Annual Report

SPARC 2014

SPARC
Stratosphere-troposphere
Processes And their Role in Climate

World Climate Research Programme
WMO
UNESCO
IOC
ICSU
International Council for Science

Annual Report
SPARC 2014

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Overview from the Co-Chairs

The SPARC Scientific Steering Group (SSG) welcomed new co-chair Neil Harris in September 2014. Neil brings extensive knowledge in ozone chemistry and tropical processes to SPARC leadership as well as a British sense of humour that we are already enjoying a great deal! Other new SSG members welcomed in January 2015 include Alexei Karpechko (Finland), Hauke Schmidt (Germany), and Tianjun Zhou (China), bring in new expertise in global modelling with applications to chemical and dynamical coupling (from the ocean to the middle atmosphere), and consequences of climate engineering.

Work in support of the next Coupled Model Intercomparison Project (CMIP6) occupied many in the SPARC community in 2014. Although still early days for CMIP6, proposals for MIP experiments and associated diagnostics were prepared and reviewed this year. Planned experiments on volcanic and solar influences, aerosols and chemistry, geoengineering, decadal prediction, detection and attribution, high-resolution modelling, and dynamic variability included many involved in SPARC. The CMIP6 experiments and analysis will likely move the scientific basis forward significantly in the coming years.

SPARC co-chairs 2014: Joan Alexander (left) and Neil Harris (right)

Many in the SPARC community were closely involved in the 2014 Scientific Assessment of Ozone Depletion published this year. The SPARC Lifetimes Activity finished its influential report on *Lifetimes of Stratospheric Ozone-Depleting Substances, Their Replacements, and Related Species*, which had a major influence on the 2014 Assessment, providing several critical tables, and leading to dozens of references of their report in the Assessment. The SPARC Data Initiative (p. 15) is in the final phase of finishing their report on Trace Gas Climatologies, and the Ozone Profile Activity (p. 20) has nearly completed its set of open access publications. The work of these two activities also contributed in significant ways to the 2014 Ozone Assessment. While these activities sunset, planning for new activities on a variety of topics related to dynamics, chemistry, and cirrus clouds are well underway, so we look forward to reporting on those in the coming year.

A Word from the Project Office

2014 started off with a bang at the very successful 5th SPARC General Assembly in Queenstown, New Zealand, which was held from 12-17 January. The SPARC Office was very involved in supporting the organisation of the conference, in particular mobilising and coordinating the financial support for participation of young scientists and scientists from developing countries. As one of the side events at the General Assembly, a lunchtime meeting focused on SPARC Capacity Development was organised by Carolin Arndt, SPARC Communications Manager. This then led to a community-wide survey on regional needs for capacity development and the organisation of a dedicated two-day capacity development workshop held in early January 2015. Both these events have helped establish more clear directives for Capacity Development at the SPARC level as well as within the wider WCRP community.

As usual, the SPARC Office did its best to ensure the smooth running of SPARC, through maintaining a frequently updated website, organising travel support for meeting and workshop attendance, amongst many other things. At the 35th WCRP JSC meeting SPARC was tasked with carrying out a survey of atmospheric dynamics-related activities across the entire WCRP. During 2014 the SPARC Office worked on this survey, which is currently nearing completion. The SPARC Office also contributed to SPARC science activities, with Fiona Tummon, SPARC Project Scientist, contributing to scientific research undertaken as part of the Ozone Profile Assessment – Phase II (SI2N) and the Chemistry-Climate Model Initiative (CCMI).

Participants of the 5th SPARC General Assembly held in Queenstown, New Zealand, from 12-17 January 2014.

During 2014 much hard work was put into securing further funding for the continuation of the SPARC Office at the ETH Zurich, Switzerland. In this respect, this work has been fruitful and the SPARC Office will continue in its Zurich home until the end of 2017.

The SPARC Office would like to acknowledge the support of ETH Zurich, the Federal Office for the Environment (FOEN), the Federal Office of Meteorology and Climatology (MeteoSwiss), the Swiss National Science Foundation (SNF), the Canadian Space Agency, and WCRP, as well as the excellent collaboration and support of the WCRP Joint Planning Staff in Geneva.

The SPARC Office team

Workshops and Meetings held in 2014

12 – 17 January
5th SPARC General Assembly
Queenstown, New Zealand

19 – 21 January
21st SPARC Scientific Steering Group Meeting
Queenstown, New Zealand

31 March – 4 April
Gravity Waves Meeting
ISSI, Bern, Switzerland

5 – 9 May
5th SOLARIS-HEPPA Workshop
Baden-Baden, Germany

20 – 22 May
2014 IGAC/SPARC CCMI Workshop
Lancaster, UK

27 – 29 August
Polar Stratospheric Clouds Workshop
Zurich, Switzerland

8 – 12 September
Joint S-RIP and DAWG Workshop
College Park, Maryland, USA

22 – 26 September
SSiRC Scientific Steering Group Meeting
ISSI, Bern, Switzerland

16 – 18 October
Data Initiative Meeting
Reading, UK

3 – 5 December
WAVAS-II Meeting
Karlsruhe, Germany

Participants of the 21st SPARC SSG meeting held in Queenstown, New Zealand, from 19-21 January 2014.

SPARC Activity Report Summaries

IGAC/SPARC Chemistry-Climate Model Initiative (CCMI)

Activity Leaders: Michaela Hegglin and Jean-François Lamarque

Achievements for 2014

CCMI has had another busy year. The 2014 IGAC/SPARC Chemistry-Climate Model Initiative (CCMI) Science Workshop was held at Lancaster University, UK, from 20-22 May, with over 130 participants. The workshop brought together experts in the development, use, and analysis of global stratosphere-troposphere resolving chemistry-climate models (CCMs), and experts in both *in situ* and remote sensing observations of short- and long-lived chemical species and aerosols. Science topics included new examples of process-oriented CCM evaluation, key observations needed for model evaluation, critical topics in tropospheric and stratospheric chemistry and dynamics, as well as stratosphere-troposphere coupling. Workshop reports were published in the IGAC and SPARC newsletters. The workshop was followed by a Scientific Steering Committee (SSC) meeting on the afternoon of 22 May 2014.

Other accomplishments include:

- A proposal for an "Aerosol and Chemistry Model Intercomparison Project (AerChemMIP)" was submitted to CMIP6. AerChemMIP is a joint, consolidated effort for CMIP6 from two international communities - CCMI and AeroCom (Aerosol Comparisons between Observations and Models, http://aerocom.met.no/Welcome.html). AerChemMIP focuses on the role of aerosol and chemistry (in particular near-term climate forcers) projections on radiative forcing and climate response. Experiments suggested for CCMI Phase 2 (Eyring *et al*., 2013b), which are traditionally run using chemistry-climate models (CCMs) with mostly prescribed sea surface temperatures and sea ice concentrations, complement this set of AerChemMIP/CMIP6 experiments. One of CCMI's principal contributions to CMIP6 (through AerChemMIP) will be an update of the SPARC CCMVal ozone forcing data base (Cionni *et al*., 2011) for use in CMIP models that do not include a representation of a comprehensive atmospheric chemistry.
- The CCMI data archive has been set up at the British Atmospheric Data Centre (BADC). Uploading of model data sets from CCMI-1 simulations has started and will soon be made publicly accessible.
- The CCMI-1 evaluation/diagnostic list currently encompasses 46 evaluations/diagnostics (see http://www.met.reading.ac.uk/ccmi/?page_id=23).
- CCMI has written two articles in the past year, contributing to both SPARC and IGAC Newsletters:
  - Michaela I. Hegglin, Jean-François Lamarque, Veronika Eyring, Peter Hess, Paul J. Young, Arlene M. Fiore, Gunnar Myhre, Tatsuya Nagashima, Thomas Ryerson, Theodore G. Shepherd, and Darryn W. Waugh, IGAC/SPARC Chemistry-Climate Model Initiative (CCMI) 2014 Science Workshop, *SPARC newsletter No. 43*, July 2014.
  - Report from the Chemistry Climate Model Initiative 2014 Workshop, *IGAC Newsletter No. 52*, August 2014.

Plans for the coming year

A major goal of CCMI's work during the next year will be the evaluation of CCMI phase-1 model simulations, which the modellers are currently finishing and uploading to the BADC data archive. These evaluations will help identify key issues in the performance of current chemistry-climate models, relate the issues to radiative, physical, and chemical processes, and contribute to model development. They will also help to refine the reference simulations and data request for CCMI Phase-2 needed to address open science questions in the next IPCC and WMO/UNEP ozone assessments.

The 2015 CCMI Science Workshop will take place in Rome, Italy, from 7-9 October 2015. Workshop preparations have started, with Dr. Federico Fierli as the local host and organizer. The CCMI Science workshop will encompass a joint day with an AeroCom workshop (5-7 October) on 7 October held in Frascati, Italy (hosted by ESA).

CCMI plans to open a joint special issue between AMT/ACP/EESD/GMD in the beginning of June 2015, to which CCMI-1 analyses can be submitted.

CCMI will further contribute to the development of a community-wide diagnostic tool for the evaluation of Chemistry-Climate and/or Earth System Models (ESMVal Tool). CCMI will also contribute to the development of emissions data sets for CMIP6 and will lead the development of an update of the IGAC/SPARC ozone data base (Cionni *et al.*, 2011) for CMIP6.

Finally, a white/overview paper on IGAC/SPARC CCMI-1 is being prepared.

Figure 1: Participants of the IGAC/SPARC CCMI workshop 2014 held in Lancaster, UK.

Gravity Waves

Activity Leaders: Joan Alexander and Kaoru Sato

Achievements for 2014

In April 2014, the Gravity Wave (GW) Activity held a focused workshop on 'Gravity wave sources and forces' at the International Space Science Institute (ISSI) in Bern, Switzerland. Meeting facilities and travel support for two young scientists were provided by ISSI. Additional travel support was provided by SPARC for colleagues from under-represented nations and a key participant. The group identified three foci for the coming year: (1) tropical waves and the phase speed spectrum of tropical gravity wave momentum flux for QBO studies, (2) identifying the sources of missing zonal wind drag in the Southern Hemisphere stratospheric circulation and quantifying gravity wave momentum fluxes in this region, and (3) studies of gravity wave and resolved Rossby wave forcing of the stratospheric Brewer-Dobson circulation and compensation between these two wave types. The activity elected our two early career scientist participants to lead on two of these foci. To facilitate the research, participants have pooled data resources, collecting necessary sets of model experiment output with gravity wave drag and momentum fluxes included.

