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Orbital control of global surface temperature: the role of tropical cloud feedbacks Axel

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Orbital forcing is a key driver for glacial variability. However, how the seasonal and latitudinal variations of incoming shortwave radiation translate into climate, ice-sheet and carbon cycle responses still remains elusive. The goal of this study is to explore the role of cloud feedbacks in translating the astronomical forcing into an annual mean global surface temperature signal. To address this question, an accelerated transient experiment that covers the orbital forcing history of the past 408,000 year is conducted with the Community Earth System Model (CESM). From a global mean perspective, our simulations reveal that the longterm mean planetary albedo renders the initial annual mean eccentricity signal of insolation ($\sim$ 100, 400 kyrs periodicity) into an obliquity signal ($\sim$ 41 kyr periodicity). Furthermore, time varying planetary albedo obtained from our transient simulations generates the precessional variations of shortwave radiation forcing ($\sim$ 19-23 kyrs periodicity) related to the seasonal amplitude. In turn it impacts earth's total energy balance, leading to precessional-scale variations of annual mean global surface temperature in the order of $\pm$ 0.5°C. The changes of cloudiness and its shortwave cloud forcing are the most apparent over northern Africa and extends into the middle East, particularly during boreal summer. In addition, to compare continental and oceanic temperature responses to the orbital forcing, the effects of combination mode and ocean dynamic processes will be also discussed.