Old-growth forests – C sequestration inference from N budgets.

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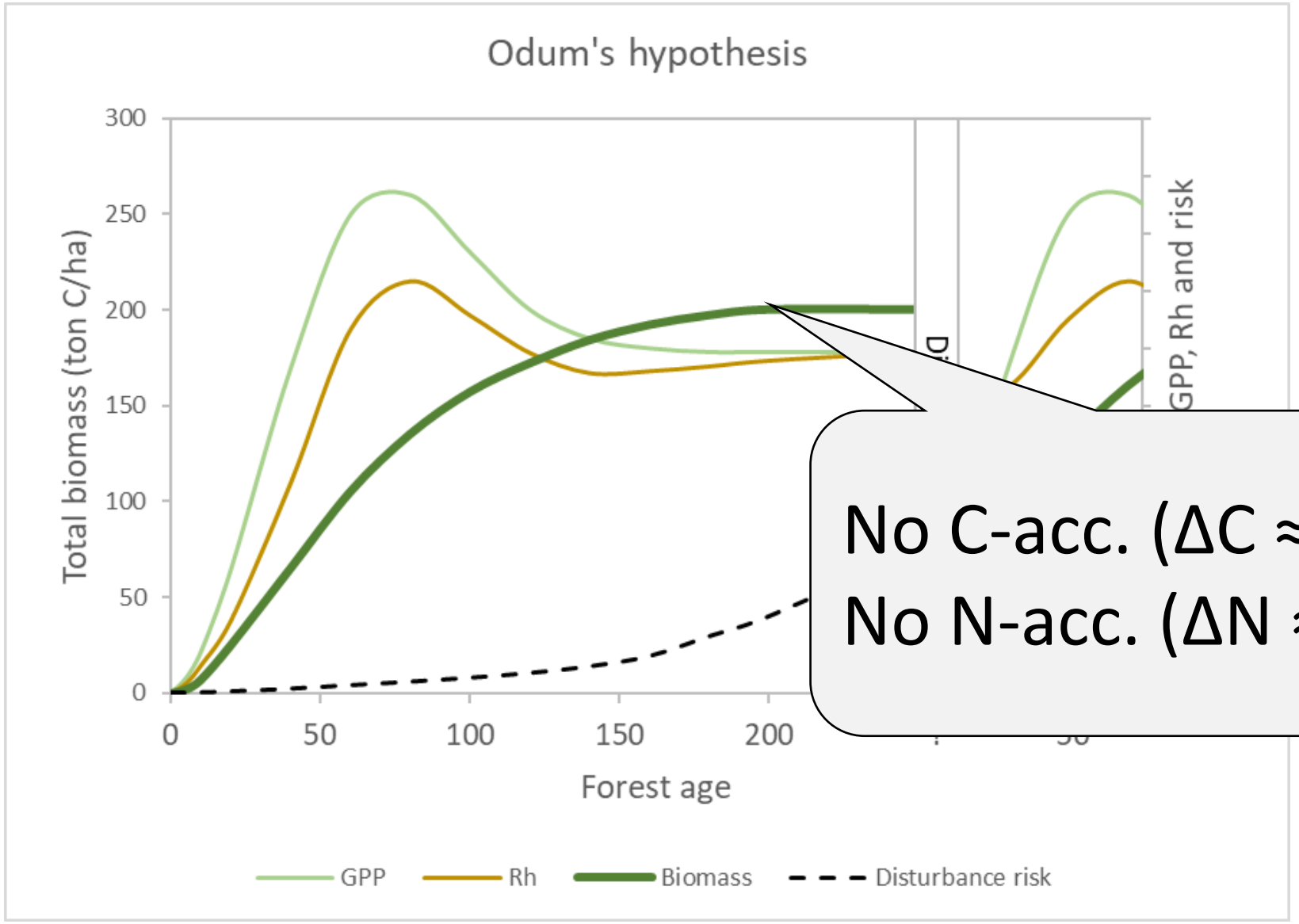
Content

- N-budgets in Danish forest reserves
- Its relation to C-storage
- Critique of Luyssaert et al. 2008
  - From nitrogen cycling perspective
  - From other perspectives

Saturation of C-sequestration → fading ecosystem N retention



No C-acc. ($\Delta C \approx 0$)

No N-acc. ($\Delta N \approx 0$)

Suserup Forest – no C-stock change 1992-2002-2012

Contents lists available at ScienceDirect

Forest Ecology and Management

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Ecosystem carbon stocks and their temporal resilience in a semi-natural beech-dominated forest

