

Suggested national groundwater scenarios in Sweden

To be used at registration of
pesticide products in Sweden.

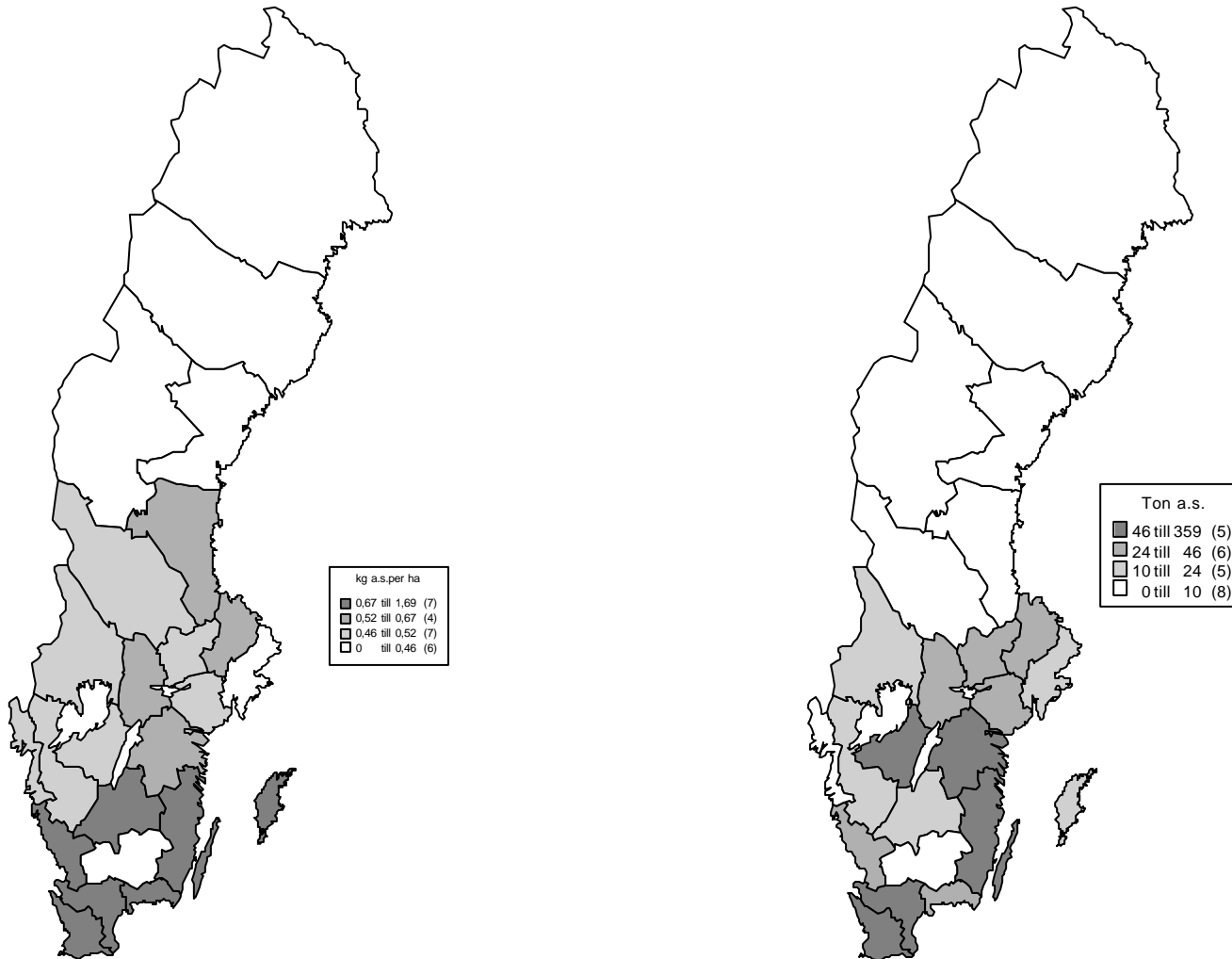


Criteria for choice of scenarios

- Cover important agricultural regions
- Cover main crops
- Cover identified vulnerable soiltypes

