Human Emissions Drive the Pacific Decadal Oscillation

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Abstract

The Pacific Decadal Oscillation (PDO) - the leading mode of climate variability driving long-term changes in the Pacific Ocean and surrounding continents - is thought to be generated by naturally occurring processes. Here, we show that instead, during the 20th century, the PDO was driven by variations in human emissions of aerosols and greenhouse gases. Several large suites of climate model simulations shows that mid-twentieth century aerosol emissions drove cooling in the North Pacific with similar timing and spatial pattern to the observed PDO. By the late 20th century, greenhouse gases replaced aerosols as the dominant forcing. This revelation allows us attribute PDO impacts – including the ongoing drought in the southwestern United States – to human activity. This was previously undiscovered because climate models underestimate the regional influence of external forcing, particularly from aerosols. Addressing this issue in climate models offers a direct path towards extending the predictability horizon of the PDO, as well as producing accurate attribution of regional climate changes.