Report on the 12th Session of the SPARC Scientific Steering Group

Victoria (BC), Canada 9-12 August 2004

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Participants of the SSG Meeting in Victoria. From left to right
1st row: V. De Luca, S. Doherty, D. Conway, K. Carslaw, T. Peter, U. Schmidt, A. R. Ravishankara, C. Granier, J. Kerr, T. Shepherd, T. McElroy, N. McFarlane, R. Michaud, J.R. Drummond
2nd row: R. Menard, M. Baldwin, D. Pendlebury, K. Kodera, D. Hartmann
3rd row: M.A. Geller, S. Polavarapu, S. Pawson, T. Wehr, V. Ryabinin, S. Yoden, W. Randel, V. Ramaswamy, V. Eyring, M. Kurylo, P. Canziani, L. Thomason, D. Carson, C. Michaut, A. O'Neill, K. Hamilton, J. Burrows, M.-L. Chanin, V. Yushkov

Introduction

The 12th session of the SPARC Scientific Steering Group (SSG) was held at Dunsmuir Lodge near Victoria (BC), Canada, at the invitation of **N. McFarlane**, the Director of the SPARC International Project Office (IPO).

Opening the meeting, **A. Ravishankara**, co-chair of the SPARC SSG, emphasized that one of the most important tasks for SPARC and the SSG session was to flesh out the scientific content of the three major project themes and define ways for their implementation. Examples of issues of high importance for SPARC are microphysics modelling, Tropical Tropopause Layer (TTL) chemistry, upper troposphere/lower stratosphere (UT/LS) interaction, the generation of stratospheric indicators of climate change, solar activity, and, increasingly, laboratory experiments. GRIPS is drawing to a close as a key successful SPARC activity, and optimal organization of future intercomparison of models is a topic of high value. In addition to fundamental research, SPARC will continue its practice of conducting focused assessments, and specialists will actively contribute to the ongoing work of the IPCC Fourth Assessment Report. SPARC must be prepared for the new WMO ozone assessment that will start soon, and must start collecting ideas for future IPCC assessments. SPARC must also decide how to maintain and foster closer connections with projects within and outside WCRP, such as CLIVAR and GEWEX, IGAC (IGBP), and groups like WGNE, and how to effectively contribute to new WCRP initiatives such as COPES.

WCRP Comments

D. Carson presented the new overarching framework for the World Climate Research Programme (WCRP), entitled "Coordinated Observation and Prediction of the Earth System" (COPES). He reviewed the development of the WCRP since its formation in 1980 under the sponsorship of the World Meteorological Organization (WMO) and the International Council for Science (ICSU) with additional support from the Intergovernmental Oceanographic Commission (IOC) of UNESCO starting from 1993. In the nearly 25 years of its existence, the main goals of WCRP have been to determine the predictability of climate and the effects of human activities on climate.

There are now a number of new challenges facing the WCRP:
- The problem of seamless prediction over time periods ranging from weeks to decades and longer,
- Prediction of the broader climate/Earth system,
- Demonstrating the use to society of WCRP-enabled science and predictions,
- Efficient use of new opportunities such as new and increasing data streams, growth of computer capacities, and complexity and breadth of models and data assimilation schemes,
- Interaction with other Earth System Science Partnership (ESSP) programmes (DIVERSITAS, IGBP, and IHDP apart from WCRP).

The main goal of COPES is to facilitate prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society, and to predict the entire climate system.

Initial suggestions for COPES activities include determining the predictability potential of current systems, with focus on seasonal time scales, further developing and testing ensemble forecasting methods, determining the scientific basis for, best approaches to and current skill of projections of regional climate change, developing well-tested chemistry-climate models (CCMs), and addressing projections at the decadal time scale. Formulation of specific tasks should be made in close consultation with the wider WCRP community.

The Joint Scientific Committee (JSC) of WCRP will oversee COPES. The WCRP Modelling Panel will coordinate modelling initiatives across WCRP, focus on climate system prediction, and oversee data management in modelling activities. The Working Group on Observations and Assimilation (WGOA) will coordinate synthesis of global observations, information and data management across WCRP and facilitate interactions with other agencies, and observing systems.

New challenges for the ESSP include developing operational tools capable of monitoring and simulating the Earth System including the atmosphere, ocean, land, and cryosphere with physical, chemical and biological processes, and introducing the human dimension. This will require collaboration of the ESSP partners and the establishment of a framework for the integration, into which existing and planned research can contribute. This process should be driven by the science of global change.

The SSG exchanged views on how SPARC could contribute to COPES. The obvious roles are providing guidance on how to prescribe atmospheric composition and to initialize the stratosphere in a range of applications, and proposing/implementing diagnostic studies and numerical experiments. Concerns on limited WCRP resources were raised and a need for close coordination between WCRP COPES and IGBP GAIM were expressed. It was also noted that the future activities would strongly depend on developments within the WMO and the Global Earth Observation System of Systems (GEOSS).

Review of the main Events since the last SSG

The 3rd SPARC General Assembly (SPARC GA) was held in Victoria on 1-6 August 2004, in the week prior to the SSG meeting. The main theme of the SPARC GA was chemistry and climate. A discussion on the lessons learned and consequences for SPARC was led jointly by **T. Shepherd** and **A. Ravishankara**, co-chairs of the Scientific Committee for the SPARC GA, and **N. McFarlane**, chair of the Local Organizing Committee. The general agreement was that the SPARC GA was very successful. The SPARC GA web site would remain online until late in 2004 to allow access to the GA presentations.

Some key developments seen in the SPARC GA are:
- CCMs have reached a high level of maturity,
- Modern process studies of UT/LS and TTL are of interdisciplinary character and involve a combination of models and measurements,
- Detailed (*e.g.* cloud-resolving) modelling is coming into the fore,
- Connections are strengthening between studies of different time scales, from seasonal to climate,
- A view of coupled long-term changes, *i.e.* beyond trends, is emerging for temperature, water vapour, ozone, methane, etc.

The discussion suggested a number of possible future SPARC actions and initiatives motivated by these developments such as coupling of microphysics and gravity waves in models, potentially in contact with the GEWEX Cloud Systems Study; use of very high resolution models for designing observing systems; a need to validate numerical weather predictions in the TTL region including data obtained by airplane campaigns; inclusion of chemistry and higher stratospheric levels in new reanalyses, etc.

The new SPARC International Project Office (SPARC IPO)

N. McFarlane, the new Director of the SPARC IPO, reported on the relocation of the office to the Dept. of Physics at the University of Toronto (Canada). Sponsorship and funding for the new IPO comes from the Meteorological Service of Canada (MSC), the Canadian Foundation for Climate and Atmospheric Science (CFCAS), the Canadian Space Agency (CSA), the Climate Change Action Fund (CCAF), and the University of Toronto (in kind). In addition, the transition between the two offices has been greatly facilitated by extended visits of **C. Michaut**, manager of the SPARC Office in Paris. Arrangements for the transition have gone well. **V. De Luca**, the new office manager, and **D. Pendlebury**, the new project scientist, were present at the SSG meeting. Deep gratitude was expressed by the SSG to the new sponsors of the IPO and also to the Centre National de la Recherche Scientifique (CNRS), the Centre National d'Etudes Spatiales (CNES) and Meteo France, for the long support given to the project while the office was located in France.

