Preliminary technical correction (TC) of the Swedish Forest reference level (FRL)

JRC 06/05/2025

Mattias Lundblad, Swedish University of Agricultural Sciences

The Swedish FRL (2021-2025)

Carbon pool	FRL	GHG-inventory
Living biomass	Modelled using Heureka RegVis	Repeated inventory of permanent plots (NFI)
Dead wood	Modelled using Heureka RegVis	Repeated inventory of permanent plots (NFI)
Stumps	Modelled using Q- model	Decomposition model (Melin et. al. 2009)
Litter		Repeated inventory of permanent plots (SFSI)
Mineral soil		Repeated inventory of permanent plots (SFSI)
Organic soil	Based on reported average of GHGI 2000-2009	Areas from SFSI and EF for CO_2, N_2O, CH_4
Fertilisation		Fertilised areas
Fire		Burned areas

Identifying the need for a TC

Consistency and emission/removal levels:

Stumps/litter/soil carbon (mineral soils)

- Q-model give total carbon stocks for stumps/litter/soil carbon.
- Major recalculation in GHGI.

Small trees (DBH<10 cm)

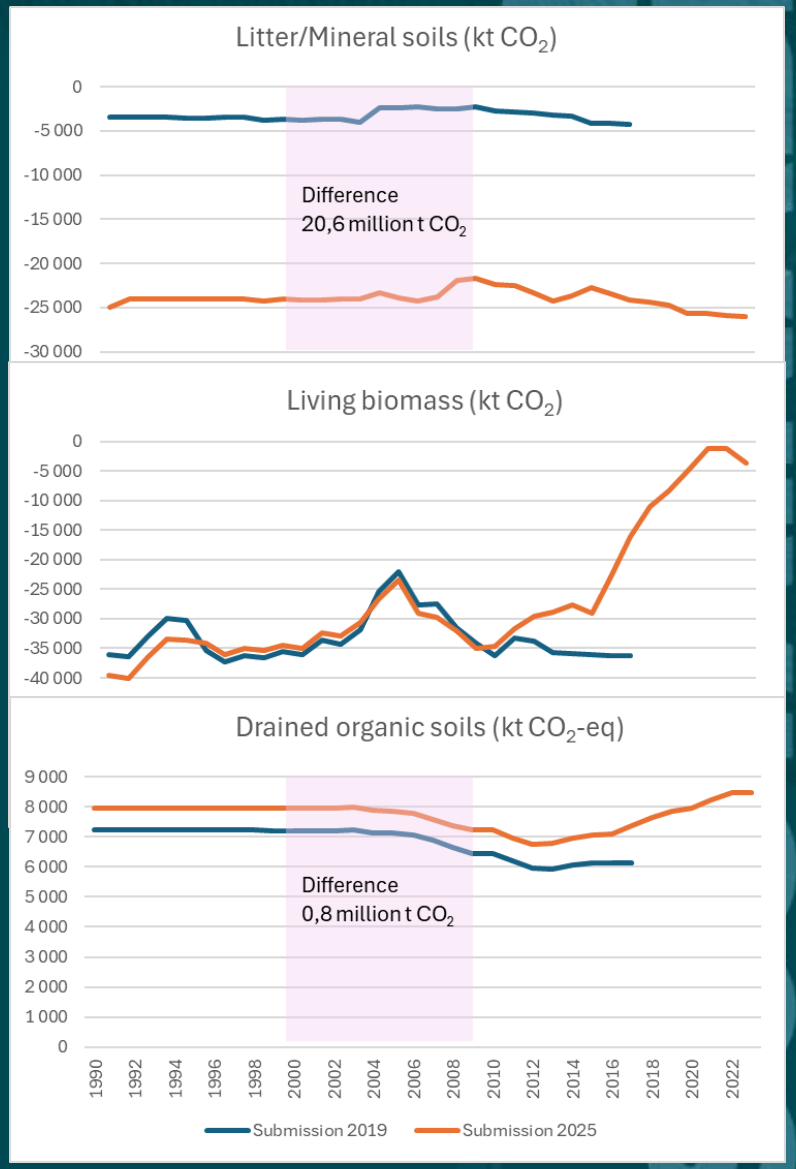
- Previously based on a constant (net removal).
- GHGI updated using measured stock changes in small trees (<100 mm DBH)

Drained organic soils

- Previously based on historical average 2000-2009
- Updated emission factors and areas in GHGI

Fertilization and fire

- Previously based on historical average 2000-2009.
- Changing reference years for simulations will require a correction



Identifying the need for a TC

- From the guidelines for FRL and the JRC TC guidance:
  - **Climate**
  - **Area**
  - **New carbon pools**
  - **Starting year of the simulation and managing the period 2010-2020**
  - **HWP**

→ Effect on growth of RCP4.5 is small. Natural variation is larger and is captured by observed growth.

