

**SPARC** STRATOSPHERIC PROCESSES AND THEIR ROLE IN CLIMATE

A Project of the World Climate Research Programme

# **Report on the 15<sup>th</sup> Session of the SPARC Scientific Steering Group**

### 18-21 September 2007, Bremen, Germany

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The 15<sup>th</sup> session of the SPARC Scientific Steering Group (SSG) was hosted by the Institute for Environmental Physics and Remote Sensing (IUP) of the University of Bremen at the invitation of **John Burrows**. The first afternoon was held jointly with the final session of the Regional SPARC Workshop that was held at the University of Bremen on September 17-18, 2007.

This year's SSG meeting marked a year of significant developments within SPARC, with the appointment of new Co-Chairs (Tom Peter and Ted Shepherd) and four new SSG members (Anne Thompson, Greg Bodeker, David Fahey and P.C.S. Devara), and with new and rejuvenated activities getting under way. In his opening remarks, **Tom Peter** thanked the outgoing Co-Chairs, A.R. Ravishankara and Alan O'Neill, for their years of excellent leadership and service to SPARC. For the benefit of the new SSG members and participants he also reviewed the organization and activities of the SPARC project and its role within WCRP

# Summary of SPARC Activities in the past year

In the last year there were a number of SPARC sponsored and related workshops and meetings, several of which are discussed below and elsewhere in this newsletter.

The SPARC Office has received an extension of its funding from the Canadian Foundation for Climate and Atmospheric Sciences to keep it operational until early 2011. It has also received additional funding for the two-year period of the IPY to enable the hiring of Elham Farahani as the SPARC-IPY coordination scientist and thereby facilitate progress in the SPARC-IPY Activity, which has become fully active in the last year (see further discussion below).

#### JSC outcomes and WCRP update

The 28<sup>th</sup> session of the WCRP Joint Scientific Committee was held in March 2007 and reported upon in SPARC Newsletter No. 29. **Ted Shepherd** summarized the main outcomes of the JSC meeting and current issues for the WCRP as they affect SPARC.

The March 2007 JSC meeting reaffirmed the central role of the WCRP core projects and working groups in delivering WCRP science. SPARC was commended by the JSC for its focus, its evolution, its highimpact activities, and for bridging between the climate and NWP communities. The





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developments within the AC&C initiative were also very well received.

Vladimir Ryabinin gave an overview of the WCRP and its place within the World Climate Program (WCP) and the Earth System Science Partnership (ESSP). The founding objectives of the WCRP are to determine the predictability of climate and the effect of human activities on climate. More recently the scope of WCRP has broadened to connect with impacts and adaptation, and include capacity building. This reflects developments within the international community and priorities of



funding agencies worldwide. In principle, the WCP and ESSP provide natural vehicles for this broadening.

The COPES (Coordinated Observation and Prediction of the Earth System) initiative remains WCRP's Strategic Framework for 2005-2015. Implementing the COPES strategy is a continuing preoccupation of the WCRP but the guiding principle is that new initiatives or rearrangements of activities and responsibilities, for example between the core projects and cross-cutting activities, must be science driven while at the same time responsive to user needs. Within SPARC the CCMVal and DynVar activities are particularly well positioned to contribute to COPES. Seamless prediction, an underlying theme of COPES, will be the central theme of the WCRP/WWRP/ IGBP Modelling Summit to be held in May 2008.

In the discussion following the opening presentations a number of issues were noted. The importance of the stratosphere in climate simulations remains an abiding issue that will be addressed in a focused

way within the DynVar activity. Surface processes must be taken into account in modelling of the whole atmosphere and so are important for SPARC. In this respect interactions with activities such as SOLAS and iLEAPS should be considered. A solid suggestion arising from the discussion was that an update of the WAVAS report would be timely.

#### **Regional SPARC related research**

As precursor to the poster session that was held in conjunction with the Regional SPARC Workshop, Björn-Martin Sinnhuber provided an overview of the research that was presented during the preceding two days of the workshop and in the poster session. (See the report by Sinnhuber et al., in this newsletter.) Much of the work presented was related to the TTL and focussed on results from several observational campaigns. The Regional SPARC Workshop was very successful and holding it just before the beginning of the SPARC SSG meeting was synergistic. It is in the interest of SPARC to encourage and facilitate such activities in the future.

#### **SPARC** Themes

#### Detection/Attribution/Prediction

#### **Decadal Predictability:**

In an invited presentation to the SSG, Noel Keenlyside discussed recent work on decadal scale prediction as a combined initial and boundary value problem. Much of this work has focused on associating decadal scale variations in the 20th century with both natural and anthropogenic causes. There is evidence for multi-decadal variability in several areas where such variability may have strong socio-economic impacts (rainfall in the Sahel, hurricane activity, and Atlantic sea surface temperature). The mechanisms for these manifestations of variability are not certain. In specific instances they could involve internal modes of variability of the atmosphere, ocean or both.

