EGU2020-9060
https://doi.org/10.5194/egusphere-egu2020-9060
EGU General Assembly 2020

Beyond Sea Surface Temperatures: a Holistic Approach to Addressing Pliocene Tropical Conditions

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The tropical Pacific thermocline structure is critical to tropical sea surface temperatures (SSTs) and variability. During the mid-Pliocene warm period (~3 Ma), the zonal SST gradient was reduced due to relatively warm SST in the Eastern Equatorial Pacific; we call this mean state “El Padre.” How did the equatorial thermocline contribute to this reduced zonal SST gradient? Here we summarize published Mg/Ca (surface and subsurface dwelling foraminifera) and alkenone records and generate new SST estimates from Mg/Ca and alkenones. The subsurface dwelling *Globorotalia tumida* Mg/Ca-based temperature records from the eastern and western equatorial Pacific show mid-Pliocene warm period subsurface temperatures warmer than today; El Padre included a basin-wide thermocline that was relatively warm, deep, and weakly tilted. We compare the published and newly generated SST and subsurface temperature records to the Pliocene Modeling Intercomparison Project (PlioMIP1) and show that few models capture the magnitude and spatial pattern suggested by the temperature records. Those models that do corroborate the temperature records have warm subsurface temperatures in the Eastern Equatorial Pacific that dynamically link to warm SSTs in the cold tongue. This highlights the need to accurately model thermocline dynamics and mid-latitude conditions, where equatorial thermocline waters originate, in order to gain an understanding of the underlying processes that explain the mid-Pliocene warm period.