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How declining aerosols and rising greenhouse gases forced rapid warming in Europe since the 1980s

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Mainland Europe's temperature rise of about 1°C since the 1980s is considerably larger than expected from anthropogenic greenhouse warming. Here we analyse shortwave and longwave surface forcings measured in Switzerland and Northern Germany and relate them to humidity- and temperature increases through the radiation- and energy budget. Shortwave climate forcing from direct aerosol effects is found to be much larger than indirect aerosol cloud forcing, and the total shortwave forcing, that is related to the observed 60% aerosol decline, is two to three times larger than the longwave forcing from rising anthropogenic greenhouse gases. Almost tree quarters of all the shortwave and longwave forcing energy goes into the turbulent fluxes, which increases atmospheric humidity and hence the longwave forcing by water vapour feedback. With anthropogenic aerosols now reaching low and stable values in Europe, solar forcing will subside and future temperature will mainly rise due to anthropogenic greenhouse gas warming.