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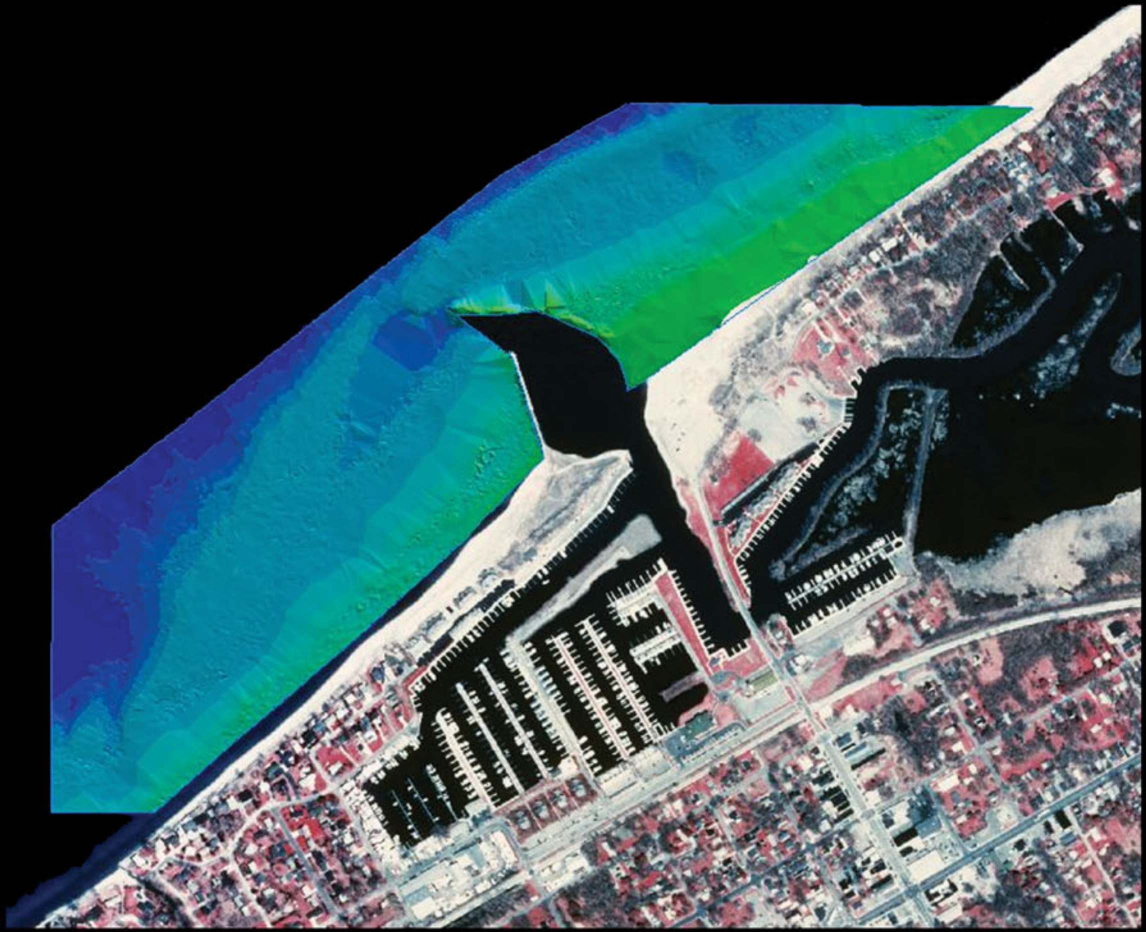

RSM

for balanced, sustainable solutions

Regional Sediment Management

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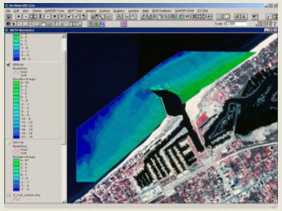
Director

About the Cover



Sample page of RSM Geographic Information System, developed through the National RSM Demonstration program...
see story page 1

Features

Departments

National Regional Sediment Management (RSM) Demonstration Program continues to advance Corps activities