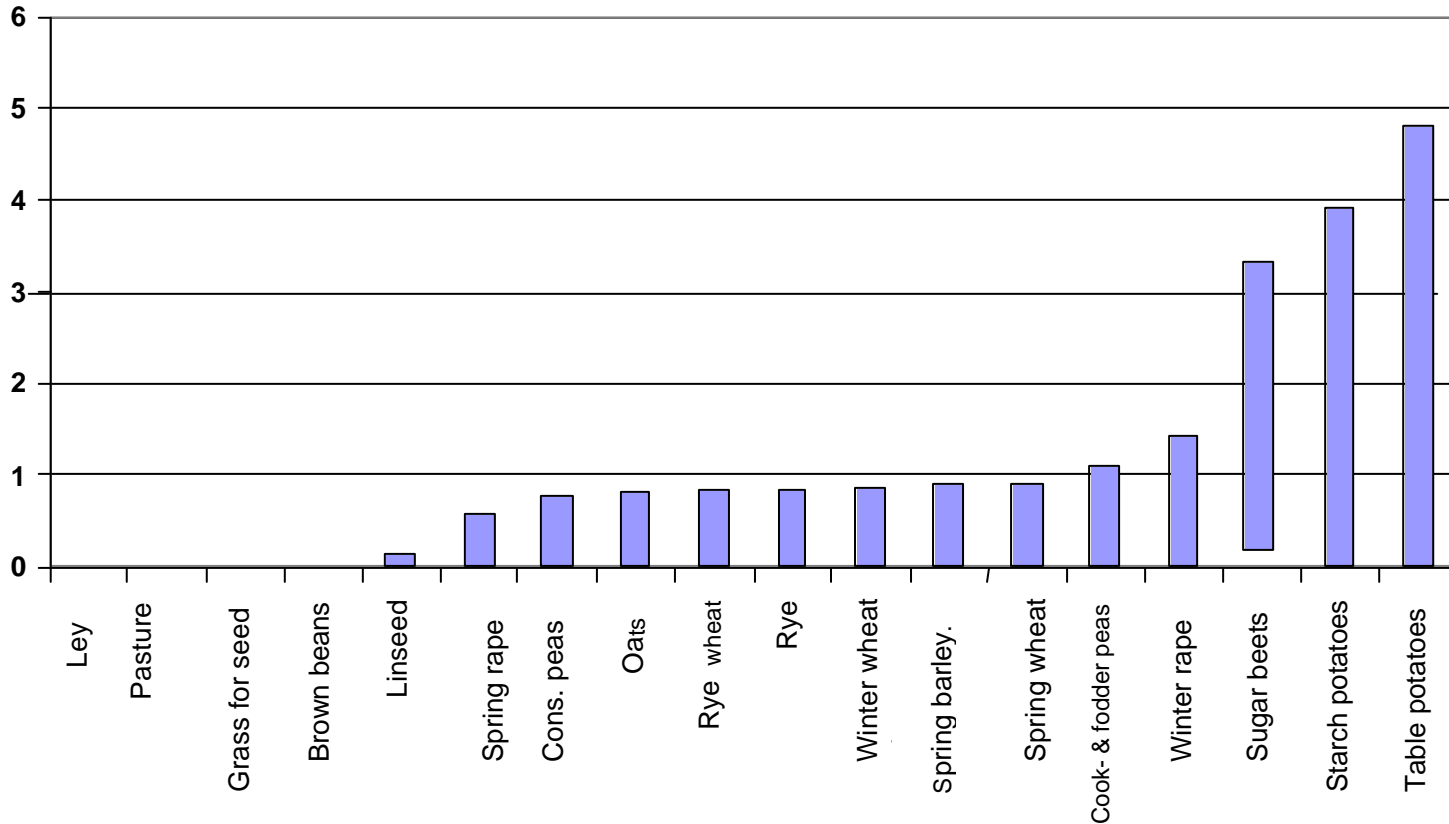
Sold amounts of PPP

Autumn 1987 and Spring 1998



Amount pesticides per crop type

kg active substance per hektare





Vulnerable areas defined

- A. Moraine overlying crystalline bedrock
75% covered by unsorted glacially derived moraine materials
Most common type of aquifers but often small private wells
- B. Eskers
Important ground water supplies – agriculture not common directly on the eskers, but possibly at the lighter slopes and at the edges
- C. Sand and gravel deposits
large water supply capacity, vulnerable to contamination, quite common with agriculture e.g. potatoes
- D. Sedimentary bedrock - fractured soils
water supplies for heavy populated areas, intensive agriculture



