Collaborative Approaches to Integrated Modeling:

Better Integration for Better Decision-Making

Workshop Participants Guide

December 10-12, 2008

Desert Conference Suites IV and VI

JW Marriott Desert Ridge

Phoenix, AZ

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U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

OFFICE OF
THE SCIENCE ADVISOR

Dear Workshop Participants:

It is my pleasure to welcome you to the workshop on **Collaborative Approaches to Integrated Modeling: Better Integration for Better Decision Making**. I am confident that with the high caliber and expertise that has assembled for this workshop you will be able to make significant progress in not only identifying the important science and information technology issues associated with integrated modeling, but charting a way forward on how we can collaboratively work to address them.

I believe that this workshop significantly reflects the vision of EPA's Office of the Science Advisor. We strive to serve as a leader and honest broker for cross-Agency science, science policy and technology issues. We are currently spear-heading an Agency-wide effort to identify cross-Agency science priorities. As we are finding through this effort, emerging and pressing environmental problems are complex, multifaceted, and often cross media and disciplines. For example biofuels, climate change, and managing the risks from contaminants in the environment require systems level assessments. Modeling plays an important role not only advancing our scientific understanding but also helping us bridge the stovepipes and provide answers to critical environmental decision making needs.

This workshop represents an important step in promoting the learning and collaboration needed across the Agency and with outside partners to effectively and efficiently develop and implement integrated models and approaches to address complex environmental issues and promote appropriate solutions. I also believe the outcomes of this workshop will be instrumental for the development of a case study that demonstrates the added value of integrated modeling for policymaking and decision tools.

Once again, on behalf of my colleagues at EPA, I thank you for your enthusiasm and willingness to engage with us in addressing these difficult but critical issues. I regret that I am not able to join you in person for this valuable meeting, but I look forward to hearing about the results of your discussions and supporting the future efforts related to the integrated modeling initiative.

Sincerely,
Pai-Yei Whung, Ph.D.
Chief Scientist

COLLABORATIVE APPROACHES TO INTEGRATED MODELING: BETTER INTEGRATION FOR BETTER DECISION MAKING

December 10-12, 2008
JW Marriott Desert Ridge Hotel, Phoenix, AZ
At the OEI Environmental Information Symposium 2008

Workshop Announcement and Invitation to Participate

The US EPA is convening this workshop to establish and initiate a community of practice for integrated modeling science and technology.

Workshop Goals:
The goals of this workshop are to survey modelers within and outside EPA to:

- identify current and emerging practices and approaches to model integration and interoperability;
- identify and prioritize the technical challenges related to model and modeling framework interoperability and determine what is required to address these issues; and
- identify the existing groups and initiatives that are tackling similar issues and determine the gaps;
- determine the role/ mission of the community of practice on integrated environmental modeling science and technology; and
- define initial projects for community participation.

Expected Outcomes:

- The technical workshop discussions will focus on the wider issues related to achieving model, as well as framework, interoperability. These discussions will help define the requirements for model reuse and interoperability as well as how standards could be employed to achieve interoperability.
- The output from this initial workshop will be a requirements analysis that will be widely disseminated throughout the modeling community detailing the rationale for the community of practice and a preliminary plan for rolling it out and how it will make progress in forging collaboration and reducing fragmentation.

So What?
Developing an infrastructure to support integrated modeling will result in the following benefits:

- Better documentation and communication of model information through model meta-data standards
- Reuse of model components
- Collaborative model development
- Enhanced access to modeling infrastructure tools for integrated model support
- Facilitating community knowledge sharing on model application

Workshop Topics:

- Integrated modeling: encompasses a broad range of approaches and configurations of models, data and assessment methods to describe and analyze complex environmental problems, often in a multimedia and multidisciplinary manner.
- Interoperability: is the ability of diverse components to work together as separate resources, but having enough common ground to reliably exchanging messages without error or misunderstanding.
- Community of practice: an organizational approach to bring together the modeling community to share tools, information and knowledge and to resolve common challenges.

Who?
The workshop is open to participants from within and outside EPA who are interested in the development and application of integrated modeling tools and systems to address existing and emerging environmental challenges, such as biofuels life-cycle analysis and development of climate adaptation strategies.

