Report on the 4th SPARC General Assembly

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The Credo of SPARC General Assemblies

The 4th SPARC General Assembly provided an interdisciplinary venue for the exchange of scientific ideas and information related to "Stratospheric Processes And Their Role in Climate." More than 330 scientists enjoyed this week in Bologna, one of Italy's most elegant and least discovered cities, known variously as la dotta ("the learned one"), la grassa ("the fat one") or la rossa ("the red one"). The local organising committee, E. Manzini and S. Corti (Co-Chairs), C. Cagnazzo, F. Fierli, M. Pantano and E. Palazzi, did a superb job in realising this enjoyment on all levels, from logistic aspects to social events. The General Assembly benefitted from the excellent auditorium, and light and spacious poster halls at the CNR Conference Centre in Bologna. Delicious Italian food and drinks were offered to lubricate the science.

SPARC General Assemblies provide a platform for people to interact, one-on-one, in small groups, and in oral sessions. Oral contributions were held in plenary sessions, *i.e.* without parallel sessions; however, SPARC General Assemblies have a particular emphasis on poster sessions. These provide an opportunity for in-depth discussions, offering plenty of time for meaningful scientific exchange to take place. In Bologna, three poster sessions served this purpose. During each session about 110 posters were presented, and each session comprised about 6.5 hours of viewing and discussion time, conducted in three 2-2.5 hour blocks. The availability of the posters for two days in the vicinity of the auditorium allowed people to look at posters outside of the dedicated poster sessions.

The plenary approach of the oral sessions allows a synthesis of information and ensures scientific exchange within and across boundaries of different scientific topics. The programme of oral presentations was divided into 6 daily sessions, as follows: Sunday: Opening and Cross-cutting Science Topics, Monday: Stratosphere-Troposphere Dynamical Coupling, Tuesday: Extratropical Upper Troposphere / Lower Stratosphere (UTLS); Wednesday: Detection and Attribution of Stratospheric Change; Thursday: Tropical Tropopause Layer (TTL), Friday: Atmospheric Chemistry and Climate (AC&C), with session titles interpreted with sufficient flexibility to allow a "home" for all the major scientific activities of SPARC.

Most of the poster and oral presentations can be downloaded from: **www.atmosp.physics.utoronto.ca/SPARC/SPARC2008GA/GA008home.html** and a very full picture of the General Assembly is available from there. The following report is a summary of perceived highlights. Where poster presentations are mentioned the abstract number is given to help the reader find the relevant presentation on the website.

Back-to-Back with IGAC

SPARC, a core-project of the WCRP, and IGAC, the International Global Atmospheric Chemistry project of the IGBP, are moving closer together. This can be seen most clearly in the cross-cutting activity Atmospheric Chemistry and Climate (AC&C), which has held a number of workshops over the past three years, commonly organised between SPARC and IGAC. To enable cross-participation of attendees of both conferences, the SPARC General Assembly and the IGAC International Conference were organised back-to-back. The IGAC Conference was held in Annecy, France during the week 7 to 12 September 2008 immediately following the SPARC General Assembly.

Within the SPARC General Assembly the Tropical Tropopause and the AC&C themes were purposely scheduled on the last two days, and participation in these two days of the SPARC General Assembly was offered to participants of the IGAC conference at a special rate. SPARC participants were offered the same bargain for participation in the first two days of the IGAC conference, featuring the topics "AC&C" and "Clouds". In the end, about 30 scientists took advantage of the back-to-back organisation.

Opening and Cross-cutting Science Topics

The General Assembly began with an Opening Lecture by **S. Solomon** 'From the IPCC Assessment to Current Research and Back: An Overview of Key Findings and Issues in the Stratosphere and UTLS'. She emphasised that many aspects of the stratosphere were important to the findings of the 4th IPCC Assessment Report and needed further investigation, not least because of the strong indications that the coupling between troposphere and stratosphere was important for regional climate change (which is the aspect of climate change of particular interest to policymakers). She noted the particularly strong connections between stratosphere and troposphere in the Antarctic, with possible implications for sea-ice changes.

