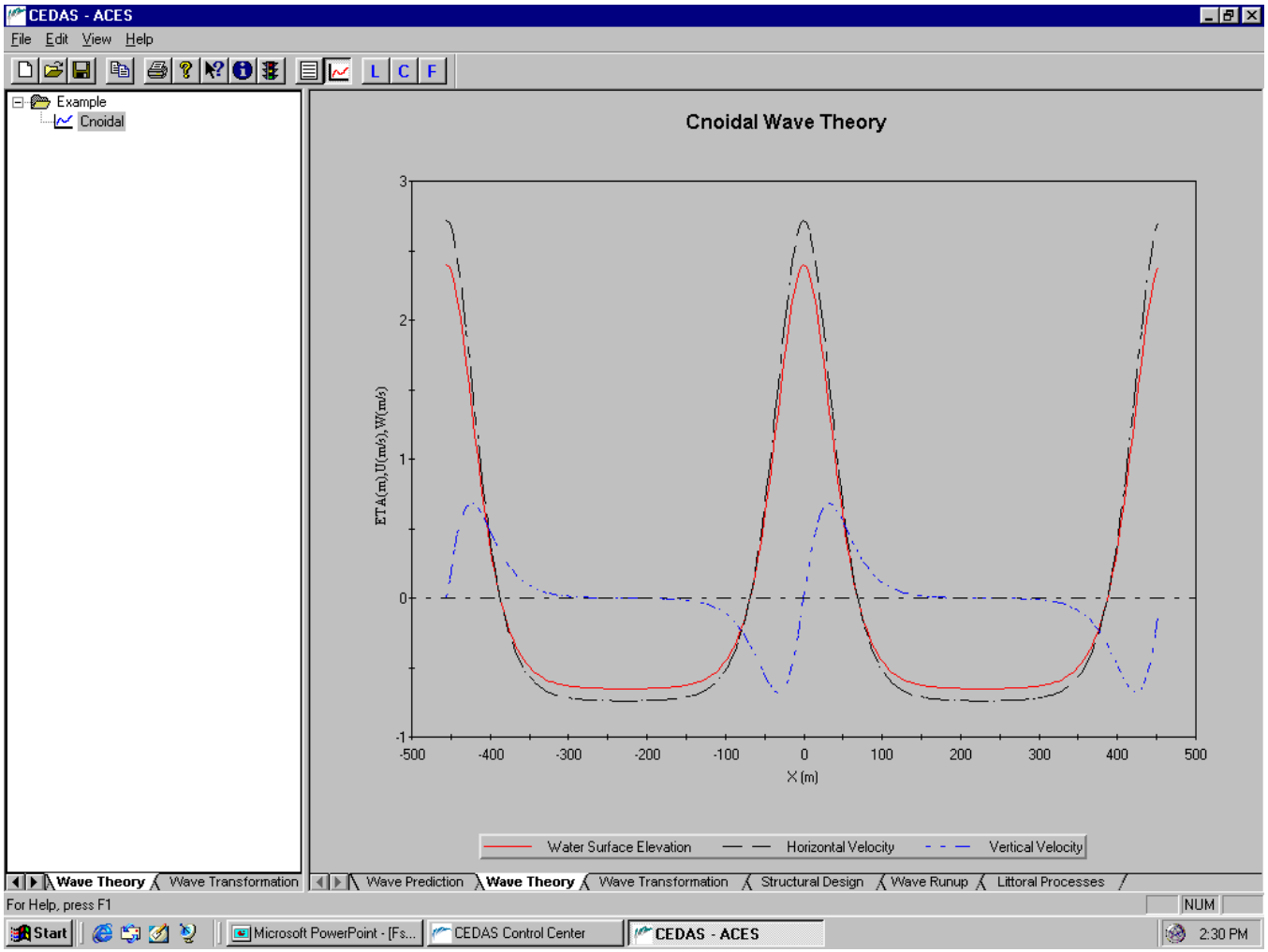
Description of selected model appears in upper right window

HELP files give system overview

CEDAS Overview

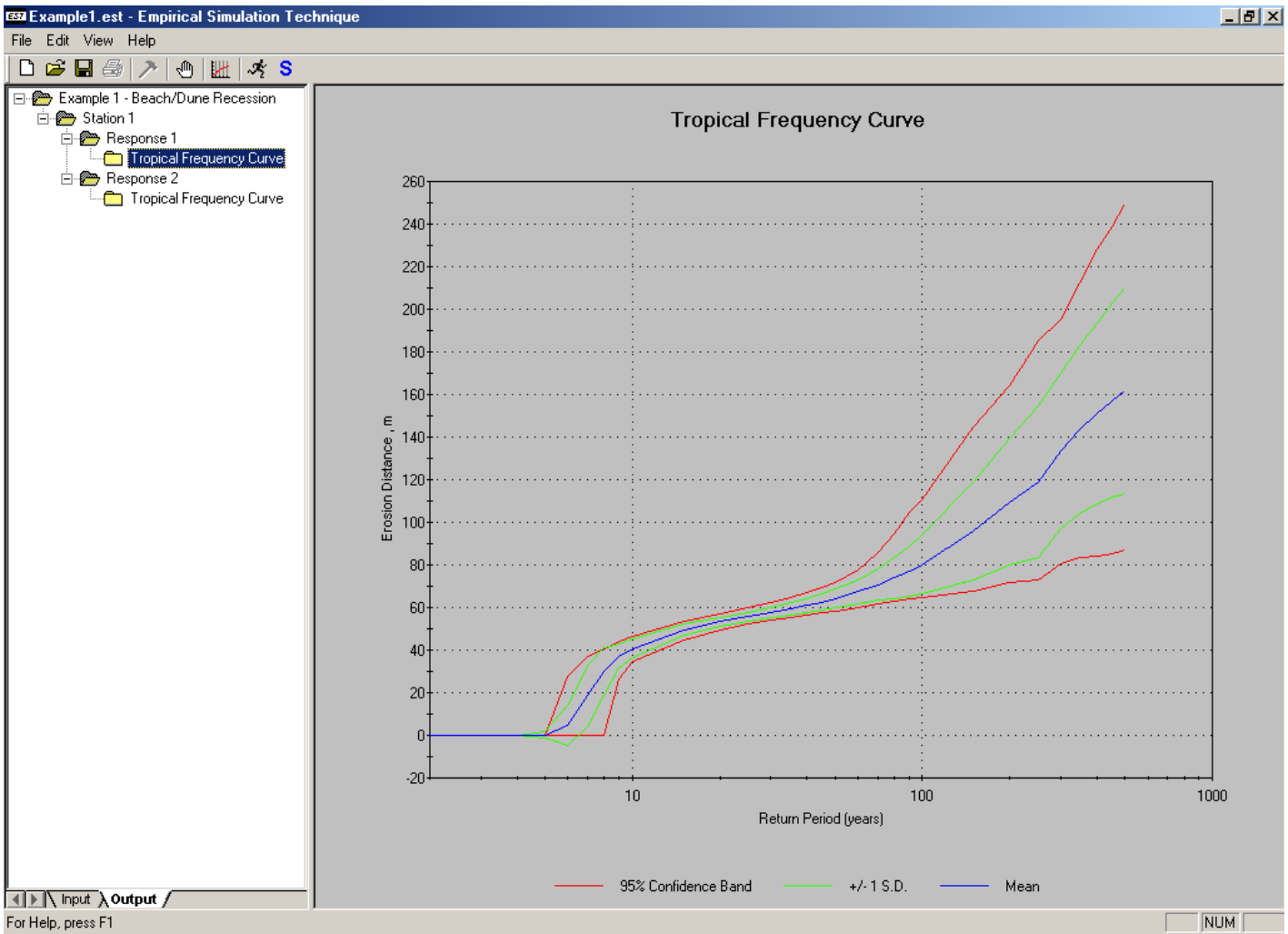
Modules	Models
General Engineering	ACES - 34 codes Empirical Simulation Technique
Inlets	SBAS DYNLET NMLong-CW
Beach	NEMOS - 11 codes SBEACH BMAP

