Abstract Submitted
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Accurate Calculation of the Linear Response Function of General Circulation Models[1] PEDRAM HASSANZADEH, Rice University, ZHIMING KUANG, Harvard University — A linear response function (LRF), M, relates the response, x, of a nonlinear system, such as the atmosphere, to weak external forcings, f, and tendencies, $\dot{x}$, via $\dot{x} = Mx + f$. Knowing the LRF of general circulation models (GCMs) helps with better understanding their internal and forced variability. But even for simple GCMs, M cannot be calculated from first principles due to the lack of a complete theory for eddy-mean flow feedbacks. We present a new framework to accurately calculate the LRFs of GCMs using Green's function: by applying a sufficiently large set of localized forcings, one at a time, to the GCM, then calculating the time-mean responses, and finally finding the LRF via matrix inversion. We discuss the accuracy and properties of the LRF of an idealized GCM that has been calculated using this approach. An eddy flux closure matrix that determines the turbulent eddy flux responses to mean-flow changes is also calculated. Some results on using this LRF to quantify the eddy feedbacks and probe causality in the midlatitude large-scale circulation will be discussed. It will also be shown that the poor performance of another common approach to calculating the LRFs, the Fluctuation-Dissipation Theorem, is linked to the non-normality of the LRFs of GCMs.

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