Restoring the Climate with "Ocean Iron Fertilization"

"Climate restoration" means restoring the climate that humans have survived long-term, with CO_2 below 300 ppm, by 2050.

Ocean iron fertilization (OIF) appears to be the fastest, safest and most effective climate-restoration solution. OIF revives fisheries and other marine life while also reducing CO_2 levels at the scale needed to restore the climate.

In fact, OIF is how nature removed a trillion tons of CO_2 ten times in the last million years, before ice ages. As a climate-restoration solution, OIF requires little or no public funding. Instead, the process can produce revenue and taxes from revived fisheries.

How does OIF work?

Nature stimulates photosynthesis in phytoplankton– single-cell green plants and algae in the ocean– with mineral dust blown from land out to sea. Phytoplankton pull down enormous amounts of CO_2 and, as the base of the marine food web, revive sea life, including fisheries and whales.

We can do the same. Simulating dust storms, OIF implementers mete out trace amounts of reddish high-iron dust from aboard a ship, in a carefully selected ocean eddy or "pasture," about 100 km in diameter. These eddies remain relatively self-contained. Full-scale implementation could remove 60 Gt of CO_2 a year. It would require iron distribution in around 500 eddies each year–about 1% of the ocean's area. The quantities involved are minute–about 1/100th of a teaspoon of iron ore dust per square meter per year.

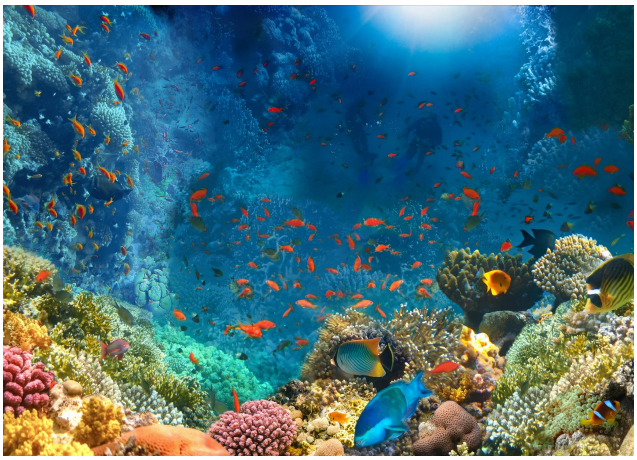
No better alternatives have been proposed for restoring CO_2 and climate to levels humans have actually survived.

Carefully administered OIF has the potential to

- Restore fisheries, both commercial and indigenous
- Restore populations of whales, seabirds and other marine life

- Restore global CO_2 levels that humans have survived long term, by 2050.

Why iron?



Today, most of the ocean shows low photosynthesis compared to previous eras. Iron is often the limiting factor, the missing nutrient, since it sinks instead of dissolving in seawater. Iron is even rarer in seawater than in previous eras: mineral dust blowing from land has decreased for various reasons. In addition, before the last century, large pods of whales would raise iron and other nutrients from the deep as they dove, surfaced, and defecated–leading to a profusion of photosynthesis and marine life. But few whales are left. OIF replenishes some of the iron and phytoplankton in the oceans with methods that nature has used for eons.

OIF can be financed by investment, with little or no government funding

OIF costs roughly $2 million per eddy per year. This amounts to a small fraction of the additional fishing revenue the process is expected to produce. Payments for carbon offsets could in some cases add to returns for stakeholders.

Next steps to enable OIF in 2023

- Submit projects to the Climate Restoration Safety and Governance Board (CRSGB)
- Secure $20 - 100 million to fund several 3-year projects that are public/private partnerships
- Develop data analysis for satellite imagery to measure OIF CO_2 removal

Why are we confident that it works?

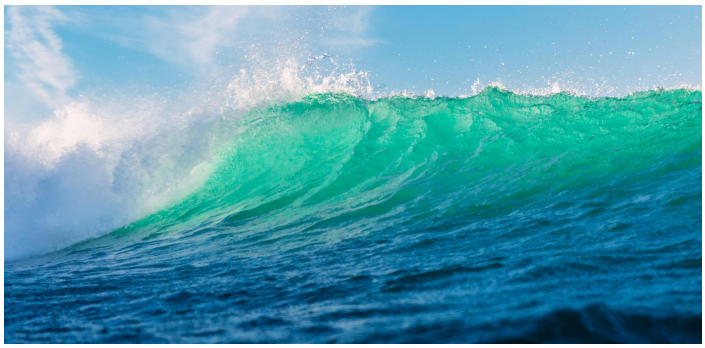
- Nature has successfully performed large-scale OIF 10 times in the last million years.
- In 1991, the Mt. Pinatubo volcano distributed mineral dust laden with iron: Over the following two years, CO_2 levels stabilized, indicating that about a year's worth of CO_2 emissions were removed.
- An implementation off the coast of Alaska in 2012 is estimated to have removed one day's worth of global CO_2 emissions. In addition, the Alaskan salmon catch increased fourfold the following year.

OIF is safe and effective

- In 13 OIF field tests, no evidence of harmful side effects have been reported. After all, dust storms and volcanoes have distributed iron dust over the ocean for millions of years. Like natural, wind-driven ocean fertilization, intentional OIF is localized and intermittent. Treating 1% of the ocean is sufficient. "Whole basin" OIF would be unnatural and could risk permanent ecosystem damage.
- Feared harmful algae blooms (HABs) and de-oxygenation occur only in coastal waters and lakes, mostly in response to sizable nutrient runoff from farms. In contrast, OIF is performed in the open ocean, in areas where nutrient volumes are much lower and iron in particular is largely absent. The iron additions are minute: *after* OIF, the water contains 1/10,000 the quantity of the mineral typically contained in coastal waters.
- Although only 10% of the carbon removed reaches the seafloor, this was also true before ice ages; the carbon mostly remains stored in the ocean depths.
- OIF became controversial after a field trial about a decade ago mainly because its ability to reduce CO_2 levels was considered a distraction from the UN goal of reducing fossil fuel emissions.
- Annual reports of fisheries ministries following the test show that the salmon catch quadrupled in parts of Alaska and Canada in the years following OIF.
- Island nations, coastal communities, and entrepreneurs are exploring public-private partnerships to implement OIF. They are eager for the food security, employment, and revenue from revived fisheries while the process reduces atmospheric CO_2.

Climate Restoration: Reclaiming a Pre-Industrial Climate by 2050

Everyone wants to restore a safe climate, one that humans have actually survived and thrived in long-term, with CO_2 levels below 300 ppm.



Reaching a safe climate will require pulling a trillion tons of legacy carbon from the atmosphere by 2050. We can do this by copying nature. Nature pulls massive amounts of CO_2 from the atmosphere by two major pathways: Boosting photosynthesis, particularly in the ocean; and forming limestone from the calcium carbonate shells of sea animals.

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