Limiting uncertainties by using “unrelated” sources of information

Filip Moldan and Sara Jutterström, CDM, IVL Swedish Environmental Research Institute, Gothenburg, Sweden

ivl
SVENSKA MILJÖINSTITUTET

Uncertainties exist, but…

- all measurements have uncertainties, but some types of measurements are much more difficult than other. Biological parameters are typically more difficult than geochemical, mass fluxes more difficult than concentrations, soils are more difficult to measure than air or water etc.

- uncertainties could be handled statistically, by improving methods to collect data etc, but can not be eliminated entirely.

- Alternative approach is to limit uncertainties by comparing several independently collected data.

An example: Nitrogen constraints to carbon sequestration in Scandinavian forests

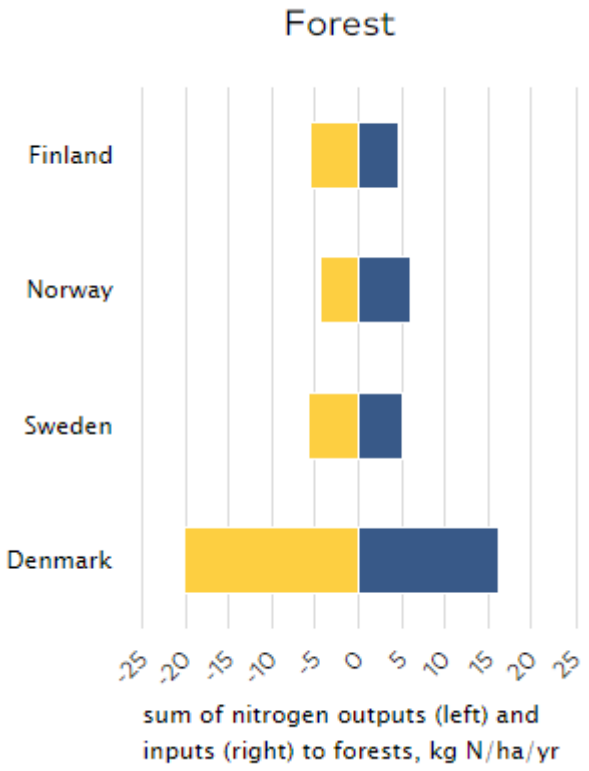
Project financed by Nordic Council of Ministers. Filip Moldan, Sara Jutterström, Johanna Stadmark, IVL Swedish Environmental Research Institute, Anu Akujärvi, Martin Forsius, SYKE Finnish Environment Institute, Kari Austnes, Heleen de Wit, NIVA Norwegian Institute for Water Research, Jesper Bak, Aarhus University.

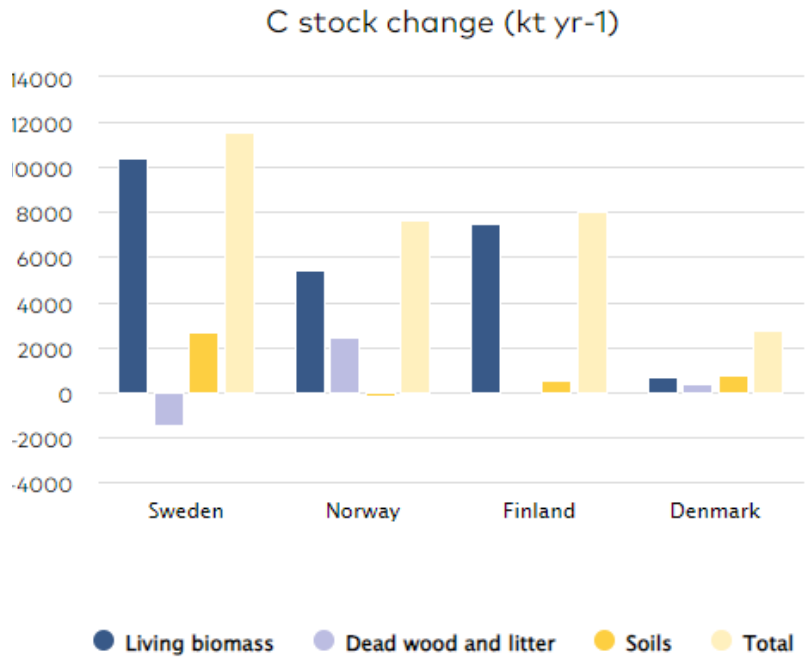
- Fluxes of CO2 to and from atmosphere are difficult to measure, C stock changes are determined by repeated measurements of C pools in soils and in biomass. Annual stock changes are determined as a small difference between repeated measurements of large pools.

