Temperature Influence on Phytoplankton Community Growth Rates

Objective:

To quantify the relationship between temperature and phytoplankton growth rates at the global scale and to improve the marine biogeochemical response to climate change in Earth system models (ESMs).

Approach:

- Compiled observation dataset of *phytoplankton community growth rates* from natural populations and analyzed them in conjunction with temperature to fit two growth models.
- Extracted this *community growth rate vs. temperature relationship* (apparent Q_{10}) from ESMs and satellite-based biogeochemical models for comparison to observed trends.

Results/Impacts:

- Both Arrhenius and Q_{10} growth models fit well.
- The optimal Q_{10} relation (Q_{10} = 1.5) was below the value of ~2 often used in models.
- Models using high Q_{10} values will overestimate growth rate increases in a warming ocean.
- Forms a new diagnostic metric for evaluating the ocean biogeochemical component in ESMs and other ocean productivity models.
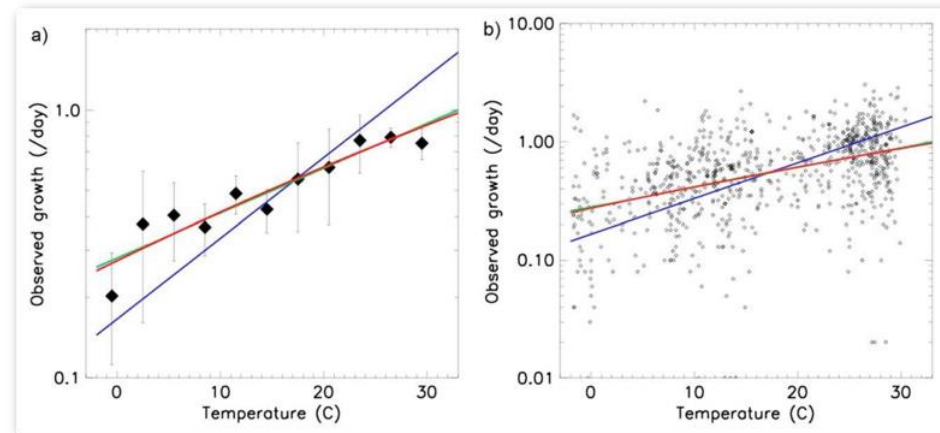
Observational estimates of phytoplankton community growth rate averaged over 3 degree windows (left panel) and the raw data (right panel). Red/green lines show best fit to the binned observations (Q_{10} = 1.5). Blue line shows trend with Q_{10} = 2.0.

BGC Feedbacks