



# CIEM:

## Community of Practice for Integrated Environmental Modeling

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- Roger Moore, Center for Ecology and Hydrology, UK



# Outline

- The Road to **CIEM**: Building the case
- **CIEM** Scope, Mission, Vision and Goals
- **CIEM** Governing Structure and Principles
- **CIEM** activities and products: IEM Hub, Community Projects and Workshops



# THE ERA OF INTEROPERABILITY

- **“This is the next frontier of human productivity. We’ve had the agricultural era, the industrial era, the information age. The next era is the era of interoperability.”**
- **The world is intuitively weaving itself into networks**
- **These are underpinned by collaboration**
- **Those who get better at collaboration will prosper**

**Michael O. Leavitt,  
Former EPA Administrator  
Secretary, Dept of Health & Human Services**

**Keynote Address to the 2005 Public Meeting of the Interagency Working Group On Earth Observations**



# The Drivers are Clear!

*“emphasize an integrated ecosystems approach ...*

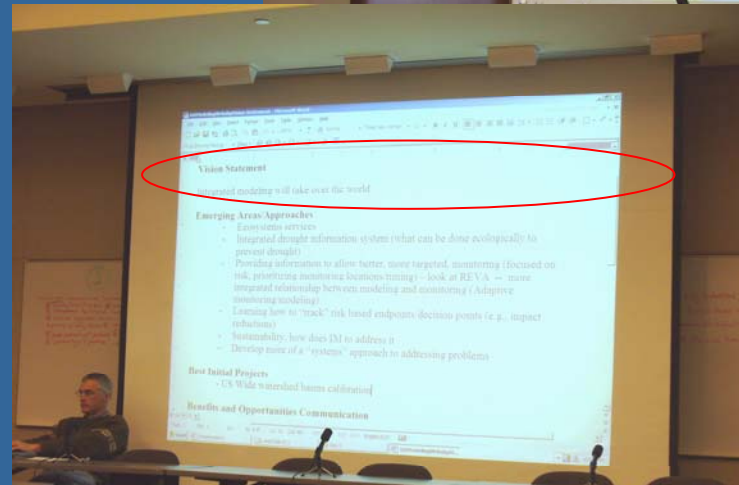
*the approaches needed to address these challenges, do not fit squarely into the old paradigm of “air,” “water,” and “land.”....*

*We explicitly acknowledge the need to consider the “cross-media” nature of these and other challenges”*

