

CRITICAL LOADS MAPS FOR THE UNITED KINGDOM

I. SOILS

A report to the Department of the Environment by

the UK Critical Loads Advisory Group

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REFERENCES

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MAP 1

PROVISIONAL MAP OF CRITICAL LOADS FOR ACIDITY OF SOILS FOR GREAT BRITAIN

The map is based on 1 km squares of the UK Ordnance Survey national grid and on 1:250 000 scale soil maps, and supporting data bases. The soil maps for England and Wales were produced and published by the Soil Survey and Land Research Centre (SSLRC, 1983), and for Scotland by the Macaulay Land Use Research Institute (MLURI, 1981). Each 1 km square was assigned a critical load for total deposited acidity on the basis of the critical load of the soil map unit which occupied the largest proportion of the square. The map units were assigned a critical load following their allocation to one of five soil classes, defined at the workshop held at Skokloster in 1988 (Nilsson and Grennfelt 1988), which were based on soil mineralogy (Table A). The soil classes proposed at the Skokloster workshop were equated with a band of critical load values, eg 20-50 keq H⁺ km⁻² year⁻¹. In the production of this map the classes have been assigned a single critical load value, the upper limit of the band suggested at Skokloster; this has been done to facilitate the production of exceedance maps showing areas where the critical loads are exceeded.

On the soil maps covering Scotland, the map units, which are identified by number, comprise groups of soils, from a given soil association, occurring within a distinct landscape/geomorphological unit. The associations are assemblages of soil series formed on a given parent material. The map units were initially allocated to one of the five soil classes, defined at Skokloster, on the basis of available information on the mineralogy of the parent material of the relevant soil association. This initial allocation was then modified, where necessary, using modifiers based on soil depth, texture and drainage, as suggested at Skokloster. Thus, where a map unit was dominated by shallow soils on slopes, the soil class based on mineralogy was decreased by one class. Conversely, in units dominated by deep soils or soils inundated regularly the class was increased by one.

The map units on the maps covering England and Wales are soil associations, which are groups of soil series occurring within defined, distinct landscape/geomorphological units. The parent material can vary within the association, but only within narrow limits. The associations within England and Wales are named after the most widespread soil series within the association. The map units were initially allocated to a soil class on the basis of the mineralogy of the most widespread soil series within the association. This initial allocation was modified, where necessary, after making allowance for variations in soil depth, texture and drainage conditions, as with the units on the maps covering Scotland.

Organic soils cannot be allocated to one of the Skokloster classes on the basis of mineralogy. An approach developed in the Department of Plant and Soil Science, University of Aberdeen has, therefore, been used. Map units dominated by base poor peats were allocated to one of the five soils classes on the basis of the H⁺ load (as H₂SO₄) which would result in a pH reduction in the surface layers of the peats, in the given location, of >0.2; it is assumed that reductions of pH of <0.2 would not have significant ecological consequences. The boundaries between classes have been set using the results of laboratory equilibration studies, and data on the relationship between changes in surface horizon pH of peats in Scotland over the last 20 years and inputs of acidic deposition over that period. The input of acidity over the last 20 years has included both nitric and sulphuric acid. In order to assign the peats to one of the five classes based on sulphur alone, it has been assumed that 70% of the input of acidity was as sulphuric acid and 30% as nitric acid. Where 30% of recent input, ie the nitric acid portion of the input, has produced a reduction in pH of >0.2, the peat unit is allocated to the most sensitive class, class 5. Where 30% of recent input would produce a reduction in surface pH of <0.2, then the critical load has been based on the 'acceptable load' of sulphuric acid, over and above the existing nitric acid load.

Finally, a land use modifier was applied to the complete map using a database developed by the Institute of Terrestrial Ecology (Bunce & Heal, 1984). For each 1km square, the critical load class of the dominant soil was decreased by one unit if the dominant land use for that area was arable or improved pasture. It was assumed that in these areas lime would be added to the soil, where necessary, to maintain the pH within the optimal range for arable crops or high yielding grass varieties. This would clearly increase the "effective critical load".

A number of points must be stressed about the map produced using the above procedures:

1. The map units portrayed on the 1:250 000 soil base maps can encompass considerable variation in soil type, although the soils within any one map unit are usually related to each other by one or more important factors. However, not all soil types within a geographical area may have been recorded at this mapping scale, and not all of the ones recorded occupy a sufficiently large area to be delineated. Thus, the most sensitive soil may have been omitted because it occupies only a very small area of land.

2. The soil properties assessed as the basis for producing the critical loads map were those of the most widespread soil (the 'dominant' soil) within the soil map unit on the 1:250 000 soil map. This may not be the most sensitive of the soils forming the association which corresponds to that map unit.

3. The 1 km squares are assigned a critical load on the basis of the most widespread soil map unit within the square - in practice, the most widespread soil type within the map unit.

4. The critical loads assigned to the soil mapping units have not been calculated using a mass balance approach, dynamic modelling or determinations of weathering rates for specific UK sites. It is a "level 0" map (UNECE, 1990).

5. The critical loads assigned to the soil mapping units are still being validated.

The resultant map is best seen as providing an indication of the regional distribution patterns of soils ranked in terms of a series of critical load/sensitivity classes.

TABLE A

Mineralogical classification of soil material and critical loads of soils:-

Class	Minerals controlling weathering	Critical load keq H ⁺ km ⁻² year ⁻¹
5	Quartz K-feldspar	20
4	Muscovite Plagioclase Biotite (<i>< 5%</i>)	50
3	Biotite Amphibole (<i>< 5%</i>)	100
2	Pyroxene Epidote Olivine (<i>< 5%</i>)	200
1	Carbonates	400

(After Nilsson & Grennfelt, 1988)

Provisional Map of the Critical Loads for Acidity of Soils of Great Britain

The map is drawn by allocating each 1 km square of the national grid of Great Britain to a critical load class on the basis of mineralogy of the dominant soil unit but with modification to allow for current agricultural management.

Critical load classes for acidification (Nilsson and Grennfelt, 1988*), expressed as $\text{keq H}^+ \text{ha}^{-1} \text{year}^{-1}$.

0.2
0.5
1.0
2.0
4.0



* Nilsson, J and Grennfelt, P., (ed.), Critical Loads for Sulphur and Nitrogen. Report from a workshop held at Skokloster, Sweden 19–24 March, 1988. Organized by UN-ECE and the Nordic Council of Ministers.



MAP 2

CRITICAL LOADS FOR ACIDITY FOR UK SOILS

This map is based on 10km squares of the UK Ordnance Survey national grid of Great Britain. The map of critical loads for acidity of soils draws on 2 datasets. For Great Britain, the 1km map of critical loads for acidity (map 1) is summarized on the 10km grid, using the calculated dominant (modal) critical load class for each grid square. For Northern Ireland and the Isle of Man, where comparable soil map data are not yet available, the 1:1 000 000 Soil Map of the European Communities (CEC, 1984) has been used to identify the dominant soil in each 10x10km grid square. The approach used for allocating soils for these areas to critical loads classes was analogous to that used for the 1km critical loads for acidity map (see notes for Map 1). The land use modifier applied to these data was taken from the 1:4 000 000 European Community farming map (CEC, 1987).

Critical loads for acidity of UK soils



