Overview of the SMS (v11.0)

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### Overview of the SMS (v11.0)

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#### 5b. GRANT NUMBER

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#### 5d. PROJECT NUMBER

#### 5e. TASK NUMBER

#### 5f. WORK UNIT NUMBER

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38th Tech Transfer Workshop, Coastal Inlets Research Program, March 6-8, 2012.

#### 14. ABSTRACT

#### 15. SUBJECT TERMS

#### 16. SECURITY CLASSIFICATION OF:

<table>
<thead>
<tr>
<th>a. REPORT</th>
<th>b. ABSTRACT</th>
<th>c. THIS PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>unclassified</td>
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<td>unclassified</td>
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</tbody>
</table>

#### 17. LIMITATION OF ABSTRACT
Same as Report (SAR)

#### 18. NUMBER OF PAGES
43

#### 19a. NAME OF RESPONSIBLE PERSON
Introduction to the Surface-water Modeling System (SMS v.11.0)

- What is it?
- Tools, Modules, Data Tree, Images, etc.
- CMS Models interface
Since 1997…
- 38 workshops
- Districts can independently run the CMS!

Advantages…
- Robust
- Physics-based
- Integrated SYSTEM
- In SMS
- User-friendly
Scales of Coverage

TIME SCALE

<table>
<thead>
<tr>
<th>TIME SCALE</th>
<th>MICRO</th>
<th>MESO</th>
<th>MACRO</th>
<th>MEGA</th>
<th>ULTRA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>sec-min</td>
<td>hour-week</td>
<td>month-year</td>
<td>decades</td>
<td>century</td>
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SPACE SCALE

<table>
<thead>
<tr>
<th>SPACE SCALE</th>
<th>MICRO</th>
<th>MESO</th>
<th>MACRO</th>
<th>MEGA</th>
<th>ULTRA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm - m</td>
<td>m - km</td>
<td>km - 10 km</td>
<td>sub-regional</td>
<td>regional</td>
</tr>
</tbody>
</table>

MORPHOLOGIC RESPONSE. SPACE

<table>
<thead>
<tr>
<th>TRANSPORT THRESHOLD</th>
<th>SEDIMENT SOURCING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ripples</td>
<td>Sand Waves</td>
</tr>
<tr>
<td>Bars</td>
<td>Long</td>
</tr>
</tbody>
</table>

FORCING, TIME

<table>
<thead>
<tr>
<th>FORCING, TIME</th>
<th>Turbulence</th>
<th>Wind</th>
<th>Tide</th>
<th>Coastal currents</th>
<th>Sea level rise / Global warming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waves</td>
<td>Storms</td>
<td>Seasonal variations</td>
<td>River discharges</td>
<td>Regional climate variation (e.g., El Niño)</td>
<td></td>
</tr>
</tbody>
</table>

Boussinesq Modeling Technology

CMS-Wave
CMS-Flow
PTM

GenCade
Inlet Reservoir Model
Sediment Budgets

Shoaling Toolbox
Sec 111 Guidance
RMAP

Berms

CPT
CSMART

Tide
RMAP
What is the SMS?

- **A Pre-Processor**
  - Organize and create input files for Corps of Engineers’ Numerical Models

- **A Post-Processor (visualize results)**
  - Create plots
  - Create film loops
  - Data calculator
  - Dataset creation

- **Connect with outside tools**
  - Import/export CAD data
  - Import/export GIS data
  - Import/export tabular ASCII data
  - Import/export image data
Overview of SMS interface

The SMS interface is modular. Separate modules pertain to each data type. As the user switches from one module to another, the menus and tools change. Inside the modules, the user associates a numerical model with a mesh or grid. When that grid is active, the tools and menus for the associated model are also enabled.

The SMS screen includes several toolbars, edit fields, and menus. Some of these change as the user switches modules or numerical models. The principal components include:

- **Menu Bar** - Menu to issue commands. These change as the module and model change.
- **Edit Window** - Fields directly below the menu bar showing the coordinates and function values for selected entities.
- **Graphics Window** - Display panel to show the data being manipulated.
- **Project Explorer (Data Tree)** - Tree representation of data currently referenced through SMS.
- **Time Step Window** – Appears if transient data are available.
- **Toolbars** - Several toolbars can be displayed. For more information on each toolbar, see the Toolbars article.
- **Help or Status Window**

