Report on the 19th Session of the SPARC Scientific Steering Group

7-10 February 2012, Zürich, Switzerland

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The 19th Session of the SPARC Scientific Steering Group (SSG) was held at the Swiss Federal Institute of Technology (ETHZ), Switzerland. The meeting was organised by the new SPARC Office team based in Zürich and the outgoing SPARC co-chair Thomas Peter**.** At the meeting, the 20th anniversary of SPARC was celebrated, as well as the relocation of the SPARC Office from Toronto, Canada, to Zürich, Switzerland (see separate article).

Opening session and WCRP update

T. Shepherd (SSG co-chair) opened the meeting by welcoming all participants, particularly the new members of the SSG, and thanked the local organisers of the meeting. In a short presentation he also introduced the main goals of SPARC, its structure, projects and activities.

A. Busalacchi (chair of the WCRP Joint Scientific Committee (JSC) – the JSC oversees the work of the WCRP) reported on the very successful WCRP Open Science Conference (OSC) which took place from the 24-29th October 2011, in Denver, CO, USA. The OSC provided a broad overview of the state of the science related to climate change and the scientific activities of the WCRP. The OSC also included presentations that discussed the aspects of climate most relevant for society (for a description of the OSC, and the aspects most relevant to SPARC, see SPARC Newsletter No. 38, January 2012). After the OSC a short JSC meeting took place in Boulder, CO (30-31 October). Besides a short review of the OSC, the important elements of the structural renewal of the WCRP (to be fully implemented in 2013) were discussed. The important elements of this renewal are:

(1) New mandates for the individual core projects;
(2) The establishment of a WCRP Modelling Advisory Council and a WCRP Data Advisory Council. These councils have been tasked with co-ordinating modelling and measurement/data related activities across the WCRP and, if required, to make recommendations. The councils will meet annually, for the first time in parallel with the next JSC meeting, which will take place in Beijing in July 2012;
(3) The definition of Grand Challenges, which represent topics that are scientifically challenging, of great interest to society, in which significant scientific progress can be expected within a few years, and which profit from the collaboration between the four core projects of the WCRP.

SPARC Measurement Requirements and ESA activities

G. Bodeker introduced the process for developing a SPARC Measurement Requirements document and led the associated discussion. The main idea behind this activity is to develop an explicit account of the kind and quality of measurements that are needed to support SPARC activities. This will allow SPARC to provide co-ordinated input to the WCRP Data Advisory Council and other international bodies such as GCOS (Global Climate Observing

System) and CEOS (Committee on Earth Observation Satellites), as well as to respond to requests from funding and space agencies concerning SPARC measurement needs and priorities. The process should also help stimulate greater use of observational products by SPARC activities. It is important that the outcomes of this activity outline why the data are required and will be of scientific interest, and give concrete examples of what can be accomplished with (or without) the data. It is not intended to be a laundry list of measurement requirements but a unified view of SPARC's data needs. It was decided that the activity leaders will receive (within two months of the SGG meeting) a template summarizing the type of information required in order to write their contributions to the measurement requirement document which will be discussed again at the next SSG meeting.

G. Bodeker also reported on SPARC activities funded by ESA (the European Space Agency). In March 2010 SPARC was approached by ESA to submit a proposal to promote the scientific use of ESA and third party mission data. In October 2010 a meeting took place in Zürich and it was decided to explore the use of four types of satellite-based instrumental records for the creation of long-term climate data records including stratospheric temperature, ozone, aerosols and water vapour. Thereafter a "SPARC Scientific Requirements Document for ESA" was developed and discussed at the previous SSG meeting in February 2011. This led to an ESA invitation to tender (ITT). A proposal was submitted by a consortium led by Michel von Roozendael, and the project kick-off meeting took place in Cambridge in February 2012. Some of the primary outputs are: (1) improvement of the data sets of SCIAMACHY and OSIRIS aerosol, SCIAMACHY water vapour, short-lived species climatologies, and GOMOS ozone; (2) merging and extending data sets: GOMOS and SAGE II ozone, extending the SSU-based upper stratospheric temperature record, improving the UTLS temperature record, and merging of GOMOS and SAGE aerosol records. An ESA review will be carried out at the end of the first year, at which point the SPARC measurement requirements will also be discussed.