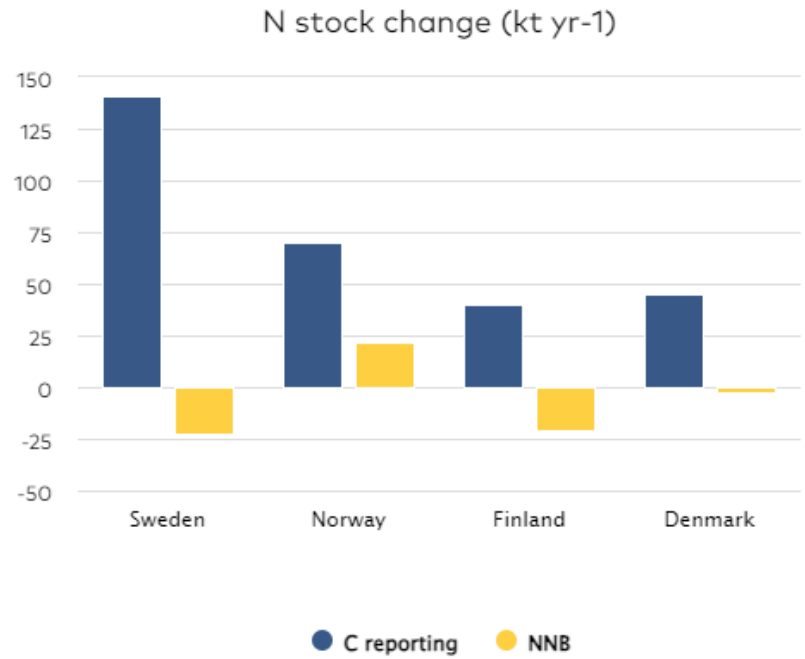
- Looking at the N part of the organic matter cycling could helt tp constrain the C stock change calculations

ivl SVENSKA MILJÖINSTITUTET

Background: in national nitrogen budgets the nitrogen fluxes associated with the forest carbon stock changes reported to the UNFCCC are unclear.







Flows of nitrogen were calculated for forest ecosystems in Sweden, Norway, Finland and in Denmark.

Inputs: atmospheric deposition, biological fixation and forest fertilization

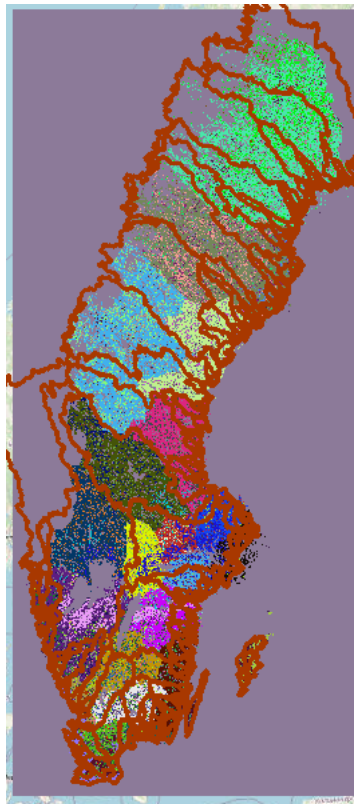
Outputs: leaching to waters, denitrification and forestry harvest

