INTRODUCTION TO PARTICLE TRACKING MODEL (PTM) IN THE CMS

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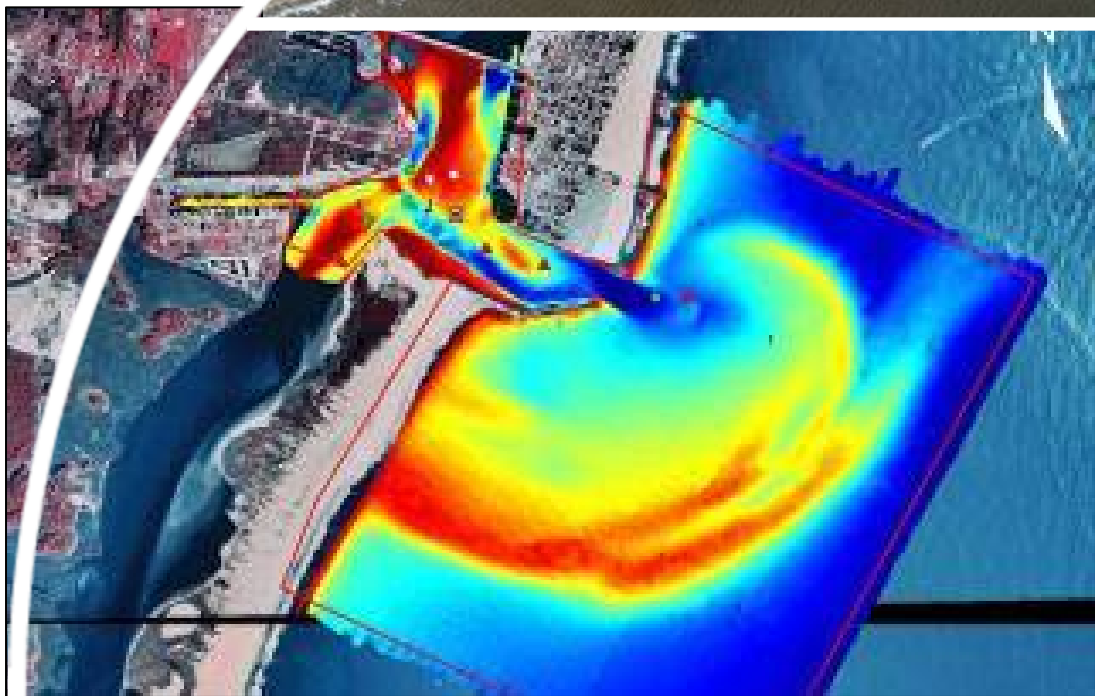