Presentations from the Canadian Climate Research Community

A half-day of the session was devoted to presentations on Canadian stratospheric research.

J. Fyfe, on behalf of **D. Whelpdale** and the MSC, welcomed SPARC to Canada and expressed their pleasure at being able to support SPARC through the establishment of the SPARC IPO at the University of Toronto. The efforts of **N. McFarlane** and **T. Shepherd** ensuring that this opportunity became a reality were recognized.

D. Conway, Executive Director of CFCAS, reported on the role of CFCAS in funding Canadian research in climate science. The vision of CFCAS is to "enhance Canada's scientific capacity by funding the generation and dissemination of knowledge in areas of national importance and policy relevance, through focused support for excellent university-based research in climate and atmospheric sciences".

Funding priorities for the 2004-2005 period will be high latitude research into the Arctic and cryosphere, extreme weather including drought, marine climate and the use of technologies in research (remote sensing and satellites). Examples of funded projects related to SPARC are: (a) Measuring the Ozone Column from Astronomical Archives, (b) Stratospheric Indicators of Climate Change, and (c) Modelling of Global Chemistry for Climate. CFCAS is also a joint partner in funding the SPARC IPO in Canada.

R. Michaud reported on key activities of the CSA. The CSA was established in 1989 with the goal of integrating Canadian space activities such as Canada's contribution to the International Space Station, the RADARSAT and the Space Science Programmes.

There are three themes in the Earth Observations branch of CSA: the environment, resource and land-use management, and security and foreign policy. The priorities in the environment, remote sensing are: (a) better understanding of the key parameters and processes of the earth-atmosphere-ocean-cryosphere and biosphere systems and their inter-relationship; (b) impact of climate change on land, marine and atmospheric environments and the variations in key factors influencing the climate; (c) support to environmental policy and decision-making at all levels.

The CSA has focused its efforts on small payloads such as the Middle Atmosphere Nitrogen Trend Assessment (MANTRA) high-altitude balloon, which measures stratospheric composition and ozone chemistry. The 3rd field campaign occured in August 2004. Other small payloads include the Gravity Wave Imaging and Mapping (GWIM), which measures gravity wave (GW) activity in the upper mesosphere and lower thermosphere with a potential flight onboard Brazil's EQUARS scientific satellite in 2007.

J. Scinocca reported on research activities of the Canadian Centre for Climate Modelling and Analysis (CCCma). The primary activity is the ongoing development and application of global coupled climate models aimed at understanding past climate change and variability, and projecting future climate change under various GHG emission scenarios. CCCma is involved in a variety of collaborative projects with universities, most of them supported (often in partnership) by a combination of agencies including MSC, CCAF, CFCAS, and the National Science and Engineering Research Council (NSERC). These include projects in Regional Climate Modelling (RCM/URANOS), Middle Atmosphere Dynamics and Chemical Processes (CMAM/GCC), Climate Variability and Prediction (CLIVAR), Clouds and Chemistry (MOC2), Carbon Cycle (GC3M), Air-Sea Interaction/Coupling (SOLAS), and Aerosols Processes (CCAF project/CAFC).

The Modelling of Global Chemistry for Climate Project (GCC) is a focus for a major part of Canadian SPARC related research activities. The two central activities of GCC, done in cooperation with MSC and CSA, are the development and use of a CCM and a chemical climate data assimilation system. In summarizing its activities, **T. Shepherd** noted that it has several unique features. Among these is a strong team of research associates, responsible to the GCC project as a whole. Another feature is participation in numerous national and international collaborative activities. These include the WMO UNEP 2002 Ozone Assessment, SPARC/SCOSTEP Mesospheric Temperature Trends Assessment, Arctic Climate Impact Assessment (ACIA), GRIPS (radiation, GW drag, circulation response to doubled CO_2, and the representation of equatorial waves), SPARC Stratospheric Data Assimilation Initiative, and SPARC CCM Process-Oriented Validation Initiative.

S. Polavarapu reported on the Canadian Middle Atmosphere Model (CMAM) data assimilation activities and the new CMAM-FDAM (Facility for Data Assimilation and Modelling). The goal of the CMAM Data Assimilation System (CMAM-DAS) is to improve the understanding of middle atmosphere dynamics by confronting a climate model with observations. A direct, rather than statistical, comparison of a climate model with measurements creates a more solid platform for the assimilation and helps to optimize design parameters for middle atmosphere observations and, as well, to produce assimilated data sets for climate studies. Comparisons of assimilated tropospheric and lower stratospheric dynamical variables with radiosondes and ECMWF analyses have produced encouraging results (Polavarapu *et al*., 2004).

J. Drummond reported on the Canadian Network for the Detection of Atmospheric Change (CANDAC), an informal organization combining technical facilities and highly skilled researchers from university and government organizations. Three great challenges that CANDAC will address are air quality, climate change and ozone depletion. A primary initial focus of CANDAC is the revitalization of measurements at the Eureka Arctic Stratospheric Ozone (ASTRO) observatory. CANDAC has held three workshops including one concept workshop funded by CFCAS in support of atmospheric networks. It has received CFI funds for the installation of observing equipment at the PEARL station.

R. Menard reported on the chemical weather prediction and assimilation capability being developed at the MSC. This integrated system will perform real time analysis and prediction and will facilitate analysis for longer-term applications. It couples the ADOM tropospheric chemistry module and the routine weather prediction Global Environmental Model (GEM). Work in progress includes implementation of the CMAM stratospheric chemistry package and development of the adjoint chemistry for 4D variational assimilation.

J.B. Kerr and **T. McElroy** discussed MSC UV measurement and modelling studies. Despite significant advances in the past 30 years, there are still gaps in knowledge of key processes such as non-homogeneous scattering and absorption by clouds and aerosols. For instance, satellites estimate up to 40% more surface UV than is measured by ground-based instruments.

The SPARC Themes

Detection, Attribution, Prediction

W. Randel's overview of this theme included discussions of:
- Key points from the Angell Workshop on Temperature Trends in the Stratosphere (Silver Springs, November 2003, co-sponsored by SPARC and reported in Newsletter No. 22);
- Using models for detection, attribution, and prediction;
- Issues regarding stratospheric temperature and water vapour trends;
- Needs for upcoming IPCC and WMO assessments.

The Angell Workshop reviewed updated observations, model simulations of stratospheric temperature changes and their interpretation, and the effects of changes in stratospheric variability and circulation. Several of the issues arising from this workshop were addressed in presentations at the SPARC GA.

