Supplementary Material for *Dust radiative forcing in CMIP6 Earth System models: insights from the AerChemMIP piClim-2xdust experiment*

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Supplementary Figures

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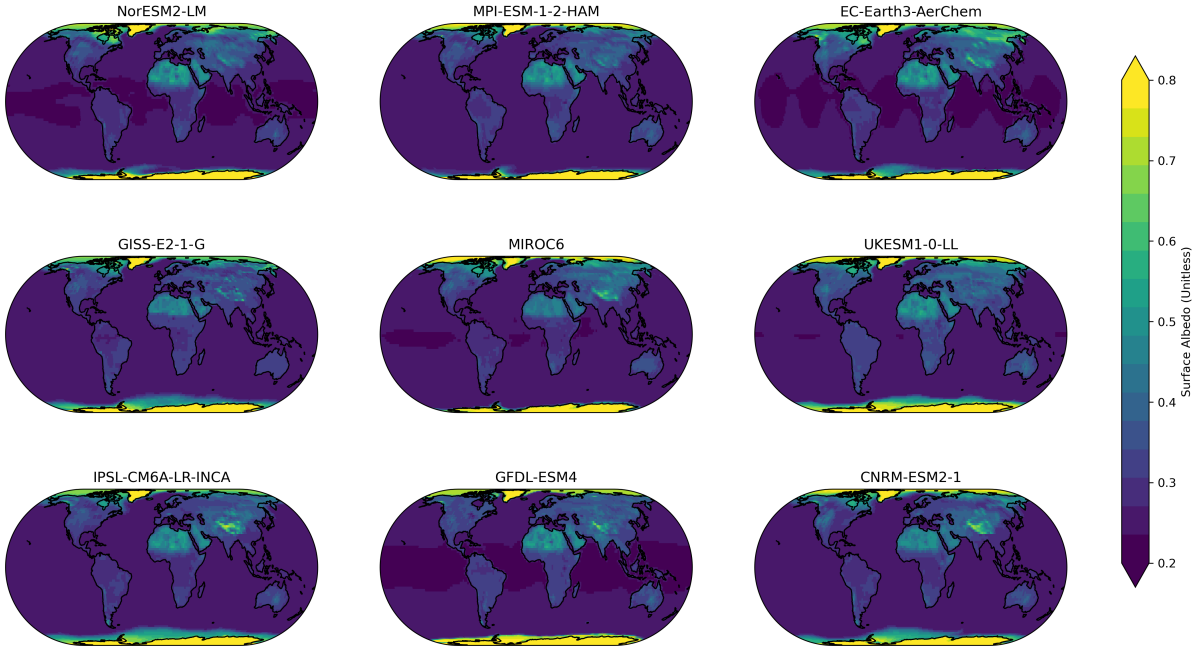

Figure S1: Map of Surface albedo (unitless) for each the nine AerChemMIP models used.

