

NOPP / USGS Coastal Community Sediment-Transport Model:

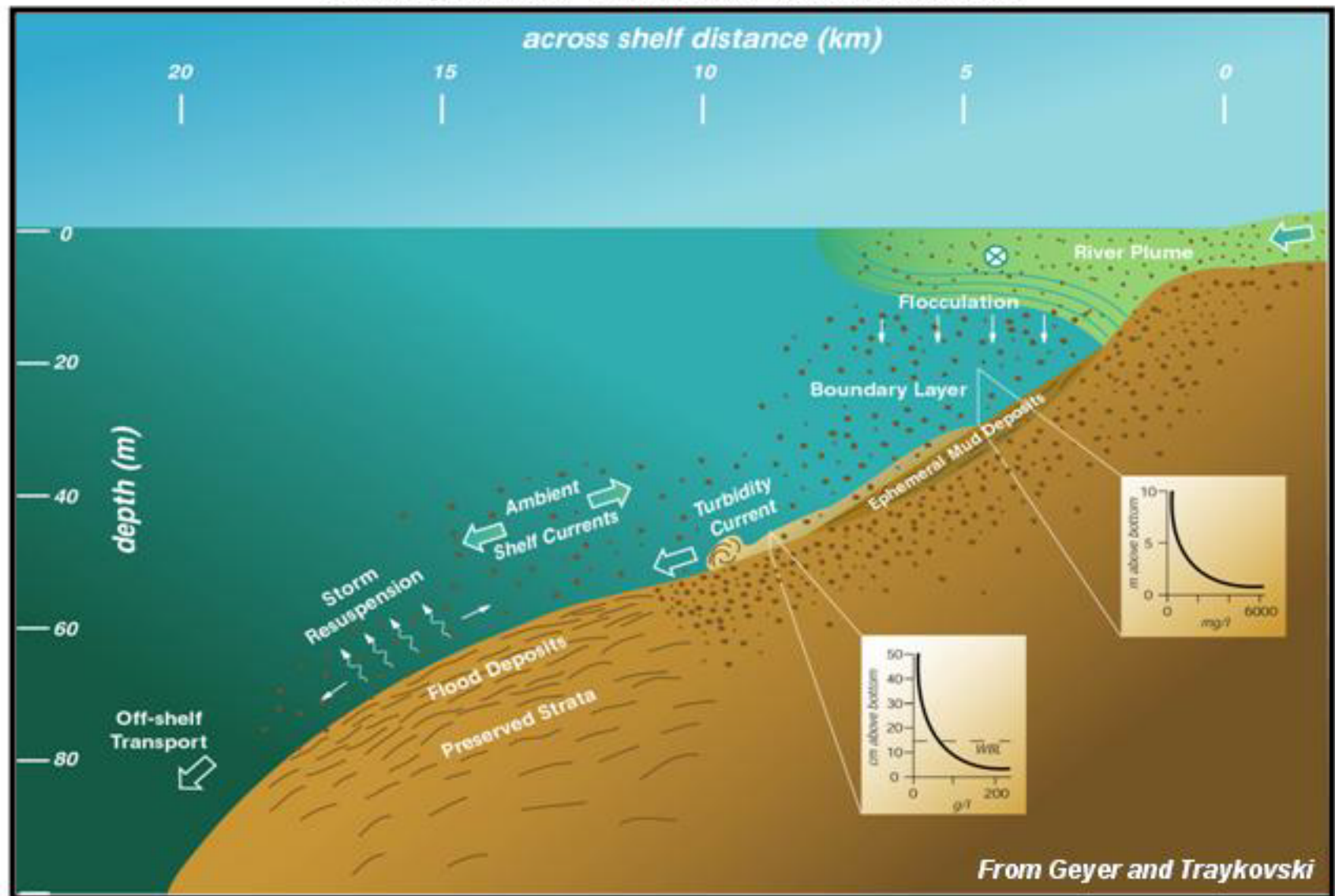
Report to the NSF Margins Source-to-Sink Community Sediment Modeling Workshop

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The Challenge: Develop Predictive Models of Sediment Transport for Coastal Environments



Outline of Talk

- The dream
- Project history 1999—2002.
- Update: Ocean Sciences Town Meeting.
- Ongoing efforts:
 - Test cases
 - Models under investigation.
- Future plans: fall workshop; future funding.
- Possibilities for collaboration with source to sink.

Progress to date ...