Four further 'cross-cutting' talks covered areas of broad SPARC interest.

S. Polavarapu reported on recent progress in middle atmosphere data assimilation. Spin offs of improved assimilation have included better representation of chemical transport and estimates of middle atmosphere gravity-wave drag (*e.g.* **Pulido A167**). **U. Lohmann** discussed the need for better understanding of cirrus clouds, *e.g*. to interpret apparent trends and described recent implementation of supersaturation schemes in GCMs. In a broad-ranging talk on satellite observations, **J. Burrows** presented the last 50 years as a golden pioneering age for space-based remote sensing observations, with information on many chemical species now available, but asked whether the satellite observing systems planned for the future would be adequate, particularly for monitoring long-term changes in climate and assessing chemistry-climate feedbacks. Finally, **F. Cairo** reviewed some of the important results that have been obtained over the last decade by measurements from the M55 Geophysica aircraft, most recently in the West African AMMA campaign. He noted that in AMMA, as in previous campaigns, there was evidence, in limited geographical regions, of moist layers above the cold-point tropopause, with an identifiable link to recent overshooting convection.

Stratosphere-troposphere dynamical coupling

In the past 5-10 years, it has been widely recognised that "two-way" coupling between the stratospheric and tropospheric circulations is an important component of variability in the extratropical atmosphere. Despite clear evidence from observations and models that stratospheric processes impact surface climate, many key aspects of stratosphere-troposphere coupling have proven remarkably difficult to understand. For example, we still do not fully understand the processes whereby changes in the stratospheric flow influence the troposphere, nor do we fully understand how changes in the stratospheric flow influence the vertical propagation of waves from the troposphere, which act as a forcing for the stratosphere. Stratosphere-troposphere dynamical coupling is an important process across time scales ranging from days to centuries. The strength of the coupling means that improvements to stratospheric representation in models might lead to improvements in seasonal and climate time scale prediction for the troposphere, and information on the state of the stratosphere might be useful input to medium and longer-range weather forecasting.

The continuing interest in and importance of these topics was reflected in a wide variety of presentations at the General Assembly. **D. Thompson** discussed recent theoretical and modelling work on the effects of stratospheric wind and temperature anomalies on the troposphere, noting that this is a particular case of the general 'climate-forcing' problem of determining the tropospheric response to external perturbation and emphasising the importance of tropospheric eddy feedbacks.

One of the clear manifestations of coupling between stratosphere and troposphere is the deep vertical structure of the "annular modes" (AMs) of extratropical climate variability. The leading AMs in the troposphere are often found to dominate the response to forcing – be it generic climate forcing or forcing in the stratosphere. As noted by **P. Kushner**, the "fluctuation-dissipation theorem" offers one route to understanding this and predicts, for example, that the response to forcing will be larger when the time scale of the leading AMs, is longer. One recent finding is that this time scale is unrealistically long in some idealised models, implying that the tropospheric response to forcing is unrealistically large (although the value of the idealised models is in highlighting mechanisms rather than giving precise quantitative predictions). There were many presentations discussing these and related issues, including the importance of the eddy response in the stratosphere (as well as the troposphere) (**Chan A357**), shifting of critical latitudes as a way to understand changes in tropospheric eddy fluxes (**Chen A165**), interactions between different AMs (**Sparrow A230**) and the limits of the fluctuation-dissipation theorem (**Cooper A205**).

In a SPARC Lecture, **T. Palmer** discussed the concept of seamless forecasting on all time scales, and of using numerical weather prediction techniques to calibrate climate models. He noted two broad categories of uncertainty in model predictions: the large spread of uncertainty among models ("uncertainty of the first kind"), and common model deficiencies ("uncertainty of the second kind"). He noted that the stratosphere is potentially important on climate-change time scales, but so are other aspects of the climate system, including tropical ocean-atmosphere coupling, and changes to the cryosphere. It is important to clarify the relative importance of these different components – which may of course vary according to location and time scale.

