Forest Knowledge Know-how METLA Well-being

Optimal steady states of forests for C sequestration

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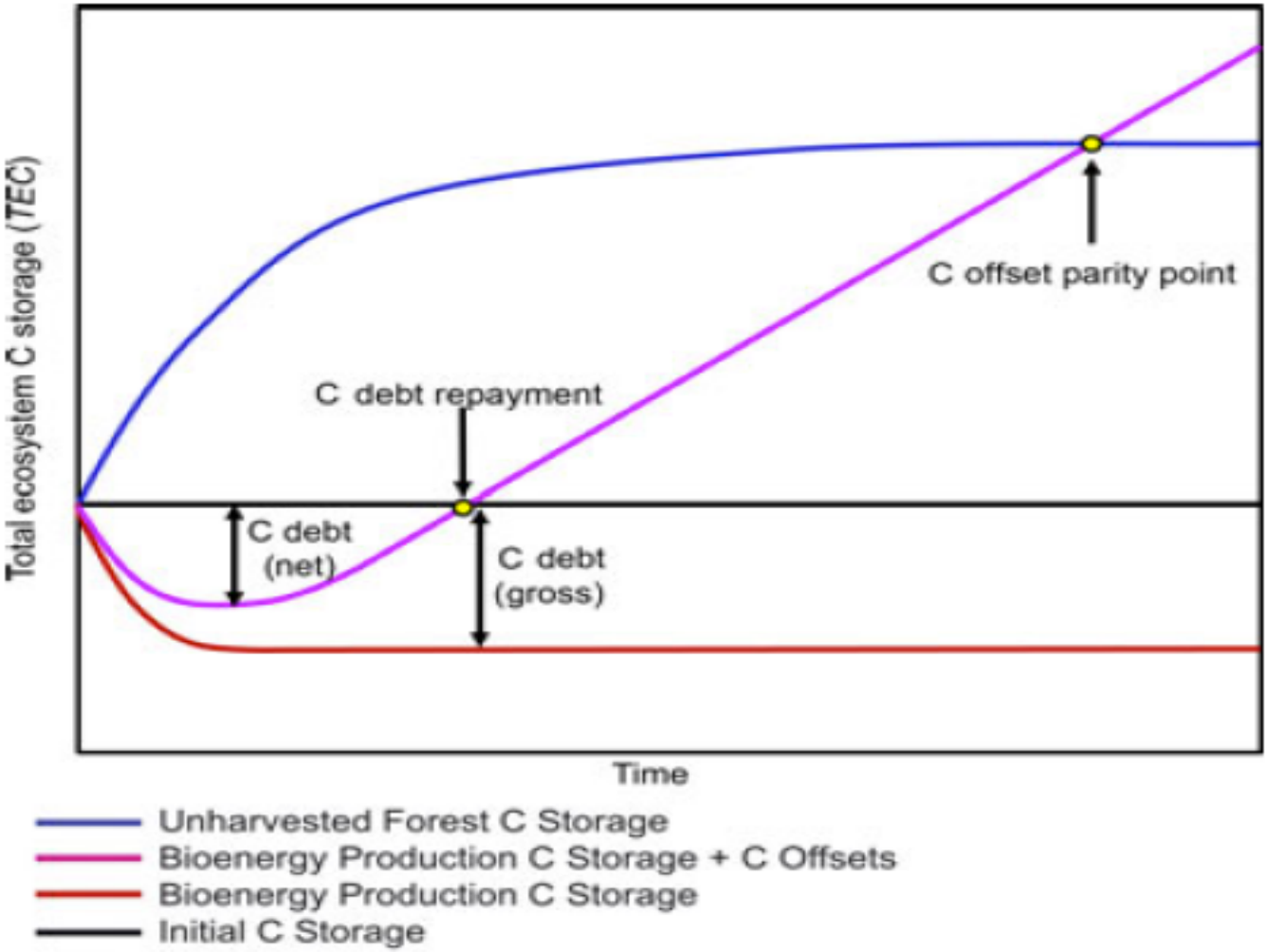
C Debt and C Sequestration Parity[a]



[a] Mitchell et al. 2012. GCB Bioenergy 4(6): 818-827.