Source: NMR policy brief, www.norden.org/sv/node/69461

ivl SVENSKA MILJÖINSTITUTET

Mineral Soil - change in C in counties

Ägoslag enligt Klimat-rapporteringen	Geografiskt område	Koldioxidupptag av markkol (kg CO_2-ekv. ha^{-1} $år^{-1}$)	Källa
Gräsmark	Hela Sverige	92 (- 695 – 811)[1], N=62	Klimatrapporteringen
Skogsmark	Blekinge län	-1 739 (-5 785 – 2 306), N=36	Markinventeringen, 2003 – 2012 & 2013 – 2020
	Dalarnas län	-462 (- 2 273 – 1 349), N=253	
	Gotlands län	10 807 (2 906 – 18 707), N=30	
	Gävleborgs län	-842 (- 2 760 – 1 075), N=194	
	Hallands län	1 742 (-3 185 – 6 668), N=64	
	Jämtlands län	190 (-1 094 – 1 474), N=283	
	Jönköpings län	-1 866 (-4 610 – 878), N=117	
	Kalmar län	-133 (-2 973 – 2 708), N=130	
	Kronobergs län	-3 307 (-7 656 –1 042), N=102	
	Norrbottens län	-532 (-1 854 – 790), N=345	
	Skåne län	-3 185 (-7 298 – 927), N=81	
	Stockholms län	-3 438 (-6 372 – -505), N=56	
	Södermanlands län	190 (-4 870 – 5 250), N=66	
	Uppsala län	287 (-3 029 – 3 603), N=77	
	Värmlands län	-278 (-3 083 – 2 526), N=186	
	Västerbottens län	228 (-1 091 – 1 547), N=263	
	Västernorrlands län	-256 (-1 976 – 1 465), N=163	
	Västmanlands län	-3 180 (-8 744 – 2 385), N=56	
Skogsmark	Västra Götalands län	-4 647 (-7 471 – -1 822), N=220	Markinventeringen, 2003 – 2012 & 2013 – 2020
	Örebro län	-218 (-3 163 – 2 726), N=110	
	Östergötlands län	-1 222 (-4 041 – 1 596), N=123	

