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Impact of Changes in Diffuse Radiation on the Global Land Carbon Sink, 1901-2100

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Recent observational and theoretical studies have shown that changes in surface radiation that lead to increasing diffuse surface irradiance, enhance plant photosynthesis (Gu et al., 2003, Niyogi et al., 2004, Oliveira et al., 2007, Roderick et al., 2001). Solar radiation reaching the land surface has changed over the industrial era due to aerosols emitted from volcanoes and various anthropogenic sources (Kvalevag and Myhre, 2007). Such changes in total surface radiation are accompanied by changes in direct and diffuse surface solar radiation. Current global climate-carbon models do include the effects of changes in total surface radiation on the land biosphere but neglect the positive effects of increasing diffuse fraction on plant photosynthesis. In this study we estimate for the first time, the impact of variations in diffuse fraction on the land carbon sink using a global model (Mercado et al., 2007) modified to account for the effects of variations in both direct and diffuse radiation on canopy photosynthesis. We use meteorological forcing from the Climate Research Unit Data set. Additionally short wave and photosynthetic active radiation are reconstructed from the Hadley centre climate model, which accounts for the scattering and absorption of light by tropospheric and stratospheric aerosols and change in cloud properties due to indirect aerosol effects.

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