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Combined obliquity and precession pacing of late Pleistocene glacial cycles

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Milankovitch postulated that deglaciation occurs when Earth's obliquity is high and precession brings Earth's eccentric orbit near the sun during Northern summer, and this general concept has been elaborated to show how precession, obliquity, or a combination of both could govern the timing of glaciation. Observational tests have demonstrated that obliquity paces the $\sim$100 ky glacial cycles but have been inconclusive with regard to precession, primarily because precession's shorter period demands greater age accuracy. Here both obliquity ($p<0.001$) and precession ($p=0.05$) are shown to pace late Pleistocene glacial cycles. Requisite age control to test for precession pacing comes from tuning a composite δ^{18}O record to align with obliquity. Likewise, precession is exclusively tuned to when testing for obliquity pacing, and the orthogonality between obliquity and precession guards against circularity in this process. The Milankovitch hypothesis is fully consistent with the test results, but not all other hypotheses are ruled out. In particular, the orbital configuration that maximizes insolation intensity at high northern latitudes also maximizes the duration of southern summers, and the latter may assist deglaciation through increasing the evasion of CO_2 from the Southern Ocean into the atmosphere.