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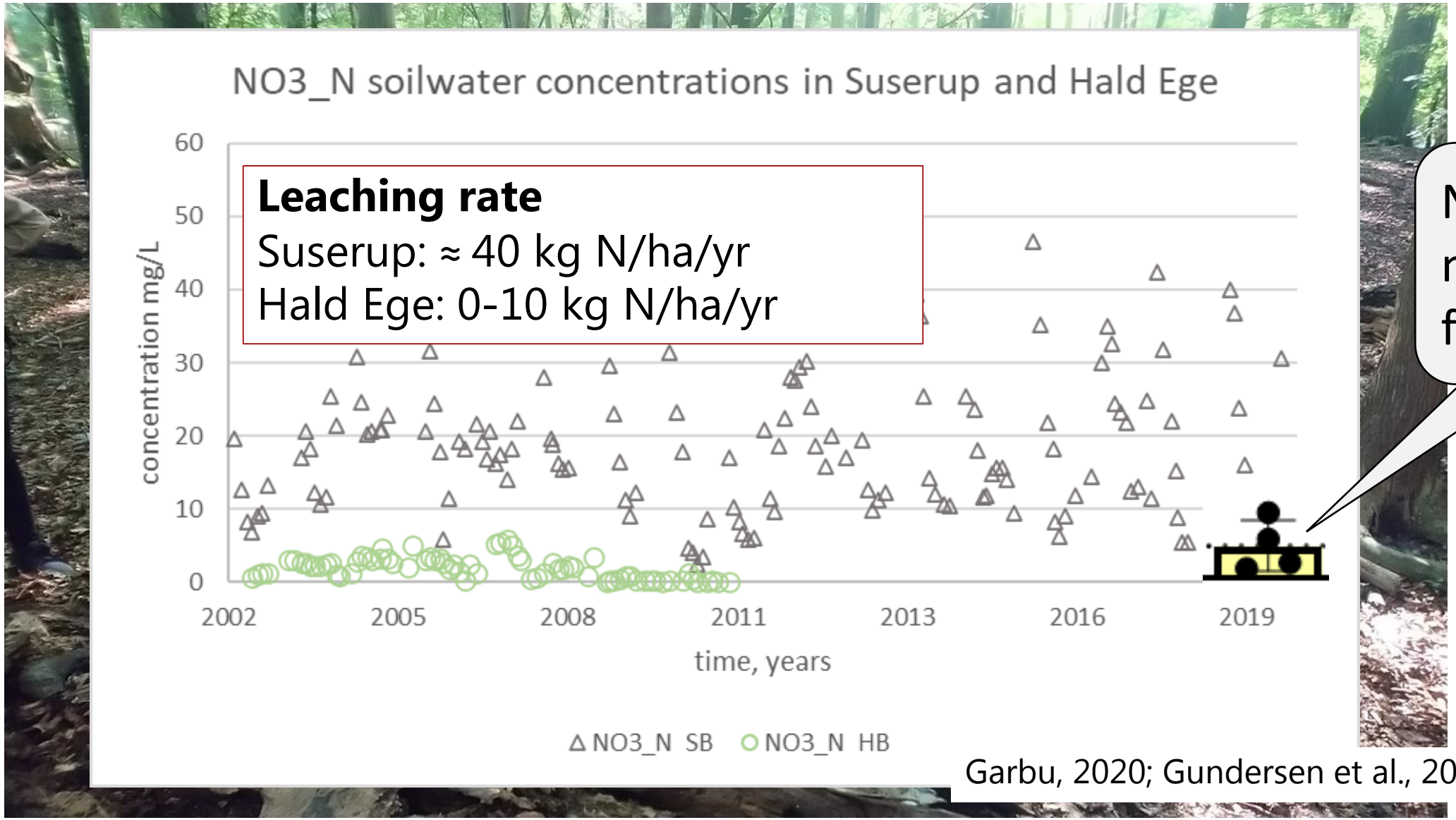