Choice of scenarios

In Mälardalen valley- one scenario

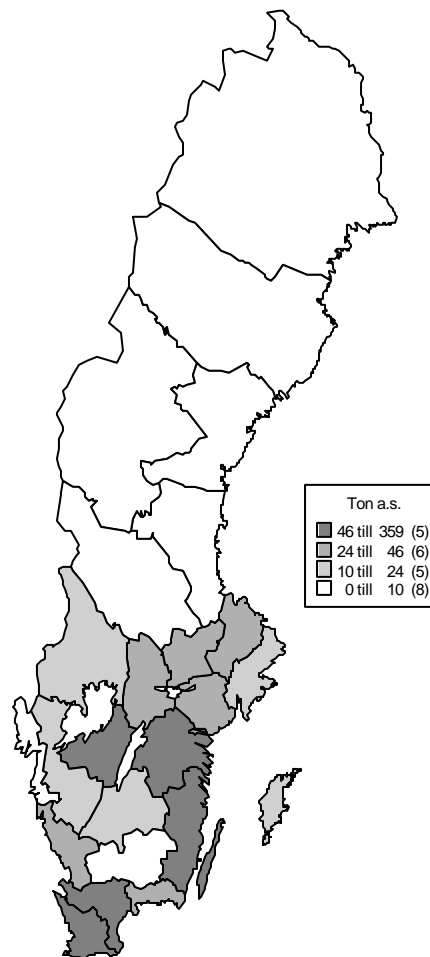
A: Krusenberg (near Uppsala)

In Scania – two scenarios chosen

C: Önnestad (near Kristianstad)

D: Näsbygård (near Vemmenhög)

Location of scenarios





Soil characterisation

at each of the three geographical locations

- For calibration of solute transport parameters: Soil cores were taken from the top soil and the upper subsoil
- Loose soil was sampled for soil physical and hydraulic properties.

Soil Properties

Soil horizons	Structure	Clay / silt / sand	OC %	Bulk dens. g/cm ³
Näsbygård 0-20 cm	Weak fine granular	10 / 12 / 78	1.02	1.34
35-55 cm	Single grain	4 / 6 / 90	0.30	1.54
55-65 cm	String fine blocky	56 / 32 / 12	0.33	1.44
Önnestad 0-20 cm	Single grain	5 / 4 / 91	1.87	1.44
33-53 cm	Single grain	2 / 2 / 96	0.16	1.58
57-77 cm	Single grain	2 / 4 / 94	0.06	1.63
110-153 cm	Single grain	2 / 2 / 96	0.03	-
Krusenberg 0-25 cm	Weak med. blocky	25 / 42 / 33	1.16	1.42
25-50 cm	Mod. med. blocky	30 / 44 / 26	0.43	1.49
50-75 cm	Weak med. Blocky	25 / 39 / 36	0.20	1.52
75-100 cm	Weak coarse prism.	20 / 28 / 52	0.15	1.58

Soil Properties

Soil horizons	Hydraulic conductivity (mm h ⁻¹)		
	Saturated	1 cm tension	10 cm tension
Näsbygård			
0-20 cm	95	52	4.7
35-55 cm	n.d.	12	3.1
55-65 cm	n.d.	n.d.	n.d.
Önnestad			
0-20 cm	104	42	8.6
33-53 cm	295	34	6.9
57-153 cm	n.d.	n.d.	n.d.
Krusenberg			
0-25 cm	n.d.	25	0.4
25-100 cm	n.d.	n.d.	n.d.



