Coupling ROMS and BEC: Application to the North Pacific

It is still under construction.

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**Chl a (ug/L)**
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**Sedimentary iron flux** (mmol/m²/yr)  
Moore & Braucher (2008)
Nishioka et al. (2013)
Dissolved iron concentrations in the North Pacific

Compiled data by Tagliabue et al. (2012)
Seasonal Biological Drawdown of Seawater pCO₂

Takahashi et al. (2002)
We investigated the iron transport process using \textit{POP+BEC (1deg)}

\textbf{Misumi et al. (2011)}
Recently, my colleague Takaki developed a high-res. North Pacific model (1/12-1/4 deg.) using ROMS that can represent the pathway of the Kuroshio and the formation of NPIW realistically.

I want to revisit sedimentary iron transport using the model, and decided to port BEC to ROMS.
BEC

POP (z-coordinate)

Figs of the vertical coordinates are from Marshall et al. (2004)
**BEC**

- Photoadaptation
- Chlorophyll pico/nano diatoms diazotrophs
- Growth
- N$_2$ Fixation
- Calcification

**Inorganic Tracers**
- NO$_3$,
- NH$_4$,
- PO$_4$,
- Si(OH)$_4$,
- Fe,
- O$_2$,
- DIC & Alkalinity

**Zooplankton (adaptive)**

- Grazing

**Mortality & Aggregation**
- Detritus suspended/DOM large (POM, silica, CaCO$_3$, dust)

**Remineralization & Dissolution**

**Excretion**

**Mortality & Sloppy Feeding**

**ROMS (s-coordinate)**

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**POP (z-coordinate)**
BEC

- Photoadaptation
- Chlorophyll pico/nano diatoms diazotrophs
- Phytoplankton pico/nano diatoms diazotrophs
- Growth
- N₂ Fixation
- Calcification
- Grazing
- Zooplankton (adaptive)
- Inorganic Tracers: NO₃, NH₄, PO₄, Si(OH)₄, Fe, O₂, DIC & Alkalinity
- Excretion
- Mortality & Aggregation
- Remineralization & Dissolution
- Detritus suspended/DOM large (POM, silica, CaCO₃, dust)
- Sinking

ROMS (s-coordinate)

- Calculates depth(z) of the s-coordinate, and passes it to BEC
- Handles modules used in BEC depending on POP

Figs of the vertical coordinates are from Marshall et al. (2004)
# Experiments by ROMS+BEC

<table>
<thead>
<tr>
<th></th>
<th>1D-model</th>
<th>3D mid-res.</th>
<th>3D high-res.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domain</strong></td>
<td>50°N, 145°W</td>
<td>20°S-65°N, 109°E-75°W</td>
<td></td>
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<tr>
<td><strong>H &amp; V reso.</strong></td>
<td>45 layers</td>
<td>1°, 45 layers</td>
<td>1/12°-1/4°, 45 layers</td>
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<tr>
<td><strong>Simulated period</strong></td>
<td>40 years</td>
<td>30 years</td>
<td>3 years</td>
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3. Compare the last year data of ROMS+BEC w/ POP+BEC clim.
Result: 3D mid-res. (ann. SSH & vertical vel. of Jan. at 200m)
Result: 3D mid-res. (annual mean temp. at 200m)
Result: 3D mid-res. (winter MLD defined as anomaly of $\sigma_\theta$)
Result: 3D mid-res. (summer MLD defined as anomaly of $\sigma_9$)
Result: 3D mid-res. (annual mean NO$_3$ at surface)
Result: 3D mid-res. (annual mean Chl a at surface)
Result: 3D mid-res.
Statistics are calculated for the North Pacific domain.
Result: 3D high-res. (annual mean Chl a at surface)
Result: 3D high-res. (Chl a)
Conclusions

• **BEC works fine with ROMS** using s-coordinate.
  • The model skill simulating obs. is **comparable** to that in POP+BEC.
  • **Some systematic differences** needed to be addressed are observed.

• **Some BGC tendencies are calculated in the ocean model routines;** we have not taken into account yet.
  • virtual fluxes for DIC and ALK
  • gas exchange

• The **high-res. model** results are **impressive**, but it is a matter **how to initialize the model** owing to its high computational cost.
Result: 1D-model
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Result: 3D mid-res. (Fe)