The observational base includes operational, climatological, process study-related and experimental data sets. Key issues for operational data are the availability of long-term high quality temperature records in the stratosphere and mesosphere, identification of problems and quantification of uncertainties in current satellite data and reanalyses, efforts to bridge data sets across the TOVS-ATOVS satellite boundary and in future satellite datasets, inclusion of SPARC input into future reanalyses and "climate network" designs. Key points for process and experimental data sets are the inclusion of specific UT/LS measurements, multiple sources of data, and ensuring the quality of radiative forcing data sets including ozone, water vapour and aerosols.

Success of modelling requires consistency of simulations and processes, and progress in parameterization. Consistency of simulations requires intercomparison of radiation codes and intercomparison of model responses to specified forcings. Key issues for process studies and parameterization are evaluating the role of interactive chemistry in model variability, improving quantification of GW parameterization effects, identifying sensitivities and uncertainties, gaining better understanding of dynamical coupling of the troposphere and stratosphere (especially Eliassen-Palm flux coupling and annular modes), evaluation of model uncertainties in the face of interannual variability (particularly in winter polar regions), improving UT/LS physics (especially aerosol and cloud microphysics), and identifying robust indicators for model sensitivity studies. SPARC should actively cooperate with AMIP and CMIP, GCOS and GEOSS. The use of PCMDI facilities for SPARC intercomparisons, and making best practices known *via* the project website would be desirable.

It follows from both the workshop and the GA that the most important issues for the Detection, Attribution and Prediction Theme include:

- Estimating signal versus noise using ensemble runs and long control simulations, emphasizing the use of a probabilistic approach for attribution and prediction;
- Understanding sensitivity of past and future predictions to uncertainties in forcings;
- Testing consistency across different indicators (*e.g.* temperature and radiative gases);
- Developing and using fingerprint techniques based on space-time patterns of signal responses and noise;
- Understanding the differences between equilibrium runs and transient response experiments;
- Quantifying the role of tropospheric forcing of the stratosphere including the impact of using observed *versus* climatological and observed *versus* simulated SSTs;
- Developing improved diagnostics to distinguish radiative and dynamical responses.

Available data for middle and upper stratospheric temperature fields include operational satellite data (SSU/MSU/AMSU), meteorological analyses and reanalyses, lidars (several locations) and research satellites, *i.e.* HALOE. Issues related to stratospheric temperature changes are: (a) taking into account details of updated SSU data; (b) comparisons with other data (*e.g.* lidar; HALOE); (c) problems with reanalyses in the stratosphere; and (d) interpreting the observed record.

Given uncertainties in quantifying and interpreting the past record, and importance for the SPARC themes and the future WMO Ozone Assessment, it was proposed that a small working group and a workshop on updating the stratospheric temperature record be organized. The workshop will be held in early 2005.

Needs for upcoming IPCC and WMO assessments

T. Shepherd discussed the use of models for detection/attribution/prediction of climate change. A key is the ratio of signal to noise. In this connection there are several challenges. The noise is not well characterized statistically and has time scales overlapping with those of the forcing. Coupling between the signal and the noise is not negligible. There may be a need to attribute some aspects of the noise. Models likely underestimate the noise and have their own sources of errors in variability.

A number of recently published studies addresses these challenges, *e.g.*, a 1000-year model run under different topographic forcings shows that PDFs of monthly mean temperature near the pole are not Gaussian (Yoden *et al.*, 2002). In Fioletov and Shepherd (2003), it is shown that springtime trends (1979–2001) explain the trends in other months of the year. This relationship holds even better for the extratropics in both hemispheres. Attribution needs to be made on a case-by-case basis, for example, for Antarctic *versus* Arctic temperature - ozone relationships (Randel and Wu, 1999).

GCM studies with imposed ozone changes cannot account for the observed trends in the Arctic and Northern Hemisphere (NH) midlatitudes over the past 20 years (Shine *et al.*, 2003). But given the magnitude of the variability, it can be argued that there is no discrepancy "within the error bars" (*i.e.* the noise), indicating that the signal is perhaps mainly natural variability. That variability may be crucial in understanding other changes, *e.g.* H_2O or O_3. CCMs are the main tools for uncovering the coupled chemical-dynamical variability. The dynamical forcing is predominantly wave drag. It is associated with (mainly horizontal) mixing. The planetary wave-drag (PWD) response to climate change may be critically important, but model studies to date are inconclusive on this point (Austin *et al.*, 2003).

All CCMs show development of the Antarctic ozone hole in line with observations. But the observations are near the lower edge of model simulations of the springtime minimum of total ozone over the Arctic. Natural variability is a major factor for the Arctic. A better characterization of PWD variability and its chemical consequences is needed. It must distinguish between the purely radiative response to the forcing and the PWD feedback. It should also include an understanding of tropospheric versus stratospheric effects on PWD.

The next round of assessments will need to build on, and improve on Austin *et al*. (2003). This will require improved diagnostic characterization of the simulations. But before the runs begin, it is essential that they use the same forcings and include all relevant chemical processes. **T. Shepherd** proposed that a small meeting of key players under the auspices of SPARC would be useful and offered to host such a meeting in Toronto in the near future.

The ensuing discussion raised a number of questions for future consideration, including the carrying out of AMIP-like CCM experiments under the auspices of SPARC, and adequate use of SPARC experience in the IPCC assessment process.

C. Granier presented highlights of the Quadrennial Ozone Symposium held in Kos (Greece), in June 2004, with 450 participants and 690 presentations. One of the key questions is whether ozone recovery is under way. Several talks addressed the leveling off of the chlorine content in the stratosphere. Is the downward trend in ozone slowing down in a statistically significant way? Natural variability and interference by other factors (*e.g.* QBO and solar cycle effects) have to be evaluated and removed from the ozone record. New analyses of ozone variations based on long records of high quality ground based measurements (*e.g.*, by Fioletov) reveal long-term changes in variability. Trends in surface ozone are upward in several locations, but not in all. Results from analyses of data from new satellite instruments were presented in several papers.

Several papers on CCMs addressed the coupling between climate and ozone changes. Among these are climate change impacts on stratosphere-troposphere exchange. Simulations show enhancements of both the Brewer-Dobson and Hadley circulations with increasing GHG loading.

The SSG noted that several new members have been elected to the International Ozone Commission (IOC). Various options for joint SPARC, IGAC and IOC meetings were suggested.

V. Ramaswamy summarized the CCSP (U.S. Climate Change Science Program) Synthesis Assessment Report on temperature trends in the lower atmosphere. The CCSP website (**http://www.climatescience.gov/Library/sap/sap-summary.htm**) contains a prospectus for the report. Its goals are to: (a) identify cases where uncertainties can be clarified/reduced, (b) consider context with subsequent US and international assessment reports, (c) identify aspects of uncertainty requiring more thorough review and assessment, and (d) identify strategies to reduce uncertainties.

The target date for release of the report is in September 2005.

