

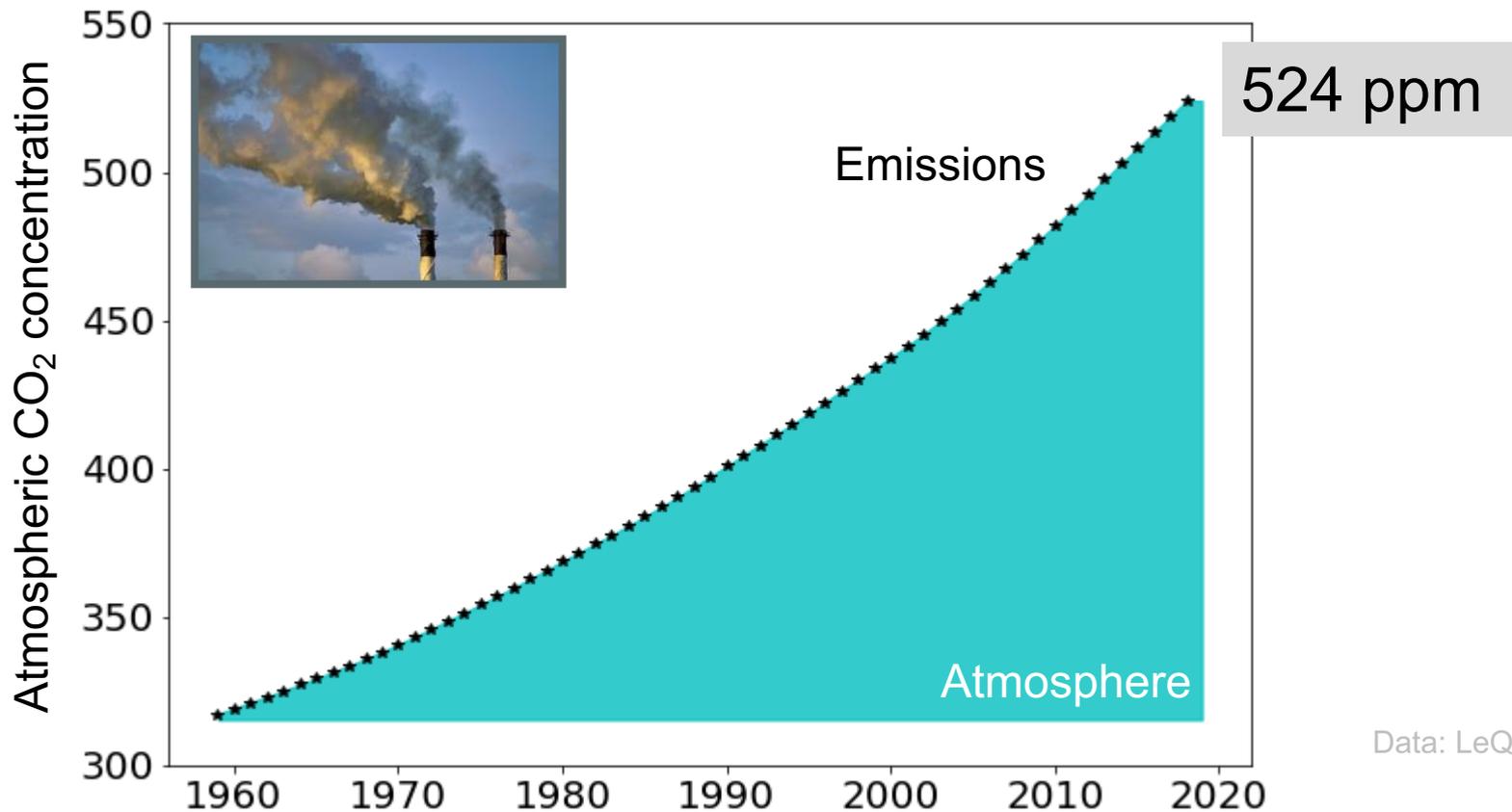
#Oceans4Future?

The ocean in the Global Carbon Budget

Judith Hauck

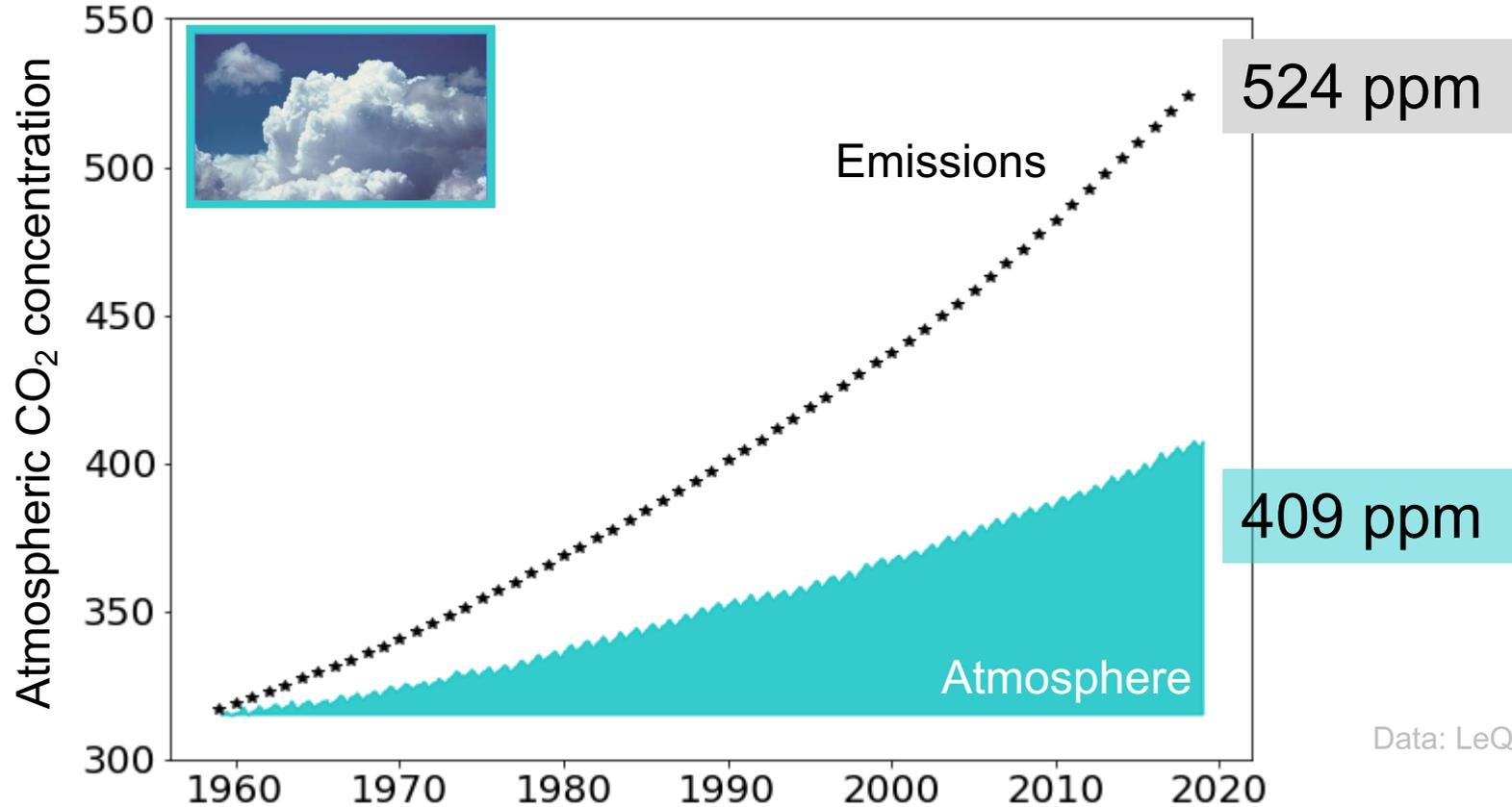
Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung

All CO₂ emissions since 1958 in the atmosphere



Data: LeQuéré et al., 2018

Where has the carbon gone?



Data: LeQuéré et al., 2018

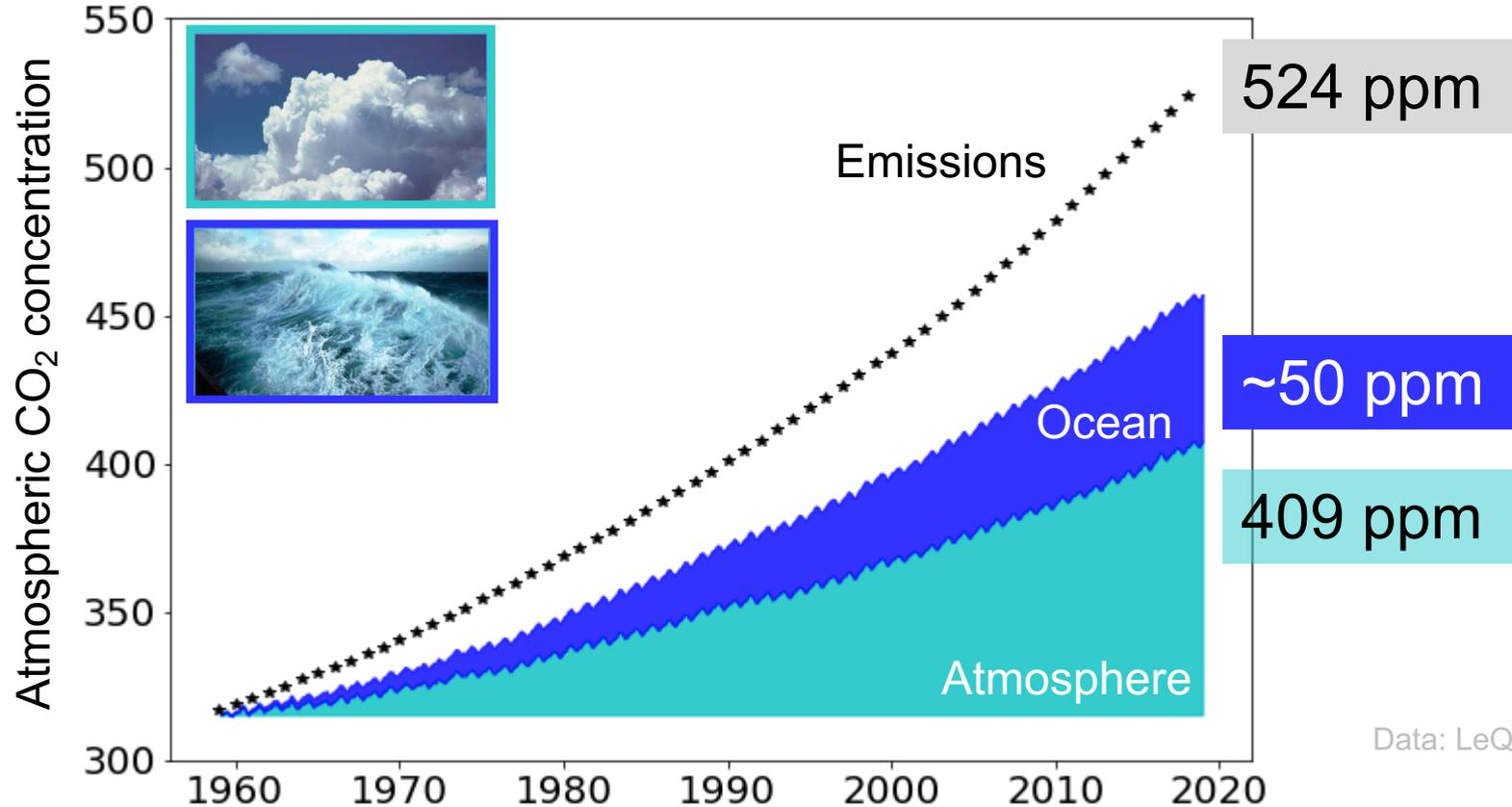


Charles Keeling

The Keeling curve

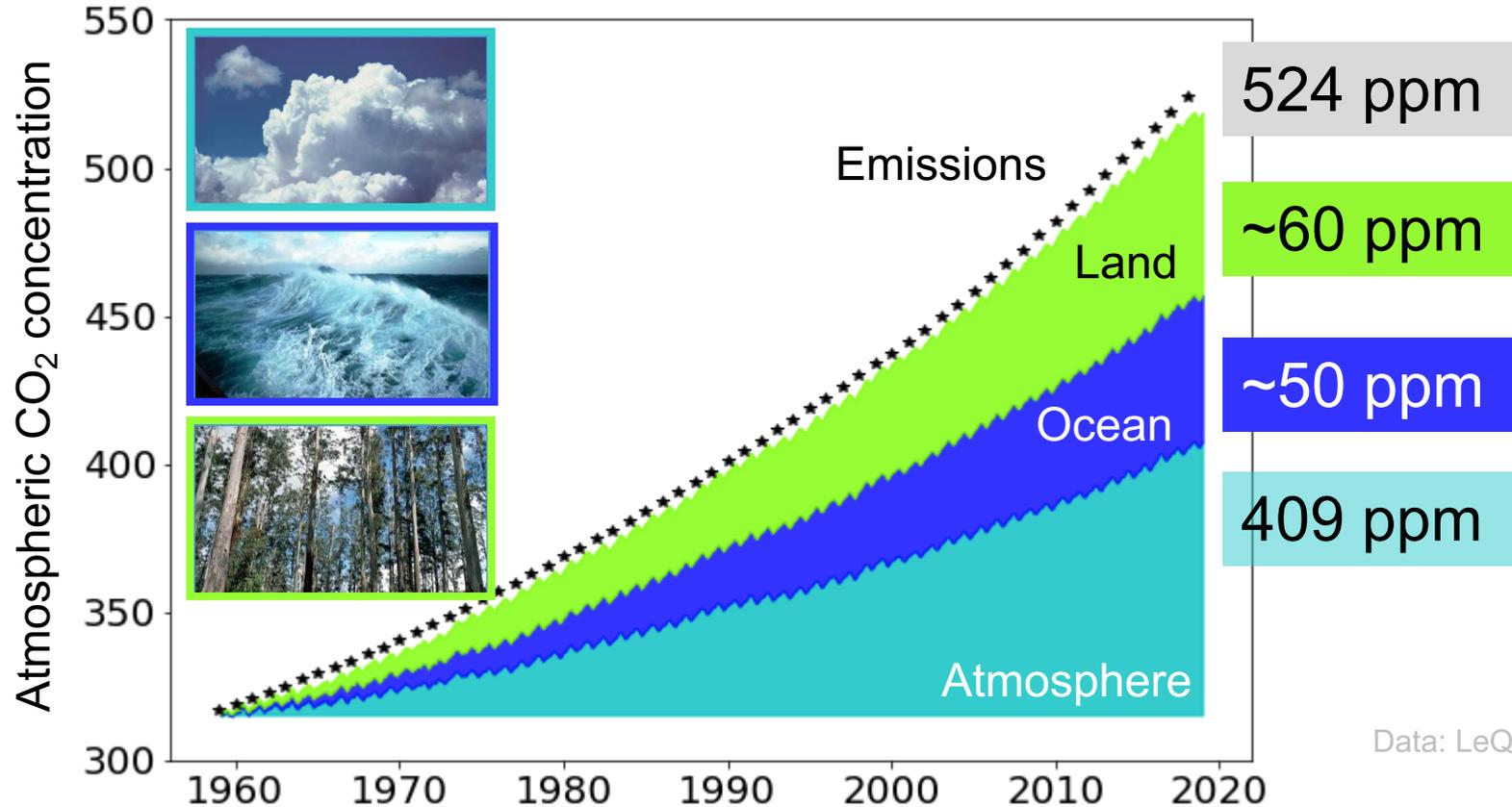
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<https://commons.wikimedia.org/w/index.php?curid=20025052>

Where has the carbon gone?



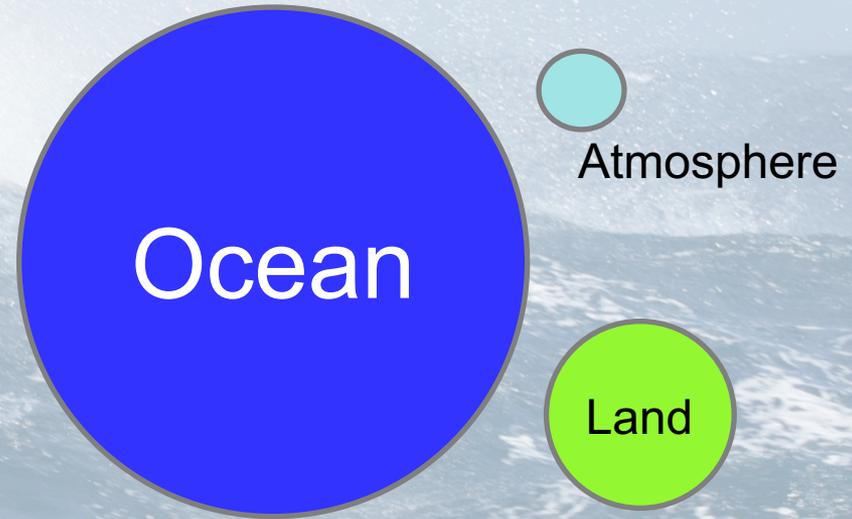
Data: LeQuéré et al., 2018

Where has the carbon gone?



