A limited role for unforced internal variability in 20th century warming.

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Abstract

The role of external (radiative) forcing factors and internal unforced (ocean) low-frequency variations in the instrumental global temperature record are still hotly debated. More recent findings point towards a larger contribution from changes in external forcing, but the jury is still out. While the estimation of the human-induced total global warming fraction since pre-industrial times is fairly robust and mostly independent of multidecadal internal variability, this is not necessarily the case for key regional features such as Arctic amplification. I will argue that the incorporation of spatiotemporal effects from varying anthropogenic aerosol emissions can substantially reduce the uncertainty linked with seemingly unexplained low-frequency modes of variability. In fact, it can be shown that once the heterogeneous nature of the aerosol forcing is accounted for appropriately (using the latest aerosol emission estimates), a substantially higher fraction of the global and hemispheric temperature evolution can be attributed to external forcing factors alone. Accounting for the slow global temperature adjustment after strong volcanic eruptions and known biases in the sea surface temperature record, almost all of the multidecadal fluctuations observed over at least the last 160+ years can be explained without a relevant role for internal variability beyond the decadal scale, which will be demonstrated using a state-of-the-art two-box energy balance model. Repercussions for the (weather event) attribution community are discussed as well.

Keywords: Climate Change, Event Attribution, Global Warming, Climate Variability, Climate Modelling

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