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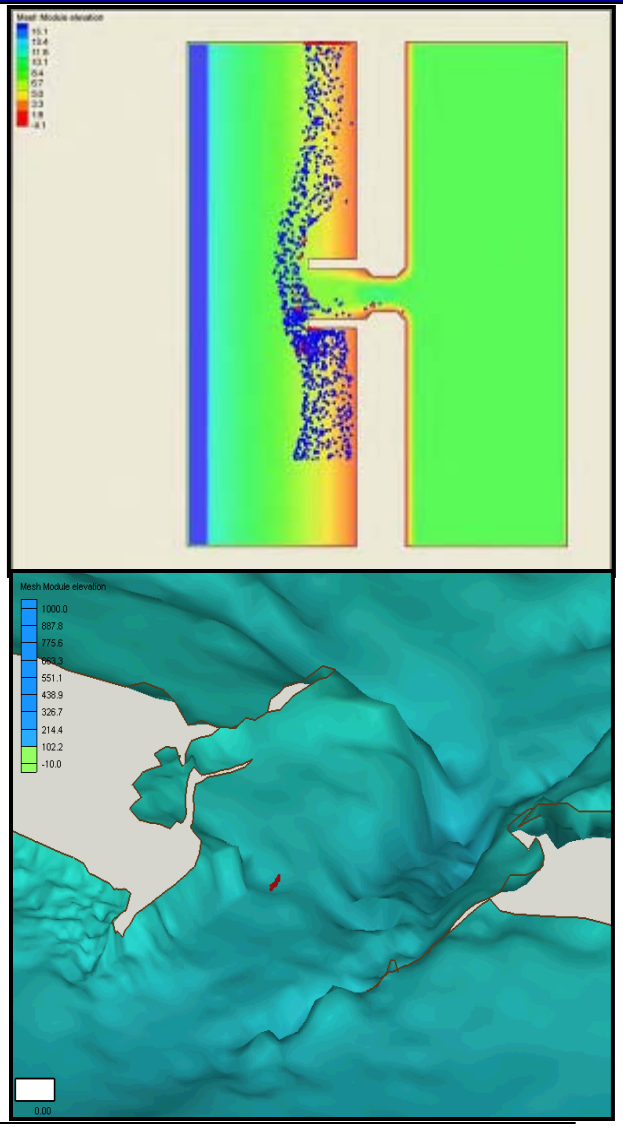
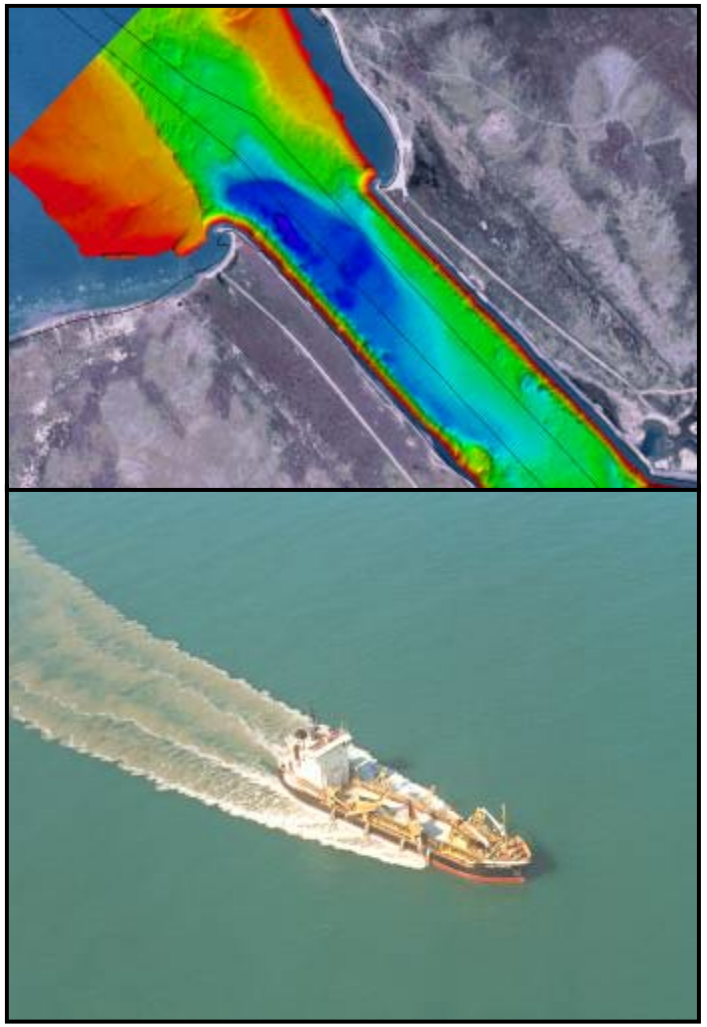
What is the PTM?