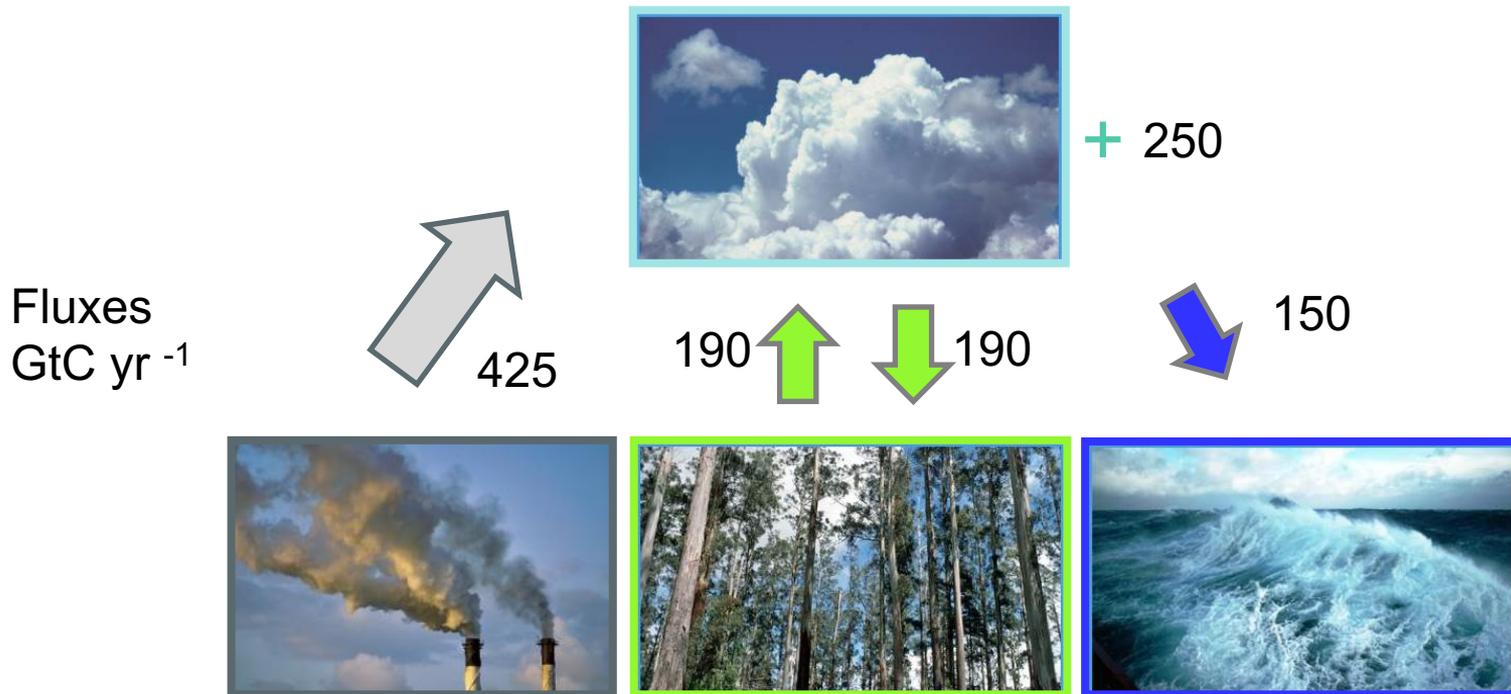
Data: LeQuéré et al., 2018

Carbon reservoirs



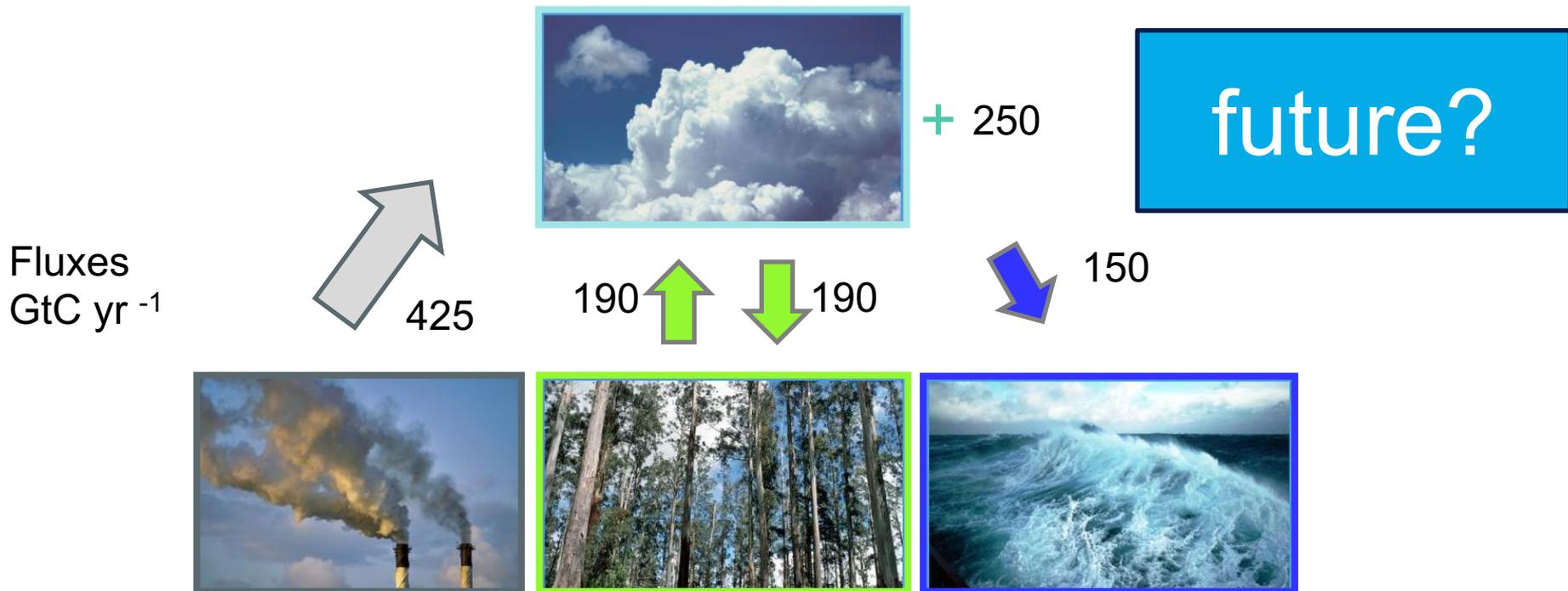
Anthropogenic carbon flows

Cumulative changes during 1870–2017



Anthropogenic carbon flows

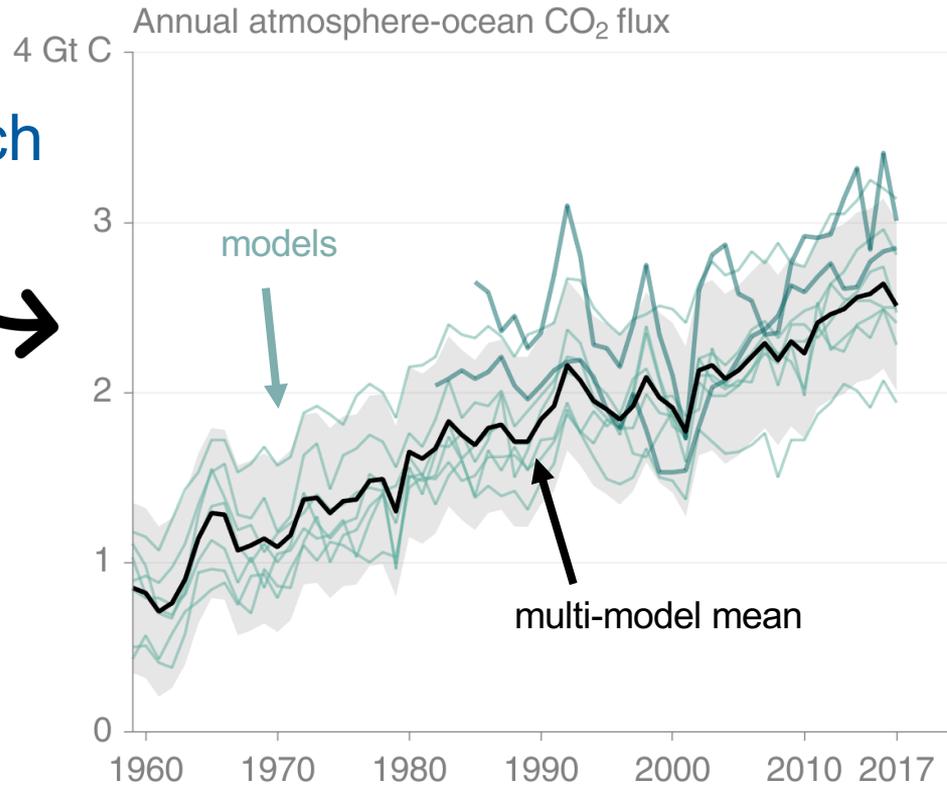
Cumulative changes during 1870–2017



