

# The state of climate change vulnerability, impacts, and adaptation research: strengthening knowledge base and community

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It has taken about 35 years for scientists to bring the global climate change issue to the attention of the world's people and their leaders. With the Copenhagen Climate Change Conference of December 2009, it was hoped that the “issue identification” phase would segue at last into the “solution” phase. However, the outcome of COP15 shows that interdisciplinary work on impacts, adaptation, and vulnerability is still critically needed to advance the development of the solution phase.

## 1 New directions

For those involved in climate change research on vulnerabilities, impacts, and adaptation, national and subnational government policymakers are finally asking urgent questions (National Research Council 2009). In ways that are unprecedented in the several decades of history of climate change science and policymaking, concerns about vulnerabilities, impacts, and adaptation (referred to as IAV) have moved to the center of discussions of climate change, its implications, and responses. The IAV research community is now in a position of playing catch-up.

At least three other changes in the context are also emerging that compel urgency. First, observations that some physical impacts are emerging more rapidly than expected, along with observations that global greenhouse gas emissions are rising more rapidly than what has been assumed by climate change scenarios, suggests that climate change may be headed for more severe magnitudes than have been carefully

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studied and considered in policymaking. Second, there is a rising acknowledgment that increasing active collaboration among different parts of the climate change research community is needed to advance the solution phase. Third, for a community that has often been starved for research support, especially by comparison with levels of support for climate modeling, the prospects for increases in research support seem to be improving at last.

## 2 Research challenges

The IAV research community faces a major challenge in responding to these urgencies in providing timely assessments while at the same time strengthening a seriously-incomplete research base. In essence, there are parallel needs for

1. *Rapid assessments* of vulnerability, impacts, and interactive mitigation and adaptation options to meet urgent requirements as decision-makers begin to mainstream climate change into ongoing and new programs and policies; and for
2. *In-depth research* published in journals such as *Climatic Change* focused on key unknowns and uncertainties in vulnerability, impacts, mitigation, and adaptation topics.

We need to be prepared to move on the two parallel tracks of assessment and research with different organizational frameworks involving a common base of knowledge and expertise.

The urgency is even greater as we consider the very real possibility that rates and magnitudes of climate change impacts and adaptation challenges will be greater than have generally been assumed. For example, it is increasingly important to learn more about human and natural system sensitivities to changes in climatic conditions and thresholds for continued viability, including possible costs of and limits to adaptation. Especially crucial are threats to vulnerable areas and iconic species, including major changes in patterns of severe weather events and in water supply regimes.

An important aspect of the IAV research challenge is to consider cross-cutting issues regarding quality, consistency, and transparency. For instance, in many cases IAV research needs to sharpen the rigor of its analyses in regard to the clarity of its mental constructs, data, and standards of evidence. One needed activity is to organize and support model intercomparison efforts, similar to those carried out for both the Earth System Models (ESM) and Integrated Assessment Models (IAM), which can be useful tools for understanding differences and improving simulation capability. An example of such a model intercomparison project for IAV research could be to compare the performance of statistical and dynamic crop models (including their simulation of physiological CO<sub>2</sub> effects) and of world food trade models. Results of such a project would help to characterize uncertainties regarding key inflection points in future world food supply.

Another critical research challenge is the integration of research across temporal and spatial scales, sectors, and mitigation and adaptation responses. For example, climate impacts and adaptation have been understudied in urban areas, even though they are now home to about half the world's population (both rich and poor), are often vulnerable to sea-level rise, and will experience integrated impacts across multiple sectors simultaneously. Cities will be leaders in both mitigation and adap-

tation practices and programs, and are an important locus of the knowledge–action interface.

Two further points help to put this interdisciplinary research in a broader context. First, IAV is moving toward a framing paradigm of risk and risk management, as contrasted with impact projection and cost estimation. Characterization of climate risks has so far been focused primarily on monetary aspects, but risks of non-monetary and social impacts need to be much better characterized. As many audiences for climate change research are asking for more specific estimates of impacts (e.g., costs of failing to mitigate), this poses special challenges for the IAV community.

Secondly, IAV researchers emphasize that climate change impacts and responses need to be characterized in context. Climate change impacts will vary depending on development pathways, evolving socioeconomic conditions, and the presence of multiple stresses. For human and human-managed systems, projecting longer-term climate change impacts and costs is complicated by the fact that systems will be changing for other reasons as well (demographic, economic, technological, institutional), and climate change impacts depend on interactions with these other changes. Responses to climate change will occur in the context of relationships between research findings and what people and their institutions actually do, including complexities in programmatic, budgetary, and regulatory conditions that shape the implementation of strategies, policies, and actions.

### 3 Organizational needs

At the same time, and indeed as a condition for success and impact, the IAV community needs to catalyze an effective self-organization process. The goals of such a process are to improve communications both within the community and between it and other parts of the climate science effort, including but not limited to climate/earth-system and integrated assessment modeling. A particular contribution to the larger effort could be the geographic and sectoral diversity and specificity resident in the IAV community research, when the Earth System Model (ESM) and Integrated Assessment Model (IAM) researchers mainly work at more aggregated scales.

This IAV self-organizing process is in fact happening from the bottom up, catalyzed in part by the process by which the Representative Concentration Pathways (RCPs) are being developed. It has been advanced at several workshops and will be discussed at the Climate Adaptation Futures Conference in Queensland, Australia June 29 to July 1, 2010. The process has a way to go to find the network and nodal structure right for the multi-faceted constellation of researchers and institutions active in this complex field, but the need for such an organization is being recognized. These efforts deserve to be nurtured.

In closing, the interdisciplinary knowledge base and the IAV community both require strengthening. There needs to be special focus on sectors that have been particularly understudied (such as cities and settlements) and on developing regions and localities. As we move toward future assessments such as the IPCC AR5, the perspective of viewing vulnerabilities, impacts, adaptation, and mitigation as a complex risk-management challenge more fundamentally than as a long-term impact projection challenge should be deepened and developed. And community-building should continue and expand.

## Reference

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