

SOM-parametizations

SMB2 -> SOM2

Bio-incorporation

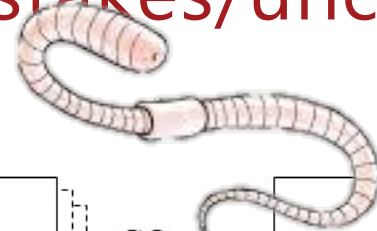
Maja Holbak
Daisy 7 launch
19-03-2025



KØBENHAVNS UNIVERSITET



Daisy soil organic matter module – mistakes/uncertainties



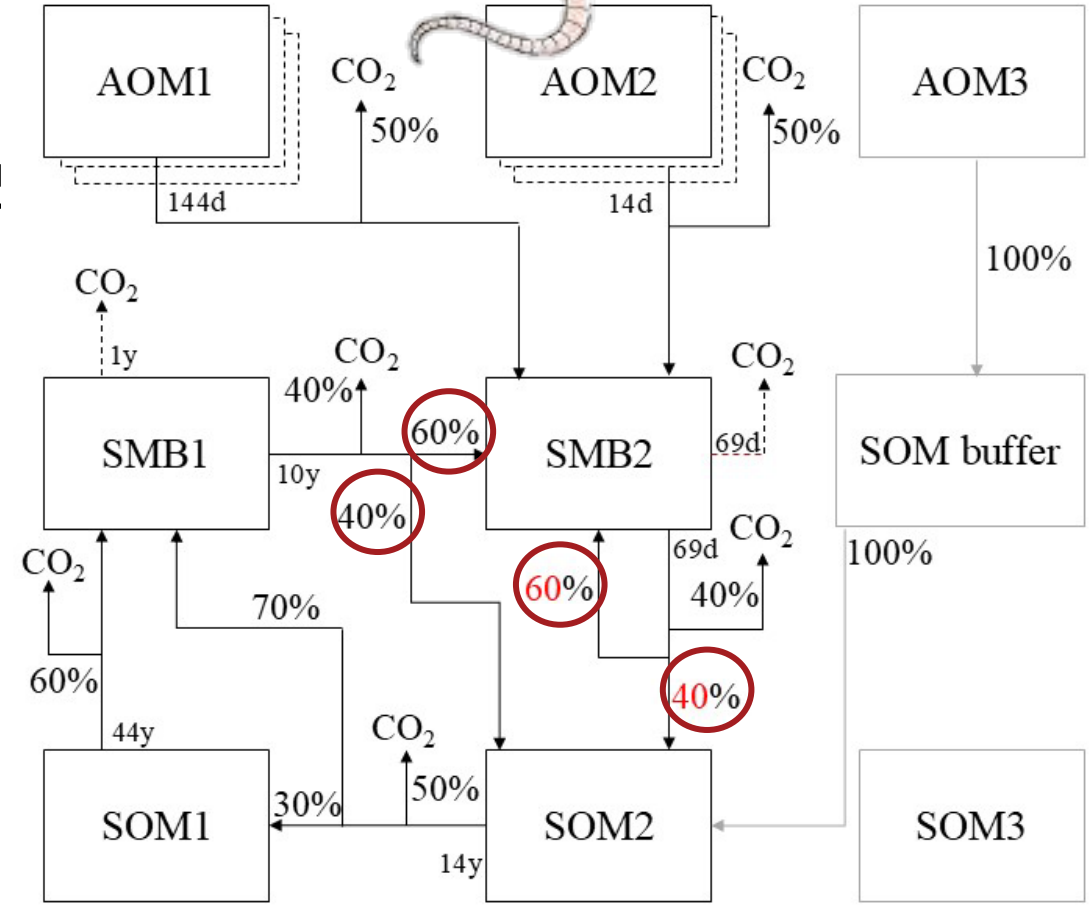
DAISY
Soil Plant Atmosphere System Model

Technical Description


Editors: M.E. Styczen, P. Abrahamsen, M. Holbak and E. Diamantopoulos

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Daisy SOM-module calibration and validation



PERGAMON

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Calibration and validation of the soil organic matter dynamics of the *Daisy* model with data from the Askov long-term experiments

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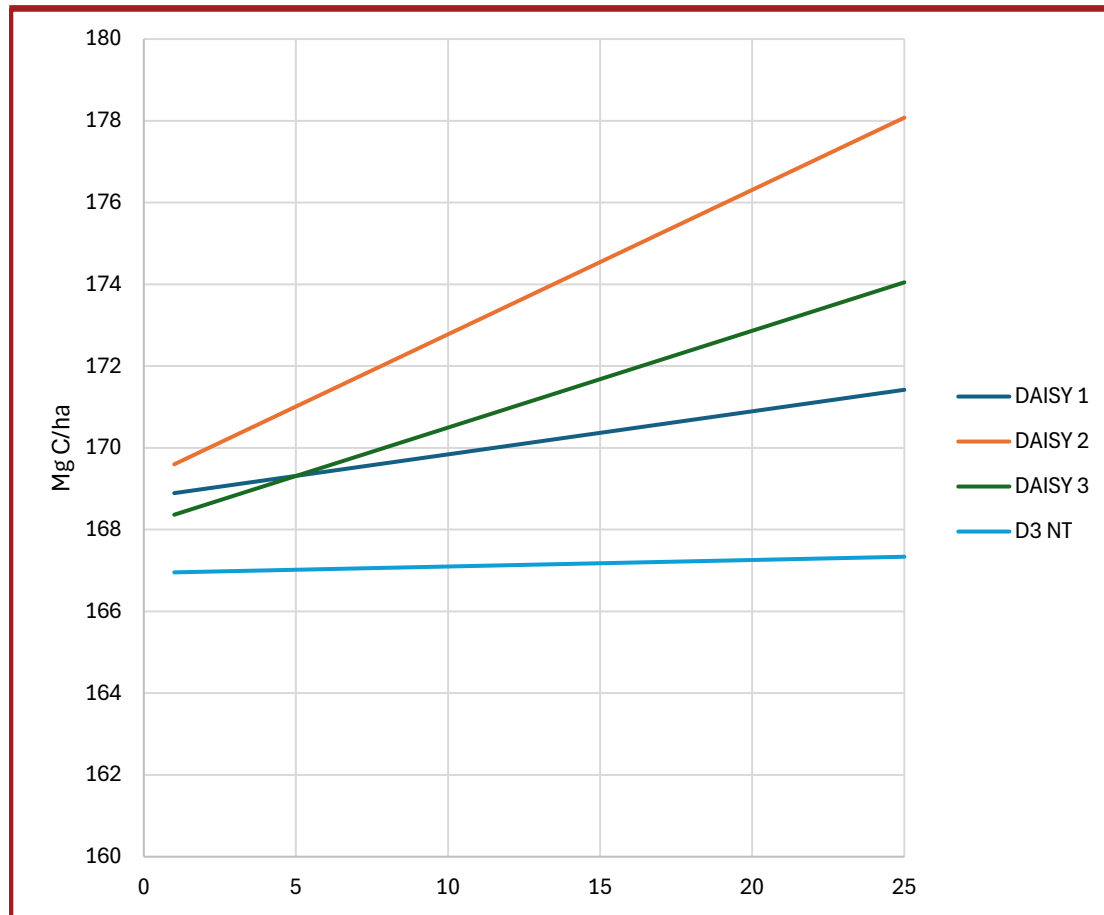
Abstract

