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EVALUATION OF METHODS TO ESTIMATE SOIL WATER CONTENT AT FIELD CAPACITY AND WILTING POINT

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Introduction

Simulation models are effective tools to evaluate the impact of agricultural management; however, their use is often limited because they require a large number of input parameters required to model the mechanistic processes which influence the plant-soil system. In fact, while the input parameter values are generally known in the conditions of research stations, when simulation models are run for large land areas, some input parameters must often be estimated. Two soil parameters which are needed by most simulation models are volumetric water content (SWC) at field capacity (FC) and wilting point (WP). In the literature, several methods to estimate these parameters have been proposed. Most of them have a strong empirical basis, consequently their applicability may be limited to the data set used to define the method. Moreover, comparisons among different methods have seldom been made.

Methods

We developed a program for Windows, ***SOIL***PAR, which implements several methods commonly used to estimate soil parameters. The methods were taken from the utility ASW/EPIC and the program LEACHW source code. Data describing 38 soil profiles were used in this study (Table 1).

Table 1. Range of variability for parameters in the 38 soil profiles.

parameter	range (measured values)
water content at wilting point (m^3 m^{-3})	0.020-0.335
water content at field capacity (m^3 m^{-3})	0.109-0.506
sand (%)	2-93
silt (%)	1-52
clay (%)	3-77
organic carbon (%)	0.09-5.83

A preliminary version of the ***SOIL***PAR program is available upon request.

Results

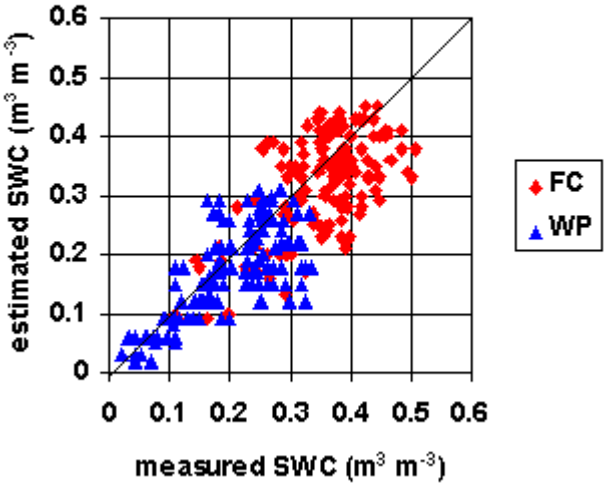
The best methods show a low RMSE, both R^2 and slope close to 1, a high EF, and a CRM close to 0.

Table 2. Key: n = no. of observations; RMSE = root mean squared error[†]; EF = modelling efficiency; CRM = coefficient of residual mass; R^2 = R squared; slope = slope of the line estimated *vs*. measured.

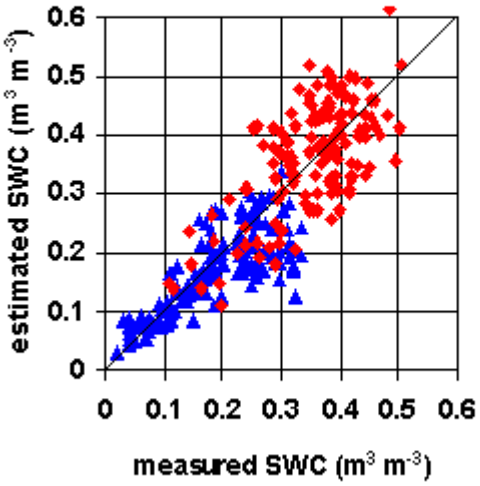
method	n	RMSE	EF	CRM	R^2	slope
Baumer ASW/EPIC	286	0.07	0.62	0.12	0.71	0.83
Brakensiek Rawls LEACHW	286	0.06	0.69	0.01	0.74	0.94
British SS - subsoils LEACHW	286	0.06	0.75	-0.01	0.76	0.85
British SS - topsoils LEACHW	286	0.06	0.70	-0.07	0.75	0.87
EPIC ASW/EPIC	286	0.08	0.57	0.14	0.70	0.80
Hutson LEACHW	286	0.08	0.55	-0.10	0.62	0.51

Manrique ASW/EPIC	286	0.08	0.47	0.20	0.70	0.87
Rawls ASW/EPIC	286	0.06	0.70	0.11	0.77	0.77

