Chemistry and Radiation Changes in the Ozone Layer

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Preface

Laboratory studies, atmospheric observations and modeling studies over the past decade have led to a deeper understanding of the natural variations and man induced chemical changes in the atmosphere and their relations to the stratospheric ozone layer reductions and to chemical changes in the troposphere. Of particular importance are recent findings of accelerated and significant ozone reductions in the lower stratosphere at northern latitudes during the 1990s and their possible connection to man's emissions of chemical compounds. Observations showed that ozone levels increased in the upper troposphere during the 1970s and the first half of 1980s. However, during the last decade ozone increases have leveled off, indicating possible changes in the man made impact on tropospheric ozone on a large scale.

A key issue that has become apparent from recent years studies is the increasing evidence of a link between atmospheric ozone changes and environmental issues: The studies have demonstrated that there is a link between stratospheric ozone decreases and an increase in surface ultraviolet (UV) radiation. Measurements of UV radiation under clear sky conditions show that low overhead ozone yields high UV radiation at the surface. Model studies of the radiative forcing caused by changes in ozone give reduced radiative forcing due to ozone loss in the lower stratosphere and increased radiative forcing from tropospheric increases. These recent studies demonstrate the link between ozone changes caused by man's activities and changing UV levels at the Earth's surface, as well as the link to climate through changes in radiative forcing and links to changes in chemical composition.

The lectures presented in this volume include resent developments in Chemistry and Radiation Changes. Laboratory studies, atmospheric observations and modeling were significant developments have been made. Laboratory studies have particularly demonstrated the importance of heterogeneous reactions in the ozone loss process. Recent observational results during intense European and US campaigns have strongly increased our understanding of the ozone loss in the Antarctic and Arctic regions. Similarly have campaigns and the setup of international UV networks improved our understanding of the level of UV radiation reaching the Earth's surface. Modeling capabilities have improved vastly over the last decade. 3-D CTMs (Chemical Tracer Models) with extensive chemistry are now in use to study the global ozone chemistry. These models are for instance used to study stratospheric ozone depletion from CFCs and the impact of aircraft on ozone at the tropopause region. Other models which are used to study the radiative forcing caused by ozone changes. There are also models that are used to study ozone- climate interactions. One important aspect is the impact of stratospheric ozone changes on stratospheric temperatures which indicate links between ozone changes and climate.

This NATO ASI brought together key scientists and young researchers which interacted in the area of atmospheric chemistry and radiation. The key speakers gave state of the art lectures on the variable ozone layer and the interplay of long and short wave radiative interactions which link the ozone, climate and UV issues. The Advanced Study Institute coincided with an extensive European Union Campaign (PAUR) in which students had the opportunity to visit observational sites in Crete and interact with researchers which were not in the tutorial group of the NATO ASI.

This volume presents the majority of lectures as well as peer reviewed contributions presented by the graduate students. Overall 33 presentations and papers are included from 14 lecturers and a large number of students.

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