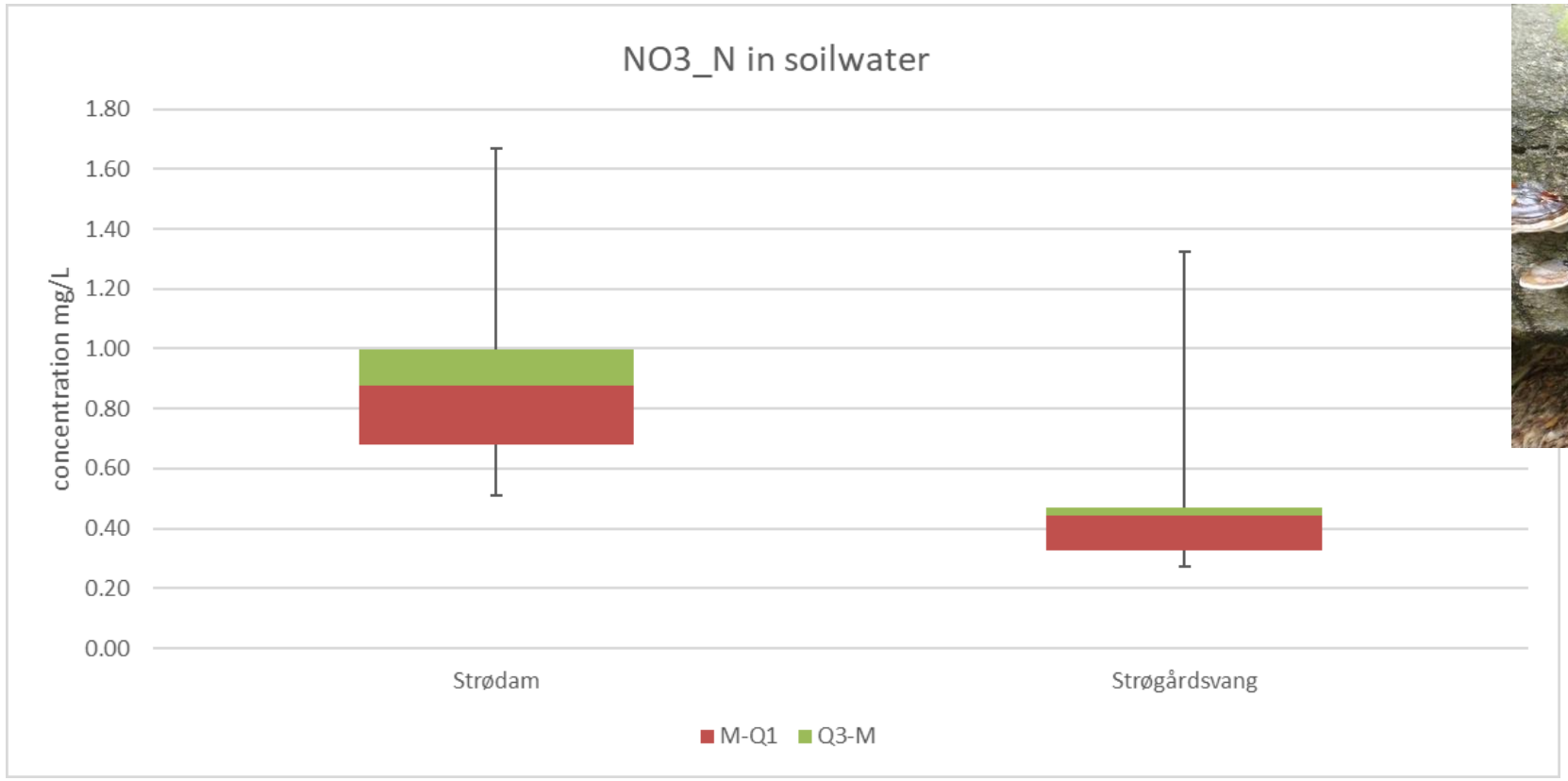
Nitrate leaching from forest reserves in DK



