Preface

Geographic information is used in many different themes and is also used as a source of information for a large number of different domains. The aim of this book is to highlight the relationship that exists between geographic information and the world of climatology. It is always a good idea to provide a definition of the subject that is being written about, so that readers do not have any misunderstandings or misinterpretations of the subject in question.

The word geography comes from the ancient Greek geo (Earth) and graphein (write). In the beginning the role of geography was to describe the Earth by creating maps. Maps are models, a way of representing what exists in reality. They are also seen as a model that can be used to transmit geographic information. Nowadays, however, the world of geography no longer only locates, observes and describes what is happening in an area. The term geography can also be applied to the study of human behavior and the environment, and whenever bio-physical areas are being studied the world of geography reminds us that these areas are very closely linked to man. Other disciplines study similar areas but what makes each of these individual disciplines different from one another is their "project", more than their actual subject content. The world of geography focuses less on the relationship that exists between man and nature, than on its spatial vision of certain phenomena. Space is to geography as time is to history, and for this reason many different studies have been carried out in areas at all levels, including studies carried out on a country, regional or territorial level, etc.

What exactly is geographical information? In order to answer this question several different responses are required so that the different chapters of this book can be understood. The term geographic can be understood here as being everything that relates to the Earth, to the interface that exists between the lithosphere, hydrosphere, and atmosphere, to the the Earth surface occupation and not only the land-use types. Every definition has its limits: do sub-soils, as well as the deepest water of the oceans form part of our study? The same logic can be applied to the air (i.e. what is not part of climatology?); does everything that exists in the air form part of our study? To avoid endless numbers of debates, which could occur on this subject, perhaps we need to adopt a certain level of pragmatism and link all of these

different areas to one geographical space whenever these different areas are indirectly associated with one of the studies. In other words, if we are to understand these different areas, it is necessary to study them as closely as possible.

If geographic information takes into consideration the state of the surface of the Earth and its surrounding environment from a spatial point of view, then there is another important point that arises and needs to be dealt with: the type of geographic information that is to be produced. Nowadays, whenever the term geographic information is used it immediately involves the use of a tool known as a Geographic Information System (GIS). GISs are everywhere and are not only found in research laboratories (where they have been in use for a long time), but they can also be found in planning departments and in many administrative and local authorities. The important idea of linking one point or one pixel to a series of information with the aim of describing the point or pixel in the best possible way has been carried out by using powerful software. And the use of raster or vector GIS allows us to adapt to the different characteristics of the areas that are being studied.

It is difficult to state where the limit between the quantitative and qualitative worlds can be found in geographic terms. In this book, geographic information is more often than not the subject of the quantitative world, although this is not always the case. In the beginning, geographic information was considered in the widest terms possible and it included also the qualitative, as are often the metadata in climatology, for example. But it is true that the numbers (quantitative data) are much easier to process and deal with, as is shown in some of the different chapters of this book. Geographic information is a basis, a starting point for a series of sometimes complex operations that require multiple super positions or combinations so that a fixed goal can be reached. If quantification is compulsory each time a digital response is required, then the quantification process is also an impoverishment that is compulsory, and this is dealt with by some of the authors of the different chapters of this book: converting a measurement site into figures loses information, but what other method can be used? Several authors of this book and in particular, D. Joly, J.-P. Laborde, and P. Carrega, have been and are still faced with the following problem: as we have to digitalize information what method can we use in order to improve the process? The old issue of carrying out research on the field is raised once again. Some scientists think it is a necessary process, whilst others think that it is a time-wasting process. Although the different opinions of the different people concerned are based on strong arguments, they also depend on the individual person, for example, how they think, their memory and their mental understanding of their environment. The more operational scientists (in other words those who are committed to using concrete results) are normally those who carry out their research on site, in the field, at least in the short term.

Climatology is seen as being a domain that is capable of challenging geographic information. The field of climatology is an extremely large domain in which the number of climatologists has increased by a scale of 30 in a period of only 20 years. This book does not discuss the differences that exist between the worlds of climatology and meteorology. One major difference that does exist between these

two worlds, and that should be mentioned, is the time scale that each of these domains focuses on. Meteorology focuses on forecasting what is going to happen over the short term (over a period of a few hours to a few days), whereas climatology focuses on defining, ranking, and describing events that have occurred over a longer period of time (regardless of whether this time refers to the past or to the future). The expression, "the climate was really nice today", is not used and this is due to the fact that the term climate is used to describe a relatively long period of time (at least 30 years). This means that when climate is being studied, it is possible to observe key values (average, median, etc), as well as observing the distribution of these values, and thus, the extreme values. Therefore, the difference between climatology and meteorology is more functional and temporal than it is spatial. However, the limits as to where one ends and the other begins are quite unclear. As far as the future is concerned, how do we know when the notion of climatology takes over from meteorology? This is where the notion of functionality comes into force. As far as weather forecasting is concerned, there are not very many methods that are used that can provide an accurate forecast for a period of more than 15 days. The American meteorological model known as GFS publishes a weather forecast online for up to 384 hours after the current date (in other words up to 16 days after). The European model, however, does not take as many risks and publishes a weather forecast for up to 240 hours after the current date (in other words up to 10 days after). The temporal limits of physics laws, and deterministic processes, appears when we try to predict what the weather will be like for any particular day in the future because of the non-linearity of the equations that are used in forecasting, and also because of the fact that the initial state of the atmosphere is never fully known whenever the forecasts are being calculated.

