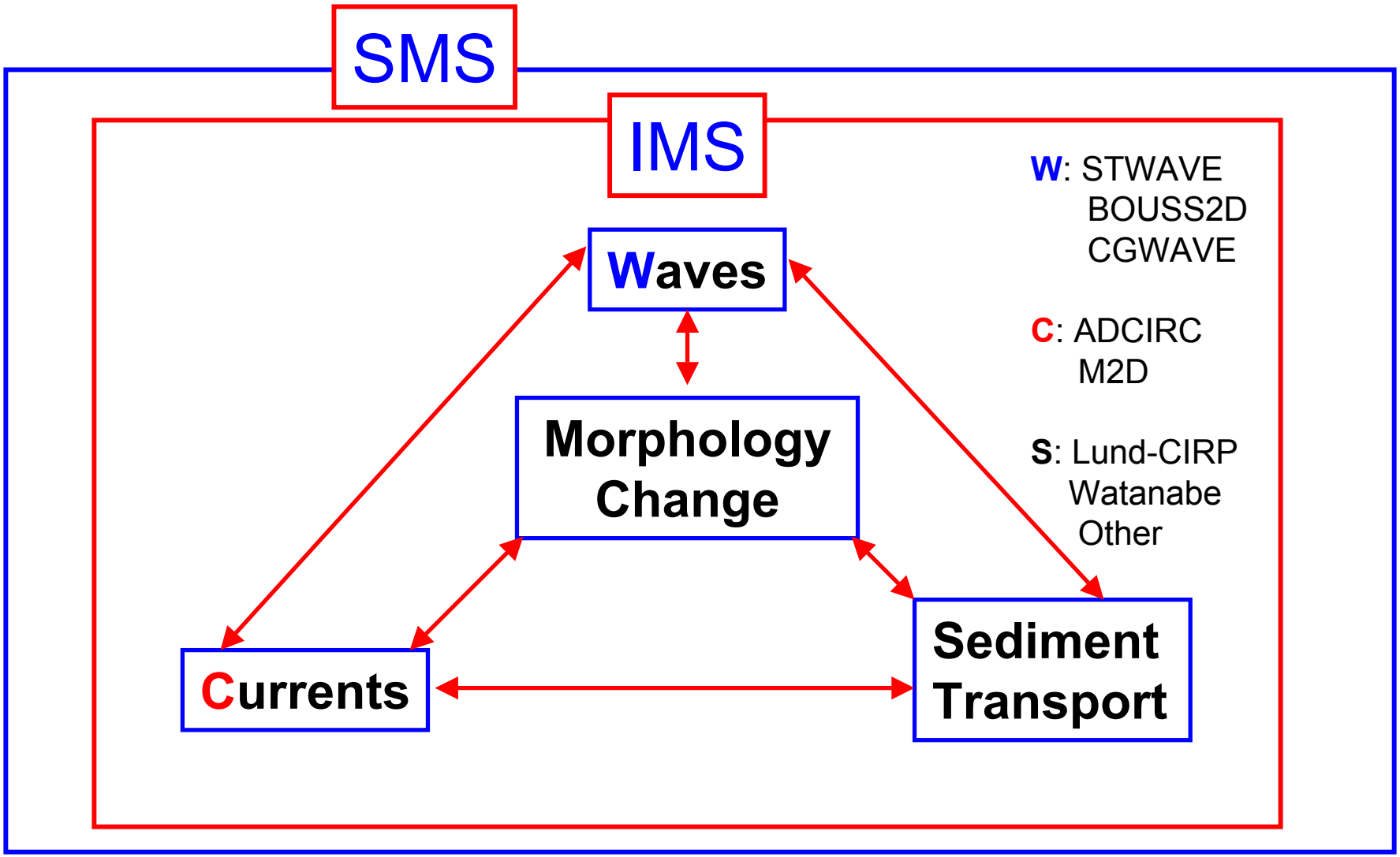
Inlet Modeling System



Approach

Provide an integrated numerical modeling system (the Inlet Modeling System (IMS)) for simulation of:

- waves,
- currents,
- water level,
- sediment transport
- bathymetry change

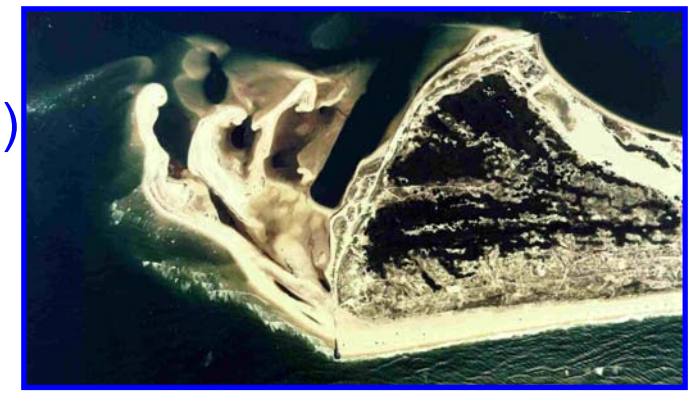
at inlets and entrances

Barnegat Inlet, NJ

Emphasis is on channel performance and sediment exchanges between the inlet and adjacent beaches.

Inlet Modeling System

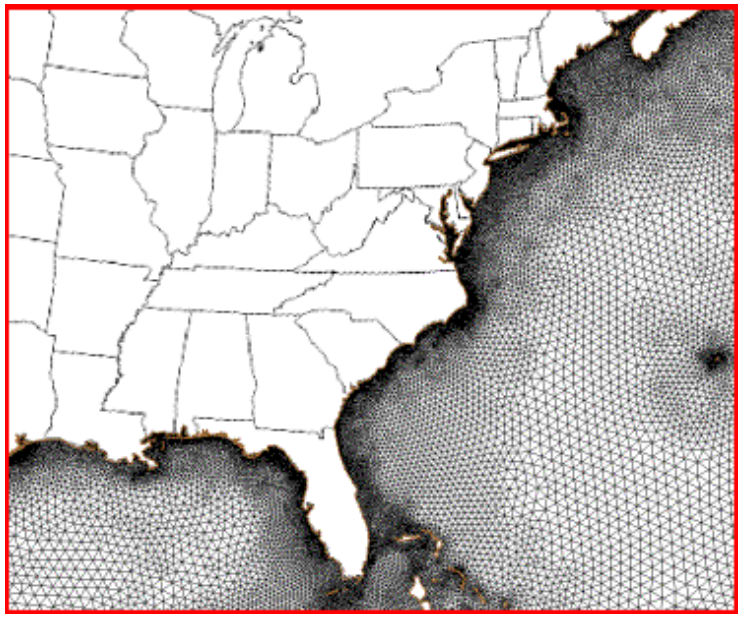
- Integrated modeling & analysis support tools for coastal engineering projects
- Circulation, wave, & morphology change models (water quality at next stage)
- Analysis toolboxes to support IMS activities
- Powerful and user-friendly interface:
  - Surface-water Modeling System (SMS)
- Applications over wide range of scales



Fire Island Inlet, NY

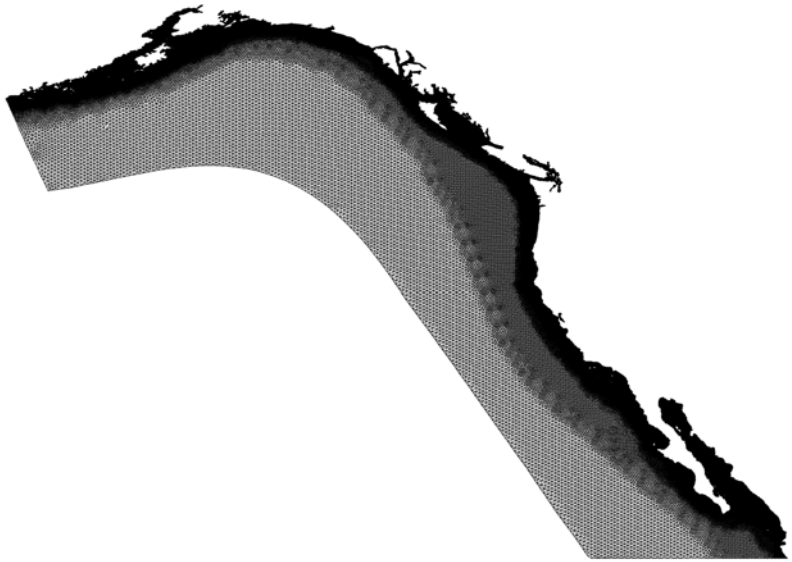
ADCIRC Model Description

- 2D finite - element model
- Large domain
- Flexible/variable range of element areas (resolution control)
  - Coarse resolution in open ocean
  - High resolution in coastal regions
  - Area ratios of 10^9 common
- Well - defined coastlines
  - Mainland and islands
  - Structures, inlets, channels
- Forcing
  - Tidal constituents
  - water level
  - wind
  - atmospheric pressure
  - wave stress gradients
  - flow rate (river discharge)



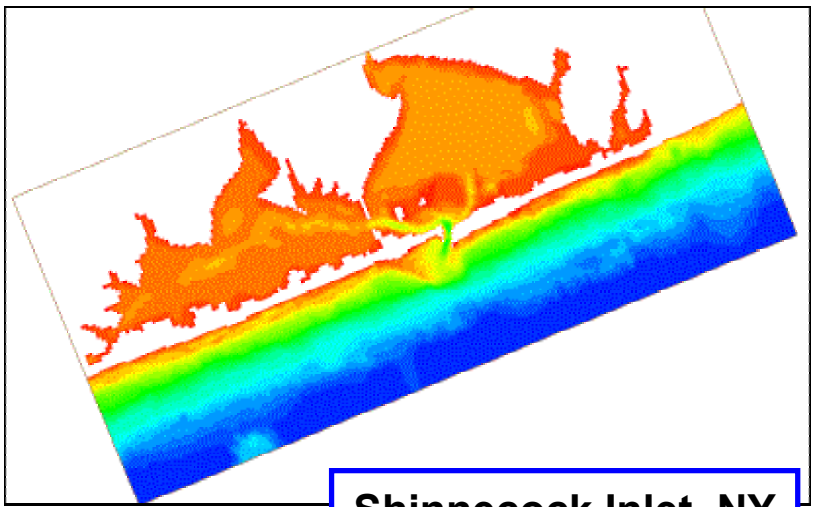
North Atlantic & Gulf of Mexico Computational Mesh

