

**NSF Grant: Macroeconomics and Global Climate Change**  
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**Project Summary**

The overall purpose of this project is to study the macroeconomics of global climate change. Its specific and overarching goal is to provide a quantitative evaluation of government policies designed to reduce emissions of greenhouse gases (such as carbon dioxide) that cause global warming.

To this end, building on the pioneering work of William Nordhaus and others, this project will construct a quantitative, welfare-based dynamic macroeconomic model of the world economy which incorporates realistic interactions between economic activity and the global climate system. The project will bring to bear state-of-the-art computational methods—developed by the PI and others to study macroeconomic models with substantial heterogeneity across both consumers and firms—that have not previously been used to analyze so-called “integrated assessment” models. These methods will allow the project to incorporate many important features that are largely absent from existing models of climate-economy interactions, including: a fully micro-founded neoclassical model with which standard welfare analysis of policy can be undertaken; uncertainty about technological, climatic, meteorological, and other possible disturbances; a very large number of regions (in the thousands across the entire globe); significant region-specific detail about the nature and magnitude of economic damages caused by changes in global climate; and rich economic interactions between regions, including trade, insurance, and migration, thereby allowing regions to adapt, through standard economic market mechanisms, to changes caused by global warming.

Armed with this rich global model of economy-climate interactions, the project will evaluate quantitatively the distributional effects across different regions of the world of a variety of policies aimed at reducing greenhouse-gas emissions. These policies include taxes on carbon emissions and “cap-and-trade” systems that require firms to obtain permits to emit greenhouse gases. This policy analysis will take into account uncertainty about how the economy and the global climate interact by reporting probability distributions over the possible outcomes of various policies. In addition, it will use the tools of decision-making under uncertainty to calculate optimal settings for policy parameters. Finally, it will address the politics of climate policy by providing a quantitative assessment of the incentives for groups of regions (e.g., countries and other economic and political unions such as the European Union) to deviate from international agreements on climate-change policy.

To achieve these goals, the project will proceed in three phases: first, development of an appropriate theoretical model of the global economy along with computational tools to analyze it; second, calibration of the model’s parameters using economic, demographic, climatic, and meteorological data at a very high degree of geographic resolution; and third, detailed region-by-region quantitative analysis of the welfare effects of climate-related policies.

The **intellectual merit** of the proposed research, then, is to advance the state of the art in “integrated assessment” modelling by bringing these models into the mainstream of modern macroeconomics and by using the tools of modern macroeconomics to build richer, more complex, and more realistic models of economy-climate interactions. The **broader impact** of the proposed research is to enrich society’s understanding of the economic effects of global warming and to improve its ability to design and evaluate government policies that attempt both to reduce global warming and to ameliorate its effects on the global economy.