Daisy is a semi-mechanistic model that simulates crop production, soil water and C and N dynamics in agro-ecosystems. In this study, the soil organic matter (SOM) submodel of *Daisy* was calibrated and validated with data from a series of long-term (30–100 yr) experiments dominated by cereal cropping systems. The experiments were conducted under temperate conditions at the Askov Experimental Station, Denmark. The recalibration of the *Daisy* model improved the model simulations considerably. The RMSE between simulations and observations of the experiments used for calibration improved from 33 to 19, whereas this measure improved from 32 to 9.0 for the experiments used for validation. The original calibration of the model appears to be based upon too low an input of organic matter (especially because rhizodeposition is ignored), too low an efficiency with which added organic matter is converted into more stable forms of SOM, and too low an overall decomposition rate. Our study suggests that the fraction of SOM involved in medium-term turnover is substantially larger than previously thought and inferred by most SOM turnover models. This may warrant a recalibration of current simulation models, and stresses the importance of using long-term experiments with widely differing treatments for model evaluation. Long-term treatments with widely contrasting initial C contents and annual C inputs, especially bare fallow treatments, appear to be valuable resources in this respect.

- Done in the old Daisy FORTRAN version
 - SMB2 → SOM2 40 %
 - SMB2 ∩ SMB2 60 %
 - No bio-incorporation

- Question: What was the effect of current setup? Difference from Bruun et al., 2003 ?
 - SMB2 → SOM2 60 %
 - SMB2 ∩ SMB2 40 %
 - Bio-incorporation efficiency 50 %

The SOM turnover history in Daisy... An example with crop rotation and high input of C on a loamy soil



- Daisy 1: Represent old FORTRAN
 - SMB2 → SOM2 40 %
 - SMB2 ↻ SMB2 60 %
 - Bio-incorporation respiration 0 %
- Daisy 2: C++ early
 - SMB2 → SOM2 60 %
 - SMB2 ↻ SMB2 40 %
 - Bio-incorporation respiration 0 %
- Daisy 3: C++ late
 - SMB2 → SOM2 60 %
 - SMB2 ↻ SMB2 40 %
 - Bio-incorporation respiration 50 %

Established two new parameterization

SOM2000 (default before version 7)

- SMB2 → SOM2 60 %
- SMB2 ↻ SMB2 40 %
- Bio-incorporation efficiency 50 %

SOM2025 (default from version 7)

- SMB2 → SOM2 40 %
- SMB2 ↻ SMB2 60 %
- No bio-incorporation

Test Set ups

Test 1

- Sand (Jyndevad) vs. Loam (Askov)
- Continues Spring Barley
- Conventional management (tillage)

