ESTIMATION OF AVAILABLE WATER-HOLDING CAPACITY OF SOILS IN EUROPE

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Abstract

As a contribution to an agro-climate study, a simple method was set up to estimate the available water-holding capacity (AWC) of soils in Europe.

Soil data taken from maps were stored on the basis of a 1/2 x 1/2 degree grid. For each grid cell three dominant soil types were recorded, with information on topsoil texture, stoniness and slope. The dataset covers the European territory up to the 44th degree of longitude.

The method suggested for estimating AWC is based on texture-available reserve relations, given in the literature. The crop rooting depth determines the thickness of the soil layer contributing to the AWC. The rooting depth can be derived from the soil type. A reduction factor is proposed for stony soils.

1 INTRODUCTION

In 1987 an agro-climate research project was started on behalf of the European Community. The aim is to investigate the effects of possible changes in climate on the agricultural production in Europe. Part of the project deals with validation and evaluation of crop-growth simulation models. Weather data and soil water data are combined to produce the model input.

The water storage capacity of the root zone determines the availability of water to the crop. This available water-holding capacity (AWC) depends on various soil characteristics. The terminology used to describe these characteristics is often little accessible to non-pedologists. For this reason relevant soil data were selected from maps and described in comprehensible terms. A database was constructed to store principal soil information for the European territory and a procedure was set up to estimate AWC from these data.

Although the dataset under consideration was set up to serve the simulation of crop production, it could also be used to present information on the water status of soils in Europe.

shallow lithic contact.

The different classification systems used on the various maps were transcribed into a current classification: the revised legend of the FAO-Unesco Soil Map of the World (2). Although not a classification system, the FAO legend serves well to describe soil types and uniform the different classification systems. Anticipating on amendments on the current version, a previsional edition of the revised legend was used.

2.2.3 Structure of the database

The soil data were stored with the help of a spreadsheet program. Each record of the spreadsheet contains the information of an entire grid cell. All records are made up by 18 fields, representing the geographical situation of the grid cell (latitude, longitude, country) and information on the three distinguished soil types (for each soil type: soil name, relative proportion, topsoil texture, slope, presence of a stony and/or lithic phase). Except for latitude and longitude, all stored information is coded for convenience' sake. The arrangement of the data is illustrated in table 1.

Table 1. Example of data arrangement in the soil database (data are coded)

lat.	long.	nation	soil1	%1	text.1	slope1	stone1	soil2	%2	text.2	slope2	stone2	soil3	%3	text.3	slope3	stone3
49.5	5.5	9	74	50	13	2	0	71	30	7	3	3	77	20	13	3	0
49.5	6	9	79	50	13	3	0	71	40	7	3	3	51	10	4	1	0
49	-4.5	0	171	60	9	2	0	178	20	9	2	0	72	20	9	3	0
49	-4	0	171	40	9	2	0	72	40	9	2	0	178	20	9	2	0
49	-3.5	9	171	50	9	2	0	72	30	9	3	0	178	20	9	2	0
49	-3	0	171	80	9	2	0	178	10	9	2	0	0	10	0	0	0
49	-2.5	0	170	60	9	2	0	70	40	10	3	2	0	0	0	0	0
49	-2	0	71	40	9	1	2	170	30	9	1	2	51	30	4	1	0
49	-1.5	9	72	50	9	2	0	171	30	9	2	0	178	20	9	2	0
49	-1	9	170	40	13	3	2	71	40	13	3	2	72	20	9	2	0
49	-0.5	9	71	50	13	3	2	170	30	3	2	2	74	20	13	3	0
49	0	9	70	60	13	3	0	90	20	9	1	2	178	20	13	3	0
49	0.5	9	90	60	9	1	2	178	30	9	1	2	171	10	9	1	2
49	1	9	171	60	9	2	1	71	30	13	3	2	90	10	9	1	2
49	1.5	9	171	34	7	2	0	178	33	9	2	0	90	33	9	1	2
49	2	9	178	50	9	2	0	171	50	9	2	0	0	0	0	0	0
49	2.5	9	171	60	9	2	0	90	30	9	1	0	51	10	4	1	0
49	3	9	90	40	9	1	2	178	30	9	1	0	23	30	7	2	3
49	3.5	9	23	40	7	2	3	90	40	9	1	2	52	20	4	1	0
49	4	9	23	70	7	2	3	74	20	7	2	3	52	10	4	1	0

Direct relations between texture classes and available water have been worked out for a variety of national systems of texture classification (e.g. 5,6,11). King et al (7) determined mean values of available water (cm/cm soil) for the five texture classes used in this study.

The ERD depends on the crop considered and on rooting obstructions in the soil profile. For cereals a maximum ERD of 100cm seems reasonable (10). Rooting obstacles like impenetrable hard layers, very coarse soil materials or relatively compact soil horizons, can be derived from the soil name. Obviously for shallow soils the ERD is limited to the depth of the soil profile. For soils having a textural change in the profile, the ERD is reduced according to the expected soil compaction. In case a lithic phase is shown on the map, the soil profile is limited to 50cm and the ERD is reduced correspondingly.

A substantial amount of stones in the soil profile results in a reduction of soil porosity. Moreover, the root development can seriously be hampered by stones.

4 DISCUSSION

The soil database under consideration uniforms information from different sources. Although set up to estimate AWC, it also enables evaluation of other soil water characteristics for the complete European territory. Data storing on the basis of a grid allows easy manipulation of the information with a personal computer and guarantees accessibility to potential users.

The data are stored on a small scale, resulting in a considerable reduction of the original soil information. For each grid cell the three dominant soil types were selected. As most mapping units consist of soil associations, first all major soil types with associated types were dissected and compared. They were regrouped to form three soil types, considering the principal differentiating soil properties and soil forming processes. Moreover, part of the geographical information is lost. The %-distribution of three major soil units in a grid cell is stored, but their distribution pattern can not be reproduced using a 1/2 x 1/2 degree lattice.

It should be noticed that the method for calculating AWC as suggested in this study has some shortcomings. Not all factors determining AWC, like bulk density and organic matter content, could be taken into account, because

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