



List of variables and code names

The table gives an overview of the variables used in the [4C Model description](#) and their names in the source code. In addition, details are specified about the declaration, calculation and use of the variables in the source code.

Calculation in: Abbreviations: (I) = initialisation in, (D) = deallocation in, (A) = allocation in

Cat. (Category): V – variable, P – parameter, S – species parameter, I - input variable, F - function

For abbreviations see [4C Model description](#), Appendix 6 Abbreviations

Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
alphac	data_species	α_c	ratio of sum of twigs, branches and coarse roots to sapwood	-	real, in type species_par	(I) <i>readspec</i>	<i>readspec, partition, npp, stand_mortality</i>	S
growthrate	local	α_h	growth rate depends on relative light regime in the middle of the canopy		real	<i>partition</i>	<i>partition</i>	V
alfm	data_par	α_m	Priestley-Taylor coefficient	-	real	(I) <i>data_par</i>	<i>upt_wat</i>	P
alpha_PT	data_par	α_{PT}	Priestley-Taylor coefficient	-	real	(I) <i>data_par</i>	<i>evapo</i>	P
ar	local	α_r	auxiliary variable of partitioning functions	-	real	<i>partition growth_seed</i>	<i>partition growth_seed</i>	V
pfref	data_par	α_{refl}	albedo of the canopy	-	real	(I) <i>data_par</i>	<i>stand_daily</i>	P
as	local	α_s	auxiliary variable of partitioning functions	cm ⁻¹	real	<i>partition growth_seed</i>	<i>partition growth_seed</i>	V



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weibal_int	data_species	α_{wint}	mortality parameter	-	real	(l) <i>data_species</i>	<i>stand_mortality</i>	P
weibal	data_species	$\alpha_{wstress}$	mortality parameter	-	real	(l) <i>data_species</i>	<i>stand_mortality</i>	P
beta	data_climate	β	Average sun inclination angle between DOY 120 and 280	rad	real	<i>prepare_site</i>	<i>light_4, l_4_coh_loop</i>	I
betar	local	β_r	auxiliary variable of partitioning functions		real	<i>partition growth_seed</i>	<i>partition growth_seed</i>	V
cnv_hum	data_soil_cn	γ_{aom}	C/N-ratio of active organic matter per layer	-	real, allocatable, dimension(nlay)	<i>cn_inp</i> (l) <i>s_cn_ini</i>	<i>humlay, minlay</i>	V
gamma	local	γ_p	modified psychrometric constant	hPa K ⁻¹	real	<i>evapo</i>	<i>evapo</i>	V
cnv_opm	data_soil_cn	γ_{pom}	C/N-ratio of primary organic matter per layer	-	real, allocatable, dimension(nlay)	<i>minlay, cn_inp</i> (l) <i>s_cn_ini</i>	-	V
cnv_opm_fol	data_soil_cn	$\gamma_{pom}^{fol,j}$	C/N-ratio of foliage litter pool per species j	-	real, type species_litter	<i>humlay</i>	<i>humlay</i>	V
delta	local	Δ	slope of vapour pressure curve against temperature	hPa K ⁻¹	real	<i>evapo</i>	<i>evapo</i>	V
vpd	local	δ	saturation vapour pressure deficit of air	hPa	real	<i>evapo</i>	<i>evapo</i>	V
vpd_13	local	δ_{13}	saturation vapour pressure deficit at noon	hPa	real	<i>evapo, calc_fire_risk</i>	<i>evapo, calc_fire_risk</i>	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
hsdev	data_plant	δ_H	standard deviation of height of plants		real	<i>amod_plant</i>	<i>planting</i>	
GR_in_PAR	data_par	η_R	factor of conversion from global radiation [J cm^{-2}] to photosynthetically active radiation [mol m^{-2}]	-	real	(l) <i>data_par</i>	<i>stand_daily</i>	P
pnus	data_species	η_s	foliage to sapwood area relationship	kg cm^{-2}	real, in type species_par	(l) <i>readspec</i>	<i>readspec, partition</i>	S
Nresp	data_species	κ_N^s	slope of photosynthesis response to N-limitation	-	real, in type species_par	(l) <i>readspec</i>	<i>redn_ini</i>	S
lamb	local	λ_v	latent heat of vaporization	J g^{-1}	real	<i>evapo</i>	<i>evapo</i>	V
lambda	data_par	λ	optimum ratio of c_i (internal partial pressure of CO_2) to c_a (ambient partial pressure of CO_2)	-	real	<i>data_par</i>	<i>opt_ps</i>	P
lambdaf	local	λ_f	partitioning coefficient leaf	-	real	<i>partition growth_seed</i>	<i>partition growth_seed</i>	V
lambdar	local	λ_r	partitioning coefficient fine roots	-	real	<i>partition growth_seed</i>	<i>partition growth_seed</i>	V
lambdas	local	λ_s	partitioning coefficient sapwood	-	real	<i>partition growth_seed</i>	<i>partition growth_seed</i>	V



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Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
tc	data_soil_t	λ_i	thermal conductivity of soil components i=air, ice, water, quartz, clay, silt, stone, humus	$\text{J cm}^{-1} \text{s}^{-1} \text{K}^{-1}$	real	<i>s_t_ini</i>	<i>cond</i>	P
t_cond	data_soil_t	λ_T	thermal conductivity	$\text{J cm}^{-1} \text{s}^{-1} \text{K}^{-1}$	real, allocatable, dimension(nlay)	<i>soil_tem</i>	<i>soil_tem</i>	V
wlam	data_soil	λ_w	lambda parameter for percolation	-	real, allocatable, dimension(nlay)	(l) <i>prepare_site</i>	<i>soil</i>	I
weibla_int	local	λ_{wint}	lambda parameter of Weibull distribution/ intrinsic mortality	-	real	<i>int_mort</i>	<i>int_mort_weib</i>	V
weibla	data_species	$\lambda_{wstress}$	lambda parameter of distribution /stress mortality	-	real, in type species_par	<i>calc_weibla</i>	<i>stand_mortality</i>	S
dens_air	local	ρ_a	mean air density at constant pressure	g cm^{-3}	real	<i>evapo</i>	<i>evapo</i>	V
prhos	data_species	ρ_s	sapwood density	kg cm^{-3}	real, in type species_par	(l) <i>readspec</i>	<i>readspec, partition</i>	S
sigmaf	local	σ_f	leaf activity rate	$\text{kg kg}^{-1} \text{DW a}^{-1}$	real	<i>partition, growth_seed</i>	<i>partition growth_seed</i>	V
hsdev	data_plant	σ_H	standard deviation of height	-	real	(l) <i>data_plant</i>	<i>planting</i>	P
sigman	data_species	σ_r	root activity rate (N uptake) per year	$\text{kg N kg}^{-1} \text{DW a}^{-1}$	real, in type species_par	(l) <i>readspec</i>	<i>readspec, partition</i>	S
psycro	data_par	ψ	psychrometric constant	K^{-1}	real	<i>data_par</i>	<i>evapo</i>	P



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
x_age	data_stand	a	tree age	years	integer, in type cohort	<i>stand_balance</i> (l) <i>prepare_stand</i>	<i>stand_balance, output</i>	V
ku_a0	local	a_0	parameter of the height curve after Kuleschis, in Gerold1991	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
ku_a1	local	a_1	parameter of the height curve after Kuleschis, in Gerold1991	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
ku_a2	local	a_2	parameter of the height curve after Kuleschis, in Gerold1991	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
assi	data_stand	A_c	optimum gross assimilation rate per tree	kg DW d ⁻¹ patch ⁻¹	real, in type cohort	<i>npp</i>	<i>npp, coh_out_d</i>	V
crown_a	data_species	a_c	parameter for calculation of crown area	m cm ⁻¹	real, in type species_par	(l) <i>readspec</i>	<i>crown_proj, initia, partition</i>	S
crown_area	data_stand	a_{cr}^c	projected crown coverage area	m ²	real, type cohort	<i>crown_proj</i>	<i>coh_out_y, cov_area, crown_proj, beetle_nat, beetle_man, coh_initial, create_mistletoe, gener_coh, growth_seed, int_coh_loop1, int_coh_loop2, int_coh_loop3, int_layer, opt_ps, partition, partition_sv, planting, seed_multi, standup, thinning</i>	V
CSa	data_species	a_{cs}	scaling factor CSM	-	real, in type species_par	(l) <i>readspec</i>	<i>pheno_begin</i>	S



