The ocean's biological pump (left) and solubility pump (right) , The solubility pump is driven by ocean physics and chemistry, and the biological pump is driven by ocean biology. Together these act to pump CO2 from surface water into the deep oceans, where it can remain out of contact with the atmosphere for hundreds of years. Figure from Chisholm, S.W. 2000. Oceanography: Stirring times in the Southern Ocean. *Nature 407: 685-687*

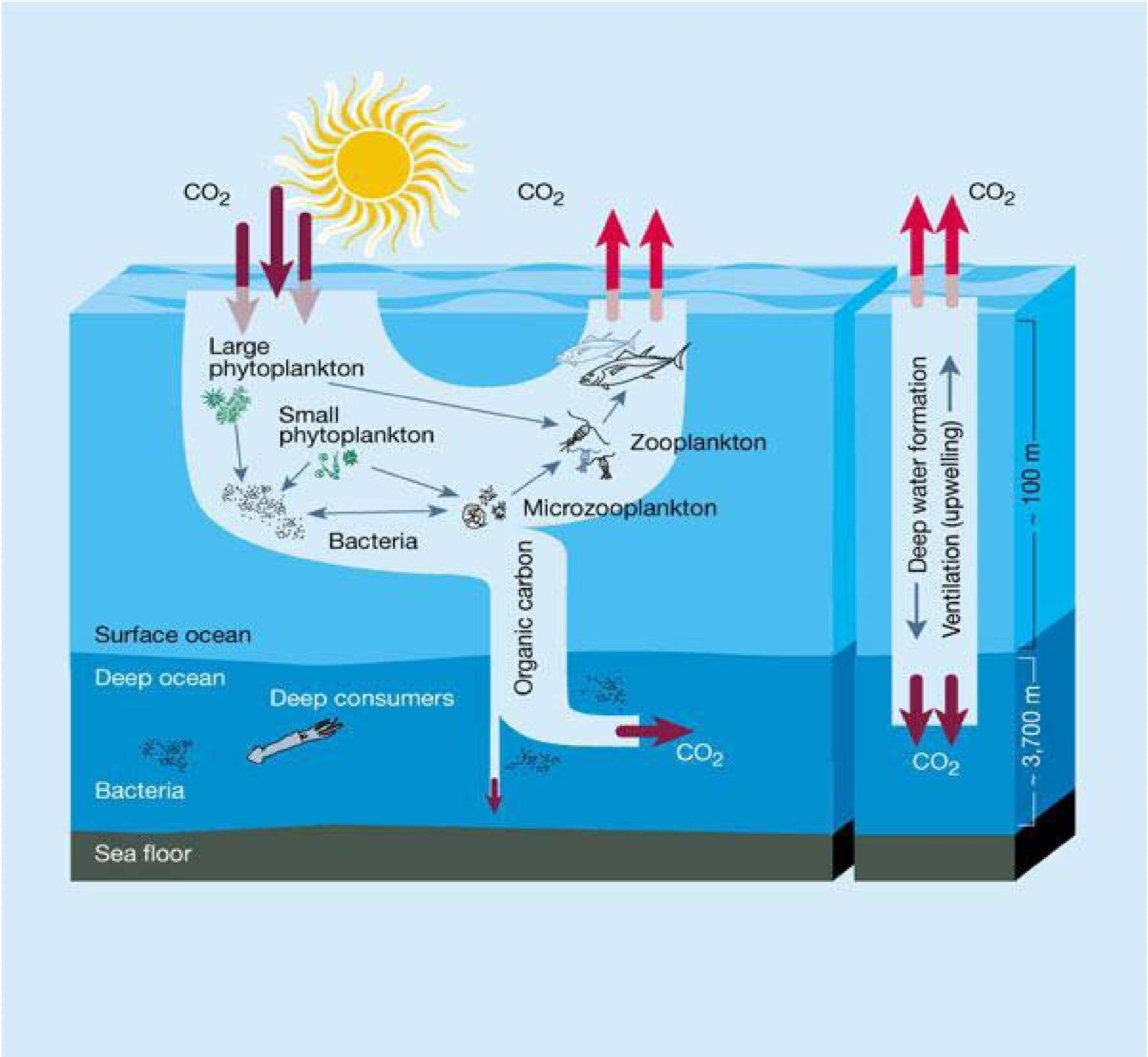
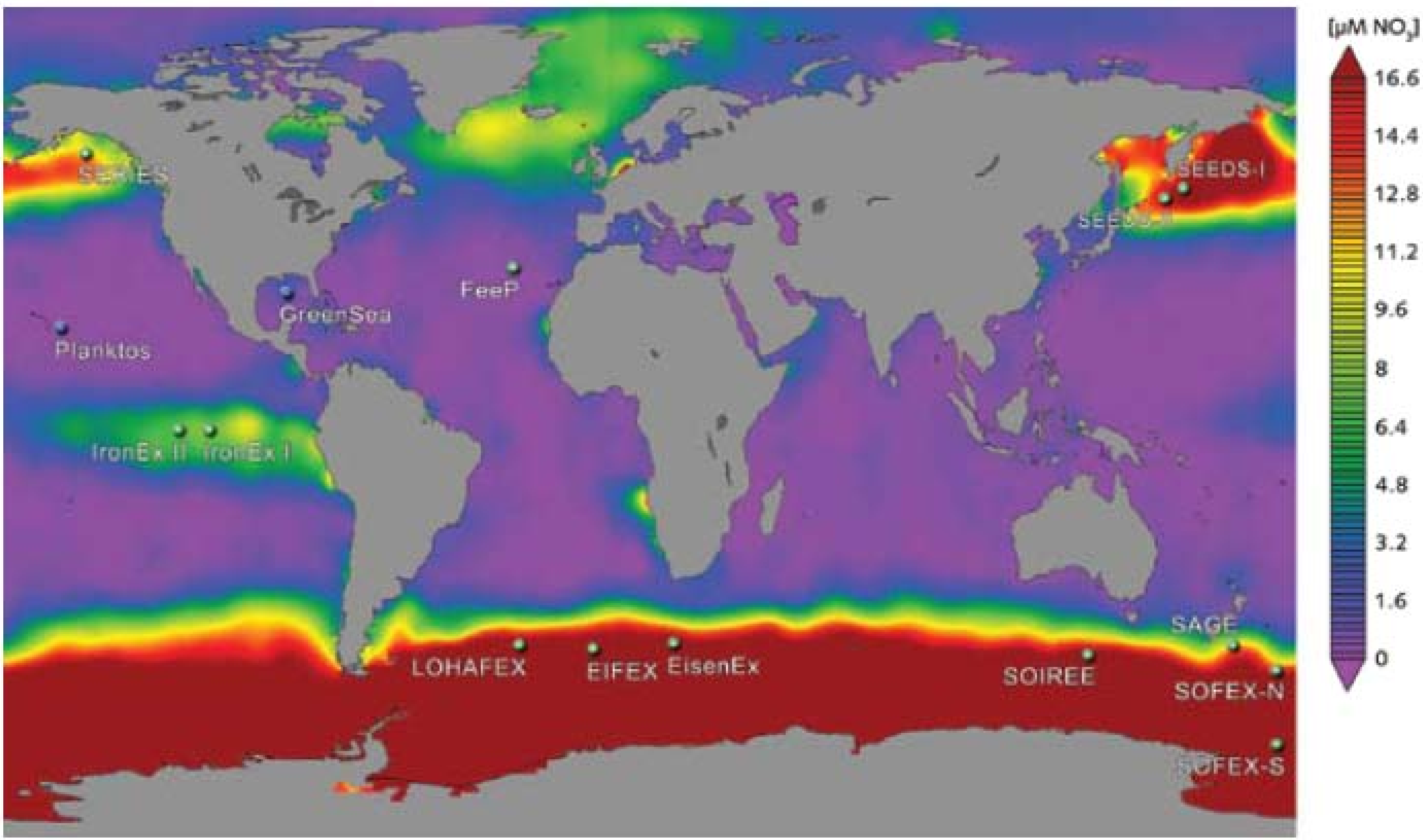