There are several ways in which the stratosphere may play a role in decadal variability. Enhanced variance of temperature is found in the NAM/SAM regions where there are strong interactions between the troposphere and stratosphere. Variability in the oceanic meridional overturning circulation (MOC) may also be linked to annular mode variability. Decadal scale variability in the stratosphere is associated with a range of processes including solar forcing and ozone changes. It is anticipated that decadal predictions using initialized coupled models will play a role in the next IPCC assessment (AR5). The likelihood of an important role for the stratosphere in decadal variability of the troposphere (and vice versa) indicates the importance of including the stratosphere in such coupled prediction models. Understanding the role of stratospheric processes (chemistry, dynamics, solar forcing) in decadal scale variability of the earth-atmosphere system is an important challenge for SPARC.

#### **Temperature Trends:**

An update on the work of the SPARC Temperature Trends Assessment group was provided by **Bill Randel**. The most recent meeting of the group was held in Washington in April 2007. A paper on updated stratospheric temperature trends is near completion with submission expected before the end of 2007. The most recent temperature trends time series include extensions back to the 1960s using radiosonde data and recent adjustments remove the effects of biased radiosonde stations on the time series. The paper will also incorporate recent updates concerning SSU data. There is now an appreciation of the fact that  $CO_2$  increases have raised the altitude of the SSU weighting functions, resulting in an apparent positive temperature trend in the stratosphere. It has also now been realized that the highest of the so-called X channels (47X) has weighting functions that are strongly dependant on latitude, making interpretation of global temperature trends more difficult. This channel will, therefore, likely be excluded from the analysis.

Outstanding issues for the future include: (a) continued homogenization of radiosonde data sets; (b) further analyses of historical satellite data (independent analysis of SSU data would be particularly valuable); (c) use of GPS as a climate monitoring tool; and (d) improved capability of reanalyses for the stratosphere.

With regard to the latter, Bill Randel also drew attention to a number of developments and issues in regard to reanalyses. The Third WCRP International Conference on Reanalysis will be held in January 2008 in Tokyo. A number of papers on stratospheric topics have been submitted. Other reanalysis developments include:

- (a) An ECMWF "interim reanalysis" is being produced using 4-DVar. This will cover the period after 1989, and address several problems evident in ERA40. Production began in 2006 and will reach the present day in 2008, after which it will be updated in near-real-time.
- (b) Homogenization of SSU data for future reanalyses is in progress at ECMWF. This includes documenting biases between overlapping SSU instruments, and collecting information on cell pressure losses for each SSU instrument. This will improve the time consistency of stratospheric analyses, especially in the 1980's. Proper handling of the transition from SSU (which ends in 2005) to AMSU (which begins in 1998) will be critical to stratospheric temperature trends.
- (c) At NASA, GMAO is about to begin production of a satellite-era (1979present) reanalysis, termed Modern Era Retrospective analysis for Research and Application (MERRA).



SPARC Co-Chairs: T. Peter and T.G. Shepherd

#### Stratosphere-Troposphere Dynamical Coupling

Mark Baldwin discussed several aspects of current activities relevant to stratospheretroposphere coupling, beginning with a brief report on the WCRP Workshop on Seasonal Prediction that was held in Barcelona in June 2007. In addition to a keynote talk by Mark Baldwin ("Why should we care about the stratosphere?") there was a SPARC session entitled Stratospheric Processes and Seasonal Prediction. The programme and a number of the presentations are available for downloading at the TFSP web pages: http://www.clivar.org/ organization/wgsip/spw/spw\_main.php.

Mark Baldwin also noted the upcoming Chapman conference in Santorini (September 24-28, 2007) which covers a broad range of topics on stratospheric processes and modeling, includes seasonal prediction and climate change. In general, the role of stratosphere-troposphere dynamical coupling has not received the attention it deserves in the IPCC assessments or within operational seasonal prediction activities. This issue is one that can be addressed in general within the DynVar activity. Mark Baldwin proposed that a simplified annular mode index could become a standard diagnostic of stratosphere-troposphere coupling in prediction models and climate change assessments, which is much less computationally demanding to produce than the full 3-dimensional EOF.

**Paul Kushner** discussed progress in the Dynamics and Variability (DynVar) activity. This activity was proposed at the 2006

SSG meeting and subsequently endorsed by the JSC at its March 2007 meeting. In the intervening time substantial progress has been made in developing DynVar, following the plan published in SPARC Newsletter No. 29. A web site for the Activity has been set up at http://www. sparcdynvar.org/. Preliminary analyses are being carried out to refine the science goals. A planning workshop will be held in Toronto in March 2008, in conjunction

with a workshop on gravity waves (see rejuvenated gravity-wave initiative below). It is anticipated that these workshops will be synergistic as it is now well established that gravity-wave drag parameterizations play a significant role in model simulations of stratospheric dynamics and stratospheretroposphere coupling.