To register for the workshop: http://www.epa.gov/crem
To register for the OEI Symposium: http://www.epa.gov/oei/symposium/2008/index.htm

For more information, contact Noha Gaber, gaber.noha@epa.gov

Workshop Organizing Committee

- Bret Anderson, EPA Region 7
- Noha Gaber, Office of the Science Advisor
- Marc Houyoux, Office of Air and Radiation
- Gerry Laniak, Office of Research and Development
- Dan Loughlin, Office of Research and Development
- Jerry Johnston, Office of Environmental Information
- John M Johnston, Office of Research and Development
- Kenneth Schere, Office of Research and Development
- Gene Whelan, Office of Research and Development
- Kurt Wolfe, Office of Research and Development
- Steve Young, Office of Environmental Information

Workshop Agenda

Day 1: Wednesday December 10, 2008

7:30-9:00	**Workshop Registration**
9:00-9:45	**Introduction to the Workshop** ▪ Gary Foley, US EPA, Office of the Science Advisor **Welcome Remarks** ▪ Molly O'Neill, US EPA, OEI Assistant Administrator, EPA CIO **Opening Plenary: Integrated Environmental Modeling : Past, Present, Future** ▪ Gerry Laniak, US EPA, Office of Research and Development
9:45-10:15	**Strategies to Promote Collaboration and Facilitate Interoperability** ▪ Phillip Dibner, Open Geospatial Consortium
10:15-10:30	**Morning Coffee Break**
10:30-12:00	**Panel Presentations/ Discussion: State of the Art and Practice in Integrated Modeling** Facilitator: Dan Loughlin ▪ **Why Openness and Collaboration Are Essential for Integrated Modelling - Lessons from the OpenMI's Development** Roger Moore, Center for Ecology and Hydrology, UK ▪ **Map Window Community** Dan Ames, Idaho State University ▪ **Introduction to the CUAHSI Community Hydrologic Modeling Platform (CHyMP)** Larry Murdoch, Clemson University ▪ **Nine Agency MOU for Environmental Modeling - Can It Work?** Ken Rojas, USDA ▪ **The Community Sediment-Transport Modeling System: Experiences with an Open-Source Approach for Developing Coupled Models for Waves, Currents, and Sediment Transport in Coastal and Estuarine Environments** Christopher Sherwood, USGS
12:00-1:00	**Lunch**
1:00-2:00	**OEI Symposium Opening Plenary:**
2:00-2:30	**Afternoon Coffee Break**
2:30-2:45	**Charge for Break-out Discussion Session 1:** Gerry Laniak
2:45-5:00	**Workshop Break-out Discussion Session 1: Technical Challenges Related to Model and Modeling Framework Interoperability**
5:30-6:30	**OEI Symposium Welcome Reception** | **Poster Session**

Day 2: Thursday December 11, 2008

8:00-9:00	**Break-out Discussion Session 1 Reporting**
9:00-9:30	**Morning Coffee Break**
9:30-11:00	**OEI Symposium Plenary Session 2: Virtual Alabama** ▪ Jim Walker, Alabama Homeland Security Director
11:00-12:00	**OEI Symposium Plenary Session 3: The Information Sharing Environment and Fusion Centers: Lessons Learned for Environmental Management** ▪ Ambassador Ted McNamara, Directorate of National Intelligence
12:00-1:00	**Lunch**
1:00-1:20	**Successful Knowledge Management Practices** ▪ Doretta Gordon, Southwest Research Institute
1:20-1:35	**Charge for Break-out Discussion Session 2** Gerry Laniak, US EPA
1:35-3:30	**Workshop Break-out Discussion Session 2: Defining the Community of Practice Concept for Integrated Modeling**
3:30-3:45	**Afternoon Coffee Break**
3:45-5:00	**Workshop Break-out Discussion Session 2 Reporting, Next-steps and Wrap-up**
7:00-9:00	**Workshop Dinner**

Day 3: Friday December 12, 2008

8:00-8:45	**OEI Symposium Plenary Session 4: Finding Solutions in the Clouds** Rajen Sheth, Sr. Product Manager, Google, Inc.	**8:00-12:00** **Implementation of the Community of Practice Concept to Model and Framework Interoperability**
8:45-9:30	**OEI Symposium Plenary Session 5: Integrated Information Systems for Sharing Public Health Information** Dr. Leslie Lenert, Director, National Center for Public Health Informatics, CDC	
9:30-10:00	**Morning Coffee Break**	
10:00-10:45	**Plenary Session 6: Microsoft Research: Innovation in Energy, Ecology and Environment** *Dan Fey, Microsoft* Research	
10:45-11:30	**Contest Highlights**	
11:30-11:45	**Closing Plenary Session** Linda Travers, Deputy Assistant Administrator for OEI	

Legend:

OEI Symposium Session	

Discussion #1:
Technical Challenges Related to Model and Modeling Framework Interoperability

Purpose: To engage workshop participants in discussing and prioritizing the technical challenges related to model and modeling framework interoperability.