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Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
assdt	local	A_{dt}	net daytime assimilation rate per tree	$\text{g C m}^{-2} \text{d}^{-1}$	real	<i>npp</i>	<i>npp</i>	V
x_Ahb	data_stand	A_{hb}	cross sectional area of heartwood at stem base	cm^2	real	<i>amod_stand</i>	<i>partition</i>	V
Ahc	data_stand	A_{hc}	cross sectional area of heartwood at crown base	cm^2	real	<i>partition</i>	<i>partition</i>	V
max_age	data_species	a_{max}	species specific maximum tree age	years	integer, in type species_par	(l) <i>readspec</i>	<i>readspec, prepare_stand</i>	P
taumax	local	a_{ring}^{max}	cambial age of the innermost ring	years	integer	<i>treeini</i>	<i>treeini</i>	V
netass	data_stand	A_{net}	realized net daily assimilation rate	$\text{kg DW d}^{-1} \text{patch}^{-1}$	real, in type cohort	<i>npp</i> (l) <i>stand_daily</i>	<i>npp, output</i>	V
age	local	a_{ring}	current age of ring	years	integer	<i>initia</i>	<i>treeini</i>	V
Asapw	data_stand	A_s	tree sapwood cross sectional area	cm^2	real	<i>partition</i>	<i>partition</i>	V
assispe	local	A_{sp}	specific gross photosynthesis per tree	$\text{g C m}^{-2} \text{d}^{-1}$	real	<i>npp</i>	<i>npp</i>	V
ku_b0	local	b_0	parameter of the height curve after Kuleschis	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
ku_b1	local	b_1	parameter of the height curve after Kuleschis	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
ku_b2	local	b_2	parameter of the height curve after Kuleschis	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
crown_b	data_species	b_c	parameter for calculation of crown radius	m	real, in type species_par	(l) <i>readspec</i>	<i>crown_proj, initia, partition_sv</i>	S
CSb	data_species	b_{cs}	scaling factor CSM	-	real, in type species_par	(l) <i>readspec</i>	<i>pheno_begin</i>	S
ident	data_stand	c	identification of a cohort	-	integer, in type cohort	<i>prepare_stand</i>	<i>output</i>	V
sumBG	data_stand	C	sum of all crown projection areas in layer j	m ²	real, in type vert_struct, dimension(250)	<i>crown_proj</i> (l) <i>canopy, crown_proj</i>	<i>light_growth, cov_area, l_3_coh_loop, light_3, l_4_coh_loop, light_4, int_coh_loop1</i>	V
c1	local	c_1	crown base height calculation (Nagel 1995)	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
c2	local	c_2	crown base height calculation (Nagel 1995)	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
CO2	data_climate	c_a	atmospheric CO ₂ content	mol mol ⁻¹	real	(l) <i>assign_CO2par, year_ini</i>	<i>opt_ps, outyear</i>	I
c_air	data_par	c_{air}	specific heat capacity of air	J g ⁻¹ K ⁻¹	real	(l) <i>data_par</i>	<i>evapo</i>	P
crown_c	data_species		parameter for calculation of crown area	m	real, in type species_par	(l) <i>readspec</i>	<i>crown_proj, initia</i>	S



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
BG	data_stand	$c_c(j)$	fraction of the patch covered by the crown projection area of cohort c in crown layer j	-	real, dimension(1:251), in type cohort	<i>cov_area</i>	<i>light_2, l_3_coh_loop, light_3, l_4_coh_loop, light_4, light_out_2, int_coh_loop1, int_coh_loop2</i>	V
Inh	data_stand	C_{chill}	counter of 'chill days', phenology model CSM	-	real, in type species_var	<i>pheno_begi</i> (l) <i>pheno_ini</i> , <i>pheno_shed</i>	<i>stand_bal_spec</i>	V
ceppot_spec	data_species	C_{int}^c	interception capacity parameter per LAI	mm m ⁻²	real, in type species_par	(l) <i>readspec</i>	<i>intercep, int_coh_loop1, standup</i>	S
sum_costs	data_wpm	C^f	sum of management costs	€	real	<i>stand_wpm</i>	<i>output</i>	V
x_health	data_stand	C_{health}	number of years without stress	-	integer, in type cohort	<i>stand_mortalit</i> (l) <i>prepare_stand</i>	<i>stand_mortality, output</i>	V
ceppot_can	data_stand	C_{int}	potential interception capacity of the whole canopy per LAI	mm m ⁻²	real	<i>standup</i>	<i>intercep, standup</i>	V
cmass	data_par	C_{mass}	molar mass of carbon	g mol ⁻¹	real	(l) <i>data_par</i>	<i>opt_ps</i>	P
x_nsc_crt	data_stand	$C_{act,crt}^{NSC}$	actual C-amount of coarse root NSC-pool	kg C / tree	real, in type cohort	<i>partition</i> (l) <i>read_stand</i>	<i>finish_simul, partition</i>	V
x_nsc_sap	data_stand	$C_{act,s}^{NSC}$	actual C-amount of sapwood NSC-pool	kg C / tree	real, in type cohort	<i>partition</i> (l) <i>read_stand</i>	<i>finish_simul, partition</i>	V
x_nsc_tb	data_stand	$C_{act,tb}^{NSC}$	actual C-amount of twigs and branch NSC-pool	kg C / tree	real, in type cohort	<i>partition</i> (l) <i>read_stand</i>	<i>finish_simul, partition</i>	V
x_nsc_crt_max	data_stand	$C_{max,crt}^{NSC}$	maximum C-amount of coarse root NSC-pool	kg C / tree	real, in type cohort	<i>partition</i> (l) <i>read_stand</i>	<i>partition</i>	V



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Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
x_nsc_sap_max	data_stand	$C_{\max,s}^{\text{NSC}}$	maximum C-amount of sapwood NSC-pool	kg C / tree	real, in type cohort	<i>partition</i> (l) <i>read_stand</i>	<i>partition</i>	V
x_nsc_tb_max	data_stand	$C_{\max,tb}^{\text{NSC}}$	maximum C-amount of twigs and branch NSC-pool	kg C / tree	real, in type cohort	<i>partition</i> (l) <i>read_stand</i>	<i>partition</i>	V
nsc_plus	local	$C_{\text{plus}}^{\text{NSC}}$	carbon available for NPP allocation after disturbance	kg DW/tree	real	<i>partition</i> (l) <i>partition</i>	<i>partition</i>	V
BGpool	data_stand	$C_p(j)$	fraction of the patch NOT covered by cohorts (LM2-4)	-	real, dimension(1:301)	<i>l_3_coh_loop, light_3,</i> <i>l_4_coh_loop, light_4</i> (l) <i>canopy</i>	<i>l_3_coh_loop, light_3,</i> <i>l_4_coh_loop, light_4</i>	V
cpart	data_par	C_{part}	part of C in biomass	-	real	(l) <i>data_par</i>	<i>partition, partition_sv, npp,</i> <i>opt_ps, readspec, soil_ini,</i> <i>s_cn_gener, cond, litter,</i> <i>stand_mort, growth_seed,</i> <i>mort_seed, target_thinning,</i> <i>target_thinning_OC, out_tim,</i> <i>asp_pruning, aust_manag,</i> <i>beetle_nat, beetle_man,</i> <i>tending, liocourt_manag,</i> <i>direct_fel, thinning, felling,</i> <i>shelterwood_man, outyear,</i> <i>coh_out_d, out_comp,</i> <i>outstore, year_ini, fire_year</i>	P
C_opm	data_soil_cn	C_{pom}	whole C-content of dead biomass per layer without stems	g C m ⁻²	real, allocatable, dimension(nlay)	<i>cn_inp</i>	<i>humlay, outyear</i>	V



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Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
cr_frac	data_species	C_{frac}	part of twigs and branches of the coarse wood fraction (twigs, branches and coarse roots)	-	real, in type species_par	(l) <i>readspec</i>	<i>partition, gen_one_coh, planting, gener_coh, read_stand</i>	S
spheat	data_soil	C_s	specific heat capacity of soil	$J g^{-1} K^{-1}$	real, allocatable, dimension(nlay)	<i>soil_te</i> (l) <i>prepare_site</i>	<i>soil_tem</i>	V
x_stress	data_stand	C_{stress}	number of stress years	years	integer, in type cohort	<i>stand_mortality</i> (l) <i>prepare_stand</i>	<i>stand_mortality, output</i>	V
h_cap	data_soil_t	C_T	heat capacity	$J cm^{-3} K^{-1}$	real, allocatable, dimension(nlay)	<i>soil_tem</i>	<i>soil_tem</i>	V
water%hc	data_soil_t	C_W	heat capacity of soil water	$J cm^{-3} K^{-1}$	real, in type therm_par	<i>s_t_ini</i>	<i>cond</i>	P
db	local	d_b	diameter at base of the stem segment	cm	real	<i>timsort</i>	<i>rabf, n0ofvol</i>	V
day_bb_bi	data_biodiv	d_{BB}^{birch}	bud break birch	d	integer	<i>calc_fire_risk</i>	<i>calc_fire_risk</i>	V
day_bb-rob	data_biodiv	d_{BB}^{rob}	bud break black locust	d	integer	<i>calc_fire_risk</i>	<i>calc_fire_risk</i>	V
diam	data_stand	d_{bh}	diameter at breast height	cm	real, in type cohort	<i>partitio</i> (l) <i>prepare_stand</i>	<i>output</i>	V
D	local	d_{bs}	diameter at forest floor		real	<i>calc_dbh</i>	<i>calc_dbh</i>	V



