Earlier emergence of temperature response to mitigation found when filtering annual variability using a physics based Green's function approach

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Abstract

The rate of global surface warming is a crucial observable quantity for tracking progress towards global climate targets. Its evolution is however also strongly influenced by interannual-to-decadal variability, which can hamper detection of the effects of emission mitigation. Hence, process-based approaches are needed that can reduce this variability, by separating interannual fluctuations from forced and longer-term changes. We present a new such approach, based on Green's functions that relate fluctuations in global mean surface air temperature to the monthly geographical pattern of sea-surface temperatures, and show that it can advance separation between the climate responses to low and high emission scenarios by up to a decade.

The observed rate of surface warming over the most recent decade (2011-2020), influenced by the El Nino of 2015-2016, is 0.35 ∘C per decade in the HadCRUT5 dataset. Our filtering approach reduces it to 0.24 ∘C per decade, making it consistent with the 50-year trend (1971-2020) from the same dataset. Conversely, the so-called "global warming hiatus" period (2001-2010) has an observed trend of only 0.08 ∘C per decade, which strengthens to 0.21 ∘C per decade using our method.

We suggest that such filtered warming rates could represent a strong addition to the tools used by the climate community to inform policy makers and stakeholder communities, provided an effort is made to develop, improve and validate standardized Green's functions.

Keywords: emergence, temperature, variability, Green's function

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