Output: A prioritized list of technical challenges associated with integrated modeling and the needs and requirements for addressing them.

Allotted Time: 2 hours 15 minutes

Facilitation:
Group 1: Co-Chairs: Gerry Laniak, Alexey Voinov
Group 2: Co-Chairs: John Johnston, Ken Rojas

Discussion Questions:
Achieving Interoperability:

- What technical issues arise when exchanging information among a set of inter-disciplinary models and/or frameworks (e.g., spatial/temporal resolution of data, dynamic feedback)?
- What are the hardware and software compatibility challenges?
- How can communication protocols between models, frameworks, and databases be designed to facilitate interoperability?
- What is the role of standards in integrated modeling?
- What are the goals and objectives of metadata for models, databases, and variables? How should they be designed and implemented?
- What are the approaches to achieving modularity (ability to Plug and Play components)?
- What are the issues associated with using legacy models/ codes in integrated systems?
- What is the responsibility of the modeler (i.e., to what extent must a modeler be an expert in each of the models and databases of an integrated system)? What are the expected modifications, if any, that a developer needs to make to their model to ensure that it is system compliant?
- What are system responsibilities versus component responsibilities?
- Which computer languages (FORTRAN, C, C++, C#, JAVA, VB, etc.) and what forms of computer languages (source code, DLLs, executables, etc.) should be considered?
- What are the issues associated with interoperability among integrated modeling frameworks?
- How can framework-to-framework connectivity be achieved to allow models that are “compliant” under one framework to be used in another framework?
- What strategic directions should be pursued with respect to leveraging the internet for integrated modeling?

- What role does remote and/or local computing and data storage have with the concept of integrated multi-disciplinary modeling (e.g., run/access from a central host location, run/access from multiple remote locations, and download to the user's host computer)?
- What are the component ownership implications associated with integrated modeling?
- Intra-system security

Data Transferability and Management Issues:

- What are the data needs for integrated modeling, and how can they be met?
- What are the most appropriate procedures for having a model access a disparate database?
- What issues arise when accessing and processing data from a myriad of sources?
- How does one deal with the dynamic nature of environmental databases, and how does the dynamic nature of the databases impact integrated modeling?
- Visualization of data
- GIS connectivity

Decision Support

- How should model User Interfaces be dealt with (e.g., tied to model, provided by system, separated from model but meets system specifications, etc.)
- To what degree do ease of use, cost reduction, and increased efficiency influence the justification of integrated multi-disciplinary environmental modeling?
- Who are the stakeholders in integrated modeling and how can they best serve and be served?
- What is the relationship between decision support and the conduct of integrated modeling?
- What additional model outputs, above and beyond the spatial and temporal predictions of concentrations, exposures, risks, etc., should be considered?
- What strategies can be employed to increase user understanding, acceptance, and confidence in integrated modeling?
- On-line help

Quality and Model Evaluation

- How should the concepts of coherence, consistency, transparency, reproducibility, and quality assurance be applied to integrated modeling?
- What are the QA/QC issues and needs with respect to archiving regulatory assessments on a central server versus a host machine?
- What special considerations should be pursued with respect to the software, documentation, and application of integrated modeling?
- How should the concepts of calibration, validation, optimization, and uncertainty/sensitivity analysis be applied to integrated modeling?

Discussion #2: Defining the Community of Practice Concept for Integrated Modeling

Purpose: To engage workshop participants in a discussion of the value of a community of practice (CoP) for Integrated Modeling, the characteristics of a CoP, and issues related to implementation of a CoP.

Output: A requirements analysis outlining the rationale for a CoP for integrated modeling and a preliminary plan for how it will be implemented

Allotted Time: 2 hours

Facilitation:
Group 1: Co-Chairs: Roger Moore, Larry Murdoch
Group 2: Co-Chairs: Alexey Voinov, Dan Ames

Discussion Questions:

- Who and what would a community of practice include?
- What goals and objectives would our community of practice will work towards?
- What can we learn from communities of practice as applied in other areas (e.g. open source software communities)?
- If you could wave a magic wand and change one thing to move the community closer to integrated modeling what would it be? If you could change three things?
- What barriers (e.g., organizational, logistical, etc.) exist to creating and maintaining a CoP, and how can they be addressed?
- What types of disciplines should ideally be involved and who within those disciplines would be willing to participate actively in this CoP?
- What are the short and long-term practices that we currently think will best move us towards our goals?
- How will those practices use and/or improve upon existing tools, activities, resources?
- In five years, what benchmarks will be used to gauge the progress of the community?

