

Table 20.1. The equations of the model describing light interception, assimilation, nitrogen uptake, allocation, mortality, decomposition and mineralisation, and their temperature, CO₂ and moisture dependencies.

Light interception	$I_{abs_{i,n}} = \frac{k_{ext,i} \cdot LAI_{i,n}}{\sum_i k_{ext,i} \cdot LAI_{i,n}} \cdot I_n \cdot \left(1 - e^{-\sum_i k_{ext,i} \cdot LAI_{i,n}}\right)$	eq 1
Potential assimilation	$A_{pot,i} = RUE_i \cdot \sum_n I_{abs_{i,n}} \cdot k_i(CO_2) \cdot k_i(T)$	eq 2
with	$k_i(T) = 0 \quad \text{if } T < T_{min,i} \text{ or } T > T_{max,i}$ $k_i(T) = (T - T_{min,i}) / (T_{opt1,i} - T_{min,i}) \quad \text{if } T_{min,i} < T < T_{opt1,i}$ $k_i(T) = 1 \quad \text{if } T_{opt1,i} < T < T_{opt2,i}$ $k_i(T) = (T_{max,i} - T) / (T_{max,i} - T_{opt2,i}) \quad \text{if } T_{opt2,i} < T < T_{max,i}$	eq 3
with	$k_i(CO_2) = 1 + b_i \cdot \ln\left(\frac{CO_2}{CO_{2,ref}}\right) \quad \text{and } CO_{2,ref} = 350\text{ppm}$	eq 4
Water-limited assimilation	$A_{w,i} = \frac{Tr_i}{Tr_{pot,i}} \cdot A_{pot,i}$	eq 5
Actual N uptake and actual assimilation (without N redistribution and storage)		eq 6
if $U_{pot,i} < n_{con,min,i} \cdot A_{w,i}$ then	$A_{act,i} = U_{pot,i} / n_{con,min,i}$ $U_{act,i} = U_{pot,i}$	
if $U_{pot,i} < n_{con,max,i} \cdot A_{w,i}$ then	$A_{act,i} = A_{w,i}$ $U_{act,i} = U_{pot,i}$ $n_{con,i} = \frac{U_{act,i} - n_{con,min,i} \cdot A_{act,i}}{(n_{con,max,i} - n_{con,min,i}) \cdot A_{act,i}}$	
if $U_{pot,i} \geq n_{con,max,i} \cdot A_{w,i}$ then	$A_{act,i} = A_{w,i}$ $U_{act,i} = n_{con,max,i} \cdot A_{w,i}$	
Potential N uptake	$U_{pot,i} = \sum_l \left(\frac{SRL_i \cdot B_{r,i,l}}{\sum_i SRL_i \cdot B_{r,i,l}} \right) \cdot Navail_l$	eq 7
Root distribution	$Y_i = 1 - k_{rf,i}^d$	eq 8
Allocation	$G_{j,i} = k_{all,j,i} \cdot A_{act,i}$	eq 9
Mortality	$M_{j,i} = k_{m,j,i} \cdot B_{j,i}$	eq 10
with	$k_{m,j,i} = \left(\frac{Age_{j,i}}{Age_{max,j,i}} \right)^4 \quad \text{for leaves and roots, and } k_{m,j,i} \leq 1$	
Decomposition	$\frac{dC_{org,c,i,j}}{dt} = -C_{org,c,i,j} \cdot k(T)_{dec,c,i,j} \cdot k(clay\%)_c \cdot k(moist)_c$	eq 11
with	$k(T)_{dec,c,i,j} = e^{[a_{c,i,j} + bT \cdot (1 - 0.5T/T_{opt,dec})]}$	eq 12
with	$k(clay\%)_c = 1 \quad \text{if } clay\% \leq 5$ $k(clay\%)_c = -0.0133 \cdot clay\% + 1.0666 \quad \text{if } 5 < clay\% \leq 50$ $k(clay\%)_c = 0.40 \quad \text{if } clay\% > 50$	eq 13
with	$k(moist)_c = 0.7383 \cdot \frac{q_c}{0.60 \cdot q_{field,c}} + 0.2657, \text{ if } q_c < 0.60 \cdot q_{field,c}$ $k(moist)_c = 1, \text{ if } q_c \geq 0.60 \cdot q_{field,c}$	eq 14
Mineralisation	$\frac{dN_{org}}{dt} = \sum_c \sum_i \sum_j \left[\left(\frac{N_{org,c,i,j}}{C_{org,c,i,j}} - n_{crit,c,j,i} \right) \cdot \frac{dC_{org,c,i,j}}{dt} \cdot \frac{1}{1 - e} \right]$	eq 15
with	$n_{crit,c,j,i} = \frac{f_N \cdot e}{f_C}$	

