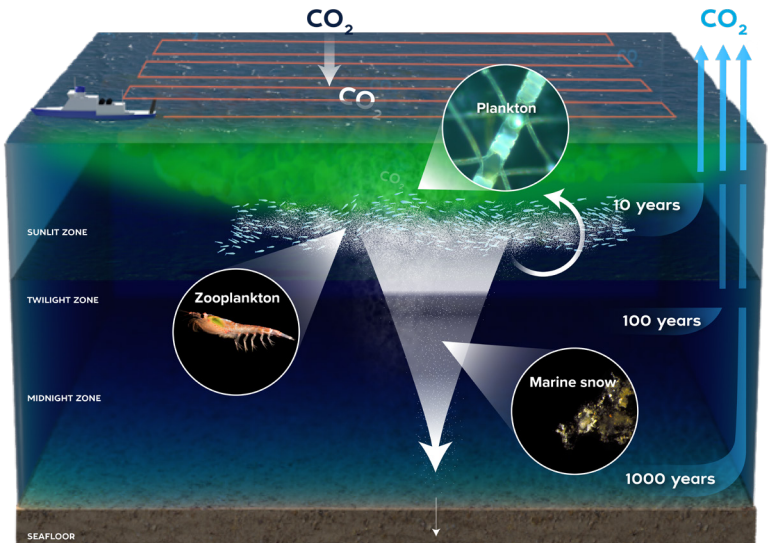
EXPLORING OCEAN IRON SOLUTIONS

Program Overview

What is ExOIS?

Exploring Ocean Iron Solutions (ExOIS) is an independent research program studying the safety and effectiveness of a form of marine carbon dioxide removal (mCDR) known at ocean iron fertilization (OIF). It is housed at the non-profit Woods Hole Oceanographic Institution in Massachusetts, USA. It brings together a diverse, international team of ocean scientists, engineers, social scientists, and marine policy experts to explore a promising but little-understood idea: whether adding iron to specific parts of the ocean could help it absorb more carbon dioxide from the atmosphere. ExOIS is committed to conducting this research openly, rigorously, and with input from stakeholders, rights holders, and coastal communities, and to reinforcing the need for emissions reductions in addition to any mCDR strategy deployed at scale.



Guiding principles for mCDR research

Despite the pressing need to address the climate crisis, the EXOIS team believes that deliberate, carefully designed field studies are necessary, and that studies should be conducted according to the following guidelines:

1. Prioritize collective benefit for humans and the environment
2. Establish clear lines of responsibility to oversee studies
3. Commit to open and cooperative research, including risk assessments
4. Perform evaluation and assessment in an iterative and independent manner
5. Engage the public in consideration of climate intervention options

Five Paths Forward for ocean iron fertilization

Next-generation field studies	**Modeling**	**Forms of iron & delivery**	**Monitoring, reporting, & verification**	**Governance & community engagement**
Design longer & larger field studies; improve carbon & environmental monitoring tools	Improve regional, global, & field site models to support monitoring, reporting, and verification (MRV) and to evaluate scaling	Optimize efficiency of iron addition; minimize environmental and societal impacts	Advance technologies to monitor carbon and assess ecological and environmental impacts	Address ethical, legal, and community concerns; incorporate public input into research

Responsible research—not at-scale deployment

ExOIS is not proposing or advocating for large-scale OIF. Our work focuses on scientific research to better understand the effectiveness and environmental impacts of OIF to support future decisions on policies and regulations governing its use. We are not funded by carbon credit sales, and all data will be publicly shared.

