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Methane's Global Mean Near-Infrared Radiative Forcing

Rachael Byrom and Keith Shine

Department of Meteorology, University of Reading, United Kingdom (rachael.byrom@pgr.reading.ac.uk)

Methane (CH_4) is a potent greenhouse gas. Its ability to effectively alter fluxes of thermal infrared radiation emitted and absorbed by the Earth's surface and atmosphere has been well studied. CH_4 also absorbs incoming shortwave radiation at near-infrared (NIR) wavelengths (0.7 – 4 μm). Currently this effect is not included in the Intergovernmental Panel on Climate Change estimates of CH_4 radiative forcing (RF).

Recent studies indicate that this NIR effect serves to enhance methane's overall RF and its related emission metrics, but is dependent on the specification of clouds and the spectral overlap with water vapour. These studies did not examine the impact of the NIR on the spatial or seasonal variation of methane's longwave adjusted RF – a detailed quantification of this is necessary.

Here a narrow-band radiative transfer model is used to generate methane's global-mean all-sky NIR instantaneous and longwave-adjusted RF at a monthly-mean 5° x 5° spatial resolution. Methane's instantaneous global-mean NIR RF is shown to be positive due to the upward scattering of NIR radiation by clouds and hence increased tropospheric absorption. The inclusion of NIR bands also serves to increase methane's longwave-adjusted forcing due to the direct warming of the stratosphere, enhancing the impact of the inclusion of NIR bands in methane's overall RF. The first spatially resolved estimates of the impact of the NIR on methane's longwave adjusted RF are also presented.