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Long-term biogeochemical effects of adding alkalinity into the ocean

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Large-scale perturbations in seawater chemistry brought about by the oceanic uptake of anthropogenic CO_2 will go on long after emissions decline or stop. Several geo-engineering approaches have been suggested to reduce atmospheric CO_2 concentrations and ocean acidification. One of them is to enhance weathering processes to remove atmospheric CO_2. This method involves dissolving rocks (i.e. limestone, olivine) or adding strong bases (i.e. calcium hydroxide) to the upper ocean. The net effect of these two approaches is to increase ocean alkalinity, thereby increasing the oceanic capacity to take up and store anthropogenic CO_2. Another effect of adding alkalinity would be to drive seawater to higher pH values and thus counteract the ongoing ocean acidification. However, whereas adding bases initially only alters alkalinity of seawater, dissolution of carbonates perturbs both, alkalinity and dissolved inorganic carbon budgets. Thus, on longer time scales, these two methods will likely have different biogeochemical effects in the ocean. Here we test enduring implications of the two approaches for the marine carbon cycle using the global ocean biogeochemical model HAMOCC which also includes marine sediments. In our model scenarios we add alkalinity in amounts proportional to fossil fuel emissions. We compare the long-term effectiveness of the two geo-engineering approaches to decrease atmospheric CO_2.