Atmospheric Chemistry and Physics An Interactive Open Access Journal of the European Geosciences Union

Data Set (GADS) N. Hatzianastassiou^{1,2}, C. Matsoukas^{2,3}, E. Drakakis^{2,5}, P. W. Stackhouse Jr.⁶, P. Koepke⁷, A. Fotiadi^{2,4}, K. G. Pavlakis^{2,8}, and I. Vardavas^{2,4} Ioannina, Greece ²Foundation for Research and Technology-Hellas, Heraklion, Crete, Greece ³Department of Environment, University of the Aegean, Mytilene, Greece ⁴Department of Physics, University of Crete, Crete, Greece ⁵Department of Electrical Engineering, Technological Educational Institute of Crete, Heraklion, Greece ⁶Atmospheric Sciences, NASA Langley Research Center, Hampton, Virginia, USA ⁷Meteorological Institute, University of Munich, Munich, Germany ⁸Department of General Applied Science, Technological Educational Institute of Crete, Heraklion, Greece Abstract. A global estimate of the seasonal direct radiative effect (DRE) of natural plus anthropogenic aerosols on solar radiation under all-sky are obtained with detailed spectral model computations separating the ultraviolet (UV), visible and near-infrared wavelengths. The global distribution of spectral aerosol optical properties was taken from GADS and surface albedo were taken from various satellite and reanalysis at the top of atmosphere (TOA, ΔF_{TOA}) is -1.62 W m⁻² (with a range of effect on the atmospheric absorption of SW radiation (ΔF_{atmab}) is 1.6 W the effect on the surface downward and absorbed SW radiation ($\Delta F_{surf'}$ 13% at the local scale, whereas on planetary scale the result is an

Both these effects, which can significantly modify atmospheric dynamics and the hydrological cycle, can produce significant planetary cooling on a surfaces. The aerosol DRE at the Earth's surface compared to TOA can be

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The direct effect of aerosols on solar radiation based on satellite observations, reanalysis datasets, and spectral aerosol optical properties from Global Aerosol

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conditions is obtained by combining satellite measurements and reanalysis data with a spectral radiative transfer model and spectral aerosol optical properties taken from the Global Aerosol Data Set (GADS). The estimates whereas data for clouds, water vapour, ozone, carbon dioxide, methane datasets. Using these aerosol properties and other related variables, we generate climatological (for the 12-year period 1984–1995) monthly mean aerosol DREs. The global annual mean DRE on the outgoing SW radiation -15 to 10 W m⁻², negative values corresponding to planetary cooling), the m^{-2} (values up to 35 W m^{-2} , corresponding to atmospheric warming), and and $\Delta F_{\text{surfnet}}$, respectively) is -3.93 and -3.22 W m⁻² (values up to -45 and $-35 \text{ W} \text{ m}^{-2}$, respectively, corresponding to surface cooling). According to our results, aerosols decrease/increase the planetary albedo by -3 to increase of 1.5%. Aerosols can warm locally the atmosphere by up to 0.98 K day⁻¹, whereas they can cool the Earth's surface by up to -2.9 K day⁻¹. regional scale, although planetary warming can arise over highly reflecting

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up to 15 times larger at the local scale. The largest aerosol DRE takes place in the northern hemisphere both at the surface and the atmosphere, arising mainly at ultraviolet and visible wavelengths.

■ <u>Final Revised Paper</u> (PDF, 1239 KB) ■ <u>Discussion Paper</u> (ACPD)

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