
Preface

The relationship of humans with the Earth's environment has changed throughout the evolution of *Homo sapiens* and the development of societies. For virtually all of human existence on the planet, interaction with the environment has taken place at the local, or at most the regional, scale, except perhaps for one example in which regional-scale human activities were repeated to create global consequences in concert with climate change – the Holocene megafauna extinction. Apart from this possible example, the environment at the scale of the Earth as a whole – the passing of the seasons, the vagaries of weather and climate, the ebbing and flowing of river systems and glaciers, the rich diversity of life in all its forms – has been a framework within which humans have been able to evolve and develop social structures, subject only to the great forces of nature and the occasional perturbations of extraterrestrial origin. The Earth's environment has been a bountiful source of resources as well as a remarkably accommodating life support system that has allowed human civilisations to develop and flourish.

This book focuses on the profound transformation of Earth's environment that is now apparent, a transformation owing not to the great forces of nature or to extraterrestrial sources but to the numbers and activities of people – the phenomenon of *global change*. Begun centuries ago, this transformation has undergone a profound acceleration during the second half of the twentieth century. During the last 100 years the population of humans soared from little more than one to six billion and economic activity increased nearly 10-fold between 1950 and 2000. The world's population is more tightly connected than ever before via globalisation of economies and information flows. Half of Earth's land surface has been domesticated for direct human use and nearly all of it is managed by humans in one way or another. Most of the world's fisheries are fully or over-exploited and little pristine coastline exists outside of the high latitudes. The composition of the atmosphere – greenhouse gases, reactive gases, aerosol particles – is now significantly different from what it was a century ago. The Earth's biota is now experiencing the sixth great extinction event, but the first caused by another species: *Homo sapiens*. The evidence that these changes are affecting the basic functioning of the Earth System, particularly the climate, grows stronger every year. Evidence from several millenia shows that the magnitude and rates of human-driven changes to the global environment are in many cases unprecedented. There is no previous analogue for the current operation of the Earth System.

This book sets out what is known about global change and the nature of the Earth System. It addresses a number of important but difficult questions. How did the Earth System operate in the absence of significant human influence? How can human-driven effects be discerned from those due to natural variability? What are the implications of global change for human well-being? How robust is the Earth System in the face of these new internal forces of change? Can human activities trigger abrupt and potentially irreversible changes to which adaptation would be impossible? How serious is this inadvertent human experiment with its own life support system? By raising and attempting to address these questions in this volume, the authors hope to give some direction to the future of Earth System science

and to challenge the global change research community to find answers to these questions.

Such an undertaking as this volume could not have been possible without the active involvement of a large number of people. The book's production has truly been a community effort. The project began as a synthesis of a decade of research undertaken under the auspices of the International Geosphere-Biosphere Programme (IGBP) but quickly grew to encompass contributions from the global change research community more generally, particularly IGBP's partner international programmes: DIVERSITAS, an international programme of biodiversity science; the International Human Dimensions Programme on Global Environmental Change (IHDP); and the World Climate Research Programme (WCRP). The acknowledgements section at the end of this volume is thus unusually long. The authors hope that the many contributions to the book have been properly acknowledged; any inadvertent oversights are the responsibility of the authors and are regretted.

Finally, this volume stands as one contribution of the many required to build the knowledge base to support the long-term, sustainable existence of the human enterprise on planet Earth. It argues that a truly global system of science is needed for coping with the challenges that lie ahead.

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