Dust impact on marine biota and atmospheric CO_2 during glacial periods

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We assess the impact of high dust deposition rate on marine biota and atmospheric CO_2 using a state-of-the-art ocean biogeochemistry model and observations. Our model includes an explicit representation of two groups of phytoplankton and co-limitation by iron, silicate and phosphate. When high dust deposition rate from the Last Glacial Maximum (LGM) is used as input, our model shows an increase in the relative abundance of diatoms in today's iron-limited regions, causing a global increase in export production by 6% and an atmospheric CO_2 drawdown of 15 ppm. When the combined effects of changes in dust, temperature, ice cover and circulation are included, the model reproduces roughly the regional changes in export production during the LGM based on several paleoceanographic indicators. In particular, the model reproduces the observed increase north of 50ºS in the Southern Ocean and in the western North Pacific bassin, and the decrease south of 50ºS and in the east part of the North Pacific bassin. We derive a residual CO_2 signal corresponding to the fraction of CO_2 at Vostok which can be associated to high dust deposition rates. This residual signal suggests that the impact of dust on atmospheric CO_2 during glacial periods is <30 ppm, consistent with our model results.