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Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
dcrb	data_stand	d_{cb}	diameter at crown base	cm	real, in type cohort	<i>calc_dbh</i> (l) <i>read_stand</i>	<i>calc_dbh</i> , <i>partition</i> , <i>read_stand</i> , <i>asp_sprout</i> , <i>aust_manag</i> , <i>stump</i> , <i>thinning</i> , <i>felling</i> , <i>shelterwood_man</i> , <i>finisim</i> , <i>coh_out_y</i>	V
dg	local	d_g	quadratic mean diameter	cm	real	<i>initia</i>	<i>inita</i>	V
dlength	data_climate	d_l	photoperiod of actual day	h	real	<i>photoper</i> (l) <i>day_ini</i>	<i>evapo</i> , <i>pheno_begin</i> , <i>stand_daily</i>	V
drlimF	local	d_{limf}	drought factor limiting the assimilation rate	-	real	<i>npp</i>	<i>npp</i>	V
demand	data_stand	E_{trd}^c	potential transpiration demand of a tree	mm d ⁻¹	real, in type cohort	<i>upt_wat</i>	<i>upt_wat</i> , <i>drought</i> , <i>coh_out_d</i>	V
aev_i	data_evapo	E_{int}	actual evaporation of intercepted water	mm d ⁻¹	real	<i>Intercep</i>	<i>soil_wat</i> , <i>old_out</i>	V
pet	data_evapo	E_{pot}	daily potential evaporation rate	mm d ⁻¹	real	<i>evapo</i>	<i>evapo</i> , <i>output</i>	V
trans_tree	data_evapo	E_{tr}	actual canopy transpiration	mm d ⁻¹	real	<i>soil_wat</i>	<i>soil_wat</i> , <i>outday</i>	V
trans_dem	data_evapo	E_{trd}	potential canopy transpiration demand	mm d ⁻¹	real	<i>upt_wat</i>	<i>upt_wat</i> , <i>outday</i>	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
fpar	data_stand	f_c	Light Model 1-3: fraction of I_{PAR} absorbed by each layer j per crown coverage area per cohort c [-] Light Model 4: fraction of I_{PAR} absorbed until each layer l per patch per cohort c [-]	-	real, dimension(250), in type cohort	<i>canopy_geometry</i>	<i>canopy_geometry, crown</i>	V
totfpar	data_stand	f_{tot}^c	total fraction of I_{PAR} absorbed by a cohort	-	real, in type cohort	<i>canopy_geometry</i>	<i>crown, npp</i>	V
dnlf	data_frost	F_{day}	number of days with late frost risk after starting the vegetation period	-	real, allocatable, dimension(year)	<i>calc_frost_index</i> , (l) <i>sim_ini</i>	<i>frost_index_total, outyear, outstore, out_var_select</i>	V
dnlf_sp	data_frost	F_{day_sp}	number of days with late frost risk after starting bud burst (deciduous species)	-	real, allocatable, dimension(year)	<i>calc_frost_index</i> , (l) <i>sim_ini</i>	<i>frost_index_total, outyear, outstore, out_var_select</i>	V
vf	data_soil_t	f_i	volume fraction of soil components, i=air, ice, water, quartz, clay, silt, stone, humus	-	real, type therm_par	<i>cond</i>	<i>cond</i>	V
respfrt	data_stand	$f_{mres,r}$	fine root maintenance respiration per day	kg DW d ⁻¹	real, in type cohort	<i>npp</i>	<i>coh_out_d</i>	V
respsap	data_stand	$f_{mres,sw}$	sapwood maintenance respiration per day	Kg DW d ⁻¹	real, in type cohort	<i>npp</i>	<i>coh_out_d</i>	V
npp	data_stand	f_{NPP}	NPP per tree of a cohort	kg DW a ⁻¹	real, in type cohort	<i>npp</i> (l) <i>prepare_stand, stand_daily</i>	<i>output, partition, growth_seed</i>	V