Steady state forest (normal forest)

- A forest area having a steady state age- and size-class distribution (a conceptual ideal *normal forest*: SAFnet dictionary)

- Permits equal volume yields from annual or periodic fellings

- We simulated steady-state forests on commercial forest sites of Southern Finland (on mineral soils): cover most (74%) of the commercial forests in Southern Finland using Motti model

- Scots pine and Norway spruce domined stands

Management regimes and rotation lengths

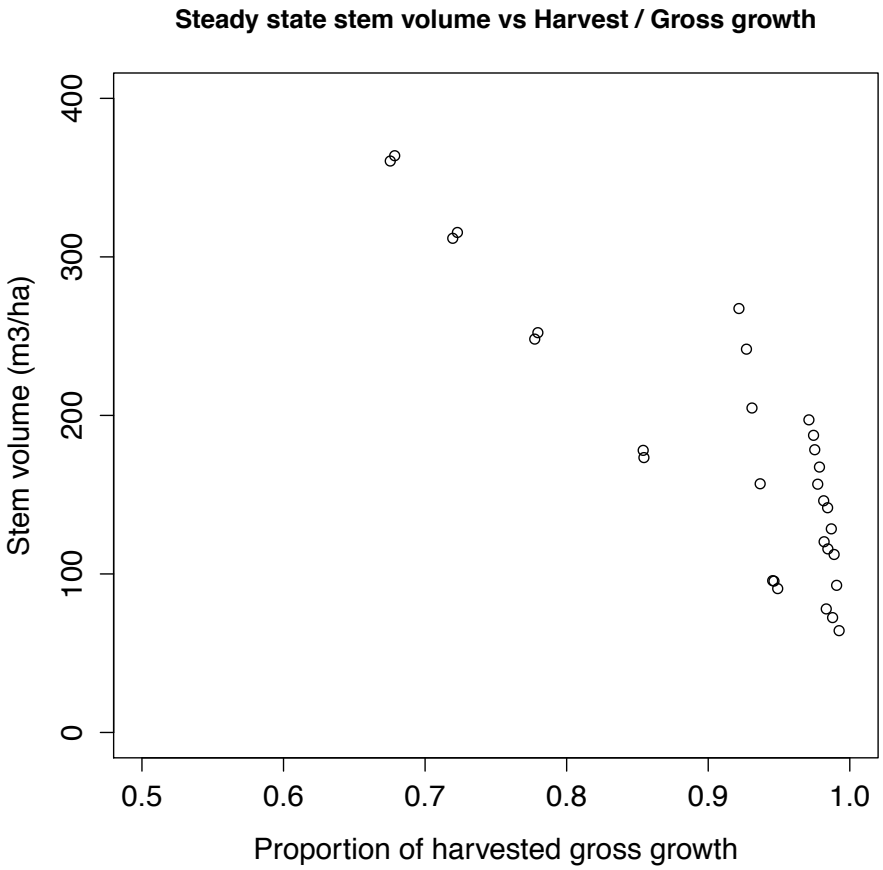
- Six management regimes - regeneration, thinnings & final cutting cycle
  - Management according to silvicultural guidelines
  - Unthinned
  - Unthinned, only precommercial thinnings
  - Light thinnings (high stocking level)
  - Heavy thinnings (low stocking level)
  - Extremely heavy thinnings
- Rotation lengths were varied +/- 40 years compared to recommended – 5 variations