Building on the discussions from the first break-out session, participants will be asked to develop a matrix that identifies how a CoP for integrated modeling science and technology can help address the technical challenges identified. For example:

Technical Issue	What is required?	How can a COP achieve that?
Achieving interoperability:	Community-based standards that will facilitate the reuse and interoperability of components, e.g. metadata standards, ontologies	
Automated data access, retrieval, and processing:	Community based software development standards will be important in both conserving resources and facilitating state of the science solutions to regulatory problems	

Half-Day Technical Session: Implementation of the Community of Practice Concept to Model and Framework Interoperability: Example Applications

Purpose: To engage workshop participants in developing and committing to a plan for implementing example applications of the Community of Practice (CoP) concept for integrated multi-disciplinary modeling.

Output: A series of example applications that clearly demonstrate the value of implementing common standards and protocols to exchange information between disparate components (e.g., models, frameworks, or databases).

Co-Facilitators: Gerry Laniak and John Johnston (EPA)

Allotted Time: 8:00 am-12:00 pm.

Scope

The purpose of the Discussion #2 breakout sessions was to define what is meant by a Community of Practice. In other words, the participants, among other things, should have been able to

- Define what a CoP is
- How a CoP is structured
- What aspects and attributes comprise the CoP
- Who represents willing partners within the CoP
- How the CoP would proceed to work together
- What compromises would need to be addressed to ensue that the CoP would contain effective partners

The objective associated with this half-day session is to take the results of Discussion #2 and develop example applications to implement the Community of Practice (CoP) concept for integrated multi-disciplinary modeling. To successfully meet the purpose and objective, this effort will hinge on two questions:

1. Do you want to be a part of a Community of Practice that will exercise various aspects associated with the community concept?
2. Are you willing to compromise to help meet the best interests of the community as a whole?

If the response to each question is an affirmative, then this session needs to flesh out the critical issues that will ensure that the group can implement the Community of Practice such that the efforts represent illustrative examples on how other groups can follow, utilize, and benefit from these efforts as members of the group. Typical questions that will need to be addressed include the following:

- How do we get the CoP operational?

- What specific examples should be addressed?
- Who will be engaged in the cooperative exercise(s)?
- What is the extent of the assessment?
- What resources can be brought to bear to ensure a successful effort?
- When does the effort(s) need to be completed?
- What aspects of the integrated multi-disciplinary modeling domain should be exercised or illustrated?
- What series of questions or challenges should be addressed?
- How should the results of the applications be documented?

To help facilitate the discussion, two illustrative ideas have been developed as examples only:

1. Investigate how various designs actually assimilate models, databases, and files into frameworks by using real-world scenarios and data, and models independently chosen and developed by others with the intent of fostering model reuse and interoperability.
2. Supplement, modify, and/or update existing modeling frameworks to include an option for implementing these frameworks or their components following a Community of Practice set of standards.

These example ideas provide a basis for discussion and may or may not be chosen by the group as initial efforts to pursue. These example ideas are presented in the following sections.

Example 1: Investigate how various designs actually assimilate models, databases, and files into frameworks by using real-world scenarios and data, and models independently chosen and developed by others with the intent of fostering model reuse and interoperability.

<u>Scope</u>: Organizing, developing, adopting, and/or coordinating interoperable integrated modeling standards, protocols, approaches, and/or wizards that allow researchers to more easily link, apply, and visualize disparate models, databases, frameworks, and processes (like parameter estimation and uncertainty techniques). The intent is to provide researchers with the ability to construct integrated modeling frameworks that are faster to build, cheaper to implement, easier to use, resulting in more scientifically defensible assessments.

<u>Activity</u>: Discuss various methods used to register disparate input/output parameters and models with various integrated framework systems. The concept is to integrate a well-defined modeling scenario, established *a priori*, containing a confederation of models independently developed by others, into your framework.

EPA and other Federal agencies invest significant resources in constructing integrated modeling systems. Many times assessors need to assimilate components (e.g., models and databases) developed by others into frameworks that have also been developed by others. In other words, the assessors are attempting to use models that they did not develop and the integrated software that they did not develop. As such, both the framework and the wizards supporting the framework must help bridge the gap between the user's limited knowledge of the I/O of the components being linked to the framework and the assumptions and constraints associated with the framework's ability to assimilate components.

