IA-IAV-ESM WORKSHOP
TOWARD MULTI-MODEL FRAMEWORKS
ADDRESSING MULTI-SECTOR DYNAMICS, RISKS, AND RESILIENCY

A Workshop of the U.S. Global Change Research Program’s Interagency Group on Integrative Modeling and Interagency Coordinating Group

May 24-26, 2016

PNNL Joint Global Change Research Institute, College Park, MD
INTERAGENCY COORDINATING GROUP
Robert Vallario, U.S. Department of Energy (ICG Chair)
Gerald Geernaert, U.S. Department of Energy (USGCRP Vice-Chair)
Gregory Anderson, National Science Foundation
Jeffrey Arnold, U.S. Army Corps of Engineers
John Balbus, National Institutes of Health
Hoyt Battey, U.S. Department of Energy
Diana Bauer, U.S. Department of Energy
Jessie Carman, National Oceanic and Atmospheric Administration
Paul Cohen, Defense Advanced Research Projects Agency
Charles Covel, U.S. Department of Homeland Security
Benjamin DeAngelo, U.S. Global Change Research Program
Anne Grambsch, U.S. Environmental Protection Agency
Fiona Horsfall, National Oceanic and Atmospheric Administration
Margaret Lange, National Geospatial-Intelligence Agency
Michael Lenihan, National Geospatial-Intelligence Agency
Jia Li, U.S. Environmental Protection Agency
James McFarland, U.S. Environmental Protection Agency
Robert O’Connor, National Science Foundation
Marilee Orr, U.S. Department of Homeland Security
Alexander Ruane, National Aeronautics and Space Administration
Ronald Sands, U.S. Department of Agriculture
*ICG Coordinator: Alison Delgado, U.S. Global Change Research Program/JGCRI-PNNL

SCIENTIFIC STEERING GROUP
Scott Backhaus, Los Alamos National Laboratory
Christopher Barrett, Virginia Tech
Budhendra Bhaduri, Oak Ridge National Laboratory
Karen Fisher-Vanden, Pennsylvania State University (Co-Chair)
Ian Kraucunas, Pacific Northwest National Laboratory
Richard Moss, Joint Global Change Research Institute, PNNL (Co-Chair)
Patrick Reed, Cornell University
Jennie Rice, Cadmus Group
Ian Sue Wing, Boston University
Claudia Tebaldi, National Center for Atmospheric Research

INTERAGENCY GROUP ON INTEGRATIVE MODELING
USGCRP’s Interagency Group on Integrative Modeling (IGIM) coordinates global change-related modeling activities across the Federal Government and provides guidance to USGCRP on modeling priorities. The 10 Federal agencies that participate in the IGIM engage on a range of relevant topics, including physical models of the Earth system, socioeconomic models of human systems and their interactions with the Earth system, and impacts models.

DAY 1 | May 24

8:00 AM - 9:00 AM
Registration and Breakfast
(Room 4058 ESSIC Lounge)

I. INTRODUCTION AND OVERVIEW OF FRAMEWORK CONCEPT
(Plenary, Room 4102)

9:00 AM: Workshop Welcome
Gerald Geernaert

9:05 AM: Welcome to the Institute
Ghassem Asrar

9:10 AM: Agenda Overview
Karen Fisher - Vanden / Richard Moss / Alison Delgado

II. MODEL FRAMEWORK CONCEPT: USER TYPOLOGIES, MODELING DOMAINS, & LEVELS OF COMPLEXITY
(Plenary, Room 4102)

Robert Vallario

9:25 AM: User Typology to Inform Framework Development
Richard Moss

9:35 AM: Overview of Classes of Models and Resources and Framework Concept
Karen Fisher-Vanden

9:50 AM: Plenary Discussion
Clarifying objectives, opportunities, and challenges of a framework for research and modeling of coupled human-environment systems in a multi-stressor world

EXAMPLE MODELS AND CAPABILITIES
Chair: Jim McFarland
(Plenary, Room 4102)

10:00 AM: Ian Kraucunas on multi-scale modeling

10:10 AM: Christopher Barrett on micro-simulation applications in human health

10:20 AM: Scott Backhaus on connected integrated infrastructure modeling

10:30 AM: Discussion

11:00 AM: Coffee Break

III. CONCENTRATED AND CONNECTED INFRASTRUCTURE
(Plenary, Room 4102)

11:30 AM: Panel: Interagency Coordinating Group (ICG) Members Introduce Example Uses
(10 minutes each)
Chair: Diana Bauer
(Example use topics are listed on page 3)

12:10 PM: Discussion

12:30 PM: Lunch
(Room 4058 ESSIC Lounge)
Breakout group co-chairs meeting in Room 3502 (30 minutes)

