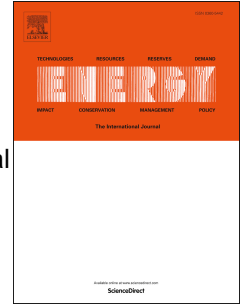


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Carbon Dioxide Emission-Intensity in Climate Projections: Comparing the Observational Record to Socio-Economic Scenarios

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Abstract

The wide spread of projected temperature changes in climate projections does not predominately originate from uncertainty across climate models; instead it is the broad range of different global socio-economic scenarios and the implied energy production that results in high uncertainty about future climate change. It is therefore important to assess the observational tracking of these scenarios. Here we compare these socio-economic scenarios created in both 1992 and 2000 against the recent observational record to investigate the coupling of economic growth and fossil-fuel CO₂ emissions. We find that global emission intensity (fossil fuel CO₂ emissions per GDP) rose in the first part of the 21st century despite all major climate projections foreseeing a decline. Proposing a method to disaggregate differences between scenarios and observations in global growth rates to country-by-country contributions, we find that the relative discrepancy was driven by unanticipated GDP growth in Asia and Eastern Europe, in particular in Russia and China. The growth of emission intensity over the 2000s highlights the relevance of unforeseen local shifts in projections on a global scale.

1 Introduction

The wide spread of projected temperature changes in climate projections does not predominately originate from uncertainty across climate models; instead it is the broad range of different global socio-economic scenarios and the implied energy production that results in high uncertainty about future climate change. While the physical-science basis of models used in Intergovernmental Panel on Climate Change (IPCC 1990-2013) reports is very much the focus of the debate in climate research (Rowlands et al. 2012), the underlying socio-economic scenarios that determine emissions of greenhouse gases have received comparably less attention. Observations over two decades are now available against which the initial sets of socio-economic scenarios underlying the IPCC reports can be assessed to study the observational tracking. Here we compare these socio-economic scenarios created in both 1992 (IS92 – see Leggett et al. 1992, Pepper et al. 1992) and 2000 (SRES – see Nakicenovic et al. 2000) against the recent observational record to investigate the coupling of economic growth and fossil-fuel CO₂ emissions. We find that global emission intensity (fossil fuel CO₂ emissions per GDP) rose in the first part of the 21st century, despite all major climate projections foreseeing a decline. Studying the differences between projections and observations we find that the relative discrepancy was driven by unanticipated GDP growth in wider Asia, particularly in Russia and China. The growth of emission intensity over the 2000s highlights the relevance of unforeseen local shifts in projections on a global scale.

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