

- + *Implementation of DynamicPhenology4 (DP4):* This method allows estimating the start of the leave fall. Required new parameters in the land-use table are (with examples):

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• method = DynamicPhenology_4;           # the new method code
• DP4_t0_dorm = 304;        # 1.11.=304/305 # starting day (Julian day number),
                                # chilling units will be summed up after this day of year
• DP4_t1_dorm = 32;          # 01.02.=32   # starting day (Julian day number),
                                # forcing units will be summed up after this day of year
• DP4_T0 = 9;                # threshold temperature for chilling units (if T < T0)
• DP4_T1 = 4;                # threshold temperature for forcing units (T > T1)
• DP4_Par_a = 1748;          # tree specific parameter
• DP4_Par_b = -317;          # tree specific parameter
• DP4_T_xylstop = 10;        # threshold temperature, the moving average of
                                # temperature has to stay below for 5 days in order to
                                # start leave fall
• DP4_t_xs1 = 183;           # time of year (Julian day number), the moving
                                # average analysis starts from (for start leave fall estimation)
• DP4_SPSLF = 5;             # (SamplePointStartLeaveFall) sample point ID which
                                # is replaced by the day of start leave fall with the
                                # original value as latest time

```

The following sequence from the control file shows the coding of the Julian day sample points:

JulDays	15	74	-1	+28	268	310	349;
Albedo	0.25	0.25	0.25	0.25	0.25	0.25	0.25; # albedo (snow free)
rsc	90	90	90	55	55	90	90; # leaf surface resistance [s/m]
AltDep	0.025	0.025	0.0	0.0	0.0	0.0	-0.025; # altitude dependency [days/m]

The starting day for unfolding leaves is marked by a -1 in the JD-list. It is calculated using forcing units after

$$T_S = \sum (T_{avg} - T_1)$$

For each day exceeding the temperature  $T_1$  (which is DP4\_T1), the  $T_S$  value is incremented by  $T_{avg}$  (the daily average of temperature) minus  $T_1$ . The critical value of  $T_S$  is calculated by

$$T_{S,crit} = a + b \ln (C_D)$$

Here,  $a$  and  $b$  are the parameters DP4\_Par\_a and DP4\_Par\_b, respectively.  $C_D$  is the number of days between DP4\_t0\_dorm and DP4\_t1\_dorm when  $T_{avg} < DP4_T0$ .

The beginning of the leave fall in autumn is estimated by a moving average of temperature (7 days average). If this value is falling below DP4\_T\_xylstop for at least 5 subsequent days, the leave fall phase will start. This estimation starts only after DP4\_t\_xs1 was reached (so that no leave fall will take place in spring already when temperatures may be low, too). To synchronize the Julian day table with the result of this moving average evaluation, the index in the JD-table for which the start leave fall date is valid must be given as parameter DP4\_SPSLF. In the example above, this is 5. So the JD with value 268 will be replaced by the day calculated by the moving average analysis. However, the given value (of e.g. 268) is also a maximum allowed value. So, if the moving average of temperatures didn't reach the threshold of 5 subsequent days until the Julian day given in this table, then the JD-value there will be taken as start leave fall date and no moving average will be evaluated further. The length of the next phenologic phase (leave fall) is taken from the difference between the JDentry with index DP4\_SPSLF and the next one (in the above example 310-268 = 42 days).

Note 1: Since DP4\_t0\_dorm is usually November, 1<sup>st</sup>, the model will switch to DP1-Method when the model run starts after this day but before DP4\_t1\_dorm. Only the following years will be handled by DP4 then. So it's a good idea to start the first model year in November, already.

Note 2: It's a good idea to set altitude correction (AltDep) for the sample points which are dynamically calculated (the one with -1 and its successor as well as the DP4\_SPSLF and its successor) to 0. Otherwise the model may behave unforeseeable.