

**MICROCOMPUTERS IN ECOLOGICAL MODELLING:  
A SPECIAL ISSUE DEDICATED TO RESEARCH,  
EDUCATION AND COMPUTER GRAPHICS**

Efraim Halfon

NWRI Contribution No. 89-16

Lakes Research Branch  
National Water Research Institute  
Canada Centre for Inland Waters  
Burlington, Ontario L7R 4A6  
Canada

April 1989

## MANAGEMENT PERSPECTIVE

This paper is the introduction to the special issue of Ecological Modeling dedicated to the application of microcomputers in ecology and ecological modelling. The paper describes the main differences in microcomputers, in the chips that drive them and their graphic capabilities. My conclusion is that Microcomputers driven by Motorola chips, such as the Commodore Amiga and the Apple Mackintosh are better suited to display of computer graphics and animation than IBM machines and compatibles driven by INTEL chips. Unfortunately the market predominance of IBM in the business market and therefore in the scientific market has led to the use of business microcomputers to develop computer graphics in scientific research. Any endorsements of mine of any specific software or hardware does not imply endorsement by Environment Canada or the Canadian Government.

## PERSPECTIVE-GESTION

Ce document constitue l'introduction du numéro spécial de Ecological Modelling traitant de l'utilisation des micro-ordinateurs en écologie et en modélisation écologique. Il décrit les principales différences entre les micro-ordinateurs, leurs microprocesseurs et leurs capacités graphiques. Ma conclusion est que les ordinateurs utilisant les microprocesseurs Motorola, comme l'Amiga de Commodore et le Macintosh d'Apple, conviennent mieux à l'affichage des images et des documents animés que les ordinateurs IBM et compatibles utilisant les microprocesseurs Intel. Malheureusement, la prédominance d'IBM sur le marché des affaires et donc sur le marché scientifique fait en sorte que même dans le milieu scientifique, on se sert de micro-ordinateurs d'affaires pour présenter des documents graphiques. Toute recommandation de ma part favorable à un logiciel ou à un matériel en particulier ne signifie pas une approbation d'Environnement Canada ou du gouvernement canadien.

## ABSTRACT

In 1986 Sven Jorgensen and I met and discussed the application of microcomputers in ecological modelling. As officials of the International Society of Ecological Modelling we are interested in the distribution of knowledge acquired in the field. Out of these conversations we decided to organize a special issue of Ecological Modelling dedicated to the application of microcomputers. In organizing this special issue my philosophy was to drive the authors to write computer programs that were user friendly, such as computer games found in arcades. The use of computer graphics was of special interest to me. The papers in this issue describe different applications from education to research. Research papers do not describe in detail the theory at the base of the software, rather they describe the procedure used in developing the software. Appropriate bibliographic references are made to lead the reader to the appropriate basics. The inclusion of all theoretical background and the description of the software would have made the papers unreadable. In this introductory paper I present my opinions about the hardware and software used to drive applications in ecological modeling. My feeling is that ecological modelers who require colour graphics presentation of model results should use microcomputers driven by Motorola chips because of their superior graphic and animation capabilities rather than business computers driven by INTEL chips. Unfortunately the market place is driving scientists away from these graphically superior machines. The proof is that authors in this special issue, including myself, present software to be run on IBM desktop computers and its compatibles. Any endorsements of mine of any specific software or hardware is a personal choice and does not imply

endorsement by any institute or agency of Environment Canada or of the Canadian Government.

## RÉSUMÉ

En 1986, Sven Jorgensen et moi nous sommes rencontrés pour discuter de l'application des micro-ordinateurs aux modèles écologiques. A titre de membres de la Société internationale de modélisation écologique, nous sommes intéressés à la diffusion des connaissances acquises sur le terrain. L'un des résultats de nos conversations a été la décision de réaliser un numéro spécial de Ecological Modelling portant sur l'application des micro-ordinateurs. En préparant ce numéro spécial, j'avais comme idée d'amener les auteurs à rédiger des programmes informatiques de type convivial, comme les jeux qu'on trouve dans les salles de jeux électroniques. L'utilisation des capacités graphiques des ordinateurs était un élément primordial à mes yeux. Les articles qui forment le présent numéro décrivent différentes applications, allant du domaine de l'enseignement à celui de la recherche. Les articles de recherche ne décrivent pas en détail la théorie sur laquelle s'appuie le logiciel, mais expliquent plutôt la méthode utilisée pour mettre au point le logiciel. Des références bibliographiques renvoient le lecteur aux sources utiles. L'inclusion de toutes les données théoriques et la description du logiciel auraient rendu les articles illisibles. Dans cet article d'introduction, je donne mon opinion sur le matériel et le logiciel

qui servent aux applications en modélisation écologique. A mon avis, les spécialistes de la modélisation écologique qui doivent présenter les résultats sous forme d'images graphiques en couleur devraient utiliser des ordinateurs munis de micro-processeurs Motorola, parce qu'ils offrent une capacité plus grande d'affichage d'images et de documents animés que les ordinateurs d'affaires utilisant les micro-processeurs Intel. Malheureusement, le marché est tel que les scientifiques sont tenus loin de ces ordinateurs graphiquement supérieurs. La preuve en est que les auteurs de ce numéro spécial, dont moi-même, présentent des logiciels fonctionnant sur des ordinateurs de bureau IBM et compatibles. Toute recommandation de ma part favorable à un logiciel ou à un matériel particulier constitue un choix personnel et ne signifie pas une approbation par un institut ou un organisme d'Environnement Canada ou du gouvernement canadien.

