Forest management for carbon sequestration - recent results from CarboEurope research

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with

John Grace, Maurizio Mencuccini,

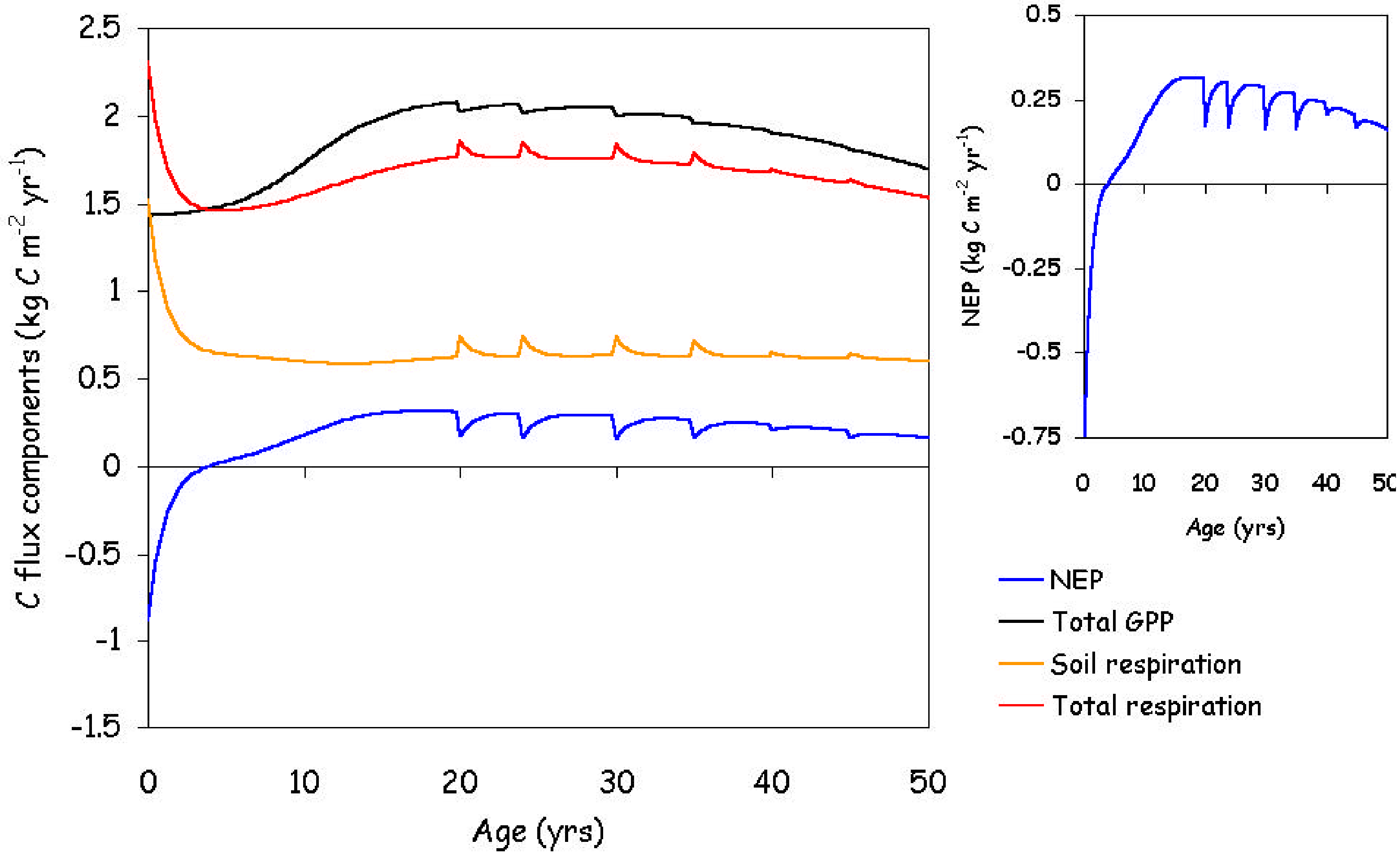
Ernst-Detlef Schulze, Reiner Zimmermann

- Which processes drive carbon sequestration in European forests ?
- Which forest components have large mean residence times for C ?
- What is the effect of forest age on carbon storage?
- What is the magnitude of variations in carbon fluxes ?
- How does nitrogen availability affect carbon storage?