→ Simulation with current area of managed forest land. Baseline based on RT 2016-2020.
Finally needs to be revised in 2027.

→ New carbon pools not relevant for SE

→ Original FRL starts in 2010 based on 2008-2012. We need to reflect age-related factors and changes in natural conditions.

→

Original FRL

Heureka simulations

- → Permanent plots 2008-2012, start year 2010.
- → Same database as in the reporting.
- → Relative growth based on long term historical average.
- → Natural losses (mortality) according to NFI 2008-2012.
- → Harvest intensity and forest management based on NFI 2000-2009
- → 20-year conversion for afforested land

Small trees

- → Constant: - 4 Mt CO_2 per year

HWP

- → Ratio wood products/forest bioenergy 2000-2009. Harvest volumes from simulation.

Q-model (stumps/litter/mineral soil)

- → Based on litter input from Heureka
- → Aggregated stump/litter/mineral soil pool

Drained organic soil and other non-CO_2

- → Based on reported average 2000-2009

Revised FRL – technical correction

Heureka simulations

- → Permanent plots NFI 2016-2020, start year 2018.
- → Same database as in the reporting.
- → Relative growth based on NFI 2016-2020.
- → Natural losses (mortality) according to NFI 2016-2020.
- → Harvest intensity and forest management based on original FRL (NFI 2000-2009)
- → 20-year conversion for afforested land
- → Capture some changes in area and some changes in natural conditions (decline in growth)

Small trees

- → Simulated or same level as reporting

HWP

- → Same ratio as in original FRL. New calculation based on harvest volume from new simulation

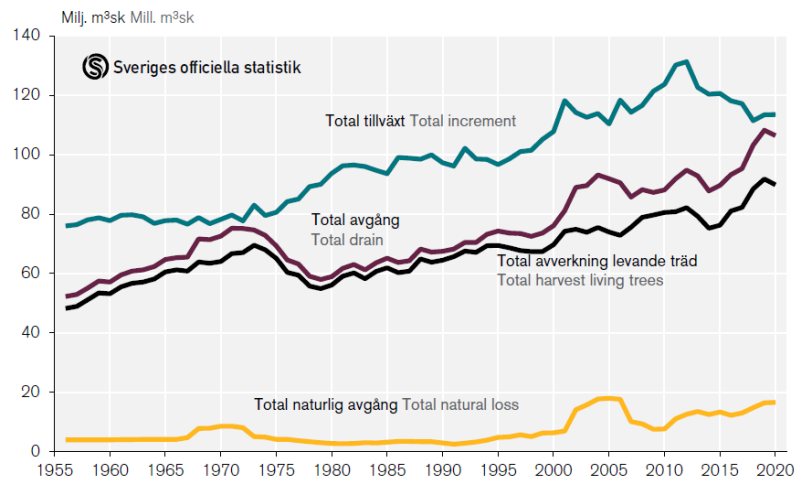
Q-model

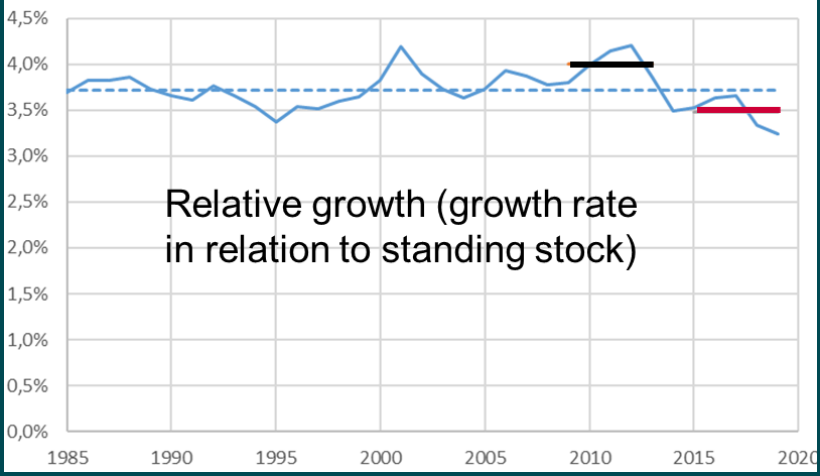
- → Based on litter input from new Heureka simulation.
- → Separation of carbon pools

Drained organic soil and other non-CO_2

- → Based on reported average 2016-2020

Updated simulation





Two steps:

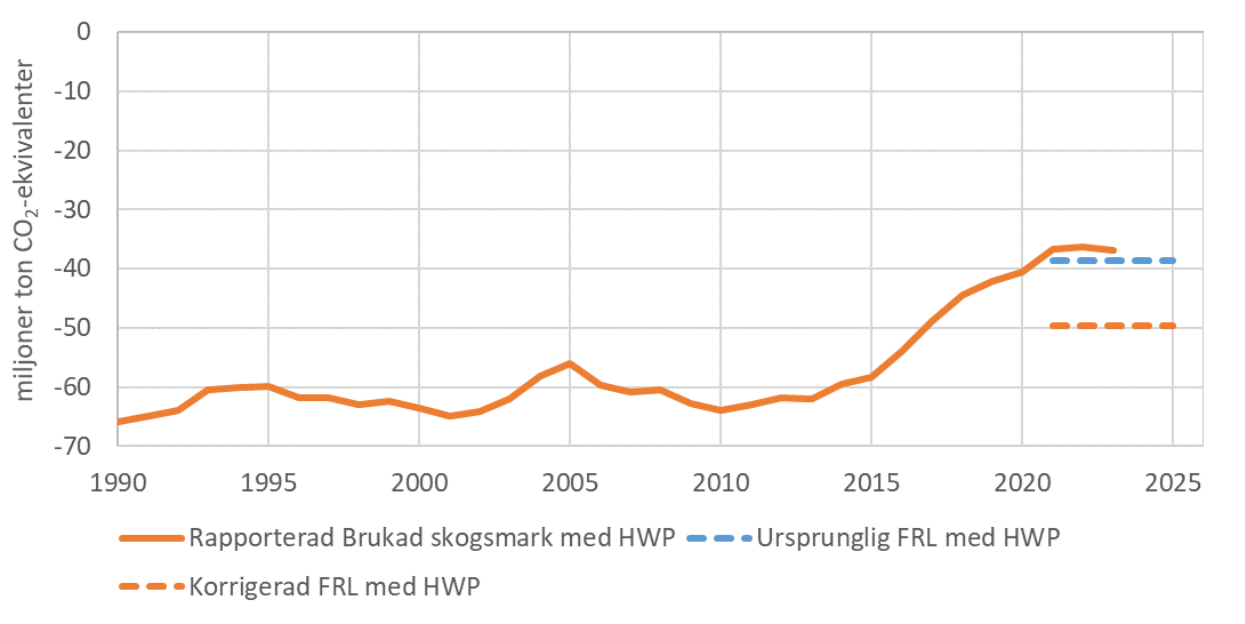
1. Simulate 2021-2025 using historical average relative growth and relative harvest from the reference period 2000-2009, starting with stand conditions in 2016-2020 inventory.
2. Simulate 2021-2025 using growth from the 2016-2020 inventory (0,28 units of a percent lower than historical) with the absolute harvest from (1), starting with stand conditions in 2016-2020 inventory.

Production forest	Harvest (M m³sk)	Growth (M m³sk)	Quota
FRL	84,8	101,2	0,84
FRL_{korr}	83,2	94,7	0,88

Results

[kt CO_2-equivalents $year^{-1}$]	FRL	FRL_{korr}	TC
Living biomass, total	-30 236	-20 321	
Production forest land (ca 21 300 kha)	-15 127	-10 977	(4 150)
Productive forests set-aside for nature conservation (ca 2 100 kha)	-7 307	-6 109	
Low-productive forest land (ca 4 000 kha)	-3 816	-2 493	
Small trees (dbh<10 cm)	-3 986	-742	(3 244)
Dead wood, total	-2 728	-9 028	(-6 300)
Laying and standing dead wood	-2 728	-1 762	
Stumps*		-7 266	
Litter and mineral soil*	-8 644	-23 941	(-15 297)
Organogenic soils (CO_2+DOC)	5 855	6 370	
Organogenic soils (N_2O, CH_4)	1 310	1 219	
Harvested wood products (HWP), total	-4 373	-4 066	
Sawn wood	-3 479	-3 210	
Wood based panels	185	169	
Paper and paper boards	-1 079	-1 025	
Fertilisation (N_2O)	23	20	
Mineralisation (N_2O)	0	0	
Indirect emissions (N_2O)	4	3	
Biomass burning (CO_2, N_2O, CH_4)	69	124	
TOTAL w.o. HWP	**-34 348**	**-45 554**	**-11 206**
TOTAL w. HWP	**-38 721**	**-49 620**	**-10 899**

Results and final remarks



- Based on Submission 2025 results for 2021-2023 the revised TC indicate a deficit of 13.9 million tonne CO_2-eq for Managed forest land alone.
- This is a preliminary correction and any updates of the annual reporting may lead to further corrections.
- We need to further analyse how changes in natural conditions (eg. for growth) during the commitment period can be handled.
- It is appropriate to perform a new analyse in connection to Submission 2026 and a final correction with Submission 2027.