The toolbars, project explorer, time steps window, and edit window are dockable windows. Dockable windows may be positioned by the user.
The Data Tree (also referred to as the “Project Explorer”) is a dockable window that appears by default on the left side of the SMS screen. This window displays a hierarchical tree structure representing all data currently being managed in an SMS simulation.
Toolbars

- Static Toolbar

- Dynamic Toolbar
  - Grid
  - CMS-Flow
  - CMS-Wave
  - Scatter
  - Annotation

- Data Toolbar

- Optional Toolbars
  - Macro
  - File
  - Display

- Module Toolbar
Dynamic Toolbar

Cartesian Grid tools
- Select Cell, Row, and Column
- Split Column and Row
- Move Column and Row Edges
- Select and Create Cellstrings
- Create Grid Frame
- Apply Contour Labels

Map Data Tools
- Select Feature Node
- Create Feature Node
- Select Vertex
- Add Vertex
- Select Feature Arc
- Create Feature Arc
- Select Feature Polygon
- Create 2-d Grid Frame
- Select 2-d Grid Frame

Selection tools usually have an arrow that points to the specific type of element.

Creation tools are identical to selection tools, only they do not have the arrow.

Scatter Data tools
- Select and Create Point
- Select and Create Breakline
- Select and Create Triangle
- Flip Triangle Edge
Data Tree Components

- The Data Tree makes selection of loaded datasets easy. Simply click on a dataset to make it active, and the graphics window updates accordingly.

- There are several “right-click” options available depending on the type of dataset activated, and within which module it is located. A few of these are:
  - Basic Dataset Information
  - Dataset-specific contour options
  - Export to file
  - Metadata Information

- The display of each asset in the Data Tree can be turned off by unchecking the display box next to the dataset name.
SMS – a complete modeling interface

Build a CMS model from start to finish – all within SMS

Import Background Data
- Topographic & bathymetric data – numerous formats supported
- Images – maps & aerial photos
- CAD, GIS & spreadsheet data

Create Conceptual Model
- Delineate CMS model domain
- Define areas of finer resolution

Generate & Run CMS Models
- Automatically generate grid
- Interpolate depths from background data
- Utilize built-in interfaces to define model-specific parameters and boundary conditions
- Run model and visualize results
SMS – Data Processing
Import Wizard

File Import Wizard - Step 2 of 2

SMS data type:
- Scatter Set

Options:
- Filter Options

Mapping options:
- Triangulate data
- Delete long triangles

No data flag: -999.0

Maximum edge length: 100000.0

Merge duplicate points within tolerance: 0.0000100

Name: Imported Data

File preview:

<table>
<thead>
<tr>
<th>Type</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>Scalar data</th>
<th>Vector X</th>
<th>Vector Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Header</td>
<td>XYZ</td>
<td>(2697 points)</td>
<td>WSE</td>
<td>Velocity</td>
<td>Velocity</td>
<td></td>
</tr>
<tr>
<td>105.074</td>
<td>-286.841</td>
<td>50.750</td>
<td>53.318</td>
<td>1.260</td>
<td>-0.706</td>
<td></td>
</tr>
<tr>
<td>104.575</td>
<td>-287.898</td>
<td>49.607</td>
<td>53.368</td>
<td>1.308</td>
<td>-0.412</td>
<td></td>
</tr>
<tr>
<td>104.076</td>
<td>-288.955</td>
<td>48.464</td>
<td>53.418</td>
<td>1.577</td>
<td>-0.712</td>
<td></td>
</tr>
<tr>
<td>103.612</td>
<td>-290.029</td>
<td>48.464</td>
<td>53.376</td>
<td>2.096</td>
<td>-0.604</td>
<td></td>
</tr>
</tbody>
</table>

First 20 lines displayed.

Help < Back Finish Cancel
Scattered Data (TINs)

- Stores spatially varied data
  - Bathymetric data most common
  - Interpolates from one grid/mesh to another
  - Allows combination of data sources
  - Facilitates data thinning or filtering
Visualization of Scattered Data

- Options
  - Magnify in Z direction
  - Oblique or plan views
  - Fill with contours options
  - Shading

*Humboldt Bay, CA*

Oblique view

Z-magnification 5x
Lidar Survey
Breaklines
### Operating With Scatter Sets

- **Merge**

![Image of scatter set operations]

- Right Click Menu
- Merge

**Project Explorer**

- Scatter Data
- DC_SP83_MD_Meters
- DC_SP83_MD_Horz
- Map Data
  - default coverage

- New Folder
- Delete
- Duplicate
- Rename
- Split
- Convert
- Coordinate Conversion
- Metadata
- Zoom to Scatter