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sfol	data_stand	$f_{s,f}$	senescence rate foliage	kg a^{-1}	real, type cohort	senescence	coh_out_y, growth_seed, partition, partition_sv, stand_mort	V
sftr	data_stand	$f_{s,r}$	senescence rate fine roots	kg a^{-1}	real, type cohort	senescence	coh_out_y, growth_seed, partition, partition_sv, stand_mort	V
ssap	data_stand	$f_{s,s}$	senescence rate sapwood	kg a^{-1}	real, type cohort	senescence	coh_out_y, partition, partition_sv,	V
radfrac	data_stand	F_t	fraction of total radiation absorbed at a given height in a given layer j (LM1)	-	real, in type vert_struct, dimension(250)	canopy_geometry	canopy_geometry	P
basal_area	data_stand	G	basal area	$\text{m}^2 \text{ha}^{-1}$	real	stand_bal_spec	initia, outyear, outveg	V
ga	data_soil_t	g_a^i	shape factor of soil particles, i=ice, quartz, clay, silt, stone	-	real in type therm_par	s_t_ini	FUNCTION kw	P
gp	data_stand	g^c	unstressed stomatal conductance of a tree	$\text{mol m}^{-2} \text{d}^{-1}$	real, in type cohort	opt_ps	opt_ps, coh_out_d, upt_wat	V
gpmax	data_par	g_{max}	maximum stomatal conductance of the canopy	$\text{mol m}^{-2} \text{d}^{-1}$	real	(l) data_par	upt_wat, upt_wat1	P
gmin	data_par	g_{min}	minimum stomatal conductance of the canopy	$\text{mol m}^{-2} \text{d}^{-1}$	real	(l) data_par	opt_ps	P
gp_can	data_stand	g_{tot}	unstressed stomatal conductance of the canopy	$\text{mol m}^{-2} \text{d}^{-1}$	real	opt_ps (l) sim_ini, opt_ps	upt_wat, outyear, outday	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
height	data_stand	H	tree height	cm	real,, in type cohort	<i>create_mistletoe,</i> <i>create_soilveg,</i> <i>gener_coh ,</i> <i>gen_one_coh ,</i> <i>growth_seed,</i> <i>growth_seed_week,</i> <i>partition, planting,</i> <i>seed_ini, seed_multi</i> <i>(l) prepare_stand,</i> <i>read_stand</i>	<i>adap_manag , asp_sprout,</i> <i>aust_manag, calc_heidom,</i> <i>calc_heidom_spec, calc_la,</i> <i>class, class_man, coh_out_y,</i> <i>crown, crown_proj, dimsort ,</i> <i>evapo, felling , finish_simul,</i> <i>gen_one_coh, growth_seed,</i> <i>growth_seed_week,</i> <i>max_height, min_dbh_tar,</i> <i>mort_seed, overstorey,</i> <i>partition, partition_sv,</i> <i>read_stand, rootc_new ,</i> <i>root_distr, seed_ini,</i> <i>seed_multi, senescence,</i> <i>shelterwood_man,</i> <i>simple_manag,</i> <i>simulation_4C, sla_ini ,</i> <i>stand_balance ,</i> <i>stand_bal_spec , stand_mort,</i> <i>gener_seed, thinning, timsort,</i> <i>year_ini</i>	V, I
x_hbole	data_stand	H_b	bole height	cm	real, in type cohort	<i>asp_sprout,</i> <i>create_mistletoe ,</i> <i>planting</i> <i>(l) prepare_stand,</i> <i>read_stand</i>	<i>asp_sprout, aust_manag,</i> <i>calc_la, coh_out_y, crown,</i> <i>felling , finish_simul, partition,</i> <i>read_stand ,</i> <i>shelterwood_man ,</i> <i>stand_bal_spec, thinning,</i> <i>timsort</i>	V, I
height	local	H_c	sapling height	cm	real	<i>planting</i>	<i>planting</i>	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
h_breast	data_par	H_{dbh}	breast height for inventory measurement	cm	real	-	<i>calc_dbh, fdfahc, treeini</i>	P
hg	local	H_g	height of the tree with diameter D_g	m	real	<i>initia</i>	<i>inita</i>	V
thr_height	data_simul	H_{thr}	height threshold for saplings	cm	real	(l) <i>data_simul</i>	<i>crown_proj</i>	P
plant_height	data_plant	H_p	specific mean height of plants	cm	real	(l) <i>data_plant</i>	<i>planting, plant_aust</i>	P
plant_hmin	data_plant	H_p^{min}	minimum sapling height	cm	real	(l) <i>data_plant</i>	<i>planting</i>	P
hum	data_climate	h_r	relative humidity of actual day	%	real	(l) <i>day_ini</i>	<i>evapo</i>	I
x_hsap	data_stand	H_s	sapwood height	cm	real, in type cohort	<i>partition</i> (l) <i>read_stand</i>	<i>partition</i>	V
fire_indb	data_biodiv	I_A	fire index of Bruschek	-	real	<i>fire_year</i> (l) <i>year_ini, sim_ini</i>	<i>outyear, out_comp</i>	V
ind_arid_an	data_climate	I_{arid}	aridity index	-	real	<i>s_year</i>	<i>outyear</i>	V
ind_bud	data_climate	I_{bud}	dryness index Budyko	-	real	<i>s_year</i>	<i>outyear</i>	V
lrel	data_stand	$i_c(j)$	relative incident light intensity at the top of canopy layer j and cohort c (LM3, LM4))	-	real, dimension(n_l), in type cohort	<i>canopy, light_1, light_2, light_3, l_3_coh_loop, light_4, l_3_coh_loop, light_4, l_4_coh_loop</i>	<i>light_growth, light_1, light_2, light_3, l_3_coh_loop, light_4, l_4_coh_loop, light_out_2, growth_seed_week, stand_regen, growth_seed</i>	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
fire_indi	data_biodiv	$I_{c,d}$	forest fire indicator east of Käse	-	real	<i>calc_fire_risk</i> (l) <i>year_ini</i>	<i>outyear, outday</i>	V
drindd	data_stand	I_{drps}^c	daily drought index	-	real, in type cohort	<i>drought</i>	<i>outday, coh_out_d</i>	V
Ind_cout_an	data_climate	I_{cm}	monthly aridity index Coutange	-	real	<i>stand_daily</i>	<i>outyear</i>	V
con_con	data_climate	I_{con}	continentality index Conrad	-	real	<i>s_year</i>	<i>outyear</i>	V
ind_cout_an	data_climate	I_{cout}	annual aridity index Coutange	-	real	<i>stand_daily</i>	<i>outyear</i>	V
con_cur	data_climate	I_{cur}	continentality index Currey	-	real	<i>s_year</i>	<i>outyear, s_year</i>	V
clim_waterb	data_climate	I_{cwb}	climatic water balance	mm	real, dimension(5)	<i>evapo</i>	<i>calc_fire_risk</i>	V
drindal	data_stand	I_{dral}	drought index for allocation calculation (cumulative)	-	real, in type cohort	<i>drought</i>	<i>partition, stand_balance, stand_bal_spec, growth_seed, s_year, outyear</i>	V
drindps	data_stand	I_{drps}	drought index for photosynthesis calculation (cumulative)	-	real, in type cohort	<i>drought, npp</i>	<i>npp, coh_out_d</i>	V
ind_emb	data_climate	I_{emb}	aridity index Emberger	-	real	<i>s_year</i>	<i>outyear, s_year</i>	V
con_gor	data_climate	I_{gor}	continentality index Gorczynski	-	real	<i>s_year</i>	<i>outyear, s_year</i>	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
ind_lang_an	data_climate	I_{lang}	aridity index Lang	-	real	s_year	$outyear, s_year$	V
lfind	data_frost	I_{lf}	late frost index	-	integer	$frost_index_total$	out_comp	V
ind_mart_an	data_climate	I_{mart}	aridity index Martonne annual	-	real	s_year	$outyear, s_year$	V
ind_mart_vp	data_climate	I_{martvp}	aridity index Martonne vegetation period	-	real	s_year	$outyear, s_year$	V
index	data_biodiv	I_N	fire danger rating index of Nesterov	-	integer, in type fire_risk	$calc_fire_risk$	$calc_fire_risk, outday$	V
ntindex	data_biodiv	I_{NMR}	nun moth risk index	-	real	$t_indices$	$outyear$	V
p_nest	data_biodiv	I_N^{val}	cumulative sum of ignition index of Nesterov	-	real	$calc_fire_risk$	$calc_fire_risk$	V
Irelpool	data_stand	$I_P(j)$	relative light intensity in the pool (LM3,4)	-	real	$I_3_coh_loop, light_3, I_4_coh_loop, light_4$	$I_3_coh_loop, light_3, I_4_coh_loop, light_4, stand_daily, growth_seed_week, growth_seed, outday$	V
PAR	local	I_{PAR}	photosynthetically active radiation	$mol\ m^{-2}$	real	$stand_daily$	$stand_daily$	V
Inh	data_species	I_{phen}	depending on phenology model: inhibitor or chill days	-	real, in type species_var	$pheno_begin$ (l) $pheno_ini$	$pheno_ini, pheno_begin$	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
ind_reich	data_climate	I_{reich}	aridity index Reichel	-	real	s_year	$outyear, s_year$	V
lrelcan	data_stand	I_{relcan}	relative light regime in the middle of the cohort's canopy	-	real, in type cohort	$light_growth$	$partition$	V
ind_shc	data_climate	I_{shc}	hydrothermal coefficient Seljaninov	-	real	$stand_daily$	$outyear, s_year$	V
ind_weck	data_climate	I_{weck}	aridity index Weck	-	real	s_year	$outyear, s_year$	V
ind_wiss_an	data_climate	I_{wiss}	aridity index Wissmann	-	real	$stand_daily$	$outyear, s_year$	V
pfext	data_species	k	light extinction coefficient	-	real, in type species_par	(l) $readspec$	$canopy$	S
aa	local	k_a	coefficients of the Campbell-equation (calculation of thermal conductivity)	-	real	$cond$	$cond$	V
k_hum	data_soil_cn	k_{aom}	mineralization constant of humus	d^{-1}	real	(l) $readsoil$	$humlay, minlay$	P
bb	local	k_b	coefficients of the Campbell-equation (calculation of thermal conductivity)	-	real	$cond$	$cond$	V
cc	local	k_c	coefficients of the Campbell-equation (calculation of thermal conductivity)	-	real	$cond$	$cond$	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
ku_c0	local	k_{c0}	parameter of the height curve after Kuleschis, in erold1991	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
ku_c1	local	k_{c1}	parameter of the height curve after Kuleschis, in erold1991	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
ku_c2	local	k_{c2}	parameter of the height curve after Kuleschis, in erold1991	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
dd	local	k_d	coefficients of the Campbell-equation (calculation of thermal conductivity)	-	real	<i>cond</i>	<i>cond</i>	V
kwa, kww	data_soil_t	k_i	weighting factor of soil components i=air, ice, water, quartz, clay, silt, stone, humus; in case of the continuous medium air and water resp.	-	real in type therm_par	<i>s_t_ini</i>	<i>cond</i>	V
k_opm_*	data_species	k_{pom}	species specific mineralization constant of litter *=fol (foliage), tb (twigs and branches), stem (stem wood), frt (fine roots), crt (coarse roots)	d^{-1}	real	(l) <i>readspec</i>	<i>humlay, minlay, decomp1, decomp2</i>	S
cof	soil_tem (surf_t)	k_s	daily correction coefficient	-	real (local)	<i>soil_tem</i>	<i>surf_t</i>	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
C0, C1, C2	data_soil_t	K_s^i	coefficients of soil surface temperature calculation, $i=0, 1, 2$	-	real	(l) <i>data_soil_t</i>	<i>surf_t</i>	P
k_syn_*	data_species	k_{syn}	species specific synthesis coefficient of litter *=fol (foliage), tb (twigs and branches), stem (stem wood), frt (fine roots), crt (coarse roots)	d^{-1}	real	(l) <i>readspec</i>	<i>humlay, minlay, decomp1, decomp2</i>	V
ku_a	local	k_{ua}	Parameter of the height curve after Kuleschis	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
ku_b	local	k_{ub}	Parameter of the height curve after Kuleschis	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
ku_c	local	k_{uc}	parameter of the height curve after Kuleschis	-	real, dimension(nspec_tree)	(l) <i>initia</i>	<i>initia</i>	P
cumlai	data_stand	L	cumulated leaf area index at a given height down to layer j	-	real, in type vert_struct, dimension (250)	<i>light_1, light_2, light_3, light_4</i>	<i>light_1, light_2, , light_3, light_4</i>	V
npv	data_wpm	L_1	liquidation value of the standing stock at the beginning of the simulation	$€\ ha^{-1}$	real, allocatable, dimension(12, t_{year})	<i>calculate_npv</i>	<i>output_wpm</i>	V
la	data_stand	L_a	leaf area at given layer j over all cohorts height	m^2	real, in type vert_struct, dimension (250)	<i>calc_la</i>	<i>light_1, light_2, , light_3, , light_4</i>	V