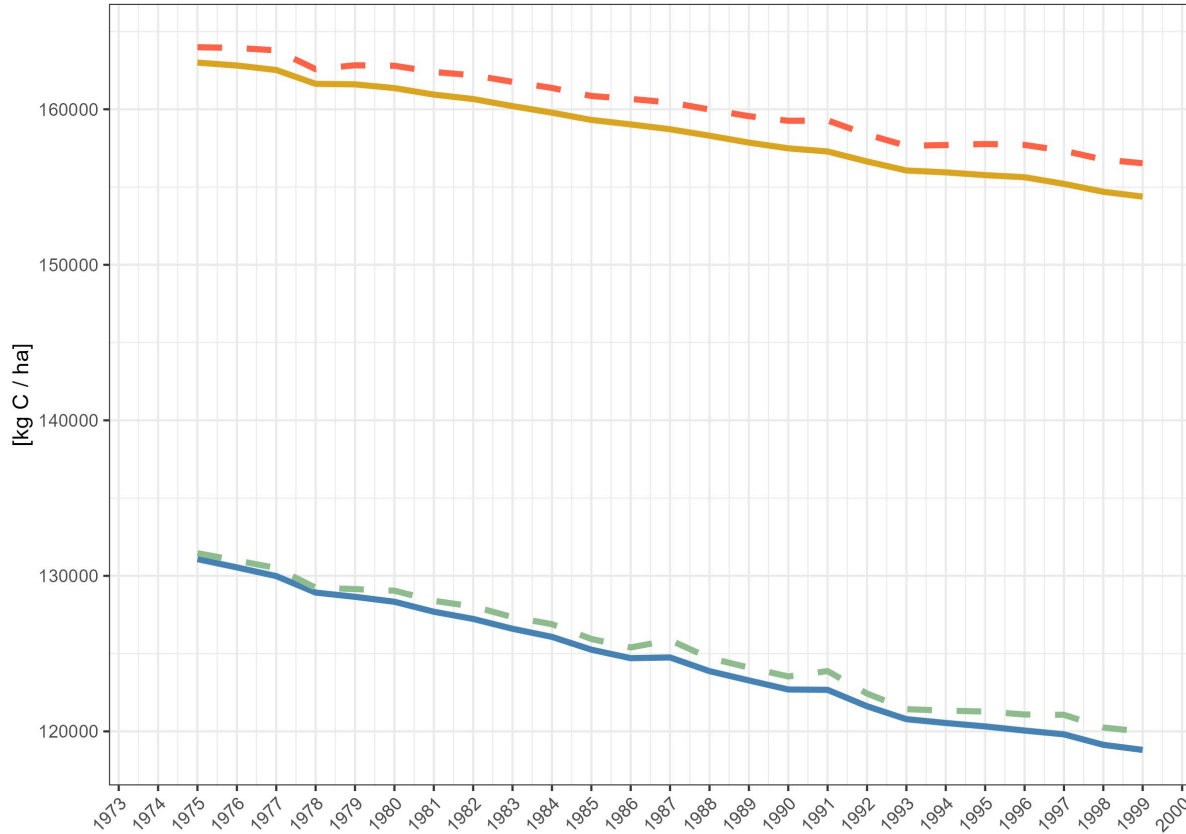
Test 2

- Loam (Askov)
- Crop rotation and Cover crops
- Leaving leaves and stem in field at harvest
- Tillage vs. No tillage

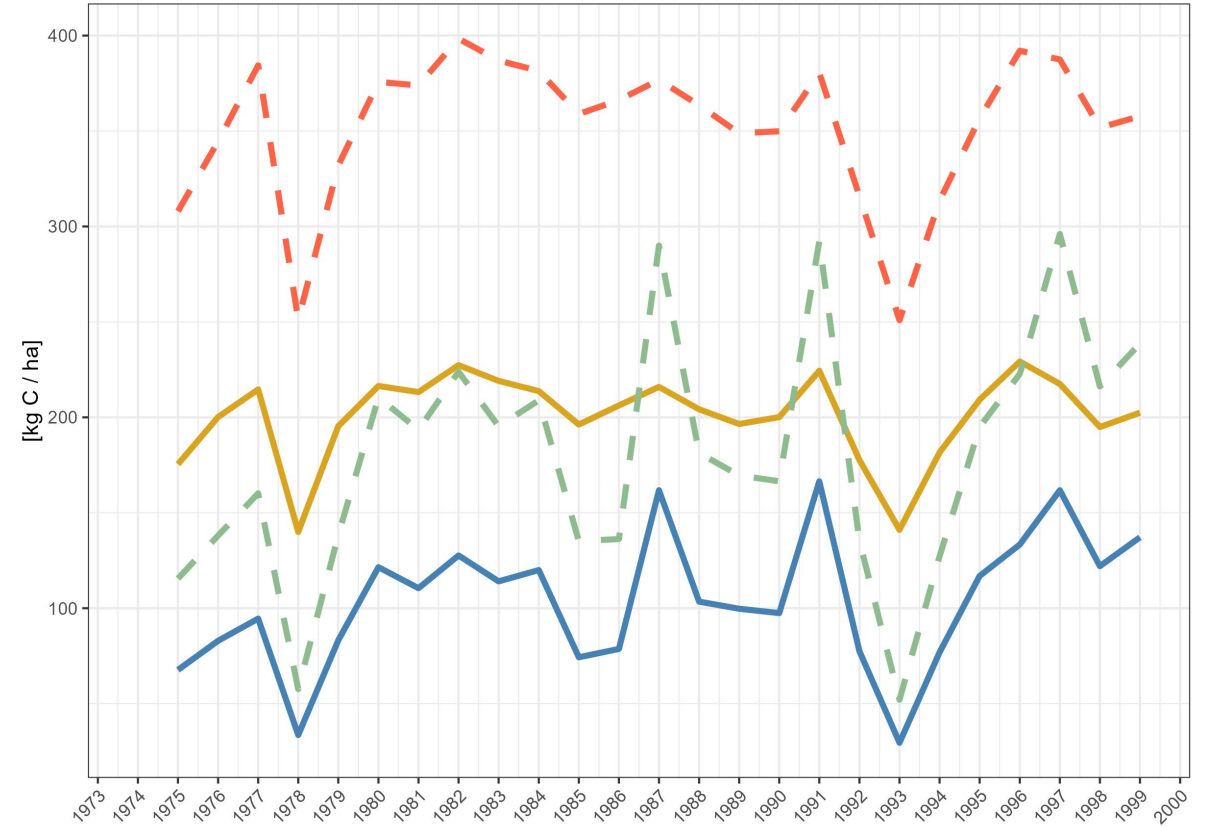
- Initialization of SOM – default option:
 - Subsoil: assume active pools are in equilibrium and $\Delta\text{SOM3} = 0$
 - Topsoil: assumption SMB2 and SOM2 quickly adapt to input and the size of the slow pool (SOM1). The input rate is estimated from the initial AOM-pool.
- Ammonium sorption was simulated with the new linear sorption model with $K_{clay} = 213 \text{ [cm}^3 \text{ g}^{-1}\text{]}$ and $K_{OC} = 23 \text{ [cm}^3 \text{ g}^{-1}\text{]}$.
- The test was run for 30 years (1970-2000), with the first 5 years as warm up.
- Taastrup weather data