General Engineering Module



A C E S

General Engineering Module

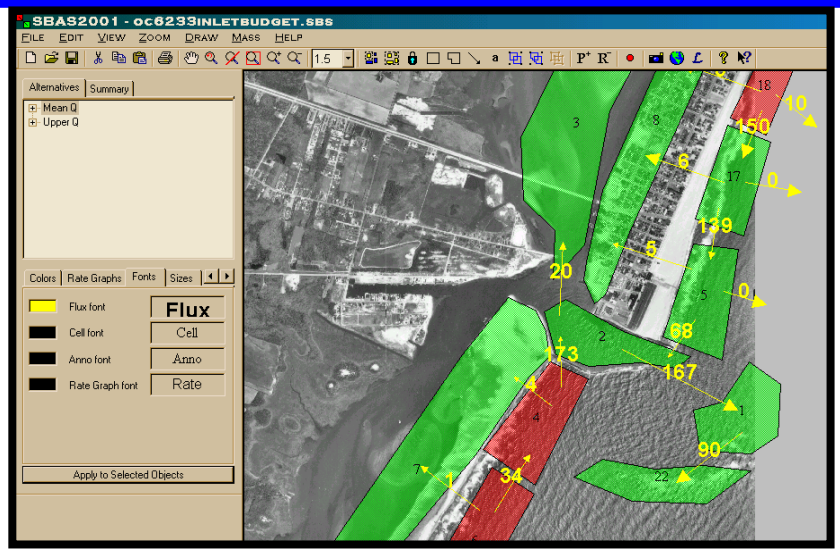


E

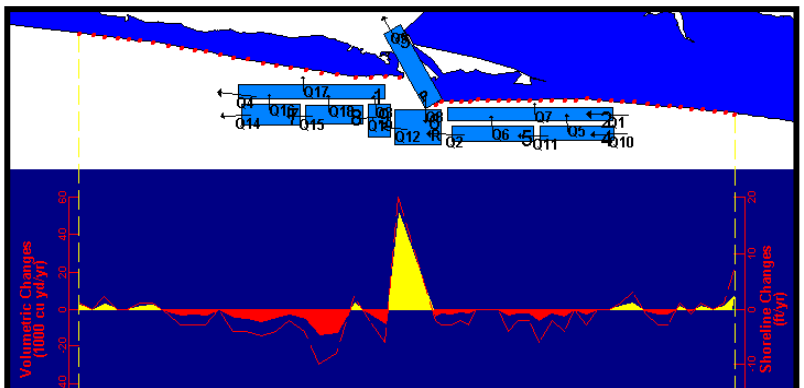
S

T

Inlets Module



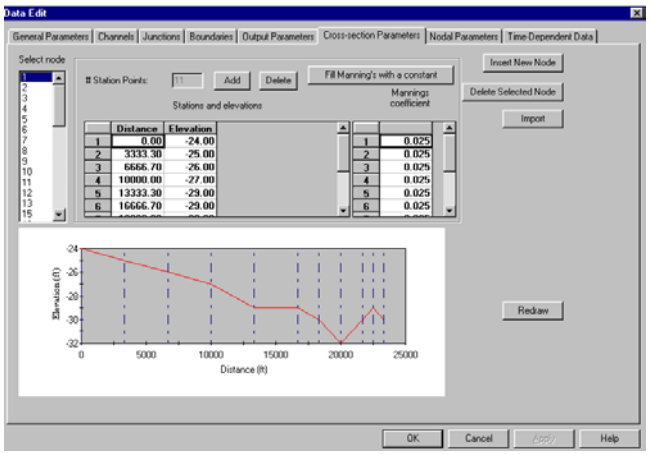
Sediment Budget Analysis System (SBAS2001)



SBAS

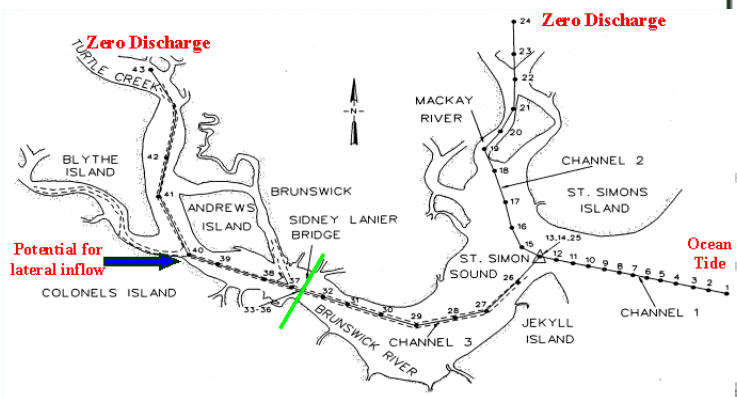
- Local & regional sediment budgets
- Color-coded cells
- Geo-referenced images
- Shoreline & volume change
- Collapse & reinstate cells