#### *Chemistry – Climate Coupling*

#### CCMVal Update:

Veronika Eyring summarized recent developments within the CCMVal activity. CCMVal had achieved some notable successes in the last two years, most visibly the organization and analysis of the CCM simulations that provided a major underpinning for the 2006 WMO/UNEP Ozone Assessment and which were also included in the IPCC AR4. In large part these successes were the result of careful planning, effective engagement of the CCM community, and timely completion of sub-projects. Two summary papers on the REF1 (past) and REF2 (future) CCM simulations have been published in JGR (Eyring et al., 2006, 2007), and several more incomparison papers based on the BADC archive are currently in progress.

The 3<sup>rd</sup> CCMVal workshop, held in Leeds, UK in June 2007, was very well attended and successful (see the report in this newsletter).

**Darryn Waugh** summarized CCMVal's plans to prepare a SPARC report on evaluation of CCMs. The aims of the report are to evaluate the ability of CCMs to represent the stratospheric ozone layer, stratospheric

climate and variability, and the coupled ozone-climate response to natural and anthropogenic forcing. The report will be completed by late 2009 so as to enable its use as a source of timely information for the next WMO/UNEP Ozone Assessment and the expected IPCC AR5. Lead authors for all 10 chapters have been identified, and the Leeds workshop helped to define the chapter outlines.

An innovative feature proposed for this report is that it will attempt to assign quantitative evaluations (scores) to model performance for different diagnostic tests. This will enable a quantitative assessment of improvements made during model development, and make it possible to assign relative weights to the projections by the different models and to form a "best estimate" that takes into account differing abilities of models to reproduce key processes. This proposal was discussed vigorously. Basic requirements for such a grading system are that it be transparent in its application and that the "best estimates" derived from it also include measures of uncertainty.

New CCM simulations in support of the CCMVal report and future assessments were discussed at the CCMVal workshop and subsequently refined (see the report in this newsletter).

#### The Role of Halogens in Ozone Depletion: A Proposed SPARC Workshop/ Study:

The implications of new data on the photolysis rate of the ClO dimer were raised in a presentation by Markus Rex in the Regional SPARC Workshop, and then discussed again at intervals throughout the SSG meeting. This issue is considered to be of such concern that a timely action by SPARC is required. A proposal, presented by **Mike Kurylo**, for a focused workshop and well defined follow-on deliverables was strongly supported. The workshop will have three principal objectives:

- (i) Evaluate the consequence of the new data on the photolysis rate of the ClO dimer on simulations of stratospheric ozone depletion, particular in winter polar regions.
- (ii) Evaluate the new results for the photolysis rate and the type of further studies that are required to resolve current differences in laboratory studies.
- (iii) Assess the qualitative and quantitative

evidence from laboratory studies, field observations and models that links ozone depletion to active chlorine and bromine amounts in the stratosphere.

The main deliverables will be a white paper describing points (i) and (ii) above and a peer-reviewed manuscript describing point (iii). Key participants must include laboratory kineticists, field experimental investigators, and modellers. The workshop should be held in early 2008 at the latest with deliverables following in 6-12 months, so as to be available for the next WMO/UNEP Ozone Assessment.

#### Atmospheric Chemistry and Climate–SPARC/IGAC Interactions

A. R. Ravishankara reviewed progress in the WCRP/IGBP Atmospheric Chemistry and Climate (AC&C) Initiative. The report published in SPARC Newsletter No. 29 summarizes the background and motivation for AC&C and provides details of its structure and activities. Progress has been steady, but there are a number of issues that 4 require attention in the coming year. These include engaging activity leaders from outside of the US, convening a steering committee for AC&C, and beginning prototype model simulations. The first-phase AC&C activities, as they involving modeling, will have to deal with data managing and archiving issues that are similar to those that have been and/or are continuing issues for SPARC (CCMVal in particular).

#### Issues Arising from the Recent Assessments

#### The 2006 WMO/UNEP Ozone Assessment

Some key issues arising from the 2006 Ozone Assessment were discussed by Shepherd and Randel in an article in SPARC Newsletter No. 29. **Ted Shepherd** reiterated these, emphasizing that despite substantial improvement in CCMs in recent years, serious quantitative discrepancies remain. Some of the discrepancies seen in the assessment in terms of the magnitude of ozone depletion may reflect weaknesses with the analysis method which tried to find a 1980 baseline from data after 1980. However, the absolute magnitudes of polar total ozone in the CCMs are generally poor, especially in the Arctic. **A.R. Ravishankara** noted that the remit emerging from the recent Meeting of the Parties to the Montreal Protocol is to deal with a number of key issues such as assessment of the state of the ozone layer and its progress towards recovery; assessment of the mutual impacts of climate change and ozone recovery, and assessment of consistent approaches to evaluating the impact of very short-lived substances, including potential ODS substitutes on the ozone layer.

