Opportunities for Integration of Remote Sensing, Integrated Assessment, and Adaptation Science

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Background

- Increasing cross-scale, cross-sector complexity of many societal-environmental interactions such as land-use/cover change, water resources, energy systems, urban systems,..

- All affected by demography, markets, security, climate, other environmental stressors, from local to global

- They can benefit from greater coordination and integration, and progress made in following four science areas during recent decades;
  - *Integrated Assessment Modeling*
  - *Vulnerability, Impacts, Adaptation Science*
  - *Remote sensing science and technology*
  - *Research on decision support*

Studying these complex systems can benefit more significantly from capabilities of these four disciplines to analyze inter-relationships, feedbacks, tradeoffs, ….

1. Facilitate greater progress on the use of remotely sensed observations to support science objectives (e.g., integrated modeling of the human-Earth systems, including IA & VIA, and decision support)
2. Identify important topics for new research projects
3. Foster an active dialogue among experts from these science disciplines, and users who will depend on the resulting information and knowledge

The ultimate goal was to identify ideas, opportunities and effective practices that enable community building, and greater progress on all three objectives.

Agenda

I: Introduction and Framing

II: Urban systems

III: Water systems

- Note: For each area, focused discussions on (i) systems perspectives and (ii) specific experiments/ projects

IV: Break-Out Groups – two approaches:
    Deep dives: urban and water
    Incubators: potential new focal areas

V: Synthesis and Lessons Learned

Developing of Potential Projects

- Interdisciplinary groups worked to define specific projects that integrate IA, VIA, RS, and DS capabilities
    - Challenge the current state of science
    - Offer potential insight for managing risks and opportunities
    - All projects are based on significant interaction of users and scientists from the participating research communities

- Next few slides describe briefly some of the proposed projects
    - All have a combination of research and "research applications" activities

Potential Projects

1. Modeling and decision support framework for evaluating urban resilience
2. Rating system for disaster risk reduction and resilience
3. Prioritizing RS needs for modeling land use/change in IAMs
4. Incorporating industry concerns and capabilities in climate resilience planning
5. Identifying enhancements to IAMs to integrate with existing models/tools and improve water resources management
6. Developing "informed intuition" among integrated modelers, remote sensing researchers, and decision makers
7. Future land and water demand for energy and agriculture in a world of 10+billion people
8. Humans, kangaroos, and cows: integrating human interactions into the natural hydrosphere to support decisions in Australia and Bangladesh
9. Leveraging RS and IA modeling to support planning infrastructure of the future in a network of cities
10. Resilience and the transformative city: from co-production of knowledge to co-design
11. Using simplified integrated models for informing developing countries national adaptation plans

Potential Projects

3. Prioritizing RS needs for modeling land use in IAMs
    - Consider both land use/cover states and drivers to improve projections in response to human and environmental systems change

5. Identifying enhancements to IAMs to integrate with existing models/tools and improve water resources management
    - Structured interviews and workshops focused on state of science and factors affecting water management to integrate cross-sector/scale dynamics in modeling and management

7. Future land and water demand for energy and agriculture in a world of 10+billion people
    - Develop more sophisticated observations/modeling approach with uncertainty analysis to explore interaction of increasing population, changing diets, extensification/intensification of agriculture under different scenarios

9. Leveraging RS and IA modeling to support planning infrastructure of the future in a network of cities
    - Develop tools that improve data on state of key conditions and effects of socioeconomic/environmental trends and choices about urban infrastructure on future urban conditions

- **Datasets development**
  - **Pre- and post-processing data for modeling and analysis at the intersection of integrated assessment modeling (IAM) and global change**
  - **Integrate remote sensing (RS), socioeconomic and other in situ data to develop multi-parameter data sets**
- **Reduced complexity modeling and analysis approaches**
  - **Simplified models for uncertainty analysis and for use by decision makers**
  - **Use RS, in situ, and extensive model-data inter-comparisons and benchmarking against full scale Earth system models**
- **Mixed complexity modeling to couple human and natural systems**
  - **Address interactions and feedbacks in human-Earth systems models**
  - **Develop methods including RS and hard/soft coupling of high resolution models of Earth and human systems, and test these capabilities for relevant cases in IA/IAV framework**
- **Urban science**
  - **Develop analyses capabilities for complex systems (e.g. urban systems), and decisions under uncertainty**
  - **Use RS, IAMs, and Earth system models to inform urbanization decisions in sustainable development, and risk/resilience decision framework**

Asrar, G. R., R. Moss, and K. L. Jacobs. 2016. Challenges and opportunities in Earth-human systems research, *AGU Eos, 97,* doi:10.1029/2016EO050919.