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Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
leafarea	data_stand	$l_{a,c}$	array of leaf area per layer j and cohort c	m^2	real, dimension(250), in type cohort	$calc_la, ight_1, light_2, light_3, , light_4$	$calc_la, int_coh_loop1, light_1, light_2, light_3, light_4, l_3_coh_loop, l_4_coh_loop$	V
lai	data_stand	L_{AI}	leaf area index of the whole patch	$m^2 m^{-2}$	real	$ight_1, light_2, light_3, light_4$	$evapo, light_1, light_2, light_3, light_4, outday, standup, surf_t, turc_ivanov$	V
l	local	$l_c(j)$	side length of the cuboid of cohort c in layer j	m	real	cov_area	cov_area	V
date_lf	local	L_{frost}	date (DOY) of the last late frost event after bud burst or start of the vegetation period	-	real, allocatable, dimension(year)	$calc_frost_index$ (A) sim_ini (I) sim_ini	$frost_index_total, outyear, outstore, out_var_select$	V
date_lftot	local	$L_{frosttot}$	date (DOY) of the last late frost event of the year	-	real, allocatable, dimension(year)	$calc_frost_index$ (A) sim_ini (I) sim_ini	$frost_index_total, outyear, outstore, out_var_select$	V
T	local	L_T	capping limit	cm	real	$initia$	$inita$	V
npv	data_wpm	$L_{t_{year}}$	liquidation value of the standing stock at the end of the simulation	$€ ha^{-1}$	real, allocatable, dimension(12, t_{year})	$calculate_npv$ (A) $allocate_in_output$	$output_wpm$	V
LUE	data_stand	L_{UE}	light use efficiency	$g C \mu mol^{-1}$	real	$data_stand$	npp	V
stembio	local	M_{bio}	total stem biomass	Kg DW	real	$treeini$	$treeini$	V
x_fol	data_stand	$M_{f,c}$	foliage biomass per tree	kg DW	real, in type cohort	$crown, partition$ (I) $prepare_stand$	$output, partition, stand_mortality$	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
x_frt	data_stand	M_r^c	fine root biomass per tree	kg DW	real, in type cohort	<i>growth_seed_week, growth_seed, partition</i> (l) <i>prepare_stand</i>	<i>growth_seed_week, growth_seed, litterflux, management, partition, npp, stand_balance. int_mort, mort_seed, seed_ini, upt_wat, coh_out_y</i>	V
x_fol_loss	data_stand	$M_{f,loss}$	lost fine root biomass due to root disturbance	kg DW	real, in type cohort	<i>disturbance_defoliator</i> (l) <i>dist_ini</i>	<i>partition, s_cn_gener dist_manag.f, partitio.f, soil_cn_link.f</i>	V
x_hrt	data_stand	M_{hw}	heartwood biomass per tree	kg DW	real, in type cohort	<i>partition</i> (l) <i>prepare_stand</i>	<i>partition, stand_mortality, output</i>	V
x_frt_loss	data_stand	$M_{r,loss}$	lost fine root biomass due to root disturbance	kg DW	real, in type cohort	<i>disturbance_root</i> (l) <i>dist_ini</i>	<i>dist_manag.f, partitio.f, soil_cn_link.f</i>	V
x_sap	data_stand	M_s	sapwood biomass per tree	kg DW	real, in type cohort	<i>Initia, partition, partition_sv, partition_mi, asp_sprout, gener_coh, gen_one_coh, seed_ini, seed_multi, growth_seed, growth_seed_week, mort_seed, liocourt_manag, target_manag, target_thinning, target_thinning_OC, adap_manag, thinning, seed_multi, target_manag</i> (l) <i>prepare_stand</i>	<i>initia, partition, npp, asp_sprout, asp_pruning, aust_manag, beetle_nat, gener_coh, gen_one_coh, seed_ini,, seed_multi, growth_seed, growth_seed_week, mort_seed, liocourt_manag, target_manag, target_thinning, target_thinning_OC, adap_manag, thinning, planting, seed_multi, stand_mort, stand_balance, stand_bal_spec, class_man, senescence, timsort, wclas, coh_out_y</i>	V



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Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
seedmass	data_species	M_{seed}	seed mass	g DW	real, in type species_par	(l) <i>read_spec</i>	<i>seed_multi, seed_ini</i>	P
N_hum_tot	data_soil_cn	N_{aom}	total N content of humus in the soil profile at the end of the year	g N m ⁻²	real	<i>soil</i> (l) <i>year_ini, sim_ini</i>	<i>outyear</i>	V
anz_coh	data_stand	n_c	actual number of cohorts	-	integer	(l) <i>prepare_stand</i>	<i>stand_balance, prepare_stand, output</i>	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
ntreea	data_stand	n_a^c	number of alive trees per cohort, $c=1 - n_c$	-	real, in type cohort	asp_pruning, asp_sprout, aust_manag, beetle_man, beetle_nat, create_mistletoe, create_soilveg, direct_fel, felling, gener_coh, gener_seed, gen_one_coh, liocourt_manag, management, mort_seed, planting, seed_ini, seed_multi, shelterwood_man, sla_ini, stand_bal_spec, stand_mort, tending, thinning (l) read_stand	adap_manag, asp_pruning, asp_sprout, aust_manag, beetle_man, beetle_nat, calc_heidom, calc_heidom_spec, calc_la, class, coh_out_y, cov_area, create_mistletoe, create_soilveg, crown_proj, del_cohort, direct_fel, drought, evapo, felling, finish_simul, gener_seed, gen_one_coh, i growth_seed, ntercep, int_coh_loop1, int_coh_loop2, int_coh_loop3, light_growth, light_2, l_3_coh_loop, light_3, l_4_coh_loop, light_4, liocourt_manag, npp, n_upt, management, mort_seed, outveg, outyear, partition, partition_sv, prepare_stand, root_distr, seed_multi, shelterwood_man, sla_ini, soil_cn, s_cn_gener, stand_balance, stand_bal_spec, stand_mort, stand_regen, standup, tending, thinning, upt_wat, upt_wat1,	V
ntreed	data_stand	n_d^c	number of dead trees per cohort	-	real, in type cohort	stand_mort (l) prepare_stand	stand_balance, stand_mortality, output	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
nplant	local	n_s^c	number of saplings per cohort	-	integer	planting , plant_aust	gener_coh , gen_one_coh , ini_gener_sap , planting , plant_aust	V
Ndemc_c	data_stand	N_{dem}^c	cumulative N demand per tree	$g\ N\ a^{-1}$	real,in type cohort	soil_cn	coh_out_y, n_upt , opt_ps, stand_balance, stand_bal_spec	V
Nuptc_d	data_stand	$N_{upt}^{c,d}$	daily N uptake per tree	$g\ N\ m^{-2}\ d^{-1}$	real,in type cohort	n_upt	coh_out_d, n_upt , opt_ps, soil_cn	V
Ndemc_d	data_stand	$N_{dem}^{c,d}$	daily N demand per tree	$g\ N\ d^{-1}$	real, in type cohort	npp (l) opt_ps	coh_out_d,n_upt, opt_ps, soil_cn	V
Nuptc_c	data_stand	N_{upt}^c	cumulative N uptake per tree and year	$g\ N\ a^{-1}$	real, in type cohort	soil_cn (l) year_ini	coh_out_y, n_upt, opt_ps, stand_bal_spec	V
nclass	local	n_{cl}	number of height classes	-	integer	ini_gener_sap, gener_coh	ini_gener_sap, gener_coh	V
days_rain	data_climate	n_{dr}	number of days with rain > 0.1 mm	-	Integer	day_ini	year_ini	V
days_dry	data_climate	n_{dry}	number of days without precipitation	-	integer	day_ini (l) sim_ini, year_ini	outyear	V
NH4_in	data_soil_cn	N_{mov}^{NH4}	ammonium transport into next layer	$g\ N\ m^{-2}$	real	n_leach	soil_cn, humlay, minlay	V
NO3_in	data_soil_cn	N_{mov}^{NO3}	nitrate transport into next layer	$g\ N\ m^{-2}$	real	n_leach	soil_cn, humlay, minlay	V
days_hot	data_climate	n_{hot}	number of hot days	-	integer	day_ini (l) sim_ini, year_ini	outyear	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
days_hrain	data_climate	n_{hrain}	number of days with heavy rain	-	integer	<i>day_ini</i> (l) <i>sim_ini</i> , <i>year_ini</i>	<i>outyear</i>	V
days_ice	data_climate	n_{ice}	number of ice days	-	integer	<i>day_ini</i> (l) <i>sim_ini</i> , <i>year_ini</i>	<i>outyear</i>	V
highest_layer	data_stand	n_l	number of the highest layer in the stand	-	integer	<i>canopy</i>	<i>canopy</i> , <i>calc_la</i> , <i>cov_area</i> , <i>light_1</i> , <i>light_2</i> , <i>light_3</i> , <i>light_4</i> , <i>intercep</i> , <i>int_layer</i>	V
days_rain_mj		n_{mj}	number of days with precipitation May-July	-	integer	<i>day_ini</i>	<i>year_ini</i>	V
numplant	data_plant	n_{pl}	number of planted saplings		integer	<i>planting</i> , <i>gener_seed</i> (l) <i>data_plant</i> , <i>target_ini</i>	<i>ini_gener_sap</i> , <i>calculate_costs</i>	V
npv	data_wpm	N_{PV}	net present value	€ ha ⁻¹	real, allocatable, dimension(12, t_{nyear})	<i>calculate_npv</i>	<i>output_wpm</i>	V
npv	data_wpm	N_{PV}^+	net present value with liquidation values	€ ha ⁻¹	real, allocatable, dimension(12, t_{nyear})	<i>calculate_npv</i>	<i>output_wpm</i>	V
nroot	data_soil	n_r	number of rooting layers		integer	(l) <i>prepare_site</i>	<i>soil</i>	I
Ndem	data_stand	N_{dem}^s	cumulative N demand per species and year	g N m ⁻²	real, in type species_var	<i>soil_cn</i> , <i>stand_bal_spec</i>	<i>RedN_Ndem1</i> , <i>opt_ps</i> , <i>outveg</i>	
seedrate	data_spec	n_{seed}^{max}	specific seed rate	m ⁻¹ a ⁻¹	real	(l) <i>readspec</i>	<i>planting</i> , <i>gener_seed</i>	S
nseed	local	n_{seed}	annual potential seed rate	-	integer	<i>gener_seed</i>	<i>seed_multi</i> , <i>simseed</i>	V



