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Modelling the direct effect of aerosols on near-infrared solar radiation on a global scale

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Usually, the direct effect of aerosols is considered in the ultraviolet and visible solar spectra, since it is stronger at the small wavelengths. Nevertheless, in terms of energetics and climate, this effect can also be important at larger wavelengths, especially in the near infrared, for coarse aerosol particles. In this study, the global distribution of mean monthly direct aerosol radiative forcing in the near infrared (NIR), between 0.85 – 5 μm, under all-sky conditions, was computed with a deterministic atmospheric spectral radiative transfer model, considering an absorbing/multiple scattering atmosphere, that uses comprehensive climatological data. The aerosol forcing was computed at the top of the atmosphere (TOA), within the atmosphere and at the Earth's surface for winter and summer conditions. The aerosol data were taken from the Global Aerosol Data Set (GADS), given for various fixed relative humidity values and for 15 wavelengths within the near-IR range, both for natural and anthropogenic aerosols. Global distributions of spectral aerosol optical thickness (AOT), single scattering albedo (ω_{aer}) and asymmetry parameter (g_{aer}), required by the model, were then computed for actual relative humidity values within the aerosol layer, based on atmospheric humidity and temperature profiles. Global distribution of cloud cover was included by using 10-year (1985-1995) data from NASA-Langley dataset, for low, middle and high-level clouds, for each month. Supplementary 10-year climatological data for surface and atmospheric parameters were also taken from NASA-Langley. The geographical variation of aerosol optical properties and radiative forcings were investigated for summer and winter, and global and hemispherical averages were computed. The results of our study show that the near-IR aerosol forcing is smaller than

that in the ultraviolet and visible, but it is still substantial over world regions characterized primarily by emission and transport of dust aerosols and secondarily by coarse sea-salt particles. The largest aerosol forcing values are found at the Earth's surface, where aerosols induce a cooling effect, while there is a smaller aerosol induced warming of the atmosphere. Though aerosols mostly cool our planet in the near-IR, over specific areas they can also produce a slight warming effect.