Achieving multi-sector, multi-scale impacts assessment through IAM/IAV/CM interactions:

Ideas for discussion
Ideas for Next Phase of PIAMDDI Research

A. Establish an innovative framework for developing multi-sector, multi-scale, multi-model approaches for IAV and the nexus of (IAMs, IAVs, and ESMs)

B. Build interdisciplinary first-principles foundations for couplings —through the development of coupling software, emulators, and translational tools.

C. Create a better organized multisectoral/multiregional/multimodel IAV community of practice by promoting systematic engagement between the IAM, IAV and CM communities.
A. Establish an innovative framework for developing multi-sector, multi-scale, multi-model approaches for IAV and the nexus of (IAMs, IAVs, and ESMs)

- Emphasize modularity, agility and inter-operability in multi-sector, multi-model IAV design and implementation

- Multi-sector IAVs – Develop improved multi-sector IAVs through connections with IAMs

- Use IAMs/IA as the primary organizing framework to bring these different components together and to explore scale limitations and linkage opportunities

- Incorporate IAVs in IAMs – Develop improved, innovative multi-sector, multiscale IAV representations in IAMs.
B. Build interdisciplinary first-principles foundations for couplings—through the development of coupling software, emulators, and translational tools

• An overarching research goal of PIAMDDI has been to improve the way feedbacks and interactions are captured in IAMs.

• There are a number of approaches to accomplish this objective, and PIAMDDI has been investigating all of them:
  
  (1) Direct coupling of models;
  
  (2) Emulators of more complex ESM and IAV models that can be 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 work has been cross-cutting all of these research projects.

• In addition to further development of these tools, the next phase of PIAMDDI will also emphasize the implementation of these tools, including the development of software couplers and test beds.
C. Create a better organized multisectoral/multiregional/multimodel IAV community of practice by promoting systematic engagement between the IAM, IAV and CM communities

Possibilities:

1. Status quo: use high resolution projections from climate models as inputs to sectoral impacts models and model intercomparisons (AgMIP/ISI-MIP)
2. Get global impacts info at intermediate scale from global IAMs
3. Get global impacts info at higher resolution from regional IAMs
4. Probably need some work in all three areas?
5. Our strength is currently in pathway (3) - we can also help some on others, especially as IA and not hard linked IAMing seems suitable
6. We can put all our work in an expanded version of this frame to set priorities and give IAMers and IAers a road map into what we are doing
7. Multi-stressor effects impacts all of the above in different ways (e.g., population/demographics, economics, trade, technology insertion)
Needed?: Integrated Assessment Perspective on Integrated Climate Impacts Analysis

- Multi-sector impacts may be significant (system boundaries)
  - Energy, land, water, food, climate, poverty, health, SLR, etc.
  - Could lead to significant competition, re-allocations, transfers of inputs

- Substitution of outputs could also be significant
  - General equilibrium effects (consumption, production, supply chains)
  - Transfers, inter-state commerce, international trade and aid, etc.
  - Can often ameliorate net impacts
  - But can also provide external shocks from outside regions

- Mitigation and impacts/adaptation interactions can be large
  - Land and water for biofuels squeeze agricultural/food markets
  - Climate change leads to energy supply and demand impacts

- Climate change feedbacks
  - Global earth system and back down
  - Regional

- Policy synergies
  - Land, agriculture, forest, energy, air quality, climate
  - Example includes climate change and air quality targeted policies.
What do existing efforts not address?

- **Use of high-resolution CM outputs by practitioners**
  - Does not consider intra-regional interactions and feedbacks
  - Ignores inter-regional trade/transfers/reallocations of e.g., energy, water, land
  - Ignores indirect general equilibrium effects on other economic sectors

- **Use of downscaled CM outputs by sectoral IAVers and MIPs (e.g., ISI-MIP/Ag-MIP)**
  - Does not consider intra-regional interactions and feedbacks
  - Ignores inter-regional trade/transfers/reallocations of e.g., energy, water, land
  - Ignores indirect general equilibrium effects on other economic sectors

- **Systems of full scale global earth system components**
  - Computationally intensive-not agile
  - Uses single modeling architecture

- **Critical Infrastructure Model**
  - Computationally intensive-not agile
  - Designed to study infrastructure vulnerabilities to extreme events, not earth systems transitions

- **Use of regional IAMs (e.g., PRIMA/RIAM)**
  - Computationally intensive-not agile
  - Uses single modeling architecture
  - Ignores indirect general equilibrium effects on other economic sectors