Daily weather data

- Weather from Sturup for Näsbygård and Önnestad
- Weather from Uppsala for Krusenberg



Weather

	Average Annual temperature deg C	Average precipitation mm/year	Average percolation mm/year min / max
Näsbygård (Sturup)	7.5	698	101 53 / 64
Önnestad (Sturup)	7.5	698	312 182 / 513
Krusenberg (Uppsala)	5.7	527	33 0 / 62



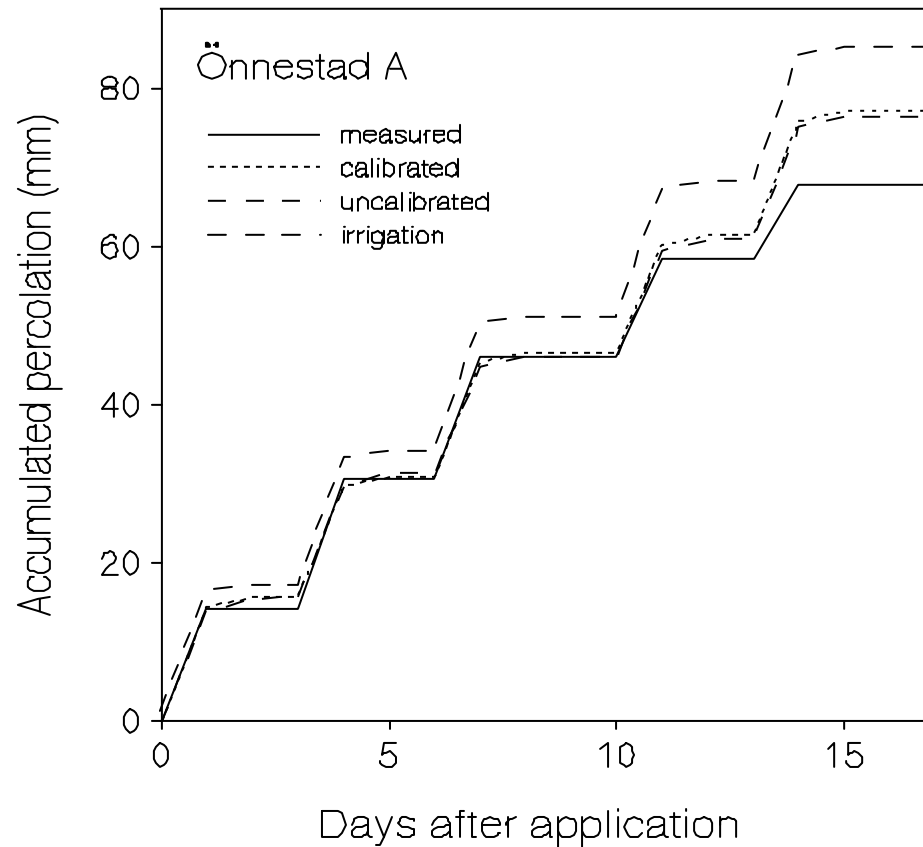
Crops

- Crops are chosen according to what is normal practice at the specific locations, which partly depends on the soil type but also on climate