The process of assimilating disparate components into an integrated modeling framework varies in complexity and difficulty. In certain circumstances, the linkage may be relatively easy and straight forward. In other situations, the linkage may be long and laborious. Several factors influence the relative ease of assimilating components, including but not limited to, familiarity with the components being assimilated, familiarity with the framework and its wizards supporting the assimilation process, level of documentation associated with the components and the framework, and design structure of the components and framework. An example of design structure issues is when the software developer scatters correlated input data into multiple unrelated files, making it difficult to find and vary the correlated input parameters (e.g., for sensitivity/uncertainty analyses).

Many integrated modeling systems have been developed and applied to a suite of problems. Each system is unique in its design. For example, some frameworks are based on file types, where as others are based on API calls. No one integrated modeling framework is necessarily better than another, as each has been developed to solve certainty types of problems in certain ways, and each has its strengths and weaknesses. Each integrated modeling system contains its own set of models, databases, and files, but in most instances, the components of these disparate systems cannot easily be extracted and recombined with the components from other frameworks to create a new integrated modeling system that is required for application at a new site or to address a new regulatory intent. Ideally, the intent is to have the ability to assimilate components, so they can seamlessly communicate, in a relatively short period of time (e.g., two weeks or less). By significantly reducing the assimilation time, the user now has the ability to plug-and-play components from various applications and by a myriad number of developers.

- As a **deliverable** for the workshop, we would like to discuss how each framework implements the assimilation process, where the framework developers or users would link well-defined but disparate components into their frameworks and document the process for others to duplicate.
- As an **action item** from the workshop, it is proposed that different frameworks start with a series of stand-alone models, databases, and files, and then assimilate these into their integrated modeling systems. One or more of these problem sets could be tackled. The models and problems would be real-world examples that have been independently chosen, and in some instances chosen by collaborating agencies. The intent is not to choose models that inherently favor one modeling system over another but to provide problems and models that may be typical of what a framework may be subjected to. We would start with a simple set of reduced-form models and move progressively to more complicated, high-fidelity models. Reduced-form models could be characterized by analytical, semianalytical, and/or empirical formulations, where each

model essentially consumes a single, flat-file dataset. High-fidelity models tend to be numerically based with complicated input/output structures. To ensure that each framework participant has all the necessary files and data needed to perform the exercise, the support material for this assimilation exercise would include each stand-alone code's

- Source code
- Executable(s)
- Input and output file examples
- "Dark-data" files. These are pre-populated files that the code accesses and reads without user intervention, files that come with the code to support the execution of a problem set.
- Documentation

As a deliverable, each participate would provide a full set of files containing the framework and all databases, files, source code, executables, where appropriate, with step-by-step instructions, so an independent analyst could follow and reproduce the approach of linking the stand-alone models and input/output parameters into the framework:

- Link models
- Run scenario
- Compare integrated output results to stand-alone output results
- Document procedures and design for linking models into the framework
- Outline the step-by-step procedures used to link the models into the framework
- Document the resources and time required to complete the linkages

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Example 2: Supplement, modify, and/or update existing modeling frameworks to include an option for implementing these frameworks or their components following a Community of Practice set of standards

Scope: The aim is a collaborative effort to supplement, modify, and/or update existing modeling frameworks to include an option for implementing these frameworks or their components following a Community of Practice set of standards.

Activity: This effort may convert multimedia frameworks to be compliant with CoP standards, or multiple frameworks could be linked through the CoP standards. Each exercise would be based on a real-world problem that would require compliance with standards and protocols not currently exercised with in the frameworks. Specific objectives of this exercise may include the following:

1. Use standards to develop architecture for designated frameworks that
    a. Maintain present functionality
    b. Replace/supplement linking by file exchange, if appropriate, with run-time communication
    c. Provide system level tools for
        i. Ensuring model compliance

   ii. Registering models
   iii. Executing linked models
   iv. Monitoring information exchange

2. Implement the system architecture on a series of real-world, realistic questions/challenges (e.g., Use Cases), where each requires an integrated approach. Each Use case should be evaluated for ease of use, resource requirements, and the degree of time associated with the linkage process. Interesting integrated Uses Cases may include
   a. both cyclic (i.e., dynamic feedback between components) and acyclic linkages,
   b. linkages between disparate frameworks, and not just models
   c. linkages to disparate databases, viewers, and other legacy peripherals and tools that support the a multimedia modeling assessment (e.g., GIS and spatial considerations).
3. Each Use Case should exercise specific aspects of model/framework/database linking integration, as they pertain to areas like
   a. data exchange
   b. iteration
   c. linking across disciplines
   d. linking models from different suppliers
   e. linking models based on different concepts
   f. linking models of varying scale (i.e., site-specific, regional, and global) and resolution (i.e., reduced-form to high-fidelity)
   g. instability
   h. uncertainty
   i. sensitivity
   j. calibration
   k. hard-ware clusters
   l. varying software languages, compilers, and/or versions, where appropriate.
4. Use these Use Cases as illustrative examples of how others could modify their frameworks to meet the agreed upon linkage standards both from the perspective of linking models-to-models or frameworks-to-frameworks.
5. Plan and build a support an organization or Community of Practice around these updated modeling frameworks as they relate to integrated modeling
6. Evaluate the
   a. added value of integrated modeling
   b. standards and protocols used by the modeling frameworks
   c. support organization that has been develop to implement the Community of Practice