**Merge Scatter Sets**

- Select Scatter Sets
- Options for the New Scatter Set
  - Name: Merged
  - Overlapping Points
    - Keep all points
    - Keep from higher priority scatter set

- Options for Dataset
  - Merge

- Select All
- Deselect All
- Move up
- Move down
- OK
- Cancel
Points and Triangles

- User can delete points or triangles to change extents of a set.
- User can swap edges to alter shape of surface
  - Used in linear interpolation
Images

Topo Maps

Aerial Photos

http://terraserver.microsoft.com
Image Data

Overlay data over images
CMS-Flow Interface: Pull-down Menus

The Data pull-down menu contains many items – here are a few:

- Steering Module – Starts/controls interaction between Flow and Wave
- Data Calculator – Dataset-based functions
- Dataset Toolbox – Dataset-based operations (includes Calculator)
- Vector/Contour Options – Change appearance of data within the Graphics Window
- Film Loop – Generate animations based on loaded data/solutions
- Grid -> Scatterpoint – Convert CMS-Flow grid to Scatterpoint dataset (TIN)

The Cellstring menu contains operations for boundary condition forcing strings.

The CMS-Flow menu contains commands to operate the model.

- Assign BC – Assigns boundary condition forcing information to cellstrings
- Delete BC – Delete the forcing information from a cellstring
- Model Control – Set up the parameters and running options for the CMS-Flow simulation
- Run CMS-Flow – Start CMS-Flow based on Model Control options.
CMS-Flow Model Control
Parameter Specification and File I/O

- Time Control
- Auxiliary Files
- Parameters
  - Wet/Dry depth
  - Flags
- Calculations to Include
  - Sediment Transport
  - Wind
  - Waves
  - Salinity
CMS-Wave Interface: Pull-down Menus

The Data are the same for both CMS-Flow and CMS-Wave.

- Steering Module – Starts/controls interaction between Flow and Wave
- Data Calculator – Dataset-based functions
- Dataset Toolbox – Dataset-based operations (includes Calculator)
- Vector/Contour Options – Change appearance of data in Graphics Window
- Film Loop – Generate animations based on loaded data/solutions
- Grid -> Scatterpoint – Convert CMS-Flow grid to Scatterpoint dataset (TIN)

The CMS-Wave menu contains commands to operate the model.

- Spectral Energy – Allows user to Create Spectral Energy forcing from wave characteristics or Import existing data from a wave gauge
- Nest Grid – Allows use of a nested (child) wave grid for better resolution in some areas
- Model Control – Set up the parameters and running options for a CMS-Wave simulation
- Model Check – Analyze present wave grid and modeling parameters for errors before run commences.
- Run CMS-Wave – Start CMS-Wave based on Model Control options.
Spectral Energy menu

Example of Imported Spectra from Wave Gauge
Generate Spectra from Bulk Criteria

Parameter Settings:
- Generation Method: TMA (Shallow Water)
- Replace Old Spectra
- Directional Spreading Distribution:
  - Wrapped Normal
  - Cosine Power
- Gauge Depth: Specify once for all spectra
  - 0.001 m
- Specify for each spectrum

Angle Settings:
- Projection: Shore Normal

Spectral Parameters:

<table>
<thead>
<tr>
<th>Index</th>
<th>Angle (deg)</th>
<th>Hs (m)</th>
<th>Tp (s)</th>
<th>Gamma</th>
<th>nn</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.0</td>
<td>2.0</td>
<td>10.0</td>
<td>3.3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Model Control

- Turn on Wetting & Drying of Cells
- Turn on Reflection (FWD, BWD)
- Choose Bed Friction type
- Set parameters
- Choose Output Datasets
- Choose Wave Source
Recent additions to the SMS

- Dataset Toolbox
- Grid duplication/rotation tools
- Web Menu
- Spatial Data Coverages
  - Data types
  - Plot types
  - Compass plots
- Coordinate Projections
  - More projections
  - Automatic re-projection of data with projection file
Dataset Toolbox

- **Math**
  - Compare data sets
  - Data Calculator
- **Temporal**
  - Sample time steps
  - Compute derivative
- **Conversion**
  - Scalar to Vector
  - Vector to Scalar
- **Modification**
  - Map activity
  - Filter

**Base**
- **pensaflow1990 (CMS-Flow)**
  - D50
  - Hard Bottom
  - ManingsN
  - Depth
  - Simulation
    - pensaflow1990_elev
    - pensaflow1990_morph