Table 1. Summary of ocean iron enrichment experiments conducted between 1993 and 2009.
See also reviews by de Baar et al. (2005) and Boyd et al. (2007).

Experiment	Year	Location	Duration	Magnitude	Rationale/Hypothesis Tested	General Conclusions
IronEx I Martin et al., 1994	1993	Eastern equatorial Pacific Ocean	10 days	450 kg Fe 64 km²	• Iron limitation of productivity in HNLC region	• Iron limits phytoplankton growth rate, but patch subducted; broader implications of OIF unclear
IronEx II Coale et al., 1996	1995	Eastern equatorial Pacific Ocean	17 days	450 kg Fe 72 km²	• Iron limitation of productivity in HNLC region	• Iron definitively limits productivity in equatorial Pacific. Larger bloom than IronEx I
SOIREE Boyd et al., 2000	1999	Southern Ocean-Australia; South of Antarctic Polar Front (APF)	13 days	1740 kg Fe 50 km²	• Iron limitation of productivity in Southern Ocean, south of the Antarctic Polar Front (APF) • Fate of carbon fixed in bloom	• Iron limits productivity in Southern Ocean • No downward carbon transport observed
EisenEx Smetacek, 2001; Assmy et al., 2007	2000	Southern Ocean-Africa; in APF zone	21 days	4 tonnes $FeSO_4$ 38.5 km²	• Iron limitation of productivity in Southern Ocean, along APF • Simulate Fe dust deposition to test whether Fe dust contributed to lower atmospheric CO_2 concentrations during glacial periods	• Iron limits productivity in Southern Ocean • Fate of the bloom uncertain • Iron only affected certain species of phytoplankton
SEEDS-I Tsuda et al., 2005	2001	Subarctic Pacific-Northwest	13 days	350 kg Fe 80 km²	• Iron limitation of productivity in HNLC of subarctic Pacific • Fate of carbon fixed in bloom	• Iron limits productivity in subarctic Pacific • Floristic shift to diatoms • Downward carbon export minimal
SOFeX-N SOFeX-S Coale et al., 2004; Buesseler et al., 2004	2002	Southern Ocean-New Zealand; north and south of APF	30 days	N: 1712 kg Fe 225 km² S: 1260 Kg Fe 225 km²	• Does OIF increase flux of carbon to deep ocean? • Silicate influence and geographic variability of response	• Increase in POC export flux, but magnitude is small relative to natural blooms
SERIES Boyd et al., 2004	2002	Subarctic Pacific-Gulf of Alaska	25 days	490 kg Fe 77 km²	• Fate of carbon fixed in iron-induced bloom • Efficiency of carbon export to deep ocean	• Majority of carbon remineralized • Inefficient transport of carbon below thermocline
EIFEX Hoffmann et al., 2006; Jacquet et al., 2008	2004	Southern Ocean-Atlantic	35 days	7 tonnes $FeSO_4$ 150 km²	• Iron addition impacts on phytoplankton community structure • Carbon sequestration efficiency and remineralization rates	• Shift away from picophytoplankton • Majority of carbon fixed was not remineralized • Unpublished "massive carbon export" paper by Smetacek et al.
FeeP Rees et al., 2007; Karl and Letelier, 2008	2004	Sub-tropical Northeast Atlantic-LNLC	21 days	5 tonnes $FeSO_4$ (+20 t PO_4) 25 km²	• Interaction between iron and phosphorus controls on biological activity in the subtropical North Atlantic	• Increased N-fixation activity was observed • No increase in primary productivity • Carbon export not measured
SAGE Law et al., 2006	2004	Southern Ocean-250 km from New Zealand	15 days	5.4 tonnes $FeSO_4$ 100 km²	• Iron addition's influence on sea-air gas exchange • CO_2 drawdown and dimethylsulfide (DMS) production	• Doubling of chlorophyll *a* but no significant DMS production and no significant CO_2 drawdown (preliminary results)
SEEDS-II Tsuda et al., 2007	2004	Subarctic Pacific-Northwest	26 days	491 kg Fe 64 km²	• Monitor ultimate fate of bloom and carbon for longer time period than SEEDS-I	• No diatom bloom response • Increased zooplankton grazing
LOHAFEX NIO Press Release, 2009	2009	Southern Ocean-Atlantic	40 days	10 tonnes $FeSO_4$ 300 km²	• Ecological shifts and fate of sinking carbon	• Increased zooplankton grazing • Negligible carbon export (preliminary results)

Locations of major iron fertilization experiments, including the pilot demonstrations of GreenSea Venture and Planktos. The color scale indicates the average annual surface nitrate concentration from the World Ocean Atlas 2005. Hotter colors indicate higher concentrations. The major HNLC regions in the Southern Ocean, the North Pacific and the Equatorial Pacific are clearly apparent as regions of high surface nitrate concentrations. Figure from Strong, A.L., J.J. Cullen and S.W. Chisholm, 2009. Ocean fertilization: science, policy and commerce. *Oceanography Magazine, 22: 236-261.*



Convention on Biological Diversity Resolution, November 2010

Ensure….. in the absence of science based, global, transparent and effective control and regulatory mechanisms for geo-engineering….**that no climate-related geo-engineering activities that may affect biodiversity take place**, until there is an adequate scientific basis on which to justify such activities and appropriate consideration of the associated risks for the environment and biodiversity and associated social, economic and cultural impacts, **with the exception of small scale scientific research studies**…. and only if they are justified by the need to gather specific scientific data and are subject to a thorough prior assessment of the potential impacts on the environment

NOAA Report to Congress on Ocean Fertilization

- Last December, the House Report that accompanied the Appropriations Act of 2010 called for NOAA to "provide a report on the potential of ocean fertilization for climate change mitigation" to the House and Senate Committees on Appropriation within 60 days of enactment of the Act.

- http://www.gc.noaa.gov/documents/2010_climate_fert_rept_Congress_final.pdf