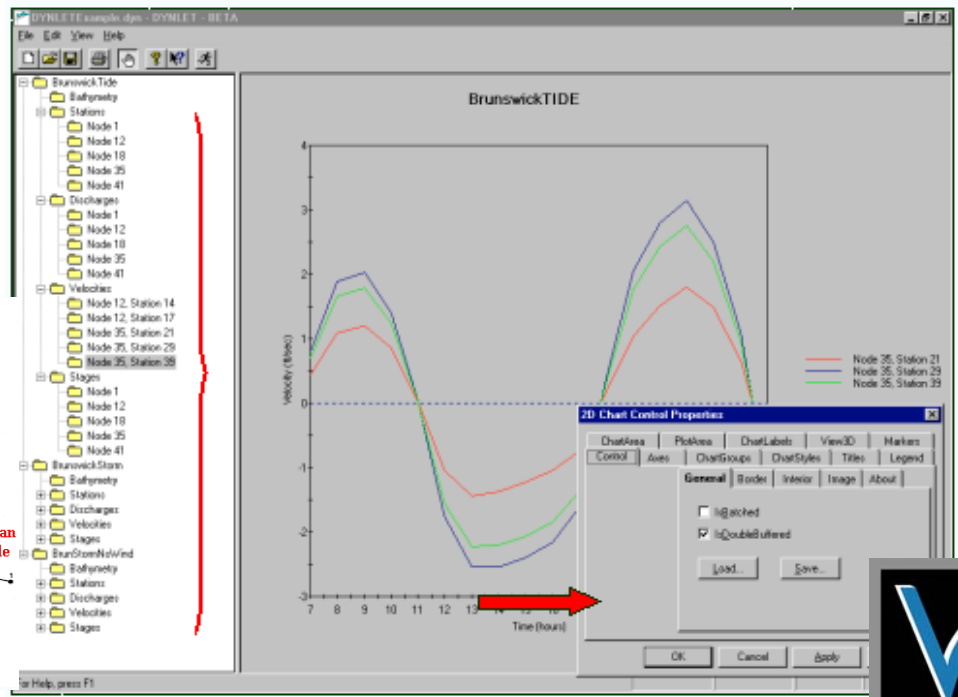
Inlets Module



DYNLET

a powerful 1-D hydrodynamic model

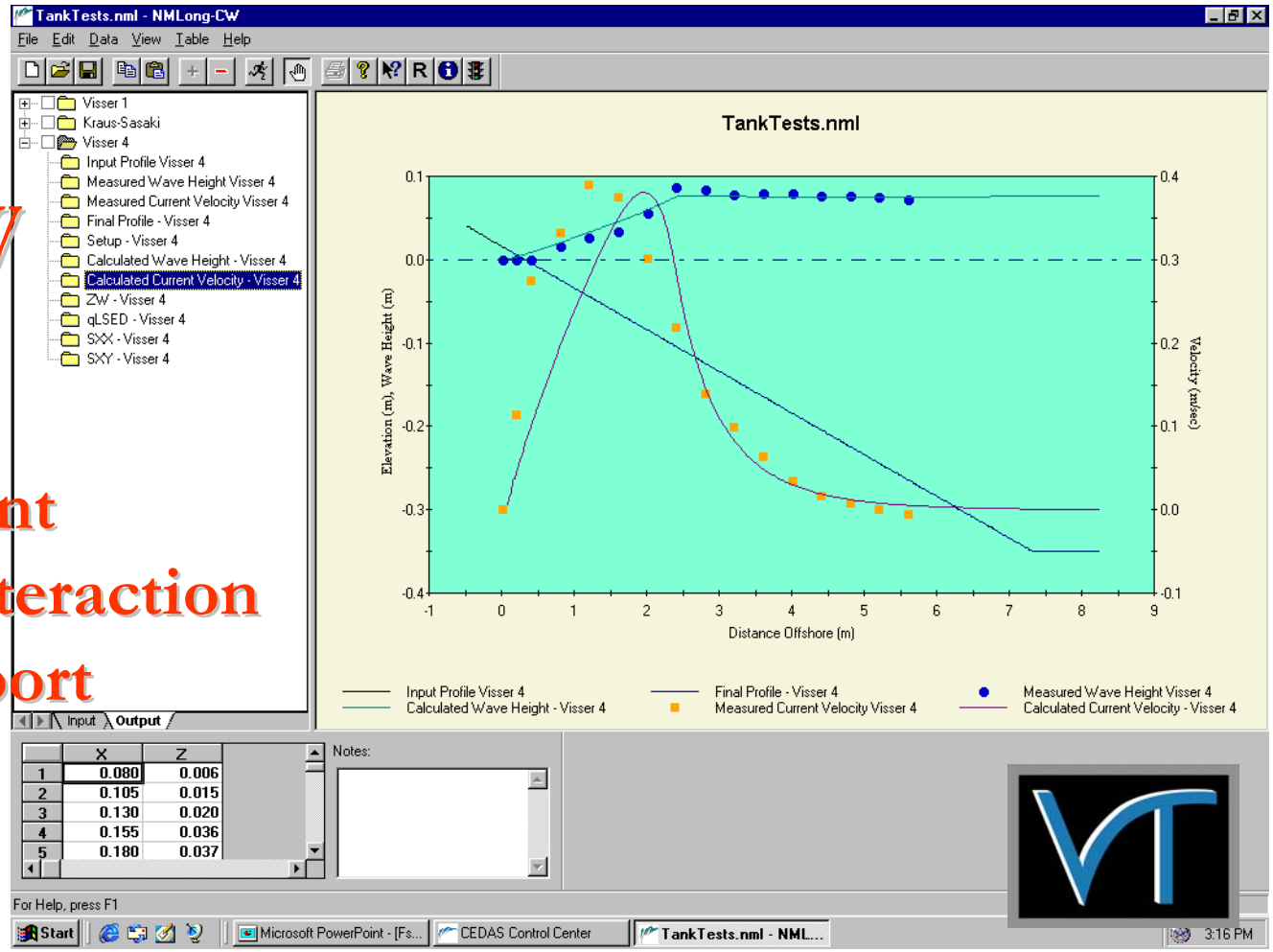




Inlets Module

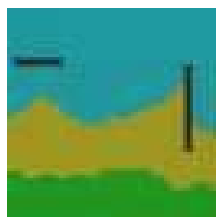
NMLong-CW

- wave height
- longshore current
- wave-current interaction
- sediment transport



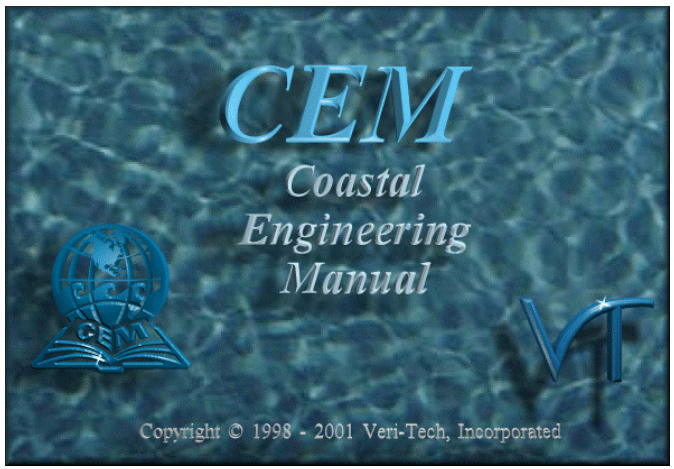
Beach Processes Module

- **BMAP**
- **SBEACH**
- **NEMOS**
  - *GENESIS*
  - *GENESIS/T*
  - *STWAVE*
  - *RCPWAVE*
  - *Toolbox*



NEMOS

Other Veri-Tech Inc. Products



Replacement for the

Shore Protection Manual

Interactive CEM
Now Available on CD-ROM

Version 1.01 - General Introduction, Coastal Hydrodynamics, Coastal Sediment Processes, Coastal Geology, and Glossary

