

# Diagnostic estimation and uncertainties of nutrient limitation of phytoplankton growth in Michaelis-Menten functional form

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Michaelis-Menten functional form (MM) is most widely used relationship of nutrient limitation of phytoplankton growth in large-scale ecosystem models. In MM functional form, the choice of parameter value of a half-saturation constant is a key point for controlling the strength of nutrient limitation. In general, the half-saturation constant increase with the size of the phytoplankton cell depending on the surface-to-volume ratio by diffusive hypothesis, and wide ranges of values are reported from observational studies. On the other hand, the most of Plankton Functional Types (PFT) models represent a phytoplankton type as one representative PFT with one global parameter. The parameter value is chosen in the observed range as a most reasonable value that could reproduce observed chl-a or nutrient concentration in each model. As a result, there are uncertainties of the global pattern of nutrient limitation among models. In this study, we diagnostically estimated the nutrient limitation using various parameter set of different global PFT models from CMIP5 together with the observation based nutrient concentrations (World Ocean Atlas for macro nutrient and multi-model median for dissolved iron and ammonium concentration). Then we show uncertainties and robustness of estimation of nutrient limitation in the current PFT models with MM functional form.

Keywords: Plankton Functional Types model, Michaelis-Menten functional form