Environmental Foresight and Models: A Manifesto

M. B. Beck (Editor), 2002. Amsterdam: Elsevier Science, Pp. 500.
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This is not a light book in any sense. At over 1kg it is not bedtime reading. Equally its intellectual content, and the complex nature of its subject, requires the reader to concentrate.

According to the editor this book developed from a group of engineers and scientists who formed the International Task Force on Forecasting and Environmental Modelling. With this beginning we might expect that they would be focused on the mathematics that we expect to be associated with environmental models; such as those for population and climate modelling. To a degree the mathematics associated with types of models is discussed, but there is a lot more.

In his preface, Beck points out that "a manifesto is a public declaration of intentions". In the context of environmental modelling, this book sets out to identify the intentions of these modellers in using "computational analysis for detecting, exploring and coping with a future in which there might well be "structural change" (p. xiv). At the heart of their work is the aim to develop and use models that will effectively help the community to identify when environmental impacts may occur, and to help manage any impacts – the issues that anyone involved in environmental education and management will be intimately concerned with.

Often when we look at models we see they are explained by their relationship to ecological, chemical and physical principles. We are then shown how they can be matched with empirical data (or case studies) so that the fine details of the model can be "calibrated". Rarely do we receive any discussion of limitations and broad structural issues which will affect the model's ability to provide useful forecasts in situations where there is considerable uncertainly and variability – in other words to provide useful forecasts of our actual environment. Consequently, it is refreshing, to say the least, to find that this book appreciates that with models we will be drawing guidance about future environmental conditions "based on inconclusive model evidence, not conclusive field evidence" (p. 3), and aiming for a modelling approach that is appropriate to "dealing with structural change in the behaviour of the environment" (p. 4) In other words, the authors seek from the outset to recognise social and environmental contexts, rather than seeking mathematical elegance.

The authors' concern with conventional modelling lies in the problematic nature of being able to measure the parameters used in models. They are particularly concerned with the assumption that this is the only way of gaining insight and forecasts for policy development. The confidence in which the modelling by the Club of Rome was initially accepted in the early 1970s is used as an example of the problems that exponential growth modelling can fall into. By comparison, an illustration of the unusual view of model-making reached by the authors is indicated in the comment that their manifesto is guided by the intention to provide environmental foresight. In this they are guided by the acceptance that the "reality" of the models will be influenced by social and cultural realities, and more specifically the principles that:

- developing models that are not "inhabited by constants" is needed;
- in being used to make statements about future conditions, a model reveals something about the features of the model, and our current understanding of the environmental systems' behaviour; and

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- the significance of the present in determining the future (forecast) should be given minimal importance over having a "string of statements about where the state of the system should be at any time from the past to the future" (p. 6) – in essence flexibility and uncertainty are part of the model.

The broad plan here is to be less concerned with predictions of actual future behaviours, and more focused on the fashioning of plans for current action. The challenge lies not with being able to interpret observed behaviours, and thereby generating understanding and explanation of the past, but to be "probing the real and the virtual to divine what may happen in the future" (p. 89). In this context they favour the use of adaptive approaches (trying, testing, modifying as necessary). This provides the opportunity to question the frequently adopted assumption that there is some environmental equilibrium point which we are striving to achieve through our environmental management and policy. As an example, in climate change and other aspects of the environment there are many possible "equilibrium points", so models need the ability to incorporate these possibilities.

These insights come from the evaluation of case studies of water quality management in Lake Erie, the interactions of acid rain on water quality, and ozone modelling. Most usefully the authors specify the lessons that have been learnt from these exercises.

Having established the problems with current practice and what is a desirable structure for models, several authors contribute to the explanation of what can be done to achieve better models. An aspect of this is the use of "belief networks", drawn from the work on artificial intelligence, and challenging the degree to which uncertainties are recognised and allowed for in modelling. Also, they argue for "a more discerning stochastic approach that exploits advanced statistical and systems methods to enhance out understanding of large environmental models" (p. 288). To test these ideas case studies are presented, focused on the interactions of landscape with stream-flow, deformation (change) of structures and systems (such as urban water quality), stream water quality, and air quality.

Taken as a whole this is an exciting and challenging book. Exciting because it raises possibilities for making modelling much more than a "black –box" exercise. The models the authors are looking for offer the chance of understanding environmental systems and assisting policy development in an "unpredictable world". For the academic world inhabitated by the model practitioners, the material is easily accessible and is compelling reading.

The qualifier to all this is that for the general reader, or one with a basic interest in models wanting to explore further, concentration and the ability to work though some complex concepts will be required. Also, since the modelling discussed in the nineteen chapters is based on mathematics, the reader needs a willingness to engage with reasonably high level concepts or a preparedness to skip over them and take the authors' word for it.

The book is not intended for use in the classroom, nor as a text for general environmental science courses at tertiary level. Its place is as a reference and guide for tertiary academics and those involved in environmental research. It is to be hoped that academics will delve into it and distil the insights about conventional model-making and use, so that tertiary students will be become more aware of the limitations and possibilities of models. Ultimately, these students may be in positions to pass this insight on to those in schools and elsewhere.

Ian Thomas
RMIT University, Melbourne

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