Reports on SPARC activities

M. Hegglin and **S. Tegtmeier** reviewed the status of the SPARC Data Initiative activity, which is an inter-comparison of different satellite measurements of vertically-resolved chemical trace gas and aerosol climatologies. As identified in previous SPARC activities, and in particular in CCMVal-2, some satellite products show ambiguous results when used to validate chemistry-climate models. This can be particularly problematic when trying to deduce long-term changes from composite satellite time series. The main objectives of the SPARC Data Initiative are: (i) assessing the state of data availability from the multi-national suite of space-based instruments; (ii) establishing a data portal for chemical observations in collaboration with space agencies; (iii) compiling climatologies of chemical trace gases and carrying out a detailed inter-comparison of the climatologies; and (iv) documenting useful information and highlighting differences between datasets. In addition, seasonal and interannual variability of the time series have been studied. The work is nearing completion and the associated report is planned to be available in late 2012.

N. Harris presented the progress made by the SPARC Initiative on Changes in the Vertical Distribution of Ozone (supported by SPARC, IGACO-O_3, IOC (International Ozone Commission) and NDACC, abbreviated as SI^2N). The main motivation for this study was the lack of reliable and critically evaluated data to assess changes in the vertical distribution of ozone over multi-decadal timescales. Secular changes in ozone might not only be affected by decreases in stratospheric concentrations of Ozone Depleting Substances (ODSs) but also by changes in climate. The initiative is organised into working groups on satellite measurements

of the last decade (primarily focussing on inter-annual variability), ground-based systems operated under NDACC, long-term satellite records, ozonesondes, and Umkehr measurements. Another working group focuses on the merging of datasets. A crucial question is the extension of the long-term satellite dataset provided by the SAGE I and II records using measurements from other occultation instruments, such as GOMOS and OSIRIS. The study is well integrated with current NASA and ESA projects and liaises with the SPARC Data Initiative. Last November a SI^2N meeting took place as part of the NDACC symposium, and in April 2012 a workshop was held in Washington DC in which the work of the second year of the project was structured and plans for publications and the contributions to the next WMO Ozone Assessment made (see article in this issue of the newsletter).

S. Reimann discussed the progress of the ODS (Ozone Depleting Substances) lifetimes activity, a SPARC project which was approved at the 2011 SSG meeting in Pune. Atmospheric lifetimes are affected by emissions, chemistry (which is likely to be temperature and altitude dependent), and transport (e.g., a strong Brewer-Dobson circulation could reduce the atmospheric lifetimes of long-lived ODSs), and can therefore change in time. For instance, the lifetimes of CFC-11 and carbon tetrachloride (CCl_4) now appear to have longer lifetimes than expected, affecting the interpretation of reported emission rates and the prediction of the expected ozone layer recovery. The aims of this activity are to produce estimates of the numerical values for lifetimes, estimate their uncertainties, assess the influence/use of different lifetime definitions (e.g., steady-state vs. instantaneous lifetimes), and assess the lifetime changes associated with the changing climate. The envisaged structure of the review is as follows, Chapter 1: Importance of global lifetimes, history of lifetimes; Chapter 2: Theory of lifetimes using models and observations; Chapter 3: Update on kinetic and photochemical data that determine lifetimes; Chapter 4: Lifetimes inferred from observed trace gas distributions; Chapter 5: Model estimates of lifetimes. The activity is making good progress within an ambitious schedule (drafts of chapters are currently under review, second draft to be sent to the reviewers by September 2012 so that the document can be released by April 2013).

J. Alexander presented recent progress and current plans for the SPARC gravity wave activity. From 28 February to 4 March 2011 an AGU Chapman Conference on Atmospheric Gravity Waves and their Effects on General Circulation and Climate took place in Honolulu, Hawaii, and a small workshop was held at the International Space Science Institute (ISSI) in Bern, Switzerland (11-15 April 2011). The goal of the second workshop was to compare gravity wave momentum fluxes from observations and models. In addition to assessing the degree of agreement/disagreement, future parameterisation applications and measurement needs were discussed. Two publications from this workshop are in preparation. Two small workshops (12-14 participants each) are planned in 2012-2014 to be supported by a new ISSI proposal (submitted in March 2012). The scientific foci are: (i) better constraints on existing climate model parameterisations; and (ii) better understanding of gravity wave sources (local momentum flux values and intermittency). The final goal is to obtain the information required to develop source parameterisations that are needed for climate model simulations. Furthermore, the activity plans to collaborate with other closely related SPARC activities by participating in the DynVar workshop (planned for early 2013), the Data Assimilation workshop, and the Brewer-Dobson Circulation workshop. An evening meeting is planned at the DA workshop to discuss the ISSI project and other possible joint projects with interested participants.