Garbu, 2020; Gundersen et al., 2009; Wang, 2023

Soil water NO_3 survey in unmanaged vs manged forest

Nine 5-m plots in both forest types with four soil samples (75-90 cm depth) bulked per plot. T-test $p<0.02$



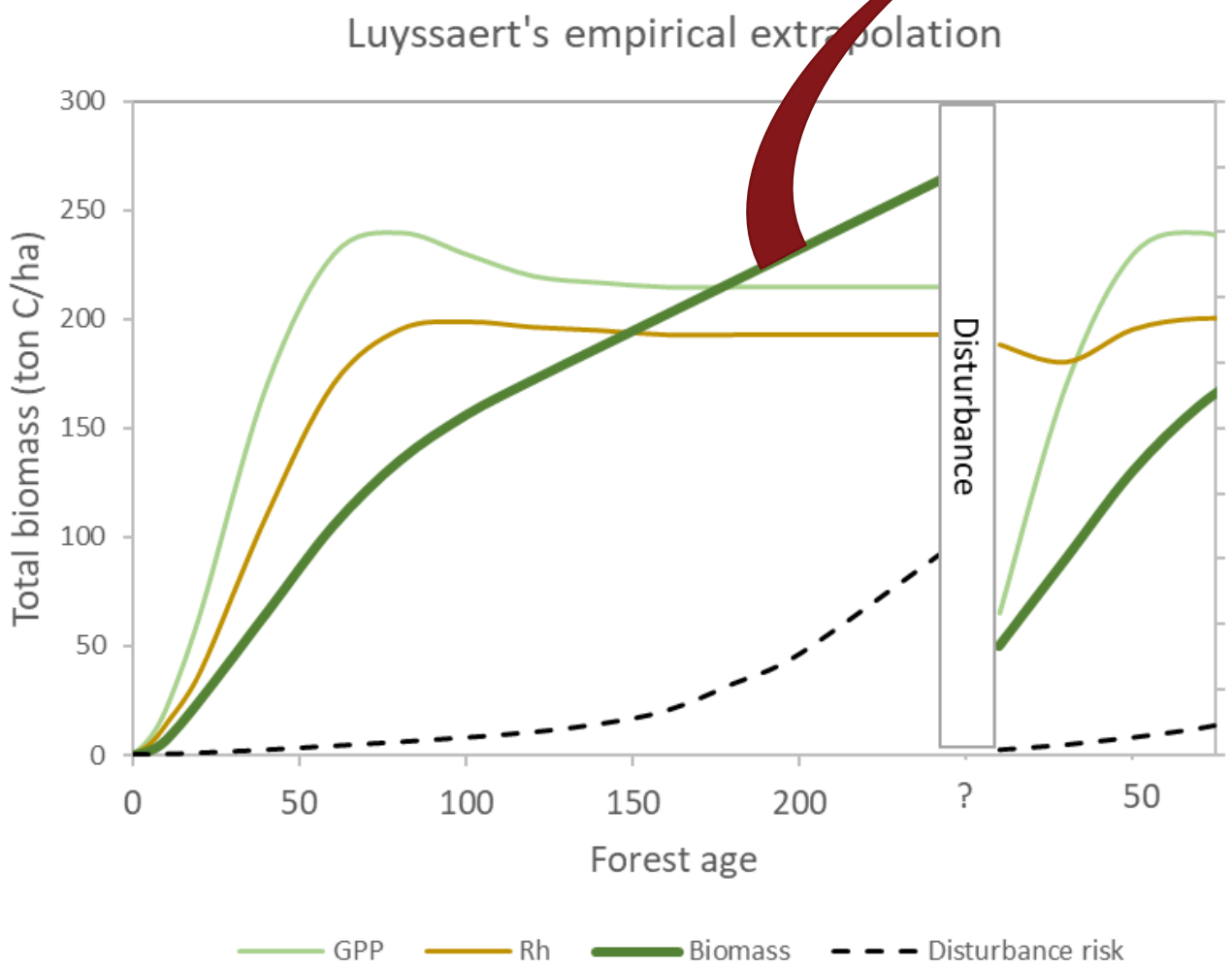
Garbu, 2020

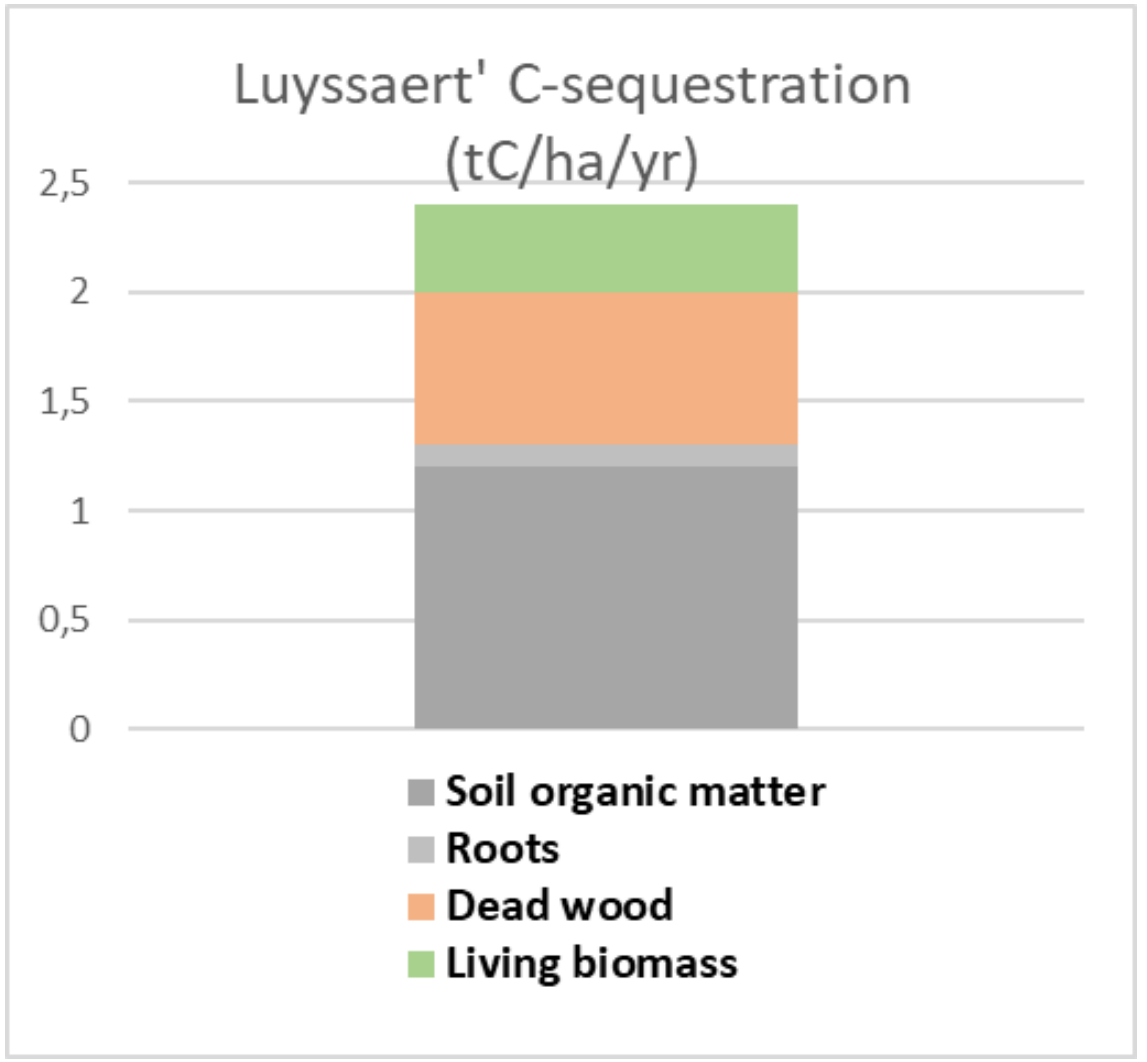
Vol 455|11 September 2008|doi:10.1038/nature07276

nature

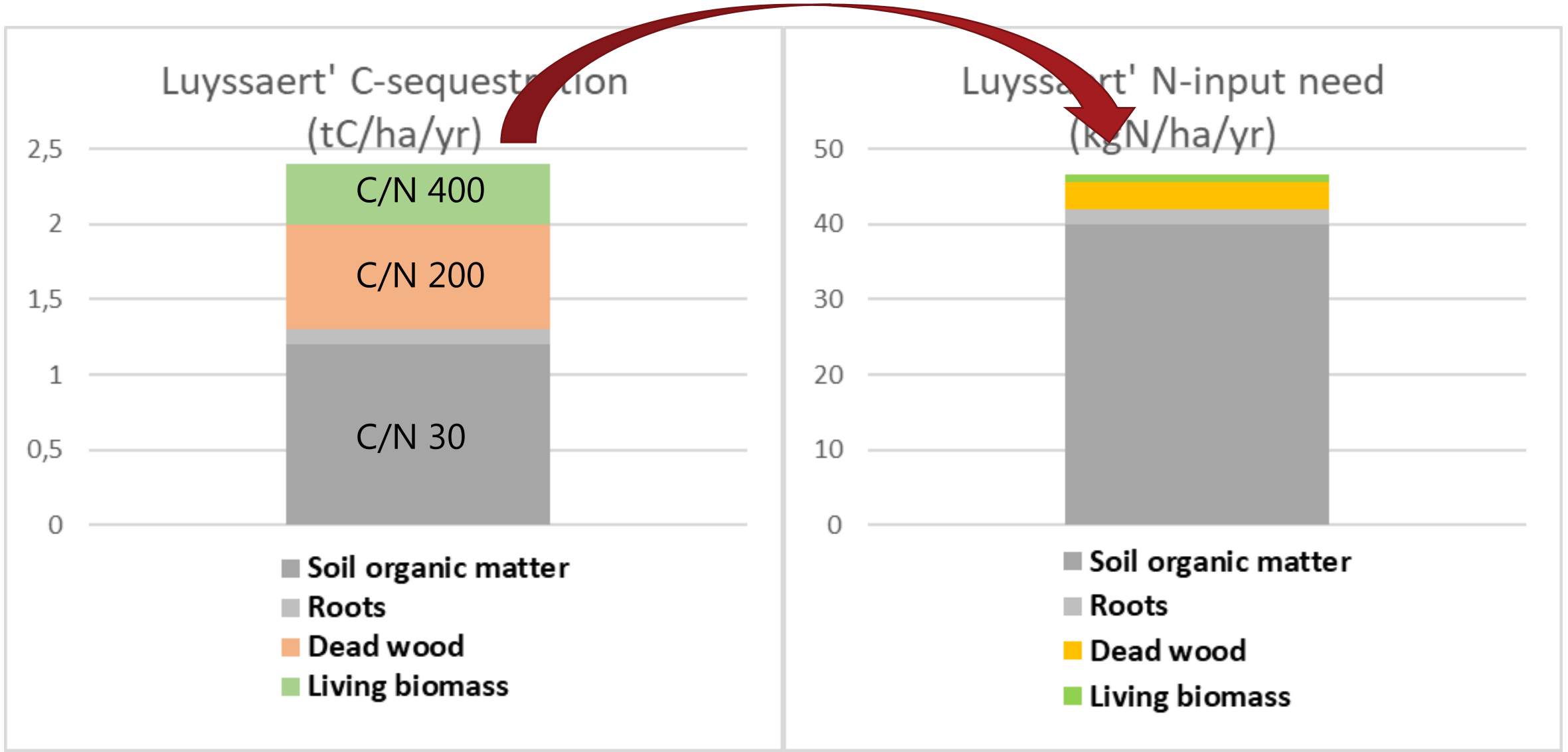
Old-growth forests as global carbon sinks

