

720,000-year records of Antarctic and oceanic temperatures related to solar forcing and CO₂

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The δD temperature proxy in Antarctic ice cores varies parallelly with CO₂ through glacial cycles with a puzzling asynchrony. To understand the mechanisms responsible for this association, precise and well-dated records of Antarctic and Southern Ocean temperature are needed. Here, we performed multiple isotopic analyses on an Antarctic ice core and reconstructed the records of temperature variations at this Antarctic site and the oceanic moisture source back to 720,000 years before present, which extend the longest records by 300,000 years. We found that (1) Antarctic temperature is affected by large variations in local insolation that are induced by obliquity. At the 41-kyr obliquity periodicity, the CO₂ variations display higher coherence with ocean temperature than Antarctic temperature. (2) At the obliquity periodicity band, changes in annual mean insolation were followed by changes in Antarctic temperatures, CO₂, and oceanic temperatures with phase lags. (3) the magnitude of the phase lag is minimal during low-eccentricity periods, suggesting that secular changes in the global carbon cycle and the ocean circulation modulate the phase relationship among temperatures, CO₂ and insolation.

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