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# Impact of light scattering by aerosols on the present-day climate of Mars

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About 40 years ago, Gierasch et al. (1972) demonstrated that the thermal structure of the Martian atmosphere cannot be accounted for by a single CO2 atmosphere, without the contribution of atmospheric dust. Dust is, indeed, the main driver of Martian climate, and its radiative properties have to be known in details to accurately predict heating rates in a Mars Global Climate Model (GCM). It is only over the last decade that research has demonstrated the other fundamental role played by water-ice clouds in shaping the thermal structure of the red planet. Even more fundamental may have been the radiative effect of dust and water ice clouds over the last hundreds of millions of years (Late Amazonian), when Mars has gone into ice ages and aerosol cover has been much thicker than today. Also, scattering by CO2 ice clouds may have been essential to warm the early martian environment, but this is well beyond our scope here.

In order to further understand the impact of aerosols on the martian climate, we thus implement a new aerosol scattering scheme in the Mars LMD (Laboratoire de Météorologie Dynamique) GCM.

First, the dust radiative properties are updated with the new Wolff et al. (2009) dataset, who used simultaneous observations of dust both from the surface (MERs) and from space (MGS and MRO), and by instruments having similar spectral windows, to derive the dust refractive index over the entire solar and infrared region.

Then, the interactions between microphysics, dynamics and light scattering by cloud particles of different sizes are modeled. For this, the water ice refractive index of Warren et al. (1984) is used to generate the single scattering parameters of various ice particle sizes. After storing these scattering parameters in a look-up table, we fully connect, in the GCM, the size distributions predicted by the cloud microphysics to the radiative transfer scheme. This is done through an on-line integration, in each grid-box, of the scattering parameters of the look-up table over the size distribution predicted by the microphysical scheme. Consequently, a three dimensional scattering parameter field is now evolving as clouds form, resulting in model instabilities that we are currently trying to tackle.

Present-day results are validated through a comparison with the reanalysis derived from TES temperature retrievals using the UK/MGCM. The use of the new Wolff et al. radiative properties results in a good thermal structure, while being at the same time consistent with the observed visible and infrared opacities. This was not the case for previous radiative properties and versions of the model. Finally, radiative effect of water-ice clouds and possible sources of remaining discrepancies are discussed.