A **deliverable** of this exercise would be an application of the framework(s) to a real-world problem demonstrating the utility and functionality of being compliant with a CoP standard.

Poster Session

Emissions Modeling Framework (EMF): An example of using custom software to manage and track modeling studies

Marc Houyoux*, Alison Eyth**
* USEPA
** University of North Carolina, Chapel-Hill

The EPA Office of Air Quality Planning and Standards (OAQPS) has created a management system for the emissions modeling work that is performed in support of numerous air quality modeling simulations. The Emissions Modeling Framework (EMF) contains data management, case management, and integrated quality assurance functions that support EPA staff and contractors who have shared responsibilities for emissions modeling. Emissions modeling for a single air quality application can involve hundreds of individual steps and hundreds of data files, all of which are tracked and maintained by the EMF. The client-server architecture of the EMF facilitates multi-user access, review, and running of simulations. Using the EMF has improved coordination, quality assurance, reproducibility, documentation, data integrity, and transparency of emissions modeling within EPA.

The EMF has been extended with additional applications in support of emissions-related activities at EPA, including control strategy development and construction, running of emissions sensitivities by non-experts, and tracking data files used by air quality simulations in addition to the emissions data. This software paradigm appears to have transferable attributes for other modeling applications.

The OpenMI Association

Roger Moore, Center for Ecology and Hydrology, UK

This poster describes the OpenMI, how it came about, what it can do you, and who it is for. It also looks at the OpenMI Association, what it does reasons behind joining the association, and steps to take to join the association.

Demonstration of integrated modelling in the Scheldt Basin, using the OpenMI

Roger Moore, Center for Ecology and Hydrology, UK

This poster also looks at “What is the OpenMI?” and why it should be applied, as well as an example of linking. The Scheldt demonstration will show the linking of a sewer and river model, a tidal and river model, a river model and water quality model, and finally linking a 1D-river model and 2D-tidal model.

Seeking collaborators to advance ecosystem service quantification and contaminant exposure reconstruction tools.

David Raikow, Ken Fritz, Tom Croley
US EPA

There are two major EPA-NERL-EERD research themes currently in need of tools to achieve their goals in freshwater ecosystems: the quantification of ecosystem services and quantification of contaminant exposure sources. Specifically, the approach described in the Ecological Services Research Program Multi-year Plan (ESRP) is not adequate to meet ecosystem service quantification Long Term Goal 2, "National Inventory, Mapping, and Monitoring". Currently the watershed is the spatial unit planned for analysis, but watersheds only define the largest potential spatial boundary of the source area and forces irrelevant areas and land covers to be included in analyses. Moreover, there simply are no tools to spatially quantify freshwater sources of exposure. One solution exists for both problems: application of the resource shed concept. Delineating the geographic area (resource shed) defining where mobile materials supplied to downstream locations (receptors) originated will improve assessment, mapping, and forecasting of high quality water provision and other directional flow-related ecosystem services. Concurrently, the same method creates the capability to spatially reconstruct sources of contaminant exposure. Critically, there is only one source for watershed-based resource shed calculations, which is limited to selected watersheds of the Great Lakes, the NOAA Distributed Large Basin Runoff Model (DLBRM). The creator of this model has retired. Hence EPA has the opportunity to take over leadership of a new and powerful analytical tool both directly applicable to its stated goals and broadly useful to the fields of hydrology, ecology, and environmental forensics. I seek in-house EPA modelers to collaborate on building the capability to delineate resource sheds within models such as the Surface Water Assessment Tool (SWAT).

Utilizing Interoperability to Leverage HPC for Dust Storm Simulations

Chaowei Phil Yang
George Mason University

The research reported seeks to test the use of interoperability to leverage high performance computing, geoscience models, and national applications to increase the spatial domain, spatial resolution, and period of forecast when applying the dust simulation model. The project sought to reduce the execution time for both two dust models and to introduce end-users to model products tailored, in this case, to perceived needs of public health services. Further research needs will be discussed to bring the interoperable features of the two models into preferred operational mode.