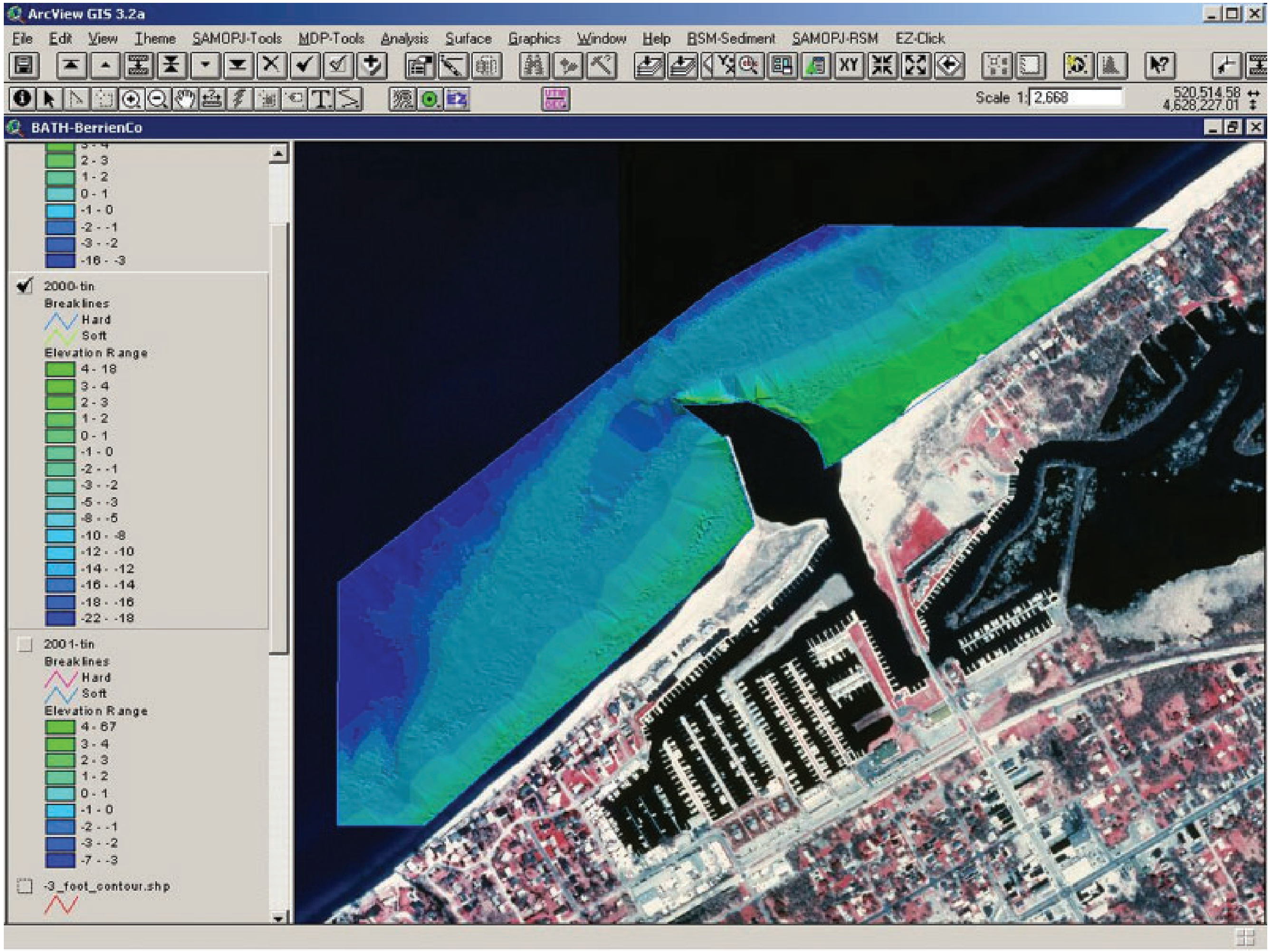
By Julie Rosati, ERDC-Vicksburg

The U.S. Army Corps of Engineers navigation mission is to maintain our Nation's waterborne transportation systems for movement of commerce, national security, and recreation. These systems include harbors, waterways, and channels. Channels are located along our coasts and in our bays and rivers. These channels must be dredged to maintain depths needed for safe passage of vessels. Sediment enters the channels from upland regions, lands, streams, and through erosion of adjacent banks and shorelines. Although upland soil conservation efforts have the positive effect of reducing the amount of sediment that enters our waterways, more can be done to better manage our sediment resources.

(continued on next page)

Aerial view of Perdido Pass, Florida. Changing dredging practices resulted in regional sustainment of beaches.

