

Perspectives on IAV/IAM Interactions in Context of DOE's Integrated Assessment Research Program (IARP)

**July 27, 2010
Snowmass, CO**



U.S. DEPARTMENT OF
ENERGY

Office
of Science

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Office of Biological
and Environmental Research

The Changing Science Paradigm

Rapidly changing perspectives on climate change with climate change impacts occurring worldwide

- ***Global and national scale*** models to global, national, and ***regional and local scale*** models
- ***“What if” projections over a century*** to “what if” projections and ***quantitative predictions at significantly shorter time scales***
- ***Inquiry*** based models to inquiry and ***policy-making, planning and decision support*** models
- ***Mitigation*** studies to mitigation, ***impacts, adaptation, and vulnerability*** studies
- ***Climate*** studies to ***combined energy, environment, and economic security*** studies

Major Program Elements 2007-2009

As long-term stewards for the science, the IARP has provided core support to:

1) two of the three leading U.S. modeling teams



2) a community of practice and major international coordination venue



3) small but strategic energy and related impacts, adaptation, vulnerability (IAV) expertise (recent addition)



...and

4) competitive research solicitations (between half and one third of total IARP funds during the period)



Office of Science
Notice DE-FG01-05ER05-13

*Integrated Assessment
of Climate Change Research*

Department of Energy

Office of Science Financial Assistance Program Notice
DE-FG01-05ER05-13; Integ

AGENCY: U.S. Department

ACTION: Notice inviting gra

SUMMARY: The Office of E
Science (SC), U.S. Departmen
applications for the Integrated
funds research that contribut
research to develop and impro
importance to integrated asses
Climate Change Science Prog
increasing greenhouse gas cor

Office of Science
Financial Assistance
Funding Opportunity Announcement
DE-PS02-08ER08-18

*Basic Research and Modeling to Support Integrated
Assessment of Climate Change Impacts and Adaptations*

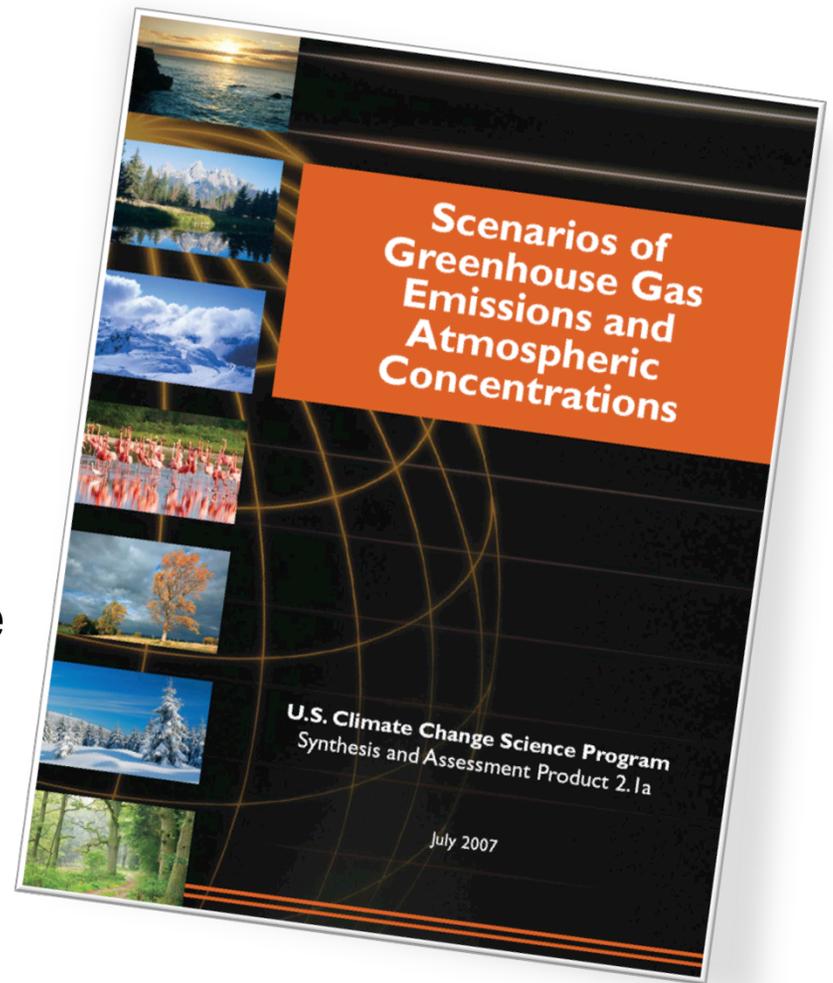
The Office of Biological and Environmental Research (BER) of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announces its interest in receiving grant applications for *basic research and modeling to support integrated assessment of climate change impacts and adaptations* under the Integrated Assessment Research Program (IARP). The IARP, located within the Climate Change Research Division (CCRD) of BER, supports the U.S. Climate Change Science Program in efforts to understand, model, and assess the complex interaction of the integrated human-natural system on climate forcing as well as the impacts to the human-natural system from climate change. Past work of the IARP has emphasized understanding and predicting anthropogenic drivers of climate change. Future work seeks to improve our scientific understanding of the impacts to human and natural systems from climate change and the potential capacity to adapt to such change. Applications are requested that advance the