B. Funke and **K. Kodera** discussed the recent development of the SPARC solar influences on climate activity (SOLARIS). An important recent development is the planned closer

collaboration between SOLARIS and HEPPA (High Energy Particle Precipitation in the Atmosphere). Within the HEPPA project, coordinated studies are planned to investigate a particularly strong solar proton event that took place from the 29-30th October 2003 (the so-called "Halloween solar proton event").

V. Eyring spoke on CCMVal and lessons from AR5 on model validation. Within CCMVal, quantitative performance metrics were introduced mainly based on comparison with specific measurements or quantities derived from measurements. These metrics were designed to support model evaluation and intercomparisons of model performance. Relating model performance to projections is, however, a difficult task and such evaluations are part of on-going studies relevant to all climate models. Future coordinated experiments, designed specifically to understand the link between model errors and model parameterisations are likely to be a focus of the WGCM, as well as other groups (WGNE, etc). The most recent CCMVal workshop was broadened into an IGAC/SPARC Chemistry-Climate Modelling and Evaluation Workshop, and was held from 21-24th May 2012, in Davos, Switzerland (see further discussion below).

E. Manzini presented recent results from the Dynamical Variability ("DynVar") activity. DynVar is currently working with the output of numerical simulations performed for CMIP5. Two synthesis papers are planned from this work: one focusing on climate and variability of the stratosphere in the CMIP5 models, and another discussing the role of the stratosphere on surface climate in the CMIP5 multi-model ensemble. A DynVar workshop is planned for early 2013 aiming at addressing the representation of stratosphere-troposphere coupling in climate and earth-system models. The workshop will also include some focus on gravity waves.

D. Jackson presented an overview of the SPARC Data Assimilation (DA) working group. The short term goals of this activity include: (i) a summary describing how the stratosphere is represented in global Numerical Weather Prediction (NWP) systems; (ii) development of greater interaction between the communities working with chemical data assimilation and satellite retrievals; and (iii) an update of the SPARC section of the WMO Observations Rolling Requirements document (last updated in 1998).

Two new stand-alone activities were proposed, arising from the DA working group:
1) The Reanalysis/analysis Intercomparison Project (S-RIP), which will include co-operation between analyses centres and scientists from SPARC and other groups. Two to three dedicated workshops are planned for 2013 and 2014, with a final SPARC Report scheduled for 2015 or 2016.
2) The SPARC Network on Assessment of Predictability (SNAP), which has the following scientific goals: (i) assessing current skill in forecasting the extra-tropical stratosphere; (ii) investigating the extent to which accurate forecasts of the stratosphere contribute to improved tropospheric predictability; and (iii) understanding the partitioning of any gains in predictability with a well resolved stratosphere between improvements in the estimation of initial conditions and improvements in forecast skills. The central aim of SNAP will be to design and organise a new intercomparison of stratospheric forecasts. This will also leave a legacy of datasets to be used by a broad community of researchers.

These two projects will foster closer links between NWP centres and SPARC, as well as between SPARC and the WGNE (Working Group on Numerical Experimentation). A third,

long-term goal of the DA working group is to assess missing drag due to sub-grid scale gravity waves.

A SPARC DA workshop was held in Brussels in June 2011. This workshop focused on data assimilation within reanalyses, the tropics and observational needs in these regions, as well as on possible SPARC – NWP linkages. Chemical data assimilation was also discussed, with suggestion of greater focus on this topic in future. The next two annual workshops are planned for New Mexico, USA, from 11-13 June 2012, and possibly in Japan in 2013.

T. Peter discussed the status of the WAVAS-2 (Water Vapour Phase 2) activity, the main leaders of which were Cornelius Schiller, Thomas Peter and Karen Rosenlof. After the SSG meeting in Pune 2011, it was decided that WAVAS-2 should generate two review papers and a SPARC summary report. The first paper is to contain a UTLS water vapour climatology, trends and related radiative effects, consisting primarily of satellite datasets plus ground-based measurements. This paper is proceeding according to plan and is planned for submission in 2012 under the leadership of Karen Rosenlof. The second review paper, also planned for submission in 2012 and led by Thomas Peter, will include issues such as supersaturation and related data quality issues primarily related to in situ data, including data from AquaVIT and MACPEX. The measurements include a comparison of different hygrometers. Given the circumstances (the passing away of Cornelius Schiller) further delays in the summary report are expected.

