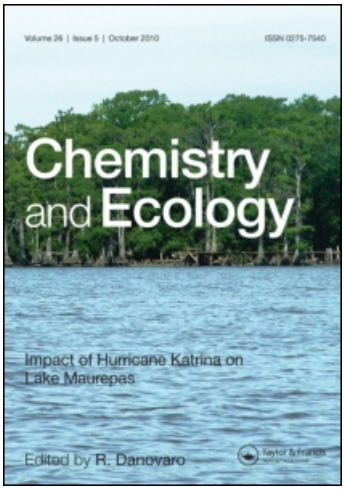

Chemistry and Ecology
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713455114

A review of: "Engineering Risk Analysis of Water Pollution. Probabilities and Fuzzy Sets"

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To cite this Article Pravdic, Velimir(1995) 'A review of: "Engineering Risk Analysis of Water Pollution. Probabilities and Fuzzy Sets"', Chemistry and Ecology, 11: 4, 269 — 270
To link to this Article: DOI: 10.1080/02757549508039075
URL: http://dx.doi.org/10.1080/02757549508039075

Chemistry and Ecology, 1995, Vol. 11, pp. 269–270
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BOOK REVIEW

ENGINEERING RISK ANALYSIS OF WATER POLLUTION. PROBABILITIES AND FUZZY SETS: J.G. Genoulis, VCH mbH, Wernheim, FRG, 1994. xi + 306pp. ISBN 3-527-30050-3 Price 136 Dm

Water pollution is a central problem of environmental protection and management. In this respect, the author provides three case studies as the last chapter of his book. One is the coastal region of Thessaloniki, Macedonia, Greece. The second is the Axios River coming from the former Yugoslav Republic of Macedonia (where it is called the Vardar River) through northern Greece and entering the Thermaikos Gulf. The third is the case of the Campasque Valley aquifers of Shepparton and Deep Lead, in north-central Victoria, Australia.

I begin this review with the final chapter to convince the reader that this book is not dealing with theoretical possibilities but with cases of outstanding practical importance. Much of the research on water pollution and water management is of a descriptive nature. Monitoring and research data are still nowadays rarely interpreted in the way the author advocates. This book is a fine example how contemporary applied mathematics is helping risk analysis to enter the realm of science. The author quotes amply from his own research, starting with his early work and PhD thesis of 1974 at the prestigious Paul Sabatier University in Toulouse.

Needless to say, studying water pollution is a field of great economic and ecological importance. It is also a challenging field because of the natural variations in ecosystems, of transient phenomena, of multiparametric approach, of competing processes whose time scales vary over two orders of magnitude, and for reasons of difficulty in defining targets and end-points.

In 1988, the author applied some of these approaches based on risk analysis to sewage disposal of the town of Thessaloniki, in a report to the Greek Ministry of the Environment, and dealt with the sewage assimilative capacity of the coastal waters of the Mediterranean.

The author has divided the book into 6 chapters. At the start, the author proclaims the most important features covered in the book: (i) the application of fuzzy set theory in engineering risk analysis; (ii) uncertainty analysis of water quality and quantity; and (iii) the stochastic simulation of hydrosystems and the model selection. He also treats, separately, design or planning problems and operational problems. For the former, two main paths are described, the first dealing with the modern mathematical approach advocated and introduced by the author, the second with the traditional engineering approach. The first considers identification of hazards, risk quantification and risk management, while the second is based on the analysis of inputs, modelling and evaluation of outputs.

The author argues that risk and reliability are relatively new subjects in water resource management and environmental engineering. For the uninitiated reader, the author offers definitions at the start (p.53): "Fuzzy set theory is a mathematical method used to characterize and quantify uncertainty and imprecision in data and functional relationships. Fuzzy sets are especially useful when the number of data is not sufficient to characterize uncertainty by means of standard statistical measures involving estimation of frequencies, (e.g. mean, standard deviation and distribution type)". And further, "Fuzziness represents situations where membership in sets cannot be defined on a yes/no basis because the boundaries of the sets are vague. The central concept of fuzzy set theory is the membership function which represents numerically the degree by which an element belongs to a set. In a classical or binary set, a sharp distinction exists between members and non-members of the set. In other words, the value of the membership function for each element in a classified or binary set is either 1 for members (those certainly belonging to it), and 0 for non-members (those that certainly do not). However, many of the concepts we commonly employ, such as classes of water quality, or the value of groundwater transmissivity, do not exhibit this characteristic. That is, their members belong to these sets up to a certain degree, which is expressed by a number between 0 and 1." The whole of Chapter 2 is devoted to introducing the fuzzy set theory; eight tables and 44 figures will greatly help the reader's understanding.

Chapter 3 is devoted to risk quantification: 34 figures and 9 tables explain the approach described by 124 equations. Chapter 4 describes the approach to risk assessment of environmental water quality, dealing specifically with coastal and underground waters. Chapter 5 introduces risk management principles. The last, Chapter 6, is a discussion of case studies, as noted above.

The mathematics used is quite within the usual educational level of engineers in civil, chemical and environmental disciplines, and for hydrologists with a variety of educational backgrounds. Research scientists and professionals in environmental sciences will be able to use this book, as would graduate students pursuing advanced degrees in these fields. In all, Chapters 2 and 3 represent the backbone of the book and for the material within them, purchase of the book would be a good deal. There is a bibliography of 132 references, of which 23 are to papers published by the author.

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