Ground vegetation basics

Ground vegetation is described with a single cohort that always covers the whole stand. With respect to light absorption, soil water uptake, photosynthesis and net primary production the same algorithms as for trees are applied. Biomass compartments and allocation are modelled with a simpler scheme. Biomass compartments are foliage (F), fine roots (R) and all organs with support and transport functions (S_{sup}). With the simplifying assumption that the carbon stocks in organs are available for allocation and growth, the total carbon available for allocation, M_{avail}:

$$M_{avail} = NPP + (1 - psf)\,F + (1 - psr)R + (1 - pss)\,S_{\sup}$$

with psf (percentage of senescence rate of foliage), psr (percentage of senescence of roots), pss (percentage of senescence of sap wood), NPP (net primary production). This is allocated following an allometric relationship (Kohlmaier et al., 1997; Lüdeke et al., 1994) between the sum of leaf and fine root mass and the mass of the supporting organs:

$$S_{\sup} = \xi\,(F + R)^{\kappa}\,.$$

The parameters ξ and κ for a generic type of ground vegetation are taken from (Kohlmaier et al., 1997). Additional ground vegetation types can be defined based on the dominating plant functional types. Ground vegetation masses can be initialized either in equilibrium with the available light at the ground or with prescribed low initial masses that simulate an establishment limitation on non-vegetated stands.

Used formulas for derivation:

A) Initialisation

Assumption that mass of foliage = mass of root, as is commonly done.

Further a steady state is assumed, so:

$$\lambda_F\,NPP = psf\;F$$
$$\lambda_R\,NPP = psr\;R$$
$$\lambda_S\,NPP = pss\,S$$

Whereas λ_F (partitioning coefficient of foliage), λ_R (partitioning coefficient of root), λ_S (partitioning coefficient of sap wood). The mass available (M_{avail}) for allocation is then given as above, so following formula is derived:

$$0 = pss\,\xi\,(F + R)^{\kappa} + (psf\;F + psr\;R) - NPP$$

For the Newton procedure the first and second derivative for (F+R) are calculated, so (F+R) are returned.

B) Common years

The mass conservation for the allocation of mass is applicaple:

$$M_{avail} = F + R + S_{\sup}$$

the formula is:

$$0 = \xi (F + R)^{\kappa} + (F + R) - M_{avail}$$

Again for the Newton procedure the first and second derivative is calculate for the return of (F+R).

References

Kohlmaier, G.H. et al., 1997. The Frankfurt Biosphere Model. A Global Process Oriented Model for the Seasonal and Longterm CO2 Exchange between Terrestrial Ecosystems and the Atmosphere. Part 2: Global results for potential vegetation in an assumed equilibrium. Climate Research, 8: 61-87.

Lüdeke, M.K.B. et al., 1994. The Frankfurt Biosphere Model: a global process-oriented model of seasonal and long-term CO2 exchange between terrestrial ecosystems and the atmosphere. I. Model description and illustrative results for cold deciduous and boreal forests. Clim. Res., 4: 143-166.