# The Road to CIEM

## Integrated Modeling for Integrated Environmental Decision Making Workshop

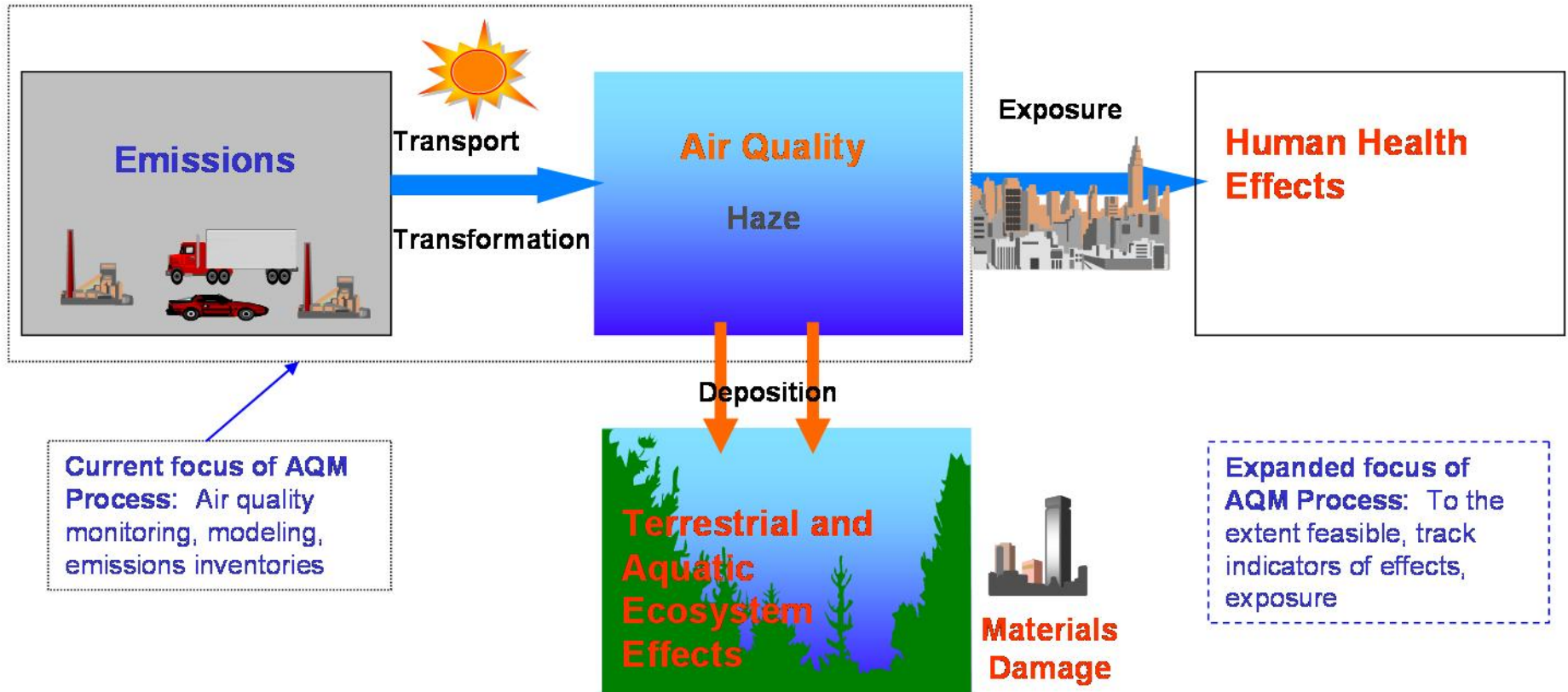
January 2007



### Vision Statement

Integrated modeling will take over the world

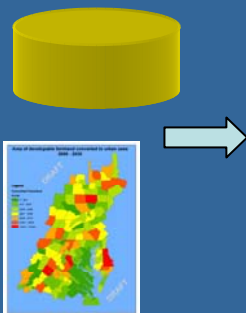
# Expanding Accountability



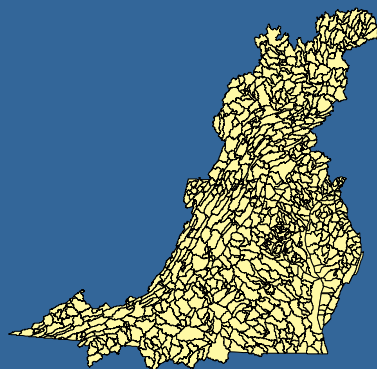
Using models that integrate multiple data sources to better assess effectiveness of past policies

# Chesapeake Bay Decision Support System

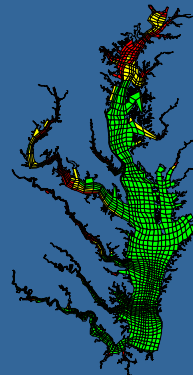
Airshed Model,  
Land Change Model,  
Data



