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Pangea break up and Mesozoic climatic evolution simulated by the GEOCLIM model

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At geological timescales, the atmospheric CO2 is controlled by the balance between the sources, i.e. volcanism flux and kerogen weathering, and the sinks, the silicate weathering and the burial of marine organic matter. Most of numerical simulations of the Phanerozoic CO2 are based on equations which reflect this balance and have been mainly developed by R.A. Berner and colleagues. The weakness of the BLAG-like models is that the climate is poorly represented and thus, a number of climatic-induced processes. Using a general circulation model (FOAM) coupled to a biogeochemical model (COMBINE), we modeled atmospheric CO2 over the Mesozoic. Our analysis indicates that atmospheric carbon dioxide had been nearly divided by ten over this time period. The first order driving force of this long term climatic evolution is the break up of the Pangea supercontinent that increases continental runoff above continents and CO2 consumption through continental silicate weathering. However, this long term global cooling and CO2 drawdown is not gentle, and is marked by a sudden and rapid cooling between the middle-late Triassic and the early-middle Jurassic, mainly driven by a northward drift of Pangea (continental mean annual temperature falls by 5.4°C). This illustrates the non linear response of global climate to the paleogeographic evolution, showing that small paleogeographic changes may induce large climatic shift. This also shows the needs for spatial resolution of weathering rates in order to correctly account for changes in geography over Earth's history. Implications of our results against the calcareous nannofossils evolution and the "Veizer" d180 curve will be discussed.