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## Quantifying the State Dependency of Climate Sensitivity Across Cenozoic Warm Intervals

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Equilibrium climate sensitivity (ECS) quantifies the amount of warming resulting from a doubling of the atmospheric CO<sub>2</sub> forcing. Despite recent advancements in climate simulation capabilities and global observations, there remains large uncertainty on the degree of future warming. To help alleviate this uncertainty, past climates provide a valuable insight into how the Earth will respond to elevated atmospheric CO2. However, there is evidence to suggest that ECS is dependent on background climate warmth, which may interfere with the direct utilization of paleo-ECS to understand present-day ECS. Thus, it is important that a range of different climate states are considered to better understand the factors modulating the relationship between CO2 and temperature. In this study, we focus on three time intervals: the mid-Pliocene Warm Period (3.3 -3.0 Ma), the mid-Miocene (16.75 – 14.5 Ma), and the early Eocene (~50 Ma), in order to sample ECS from Cenozoic coolhouse to hothouse climates. Here, we combine the Bayesian framework of constraining the ECS and its uncertainty with several published methods to estimate the global mean surface temperature (GMST) from sparse proxy records. This framework utilizes an emergent constraint between the simulated GMST changes and climate sensitivities across the model ensemble. For each time interval, we employ a combination of parametric and nonparametric functions, coupled with a probabilistic approach to derive a refined estimate. Preliminary results for the Pliocene indicate a GMST reconstruction of approximately 19.3°C, which is higher than previous estimates that were derived using only marine records. Using this estimate, we calculate an ECS that is also higher than previously published values, especially due to the inclusion of high-latitude terrestrial temperature records into our estimates. Intriguingly, using the consistent methodology, our calculated ECS for the early Eocene is lower than that of the mid-Pliocene. This result does not support an amplified ECS in hothouse climate, and points to a potentially important role of ice albedo feedback in amplifying the ECS in coolhouse climate. Ongoing work will apply the same methodology to the mid-Miocene and further investigate the source for the estimated ECS state dependency between these climate intervals.

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