"WinModel" – a Model Integration, Management, and Visualization Toolbox

Todd Redder
LimnoTech

LimnoTech has developed the "WinModel" application across a series of surface water modeling projects to provide an integrated collection of model management, visualization, and linkage tools. WinModel, which is programmed in Visual Basic 6, provides a wide range of features and capabilities across multiple surface water and watershed modeling packages. Visualization tools are available for EFDC, WASP5, HSPF, RCA, ECOMSED, FEQ, and BLTM/DAFLOW. Comprehensive pre-processing capabilities are available for WASP5, RCA, FEQ, and BLTM/DAFLOW via supporting Microsoft Access databases and Excel spreadsheets. Linkages between WASP5-FEQ, BLTM-DAFLOW, EFDC-RCA are also supported. Visualization capabilities available for all supported models include spatial and temporal profiles and animations, model-data comparisons, cumulative frequency distributions, one-to-one plots, mass balance diagrams, and map-based visualizations. In addition, WinModel provides flexible options for processing and visualizing model results for compliance with site-specific water quality standards. The WinModel toolbox has undergone rigorous testing and is being further developed through the integration of additional models and new visualization features. The WinModel application significantly improves the overall efficiency and accuracy of model development, calibration, and application tasks, including streamlined management of multiple simulations and scenarios. Furthermore, this toolbox serves a valuable role as a communication and education tool for client and stakeholder groups.

Speaker Biographies

Daniel Ames

Mr. Ames is an assistant professor in the Department of Geosciences as Idaho State University. His teaching and research topics include GIS, GPS, watershed analysis, decision support systems, terrain analysis, spatial statistics, probabilistic modeling, and environmental systems modeling. He is the program coordinator for the M.S. GISci program, director of the Idaho Falls Geospatial Software Lab, and project leader of the MapWindow GIS project.

Phillip Dibner

Phillip C. Dibner is the Director of Research Programs for the OGC Interoperability Institute (OGCii), the research and educational affiliate of the Open Geospatial Consortium (OGC). The OGC is an international standards body comprised of more than 360 agencies, academic institutions, and commercial organizations worldwide, dedicated to the development and application of standards that promote seamless, interoperable sharing of geospatial data and services. Mr. Dibner has been involved with the OGC since its inception. As a member of its Interoperability Program Team, he has managed technical integration and coordinated demonstrations for testbeds, interoperability experiments, and pilot implementations, in remote collaboration with participants throughout Europe, North America, and Australia. He also established and continues to chair the OGC Natural Resources and Environment Working Group, recently renamed the Earth Systems Science Domain Working Group (ESS DWG).

Trained as an ecologist at the Yale School of Forestry and Environmental Studies, Mr. Dibner has had field experience throughout the continental United States. Prior to his involvement with the OGC, he joined the Silicon Valley technology boom of the 1980s and '90s, working at Hewlett Packard, Sun Microsystems, NeXT, and Apple Computer, where he gained expertise in operating systems and network protocols, while pursuing his interest in environmental and ecological data acquisition and analysis.

Gary Foley

Dr. Foley currently serves as EPA’s Earth Observation Executive in the newly expanded Office of the Science Advisor. In this role, he oversees a team that brings together expertise in measurements, observations, models and decision-support tools and how these bring science into decision-making. He currently chairs the EPA Council for Regulatory Environmental Modeling. Over the last four years this Council has developed model use guidelines and a models knowledge data base for EPA. Dr. Foley was appointed as the United States Co-Chair on the User Requirements and Outreach Sub-Group of the ad-hoc Group on Earth Observations (GEO) in 2003. Two years later when the Ministers launched GEO, this sub-group was replaced by the User Interface Committee which he co-chairs. The purpose of GEO is to improve coordination of strategies and systems for observations of the earth, with a view to moving toward a comprehensive, coordinated, and sustained earth observation system or systems.

Doretta Gordon

Doretta Gordon is Assistant Director of Emerging Training and Performance Department at the Southwest Research Institute, which conducts research on content reuse and corporate capture of expertise in danger of being lost (aka expert knowledge transformation). The institute also provides blended learning solutions for training and performance support. Ms. Gordon received her Ph. D. in Human Performance Technology/Instructional Systems Design, as well as an MS in Instructional Design, from Florida State University.