CarboEurope Chronosequences

- Oak
- Beech
- Pine
- Spruce

Carbon fluxes versus biomass stocks

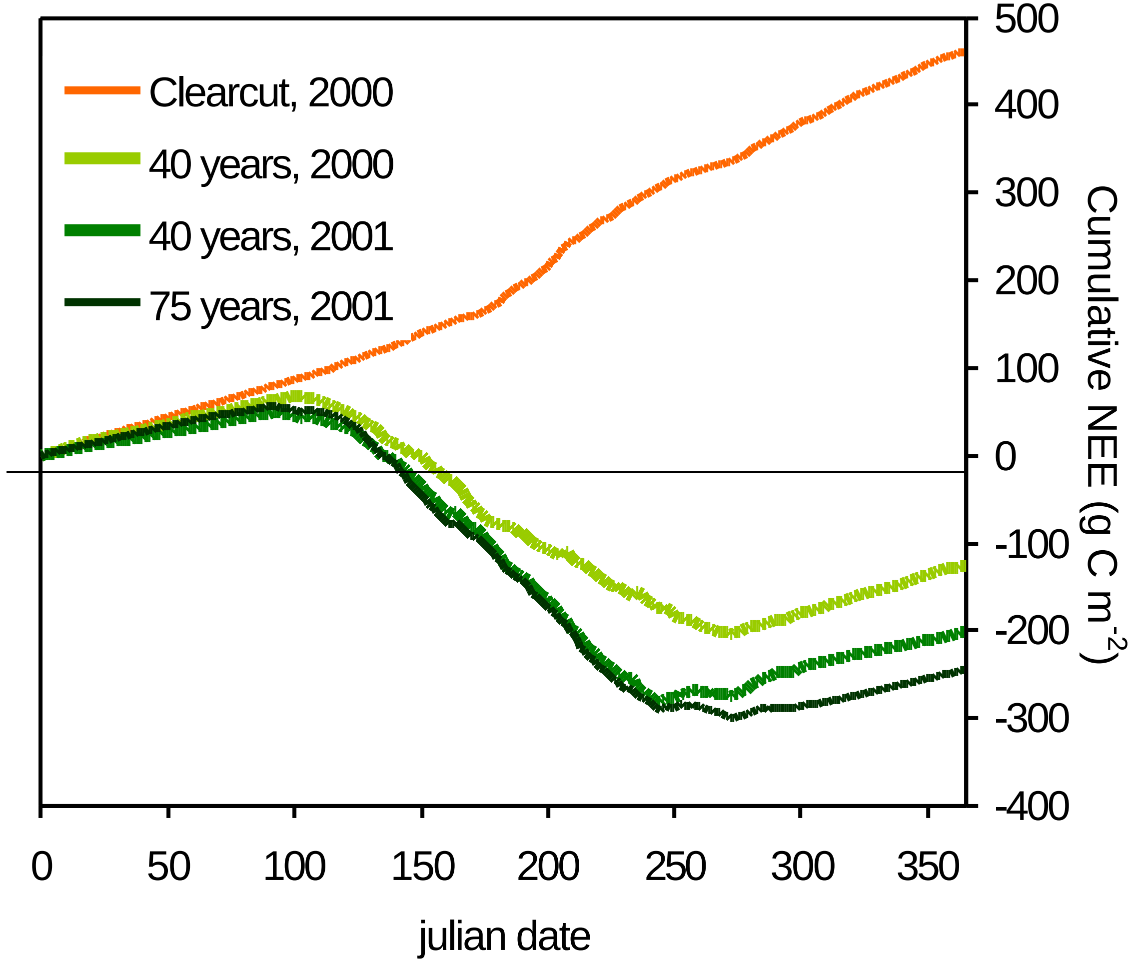


Simulation results of the 3PG-3 model for the Bray site. Long-term dynamics of carbon exchange components, leaf area index (LAI) and stand woody biomass (W_W) in a thinned *Pinus pinaster* stand

