

Earth Observation of Global Change

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The Role of Satellite Remote Sensing
in Monitoring the Global Environment

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 Springer

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*Then I saw a new heaven and a new earth.
The former heaven and the former earth had passed
away,
and the sea was no more (Apocalypse 21:1)*

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Preface

The earth environment has always been affected by change, since all forces interacting to shape world landscapes are intrinsically dynamic. However, the pace of change varies widely between processes: from slow moving plate tectonics and erosion, to fast changing wind or temperature conditions. Considering phenomenon at the human time scale, weather and vegetation changes are the most noticeable. Along with temporal change, spatial variations are also evident over a range of scales from the very local to thousands of kilometres, depending on the process being considered.

Both temporal and spatial transformations are considered in terms of Global Change, although the expression has a broad range of meanings. Some authors use it as synonym of climatic change, while others refer to broad planetary changes, including human land use transformations. This latter sense has been used throughout this book, which includes both climate related changes, as well as direct human landscape conversion.

Concern about global change has greatly increased in the last two decades, and particularly in the last five years, when it has become a controversial issue in daily newspapers and other media. The impact of human activities on climate through extensive consumption of fossil fuels is a main factor of concern for decision makers, because of the economic and geopolitical implications. Other critical factors, such as tropical deforestation, biodiversity loss, water pollution or soil erosion are often less reported on, perhaps because they have a less direct impact on the developed economies. However, they are the most evident signals of global change, and are – unlike global warming- clearly beyond scientific dispute as to whether or not they are human caused.

The identification of any type of global change involves having the means to observe global environmental processes. To be confident that changes are occurring, a baseline and repeated observations are needed. This requires access to long-term and global data that are acquired systematically and calibrated enough to be fully comparable and capable of measuring long-term changes. Means of observing environmental processes are very diverse: weather probes, water gauges, vertical profile balloons, tree rings, pollen records, ice core drills, sediments fossils, etc. Satellite observation is particularly useful for the study of global change processes, since satellite data provide one of the most systematic ways of collecting data worldwide, in a fully comparable and repeatable way. For this reason, the use of satellite

observations in global change studies have been very significant in the last decades, from weather surveys and forecast to vegetation, ice and water monitoring.

This book aims to present the main contributions of satellite Earth Observation for the study of global-scale environmental processes. Although a great number of books have addressed the implications of global change, a small number have been focused on the means to monitor that change. Some previous books have used satellite images to display global processes, but few have dealt with analyzing the actual contribution of satellite images to global change projects, and the key global variables that can currently be derived from satellite data. This is the main purpose of this book.

The book should be useful to those studying global change processes, particularly those interested on how data are acquired and processed. The book has an environmental scope, and therefore should be valuable for a diverse collection of scientists, such as ecologist, geographers, foresters, land use planners, geologists, oceanographers, and physics.

The origin of this book was an international symposium on Earth Observation of Global Change that I organized in Madrid (Spain) in 2006, under the auspices of the Fundacion Areces and the Spanish Royal Academy of Sciences. The experts gathered there recognized the need of a textbook providing an overview on how satellite remotely sensed data have been used in different disciplines, from oceanography to land use, from forest fires to water, ice and snow. A review of current missions to observe global processes was also desirable, since information of space missions is much dispersed and needs critical assessment. A brief introduction to institutions and networks of scientist working on global change was also recommended. As a result of this interaction, the scheme of this book was finally agreed on.

We favored a textbook style, rather than a collection of specialized chapters. Therefore, the sections of the book were generally conceived to provide a state of the art review on the different topics, instead of just presenting everyone's own research on the field. The reader should judge if we succeeded in this comprehensive view. Since displaying satellite information in black and white limits their information content, a CD-ROM with color plates of the same figures has been attached to the book. The reader should find there additional material to explore actual applications of satellite data to global change studies.

We finally acknowledge the Fundacion Areces and the Spanish Royal Academy of Sciences for their support to organize the meeting, and the Springer editors for their favorable response to convert the presentations from that meeting into a textbook. We hope that the final result will be worth the effort, and will make a sound contribution to emphasizing the importance of global change studies, and particularly to the support of long-term satellite observations of global processes.

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College Park (1st April 2007)

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