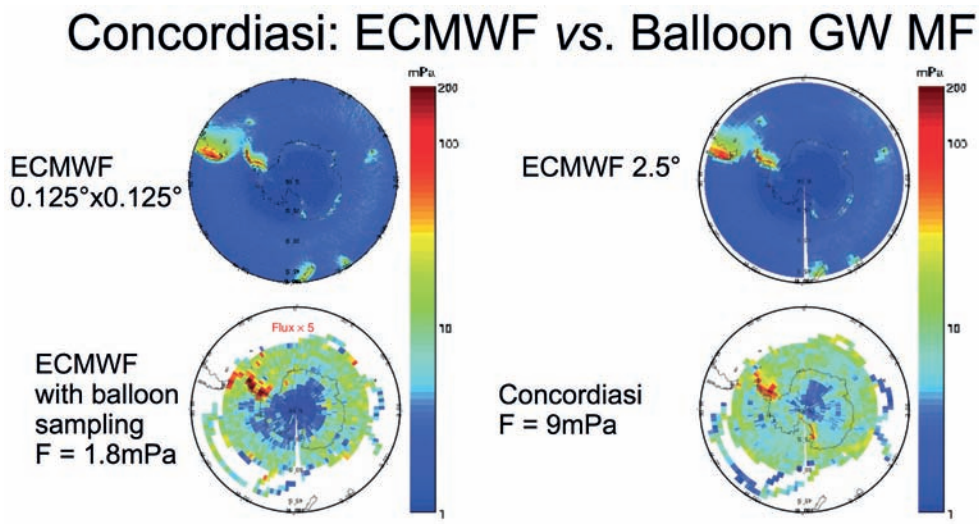

Figure 2: Comparison of momentum fluxes at 20km altitude from ECMWF analysis and Concordiasi super-pressure balloon measurements from September 2009 to January 2010. (a) ECMWF at native resolution, (b) 2.5° Concordiasi-like resolution, (c) with the space/time balloon sampling taken into account, multiplied by 5x, and (d) GW momentum fluxes inferred from the Concordiasi balloon campaign. The spatial distribution of GW fluxes agree well (except over Antarctica), but the ECMWF fluxes are underestimated by a factor of five, essentially due to the limited resolution of the ECMWF model. From Jewtoukoff *et al.*, 2015.

Since GW drag is now recognized as an important component of atmospheric models used for prediction of regional climate patterns and for long-range weather forecasting, new emphasis lies on including realistic sources of GWs as well as testing and improving GW parameterization methods for global models. Parameterizations that permit climate and weather feedbacks on sources are being included in more models, and experiments with these models show some intriguing connections between the stratosphere and the surface. In the tropics, sensitivity to the details of the method of

GW parameterization have been shown to strongly influence predicted changes in the QBO period. It is clear that changes have already occurred in the strength of the QBO in recent years, an observation that puts new emphasis on the importance of longer-term QBO prediction. At extra-tropical latitudes, GW sources include not only flow over topography, but also precipitating storms, fronts, and jets. Sources of GWs are clearly very intermittent and new stochastic parameterization methods better capture this intermittency as well as more realistic effects on the stratospheric circulation.

Jointly with the WCRP WGNE group, we have also sponsored a call for information on surface drag processes in climate models for the WGNE surface momentum budget study.

Plans for the Coming Year

Activity leaders produced an article for the January 2015 SPARC newsletter. The article reviews recent developments on the role of gravity waves in climate studies. We are also considering a review summarizing recent developments in the field for publication in a peer-reviewed journal. We hope to have a small meeting in 2015 of leading authors to plan the review.

Solar Influences (SOLARIS-HEPPA)

Activity Leaders: Katja Matthes and Bernd Funke

Achievements for 2014

The 2nd SOLARIS-HEPPA (SOLAR Influences for SPARC) workshop was held together with the 5th HEPPA (High Energy Particle Precipitation in the Atmosphere) workshop from 5-9 May 2014 in Baden-Baden, Germany (www.imk-asf.kit.edu/english/HEPPA_SOLARIS_2014.php). It was the 5th meeting in a series focussing on the mechanisms by which energetic particles and solar irradiance affect the atmosphere and climate. The topics covered were:

- Variability of energetic particle precipitation and solar irradiance;
- Uncertainties in their measurements;
- Observed and modelled impacts of solar forcing on the atmosphere (thermosphere to surface) and climate;
- Predictions for future scenarios under a weakening sun.

One of the scientific highlights was the finding that the impact of energetic particle precipitation on regional North Atlantic climate can be similar in magnitude to solar irradiance forcing, which means that energetic particle precipitation needs to be included in climate model studies. HEPPA/SOLARIS-2014 was attended by 72 participants from 13 countries, who all contributed papers presented as posters, while 12 overview talks provided introductions to the topics. The next HEPPA/SOLARIS workshop will be held in about two years in Helsinki, Finland.

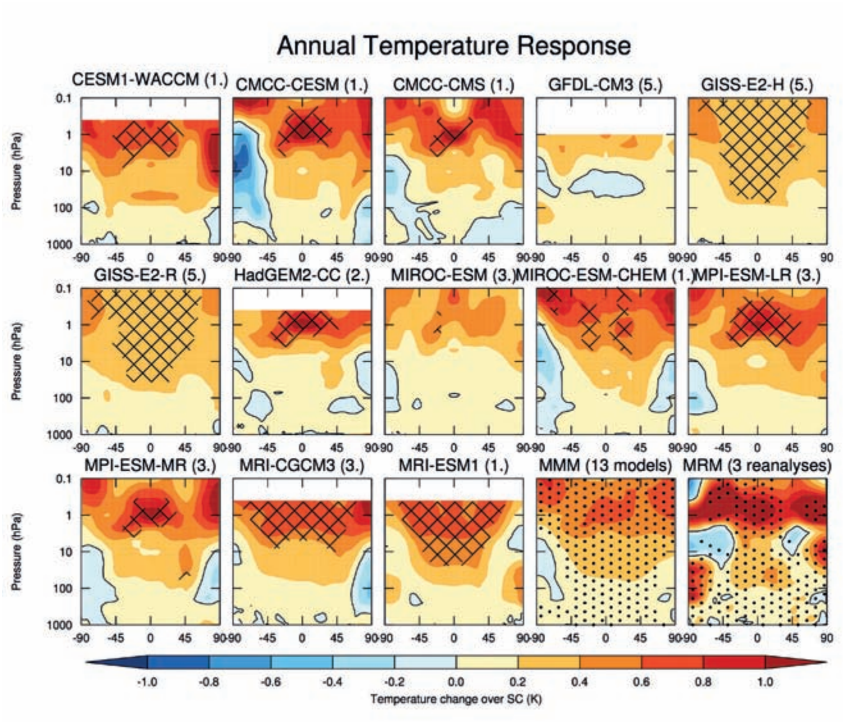

Figure 3: The annual temperature response due to the 11-year solar cycle for individual CMIP5 high-top models, and the multi model mean (MMM), covering the period 1850-2005. Hatched areas for the individual models show 95% significance. The bottom right plot shows the multi reanalysis mean (MRM), where stippled areas show where all reanalyses agree on the sign of the response. For the MMM, stippled areas show where 80% of the models agree on the sign of the regression coefficient. The multi-model mean of CMIP5 models does not reproduce the warming in the tropical lower stratosphere during solar maximum conditions. The solar ozone signal might play a role for this discrepancy and is currently under investigation. From Mitchell *et al*., 2015.

Several publications covering the intercomparison of solar signals in CMIP5 simulations (SolarMIP; Mitchell *et al.*, 2014; Misios *et al.*, 2014; Hood *et al.*, 2014) and related investigations (Thiéblemont *et al.*, 2014) are in the publishing process. Publications of the HEPPA-II intercomparison results are currently in preparation.

Publication of the CAWSES-II TG1 overview paper with contributions from SOLARIS-HEPPA:

- Seppälä, A., K. Matthes, C. E. Randall, and I. A. Mironova, 2014: What is the solar influence on climate? Overview of activities during CAWSES-II, *Progress in Earth and Planetary Science*, 1:24, doi:10.1186/s40645-014-0024-3.

Several contributions to the TOSCA 'handbook' on solar impacts on climate (undergraduate level), which consists of a series of short topical chapters related to solar impacts on climate, have been submitted and accepted for publication.

A new SolarMIP proposal has been submitted to the CMIP6 panel. The proposed MIP includes a solar forcing only experiment, and sensitivity experiments to address (1) the uncertainty in spectral solar irradiance forcing and (2) future regional climate impacts by secular variations of the solar background.

Plans for the Coming Year

We plan to have a working group meeting (November 2015, Boulder), focusing on the coordinated evaluation of the solar cycle signal in CCMI hindcast simulations and satellite observations (including the assessment of analysis tools and quantification of individual contributions to the solar signal).

We also plan to finalize the CMIP6 solar forcing data and publish a dataset description in the CMIP6 special issue. Finally, we will launch a working group to assess the solar signal in stratospheric ozone. Results will be used to constrain the solar signal in the CMIP6 ozone climatology, to be consistent with the proposed solar forcing.

Dynamical Variability (DynVar)

Activity Leaders: Elisa Manzini and Edwin Gerber

DynVar is an international working group focused on modelling the dynamics and variability of the stratosphere-troposphere system. DynVar aims at improving our understanding of the interactions between atmospheric variability, dynamics, and climate change, with a particular emphasis on the two-way coupling between the troposphere and stratosphere. To this end, DynVar promotes the development and use of coupled atmosphere-ocean-sea-ice general circulation models, with the atmospheric component extending to above the stratopause. The key questions addressed by the activity are:

- How do dynamical processes contribute to persistent model biases in the mean state and atmospheric variability, including biases in the position, strength, and statistics of blocking events, storm tracks, and the stratospheric polar vortex?
- How does the stratosphere affect climate variability at intra-seasonal, interannual, and decadal time scales?
- What is the role of dynamics in shaping the atmospheric circulation response to anthropogenic forcing (*e.g.* global warming, or ozone depletion) and how do dynamical processes contribute to uncertainty in future climate projections?