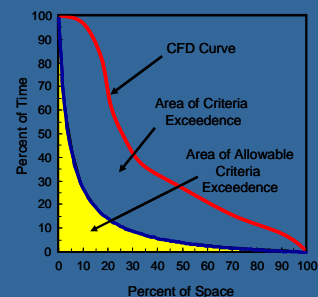
Watershed  
Model



Bay  
Model



Criteria  
Assessment  
Procedures

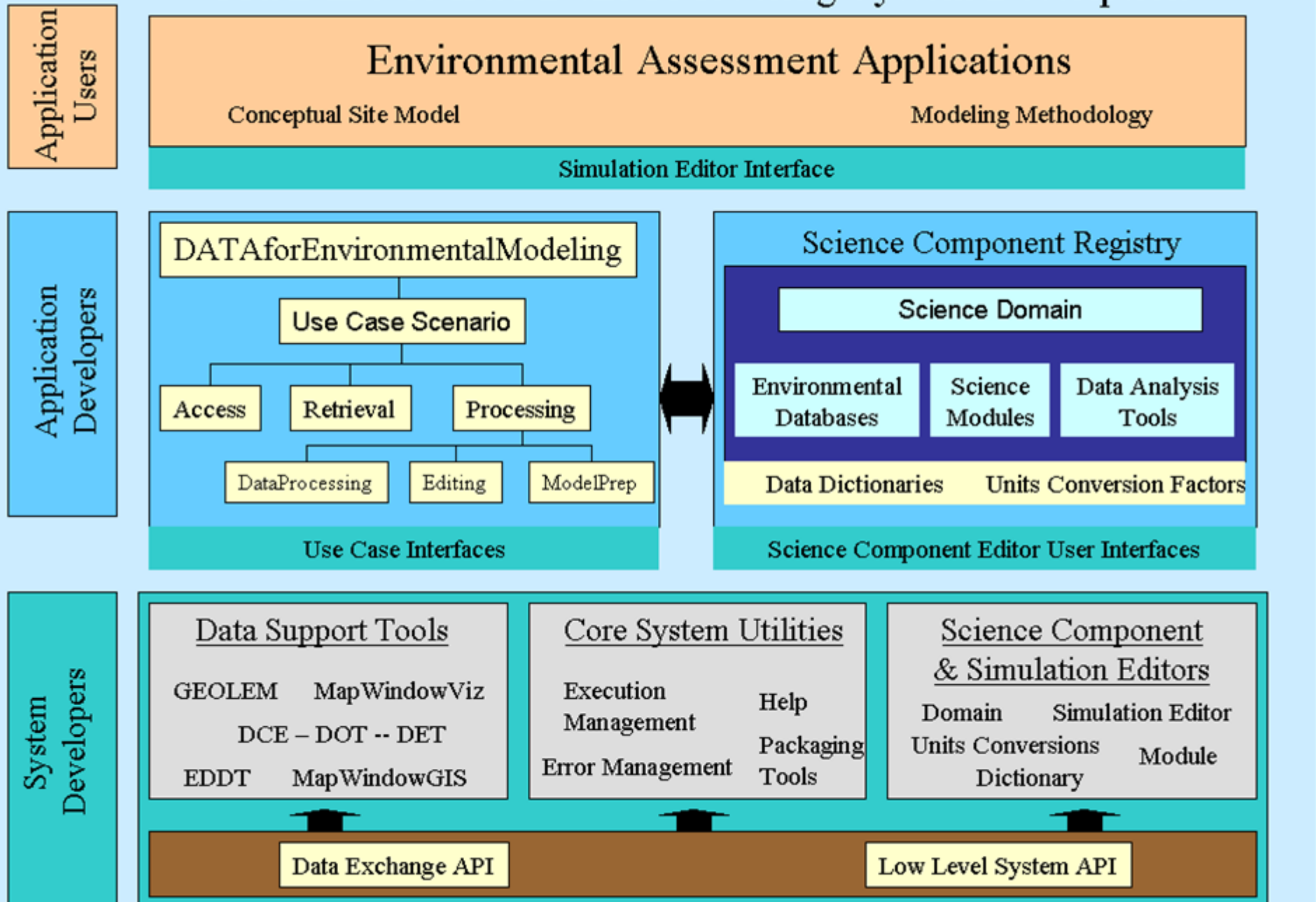


Effects

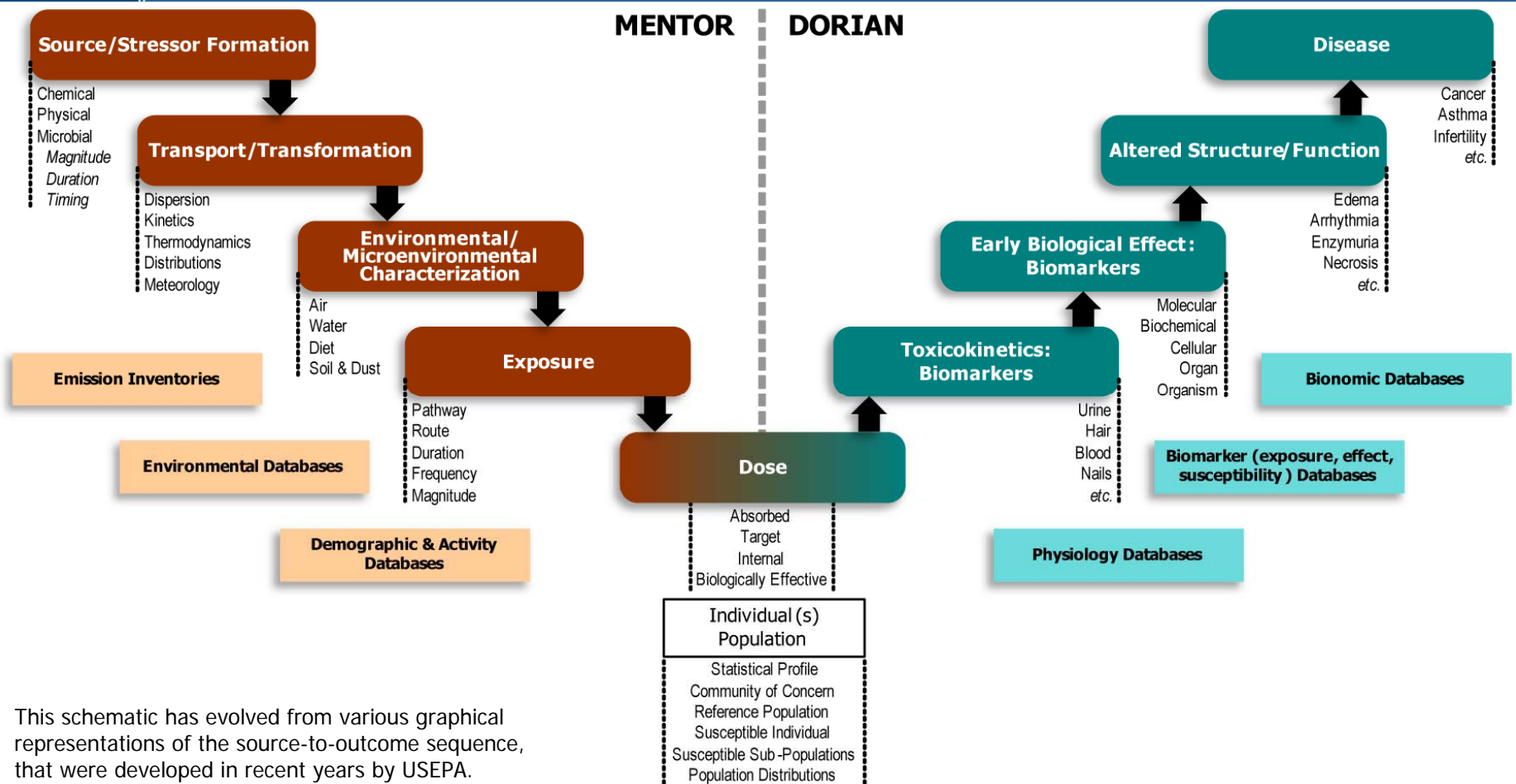
Allocations



# FRAMES-3MRA-D4EM Modeling System Description



# A mechanistically consistent infrastructure for both exposure assessment and health impact analysis: CERM/MENTOR and ebCTC/DORIAN address the source-to-outcome continuum



