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How do rain drops affect atmospheric radiative fluxes and heating rates?

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General circulation model (GCM) radiation schemes are becoming increasingly sophisticated; the treatment of clouds has become more refined while the number of gases and aerosol species that are represented continues to rise. However, all GCMs continue to ignore the radiative effect of precipitating liquid water (rain). The resulting biases are expected to be small, but they have yet to be quantified. This study aims to provide a first estimate of how rain affects the atmospheric radiation budget at a range of temporal and spatial scales. This is a necessary first step towards determining whether GCM radiation schemes should include rain.

We define the rain radiative effect here as the difference between radiative fluxes calculated with and without rain. We perform calculations using the SOCRATES (Suite Of Community Radiative Transfer codes based on Edwards-Slingo) radiative tranfser scheme. Input atmospheric profiles are taken from two weeks (one week during boreal winter and the other during boreal summer) of a Goddard multiscale modelling framework (MMF) simulation.

Based on these calculations, we shall quantify and explain how rain affects the transfer of radiation through the atmosphere and thus radiative heating rates and fluxes at both the surface and top of atmosphere.