- **USGS Project: funded 1999 – present.**
 - Promote and support community modeling effort.
 - Apply models in USGS regional studies.
- **Woods Hole Workshop, June, 2000**
 - Attendees endorsed community modeling concept.
 - Emphasized need for better understanding of physics.
 - Need for suite of test cases.
 - EOS Article; Late Summer of 2000.
- **NOPP Planning Project, 2001—2002**
 - Town meeting, Ocean Sciences meeting.
 - Development of model criteria.
 - Planning for future efforts.

The Vision: Developed at Woods Hole Meeting

across shelf distance (km)

20

15

10

5

0

- Good open-source code.
- Active model development and application.
- Research programs to improve sediment-transport components.
- Provide realistic computational tool for other disciplines.
- Communication via web site with code, tools, test cases, discussions, scientific papers.
- Exchange via meetings, scientific exchange.

From Geyer and Traykovski

Strategy: Developed at Woods Hole Meeting

- Start with existing models.
- Work on weakest model components.
- Make them available, encourage their use.
- Compare with test cases, evaluate against good data, apply to real problems.
- Improve algorithms by observation and experiment.
- Effort driven by parallel research objectives.

The Scope: Developed at Woods Hole Meeting

Space	Regional-scale (10s to 100s of km).
Environment	Coastal (estuarine and shelf; not near-shore*).
Time-scale	Hourly fluctuations through seasonal (observable).
Dirt	Cohesive and non-cohesive (not carbonates)

The Approach: Start with available hydrodynamic models and assess their ability to serve as a forum for sediment-transport calculations. Then add, couple, or improve a representation of sediment transport within these models.

****Near-shore subject of intensive study through NOPP***

NOPP Planning Project: 2001 – 2002

Sherwood, USGS

Geyer, WHOI

Arango and Glenn, Rutgers

Harris, VIMS

Blumberg and Shrestha, HydroQual

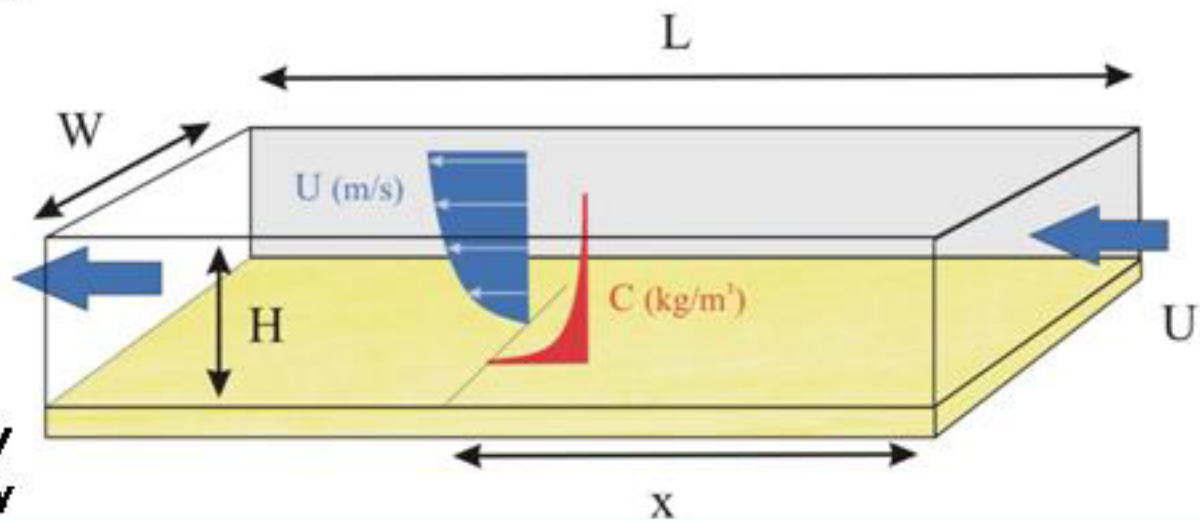
Signell, NATO/SACLANTC

Hamrick, TetraTech

- Web site(s) with code, test cases, tools
- Facilitate exchange of information (web site, mailing list, special session, town meeting)
- Develop and exercise test cases
- Host fall workshop

Test Cases

- Build bank of test cases with input conditions, data, and results.
- Intent: find bugs; check initialization and forcing; compare models or algorithms; set parameters.
- Need spectrum of cases, from simple and idealized to complex and realistic.
- Develop physical intuition for idealized cases.



**Test Case 1: Steady
Open Channel Flow**

Available Models

Differ in gridding convention, numerical schemes, representation of hydrodynamics, representation of sediment transport. ...

No clear choice as to "the best" model.

