THE ROLE OF SULFUR FROM HUMAN EMISSIONS IN DRIVING CLIMATE CHANGE

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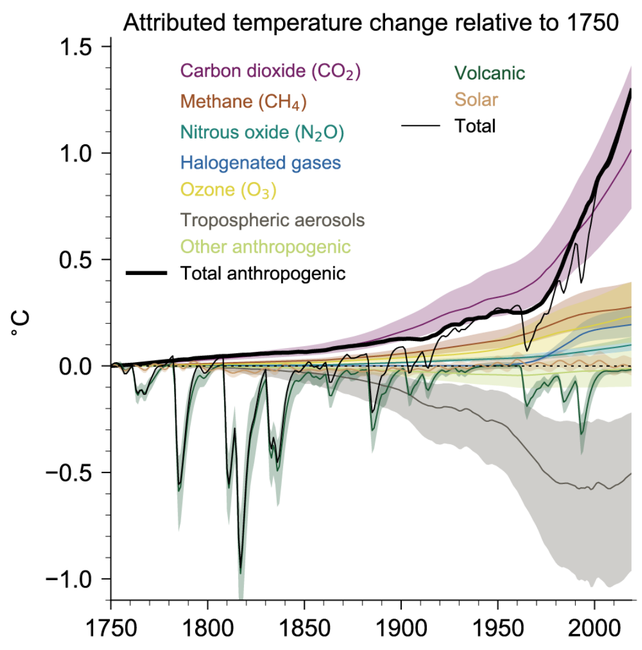
1. AEROSOLS COOL DOWN THE CLIMATE

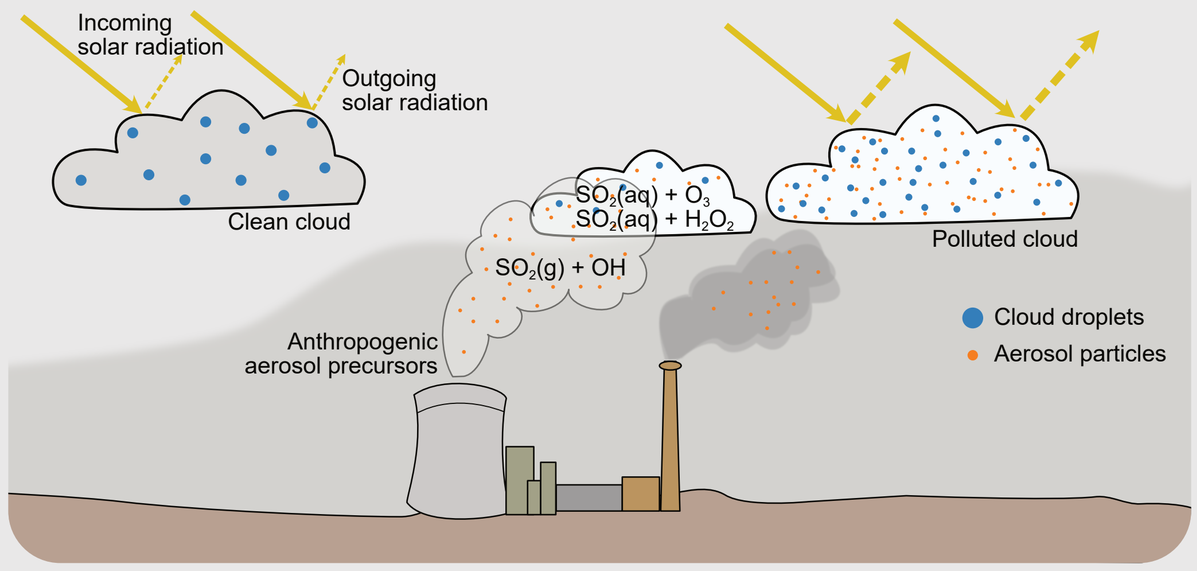


Aerosol effects on climate are one of the most uncertain aspects of climate studies.

Sulfur dioxide (SO_2) is a gas that reacts with other gases to form aerosols.

As climate scientists, we aim to improve our future predictions by elucidating the relationships between various aspects of the Earth system.

Figure 1. Attributed global surface air temperature change for key climate metrics (IPCC AR6, 2021)

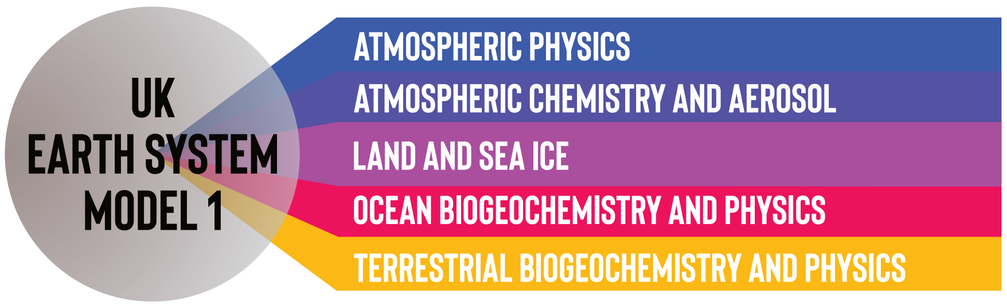


OUR WORK ASKS

"HOW DO GREENHOUSE GASES SUCH AS METHANE AND OZONE AFFECT AEROSOL FORMATION AND CLIMATE"

2. METHODS: EARTH SYSTEM MODELS

Earth system models simulate how chemistry, biology, and physical forces work together.



