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Modelling the impact of diffuse light changes on the land carbon sink

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Various theoretical, experimental and modeling studies indicate that photosynthesis can increase with the diffuse fraction of the solar irradiance (Gu et al.2003, Roderick et al. 2001, Farquhar and Roderick 2003). It has even been suggested that the decrease in the atmospheric [CO_2] growth-rate after the eruption of Mount Pinatubo in 1991, was caused by such an enhancement of photosynthetic uptake as volcanic aerosols scattered the incoming sunlight to produce a higher diffuse fraction (Roderick et al.2001, Gu et al, 2003).

In order to assess this hypothesis, we have implemented an improved plant canopy radiation scheme within the JULES land-surface model (as used in the Hadley Centre GCMs). The scheme distinguishes between the absorption of direct and diffuse radiation, and between sunlit and shaded leaves. The improved JULES was applied in a global gridded-simulation of the land carbon sink for the period 1980 to 2000. In this talk, we will describe the resulting simulation of the land carbon cycle through the Pinatubo event, and diagnose the impact that changes in diffuse radiation had on the atmospheric [CO_2] growth-rate. We will also discuss the implications of these results for the future land carbon-sink, under likely changes in the atmospheric aerosol loading.