These issues raise several key questions for the 2010 assessment: (a) Can ODSs be dealt with separately from ozone? (b) What is the "baseline" (and is it even needed?), in particular are pre-1980 values the most appropriate? (c) Is the idea of "super-recovery" needed? (d) Is current understanding consistent (*e.g.* ozone trends in the tropics, vertical profile and regionality of ozone trends)? (e) Is it possible to better quantify the effects of polar ozone depletion on midlatitude depletion?

A number of steps can be taken by SPARC to "shape" the next assessment including: (a) holding a workshop and perhaps constituting a working group on ozone recovery, (b) developing better approaches to quantifying age of air, lifetimes of ODSs, and dealing with very short-lived substances (perhaps within the AC&C initiative), (c) facilitating through CCMVal continued contributions on climate-ozone linkages.

#### IPCC AR4

In an invited presentation to the SSG, **Piers Forster** reviewed issues for SPARC arising from the IPCC AR4. He noted that the AR4 had an unprecedented level of SPARCfriendly authorship and, in his view, stratospheric issues were very well covered in the report. For example, a basic conclusion of the AR4 is that the observed pattern of tropospheric warming and stratospheric cooling is very likely due to the combined influences of greenhouse gas increases and stratospheric ozone depletion.

Notwithstanding the growing recognition of the role of the stratosphere, climate change science is diversifying with more components of the climate system taking on added significance, and the onus is on the SPARC community to prove its continued relevance. There were many gaps in IPCC AR4 that are relevant to SPARC. In regard to forcings, stratospheric ozone has not been updated since the IPCC TAR, stratospheric water vapour remains a key uncertainty, and solar indirect effects were not evaluated. Other gaps include the little attention given to (a) variability and change of mid to upper stratospheric temperatures, (b) the dynamical response to solar forcing and volcanoes, (c) the role of the stratosphere in simulations of modes of variability (SAM/NAM/QBO) their importance for surface climate change, and (d) directly relating stratospheric processes to regional surface changes — particularly outside of Antarctica.

Although the role of the stratosphere is, for the first time, mentioned in the chapter of the AR4 dealing with projections of climate change, climate modelling groups still don't pay sufficient attention to the role of the stratosphere (as noted also in the presentation of Mark Baldwin). Two key issues that SPARC should address are: (a) the discrepancy between what the report says in terms of understanding and what is in the models (since modelling groups must be convinced that the stratosphere is relevant if they are going to commit resources to its representation); (b) the need to provide information in a correct, user-friendly way for the next IPCC report (e.g. calculate forcings, effects on surface; tell modelling groups what resolution is needed in the stratosphere).

#### Issues for IPCC AR5

Although an IPCC AR5 is not yet assured, planning for modelling and analysis activities in support of it are under way in most of the major modelling centres and were a major focus of the recent WGCM meeting in Hamburg. **Veronika Eyring** and **Marco Giorgetta** represented SPARC at this meeting. They summarized for the SSG the discussions and issues of concern to SPARC that were raised at the meeting.

SPARC and AC&C contributions to the coordinated AOGCM and ESM experiments in support of AR5 (if there is one) should include providing ozone fields. As a first step, a "best guess" of ozone from the CCMVal simulations performed in support of the recent WMO/UNEP Ozone Assessment could be used to derive ozone changes to drive the IPCC models. However, there are a number of issues for SPARC and AC&C to resolve in addressing this goal. What is the best approach to providing chemical fields such as ozone for use

in ESM simulations: existing CCMVal runs or new runs that are consistent with new scenarios? What is the optimal approach to produce a best guess and uncertainties: multi-model or weighted mean? How to handle grading and weighting issues? Should observations be used for periods up to the present day and combined with projections for the future? How can model results and observations be combined so as to account for uncertainties and biases? (See also the report on CCMVal reference and sensitivity simulations in this newsletter).

#### **Cross-Cutting Activities**

#### Gravity-wave Initiative

Activity within the SPARC gravity-wave initiative has waned in recent years. However, understanding the role of gravity waves in the dynamics of the atmospheric general circulation and improving gravity-wave drag parameterizations continues to be a critical modelling issue. With the advent of DynVar, rejuvenation of the gravity-wave initiative is important.

**Joan Alexander** summarized historical and current gravity-wave issues relevant to SPARC and some new research developments, and suggested some research activities that could form the basis of a rejuvenated SPARC gravity-wave initiative.

Progress in computing technology has enabled simulation of vertically propagating gravity waves and their interaction with the larger scale flow on increasingly broad ranges of spatial and temporal scales. Advances have been made in the use of data assimilation techniques to estimate gravitywave drag from wind observations. Progress has also been made in estimating gravity-wave properties, such as the magnitude of vertical momentum flux, from satellite measurements.