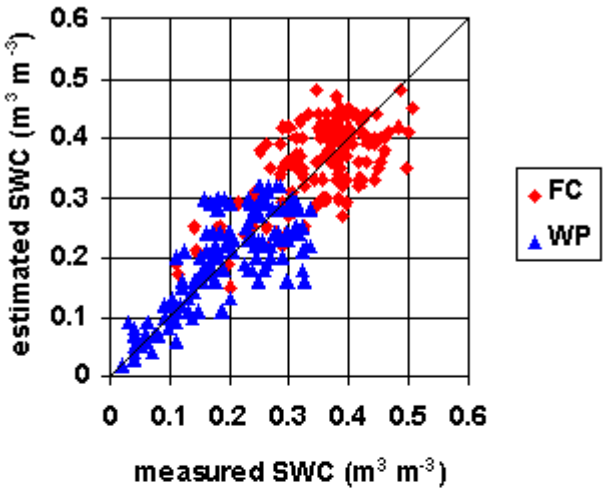
Method Baumer



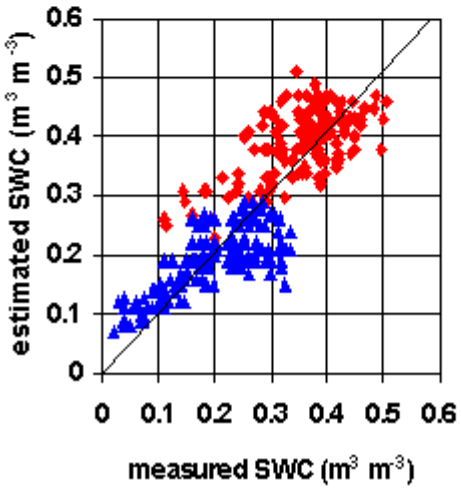
Method Brakensiek and Rawls



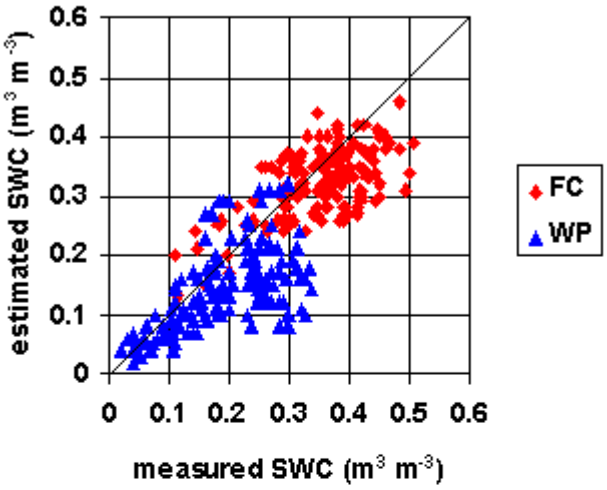
Method British SS - subsoils



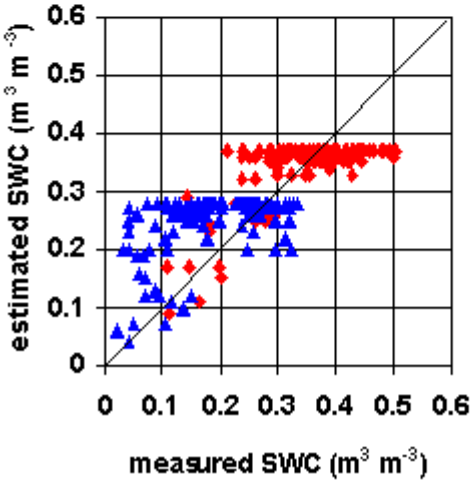
Method British SS - topsoils



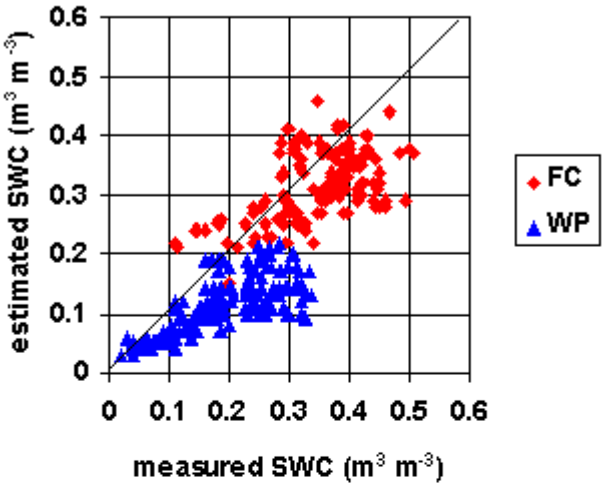
Method EPIC



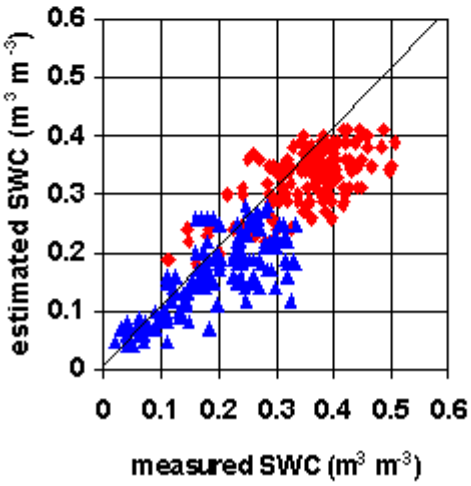
Method Hutson



Method Manrique



Method Rawls



Conclusions
The Brakensiek and Rawls, and the British Soil Survey methods, appear to be the most reliable options to estimate SWC at FC and WP. To allow broadening comparison of methods, the implementation of other methods in the program ***SOIL***PAR continues.

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