STAND-SCALE < BUDGET MODEL

REGION-MEAN

climate → management ← POLICY

$$\frac{\partial M_c(t)}{\partial t} = f_{growth}(\Psi,t) - F_{mort}(\Psi)\times\Psi - F_{harv}(t,\Psi)\times\Psi \quad (S1)$$

Peatland C balance

growth rate — mortality — harvests

living tree biomass C

$$+ F_L(\Psi)\times\Psi + \beta_1 F_{mort}(\Psi)\times\Psi + \beta_2 F_{harv}(t,\Psi)\times\Psi$$

POLICY: Manag

LIVING — MORTALITY — HARVEST RESID.

litter input

$$- D_L(t) - D_P(t)$$

CLIMATE: MANAG DRAINAGE

litter — old peat

decomposition

Ψ = Basal area or Stem volume

t = time (age)

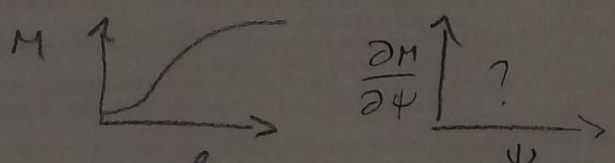
$0 < \beta_1, \beta_2 < 1$

GOAL: Analytical intuitive model to analyse impact of management and climate trends on C-balance in "inventory context"

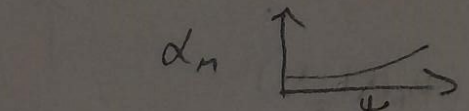
(?) can we omit t from RHS → everything simply $f(\Psi)$ and climate only?

Biomass Growth rate: $\frac{\partial M_{Tree}}{\partial t} = \alpha_b \frac{\partial \Psi}{\partial t}$ / α_b = BA to biomass

- Schumacher or Weibull-eq?
- fit against Matti or Susi growth predictions for fertile (Carex) infertile (Sphagnum) at regions N+S



Mortality rate: $F_{mort} = \alpha_M(\Psi)\times\Psi$ | + intercept term?



Bergtsson, Hagglund: "non-linear, weakly increasing with BA"

HARVESTS

F_{harv} : - fraction of Ψ harvested annually (regional)
- market-driven at 10–40 a intervals
- policy-affected (stand)
→ external flux prescribed

β_2 : fate of cutting residues
→ residue litter
- feedback to litter flux and decomp. (direct)

- indirect effect on WTL.

LITTER INPUTS : AS NOW

- living : tree-litter τ_i; $M_{L,i}$ | τ_i organ turnover
fine root litter : $f(\Psi)$; positive slope
GW litter : $f(\Psi)$; negative slope

DECOMPOSITION KEY UNKNOWN

- compare and discuss alternatives : means, trends, management response

1° current Ojanen-approach ;
eq (S1) with eq. (9)

2° revised Ojanen empirical approach

$$F_{dec} = f(WTD, T_{ss})$$

$WTD = f(\Psi, region)$ ← obtain from Susi / sparsity-peat simulations

Ask: i) How different are results and sensitivities when two published models based on same data are used?

ii) Do we have trend in 30 yr running average WTD (Sus1, data available?)?

Do we have positive strong correlation w.t.n. WTD and T_{gs}? If not, arguments for current model are weak.

- If WTD dependency is introduced, what triggers to T-sensitivity, i.e. effect of regional warming?

3°) Yasso 07 for all litter + $D_t = f(WTD, T_s)$

- for intuitive solution of eq. S1 use Yasso-simulations to construct effective 1-pool cohort-based model.

i.e.

$$\frac{\partial M_{L,j}}{\partial t} = -k M_{L,j}$$

$$\frac{\partial M_L}{\partial t} = \sum_{i=0}^{N} \frac{\partial M_{L,i}}{\partial t}$$

→ we get $\sum$ of "Me^{-kt}" -terms

j = cohort number

k = effective decay rate over all Yasso pools

Rationale: Majority of litter produced into oxic layers ⇒ should decompose without WTD-dependency. Then litter-decomposition also consistent with how residue litter currently decomposed. And consistent with mineral soil GHG inventory.

(?) How to formulate peat decomposition D_p ?

- $f(T_{gs})$ → $Q_{10} \sim 2$, take as given. Note: trend $\frac{\partial T_s}{\partial t} \sim 0{,}03\,°C/yr$
- $f(WTD)$ → oxic layer depth
  → water retention: oxic layer effective depth < depth of WTD but
  can we assume $h_{oxic} = -WTD$?

If we can, we assume a fraction k of oxic peat mass decomposes annually. Thus:

$$D_p \propto k\, M_{p,oxic} * f(T_{gs}) \text{ , where}$$

$$M_{p,oxic} \sim -\overline{\rho_b}\, WTD \text{ . In reality, } \overline{\rho_b} = \overline{\rho_b(z)} = f(WTD).$$

ρ_b = bulk density, f(peat type)
z = depth
$k = f(\text{peat type}, \overline{\rho_b})$

Link: $\overline{T_{gs}} = f(WTD)$ to account for soil T-profile