An immediate goal of a new gravity-wave initiative for SPARC could be to apply new observational constraints on momentum fluxes to parameterizations in global models. In the near term it would also be valuable to combine these observational constraints with "missing force" determinations from various analysis systems to examine the strengths and weaknesses of various parameterization schemes.

It was agreed that a useful first step in

developing a rejuvenated SPARC gravity-wave initiative would be to convene a workshop in which modellers and observationalists met together to begin the process of developing new model diagnostics and observationally-based quantities that may be compared. In discussion it was clear that the new SPARC gravity-wave initiative will be synergistic with the DynVar activity and that the two efforts should evolve in a closely collaborative way. The proposed first step of holding a gravity-wave workshop jointly with the DynVar workshop in March 2008 was endorsed by the SSG.

#### SOLARIS and Solar Variability

Katja Matthes and Kuni Kodera discussed recent activities and current issues within the SOLARIS project. A summary of the first SOLARIS workshop was published in SPARC Newsletter No. 28 (Matthes *et al.*, 2007), and an analysis of the solar signal in CCMVal REF1 simulations has been published (Austin *et al.*, ACPD, 2007).

An understanding of the processes of importance for simulating the solar signal is developing. However, many effects are still not well understood. Newer CCMs show better agreement with observations but the reasons are not fully undersood. Variable solar forcing and variable SSTs appear to play a role. The role of the nonlinear interaction between the OBO and the solar signal in climate simulations is not well understood. Additionally, there is evidence for a difference, between maxima and minima of solar forcing, in the magnitude and vertical extent of the stratospheric cooling that is associated with increasing CO<sub>2</sub>. A goal of SOLARIS is to address these issues through a series of carefully designed and coordinated modelling studies, preferably involving 3-4 different modelling groups. These may involve both CCMs and AGCMs. Among the experiments planned for the near future are (a) simulations (approximately 50 simulated years in length) using CCMs with a fixed solar cycle and variable QBO, and (b) AGCM simulations with prescribed heating rates (from whole atmosphere CCMs such as WACCM or HAMMONIA) plus variable QBO (internally generated or prescribed).

Upcoming SOLARIS project activities include the CAWSES symposium in Kyoto in October 2007 and the SOLARIS session at the EGU meeting in April 2008 (Solar Influence on the Middle Atmosphere and Dynamical Coupling to the Troposphere, convenors: Katja Matthes, Kuni Kodera and Lesley Gray).

#### Aerosols and PSCs

On behalf of Larry Thomason and collaborators, Tom Peter summarized recent and ongoing work on characterization of Polar Stratospheric Clouds with CALIPSO. Significant gaps in knowledge concerning PSCs still exist including understanding of the role of large solid particle formation (NAT rocks) and their denitrification potential, and accurate representation of PSCs in global models and their quantitative influence on predictions of future ozone loss. CALIPSO provides a comprehensive picture of PSCs. Ongoing and future work includes: (a) utilizing combined measurements from CALIPSO and other instruments to investigate evolution and formation of PSCs, (b) producing robust inferences of PSC bulk microphysical properties such as surface area density, (c) partnering with chemical modelling groups to assess and improve PSC parameteriza- 5 tion schemes.

#### The Tropical Tropopause Layer – SPARC/IGAC/GEWEX Links

Thomas Birner summarized the history and recent activities within the collaborative activity between SPARC, GEWEX, and IGAC on the role of deep convection in the tropical tropopause layer (TTL). This activity began with the TTL workshop in Victoria, Canada in 2006. Among the issues raised at this workshop were: (a) questions concerning the performance of cloud-resolving models (CRMs) at TTL altitudes (important parametrizations such as subgrid scale mixing and microphysics are conventionally tested at much lower altitudes), (b) the supersaturation puzzle (do we understand cloud/condensation microphysics at TTL altitudes/temperatures?), and (c) using results from the many recent field campaigns to explicitly address TTL questions.

Since the Victoria workshop some specific efforts have begun. A TTL case study is being developed to evaluate the role of different microphysical processes in CRMs in the water vapour budget of the TTL and water vapour transport across the cold point. Encouraging preliminary results for this case study have been generated by W. Grabowski. It is planned to present this case study for consideration by the GEWEX/GCSS deep convection working group at the pan-GCSS workshop in June 2008.

Other work that is promising as a means of understanding dynamical influences of convection in the TTL includes studies with the highly anisotropic tropics-wide domain (1 km zonally, 40 km meridionally) modeling framework used by Shutts and collaborators (Shutts *et al.*, DAO, 2007) to study the dynamics of Hadley cells, convectively coupled waves, *etc.* the recent evaluation of the ability of GCMs to simulate key features of the TTL (Gettelman and Birner, JGR, in press).