- Over 20 year years, significant independent contributions to the science as well as advancing careers of many leading climate researchers
- President’s Science Advisor and Administrator of the Energy Information Administration among former PIs.

IARP is an Integral Part of U.S. Science

US Global Change Research Program

- OSTP/CEQ Task Group on Adaptation Science
- Human Contributions and Response IWG
- Modeling Building Blocks IWG
- Connections with the US Climate Change Technology Program (CCTP)
- Major scientific studies/assessments



IARP is an Integral Part of the International Science Effort

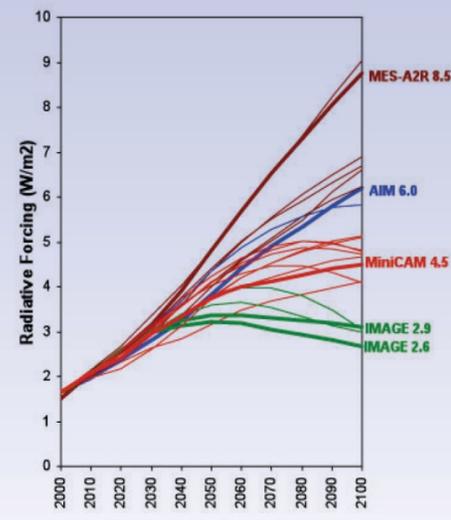
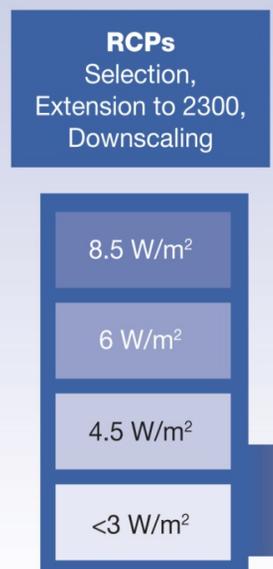
With support from IARP, U.S. Team (JGCRI) heads the RCP 4.5 modeling effort

IA Provides the Inputs to ESMs for the IPCC Fifth Assessment Report

Summary of IAM Outputs to ESMs			
Variable	Units	Spatial scale	
		Concentrations	Emissions
GHGs			
CO ₂ (fossil fuel, industrial, land-use change)	ppm and Pg/yr	Global average	Sum
CH ₄	ppb and Tg/yr	Global average	< 1° x < 1°
N ₂ O	ppb		
HFCs	ppb		
PFCs	ppb		
CFCs	ppb		
SF ₆	ppb		
Aerosols			
Sulfur (SO ₂)	Tg/yr		
Black Carbon	Tg/yr		
Organic Carbon	Tg/yr		
Chemically active gases			
CO	Tg/yr		
NO _x	Tg/yr		
VOCs	Tg/yr		
NH ₄	Tg/yr		
Land use and land cover			
CO ₂ flux (land-use change)	Tg/yr		
Land-use and land cover	Fraction		

IA is an Integral Part of the Science for the IPCC

Fifth Assessment Report Representative Concentration Pathways (RCPs)



- RCP 8.5**
>8.5 W/m² in 2100, rising
- RCP 6**
~6 W/m² at stabilization after 2100, stabilization without exceeding target
- RCP 4.5**
~4.5 W/m² at stabilization after 2100, stabilization without exceeding target
- RCP 3-PD**
<3 W/m² in 2100, peak and decline stabilization

Climate Modeling Community Develops RCP-based Ensemble Runs

Fig. 2.6. IA Provides the inputs to ESMs for the IPCC Fifth Assessment Report. The land use and land cover have greater detail than any previous set of scenarios provided. The list of GHGs and SLS is more inclusive than in previous scenarios of climate for with 1/2° x 1/2° spatial resolution. Source: Moss et al. 2008.

