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Introduction

Integrated assessment of uncertainties in greenhouse gas emissions and their mitigation: Introduction and overview

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Abstract

This paper provides the background and the context for the analyses presented in the seven papers of this Special Issue on Integrated Assessment of Uncertainties in Greenhouse Gas Emissions and their Mitigation. First, the main topic and content of the Special Issue is given, followed by an overall overview. Second, detailed overviews and summaries of the seven papers are given. The specific analytical and methodological features and findings of each paper are highlighted and the linkages between the various papers presented in the Special Issue are provided.

1. Introduction

Climate change and possible response strategies have high scientific and policy relevance but are also associated with major controversies. The time frame of a century or more involved in any analysis of climate change, as well as, the complexity of natural and socio-economic systems and their interactions – all shrouded by deep uncertainties – pose major scientific and policy challenges. There needs to be a shared

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understanding of these challenges in order to come to grips with the possible magnitude and nature of climate change and to craft response strategies. This all makes climate change perhaps one of the most challenging issues to be addressed by interdisciplinary research and by policy measures to date. How will human drivers ranging from the realm of demographics, economics, and technology to social behavior and institutions shape future emissions of greenhouse gases (GHGs)? Are there ways of "bending down" the curve of ever increasing radiative forcing? What will be the consequences of radiative forcing change on global, regional, as well as local climates both in terms of changes in magnitude (e.g., warming, precipitation) as well as in nature (most prominently variability and possibilities of extreme events)? What will be the impacts on natural and human systems of a changing climate? Finally, what are the feasibilities, costs, and benefits (in terms of avoided impacts) of response strategies? These are some of the questions this Special Issue addresses from an integrated and interdisciplinary perspective.

There are sufficient scientific and policy reasons to justify interest in climate change and to devote a full Special Issue to this topic. However, interest in itself needs to be complemented by new analytical and methodological perspectives. The collective objective of the papers presented here is to report and document new methods and findings of the integrated assessment of climate change at the International Institute of Applied Systems Analysis (IIASA) in Laxenburg, Austria.

The main methodological approach for addressing the complex couplings of socio-economic and natural systems that characterize climate change are the so-called integrated assessment frameworks that try to capture the most important linkages and feedbacks through reduced form models of varying complexity and detail. Many readers of this journal will be familiar with this approach, which is an offspring of the "global modeling" of the 1970s in response to perceived "limits to growth". Another methodological avenue explored in climate change analysis has been to complement detailed, disciplinary models, most prominently those of coupled energy–economy systems with reduced form representations of the carbon cycle, global climate change, and its impacts. These models and the cost–benefit analytical paradigm they often employ have generated important insights and have structured much of the climate-change policy debate to date.

The approach reported in the papers of this Special Issue extends the methodological paradigm of integrated assessment models into a broader interdisciplinary integrated assessment based on coupling detailed models of energy and industrial systems, agriculture, and forests. These sectors are both the main emitters of GHGs causing potential climate change, as well as, key targets to implement response strategies.

IIASA is a unique institution in that it provides the blend of disciplinary expertise combined with an interdisciplinary research mission. On first reflection, this might appear to be sufficient for a true system analytical and integrated assessment perspective that climate change requires. Yet, it took a group of dedicated researchers from diverse and interdisciplinary fields such as demographics, technology, energy, agricultural, and forest systems to overcome the customary topical compartmentalization of collaborative research and to establish an institute-wide integrated research effort called the Greenhouse Gas Initiative. The first research results of this integrated interdisciplinary effort are presented in this Special Issue. The research mission of the Greenhouse Gas Initiative is to "link all major research programs of IIASA dealing with areas of climate change and that include both basic as well as applied, policy-relevant research, aiming to assess conditions, uncertainties, impacts as well as policy frameworks for addressing climate stabilization both from a near-term as well as long-term perspective." While in its origins and governance structure the Greenhouse Gas Initiative was a typical "grass-roots" movement, it could only blossom and evolve into a fully integrated research effort because of the support and funding from IIASA's management and governing board, the IIASA Council, which are both gratefully acknowledged here for their continued support and guidance.