COASTAL ENGINEERING MANUAL

Beach Processes Module

- **BMAP**
- **SBEACH**
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  - *GENESIS*
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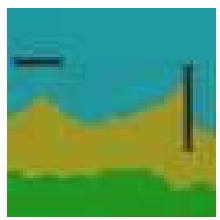


NEMOS

Beach Processes Module

BMAP

Beach Morphology Analysis Package

BMAP is a collection of automated and interactive tools to analyze morphologic and dynamic properties of beach profiles. BMAP is dynamically linked with SBEACH to support modeling of storm-induced beach erosion of beach fill projects. It includes a variety of functions to inspect and analyze beach profiles and beach profile change. The graphical interface produces on-screen plots of user-selected profiles and calculation report files.

Beach Processes Module

BMAP – Analysis Functions

- Average
- Bar Properties
- Profile Comparison
- Cut and Fill
- Combine Profiles
- Horizontal Alignment
- Translate
- Volume
- Volume between transects
- Transport Rate
- Beach Fill Placement
- Least-Square Equilibrium Profile Estimate
- Equilibrium Profile
- Modified Equilibrium Profile
- Plane Slope Profile
- Interpolate Profile

Beach Processes Module

SBEACH

Storm-Induced **BEA**ch **CH**ange Model

SBEACH simulates cross-shore beach, berm, and dune erosion produced by storm waves and water levels. Specification of a non-erodible hard-bottom profile is available for simulation of profile change in the presence of nearshore rock outcrops or reef structure. The effect of seawalls or revetments located on the profile can be simulated (three seawall failure mechanisms may be specified).

SBEACH

Description

- Energy Dissipation-Based Morphologic Model
- Short Term Cross-Shore Profile Response
- Longshore Processes Assumed Uniform

Processes Modeled

- Beach and Dune Erosion
- Bar Formation and Movement
- Limited Beach Recovery
- Wave Transformation and Setup

Engineering Applications

- Evaluate and Design Beaches for Erosion / Flood Protection
- Evaluate Short-Term Performance of Beach Fill
- Provide Information for Economic Analyses

SBEACH

Data Requirements

- Initial Beach Profile
- Median Grain Size
- Boundary Conditions
- Wave Information (constant or time series)
- Water Elevation (constant or time series)
- Wind (optional)
- Calibration Events
- Model Configuration Parameters

Application Issues

- Calibration/Performance Evaluation
- Selection of Representative Beach Characteristics
- Storm Input and Assignment of Probability
- Sensitivity Testing
- SBEACH Output for Economic Analyses

SBEACH

Factors Controlling Storm Erosion Based on Energy Dissipation/Equilibrium Concepts

- Grain Size
  - shape (slope) of equilibrium profile
- Water Level (tide + surge)
  - range of profile response
- Wave Height
  - energy available to induce transport
  - range of profile response
- Storm Duration (surge and wave)
  - time scale to adjust to equilibrium
- Pre-Storm Profile Shape
  - degree of disequilibrium
  - volume change required to achieve equilibrium

SBEACH

Theory

Zone I: Prebreaking Zone

Exponential decay with distance offshore.

Zone II: Breaker Transition Zone

Exponential decay with distance offshore (slower ra of decay than in Zone I).