Parameters: Agem_{max,i} = maximum life span of plant organ j of species i (day), α_{c,j,i} = parameter determining absolute decomposition rate of litter class c of plant organ j and species i, b = parameter determining temperature dependency decomposition rate, β_i = CO₂ growth enhancement factor of species i (-), ε = microbial assimilation efficiency (-), f_c = microbial C concentration (g C g⁻¹), f_N = microbial N concentration (gN g⁻¹), k_{all,j,i} = allocation parameter to plant organ j of species i (-), k_{ext,i} = light extinction coefficient of species i (-), k(T)_{dec,c,j,i} = relative decomposition rate of class j and plant organ j of species i (g C g C⁻¹ timestep⁻¹), k(clay%)_c = soil texture dependency of decomposition of litterclass c (-), k_i(CO₂) = CO₂ dependency of assimilation of species i (-), k_{rf,i} = root distribution parameter (-), k(moist)_c = soil moisture dependency of decomposition of litterclass c (-), k_i(T) = temperature dependency of assimilation of species i (-), k_{m,j,i} = mortality parameter plant organ j of species i (timestep⁻¹), n_{con,min,i} = minimum N concentration per gram new produced plant material of species i (gN g⁻¹), n_{con,max,i} = maximum N concentration per gram new produced plant material of species i (gN g⁻¹), n_{crit,c,j,i} = critical N concentration of class c and plant organ j of species i (g N g C⁻¹), RUE_i = potential radiation use efficiency of species i (g MJ(PAR)⁻¹), SRL_i = specific root length (m kg⁻¹), T_{min,i} = minimum temperature for assimilation of species i (°C), T_{opt,dec} = optimum temperature for decomposition (°C), T_{opt1,i} = optimum temperature 1 for assimilation of species i (°C), T_{opt2,i} = optimum temperature 2 for assimilation of species i (°C), T_{max,i} = maximum temperature for assimilation of species i (°C), θ_{field,c} = volumetric moisture content at field capacity in litter class c (m³ m⁻³)

Variables: A_{act,i} = actual assimilation rate of species i (kg ha⁻¹ timestep⁻¹), A_{pot,i} = potential assimilation rate of species i (kg ha⁻¹ timestep⁻¹), A_{w,i} = water-limited assimilation rate (kg ha⁻¹ timestep⁻¹), Age_{j,i} = age of plant organ j of species i (day), B_{j,i}: biomass of plant organ j of species i (kg ha⁻¹), B_{r,i,l}: fine root biomass of species i in root layer l (kg ha⁻¹), C_{org,c,i,j} = soil organic C of class c and plant organ j of species i (kg C ha⁻¹), d = depth (cm), G_{j,i}: growth rate of plant organ j of species i (kg ha⁻¹ timestep⁻¹), I_{abs,i,n} = absorbed radiation by species i in canopy layer n (MJ(PAR) ha⁻¹ timestep⁻¹), LAI_{i,n} = leaf area index of species i in canopy layer n (ha ha⁻¹), I_n = incoming radiation in canopy layer n (MJ(PAR) ha⁻¹), M_{j,i}: mortality rate of plant organ j of species i (kg ha⁻¹ timestep⁻¹), Navail_l = available N in root layer l (kg N ha⁻¹), n_{con,i} = N concentration in new produced plant material of species i (gN g⁻¹), N_{org,c,i,j} = soil organic N of class c and plant organ j of species i (kg N ha⁻¹), T = air temperature (°C), Tr_i = actual transpiration rate of species i (mm H₂O timestep⁻¹), Tr_{pot,i} = potential transpiration rate of species i (mm H₂O timestep⁻¹), U_{act,i} = actual N uptake rate of species i (kg N ha⁻¹ timestep⁻¹), U_{pot,i} = potential N uptake rate of species i (kg N ha⁻¹ timestep⁻¹), Y_i = cumulative root fraction of species i (-), θ_c = volumetric moisture content in litter class c (m³ m⁻³)