Marco Borghetti et al., Università della Basilicata, Potenza

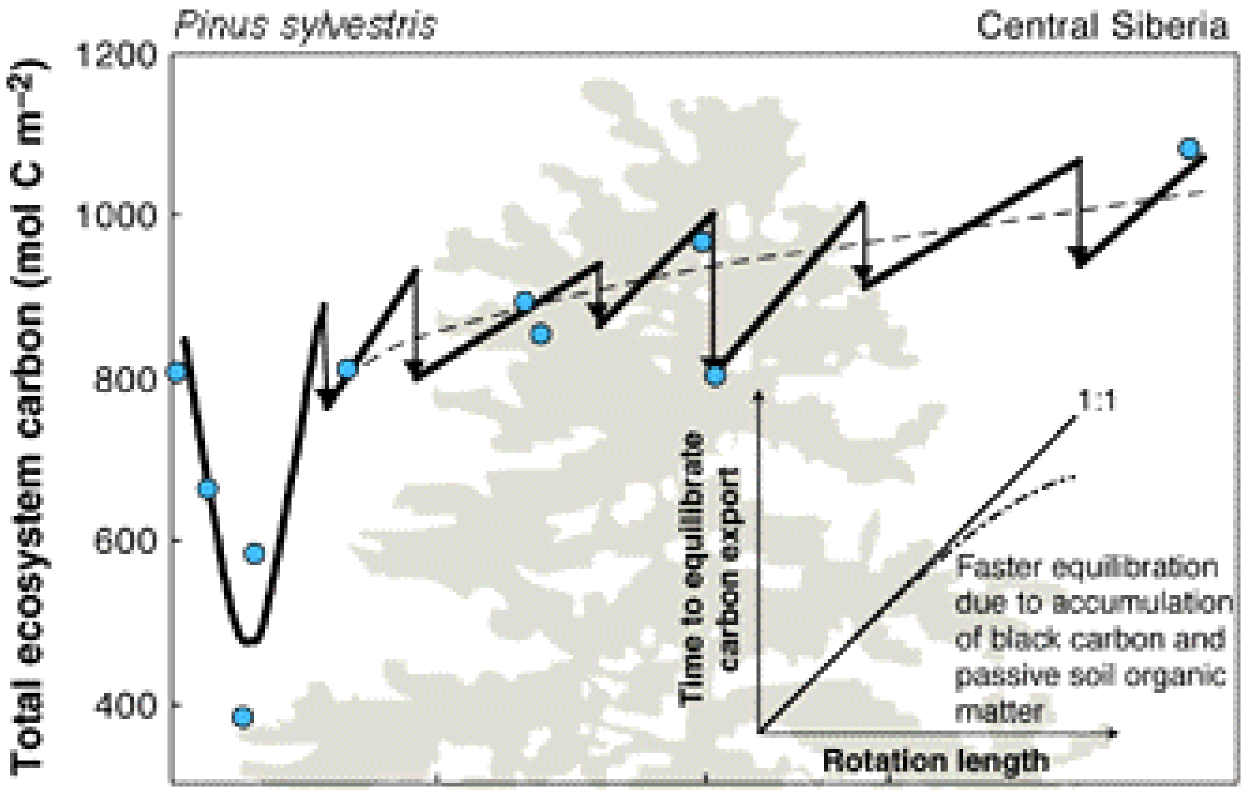
CARBO EUROPE

Annual carbon budgets of in different age classes of *Pinus sylvestris*, Finland



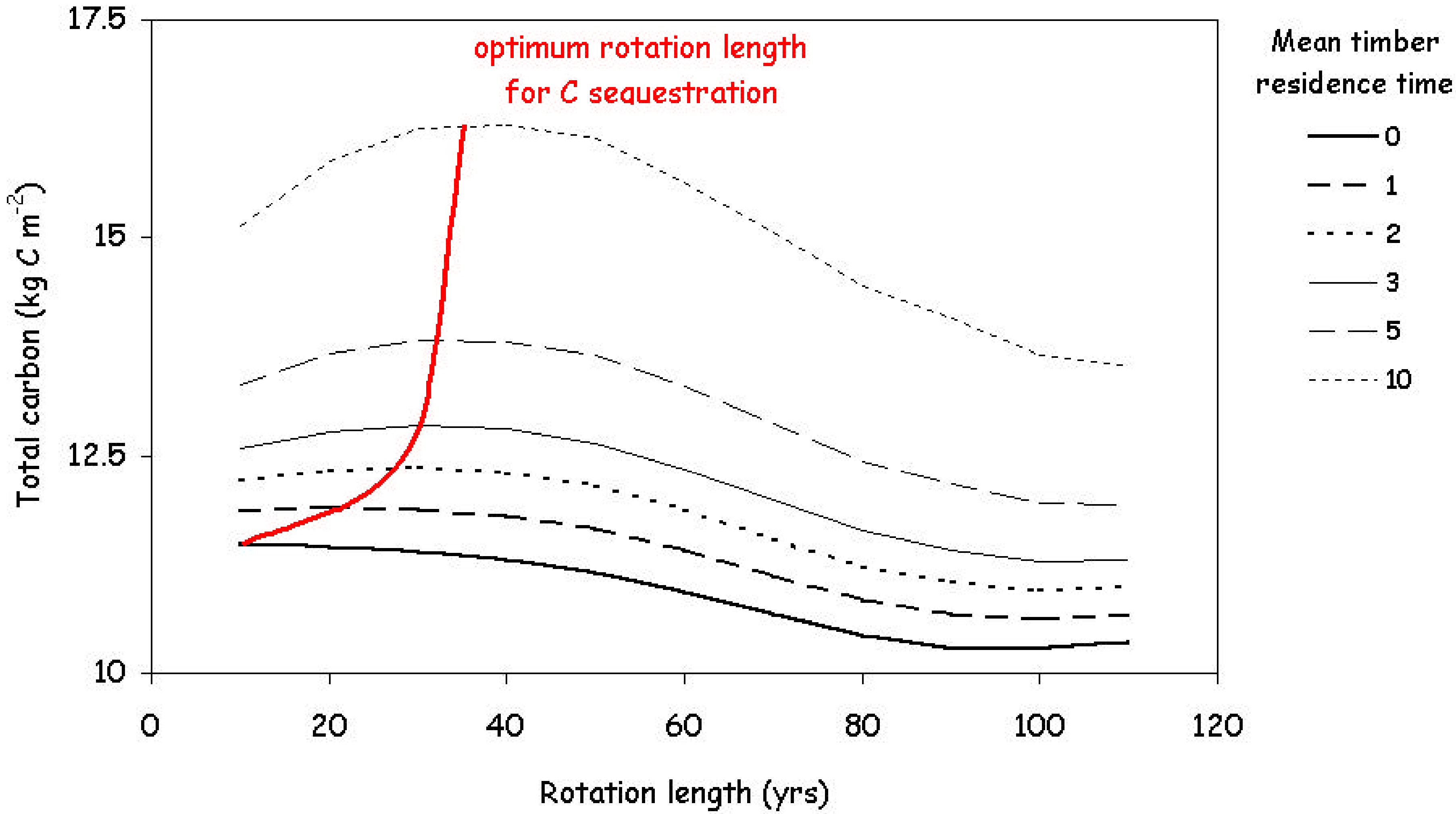
Pertti Hari, Department of Forest Ecology, University of Helsinki

