

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



U.S. Global Change
Research Program

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 Covell, 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
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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.

Photo Credits: Selected photos from the Third U.S. National Climate Assessment, 2014 (<http://nca2014.globalchange.gov>); U.S. Department of Energy, 2014: *The Water-Energy Nexus: Challenges and Opportunities*; U.S. Environmental Protection Agency, 2010 (<https://www.epa.gov/chesapeake-bay-tmdl>); and U.S. Global Change Research Program, 2016: *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* (<http://dx.doi.org/10.7930/JOR49NQX>).

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)

9:15 AM: IAV-IA-ESM Multi-Model Framework – Needs, Opportunities, and Context

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

DAY 2 | May 25

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 Covell
(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

Cross-Cutting Topics

Group 1 – Framework Vision (Co-Chairs: Anne Grambsch and Ian Sue Wing) | Room 4102, Plenary

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, "if we have this framework, what would we do with it?" 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?

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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