oceanironfertilization

# Ocean Fertilization:
# Ironing Out Uncertainties in Climate Engineering


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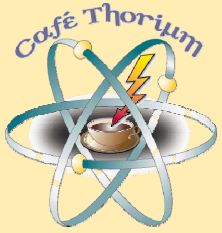
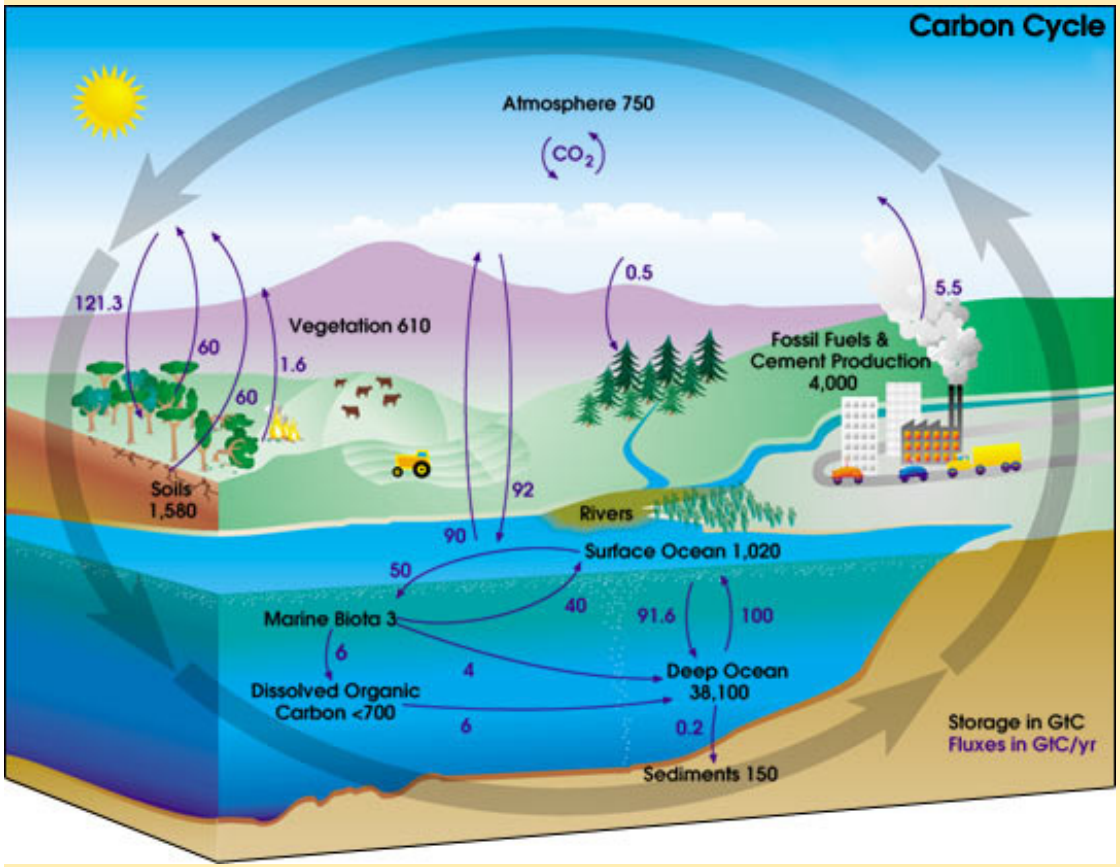
"Give me half a tanker of iron and I'll give you the next ice age"

