Program on Integrated Assessment Model Development, Diagnostics, and Intercomparison (PIAMDDI)

Annual Project Meeting
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Stanford University

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PIAMDDI

• Who are we?
  • A transdisciplinary network of researchers engaging in empirically driven research that provides valuable tools and insights to the IAM community and other global change research communities.

• What is our role in the IAM community?
  • Given the diversity and orientation of the research group, we don’t favor any one approach—in instead embracing the need for “horses for courses”
  • We strive to be a group of researchers who evaluate alternative approaches in a consistent and balanced way (i.e, we are inter-disciplinary “honest brokers”)
  • We bring together a team of researchers considered experts in their fields that serve or could serve as advisors to the IAM community
PIAMDDI

• What is our goal?
  • An overarching research goal is to improve the way feedbacks are captured in IAMs.
  • There are a number of approaches to accomplish this objective, and PIAMDDI is investigating all of them:
    (1) Direct coupling of models;
    (2) Emulators of more complex models coupled with IAMs;
    (3) Pattern scaling, dynamical downscaling, statistical emulations to be incorporated directly into IAMs;
    (4) Integration and translational tools for facilitating the flow of information across models.
  • Uncertainty quantification, model diagnostics and inter-comparison cross-cut all of these research projects
Integrated Climate Change Impacts Assessment

Water

- WBM development: (1) generalized operating rule for large reservoirs; (2) inter-basin water transfers; (3) water tracking (e.g., water use by source)

- “Downstream Impacts of Improved Irrigation Efficiency,” Danielle Grogan, Dominik Wisser, Richard Lammers, and Steve Frolking

- “Invisible water, visible impact: Groundwater use and Indian agriculture under climate change,” Zaveri, Grogan, Fisher-Vanden, Frolking, Lammers, Wrenn, Prusevich, and Nicholas

- UNH-BU collaboration soft coupling WBM variables to CGE modeling, Ian Sue Wing and Gokce Akin-Olcum.

- Combining the physically-based UNH WBM with the macro-scale Purdue University Simplified International Model of agricultural Prices Land use and the Environment (SIMPLE) to explore the interaction of supply and demand for fresh water globally. Lammers RB, Hertel T, Prusevitch A, Baldos U, Frolking S, Liu J, Grogan D.

- Empirical study of water markets as adaptive institutions in the western United States, Fisher-Vanden, Olmstead, and Rimsaite

- Empirical work on global dams as adaptive or maladaptive institutions, Olmstead, Sigman
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Integrated Climate Change Impacts Assessment

- Agriculture and Land Use

  - U.S. and global-scale projections of climate change impacts on crop yields, Sue Wing, Monier, Akin-Olcum

  - Assessing food security impacts of climate change using data from GEOSHARE, Hertel, Baldos, Villoria

  - “Commodity prices and volatility in response to anticipated climate change,” Schlenker, Tran, Lobell, Roberts, Welch

  - Public policies that inhibit adaptation by farmers: US crop insurance, Schlenker

  - Climate change-induced migration: incorporating empirical results into an IAM, Fan, Fisher-Vanden, Klaiber
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Integrated Climate Change Impacts Assessment

- Extreme events
  - “Estimating Global Damages from Sea Level Rise with the Coastal Impact and Adaptation Model (CIAM)” Delavane Diaz
  
  - Technical innovation as a form of adaptation, Popp, Miao
    - Impacts of natural disasters (floods, drought, earthquakes) on risk-mitigating technologies
    - Role of technical and tacit knowledge in reducing disaster impacts
    - Do weather shocks induce learning?
    - What factors induce state-level adaptation planning?

  - “The Geography of Extreme Heat in the USA: Assessment of CMIP5 Models over the Twentieth Century,” Schlenker, Andaloussi
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Integrated Climate Change Impacts Assessment

- **Energy**
  - “Water – CO2 Trade-offs in Electricity Generation Planning,” Mort Webster, Pearl Donohoo, and Bryan Palmintier
  - Climate change impacts on energy demand and supply, Sue Wing, de Cian
    - Constructed reduced-form estimates of the response of global fuel demand to temperature and humidity
    - Empirical estimates of response of global hydropower production to changes in runoff
  - Extensive versus intensive energy demand in response to climate change, Mansur, Sue Wing
    - Main finding: every additional day above 80 degrees increases probability of adopting A/C by 2%.
  - Advanced energy technology assessment, Benson, Leibowicz and Weyant
    - Incorporation of spatial technology diffusion in IAMs
    - IAM framework that captures oligopolistic technology markets
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Energy-Water-Land

“Exploring the interactions between water scarcity, land use and food and energy production,” Hertel, Diffenbaugh, et al.

