POLICY RESPONSES TO CLIMATE CHANGE IN A DYNAMIC STOCHASTIC ECONOMY

Research Challenge
There are uncertainties in climate and economic systems. Integrated Assessment Models (IAMs) of climate and the economy are designed to analyze the impact of policy responses to climate change. We develop and solve new computational IAMs that merge spatial temperature systems, climate tipping points, economic risks, clean energy usage, regional economic activities, etc. to do economic analysis about the optimal climate policy under uncertainty and risks, and how such a policy will impact economic activities.

Methods & Codes
We developed DSICE (Dynamic Stochastic Integration of Climate and the Economy) as a computational framework for this research. There are 3 parallel packages for stochastic dynamic programming, nonlinear certainty equivalent approximation, and supergames with high parallel efficiency. They are designed to handle large-scale problems and perform well on Blue Waters.

Results & Impact
Economics integrated with climate change introduces problems with the size and complexity that justify using massively parallel systems. The Blue Waters work allows economists to solve computationally intensive problems. We have produced three papers; the first showed an 8-fold increase in social costs of carbon; the second led to a method to solve huge-dimensional stochastic problems efficiently; and the third demonstrated a new parallel algorithm to model strategic interactions among multiple constituents.

Why Blue Waters
Our parallel algorithms include frequent communications, in our master-worker structure, of small or moderate sizes. These algorithms are limited by the high latency inherent in commodity clusters to solve large problems in a reasonable amount of time. The largest problem we have solved on Blue Waters had 372 billion tasks, and Blue Waters has allowed us to solve this and similarly large calculations efficiently.