- EcomSed <http://www.hydroqual.com>
- TOMS/ROMS
<http://www.rutgers.edu/po/models/roms/index.php>
- EFDC beta soon (full release in 2003)
- Delft3D for ONR and NSF investigators ... soon?
- NCOM?
- Others: COHERENS, CH3D-SED, etc.

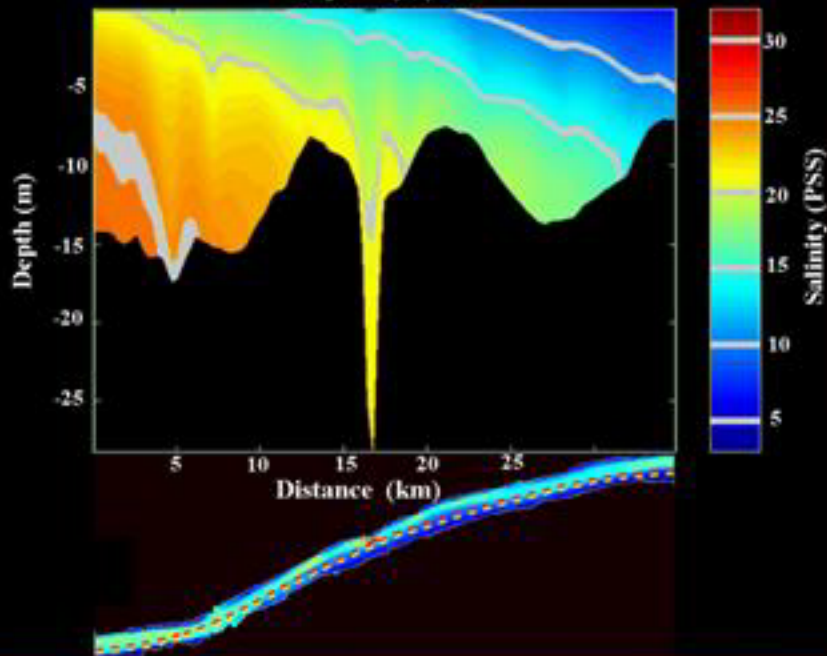


A Community Terrain-following Ocean Modeling System



Hudson River Estuary

averaged salinity, day= 0.75



- **Modular community hydrodynamic model**
- **Generalized vertical coordinates**
- **Parallelization, shared or distributed memory**
- **Multiple levels of nesting**
- **Advanced data assimilation**
- **Modules include biogeochemistry and...**
- **Sediment erosion, transport, and deposition!**

<http://marine.rutgers.edu/pol/models/roms/index.php>

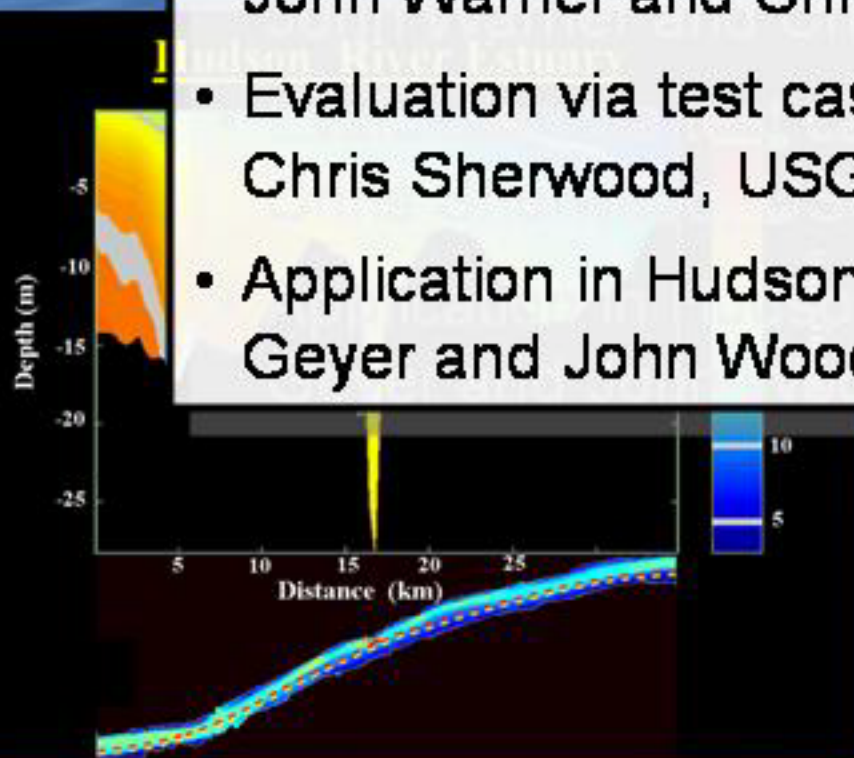


A Community Terrain-following Ocean



Activities:

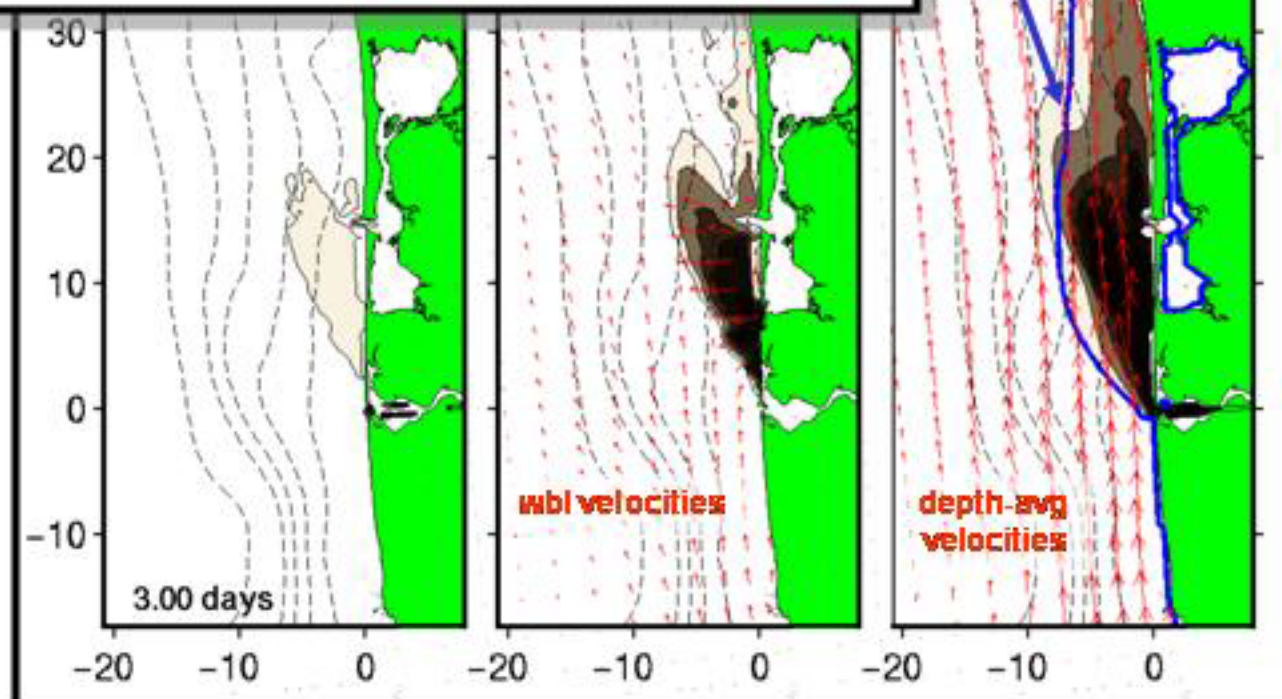
- Development of sediment transport module: John Warner and Chris Sherwood, USGS.
- Evaluation via test cases: John Warner and Chris Sherwood, USGS.
- Application in Hudson River Estuary: Rocky Geyer and John Woodruff, WHOI.



- **Advanced data assimilation**
- **Modules include biogeochemistry and...**
- **Sediment erosion, transport, and deposition!**

Activities Relating to ECOM-SED

- Model test cases by Shrestha (Hydroqual).
- ECOM-SED made available for non-profit use (Winter, 2001); reported by Shrestha (Hydroqual).
- Used by Hydroqual, and Harris and Geyer to represent the Eel River shelf, northern California.



DELFT-3D as Community Model

- Efforts underway to make DELFT-3D available to ONR / NSF-funded researchers.
- Being evaluated with respect to test cases (Roelvink, DELFT).
- Being applied to USGS Coastal Erosion Study in Southwest Washington by Sherwood and Lacy.

EFDC as Community Model

EFDC = Environmental Fluid Dynamics Code.
Developed and overseen by John Hamrick
(Tetratech).

Limited use to scientific problems; more widely used for engineering and contaminant issues. But has similar setup to other models and has fairly involved sediment-transport routines.

