Land use parameter (multilayer_landuse table and landuse_table)

Parametrizations of land uses is done using two different tables:

- the first table is the [multilayer_landuse] table, defining codes for each combination of single land uses which must match to the cells of the land use grid. Each single land use in such a combination is characterized by another code, referring to the [landuse_table]
- The second table, the [landuse_table], defines the parameters for each of the single land use codes referred to by the [multilayer_landuse] table.

Multi layer land use table

The table defined in the control file section [multilayer_landuse] defines combinations of basic land uses as listed in the following section.

Here is an example of that table:

```
[multilayer_landuse]
10 # count of multilayer landuses
1 water { Landuse_Layers = 1,    -9999, -9999;
          k_extinct = 0.3;
          LAI_scale = 20;
         }
2 settlements    { Landuse_Layers = 2, -9999, -9999; k_extinct = 0.3; LAI_scale = 20;}
3 pine_forest    { Landuse_Layers = 3,     8, -9999; k_extinct = 0.3; LAI_scale = 20;}
4 deciduous_for. { Landuse_Layers = 4,     8,     7; k_extinct = 0.3; LAI_scale = 20;}
5 mixed_forest   { Landuse_Layers = 5,     8,     7; k_extinct = 0.3; LAI_scale = 20;}
6 agriculture    { Landuse_Layers = 6, -9999, -9999; k_extinct = 0.3; LAI_scale = 20;}
7 grass_variable { Landuse_Layers = 7, -9999, -9999; k_extinct = 0.3; LAI_scale = 20;}
8 bushes         { Landuse_Layers = 8,     7, -9999; k_extinct = 0.3; LAI_scale = 20;}
15 rock          { Landuse_Layers = 15,-9999, -9999; k_extinct = 0.3; LAI_scale = 20;}
19 horticulture  { Landuse_Layers = 19,-9999, -9999; k_extinct = 0.3; LAI_scale = 20;}
```

As can be seen from the first entry, it is not required to put all parameters into one row. However, it is important to enclose each entry with brackets "{}" and to close each single parameter with a semi colon.

The <id> entries of that table refer to the cells in the land use grid. The name is for user convenience only.

***Note**: the land use type "water" is an example only. It should rather not be used, since water does need some special parameter handling. To apply land use water to some cells, consider to use the lake model (see chapters on lake model and evaporation).*

Table 4.10.1: Reference table of the parameters for an entry in the multilayer_landuse table

Parameter	**Sample values**	**comment**
Landuse_layers =	List of (single) land use codes like 4, 8, 7;	Each code in the list referres to an entry in the basic land use table. The example here stands for trees (basic land use code 4), bushes/shrubs (basic land use code 8) and herbs/grass (land use code 8); the first land use code is assumed to define the uppermost layer, the next one comes as second layer etc.

Parameter	Sample values	comment
k_extinct =	0.3;	extinction coefficient of d'Lambert-Beer's law for reducing radiation in its way through the canopies (after COUPmodel, Jansson and Karlberg)
LAI_scale =	20;	Scaling factor for calculating the aerodynamic resistencies of layer 2..n dependent on the cumulated leaf area index (after COUPmodel, Jansson and Karlberg)

Basic land use table

Here is a complete list of all possible entries in the parameter section of the land use table. The <ID> code of such an entry is referred by the Landuse_layers list of the [mulitlayer_landuse] table.

table 4.10.2: Reference table for all possible parameters for a land use table entry

Parameter	Sample values	comment
Method =	VariableDayCount DynamicPhenology_1 DynamicPhenology_2 DynamicPhenology_3 DynamicPhenology_4	Mandatory; Fix sample days for all phases dynamic sample days, see the respective chapter Fehler: Referenz nicht gefunden on dynamic phenology.
RootDist =	-1 … +1	Mandatory; Controlling the root density and it's change with depth
TreduWet =	0.9...1.0	Mandatory; relative Theta value for beginning water stress (under wet conditions -> set >= 1 for crop which doesn't depend on an aerobic zone
LimitReduWet =	0.5...1	Optional (default=0); minimum relative reduction factor of real transpiration when water content reaches saturation. The reduction factor value will go down linearly starting at 1.0 when relative Theta equals TReduWet (e.g. 0.95) to LimitReduWet when the soil is saturated (Theta rel = 1.0)
UseInternalParameters =	00000000 … 11111111 positions: 1 = Albedo,	each single position switches the internal estimation of time variant parameters ON, a 0 switches it OFF --> those parameters must be read from external grids (whereas the cells with