Historically, dredged sediment was placed in the most economical locations, which often were on the banks of rivers, or alongside the channel in rivers, bays, and estuaries resulting in submerged features and island formations. More recently, environmental concerns over the effects of open water or unconfined placement resulted in sediment being put in confined areas either upland or in the water. Along the coast, for example at inlets, the sediment was put in deeper offshore waters. These practices, new and old, do not necessarily consider regional sediment processes. For example, taking coastal sediment to deep water removed it



Sample page of RSM geographic information system (GIS), developed through the National RSM Demonstration Program. Users can quickly access and analyze data for RSM applications using the custom-built utilities.

from the littoral zone where it may have been needed for sustaining beaches. The result may be an optimized, least-cost project (e.g. low channel maintenance cost) for the local area, but possibly not the best solution for the region. Regional sediment management is the practice of making the best local project decisions within the context of a regional plan that maximizes regional benefits or reduces regional costs.

In 2000, the Corps initiated a National RSM Demonstration Program. Six Corps District offices were tasked with implementing regional sediment management concepts as a part of their District projects. The program was initially designed as a series of coastal RSM demonstrations, but the individual District offices have extended the range of their projects up into their river systems. In 2003, District and Division offices that have one or more RSM demonstration projects are: Mobile, Jacksonville, Philadelphia, New York, Detroit, Los Angeles, and the Northwest Division (Portland and Seattle Districts). By implementing regional sediment management as a part of their business management practices, each District has documented challenges encountered. These challenges have included how to use present technologies (tools and models) to predict regional consequences of local sediment management actions, the policy constraints within the existing organizational structure, and institutional hindrances. As challenges are noted, they are acted upon and resolved by Corps Headquarters managers.

The National RSM Demonstration Program continues through 2005, with the ultimate goal to integrate regional sediment management throughout all Corps business management practices. It is noteworthy that the National RSM Demonstration Program has already reaped benefits for the Corps. New technology, shared knowledge via National and individual District workshops, and development of new business practices are some of the benefits already derived.

For additional information, contact Julie Rosati at *Julie.D.Rosati@erdc.usace.army.mil*, RSM Demonstration Program Manager, and visit the Website at *http://www.wes.army.mil/rsm/RSM-NDP/demos.html*

Meet the RSM Program Manager: Jack E. Davis, Ph.D., on
"Why regional sediment management?"

"Regional sediment management" is the fitting of our sediment management actions into the context of a regional plan. The plan is an accepted set of goals and objectives compiled by a region's stakeholders. The regional plan's objectives include environmental, social, and political needs, with consideration given to the large- and small-scale sediment processes within the region.

A "region" is a defined area over which the sediment management actions will have a cumulative impact within the given time-period of interest and with regard to the objectives of the plan.

Sediment management actions are activities that affect the erosion or removal, transport, and deposition of sediment. Common actions include dredging and placement; building structures that divert or trap sediment; and creating erosion protection for riverbanks, shorelines, seabeds, and channel bottoms. Regional sediment management, then, is a methodical approach to balanced and sustainable solutions that deal with sediment issues within the greater region.

The U.S. Army Corps of Engineers business practices are moving toward this holistic view of managing civil works projects. To manage successfully, new tools and technology are needed to better predict sediment management impacts over longer time and larger space; greater knowledge is needed about small- and large-scale sediment processes, and guidance is needed for handling of and dealing with regional sediment management issues. With these needs identified, the Corps initiated the RSM Research and Development Program in Fiscal Year 2002 to address them.

Some of the work under way includes the development of two modeling systems allowing large-scale evaluation of regional systems. The first is the Coastal Morphology Management System, which through a combined suite of modeling tools developed over the last several years, can simulate longshore sediment transport, inlet channel infilling, inlet morphology change, and bypassing – for a wide range of conditions, including multiple projects spread over large regions and considered over long time frames. The system also considers the major phenomena related to beaches, barrier islands, inlets, jetties, entrance channels, rivers, washover, wind-blown sand, cliff erosion sources, and so on.

The second system is the River-Basin Morphology Management System. This system will use the Corps' highly popular, world-class, advanced 1-D river hydraulic model.

The system will include sediment transport, and morphology change capabilities will be incorporated into it. The system also includes interfaces with watershed sediment-loading models and multi-dimensional models for localized detailed modeling. A multi-level framework and graphical user environment for moving between simple and complex models, and data analysis tools based on GIS, will be developed. Data management approaches for handling the enormous volume of data needed in region-based studies will serve as the building blocks for future interactivity of the many data sets to be collected.

