

## MARBL update

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10 February 2016

CESM OMWG Workshop

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# Modular biogeochemical modeling for next-generation ocean models

MARBL  
Marine Biogeochemistry Library



## Objectives

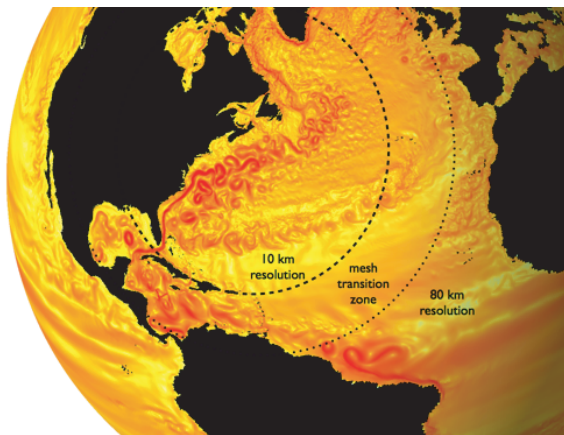
1. Enable portability to alternate physical frameworks.
2. Enable question-dependent configuration.
3. Improve physiological and ecological realism.

## The tracer equation view of biogeochemistry

$$\frac{\partial \chi}{\partial t} + \nabla \cdot (\mathbf{u}\chi) - \nabla \cdot (K \cdot \nabla \chi) = B_{\chi}(\mathbf{x})$$

# Enable portability to alternate physical frameworks

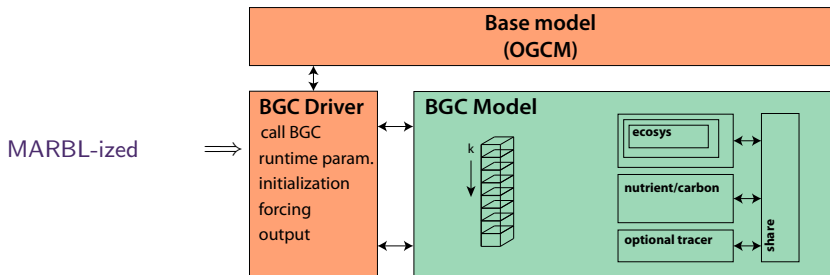
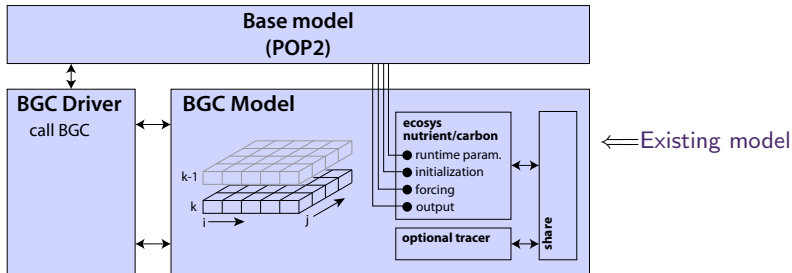
## MPAS-Ocean Model for Prediction Across Scales