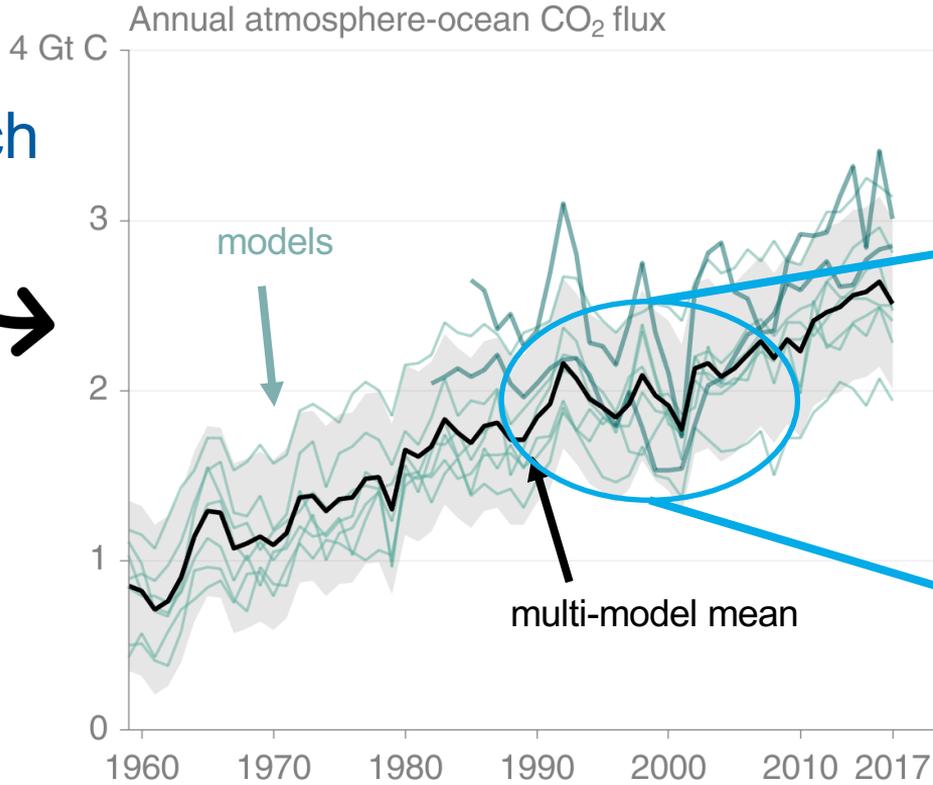
Global Carbon Budget

Annual updates of the CO₂ emissions, and CO₂ fluxes between ocean, land and atmosphere

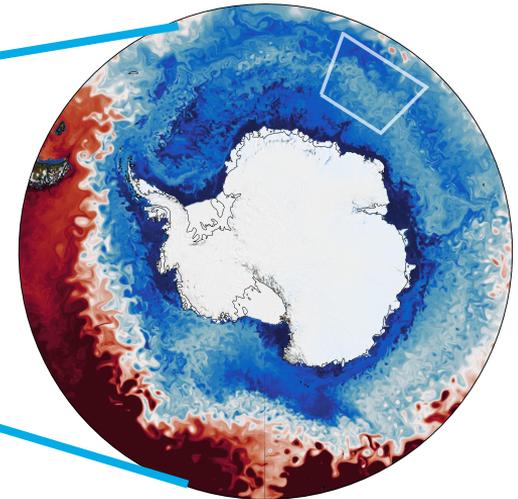
How much CO₂ goes into the ocean each year



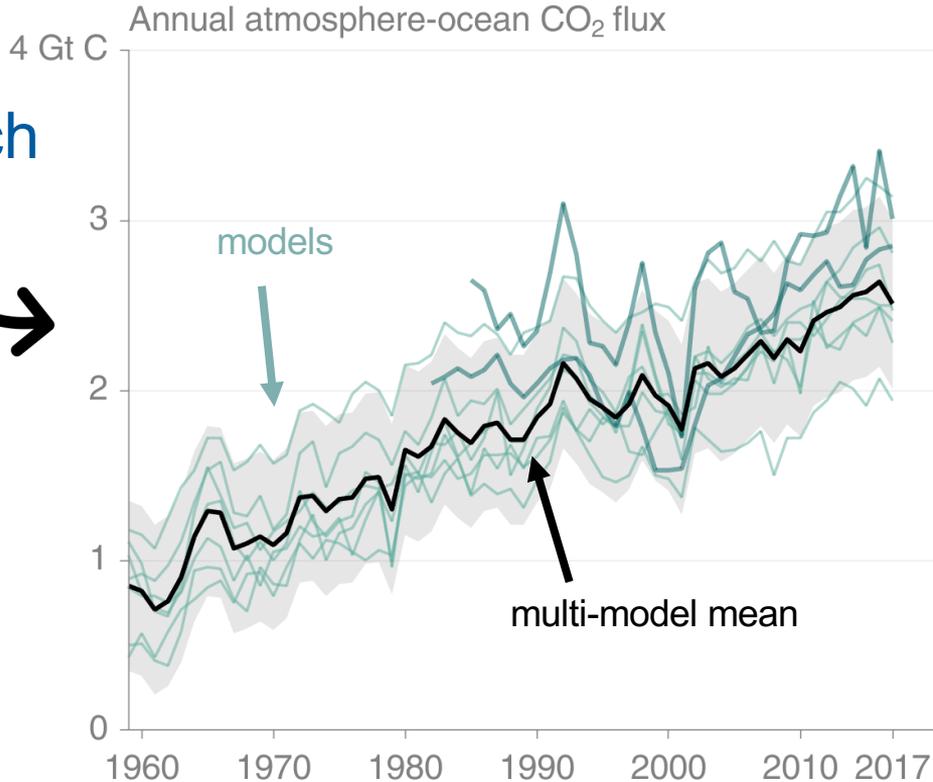
How much CO₂ goes into the ocean each year