- The PTM is a Lagrangian model
- Designed to evaluate behavior of materials under combined waves and currents
- Implement a Lagrangian approach to track particles
  - parcel calculation technique used
  - a parcel is represented by particles with known attributes (diameter, density, mass)
  - parcels are free to advect, disperse, settle or be entrained from the bed



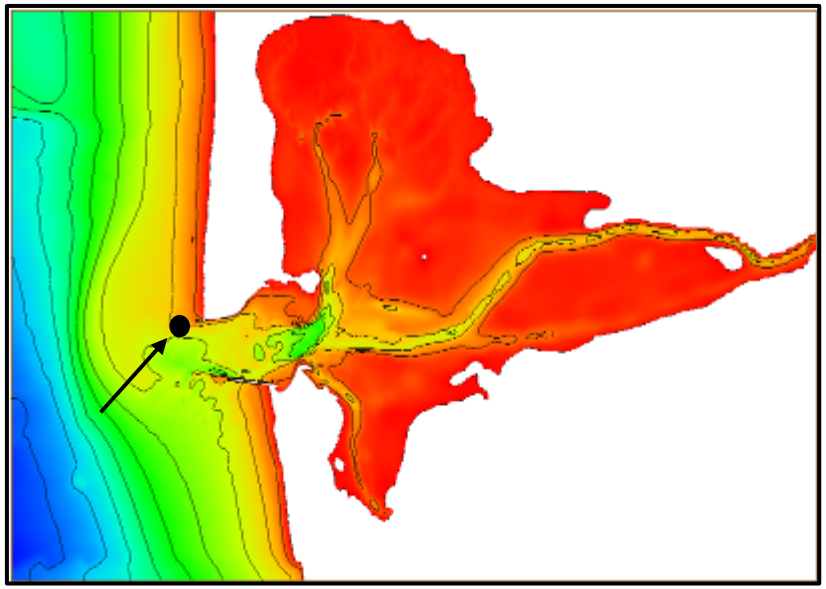
PTM Capabilities

- Visualize particle pathways and fate
- Calculate residence time
- Monitor specific sources of sediment transported to inlets and navigation channels
- Monitor dispersion sediment from dredged material placement sites
- Predict accretion and erosion zones
- Forecast potential increase in turbidity and deposition
- Isolate and track particles from other sources, such as outfalls, propeller-induced suspension, …



The CMS-PTM Coupled System

- The CMS is a coupled and integrated wave, flow, sediment transport, and morphology change modeling system
- The CMS provides hydrodynamic output (waves and current) to the PTM
- The PTM determines migration of particles based on the CMS input
- The CMS-PTM is implemented in the SMS (Surface-water Modeling System)



Calculations in the PTM

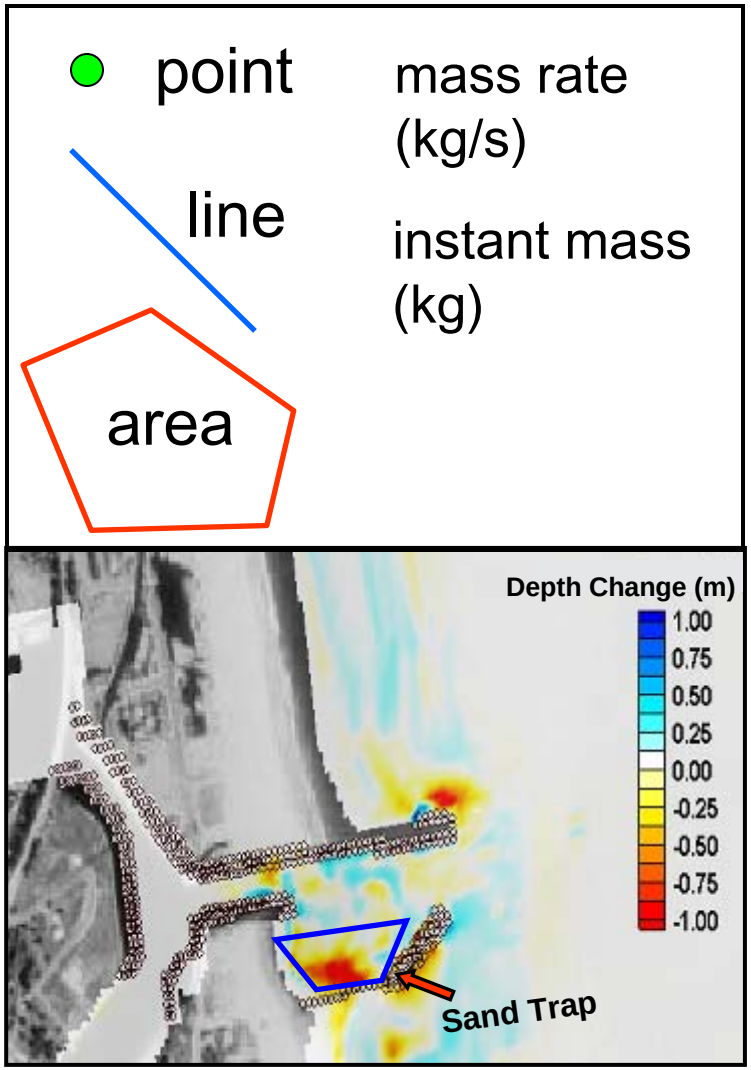
- Current and wave conditions required as from the CMS
- Combined wave-current sediment mobility (Soulsby & Whitehouse)
- Temporally and spatially varying bedforms (Mogridge et al.)
- Combined wave-current bottom shear stresses (O'Connor & Yoo, van Rijn)
- Suspended sediment transport (Rouse, van Rijn)
- Bed load transport (van Rijn)
- Settling and entrainment algorithms (Soulsby)
- Hiding and exposure function (Egiazaroff, Kleinhans & van Rijn)
- Neutrally-buoyant particles