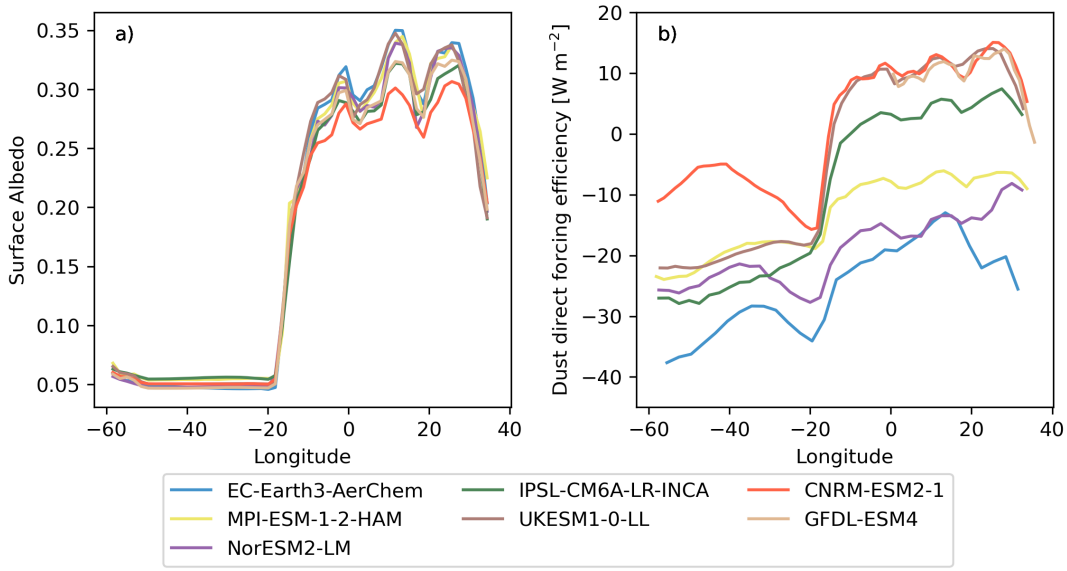

Figure S2: **(a)** Surface albedo and **(b)** dust direct forcing efficiency per unit of AOD averaged between 5°– 31°North. In the zonal extent of the area include the Sahara (high albedo desert) and North Atlantic (low albedo ocean).

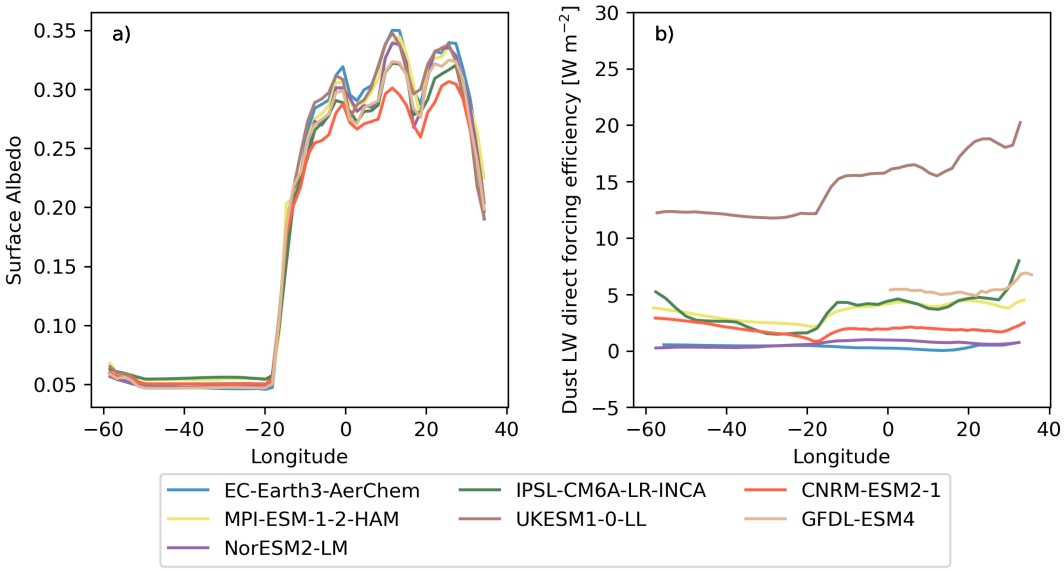

Figure S3: As Figure S1, except showing the longwave direct forcing efficiency only.