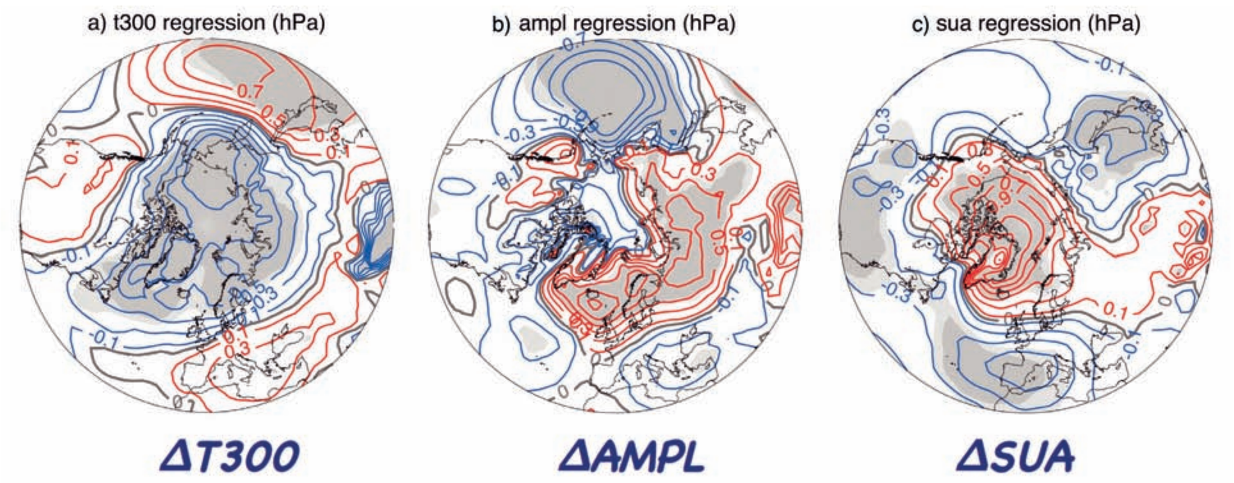

Figure 4: Winter (DJF) SLP (sea level pressure, hPa) regression coefficients from the CMIP5 multi-model analysis of Manzini *et al.* (2014). The plots highlight the fact that differences in climate models' SLP response to anthropogenic forcing (2061–2100 RCP8.5 minus 1961–2000 historical) are comparably connected to differences in their stratospheric circulation response as to differences in upper tropospheric or Arctic surface warming. Hence inter-model differences in stratospheric changes contribute as effectively to uncertainty in the surface circulation as differences in climate sensitivity or Arctic surface warming. Regression coefficients (contours: 0, ±0.1, and every 0.2hPa thereafter) are shown for (a) ΔT300, (b) ΔAMPL, and (c) ΔSUA indices of changes across 24 CMIP5 models. ΔT300 captures differences in models' climate sensitivity and is defined by the change in zonal mean temperature at 300hPa, averaged between 30oS-30oN; ΔAMPL captures differences in polar amplification, and is defined by the change in zonal mean temperature at 850hPa, averaged between 60^{o}N-90^{o}N; ΔSUA captures residual differences in the stratospheric mean wind response, and is defined by the change in zonal mean zonal wind at 10hPa, averaged between 70^{o}N-80^{o}N (sign reversed: +ΔSUA for easterly change).

Achievements for 2014

DynVar has been active in the assessment of stratospheric mean climate, variability and change, as well as stratosphere-troposphere dynamical coupling in climate models that participated in the fifth Coupled Model Inter-comparison Project (CMIP5). The DynVar call for analysis of the stratosphere and stratosphere-troposphere coupling in the CMIP5 models continued to deliver peer-reviewed publications in 2014. These publications include work promoted within DynVar as well as independent responses to the DynVar call for analysis, given the free availability of CMIP5 model output.

Initiatives within DynVar are also focused on analysing the stratospheric seasonal prediction hindcasts produced as part of the Working Group on Seasonal to Interannual Prediction's (WGSIP) Stratosphere Historical Forecast Project (SHFP) to discern the role of the stratosphere on intraseasonal time scales.

In order to facilitate the analysis of model output from the next phase of CMIP, DynVar has noted the need for archiving standard variables (e.g. zonal and meridional winds, temperature, and geopotential height) as daily means in the troposphere and stratosphere and requested archival of the Transformed Eulerian Mean (TEM) atmospheric circulation, of parameterized atmospheric gravity wave driving, and heating rates in CMIP6. Our request is under consideration as a 'diagnostic MIP' by CMIP6.

A discussion on how sudden stratospheric warmings (SSWs) are formally defined and how we might update this definition, originated during the last DynVar Workshop in 2013, and is on going under the lead of Amy Butler, see the SSW Forum website (https://sites.google.com/site/stratosphericwarmings/home).

Plans for the Coming Year

Major activities in 2015 will be aimed at linking further with CMIP6 and contributing to the construction of the model standard output by defining variables and prioritizing experiments with focus on diagnostics of atmospheric dynamics.

We expect follow-up from the discussion started by DynVar with SolarMIP and VolMIP (respectively, Solar Model Intercomparison Project and Volcanic Forcings Model Intercomparison Project, also submitted for endorsement to CMIP6) on the joint design of idealized experiments aimed at elucidating dynamical mechanisms of troposphere-stratosphere coupling related to solar variability and volcanic effects on climate.

The SSW definition activity will have the opportunity for community discussion both at the American Meteorological Society (AMS) Middle Atmosphere Meeting in January 2015, as well as at the EGU General Assembly next April 2015.

During 2015 we will plan for the DynVar Workshop to be held in 2016. Alexey Karpechko has kindly offered to host the workshop at the Finnish Meteorological Institute, Arctic Research, Helsinki, Finland.

SPARC Data Initiative

Activity Leaders: Michaela Hegglin and Susann Tegtmeier

Achievements for 2014

The SPARC Data Initiative has made great progress in the past year and the SPARC Data Initiative report is nearly finalized. A Report Finalization Meeting was held in Reading, UK, in October 2014, during which the co-leads met together with Diane Pendlebury to finalize the typesetting of chapters 2 and 3 as well as most of chapter 4. The current status of the report is as follows:

- Chapter 2 (''Satellite instruments and data sets'') and chapter 3 (''Climatology framework'') have been typeset, proof-read by the team and editors, and transferred to the SPARC Office for printing.
- All chapters of the long-lived species (O_3, H_2O, CH_4, N_2O, CCl_3F, CCl_2F_2, CO, HF, HCl, and SF_6) have been finalized and typeset.
- Most chapters of the short-lived species (8 out of 15) have been finalized and typeset. The remaining chapters are currently being revised.
- The executive summary and introduction have undergone an external review and will be finalized after completion of all trace gas chapters.
- The front page of the report has been designed in collaboration with Diane Pendlebury and the SPARC Office.

Access to the SPARC Data Initiative ozone data sets, which was made available through the SPARC Data Centre at the end of 2013, has been requested by 20 international scientists over the past year. Work on the generation of specific model validation diagnostics including a 'best' estimate and its uncertainty range for use in model-measurement comparison exercises has been started. First results were presented at the CCMI workshop in Lancaster in May 2014.

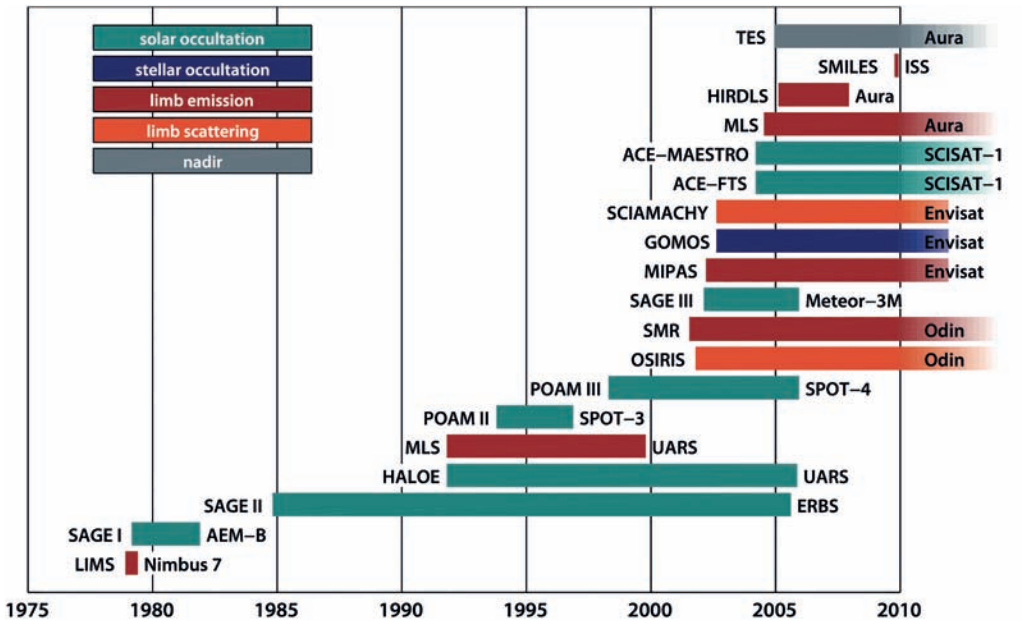

Figure 5: Limb satellite instruments evaluated within the SPARC Data Initiative. The figure also indicates the satellite platform, measurement geometry, and operation period of the respective instruments.

Major milestones have been reached by the publication or submission of the following papers to the SPARC Data Initiative special issue in the Journal of Geophysical Research:

- Neu, J. L. and the SPARC Data Initiative Team (2014): The SPARC Data Initiative: Comparison of upper troposphere/lower stratosphere ozone climatologies from limb-viewing instruments and the nadir-viewing Tropospheric Emission Spectrometer (TES), *J. Geophys. Res.*, **119**, 6971-6990, doi:10.1002/2013JD020822.
- Tegtmeier, S. and the SPARC Data Initiative Team, SPARC Data Initiative: A comparison of CFC-11, CFC-12, HF and SF6 climatologies from international limb satellite sounders, *J. Geophys. Res*., in revision.

Plans for the Coming Year

Early in 2015 the SPARC Data Initiative report will be finalized and published. This includes finishing the revisions of the remaining chapters on short-lived species (HOCl, ClO, BrO, OH, HO_2, CH_2O, and CH_3CN) and the aerosol evaluations. All SPARC Data Initiative trace gas and aerosol data sets will be made available through the SPARC Data centre in spring 2015.

In addition, we intend to submit at least three more manuscripts to the SDI special issue:

- Hegglin, M. I. and the SPARC Data Initiative Team, SPARC Data Initiative: Comparison of trace gas and aerosol climatologies from international satellite limb sounders, in preparation.
- Tegtmeier., S. and the SPARC Data Initiative Team, SPARC Data Initiative: Comparison of nitrogen species climatologies from international satellite limb sounders, in preparation.
- Hegglin, M. I. and the SPARC Data Initiative Team, SPARC Data Initiative: Comparison aerosol climatologies from international satellite limb sounders, in preparation.

Data Assimilation Working Group

Activity Leader: Quentin Errera

Achievements for 2014

The goal of the SPARC Data Assimilation Working Group is to sustain a forum for data assimilators, data providers, modellers, and data users around the SPARC themes. This year, we had a workshop at NOAA (College Park, Maryland, USA) together with the SPARC S-RIP activity. Days 1 and 2 were dedicated to the Data Assimilation Working Group (DAWG) meeting, days 4 and 5 were dedicated to the S-RIP progress meeting, and day 3 was a joint workshop between both activities.

Several interesting results were presented at the DAWG part of the workshop and in particular results from MERRA-2, the latest reanalysis produced by NASA. **Figure 6** compares the temperature and zonal wind in the northern hemisphere high latitudes from MERRA-1 and MERRA-2 during January 2010, when a Stratospheric Sudden Warming occurred. Thanks to the assimilation of temperature profiles observed by the Aura MLS instrument above 5hPa, MERRA-2 is able to provide a much more accurate picture of this event.