V. Ramaswamy reported on timelines and the structure of the IPCC AR4 (2007) report and noted some key points from the IPCC Climate Sensitivity Workshop held in July 2004 (report available at the IPCC web site: **http://www.ipcc.ch**). The workshop included reports on advancements in radiation codes since the last intercomparison (presentations by Fu and Ramaswamy) and IPCC GCM radiative forcing intercomparisons (presentations by Collins and Ramaswamy). The first Lead Authors meeting has been held in Trieste in September 2004. All material referenced in the AR4 should be available by May 2005. The suggested timescale for WCRP projects to directly contribute is by the end of 2004. Some chapters may be of direct relevance to SPARC.

V. Ramaswamy then summarized some aspects of the radiative forcing intercomparison. The radiative transfer calculations used standard clear sky midlatitude profiles. Computations of absolute SW and LW fluxes and forcings from line-by-line (benchmark) and GCM radiation codes were compared for specified concentrations of well-mixed GHGs (present-day minus pre-industrial 2xCO_2 minus 1xCO_2), and a case when carbon dioxide and water vapour are changed simultaneously). One important result is that absorption of solar radiation by CH_4 bands (not usually included in GCMs) is comparable to that of CO_2.

Stratospheric Chemistry and Climate

A. Ravishankara gave an overview of outstanding issues, which include polar stratospheric cloud (PSC) climatology, a review of chemistry in the TTL, and microphysics modelling for the TTL. Cloud resolving models may be productive for exploring a number of TTL issues. It was noted that Chemistry and Climate is a cross-cutting theme within the WCRP. The SSG agreed that overlapping interests with the GEWEX Global Cloud Systems Study (GCSS) concerning microphysical processes should be explored.

SPARC Polar Stratospheric Cloud Assessment (SPA)

K. Carslaw presented a summary of progress in preparing for the SPA, noting first that the motivation for carrying out the assessment is the existence of significant gaps in our understanding that are relevant to stratospheric chemistry, the lack of consensus on how to describe PSCs and denitrification in global models, the limited and selective use of PSC observations, and the risk of instrument-dependent climatologies since intercomparisons are rare, as well as the lack of a large-scale consistent and evaluated data set for model testing.

Both Arctic and Antarctic PSCs will be included in the assessment and information will contain their occurrence (seasonal, spatial, interannual and long term variability and trends), assessment and development of understanding (model and theory testing and consistency with lab experiments), instrument intercomparison of primary and consistent secondary quantities (lidar, satellite and *in situ* measurements), and consistency with denitrification and dehydration mechanisms. Excluded from the assessment will be heterogeneous reaction rates and PSC effect on stratospheric chemistry. The aims of the assessment are to gather a consistent microphysical interpretation of all measurements and to generate a particle climatology and evaluate statistical occurence of PSCs. Understanding of the microphysical processes will be examined to test hypotheses and models, and to make recommendations to modellers regarding past and future changes in PSCs.

The chapter titles have been defined and the lead authors have been chosen and accepted. The lead authors have prepared chapter outlines. Co-authors have yet to be contacted. A kick-off meeting is being arranged for early 2005, and the first science meeting will be held in Summer 2005. The chapters are laid out in the following way: *Chapter 1* - PSC Processes (N. Larsen); *Chapter 2* - Detection and discrimination (B. Luo , M. Fromm); *Chapter 3* - Observations and their intercomparison (T. Deshler and L. R. Poole); *Chapter 4* - Assessment of understanding (K. Drdla, K. Carslaw); *Chapter 5* - Denitrification and dehydration (M. L. Santee and G. E. Nedoluha); *Chapter 6* - PSCs in a changing stratosphere (M. Rex and R. Bevilacqua).

Process Based Comparison of Coupled Chemistry-Climate Models

V. Eyring discussed progress on process-oriented validation of coupled CCMs. GRIPS has examined the dynamical/radiative state of stratospheric GCMs. Now that CCMs are mature enough, it seems appropriate to evaluate the chemistry and transport in these models to the same extent, using a process-oriented validation approach similar to that used for GRIPS. Measurement and process-studies communities, for example trajectory modelling, need to be involved.

A detailed summary of the CCM Validation Project appeared in SPARC Newsletter No. 23 (V. Eyring *et al*., 2004) and a BAMS paper has been submitted. In addition, the coordinators are committed to having a project publication before the next WMO-UNEP assessment.

Individual assessments of different processes are already under way; for example a comparison of radiation schemes used in climate models, microphysical model calculations for the SPARC Assessment of Stratospheric Aerosol Properties (ASAP), and the evaluation of GW drag schemes.

Progress is being made on development of software packages for complex diagnostics and further development of a table of core processes. The next CCM validation workshop will be held in October 2005.

As the CCM Validation Project has been based on the experience gained in the GRIPS project and is a natural extension of it, amalgamation and renaming of the two projects were proposed and approved by the SPARC SSG. This will take place following the final GRIPS workshop, which will be held in Hawaii in March 2005.

SPARC/IGAC Collaboration

A. Ravishankara introduced the topic, noting that this joint venture between natural partners started under the previous co-chairs of SPARC. He drew attention to the report from the Joint SPARC-IGAC Workshop on Climate-Chemistry Interactions held in Giens (France) in 2003. It can be downloaded from the SPARC web site: (**http://www.atmosp.physics.utoronto.ca/SPARC**).

S. Doherty continued the discussion. The traditional view of IGAC has been that SPARC represents research in atmospheric properties and processes for the tropopause and higher, IGAC for the free troposphere, and iLEAPS for the atmospheric boundary layer the surface. The overlap in research interests between SPARC and IGAC, the tropopause layer and UT/LS region, was explored in Giens. Topics included stratosphere-troposphere coupling, LS ozone and its changes, tropospheric ozone and other chemically active GHGs, aerosols and their role in climate, and water vapour and clouds. Overarching issues for the workshop were temporal and spatial scale mismatch (*in situ vs.* model *vs.* satellite data), and chemical kinetics and laboratory studies.

In the UT/LS region, two projects are underway. An NCAR initiative led by **L. Pan** studies the coupling of large and small scales. It started as an internal initiative inspired by NCAR HAIPER and AURA. The second is the EU Project SCOUT headed by **J. Pyle**. It has a significant component of chemical-climate modelling with a focus on the tropics.

Stratosphere/Troposphere Dynamical Coupling

M. Baldwin gave an overview of scientific issues in this theme. He started with the results of the Workshop on Stratosphere-Troposphere Dynamical Coupling held in Whistler (BC), Canada, in April 2003 (see report in the SPARC Newsletter No. 22). A second workshop on stratosphere-troposphere coupling in 2006 will focus on understanding dynamics, coupling on longer (10-100 years) time scales and chemical/dynamical coupling.

