KlimaCampus Colloquium

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Addressing Positive Feedbacks and Impacts of Abrupt Climate Change in Actor-Based System Dynamics Integrated Assessment Models

KlimaCampus Hamburg

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Abstract

The lecture presents an actor-based system dynamics approach to modelling the coupled climate–socioeconomic system. The evolution of the modeled economy is governed by the interactions of a few key aggregated actors (a firm, household, government, bank etc.) pursuing individual, often conflicting, goals. The economy is treated as a nonlinear system described by a set of system dynamics equations closed by the specification of the actors' control strategies. As examples, a Multi-Actor Dynamic Integrated Assessment Model System (MADIAMS) and its prototype, the Structural Dynamic Economic Model (SDEM), are presented. An important feature of MADIAMS is the explicit treatment of non-equilibrium economic dynamics (i.e. supply is generally not equal to demand, and market clearing is not assumed).

Two examples of addressing topical problems of economics of climate change by actor-based system dynamics models are provided. As the first example an actor-based system dynamics Integrated Assessment model tailored to explore the effects of exhaustibility of fossil fuel resources (in the Arctic and globally) is presented to assess the potential impacts of shrinking arctic sea ice on global energy markets. The model includes a positive nonlinear feedback through which global warming and shrinking sea ice in the Arctic leads to intensification of the offshore extraction of hydrocarbons, thereby enhancing global warming even further.

As the second example, the original prototype model SDEM is extended to assess the long-term global impacts of strongly nonlinear climate change (with strongly nonlinear Weitzman climate damage function and the 4-box Atlantic thermohaline circulation module allowing for abrupt climate change) in combination with various climate mitigation strategies.