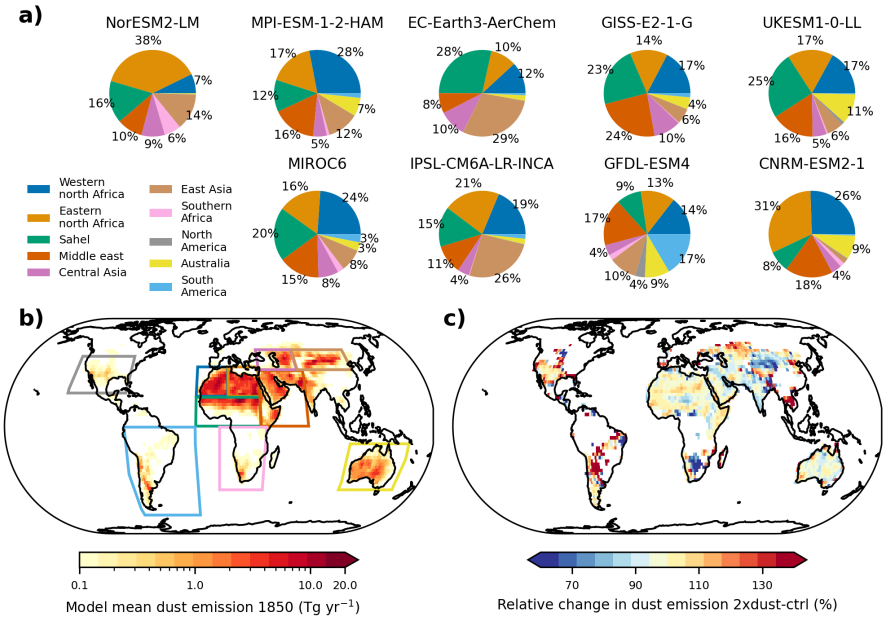

Figure S4: **(a)** The relative change from *piClim-control* in dust emission from different dust emitting regions the regional extent of each region is indicated in panel b. **(b)** *piClim-control* multi-model mean dust emission flux (Tg year^{-1}), the rectangle show key dust emission regions according to Kok et al. (2021). **(c)** The multi-model mean change in dust emissions of *piClim-2xdust* relative to the *piClim-control*.

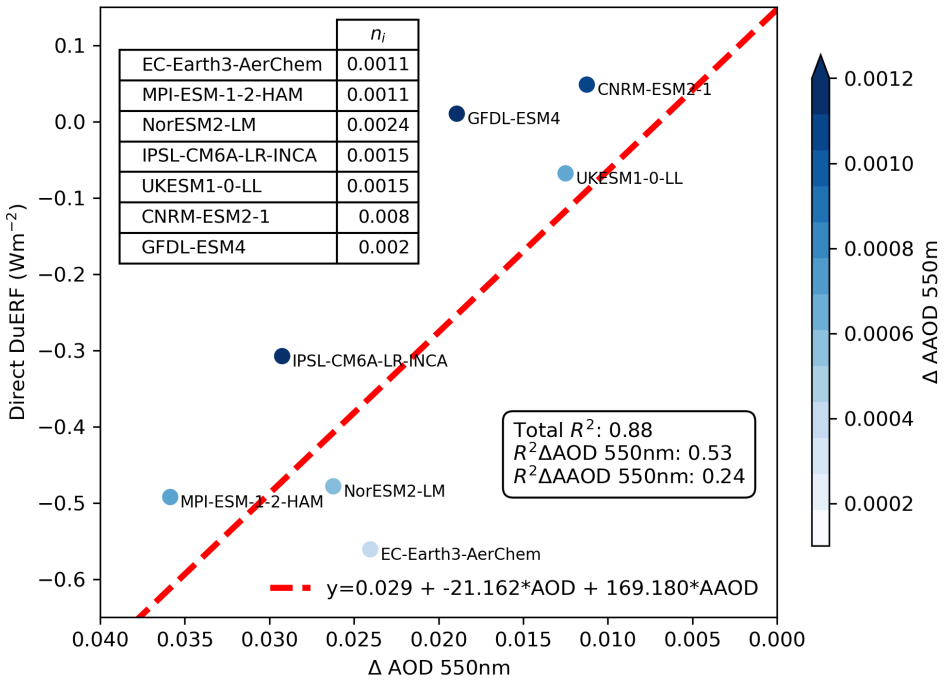

Figure S5: Change in AOD *piClim-2xdust* vs *piClim-control* (x-axis) and direct dust effective radiative forcing (y-axis). The colouring shows the change in AAOD. The table show the complex index of refraction at 550nm for the models. The red stippled line shows the multiple linear regression line. The r-squared values for the linear fit using Δ AOD 550nm, AAOD 550nm and both are written out in the round text box.