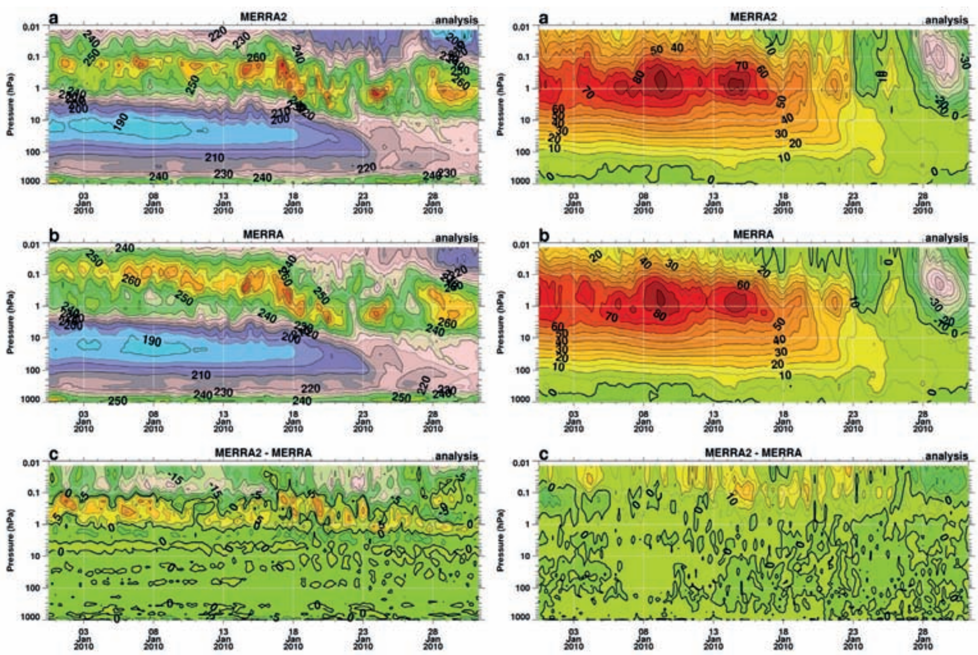

Figure 6: Time series of mean temperature between 60°N-90°N (left) and zonal wind at 60°N (right) from MERRA-2 (top), MERRA-1 (middle), and their differences (bottom) in January 2010. Figure provided by Lawrence Coy.

Plans for the Coming Year

DAWG will again organize a joint workshop with S-RIP. This workshop will take place at the Pierre and Marie Curie University, Paris, France, from 14-16 October 2015. Themes have not yet been confirmed but will likely be: (1) Harmonization of long-term data records and bias correction in data assimilation, (2) the added value of chemical data assimilation, (3) model representation of the upper stratosphere and mesosphere, and (4) latest results from S-RIP.

Water Vapour Phase II (WAVAS II)

Activity Leaders: Karen Rosenlof, Thomas Peter, and Gabriele Stiller

Achievements for 2014

Work on the quality assessment of satellite observations of water vapour was continued during 2014. The assessment covers the following aspects:

- Comparison of satellite data co-located with measurements from balloon sondes (frost point hygrometers from 27 stations) for the upper troposphere/lower stratosphere (UTLS) and the lower stratosphere as well as co-locations with ground-based microwave radiometer data (6 stations) for the upper stratosphere/lower mesosphere;
- Intercomparison of co-located satellite data in terms of latitude bands, over specific regions (like the Asian monsoon region or the West-Pacific), as well as for different seasons;
- Drift analysis versus long-term balloon data records (*e.g.* Boulder data) for co-located satellite data;
- Drift analysis of pairs of co-located satellite data;
- Intercomparison of satellite observations, in particular analyses with respect to amplitudes of the seasonal cycle, semi-annual cycle, QBO, and ascent rates in the tropical tape recorder; Determination of ascent rates within the tape recorder signal and inter-comparison;
- Intercomparison of upper tropospheric humidity from nadir sounding instruments;
- Intercomparison of water vapour isotopologue records.

The current state of the project was presented at the Climate Symposium, 13-17 October 2014, in Darmstadt, Germany as a poster presentation. A wrap-up meeting focused on discussing the results of the comparisons was then held from 3-5 December 2014 at KIT in Karlsruhe, Germany, which lead into the writing phase.

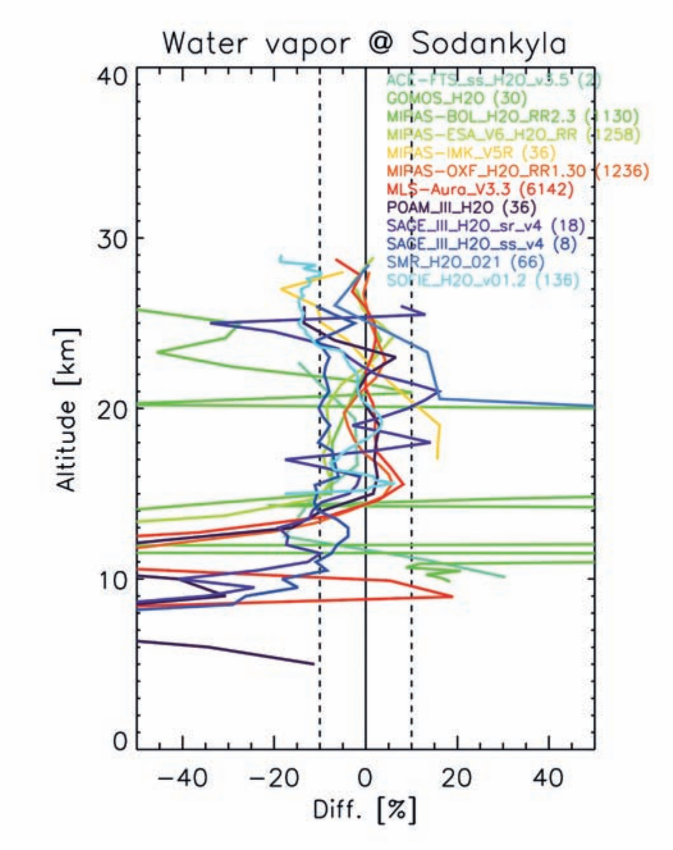

Figure 7: Comparison of coincident satellite measurements of water vapour profiles from 12 satellite records with balloon-borne frost point hygrometer soundings (CFPs and NOAA FPHs) at Sodankylä, Finland. The figure shows the differences 'CFP/FPH minus satellite'. Differences are averaged over all available co-locations for each satellite data record. Coincidence criteria vary with satellite instrument (typically 12h and 1000km).

The *in situ* data portion of the WAVAS-II activity is looking into the issue of supersaturation in the UTLS. A model has been developed to use for analysis, and we now have results from the AquaVIT 2 campaign to consider.

Plans for the Coming Year

The satellite data part of WAVAS-II plans to concentrate on producing a paper summarising the results covering the quality of satellite data available outside of WAVAS-II (review part of the paper) and the results achieved within WAVAS-II (original part of the paper). A final review meeting to discuss the paper is foreseen for late spring 2015, and submission of the paper is planned before summer 2015. Work towards a final SPARC report including a lot of descriptive material that may not fit well into a journal publication is planned after that.

For the *in situ* part, we hope to have a science meeting in 2015 to finalize results. An outline of the paper/report has been circulated to potential authors, and time-permitting, we hope to have a final draft completed within a year. There will be an AquaVit 2 science meeting in Spring 2015, and discussion there will consider how results should be presented, with the main results from AquaVIT 2 likely being incorporated into the WAVAS-II supersaturation report.

Ozone Profile Phase II (SI2N Initiative)

Activity Leaders: Neil Harris, Johannes Stähelin, and Richard Stolarski

Achievements for 2014

The key results of the activity have been presented in a special issue jointly organized between Atmospheric Chemistry and Physics (ACP), Atmospheric Measurement Techniques (AMT), and Earth System Science Data ESSD): Changes in the vertical distribution of ozone – the SI2N report (Editors: P. K. Bhartia, N. Harris, M. Van Roozendael, M. Weber, R. Eckman, D. Loyola, J. Urban, C. von Savigny, M. Dameris, and S. Godin-Beekmann). The special issue presently includes 43 published papers and at least five papers that are currently under review. The papers cover a wide variety of studies and deal with important aspects such as data quality and trend analyses of ground-based ozone profile measurements (in relation to NDACC and GAW) and different satellite data sets. Seven merged long-term satellite series (covering different lengths) were produced and used as a basis for a quasi-global ozone profile trend analysis.

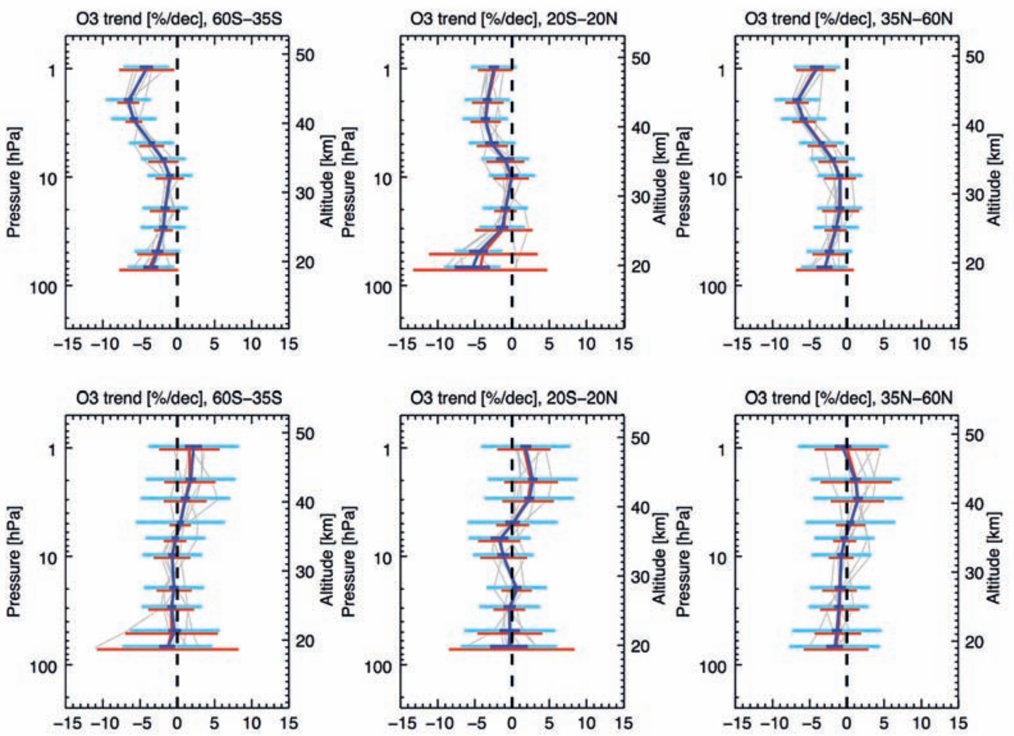

Figure 8: Combined ozone profile trends for the periods before 1998 (top row) and after 1998 (bottom row). Pre-1998 trends are calculated from the trends for 1979-1997 for two SBUV records and GOZCARDS together with 1984-1997 trends for SAGE-OSIRIS, SAGE-GOMOS and SWOOSH. The post-1998 trends are calculated from all six satellite data sets. The error bars show the 95% confidence level calculated in three ways: thick blue lines show the central estimates and their associated most likely range for the ozone trends found by propagating the individual trend errors assuming data sets are independent. Light blue lines, based on the same analyses, additionally include a term for the possible drift of the overall observing system of 1.5% for the early trends (top row), and 2% or 3% for the later trends in the middle or lower and upper stratosphere, respectively (Hubert *et al.*, 2015). The thick red lines show the possible range for the ozone trends calculated assuming the data sets are not completely independent. The conversion to a common pressure scale of trends derived from instruments whose natural measurement coordinate is altitude was made using MERRA temperature profiles.