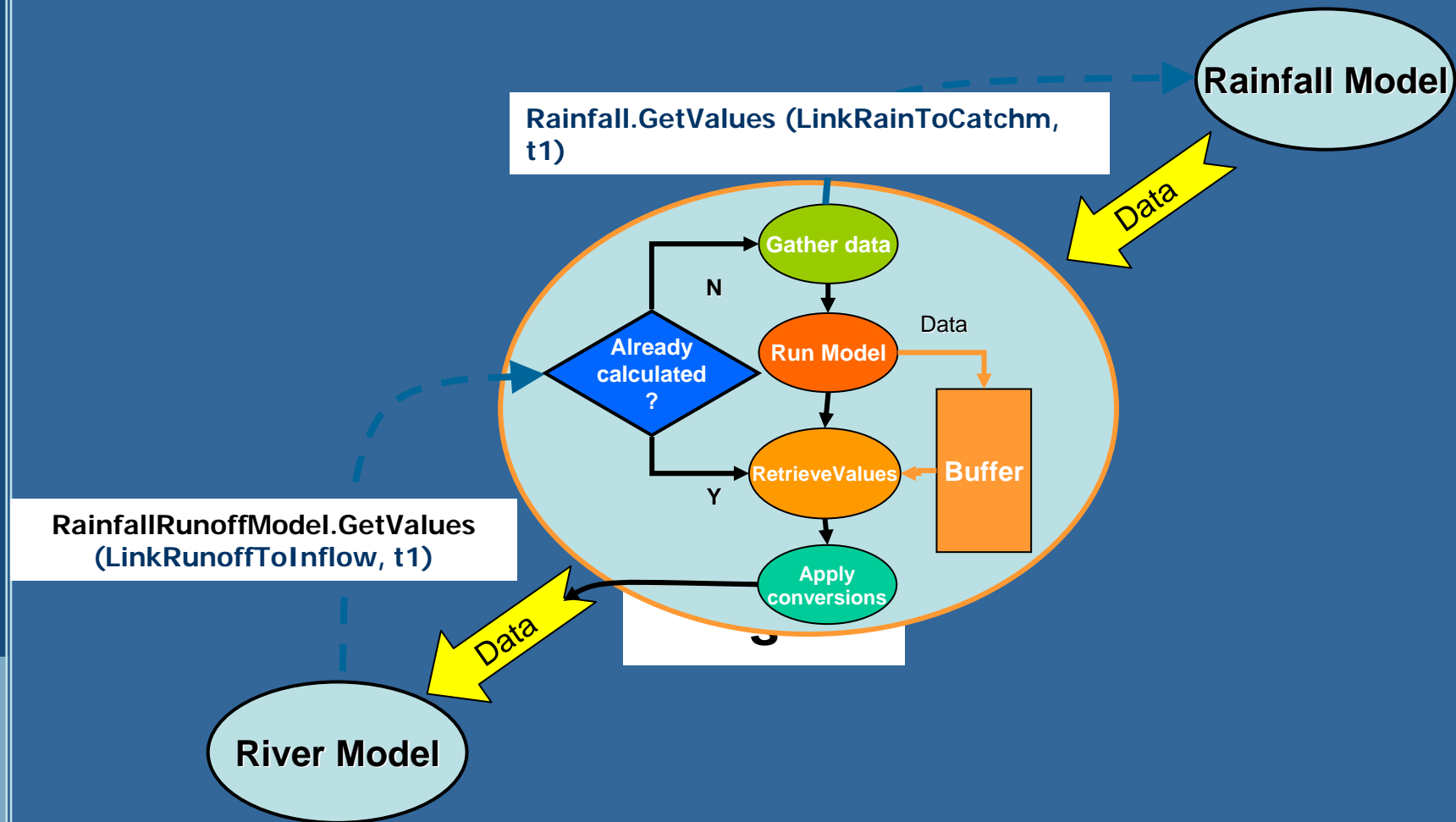
**CERM:** Center for Exposure and Risk Modeling

**MENTOR:** Modeling ENvironment for TOrtal Risk studies

**ebCTC:** environmental bioinformatics and Computational Toxicology Center

**DORIAN:** DOse-Response Information Analysis system

# Open MI: Open Modelling Interface





# Integrated Modeling

*“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 multi-media and multi-disciplinary manner”*

**Building an  
understanding of  
linkages**

**Assessments**

**Decision Analysis**



## Current State of IM at EPA: The good news

- IM concepts are increasingly appreciated
- Numerous examples of integrated modeling across program offices, regions, ORD, and across Federal Agencies
- Managers acknowledge critical role of IM in support of the regulatory decision process
- Modelers and analysts appreciate the science issues related to IM