#### The SPARC Tropopause Initiative

At the 2006 SSG meeting, Andrew Gettelman, Peter Haynes, and Marv Geller were tasked with looking at the status of tropopause research and reporting back to the SSG on the merits of an organized activity on this topic. A summary article 6 (Gettelman *et al.*,) which included a proposal for such an activity was published in SPARC Newsletter No. 29. Peter Haynes summarized the current status of this initiative proposal. He noted that a number of SPARC workshops dealing with tropopause related topics have been held since 1993 and reported upon in SPARC newsletters. The areas of interest in tropopause related research can be broadly subdivided into topics relating to the tropics (TTL), extratropics (ExTL), tropical-extratropical interaction, and climate change.

In regard to the tropics the research situation and state of activities is relatively healthy. A TTL paradigm has emerged and evolved over last 10 years and there is active research dealing with stratospheric water vapour, the TTL as the gateway to the stratosphere for tropospheric source gases, particularly VSLS, many measurement campaigns (SOWER, Aura validation, SCOUT-O3, ACTIVE, TC4, AMMA) and associated meetings. In addition, the SPARC-GEWEX- IGAC TTL initiative is developing.

In regard to the extratropics there have been activities stimulated by previous and new observations and measurement campaigns, but there has not yet been a significant convergence of ideas. In regard to tropical-extratropical interaction there are several issues concerning two-way interactions that should not be overlooked in the current focus on the TTL. The importance of transport from the TTL to the extratropical lowermost stratosphere is being rediscovered, *e.g.* the largest potential impact of VSLS on ozone. These interactions play an important role in setting the chemical composition of extratropical lowermost stratosphere and its temporal (*e.g.* seasonal) variation. Transport from the extratropics likewise plays a role in setting the structure of the TTL.

In regard to climate change, there are many interesting science questions: How will the tropopause and stratosphere-troposphere exchange change and what does this mean (*e.g.* taking a particular tropopause definition)? What is the role of the tropopause region (dynamical and chemical structure) in climate change ('climate sensitivity to changes in tropopause region')? What is the role of the UTLS in dynamical coupling between troposphere and stratosphere? Are chemical-climate interactions in the UTLS the next challenge for CCMs? More programmatically, is there a gap in AC&C between the CCMVal and TropChem activities?

A web site (http://www.acd.ucar.edu/ sparctrop) has been set up as a communication medium with links to the SPARC Office, data, papers, and other activities (*e.g.* CCMVal). Upcoming relevant activities include the UTLS session at the AGU meeting (Fall 2007), and TTL and Extratropical UTLS sessions at the EGU meeting (Spring 2008). Possible future activities include a focused workshop in 2009 in light of the above and a study of chemical-climate interactions in the UTLS.

#### SPARC Data Assimilation Working Group and SPARC-IPY

**Saroja Polavarapu** summarized activities of the data assimilation working group over the last year. The combined SPARC-DA and SPARC-IPY workshop in Toronto in September 2007 was very successful (see the report in this newsletter). Because of the SPARC General Assembly in 2008, the next SPARC-DA workshop will not be held until 2009 at a location yet to be determined.

Ellie Farahani gave an overview of the SPARC-IPY activity. A major current fo-

cus within the SPARC-DA working group is on addressing the data assimilation component of the SPARC-IPY activity. The new SPARC-IPY archive of analyses is now receiving data. This archive will include data from two Canadian assimilation systems (the operational GEM-BACH and the research CMAM-DAS systems) as well as from other major operational centers such as ECMWF, Met Office, NCEP, GMAO, and KNMI. SPARC-IPY data is being made available through the SPARC Data Center and can be accessed by registering as a SPARC-IPY user following the procedures documented on the Data Center web site.

While the data assimilation component of SPARC-IPY is under way and functioning well, there are a number of other aspects of the activity, predominantly associated with the observational component, that are more diverse and in varying states of progress. Several of these were reviewed at the workshop. Issues such as acquisition and management of observational data and outreach were also discussed. (See the workshop report in this newsletter).

**Pablo Canziani** gave a brief summary of ongoing work on stratosphere-troposphere coupling studies at high southern latitudes and work on Antarctic Historical Data analysis. This involves recovery and consistency checking of historical data sets in the region, particularly for Antarctica, where there are few but valuable observations starting after the Second World War.

### Coordination with other agencies and programmes

Jörg Langen presented an update of ESA activities relevant to SPARC. The ERS-2 and Envisat satellites are currently in orbit and performing well. Envisat carries the GOMOS, MIPAS, and SCIAMACHY instruments. The main objectives of these satellites are to provide accurate stratospheric ozone profiling for studies of stratospheric chemistry and dynamics. The expected lifetime of Envisat is 2014. Future approved Earth Explorer missions include the ADM-Aeolus and EarthCARE missions. ADM-Aeolus is a wind profiling mission with an expected launch date in 2009. The Earth Clouds, Aerosol and Radiation Experiment (EarthCARE) mission involves a collaboration between ESA, NICT, and JAXA. Its mission objective is to quantify aerosolcloud-radiation interactions so they may be included correctly in climate and numerical weather forecasting models.