Three overview papers that summarize the main results of SI2N have been prepared. One of these papers, describing all relevant measurement systems, was published in ACP in April 2014. The other two, one providing an overview of the validation of satellite measurements with ground-based measurements and the other a summary analysis and interpretation of all trends, will be submitted before the end of April 2015, when the SI2N special issue closes.

Plans for the Coming Year

The SI2N activity will be coming to an end in 2015. SPARC should, however, consider setting up a small group to look at the consistency between long-term changes in ozone, temperature, water vapour, and how this relates to current model performance. In the longer term, it is in SPARC's interest to ensure that high quality measurements of the vertical distribution of trace species are available and so it should maintain a watching brief on what is happening with respect to data quality assurance.

Stratospheric Network for the Assessement of Predictability (SNAP)

Activity Leaders: Andrew Charlton-Perez and Gregory Roff

Achievements for 2014

SNAP partners have completed model integrations for the phase-1 experimental runs (forecasts of the January 2013 major sudden stratospheric warming (SSW)). We have collected the data from 7 models and archived it at BADC. The data is now available for analysis and we are in the process of promoting its use.

Initial analysis of the phase-1 experiments was presented at several international meetings (World Weather Open Science Conference, Sub-seasonal to seasonal prediction project (S2S) workshop, and Polar Prediction Project (PPP) workshop). **Figure 9** shows the forecasted zonal mean zonal wind at 10hPa and 60°N by different models at 15- and 10-day lead times.

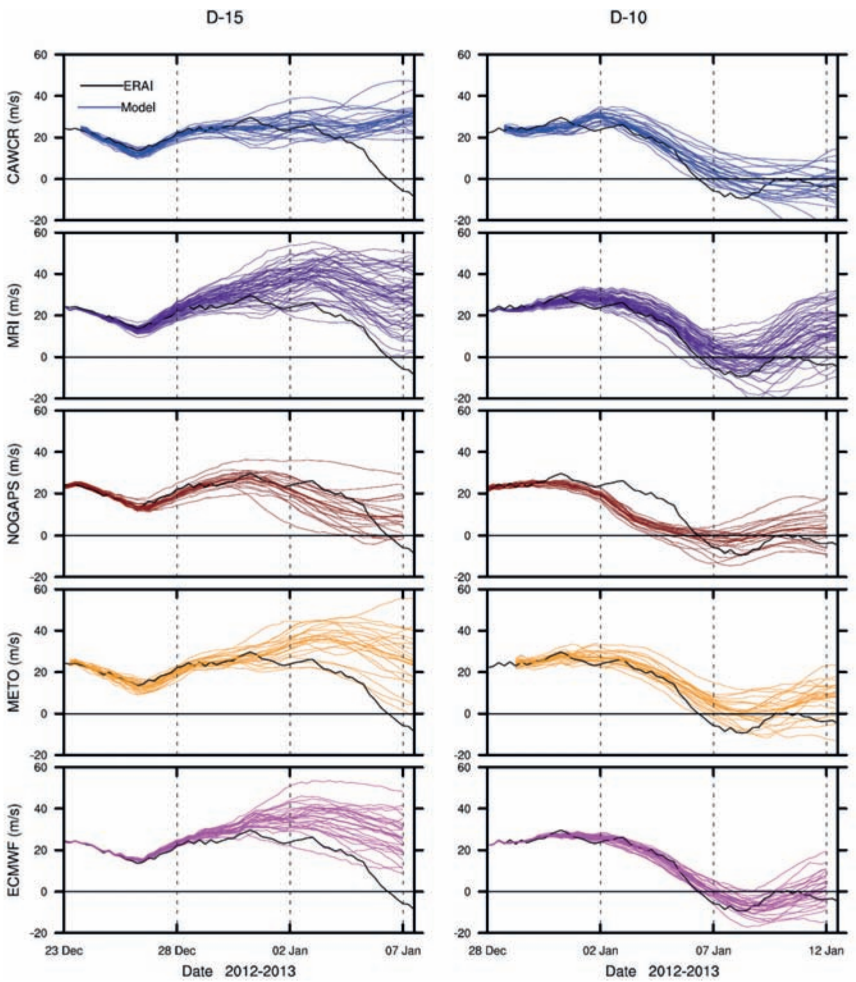

Figure 9: Zonal mean zonal wind at 10hPa and 60°N from ERA Interim (thick black lines) and model ensemble members (thin coloured lines). The thick coloured line denotes the ensemble mean. Left column is for the initialization of 2012/12/23 (D-15) and the right column is for the initialization date of 2012/12/28 (D-10). Vertical date lines are drawn at 00 (UT).

We have developed agreed collaborations with S2S and PPP. SNAP will promote the use of S2S data within the SPARC community and help to develop some of the early science using this dataset. We are currently working on some early analysis of ECMWF monthly forecast data to set the scene for this. Collaboration with PPP could provide an excellent way for SNAP to have longevity beyond the planned end of its funded portion in 2016. We are working on developing a plan to maintain and strengthen this collaboration.

A major achievement (meeting one of our deliverables) has been the publication of our review paper on stratospheric predictability, which was published in the Quarterly Journal of the Royal Meteorological Society and chosen as a featured article.

Plans for the Coming Year

Over the next 3-6 months we plan to collect and archive phase-0 data (forecasts for one calendar year) at the BADC. We are also almost ready to submit a publication considering a detailed analysis of phase-1 data for the northern hemisphere January 2013 major SSW. One highlight from this work is that we can begin to understand some of the limits to predictability of SSWs which stem from the inability to capture tropospheric stationary wave development in some of the models. We also plan to undertake a detailed analysis of the phase 1 data for the southern hemisphere October 2012 final warming. We will present phase-1 findings at international meetings and conferences such as AMS, EGU, *etc.*

A major part of our future plan is to host a conference session and break-out meeting at EGU 2015 to further develop the SNAP network and plan for the next phase of activity (2016 onwards).

References

Tripathi, O. P., M.Baldwin, A., Charlton-Perez, M., Charron, S.D., Eckermann, E., Gerber, R.G., Harrison, D.R., Jackson, B.-M., Kim, Y., Kuroda, A., Lang, S., Mahmood, R., Mizuta, G., Roff, M., Sigmond, S.-W. and Son, 2014: Review: the predictability of the extra-tropical stratosphere on monthly timescales and its impact on the skill of tropospheric forecasts, *Q. J. R. Met. Soc.*, doi: 10.1002/qj.2432.

Temperature Trends

Activity Leaders: William Randel, Dian Seidel, and David Thompson

Achievements for 2014

As a result of discussions at our September 2013 workshop, colleagues at NOAA and the UK Met Office have written two papers on their revised, improved climate data records based on Stratospheric Sounding Unit (SSU) measurements. While disparities between the two groups' data products remain, some inconsistencies have been resolved, and the reasons for the discrepancies are now better understood and have been explained in the peer-reviewed literature, in the following papers:

- Zou, C.-Z., H. Qian, W. Wang, L. Wang, C. Long, 2014: Recalibration and merging of SSU observations for stratospheric temperature trend studies, *J. Geophys. Res. Atmos.*, **119**, 13,180–13,205, doi:10.1002/2014JD021603.
- Nash, J. and R. Saunders, A review of Stratospheric Sounding Unit radiance observations in support of climate trends investigations and reanalysis. *Forecasting Research Technical Report* No: **586**. December 2013. Available at www.metoffice.gov.uk/media/pdf/1/r/FRTR_586.pdf