Pristine pine forests in Siberia still take up carbon



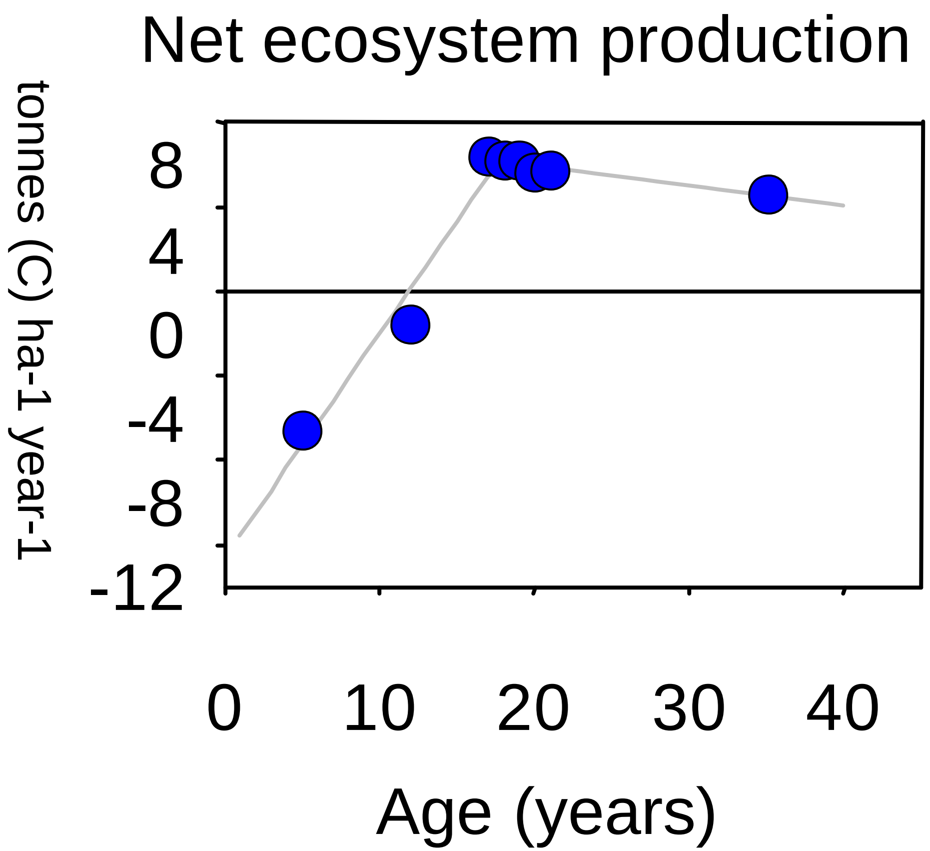
Schulze et al., Science 289: 2058-2059

Timber mean residence determines optimum rotation length

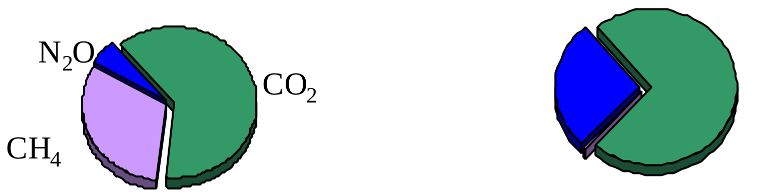


3PG-3 sensitivity analysis. As mean timber residence time in manufacts increases, optimum rotation length is found to increase. Carbon sequestration through changes in timber residence time largely exceed the increase in soil carbon through adaptive management (thick line). Marco Borghetti et al., Università della Basilicata

NEP and trace gas fluxes from soil vary over the chronosequence (Harwood, UK)