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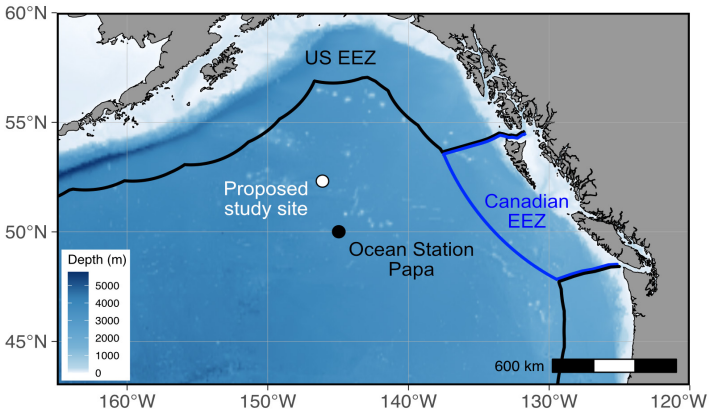
Field experiment details

The North Pacific Carbon Study (NPCS) is a set of proposed experiments located about 400 nautical miles off the coast of Alaska to explore the safety and effectiveness of OIF. These experiments will answer key scientific questions about carbon storage while minimizing unintended impacts to the environment, in order to support informed regulation of potential future large-scale mCDR efforts.



» **Iron deployment:** Add relatively small amounts of bioavailable iron to a 30 x 30 km (16 x 16 nautical mile) patch of ocean water over 7-10 days—equivalent to the concentration of one paper clip dissolved in an Olympic-sized swimming pool.

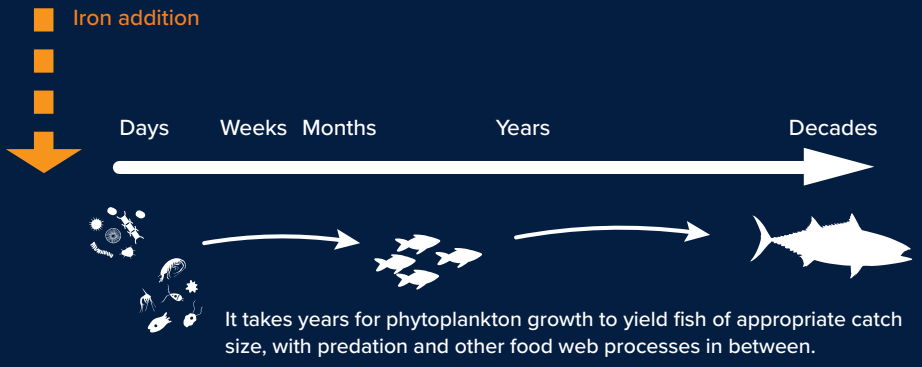
» **State-of-the-art technology:** Use ships, ocean & satellite-based sensors, and autonomous vehicles to monitor the study area for 1 to 3 months before and after iron release.

» **Carbon removal:** Measure the amounts of carbon taken up in the surface ocean and sinking to deeper waters to be stored for more than 100 years. Model the uptake of atmospheric carbon dioxide by the ocean to predict the effects of larger iron additions.

» **Extensive environmental monitoring:** Monitor surrounding waters to ensure changes remain localized and within expected ranges, with particular attention to ecosystem health.

Connection between OIF and fisheries

Proposed OIF field trials are small and not intended to enhance fisheries. However, they will measure phytoplankton, zooplankton, and carbon export to improve predictions of how OIF could influence marine ecosystems and fisheries over longer timescales.



What we know

1. **Added iron increases phytoplankton abundance.** Iron additions consistently stimulate phytoplankton growth, often favoring large diatoms important to marine food webs.
2. **Natural iron inputs have been linked to phytoplankton productivity.** Events like dust deposition and volcanic eruptions have been associated with higher phytoplankton productivity, the base of the marine food web.
3. **Food webs respond to iron inputs.** Studies show changes in plankton communities that can lead to enhanced export of organic matter, both of which influence the food web.

What we don't know

1. **Do increases in phytoplankton lead directly to more fish biomass?** It remains unclear due to mismatches in the scale and timing of experiments versus fishery responses.
2. **Would changes in plankton composition affect fish?** While diatom increases may enhance fisheries, impacts on nutrition and ecosystem balance are uncertain.
3. **Could there be unintended environmental impacts that affect fisheries?** Potential risks like low oxygen, harmful algal blooms, and downstream nutrient effects have not been observed in past experiments but require careful monitoring.