Downscaling global land cover projections from an integrated assessment model for use in regional analyses: results and evaluation for the US from 2005 to 2095

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➢ **GCAM landuse and landcover distribution at 5km.**
➢ **Current distribution based on satellite observation.**
➢ **Projected landuse change spatially distributed following proximity and landuse transition rules.**
➢ **Ongoing applications as input for Earth System models which do need gridded projections (e.g. IPCC).**
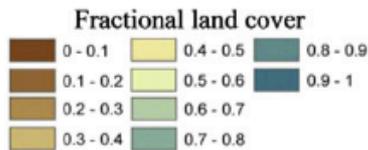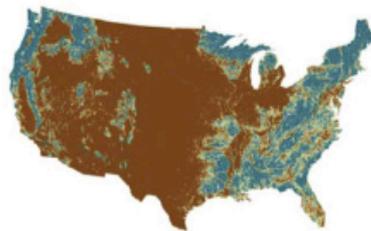➢ **Ongoing development of a global version.**
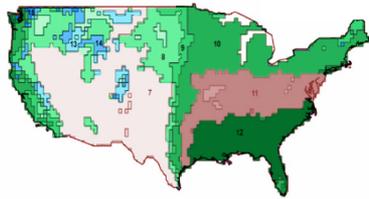
Land cover change compared to Reference 2010

Reference 2010 — 5km resolution | Reference 2090 | MP 4.5 2090 | MP 2.6 2090

Cropland / Forest

Fractional land cover: 0 - 0.1, 0.1 - 0.2, 0.2 - 0.3, 0.3 - 0.4, 0.4 - 0.5, 0.5 - 0.6, 0.6 - 0.7, 0.7 - 0.8, 0.8 - 0.9, 0.9 - 1
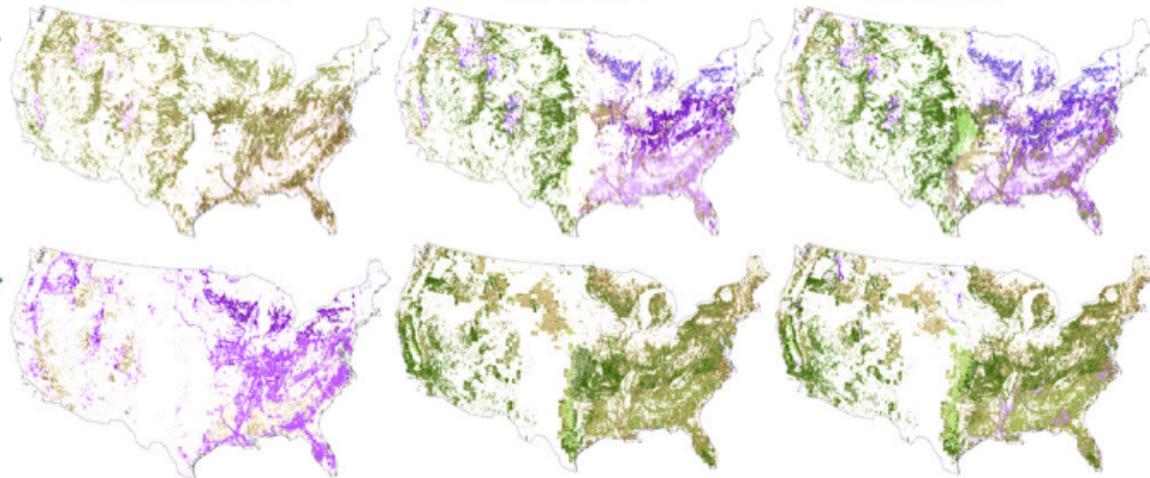
Change in fractional land cover: -1.00 - -0.50, -0.49 - -0.25, -0.24 - -0.10, -0.09 - -0.05, -0.04 - -0.01, 0, 0.01 - 0.05, 0.06 - 0.10, 0.11 - 0.25, 0.26 - 0.50, 0.51 - 1.00

Thank you.