GTAP-AEZ-BIO-W


Climate change velocity under equivalent cumulative emissions pathways, LoPresti, Davis, Charland and Diffenbaugh.
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Integrated Assessment Model Component Emulation and Downscaling

“Using atmospheric circulation patterns to detect and attribute changes in the risk of extreme climate events,” Noah Diffenbaugh.

“Improving the representation of sea-level and storm surge changes in integrated assessment and impacts, adaptation and vulnerabilities models,” Klaus Keller

“CESM connections to integrated assessment and climate impacts: sea-level rise and energy demands,” Sriver, Keller, Forest, Nicholas, and Sue Wing

“Analyzing earth system model ensembles for integrated assessment and regional impacts analysis,” Ryan Sriver and Emily Hogan

“Assessing robust uncertainty information at regional scales using the community atmospheric model (CAM) framework,” Chris Forest, Judy Tsai, Wei Li, Alexis Hoffman, Joseph Barsugli

“Hector updates and future directions,” Corinne Hartin
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Characterizing/Representing Uncertainty In IAMs

“Sequential decision making under uncertainty,” Mort Webster

“CESM connections to integrated assessment and climate impacts: sea-level rise and energy demands,” Sriver, Keller, Forest, Nicholas, and Sue Wing

“Distinguishing time-varying regional stabilization sensitivities to alternative low carbon energy pathways” Lamontagne, Reed, Link, McJeon, Clark, and Keller

“Model comparison under uncertainties project (MUP),” William Nordhaus, Ken Gillingham

“Representing uncertainty in climate impacts in integrated assessment modeling,” Delavane Diaz, Klaus Keller, and others.

“Electric sector investments under technological and policy-related uncertainties: a stochastic programming approach,” Bistline, and Weyant
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Model Diagnostics

“Diagnostics of IAM solutions — comparing RCP/SSP scenario combinations with decomposition based on history,” Ian Sue Wing And Jamie Baldwin.

“Distinguishing time-varying regional stabilization sensitivities to alternative low carbon energy pathways” Lamontagne, Reed, Link, McJeon, Clark, and Keller


“Avoiding new technology introduction biases in integrated assessment models,” Delgado, Leibowicz, Benson and Weyant

“Looking back to move forward: Evaluating global agricultural land use in integrated assessment models,” Hertel, Baldos and van der Mensbrugghe
Progress in Each Of These Areas Requires Parallel Efforts In:

• Basic research
• Research co-ordination
  – DOE PI Meetings/BERAC
  – Across multiple disciplines and team members
  – Outreach and communication accomplished through global networks
    • IAMC, WCRP, IAV, DMUU, AEA, INFORMS
    • AMPERE (EU), ADVANCE(EU), PESETA (EU), CD-LINKS (EU), LCS(Japan), LAMP (EPA-JGCRI)
    • Global disciplinary research networks, NBER, GTAP, etc.
    • US Agencies
    • EU/ROW Agencies
• Model diagnostics and validation
  – PCMDI/CMIP5/ADVANCE, etc.
  – New focus on hindcasting
• And these three types of activities need to be tightly coordinated and between the three areas
Climate impacts on agriculture: An inter-method comparison exercise

Wednesday, December 16, Stanford University—organized by Juan Carlos-Ciscar (JRC), Karen Fisher-Vanden, and John Weyant

Purpose: There are multiple methods (crop models, IAMs, econometric models, emulators) that generate similar results (e.g., temperature/precip effects on yields), but no good study has examined how these results compare, why they are different, and how they are validated to historical observations

Questions to pursue:
1. How are the results across the four methods similar and how are they different? What explains these differences? How are water resources incorporated (if at all)?
2. Who are the consumers of these studies? Which approaches are better for certain uses? How do we address downscaling and aggregation issues?
3. From this initial examination, what are some key messages that emerge?
4. Assuming the IAMs and IAVs communities are key consumers of these impact studies, how do the different methods behave empirically; i.e. is there a good empirical basis for the agricultural damage functions?
5. Is there a need to compare these results for a given set of crops and regions via a scenario protocol? Can we compare using existing studies or do new results need to be generated? Is there a need for more systematic comparison across methods for some case studies?
The End
THANK YOU