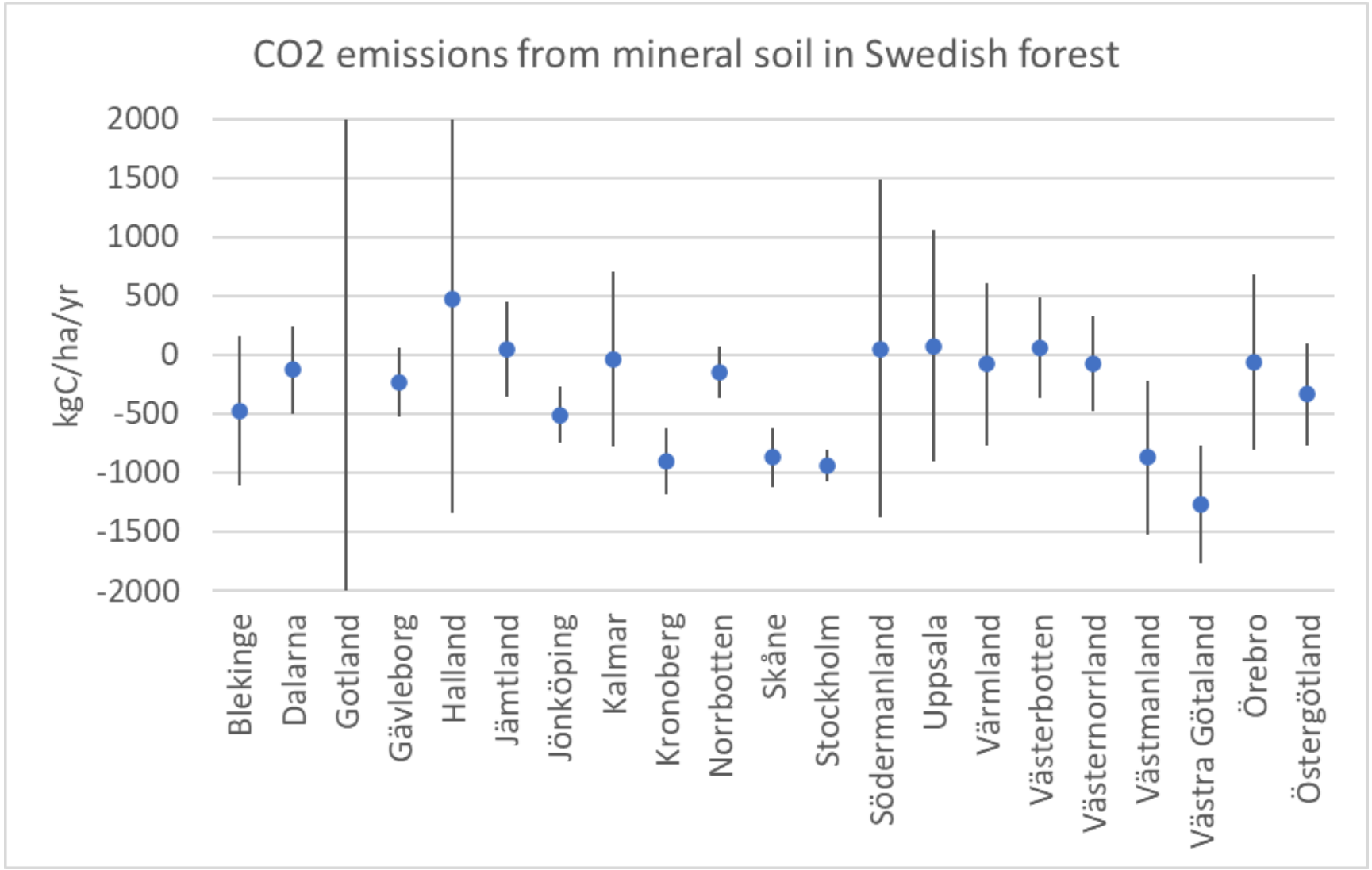


Soil C pools are notoriously difficult to measure due to several factors such as soils' small-scale spatial heterogeneity or uncertainty in soil thickness measurements.

Source: Lindahl A., och Lundblad, M., 2022. Kartering av Sveriges kolförråd och kolförrådsförändring i mark. SLU Dokumentation 2022-02-07, Tabell 8.

