Chapter 4

Climate Changes and Atmospheric Pollution: Global and Regional Impacts

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ABSTRACT

The objective of this chapter is to present the central concepts, parameters, and methods for the monitoring of climate changes, with a focus on air pollution, and the possible global and regional impacts of climate changes as well. There are plant species used as bioindicators that have a high sensitivity or ability to accumulate environmental pollutants. Another method that this chapter will present is the use of receiver models that employ both mathematical and statistical approaches to quantify the individual contribution of a given number of emission sources in the composition of a sample. The data presented in this chapter will provide reliable bases and methodologies for environmental control, supporting the adoption of more restrictive policies.

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INTRODUCTION

Monitoring of the impacts of climate changes introduces some questions about its effectiveness, timing, intervention levels, the uncertainty of data, available financial resources, among others, which need to be considered.

Air pollution can be defined as the presence of harmful substances in the atmosphere in an amount sufficient to affect its composition or equilibrium, damaging the environment and the most varied life forms. This type of pollution causes severe impacts not only on human life, but also on animal and plant life, as well as the deterioration of cultural leisure goods, and the disablement or depletion of natural resources. In this context, bioindicators are organisms that react to environmental changes by modifying their vital functions, and their chemical composition, providing information about the environmental scenario. A bioindicator should be taxonomically defined and easily recognizable by non-specialists; present a wide geographical distribution; be abundant or easy to collect; have well-known ecological characteristics and be able to be used in laboratory studies. Indicator organisms are still a tool of great importance to diagnose the quality of ecosystems, besides contributing to the identification of reference areas and critical areas in a given region. Morphological, physiological or genetic changes in microorganisms, plants, and animals including humans may be a consequence of potentially toxic or genotoxic chemicals present in the atmosphere.

The global impact of air pollutants refers to those that can affect the planet as a whole. The most critical problem caused by the use of fossil fuels is gases, such as carbon dioxide (CO₂), chlorofluorocarbons (CFCs), methane (CH₄), nitrous oxide (N₂O), etc. These gases are known as greenhouse gases and capture part of the infrared radiation that the Earth returns to space, causing the increase of the atmospheric temperature due to climatic changes. The most important greenhouse gas is carbon dioxide which is the main compound resulting from the complete combustion of fuels. When in large quantities, carbon dioxide and other pollutants end up forming a filter in the atmosphere, during the day the Earth is heated by the sun, and at night it loses the stored heat, resulting in a reduction in temperature. However, with the layer of pollutants present, the heat is retained in the Earth, causing an increase in the average temperature. The transport sector has a considerable stake in climate issues as it contributes 22% to the global emission of greenhouse gases, employing practically 100% of fossil fuels. Brazil has one of the highest growth rates of its CO₂ emissions due to the industrialization that has taken place, and the growth of the existing vehicle fleets. There is, therefore, a great need for effective public policies in this sector, in order to change this framework in which, in addition to climate change, there are direct damages to human health and the environment.
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