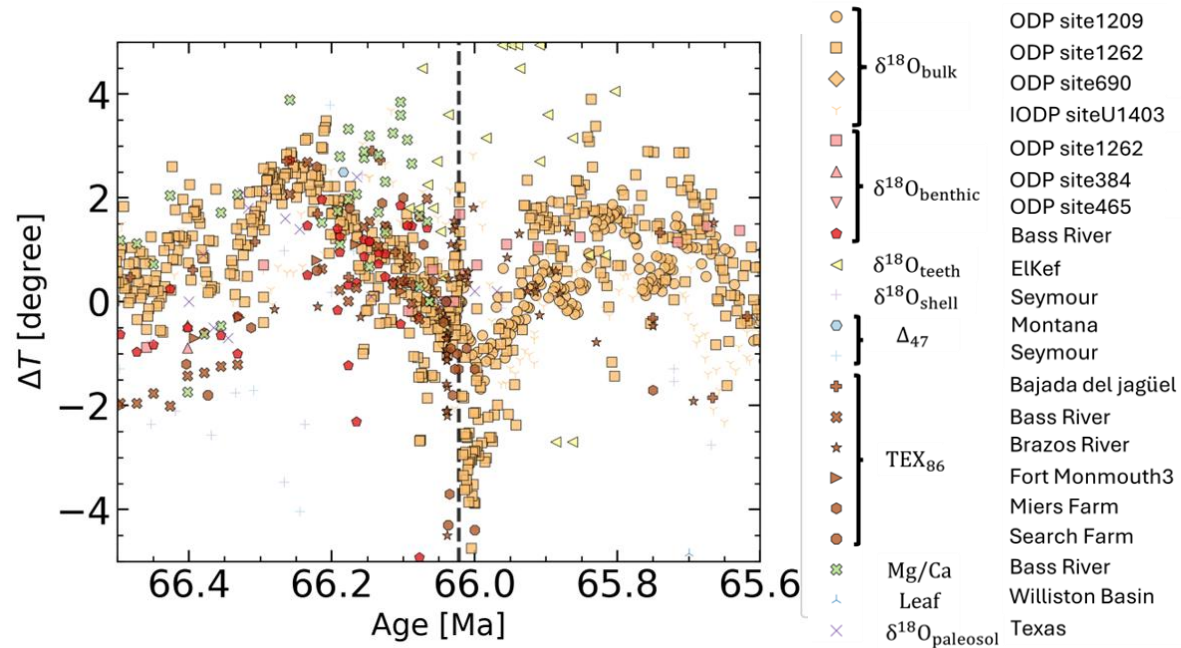


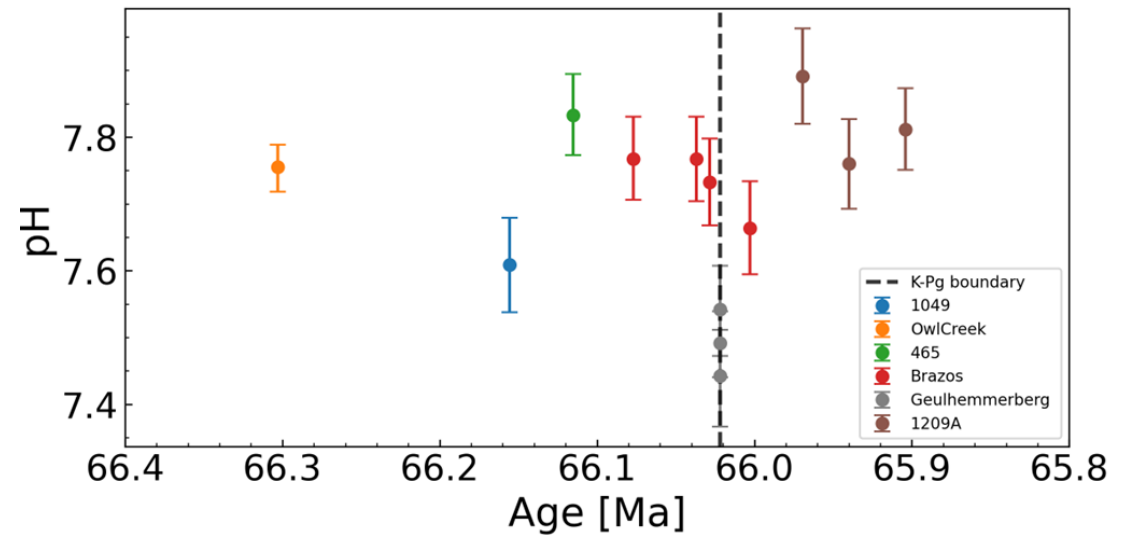
Supplementary Materials:
Modelling the changes in marine ecosystem
and carbon cycle after the K/Pg boundary event

Tomoki Takeda and Eiichi Tajika (Department of Earth and Planetary
Science, UTokyo)

Geological records



Data compiled from Hull et al. (2020)

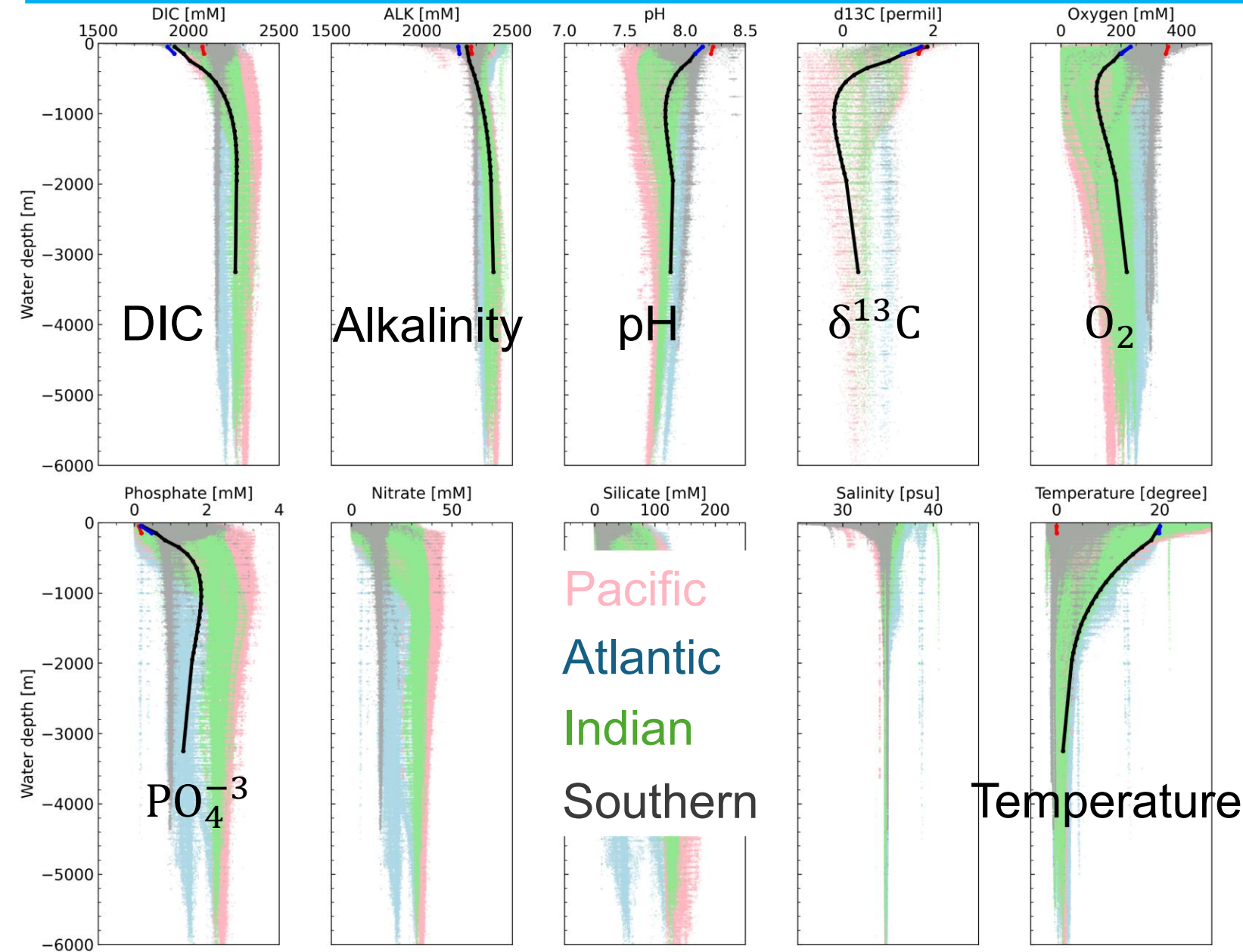


Data compiled from Henehan et al. (2019)

● pH data are calculated from boron isotope records [Henehan et al., 2019]

1-D Ocean Biogeochemical Model

Model Validation

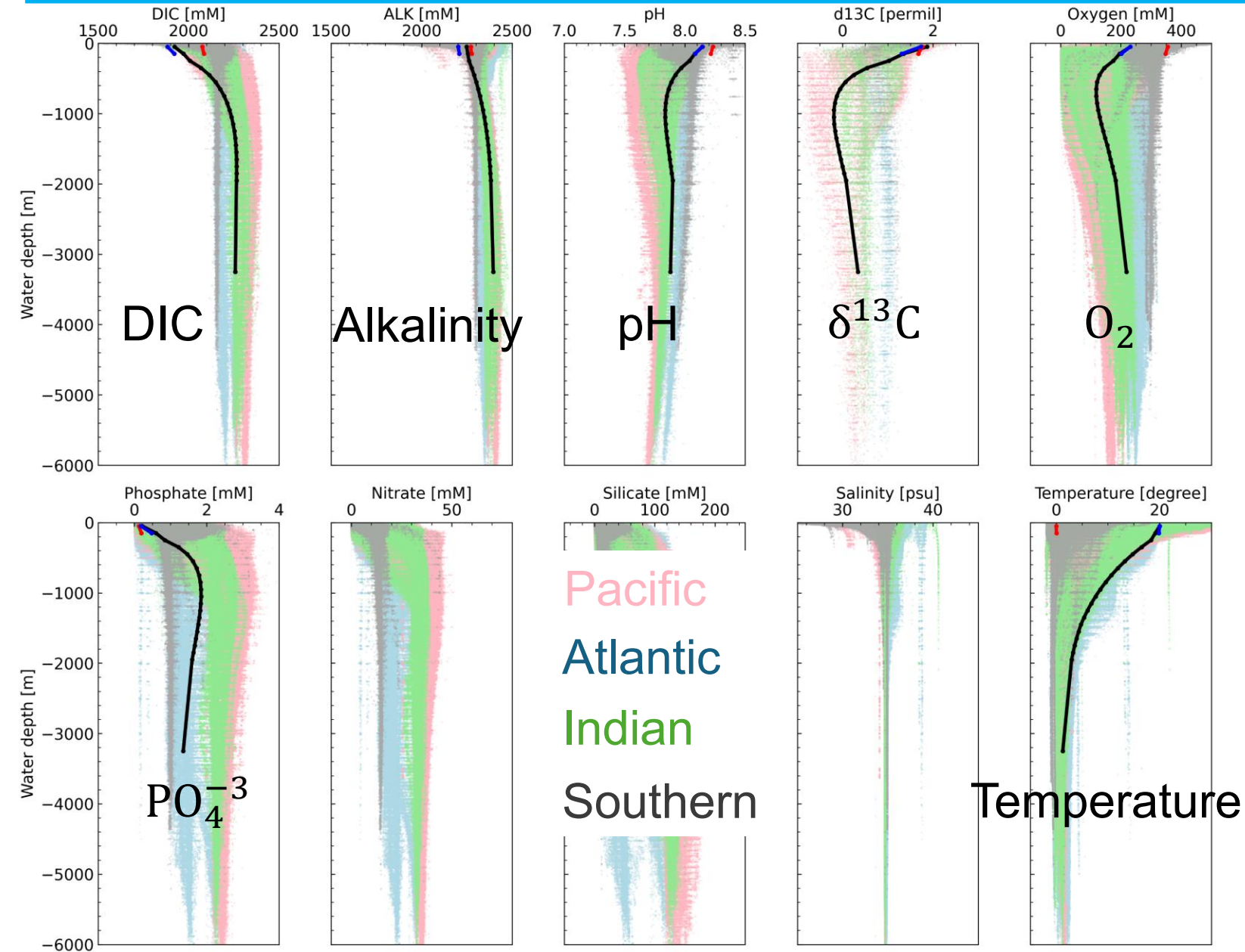


- Model parameters were tuned to modern ocean observations from GLODAPv2.2023

Tuned parameters

- Riverine phosphorus input flux
- Rate constant of carbonate productivity
- Decomposition rate of POM
- Fraction of refractory POM
- Ocean circulation velocity
- Vertical diffusivity coefficient
- Organic carbon degassing flux

Model Validation



Export productivity

[Gt C y⁻¹]

Model

Reference

~8.6

9.6 ± 3.6

[Dunne et al., 2007]

Carbonate productivity

[Gt C y⁻¹]

Model

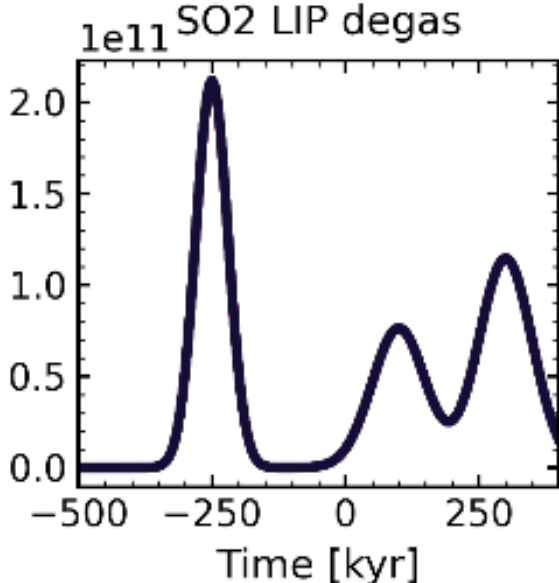
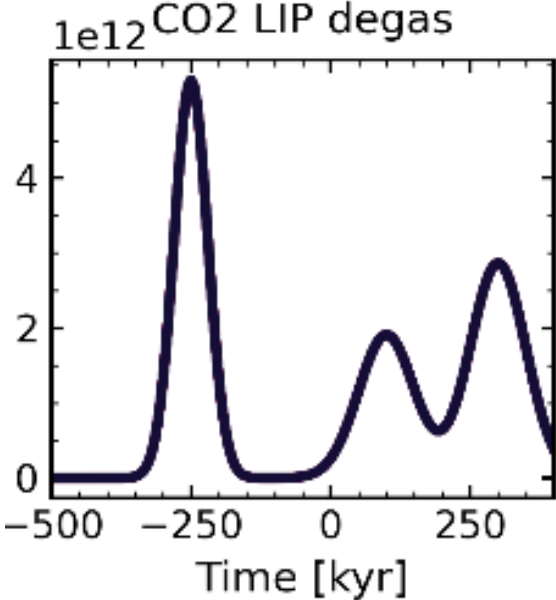
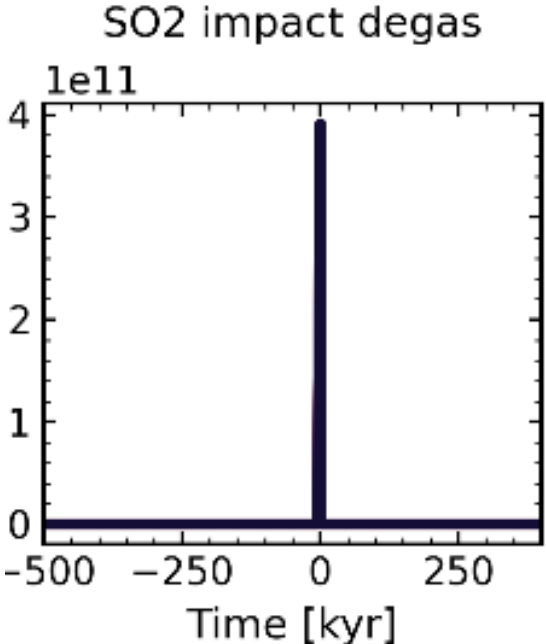
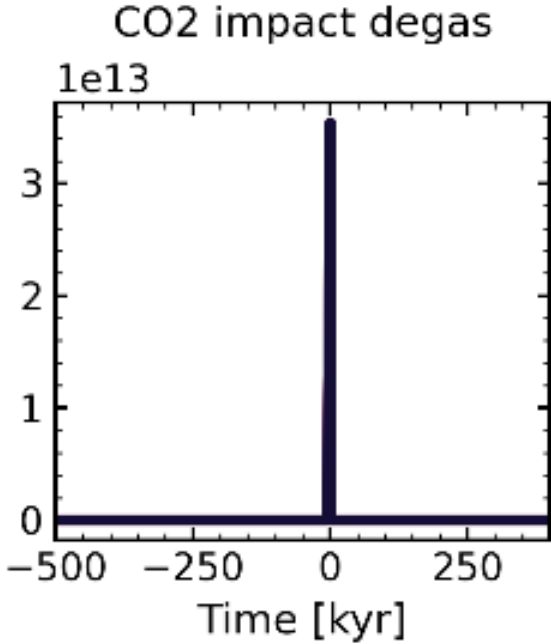
Reference