Climate change effects in the Southern Ocean

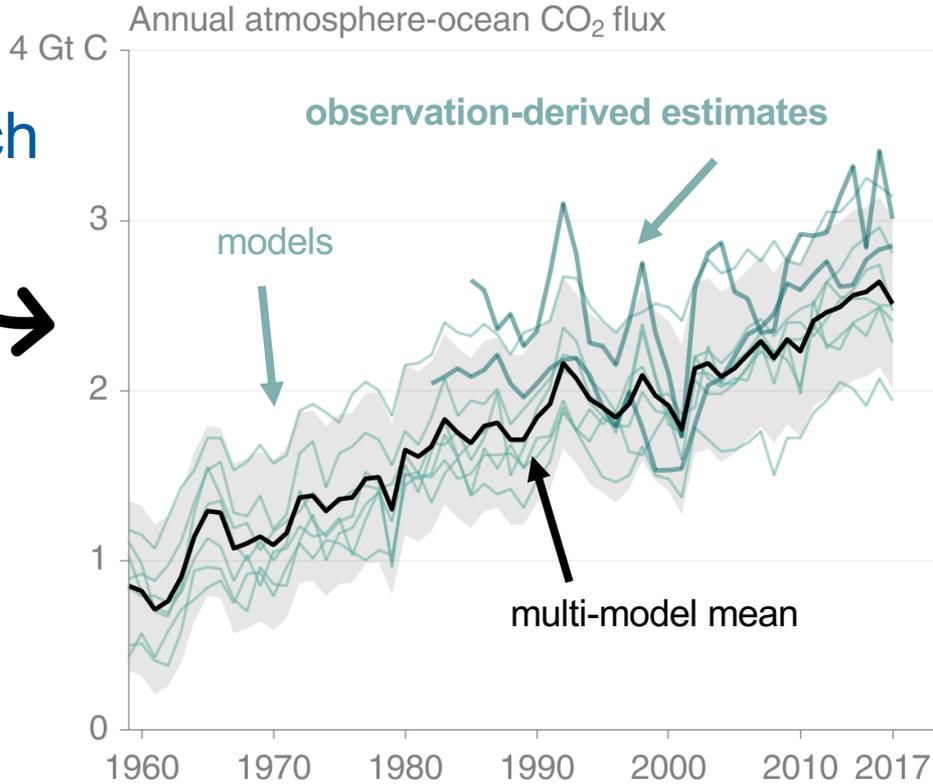


How much CO₂ goes into the ocean each year

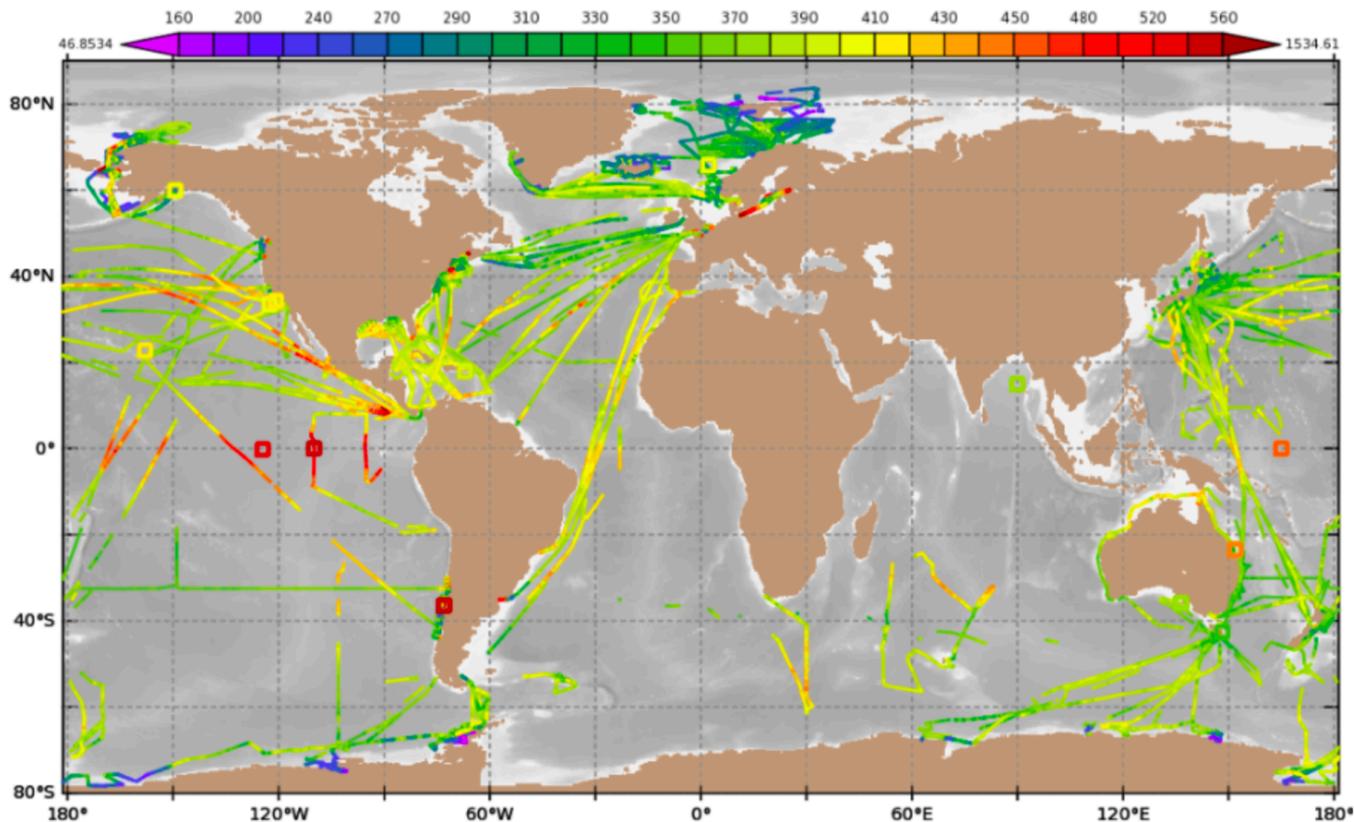


Ocean models Including: REcoM

How much CO₂ goes into the ocean each year

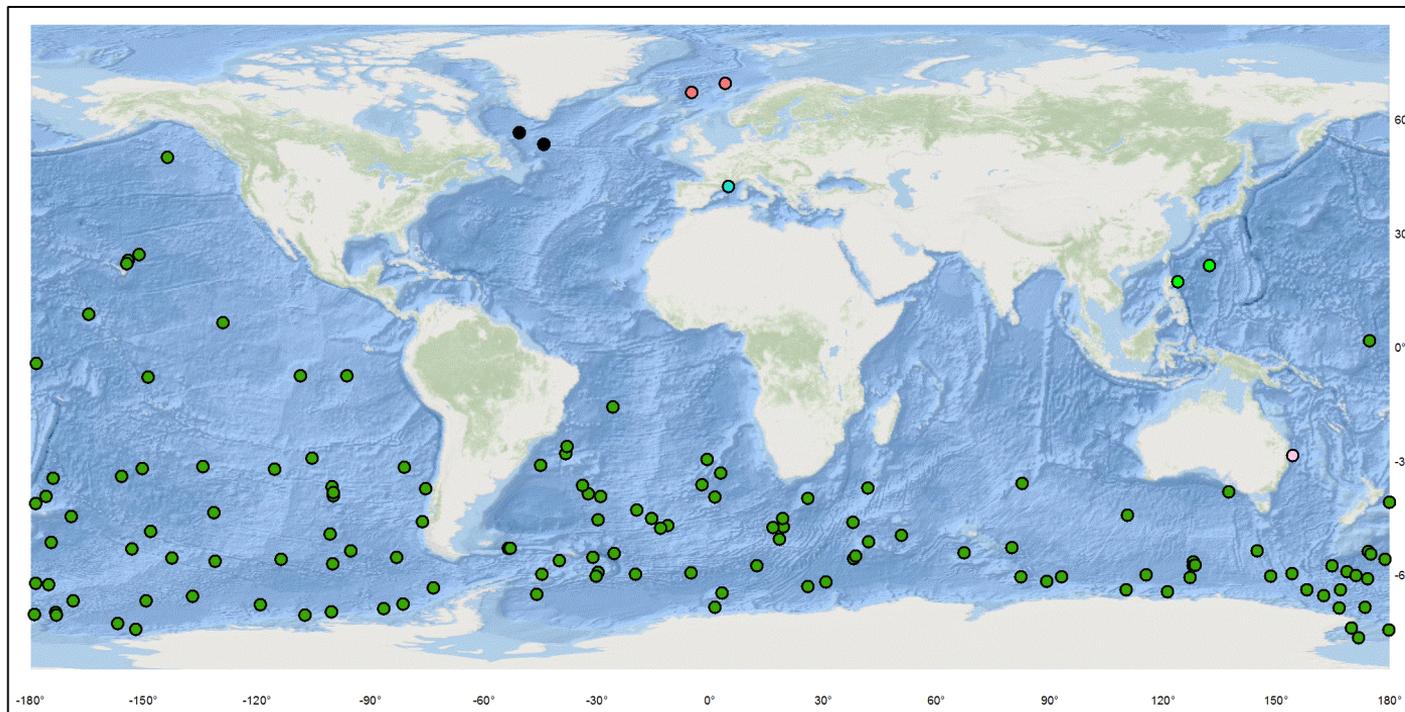


Surface ocean pCO₂ measurements in 2017



Robotic carbon observation systems?