Recent work on predictability and downward propagation of the Northern Annular Mode is indicative of the potential importance of stratosphere-troposphere dynamical coupling for long-term prediction. M. Baldwin reported on the WCRP COPES Task Force on Seasonal Prediction (TFSP). The goal is to determine to what extent seasonal prediction is possible in all parts of the globe with currently available models and data. The importance of the stratosphere in seasonal prediction was unanimously recognized at the TFSP meeting held in Hawaii (USA) in November 2003. The TFSP defined "seasonal" to begin at 7-10 days in order to be consistent with the COPES seamless prediction strategy. SPARC actions could include establishing partnerships with other WCRP projects and working groups, and with operational forecasting centres to promote and facilitate the inclusion of the stratosphere in the operational analysis and prediction systems.

M. Baldwin also discussed the role of the stratosphere in climate change. Most models predict a stronger Brewer-Dobson circulation in a warmer climate with increased GHGs. Recent simulations (*e.g.* by J. Kettleborough), also suggest a weaker polar vortex consistent with enhanced planetary wave driving. Future changes will depend on both chemical and dynamical stratosphere-troposphere coupling.

The theme of the stratosphere-troposphere dynamical coupling was continued by **S. Yoden**. The familiar idea that the troposphere affects the stratosphere through upward propagation of waves (large-scale Rossby and also gravity waves) goes back to the simple theory of Charney and Drazin. It is supported by numerical experiments with so called "mechanistic" and troposphere-stratosphere general circulation models (GCMs) and as well by observations of summer-winter and interhemispheric differences.

Sudden stratospheric warmings, a major perturbation of wintertime stratospheric circulation, were a research focus for dynamics in 1970s and 1980s. Occurrence of the SH warming and "vortex split" in September 2002 has reinvigorated interest to this topic. Despite ongoing efforts, we still cannot point to circulation anomalies in the troposphere and identify them as the "cause" of a dynamical perturbation in the stratosphere. The one-way view of troposphere affecting stratosphere no longer makes sense. Extratropical dynamics is non-local in both the horizontal and the vertical. Changes in the LS inevitably affect the UT and *vice versa*. There is evidence from numerical modelling studies, *e.g.* Boville (1984), and Kodera *et al.* (1990), that changes in the middle and upper stratosphere affect the troposphere and that communication is dynamical.

Stratosphere-troposphere dynamical coupling is primarily through the mechanism of planetary wave drag (as noted in the presentation of **T. Shepherd**). It is currently a major research activity, aided by a hierarchy of models. Attention was drawn to several of the presentations in the SPARC GA that dealt with various aspects of this topic (talks by P. Haynes, S. Yoden, M. Baldwin, B. Christiansen, T. Hirooka, W. Robinson, L. Polvani, K. Hamilton, J. Perlwitz, M. Geller, and G.L. Stenchikov). Three paradigms have emerged, supported by results of observational and modelling studies: (a) the troposphere affects the stratosphere (seasonal cycle in stratospheric circulation, interhemispheric differences etc.); (b) the stratosphere affects the troposphere (tropospheric signal of QBO, solar cycle, volcanic aerosol, dynamical response to ozone depletion); and (c) there is two-way coupling (aspects of low frequency variability in NH winter, SH spring, response to changes in long-lived GHGs).

D. Hartmann introduced the ENSO and stratosphere theme. Recent work indicates that warm ENSO events are associated with a warm Arctic polar stratosphere and more stratospheric warming events in winter, while colder ENSO events are associated with a cold polar stratosphere and an enhanced vortex. Earlier work has also shown a relationship between stratospheric variability and ENSO. Simulations with the NCAR WACCM model support observations and show that warming events are significantly more likely during ENSO years (Taguchi and Hartmann, 2004). When El Niño and warming events occur together, they produce cumulative effects over North America. In summary, evidence has been accumulating to show that ENSO events have a strong influence on the NH stratosphere.

Cross-Cutting and Supporting Projects

Assessment of Stratospheric Aerosol Properties (ASAP)

L. Thomason reported that the final texts of the ASAP report chapters were to be reviewed in September 2004. Technical editing had also been arranged and it was expected that the report would be ready for publication by the end of 2004. The assessment will consist of 6 chapters: *Chapter 1* - Aerosol processes (an overview); *Chapter 2* - Aerosol precursors; *Chapter 3* - Instruments; *Chapter 4* - Data assessment; *Chapter 5* - Trends; *Chapter 6* - Modelling.

The report will outline several key findings as follows: most observations do not comprise a complete measurement set. Some parameters are derived indirectly from the base measurement, and during periods of very low aerosol loading significant differences exist between data sets for key parameters, *e.g* for surface area density and extinction. It is found that only the period from 1999 onwards can be confidently identified as free of volcanic aerosols. There is also a significant dearth of SO_2 measurements. Sedimentation plays an important role in the vertical redistribution of aerosol throughout the stratosphere. Understanding of aerosols in terms of coherence of measurements and modelling in the LS during periods of low loading is poor, although there is reasonable agreement during post-volcanic periods.

Data Assimilation

S. Polavarapu discussed data assimilation of stratosphere and climate models, noting that it could provide many benefits to SPARC and WCRP. An immediate result would be the inclusion of mesospheric data in the SPARC Data Centre. There is a wealth of current mesospheric satellite data available from SCIAMACHY, TIMED, OSIRIS, GOMOS, MIPAS, SABRE, and SCISAT. A similar proposal has been made within the CAWSES programme of SCOSTEP.

Links to other WCRP activities can be made through the WGOA within the COPES framework. GEWEX has proposed a new climate system reanalysis including chemistry, which may benefit from data assimilation. The COST 723 action group also includes a data assimilation task, and the WGNE is ideal as a liaison. Possible activities for data assimilation within SPARC are process oriented validation, the use of analyses to assess gravity wave drag parametrizations in GCMs and CCMS, and water vapour analysis.

An annual workshop on data assimilation with the focus on the middle atmosphere and climate was proposed. This is desirable since other data assimilation workshops usually focus predominantly on operational forecasting issues, with the stratosphere as a side topic. The workshop would also bring together non-data assimilation people from the SPARC community with complementary expertise on dynamics, chemistry, and transport. It would be possible to assess our knowledge of stratospheric winds and quality of their analyses, and focus on both climatologies and winds for process studies and transport calculations.

The SPARC Gravity Wave Initiative

K. Hamilton reported on the SPARC Equatorial Circulation Experiment (ECE). This initiative was inspired by the VORCORE experiment proposed by **F. Vial** at the 10th SPARC SSG meeting in Kyoto in 2002. The VORCORE involves launching an ensemble of super-pressurized balloons (SPB) that would fly for several months at 50 hPa to 70 hPa levels in the vicinity of the Antarctic polar vortex. It received strong support from the SPARC SSG with a suggestion that a similar campaign would be valuable in the tropics. The SPARC ECE will be a tropical campaign. A working group has been formed, co-chaired by K. Hamilton and F. Vial. VORCORE will take place in 2005 as planned. ECE is planned for 2006 near Darwin, and a workshop may be held at the end of the project. Continued SPARC interest is important for its success.