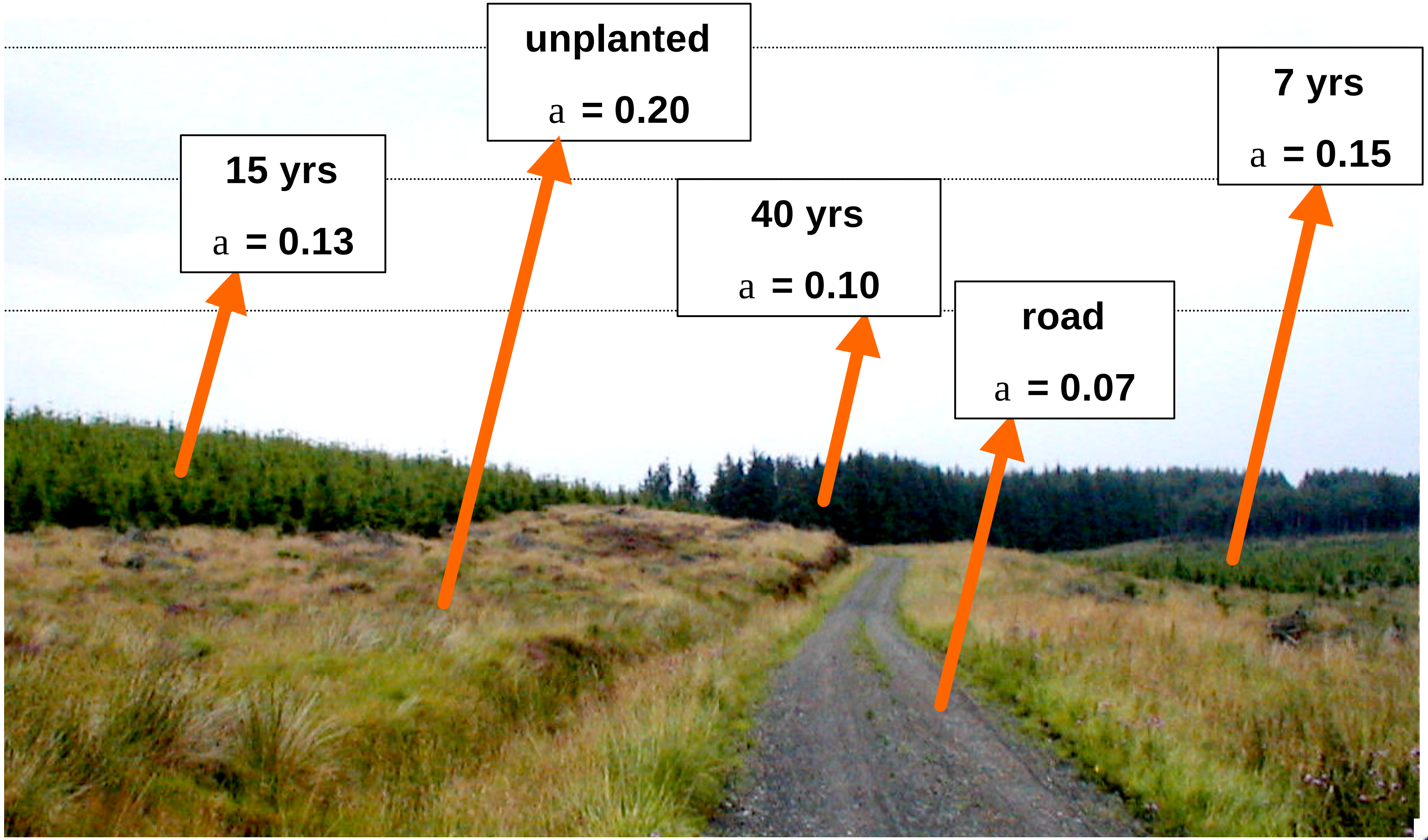
Rayment,
Mencuccini,
Grace,
Ball ,
Smith,
Moncrieff