Parameter	Sample values	comment
	2 = rs_evaporation, 3 = rsc, 4 = rs_interception, 5 = LAI, 6 = VCF, 7 = RootDepth, 8 = Z0	a landuse with a 1 at this position will be calculated as usual. The positions are in the order they are defined in the flags-string (see left)
HReduDry =	3.45 (3...5m)	Mandatory; hydraulic head (suction) for beginning dryness stress (for water content resulting in higher suctions, ETR will be reduced down to 0 at suction=150m)
StartVegetationPeriodForBalance =	Any sample day index, e.g. 2	Optional (default=0); the sampling point in the following JD-Table when the vegetation period starts, default = 0 (start of model run)
StopVegetationPeriodForBalance =	Any sample day index, e.g. 6	Optional (default=n+1) the sampling point in the following JD-Table when the vegetation period ends, default = n+1 (end of model run)
JDVegetationResetForBalance =	1...365	Optional (default=-1 = at model start); Julian day, when vegetation start and vegetation stop grids are re-initialized to -1 (northern hemisphere: usually day 1)
JDVegetationWriteForBalance =	1..365	Optional (default=0=at model end); Julian day, when vegetation period dependent grids should be written (usually just before JDVegetationResetForBalance, e.g. 365). Attention: this Value should be identical for all land uses, since grids cannot be written for specific land uses only, so a global variable should be used in the control file
IntercepCap =	0...1 mm	Optional (default=0): specific thickness of the water layer on the leafs in mm. if omitted here, the default parameter from interception_model is used
StressFactorDynPhen =	1...2	Optional (default=0); stress factor for slowing down the phenologic development when plants are under dry stress.
F* =	e.g. 175 (for DP1, only an example)	Mandatory for methods DP1, DP2 and DP4, else ignored; Forcing threshold to start the new phenologic phase
DP1_t1_dorm =	60 (end of February, example only)	Mandatory for methods DP1, DP2 and DP4, else ignored; starting day (Julian day number), forcing units will be summed up after this day of year (when using DP1 or DP3 or when falling back to DP1 from DP2 and DP4 in the first model year)

Parameter	Sample values	comment
DP1_T_Bf =	0	Mandatory for methods DP1, DP2 and DP4, else ignored; threshold temperature for a positive forcing unit after thermal time model (when using DP1 or DP3 or when falling back to DP1 from DP2 and DP4 in the first model year)
JDReset_TStart =	1	Mandatory for DP1 to DP4; Julian Day when TStart is reset to -1 and Forcing untis are reset to 0 for a new vegetation period
maxStartJDforDP1 =	150	latest start day for the model run to use DynamicPhenology_1. If start date is after this date, then TStart is set to maxStartJDforDP1 minus the delta of the next column (e.g. 150 - 18 = 132), so we assume that this start date meets a fully developed vegetation. If start day is even after DP2_t0_dorm, then the next year will use DP1 only
DP2_t0_dorm =	244	used for DynamicPhenology_2 only: starting day (julian day number), chilling units will be summed up after this day of year until DP2 _t1_dorm is reached
DP2_t1_dorm =	110	used for DynamicPhenology_2 only: starting day (julian day number), forcing units will be summed up after this day of year
DP2_T_Bf =	0	used for DynamicPhenology_2 only: threshold temperatur for a positive forcing unit
DP2_T_Bc =	11.1	used for DynamicPhenology_2 only: threshold temperatur for a chilling unit
DP2_Par_a =	303.2	used for DynamicPhenology_2 only: Parameter a in F*=a*exp(bC*)
DP2_Par_b =	-0.019	used for DynamicPhenology_2 only: Parameter b in F*=a*exp(bC*)
DP2_Offset_1 =	-3.4	used for DynamicPhenology_2 only: value for z1 in R_c(T_i)=(T_i-z1)/(T_Bc-z1) when z1 < T_i < T_Bc
DP2_Offset_2 =	10.4	used for DynamicPhenology_2 only: value for z2 in R_c(T_i)=(T_i-z2)/(T_Bc-z2) when T_Bc < T_i < z2
DP4_t0_dorm =	e.g. 304	Used by DP4 only: starting day (julian day number), chilling units will be summed up after this day of year
DP4_t1_dorm =	e.g. 32	Used by DP4 only: starting day (julian day number), forcing units will be summed up after this day of year
DP4_T0 =	e.g. 9	Used by DP4 only: threshold temperatur for