Additionally, the RSM Program's technology transfer commitment will develop a framework for implementing regional sediment management in the operation of Corps projects and activities; identify solutions that provide the most benefits for the least cost; develop guidance and recommendations for measurement and monitoring for regional sediment management purposes; and increase knowledge of basic sediment processes.

Regional Sediment Management: Research Program Overview

Research staff at the U.S. Army Engineer Research and Development Center's laboratories in Vicksburg, Miss., Hanover, N.H., along with the Corps' Institute for Water Resources and other partners from federal, state, and regional governments and academia, are pursuing a rigorous investigation of a regional sediment management approach to solve sediment related problems. The year-old RSM Program is the Corps' effort for developing the tools and knowledge necessary to understand the effects of sediment management actions on local and regional scales. The program will develop methods and procedures needed to design regional plans. The studies include all landscapes, from the upper watersheds to the coasts.

Objectives

Major products resulting from the research will include:

- A watershed sediment budget tool that can be used to rapidly assess the impacts on downstream channels of upstream or watershed activities
- A morphology modeling system for the coast and river systems that predicts long-term, large-scale morphology changes
- A framework for developing regional sediment management plans and for implementing regional sediment management in the field.

The Corps' RSM Demonstration Program (page 1) has shown that managing sediment on a regional scale can result in actual cost savings and increased benefits. The Demonstration Program has also shown the extensive and intensive partnerships and stakeholder involvement necessary for successful regional sediment management. Because "regions" extend beyond the limits of Corps projects, and at times beyond District boundaries, many stakeholders with varied objectives and disciplines must become involved. Often, the Corps is the facilitating agency in developing regional sediment management plans, and, partners look to the Corps as the agency with the technological skill and capability to assess the impact of alternative plans.

Regional sediment management is as much a concept and philosophy for doing the Corps' work, as it is a technical capability. Therefore, users of the knowledge and tools developed in the RSM Program are Corps personnel and their partners. Many of the specific tool sets under development can and will be of use to the private sector. Active technology transfer opportunities will be pursued throughout the life of the program.

Program Organization

The RSM Program began in Fiscal Year 2002. The research areas within the projects are interrelated, where research staff provide information and capabilities to one another and produce information or capabilities that will be incorporated into RSM tools and capabilities. The work areas fall into five categories:

- ➢ Basic sediment processes
- ➢ Engineered solutions
- ➢ Tools
- ➢ Informatics
- ➢ Technology Transfer and Insertion

Additional information is available from the RSM Website at *www.wes.army.mil/rsm*

Multi-agency effort ensures safety of endangered birds

By JoAnne Castagna, USAE District, New York

If we take a boat ride beginning from the southern tip of Texas, travel east through the Gulf coast, all the way up the east coast to New Jersey and then continue inland into a spur channel into Long Island's Great South Bay, Moriches Bay, and Shinnecock Bay, we would have traveled the Gulf and Atlantic Intracoastal Waterway.

Within these bays is the Long Island Intracoastal Waterway, a small portion of the entire water system, and the location for the New York District's Long Island Intracoastal Waterway Dredging Project, a multi-agency effort that is using dredged sand to create a habitat for several species of endangered shore birds.

The Atlantic Intracoastal Waterway, built in the 1930s and 40s, was designed so that small vessels, fishing boats, transportation vessels, private vessels, and small barges can travel along the coast without having to head into the ocean where the seas are rough. In the case of Long Island, small vessels are able to travel from the Fire Island Inlet all the way to the Shinnecock Canal in a sheltered environment.

> **"We used to wait until there was a lot of shoaling, or sand buildup, in the channel before we dredged"**
>
> *John Tavolaro*
> Chief of Operations Support Branch,
> New York District

Approximately every eight years the Corps has dredged the Long Island Intracoastal Waterway, a span of approximately 33.6 miles, from the Town of Patchogue to the south end of the Shinnecock Canal. The dredging eases the way for boat travel. Dredged material is placed on upland sites on the mainland and ocean barrier islands.

However, in the last few years, the District has found itself in a dilemma. Because of a growing Long Island population and the building of homes on these upland sites, this was no longer an option.

"Homes and marinas are built on many of the areas where we used to deposit sand," said Tavolaro. "We tried to think synergistically and creatively – outside of the box," said Tavolaro. "We looked at what other Districts along the Atlantic Intracoastal Waterway were doing with their dredged sand."