Tidal Constituent Databases



M2D Model Description

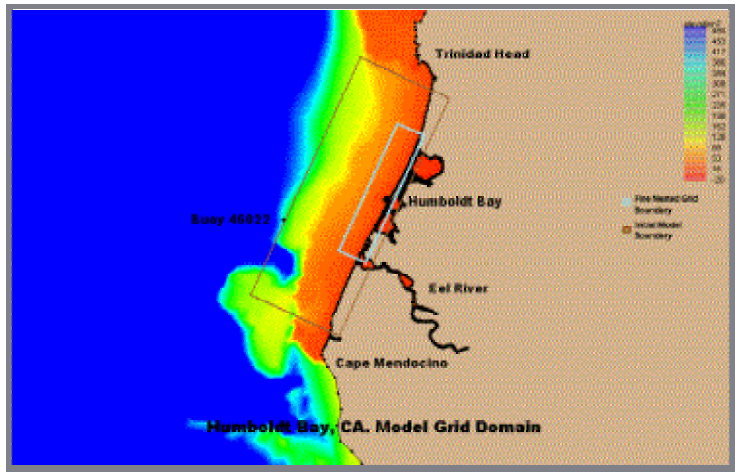
- Horizontal circulation model (water level & current)
- Rectilinear grid, variable cell size
- Multiple types of forcing:
  - Water level, wind, waves, flow rate, tidal constituents
- Efficient calculations, no matrix solutions
- Efficient storage in memory
- Easy to configure & run
- Convenient for small projects

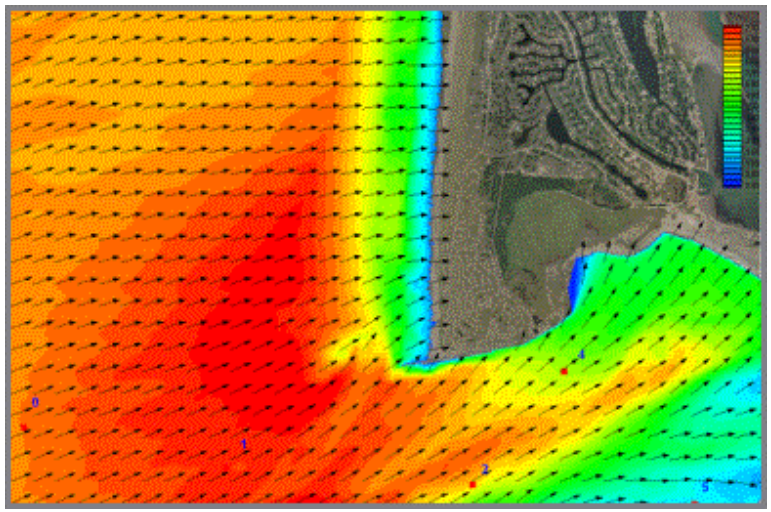


Shinnecock Inlet, NY

STWAVE Model Description

- Steady-state spectral wave model
- Rectangular grid
- Nested grids
- Wave height, direction, period (bulk parameters and spectra)

