

What is our niche?

CESM provides a well-developed **community** framework for groups to test and evaluate new conceptual & model developments for detailed aspects of biogeochemistry in the context of a consistent global system.

The core activities of CESM provide a broad and deep starting point for researchers at universities. There is a large return on investment for the large, expensive model simulations (CMIP scenarios; large ensemble; etc) run by CESM. (developers, users, users of output from the model; need to provide useful output for users of output; early engagement)

-- big data problem, maintain leadership on this front

The modular nature allows diverse research groups to design their own research efforts on both climate and biogeochemical

Where should we go in the next 5 years?

1) Assessment: a rigorous identification of model biogeochemical and coupled BGC-physical biases using a systematic evaluation relative to a diverse suite of observations

2) Improving the coupled BGC-physical model performance based on an assessment of fundamental processes while avoiding over-tuning of the BGC to compensate for errors in the physics

- what is strongly supported by either theory, lab or field observations?
- where are the knowledge gaps & uncertainties?
- what are effectively free (or tunable) parameters?

3) Long-term planetary sustainability over multiple future timescales (decade, century, and *millennium*).

- fisheries in the oceans
- agricultural productivity on land
- nutrient coupling, radio carbon, CH₄, N₂O, and soil fertility

What are our needs?

How should we frame BGC efforts within CESM:

coherent, fully coupled BGC-physics is important for capturing the overall system dynamics and sensitivity to anthropogenic perturbations, feedbacks, and information relevant to impact, adaptation and mitigation studies

Biogeochemical dynamics require fully coupled physical systems linking biological productivity and biogeochemical fluxes (C, N, P, Fe etc.) in a consistent fashion with water, energy, circulation etc. across the full range of time and space scales (from diurnal and synoptic to centennial and from grid-scale to global).