Baltimore District and Mobile District are successfully using their dredged material for beneficial uses including creating "artificial islands," wildlife habitats, marshes, and oyster beds. Other Districts, including Norfolk and Galveston, are dredging "bite size pieces" of their Intracoastal Waterway every year instead of dredging larger areas every few years. The New York District's plan was to combine both concepts.

The District assembled a team to look for opportunities to enhance the environment with dredged material on Long Island. Team members included staff from the U.S. Fish and Wildlife Service, U.S. Coast Guard, New York State Department of Environmental Conservation (Region 1), New York State Department of State, National Park Service (Fire Island National Seashore), and the Town of Brookhaven.

Tavolaro said, "By doing what these other Districts are doing — dredging more frequently in smaller areas — we will only need a few smaller places to dispose the material each time. Instead of dredging 200,000 cubic yards and 25 miles of channel, we will dredge only 80,000 cubic yards in one segment of the bay."

In September 2002, the Long Island Intracoastal Dredging Project began. The team decided to place the dredged sand on East Inlet Island, a 30-acre island one-half mile off the Town of Moriches mainland, to enhance habitat for several endangered shore bird species, including least terns, common terns, piping plovers, and roseate terns.

In recent years, these bird populations have dropped due in part to

increasing human development and recreation on or near the coast where they migrate in the springtime to colonize, nest, and breed. The Long Island coast is one of their nesting areas. In the fall they fly south to spend their winters in regions including Florida, the Gulf coast of Mexico, the Caribbean, and South America.

"Placing the dredged sand on an island is better for the birds than dumping the sand on the mainland," said Tavolaro. "Placing the sand on an island that is relatively untouched by people and other predators gives the new habitat a chance to survive and thrive. An island is more protected than a mainland area. It has water around it. Just a few feet of water is a deterrent to many predators."

Operating from the Moriches Bay Coast Guard Station, Innerspace Services, a Maine contractor, conducted all of the dredging from mid October 2002 to mid January 2003, outside the region's winter flounder spawning season, public recreational activity, and the months the birds are around. “If one bird showed up we might have had to close up shop. We couldn’t afford such a contingency,” said Tavolaro.

The company dredged approximately 5 miles of the Moriches Bay from the Village of West Moriches to the Village of East Moriches. They dredged 1300 cubic yards of sand a day, to an authorized depth of 6 feet below mean low water, said Jodi McDonald, project manager. “The dredged sand was pumped onto the East Inlet Island by a hydraulic dredge and pipeline into a specified disposal area. The sand was pumped into a diked disposal area and then regraded to achieve the proper slope and texture preferred by nesting birds.”

“To help encourage the birds to nest on the island, we made the habitat more friendly by de-vegetating the island and building nest boxes to replicate the habitat needs of these threatened and endangered shorebirds. In addition, we placed string fencing and interpretive signage reminding the public that the area is restricted from human use. To ensure project success we also developed a predator control program, in the event land predators, such as foxes, feral cats, or raccoons, are identified on the site. The area will be maintained and monitored by biologists from the U.S. Fish and Wildlife Service, the Town of Brookhaven (the island’s owner), and the New York State Department of Environmental Conservation,” said Steve Mars, supervisor of the Long Island Field Office of the U.S. Fish and Wildlife Service.

> **“To help encourage the birds to nest on the island, we made the habitat more friendly...**
>
> Steve Mars
> Supervisor, Long Island Field Office, U.S. Fish and Wildlife Service

“The agencies combined their goals and desires and came up with something innovative where everyone won,” said Tavolaro. “The U.S. Coast Guard received a cleared bay channel so they could more effectively perform their search and rescue operations; the State of New York received environmental enhancement of a degraded upland area and preserved an island, many of which are disappearing in the region; the U.S. Fish and Wildlife Service got a net environmental benefit for endangered species they are responsible to manage, and the Corps fulfilled its navigation mission while making an effort to benefit the environment, at no additional cost to the taxpayers. It’s a win-win-win-win-win situation.”

The $1 million project was funded entirely by the Federal Government. Tavolaro hopes that the success of this project is a catalyst for future similar work on the Long Island Intracoastal Waterway.

“The stakeholders are very much in favor of this type of work. The Town of Brookhaven and the U.S. Fish and Wildlife Service are even suggesting other islands to us,” he said. “If this goes as we hope and we see birds nesting there in the spring, I think this will reinforce the importance of such a project.”