Pre-2007 Snapshot

- **Two DOE modeling teams focused principally on mitigation** - JGCRI and MIT
 - Long-term leadership and commitment by DOE to maintain two of three leading U.S. models (not too different than U.S. approach to climate modeling) -- a highly peer reviewed process!
- **Competitive grants focused principally on mitigation** - Awards focused on foundational research, and smaller more agile models for the same - “horses for courses”
- **Community of Practice, somewhat broader focus**
 - Snowmass, similar constraints but broader historical focus that did include impacts.

Significant Programmatic Shifts in 2007-2009 within a Flat Budget

- **Expanded IAV emphasis of two main modeling teams in IAM**, with goal of exploring the mitigation-adaptation interface.
 - E.g., energy-water-land interactions including but not limited to bio-fuels. (Not an insignificant modeling challenge).
- **New university call in 2008 on IAV for IAM**, *Basic Research and Modeling to Support Integrated Assessment of Climate Change Impacts and Adaptations*. (*Largely funded modelers in the IAV community to interact with IAMs – 100% turnover*).
- **Brought a Recognized energy and broader IAV expert from ORNL into the IAM modeling mix** to catalyze efforts of the modeling groups and to interface with the IAV community. [Former NAS CHDGC Chair, and USGRP SAP 4.5 (energy Impacts) lead author).

Significant Shifts (Contd.)

- **Launched a community based process to develop a long-term vision for the field.**

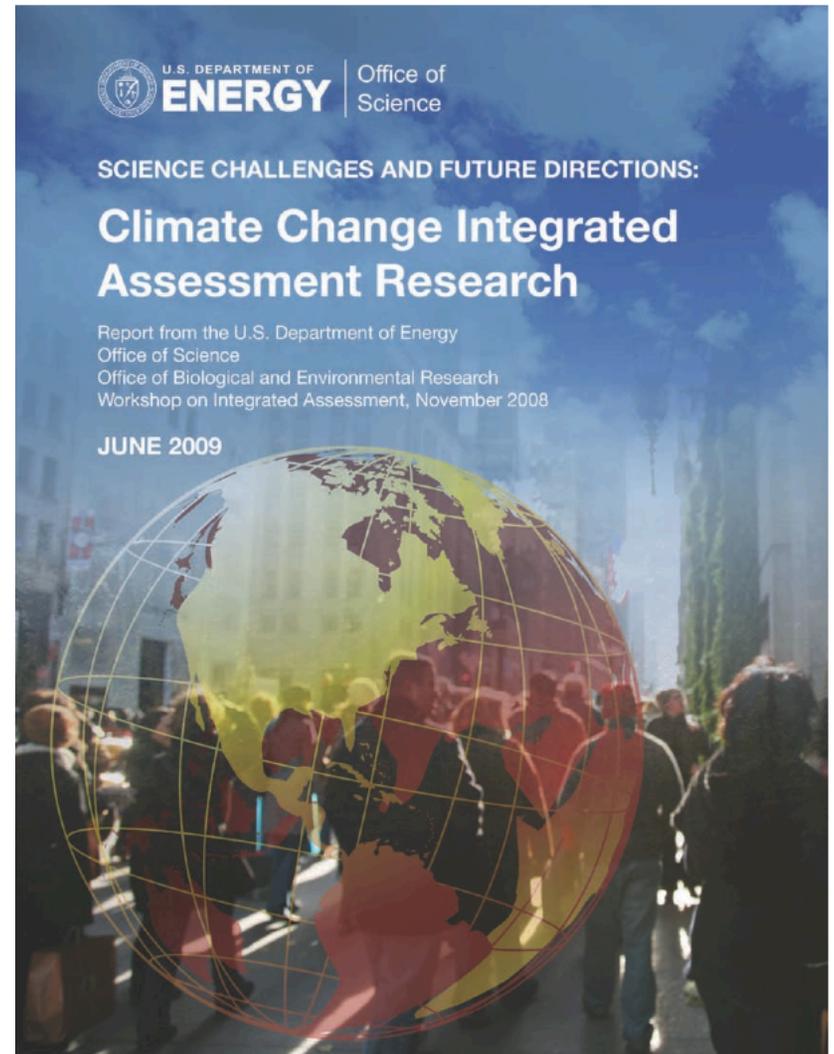
Many leading IA scientists...