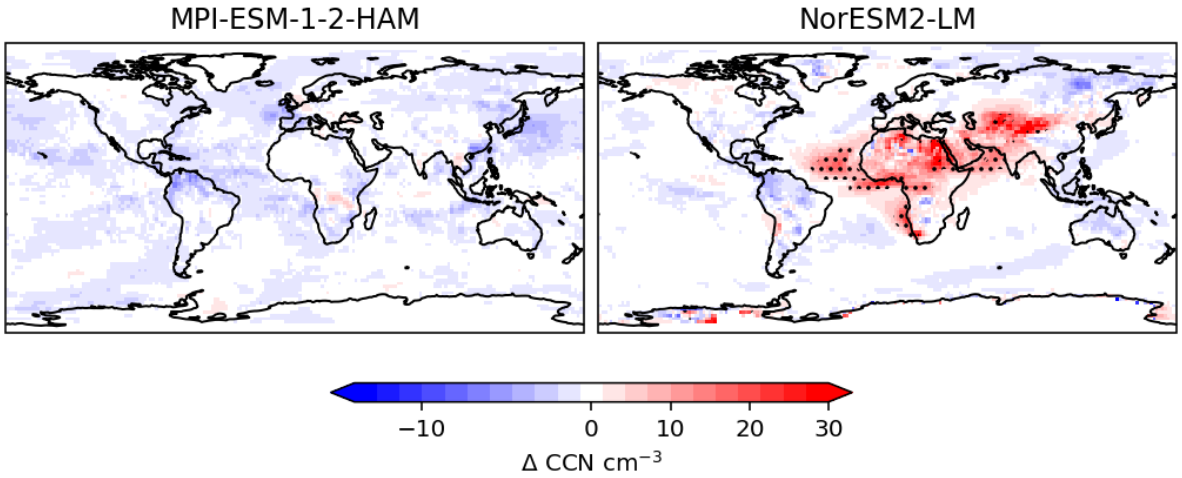

Figure S6: Absolute change in CCN concentration between *piClim-2xdust* and *piClim-control*, for MPI-ESM-1-2-HAM and NorESM2-LM.