4C List of variables and code names

Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
days_snow	data_climate	n_{snow}	number of days with snow	-	integer	<i>snowpack</i> (l) <i>sim_ini</i> , <i>year_ini</i>	<i>outyear</i>	
days_summer	data_climate	n_{summer}	number of summer days		integer	<i>day_ini</i> (l) <i>sim_ini</i> , <i>year_ini</i>	<i>outyear</i>	
Nupt	data_stand	N_{upt}^s	cumulative N uptake per species and year	g N m^{-2}	real, in type species_var	<i>soil_cn</i> , <i>stand_bal_spec</i>	<i>RedN_Ndem1</i> , <i>opt_ps</i> , <i>outveg</i>	V
Nupt_c	data_soil_cn	N_{upt}	yearly total N uptake	gN m^{-2}	real	<i>soil_cn</i> (l) <i>year_ini</i> , <i>sim_ini</i>	<i>output</i>	V
days_wof	data_climate	n_{wof}	number of days without frost $T_{min} > 0^\circ\text{C}$		Integer	<i>day_ini</i>	<i>year_ini</i>	V
nlay	data_soil	n_z	number of soil layers	-	integer	(l) <i>prepare_site</i>	<i>prepare_site</i> , <i>soil</i> , <i>soil_cn</i>	I
Int_rate	data_wpm	p	Interest rate	-	-	(l) <i>read_sea_prices</i>	<i>calculate_npv</i>	V
PPb	data_species	p_1, p_4	scaling factor of phenology model PIM	-	real, type(species_par)	<i>pheno_ini</i> , <i>pheno_begin</i>	<i>pheno_ini</i> , <i>pheno_begin</i>	S
svp_13	local	p_{sat}^{13}	saturated vapour pressure at 13 h		real	<i>evapo</i> , <i>calc_fire_risk</i>	<i>evapo</i> , <i>calc_fire_risk</i>	V
Pla	data_species	p_2	inhibitor scaling factor of phenology model PIM	-	real, in type species_par	<i>pheno_ini</i> , <i>pheno_begin</i>	<i>pheno_ini</i> , <i>pheno_begin</i>	S
PPa	data_species	p_3	promotor scaling factor of phenology model PIM	-	real, in type species_par	<i>pheno_ini</i> , <i>pheno_begin</i>	<i>pheno_ini</i> , <i>pheno_begin</i>	S



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
kpatchsize	data_stand	P_a	patch area	m ²	real	(l) <i>readsim</i>	<i>npp, canopy</i>	I
pab	local	p_{ab}	internal parameter for sapling growth	-	real	<i>growth_seed_week</i> (l) <i>growth_seed</i>	<i>growth_seed_week</i> , <i>growth_seed</i>	V, P
press	data_climate	P_{act}	air pressure of actual day	hPa	real	(l) <i>day_ini</i>	<i>evapo</i>	I
sum_prec	data_climate	P_{ann}	annual sum of precipitation	mm	real	(l) <i>year_ini</i>	<i>day_ini, output</i>	P
prec	data_climate	P_d	precipitation of actual day	mm	real	(l) <i>day_ini</i>	<i>soil_wat, intercep</i>	I
pha	data_species	p_h	height growth rate	cm kg ⁻¹	real, in type species_par	(l) <i>readspec</i>	<i>readspec, partition</i>	S
pheight1	data_species	p_{h1}	species-specific parameter for height-shoot biomass relation of seedlings	-	real	(l) <i>readspec</i>	<i>seed_ini, growth_seed</i>	S
pheight2	data_species	p_{h2}	species-specific parameter for height-shoot biomass relation of seedlings	-	real	(l) <i>readspec</i>	<i>seed_ini, growth_seed</i>	S
pheight3	data_species	p_{h3}	species-specific parameter for height-shoot biomass relation of seedlings	-	real	(l) <i>readspec</i>	<i>seed_ini, growth_seed</i>	S



4C List of variables and code names

Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
pha_v1	data_species	p_{hv1}	height growth parameter 1 for nonlinear foliage height relationship	-	real	(l) <i>readspec</i>	<i>partition</i>	S
pha_v2	data_species	p_{hv2}	height growth parameter 2 for nonlinear foliage height relationship	-	real	(l) <i>readspec</i>	<i>partition</i>	S
pha_v3	data_species	p_{hv3}	height growth parameter 3 for nonlinear foliage height relationship	-	real	(l) <i>readspec</i>	<i>partition</i>	S
intmort	local	p_{int}, p_{wint}	yearly intrinsic death rate (p_{wint} species-specific)	-	real	<i>stand_mortality</i>	<i>stand_mortality</i>	V
loss	local	$p_{Mr,loss}$	percentage loss of foliage biomass	-	real	(l) <i>disturbance_defoliator</i>	<i>disturbance_defoliator</i>	V
sum_prec_mj	data_climate	P_{mj}	sum of precipitation May-July	mm	real	<i>day_ini</i>	<i>year_ini</i>	V
prec_mon	data_climate	P_{mon}	monthly precipitation sum	mm	real, dimension(12)	<i>stand_daily</i>	<i>outyear, stand_daily, year_ini</i>	V
totmort	local	p_{mort}	total mortality of a cohort		real	<i>stand_mort</i>	<i>stand_mort</i>	V
loss	local	$p_{Mr,loss}$	percentage loss of fine root biomass	-	real	(l) <i>disturbance_root</i>	<i>disturbance_root</i>	V
pcnr	data_species	p_{NC}	N/C ratio of biomass	kg kg ⁻¹	real, in type species_par	(l) <i>readspec</i>	<i>readspec, partition</i>	S



4C List of variables and code names

Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
phlo_feed	data_stand	p_{pfeed}	percentage loss of carbon	-	real	(l) <i>dist_ini</i> , <i>disturbance_phloem</i>	<i>npp</i>	P
Pro	data_stand	P_{phen}	promotor of the phenology model PSM	-	real, in type species_var	(l) <i>pheno_ini</i> , <i>pheno_shed</i>	<i>pheno_begin</i> , <i>stand_bal_spec</i>	V
prg	data_species	p_{rg}	growth respiration per day		real, in type species_par	(l) <i>readspec</i>	<i>npp</i> , <i>readspec</i>	S
seeda	data_spec	p_{sa}	species-specific parameter for shoot-foliage relationship of seedlings	-	real, in type species_par	(l) <i>readspec</i>	<i>seed_ini</i> , <i>growth_seed</i>	S
svp	local	P_{sat}	saturated vapour pressure of actual day	hPa	real	<i>evapo</i>	<i>evapo</i>	V
seedb	data_spec	p_{sb}	species-specific parameter for shoot-foliage relationship of seedlings	-	real, in type species_par	(l) <i>readspec</i>	<i>seed_ini</i> , <i>growth_seed</i>	S
stem_rot	data_stand	p_{srot}	Percentage loss of stems	-	real	(l) <i>dist_ini</i> , <i>disturbance_stem</i>	<i>dist_manag</i> , <i>stand_mort</i>	P
stol	data_species	p_{st}	shade tolerance class (1-5)		integer, in type species_par	(l) <i>readspec</i>	<i>readspec</i> , <i>prepare_stand</i>	S
strmort	local	p_{stress}	stress induces mortality rate		real	<i>stand_mort</i>	<i>stand_mort</i>	
vpress	local	P_{vap}	vapour pressure	hPa	real	<i>evapo</i>	<i>evapo</i>	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
xylem_dis	data_soil	p_{xcond}	Percentage loss of xylem conductivity	-	real	(l) <i>dis_manag</i> <i>disturbance_xylem</i>	<i>disturbance_xylem</i>	
Q10	local	Q_{10}^{min}	Q10 coefficient of van't Hoffs rule	-	real	(l) <i>rmin_t</i>	<i>rmin_t</i>	P
Q10	local	Q_{10}^{nit}	Q10 coefficient of van't Hoffs rule	-	real	(l) <i>rnit_t</i>	<i>rnit_t</i>	P
tutrf	local	r_a	surface aerodynamic resistance for water vapour	$s\ m^{-1}$	real	<i>evapo</i>	<i>evapo</i>	V
frtrel	data_stand	$r_{fr}^c(z_i)$	relative part of fine root mass of tree per soil layer i	-	real	<i>upt_wat</i>	<i>upt_wat</i>	V
frtrelc	data_stand	$r_{Mr}^c(z_i)$	relative part of fine root mass of cohort of total layer fine root mass per soil layer i	-	real	<i>upt_wat</i>	<i>upt_wat</i>	V
RedNc	data_stand	R_N^c	photosynthesis nitrogen reduction factor for each cohort	-	real, in type cohort	<i>opt_ps</i>	<i>npp, drought, output</i>	V
respcoeff	data_species	r_{co}	respiration coefficient - fraction of gross production respired by the plant	-	real	<i>data_species</i>	<i>npp</i>	S
resp	data_stand	R_{dc}	leaf respiration rate	$kg\ DW\ d^{-1} patch^{-1}$	real, in type cohort	<i>npp</i>	<i>npp, output</i>	V
respspe	local	R_{ds}	specific leaf respiration	$g\ C\ m^{-2}\ d^{-1}$	real	<i>opt_ps</i>	<i>opt_ps</i>	V