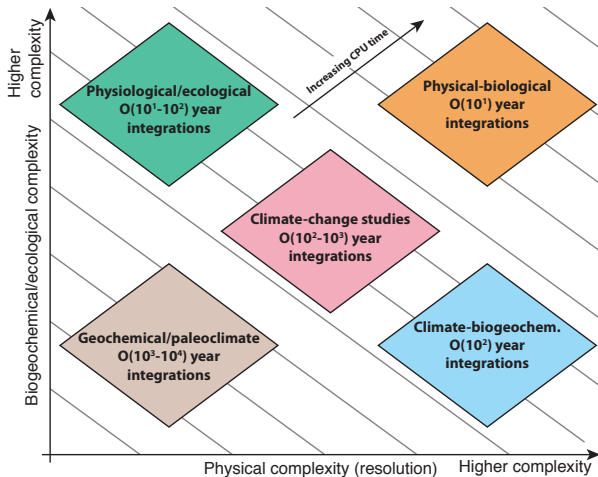
Surface kinetic energy

*courtesy of T. Ringler*

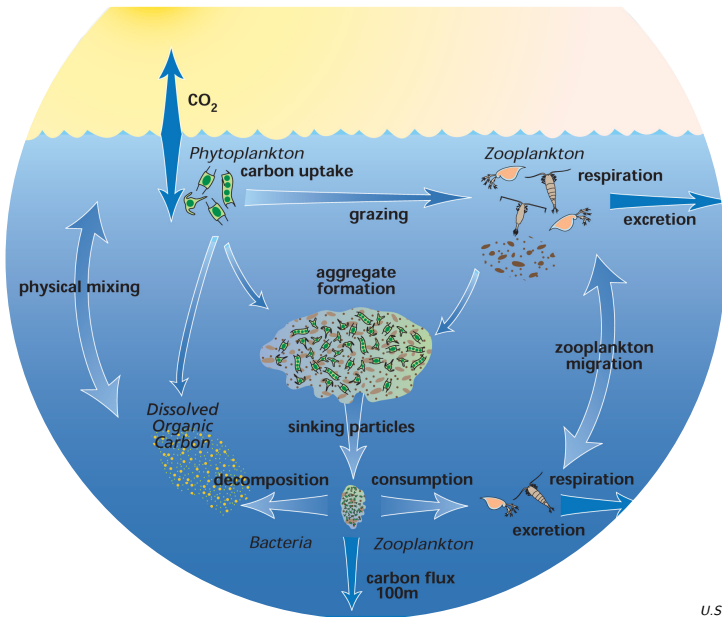




# Enable question-dependent configurations

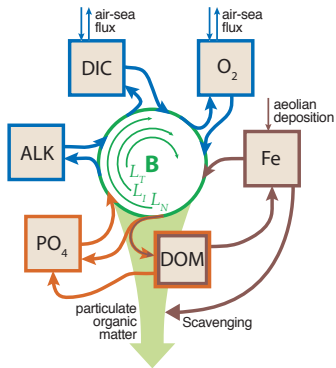


# The biological pump

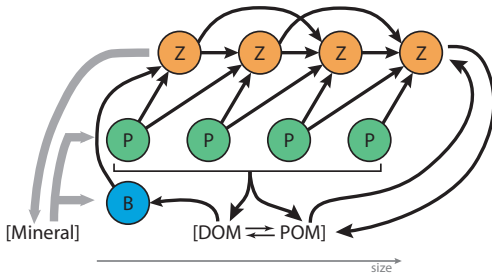


# End-members: biogeochemical versus ecological

## Implicit biomass treatment



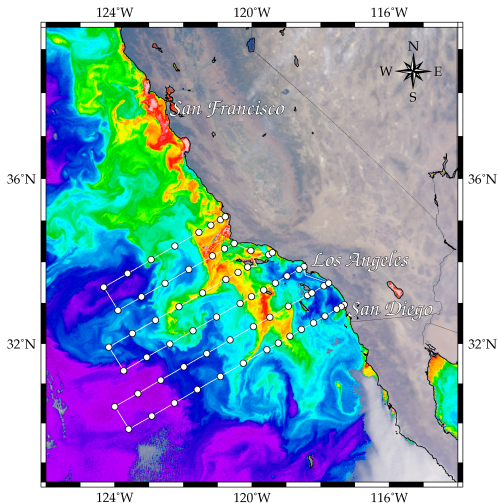
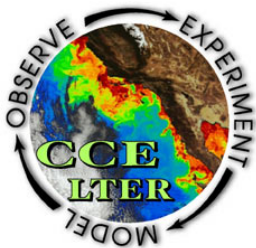
## Planktonic food webs



# Improve physiological and ecological realism

## California Current Ecosystem LTER

- ▶ Highly dynamic upwelling system;
- ▶ Sensitive to inter-annual variability (PDO, ENSO);
- ▶ Intensive observations sustained for over 60 year.



# Summary

## MARBL objectives

1. Enable portability to alternate physical frameworks.
  - MPAS-O;
  - Offline transport codes;
  - ROMS?
2. Enable question-dependent configuration.
  - Build flexibility to enable ecosystems spanning a range of complexity.
3. Improve physiological and ecological realism.
  - Partnership with LTER group.