1:30 PM: Breakout Group Instructions
(Plenary, Room 4102)

1:45 PM: Breakout Groups
(Room numbers found in table on page 3)

DAY 1 WRAP-UP
(Plenary, Room 4102)

5:00 PM: Comments from Organizers and Participants; Review Overnight Assignment: Table of Capabilities and Models

5:30 PM: Adjourn
8:30 AM - 9:00 AM
Registration and breakfast
(Room 4058 ESSIC Lounge)

PANEL DISCUSSION: INFRASTRUCTURE BREAKOUT GROUP RESULTS
Chair: Robert O’Connor
(Plenary, Room 4102)

9:00 AM: Reports from Breakout Groups:
   Implications for Model Framework

10:00 AM: General Discussion

10:15 AM: Coffee Break

IV. DROUGHT AND INCREASED VARIABILITY OF WATER SUPPLY
(Plenary, Room 4102)

10:45 AM: Panel: ICG Members Introduce
   Example Uses (10 minutes each)
   Chair: Jessie Carman
   (Example use topics are listed on next page)

11:25 AM: Discussion

11:45 AM: Lunch
   (Room 4058 ESSIC Lounge)
   Breakout group co-chairs meeting in Room 3502 (30 minutes)

1:00 PM: Breakout Group Instructions Revisited
   (as required)
   (Plenary, Room 4102)

1:15 PM: Breakout Groups
(see room numbers in the table on the next page)

DAY 2 WRAP-UP
(Plenary, Room 4102)

4:30 PM: Comments from Organizers and Participants; Review Overnight Assignment:
   Table of Capabilities and Models

5:00 PM: Adjourn

5:00-5:30 PM: Meeting of Breakout Group Chairs, Rapporteurs, and ICG/SSG Members
   (Room 3502, JGCRI Third Floor)
## Agency Example Uses: Concentrated and Connected Infrastructure

| 1.1 Electric system reliability and demands affected by water quantity/quality | Room 4102, Plenary  
ICG co-chair: Robert Vallario  
SSG co-chair: Scott Backhaus |
|---|---|

| 1.2 Health services affected by cascading infrastructure failures and interdependencies | Room 4056, Small Conference Room  
ICG co-chair: John Balbus  
SSG co-chair: Christopher Barrett |
|---|---|

| 1.3 Coastal city inundation affected by sea level rise and extreme weather events | Room 4046, “Classroom”  
ICG co-chair: Charles Covel  
SSG co-chair: Ali Abbas |
|---|---|

| 1.4 Urban socioeconomic systems and vulnerable communities affected by heat waves and air quality events | Room 3502, JGCRI Third Floor  
ICG co-chair: Jia Li  
SSG co-chair: Jennie Rice |
|---|---|

## Agency Example Uses: Drought and Increased Variability of Water Supply

| 2.1 Reservoir resilience affected by droughts, floods, and changing extremes | Room 4102, Plenary  
ICG co-chair: Kate White  
SSG co-chair: Patrick Reed |
|---|---|

| 2.2 State economies, including agriculture, affected by drought | Room 4056, Small Conference Room  
ICG co-chair (facilitator listed first): Ronald Sands and Alexander Ruane  
SSG co-chair: Karen Fisher-Vanden |
|---|---|

| 2.3 Planning for wildfire impacts and management under changing climate, environmental, demographic, and policy futures | Room 4046, “Classroom”  
ICG co-chair: Linda Langner  
SSG co-chair: Claudia Tebaldi |
|---|---|

| 2.4 Surface water quality and ecosystem services affected by droughts, floods, and changing land use/land cover trends | Room 3502, JGCRI Third Floor  
ICG co-chair: Anne Grambsch  
SSG co-chair: Ian Kraucunas |
|---|---|
8:30 AM - 9:00 AM
Registration and breakfast
(Room 4058 ESSIC Lounge)

PANEL DISCUSSION OF DROUGHT BREAKOUT GROUP RESULTS
Chair: Benjamin DeAngelo
(Plenary, Room 4102)

9:00 AM: Reports from Breakout Groups:
Implications for Model Framework

10:00 AM: General Discussion

V. CROSS-CUTTING ISSUES

10:15 AM: Cross-cutting Breakout Group
Instructions
(Plenary, Room 4102)

10:30 AM: Coffee Break

11:00 AM: Breakout Groups on Cross-Cutting Issues (see room numbers in table on next page)

12:30 PM: Lunch
(Room 4058 ESSIC Lounge)

1:30 PM: Cross-Cutting Group Reports
Chair: Jia Li
(Plenary, Room 4102)
Report back from cross-cutting breakout sessions (10 minutes each) followed by discussion