K. Hamilton also reviewed the Gravity Wave Initiative, which is nearing its completion. A radiosonde climatology paper is in preparation. The DAWEX campaign took place in late 2001, and a workshop was held in Honolulu in 2002. It was reported in SPARC Newsletter No. 20 and a series of papers are part of a forthcoming JGR Special Issue.

SPARC was a cosponsor of the Chapman Conference, held in Waikoloa, Hawaii, in January 2004. This was a very successful conference with 64 participants from 11 countries (see report in SPARC Newsletter No. 23).

K. Hamilton proposed an additional, smaller workshop on convectively forced gravity waves, to be held in 2006, which will focus on some key remaining theoretical questions of relevance to GW parameterization, analysis of results from, or planning for the 2006 field experiment.

In discussion of the Gravity Wave Initiative, **M. Geller** suggested that the high-resolution radiosonde data used for the climatology could be made available for general use through the SPARC Data Centre.

LAUTLOS Field Campaign for Hygrosonde Comparisons

V. Yushkov presented some results from the measurement campaign of the UT/LS Water Vapour Validation Project (LAUTLOS-WAVVAP). This project is aimed at improving the knowledge of the role of water vapour in the atmosphere-biosphere system. The focal point of this project is the improvement of water vapour observation in the UT/LS. The LAPBIAT campaign was hosted at the Arctic Research Centre of the Finnish Meteorological Institute, and the participants included the Central Aerological Observatory (CAO) (Dolgoprudny, Russia), the University of Colorado (Boulder, USA), the Meteolabor AG (Wetzikon, Switzerland), the University of Bern (Switzerland), the Alfred Wegener Institute (Potsdam, Germany), the German Weather Service (DWD) (Lindenberg, Germany), Vaisala (Helsinki) and FMI-ARC (Sodankylä, Finland).

Instruments involved in the campaign were the Lyman-alpha optical hygrometer FLASH-B (CAO, Russia), NOASS-CMDL frostpoint hygrometer (University of Colorado), Snow White chilled mirror hygrometer (Meteolabor, Switzerland), FN method hygrometer (Lindenberg Observatory, Germany), Vaisala RS-92, and Microwave 22 GHz MIAWARA (IAP, Switzerland). The campaign consisted of 13 night-time flights on balloons with 6 onboard instruments (FLASH-B, NOAA frostpoint, Snow White, FN, Vaisala RS-92 and an ozonesonde), and 1 day and 1 night-time launch on rubber balloons with 5 instruments on board (Snow White, FN, Vaisala RS-80, RS-90 and RS-92). Simultaneous measurements of stratospheric water vapour content were made by FLASH-B and NOAA hygrometers.

Coordination with Other Agencies/Programmes

European COST 723 Action

V. Ryabinin reported activities of the Data Exploitation and Modelling for the UT/LS Action group (COST 723) working under the auspices of the European Cooperation in the Field of Scientific and Technical Research (COST).

Working Group 1 of COST 723 covers data and measurement techniques. Their mandate is to gather data and to make it available to the Action, critically assess the weak links in measurement capabilities, and help identify new techniques and platforms to reduce those weaknesses. The focus is on humidity in the UT/LS region. The inconsistency of humidity data sets is a most prominent issue on the global scale. It requires simultaneous temperature data for conversion of absolute/relative humidity.

Working Group 2 focuses on assimilated ozone and humidity datasets. The task is to identify the most relevant datasets of atmospheric constituents and other key parameters for the UT/LS, develop and publish assimilation algorithms, ensure quality control of observations and models, analyze the benefits of combining nadir and limb sounder information and preliminary studies towards an assimilation of instrument radiances from research satellites.

Working Group 3 is focusing on the state of the UT/LS and understanding the relevant processes. Its tasks are to assess the UT/LS climatology and trends, study dynamical processes in the UT/LS, and quantify the anthropogenic effects on the UT/LS. Specific areas of study include ozone assessment and variability, vertical diffusivity in the UT/LS, cirrus clouds and supersaturation.

COST Action 723 will host a Summer School at the Cargese Institute of Scientific Studies, Corsica, France, from 26 September to 8 October 2005. Topics will include UT/LS measurement techniques, data assimilation, and modelling studies of the UT/LS. The school will be limited to 15 lecturers and 50-60 participants.

Participation of SPARC in the International Polar Year 2007-2008 and International Geophysical Year

M. Baldwin and **C. Granier** addressed the issue of SPARC participation in the International Polar Year (IPY) and the International Geophysical Year (IGY) programmes. The 125th, 75th, and 50th anniversaries of the first two IPYs and IGY will occur in 2007-2008. These milestones represent an opportunity to foster new polar science research. ICSU and WMO will establish an IPO for IPY. The IPO will support the anticipated ICSU-WMO IPY joint committee tasked with the oversight and guidance of the IPY planning and implementation.

SPARC participation is important; a well identified focus is needed. Possible research areas include polar ozone, the polar vortex, polar stratospheric and mesospheric clouds, chemistry-climate interactions, tropospheric bromine in polar regions, tropospheric precursors, and arctic haze.

ESA/Earth Explorer Missions for Implementation

T. Wehr reported on current ESA operational missions. These are ERS-2, ENVISAT, PROBA, and the operational meteorological satellite Meteosat Second Generation.

ERS-2 carries the GOME instrument. It is performing well, but a failure of the tape recorders reduces coverage. An increased number of ground stations somewhat compensate for this gap in data. ENVISAT carries GOMOS, MIPAS and SCIAMACHY. An ENVISAT validation workshop was held in May 2004 (Frascati, Italy) and an ENVISAT symposium will be held 6-10 September 2004 in Salzburg, (Austria). PROBA is a microsatellite with a high-resolution imaging spectrometer (CHRIS), a high-resolution camera (HRC), a wide-angle camera (WAC), a Space Radiation Environment Monitor (SREM), and a debris in-orbit evaluator (DEBIE). It has been operational since 2001.

The Meteosat Second Generation in cooperation with EUMETSAT continues the Meteosat programme with enhanced performance and adds elements of climate observing capability. It consists of a series of at least three geostationary weather satellites. MSG-1 was launched September 2002, and was re-named Meteosat-8. The instruments are SEVIRI (imaging radiometer), GERB (Earth radiation budget), and S&R (search and rescue transponder).

There are several future ESA missions. Details are available at the ESA web site (**http://www.esa.int/export/esaEO/index.html**). Either EARTHCARE or SPECTRA will be selected this autumn for implementation. The EARTHCARE payload will include a backscatter lidar, a cloud profiling radar (a Japanese contribution), a multi-spectral imager, and a broad-band radiometer. EARTHCARE will quantify aerosol-cloud-radiation interactions for improvement of climate and numerical weather prediction models. SPECTRA will quantify surface processes, ecosystem changes, and terrestrial vegetation. It is a hyperspectral multi-directional imager.

