



## **Pacific freshening drives Pliocene cooling and Asian monsoon intensification**

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The monsoon is a fundamental component of Earth's climate. The Pliocene warm period is characterized by long-term global cooling yet concurrent monsoon dynamics are poorly known. Here we present the first fully quantified and calibrated reconstructions of separate Pliocene air temperature and East Asian summer monsoon precipitation histories on the Chinese Loess Plateau through joint analysis of loess/red clay magnetic parameters with different sensitivities to air temperature and precipitation. East Asian summer monsoon precipitation shows an intensified trend, paradoxically at the same time that climate cooled. We propose a hitherto unrecognized feedback where persistently intensified East Asian summer monsoon during the late Pliocene, triggered by the gradual closure of the Panama Seaway, reinforced late Pliocene Pacific freshening, sea-ice development and ice volume increase, culminating in initiation of the extensive Northern Hemisphere glaciations of the Quaternary Ice Age. This feedback mechanism represents a fundamental reinterpretation of the origin of the Quaternary glaciations and the impact of the monsoon.