THE NATIONAL ACADEMIES
*Advisers to the Nation on Science, Engineering, and Medicine*

*Background:*

**Abrupt Climate Change, Extreme Events, and Human Systems:**
**Modeling Consequences and Improving Understanding of Damages**

As pointed out in a number of recent high-level documents [1, 2, 3, 4, 5, 6] abrupt climate changes and extreme events may have impacts that have the potential to severely affect the physical climate system, natural systems, and human systems. There is a tendency to conflate abrupt changes with extreme events, and the terms need to be clarified. Yet, a key characteristic of these changes is that they can come faster than expected, planned, or budgeted for, forcing more reactive, rather than proactive, modes of behavior. Their effects have the potential to be extremely wide ranging, including disruption of vital ecosystem goods and services and severe effects on infrastructure, communities, human health, and national security. It is prudent to anticipate, and to better understand the complex and contingent interconnections among systems to inform choices about adapting to and reducing vulnerability. Current economic impact estimates vary in coverage of subsets of economic sectors, assumed damage functions, and discount rates; depend on a large number of assumptions; and do not account for catastrophic changes, tipping points, and many other factors. However, these incomplete estimates range from 0.2 to 2.0%; the actual losses are likely to be much greater than this but at present we have no way to produce more accurate estimates.

The number of social issues affected (for examples, land and commodity prices, taxes, zoning restrictions, regulatory frameworks, social norms of behavior, producer and export/import price indices, futures trading, drought management, wildfire risk reduction, flood preparation, etc.) is large. But, communities need information, support, and assistance to prepare for climate change impacts and improve resilience. This will require a significant improvement in current capacity to model interactions between the socio-economic system and the biophysical environment. Without formally treating the set of feedback mechanisms that make up the social system, it is not possible to evaluate alternative strategies, to trace their impacts across the coupled system, or to test the stability of the system under each potential strategy. Significant collaborative, international effort will be required to accomplish the level of integration needed.

Discussion will include identification of needs for information to support risk management and opportunities for data collection, monitoring, research, and modeling.

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[1] IPCC Special Report (2012): *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)*. http://www.ipcc-wg2.gov/SREX/

[2] IPCC 5 – WG2 (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability.* http://ipcc-wg2.gov/AR5/images/uploads/IPCC_WG2AR5_SPM_Approved.pdf

[3] National Research Council (2013). *Abrupt Impacts of Climate Change: Anticipating Surprises*. Washington, DC: The National Academies Press. http://www.nap.edu/catalog.php?record_id=18373

[4] National Research Council. (2013). *Climate and Social Stress: Implications for Security Analysis*. Washington, DC: The National Academies Press. http://www.nap.edu/catalog.php?record_id=14682

[5] PCAST. (2011). *Sustaining Environmental Capital: Protecting Society and the Economy*. http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_sustaining_environmental_capital_report.pdf

[6] The President's Climate Action Plan (2013). http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf