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Processes causing the temporal changes in Si/N ratios of nutrient consumption and export flux during the spring diatom bloom

N. Yoshie (1) and Y. Yamanaka (1,2)

(1) Graduate School of Environmental Earth Science, Hokkaido University, Japan, (2) Frontier Research Center for Global Change, Japan (naoki@ees.hokudai.ac.jp/+81-11-706-4865)

Two processes, (I) physiological changes of diatom under the stress of photosynthesis of diatom and (II) differences of regeneration between silicon and nitrogen, are generally explained as causes of temporal changes of stoichiometric silicon/nitrogen (Si/N) ratios of sinking particles and of nutrient consumptions in the surface water during the spring diatom bloom. We investigated which process plays an important role in these changes by using a one-dimensional ecosystem model that explicitly represents diatom and the other non-silicious phytoplankton. The model was applied to station A7 (41.5N, 145.5E) in the western North Pacific, where diatom regularly blooms in spring. Model simulations show that the Si/N ratios of export flux by the sinking particles at 100m depth and of nutrient consumptions in the upper 100m surface water have their maxima at the end of the spring diatom bloom, whose values and timings are significantly different from each other. Analyses for the model results show that the differences of regeneration between silicon and nitrogen mainly cause the temporal changes of the Si/N ratios. On the other hand, the physiological changes of diatom under stress hardly cause these temporal changes, because the effect of the change in the diatom's uptake ratio of silicon to nitrogen is cancelled by that in its sinking rate.