(previously featured in *The New York District Times*, Winter 2002)

RSM State of the Science:

One-stop knowledge transfer on grid resolution in numerical models for depth, velocity and concentration offered

by Charlie Berger and Jennifer Tate, ERDC-Vicksburg

Engineers and scientists all over the world have described flow and transport of water as they apply to particular problems such as salinity intrusion, transport of contaminants, prediction of maintenance dredging, potential for scour, navigation conditions, flood potential, and others. Generally, this work is performed with the use of physical models, analytic techniques, and numerical models. Numerical models are especially widely created, used, and applied.

What do numerical models do?

There are equations that describe how water and constituents move. These are analytic equations that apply at all points in the domain. Unfortunately, these equations describe relationships between accelerations and pressure or gradients of constituents in time and space and therefore are differential equations. However, values of depth, velocity, and concentration——not their gradients—are what is truly needed to make engineering decisions. Therefore, integrated equations are required.

The equations cannot be directly integrated for general conditions, and therefore they must be solved numerically. This is done by breaking up the region to be studied into a grid, and time into discrete steps. In order to properly represent these equations the grid elements/cells need to be small. The smaller the grid the closer one comes to representing these underlying equations. At some point, the grid is sufficiently fine that additional refinement does not significantly change the result. That is, the differences are within the tolerance of the decision maker. No additional resolution will improve the decision at this point.

What difficulties may arise?

If the grid is too crude, i.e., the cells are large, it can be demonstrated that a different set of equations is actually solved. Typically this crude grid will produce a solution that is much more smooth/diffuse than the true solution or it will contain unrealistic oscillations.

The following figures show how the refinement level of a grid can greatly affect the results. Figure 1a shows four different fineness levels, and Figure 1b represents a concentration cloud at a single timestep as the cloud travels downstream. All four grids began with the same conditions: flow field and cloud configuration. The only variant among the four is the size of the elements. The coarsest grid gives very different answers from those of the finest grid. However, there is a point when no matter

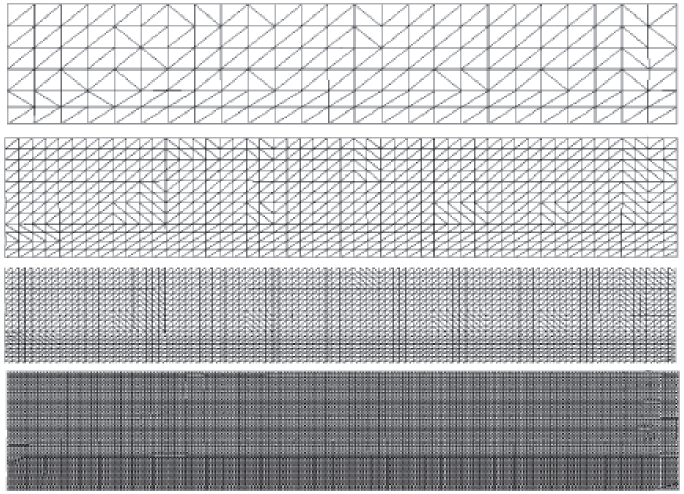


Figure 1a. The four grid spacings.

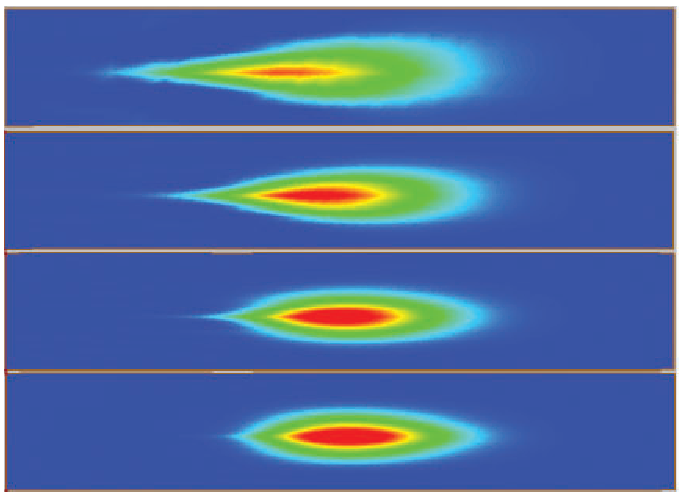


Figure 1b. The cloud at a single timestep.

how much finer we make the grid, the solutions no longer change. This can be understood from the finest two grids shown in Figure 1a. The difference between these two is very slight, and further refinement probably is not needed.