H. Vömel briefly introduced the concept and philosophy of the data quality assurance of water vapour measurements as used in GRUAN (GCOS Reference Upper Air Network). The goals of GRUAN are to provide long-term high quality climate records, constrain and calibrate data from more spatially-comprehensive global observing systems (including satellites and current radiosonde networks), and fully characterize the properties of the atmospheric column.

D. Thompson discussed recent progress in the SPARC Stratospheric Temperature Trends activity. The group is presently chaired by Dave Thompson and Bill Randel. Analyses presented in 2009 showed that global mean temperatures derived from MSU channel 4 brightness temperatures and radiosonde observations indicate that the lower stratosphere cooled at a rate of ~0.5K/decade from 1979 to 2007, whereas in the global mean, the lower stratosphere has not noticeably cooled since 1995. Recently, however, the temperature trends have been re-evaluated using longer SSU datasets (Wang, et al., 2012). The new NOAA product shows substantial deviations from the previous dataset (Mears et al., 2003; Christy et al., 2000), particularly indicating large negative temperature trends over the tropics. Current activities by the group include: (i) combining new SSU data with AMSU observations (C. Mears, C. Long, C.-T. Zhou); (ii) comparing extended SSU with research satellite data from MIPAS/GOMOS (V. Sofieva); (iii) comparisons with CCMVal-2 (D. Thompson, W. Randel, D. Seidel); (iv) use of COSMIC/CHAMP to aid in merging AMSU data; and (v) links to stratospheric reanalysis inter-comparisons. A co-ordination meeting is planned for late spring 2012.

M. Baldwin advertised the upcoming Brewer-Dobson Circulation Workshop, which will take place 25-29 June 2012 in Grindelwald, Switzerland. The Brewer-Dobson circulation is a fundamental stratospheric transport pathway and climate models predict a strengthening of this feature under climate change. However, it is difficult to observe any such changes in the available measurements. Because of the vital role of the Brewer-Dobson circulation in the stratosphere, a review meeting is an important step to evaluate and discuss the different views

of the community. The main results of the workshop are to be published as an invited review paper in the Quarterly Journal of the Royal Meteorological Society.

A. Robock presented plans for collaboration with the GeoMIP project. GeoMIP is a CMIP coordinated experiment, and therefore part of the Climate Model Intercomparison Project 5 (CMIP5). In this framework, the new GCMs being run for CMIP5 will be used to run similar standard experiments to investigate whether results from earlier simulations estimating the impacts of geoengineering are robust. Important questions in this context are: How will the hydrological cycle respond to stratospheric geo-engineering? For example, will there be a significant reduction of Asian monsoon precipitation? How will ozone and UV change? A workshop was held at the end of March (see article in this issue of the newsletter).

New proposed activity

M. Rex and **C. Timmreck** presented a progress report on the emerging SPARC activity Stratospheric Sulphur and its Role in Climate (SSiRC – see article in this issue of the newsletter). The purposes of the proposed activity include: (i) providing a coordinating structure for the various individual activities already underway in different research centres; (ii) encouraging and supporting new instrumentation and measurements of sulphur containing compounds, such as COS, DMS, and non-volcanic SO_2 in the UT/LS globally; and (iii) initiating new model/data inter-comparisons. SSiRC is expected to feed into the GeoMIP activity as it deals with more fundamental questions relating to sulphur and aerosols in the stratosphere, while GeoMIP will use the outcomes to better understand its own results. A more comprehensive implementation plan will be presented at the next SSG meeting.