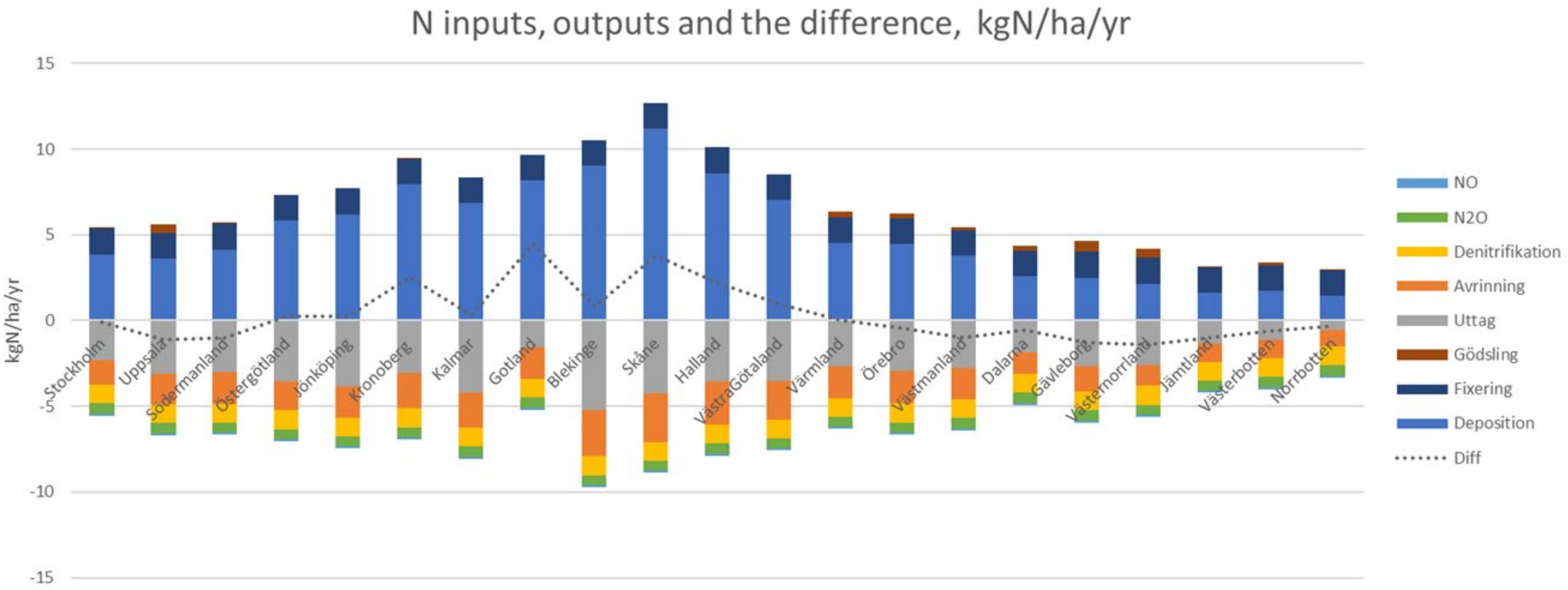
ivl SVENSKA MILJÖINSTITUTET

Mineral Soil - change in C, 0.05 and 0.95 percentiles



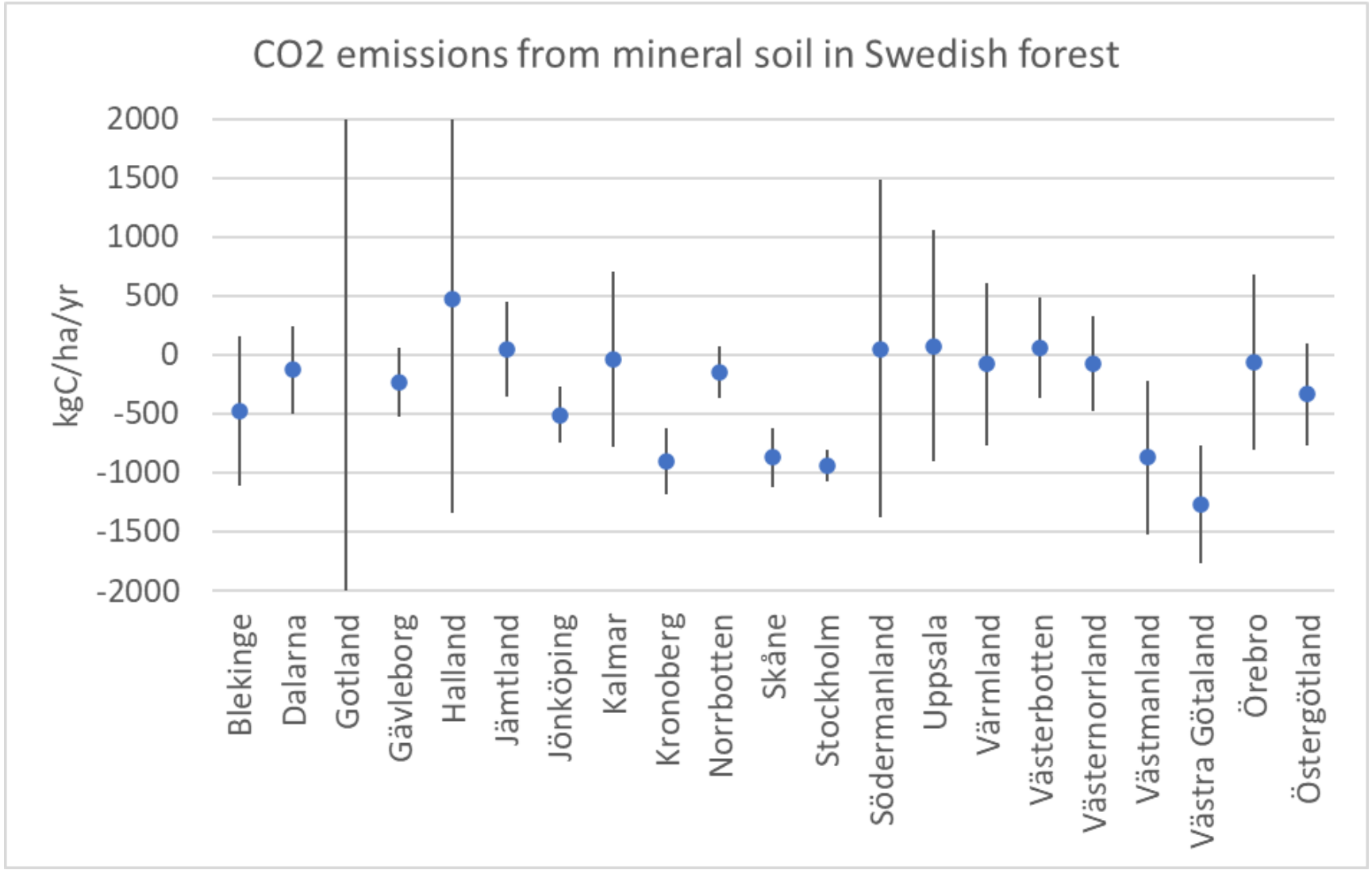
ivl SVENSKA MILJÖINSTITUTET

Can we use N to find where in the range the representative value is?



