**Change to model structure**

One change has been made to model structure, related to photosynthesis of sparse stands. Currently, the model is based on calculating the effective leaf area which depends on crown size and density (Duursma and Mäkelä 2007). Denote the of the whole stand obtained with this method by . Now we also calculate using the LPJ method (Sitch et al. 2003 GCB):

where is the homogenous extinction coefficient, is (mean) leaf area index and is crown coverage. When crown coverage is very low, the approximation assumed by Duursma and Mäkelä (2007) becomes inaccurate and tends to over-estimate photosynthesis. On the other hand, when the stand is dense, the LPJ method gives larger values than the original method, because it approaches the homogeneous canopy assumption, while Duursma and Mäkelä (2007) account for clumping even in dense stands. Therefore, we choose to use the smaller of the two:

This formulation now means that the model can start to simulate old-growth forests and sparse uneven-aged forests in a more reasonable way.