# Implemented changes

## Partitioning

Assigning the value “MaasLikeSen\_P1logistic” to the ini variable P1\_sen\_model make the algorithm to use a logistic function for P1 and the Maas approach for senescence. Note, the use of a logistic for the senescence was attempted but failed.

The logistic is defined over the support of GDD as

Where L is the curve maximum value, x0 is the x-value of mid-point, and k is the steepness of the curve (negative values make the function to decrease).

Insteda of using x0 and steepness, in the implantation the function is parametrized by x\_min and x\_max

K = (C\_min-C\_max)/(x\_max-x\_min)

X0 = 1/k\*C\_min + x\_min

C\_min = ln(1/cutoff-1)

C\_max= ln(1/1-cutoff-1)

Where cutoff is typically 0.01. Cutoff is used to numerically represent the asymptotic behaviour of the function.

Note that the free parameters used are a (for x\_max) and b (for L). x\_min is the GDD at the beginning of the simulation, so always 0.

## Near future refinements

The following items require urgent attention:

* Computation of J for senescence (and first guesses);
* Computation of reasonable first guesses for a,b,c and d. Parameter c and a can be estimated as the GDD between SOS and time of max from phenology;
* Different approach to compute water stress reduction factor;
* Test of model inversion on the full database of flux measurements.

# OLD reasoning

## Partitioning

Partitioning into leaves is modelled with LUT (as a function of development stage, ranging from 0 to 2, 1 is flowering) in WOFOST. The functions can be approximated by logistics.

Note that at the beginning P1 is never 1 in WOFOST because there is also root allocation.

We would probably need to make a distinction between annual crops and perennial grassland (perennials may have root system already in place). In addition, the aboveground biomass of crop is partitioned into stems as well, while for grassland it is mostly leaves.

## Senescence literature review

Senescence then occurs i because of competition effects for solar radiation and N in the canopy and ii after flowering due to N translocation to grains and crop ontogeny. (A model of leaf area development and senescence for winter oilseed rape. Available from: <https://www.researchgate.net/publication/223872430_A_model_of_leaf_area_development_and_senescence_for_winter_oilseed_rape> [accessed Dec 6, 2016])

In field-grown crops, leaf senescence occurs some days before flowering, and continues until maturity (doi:10.1006/anbo.1999.1104).

As actual NDVI is observed try a parametric curve (hyperbolic tangent?) that 1 at time of max, 0 at EOS and to be modelled in between.

Logistic function:

x0 is the x-value of mid-point

k is the steepness of the curve (negative values make the function to decrease)



## First guesses

### Partitioning

First guess based on linear decrease from 1 at sos to 0 at max NDVI (both taken from pheno)

### Senescence

First guess estimates:

Times x\_max (time of max NDVI) and x\_min (time of EOS0.05) at which the F(x\_max) = 0.05, and F(x\_min) = 0.95

K and x0 are compute as:

C\_min = ln(1/0.05-1)

C\_max= ln(1/0.95-1)

K = (C\_min-C\_max)/(x\_max-x\_min)

X0 = 1/k\*C\_min + x\_min

To make sure that LAI is not created when senescence start I can fix that coeff a of partitioning is the same of x\_min (ans I spare one parameter). In this case senescence would only start after maximum LAI is reached

## Modifications

Get TOM from Phenology X

Read from ini:

* P1\_sen\_model = “MaasLike” or “Logistic”

This should be a new model parameter

* P1atDOY0 = 0.5 (wofost uses 0.325 for winter wheat but there are also stems that recive something)

First guesses of P1 and se are given in terms of GDD at with the two function get the value of 0.05 and 0.95 (or any cutoff value).

Notes:

* P1 starts at GDD=0 with P1 atDOY0, it is not a free parameter (it is DOY0 that is)
* The point at with P1 is 0.05 (or any cutoff value) is shared by the point at which sen is 0.95 (or any cutoff, by definition, to avoid overall and hill posed problem), its first guess is the typical (long trem avg) GDD corresponding to the period SOS0.05 - TOM.
* The point at which sen is 1, at this point all active LAI is removed. First guess id LTA GDD from SOS to EOS0.05

So in total I have 2 new parameter GDD\_of\_P1\_05 and GDD\_of\_SEN\_95. Plus the value of P1\_at\_DOY0.

I can thus use the old Maas parameters a,b and c. In case of logistic parametrization the parameter d is not used.

Results show that having a common point (a) for both P1 and senescence does not work. Try to keep them separately.