Robotic carbon observation systems?



Financed by:

- USA
- Germany
- Norway
- China
- Australia
- Europe

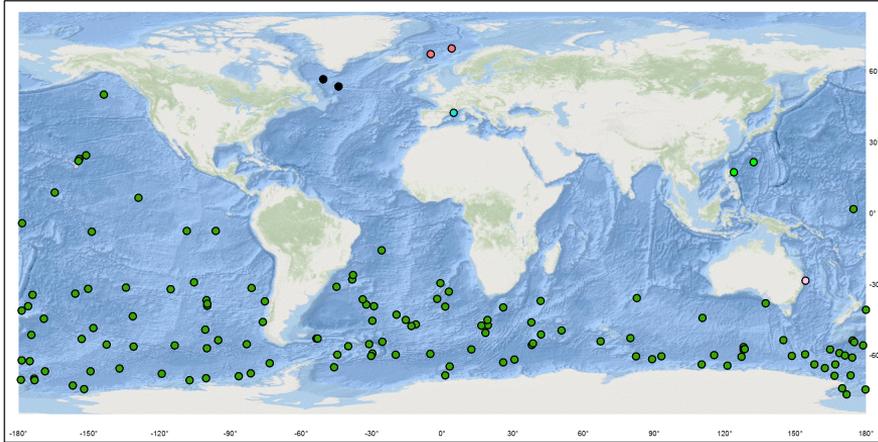


BGC-Argo pH

28/10/2019

Generated by jcommops.org

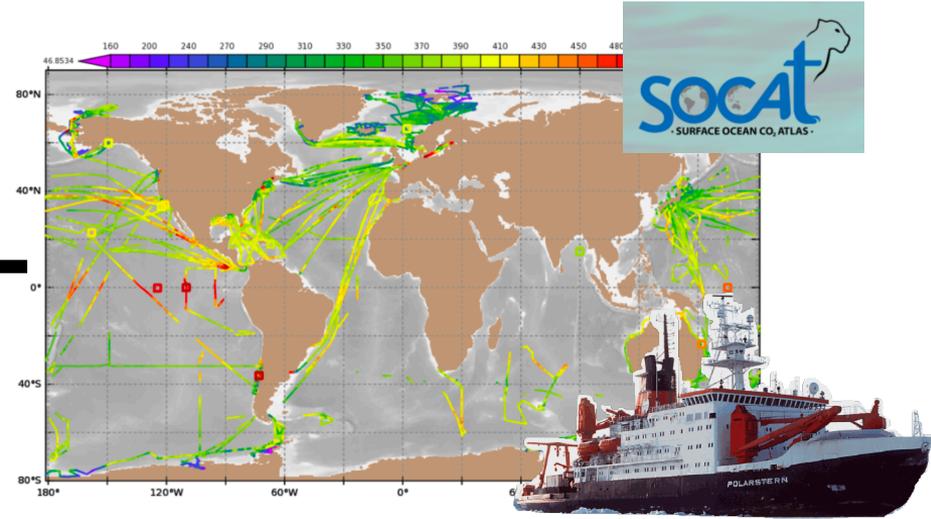
The ocean carbon cycle community is longing for an integrated ocean carbon observing network



Argo

BGC-Argo pH

28/10/2019



- Higher uncertainty