There were interesting presentations on the effect of stratospheric representation in climate models, *e.g*. **Giorgetta (A196)** reported a careful comparison between high-top and low-top models, finding several differences between the two and concluding that many of these were as a result of the fuller representation of stratospheric wave mean-flow interaction in the high-top model. **Fletcher (A156)** reported a case where the high-top simulation was poorer than the low-top simulation, (*i.e*. a high-top is not a panacea), and **Sigmond (A367)** identified the primary influence of gravity-wave drag as setting the 'background state' for planetary-wave propagation.

One seemingly robust result from models with good stratospheric representation is that the strength of the Brewer-Dobson circulation will increase as greenhouse gases increase (*e.g*. Butchart *et al*., 2006), with a corresponding decrease in age-of-air. There is improved understanding of the mechanisms for this strengthening, though the mechanisms seem to vary from one model to another. **Deckert (A115)** identified increased generation of planetary waves in the tropics, particularly in the summer hemisphere, **R. Garcia** saw increased subtropical wave-driving in the lower stratosphere, perhaps due to increases wave generation in the tropics, or to increased propagation out of the extratropics (**Figure 1**, colour plate I), and **C. McLandress** saw changes to both planetary waves and (parameterized) gravity waves. But counter to the apparent consensus in models that the Brewer-Dobson circulation will strengthen in the future, and has strengthened in the recent past, **Möbius** (**A414**, paper to appear as Engel *et al*., 2009 in Nature Geoscience) described observational estimates that indicate an increase of age-of-air from SF_6 over the last 30 years, implying a decrease in the strength of the Brewer-Dobson circulation.

Significant interest continues in the influence of the solar cycle on the stratosphere and troposphere. Much of the general work on the response of the tropospheric circulation to external forcing is relevant here, and some studies have solar-cycle effects particularly in mind (**Simpson A153**). There has been substantial progress in simulating the influence of the solar cycle in comprehensive GCMs. **K. Matthes** presented results from a study with WACCM showing that inclusion of a forced equatorial QBO together with variable (*i.e*. not time-slice) solar cycle forcing was necessary to give good simulation of the seasonal evolution of the solar-cycle anomaly in the stratosphere. If these results hold for other models, it might help to explain the mechanism for the observed Labitzke-van Loon relationship among the solar cycle, the QBO, and polar temperatures.

Extratropical UTLS

The science presented under this heading fell, roughly speaking, into three subject areas: ice supersaturation in UT, chemical and dynamical processes in UTLS, and polar ozone chemistry. There was a broad range of research approaches including satellite and airborne observations, modelling and new laboratory measurements, reflecting the recent advances in technology.

The first invited speaker, **D. Murphy** presented a newly developed technique to analyse chemical composition of single particles in the region of UTLS. He showed that particles in the upper tropical troposphere are not primarily sulfuric acid, but have high organic content, which suggested a potential of ice nucleation. **P. Spichtinger** focused on internal dynamics of cirrus clouds. He used an anelastic non-hydrostatic model together with his original ice microphysics scheme, showing that the occurrence of cirrus clouds in the ice-supersaturated regions over the extratropics is strongly correlated to large-scale dynamics. In some cases, high supersaturations inside thick clouds could exist. Some related talks on ice cloud formation were also given in the TTL session.

There were some outstanding talks on stratosphere-troposphere exchange and dynamical mechanisms controlling chemical transport in UTLS. **T. Birner** gave an update on the tropopause inversion layer (TIL), the region of high static stability found just above the extratropical tropopause, which provides a new angle on the question "How sharp is the extratropical tropopause?" **M. Hegglin** presented recent results obtained from the ACE (Atmospheric Chemistry Experiment)-FTS. The main message from her talk was the value of satellite measurements in providing a global view of the chemical composition of the extratropical UTLS, whereas up to now most information has been obtained from balloons and aircraft. She extended our limited knowledge of stratospheric O_3-N_2O correlation to global scale and provided the first comprehensive data set for the investigation of interhemispheric, interseasonal, and height-resolved differences of the O_3-N_2O correlation structure.