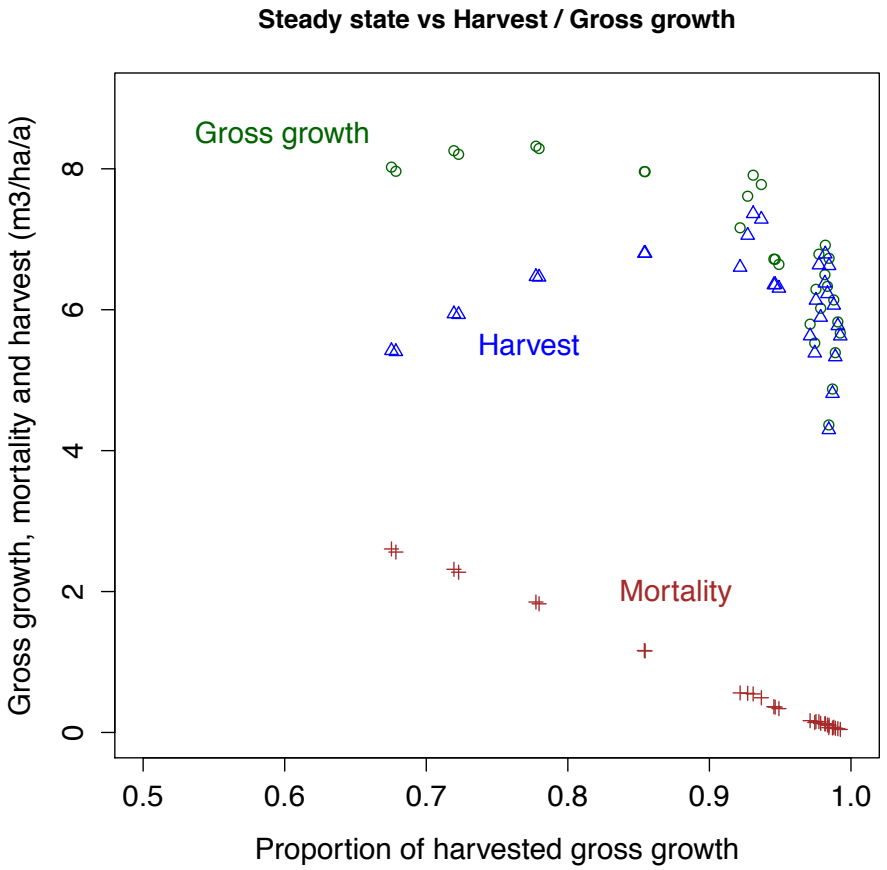
⇨

Totally 30 options / site type

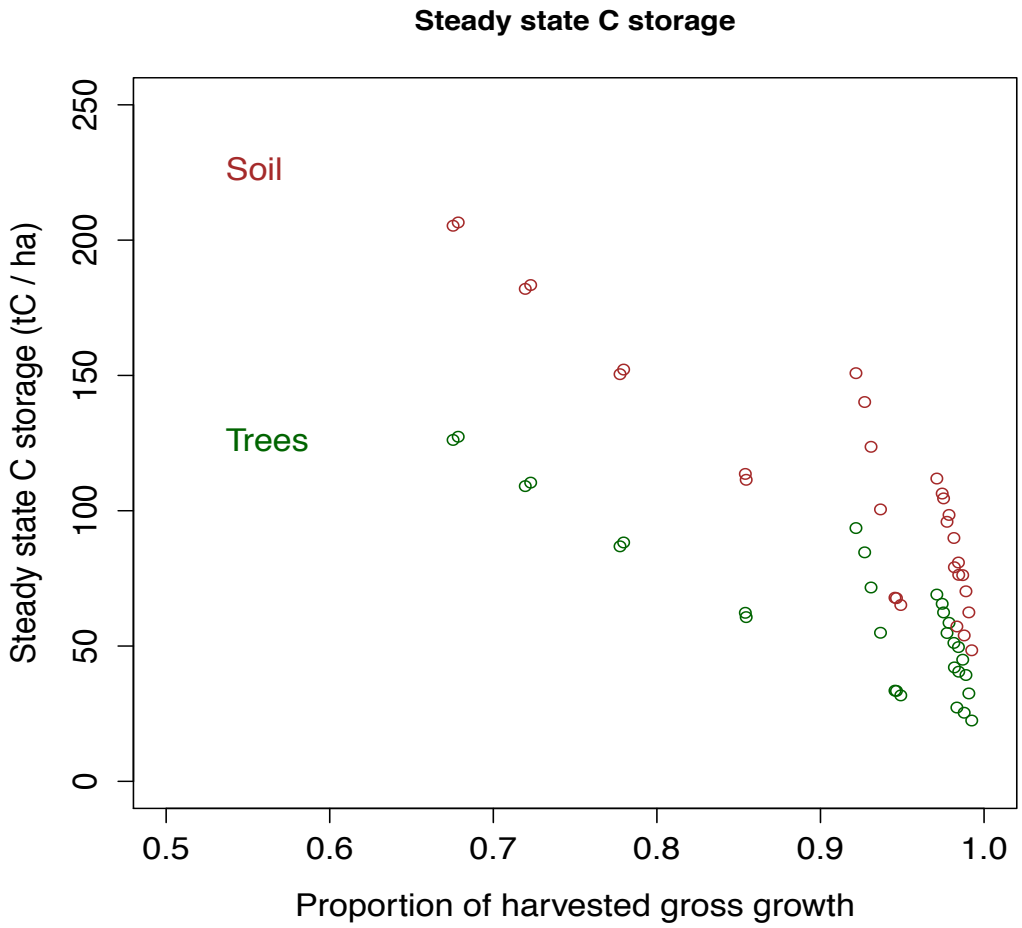
Site type	Simulated rotations
Grovelike, OMT Spruce	40/ 60 / **80**/ 100/ 120
Fresh site, MT Spruce	50/ 70 / **90**/ 110/ 130
Fresh site, MT Pine	50/ 70 / **90**/ 110/ 130
Dryish site, VT Pine	55/ 75 / **95**/ 115/ 135
Dry site, CT Pine	75/ 95/ **115**/ 135/ 155