~0.87

~0.50 – 1.3

[e.g., Sulpis et al., 2021]

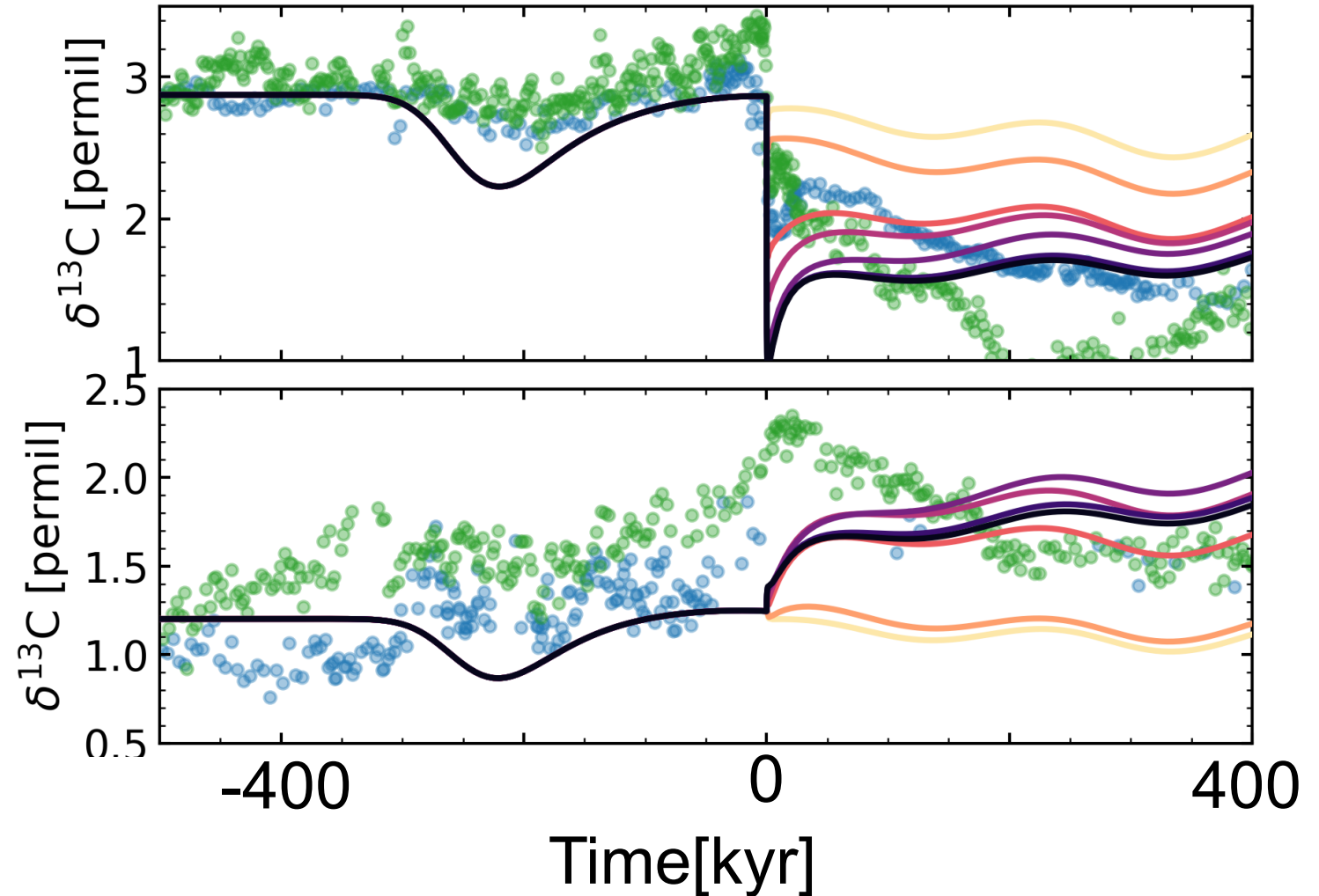
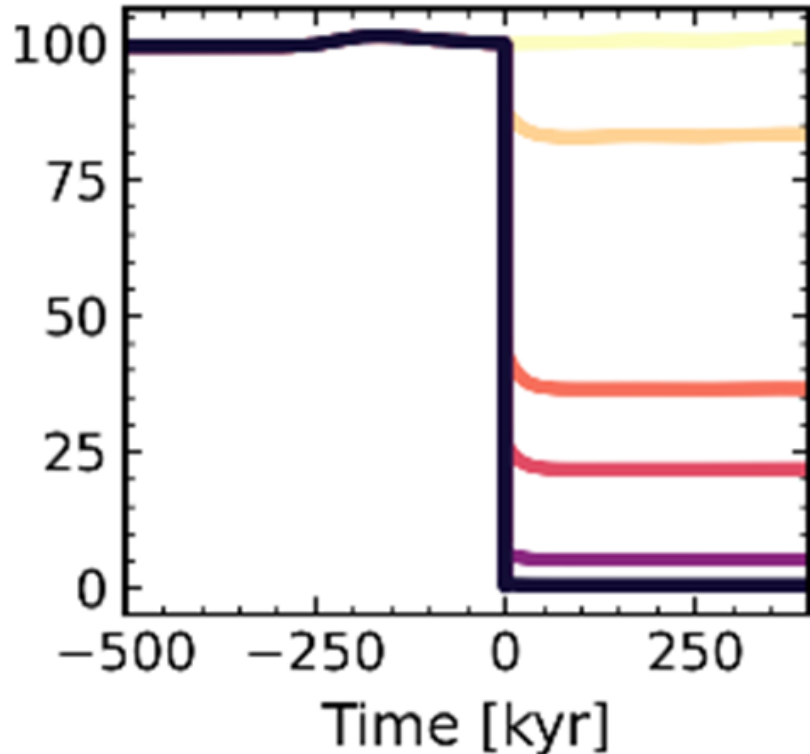
Outgassing conditions