*J. Martin, 1988*

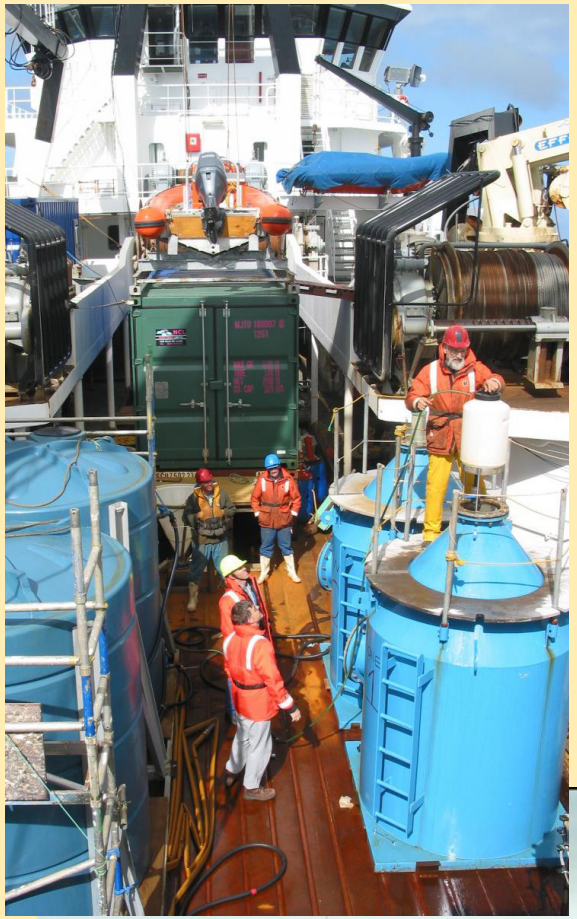



http://cafethorium.whoi.edu

# Global Carbon Cycle

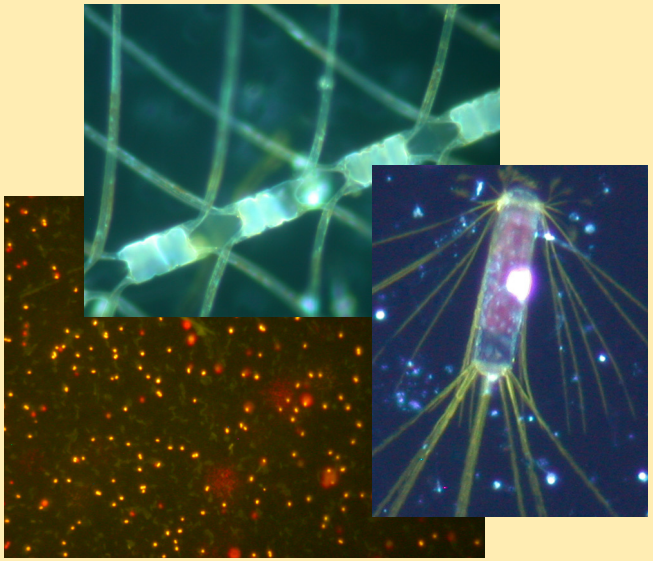


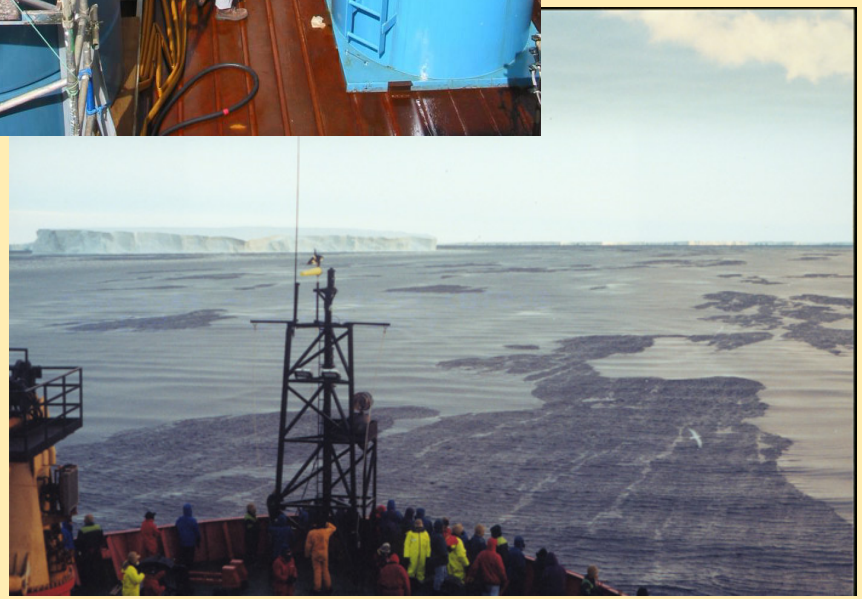

- human activities release ~7.5 billion metric tons C/yr as $CO_2$
- marine algae contribute half of global photosynthesis
- deep ocean 50 times larger carbon reservoir than atmosphere



