1 sELM

Model outputs are GPP (gross primary production) and LAI. To calculate the GPP, need to calculate the GPP flux. GPP flux is calculated from the Williams model . We need the allometric parameters $a = [a1, a2, a3, a4, g]$. We need the phenology to calculate the leaf area index, which in turn is used to calculate the GPP. The model outputs are

- LAI
- GPP
- NPP
- GR
- MR
- HR
- NEE

The processes associated with each QOI is dependent on the type of physical process. The type of processes associated within the simple sELM are: Phenology, ACM, Maintenance respiration, Allocation and growth respiration and Litter and SOM decompostion model.

1.1 Phenology

We need to calculate the leaf area index (lai) that is needed for GDD. Phenology model depends on the following parameters: gdd_{crit}. First decide whether or not the phenology is decidiuous or not

- deciduous
- evergreen

If the phenology is deciduous, then need to calculate the following

- leafon
- leafoff

Note that $leafon$ depends on the parameter $ndayson$, and the $leafc_{trans_{tot}}, frootc_{trans}$ needs to be caculated. Calculating $leafc_{trans_{tot}}$ is

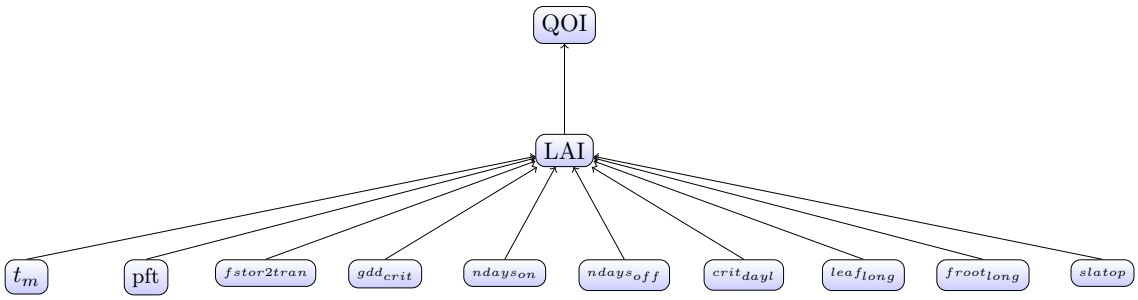
$$leafc_{trans_{tot}} = leafc_{stor}(n_{obs}) * fstor2tran \tag{1}$$

Note that $leafc_{stor}$ depends on the number of observations. Similarly,

$$frootc_{tot} = frootc_{stor}(n_{obs}) * fstor2tran \tag{2}$$

If the variable $leafon > 0$ then $leafc_{trans_{tot}}, frootc_{trans}$ is normalized by the number of days on $ndays_{on}$ Also, we need to calculate the number of days off, which depends on $dayl, crit_{dayl}, leafc, frootc$ Similar to days on, if $leafoff > 0$ then