Several candidate Earth Explorer missions are under consideration, for the most relevant for SPARC being PREMIER (PRocess Exploration through Measurements of Infrared and millimetre-wave Emitted Radiation)

**Rolf von Kuhlman** discussed activities related to atmospheric composition and climate within the German Space Agency (DLR). There is strong DLR input into current and planned ESA missions dealing with atmospheric composition. However, there is no dedicated budget line in DLR for atmospheric missions. The German strategy builds on supporting activities and technology developments for European missions, utilizing the high level of competence within DLR in lidar and high spectral resolution optical systems.

Mike Kurylo presented an update on measurements of atmospheric composition within the NASA Earth System Science program. This program employs a range of observing systems including satellites, aircraft, balloons, and ground-based observing systems. There have been notable accomplishments in this program. The satellite measurement program has produced significant global observations relevant to ozone (e.g. 25 years of merged TOMS and SBUV measurements) and ozone chemistry, air quality, and climate. Valuable supplementary measurements have come from various sub-orbital field campaigns and long-term ground-based observing networks. Modelling and data analysis systems have been developed to help with interpretation of satellite data and contributed to the latest WMO/UNEP assessment of ozone depletion.

A number of NASA satellite missions and programs for measurement of atmospheric composition may be limited in the future by funding constraints. A number of sub-orbital field programs for science and validation are planned for coming years but several are subject to uncertainties in either platform availability or availability of resources.

**Shuji Kawakami** presented a survey of current and planned activities within the JAXA Earth Observation Program. Currently the program focuses on the Asia-Pacific region and priority areas are (a) reduction and prevention of disasters, (b) climate change including water-cycle variation, and (c) global warming and carbon cycle change.

Within the climate change/water cycle program currently operational instruments on the AM SR-E platform include the TRMM precipitation radar and passive microwave radiometers (AQUA) for measuring surface variables (SST, sea ice, soil moisture). Follow-on and expanded missions are planned for 2009 and beyond to enable measurement of a range of variables including surface wind speed, temperature, sea ice concentration, soil moisture, integrated water vapour and cloud water, precipitation, and snow depth. JAXA will provide a cloud profiling radar as a component of ESA's EarthCARE payload.

Christian von Savigny gave an overview of the activities of the Limb Working Group which includes the OSIRIS, SAGE III, SCIAMACHY and OMPS teams. This group has held annual workshops for the last four years, co-sponsored by WCRP/SPARC, which have focussed on algorithm development, sensitivity analyses and error budgets, validation of data products, scientific applications, and common problems and solutions. The limb community is growing, and workshops/conferences will continue in the future.

Measurements with current and previous (SAGE II and III, HALOE, POAM III) limb scatter instruments have produced a wide range of products including vertical profiles for several gaseous chemical constituents as well aerosol extinction and PSC measurements. The limb-scatter instruments have demonstrated great potential, and will fill the gaps left by the shut-down of solar occultation instruments. Future limb-scatter missions are needed to provide global profile information of relevant minor constituents and aerosols.

**Stella Melo** presented an overview of the Canadian Space Agency (CSA) Atmospheric Environment Program and current and planned missions. Currently operational missions include the MOPITT instrument on the TERRA satellite, OSIRIS on the Odin satellite, ACE-FTS and MAESTRO on SciSat, and partnership activities in the NASA CloudSat mission. MOPITT has been in operation since 1999 and has produced the longest existing global record of carbon monoxide measurements. However, as the MOPITT technology is now 10 years old a follow-on instrument (MOPITT-II/MAPLE) is currently under development. OSIRIS was launched in 2001 and produces measurements of ozone in the 7-60 km altitude range and of NO<sub>2</sub> and aerosols in the 10-40 km range. Aerosol extinction profiles are currently available and work is under way to produce additional products including number density and size distributions of sulphate aerosols. ACE-FTS and MAESTRO were launched in 2003 and together provide profile measurements of a large number of chemical species. They will be continued at least through the IPY period. The possibility of flying an ACE-FTS follow-on is under consideration.

The one future CSA atmospheric mission currently in the works is Chinook, which consists of SWIFT (which will measure stratospheric winds and ozone fluxes) and a GPS receiver known as ARGO. However, there are some budget con-7 cerns and the mission is currently on hold pending further technical development. It was noted in discussion that SWIFT's measurements will be unique and would be of particular interest to SPARC, given the growing recognition of the importance of tropical stratospheric winds in climate variability and stratosphere-troposphere coupling, and the fact that existing knowledge of tropical winds is very poor.

