Jet Propulsion Laboratory
California Institute of Technology

NASA Data & Models To Support Marine Carbon Dioxide Removal

Challenges & Opportunities

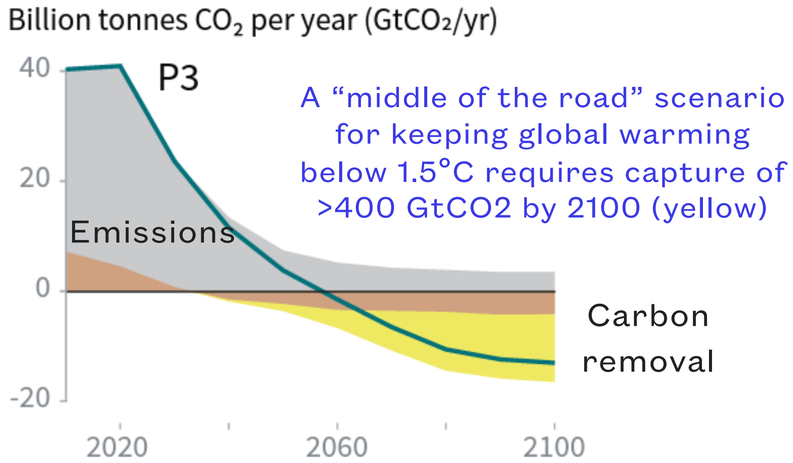
Kay Suselj (kay.suselj@jpl.nasa.gov)

JET PROPULSION LABORATORY / CALIFORNIA INSTITUTE OF TECHNOLOGY

Marine carbon dioxide removal

A NEW FRONTIER IN THE CLIMATE CHANGE FIGHT

- Removal of multiple gigatons of atmospheric carbon will be needed to keep global warming below 1.5°C, per the latest IPCC assessment report
- Marine carbon dioxide removal (mCDR) approaches are potentially more scalable than direct carbon capture and other land-based approaches
- Approaches that mimic and accelerate the natural carbon cycle minimize risks to marine ecosystems. Moreover, they can simultaneously combat ocean acidification and help safeguard biodiversity



A “middle of the road” scenario for keeping global warming below 1.5°C requires capture of >400 GtCO2 by 2100 (yellow)

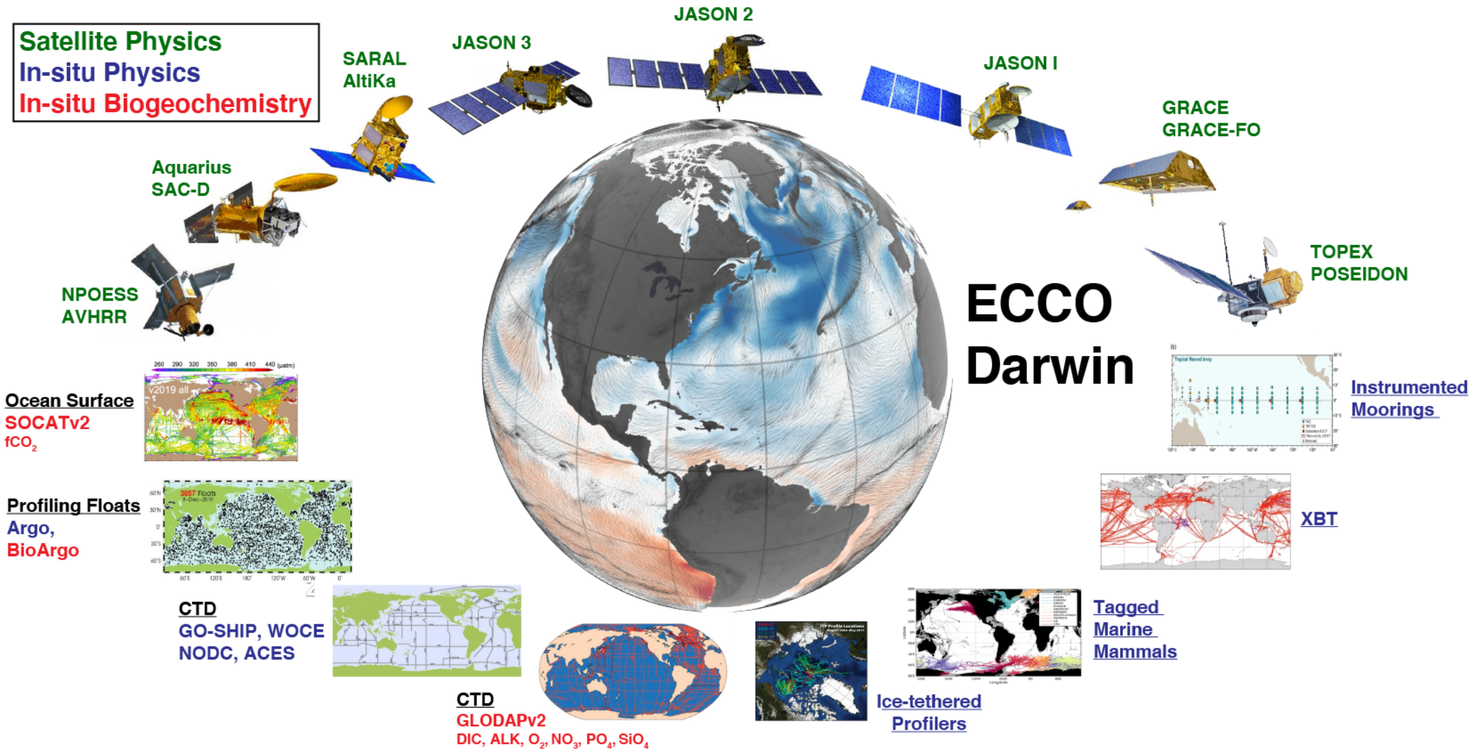
1 gigaton is >100 million African elephants

NASA's role in the biggest challenge in human history

- A mission of this scale has many crucial components: deploying safe and effective mCDR strategies at the appropriate times, locations, and scales
- Optimizing these components requires science-based approaches, investment in observations and modeling on a scale that the private sector has difficulty achieving
- As the global carbon market matures, there is increasing emphasis on independent measurement, reporting, and validation (MRV) of carbon removal
- NASA is in a uniquely powerful position to facilitate and accelerate these crucial components of climate change mitigation

Current NASA assets

- **Unparalleled assets**
  - Comprehensive observations of global carbon, ocean dynamics, and related quantities
  - Open-source data assimilative models including ECCO-Darwin (https://github.com/MITgcm-contrib/ecco_darwin)
  - Research infrastructure and human capital
  - Long-term vision and ability to implement it



Carroll et al., 2020: The ECCO-Darwin Data-Assimilative Global Ocean Biogeochemistry Model. JAMES, doi:10.1029/2019MS001888

Future opportunities

- Develop ECCO-Darwin for optimizing mCDR deployments and measurement, reporting, and validation (MRV) *(see poster #43 for specifics; Suselj et al., 2024 Earth's Future in prep.)*
- Close knowledge gaps in ocean science and biogeochemistry to improve understanding of ocean systems and how they interact with inorganic carbon
- Understanding impact of mCDR on ecosystem health and resilience using NASA tools (e.g. ECCO-Darwin)
- Close collaborations with mCDR industry to help optimize and scale mCDR deployments and provide unbiased MRV and risk assessment (current collaborations with Running Tide Inc., Google, and The Climate Foundation - many more opportunities)