Test 1 Results – C dynamics

Soil C



SMB2 C

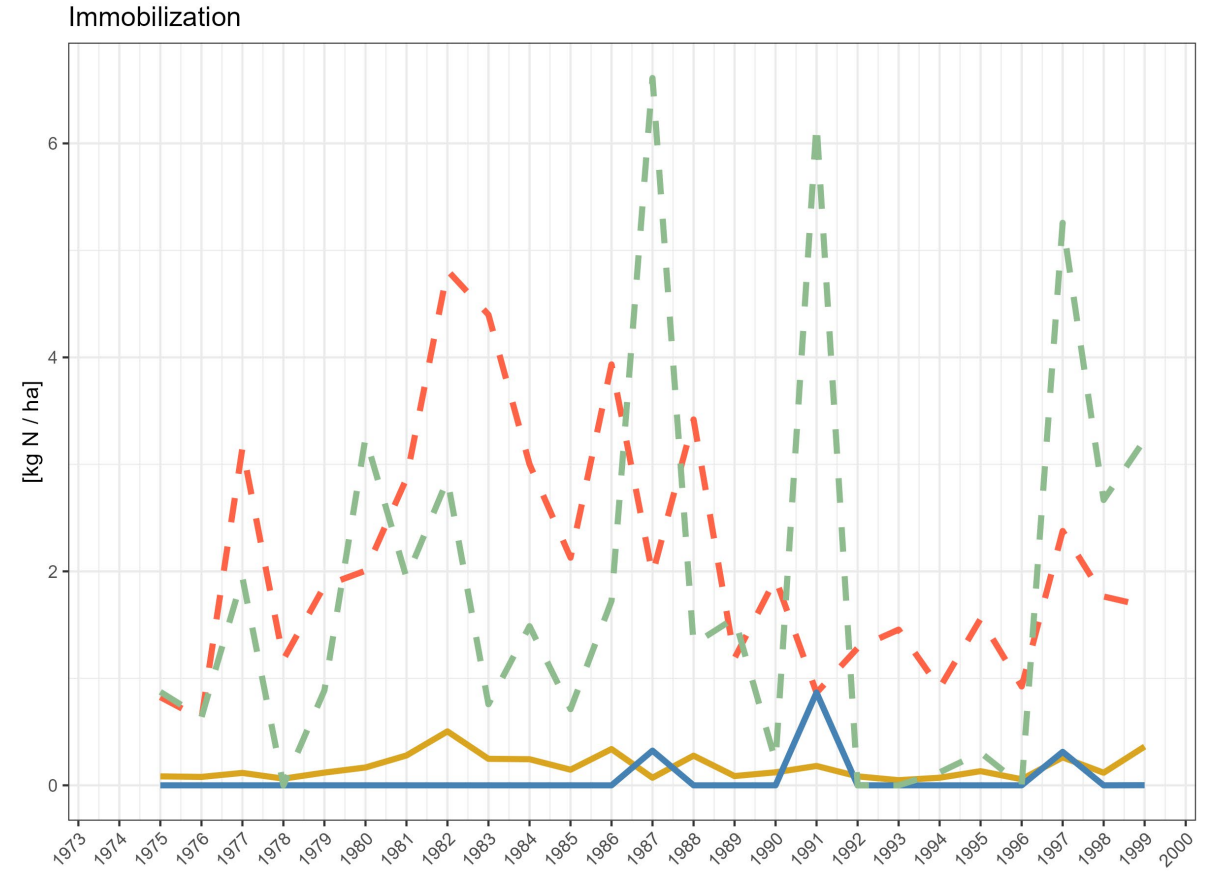
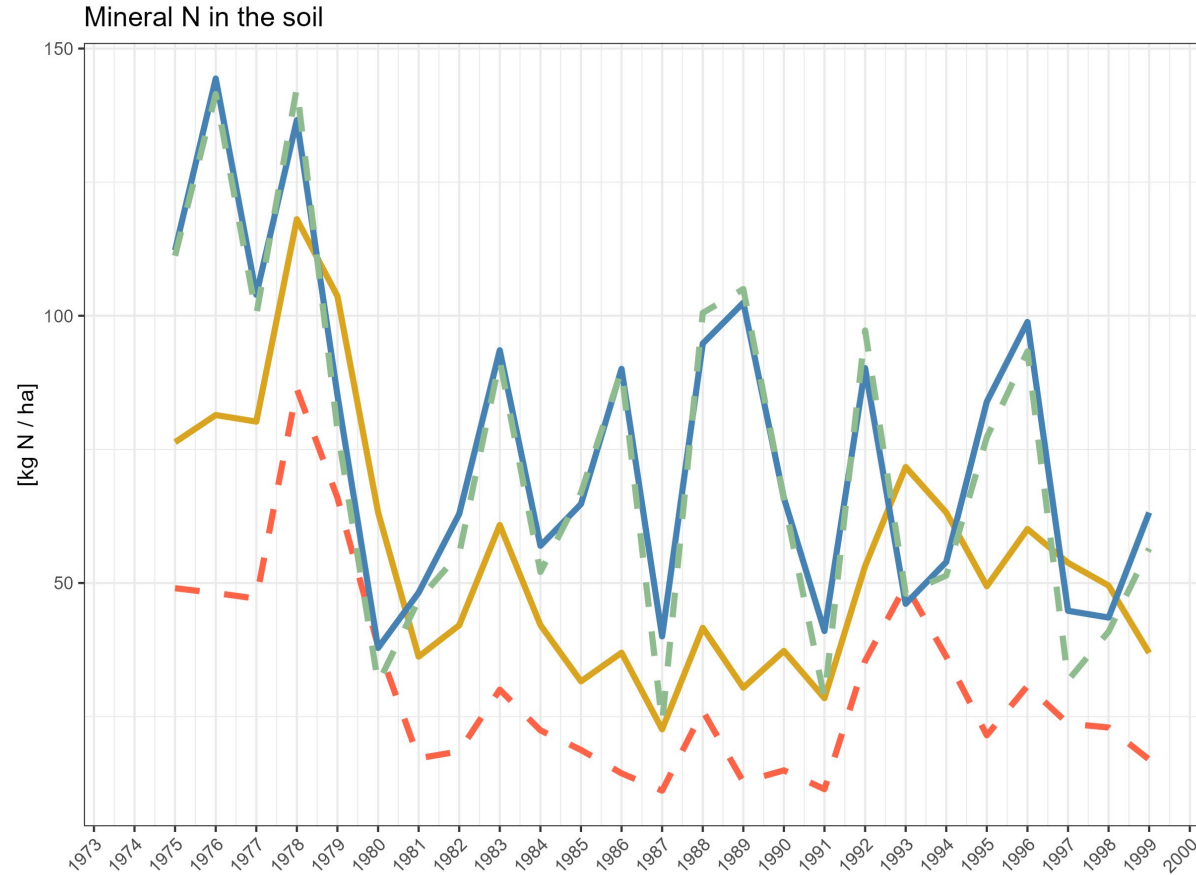


