

# Equations of the phytoplankton growth model.

The phytoplankton growth is given by the five following equations, where  $A$  stands for pp, np or mp.

$$\begin{aligned}\mu_A &= \mu_{maxA} \lim_{IA} \lim_{TA} (\lim_{NO_3A} + \lim_{NH_4A}) \\ \lim_{NO_3A} &= \left( \frac{NO_3}{NO_3 + K_{NO_3A}} \right) \exp(-\Psi NH_4) \\ \lim_{NH_4A} &= \left( \frac{NH_4}{NH_4 + K_{NH_4A}} \right) \\ \lim_{IA} &= \frac{2(1 + \beta_{IA}) \frac{PAR}{I_{optA}}}{\left( \frac{PAR}{I_{optA}} \right)^2 + 2\beta_{IA} \frac{PAR}{I_{optA}} + 1} \\ \lim_{TA} &= \max \left( \frac{2(1 + \beta_{TA}) \frac{T - T_{letA}}{T_{optA} - T_{letA}}}{\left( \frac{T - T_{letA}}{T_{optA} - T_{letA}} \right)^2 + 2\beta_{IA} \frac{T - T_{letA}}{T_{optA} - T_{letA}} + 1}, 0 \right)\end{aligned}$$

where the parameters are defined in the following table

parameter	definition
$\mu_A$	growth rate of $A$
$\mu_{maxA}$	maximum growth rate of $A$
$\lim_{NO_3A}$	limitation by $NO_3$ for $A$
$\lim_{NH_4A}$	limitation by $NH_4$ for $A$
$K_{NO_3A}$	half-saturation coefficient of $NO_3$ for $A$
$K_{NH_4A}$	half-saturation coefficient of $NH_4$ for $A$
$\Psi$	inhibition coefficient by $NH_4$
$NO_3$	$NO_3$ concentration
$NH_4$	$NH_4$ concentration
$\lim_{IA}$	limitation by light for $A$
$\beta_{IA}$	shape factor for photoinhibition curve
$I_{optA}$	optimum insolation for $A$
$PAR$	photosynthetic active radiation
$\lim_{TA}$	limitation by temperature for $A$
$\beta_{TA}$	shape factor for thermoinhibition curve
$T_{optA}$	optimum temperature for $A$
$T_{letA}$	lower lethal temperature for $A$
$T$	temperature

Table 1: Parameters of the phytoplankton growth model