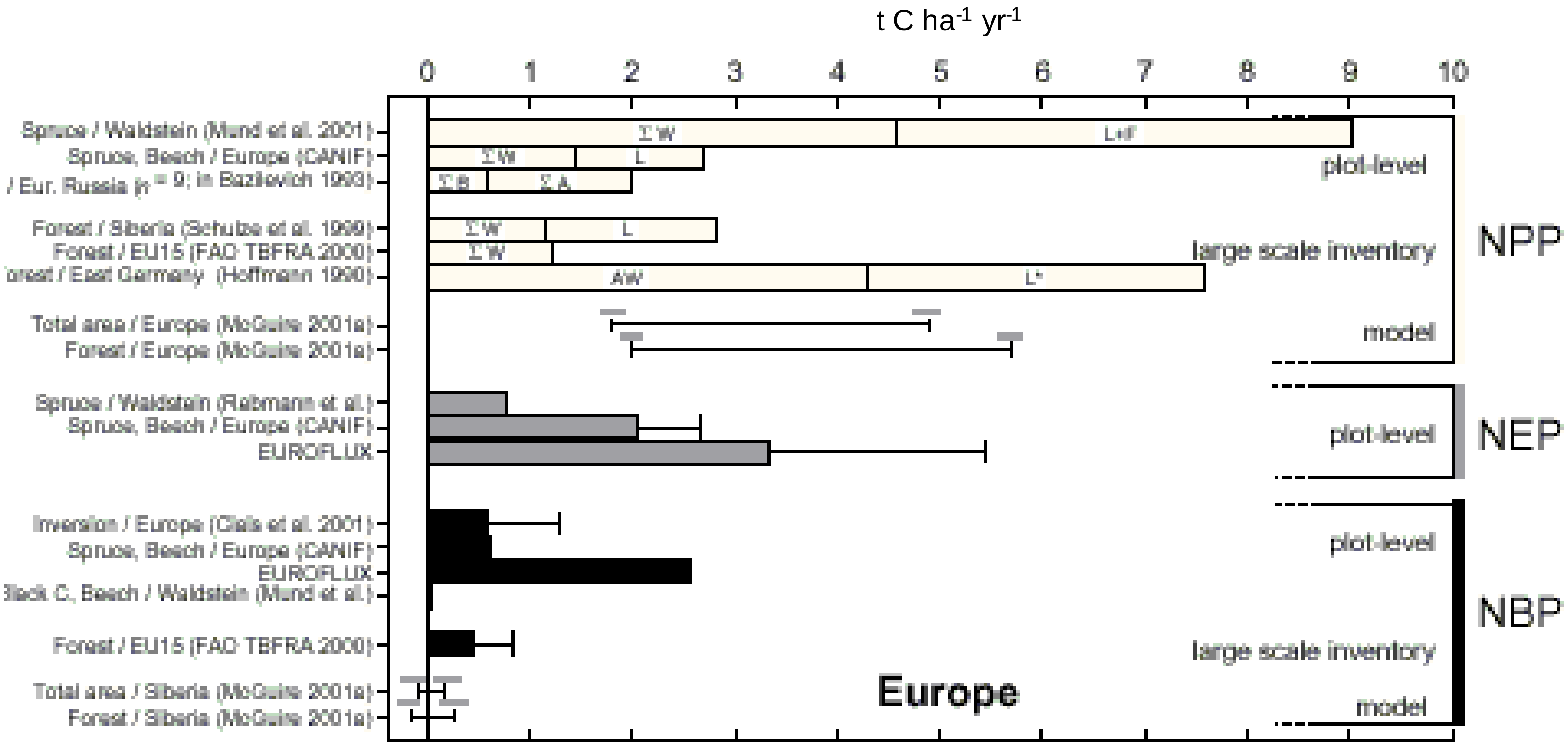
Equivalent to 5.2 tC ha^{-1} y^{-1} **6.9 tC ha^{-1} y^{-1}**

