

# Aligning Integrated Assessment Research to be Responsive to the Emerging Needs of Climate Change Decision Makers

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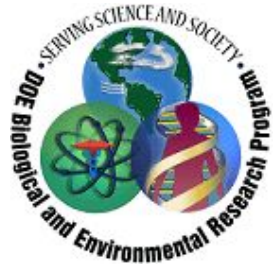
**AAAS**

**Transforming Our Ability To Predict Climate Change  
and Its Effects**

**Boston, MA**

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**Bob Vallario**



# Today's Focus

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- Start with the endpoint in mind – what are the decision makers' questions?
- Perspectives on timing
- Overview of Integrated Assessment (IA) Research
- Response of the Integrated Assessment Research Community
- Related collaborative trends by the broader climate science community
- Key future challenges for integrated assessment research

# Caveats

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- One person's perspective...and one snapshot in time.
- Seen through the lens of Integrated Assessment and strictly from the IA vantage point.
- Not intended to represent the full range of critical climate science issues and decision-making information needs.

# What are the significant questions?

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- **Impacts** – potential consequences of climate change for human and natural systems?
- **Adaptations** – capacities for human and natural systems to adapt to changes in the Earth's climate?
- **Combined human dimensions** – drivers, responses, and dynamic feedbacks?
- **Complexity of the full human-earth system** – understanding of interactions in what may be one of the most complex science modeling efforts of our time?

# What are the significant questions?...CONTINUED

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- **Geographic specificity** – regional and local implications of climate change?
- **Non-idealized behaviors** – real world departures of human systems behaviors from those predicted by strict economic science and/or market theory?
- **Role of S&T innovation** – potential role of science-driven technology innovations?
- **Context for interpreting of results** – interpreting results in light of probabilities and uncertainties?

(SAP 2.1b, Global-Change Scenarios, Their Development and Use - see <http://www.climate-science.gov/Library/sap/sap2-1/default.php>)

# And some important questions for earth systems modelers...

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- What don't we know (or what do we know) about the potential for **abrupt climate change**?
- Where is the **water** going to be relative to where we need it?
- What **extreme climate-induced events** (storms, droughts, heat-waves) can we expect and how often?

# Perspectives on timing

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- Mitigation and adaptation actions will proceed with or without more climate science.
- Good science is out there now to help decision-makers with some of the “easier” questions.
- As we pursue solutions over many decades, the right scientific answers at the right times may help avoid significant future missteps.
- Options where the technology is not fully resolved or where scientific breakthroughs are needed pose special challenges for decision makers and the integrated assessment research community.
  - Performance?
  - Costs?
  - Issues at scale?

# Perspectives on timing – CONTINUED

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- There will be time...and need...to revisit decisions., perhaps more than once, in the face of improved science and experience...some “learn as you go” will be unavoidable.
- Good news – there will be time for S&T research and new solutions to play out as they will be critical in addressing the scope and magnitude of the challenges.

(SAP 2.1a, Scenarios of Greenhouse Gas Emissions and Atmospheric Concentrations – see

<http://www.climate.gov/Library/sap/sap2-1/default.php>)

- No time to rest on our laurels – advancing the climate science and the basic research for transformational technology solutions must progress in parallel at an urgent pace.



# What is Integrated Assessment Research?

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Basic research and science-based models and tools for understanding the combined influences of human and natural systems in causing decades-to-century climate change and the possible long-term impacts from such change on human and natural systems, including the role of adaptation.

# Some History...

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**Early 1990's – basis for the Integrated Assessment Research Program (IARP) started in the Office of Science with help from the Executive Office of the President and the DOE Policy Office:**

- **considerable science expertise required**
- **science organization can bring neutral, independent perspectives to the treatment of diverse elements (e.g., research innovation and technology pathways)**
- **must maintain a science focus but deliver the needed science-based tools for decision makers**



# IARP Science Focus

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- **Competitive research grants on focused topics – many researchers, many organizations, mostly university-based.**
- **Alternative scientific approaches through two different lead modeling teams (one university, one national laboratory-university collaborative)**
- **Investments in a research community of practice and outreach to involve the broader scientific community (university-based)**
- **Focus on synthesis of human-system and earth-system sciences, typically through an economic lens**
- **Research on scenarios designed as knowledge-builders and to develop the models - NO policy studies or analyses!**