- + Access to remote areas

- + High-quality
- Data gaps

“Most 1.5°C and 2°C pathways are heavily reliant on CDR [carbon dioxide removal] at a speculatively large scale before mid-century.”

IPCC 1.5°C Report

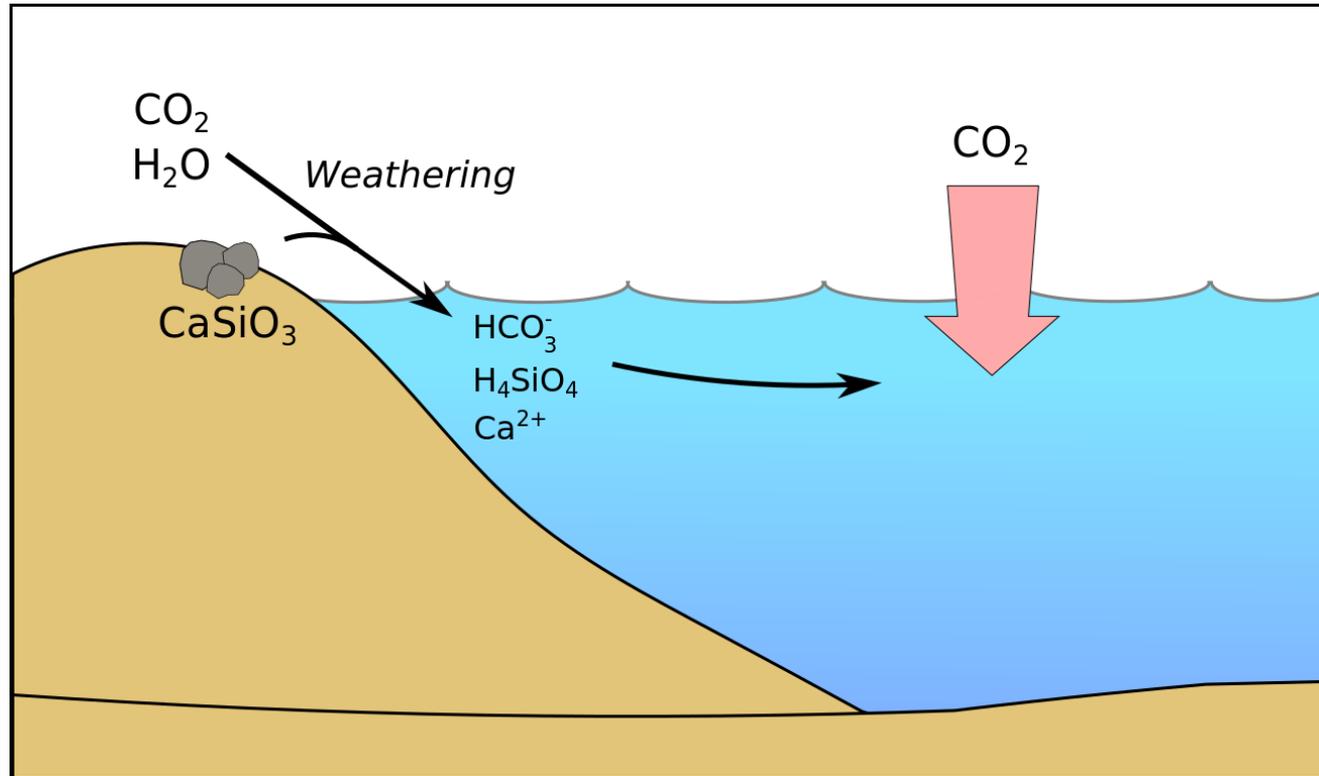
“Most 1.5°C and 2°C pathways are heavily reliant on CDR [carbon dioxide removal] at a speculatively large scale before mid-century.”