Stand age and surface albedo

(Harwood forest, illustrative only)



Continental scale uncertainty



Heimann, Schulze et al., unpublished

Sample sizes for mean detectable changes in soil carbon

Location	Area ha	Sample n	Carbon $MgC\ ha^{-1}$	CV %	MDC $MgC\ ha^{-1}$	SS* n
Tennessee, USA (235m alt.)[3]	0.02	18	40	10	2.8	**7**
Tennessee, USA (335m alt.)[3]	0.02	18	38	15	3.9	**12**
Helsinki area, Finland[4]	0.005	126	45	15	1.7	**17**
Tennessee, USA (1000m alt.)[3]	0.02	18	74	13	7.2	**36**
Tampere area, Finland, (site 1)	10	12	64	17	9.9	**43**
Tennessee, USA (940m alt.)[3]	0.02	18	107	10	7.9	**43**
Tennessee, USA (1670m alt.)[3]	0.02	18	96	12	8.3	**46**
Oregon, USA[5]	126	271	86	15	2.4	**63**
Tennessee, USA (1650m alt.)[3]	0.02	18	89	18	11.6	**91**
Tampere area, Finland, (site 2)	1	6	78	25	28	**136**
Tierra del Fuego, Argentina[6]	48.6	18	66	32	15.5	**160**
Maine, USA[7]	0.4	24	111	26	17.9	**287**
Griffin, UK, (undisturbed)	0.85	20	98	30	19.9	**290**
Griffin, UK, (ploughed)	0.85	80	97	49	14.9	**870**
New Hampshire, USA[8]	23	55	160	38	24.4	**1268**
North., UK, (ploughed) (plot)	0.03	8	213	36	90.8	**2065**
North., UK, (ploughed) (forest)	578	240	213	49	19.9	**3766**

*Sample size for MDC=5 Mg C ha^{-1}

John Grace, Maurizio Mencuccini

Conclusions

- Old-growth forests still take up carbon
- Highest carbon uptake in forest converting to natural state (dead wood), along with highest biodiversity
- Long-term carbon storage opposes maximum carbon substitution
- Carbon losses after clearcut and during establishment of plantations on soil rich in labile carbon may need 10 or more years to be compensated by NEE
- Forestry on peat/peaty soils is at best climate-neutral (CH4, N2O)