



## aerosol radiative forcing with the MACv2 climatology

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The MACv2 aerosol climatology for aerosol optical properties is applied to quantify the radiative effects of tropospheric aerosol and the impact of extra anthropogenic aerosol since pre-industrial times. Hereby, a separation is done between direct (aerosol presence) and indirect (through modified clouds) effects. For the radiative energy balance at the top of the atmosphere the indirect effect (of clouds through extra aerosol concentrations) is dominant, while for atmospheric solar heating (and dynamics) and for influences on the radiative energy balance at the surface the aerosol direct effect (thus, aerosol amount and composition) is more important. All aerosol radiative impacts are highly variable in space and time - with significant shifts in aerosol (climate cooling maxima) from Europe and the US to southern and eastern Asia over recent decades. Despite these major regional changes globally the radiative forcing by anthropogenic aerosol (a cooling) has stayed at  $-1\text{W/m}^2$  (ca.  $-0.8$  indirect,  $-0.2$  direct) also in part, as slight AOD increases are compensated by a more absorbing aerosol type.