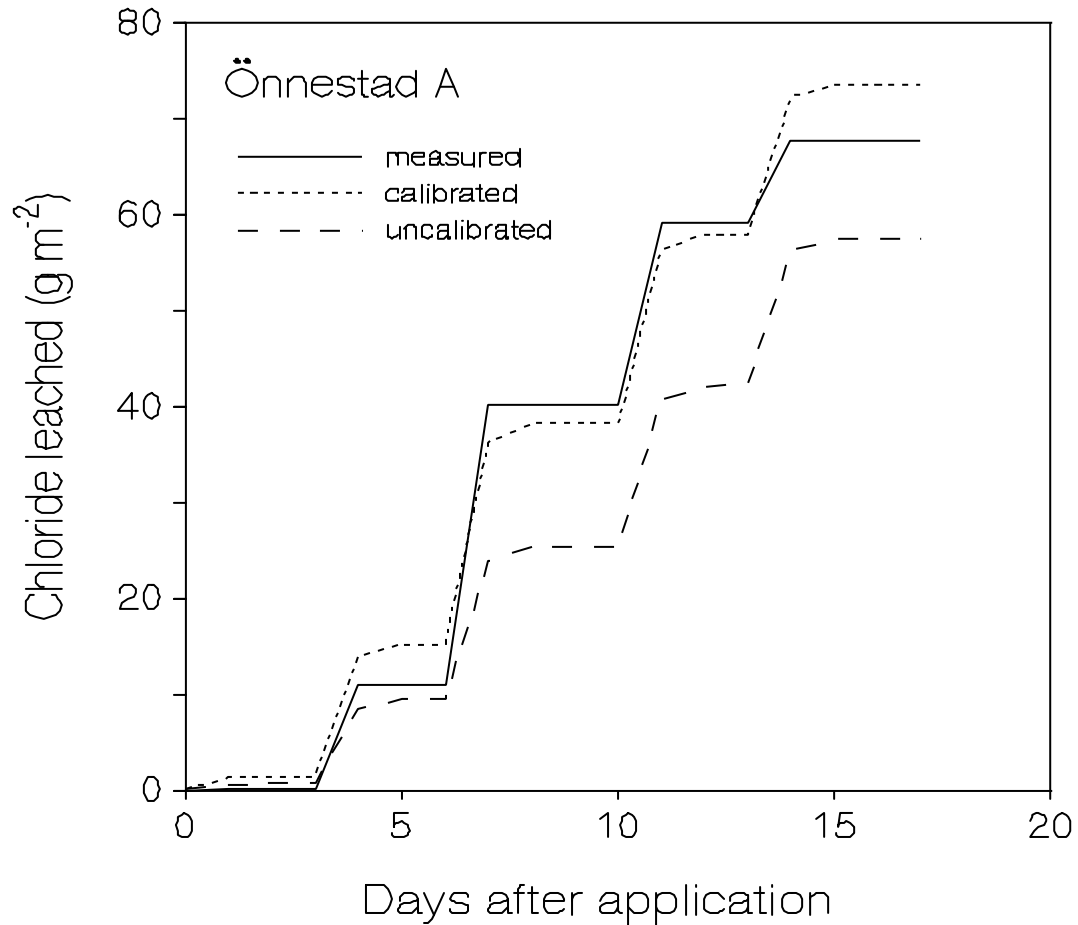
Crops and locations

Crops	Scenarios
Winter and spring cereals, legumes	N, Ö, K
Winter oil seed rape, sugar beets, pome/stone fruit (i)	N, Ö
Leafy vegetables	N
Root vegetables (i), bulb vegetables (i), bush berries (i)	Ö, K
Potatoes (i), spring oil seed rape, strawberries (i)	Ö, K

Measured (mean, n=4) and simulated water outflows, Önnestad topsoil



Measured (mean, n=4) and simulated chloride leaching, Önnestad topsoil





Model used

- MACRO in FOCUS ver. 3.3.1
- Same criteria as in FOCUS groundwater
- Addition of Swedish scenarios of soils, crop data and weather data



Runs, examples

	Dose g/ha	Date	DT ₅₀ days	Koc	1/n	Conv. Factor
Dummy C Spring cereals, pre-em	1000	114	20	172	0.9	-
Metabolite dummy C	-	-	100	52	0.9	0.50
Dummy X Winter cereals, pre-em	10	284	13	32	0.9	-
Metabolite dummy X	-	-	74	157	0.9	0.59

Concentration in leachate at reference depth, 80%-ile

Scenario	Krusenberg	Näsbygård	Önnestad
Refere. depth	1.3 m	1.5 m	1.6 m
	$\mu\text{g/l}$	$\mu\text{g/l}$	$\mu\text{g/l}$
Dummy C	0.0086	1.02	0.011
Metabolite dummy C	40-60	24	37
Dummy X	0.043	0.13	0.088
Metabolite dummy X	0.13	0.16	0.095