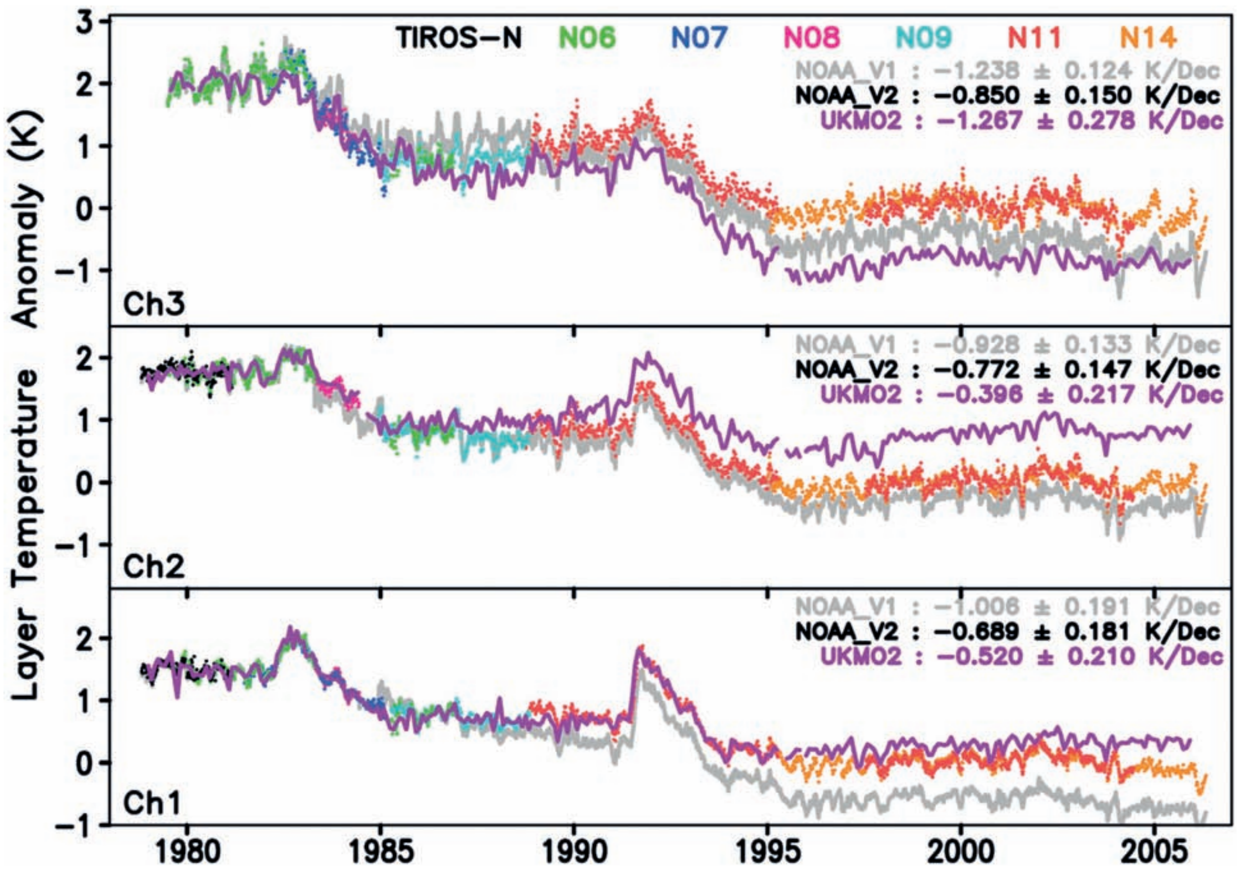

Figure 10: Time series of deseasonalized global temperature anomalies for NOAA version 2 (V2) SSU data (multi-coloured data points), compared with results from NOAA version 1 (V1) (grey lines) and UKMO results (purple lines). Results are shown for the three SSU channels, spanning the middle to upper stratosphere. From Zou *et al.*, 2014.

A paper based on the above report has been accepted for publication in the Quarterly Journal of Royal Meteorological Society.

These new data products are now being analysed as part of a study of stratospheric temperature change during the satellite era. This study takes advantage of all available peer-reviewed SSU, Microwave Sounding Unit (MSU), and Advanced MSU (AMSU) stratospheric temperature climate data records and uses empirical orthogonal function analysis (without a priori assumptions about climate signals) and multiple linear regression analysis (using predictor time series) to identify the main signals of temperature change in the lower, middle, and upper stratosphere from 1979-2013.

Plans for the Coming Year

Our analysis of satellite climate data records mentioned above will be presented at the January 2015 AMS Middle Atmospheres conference, and a paper will be prepared during the year. We expect the results will provide a more detailed basis for evaluating model simulations of stratospheric temperature during the satellite era, which will be the next focus of our activity.

A workshop will be held in April 2015, in Victoria, British Columbia, Canada, hosted by Nathan Gillett. The two main goals of this meeting will be to: 1) have a science focus on comparisons of stratospheric temperature variability and trends between observations and models, and 2) discuss future plans and activities for the SPARC Temperature Trends Activity in the context of new and evolving SPARC goals and plans, and in coordination with other SPARC Activities. The main deliverable will be a recommendation for a clear direction for this activity for consideration by the SSG.

Stratospheric Sulfur and its Role in Climate (SSiRC)

Activity Leaders: Markus Rex, Claudia Timmreck, Larry Thomason, Jean-Paul Vernier, and Stefanie Kremser

Achievements for 2014

Meetings, Database and Review Paper

- The SSiRC scientific steering committee (SSC) held its second meeting at ISSI in Bern, Switzerland from 22-26 September 2014. The focus of this meeting was to summarize current and future SSiRC activities, to discuss the next SSiRC workshop that will be organized in the form of a Chapman conference, and to initiate a review paper about current SSiRC-related research.
- A Wiki page that hosts a compilation of capacities relevant to SSiRC was established in 2014. The Wiki lists all available measurements of sulfur compounds from different sources, such as lidar, satellite, and ground-based instrumentation. The capacity database is continuously updated. This Wiki page is not yet publically available but we aim to make it so by the end of 2015.
- A scientific review paper summarizing the current state of knowledge in the fields of stratospheric sulfur and aerosol was initiated. Considerable scientific effort has occurred since the publication of the SPARC Assessment of the Stratospheric Aerosol Properties in 2006 so that we are now in a good position to answer some of the open science questions that came out of this assessment. The SSiRC SSC has agreed on an outline of the SSiRC review paper and this paper is going to be submitted to Reviews of Geophysics in June 2015.

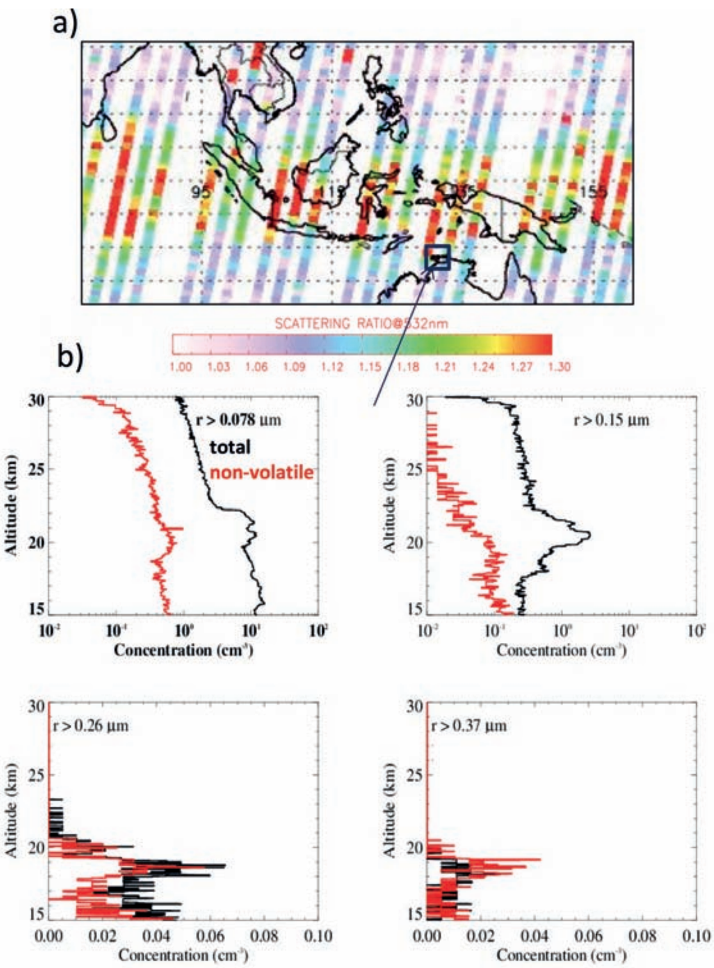

Figure 11: *In situ* balloon measurements within the Kelud volcanic plume. **(a)** Maps of aerosol scattering ratio at 532nm between 18-21km using 10 days of accumulated lidar observations between 14-24 May 2014 from the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO). **(b)** Profiles of total (black) and non-volatile (red) aerosol number concentration for particle radius greater than 0.078, 0.15, 0.26, and 0.37 micron using optical particle counters attached to a large balloon flight launched from Corroboree, Northern Territory, Australia (blue box on the maps) on 20 May 2014 during the KLASH (Kelud-Ash) campaign.

Supported field campaigns

- After the Mount Kelud eruption in Indonesia on 13 February 2014, a balloon-borne field campaign was organized with the support of SSiRC. The KlAsh (Kelud Ash Experiment) campaign took place between 14-26 May 2014 from Darwin, Australia, and was aimed at making measurements of the Kelud volcanic plume. NASA Langley and University of Wyoming's scientists deployed COBALD backscatter sondes and Optical Particle Counters (OPC) under balloon platforms to derive the optical properties and size distribution of volcanic aerosol within the Kelud plume. The plume was also observed by the CALIPSO space-borne lidar during the campaign circumnavigating the tropics between 10°N-20°S (see **Figure 11a**). Balloon measurements shown in **Figure 11b** indicate that non-volatile particles dominated the aerosol population with a radius greater than 0.26 microns below 20km. There is a clear altitude separation between non-volatile layers at 18-19km, with the volatile 0.15 micron particle layer at 20-22km. It suggests a separation between ash (non-volatile) and sulfate (volatile) volcanic layers. The key finding of KlAsh was to identify the presence of long-lasting fine ash particles in the lower stratosphere more than 3 months after the Kelud plume. The persistence of ash after a volcanic eruption is currently unaccounted for in climate models (Vernier *et al.*, 2015, in preparation).
- Balloon-borne activities to measure upper tropospheric and lower stratospheric aerosol over Asia with related campaigns from India (BATAL) and China (SWOP) in August 2014.

Forcing dataset and modelling efforts

- An update of the stratospheric aerosol database for coupled model intercomparison project (CMIP) activities is in preparation and this updated dataset will meet the CCMI requirements.
- Substantial progress has been made toward the recovery of historical NASA Langley Research Center Airborne Lidar data. Data from 1982-1984 (post El Chichón) have been archived at the NASA ASDC while data obtained from airborne missions in 1991 and 1992 (post Pinatubo) are expected to be recovered shortly.
- SSiRC model data intercomparison experiments have been clearly defined as described on www.sparc-ssirc.org. These model experiments are planned for 2015/16.
- A proposal of a Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP) has been submitted to the CMIP6 Panel. VolMIP aims to contribute towards advancing our understanding of the dominant mechanisms behind simulated post-eruption climate evolution, but also more generally, of climate dynamics and decadal variability.

Plans for the Coming Year

- Finalization of SSiRC review paper including submission. The SSiRC SSC will finalize the paper during their next meeting at ISSI in Bern at the end of April 2015.
- Generate a homogenized data set of aerosol properties derived from a combination of satellite sensors for the period 1979-2012. This will provide a stratospheric aerosol forcing data set in support of CMIP6 and CCMI simulations.
- Model data intercomparison experiments will be started.
- Plan the next SSiRC workshop for 2017, including writing the proposal to convene the workshop as a Chapman conference.

SPARC Reanalysis Intercomparison Project (S-RIP)

Activity Leaders: Masatomo Fujiwara and David Tan

Achievements for 2014

In January 2014, during the SPARC General Assembly in New Zealand, an S-RIP side meeting was held with about 30 participants. During the SPARC Scientific Steering Group (SSG) meeting, the S-RIP Implementation Plan was approved and S-RIP was made a full SPARC activity. In June 2014, an S-RIP progress report was submitted to the SSG, as planned, one year after the 2013 S-RIP planning meeting. On 10-12 September 2014, the S-RIP 2014 workshop was held at the NOAA Center for Weather and Climate Prediction, with about 30 participants from both the scientific and reanalysis communities. The SPARC Data Assimilation activity had a workshop at the same location from 8–10 September, with a day common to both activities on 10 September. In April 2014, David Jackson (Met Office, UK) stepped down as S-RIP co-lead, and at the 2014 workshop, it was agreed that David Tan become the new co-lead. Masatomo Fujiwara remains the other S-RIP co-lead.

