

Seasonal predictability of ocean biogeochemistry and potential benefits of ESA CCI data assimilation

David Ford¹, Joan Llort², Pablo Ortega², Andrea Rochner¹

¹Met Office, ²Barcelona Supercomputing Center

CMUG

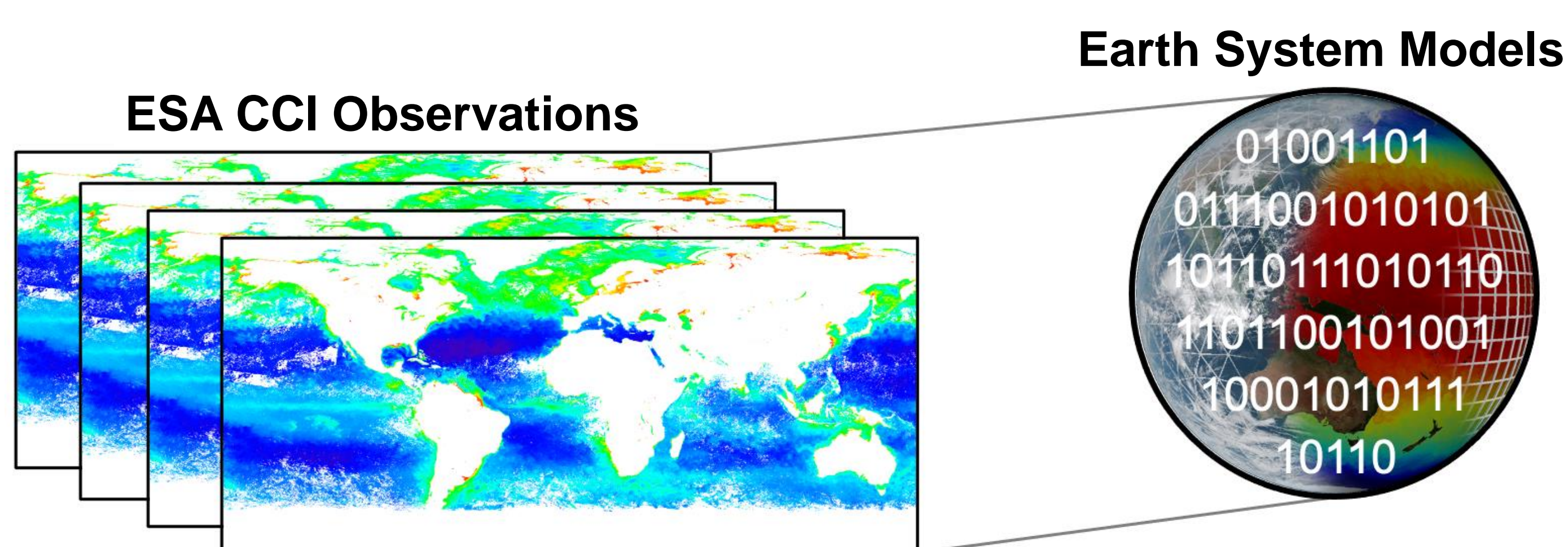
The ESA Climate Change Initiative (CCI) Climate Modelling User Group (CMUG) provides a dedicated forum through which the Earth observation data community and the climate modelling and reanalysis community can work together.

A new three-year phase of CMUG began in Autumn 2023, comprising several short science projects among other activities. WP5.4 “Seasonal predictability of ocean biogeochemistry and potential benefits of ESA CCI data assimilation” runs from April 2024 to July 2025.

Science questions

This study aims to address three broad science questions:

1. What is the value of assimilating physical (sea surface temperature, sea surface salinity, sea level, sea ice) and biogeochemical (ocean colour) ESA CCI ocean data in generating initial conditions for seasonal predictions of ocean biogeochemistry?
2. What is the dominant factor at initialisation (the physical or the biogeochemical state) in determining predictive skill at global and regional scales?
3. What is the best strategy for constraining initial conditions to achieve skilful predictions of ocean biogeochemistry?



Science background

Recent progress in Earth System Models (ESM), particularly the representation of ocean biogeochemistry, has begun to allow ESMs to be used to predict changes in key ocean biogeochemical variables (e.g., pH, oxygen, net primary production, chlorophyll) at seasonal to decadal time scales. Such predictions could be used for environmental monitoring, fisheries management, and other purposes. Ocean observations are vital for initialising and validating predictions. But the optimal strategy for use of satellite data in initialisation remains an open question.

Outline of work and status

Met Office and BSC will run experiments using the ocean components of two ESMs (UKESM and EC-Earth3-CC). These will assimilate different combinations of ESA CCI Essential Climate Variables, to assess the added value of these data. One set of experiments will focus on assimilating physics data, and another on adding assimilation of ocean colour data. Met Office will assimilate chlorophyll concentration, and BSC will assimilate particulate organic carbon derived from CCI ocean colour.

A kick-off meeting was held in April, and work has been ongoing to implement and test the assimilation capabilities in both ESMs. Experiments will be run shortly, and results will be presented in various forums once available.

ECV	Product	Assimilation	Validation
SST	CCI v3.0	Along-track L2P/L3U (MO) Daily L4 (BSC)	Daily and monthly L4 (MO, BSC)
SSS	CCI v4.41	Along-track L2P (MO)	Weekly and monthly L4 (MO, BSC)
Sea Level	CMEMS L2 C3S L4 CMEMS L4	Along-track L2 (MO)	Daily and Monthly L4 (MO, BSC)
Sea Ice	CCI/OSI SAF v3.0 C3S SIT	Daily L4 ice concentration (MO, BSC)	Daily and monthly L4 ice concentration (MO, BSC) Daily and monthly L4 ice thickness (MO, BSC)
Ocean Colour	CCI v6.0 BICEP/NCEO	Daily L3 chlorophyll (MO) Monthly L3 particulate organic carbon (BSC)	Daily and monthly L3 chlorophyll (MO, BSC) Monthly L3 primary production (MO, BSC) Monthly L3 phytoplankton carbon (MO, BSC) Monthly L3 particulate organic carbon (MO, BSC)