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UNDERSTANDING DRIVERS OF NATURAL CLIMATE VARIABILITY

Abstract

Global climate models are one of the most critical tools to understand the interactions and feedbacks between interconnected systems. However, their usefulness relies on their skill in accurately capturing trends and variability that have been observed or inferred from historical data. In pre-industrial times, the major drivers of climate variability were solar cycles and volcanic events. Since many of the effects of solar variability and volcanoes happen on a very small scale, they are frequently not calculated directly but rather parameterized. Although these parameters are included in paleoclimate models, such as those in CMIP5, questions have been raised about their methodology and accuracy.

Although the magnitude of solar variability over the 11 year solar cycle is known to be small, and the surface temperature effects minimal, it is unclear whether the photochemical effects above the tropopause are negligible. Nonlinear relationships between atmospheric modes of variability, such as QBO, and solar output may have stronger effects on stratospheric ozone concentrations than previously thought. We will validate currently accepted ozone concentrations by running a range of solar scenarios through NASA's ModelE earth system model. This model includes interactive stratospheric chemistry and dynamics, including a robust QBO.

Similarly, models often fail to capture the paleoclimatologically demonstrated effects of volcanoes and tend to overestimate subsequent global cooling. We will use the same model to test the chemical and dynamical dependencies of volcanic eruptions, particularly in the stratosphere. The goal is to bring model output closer to conditions that can be inferred from ice core and tree ring evidence in the wake of explosive volcanic eruptions.