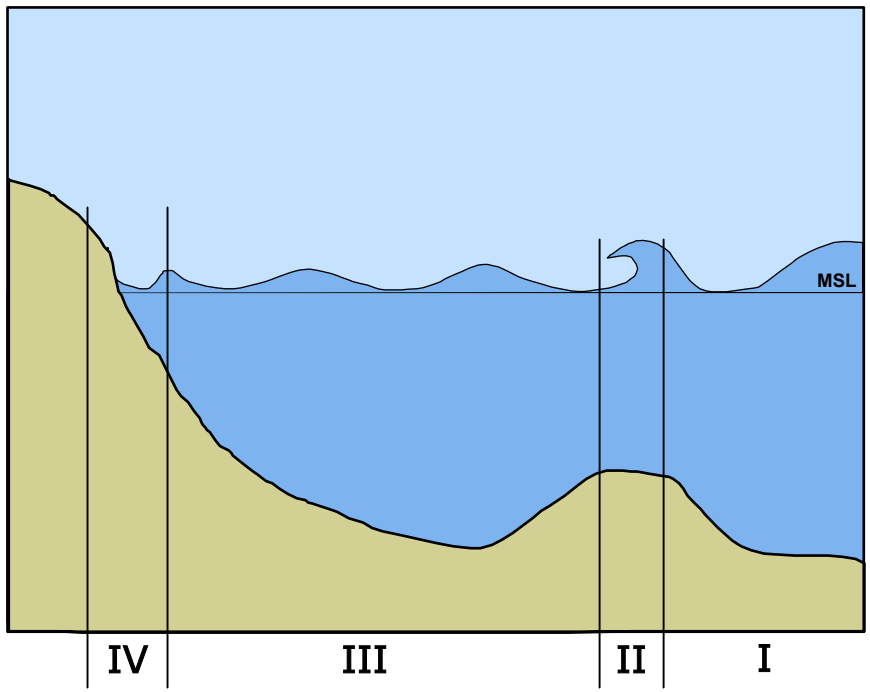
Zone III: Breaker Transition Zone

Wave energy dissipation per unit water volume

$$q = K\left(D - Deq\right) + \varepsilon \frac{dh}{dx}$$

Zone IV: Swash Zone

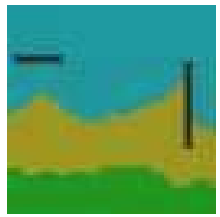
Linear decay to limit of wave runup



Four Principle Zones of Cross-Shore Transport

Beach Processes Module

NEMOS
Nearshore Evolution MOdeling System



NEMOS provides an integrated environment for the application of major Corps of Engineers coastal processes numerical models. Within the system, offshore wave information is analyzed, filtered, and statistically characterized then imported to a 2D nearshore wave model and transformed across an irregular nearshore bathymetry with results passed into the shoreline change model GENESIS. The system provides for visualization of virtually all data sets and results. NEMOS is ideally suited for the conduct of coastal shore-protection design analyses and optimization.

NEMOS

Major Numerical Models

- **GENESIS** (**GENE**ralized Model for **SI**mulating **S**horeline Change) – simulates long-term planform evolution of the beach in response to imposed wave conditions, coastal structures and other engineering activities (e.g., beach nourishment, sand bypassing).
- **GENESIS/T** (**GENE**ralized Model for **SI**mulating **S**horeline Change / **T**ombolos, Regional **T**rend Contours, **T**idal Currents, Variable Wave **T**ransmission) – enhanced GENESIS model explicit solution scheme.
- **STWAVE** (**ST**eady State Spectral **WAVE** Model) – a computationally efficient steady state spectral wave energy model for nearshore wind-wave growth and propagation.
- **RCPWAVE** (**R**egional **C**oastal **P**rocesses **WAVE** Propagation Model) – a computationally efficient linear, plane wave propagation model for nearshore wave transformation over an arbitrary bathymetry.

NEMOS Toolbox of Auxiliary Codes

- **GRIDGEN –** is a code to create uniform rectilinear 2D computational grids at arbitrary orientations from random bathymetry/topography data. It is used to create *spatial domain* and *station* files required by the wave models.
- **WWWL –** is a wave, wind, and water level editor used to process and filter time series information such as offshore wave information required by GENESIS.
- **WSAV –** is a wave statistical analysis and visualization code used to statistically analyze wave time series information. It enables the creation of wave height, period, and direction, bands for characterizing the offshore wave climatology with a limited number of representative wave conditions that can be output in a *permutations* file.

NEMOS Toolbox of Auxiliary Codes

- **WMV –** is a wave model visualization code that enables visualization of wave model results. It provides a graphical environment for the display and overlay of a variety of wave model results over the entire computational domain as well as at user specified *stations*.
- **SPECGEN –** is a code used to import, create, and visualize directional spectra that is required by STWAVE. It accepts, as input, output from WSAV in the form of a *permutations* file.
- **WISPH3 –** is a simplified point-to-point spectral wave transformation code that employs the WIS Phase III transformation technique. It is used to transform wave information from, for example, a hindcast output station to the offshore boundary of a nearshore wave transformation model.