PML | Plymouth Marine Laboratory



Dr Gemma Kulk,
gku@pml.ac.uk,
Plymouth Marine Laboratory
SCOPE Project Lead, COOL Project Co-lead



Dr Victor Martinez-Vicente,
vmv@pml.ac.uk
Plymouth Marine Laboratory
COOL and SUPaCOOL Project Lead

Satellite-Derived Products for the Ocean to Inform Carbon Assessments

Satellite observations provide a robust and increasingly comprehensive basis for monitoring ocean carbon at a global scale, supporting climate science, carbon budget assessments and evidence-based climate policy

Why does this matter? What do we do about it?

The ocean absorbs around a quarter of anthropogenic CO_2 emissions. However, ocean carbon data derived from satellite observations remain underrepresented in global carbon budget assessments.

To improve the characterisation of the global ocean carbon budget, Earth Observation experts explore the best methods to improve and produce satellite-derived ocean carbon datasets.

This poster highlights initiatives led by Plymouth Marine Laboratory, to advance satellite derived ocean carbon mapping and to produce accessible datasets for more effective integration into carbon budget assessments by researchers, policymakers and other end users. It also announces upcoming lines of research on this direction.

Ocean carbon pools and fluxes from space

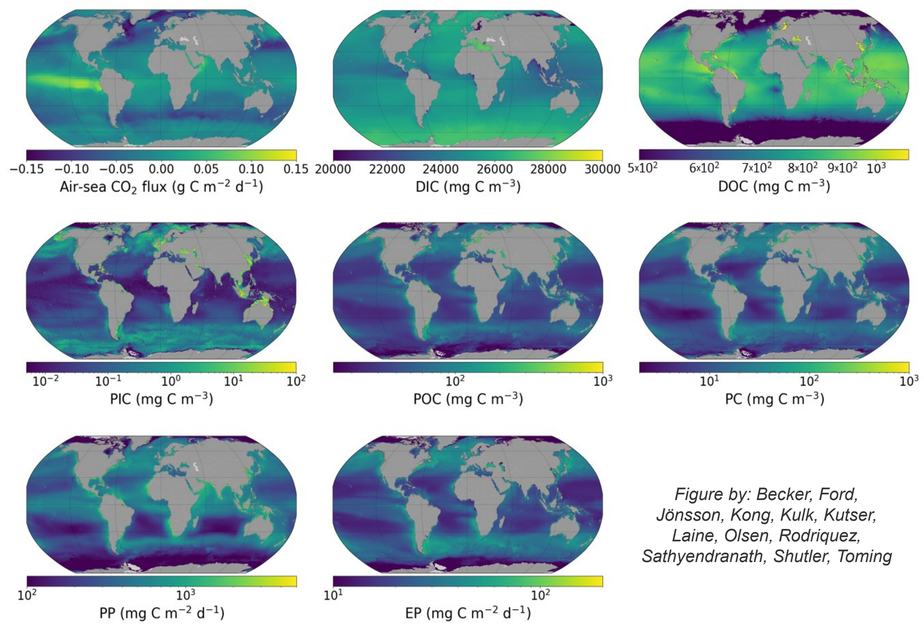


Figure by: Becker, Ford, Jönsson, Kong, Kulk, Kutser, Laine, Olsen, Rodriquez, Sathyendranath, Shutler, Toming

How can satellite data be used to observe the ocean carbon cycle?

Satellite remote sensing provides the only practical means of observing the global ocean systematically and repeatedly at the spatial and temporal scales required to monitor long-term change.

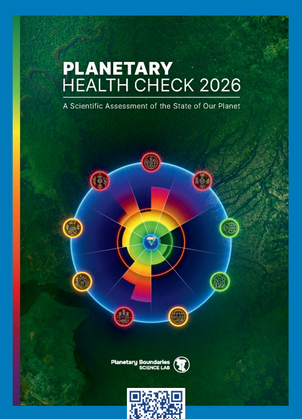
When integrated with in situ observations, models and data assimilation approaches, the satellite observations provide consistent, uncertainty-characterised products that capture key components of the ocean carbon cycle across space and time. Establishing a foundation for long-term ocean carbon monitoring to inform climate science, policy, and operational carbon monitoring activities.

What are policy and climate examples of the data usage?

Satellite-derived data products are increasingly contributing to major international climate assessments and modelling activities, demonstrating their growing value for climate research and policy, such as:

- ✓ Global Carbon Budget assessments
- ✓ IPCC assessments
- ✓ Copernicus State of the Climate
- ✓ Planetary Health Check
- ✓ Earth System Model evaluation
- ✓ National climate reporting
- ✓ Policy development

GLOBAL CARBON BUDGET



What data products are currently available?