So why not make all of the elements small so that there is no chance of encountering this problem? It is a matter of computational expense. A grid with higher resolution means that there are more points at which the equation set must be solved, increasing the time to run the problem and the space for storage of the information. In the figures shown, the high resolution was only necessary around the concentration cloud that is moving downstream over time. In this case, the equations are being solved at all of the high-resolution points before and after the cloud has passed rather than just when the resolution is necessary.

What would happen if the areas of high importance vary over time, such as with a dye cloud or with sediment deposition and erosion? A static grid would have to be fine enough to pick up the activity in all of these areas as they occur. So if a region needs high resolution at any point in time, a static grid would require that the resolution be there at all times. Furthermore, the user would have to know ahead of time where the important areas will be within the domain so that the grid will capture all of them, regardless of when they occur. This can be a particularly difficult problem when modeling sedimentation. During a flow hydrograph, the regions of high activity, scour, and deposition will change as the flow evolves. Pockets of erosion will generally require high resolution. These locations will change over time. So a region will need high resolution for a time, and perhaps later it will not. The only way for a static grid to account for all of the changing regions of activity throughout the complete run would be to make the entire domain very fine. This might be too computationally expensive.

How does ADH solve these problems? The Adaptive Hydraulics (ADH) numerical model provides for a dynamic grid in which the code is able to determine if more resolution is needed in a particular area and then refines that area. When this resolution is no longer required, ADH can remove it. The advantage is that the grid developed by the modeler needs only to be fine enough to describe the bathymetry of the region. The equations being solved—shallow water, navier stokes, transport—are checked with a user-specified tolerance to determine if the results are acceptable or if the grid needs to be refined. At some later time if the error is low enough, the grid can be unrefined back to its original configuration. This process allows for less computation time and memory requirements because it never solves the equation set at unnecessary locations, making the model more efficient and requiring less foresight from the modeler.

An example of automatic grid adaption in ADH is shown in Figure 2. The grid shows a supercritical flow channel transition. Shocks form over time from the initial conditions. These shocks are regions of sharp gradients in depth. The

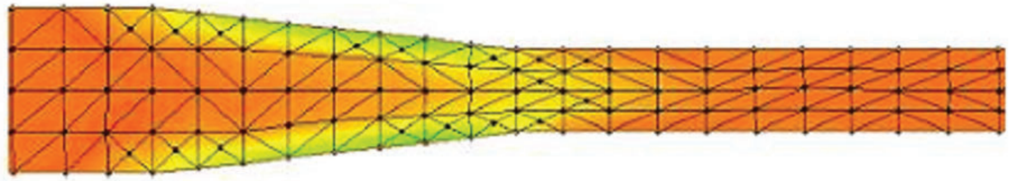


Figure 2a. Water surface elevation at an early timestep.

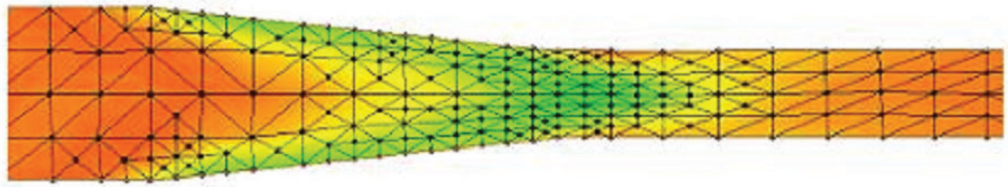


Figure 2b. Water surface elevation at an intermediate time.

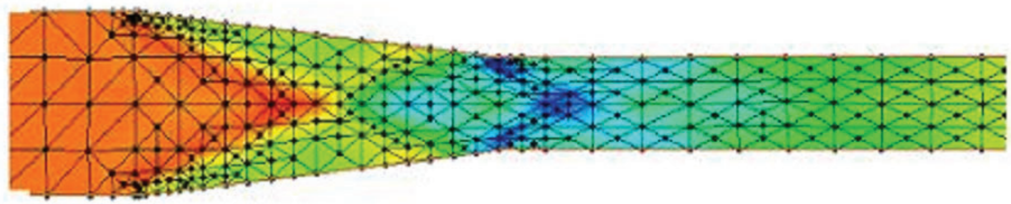
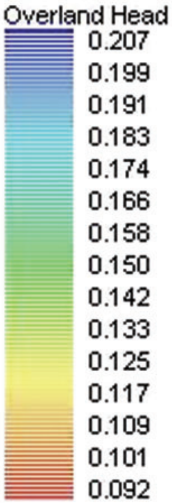


Figure 2c. Water surface elevation at steady-state.



shock pattern that results is depicted in the water surface elevation throughout the channel transition. In order to represent these shocks properly, more resolution is needed. The resolution is needed in the immediate vicinity of the shocks. Figure 2a shows the water surface elevation near the beginning of the simulation. Figure 2b is at an intermediate time, and Figure 2c is at steady-state. The flow field and the grid evolve together to produce an accurate solution.