Coordination with IGAC and tropospheric chemistry activities

C. Granier spoke in her role as IGAC (International Global Atmospheric Chemistry) liaison on the current activities of IGAC. IGAC is a core project of the IGBP (International Geosphere Biosphere Programme) which, in addition to including atmospheric chemistry as a core activity, also includes "Sustainability Connections" which look at the effects of atmospheric composition on climate, human health, and ecosystems, covering individual and societal responses to choices related to energy sources, material resource uses, economic priorities, etc. IGAC activities cover measurement campaigns and observation networks, with projects such as Halogens in the Troposphere, the GEIA Global Emission InitiAtive, the China working group, Atmospheric Chemistry and Climate (AC&C), and synthesis reports such as "Bounding the role of Black Carbon in Climate" and "Impacts of Megacities on Air Pollution and Climate", a science policy dialogue, thus including many important aspects of tropospheric chemistry. IGAC will be having their next biennial conference in Beijing, China, from the 7-12th September 2012.

J. Staehelin presented a report on "The second international workshop on tropospheric ozone changes", which took place in Toulouse from 11-14th April 2011. The workshop was an opportunity for discussions between scientists engaged in data analysis, data quality or interpretation with colleagues performing numerical simulations. Amongst other discussions, the results from two recent studies were summarized at the workshop: a study by Logan et al. (2012) presenting a critical evaluation of long-term ozone time series over Europe, which found particular data quality issues with earlier ozonesonde measurements comprising the longest European records (using Brewer Mast ozonesondes) when comparing these with ozone measurements of high mountain peaks and regular aircraft measurements; and a study by Parrish et al.(2012), in which selected reliable ground-based sites were evaluated,

confirming the large surface ozone increases in baseline values between World War II and around 2000 in northern mid-latitudes. Ozone mixing ratios at most of the ground-based remote European sites, except in the marine boundary layer, show a flattening of upward trends since around 2000, whereas sites from Japan and the western part of North America indicate continuous increases.

Joint IGAC/SPARC activities were considered through a panel discussion led by Thomas Peter, Johannes Staehelin, Veronika Eyring, and Claire Granier. Attention focused on how to bring together current activities --- ACC-MIP (Atmospheric Chemistry-Chemistry Model Intercomparison Project), the IGAC/SPARC Hindcast activity, and CCMVal --- in order to reflect the increasing integration of the scientific questions and achieve practical synergies. It was acknowledged that the existing AC&C activity was not proving to be an effective mechanism for doing this. Over the past year, it was decided that the CCMVal workshop planned for May 2012 be broadened into an IGAC/SPARC Chemistry-Climate Modelling and Evaluation Workshop, in order to accelerate the integration of IGAC and SPARC global chemistry climate modelling and evaluation activities (see separate report in the next SPARC newsletter, No. 40). The SPARC SSG welcomed this development, and looks to this workshop for providing the main concrete mechanism for IGAC/SPARC cooperation going forward.

Other coordination of SPARC with activities within and outside WCRP

G. Bodeker presented an update on GCOS when reporting on a meeting of WOAP (the WCRP Observation and Assimilation Panel) that took place in ESRIN, Frascati, Italy from the 18-20th April 2011. The focus of the workshop was on the evaluation and assessment of satellite-related global climate datasets. He reported that the work of SPARC was viewed as a model for producing independent assessments, such as WAVAS and the SPARC climatologies report. The focus was on generating and evaluating climate data records (CDRs) of essential climate variables (ECVs) from satellite measurements. The outcome of the workshop included a report detailing the existing ECV datasets, using a range of satellite measurements, evaluated against the GCOS guidelines. The conclusions of the workshop were that the formal evaluation of CDRs is a major task which needs proper funding support, confirming the commitment of agencies to transparency and the generation of quality climate datasets. Independent expert-group assessments of the datasets associated with ECVs enhance their utility and are expected to lead to improvements in individual datasets (as happened in many SPARC assessments). However, if SPARC gets more involved in the generation of CDRs the level of investment of time and effort required to meet the GCOS guidelines will likely increase and these efforts might exceed the possibilities of volunteer efforts.

V. Eyring reported on activities of the WGCM (Working Group on Coupled Modelling. The WGCM has a broad mandate, including reviewing and fostering the development of climate models, co-ordination of model experiments and inter-comparisons (including CMIP5), as well as promotion and facilitation of model validation. The WGNE/WGCM Climate Model Metrics panel plays an important role in the latter aspect, since it is vital to determine in an objective manner whether models are improving over time. SPARC provides an active contribution to this work with the quantitative performance metrics developed in the CCMVal activity. The Obs4MIP initiative was also presented. This activity, with a website hosted by the ESG (Earth System Grid), aims at integrating observational data from several sources for model validation purposes. Technical documents describing satellite instruments and techniques as well as some data are already available on the portal.