“... substantial uncertainty about the adverse effects ...”

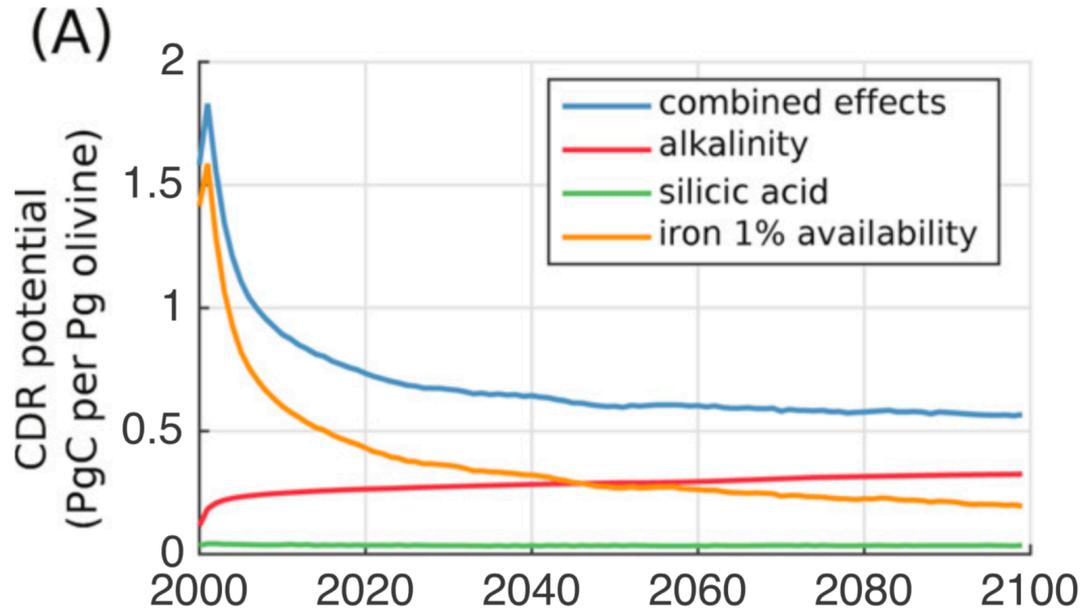
IPCC 1.5°C Report

Carbon dioxide removal

Enhanced weathering / ocean alkalization



Carbon dioxide removal



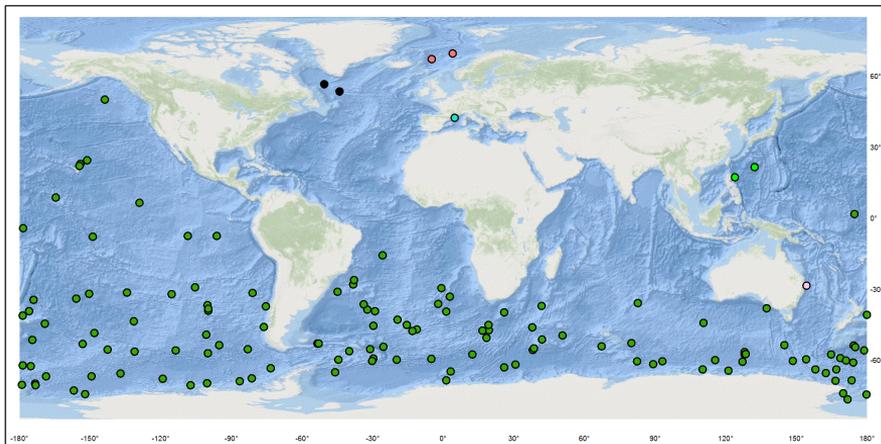
Scale:

Large-scale mining activities for silicate rocks would be necessary

Risks and side-effects:

Unknown

An integrated ocean carbon observing network is needed

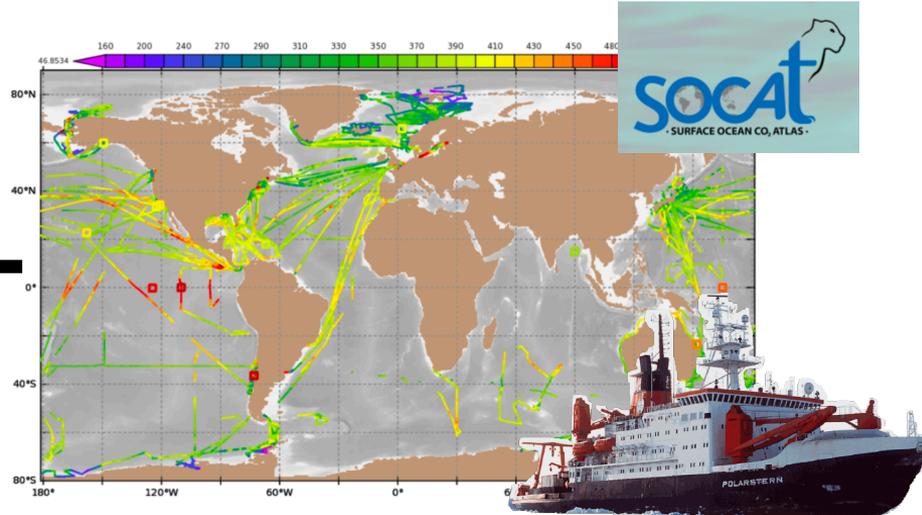


Argo

BGC-Argo pH

28/10/2019

+



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