4C List of variables and code names

Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
root_fr	data_soil	r_{fr}	root fraction per soil layer	-	real, allocatable, dimension(nlay)	<i>root_distr</i> (l) <i>root_ini</i>	<i>fred3, s_cn_gener, n_upt</i>	V
rad	data_climate	R_g	global radiation of actual day	$\text{J cm}^{-2} \text{ d}^{-1}$	real	(l) <i>day_ini</i>	<i>evapo</i>	I
prmr	data_species	$r_{m,r}$	specific fine root maintenance respiration rate per day	$\text{kg kg}^{-1} \text{ d}^{-1}$	real, in type species_par	(l) <i>readspec</i>	<i>readspec, npp</i>	S
prms	data_species	$r_{m,sw}$	specific sapwood maintenance respiration rate per day	$\text{kg kg}^{-1} \text{ d}^{-1}$	real, in type species_par	(l) <i>readspec</i>	<i>readspec, npp</i>	S
rmin_phv	data_soil_cn	R_p^{\min}	reduction of mineralization depending on pH-value	-	real, allocatable, dimension(nlay)	<i>s_cn_ini</i>	<i>humlay, minlay</i>	V
rmin_t	-	R_T^{\min}	reduction of mineralization depending on soil temperature	-	real function	<i>rmin_t</i>	<i>humlay, minlay</i>	F
rmin_w	-	R_w^{\min}	reduction of mineralization depending on soil water content	-	real function	<i>rmin_w</i>	<i>humlay, minlay</i>	F
Rnet	local	R_n	net radiation	J cm^{-2}	real	<i>evapo</i>	<i>evapo</i>	V
Rnet_cum	data_climate	R_{nets}	annual radiation sum	J cm^{-2}	real	<i>evapo</i>	<i>Year_ini</i>	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
rnit_t	-	R_T^{nit}	reduction of mineralization depending on soil temperature	-	real function	<i>rnit_t</i>	<i>humlay, minlay</i>	F
rnit_w	-	R_W^{nit}	reduction of mineralization depending on soil water content	-	real function	<i>rnit_w</i>	<i>humlay, minlay</i>	F
rnit_phv	data_soil_cn	R_p^{nit}	reduction of nitrification depending on pH-value	-	real, allocatable, dimension(nlay)	<i>s_cn_ini</i>	<i>humlay, minlay</i>	V
rc	local	r_c	canopy surface resistance	$s\ m^{-1}$	real	<i>evapo</i>	<i>evapo</i>	V
rsap		r_{sap}	describes the fraction of wood which is sapwood	-	real	<i>initia</i> <i>treeini</i>	<i>initia, treeini</i>	V
RedN	data_stand	R_N^s	tree specific photosynthesis nitrogen reduction factor	-	real, in type species_var	<i>opt_ps, redn_calc,</i> <i>redn_ndem,</i> <i>redn_ndem1, s_year</i> (l) <i>readredn, redn_ini</i>	<i>create_soilveg, drought, npp,</i> <i>opt_ps, outday, s_year</i>	V, P
psla_a	data_species	s_a^c	average specific one-side leaf area per cohort	$m^2\ kg^{-1}\ DW$	real, in type species_par	(l) <i>readspec</i>	<i>asp_sprout, create_soilveg,</i> <i>gener_coh, gen_one_coh,</i> <i>growth_seed,</i> <i>growth_seed_week,</i> <i>light_growth,</i> <i>planting, seed_ini,</i> <i>seed_multi, sla_ini, treeini</i>	S



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
med_sla	data_stand	s_{av}^c	average specific one-side leaf area per cohort	$m^2 kg^{-1} DW$	real, in type cohort	<i>canopy, gener_coh, gen_one_coh, growth_seed, growth_seed_week, planting, prepare_stand, seed_ini, seed_multi</i>	<i>crown, felling, gener_coh, gen_one_coh, growth_seed, growth_seed_week, partition, planting, prepare_stand, seed_ini, seed_multi</i>	V
psla_min	data_species	s_{min}^c	minimum specific one-side leaf area (SLA of sun leaves)	$m^2 kg^{-1} DW$	real, in type species_par	(l) <i>readspec</i>	<i>asp_sprout, treeini, planting, gen_one_coh, gener_coh, sla_ini, create_soilveg, seed_multi, seed_ini, growth_seed, growth_seed_week, light_growth</i>	S
psf	data_species	s_f	specific foliage senescence rate per year	$kg kg^{-1} a^{-1}$	real, in type species_par	(l) <i>readspec</i>	<i>readspec, crown. partition, stand_mortality</i>	S
length	data_tsort	S_l	length of the stem segment	cm	real, in type timber	<i>out_tim</i>	<i>timsort, outyear, out_timlist</i>	V
psr	data_species	s_r	specific fine roots senescence rate per year	$kg kg^{-1} a^{-1}$	real, in type species_par	(l) <i>readspec</i>	<i>readspec, partition</i>	S
pss	data_species	s_s	specific sapwood senescence rate per year	$kg kg^{-1} a^{-1}$	real, in type species_par	(l) <i>readspec</i>	<i>readspec, partition</i>	S
iday	data_simul	t	actual day of simulation	day	integer	(l) <i>stand_daily</i>	<i>assign_clim, old_out, output, soil, soil_cn</i>	V
airtemp	data_climate	T_a	average air temperature of actual day	$^{\circ}C$	real	(l) <i>day_ini</i>	<i>soil_wat, evapo, soil_temp, output</i>	I



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
med_air	data_climate	T_{ann}	yearly mean temperature	°C	real	<i>day_ini, stand_bal</i> (l) <i>s_year, sim_ini</i>	<i>outyear</i>	V
CSTbT	data_species	T_b	base temperature CSM	°C	real, in type species_par	(l) <i>readspec</i>	<i>pheno_begin</i>	S
LTbT	data_species	T_b	base temperature TSM	°C	real, in type species_var	(l) <i>readspec</i>	<i>pheno_begin, calc_fire_risk</i>	S
CSTbC	data_species	T_c	chilling base temperature CSM	°C	real, in type species_par	(l) <i>readspec</i>	<i>pheno_begin</i>	S
med_air_cm	data_climate	T_{cm}	average temperature of the coldest month	°C	real	<i>stand_daily</i>	<i>s_year</i>	V
Tcrit	data_stand	T_{crit}	required temperature sum for bud burst	°C	real, in type species_var	<i>pheno_begin,</i> (l) <i>pheno_ini</i>	<i>pheno_begin</i>	V
LTcrit	data_spec	T_{crit}	critical temperature sum TSM	°C	real, in type species_var	(l) <i>readspec</i>	<i>pheno_begin, calc_fire_risk</i>	S
dpTEMP	data_climate	T_{dew}	dew point temperature	°C	real	<i>evapo</i>	<i>evapo, calc_fire_risk</i>	V
gdday	data_climate	T_{gdd}	annual growing degree day	°C	real	<i>day_ini</i> (l) <i>sim_ini</i>	<i>outyear</i>	V
thr_gdd	data_par	$T_{gdd,0}$	threshold for growing degree day calculation	°C	real	-	<i>day_ini</i>	P
Pitmax	data_species	$T_{l,max}$	inhibitor maximum temperature of phenology model PIM)	°C	real, type(species_par)	<i>pheno_ini,</i> <i>pheno_begin</i>	<i>pheno_ini, pheno_begin</i>	S