A. Scaife summarised the work of WGSIP (Working Group on Seasonal to Interannual Prediction) relevant to SPARC. The most important link between SPARC and WGSIP is the Stratospheric Historical Forecast Project, which is part of the larger Climate-system Historical Forecast Project (CHFP). In this context, the stratosphere-resolving hindcast experiments are analysed to compare models with high and low model tops. The most important aspects include the ENSO teleconnection and comparison of strong and weak vortex events. The results are to be published in 2012.

D. Jackson presented results arising from the collaboration between SPARC and WGNE (Working Group on Numerical Experimentation). In the past, the liaison between WGNE and SPARC was managed by Saroja Polavarapu, who has now handed over to David Jackson. WGNE recognizes that the SPARC Reanalysis Intercomparison Project (S-RIP) and the Stratospheric Network on Assessment of Predictability (SNAP) are relevant to WGNE's activities. In future, there could also be collaboration between the Gravity Wave Initiative and Boundary Layer projects in WGNE and it was suggested that this point be considered at the next WGNE meeting.

J. Arblaster discussed the role of the stratosphere in climate from an AR5 perspective. She explained the different model runs being carried out within CMIP5 (Coupled Model Intercomparison Project phase 5), under the auspices of the WCRP's Working Group on Coupled Modelling (WGCM), in support of the next IPCC Assessment. In contrast to the previous IPCC Assessment, there is now widespread recognition of the role of ozone forcing in driven changes in surface climate, especially in the Southern Hemisphere. To better simulate the effects of changes in the stratosphere on surface climate, 15 of the models contributing to CMIP5 are high-top models. The CCMVal/SPARC/AC&C ozone database was prescribed for use by those models that do not simulate ozone. In general, the models have large biases in jet location and are quite likely exhibiting a jet response that is excessively sensitive to both greenhouse-gas (GHG) and ozone forcing. Key conclusions from this presentation were:

- The models contributing to CMIP5 are now much better placed to assess the role of the stratosphere on surface climate. All contributing models include increasing stratospheric ozone into the future, and many of the models simulate changes in stratospheric chemistry (i.e. they are chemistry-climate models).
- Many recent publications have highlighted advances in diagnosing changes in the annular models, jet shifts and storm tracks and the relative roles of changes in GHGs and stratospheric ozone in driving changes in these climate patterns. Current indications are that ozone recovery will largely offset the summertime response of the southern hemisphere circulation to GHGs.
- The new simulations based on the Representative Concentration Pathways (RCPs) present an opportunity to contrast the impacts of ozone recovery and GHGs in future projections of climate change.

T. Shepherd presented an update on the WCRP polar climate predictability initiative. The present frontiers of science include understanding and predicting the rate of Arctic sea-ice loss and understanding the drivers of change in the Antarctic, including connections to ocean circulation, carbon uptake, and ice-shelves. Several science topics could provide foci for the planned initiative, for example, ocean/ice-shelf interactions, the response of southern ocean circulation to surface winds or the seasonal predictability of Arctic summer-time sea ice. The planning continued at a meeting that took place in Toronto from 2-4 April 2012, involving around 30 participants, representing science topics and partner activities. A draft implementation plan will result, for consideration at the WCRP JSC meeting in July 2012.

K. Rao spoke about the Indian monsoon. It is well known that the monsoon is a very important feature of weather and climate in India. A co-operation between SPARC and the Indian atmospheric science community was planned at the last SSG meeting in Pune, India, to focus on this theme. In a second part of the presentation the planning status of the Indian-SPARC (I-SPARC) was shown. In June 2011 "Tropical stratosphere-troposphere: Implications for the Indian monsoon and climate" was selected as a broad theme by the Indian Science Council. The first meeting was attended by 25 scientists and took place on November 30, 2011 in Bangalore. Eight proposals from India and one from outside India were received. The recommendations are to form a National Steering Committee (NSC-ISPARC) to oversee the I-SPARC programme and to produce a scientific programme. The I-SPARC themes are chemistry-climate interactions over the Indian region, the impact of organised monsoon convection on the tropopause layer as seen from observational campaigns and satellite data, and numerical modelling of stratosphere-troposphere dynamical coupling. In addition, 10 topics for focused research were identified.