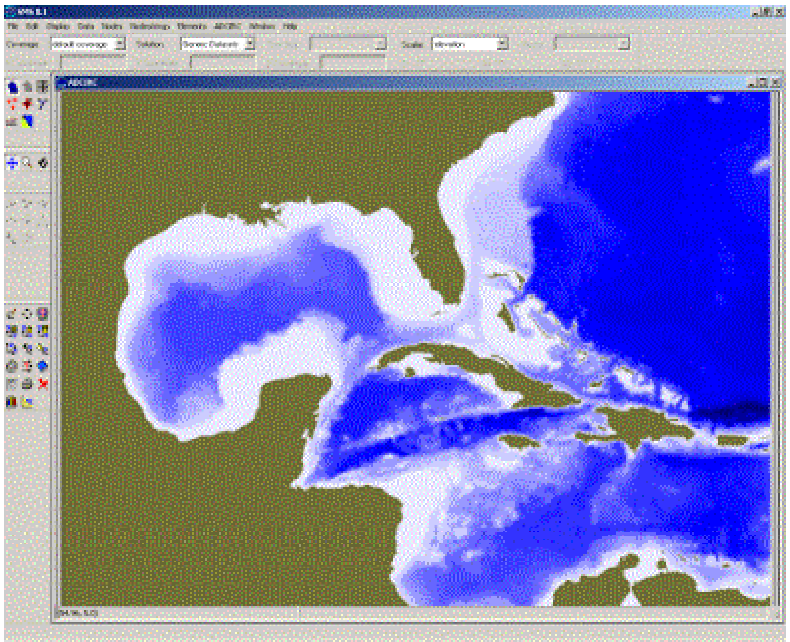




SMS Interface

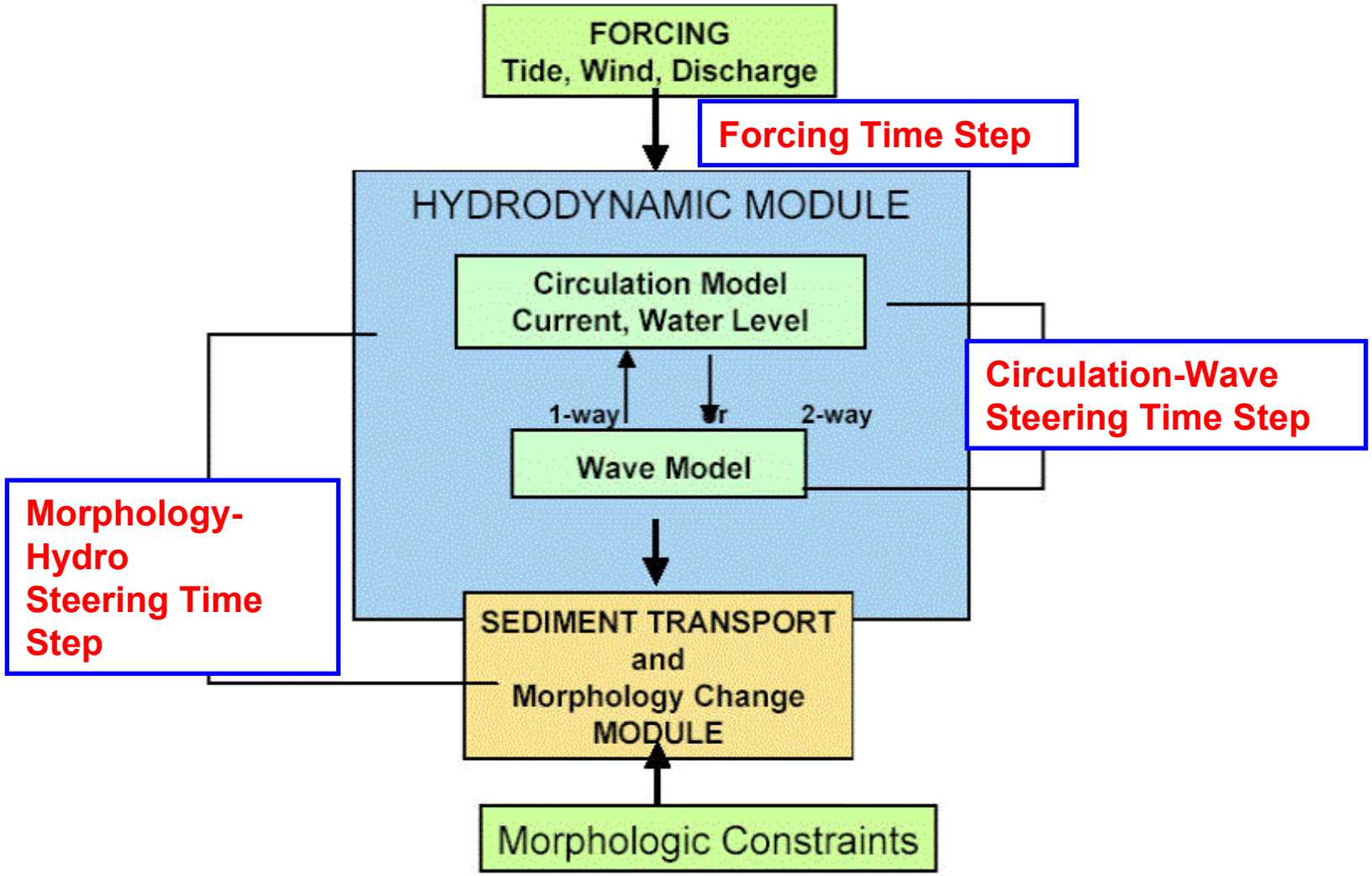
Surface-water Modeling System

- Grid generation and editing
- Coordinate conversions
- Current/wave stress interpolation
- Model control file generation
- Input forcing functions:
  - *Tide, wind, waves, etc.*
- Model simulation
- Model output visualization
- Report-quality graphics