Many other studies also applied new satellite data to investigate the distribution of chemical species and dynamical processes related to transport in UTLS. Sensors such as MLS (Microwave Limb Sounder) and HIRDLS (High Resolution Dynamics Limb Sounder) onboard EOS-Aura have provided useful data to understand ozone transport mechanisms (**J. Gille**, **M. Santee**, **J. Rodriguez**). The new satellite data is also providing potentially valuable information on gravity waves, giving the possibility of identifying wave sources (**J. Alexander**), and the three-dimensional structure of the waves (**T. Horinouchi).**

New aircraft measurements were also highlighted. **H. Bönisch** reported simultaneous *in situ* measurements of CO_2 and SF_6, which were taken in the extratropical UTLS for the time period 2000 - 2003 during the SPURT (SPURenstoff-transport in der Tropopausenregion) project. His study gives useful information on the time scale of troposphere-to-stratosphere chemical transport, and for validating of chemical transport models.

Another outstanding topic was on the impact of new laboratory measurements on polar chemistry presented by **M. Rex**. New laboratory work by Pope *et al.* (2007) on the cross-sections of ClOOCl suggests that the photolysis of ClOOCl under polar stratospheric winter/spring conditions is nearly an order of magnitude slower than what would be required to explain the observations of ozone loss and ClO in the atmosphere. As reported by Rex, in most chemical models, the ozone loss rates calculated based on the known ozone loss mechanisms become much smaller than estimated from observations. If the cross-sections reported by Pope *et al*. (2007) are correct, a major fraction of observed polar ozone loss is due to a currently unknown mechanism. This indicates "a major challenge of our fundamental understanding of the polar stratospheric ozone loss process". (See also **Harris A266** and **Chipperfield A425**.) A SPARC initiative, "The Role of Halogen Chemistry in Polar Ozone Depletion" has been set up to deal with this issue, and work continues to resolve the discrepancy between laboratory data and observational results.

Polar stratospheric clouds also have a critical role in ozone destruction. An innovative technology from space-based lidar, CALIOP (Cloud-Aerosol LIdar with Orthogonal Polarization), provides a fantastic picture of spatial distribution of polar stratospheric clouds with their microphysical information (**M. Pitts**). It is desirable that such advanced observations will continue into the future.

Detection and Attribution of Stratospheric Change

The concepts of detection and attribution have become central to the discussion of the recovery of the ozone layer. Detection of statistically significant changes in ozone tendency, based on analyses of long-term high quality measurements, coupled with attribution of those changes to decreases in stratospheric halogen loading, forms the basis for the discussion of ozone recovery. To attribute changes in ozone unambiguously to changes in ozone depleting substances (ODSs) it is necessary to first quantify the effects of other factors that may affect ozone, such as changes in stratospheric temperatures or transport, the effects of the solar cycle, or changes in other chemical cycle, *e.g.* changes in HO_x cycles resulting from changes in stratospheric water vapour. Regression analyses, where basis functions describing the known geophysical forcings of ozone are optimally fitted to measured ozone time series, is a commonly used technique to quantify non-ODS effects on ozone (**Wohltmann A39**), and to detect trends in stratospheric composition and temperature (**Hassler A119**; **McDermid A45**). Because of the role that stratospheric processes play in climate, detection and attribution of stratospheric change becomes a part of the process of attribution of climate change (**Roscoe A18**). Without such attribution, quantifying the contribution of anthropogenic activities to observed and projected changes in climate is not possible.

A number of oral and poster presentations in this session focused on the topic of ozone recovery and understanding the interplay between the different processes affecting both the detection and attribution of ozone recovery (**P. Newman**). Detection of the first two stages of ozone recovery (reductions in the rate of decline and then increasing ozone attributable to decreases in ODSs) has been demonstrated in many locations in the atmosphere, and the emphasis has now shifted to better understand what processes will affect the long-term full recovery of the ozone layer, including the future evolution of equivalent effective stratospheric chlorine (EESC) and future trends in stratospheric temperatures. Because of the strong dependence of ozone recovery on changes in EESC, understanding and reducing the uncertainties in projections of stratospheric halogen loading was a key topic, see **Figure 2** (colour plate I).