Sensitivity Experiment 1 with outgassing

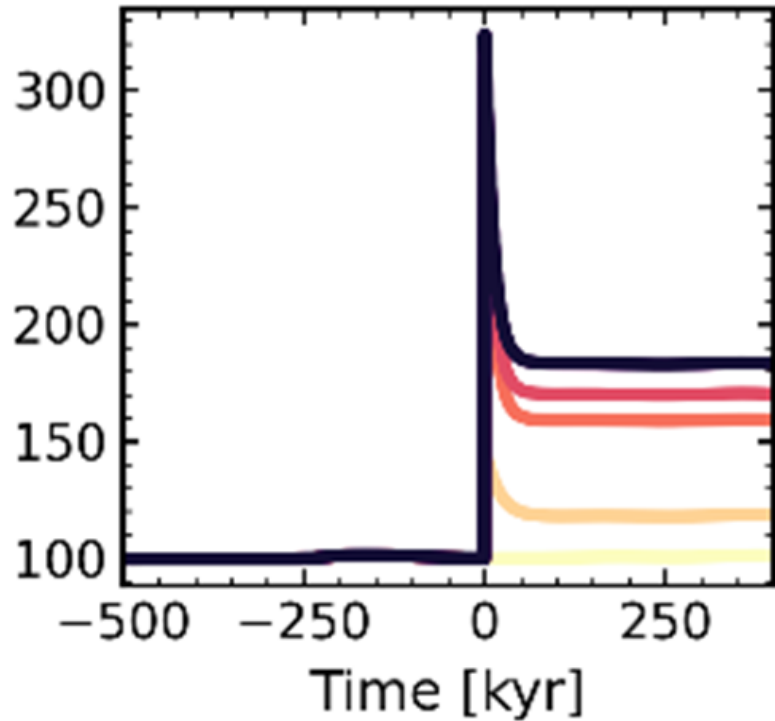
- Bioproduction efficiency was reduced to 100%, 50%, 10%, 5%, 1%, 0.1%, and 0% of the pre-K/Pg value

✓ Productivity and POM sinking velocity are constant in the Neritic ocean

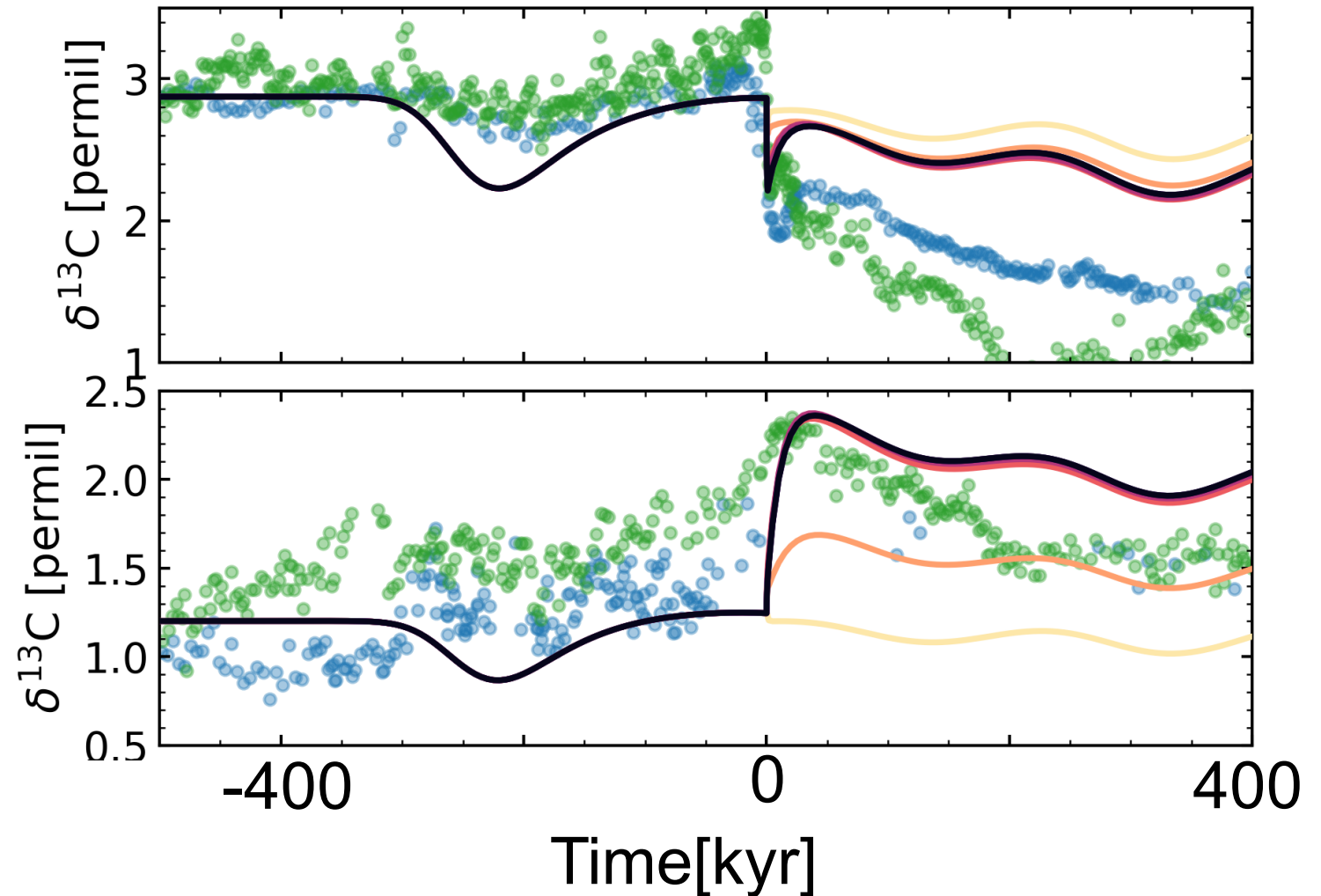


Sensitivity Experiment 2 with outgassing

- POM sinking velocity was reduced to 100%, 50%, 10%, 5%, 1% of the pre-K/Pg value



