World Climate Research Programme and Ozone Depletion and Recovery and Climate Change

Description

Although depletion of stratospheric ozone was, at first, considered as being somewhat distinct from climate change issues, it had become increasingly clear that the future evolution of the ozone layer and its eventual recovery are part of the broader story of climate change associated with increasing concentrations of radiatively, and chemically active substances in the atmosphere as a result of human activities. The critical role of such substances in the chemistry of ozone in the Antarctic stratospheric winter polar vortex, remote from their source regions, is in itself indicative of the importance of transport and exchange between the troposphere and stratosphere on time scales ranging from weeks to years. It was becoming understood, however, that this dynamical coupling could influence the troposphere as well. In addition, the recognition that the signal of climate change is sensitive to the composition and structure of the upper troposphere/lower stratosphere region underlined the need for a programme of research directed toward understanding the role of the stratosphere in the climate system. It was also clear that to be successful this programme would have to combine a wide range of disciplines and expertise and fully recognize the key role of atmospheric chemistry in climate change.

Since its inception in 1992, the WCRP core project Stratospheric Processes and their Role in Climate (SPARC) has addressed key issues related to the stratosphere and its role in climate, both from scientific and policy information perspectives. Further, as the science and science-policy needs have evolved, SPARC has refocused its activities to provide the most useful research and information.

The current SPARC programme focuses on three key themes of modern climate science:

1. Chemistry-Climate Interactions,
2. Detection, attribution, and prediction of stratospheric change, and
3. Stratosphere-troposphere dynamical coupling. These main themes are complemented by a number of cross-cutting activities with specific foci. Current prominent SPARC activities include the Chemistry-Climate Model Validation project (CCMVal), work by the Data Assimilation Working Group (SPARC-DAWG), the activity on Solar Influence (SOLARIS), and the recently initiated Dynamical Variability activity.

The first of the SPARC themes listed above deals specifically with ozone depletion and recovery and its relationship to climate change. It addresses such questions as:

- How do stratospheric ozone and other constituents evolve as climate changes?
- How do changes in stratospheric composition affect climate?
- What are the links between changes in stratospheric ozone, UV radiation and tropospheric chemistry?

Whilst understanding and modelling stratospheric chemistry and its role in climate has always been a central component of SPARC, the need to go beyond this perspective to deal with the role of chemistry-climate interactions throughout the whole atmosphere will receive increased attention within SPARC in the future in the context of the Atmospheric Chemistry and Climate (AC&C) Initiative which has recently come into being as a major joint effort of WCRP and IGBP, with the SPARC and IGAC projects leading its implementation. The first phase of this activity involves a modelling effort, which will utilize and build upon the SPARC CCMVal activity, so as to move toward a broader based activity that will utilize modelling and observational activities in a synergistic way to define gaps in understanding, quantifying, and modelling chemistry-climate interactions.

SPARC has played a key role in production of recent assessments of ozone depletion and recovery. For the 2006 WMO/UNEP Scientific Assessment of Ozone Depletion., scientists within the SPARC community served as members of the Assessment Steering Committee, lead and contributing authors, and reviewers ("This report builds upon the previous assessments, research over the last 4 years, reports from SPARC committees, and observations from various field campaigns and new satellite instrumentation", Chapter 4).

The CCMVal project organized the key element of the assessment process, the Chemistry Climate Model simulations. These simulations were of critical importance in assessing the evolution of ozone, temperature, and trace species in the stratosphere in the recent past as well as in making projections of ozone recovery in the twenty first century. (More information and a list of recent publications is available from the CCMVal web site: http://www.pa.op.dlr.de/CCMVal/List_CCMValCollaborators.html)

SPARC will continue to play a key role in the WMO/UNEP Ozone Assessment process, and CCMVal is already engaged in planning to ensure an even stronger contribution to the expected 2010 Ozone Assessment. It is now clear that ozone recovery and climate change are so closely linked that future efforts to improve predictions of long term variability and change, for both stratosphere and troposphere, will require taking the role of stratospheric ozone fully into account. It is anticipated that SPARC will, in collaboration with the Working Group on Coupled Modelling (WGCM), become involved in planning and executing modelling activities for future climate change assessments (AR5 and beyond).