Environmental effects of ozone depletion and its interactions with climate change: 2002 assessment

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Introduction

The four earlier assessments on Environmental Effects of Ozone Depletion, between 1989 and 1998, dealt almost exclusively with increasing ultraviolet radiation and its impacts. The present assessment gives an update on these same problems, but with a special emphasis on the interactions with climate change, at the request of the 11th Meeting of the Parties to the Montreal Protocol. Depletion of the stratospheric ozone layer and climate change are dealt with in separate international conventions. Although both processes are aspects of global atmospheric change, the measures needed for phasing out ozone depleting chemicals and for limiting the increasing greenhouse effect are distinctly different. Even if separated in this fashion, it is becoming increasingly clear that the two processes have many interactions. For the time period that these two threats co-exist, there is a strong likelihood that their interactions will have consequences for the environment.

Some of these interactions take place within the atmosphere and influence the UV radiation reaching the earth's surface, resulting in effects on health, ecosystems and materials. In other cases, a particular effect of UV radiation, *e.g.*, on phytoplankton in the oceans, may even play a role in the large-scale interactions between climate change and ozone depletion. In addition, a specific biological system or material may be affected by increased UV radiation in combination with rising temperatures, changing precipitation or other aspects of climate change; these various factors may interact with each other in an additive, antagonistic or synergistic way.

Climate models that simulate future ozone levels have improved but still remain highly uncertain. Several models predict delays in recovery of the ozone layer, ranging from almost zero to a decade or more or even to further ozone depletion late in the century. This calls for an analysis of the consequences of a prolonged period of increased UV-B radiation on health and the environment.

Changes in snow and ice cover arising from global warming can modify the UV radiation received at the Earth's surface. The penetration of UV radiation into the sea and freshwaters is dependent on the concentration of dissolved organic matter in the water, which is modified by both UV radiation and temperature. Oceanic productivity is also influenced by temperature and UV radiation; the changed productivity in turn leads to changes in sulphur emission from the ocean, potentially altering the transmission of sunlight to the surface. The induction of skin cancer by solar UV radiation is likely to increase with global warming. Increasing temperatures are also expected to exacerbate the UV-related problems in air quality, and UV-induced damage to materials.

Research and understanding of most of these complex processes is still in an initial and uncertain phase, but it appears that some of these will have environmental impacts. In the following papers, new information on the effects of increased UV radiation will be discussed in more detail, with special attention given to the role of interactions between ozone depletion and climate change.

Jan van der Leun, Xiaoyan Tang and Manfred Tevini

United Nations Environment Programme
PO Box 30522
Nairobi, Kenya
http://www.unep.org/ozone
http://www.unep.ch/ozone

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