#### **Update from Japan**

Sachiko Hayashida reported on the new structure of the Science Council of Japan (SCJ) and its implications for the SPARC and IGAC communities in Japan. She also provided an update on the status of the ILAS/ILASI-II and SMILES missions.

The current structure of the SCJ includes a WCRP/IGBP joint committee with subcommittees for some of the WCRP and IGBP projects including a sub-committee for SPARC, currently chaired by S. Hayashida. Both the SPARC and IGAC communities are active in Japan — for example a successful SPARC session was held at the 2007 meeting of the Japan Geosciences Union (JGU). However, a concern is that these two communities do not interact strongly with each other and the SPARC community is less visible than the IGAC community. Increasing interactions and collaborations between the SPARC and IGAC communities in Japan is desirable and would benefit both the Japanese and international research programmes.

The ILAS/ILAS-II project ended in March 2006, but data provision is ongoing through web sites (http://www-ilas.nies. go.jp/, http://www-ilas2.nies.go.jp/). S. Hayashida summarized several recent scientific results obtained using ILAS and ILAS-II data. SMILES (Superconduc-Submillimeter-WaveLimb-Emission tive Sounder ) will be launched in 2009. Its objective is to provide measurements of trace gas compositions in the 10-60 km altitude range with a latitudinal coverage between 65°N and 38°S. Target gases include O<sub>2</sub>, HCl, ClO, HO<sub>2</sub>, HOCl, BrO, O<sub>2</sub> isotopes, HNO<sub>2</sub>, and CH<sub>2</sub>CN.

#### Discussion of the Geoengineering Proposal of P. Crutzen

Tom Peter led a discussion on the proposal by P. Crutzen published in an article in Climatic Change in 2006 entitled "Albedo enhancement by stratospheric sulfur injections: A contribution to resolve a policy dilemma?"

This proposal has already received much attention in both popular and scientific literature. Much of the discussion has focused on the impacts on the lower troposphere and surface of introducing such a sunblocking layer in the stratosphere. Among the concerns that have been raised are that such a measure, if indeed viable, may have undesirable consequences such as interfering with efforts to address the root cause of the global warming problem, namely human production of CO<sub>2</sub> and other greenhouse gases through burning of fossil fuels. With such an outcome a number of serious environmental issues, such as acidification of the oceans due to increased CO<sub>2</sub> loading in the atmosphere, would remain unaddressed.

There has been less discussion of the impact that such a measure may have on the stratosphere. SPARC is the authoritative body to address this. The question considered was whether it is already now timely for SPARC to do so. The discussion on this issue was vigorous. The consensus view that emerged was that there is currently insufficient information for SPARC to issue an authoritative statement. Nor does it seem that SPARC would be well advised to undertake a study of the issue on its own (especially given the current commitments within CCMVal). However, the issue is important and merits serious study, possibly as part of a wider geoengineering study that could be carried out within the WCRP. Therefore the Co-Chairs will bring this issue forward to the next meeting of the WCRP JSC in April 2008.

### Update from the SPARC Data Center

**Stefan Liess** reported on the current status of the SPARC Data Center funding, hardware, data holdings, and planned enhancements in software. NASA has funded the Data Center operations since 1999. A proposal for new funding for the SPARC Data Center has been under consideration by NASA for the past two years. The first year of this proposed new funding has recently been awarded but with a 20% reduction from the originally proposed level. Options for supplementary funding to make up this difference are being considered.

Hardware upgrades for the Data Center are under consideration. Also steps are now being taken to establish a mirror site for the Data Center at Kyoto University. Enhancements of online downloading and plotting software are also being developed.

#### The 4<sup>th</sup> SPARC General Assembly

Elisa Manzini summarized the status of preparations for the 4th SPARC General Assembly (see the announcement in this newsletter). Planning is well under way with arrangements for the venue (the CNR Congress Centre, Bologna), local services, and registration services having been made. The scientific programme committee, jointly chaired by Peter Haynes and Tom Peter, is coordinating planning of the programme with the corresponding committee for the IGAC conference which will be held in the following week in Annecy-le-Vieux, France. Discussions are under way to coordinate registration fees for these two conferences to encourage cross-participation. A significant issue for the coming months is arrangement of funding to support participation by young scientists, scientists from developing countries and other needy participants. The SPARC Office will assume responsibility for coordination of funding initiatives to provide such support.

# Closure of the 15<sup>th</sup> session of the SSG and plans for the next SSG meeting

Because of the juxtaposition of the SPARC and IGAC conferences, the 2008 SPARC SSG meeting will not be held immediately following the General Assembly. Instead it will be held later, at a date to be determined, in Toronto, Canada, hosted by the SPARC Office.

The 15<sup>th</sup> session of the SPARC SSG closed on Friday afternoon, with the Co-chairs thanking all for participating and reiterating thanks to Prof. John Burrows and staff of the IUP for the excellent arrangements and assistance that was provided during the meeting.