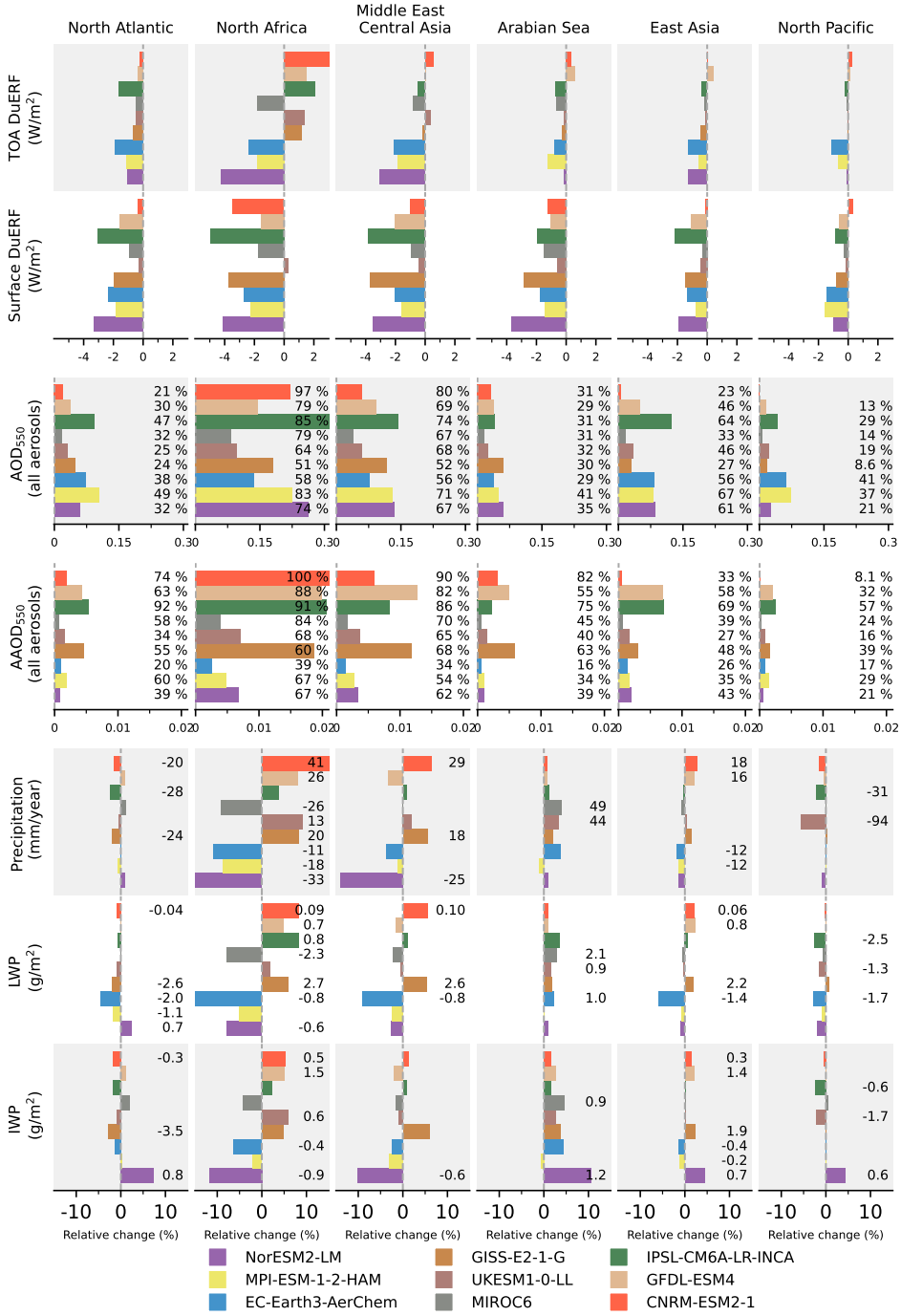

Figure S7: The difference between *piClim-control* and *piClim-2xdust* for key dust outflow regions; North Atlantic (6°S - 34°N, 66°W - 16°W), Arabian Sea (6°S - 19°N, 19°E - 82°E) and North Pacific (15°N - 48 °N, 117°E - 147°E) and dust sources: North Africa (10°N - 31°N, 14 °W - 37 °E), Middle East and Central Asia (°19°N - 44 °N, 37°E - 79°E) and East Asia (23°N - 61°N, 117°E - 147°E). From top to bottom; Dust Effective radiative forcing at TOA and surface, AOD and AAOD at 550nm, Precipitation, Liquid water path (LWP) and Ice water path (IWP). The bars in the top four panels show absolute changes, while in the bottom 3 panels the bars indicate the relative change. The value of the changes that are significant in panel 2-5 are displayed.

References

Kok, J. F., Adebiyi, A. A., Albani, S., Balkanski, Y., Checa-Garcia, R., Chin, M., Colarco, P. R., Hamilton, D. S., Huang, Y., Ito, A., Klose, M., Li, L., Mahowald, N. M., Miller, R. L., Obiso, V., Pérez García-Pando, C., Rocha-Lima, A., and Wan, J. S.: Contribution of the world's main dust source regions to the global cycle of desert dust, Atmospheric Chemistry and Physics, 21, 8169–8193, https://doi.org/10.5194/acp-21-8169-2021, publisher: Copernicus GmbH, 2021.