Ozone recovery in turn drives long-term tendencies in stratospheric dynamics such as the final warming date in Antarctica (**J. Haigh**), and in surface climate such as the southern annular mode (SAM). It was shown that stratospheric ozone loss above Antarctica is 7 to 70 times more likely to be the cause of the observed increase in the strength of the SAM over the past 2-3 decades than greenhouse gases (**Roscoe A18**). Therefore, as the ozone hole recovers, the SAM should weaken (Perlwitz *et al*., 2008).

In the past a number of linear correlations between stratospheric variables have been empirically deduced, *e.g*. the V_{PSC} *vs*. ozone loss relation (Rex *et al*., 2004). Such relationships are useful in attributing interseasonal variability in the stratosphere but until we can quantitatively understand the linear behaviour of these relationships and their uncertainties (Jackson and Orsolini, 2008), we cannot be sure that they are applicable outside the range of parameters from which they were derived. A better understanding of the linearity of the V_{PSC} *vs*. ozone loss relationship has now been demonstrated (**N. Harris**).

The mechanisms underlying solar cycle variability in ozone, and the transmission of the solar signal to lower altitudes in the atmosphere, were discussed in a number of presentations (**L. Hood; Remsberg A76**). There is renewed interest in the effects of energetic particle precipitation, which, through ionization and dissociation processes, drives increases in NO_x and HO_x and increases ozone destruction.

A focal point for this session was the measurement of water vapour in the stratosphere (**O. Moehler**) and detection and attribution of long-term changes in stratospheric water vapour. It was shown (**M. Weber**) how observed changes in stratospheric water vapour can be linked to recent changes in the strength of the Brewer-Dobson circulation and lifting of the tropopause (**Van Malderen A118**), a link here to the discussion of dynamical changes in the Brewer-Dobson circulation in the stratosphere-troposphere coupling session. Time series of GPS radio occultation measurements are becoming sufficiently long to allow for detection of changes in stratospheric temperatures and water vapour (**D. Narayana Rao**).

Tropical Tropopause Layer

Study of the TTL (Tropical Tropopause Layer) has grown enormously in the past decade or so (see review by Fueglistaler *et al*., 2008a). Papers on TTL research have been highly visible at the previous two SPARC General Assemblies and in Bologna there were 11 oral presentations and more than 40 posters on this topic. Noteworthy observations in the TTL included convective influences over India (**Kulkarni A87**), a range of stratospheric and convective influence in upper troposphere and TTL ozone over La Reunion over the western Indian Ocean (**Clain A129**), black carbon in the TTL from flights out of Costa Rica (**Spackman A295**), MJO signatures over Indonesia (**Hermawan A106**), water vapour, clouds and supersaturation (**Voemel A430**), and QBO and ENSO signals in the TTL from SHADOZ (**Lee A280**).

Several invited talks highlighted complexities in understanding processes in the TTL, including reconciling observations with theory. For example, **L. Donner** focused on inadequacies of general circulation models for representing the sub-grid convective transport that redistributes species between the surface and upper troposphere, and on through the TTL.

Two comprehensive papers presented in the TTL session were a theoretical one on the UTLS diabatic heat budget of the TTL (**S. Fueglistaler**), and an observational study of TTL waves and cirrus using lidar and sounding data from tropical Pacific cruises (**M. Fujiwara**). Understanding the heat budget is crucial to transport processes at the tropopause. Given that there is significant cancellation between individual terms in the heat budget and that clouds are a major complication, accurate calculation of the budget is a challenge. Illustrations from various campaigns demonstrated the variable effects (positive or negative) in the vicinity of thick clouds. **S. Fueglistaler** also compared ECMWF analyses and reanalyses (ERA-40) with relevant diagnostics to illustrate deficiencies in present-day model evaluations of individual terms in the diabatic heating rate.

