



ELSEVIER

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

SCIENCE @ DIRECT®

Geoderma 122 (2004) 103–104

GEODERMA

[www.elsevier.com/locate/geoderma](http://www.elsevier.com/locate/geoderma)

## Book review

### Soil Water Dynamics

by A.W. Warrick, Oxford University Press, Oxford, 2003. Hardbound, 391 pp. ISBN 0-19-512605-X. US\$85.

This is a textbook on the physics of soil water whose target audience is advanced postgraduate student in soil physics, researchers and modellers. I suppose there are two challenges in writing a soil physics book: the first is the presentation and explanation of the physics and its equations in a neat and readable form, and the second is implementation of the calculations in practical and easily accessible computer programs. This book concentrates on soil–water transport, with emphasis on analytical and numerical solutions in line with Kirkham and Powers (1972). Warrick contrasts it to other soil physics books: it is more quantitative and advanced compared to Jury et al. (1991) and Hillel (1998). It is more specific and advanced than Koorevaar et al. (1983) with more detailed numerical implementation than Campbell (1985) and Anlauf et al. (1990). The audience of the book needs some intermediate maths and calculus background to be able to follow Warrick's exposition.

Presenting the calculations and models in computer programs is difficult, as programming languages evolve and change. Soil physics books with specific reference to computer programs—such as De Wit and van Keulen (1975)—will inevitably become obsolete. The BASIC programs in Campbell (1985) and Anlauf et al. (1990) are outdated, although with few modifications they can be transformed them into Visual Basic. Warrick's main objective is to present the solutions to different flow processes and implement the algorithms in Mathcad and Fortran. Fortran is used to implement the finite difference calculation, as it is still mostly used by

researchers in soil physics and hydrology. As noted in the preface, readers can apply the algorithms using different programs (I manage to implement one program in Matlab).

The book is organised in nine chapters, the first chapter describes the soil physical properties and soil water potential concept. Detailed description is given of the angular pore model but it would have been beneficial to have a program implementing the calculations. Brief descriptions are given of geostatistics, scaling, fractal theory and pedotransfer functions. The author expounds the basic laws and equations describing water flow (Darcy's law and Richard's equation) in Chapter 2. Readers are introduced to some favorite soils of soil physics: the Yolo light clay and the Sarpy loam. The subsequent chapters discuss specific processes: saturated flow (Chapter 3), unsaturated flow: 1-D absorption (Chapter 4), and 1-D vertical flow (Chapter 5), multidimensional (2- and 3-D) flow (Chapter 6), and solute transport (Chapter 7). Each chapter starts with analytical solutions under different initial and boundary conditions, then a numerical finite-difference solution. 'Additional Topics' is a kind of annex containing formula derivation, program listing and supplementary topics. 'Problems' are given at the end of each chapter, which include good exercises for readers.

Warrick attempts to embrace a range of contemporary and classical subjects, such as Philip's solution. Step-by-step guidance in calculating Philip's solution for 1-D horizontal and vertical flow with a Mathcad implementation is instructive. There are a few snags that can be improved; e.g., some commentary can be deleted and the section on geostatistics can be removed as it has been dealt with more detail in other books. Some topics can be dealt more extensively, such as hysteresis and drainage. References to some computer programs are often not necessary; e.g., RETC in

Chapter 2 and Hydrus (p. 220) seem like statements of promotion for the programs. Some items on my wish list include redistribution, flow in swelling soil and linking the soil water transport, plant extraction and solute transport. The book systematically lays out the flow principles coupled with a compilation of analytical and numerical solutions. The derivation and computation algorithms are easy to follow. Finite-difference solutions are explained at length. The codes in Fortran and Mathcad are well commented and readers can track the algorithm easily while reading the book. The presented numerical examples and case studies are useful and examples from classical cases such as Yolo light clay will help readers when they encounter the term in the future. Detailed descriptions on subsurface drainage (Chapter 3) and multidimensional flow (Chapter 6) are unique topics of this book.

Warrick brings his expertise in soil water modeling and combines it with various analytical and numerical solutions from the published literature. The book is rich in equations and is a valuable resource for soil physicists and vadose zone hydrologists. I found the 1-D (AL.for) and 2- and 3-D (A2&3.for) flow programs helpful and they can be used in soil research. The programs have major advantages compared to ready-made packages or research codes that contain many components. The programs, data and errata of the book can be found

on the author's website: <http://ag.arizona.edu/swes/projects/soilwaterdynamics/Index.htm>.

## References

- Anlauf, R., Kersebaum, K.Ch., Liu, Y.P., Nuske-Schuler, A., Richter, J., Springob, G., Syring, K.M., Uitermann, J., 1990. Models for Processes in the Soil. Catena-Verlag, Cremlingen-Destedt.
- Campbell, G.S., 1985. Soil physics with BASIC-transport models for soil-plant systems. Developments in Soil Science, vol. 14. Elsevier, New York.
- De Wit, C.T., van Keulen, H., 1975. Simulation of Transport Processes in Soils, 2nd ed. Centre for Agricultural Publishing and Documentation, Wageningen.
- Hillel, D., 1998. Environmental Soil Physics. Academic Press, New York.
- Jury, W.A., Gardner, W.R., Gardner, W.H., 1991. Soil Physics, 5th ed. Wiley, New York.
- Kirkham, D., Powers, W.L., 1972. Advanced Soil Physics. Wiley-Interscience, New York.
- Koorevaar, P., Menelik, G., Dirksen, C., 1983. Elements of soil physics. Developments in Soil Science, vol. 13. Elsevier, Amsterdam.

Budiman Minasny  
*Faculty of Agriculture,  
 Food and Natural Resources,  
 The University of Sydney, Australia*  
 E-mail address: [budiman@acss.usyd.edu.au](mailto:budiman@acss.usyd.edu.au)  
 Tel./fax: +61-2-93513706