

20 FEBRUARY 2002 : RADIATIVE FORCING OF CLIMATE CHANGE

Prof K Shine, University of Reading - How good is radiative forcing as an indicator of climate change? - k.p.shine@reading.ac.uk

Radiative forcing is a measure of the perturbation of the planetary radiation budget following a change in, for example, carbon dioxide concentration. It provides a useful first-order estimate of the importance of a climate change mechanism and has been used as such for about 15 years. More recently, it has begun to be used in a 'legislative framework' as it underpins the use of Global Warming Potential (GWP); the GWP is used within the Kyoto Protocol to allow countries to intercompare emissions of different greenhouse gases. The validity of the concept of radiative forcing is dependent on there being a well-defined relationship between radiative forcing and 'climate change' (here defined as the global mean temperature change). This talk will introduce the concept of radiative forcing and examine the extent to which such a well-defined relationship is believed to exist, by presenting results from a recent comparison of results from three different general circulation models.

Dr P Forster, University of Reading - Radiative Forcing from Stratospheric Ozone and Stratospheric Water Vapour Changes - piers@met.rdg.ac.uk

This talk will present my own work since the IPCC third assessment report. I will begin by discussing some of the difficulties in the calculation of radiative forcing for stratospheric ozone and water vapour changes. Subsequently, using ozonesonde data, I will show that approximately 50% of the Northern Hemisphere stratospheric ozone radiative forcing is associated with dynamical movement of the ozone profile. Further, using data collected as part of a recent stratospheric water vapour assessment exercise, I will show that increases in stratospheric water vapour over the last 40 years may have had a very large positive radiative forcing – comparable in magnitude to the CO₂ radiative forcing. I will also discuss whether this stratospheric water vapour trend ought to be thought of in terms of a radiative forcing or climate feedback.

Dr J Haywood, Met Office - Direct radiative forcing by tropospheric aerosols - jim.haywood@metoffice.com

While the radiative forcing due to well-mixed greenhouse gases have a high 'Level of Scientific understanding' (LOSU) attached to them in IPCC (2001), the direct radiative forcing due to various different aerosol species continues to be poorly quantified with 4 out of the 5 anthropogenic aerosol components having a very low LOSU. This talk will explain why the radiative forcing due to aerosols continues to be a major uncertainty in climate modelling scenarios (both past and future), and looks at recent modelling and measurement advances made since IPCC (2001) that will help reduce this uncertainty in the future.

Dr O Boucher, University of Lille - Indirect radiative forcing by tropospheric aerosols and aircraft emissions - boucher@loa.univ-lille.fr

The definition of the aerosol first and second indirect effects will be introduced. We will then summarize the in-situ and remote observations supporting the existence of the first and second indirect effects. A compilation of the global-scale modelling studies dealing with the aerosol indirect effects will be presented. We will explain the reasons behind the broad range 0 to -2 Wm⁻² given by the IPCC for the first aerosol indirect effect. Beyond the IPCC Third Assessment Report, the most recent studies and the role of aerosols vis-à-vis the hydrological cycle will be discussed.

Dr R Betts, Hadley Centre, Met Office - Radiative Forcing by changes in vegetation cover - richard.betts@metoffice.com

The albedo of the land surface depends strongly on vegetation cover, particularly in snowy conditions when the albedo of forests is much lower than that of open land. Removal of the mid-latitude forests over the last few hundred years has therefore led to a negative radiative forcing, and this talk presents current estimates of the magnitude of this forcing. Climate change mitigation plans include the plantation of forests as carbon sinks, but this could lead to a positive radiative forcing through reduced surface albedo - comparison of CO₂ and albedo forcings by forestation is presented. Future deforestation seems likely to be concentrated in the tropics, and the problem of comparing this with other climate forcings will be discussed.

Prof J Haigh, University of London - Solar radiative forcing of climate change - j.haigh@i.c.ac.uk

Variations in solar irradiance indubitably provide a radiative forcing of climate. However, there are uncertainties in quantifying this due to inaccuracies in the measurement of total solar irradiance over a sufficiently long time period and a lack of knowledge of the spectral composition of the variation. Furthermore changes in solar spectral irradiance affect photochemical dissociation rates and thus atmospheric composition, particularly stratospheric ozone, thereby providing a potential feedback on the direct radiative forcing. Another proposed feedback mechanism involves the production of cloud condensation nuclei through cosmic ray ionisation during periods of lower solar activity. Each of these effects will be discussed.