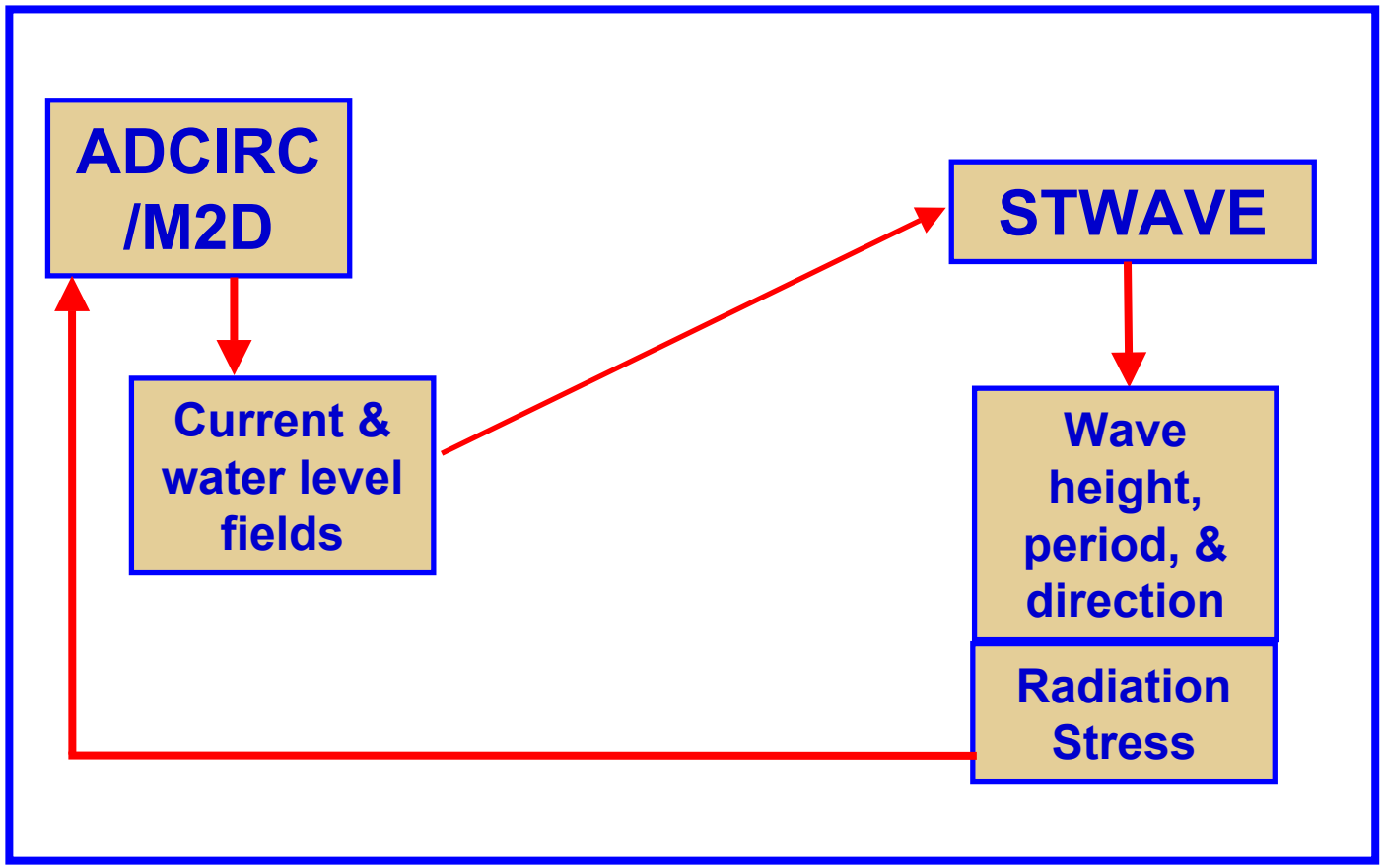
Steering Module

Controls information passing between models



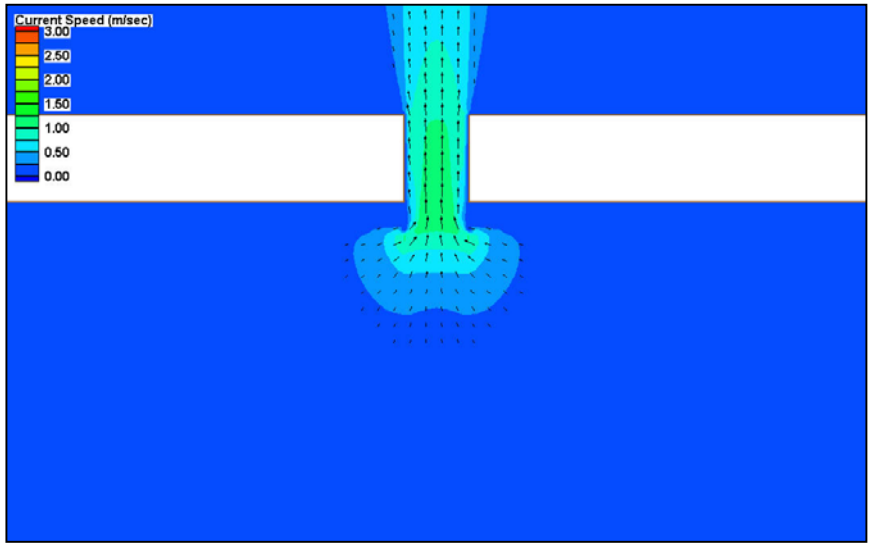
Hydro Steering Module

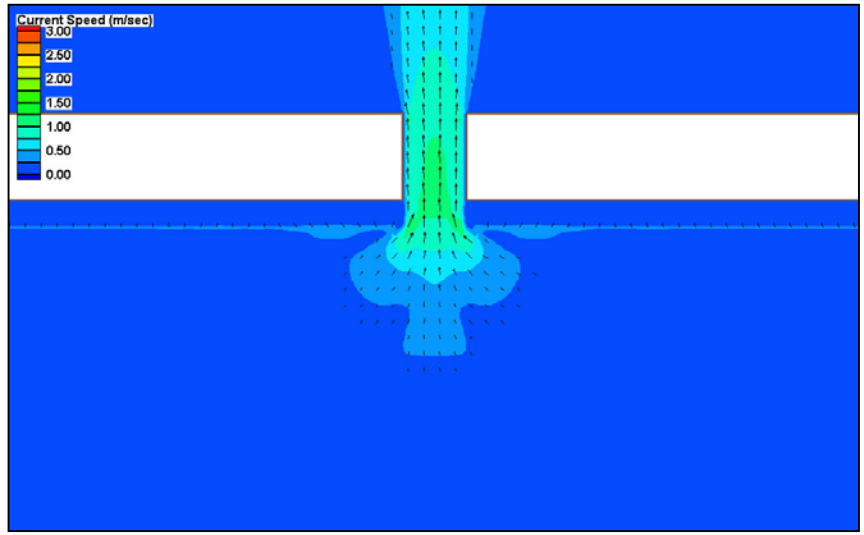
Controls information passing between ADCIRC/M2D & STWAVE