✓ Productivity and POM sinking velocity are constant in the Neritic ocean



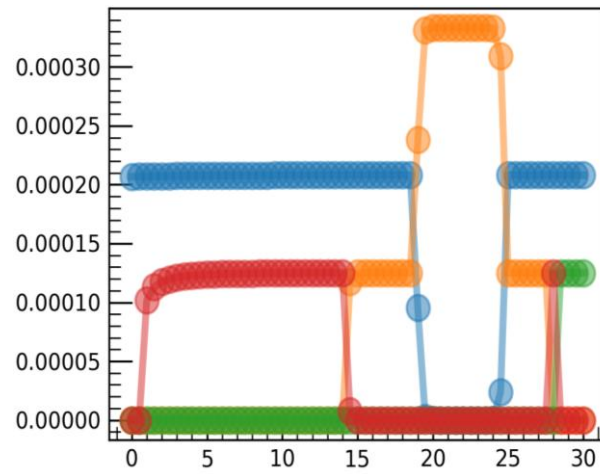
Marine Ecosystem Model

Sensitivity Experiments

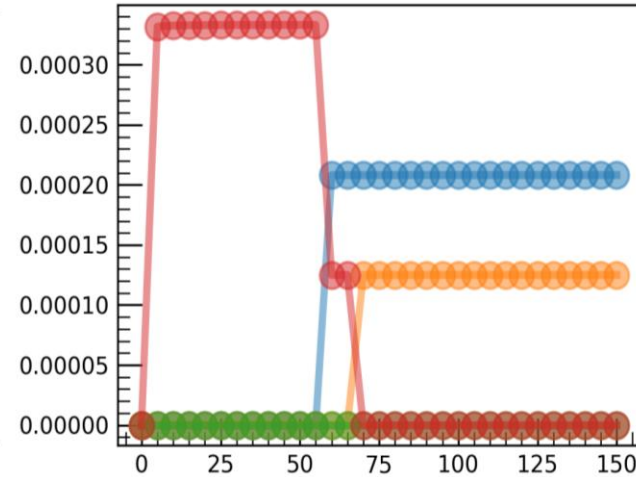
—●— Diatom —●— cocco —●— Pico —●— Diaz

Standard: $T=25$ deg, $PAR=100$ W/m^2 , $pH=7.8$

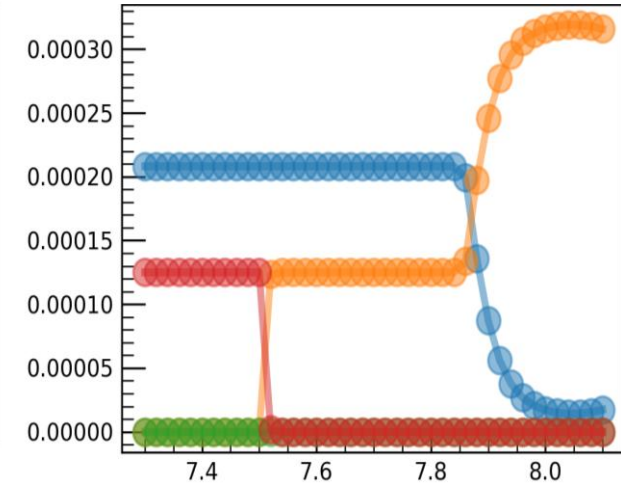
$[PO_4]=0.001$ mM, $NO_3=0.025$ mM, $Si(OH)_4=0.01$ mM



Temperature[deg]



PAR[W/m²]