Before discussing the results of three western Pacific cruises, **M. Fujiwara** reviewed earlier TTL observations based on Indonesian ozonesonde-radiosonde measurements. Both equatorial Kelvin waves and breaking Rossby wave intrusions of midlatitude air were detected and the observations confirmed with back-trajectories and models, as is corroborated by SOWER (Studies of Ozone and Water Vapor in the Equatorial Region, **F. Hasebe**). Similar processes contributed to temperature, wind and cirrus variability on three month-long R/V Marai cruises in early winter 2001, 2002 and 2004-2005. Observations interpreted with ECMWF analyses and back-trajectories indicated the presence of both "visual" and sub-visual cirrus at various times and four processes that appear to control cirrus. Two of these, convective (vertical) transport of water vapour and cloud particles, and advection of water vapour and cloud particles possibly associated with equatorial Rossby waves, were implicated in the relatively dense cirrus observed on the 2004-2005 cruise. This cruise featured fairly rapid quasi-steady diurnal variations in TTL cirrus that might point to an additional mechanism for TTL dehydration. (See **Figure 3**, colour plate II).

A worthy complement to the papers presenting cirrus and aerosol particle data in the TTL was **T. Koop**'s SPARC Lecture on microphysics and ice nucleation in various regimes. A theoretical framework for homogeneous and heterogeneous nucleation was provided, including, under certain circumstances, a role for a "glassy" aerosol phase. Data were supplied by field and chamber experiments (see **Figure 4**, colour plate III).

Atmospheric Chemistry and Climate

Since the last SPARC General Assembly in 2004, the Chemistry-Climate Model Validation (CCMVal) Activity has become the major chemistry-climate modelling initiative within SPARC. A summary of CCMVal-1 results was presented in a SPARC Lecture by **D. Waugh**. CCMVal defined the forcings and simulation protocols for the chemistry-climate model (CCM) reference simulations that provided a major underpinning for the 2006 WMO/UNEP Scientific Assessment of Ozone Depletion (WMO, 2007). The CCMVal-1 runs were analysed in community publications (*e.g*. Eyring *et al*., 2007) and were of critical importance in assessing the evolution of ozone, temperature, and trace species in the stratosphere in the recent past as well as in making projections of ozone recovery in the 21st century. The projected stratospheric ozone evolution in the 21st century on a global scale is mainly determined by decreases in halogen concentrations and continued cooling of the global stratosphere due to increases in greenhouse gases. Ozone is also affected by stratospheric circulation changes arising from climate change. For example, models consistently project a decrease in tropical lower stratospheric ozone associated with increased tropical upwelling. Such a decrease in lower stratospheric tropical ozone is in fact observed (Randel and Wu, 2007), but it is attributed to climate change, not to CFCs, and so is not expected to reverse in the future. Using the CCMVal-1 model simulation archive, Son *et al*. (2008) showed that the recovery of the Antarctic ozone hole should lead to a reversal of the observed Southern Annular Mode (SAM) trend over the next half-century. Such a reversal is not predicted by the IPCC AR4 models and even those with imposed ozone recovery did not predict as large a change in the SAM trend as was found in the high top CCMs (**Figure 5**, colour plate III). This demonstrates the importance of a fully coupled representation of ozone and climate in a stratosphere-resolving model. Elsewhere in this session a variety of related talks and posters were presented, including results from improved model versions that will feed into CCMVal-2, which is currently in preparation.

Stratosphere-troposphere exchange is a major source of natural variability in tropospheric ozone, and the inclusion of realistic time-varying ozone and a nudged QBO in the HADGEM1 model greatly increases the variability of parameters at the Earth's surface (**L. Gray**). **C. Mathison** showed how improved representations of ozone can lead to better temperature analyses and forecasts *via* more accurate radiative heating rates and better assimilation of satellite radiances. **K. Tourpali** presented surface UV simulations in the 21st century which used CCMVal-1 results as input to a radiative transfer model to calculate future UV irradiance levels under cloud free conditions.

