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Unravelling the causes of the Cenozoic climatic evolution

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The Cenozoic is a period of drastic environmental changes expressed by a transition from greenhouse to icehouse climate close to the Eocene/Oligocene boundary (33.8Ma) and marked by the formation of the Antarctica ice sheet with a major ice accumulation starting in the earliest Oligocene. Superimposed to this global cooling trend, the middle Miocene appears as an interlude of warmer conditions. The lowering of the atmospheric CO_2 concentration is considered as the main cause of the Cenozoic climate cooling, although the ultimate reasons for this lowering are not identified. Conversely, the causes for the warm Middle Miocene remains unclear. Here we investigate the role of the tectonic forcing, the lithological changes and the Earth's degassing on the Cenozoic atmospheric CO_2 levels. We use simulations of climate and geochemical carbon cycles to depict the successive factors controlling the chemical weathering rates over the Cenozoic. The tectonic forcing induces generally low atmospheric pCO_2 through the Cenozoic except for a part of the Miocene period during which northward drifting of the African plate may have decreased the continental surface exposed to the chemical weathering and generated high CO_2 values. When using the reconstruction of the Earth's degassing flux, our model reproduces a decrease in atmospheric CO_2 from the Eocene to the Oligocene. Drifting of India and the Deccan traps across the intertropical convergence zone associated to the outpouring of the Ethiopian trap also induce very low CO_2 values for the early Oligocene.