Using Big Data to Quantify the Economic Impacts of Climate change

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What are the likely economic impacts of climate change? Answering this question requires translating global temperature change projections into concrete, local impacts on a range of areas, including mortality, agriculture, crime, and coastal damage. Trevor Houser, Co-director of the Climate Impact Lab and Partner at Rhodium Group, explained how researchers are drawing on twenty-one climate models, assembling more than 500 terabytes of data, and using millions of hours of computer processing power to project likely climate impacts on a range of factors on a "hyper local" scale—down to the county level, in a recent analysis of the United States.

The Climate Impact Lab, which involves a collaboration between researchers from the University of Chicago, Berkeley, Rutgers, and the Rhodium Group, is using historical data to model a historical "dose-response" function for each of eight possible areas of impact: mortality, agriculture, energy, labor, conflict, crime, migration, and coastal damage, Houser explained. If temperature is the "dose," the "response" function is created for each of the eight areas, based on historical data—then these models are applied as granularly as possible (in the United States, at the county level), using current projections of likely temperature changes out to the end of the century.

This kind of highly granular analysis reveals some interesting patterns in the likely future impacts of climate change, Houser said. In a 2017 report on projected impacts of climate change on the US, economic damage projections (mostly driven by increases in heat-related deaths) showed a stark difference in impacts in the different regions of the US, with some colder states (such as Maine, and, to a lesser extent, Massachusetts) projected to experience benefits from a warmer climate, while states in the Southeast saw significant damages in most counties. Given the geographic distribution of impacts, the worst damage is anticipated in the lowest-income counties.

Currently, Houser reported, the Climate Impact Lab is working on a similar analysis at a worldwide scale, collecting historical data where it is available (the US, Mexico, Brazil, Chile, Europe, China, India, and Japan, primarily), and working to extrapolate estimates to apply to the rest of the world to come up with relationships such as a global mortality response fuction, modeling how termperature impacts mortality. Preliminary results show that the relationship between mortality and temperature varies. Rich countries see fewer deaths associated with each additional very hot day than poorer countries. Similarly, for countries that already see a significant number of very hot days, adding one more hot day is not likely to cause as many additional deaths as adding a very hot day in part of the world unused to high temperatures. By taking these "per day" relationships between outcomes and heat and multiplying them by the likely additional number of days of extreme heat per year in different parts of the globe, researchers are able to project total likely mortality costs in different regions, and for the globe as a whole, Houser explained—information that is important to calculating the social cost of carbon, Houser noted.

Worldwide, as the climate changes between now and 2100, Houser explained, the Climate Impact Lab models allow researchers to project impacts such as the deaths associated with different levels of carbon emissions, along with how much the mortality impact of climate change is likely to be offset by income growth and adaptation (such as

increased use of air conditioning). Adaptations, however, Houser noted, are “not all for free,” so the model also incorporates an estimate of the cost of adaptation. Projected changes in mortality can be translated into economic damages, with results that will vary depending on researchers’ choices about how to value additional years of life.

Houser spoke as part of the Kennedy School’s Energy Policy Seminar Series, which is sponsored by the Consortium for Energy Policy Research of the Mossavar-Rahmani Center on Business and Government.