Transport Processes Represented in the PTM

- Influence of bed slope on transport
- Mixed sand-silt-clay sediment transport algorithms
- Active layer mixing/armoring
- Variable bed roughness for growth/decay of bedforms
- Fully-3D transport of particles

Sediment Sources and Traps

- User-specified particle sources
  - Temporally- and spatially-varying point, line, or area sources
  - Mimic complicated dredging operations
- Particle traps
  - Used to monitor (count/collect) particles
  - Trap types may be defined as a line or area (zone or region)
- Residence time and spatial maps of particle transport parameters
  - Mobility, shear stress, and bedform
  - Pathways



PTM Applications

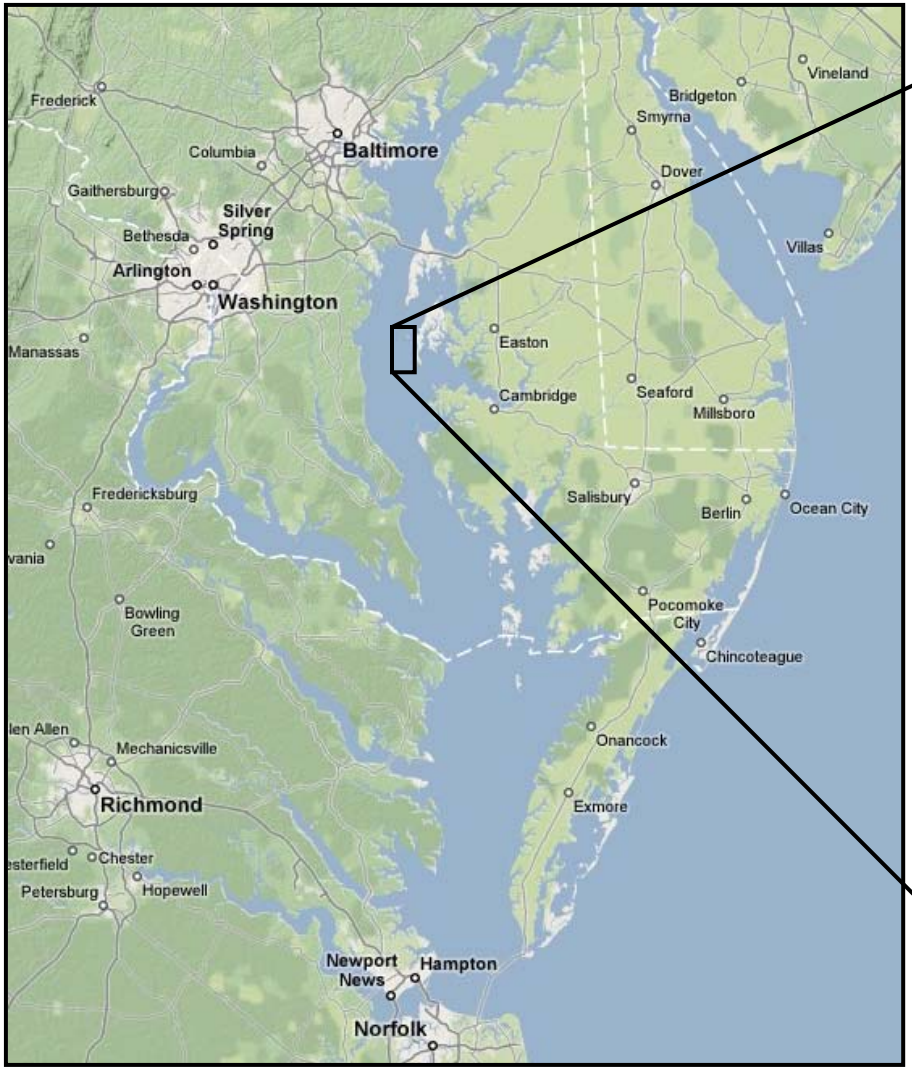
- Reconnaissance, feasibility, and design of O&M projects
- Inlet channels, shoals, structures, and adjacent beaches
- Channel design, infilling, and bypassing projects
- Study of fate and pathways of sediments in evolution of inlets
- Short-term (storm) analysis to long-term (project life) trend

PTM Applications

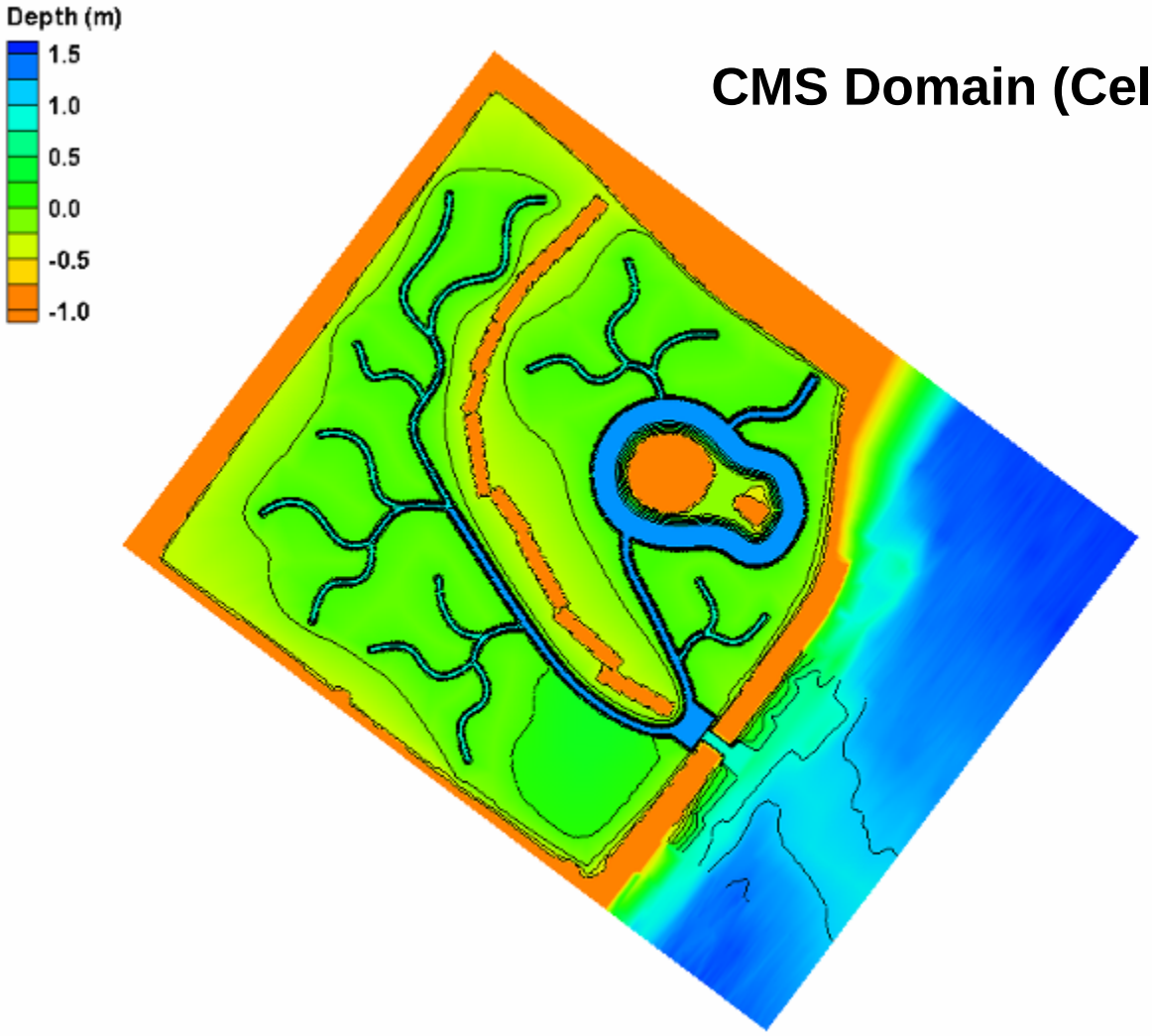
- CMS-PTM coupling
  - Idealized Inlet studies (R&D)
  - Grays Harbor (NWS)
  - Mouth of Columbia River (NWP)
  - Matagorda Ship Channel (SWG)
  - Packery Channel (SWG)
  - Chesapeake Bay/Poplar Island (NAB)
  - Sabine-Neches Waterway (SWG)