The suite of data products, which were developed as part of the ESA funded ‘Satellite based observations of Carbon in the Ocean: Pools, fluxes and Exchanges’ (SCOPE) project, will help improve understanding of how the ocean carbon cycle is changing, which is fundamental to monitoring climate change, improving climate predictions and supporting evidence-based mitigation and adaptation strategies. These include air-sea CO_2 exchange, dissolved inorganic and organic carbon, particulate inorganic and organic carbon, phytoplankton carbon and primary and export production, as shown in the diagram below.

All products contained in the ocean carbon data record underwent rigorous validation, which assessed the accuracy, robustness and uncertainty of the datasets against independent in situ observations and established reference datasets. Validation demonstrated that the products provide a reliable and consistent representation of ocean carbon variables.

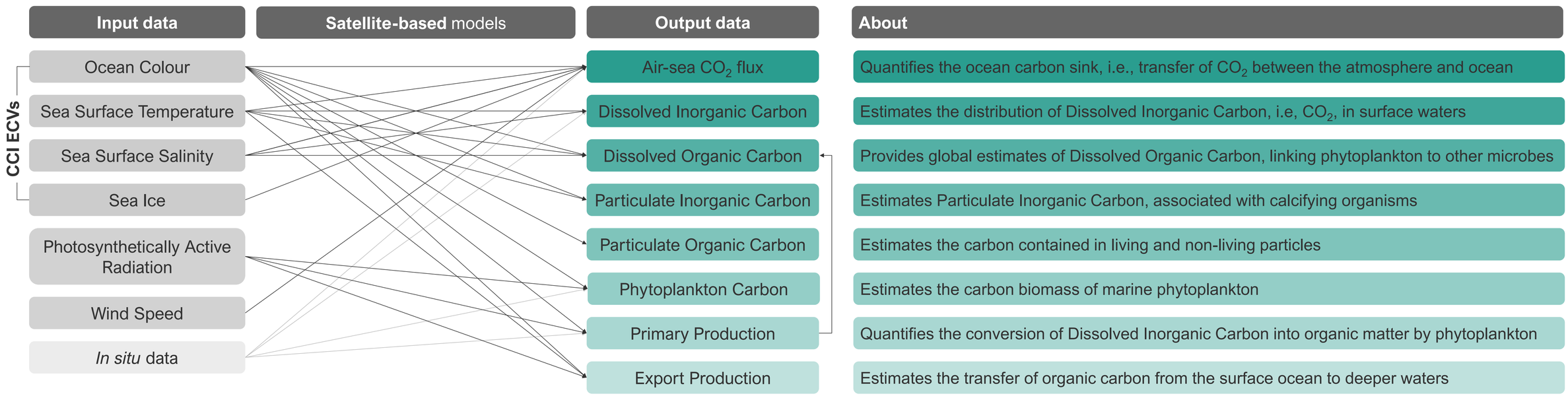
Data access and contact

All data products will be made openly available through ESA EarthCODE (https://earthcode.esa.int/). While the datasets are currently provided in scientific formats suitable for advanced users, the aim is to make access to the information as straightforward as possible for a wider range of users including researchers, Earth System modellers, climate services and policymakers.

All datasets have been developed with uncertainty estimates to support both scientific and policy applications. The documentation, references and so on will be made available on the SCOPE website: www.oceancarbon-scope.org. In case of questions please email forinfo@pml.ac.uk .

SCOPE

Funded by: esa



What is next? The coastal ocean!

Coastal oceans, though small in area, play a major role in global carbon cycling and support vital ecosystems and industries like fisheries and aquaculture. However, they are also sensitive to human impacts from land. While satellite technology has advanced significantly in tracking carbon in the open ocean, monitoring coastal waters remains challenging due to their optical complexity and proximity to land.

By developing advanced satellite algorithms to measure key carbon components such as particulate and dissolved organic carbon and primary production with high spatial and temporal resolution the ESA-funded ‘Carbon from Earth observation between ocean and land’ (COOL) project aims overcome this challenge. Complementing the COOL project is SUPaCOOL which prepares tools ready for the next generation of hyperspectral and temperature satellites (ESA CHIME and LSTM) across the land-ocean continuum, supporting future climate assessments and decision-making.

COOL
CARBON FROM EARTH OBSERVATION BETWEEN OCEAN AND LAND
www.coastalcarbon-cool.org

SUPaCOOL
Sentinel User Preparation and organic Carbon from earth Observation between Ocean and Land
www.coastalcarbon-supacool.org

Funded by: esa