Simulation

- CT Loam SB SOM2000
- - - CT Loam SB SOM2025
- CT Sand SB SOM2000
- - - CT Sand SB SOM2025

Name	SMB2 → SOM2	SMB2 ↻ SMB2	Bio-In eff.
SOM2000	60	40	0.5
SOM2025	40	60	0

Test 1 Results – N dynamics



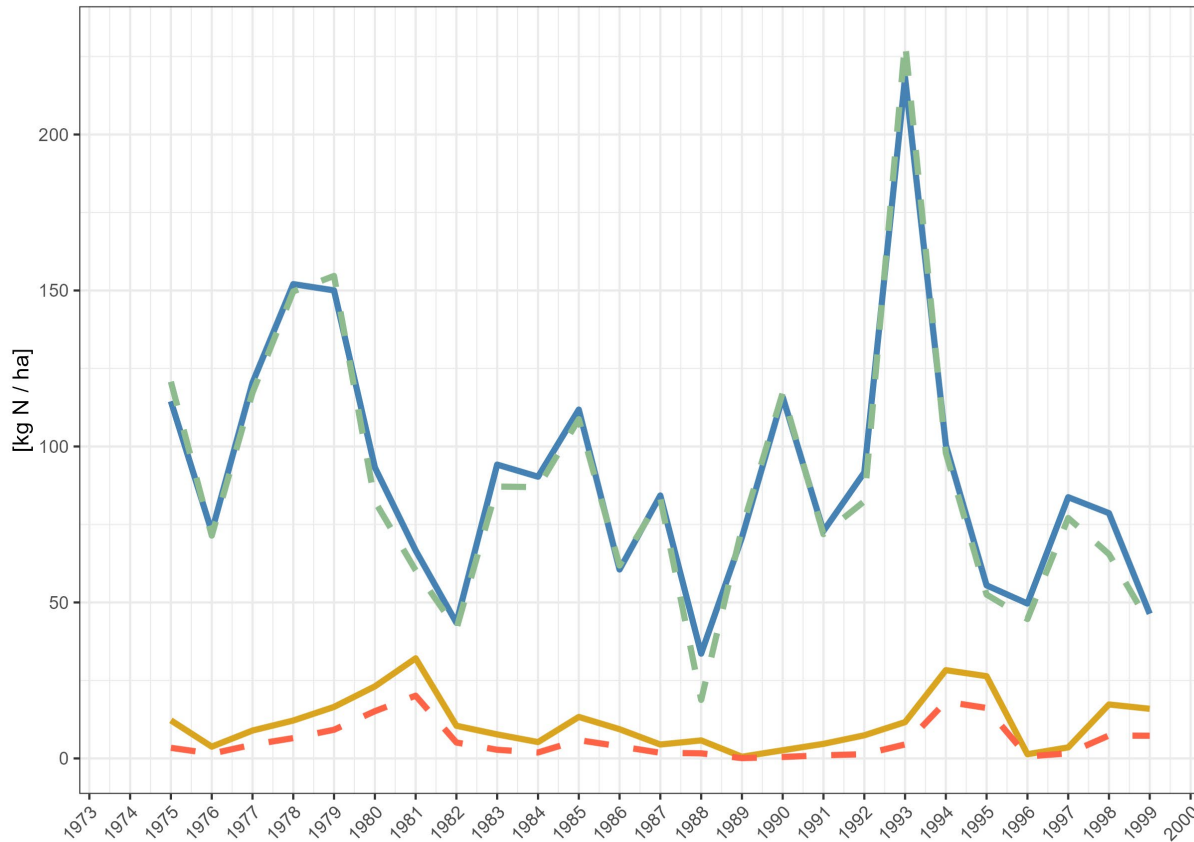
Simulation

- CT Loam SB SOM2000
- - - CT Loam SB SOM2025
- CT Sand SB SOM2000
- - - CT Sand SB SOM2025