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
Pltmin	data_species	$T_{l,min}$	inhibitor minimum temperature of phenology model PIM	°C	real, type(species_par)	<i>pheno_ini, pheno_begin</i>	<i>pheno_ini, pheno_begin</i>	S
Pltopt	data_species	$T_{l,opt}$	inhibitor optimum temperature of phenology model PIM	°C	real, type(species_par)	<i>pheno_ini, pheno_begin</i>	<i>pheno_ini, pheno_begin</i>	S
htempm	local	T_m	monthly mean temperature	°C	real	<i>t_indices</i>	<i>t_indices</i>	v
airtemp_max	climate	T_{max}	maximum air temperature	°C	real	(l) <i>day_ini</i>	<i>calc_fire_risk, day_ini, evapo</i>	V
airtemp_min	climate	T_{min}	minimum air temperature	°C	real	(l) <i>day_ini</i>	<i>calc_frost_index, day_ini, evapo, stand_daily</i>	V
med_air_mj	data_climate	T_{mj}	mean temperature May-July	°C	real	<i>s_year</i> (l) <i>day_ini</i>	<i>s_year</i>	V
temp_mon	data_climate	T_{mon}	monthly mean temperature	°C	real, dimension(12)	(l) <i>stand_daily</i>	<i>outyear, simulation_4C, stand_daily, year_ini</i>	V
year	data_simul	t_{nyear}	number of simulation years	-	integer	(l) <i>prepare_global</i>	<i>prepare_site, simulation_4C</i>	I
toptm	local	T_{opt}^{min}	optimal temperature for mineralisation	°C	real	(l) <i>rmin_t</i>	<i>rmin_t</i>	P
toptn	local	T_{opt}^{nit}	optimal temperature for nitrification	°C	real	(l) <i>rmit_t</i>	<i>rnit_t</i>	P
PPtmax	data_species	$T_{p,max}$	promotor maximum temperature of phenology model PIM	°C	real, type(species_par)	<i>pheno_ini, pheno_begin</i>	<i>pheno_ini, pheno_begin</i>	S



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
PPtmin	data_species	$T_{p,min}$	promotor minimum temperature of phenology model PIM	°C	real, type(species_par)	<i>pheno_ini</i> , <i>pheno_begin</i>	<i>pheno_ini</i> , <i>pheno_begin</i>	S
PPtopt	data_species	$T_{p,opt}$	promotor optimum temperature of phenology model PIM	°C	real, type(species_par)	<i>pheno_ini</i> , <i>pheno_begin</i>	<i>pheno_ini</i> , <i>pheno_begin</i>	S
temps	data_soil	T_s	soil temperature per layer	°C	real, allocatable, dimension(nlay)	<i>soil_tem</i> (A) <i>prepare_site</i> (I) <i>prepare_site</i> (D) <i>finisim</i>	<i>soil_cn</i>	V
temps_surf	data_soil_t	$T_{s,s}$	soil surface temperature	°C	real	<i>surf_t</i> , <i>snowpack</i>	<i>s_t_strt</i> , <i>soil_temp</i> , <i>num_t</i> , <i>btfour</i>	V
temp_snow	data_par	T_{snow}	threshold of air temperature for snow fall	°C	real	(I) <i>data_par</i>	<i>intercep</i> , <i>Int_layer</i> , <i>intercep_sveg</i> , <i>snowpack</i>	P
Pro	data_stand	T_{sum}^*	temperature sum for the phenology models CSM, TSM	°C	real, in type species_var	<i>pheno_begin</i> (I) <i>pheno_ini</i>	<i>pheno_begin</i> , <i>calc_fire_risk</i>	V
ntindex	local	T_{sum}^a	annual temperature sum	°C	real	<i>t_indices</i>	<i>t_indices</i>	V
med_air_wm	data_climate	T_{wm}	average temperature of the warmest month	°C	real	<i>daily</i>	<i>Year_ini</i>	V
time	data_simul	t_y	actual simulation year	-	integer	(I) <i>simulation_4C</i>	<i>simulation_4C</i> , <i>npp</i> , <i>partition</i> , <i>output</i> , <i>stand_daily</i> , <i>assign_clim</i> , <i>stand_mort</i> , <i>soil</i> , <i>soil_cn</i>	V
vd	local	V_D	stem volume	m ³	real	<i>treeini</i>	<i>treeini</i>	V



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
w	local	$w(j)$	length of the effective shadow cast of canopy layer j	m	real	<i>l_4_coh_loop</i>	<i>l_4_coh_loop</i>	V
wat_ava	local	W_{av}^c	available soil water per tree cohort c and layer plant available water per layer	mm	real	<i>upt_wat</i>	<i>upt_wat</i>	V
supply	data_satand	W_{upt}^c	supply of soil water to roots of each cohort	mm d ⁻¹	real, in type cohort	<i>upt_wat</i> (l) <i>upt_wat</i>	<i>soil, drought, coh_out_d</i>	V
wupt_ev	data_soil	W_{ev}	water withdrawal by evaporation per layer	mm	real, allocatable, dimension(nlay)	<i>soil_wat, take_wat</i> (A) <i>prepare_site</i> (l) <i>soil_ini</i> (D) <i>finisim</i>	<i>n_leach, soil_wat</i>	V
wei_f	local	w_f	height function according to Weimann	cm	real	<i>initia</i>	<i>initia</i>	V
interc_can	data_inter	W_{int}	daily interception	mm d ⁻¹	real	<i>intercep</i>	<i>soil_wat</i>	V
cepmax_can	local	W_{int}^{max}	potential canopy interception storage	mm	real	<i>intercep</i>	<i>intercep</i>	V
int_st_can	data_inter	W_{int}^{st}	actual canopy interception storage	mm	real	<i>intercep</i>	<i>intercep</i>	V
wei_k1	local	w_{k1}	height function parameter	-	real	-	<i>initia</i>	P
wei_k2	local	w_{k2}	Height function parameter	-	real	-	<i>initia</i>	P



Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
perc	data_soil	W_p	percolation water per layer	mm	real, allocatable, dimension(nlay)	soil_wat (A) prepare_site (D) finisim	n_leach, soil_wat	V
hred	local	w_{ru}	water uptake resistance coefficient of each cohort per layer		real	upt_wat	upt_wat	V
wats	data_soil	W_s	water content per layer	mm	real, allocatable, dimension(nlay)	soil_wat (A) prepare_site (I) soil_ini (D) finisim	bucket, fred1, fred3, fred6, fred7, fred11, humlay, minlay, outday, soil_cn, soil_ini, soil_wat, take_wat, upt_wat, upt_wat1	V
field_cap	data_soil	W_s^{FC}	field capacity of layer	mm	real, allocatable, dimension(nlay)	soil (A) prepare_site (D) finisim	soil	I
snow	data_soil	W_{sn}	snow equivalent	mm	real	soil	soil	V
snow_sm	local	W_{sn}^{pot}	potential water from melting of snow	mm	real	snowpack	snowpack	V
pv	data_soil	W_s^{sat}	pore volume of layer equals to saturated water content	mm	real, allocatable, dimension(nlay)	(A) prepare_site (I) prepare_site (D) finisim	soil, soil_cn	I
wilt_p	data_soil	W_s^{WP}	wilting point of layer	mm	real, allocatable, dimension(nlay)	(A) prepare_site (I) soil (D) finisim	soil	I
wupt_r_c	data_soil	W_{upt}	cumulative total water uptake by roots	mm	real	soil (I) year_ini	soil, soil_out	V
xlat	data_site	X_{lat}	latitude	radian	real	prepare_site	evapo, day_ini, daily, glob_rad	V



4C List of variables and code names

Variable source code name	Data Module	Variable	Definition	Dimension	Data type	Calculation in	Used in	Cat.
y	local	y	length of the potential shadow cast	m	real	<i>L_4_coh_loop</i>	<i>L_4_coh_loop</i>	V
yrec	data_species	Y_s	stress recovery time	years	integer, in type species_par	(I) <i>readspec</i>	<i>readspec, stand_mortality</i>	S
survage	local	$Y_{s,i}$	survival age under stress for tolerance class i	year	real function	<i>prepstand</i>	<i>stand_mort</i>	F
depth	data_soil	z	depth of soil layer	cm	real, allocatable, dimension(nlay)	<i>soil</i> (A) <i>prepare_site</i> (D) <i>finisim</i>	<i>soil</i>	I
dz	data_stand	z_{cr}	thickness of a crown layer	cm	real	(I) <i>readsim</i>	<i>calc_la, cov_area, crown, int_coh_loop1, light_4</i>	I
mid	data_soil	z_i	of middle of layer i	cm	real, allocatable, dimension(nlay)	<i>soil_ini</i> (A) <i>prepare_site</i> (D) <i>finisim</i>	<i>s_t_prof</i>	I