Several contributions considered the tropical tropopause layer, which is important for the dynamics, radiation, and chemistry of the atmosphere. **T. Reichler** showed results from a model-based approach to investigate tropical tropopause trends in his talk. The tropopause height increases almost steadily during the 140 simulation years from 1960 to 2100 with the CCM AMTRAC. On the other hand, tropopause temperature shows a marked and climatically important transition near the year 2000 in this CCM, with cooling in the past and warming in the future. Using multi-linear regression, they showed that long-term trends in tropopause parameters can be fit with high accuracy to terms representing total column ozone, tropical mean sea surface temperatures, and tropical mass upwelling. The change in tropopause temperature trend near the year 2000 is related to the change in the sign of the stratospheric ozone trend.

Changes in tropospheric chemistry, their impacts on climate, and the effects of deep cumulus convection on atmospheric chemistry were presented in two invited talks by **K. Sudo** and **M. Lawrence**. A changing climate will change air quality and the tropospheric ozone budget has a role in climate change. The tropospheric ozone burden has increased by 71 Tg between 1890 and 1990 — an increase of ~30%. In the future climate, the decreased tropospheric burden will be the result of competition between increased ozone destruction due to higher relative humidity and increased influx of ozone from the stratosphere. Stevenson *et al*. (2006) showed that the different models participating in the PHOTOCOMP-ACCENT-IPCC model intercomparison study have different sensitivities to these processes. In polluted regions, climate change will have a positive feedback on surface ozone, whereas in clean regions, climate change will have a negative feedback on surface ozone. Deep cumulus convection has several important influences on atmospheric chemistry, such as vertical transport, scavenging of soluble gases and aerosols by precipitation, and generation of lightning, which produces NO. Deep convection also effects atmospheric chemistry indirectly through its contributions to solar and infrared radiation budgets, and to both synoptic and global scale circulations. Several key aspects were highlighted from simulations with the chemistry- transport model MATCH (Lawrence and Salzmann, 2008) and the CCM EMAC. This highlights issues relevant to chemistry of the UTLS region, which is important for the IGAC/SPARC AC&C Activity 2 concerning processes controlling vertical distributions of trace gases and aerosols.

SPARC 2008 Poster Awards

Kevin Grise (Colorado State University, Fort Collins, USA), Susann Tegtmeier (Environment Canada, Toronto, Canada) and Padmavati Kulkarni (National Atmospheric Research Laboratory, Gadanki, India) received SPARC 2008 Poster Awards for their outstanding posters presented during the 2008 SPARC General Assembly. The members of the scientific organising committee are grateful to these young members of the SPARC research community for helping to turn this conference into a wonderful success!

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SPARC Dynamics and Variability Project (DynVar): Plans and Status

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Introduction

In SPARC Newsletter No. 29, we introduced the SPARC Dynamics and Variability Project (SPARC DynVar), a model intercomparison project focused on the question of stratospheric influence on tropospheric climate. We here summarise the DynVar project plans for the next few years based on input from a workshop held at the University of Toronto, 27-28 March 2008, and from surveys of the DynVar participants. Further details and updates will be posted on the SPARC DynVar website, **www.sparcdynvar.org**.

Review and Update on DynVar Goals

The SPARC DynVar project aims to study the dynamical influence of the stratosphere on the troposphere using "high-top" atmospheric general circulation models (AGCMs) with good stratospheric representation. The project's long-term goal is to determine the dependence of the mean climate, climate variability, and climate sensitivity on the stratospheric general circulation as represented in AGCMs. It aims to answer the thematic questions posed in our article in SPARC Newsletter No. 29:

1. *How does the stratosphere (more specifically, the stratospheric general circulation as represented in climate models) affect the tropospheric general circulation?*
2. *How does the stratosphere influence climate variability on all time scales?*
3. *How does the stratosphere influence climate change?*

Within its scope, the project includes ocean models coupled to high-top AGCMs to investigate in a more realistic setting the two-way troposphere-stratosphere dynamical coupling. It also includes a theoretical component intended to improve our physi-