New views of warm worlds from paleoclimate data assimilation

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The warm climate states of the Cenozoic are some of our best geological analogs for future climate change under anthropogenic global warming. However, our views of past warm worlds are fundamentally limited by uncertain, and spatially and temporally restricted, paleoclimate data. Conversely, climate model simulations provide a full field view of past climates but are only our best "guess" of what happened based on physical expectations. Paleoclimate data assimilation provides a way forward by formally combining the model simulations and the data. Here, we present some initial results from data assimilation of geochemical proxies for ocean temperature with state-of-the-art simulations done with the NCAR Community Earth System Model (CESM). Our assimilation technique uses a suite of Bayesian forward models and timeslice simulations of the Pliocene and Eocene, respectively. The assimilated model fields provide data-informed insights into climate parameters that we have no specific proxies for, such as Walker circulation, winds, and global patterns in precipitation. Although continental configurations do alter the patterns of observed change in high CO_2 worlds, there are basic features of the response that share a close similarity with future climate predictions, suggesting that the past can inform the future more directly than is sometimes supposed.