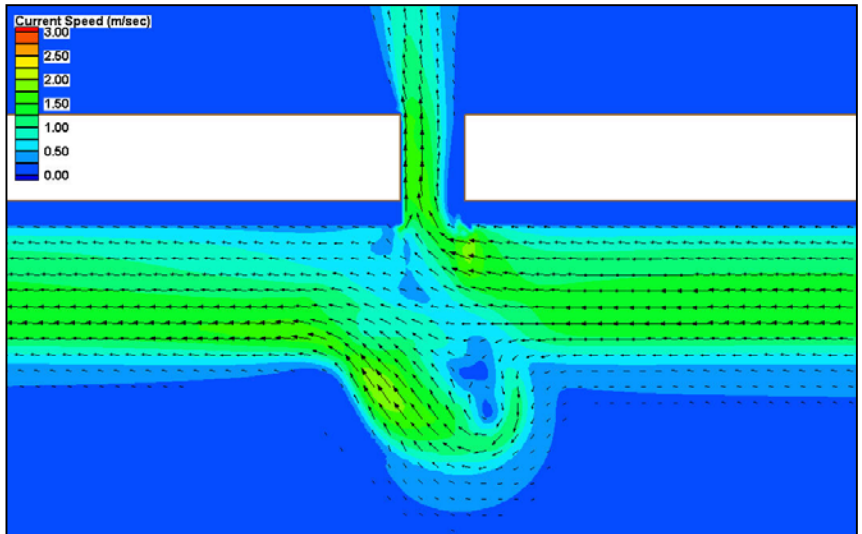


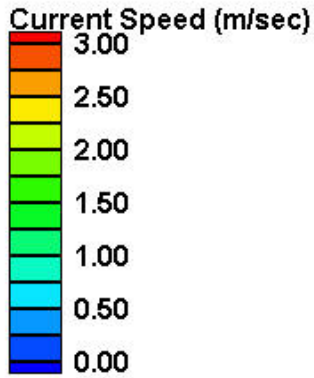
Idealized Inlet
waves → currents

Flood



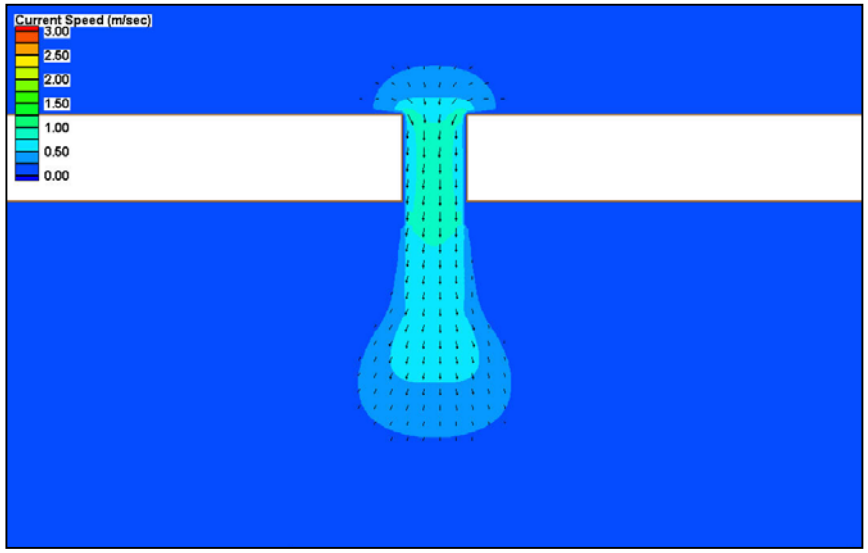


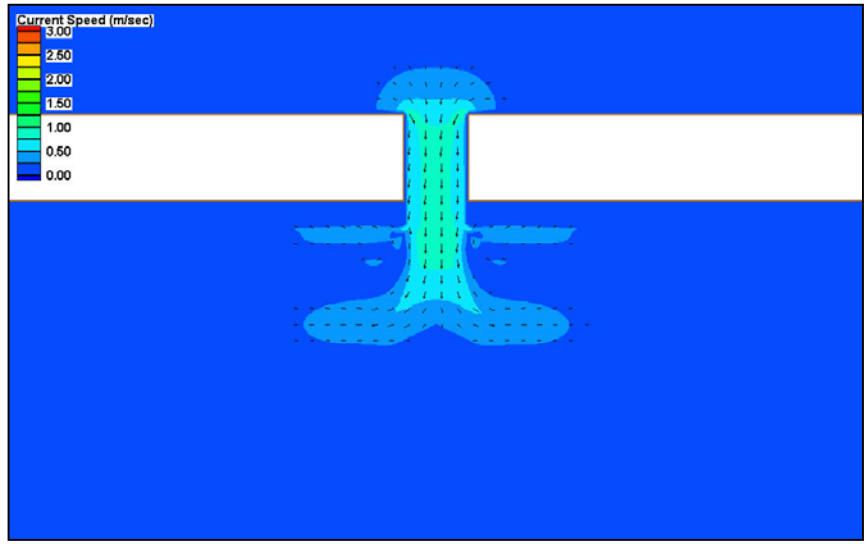


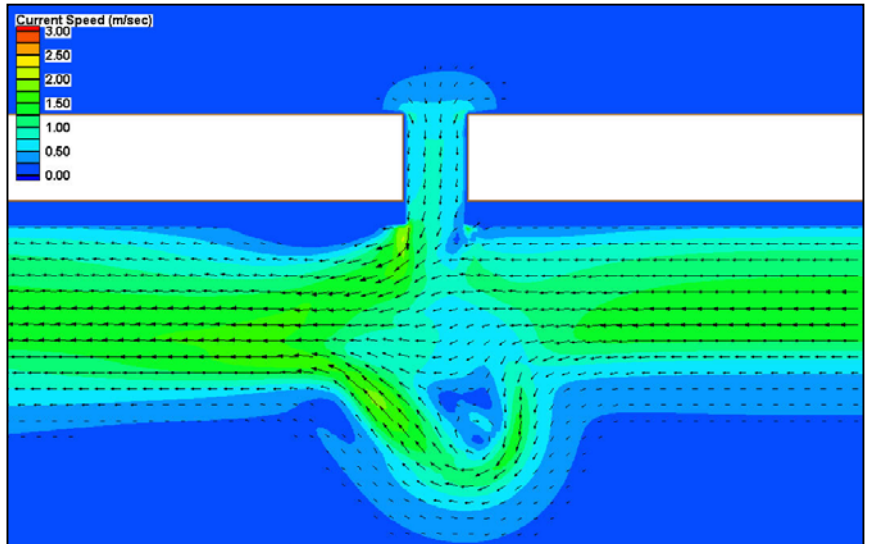


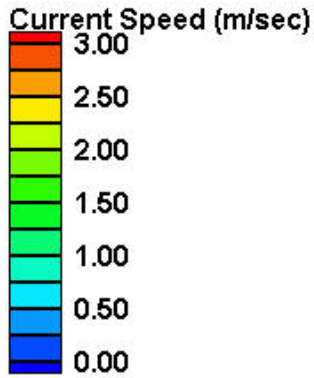
Idealized Inlet
waves → currents

Ebb

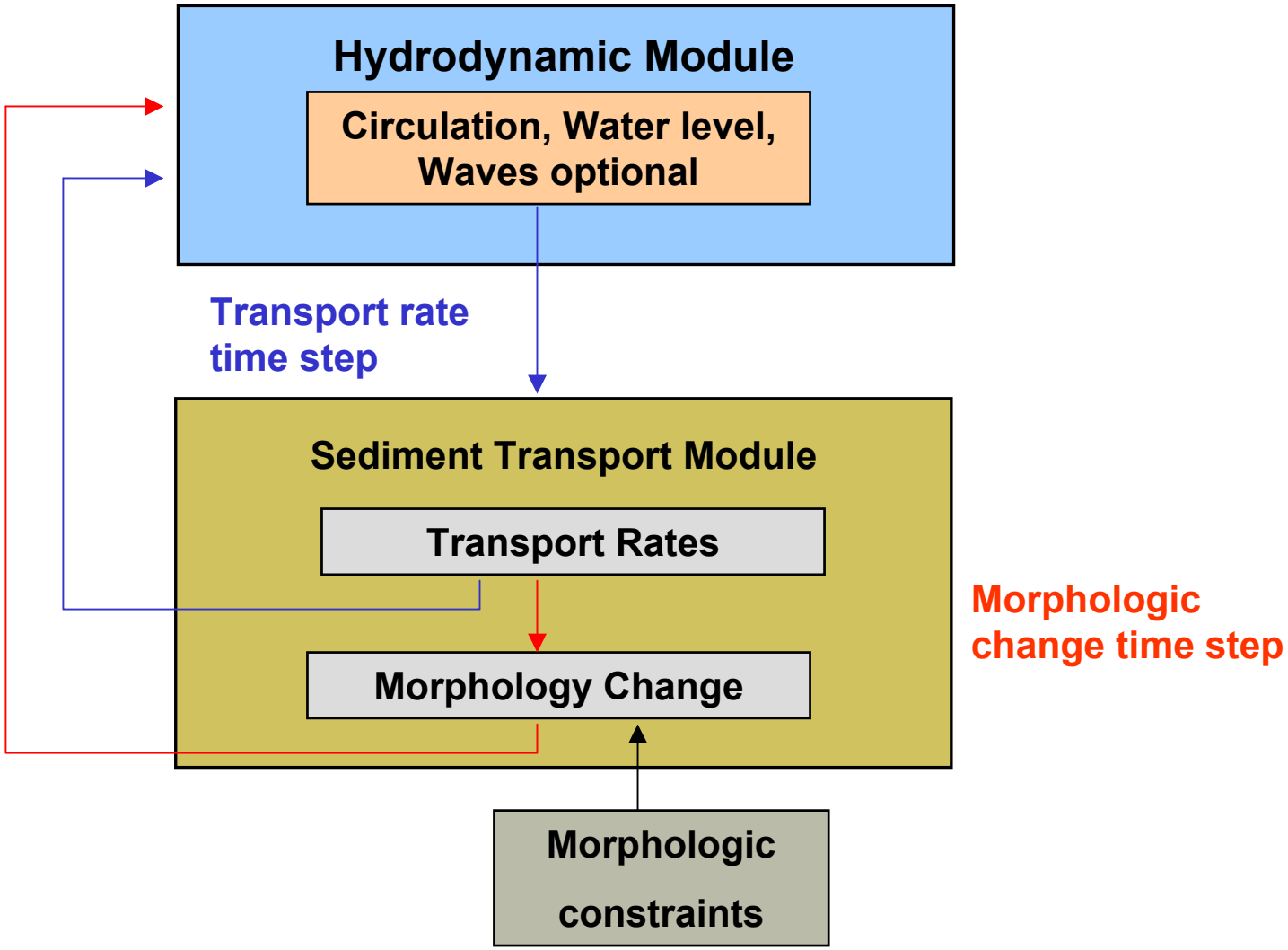






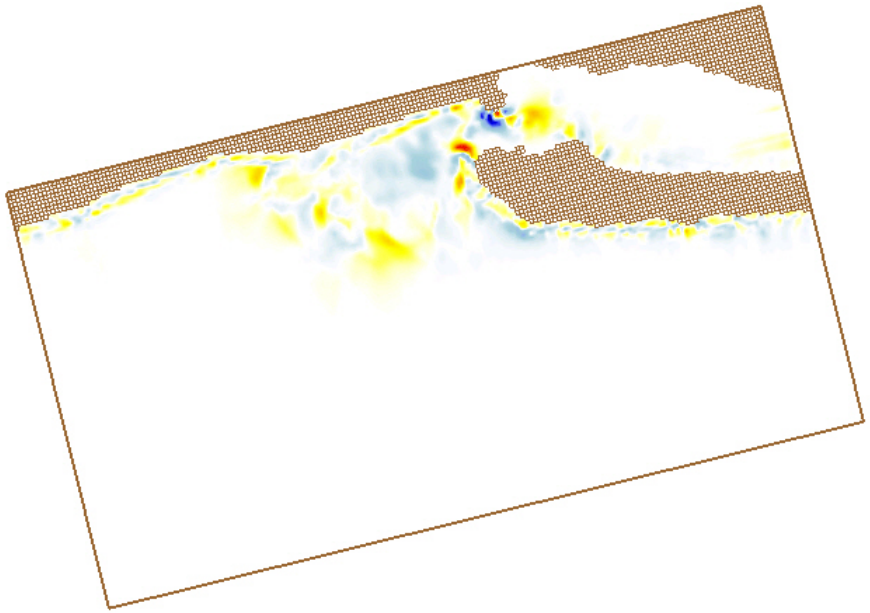


Morphology Steering Module



Sediment Transport

- Implemented:
  - Lund-CIRP
  - Watanabe



- In Planning:
  - Wakramanayake &
  - van Rijn
  - Fine-grained sediment formulas
