Radiative transfer in atmospheres with large aerosols

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Cloudy / hazy atmospheres are ubiquitous both in and beyond the Solar System, which motivates a deeper understanding of radiative transfer in the presence of aerosols. In our Solar System, geomorphic evidence points to the presence of liquid water on the surface of early Mars. A favoured explanation was the presence of carbon-dioxide ice clouds in the early Martian climate (cf. Forget & Pierrehumbert 1997), but this was later shown to be an artefact of using simplified (two-stream) radiative transfer, which overestimated the scattering greenhouse effect by about 50 K. Here, I present recent work on generalising the two-stream radiative transfer technique, such that it is capable of accurately handling the presence of medium-sized and large aerosols. This novel method retains the computational simplicity of a two-stream method, but has the accuracy of a 32-stream method, which allows for its easy inclusion in exoplanet models that aim to explore a large parameter space. It is also ripe for inclusion in three-dimensional GCMs.

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