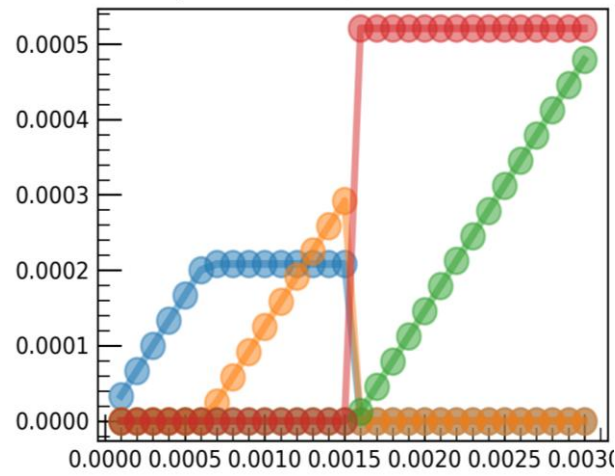
pH

Sensitivity Experiments

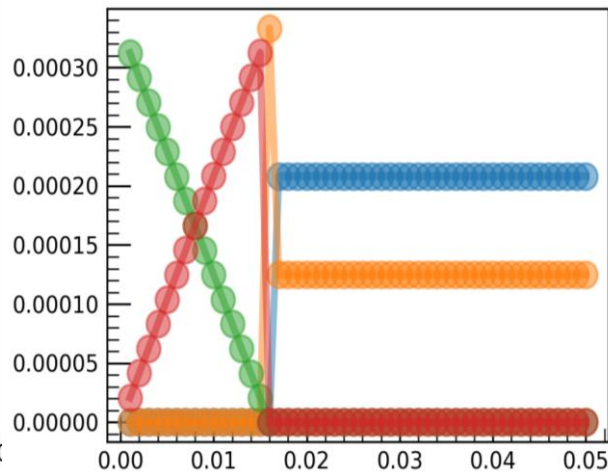
—●— Diatom —●— cocco —●— Pico —●— Diaz

Standard: $T=25$ deg, $PAR=100$ W/m^2 , $pH=7.8$

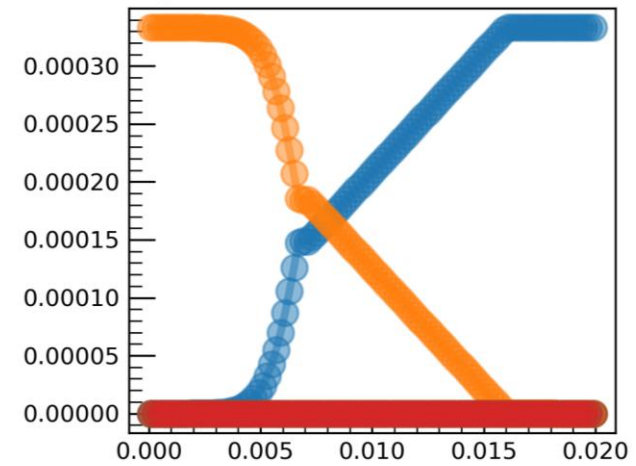
$[PO_4]=0.001$ mM, $NO_3=0.025$ mM, $Si(OH)_4=0.01$ mM



PO_4 [mM]



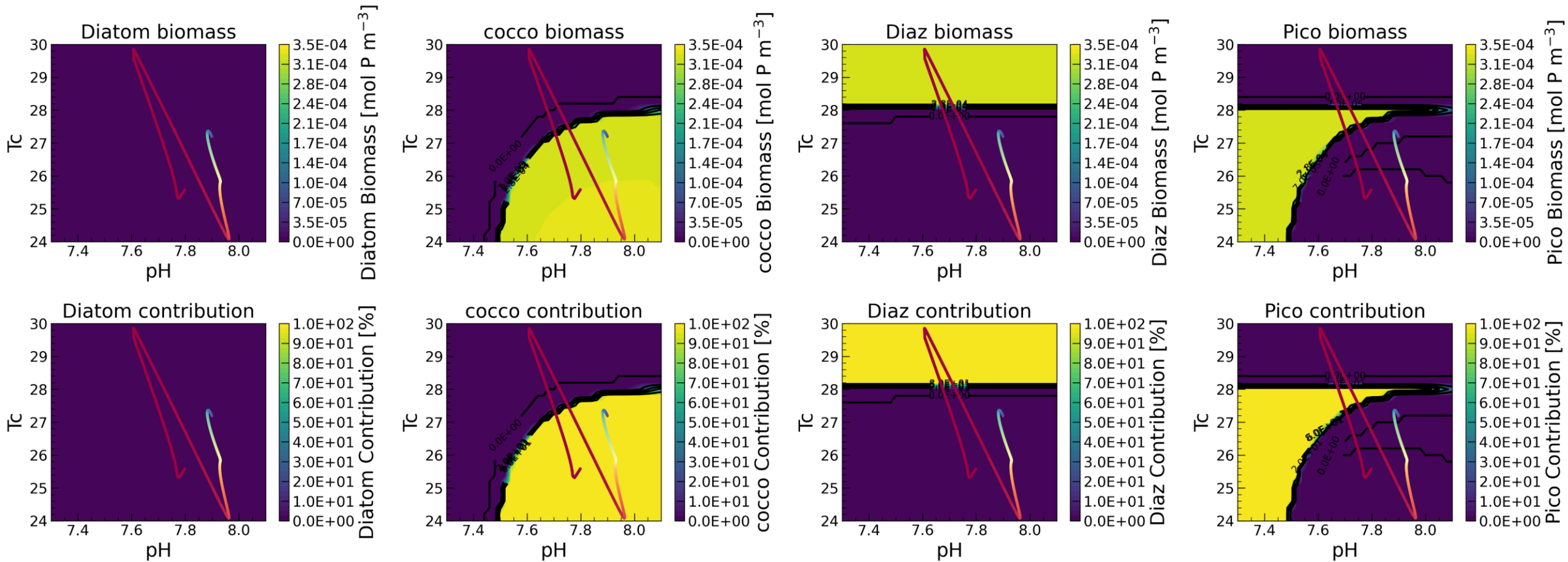
NO_3 [mM]



$Si(OH)_4$ [mM]