A. Gettelman discussed a number of international flight campaigns planned over Asia and aircraft and balloon campaigns in the Asia-Pacific region in the next few years. These are designed, in part, to address key science questions regarding the tropical tropopause layer (TTL), including how the TTL cirrus layer is maintained, the radiative impact of TTL clouds, and the transport of key chemical species into the stratosphere. These activities could mutually benefit from international collaboration and co-ordination, but presently only informal contacts and letters of support exist. Work in progress also includes data sharing agreements. Discussion of science objectives, co-ordinated planning, information on aircraft flight planning, multiple balloon locations and co-ordination of balloons with aircraft are believed to be valuable tasks. For this purpose a TTL observation workshop is tentatively scheduled to take place in Honolulu, Hawaii, 15-19 October 2012. SPARC was asked to consider the possibility of contributing to this workshop/co-ordination exercise.

Capacity Development

Capacity development is a focus of the WCRP as a whole as the success of the research community depends crucially on the next generation of scientists. However, apart from encouraging the participation of young scientists in its activities, capacity development has not historically had a prominent role in SPARC. **R. Diab** discussed ways in which SPARC could engage more actively in capacity development with a particular focus on African countries. Several obstacles hinder science training in Africa: (i) African countries often have few job opportunities for researchers so relatively few aspire to such jobs; (ii) well-trained scientists are often promoted to managerial jobs too soon; (iii) pressure to earn money; (iv) lack of infrastructure and people in the same field; (v) need to overcome the isolation - importance of being a member of a network/international research group; (vi) students often have weak backgrounds due to poor schooling. Before SPARC becomes engaged in capacity development, its motivation in this process needs to be determined, and it is essential that the motivation be aligned with the needs and abilities of the partner countries. Motivation could include: regional inclusivity, increase in science manpower/human capital, need to fill in the regional gaps, data needs or in-country verification of model/satellite products, and for altruistic reasons. In addition, it is important to understand the limitations imposed by the lack of local infrastructure in some countries. A possible focus for SPARC could be doctoral and post-doctoral training and mentoring partnerships to ensure that individuals are well networked. Summer/winter schools in developing countries, and inclusion of local institutions in field campaigns are also possible opportunities, but it is essential that the partner countries

be included in the beginning stages of the planning process in order to benefit both SPARC and the partners.

SPARC items

J. Staehelin warmly thanked Norm McFarlane and all former co-workers of the SPARC Office in Toronto for their invaluable help with the transfer of the SPARC Office to Zürich, which was completed at the beginning of 2012, after the transition year in 2011.

M. Geller spoke about the SPARC Data Center, which contains datasets relevant to SPARC research such as the SPARC reference climatology, and the US high-resolution radiosonde and rocketsonde data. The Data Center has always been funded by NASA through M. Geller's research grants, and funding has been secured for the next year. However, M. Geller is planning to retire in the next few years and it is therefore critical that a more permanent solution to funding and maintaining the Data Center be found. The acquisition of high-resolution US radiosonde data for 2009□2011 is currently being undertaken. The high-resolution data exhibits great potential for studies of the tropopause and the effect of vertical resolution in studying this region. A workshop supported by NSF funding is in the planning process, and it was suggested that SPARC could be a co-sponsor.

G. Bodeker discussed the possibility of a new SPARC members database that would allow for the inclusion of additional characteristics of the people in the current SPARC database, such as research interests. This information would be attractive for the database members who might choose to be informed about specific SPARC activities, as well as for the SPARC activity leaders and SSG members who could more easily find people willing to participate in new activities. Such an extended database would require the help of the database members to fill out the questionnaire with details such as their expertise and scientific interest, and security and privacy issues would need to be considered.

C. Arndt, the new SPARC communication officer, introduced the new SPARC web site (**www.sparc-climate.org**). The opportunity for fast and easy communication is crucial in a programme like SPARC, and she discussed the potential for advertising new high-impact papers that are relevant to the SPARC community.

SPARC future

An open discussion was held on the future evolution of SPARC, picking up from the earlier discussion of the outcomes of the OSC and the evolution of the WCRP itself. The overall context is that there is a rapidly increasing demand for "actionable" climate information based on sound science, as reflected in the Global Framework for Climate Services (GFCS), as well as a growing emphasis on an inter-disciplinary approach to global sustainability, as reflected in the "Future Earth" initiative. At the same time, models still have major systematic deficiencies, and the global climate observing system is not only inadequate but is in a very real danger of deteriorating. The challenge for the WCRP is to keep focusing on the imperatives of improving models, and improving observations (including data quality — a big issue), while demonstrating the value of these fundamental activities for applied research. In particular, the WCRP needs to help make stronger links between climate science and risk-based frameworks such as food security and water security. The hope is that climate research can actually be empowered by a user-driven approach, which will identify key sources of uncertainty for practical issues.