Many scientists from other climate research communities...

Many agencies...

Many perspectives!

Incorporation of IAV listed as the “Grand Challenge”!



Significant Shifts (Contd.)

- **Pushed to bring water modeling expertise into the mix, supporting an international leader joining the MIT team.**
- **Expanded the community of players:**
 - 2008 Funding Opportunity Announcement – 100% turnover in PIs (nearly all from outside the traditional IA community).
 - ANL, University of Chicago, Northwestern, Univ. of Illinois Champaign co-funded workshop on uncertainty in IA – connections with G. Yohe’s strategic EMF workshops on uncertainty in IA.
 - Summer JGCRI 2007 workshop series (one focused on IAV).
 - Supported participants in IPCC RCP process and WG integration
 - Co-lead Urban IAV-IAM last year with expanded agency participation (DOE, NSF, EPA, NOAA, NASA).

In 2010, Some Really Big Moves...

Informed by the workshop general research priorities, an increase in budget from ~\$3M to ~\$9M, and a one time shot of \$4.860M for ARRA:

1. A major university 2010 FOA for IA community-wide, ***Inter-model Development, Testing, and Diagnostics***
2. A 2010 lab call for ***Regional Models for Climate Change Integrated Assessment*** (potential for one or two awards)
3. A Recovery Act (ARRA) investment in a **dedicated IA High Performance Computing System** that will **facilitate IAM, IAV, and ESM interactions; IAM movement to finer scales; and community-based modeling activities.**
 - **Computation**
 - **Networking**
 - **Large Data Repository**
 - **Visualization**



2010 Competitive University Award for Inter-model Development, Testing, and Diagnostics

\$2.2M/year over three years to winning team of Stanford, Penn State, Purdue, Yale, (and LLNL & LBNL)

(1) Advance progress on a select set of major scientific challenges in the field of Integrated Assessment that are widely recognized and confronting the major Integrated Assessment modeling teams.

(a) Science and technology.

(b) Impacts and adaptation.

(c) Regional scale integrated assessment modeling

(d) Key intersecting energy-relevant systems (e.g., energy-water-land connections) and the mitigation adaptation interface.

(e) Uncertainty

(2) Advance methods and capabilities for inter-model testing and diagnostics.

(3) Enhance capabilities for multi-model, "ensemble-like" analyses for improved insights in science studies and science-based analyses.

2010 National Laboratory Competitive Award for Regional Models for Integrated Assessment

\$1.8M/year over five years to winning team of PNNL (JGCRI) and ORNL.

- (1) Mitigation-adaptation interface.**
- (2) Energy impacts, vulnerabilities, and adaptations**
- (3) Interaction of complex climate change stressors**
- (4) System and process scale dependencies (e.g.,
nested scale approaches)**
- (5) Regional scales and multi-scale issues
- (6) Uncertainty and risk
- (7) Representative regions

2010 – Other Transformations

- Push toward **open source, community-based modeling**
- Funding to **strengthen IAM/IAV interactions and incorporate climate change impacts and adaptations for energy systems into the two leading DOE supported models (JGCRI and MIT)**, exploring some broader issues at the mitigation-adaptation interface (energy-water-land connections).
- **Improving representations of uncertainty and risk in IAMs with a dedicated Early Career Award to PI Webster**, one of a handful of highly competitive and prestigious DOE awards.
- Development of an **Integrated Earth System Model**, funded by the DOE ESM program but managed by the IARP Program Manager to explore the interface of IA and ESM and capabilities for deep dives. Jointly planned but championed (and funded) by former PM Bamzai.

2010 USGCRP and Other Interagency Activities

- USGCRP Modeling BB activity (IAM, IAV, ESM interactions)
- NRC scenarios workshop (Snowmageddon)
- Adaptation Science Working Group
- National Climate Assessment: upcoming workshops (late fall/early winter)**
 - Scenarios** - DOE lead agency, many agency participants
 - *Moss, Workshop Chair*
 - Modeling** - DOE lead agency, many agency participants
 - *Janetos and Collins, Workshop Co-Chairs*
 - Social and Economic Valuation** - EPA and DOE co-lead agencies, many agency participants
 - *Clarke & Sussman, Workshop Co-Chairs*

Final Thoughts on IAV-IAM (and ESM) Interactions:

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We believe we get it!

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We believe we get it!
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Excited to be part of this new,
emerging science!