Steady states



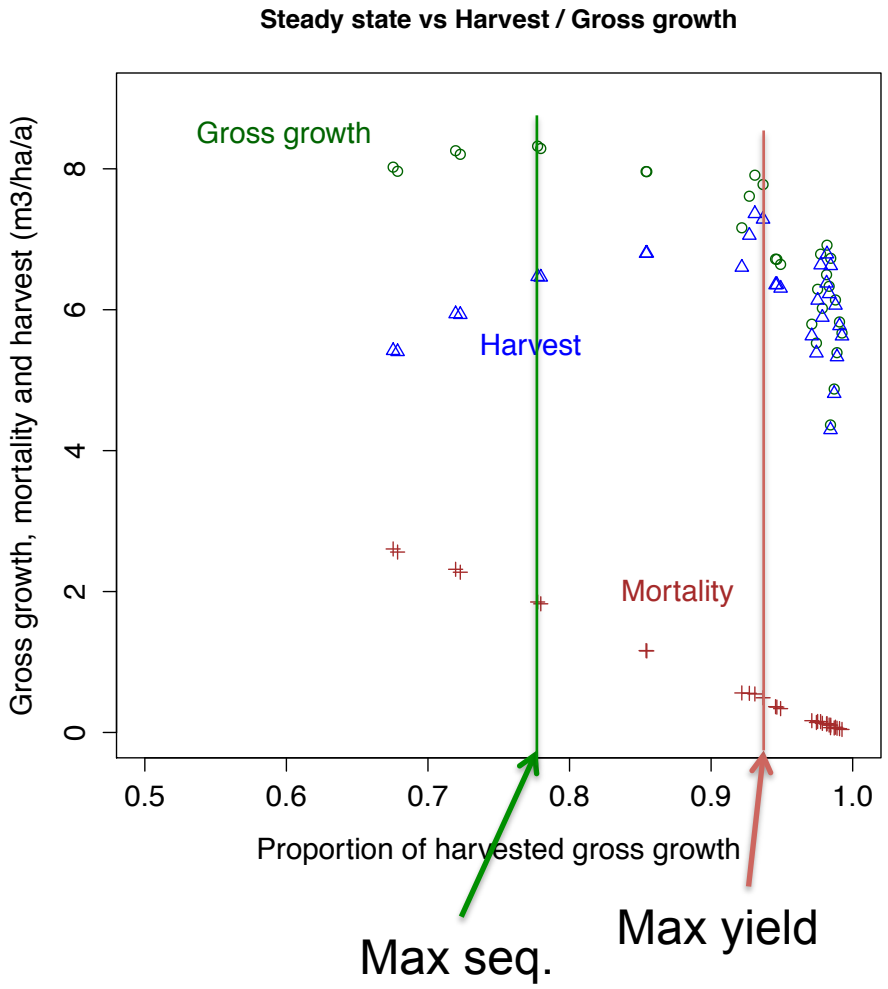


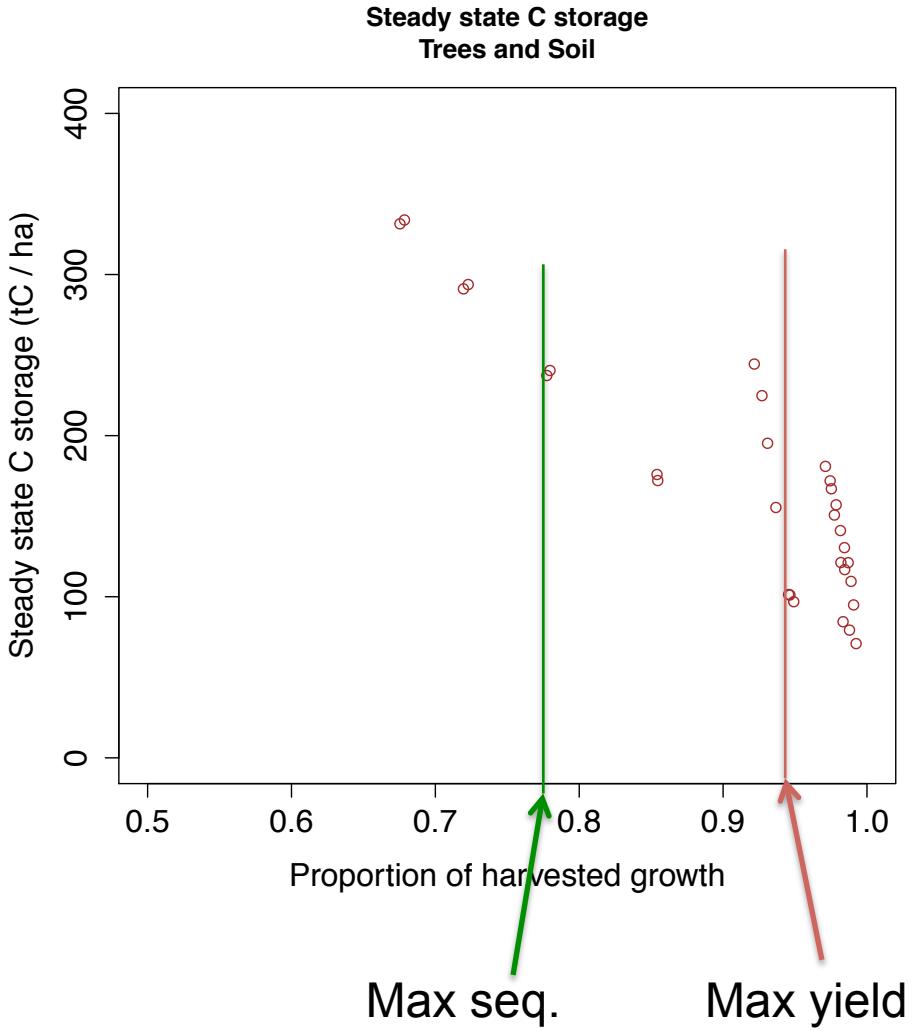
Steady-state C storages
Biomass expansion factors & Yasso for soil[A]



[A] Harvest residues are left in forest

Max. yield vs. max sequestration harvest levels





Max. yield vs. max sequestration harvest levels

	Harvest/ Gross Growth	Gross Growth	Harvest	Stem volume	C storage
	%	m3/ha/year	m3/ha/year	m3/ha	t C/ha
Max yield	94%	7.2	6.8	165	160
Max seq.	78%	8.3	6.5	250	238

Maximum yield vs "climate friendly" operating point:

- Additional harvest 0.3 m3/ha/year by max yield substitutes fossil fuels about 0.03 (DF = 0.51) – 0.05 (DF = 1) t C/ha/year
- C storage difference = 78 t C/ha, corresponds to 2600 – 1490 years of substitution effect (567 – 1113 years if C storage of trees only)

Conclusions

1. C storage dominates C flux in Southern Finland (boreal conditions)
2. Gross growth and also amount of harvests are quite flat vs. share of harvested gross growth => many “optimal” harvest levels possible.
3. How to connect to analysis the transient from current state towards optimal steady state?
4. Preliminary analysis: only biomass production was considered in a simplistic manner.