As ADH is running, it will automatically adapt the grid to capture important flow features.

Additional information may be obtained by contacting Charlie Berger at *Charlie.R.Berger@erdc.usace.army.mil*.

Mark your Calendar

24-27 Mar 2003 - Hydro '03 Conference in Biloxi, MS. This conference presents both technical papers and vendor exhibits covering the latest in hydrographic surveying and coastal mapping and charting. For more information, contact Jeff Lillycrop or see http://www.thsoa.org

31 Mar 2003 - Abstracts due for *Soil erosion and sediment redistribution in river catchments: measurement, modeling and management in the 21st Century.* Abstracts should be sent (ideally as an Email attachment, and no more than 200 words) to either Alison Collins or Phil Owens . Decisions will be made by 30 Apr 2003 (see also 9-11 Sep) http://www.silsoe.cranfield.ac.uk/nsri/conference/

9 Apr 2003 - WEDA XXIII submission of **Final Manuscript**

- Dr. Ram K. Mohan, Blasland, Bouck & Lee, 326 First Street, Suite 200, Annapolis, MD 21403, Tel: 410 295 1205, Fax: 410 295 1209, Email: rkm@bbl-inc.com
- Dr. Robert E. Randall, Department of Civil Engineering, Texas A&M University, College Station, TX 77843, Tel: 979 862 4568, Fax: 979 862 8162, Email: r-randall@tamu.edu
- Mr. Stephen Garbaciak, Jr., Blasland, Bouck & Lee, 200 S. Wacker Dr, Suite 3100, Chicago, IL 60606, Tel: 312 674 4937, Fax 312 674 4938, Email: sdg@bbl-inc.com

18-23 May 2003 - Coastal Sediments '03, Clearwater, FL. A multi-disciplinary international conference convened for researchers and practitioners to discuss science and engineering issues of coastal sediment processes. A special RSM session will be held. http://www.coastalsediments.net/

11-13 Jun 2003 - WEDA XXIII and Texas A&M's 35th Annual Dredging Seminar, Chicago, IL. Program theme is *The Dredging Contractor.* For additional information, contact Lawrence M. Patella, Tel: 360 750 0209, Fax: 360 750 1445 or visit http://www.westerndredging.org

9-11 Sep 2003 - International conference, sponsored by the National Soil Resources Institute (NSRI), Cranfield University, in Silsoe, Bedfordshire UK, under the topic *Soil erosion and sediment redistribution in river catchments: measurement, modeling and management in the 21st Century.* Final registration is likely to be 30 Jun 2003. Additional information is available by visiting http://www.silsoe.cranfield.ac.uk/nsri/conference/

2-6 Aug 2004 - International Symposium on Sediment Transfer through the Fluvial System, Moscow, Russia. Sponsored by The International Association of Hydrological Sciences (IAHS), International Commission on Continental Erosion (ICCE), and co-sponsored by Moscow State University. Contact and information Valentin Golosov or Vladimir Belyaev at Tel: 007-095-9395044 , Fax: 007-095-9395044

- 30 Apr 2003 - Deadline for abstracts
- 30 Jun 2003 - Replies to authors
- 30 Nov 2003 - Deadline for papers

New Online Publications

Papers

Gatto, L.W., and M. G. Ferrick, 2002, The effect of freeze-thaw cycling on soil erosion: laboratory experiments. Paper No. 022222, Proceedings of the ASAE Annual International Meeting/GIGR World Congress, American Society of Agricultural Engineers CD, 16 pp.

Research Briefs

Geomorphic Processes Affecting the Formation and Response of Sedimentological Features in Regional Sediment Systems (January 2003)

Freeze-Thaw Effects on Soil and Bank Erosion and on Bank Stability (January 2003)

Coastal Morphology-Change Models (January 2003)

www.wes.army.mil/rsm/news/