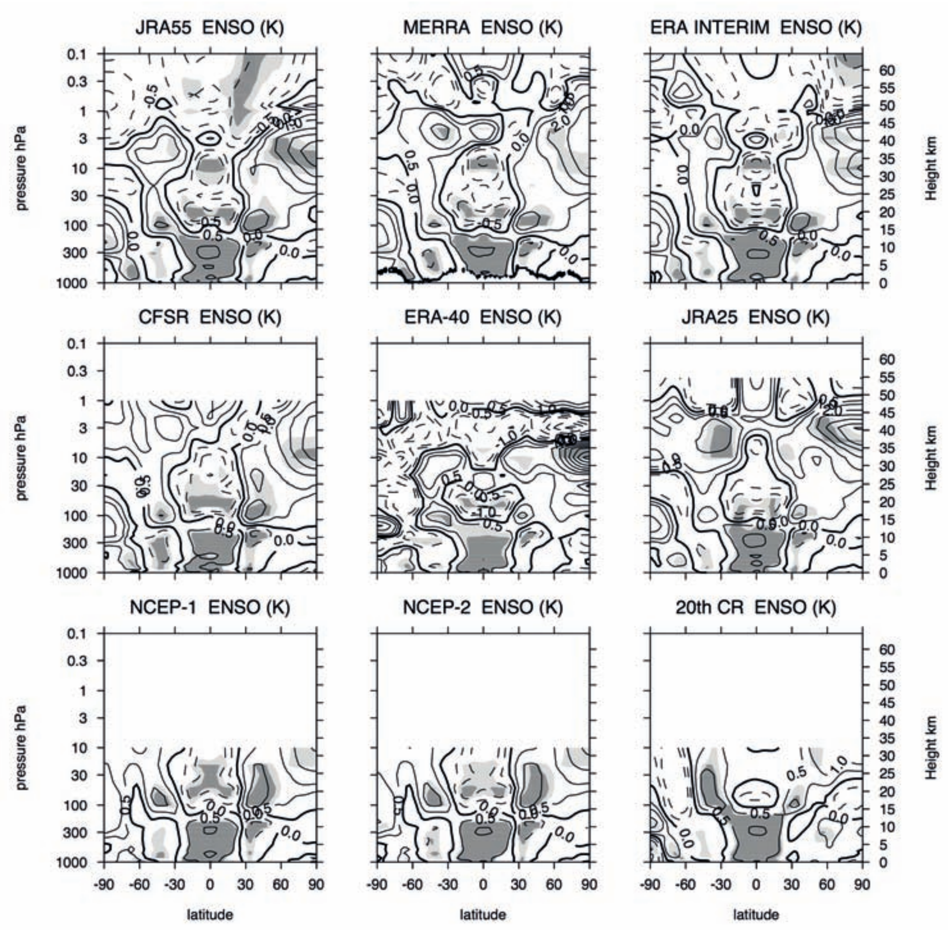

Figure 12: The annual temperature response to El Niño Southern Oscillation (ENSO) for each of nine reanalyses, obtained using multiple linear regression. The regression considers volcanic eruptions, ENSO, the Quasi-Biennial Oscillation, and the 11-year solar cycle as well as seasonal variations. The units are in K per standard deviation of the ENSO index, then multiplied by the difference between the warmest and the coldest ENSO events. From Mitchell *et al.*, 2014.

All information and documentation are available on the S-RIP website: s-rip.ees.hokudai.ac.jp/. Internal webpages using Wikimedia have also been established on this website and some of the S-RIP participants have started to write the chapters of the report scheduled for 2015 (basic chapters only) and 2018 (both basic and advanced chapters).

Plans for the Coming Year

In 2015, we will complete the basic chapters and would like to publish them as an interim report. We think that publishing a report in an official form at this time would have very positive effects not only for the community but also for the S-RIP participants, encouraging them to work for the project.

We are planning to hold a 2015 S-RIP workshop in Paris, France, from 12-16 October 2015. The local organizer will be Bernard Legras. As for 2014, the workshop will be held jointly with a SPARC Data Assimilation workshop. The 2015 CCMI workshop will be held in Rome, Italy, the week prior, so some participants may attend both workshops.

Furthermore, together with the QBO modelling initiative, the S-RIP QBO chapter lead authors (James Anstey and Lesley Gray) are co-organizing a workshop focused on QBO Modelling and Reanalyses, to be held in Victoria, Canada, from 16-18 March. The workshop will also foster links with other SPARC activities, namely the Gravity Wave activity and DynVar.

The S-RIP co-leads believe that in the future, it would be valuable to extend S-RIP to examine more issues related to tropospheric climate, and would welcome further discussion with interested parties on how this could be moved forward.

References

Mitchell, D.M., L.J. Gray, M. Fujiwara, T. Hibino, J.A. Anstey, W. Ebisuzaki, Y. Harada, C. Long, S. Misios, P.A. Stott, and D. Tan, 2014: Signatures of naturally induced variability in the atmosphere using multiple reanalysis datasets, *Q. J. Roy. Met. Soc*., doi: 10.1002/qj.2492.

Emerging Activity (full activity as of January 2015)

SPARC and IGAC joint Emerging Activity: Atmospheric Composition and Asian summer Monsoon (ACAM)

Activity Leaders: Laura Pan and Jim Crawford

Achievements for 2014

This is the first year of the ACAM activity, which is still in development. Accomplishments during the last year include:

- A 14-member Activity Formation Committee (AFC) has been formed to lead the activity formation. The committee includes a liaison from SPARC and IGAC as well as the co-leads of four working groups. The members are distributed between Asian monsoon regional countries, North America, and Europe. The list can be found on the activity website: www2.acd.ucar.edu/acam/committee.
- Four working groups have been initiated to facilitate collaboration and foster action in priority areas identified during the first ACAM workshop in 2013. The themes of the working groups are: Data Sharing (WG1), CCMi Partnership (WG2), Field Campaigns (WG3), and Capacity Development (WG4). More details on the working groups can also be found online: www2.acd.ucar.edu/acam/working-groups.
- A project website and mailing list were established to serve as the main information exchange platforms: www2.acd.ucar.edu/acam.
- A special ACAM session was held during the AOGS meeting in Sapporo, Japan, in July. An ACAM information side meeting was also held during the IGAC conference in Natal, Brazil, in September.
- Planning of the 2nd ACAM workshop to be held in Bangkok, Thailand, from 8-10 June 2015 is ongoing (www2.acd.ucar.edu/acam/bangkok2015). To reach the regional community, a 17-member Local Organizing Committee (LOC) has been established to include liaisons to most monsoon regional countries. ACAM WG4 is also planning to convene a 2-day training session for young Asian scientists immediately after the workshop.

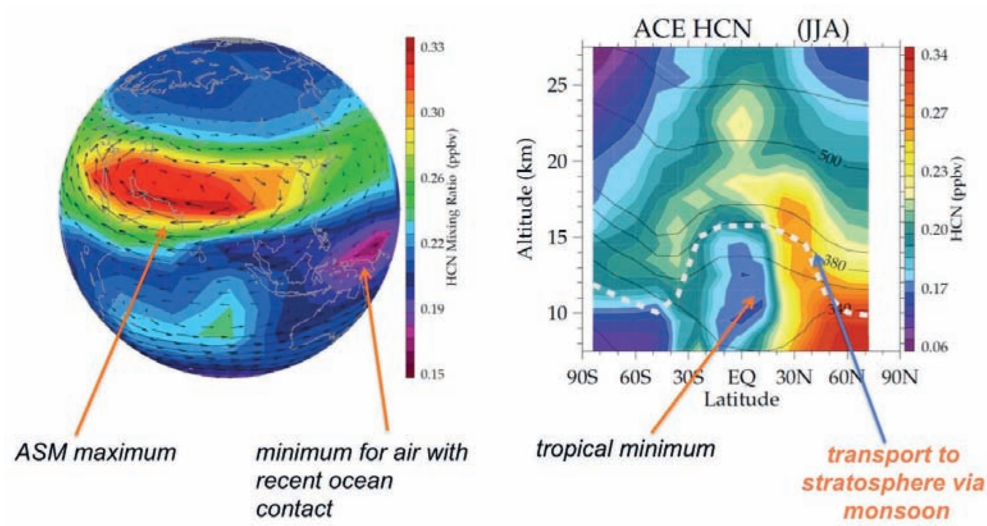

Figure 13: Average boreal summer (June to August) HCN mixing ratios derived from ACE-FTS satellite measurements. Left: at 13.5km altitude (arrows indicating average circulation pattern). Right: zonal mean values (white dashed line denotes the tropopause, while the black lines denote isentropic levels). From Randel *et al.*, 2010.

Plans for the coming year

- Hold the 2nd ACAM workshop in Bangkok, Thailand, from 8-10 June 2015.
- Conduct a 2-day training school in conjunction with the 2nd ACAM workshop for Asian monsoon regional scientists aimed at promoting the us of models (WRF, WRF-chem, CCMS, CTMs) and satellite data.
- Continue development of working group activities.

Connections

CliC

As part of the WCRP Grand Challenge "Cryosphere in a Changing Climate", CliC is cooperating with SPARC on the development of the WCRP Polar Climate Predictability Initiative (PCPI, see details below). The stratosphere exerts a discernible impact on the processes determining seasonal and longer time-scale predictability of the troposphere, and so do some cryospheric variables, primarily, sea-ice and snow. Through the Stratospheric Historical Forecast Project and Sea-Ice Historical Forecast Project, CliC and SPARC are contributing to research on seasonal predictability coordinated by the WCRP Working Group on Seasonal to Interannual Prediction (WGSIP, see below). Studies of polar stratospheric ozone, where SPARC is the leading research community, and the diverse research on interactions of the ice sheets and the polar oceans, where CliC plays a key role, both create a new level of understanding of the polar climate system. Another area of potential SPARC-CliC collaboration concerns the interaction between polar climate change and mid-latitude circulation.

GEWEX

SPARC and GEWEX colleagues are working together on the Grand Challenge on Clouds, Circulation, and Climate Sensitivity. SPARC is leading the sub-initiative on storm tracks addressing the question, "How will storm tracks change in future climate?" Storm tracks and jets, together with their modes of variability, affect the regional distribution of precipitation, temperature, and wind in the mid-latitudes of both hemispheres. A first workshop focusing on this initiative will be held from 24-28 August 2015 in Grindelwald, Switzerland. Also with GEWEX, which is leading the WCRP Grand Challenge on Climate Extremes, SPARC will organize a workshop on Atmospheric Blocking and Extremes. The workshop will likely take place in Reading, UK, in March/April 2016 and is aimed at providing a forum to discuss and develop our understanding of atmospheric blocking events and their impacts on climate extremes. A better quantification of these phenomena is essential to improving sub-seasonal to decadal predictions of extremes as well as reducing uncertainties in longer-term climate projections.

