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The role of anthropogenic aerosol emission reduction in achieving the Paris Agreement's objective

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The Paris agreement reached in December 2015 under the auspices of the United Nation Framework Convention on Climate Change (UNFCCC) aims at holding the global temperature increase to well below 2 [U+25E6]C above preindustrial levels and "to pursue efforts to limit the temperature increase to 1.5 [U+25E6]C above preindustrial levels". Limiting warming to any level implies that the total amount of carbon dioxide (CO_2) - the dominant driver of long-term temperatures – that can ever be emitted into the atmosphere is finite. Essentially, this means that global CO_2 emissions need to become net zero. CO_2 is not the only pollutant causing warming, although it is the most persistent. Short-lived, non-CO_2 climate forcers also must also be considered. Whereas much effort has been put into defining a threshold for temperature increase and zero net carbon emissions, surprisingly little attention has been paid to the non-CO_2 climate forcers, including not just the non-CO_2 greenhouse gases (methane (CH4), nitrous oxide (N2O), halocarbons etc.) but also the anthropogenic aerosols like black carbon (BC), organic carbon (OC) and sulfate. This study investigates the possibility of limiting the temperature increase to 1.5 [U+25E6]C by the end of the century under different future scenarios of anthropogenic aerosol emissions simulated with the very simplistic MAGICC climate carbon cycle model as well as with ECHAM6.1-HAM2.2-SALSA + UVic ESCM. The simulations include two different CO_2 scenarios- RCP3PD as control and a CO_2 reduction leading to 1.5 [U+25E6]C (which translates into reaching the net zero CO_2 emissions by mid 2040s followed by negative emissions by the end of the century); each CO_2 scenario includes also two aerosol pollution control cases denoted with CLE (current legislation) and MFR (maximum feasible reduction). The main result of the above scenarios is that the stronger the anthropogenic aerosol emission reduction is, the more significant the temperature increase by 2100 relative to pre-industrial temperature will be, making the 1.5 [U+25E6]C temperature goal impossible to reach. Although the global reduction of anthropogenic aerosols can greatly enforce the global warming effect due to GHGs, all our simulations resulted in temperature increase bellow (but not well bellow) 2 [U+25E6]C above preindustrial levels - a slightly more realistic target compared to 1.5 [U+25E6]C. The results of this study are based on simulations of only two climate models. As such, we do not regard these results as indisputable, but we consider that aerosols and their effect on climate deserve more attention when discussing future aerosol emission.