#### About microcomputers and mainframes

Microcomputers are common tools in offices and research laboratories. Some microcomputers can access large amounts of memory. For example a Cyber 830 mainframe computer has 372 kilobytes of memory while my desktop computer has 640 kilobytes. The difference is that the mainframe computer has 60 bits words while an 8086 INTEL chip based machine has 8 bit words. The numerical accuracy of mainframe computers, often necessary in complex simulations, has not been replicated yet in desktop machines.

To mathematical modelers interested in simulation, microcomputers and mainframe computers occupy two different niches. Microcomputers have been used for personal word processing, spreadsheets and colour graphics, while mainframe computers are used for high powered calculations.

#### About computer generated graphics

I introduced myself to microcomputers in 1982 by buying a Commodore 64 for home use. The Commodore 64 has a speed of 1 MHz compared with an average of 5 MHz for an IBM PC XT, 12 MHz for an IBM PC AT and 20 MHz for 386 based machines. Nevertheless the Commodore 64 has a great flexibility with computer graphics while IBM machines are only now supplied with graphics cards, EGA and VGA, that allow users to program decent colour graphics. Thus for a number of years since 1982 I have been able to program better graphics program at home than on "professional" machines at work.



#### About chips that drive microcomputers

Two kinds of chips now dominate the desk top computer market, one series (8086, 286 and 386) is produced by INTEL and drives IBM microcomputers and its compatibles. Motorola produces another series of chips, the 68000, 68020 and 68030, that drive among others the Apple Mackintosh personal computer, the Commodore Amiga and SUN workstations. The 8086 chip has 8 bit words, the 286 16 bits and the 386 has 32 bit words. The Motorola chips have 16/32 bits words. Interestingly for computer modelers machines driven by Motorola chips are much better in graphics capabilities than computers based on INTEL chips. Unfortunately the dominance of IBM in the business market has lead scientists to use IBM machines rather than the graphically more powerful Motorola chips. For example machines like the Commodore Amiga computer have very powerful graphics with 4096 colours, great animation capabilities while the best VGA cards have only 256 colours.

#### About software

No consensus has been reached on the best commercial software to develop programs and to develop computer graphics. Some authors, like myself, have used commercial packages like BASICA, GWBASIC or HALO to add graphics to their presentations. Other authors have developed their own graphic software starting from the basics. In this case the language of choice seems to be C which allows access to the computer memory including screen memory. Lately I have come across some packages that translate FORTRAN programs into C. These utilities can be quite useful to ecological modelers that are accustomed to develop their simulation models in FORTRAN but they might want to expand the

accessibility of their software. If a FORTRAN program is translated into C, a computer programmer can easily add interactive graphics screens without having to start a new program development from scratch.

#### Purpose of the special issue

Papers in this special issue of Ecological Modeling describe software that is available from the authors either for free, for a moderate fee or as full fledged commercial programs. Some programs rely on commercial packages such as spreadsheets; some programs are used for educational purposes and others are used for scientific research. The common denominator of these papers is that they describe software that is relatively easy to use, is self contained, has interesting applications and is available for distribution now. Each paper was peer reviewed for its scientific content and each software program was also peer reviewed. A paper has been accepted for publication only if both the paper itself and the software were deemed acceptable by independent reviewers. I therefore urge readers interested in applications to contact the individual authors to obtain copies of the software, only then the purpose of this special issue will be accomplished.

#### About future prospects

My main disappointment is the fact that all software runs on IBM compatible machines. No contributions were received for ecological programs that run on machines like the Commodore Amiga or Apple Mackintosh computers. Most software programs require only the use of CGA graphic cards. The CGA cards are very limited since they only have four colours. VGA cards are only

now entering the market and hopefully ecological modelers will use in full its colour graphics capabilities.

In the future I hope that ecological modelers will expand the use of microcomputers and will publish results on the development of computer graphics techniques particularly relevant to the display of computer simulations. I also hope that a variety of computers will be used and not only IBM compatible machines. Finally, my suggestion to developers of computer graphics for ecological modelling is to develop programs that run like games. When a person approaches a computer game, the user is immediately directed to understand the goal of the game and how to reach it. The program is user friendly even if most games require a good eye-hand coordination. In this effort I tried to influence the authors to write software that is easy to understand and to run. I hope I have succeeded.

#### ACKNOWLEDGMENTS

The preparation of this special issue required a large effort by a team of professionals. I thank all the reviewers that took time in reading the manuscripts and running the software. Most authors sent me their thanks since the review process improved their manuscripts and especially the software. In particular I would like to thank Mr. David De Jong, Mr. K. Plaxton of Elsevier and Dr. Sven Jorgensen.