CLIVAR

CLIVAR is organizing an Open Science Conference to be held in Qingdao, China, in the third quarter of 2016. The meeting will focus on 'Solving climate problems of the future that will require even more comprehensive engagement and interdisciplinary approaches'. It will provide a dynamic forum for the CLIVAR community to meet with members of other WCRP and related projects and disciplines, to appraise progress and identify new opportunities to work together. A scientific organizing committee has been formed, with representation from SPARC. An early-career scientists symposium, organized in large part by early-career scientists, will also be held prior to the main conference.

WGNE

The Working Group on Numerical Experimentation (WGNE), established by the WCRP and the WMO Commission for Atmospheric Sciences, aims to foster the development of atmospheric circulation models for use in weather prediction and climate studies. WGNE is involved in a number of coordinated projects and experiments, of which the Project on Polar Prediction Verification is of direct relevance to SPARC through the PCPI (see below). SPARC's Quasi-Biennial Oscillation Initiative (QBOi) was presented at the 29th WGNE session held in March 2014, with the aim of WGNE endorsing the project. QBOi is of relevance to WGNE since QBO teleconnections between the stratosphere and troposphere in high latitudes are thought to be important for seasonal forecasting. Most current models are not able to accurately simulate the QBO or reproduce these teleconnections, and one of QBOi's target activities will be to improve predictability of the QBO. The QBOi is currently integrated as an emerging sub-project within DynVar (see p. 13).

WGSIP

The Working Group on Seasonal to Interannual Prediction (WGSIP) is the WCRP modelling group for initialized climate predictions and is chaired by Adam Scaife (Met Office, UK) and Francisco Doblas-Reyes (IC3, Spain). WGSIP runs research projects to improve climate predictions and recently completed projects on the effects of Arctic Sea Ice and the stratosphere, with the latter topic lead by the SPARC community (Amy Butler). There is now clear evidence that seasonal forecasts benefit from inclusion of the stratosphere. WGSIP is now embarking upon new projects on tropical-extra-tropical interactions, model drift and shocks following initialization, and the effects of snow cover on seasonal forecasts. WGSIP is also leading the development of the CMIP6 protocol for decadal prediction with CLIVAR and WGCM. Many WGSIP members also come from WMO designated Global Producing Centres for seasonal forecasts and provide real time forecasts each month via the WMO Lead Centre for long-range forecasts: www.wmolc.org. A database of retrospective hindcasts is now also up and running and serves data from leading seasonal forecast systems to researchers worldwide: http://chfps.cima.fcen.uba.ar/. We welcome further interaction with SPARC scientists to exploit this important and growing database, which is rapidly becoming the equivalent of the CMIP database for seasonal forecasting.

WGCM

The 18th session of the Working Group on Coupled Modelling (WGCM) was held at the Eibsee Hotel, Grainau/Garmisch-Partenkirchen, Germany, from 8-10 October 2014 and kindly hosted by the German Aerospace Center (DLR). Most of the session was dedicated to refining the CMIP experimental design in close consultation with representatives from the modelling community, in particular, the composition of the CMIP Diagnostic, Evaluation, and Characterization of Klima (DECK), the criteria for MIP endorsement, the CMIP timeline including the review process and forcings, as well as coordination with the WGCM Infrastructure Panel (WIP) regarding protocols, standards, and data request. The final WGCM18 report is available at: www.wcrp-climate.org/images/documents/reports_flyers/WGCM18_report.pdf. More information on CMIP can be found on the CMIP Panel website at www.wcrp-climate.org/index.php/wgcm-cmip/about-cmip.

The Polar Climate Predictability Initiative

The Polar Climate Predictability Initiative (PCPI) aims to advance understanding of the sources of polar climate predictability on timescales ranging from seasonal to multi-decadal, which stems from the unique persistence of signals in ice and snow as well as through exchange with the ocean at all depths and the stratosphere. The WCRP JSC agreed to designate PCPI as a sub-initiative of the "Cryosphere in a Changing Climate" Grand Challenge, with especially close ties to CliC and SPARC. Two champions were chosen for each of the six themes to comprise a PCPI leadership committee, which began organizing activities in 2013.

The first PCPI leadership meeting was held in Boulder, USA, in April 2014. Plans and goals were established for each of the six themes. A subset of the participants wrote a journal article titled 'Influence of internal variability on Arctic sea-ice trends' (Swart *et al*., 2015), published in *Nature* Climate Change.

The SPARC Data Centre

The SPARC Data Centre (SDC), which is now hosted at the UK Centre for Environmental Data Archival's (CEDA) British Atmospheric Data Centre (BADC), continues to support the distribution of data and documents for SPARC activities. This includes data for several active SPARC activities including the SPARC Data Initiative, CCMI, the Gravity Wave activity, and WAVAS-II, as well as several past activities such as CCMVal-II and the SPARC Lifetimes activity, amongst many others. During 2014, the migration of all data from Stonybrook University to a new server at CEDA was nearly entirely completed (final data from the SPARC International Polar Year are currently the last being transferred). This migration means all data sets are hosted in the same location under the unified banner of the SDC. NASA are thanked for providing their continuous support of the SDC from 1999-2014, including funds for the move of the SDC data holdings to the BADC. Peter Love, the SDC scientist, continues to provide scientific support, specifically in terms of the ingestion of data into the SDC. He is also warmly thanked for his continuous contribution to the functioning of the SDC.

Workshops and Meetings 2015

This list is updated throughout the year as further meetings/workshops are planned.

10 – 11 January
SPARC Capacity Development Workshop
Granada, Spain

12 – 13 January
SPARC Regional Workshop on the Role of the Stratosphere in Climate Variability and Prediction
Granada, Spain

13 – 16 January
22nd SPARC Scientific Steering Group Meeting
Granada, Spain

16 – 18 March
QBO Modelling and Reanalyses Workshop
Victoria, British Columbia, Canada

9 – 10 April
Temperature Trends Workshop
Victoria, British Columbia, Canada

24 April – 1 May
SSiRC Meeting
ISSI, Bern, Switzerland

8 – 10 June
2nd ACAM Workshop
Bangkok, Thailand

20 – 23 July
Tropical Troposphere-Stratosphere Science Meeting
Boulder, Colorado, USA

26 – 31 July
AGU Chapman Conference on 'The Width of the Tropics'
Sante Fe, New Mexico, USA

24 – 28 August
SPARC Workshop on Storm Tracks
Grindelwald, Switzerland

5 – 6 October
Workshop on 'Solving the Mystery of Carbon Tetrachloride'
Zurich, Switzerland

8 – 9 October
2015 IGAC/SPARC CCMI Workshop
Rome, Italy

12 – 14 October
S-RIP 2015 Workshop
Paris, France

14 – 16 October
11th SPARC Data Assimilation Workshop
Paris, France

9 – 13 November
23rd SPARC Scientific Steering Group Meeting
Boulder, Colorado, USA

Find all meetings at: http://www.sparc-climate.org/meetings/

Acronyms

ACAM – Atmospheric Composition and the Asian Summer Monsoon
ACP – Atmospheric Chemistry and Physics
AerChemMIP – Aerosol and Chemistry Model Intercomparison Project
AeroCom – Aerosol Comparisons between observations and models
AGU – American Geophysical Union
AMS – American Meteorological Society
AMT – Atmospheric Measurement Techniques
AOGS – Asia Oceania Geosciences Society
AquaVIT – Aqua Validation and Instrument Tests
BADC – British Atmospheric Data Centre
CCM – Chemistry-Climate Model
CCMI – Chemistry-Climate Model Initiative
CCMVal2 – Chemistry-Climate Model Validation Project 2
CEDA – Centre for Environmental Data Archival
CliC – Climate and Cryosphere project
CLIVAR – Climate Variability and Predictability Project
CMIP5 – Coupled Model Intercomparison Project 5
CMIP6 – Coupled Model Intercomparison Project 6
DAWG – Data Assimilation Working Group
DECK – Diagnostic, Evaluation, and Characterization of Klima
DLR – German Aerospace Center
DynVar – Dynamical Variability
ECMWF – European Centre for Medium-Range Weather Forecasts
EGU – European Geosciences Union
ENSO – El Niño Southern Oscillation
ESA – European Space Agency
ESMVal – Earth System Model Validation Project
ESSD – Earth System Science Data
GAW – Global Atmosphere Watch
GEWEX – Global Energy and Water Exchanges Project
GMD – Global Monitoring Division
GW – Gravity Waves
IGAC – International Global Atmospheric Chemistry
IPCC – Intergovernmental Panel on Climate Change
ISSI – International Space Science Institute
JSC – Joint Scientific Committee
KIT – Karlsruhe Institute of Technology
MMM – Multi Model Mean
MRM – Multi Reanalysis Mean
MSU – Microwave Sounding Unit
NASA – National Aeronautics and Space Administration
NDACC – Network for Detection of Atmospheric Composition Changes
NOAA – National Oceanic and Atmospheric Administration
OPC – Optical Particle Counter
PCPI – Polar Climate Predictability Initiative
PPP – Polar Prediction Project
QBO – Quasi-Biennial Oscillation

Acronyms - *continued*

QBOi – Quasi-Biennial Oscillation Initiative
S2S – Sub-seasonal to Seasonal Prediction Project
SDC – SPARC Data Centre
SHFP – Stratosphere-resolving Historical Forecast Project
SI2N – Ozone Profile Assessment Phase II
SLP – Sea Level Pressure
SNAP – Stratospheric Network for the Assessment of Predictability
SNF – Swiss National Science Foundation
SOLARIS-HEPPA –SOLAR Influences for SPARC – High Energy Particle Precipitation in the Atmosphere
SolarMIP – Solar Model Intercomparison Project
S-RIP – Stratospheric Reanalysis Intercomparison Project
SPARC – Stratosphere-troposphere Processes and their Role in Climate
SSC – Scientific Steering Committee
SSG – Scientific Steering Group
SSiRC – Stratospheric Sulfur and its Role in Climate
SSU – Stratospheric Sounding Unit
SSW – Sudden Stratospheric Warming
TEM – Transformed Eulerian Mean
UNEP – United Nations Environment Programme
UTLS – Upper Troposphere/Lower Stratosphere
VolMIP – Volcanic Forcings Model Intercomparison Project
WAVAS II – Water Vapour Phase II
WCRP – World Climate Research Programme
WGCM – Working Group on Coupled Modelling
WGNE – Working Group on Numerical Experimentation
WGSIP – Working Group on Seasonal to Interannual Prediction
WIP – WGCM Infrastructure Panel
WMO – World Meteorological Organisation

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