

# Appendix 2

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## Radiative Forcing and Global Warming

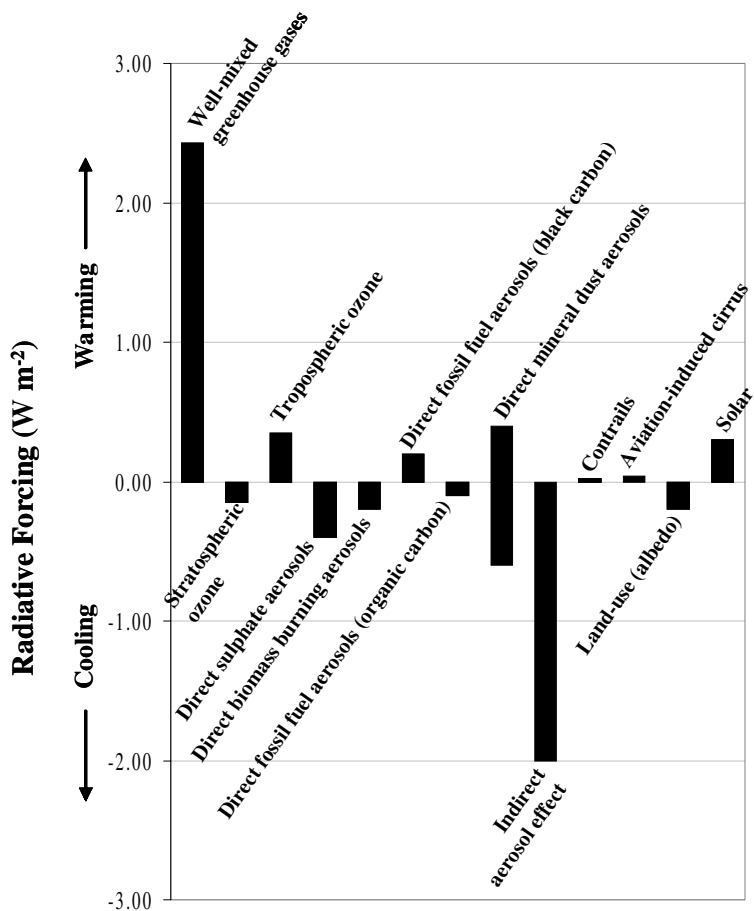
Climate change results from natural internal processes and from external forcings. Both are affected by persistent changes in the composition of the atmosphere brought about by changes in land use, release of contaminants, and other human activities. Radiative forcing (see pages 269–270) is the change in the net vertical irradiance within the atmosphere. Radiative forcing is often calculated after allowing for stratospheric temperatures to readjust to radiative equilibrium, while holding all tropospheric properties fixed at their unperturbed values. Commonly, radiative forcing is considered to be the extent to which injecting a unit of a greenhouse gas into the atmosphere changes global average temperature, but other factors can affect forcing, as shown in Figure A2.1.

The International Panel on Climate Change (IPCC) has applied a “level of scientific understanding” (LOSU) index is accorded to each forcing (see Table A2.1). This represents the Panel’s subjective judgment about the reliability of the forcing estimate, involving factors such as the assumptions necessary to evaluate the forcing, the degree of knowledge of the physical/chemical mechanisms determining the forcing, and the uncertainties surrounding the quantitative estimate of the forcing. The relative contribution of the principal well-mixed greenhouse gases is shown in Figure A2.2.

For more information, see

IPCC, 1996, *Climate Change 1995: The Science of Climate Change*. Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T., L.G. Meira Filho, B.A. Callander, N. Harris, A. Kattenberg, and K. Maskell (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY.

IPCC, 1996, *Climate Change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses*. Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change [Watson, R.T., M.C. Zinyowera, and R.H. Moss (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY.

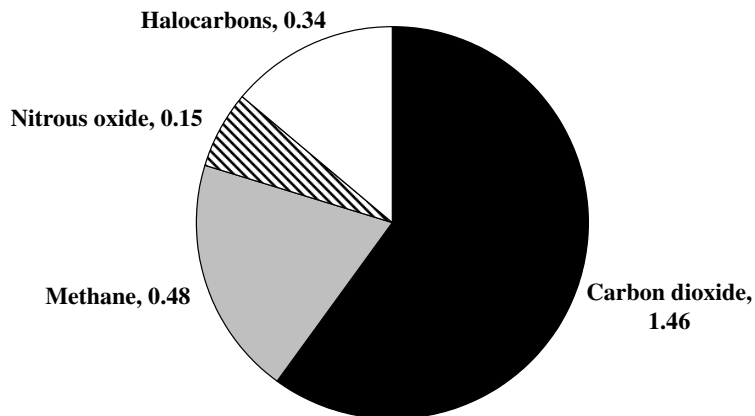


**Figure A2.1** The global mean radiative forcing (watts per square meter,  $\text{W m}^{-2}$ ) of the climate system for the year 2000, relative to 1750. Data from IPCC, *Climate Change 2001: The Scientific Basis*, Chapter 6—Radiative Forcing of Climate Change, 2001.

**Table A2.1** Level of Scientific Understanding (LOSU) of Radiative Forcings

Forcing Phenomenon	LOSU
Well-mixed greenhouse gases	High
Stratospheric ozone	Medium
Tropospheric ozone	Medium
Direct sulphate aerosols	Low
Direct biomass burning aerosols	Very low
Direct fossil fuel aerosols (black carbon)	Very low
Direct fossil fuel aerosols (organic carbon)	Very low
Direct mineral dust aerosols	Very low
Indirect aerosol effect	Very low
Contrails	Very low
Aviation-induced cirrus	Very low
Land-use (albedo)	Very low
Solar	Very low

Source: IPCC, *Climate Change 2001: The Scientific Basis*, Chapter 6—Radiative Forcing of Climate Change, 2001.



**Figure A2.2** Relative contribution of well-mixed greenhouse gases to the  $+2.43 \text{ W m}^{-2}$  radiative forcing shown in Figure A2.1. Data from IPCC, *Climate Change 2001: The Scientific Basis*, Chapter 6—Radiative Forcing of Climate Change, 2001.