Preface

This book begins with the observation that modelling environmental dynamics becomes more urgent everyday. It becomes all the more pressing because modelling results can contribute to a better understanding of current, complex phenomena and time projections using predictions and scenarios which can resolve many of the challenges that occur in daily life: global climatic changes, biodiversity, deforestation, risk prevention and land planning at the local level, etc. A great deal of research has been completed. In spite of this, actual modelling tools remain exploratory rather than operational and most of them can't be applied in common policy instruments intended to avoid or even resolve the above-mentioned problems. Also today's accessibility of user-friendly modelling tools also brings with it some risks; it seems easy to model practically anything. Particularly newsworthy topics such as global change links to the increase of temperature, the melting of ice caps or the discussed cessation of the Gulf Stream have become subject to numerous publications using models and predicting more or less catastrophic simulations. In spite of numerous, serious research results and crucial planetary stakes we have to remain humble and critical and ask ourselves about the degree of our understanding of complex environmental systems, the amount and the quality of the data used and the validation of model results. These are major topics in this book, which presents various research results in modelling environmental dynamics in a transparent way focussing on result validation.

What is this book about?

The main objective of this book is to contribute to advances in modelling environmental dynamics involving both: the spatial and the temporal dimension. The goal is to perform simulations either as probabilistic predictions or scenarios showing 'what will be if'. The aims of modelling are various and cover a wide range stretching from better comprehension to decision support.

During the last few years, the modeller's toolbox has become significantly enriched by novel methods such as fuzzy logic, multi-agent systems or neural networks to resolve geographical problems. This book, starting with an introductory overview about the challenges and modelling approaches, provides a sample of actual research results using a variety of modelling methods and tools applied to an assortment of environmental dynamic situations. It also shows a wide range of model results and topical modelling conceptualisation like participatory modelling. All of these

contributions follow the same structure and emphasize mainly the methodological aspects such as model calibration and model validation.

What is this book not about?

Modelling is, from a conceptual point of view, a current and important issue in many research areas. A lot of concepts and methods are emerging. This book doesn't offer new conceptual or methodological advances but it shows validated modelling results based on innovative methods like neural network, multi-agent system, cellular automaton, fuzzy modelling and more traditional, mostly stochastic, approaches.

For this reason, this is a first actual set of case studies, and some theoretical aspects can't be discussed in depth. However, in part A of this book, there is an attempt at creating a synoptic summery with numerous references to help the user find further reading.

However with the harmonized presentation of the contributions, this book is neither a manual nor a tutorial.

How to use this book

This book is written for academics, students and professionals belonging to a wide range of disciplines like geography, geomatics, environmental sciences, land planning and urbanism with at least an initial experience with spatio-temporal data, GIS and modelling. It also may be a welcome application example for specialists the in computer sciences dealing with spatio-temporal data. The gradual concept of the book and the presentation of performed research results, which are presented using the same structural set-up in each chapter, may make it useful for more thematic experts too.

Since the audience has various levels of knowledge and experience in geomatics and modelling and different academic and professional backgrounds, the book starts with a succinct overview about modelling (what, with what and for what?). Advanced readers may skip this introductory part and turn their attention directly to the following case studies. Each of them provides a large list of references for further reading.

Structure of the book

This book contains two main parts: a brief introduction to modelling and a set of case studies.

Part A launches basic ideas about modelling environmental dynamics starting with its challenge. In this chapter the reader will find the scientific context of this work and its objectives: *What*? Environmental dynamics. *With what*? Geomatics solutions. *For what*? Outcome, modelling for simulation. This first chapter is completed with a summary of the opportunities created by this book as well as references to some earlier works.

The second chapter of part A is about modelling approaches and shows a methodological overview followed by a description of commonly used modelling tools (software). As this book is particularly interested in the validation of model outputs; a topic presents model validation techniques.

Part A ends with the description of case studies to follow in Part B. At this point, the authors compare the thirteen contributions presented by developing and discussing a list of relevant topics: themes and objectives, related time scales, chosen modelling approaches and tools, involved databases, used study areas and scales, performed calibration, results and validation techniques and the outcome and originality of each work.

Part B of this book is a collection of thirteen case studies carried out by researchers from Brazil, France, Italy, Mexico and Spain. Each contribution deals with spatio-temporal data and presents validated model outputs in the form of time projections: predicting simulation or scenarios. Considering that the modelled objects, the conceptual and methodological approaches as well as the finality of modelling are very diverse, therefore each contribution follows the same structure. Abstracts offer a summery accessible to a large readership. Every contribution begins with an introduction clarifying the context and the main problems. The description of the test areas and data sets ensure transparency with regard to the performed results. The methodological part is split into two subchapters to improve the readability: methodology and practical application of the data sets. The presentation of the achieved results is followed by their validation and discussion. All articles have a conclusion and an outlook and are completed with acknowledgements and references.

Toulouse and Granada, April 2008

Martin Paegelow and María Teresa Camacho Olmedo