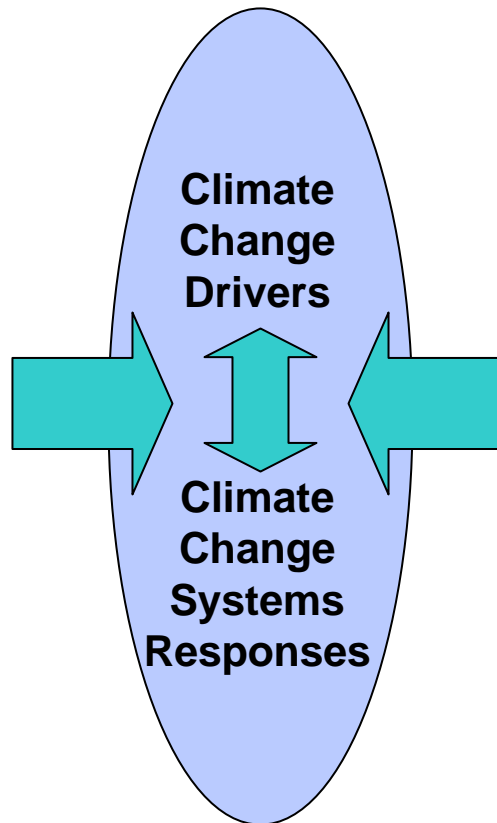
# A Convergence of Sciences

## ***Human-System Sciences***

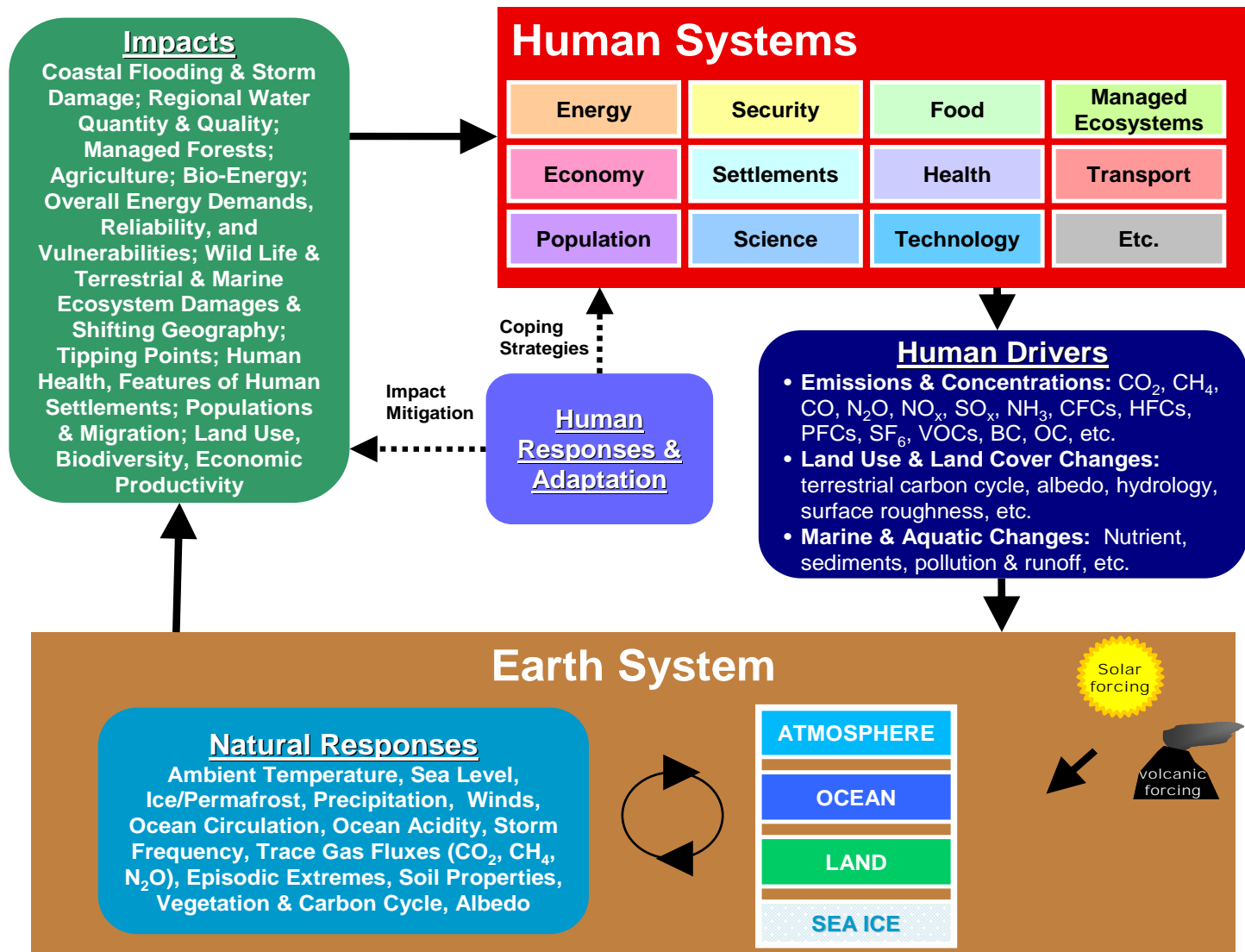
- Energy Sciences
- Industrial Science
- Genomic Science
- Environmental Science
- Economic Science
- Transportation Sciences
- Building Sciences
- Materials Science
- Coastal Eng. Sciences
- Agricultural Science
- Animal Science
- Plant Science
- Forestry Science
- Population Science
- Social Sciences
- Health Sciences
- Land Use Science
- Water Mgmt. Sciences
- Innovation Science
- Resource Mgmt. Sciences

