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The Next Generation Of Iron Fertilization Experiments In The Southern Ocean

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Of the various macro-engineering schemes proposed to mitigate global warming, ocean iron fertilization (OIF) is one that could be started at short notice on relevant scales. It is based on the reasoning that adding trace amounts of iron to iron-limited phytoplankton of the Southern Ocean will lead to blooms, mass sinking of organic matter and ultimately sequestration of significant amounts of atmospheric carbon dioxide (CO_2) in the deep sea and sediments. This iron hypothesis, proposed by John Martin in 1990 (Martin 1990 *Paleoceanography* **5**, 1–13), has been tested by five mesoscale experiments that provided strong support for its first condition: stimulation of a diatom bloom accompanied by significant CO_2 drawdown. Nevertheless, a number of arguments pertaining to the fate of bloom biomass, the ratio of iron added to carbon sequestered and various side effects of fertilization, continue to cast doubt on its efficacy. The idea is also unpopular with the public because it is perceived as meddling with nature. However, this apparent consensus against OIF is premature because none of the published experiments were specifically designed to test its second condition pertaining to the fate of iron-induced organic carbon. Furthermore, the arguments on side effects are based on worst-case scenarios. These doubts, formulated as hypotheses, need to be tested in the next generation of OIF experiments. We argue that such experiments, if carried out at appropriate scales and localities, will not only show whether the technique will work, but will also reveal a wealth of insights on the structure and functioning of pelagic ecosystems in general and the krill-based Southern Ocean ecosystem, in particular. The outcomes of current models on the efficacy and side effects of OIF differ widely, so data from adequately designed experiments are urgently needed for realistic parametrization. OIF is likely to boost zooplankton stocks, including krill, which could have a positive effect on recovery of the great whale populations. Negative effects of possible commercialization of OIF can be controlled by the establishment of an international body headed by scientists to supervise and monitor its implementation.