VI. FINAL PLENARY: THE WAY FORWARD
Chair: Charles Covel
(Room 4102)

2:30 PM: Closing Panel Discussion: Final Synthesis and Next Steps
Robert Vallario, Marilee Orr, and Alexander Ruane

3:00 PM: General Discussion

3:30 PM: Close
Gerald Geernaert
<table>
<thead>
<tr>
<th>Cross-Cutting Topics</th>
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<tbody>
<tr>
<td>**Group 1 – Framework Vision (Co-Chairs: Anne Grambsch and Ian Sue Wing)</td>
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<td>Looking across the opportunities and needs identified by the different breakout groups, develop ideas for the framework’s overall vision, near term wins/advances, and long-term research needs. Consider the question, &quot;if we have this framework, what would we do with it?&quot; What science questions and scenarios could be investigated? What are some of the priority application areas that could benefit from a framework such as this?</td>
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| **Group 2 – Tools for modeling across multiple scales and sectors (Co-Chairs: Marilee Orr and John Weyant) | Room 4056, Small Conference Room** |
| Given the capabilities identified by different breakout groups, what are some of the key model development needs that must be addressed to make progress in developing the framework, e.g., coupling strategies, model hierarchies, software development, need for emulators, increased cross-scale and interdisciplinary coordination of scenarios, etc. What strategies would be effective in developing and implementing the framework (e.g., a framework wiki, periodic conferences, targeted competitions to develop components, software specifications)? |

| **Group 3 – Data: What other information do we need to gather? (Co-Chairs: Jay Hnilo and Deborah Balk) | Room 4046, “Classroom”** |
| What are some of the major opportunities and gaps with respect to data for different dimensions of the framework and different spatial/temporal scales of analysis? Is there a typology that can be used to describe data needs? What emerging approaches could we harness, for example opportunities for machine learning and data analytics? |

| **Group 4 – Model evaluation, uncertainty characterization, visualization, and decision support (Co-Chairs: Jim McFarland and Rob Lempert) | Room 3502, JGCRI Third Floor** |
| Considering the use perspectives addressed in the breakout groups, what are some of the common elements/needs related to uncertainty characterization, visualization, interfaces, scenarios, etc.? What are some of the grand challenges, for example extending probabilistic approaches for analysis of different drivers/influences, including climate change? What approaches and priorities should be established for model evaluation? |
WORKSHOP BACKGROUND & OBJECTIVES

This workshop is one of several efforts convened under the auspices of the U.S. Global Change Research Program that are intended to develop concepts for a modeling framework or architecture to couple Impacts, Adaptation and Vulnerability (IAV) models; Integrated Assessment (IA) models; and climate, Earth system, hydrology, land use, demography, and other models. The framework will facilitate integration of a wide range of model capabilities to meet a growing societal need to better understand the potential for cascading impacts of interacting societal and environmental change across sectors and scales. The workshop is being coordinated by an Interagency Coordinating Group with technical inputs from a Scientific Steering Group. The agencies that comprise the workshop’s Interagency Coordinating Group share a common interest in the scientific challenges associated with modeling the interactions of human and environmental systems to support risk management.

The workshop addresses the following challenges:

- **Systematize needs and uses**: Explore uses, scale and information dependencies associated with these uses, and specific information needs for categories of problems. Discussions at the workshop are intended to help development of a “use typology” that will identify needs to guide research and development of the framework.

- **Inventory and evaluate the state of science**: Inventory extant and emerging models and frameworks for representing and integrating key processes and interactions. This will include evaluating sector-specific IAV models (ranging from those focused on resource productivity to market interactions), IAMs, a range of approaches for characterizing changes in climate and related physical systems (e.g., hydrology, land cover), and methods for modeling socioeconomic systems and behavior. The workshop will explore data requirements, coupling strategies, mechanisms to capture impact and adaptation information that is not amenable to modeling, approaches for evaluating risk, and model evaluation.

- **Develop the conceptual framework**: Discuss a conceptual framework for research and modeling that defines data and coupling needs by identifying interactions across scales, sectors, and temporal processes essential for addressing the problems and information needs. Participants will also explore the near-term mechanisms and activities for implementation of the framework concept in ongoing and planned model development activities across the USGCRP and interested research community.

- **Identify research needs/opportunities and options for program development**: Explore needed advances in fundamental research on Earth systems, environmental, and societal processes; specialized sector-specific models; and models able to represent interactions and tradeoffs across sectors, systems, and time/spatial scales that can contribute to advancing the state of science. This will include identifying research gaps and priorities for different intended applications and user communities.

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U.S. Department of Energy
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