4 CMIP6 simulations were analysed in this work.

histSST	piAer	piO3	piCH4
=	=	=	=
+	+	+	+
Historical emissions	Pre-industrial **aerosol** precursors emissions	Pre-industrial **ozone** precursors emissions	Pre-industrial **methane** concentration

3. RESULTS: AEROSOLS FORMATION

We found that greenhouse gases modify how SO_2 reacts to form aerosols.

A) When SO_2 reacts in the gas phase, it **adds new aerosol** particles.

B) When SO_2 reacts in the aqueous phase, **existing aerosols grow** in size.

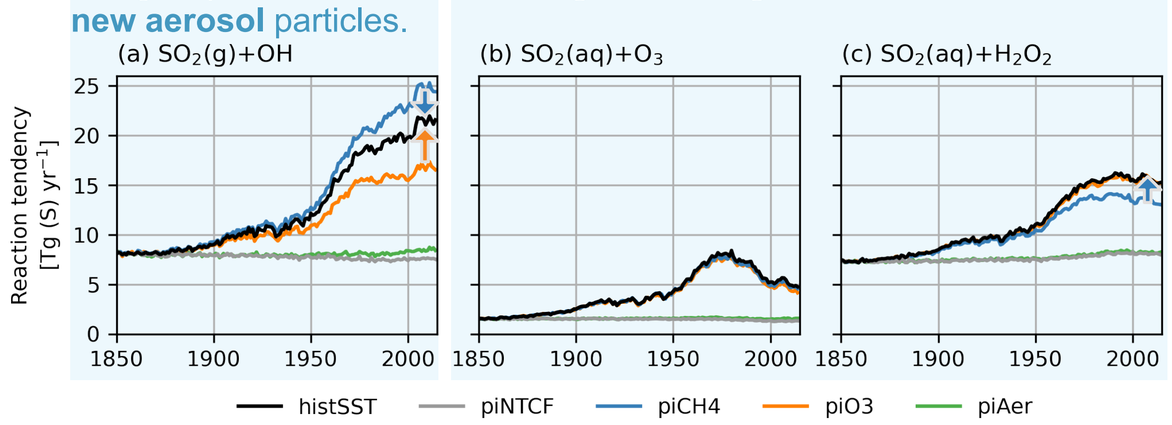


Figure 2. Global sulfur dioxide reaction tendencies

4. EFFECTS ON CLIMATE AND FUTURE

Effective radiative forcing (ERF) measures the Earth's radiation budget. ERF > 0 is warming. ERF < 0 is cooling.

Aerosol ERF = Greenhouse gas effect + Cloud scattering + Aerosol direct scattering

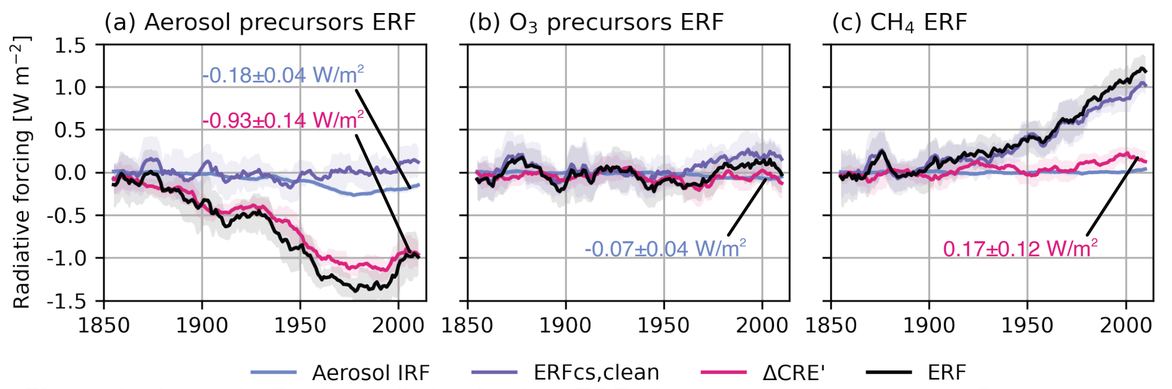


Figure 3. Aerosol effective radiative forcing (ERF) due to aerosol precursors, O_3 precursors and CH_4

↑ CH_4 → ↓SO_2+OH, ↑SO_2+H_2O_2 → ↓ Aerosol size, ↓ Aerosol number, ↓ Cloud particles → ↑ Aerosol direct scattering (Warming)

↑ O_3 → ↑SO_2+OH → ↓ Aerosol size, ↑ Aersol layer thickness → ↓ Cloud scattering (Cooling)

OUR WORK SHOWS THAT HISTORICAL EMISSIONS OF GASES THAT DON'T DIRECTLY REACT WITH SO_2, SUCH AS CH_4, CAN STILL LEAD TO THE MODIFICATION OF AEROSOL PROPERTIES, FURTHER ENHANCING THE CLIMATE IMPACT OF THESE GREENHOUSE GASES.

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