## Could we geoengineer the ocean to be a larger carbon sink by adding "micronutrient" iron?

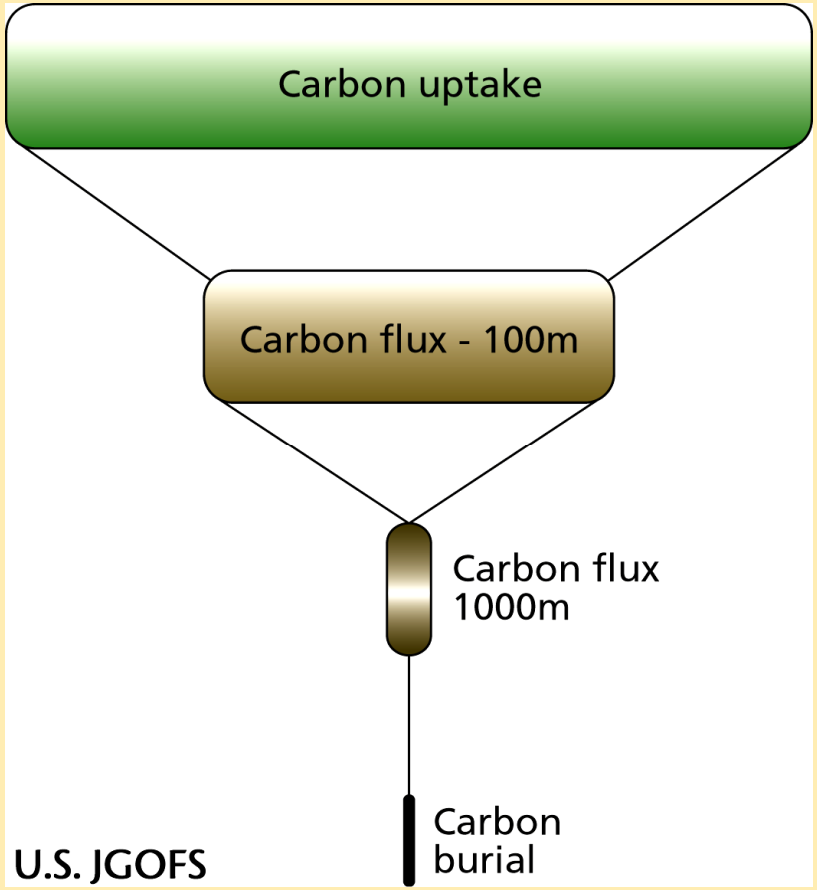
1. Add iron
   Fe:C = 1:100,000
2. See marine algae "bloom"
   *- 12 experiments*





3. Measure $CO_2$ decrease
   *- but only in surface, as plants need sunlight*

# Does iron enhance ocean carbon sink?




**Photosynthesis = $CO_2$ uptake**

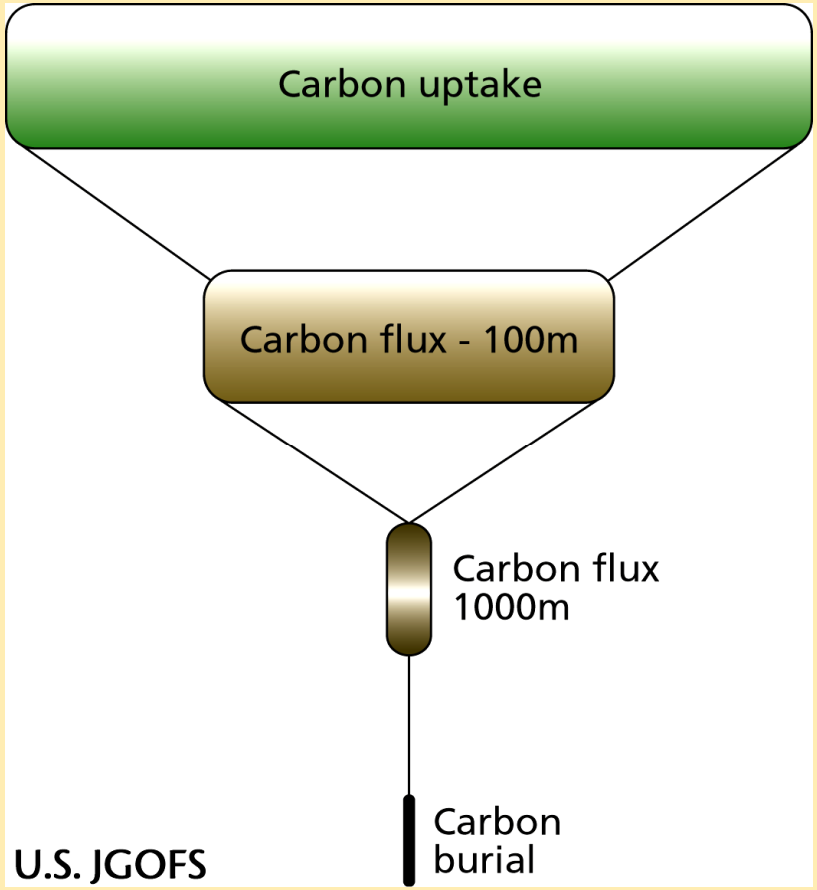
**Carbon sequestration**

**to 100m**
*<2 to >50% (decades)*

**to 1000m**
*~1-20% (centuries)*

**to sediments**
*~0.1% (millennia)*

# Does iron enhance ocean carbon sink?




$CO_2$ uptake

Carbon sequestration

*decades*

*centuries*

*millennia*

Most carbon does not reach the deep sea (~10%)