The EGPM (microwave radiometer and precipitation radar) mission will be pursued with the Earth Watch programme, focused on pre-operational and prototype operational missions.

A new call for future missions within the Earth Explorer Programme will be posted toward the end of 2004. This call will be coordinated with the NASA ESSP call.

T. Wehr also briefly summarized ongoing preparatory activities in the area of climate and atmospheric chemistry, stratospheric dynamics and ozone transport, and data assimilation.

Planned future missions of interest to SPARC are:
- ***ADM-Aeolus****:* wind retrievals from Doppler shift of UV-lidar (355 nm) light back-scattered by aerosols and molecules along the line-of-sight. Launch is expected in 2007. Additional products are: cloud profiles, cover, heights; multi-layer clouds including cloud extinction and optical thickness, tropospheric aerosol extinction, optical thickness and stratification; wind variability and clear air turbulence.
- ***Metop:*** a sequence of three polar-orbiting meteorological satellites with the first launch in 2005. Operations are expected to continue for 14 years. Meteorological payload includes two IASI and ESA-developed instruments; GRAS for GPS radio occultation, measuring atmospheric refractivity for temperature and humidity profile retrievals; and GOME-2, an improved version of ERS-2 GOME (maximum swath width of 1920 km instead of 960 km), improved polarization measurements, optics and calibration.
- ***Meteosat 3rd Generation (MTG):*** to be launched around 2015. Preparatory activities are ongoing. Industrial pre-Phase A is currently in preparation. Considered instrumentation is com-

prised of imagers and sounders, including an infrared sounder (4.0 15 mm; IASI & GIFTS heritage) and UV-Visual sounder (GOME/SCIAMACHY heritage) for frequent observations of mainly O_3, CO, NO_2, SO_2, H_2CO (total tropospheric column). Atmospheric chemistry is part of the current mission requirements baseline.

The website for presenting future ESA programmes is located at **http://www.eumetsat.de**.

In discussion, **J. Burrows** noted that SPARC support for the atmospheric chemistry component of MTG would be beneficial.

NASA

M. Kurylo, in place of **P. De Cola**, gave a brief description of the restructuring of NASA and presented a comprehensive report on EOS AURA, which was successfully launched into a polar orbit on July 15, 2004, and flies approximately 15 minutes behind Aqua. It includes four instruments:
- ***HIRDLS***: a UK and USA IR limb sounder,
- ***MLS***: an US microwave limb sounder,
- ***OMI***: a Netherlands/Finland visible and UV nadir hyperspectral imager,
- ***TES***: an US IR limb and nadir high-resolution spectrometer.

All four instruments view the same location within 14 minutes.

The mission is described in the paper by Schoeberl *et al*., 2004. Its science objectives are: tracking ozone layer recovery, recording the impact of atmospheric constituents on climate, making global measurements of air quality (ozone, nitrogen dioxide, aerosols), determining pollution sources from mapping tropospheric trace gases, and observing influences on the global oxidizing capacity of the atmosphere. It is expected to have a six-year lifetime. These objectives address the following science questions: Is the ozone layer changing as predicted and are international protocols working? What are the roles of upper tropospheric water vapour, aerosols, and ozone on climate forcing? What are the sources and distribution of tropospheric pollutants and their impact on environmental health? How does the transport of gases between the stratosphere and troposphere influence ozone, climate change, and air quality?

The discussion supported a suggestion by **M. Geller** that SPARC should send NASA a letter of congratulation on the successful launch of the AURA mission.

CSA Activities of Relevance to SPARC

R. Michaud presented a summary of the CSA initiatives. MANTRA is a series of high-altitude balloon missions (1998, 2000, 2002 and 2004) to study stratospheric composition at midlatitudes. The project is an international collaboration with the participation of the University of Denver (USA) and Service d'Aéronomie du CNRS (France). A number of instruments are involved, including several Fourier Transform Spectrometers (University of Denver, MSC/University of Toronto, University of Waterloo), emission radiometers (MSC/University of Toronto), Sun photospectrometers, MAESTRO-B (MSC/University of Toronto), and the SAOZ instrument (CNRS).

OSIRIS on Odin (2001) is composed of a UV/visible spectrograph that continues to provide vertical profiles of ozone and other minor atmospheric species, such as NO_2, OClO and BrO, in the stratosphere, and an IR imager whose observations will be used to obtain distributions of ozone in the upper stratosphere and lower mesosphere. There have been requests from many different research groups for OSIRIS data. A new effort to enhance the returns from OSIRIS through collaboration with the SCIAMACHY Team in Bremen has been initiated, and the partner agencies (Sweden, France, Finland and Canada) have agreed to extend the mission until April 2005.

The Atmospheric Chemistry Experiment (ACE) with SCISAT provides simultaneous measurements of trace gases, clouds, and aerosols using the solar occultation technique. The goal is to gain a better understanding of the chemical processes that control the distribution of ozone in Earth's atmosphere, especially at high latitudes. It was launched successfully on 12 August 2003. The first Arctic Validation campaign was carried out at Eureka in February-March 2004, and SCISAT has been making routine sunset and sunrise occultation measurements since April 2004.

An upcoming satellite instrument for CSA is the Stratospheric Wind Interferometer For Transport studies (SWIFT), which is a Canadian instrument designed to make global stratospheric wind measurements both in daytime and night-time conditions at heights between 15 and 55 km and provide simultaneous co-located ozone profiles. There is also potential for obtaining operational stratospheric wind measurements for medium range forecasts. SWIFT has been endorsed and Phase A studies have been performed by ESA and JAXA. Unfortunately, JAXA has re-scoped the GOSAT satellite and disembarked SWIFT (December 2003). Currently, CSA is performing preliminary studies for flying SWIFT on a small Canadian satellite, and both CSA and ESA are investigating alternative flight opportunities for SWIFT. Potential secondary payloads are being considered.

SPARC support for SWIFT is considered to be important. It was suggested that letters of support from the co-chairs directed to both the CSA and ESA would be helpful at this stage. After discussion this action was approved by the SSG.

Network for Detection of Stratospheric Change

M. Kurylo, in a brief report, confirmed to the SSG the commitment of NDSC to continue its operations. The current priorities are supporting the networks that have problems, extending the system into the tropics working jointly with SHADOZ, replace some of the instruments which are already 20 years old, and to keep the validation going.

COSPAR News from the Recent General Assembly

The 35th COSPAR (Committee on Space Research) symposium was held in Paris from 20-25 July, 2004, and was attended by approximately 3000 participants. **M.-L. Chanin** was the Programme Chair. Relevant to SPARC are Commission A dealing with the Atmosphere, and Commission C on the Upper Atmosphere and Planetary Atmospheres.