Sebastiaan Luyssaert[1,2], E. -Detlef Schulze[3], Annett Börner[3], Alexander Knohl[3], Dominik Hessenmöller[3], Beverly E. Law[2], Philippe Ciais[5] & John Grace[6]





Is there enough nitrogen (N) to support the C-sequestration?



Luyssaert's database, average ± SE by category

NEP (Mg C ha^{-1} yr^{-1})	All ages		>100 yrs		>200 yrs	
	n	NEP	n	NEP	n	NEP
All forests	142	2.4 ± 0.2	37	2.2 ± 0.4	12	**1.6 ± 0.6**
Managed	81	3.1 ± 0.2	18	3.4 ± 0.5	2	3.4 ± 1.8
Unmanaged	26	1.5 ± 0.4	19	1.1 ± 1.7	10	**1.3 ± 0.6**
Recently disturbed	25	1.6 ± 0.7	0	-	0	-

Matters arising

Old-growth forest carbon sinks overestimated

https://doi.org/10.1038/s41586-021-03266-z
Received: 10 March 2020
Accepted: 19 January 2021

Per Gundersen[1]✉, Emil E. Thybring[1], Thomas Nord-Larsen[1], Lars Vesterdal[1], Knute J. Nadelhoffer[2] & Vivian K. Johannsen[1]

ARISING FROM: S. Luyssaert et al. *Nature* https://doi.org/10.1038/nature07276 (2008)

Luyssaert said:
2.4 ± 0.8
Mg C/ha/yr

Bias – biometric vs eddy covariance C flux estimates

nature COMMUNICATIONS

ARTICLE

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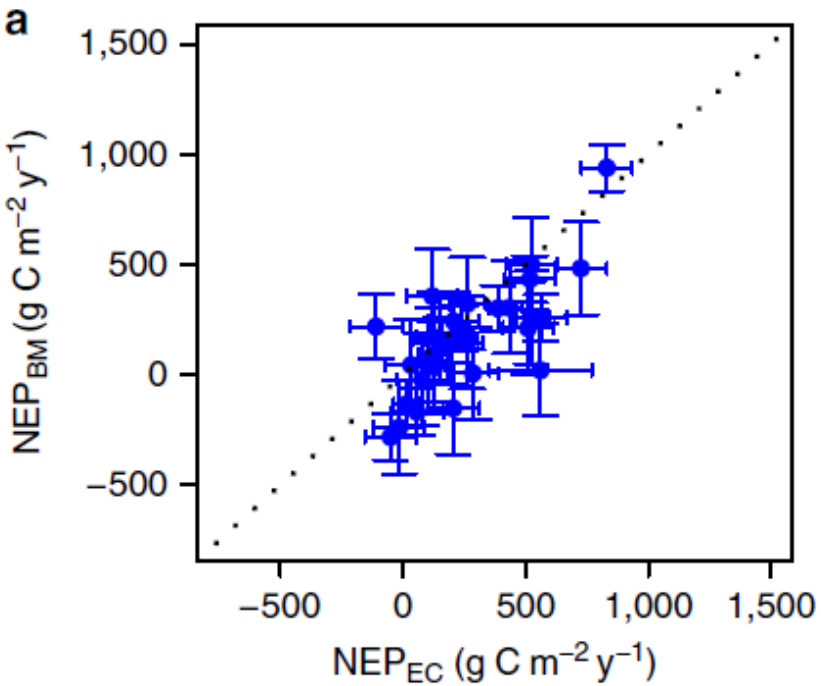
Evaluating the convergence between eddy-covariance and biometric methods for assessing carbon budgets of forests