# Ocean Iron Fertilization

## Science is *certain* regarding-

1. Small iron additions can stimulate algal blooms & $CO_2$ uptake

## Science is *uncertain* regarding-

1. Will it work?

   how much $CO_2$ & how long

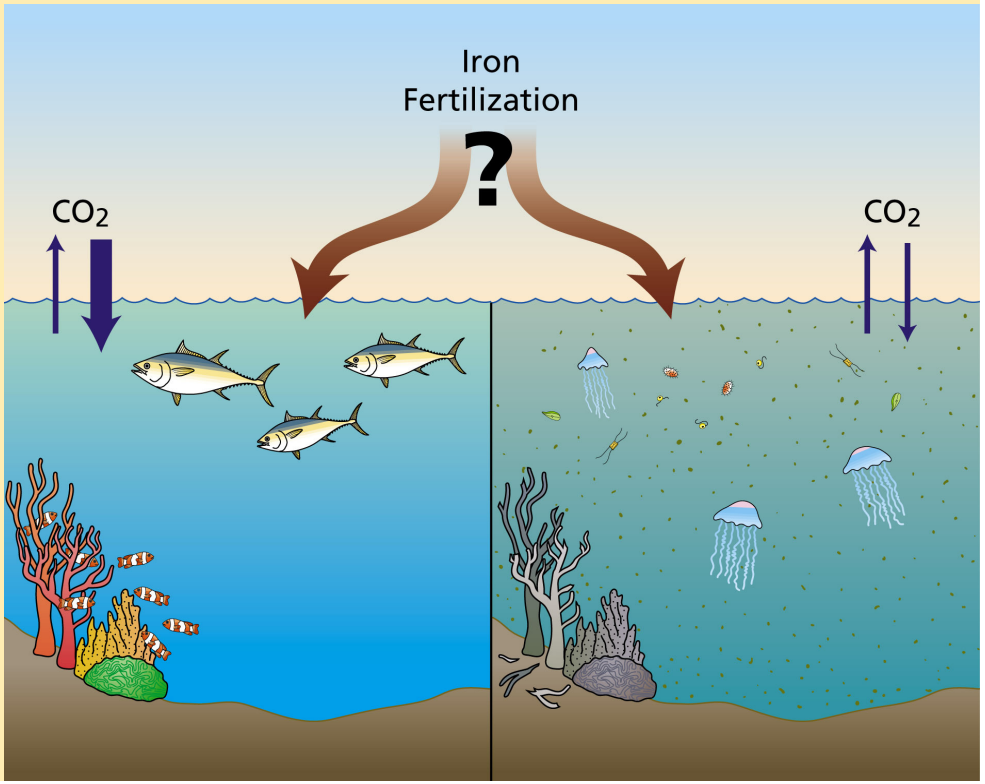
   *(big potential- 100's MtC/yr)*

2. What are the ecological consequences?

   intended & unintended

3. What is variability & predictability?

   especially at larger & longer scales



# What comes next?

POLICYFORUM

ENVIRONMENT

## Ocean Iron Fertilization—Moving Forward in a Sea of Uncertainty

It is premature to sell carbon offsets from ocean iron fertilization unless research provides the scientific foundation to evaluate risks and benefits.

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## Scientific research priorities are clear

- ✓ Larger & longer experiments
- ✓ Follow subsurface fate of C
- ✓ Study ecological consequences
- ✓ Studies of other gases- $O_2$, $N_2O$, $CH_4$, DMS
- ✓ Improve models

# Is marine geoengineering a solution?

1. scaling is key
   - "large scale" projects (100x100 km) are small and transient relative to natural ocean C cycle
   - would need to regulate or expect tragedy of the commons

2. other climate mitigation options, including no action, have an impact on the oceans
   - sea level rise, acidification, temperature, UV

boston.com

THIS STORY HAS BEEN FORMATTED FOR EASY PRINTING

## US corn boom threatens sea life

### Fertilizer runoff polluting Gulf

The Boston Globe

By Henry C. Jackson, Associated Press | December 18, 2007

JEFFERSON, Iowa - Because of rising demand for ethanol, American farmers are growing more corn than at any time since the Depression. And sea life in the Gulf of Mexico is paying the price.

# Is marine geoengineering a solution?

1. scaling is key

2. other climate mitigation options, including no action, have an impact on the oceans

3. watch out for bold claims on both sides!
   + enhanced fisheries & food for whales
   - harmful algal blooms, anoxia and dead fish

4. further research would inform important policy decisions


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