Parameter	Sample values	comment
		chilling units (if T < T0)
DP4_T1 =	e.g. 4	Used by DP4 only: threshold temperatur for forcing units (T > T1);
DP4_Par_a =	e.g. 1748	Used by DP4 only: tree specific parameter, see chapter on dynamic phenology 4
DP4_Par_b =	e.g. -317	Used by DP4 only: tree specific parameter, see chapter on dynamic phenology 4
DP4_T_xylstop =	e.g. 10	Used by DP4 only: threshold temperature, the moving average of temperature has to stay below for 5 days in order to start leave fall
DP4_t_xs1 =	e.g. 183	Used by DP4 only: time of year (julian day number), the moving average analysis starts from (for start leave fall estimation)
DP4_SPSLF =	e.g. 5	Used by DP4 only: (SamplePointStartLeaveFall) sample point ID which is replaced by the day of start leave fall with the original value as latest time
JulDays =	e.g. 1 -1 +10 258 288 319 349 ; for DP1 or 15 46 74 105 135 166 196 227 258 288 319 349 for VariableDayCount	Mandatory; Julian days for all following rows. Each parameter must match the number of Julian days given here! The count of days doesn't matter (these are the so called “sample days”)
(max) JulDays =		Same as JulDays, (max) is ignored for all methods except DP3
Albedo =	e.g. 0.25 0.23 0.22 … 0.32	Mandatory; List of values for each sampel day
Rsc =	e.g. 80 80 75 65 55 55 55 55 55 75 80 80	Mandatory; leaf surface resistance in s/m, one value for each sample point.
LAI =	Some LAI values	Mandatory; Leaf Area Index (1/1); one value per sample day
Z0 =	Some roughness length values	Mandatory; Roughness length in m; one value per sample day
VCF =	Some vcf values	Mandatory; Vegetation covered fraction; one value per sample day
RootDepth =	0...2m	Mandatory; Root depth in m; one value per

Parameter	Sample values	comment
		sample day
AltDep =	-0.025 … +0.025	Mandatory; altitude correction: positive values: JD for start of this phenologic phase is later, depending on elevation; negative value: phenophase starts earlier; one value per sample day
rs_interception =	Usually lower values than rsc	Optional (default 20) when using interception method 2 ; INTERCEPTION surface resistance in s/m; one value per sample day
rs_evaporatio =	e.g. 150	Optional (default 200); SOIL surface resistance in s/m (for evaporation only); one value per sample day
SoilTillage =	e.g. 90 250;	optional set of 1..n Julian days, defining days with soil tillage. Important for silting up model only (else ignored)
SR_cultivation =	conserving, nonconserving, other	Used in surface routing only; type of cultivating the surface, see value list;
SR_StemDiameter =	e.g. 0.05 0.07 … 0.1 … 0.05 etc.	Used in surface routing only; default: 0.01: diameter of the stalks or effective diameter of crop/tree stems (perpendicular to the streamlines); used for nonconserving land use (using a plough); one value per sample day
SR_ResidCovrg =	e.g. 0.2 0.25 0.3 ...	Used in surface routing only; default: 0.01 fraction of soil covered by vegetation, stones, and residuals (mulch); used for conserving land use only; one value per sample day
SR_CropDistX =	e.g. 0.3;	Used in surface routing only; default: 0.3 distance of crops in flow direction; used for non-conserving land use (using a plough) only; one value per sample day
SR_CropDistY =	e.g. 0.4;	Used in surface routing only; default: 0.3 distance of crops perpendicular to flow direction, used for non-conserving land use (using a plough) only; one value per sample day
SR_K_ST =	e.g. 10;	Used in surface routing only; default: 10 Manning-Strickler-roughness for the soil surface in (m^1/3)/s; used for non-conserving and other landuse only; one value per sample day
SR_C_WR =	e.g. 1.5;	Used in surface routing only; default: 1.5 form drag coefficient for a circular cylinder in a group; used for non-conserving landuse only; one value per sample day
SR_rough_coeff1 =	e.g. 0.00496 0.892	Used in surface routing only; default: 0.0198 0.712 0.142; coefficients for

Parameter	Sample values	comment
	0.0311	# k_st-calculation for conserving landuse, Reynolds number < 20000; three values for the three coefficients
SR_rough_coeff2 =	e.g. 0.00519 1.200 0.177;	Used in surface routing only; default: 0.0198 0.712 0.142; coefficients for k_st-calculation for conserving landuse, Reynolds number >= 20000; three values for the three coefficients
N-factor	e.g. 0.7 0.7 0.95 1.0 1.1 1.2 1.1 1.1 1.0 0.8 0.7 0.7	Optional (default: the values given in the heat transfer section for freezing and thawing conditions): Scaling factor to apply on the air temperature to get the upper boundary condition.