**Alternate**
- **pensaflow1990 (CMS-Flow)**
  - D50
  - Hard Bottom
  - ManingsN
  - Depth
  - Simulation
    - pensaflow1990_elev
    - pensaflow1990_morph

**Data Set Info...**
- Value if base is inactive: -99.0
- Value if alternate is inactive: 99.0

**Output data set name:** new data set

**Update Available Tools**

**Compute**

**Done**
Dataset Toolbox

- Temporal Operations
  - Sample times
  - Temporal derivatives
- Mathematical Operations
  - Comparisons
  - Data Calculator
- Spatial Operations
  - Spacing
  - Gradients/Derivatives
  - Smoothing
- Conversions
  - Vector <-> Scalars
- Coastal Functions
  - Wavelength/Celerity
  - Courant number
- Activity Mapping
  - Map activity
  - Value filtering
Web Menu

- **Import data from web ...**
  - Virtual Earth
  - Image data
  - Elevation data

- **Find Data**
  - Links to useful web sites

- **Tidal Data**
  - Links to coastal filtering tools
Spatial Data Coverages

- Create nodes at locations of interest (gauges)
- Associate temporal data with location
  - Scalar data
  - X/Y vector data
  - Mag/dir vector data
- Plot types
  - Scientific
  - Multi-axis
  - Rose plots
Compass plot
- Displayed on graphics window
- Updates with dates
- User managed
Coordinate Projections

- All major datums
- Project
  - Point
  - Object
  - Entire project
- Support for projection files
- Automatic detection of projections
  - Images
  - CAD
  - GIS
SMS – Post Processing

- Annotations
- Graphic images
- Animations
  - AVI filmloops
  - kmz – Google Earth Exports
- 2D Plots
  - Time series
  - Profiles and Cross sections – both steady state and transient
Annotation Layers

- Replaces Drawing Objects
- New Objects
  - Screen space images (logos)
  - Scale bars
  - North Arrows
- Organizes entities into layers
- Anchored in either world or screen
Contour/Vector Plots
Obtaining and Activating SMS


USACE –
Contact sms@erdc.usace.army.mil and request a password for SMS 11.0.

Others –
- Contact Aquaveo sales at sales@aquaveo.com or call (801) 302-1400.
- Request evaluation version from within the SMS registration form.
Documentation

- CIRP website
- Wiki Website

http://cirp.usace.army.mil/

http://cirp.usace.army.mil/wiki/
Products
- CMS
- GenCade
- Others

Publications
- Technical Reports
- CHETNS
- Journal Articles
- Others

Workshops
- Upcoming
- Recent

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The Coastal Inlets Research Program (CIRP) is pleased to celebrate our 12th Annual Technology-Transfer Workshop in conjunction with the 24th Annual National Conference on Beach Preservation Technology. The CIRP workshop will be held just prior to the FSBPA conference, from Monday, February 7th through Wednesday, February 9th (half day), 2011.

CIRP Workshop Information
CIRP Workshop Program
CIRP Workshop Registration
CIRP Workshop Hotel Reservations

Julie Rosati and CIRP Pla
Channel Portfolio Tool (CPT)

POC: Dr. Kenneth Ned Mitchell
Kenneth.n.mitchell@usace.army.mil
601-634-2022
US Army Engineer Research and Development Center (ERDC)
Coastal and Hydraulics Lab (CHL)

Active URL (Corps machines only): https://itgis01.usace.army.mil/CPTWeb/

CPT is developmental software that is updated frequently.

CPT general layout

Setting the level of analysis (Reach, Project, District, Division)

CPT is designed to enable analysis of commercial utilization of the Corps-maintained waterway infrastructure at a variety of coverage levels. At the most detailed level, individual channel sub-reaches may be chosen for analysis and compared to other sub-reaches in the USACE portfolio of navigation projects. However, in order to provide decision support to personnel at all levels of Corps management, CPT can also be used to analyze and compare commercial usage figures at the Project, District, and Division levels. For example, a District program manager might want to see which navigation project under his or her control handles the most exports of a particular commodity. CPT pulls from a large database that is maintained by the Corps’ Waterborne Commerce Statistics Center (WCSC). Setting the desired level of analysis is done through the CPT Home screen: https://itgis01.usace.army.mil/CPTWeb/. Figure 1 shows the four levels of analysis provided by CPT; the desired level is chosen by simply clicking on the respective link.
Questions?

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