There has been an undeniable amount of progress made in the world of meteorology over the last 20 years thanks to the use of such meteorological models, and the use of other complex solutions, which P. Bessemoulin describes in Chapter 4. However, these models and solutions have spatial and temporal limits. Nevertheless, this logic (and its future updated versions), is used to forecast the average state of the atmosphere in 20, 30 or even in 100 years time. This logic is also the subject of many current debates that are taking place and which deal with the following themes: what will the climate be like in the future? What do we all need to do so that climate change can be limited? What do we all need to do in order to adapt to the changes that will inevitably take place?

Climatology is also a field that is empirical and dominated by statistics, when models, which are traditionally used in the world of physics, are unable to respond to or have difficulties in responding to the demands that exist in climatology. If a new embankment is going to be built, working out its height involves considering the water levels that were measured in the area in the past. If these measurements are adjusted by Gümbel's distribution (for example), it then becomes possible to work out the probability that a certain level of water will be exceeded, and thus its "return period". All of this information should form part of what is known as a stationarity hypothesis, which nowadays is not normally validated.

Bringing together models from both the worlds of physics and statistics is a usefull exercise from an an intellectual point of view, although formal, because interactions between models from these two domains occur on a daily basis. Each physical model relies ever so slightly on the use of calibration coefficients that are determined by statistics, and inversely, each effective and operational statistical model that is used in climatology relies on the use of different fundamentals that stem from the world of physics.

The most common methods that are used today include: multiple regressions, and geostatistics based on spatial autocorrelation (kriging in particular), which are sometimes combined. The use of neural networks is not as widespread, and this method does not seem to solve many of the issues that people thought it would be able to a few years ago.

Remote sensing is a term that is used to group together all of the different tools that are able to record information from a distance, which is usually done using airplanes or satellites. The multiple sensors, which can be found on board these vessels, can contribute to collecting geographic information that can be used to recreate the relief of an area or to evaluate how well a particular crop is growing from a phenological point of view, etc. Sensors can also be used to measure different climatological variables, such as the temperature of the Earth's surface or the temperature of the clouds as is explained in Chapter 3 by Dubreuil. What makes remote sensing different from other methods is that it can provide data on two different pieces of information that are being researched at the same time, or at least in part.

There is one fundamental issue that affects geographic information and the relationship that it has with the world of climatology: how is it possible to make these two different domains evolve together in the future? Roussel, the author of Chapter – 6, reminds us that the geographic information produced depends on the metrological and political context in which it is used. With this in mind, different rules and regulations, as well as different socio-economic contexts and the mentality of the general public, will influence how the geographic information is used. Advances in technology in the future will probably change the way in which geographic information is measured, and as a result what is actually being measured. Will financial fluxes be a more important part of geographical information in the future?

This book is made up of eight chapters, and can be divided into two main parts.

The first part of the book is devoted to the technical aspect and the tools used to gather geographic information. In Chapter 1, Wolfgang Schoner analyses the bases of climatological observations for GIS applications, while in Chapter 2 Daniel Joly focuses on spatial analysis and cartography, and throughout the chapter he elaborates on the use of the statistical approach. In Chapter 3, Vincent Dubreuil shows how remote sensing can be used to provide us with both geographic information and information relating to the climate. In Chapter 4, Pierre

Bessemoulin provides us with an explanation of a number of key elements that are used to give us a better understanding of the way in which meteorological and climate models exploit geographic information so that they can be used effectively.

The second part of the book is devoted to how the geographic information is applied to different domains. The themes that we have chosen to focus on are associated with risks or certain constraints. The characteristics of the climate as it is today are associated with the actions of man, his needs and his limits. The research that we have carried out focuses on these limits. In Chapter 5, Maria Joao Alcoforado shows the necessity of geographical information to understand the specificity of urban climates; and, in Chapter 6 Isabelle Roussel focuses on the complexity of the relationship that exists between climatology, atmospheric pollution, and geographic information. Throughout the chapter she shares her views on what the term geographic information means and in some cases questions the term itself.

In Chapter 7, Jean-Pierre Laborde, who is a passionate hydrologist and renowned technician, proves that it is necessary to take a step back to understand exactly what a simple water flow or fload means. By taking spatialized geographic information into consideration he places a lot of importance on climatology. Finally, in Chapter 8, Pierre Carrega defines meteorological risk levels associated with forest fires. He bases his research on two different methods that can be used to generate the meteorological risk level index and compares them throughout the chapter. The two methods are both part of geographic information and the world of climatology.

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