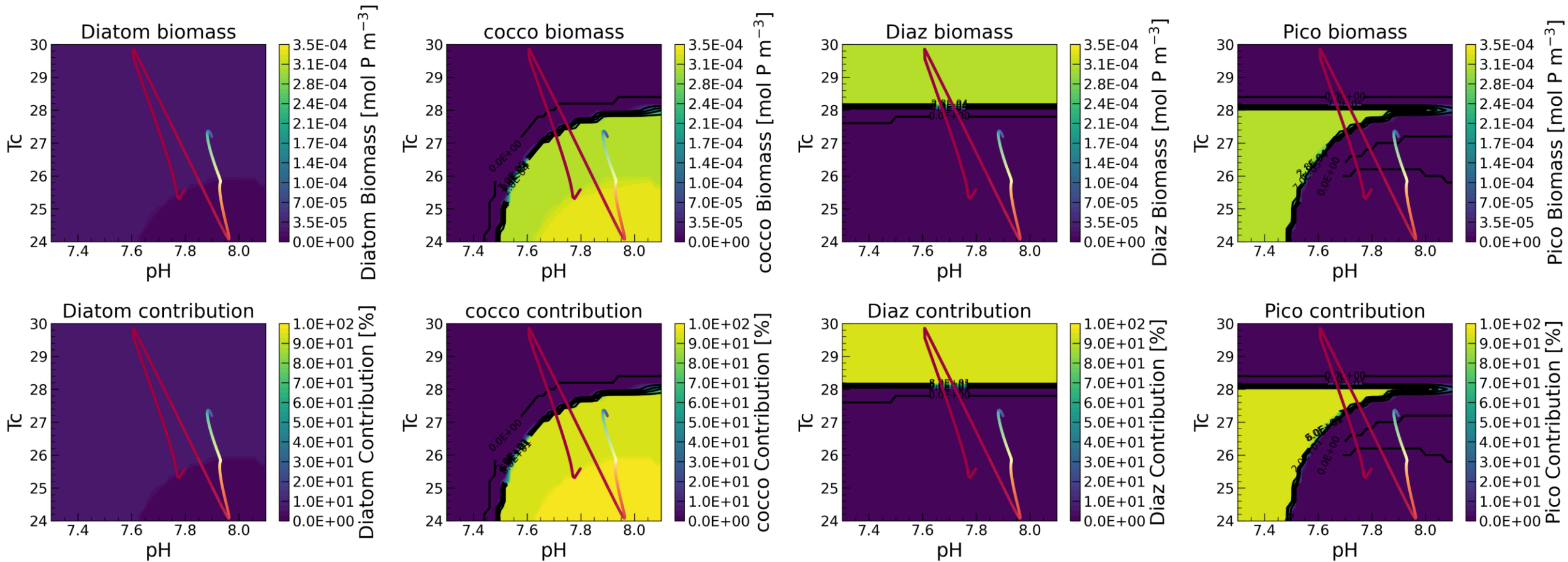
0-D Ecosystem Model: Biomass vs Model pH-Temperature

Biomass and contribution maps | $CiSi=1.00E-04$ | fixed: $CiNH_4=0.00E+00$, $PAR=1.00E+02$, $CiP=1.00E-03$, $CiNO_3=2.50E-02$



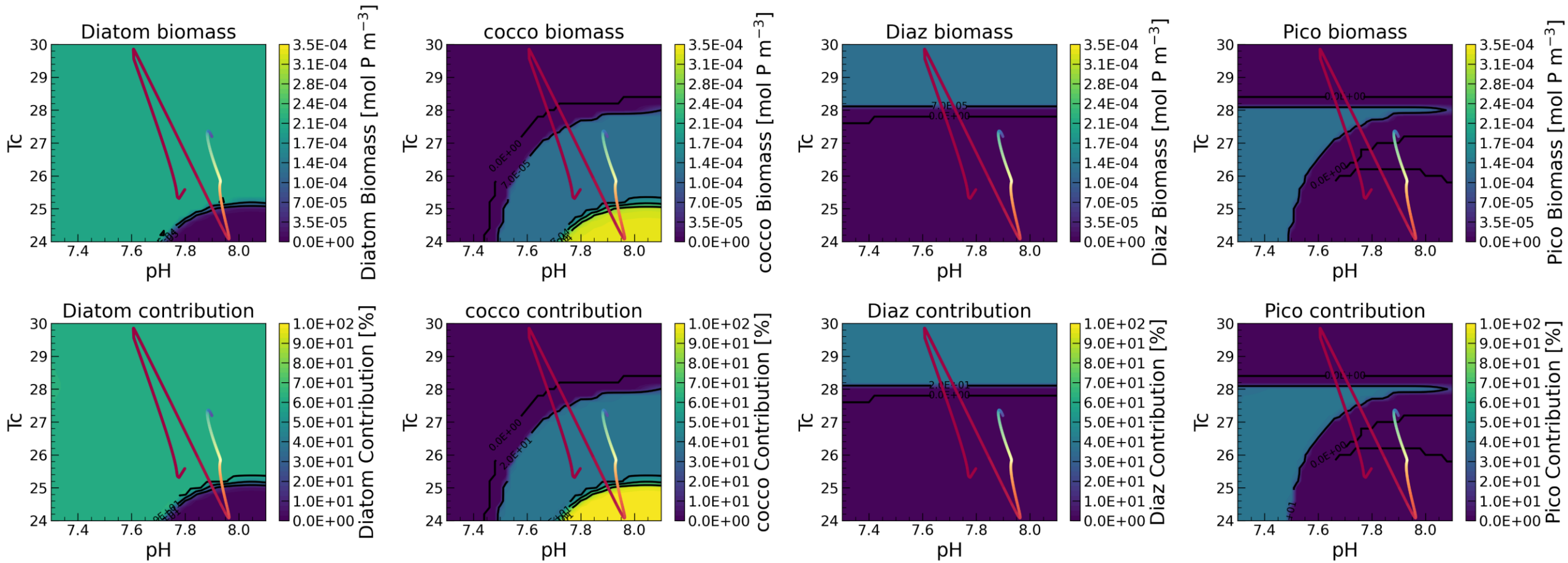
0-D Ecosystem Model: Biomass vs Model pH-Temperature

Biomass and contribution maps | $CiSi=1.00E-03$ | fixed: $CiNH_4=0.00E+00$, $PAR=1.00E+02$, $CiP=1.00E-03$, $CiNO_3=2.50E-02$



0-D Ecosystem Model: Biomass vs Model pH-Temperature

Biomass and contribution maps | $CiSi=1.00E-02$ | fixed: $CiNH_4=0.00E+00$, $PAR=1.00E+02$, $CiP=1.00E-03$, $CiNO_3=2.50E-02$



0-D Ecosystem Model: Biomass vs Model pH-Temperature

Biomass and contribution maps | $CiSi=1.00E-01$ | fixed: $CiNH_4=0.00E+00$, $PAR=1.00E+02$, $CiP=1.00E-03$, $CiNO_3=2.50E-02$

