A Synthetic Ensemble of Global Ocean Chlorophyll Concentration

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Abstract

Ocean primary production constitutes approximately half of global biospheric production, affecting both fisheries productivity and biogeochemical cycling. Although climate change is predicted to affect the ocean's biological productivity, the extent of the global impact is poorly quantified. Assessing changes in the ocean biosphere using remote sensing data is challenged by the relatively short length of the observational record, restricting our ability to disentangle fluctuations in internal variability from forced anthropogenic trends. Additionally, the majority of ocean circulation models with embedded biogeochemistry do not skillfully predict observational records of ocean chlorophyll at ocean time series locations. To overcome these limitations, we have constructed a synthetic ensemble of global ocean chlorophyll concentration. By employing statistical resampling methods to the SeaWiFS and MODIS ocean color datasets and creating surrogate climate modes of ENSO and PDO, we quantify the range of internal climate variability in the 20 year observational record and create multiple alternate realities for the possible evolution of the ocean biosphere over time. Our synthetic ensemble can be used for a variety of purposes, including diagnosing patterns of internal variability and emergence of anthropogenic trends in observed chlorophyll, and validating Earth system model representation of such variability.

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We have created **alternate evolutions** of **ocean chlorophyll** over time.

Using a synthetic ensemble to evaluate the role of internal variability on marine phytoplankton

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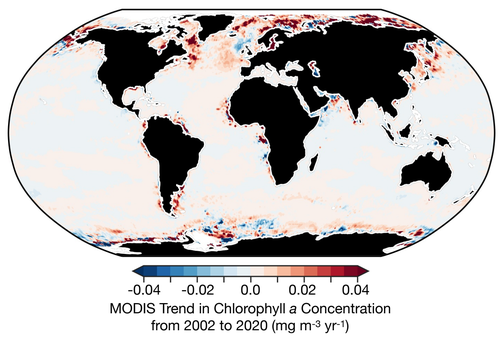
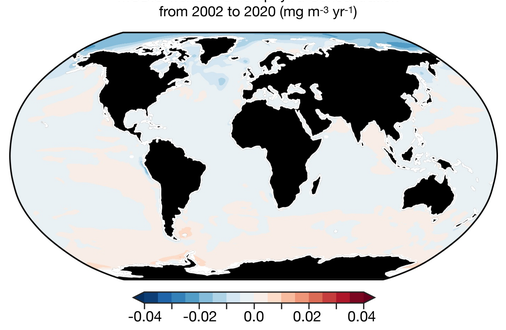
INTRODUCTION

Are the effects of anthropogenic climate change on marine phytoplankton already visible?

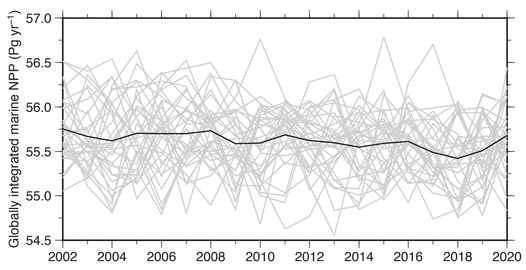
Satellite-derived remote sensing datasets suggest the effects can be observed already.



Large ensembles of ESMs indicate the effects have not yet emerged over the historical period.



We aim to reconcile this conflict by constructing a synthetic ensemble to constrain the effect of internal climate variability on phytoplankton.



METHODS

How to create a synthetic ensemble.

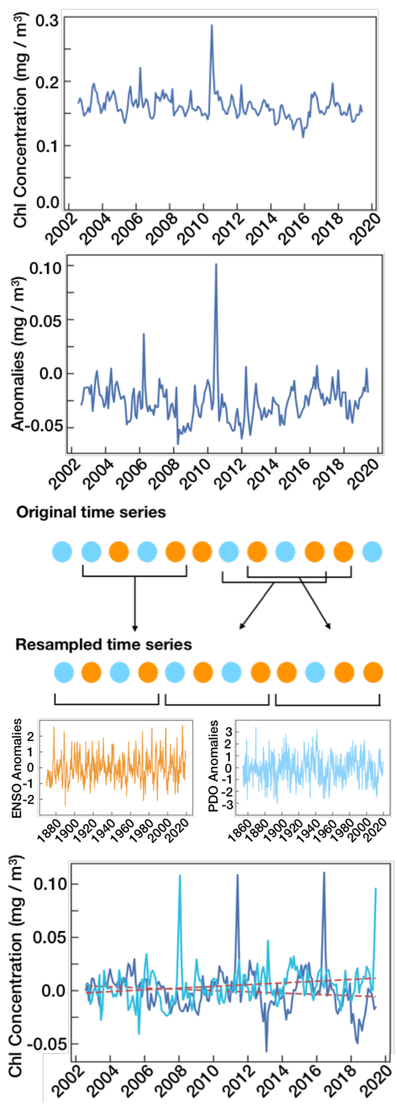
Generate a time series

Remove the linear trend, seasonal cycle, and climate modes

Block bootstrap the anomalies

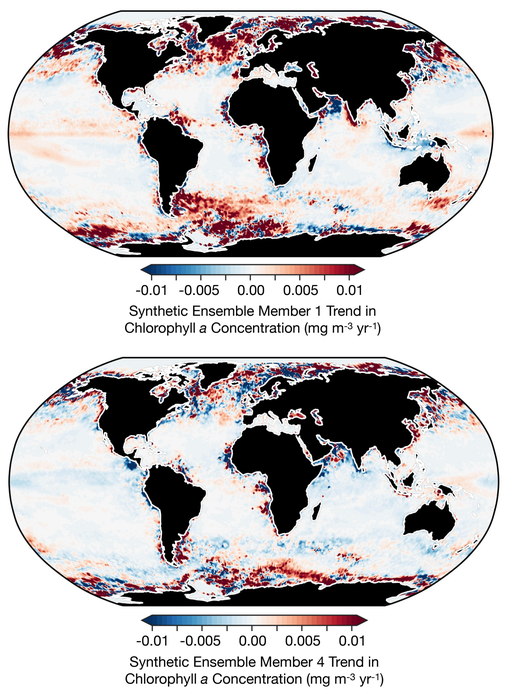
Generate surrogate climate modes

Combine the linear trend, seasonal cycle, block bootstrapped anomalies, and surrogate modes



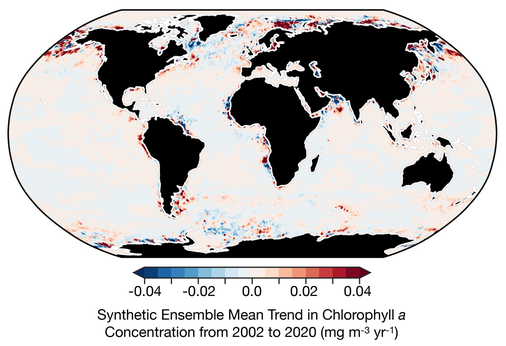
RESULTS

We created a synthetic ensemble of global chlorophyll concentration.



CONCLUSION

The synthetic ensemble reveals the important role of internal climate variability on the ocean biosphere's evolution.



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