Name	SMB2 → SOM2	SMB2 ↔ SMB2	Bio-In eff.
SOM2000	60	40	0.5
SOM2025	40	60	0

Test 1 Results – N leaching and Harvest

Matrix Leaching



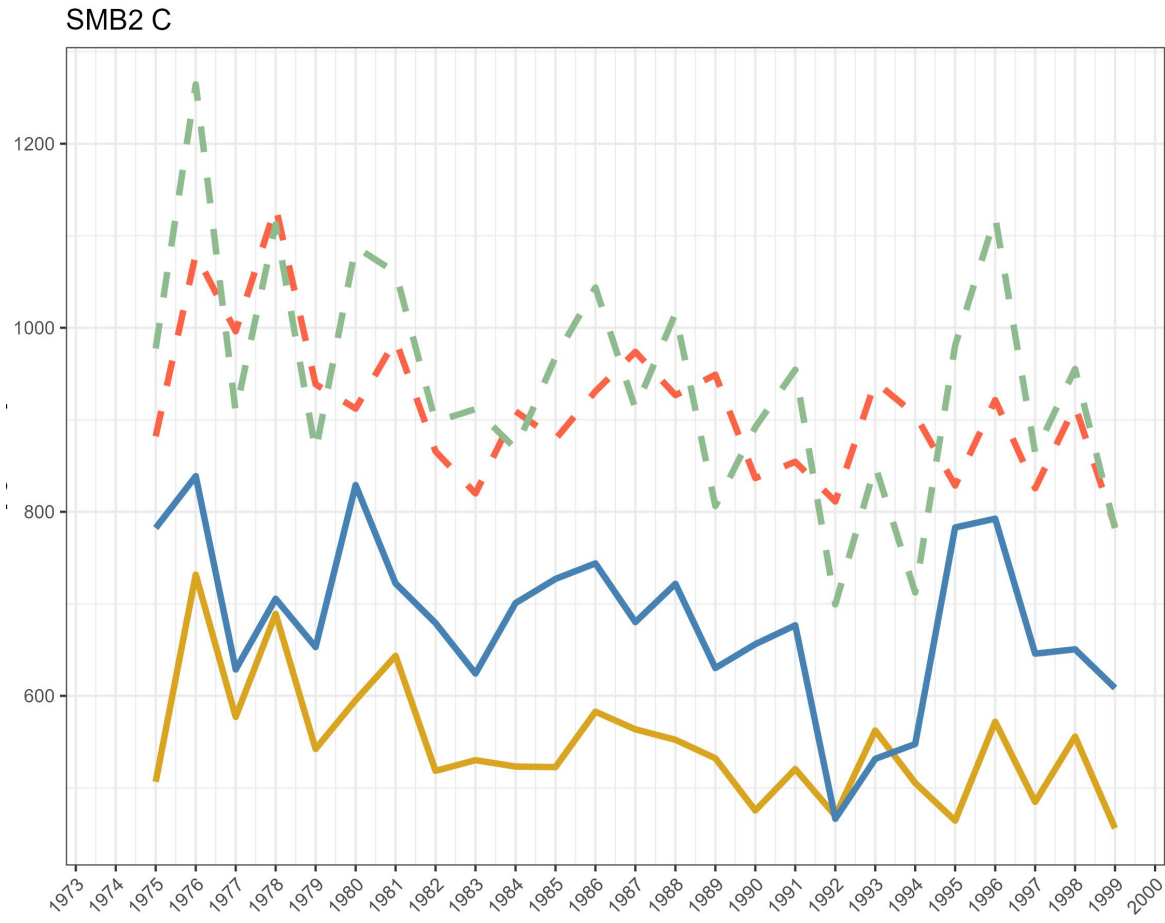
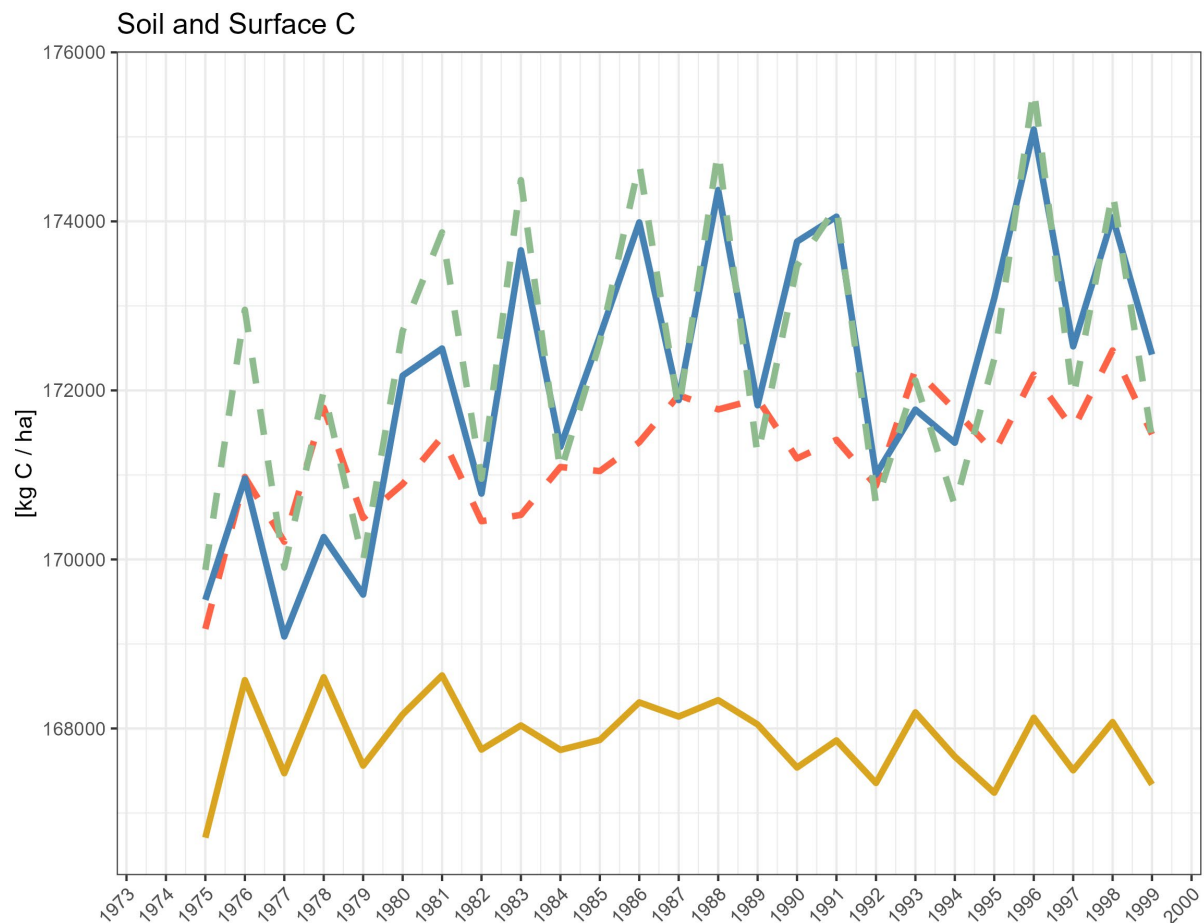
Soil	Crop	SOM parameter	Mean Harvested C [Kg C/ha] (Sd)	Mean Harvested N [Kg N/ha] (Sd)
Loam	Spring barley	SOM2000	3522 (954)	129 (13)
Loam	Spring barley	SOM2025	3517 (951)	126 (12)
Sand	Spring barley	SOM2000	1844 (992)	78 (31)
Sand	Spring barley	SOM2025	1848 (993)	80 (31)

Simulation

- CT Loam SB SOM2000
- - - CT Loam SB SOM2025
- CT Sand SB SOM2000
- - - CT Sand SB SOM2025