## Current State of IM at EPA: The bad news

- Fragmented and ad hoc nature of efforts:
  - Leads to inconsistent and sometimes conflicting results
  - Extremely inefficient (high degree of “re-inventing the wheel”)
  - Resource allocation skewed to support software and not the science
  - NIH syndrome

# Challenges

*Evolution from single pathway analysis to integrated systems analysis*



## Science

- Multi-media and multi-disciplinary
- Model evaluation and uncertainty analysis

## IT

- Interoperability and standards
- Data and model access and retrieval

## Organizational

- Limited collaboration across programs
- Fragmentation
- “Stove-piping”
- Limited resources

# The Road to CIEM

- What is integrated modeling? Why is it needed? What are its applications?
- What is the state of the art?
- What are the challenges?
- Vision and action plan for creating an enabling environment for more consistent, coherent integrated modeling







# The Road to CIEM

- **Need for Integrated Modeling/ Analysis:**
  - Integrating models and scientific components across media, disciplines and scales offers valuable insights
- **Need for Integrated Modeling to Inform Decision Making:**
  - Enhancing stakeholder collaboration and decision making transparency.
- **Need for Organization-Level Solution/ Enabling Environment:**
  - Promoting consistency and repeatability of analyses
  - Establish and maintain a connected stakeholder community
    - Promote better understanding of integrated modeling
    - Understanding new needs
    - Sharing experience, knowledge, technologies
  - Develop standards to facilitate reuse and interoperability of existing and new integrated modeling technologies



# The Road to CIEM

## Collaborative Approaches to Integrated Modeling Workshop December 2008

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### Topics:

- Discuss emerging practices and approaches to model integration and interoperability;
- Identify technical challenges related to model and modeling framework interoperability and determine what is required to address these issues;
- Identify collaborative projects that could be the focus of the modeling community



# Technical Challenges Related to Model and Model Framework Interoperability

- QA/QC for model integration and ensuring system level integrity
- Spatial and temporal synchronization
- Adequate documentation of models, algorithms and frameworks
- Open source vs. proprietary
- Benchmarks to compare models and frameworks

# Priorities to Overcome Challenges

- Establish standards to facilitate reusability and interoperability
- Establish shared ontologies
- Emphasize the economies of scale of building on and reusing community products



**A Community  
Approach**



# The Six “ility” Principles

- **Interoperability:** To share components across platforms.
- **Accessibility:** To locate and access components.
- **Reusability:** To use components in multiple and varied contexts.
- **Durability:** To withstand technology evolution and changes without costly redesign, reconfiguration or recoding.
- **Maintainability:** To withstand content evolution and changes without costly redesign, reconfiguration or recoding.
- **Adaptability:** To tailor components to individual and organizational needs



# Community of Practice for Integrated Environmental Modeling

# CIEM



# What is a Community of Practice?

“A CoP is a group of people who share an interest in something, and come together to develop knowledge around this topic, in order to use it in practice.”

Wenger, E. 1991

- This “community” usually share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis.
- These people don't necessarily work together every day, but they meet because they find value in their interactions.
- As they interact, they share information, insight, and advice and help each other solve problems.
- They ponder common issues, explore ideas, and act as sounding boards.



# CIEM Vision (DRAFT)

Integrated analysis and management is the only option for the future management of our resources.

The vision of the **CIEM** is of a future where the concept of integrated modeling is widely accepted by authorities as leading to better decisions, and where it is the adopted practice in optimizing the management of complex systems.





# CIEM Mission (DRAFT)

The **CIEM** will stimulate interactions among its members to foster learning and knowledge sharing and spark innovation in the field of integrated environmental modeling. The **CIEM** will promote integrated modeling as a means of achieving better management decisions, so that resources are more sustainably exploited and impacts are better understood.