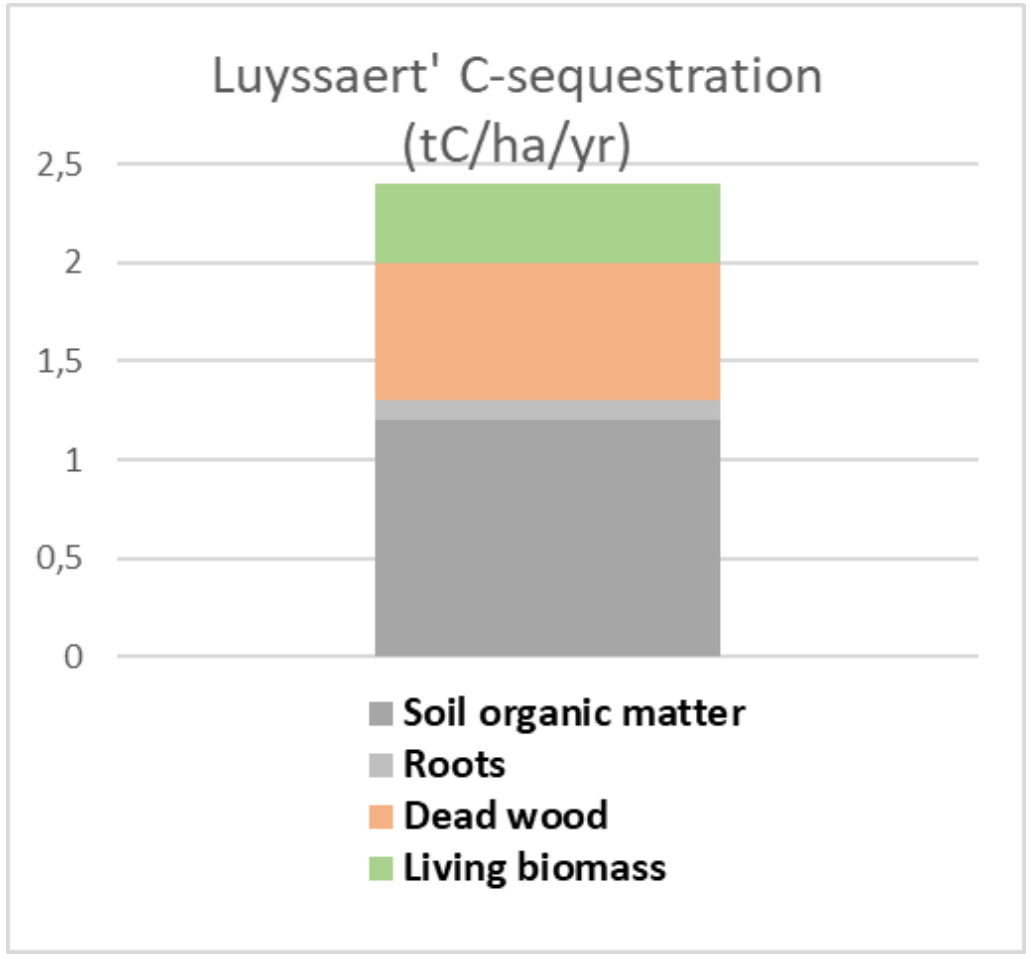
M. Campioli[1], Y. Malhi[2,*], S. Vicca[1,*], S. Luyssaert[3,*,†], D. Papale[4,5], J. Peñuelas[6,7], M. Reichs
M. Migliavacca[8], M.A. Arain[9] & I.A. Janssens[1]