Gerry Laniak

Gerry Laniak is an environmental engineer with the US EPA Office of Research and Development. He has been with the Agency for twenty years and has focused his efforts on developing and applying models, modeling systems, and related methods for applications related to multimedia environmental assessment. In recent years technical attention has centered on two modeling support systems, FRAMES (Framework for Risk Analysis of Multimedia Environmental Systems) and D4EM (Data for Environmental Modeling). FRAMES is a modeling infrastructure/framework that facilitates the linking and coordinated execution of individual models (e.g., a watershed model linked with a surface water model). D4EM is a software system designed to fully automate the data access, retrieval, and processing needs of linked systems of models. Much time and effort is also devoted to establishing collaborative relationships with others interested in integrated modeling.

Roger Moore

Roger Moore has over 30 years experience of leading UK and international multidisciplinary teams from industry and academia. These have all addressed scientific problems in which IT forms an important element. From 2002-06, he coordinated the European Commission’s FP5 HarmonIT project, which developed the Open Modelling Interface (the OpenMI). The European Commission sees such an interface as key to transforming integrated modelling into an operational tool, and hence change integrated management from an aspiration into an implementable policy. As a result of the OpenMI’s success, Roger Moore now leads the follow up project OpenMI-Life and is facilitating the OpenMI’s use in the USA and worldwide. He is Chairman of the Executive Committee of the OpenMI Association.

Larry Murdoch

Larry Murdoch is a professor at Clemson University, where he teaches and does research on hydrogeologic modeling and field applications. He is on the Board of Directors of CUAHSI, and has been involved in their effort to advance community modeling in hydrology, which is the topic of his talk today.

Molly O’Neill

Molly A. O'Neill, confirmed by the U.S. Senate on December 8, 2006, is the EPA's Assistant Administrator for the Office of Environmental Information (OEI) and Chief Information Officer (CIO). She is responsible for EPA's strategic planning concerning the collection, management, and access to the Agency's environmental information. As EPA's CIO, she is a member of the Federal CIO Council, where she currently serves as the Co-chair of the Architecture and Infrastructure Committee.

Prior to joining EPA, Ms. O'Neill was the State Director for the National Environmental Information Exchange at the Environmental Council of the States (ECOS). As State Director, she was responsible for coordinating, supporting, and leading the efforts of 50 state environmental department participants, and interfacing with U.S. EPA counterparts and other partners. In recognition for her leadership on the Exchange Network, Ms. O'Neill received a 2004 Federal 100 award as one of the top executives influencing government technology. Prior to her work on the Exchange Network, Ms. O'Neill spent 14 years working as a management and information technology consultant in the private sector focusing on the environment, health, and safety industry. She has many years of experience working on organizational and performance assessments; performance measures; business process reengineering; and large-scale information management system implementation projects. She is a graduate of Virginia Tech.

Ken Rojas

Ken Rojas is Application Deputy Project Manager for the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Information Technology Center (ITC), located at the Natural Resources Research Center (NRRC) in Fort Collins, Colorado. The ITC is an operational support unit for field-oriented national information systems. ITC responsibilities include the development of field office applications, developing and supporting national databases, and supporting and acquiring information technology infrastructure. A primary focus for the ITC is central management of software development, providing for consistency and compatibility across application information systems. Operational support for telecommunications, security, computing platforms, Federal Information Processing (FIP) acquisition, implementation and technical assistance support is also provided to the NRCS field, state, and regional offices by the ITC staff.

Christopher Sherwood

Chris Sherwood is a Research Oceanographer at the U.S. Geological Survey, Coastal and Marine Geololgy Program, Woods Hole Science Center. He develops and applies numerical models of coastal-ocean circulation and sediment transport and makes field measurements to assess the models. He is co-principal investigator for the Community Sediment-Transport Modeling System project funded by USGS and the Office of Naval Research through the National Oceanographic Partnership Program. He is also working with the U. S. EPA (Region 9) evaluating natural recovery and remediation alternatives for the Palos Verdes Superfund Site near Los Angeles. Before joining the USGS in 1999, Dr. Sherwood was a senior research scientist at the Australian Commonwealth Scientific and Industrial Research Organisation in Hobart, Tasmania from 1996 - 1999. Before that he worked for Battelle at the Pacific Northwest National Laboratory in Richland and Sequim, Washington from 1986 - 1996 and at Northern Technical Services in Anchorage, Alaska from 1984 - 1986. He got his MS (1982) and PhD (1995) in Geological

Oceanography at the University of Washington. His undergraduate degree is in Economics and Environmental Studies from Bowdoin College, Maine, in 1976.