Regional contributions of ocean iron fertilization to atmospheric CO2 changes during the last glacial termination

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Mineral dust aerosols affect climate directly by changing the radiative balance of the Earth, and indirectly by acting as cloud condensation nuclei and by affecting biogeochemical cycles. The impact on marine biogeochemical cycles is primarily through the supply of micronutrients such as iron to nutrient-limited regions of the oceans. Iron fertilization of High Nutrient Low Chlorophyll (HNLC) regions of the oceans is thought to have significantly affected the carbon cycle on glacial-interglacial scales and contributed about one fourth of the 80-100 ppm lowering of glacial atmospheric CO_2 concentrations.

In this study, we quantify the effect of global dust fluxes on atmospheric CO_2 using the cGENIE model, an Earth System Model of Intermediate Complexity with emphasis on the carbon cycle. Global Holocene and Last Glacial Maximum (LGM) dust flux fields were obtained from both dust model simulations and reconstructions based on observational data. The analysis was performed in two stages. In the first instance, we produced 8 global intermediate dust flux fields between Holocene and LGM and simulated the atmospheric CO_2 drawdown due to these 10 dust levels. In the second stage, we only changed dust flux levels in specific HNLC regions to isolate the effect of these ocean basins. We thus quantify the contribution of the South Atlantic, the South Pacific, the North Pacific, and the Central Pacific HNLC regions to the total atmospheric CO_2 difference due to iron fertilization of the Earth's oceans.