- DOER (Dredging Operations & Environmental Research) Program applications: LA/LB Complex (SPL); Willamette River (NWP); Port of Anchorage & Cook Inlet (POA); Cleveland Harbor (LRD); Brunswick Harbor (SAS); Providence River (NAD); Keith Lake River (SWG)

Poplar Island, MD



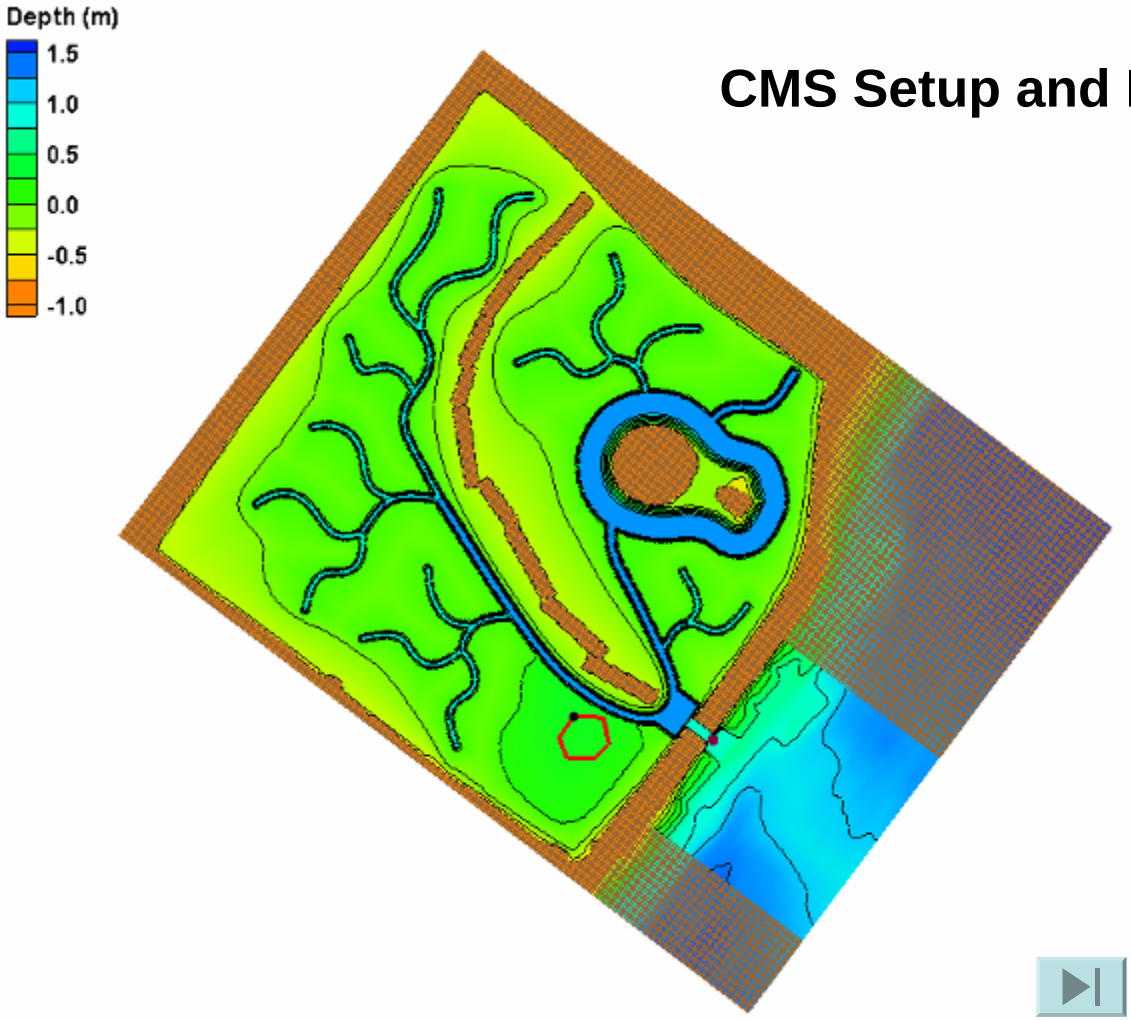
Poplar Island, MD



CMS Domain (Cell-1A)

Poplar Island, MD

CMS Setup and Results



Residence Time*

PARTICLES	AREA	TIME IN	TIME OUT	RESIDENCY (s)
7810	1	2001/01/01 07:20:20.0	2001/01/01 07:25:20.0	300.0
8228	1	2001/01/01 07:18:40.0	2001/01/01 07:28:20.0	580.0
9975	1	2001/01/01 07:27:20.0	2001/01/01 07:30:20.0	180.0
9378	1	2001/01/01 07:17:50.0	2001/01/01 07:30:40.0	770.0
9835	1	2001/01/01 07:17:20.0	2001/01/01 07:30:50.0	810.0
128	1	2001/01/01 07:17:40.0	2001/01/01 07:31:30.0	830.0
1576	1	2001/01/01 07:25:20.0	2001/01/01 07:32:20.0	420.0
9279	1	2001/01/01 07:21:30.0	2001/01/01 07:32:40.0	670.0
1318	1	2001/01/01 07:20:40.0	2001/01/01 07:33:20.0	760.0
7070	1	2001/01/01 07:28:20.0	2001/01/01 07:33:20.0	300.0
6417	1	2001/01/01 07:16:40.0	2001/01/01 07:33:30.0	1010.0
3615	1	2001/01/01 07:20:20.0	2001/01/01 07:34:00.0	820.0
.....				

•Residence Time = Time Particles Exit the Trap - Time Particles Enter the Trap
(TIME OUT) (TIME IN)

Future PTM Improvement

- CMS-specific PTM interface to simplify model setup
- Incorporation of sediment transport calculations of CMS and PTM (algorithms and parameters)
- Sediment concentration, cohesive sediment flocs, deposition mapping