Name	SMB2 → SOM2	SMB2 ↔ SMB2	Bio-In eff.
SOM2000	60	40	0.5
SOM2025	40	60	0

Test 2 Results – C dynamics

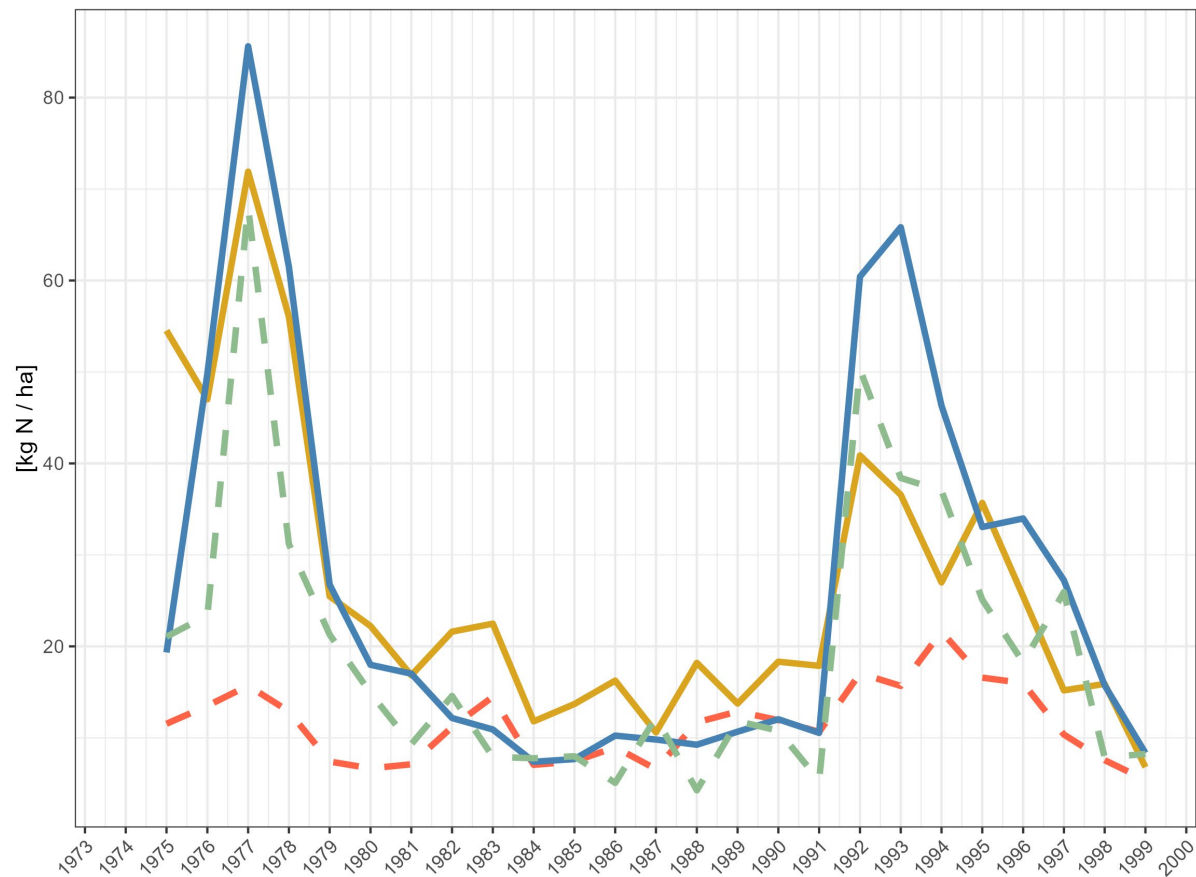


- Simulation**
- NoT Loam Rotation SOM2000
 - - - NoT Loam Rotation SOM2025
 - CT Loam Rotation SOM2000
 - - - CT Loam Rotation SOM2025