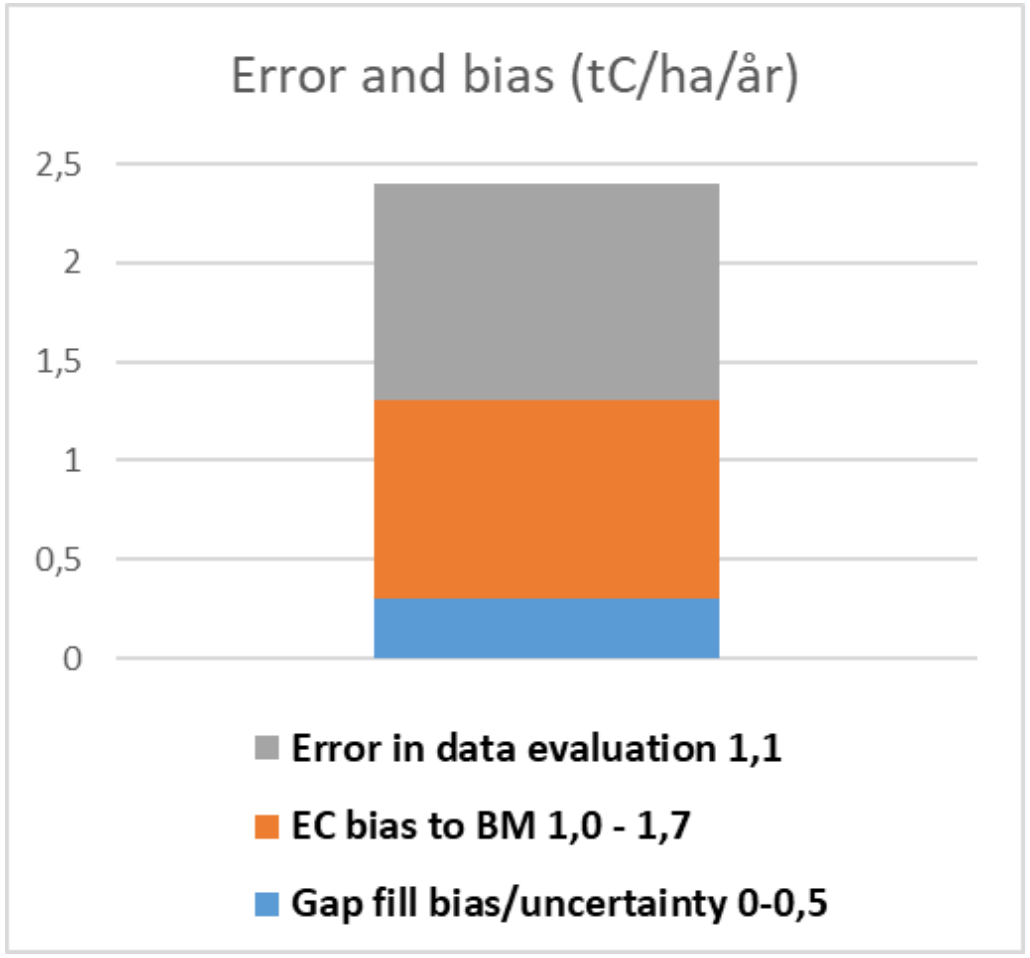
	BM versus EC		
	NEP	Reco	GPP
Global			
Site replicates (*n*)	31	25	18
Absolute difference (mean ± s.e.m)	−98 ± 32	120 ± 61	25 ± 67
Significance difference (*P*)	0.0042**	0.061+	0.71
Relative difference (mean ± s.e.m in %)	NA	13 ± 4	5 ± 4
Boreal			
Site replicates (*n*)	6	6	4
Absolute difference (mean ± s.e.m)	−167 ± 44	189 ± 75	89 ± 59
Significance difference (*P*)	0.013*	0.031*	0.23
Relative difference (mean ± s.e.m in %)	NA	18 ± 7	8 ± 5
Temperate			
Site replicates (*n*)	22	15	11
Absolute difference (mean ± s.e.m)	−95 ± 28	160 ± 85	59 ± 100
Significance difference (*P*)	0.0028**	0.079+	0.57
			6 ± 6



Bias:
1.0 - 1.7
Mg C/ha/yr

Overall evaluation – C-sequestration could as well be zero





Conclusions

- N-leaching in old-growth forest signal C-saturation
- Old-growth (forest reserves) in DK support the Odum hypothesis
- Disregard the data and conclusion in Luyssaert et al. 2008.
- Forest C-balances based on eddy-covarians technology needs to be revisited based on better data handling algorithms

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