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Recent decadal weakening of the summer Eurasian westerly jet attributable to anthropogenic aerosol emissions

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The Eurasian subtropical westerly jet (ESWJ) is a major feature of the summertime atmospheric circulation in the Northern Hemisphere. Here, we demonstrate that four reanalysis datasets show a robust and substantial weakening trend in the summer ESWJ over the last four decades, amounting to a total change of approximately 7%. This weakening has been linked to significant impacts on extreme weather in the northern hemisphere. Furthermore, we use climate model simulations from the Coupled Model Intercomparison Project Phase 6 (CMIP6) to identify the causes of the weakening trend. Our results strongly suggest that anthropogenic aerosols were likely the primary driver of the weakening ESWJ. In particular, warming over mid-high latitudes due to aerosol reductions in Europe, and cooling in the tropics and subtropics due to aerosol increases over South and East Asia acted to reduce the meridional temperature gradient at the surface and in the lower and middle troposphere, leading to reduced vertical shear of the zonal wind and a weaker westerly jet in the upper troposphere. Our results suggest that if, as expected, Asian anthropogenic aerosol precursor emissions decline in future, we should anticipate a renewed strengthening of the summer ESWJ.