Name	SMB2 → SOM2	SMB2 ↔ SMB2	Bio-In eff.
SOM2000	60	40	0.5
SOM2025	40	60	0

Test 2 Results – N dynamics

Mineral N in the soil and on the surface

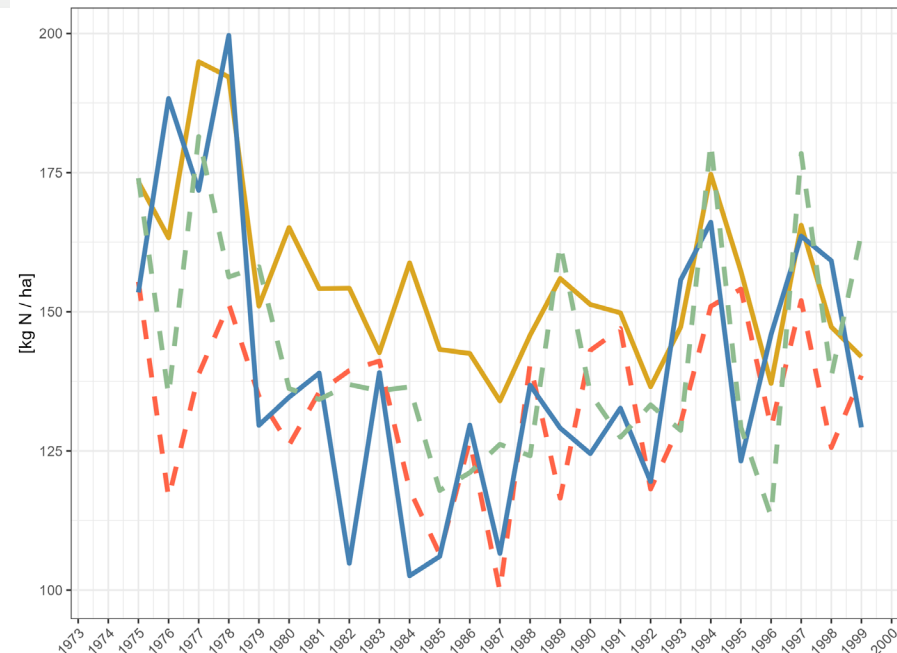


Simulation

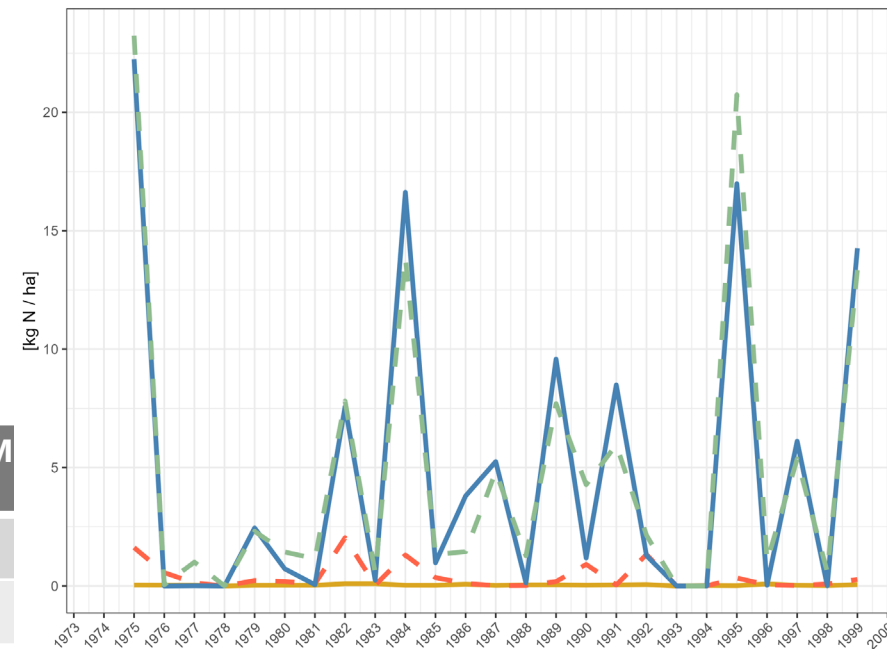
- NoT Loam Rotation SOM2000
- - - NoT Loam Rotation SOM2025
- CT Loam Rotation SOM2000
- - - CT Loam Rotation SOM2025

Name	SMB2 → SOM
SOM2000	60
SOM2025	40

Mineralization

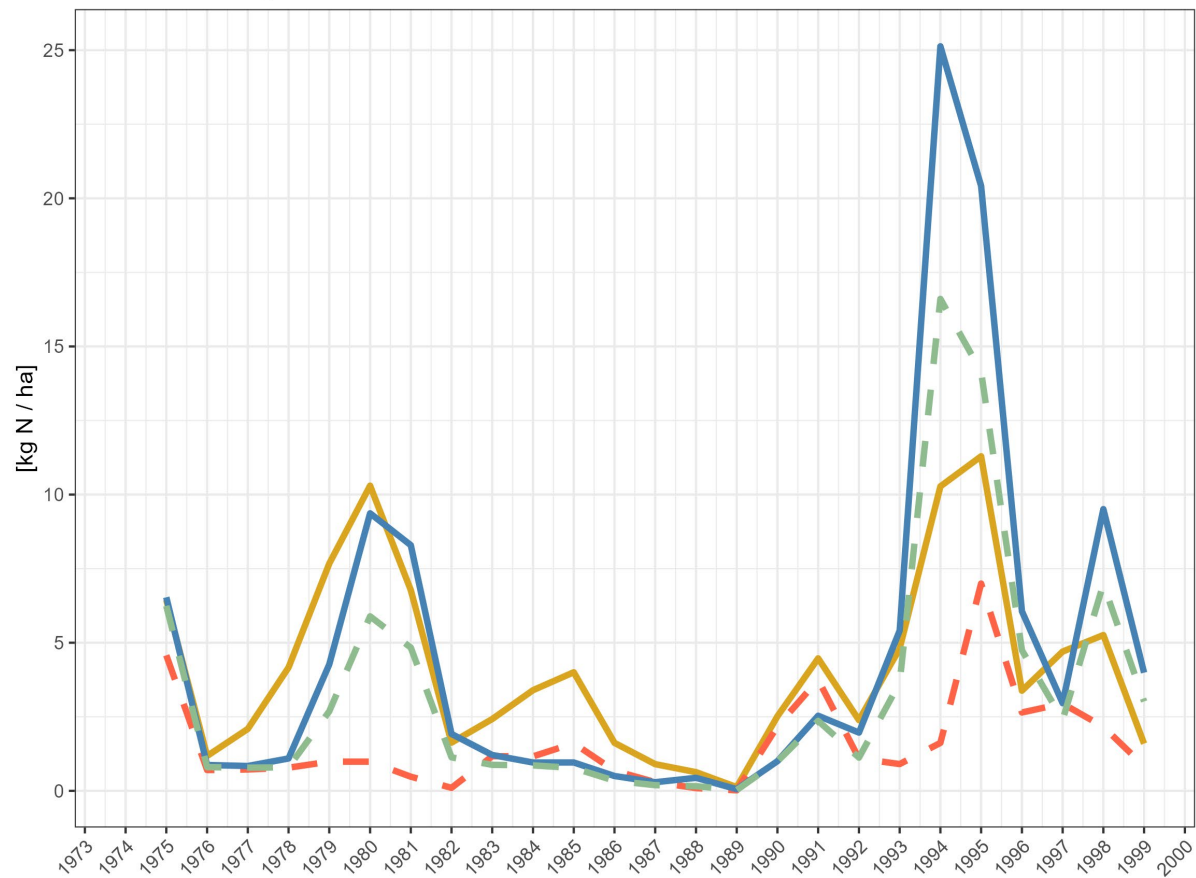


Immobilization



Test 2 Results – N leaching and Harvest

Matrix Leaching



Simulation

- NoT Loam Rotation SOM2000
- - - NoT Loam Rotation SOM2025
- CT Loam Rotation SOM2000
- - - CT Loam Rotation SOM2025

Soil	Crop	SOM parameter	Mean Harvested C [Kg C/ha] (Sd)	Mean Harvested N [Kg N/ha] (Sd)
Loam	Spring barley	SOM2000	2829 (429)	100 (15)
Loam	Spring barley	SOM2025	2863 (444)	100 (15)
Loam	Winter rape	SOM2000	1373 (812)	94 (15)
Loam	Winter rape	SOM2025	1350 (794)	88 (15)
Loam	Winter wheat	SOM2000	2140 (301)	119 (26)
Loam	Winter wheat	SOM2025	2072 (300)	115 (31)

Name	SMB2 → SOM2	SMB2 ⇄ SMB2	Bio-In eff.
SOM2000	60	40	0.5
SOM2025	40	60	0

How to set // Questions and perspectives...

- (OrganicMatter SOM2000)
- (OrganicMatter SOM2025)
- *If you do not write anything you get SOM2025*
- Test against data