SPARC has long been interdisciplinary (with an equal focus on dynamics and chemistry) and focused on deliverables and user needs (e.g. assessments, space agencies), so is well positioned to respond to these overall developments. Moreover, the various SPARC activities are themselves evolving naturally to develop a greater emphasis on stratosphere-troposphere coupling, as this is where the science is headed, so SPARC is already evolving in a way that matches its new mandate from the WCRP. In the future, SPARC will continue to focus on the key imperatives of: (i) improving models through model-measurement comparison; (ii) improving the use of imperfect model information through model assessment and process-oriented diagnostic analysis; (iii) improving reanalyses through assessment of the products; and (iv) improving the observational record through assessment of the products and development of climate data records. SPARC will also continue to contribute to assessments. For the GFCS, SPARC would expect to work mainly through the various WCRP working groups.

One apparent gap in WCRP activity lies in the area of direct and indirect aerosol radiative forcing, which represents a key uncertainty in climate. This could be a future area of activity for SPARC, in collaboration with other projects. There is already an emerging activity within SPARC focused on sulphate aerosols, which could provide a starting point.

More generally, SPARC will need to become actively engaged in the relevant WCRP Grand Challenges, which emerged from the short JSC meeting in Boulder in October 2011. The Grand Challenges are defined more from a user-driven point of view, in contrast to the previous cross-cutting activities (which they are essentially replacing) which were defined more from a process/science-driven point of view, and should thus provide key "pathways to impact" for the WCRP. For SPARC, the most relevant Grand Challenges are (i) Provision of skilful future climate information on regional scales (including decadal and polar predictability), and (ii) Interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity. It is probably fair to say that SPARC is reasonably well positioned to contribute to (i), although it was emphasized that SPARC needs to ensure that the stratosphere is included in the planning for the Regional Production Centres that will underpin the GFCS, and that its own activities (such as CCMVal) provide appropriate diagnostics for regional climate issues. On the other hand, contributing to (ii) will be more of a challenge for SPARC as the mechanisms for doing so do not yet exist, and will need to be developed. In particular, it will be necessary to build chains from measurements and models to climate sensitivity, through climate system components such as sulphate aerosol, cirrus, and upper tropospheric water vapour, which are all of direct interest to SPARC. This area could be an appropriate place for Climate Process Teams to address key systematic model errors such as tropical tropopause temperature and water vapour.

T. Peter led the discussion regarding a possible name change for SPARC. The name is important for the identity of SPARC, and a change may be appropriate given that the WCRP will be extending the mandate of SPARC to include tropospheric processes (to be implemented in 2013). A possible name change was already discussed at previous SSG meetings, and a blog was initiated to allow the SPARC community to comment and make any suggestions. The blog was very active and a large number of opinions were presented with several potential names put forward. The blog has recently been reinitiated with the hope that the community will use this dialogue opportunity again. The final decision about the new name will be made at the next SSG meeting.

G. Bodeker presented the arrangements for the next SPARC General Assembly, which will take place 12-17 January 2014 in Queenstown, New Zealand. The planning process is already

well under way. G. Bodeker is in contact with the Air New Zealand Environment Trust to develop novel ideas for carbon offsets for the General Assembly, since the long-distance flights to New Zealand will lead to a significant carbon footprint, and may discourage some colleagues from attending. To help drum up interest in the region, J. Arblaster is organizing a special SPARC session at the next Australian Meteorological and Oceanographic Society meeting, in February 2013.

The next SSG Meeting will take place in Buenos Aires, Argentina, with a 1.5 day Regional Workshop on 26-27 November 2012 followed by a 3.5 day SSG meeting on 27-30 November 2012, hosted by the University of Buenos Aires. These SPARC SSG meetings will be followed by a WCRP Workshop on Climatic Effects of Ozone Depletion in the Southern Hemisphere, from December 3-7, 2012, which will be of obvious interest to the SPARC community.