

Using the framework of fast response and slow feedback to understand climate change

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A key issue in projection of future climate change is to understand the response of climate system to external forcings, such as changes in greenhouse gas and aerosol concentrations. Traditionally, climate response to a change in external forcing is analyzed in terms of equilibrium response of the climate system or climate evolution on different timescales ranging from years to centuries. Over the past decade, the framework of fast response and slow feedback has emerged as a useful paradigm for understanding climate change. Fast response refers to rapid climate adjustment to a change in external forcing that occurs before substantial change in global mean surface temperature, and slow feedback refers to climate response that is associated with the change in surface temperature.

In this study I will show some examples that utilize the conceptual response-feedback framework to understand climate change in response to external forcings. First, the different characteristics of climate response to CO₂ forcing and solar forcing are investigated using the framework of fast response and slow feedback; Second, model-simulated climate response to solar geoengineering is analyzed in the context of the response-feedback framework; Third, utility and limitation of the linear response-feedback paradigm in representing total climate change is discussed. It is shown that the response-feedback framework provides new insight into the understanding of the behavior the climate system.

Key words: climate change, fast response, slow feedback, climate modeling