J. Burrows was chair of the organizing committee for the COSPAR 2004 Session "Atmospheric Remote Sensing: Earth's Surface, Troposphere, Stratosphere and Mesosphere." It ran for 5.5 days with 220 contributions and approximately 110 speakers. A summary of the session can be found in this issue of the SPARC Newsletter. The 36th COSPAR Symposium will be held in Beijing in 2006.

M.-L. Chanin noted a number of general issues dealt within COSPAR that are also of interest to SPARC. It is important for SPARC to encourage ESA and national agencies to continue calibration and validation activities for ENVISAT instruments, and to continue the improvement of the ground segment, data re-processing and distribution. It is also necessary to stress a need for continuity and development of atmospheric observation.

A number of points regarding interactions with the COSPAR community were brought forward in discussion. One suggestion (**M. Geller**) is to encourage SPARC scientists to contribute to the improvement of the COSPAR reference atmosphere (CIRA).

SCOSTEP and Interactions with SPARC/GRIPS

M. Geller reported on SCOSTEP CAWSES activity. The mission of SCOSTEP is to implement research programmes in solar-terrestrial physics that benefit from international participation and involve at least two ICSU bodies. Under SCOSTEP, the Climate And Weather of the Sun-Earth System (CAWSES) has been developed to run between 2004 and 2008. The CAWSES Office has been established at Boston University, with **D. Pallamraju** as the scientific coordinator. The first newsletter was published in March 2004 and the first CAWSES campaign organized in March-April 2004 in conjunction with the CPEA Campaign.

There was a special all-day CAWSES meeting at Observatoire de Paris on 17 July 2004 and a CAWSES presentation at the ILWS Session in the COSPAR GA.

There are four main themes of CAWSES: *Theme 1* "Solar Influence on Climate" [co-chairs: M. Lockwood (UK) and L. Gray (UK)], has two working groups: "Assessment of Evidence for Solar Influence on Climate" and "Investigation of Mechanisms for Solar Influence on Climate". *Theme 2:* "Space Weather: Science and Applications" [co-chairs: J. Kozyra (USA) and K. Shibata (Japan)]. *Theme 3*: "Atmospheric Coupling Processes" [co-chairs: F.-J. Luebken (Germany) and J. Alexander (USA)], has working groups on "Dynamical Coupling and its Role in the Energy and Momentum Budget of the Middle Atmosphere", "Coupling *via* Photochemical Effects on Particles and Minor Constituents in the Upper Atmosphere", "Coupling by Electrodynamics including Ionospheric Magnetospheric Processes", and "Long-Term Trends in Coupling Processes". *Theme 4*: "Space Climatology" [co-chairs: C. Froehlich (Switzerland) and J. Sojka (USA)] with working groups "Solar Irradiance Variability", "Heliosphere Near Earth", "Radiation Belt Climatology", and "Long-Term trends in Ionospheric and Upper-Atmospheric Variability".

In addition to the themes, CAWSES runs a capacity building and education programme, co-chaired by M. Geller, **S. T. Wu** and **J. Allen**. This programme provides training courses and helps with computational and data resources for scientists from developing nations. It will also establish partnerships between developing and industrialized nations. An ICSU Grant Application has been made for such activities.

There are several national and regional CAWSES programmes under way or planned. The programmes for India, Germany, and Japan held an inaugural workshop in June 2004. The 11th SCOSTEP Quadrennial STP Symposium "Sun Space Physics and Climate" will be held on 5-12 March 2006 in Brazil.

Solar Impact Intercomparison

K. Kodera discussed the status of the GRIPS Solar Impact Intercomparison. A summary paper has been published (Kodera *et al.*, 2003). A session entitled "Solar Influence on Climate Through Mesospheric-Stratospheric Chemical-Dynamical Processes", co-organized by K. Kodera, U. Langematz and A. Smith, will be held at the fall AGU meeting (San Francisco, USA, 13-17 December 2004). The SSG discussed the future and evolution of the Solar Impact Intercomparison. It was agreed that it should continue to be supported by SPARC. With eventual merger of GRIPS and the CCM Intercomparson activities, it could become part of a possible future joint CAWSES-SPARC collaboration.

SPARC Data Centre

M. Geller reported on the current status of the SPARC Data Centre. One more year of funding is available, but it is possible to extend the funding for another round. A new project scientist is being recruited. Previous scientists were supported jointly by SPARC Data Centre funding and M. Geller's research funds. However, it may be useful to employ a full-time person who could work on projects specifically for the Data Centre.

There was unanimous support for M. Geller to continue as the Director of the SPARC Data Centre. A group of members within the SSG have been tasked with drafting a letter from SPARC that will convey the continuing need for the centre. A mirror site in Japan was being considered. The group felt that more pressure would be put on the centre when large amounts of chemical data come onboard.

Next SSG Meeting

A. O'Neill offered to host the next meeting of the SSG. This invitation was accepted with appreciation. The next meeting of the SSG will be held in Oxford (UK) on 26-29 September 2005.

Closure of Session

The co-chairs closed the Session in the afternoon of Thursday, 12 August 2004. The attendees unanimously thanked **N. McFarlane** for organizing the session and arranging for excellent conditions for its work.

References

Austin, J., *et al*., Uncertainties and assessments of chemistry-climate models of the stratosphere. *Atmos. Chem. Phys*., **3** (1), 1-27, 2003.

Boville, B.A., The influence of the polar night jet on the tropospheric circulation in a GCM. *J. Atmos. Sci*., **41**, 1132-1142, 1984.

Fioletov, V.E. and T. G. Shepherd, Seasonal persistence of midlatitude total ozone anomalies. *Geophys. Res. Lett*.. **30**, 1417, 2003.

Kodera, K., *et al*., Downward propagation of upper stratospheric mean zonal wind perturbation to the troposphere. *Geophys. Res. Lett*., **17** (9), 1263-1266, 1990.

Matthews K., *et al*., GRIPS solar experiments intercomparison project: Initial results. *Papers in Met. and Geophys*., **54**, 71-90, 2003.

Polavarapu, S., *et al*., Data assimilation with the Canadian Middle Atmosphere Model. Accepted to *Atmos.-Oceans*, 2004.

Randel, W. and X Wu, Cooling of the Arctic and Antarctic polar stratospheres due to ozone depletion. *J. Climate*, **12** (5) 1467–1479, 1999.

Schoeberl, M. R., *et al*., Earth Observing System missions benefit atmospheric research, *Eos Trans. AGU*, **85** (18), 177, 2004.

Shine, K.P., *et al*., A comparison of model-simulated trends in stratospheric temperatures. *Quart. J. Roy. Met. Soc*. **129**, 1565, 2003.

Taguchi, M., and D. L. Hartmann, El Nino, Stratospheric sudden warmings, and enhanced climate anomalies. Poster at 3rd SPARC General Assembly, 2004 and submitted to *Science*, 2004.

Yoden, S., *et al*., Numerical studies on time variations of the troposphere-stratosphere coupled system. *J. Met. Soc. Japan*, **80**, 811-830, 2002.