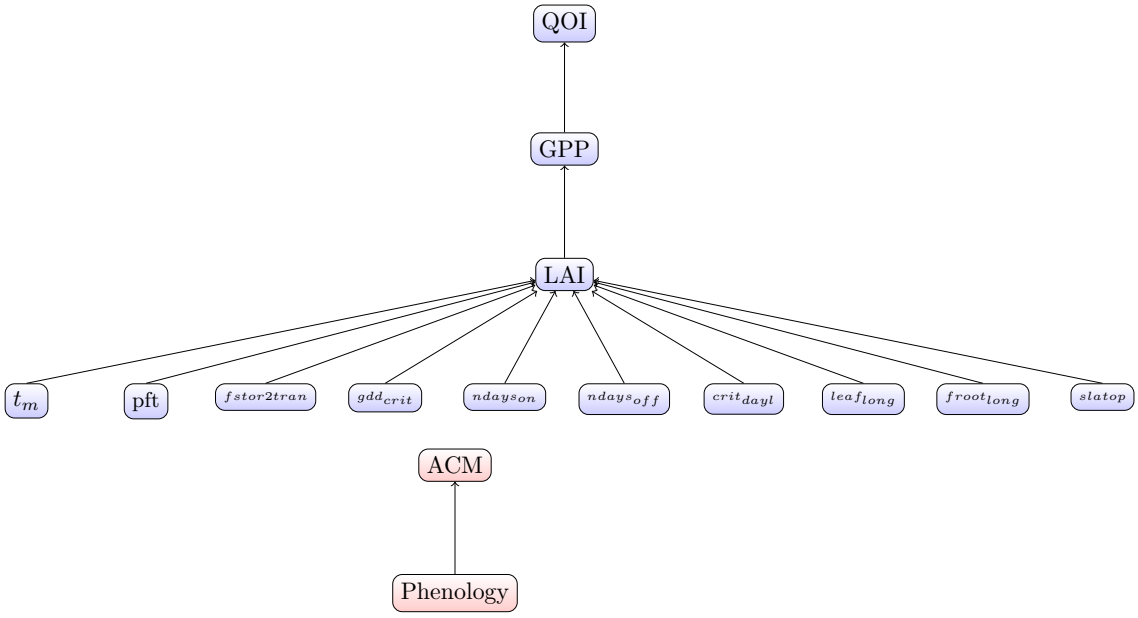
1.2 Pheonology-tree structure



2 GPP subroutine

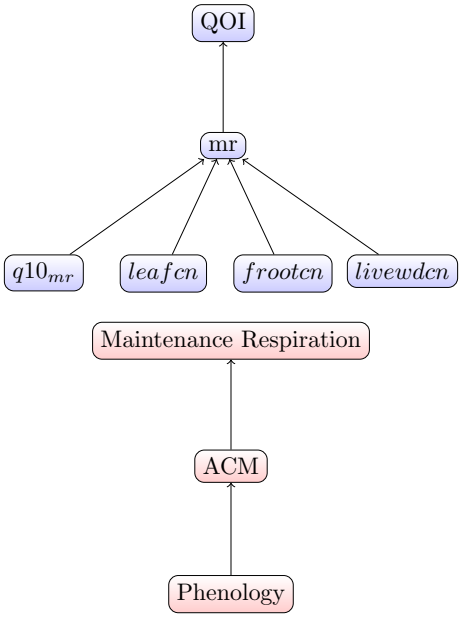
Calculating the GPP depends on the leaf area index (LAI). If the $LAI < 10^{-3}$, then the GPP for that observation is 0. Also, if the average temperature is below 0 $(tmax, tmin)$ then the GPP is 0. When $LAI > 10^{-3}$ then GPP is non-zero. The GPP depends on th paramter $leafcn, slatop$, where

$$leafn = 1.0/leafcn * slatop \tag{3}$$



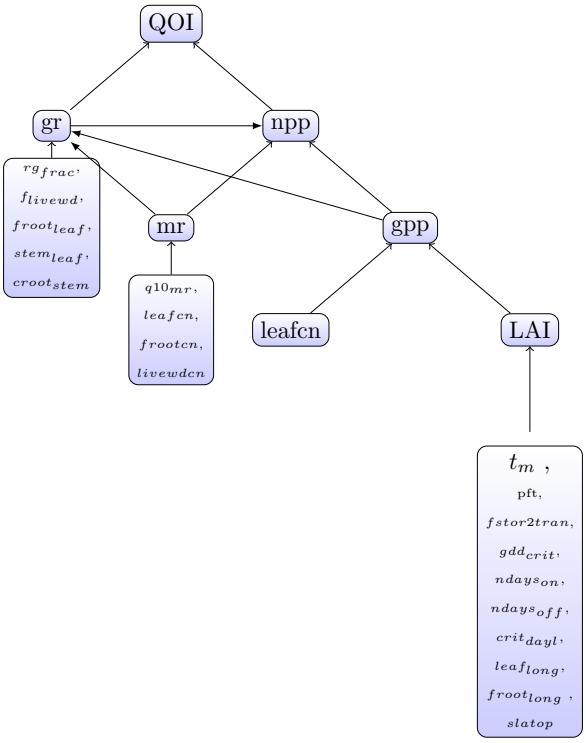
3 Maintenance Respiration

The output parameter $xsmr$ is dependent on $leafcn, frootcn, livewdcn, br_{mr}$ and the other output GPP. Another parameter that is needed is $trate$ which depends on $tmin, tmax$ (min and max temperatures) and the parameter $q10_{mr}$.



