Update on BGCWG Activities, Jan 2013

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• Notable BGC biases from CMIP5 Runs
• Developments for CESM1.2 release and beyond
• Other Projects in Progress

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CO$_2$ in 20$^{th}$ Century Experiments

Modeled increase of CO$_2$ over 1850-2005 too large:

- Observed: 94 ppmv
- Diagnostic CO$_2$ tracer: 125 ppmv
- Prognostic CO$_2$ tracer: 114 ppmv

Lindsay et al., submitted
20\textsuperscript{th} Century CO$_2$ Sinks from Atm

Land Residual Uptake

Ocean Uptake

\begin{itemize}
\item [\textbf{CESM1-(BGC), PROG}]
\item [\textbf{CESM1-(BGC), PRES}]
\end{itemize}

Lindsay et al., submitted

Gray bars are 1990s estimates from Canadell et al., PNAS, 2007.
Sea-to-Air CO$_2$ Flux

Long et al., submitted
Anthropogenic CO$_2$ vs GLODAP

Long et al., submitted
Transient tracer uptake

Sensitivity experiments: bias (control) and change
Model Chl vs Satellite Product

Moore et al., submitted
Model Surface Nutrient vs WOA

Moore et al., submitted
Subsurface $O_2$ vs WOA

Moore et al., submitted
Developments for CESM1.2 release

• Generalization of functional group implementation
• Diagnostic PI DIC tracer

• KPAR computation
• Growth, Temperature, and Q10 Value
• Phytoplankton Iron/Carbon Ratios (Fe quotas)
• Remineralization Curves (for un-ballasted POM)
  – length scale increases with depth in upper ocean (100-600m)
  – increased length scale under low O2 concentrations

• Improved DOM cycling
• Optimized grazing and aggregation parameterizations
• Updated initial conditions (O2) and forcing (iron)
Developments beyond CESM 1.2

- Explicit calcifier functional group
- Ocean Acidification feedbacks
- PAR under sea-ice
- Optional Phaeocystis functional group
- Fe in Sea-Ice
- Carbon Isotopes
- NH₄ emissions, N₂O tracer
- Spatially varying iron ligand
- Methane module
- Couple to Sea-Ice Algae
Other Projects

• Enhanced interaction with OMWG
• Comprehensive Diagnostics Package
• Inclusion of BGC in Large Ensemble Experiment
• Newton-Krylov based fast spinup
• Offline tracer tools
• Ecosystem dynamics with resolved eddies