A Presentation of Preliminary Standard Swedish Scenarios for Simulation of Pesticides Leaching to Groundwater

Aim of model simulations

The use of model to simulate leaching of pesticides to groundwater can be used for at least two reasons. As one of the tools in the national registration of pesticides, which has been put on the Annex 1 list of the PPP directive 91/414/EEC or such substances that are under evaluation in EU and can be given provisional registration in a member state. It can of course also be used as a comparative tool to assess possible leaching differences between different pesticides to be used for substitution. Comparative assessment and substitution has been tools used in Sweden in our re-registration work during the 1990's. Simulations can also be used to identify substances, which should not be used in certain vulnerable areas.

Swedish hydrogeology

Sweden has together with some other northern countries in Europe a very specific geology dated back to the time of melting of the inland ice. We also have a fairly cold climate, where pesticides are used more frequently, with a mean yearly temperature in the Scania of about 7.5 °C to less than 5°C. These circumstances taken together constitute a somewhat different approach to define scenarios than was done for mid Europe. Besides in Sweden the catchments are usually quite small and in many cases well defined. The formation of ground water differs from that in main Europe.

Use of the 9 FOCUS scenarios in national registration in Sweden

There are two FOCUS-scenarios that may be of interest in Swedish national registration, mainly based on the geographical positions of these scenarios.

One is Jokkioinen, which is situated at about the same latitude as for example the agriculture area of the lake regions (east Vänern, Mälaren and Hjälmaren). However the soil types in these regions differ from the one in Jokkionen. Few Swedish soils of greater interest have this large organic content as the Jokkioinen soil and a majority of the Swedish clay soils can be characterised to have macro pore flow.

The other scenario is the Hamburg scenario, which has a sandy soil. This type of soil is fairly common in Sweden. However, the mean yearly temperature in Sweden differs with maybe 2 – 3 degrees.

Together with Nick Jarvis at SLU, Uppsala, National Chemicals Inspectorate (KemI), which is the Registration Authority for PPP in Sweden, has decided to define specific national scenarios for Sweden, using the MACRO model, which can simulate macro pore flow. As we can see it this model comes closer to a more realistic prediction of leaching of pesticides under Swedish hydro/geological and climatic conditions than the models which are based on chromatographic flow.

Identification of Swedish scenarios

KemI has decided that the scenarios should include agricultural areas, which can be classified as “vulnerable” to groundwater contamination. The identification of such areas was carried out by a hydro/geological consultant (Geosigma AB). The areas should be “typical” agriculture areas also including major crops. Agriculture is carried out also far north in the country along the main larger rivers and coastal areas in the north of Sweden. However, for the time being, we have developed three scenarios. Two of them are situated in the very south of Sweden at a latitude ca. 56°N, and one is situated at a latitude of ca. 60°N. The reason for this choice is partly from the fact that the agriculture areas between these two latitudes correspond to the major use of pesticides in Sweden. One or two more scenarios may be developed or may substitute any of these three preliminary scenarios if there is a reason for this.

MACRO-model version to be used

KemI has decided to use the same MACRO shell and version as the one used in FOCUS and the model will be downloaded from JRC, Ispra. The Swedish scenarios will be delivered by KemI. The FOCUS criteria in MACRO in Focus are kept the same with an exception regarding reference depth, which are set below root depth and is approximately 1.3 to 1.6 meters below soil surface in the defined scenarios.

Status of the national leaching scenarios in Sweden

The soils of all three scenarios have been calibrated by Nick Jarvis and his institution at SLU, Uppsala, Sweden. The scenarios have been tested at KemI with proper pesticide input data as well as GAP data for each respective scenario and crop. There is a further need to make test runs and to discuss the results with Nick Jarvis.

We plan to have the scenarios ready for use in early autumn and also to have a contract with the institute who has delivered the weather data as to be able to make it possible for, in first hand industry and maybe also interested universities to use the Swedish scenarios. When everything is ready we plan either send a message to industry or to write about it on our home page, www.kemi.se. There we will present the scenarios and give guidance how to download the scenarios.