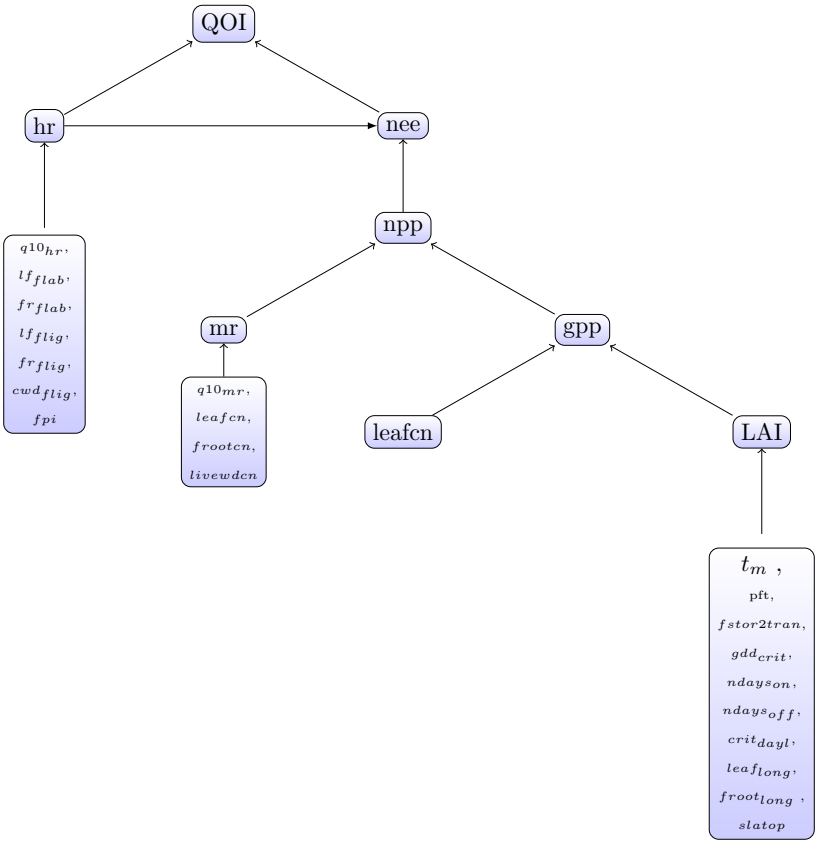
4 Allocation and growth respiration

Allocation and respiration depends on the type of pheonogy used (deciduous or evergreen). The parameters $rg_{frac}, f_{lievwed}, froot_{leaf}, croot_{Stem}, r_{mort}$ is important to calculate *npp*. *npp* depends on *gpp*.

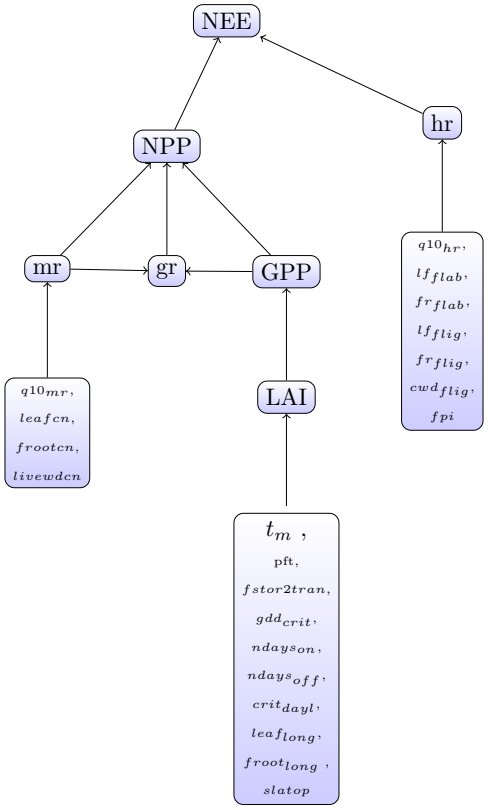


5 Litter and SOM Decomposition

Outputs are $totlitc, totsomc, totecosysc, nee$.


QOI
hr
nee
npp
mr
gpp
leafcn
LAI
$q10_{hr}$, lf_{flab}, fr_{flab}, lf_{flig}, fr_{flig}, cwd_{flig}, fpi
$q10_{mr}$, $leafcn$, $frootcn$, $livewdcn$
t_m , pft, $fstor2tran$, gdd_{crit}, $ndays_{on}$, $ndays_{off}$, $crit_{dayl}$, $leaf_{long}$, $froot_{long}$, $slatop$

6 Tree Structure of QOI's and their dependencies



7 Neural Network Approach for Surrogates

To do....