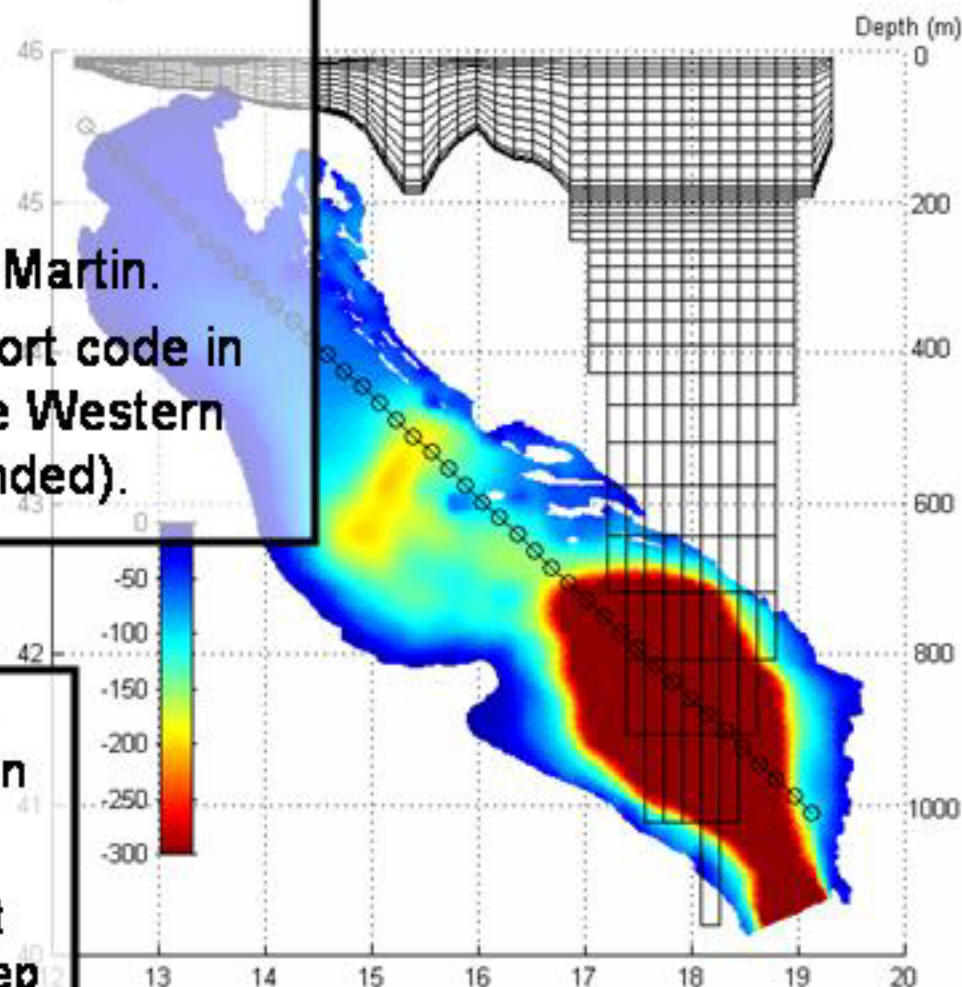
- Code and documentation available through TETRA-TECH.
- EPA funding new release and user interface.

NCOM: Navy Coastal Ocean Model

- Hybrid sigma – z coordinate system.
- Nesting capabilities.
- Parallelized.
- Developed by NRL; Paul Martin.
- Develop sediment-transport code in 2002 for application in the Western Adriatic. (Harris, ONR-funded).

16 layers sigma levels from 0—180 m with increased resolution near the surface and bottom.

Z levels below 180 m to prevent sigma level problems over steep topography of pit.



Grid by Pullen (NRL) and Signell (SACLANT-CEN)

Future Efforts:

- **Workshop in September, 2002; East Coast location.**
- **Exchange of scientific results achieved using community models**
- **Develop list of high-priority critical modeling and model infrastructure activities**
- **Develop list of high-priority observational or experimental science to advance models**
- **Form a steering committee that includes experienced folks from the oceanographic community, and that includes potential users of the model (chemists, biologists, geologists).**
- **Form some working groups before the Fall meeting and issue assignments to them (model standardization, refinement of model scope, etc).**

Future Funding:

- **NOPP; perhaps in next funding cycle (2003—2004).**
- **USGS Coastal and Marine Geology.**
- **Individual research programs through ONR and NSF ??**

Collaboration with Source-to-Sink

- Coastal community model is focused on relatively short time-scales and on a specific type of environment.
- Coastal environments form a portion of a source-to-sink view of the world.
- The coastal community modeling effort could contribute towards working groups of a larger-scale effort.
- Duplication of effort with respect to pre- and post-processing of model results should be minimized.