

## **Radiative Forcing by Greenhouse Gases and its Representation in Global Models**

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The radiative effects from increased concentrations of long-lived greenhouse gases (LLGHGs) represent the most significant and best understood anthropogenic forcing of the climate system. The most comprehensive tools for simulating past and future climates influenced by LLGHGs are fully coupled atmosphere-ocean general circulation models (AOGCMs). Because of the importance of LLGHGs as forcing agents, it is essential that AOGCMs compute the radiative forcing by these gases as accurately as possible. The fidelity of an ensemble of AOGCM calculations has been evaluated as part of the current climate assessment by the Intergovernmental Panel on Climate Change (IPCC). Several lines of evidence from this evaluation indicate that there are substantial discrepancies among the AOGCMs in the ensemble and between the AOGCMs and reference line-by-line (LBL) codes. In some cases this is because the AOGCMs neglect particular absorbers, while in others it is due to the methods for modeling the radiative processes. These differences have important implications for interpreting variations in forcing and response across the multi-model ensemble of AOGCM simulations assembled for the IPCC fourth assessment report (AR4). We conclude by presenting new mathematical methods for improving the accuracy of the radiative parameterizations in global models.