  - YFF (Your favorite formula)

- Particle Tracking Model

Progression of Major CIRP Technology-Transfer Workshops

Nov 1998	Avalon, NJ Redondo Beach, CA	Recent developments in CIRP: ADCIRC & STWAVE
Feb 2000 #1 – FSBPA	Melbourne, FL	Waves, tidal hydrodynamics, tidal inlet circulation
Feb 2001 #2 – FSBPA	Orlando, FL	ADCIRC, STWAVE, & ADCIRC/STWAVE linkages
Jan 2002 #3 – FSBPA	Biloxi, MS	GIS for coastal and navigation projects
Jul 2002	Vicksburg, MS	SMS Steering Module Workshop
Feb 2003 #4 – FSBPA	Ponte Vedra Beach, FL	M2D Hydro Steering Module and start of sediment transport/morphology change
May 2003	Clearwater Beach, FL	CS03 Modeling Tidal Inlets
Feb 2004 #5 – FSBPA	Orlando, FL	Calculating sediment transport/morphology change (Watanabe)
Aug 2004	New York, NY	Hydrodynamic & Morphodynamic Steering Modules: Calculating sediment transport/morphology change (Lund-CIRP; Watanabe)
Feb 2005 #6 – FSBPA	Destin, FL	Modeling sediment transport and morphology change (Lund-CIRP; Watanabe; & ….)

IMS Near Future Plans

- More sediment transport formulas (M2D & ADCIRC)
- Salinity (ADCIRC)
- 3-D (ADCIRC & M2D)
- DG Hydro and Sediment (ADCIRC)
- CG/DG piecewise (ADCIRC)
- Parallel IMS (ADCIRC & M2D/M3D)