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A model for cold-snap episodes occurring during the Mesozoic

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The Mesozoic, perhaps representing the longest period of warmth during the Phanerozoic Earth history has been repeatedly affected by short-lived cold interludes lasting less than a million of years in length. The evidence for these cooling events includes glendonite abundance, stable oxygen isotope records and faunal migration. While plausible mechanisms have been proposed for the two largest ice age event of the Phanerozoic, convincing explanations for these Mesozoic cold snaps are still lacking. Thought, these events are intriguing because they occur in a greenhouse world and because of their relative short duration. Here, we investigate the climate-carbon cycle behavior during these events with a particular focus on the Middle Late Jurassic Transition using a general circulation model with coupled components for atmosphere, ocean, cryosphere and biogeochemical cycles of C, O and P. We force our climate-carbon model with geological evidences of the timing of the evolution of carbonate production in the mid and low latitudes. We show that the general drawdown of carbonate platforms is a powerful mechanism capable of explaining a fast atmospheric CO2 decrease, a moderate sea level drop associated with ice-sheet buildup and an increasing seawater d13C owing to newly fresh limestones exposed to aerial erosion. Temporary nature of the carbonate drawdown explains the relative short time of these cold events but allows accounting for ice sheet inception and dearth.