## ***Earth-System Sciences***

- Atmospheric Sciences
- Ocean Sciences
- Biological Sciences
- Ecological Sciences
- Geological Sciences
- Meteorological Sciences
- Polar Science
- Space & Solar Sciences
- Fluid Dynamics
- Thermodynamics
- Chemistry
- Physics
- Vulcanology
- Mathematical Sciences
- Computational Sciences
- Cloud Microphysics
- Paleoclimatology
- Instrumentation Sciences
- Soil Science
- Hydrological Sciences



# Some of the Major Elements & Interactions



# Limitations

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- Understanding of climate drivers has been emphasized over understanding of potential system responses to climate change
  - A partly budget driven decision recognizing that IARP investment in impacts would be too small and narrowly defined to contribute effectively to meta-analysis
  - Until recently, impacts has been less mature and has lacked a unifying principle that allows absorption into IA models
- For mitigation, economic focus has worked well but non-monetary representations may be needed for impacts.
  - Compare with scientific support for other disciplines that contribute to IPCC

# A Strong “User” Base

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- U.S. Climate Change Science Program
- Earth Systems Modeling (ESM) and Impacts, Adaptation, and Vulnerability (IAV) Communities
- DOE Office of Science (carbon cycle and climate modeling research communities)
- Council of Economic Advisors
- Office of Management and Budget
- Energy Information Administration
- DOE leadership
- U.S Climate Change Technology Program
- DOE Applied Energy Research Programs
- EPA – recent legislative reviews and briefings for the sub-cabinet
- Congress
- State and Local Governments
- Industry
- Non-profits

# Current Themes for Integrated Assessment Research

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- **Fundamental Understanding** - Develop new knowledge and insights into the complex interactions among human and natural systems in climate change.
- **Bridging the gap** - Advance the science and tools that bridge the gap between the deepest, most complex research and models and the needs of decision-makers for agile, responsive science-based analysis tools and research insights.
- **Research Integration** - Encourage seamless connections between the IA, ESM, and IAV communities as the communities self-assemble to function as a “system of systems”. Support the other communities with key knowledge and data from IA.
- **Community of practice** - Build and maintain a general community of practice in IA basic research to accelerate developments in the field.



# Rationale for Realignment and Current Emphases

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- Independent advisory committee review of the IARP - 2007
- Snowmass '07 Annual Workshop on Integrated Assessment
- Joint Global Change Research Institute/Oak Ridge National Laboratory '07 Interagency Summer Workshop Series – impacts, adaptation, and frontiers in science
- Strategic planning for Integrated Assessment Research Program
- Innovations in international scenarios development anticipating the next round of the IPCC
- U.S. Climate Change Science Program's Interagency Working Group on Human Dimensions and Decision Support

# Current Research Emphases

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- Innovative **generic** methodologies and approaches for representing impacts and adaptations within integrated assessments
- Innovative methodologies and approaches for modeling:
  - **Energy system impacts and adaptive capacity** – e.g., energy-water connection, vulnerabilities, role of S&T
  - **Land-use**
- Probabilistic approaches and uncertainty analyses
- Inter-model comparisons
- Toward a “system of systems” - expand '07 progress on integration of the IAM, ESM and IAV communities