# CIEM Goals

- Leveraging the knowledge and tools of the community to advance integrated modeling science and technology
- Reduce fragmentation and redundancy: Let's not reinvent the wheel!
- Multi-disciplinary focus: not just water, air, etc; not just physical environment, but integrated systems
- Serve as a community of communities
- Facilitate linkage of models, tools, frameworks and people.
- Help to develop community priorities and set objectives.
- Focus on tackling science and technology challenges with ultimate goal of supporting decision making



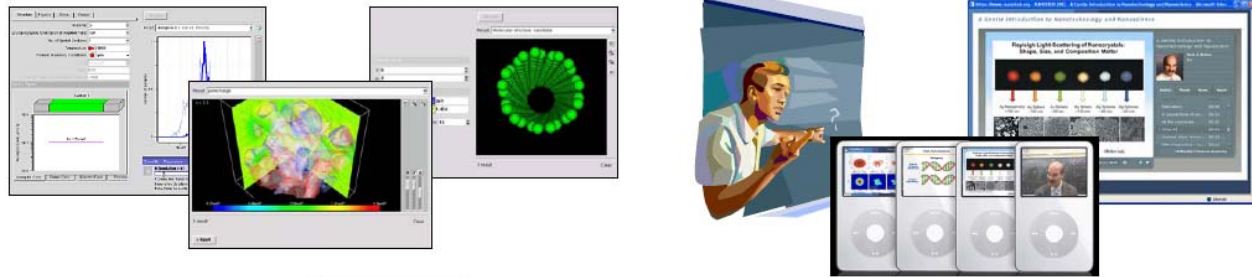
# CIEM Governance

- CIEM Co-Chairs
- CIEM Steering Committee
- CIEM Facilitator
- CIEM Technical Administrator
- CIEM Members: a diverse community of individuals and organizations that have a stake in the development and use of integrated modeling to characterize the environment and develop solutions to complex environmental challenges

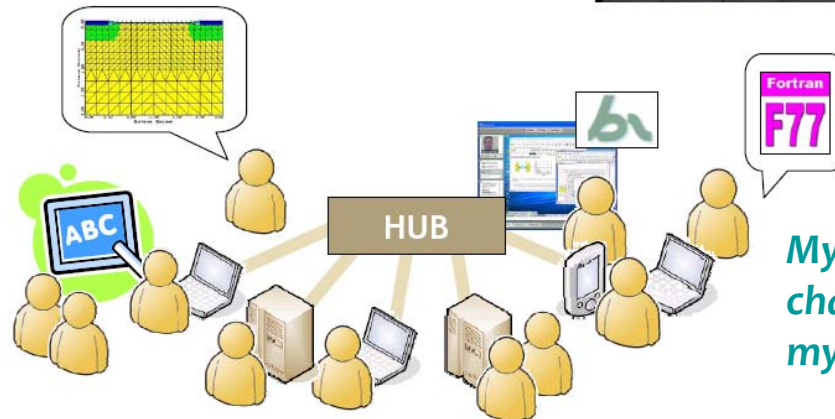
# Integrated Environmental Modeling Hub

Cyberinfrastructure = HUB

*Online simulation...*



*Dynamic and interactive, with more information and knowledge being added every day.*



*My challenge is your challenge; your solution is my solution.*

- Unique middleware for simulation and modeling
- Content management system for scientists
- Collaboration and social networking



# CIEM and IEM Hub Launch

- International Environmental Modeling and Software Society meeting 2010 (iEMSs 2010), July 5-8, 2010
  - Technical session: Integrated Modeling Technologies
  - Workshop: The Future of Science and Technology of Integrated Modeling
  - IEM Hub Workshop
  - CIEM Business Meeting



# Why Join CIEM?

- The real power CIEM will be in its ability to facilitate contributions from people in the community from all over the globe, enabling us to maximize the use of scarce resources -skilled people, time, and money.
- IEM Hub will serve the framework within which each of us can deposit our knowledge and ideas, where we can sort, summarize, digest, clarify and compare them, across distance and time.



# Join Us!

- Join the Google Group:  
<http://groups.google.com/group/commiem>
- Contribute to the Charter
- Volunteer for **CIEM** positions
- Secure further institutional sponsors/  
champions
- Become an active member of IEM Hub
- Participate in the **CIEM** sessions at iEMSs  
2010.



# Thank You!

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<http://www.epa.gov/crem>

<http://www.epa.gov/athens>