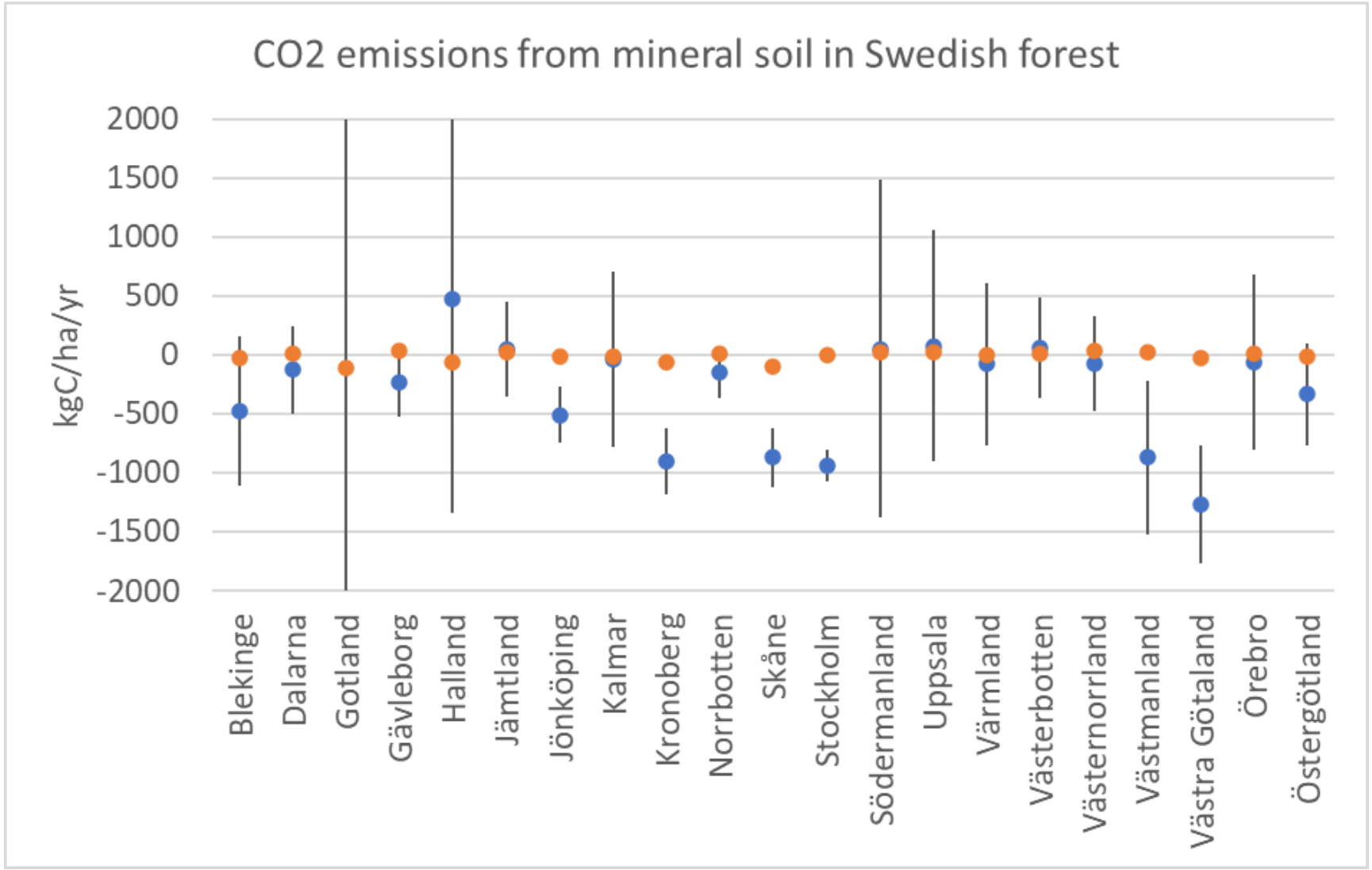
ivl SVENSKA MILJÖINSTITUTET

Mineral Soil - change in C, 0.05 and 0.95 percentiles



ivl SVENSKA MILJÖINSTITUTET

Mineral Soil - change in C



ivl SVENSKA MILJÖINSTITUTET

Uncertainties exist, but…

- In some cases, large uncertainties exist and are difficult to eliminate by better sampling techniques, more intense data collection or statistically.

- Alternative approach is to limit uncertainties by comparing with related data. Such as e.g. comparing deposition with emissions, comparing weathering rates in soils with catchment mass balances. Or by comparing C and N fluxes.

- Comparison with other types of data is often done for getting perspective, but it could also be used to limit uncertainties (by defining what is realistic and where more work is needed).

- To keep in mind laws such as The Law of Conservation of Mass or The law of electroneutrality could be helpful.

“Never leave a number all by itself. Never believe that one number on its own can be meaningful. If you are offered one number, always ask for at least one more. Something to compare it with.”

— *Hans Rosling, Factfulness: Ten Reasons We're Wrong About the World – and Why Things Are Better Than You Think*

Thank you for your attention!