SPARC
Stratosphere-troposphere processes and their role in climate

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The SSG

SPARC Office
Zurich
• Highlights of recent SPARC science
• Possible scientific developments
• Organisation
  • Management plans and challenges
  • Regional / training aspects of SPARC and WCRP
  • Modeling and data requirements
Implementation Plan

SPARC Implementation Plan 2016-2020

Whole atmosphere approach

Atmospheric Dynamics & Predictability

Chemistry & Climate

Long-term Records for Climate Understanding
Chemistry & Climate

Changes in the chemical composition of the troposphere and stratosphere are critical factors determining radiative forcing, modulating climate sensitivity, and decadal-scale climate change.

FOCI:

- Interactions between composition, clouds, and radiation
- Tropospheric ozone and stratosphere-troposphere exchange
- Impact of changes in atmospheric composition on radiative forcing and climate
Atmospheric Dynamics & Predictability

On regional scales, unlike the global mean, it is the **dynamics** as much as the **thermodynamics** that determines climate. **Regional circulation patterns** can greatly **exacerbate** or **completely counter** the **thermodynamic component** of climate change.

**FOCI:**

- Assess atmospheric predictability and variability, and the underlying mechanisms
- Bring observational expertise to bear on models
- Understanding the dynamics of surface climate extremes
Long-term Records for Climate Understanding

Understanding and detecting climate change requires a dedication to creating, analysing, and interpreting ground-based and satellite observations, as well as associated uncertainties.

FOCI:
- Develop new methodologies for constructing climate data records (CDRs), time series analysis, and detection and attribution studies
- Promote the collection and curation of CDR metadata
- Ensure collaboration with relevant international groups
On-going activities

Long-term Records for Climate Understanding

Atmospheric Dynamics & Predictability

Coupled Chemistry Modeling

Chemistry in Asian Monsoon Region

Solar & High-Energy Particle Influences

Stratospheric Sulfur

Carbon Tetrachloride

Polar Stratospheric Clouds

Data Assimilation

PSC

SOLARIS-HEPPA

SSiRC

ACAM

S-RIP

SNAP

Gravity Waves

Gravity Waves & Momentum Budget

Assessing Predictability

Reanalyses Intercomparison

Dynamical Variability

Quasi-biennial Oscillation

DynVar

QBOi

NEW

Gravity+Waves+&++++++
Momentum+++++++++++++++++
Budget

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Gravity Waves
**SNAP**

Stratospheric Network for Assessing Predictability

- **Review** role of the stratosphere in short-term predictability and coordinated WFM experiments
- Link between **SNAP** and **WWRP/WCRP S2S initiative** established
- Next phase of SNAP: Analysis of the S2S data by the SPARC community
  - More information and invitation to participate via SPARC Newsletter No. 46 - January 2016 article (Tripathi et al. 2016).

**Skill is significantly enhanced for tropospheric forecasts initialized during periods of weak and strong stratospheric winds.**

*Tripathi et al 2015*
Gravity Waves

- Focused study group on *Gravity Wave Sources and Forces*
  - co-sponsored with ISSI
  - at least 4 papers in 2015
- 2016: define new foci related to weather effects and global high-resolution model studies
- SPARC Newsletter Article on Gravity Wave Dynamics and Climate (44, 2015, Alexander and Sato, review article in preparation)

*Stochastic gravity wave parameterizations can simulate realistic spatial and temporal intermittency in large amplitude gravity wave events and realistic stratospheric drag for improved climate simulations. de la Cámara and Lott (2015)*
QBO Initiative

- First workshop in March 2015
  - Defined key challenges and identified model experiments & analysis metrics
  - Meeting report published both in EOS and SPARC Newsletter
- 2016 Workshop in September 2016 in Oxford will discuss first results
- Successful with Belmont Forum bid on broader issues.....

In models, the QBO peaks too high in altitude, and does not penetrate deeply enough and decays in latitude more quickly in the lowermost stratosphere. (Schenzinger et al 2016 in preparation)
• Long standing SPARC activity (~20 years)
• 2015 Achievements: publication of several research/review papers, a workshop, and a transition of leadership: Andrea Steiner (University of Graz) and Amanda Maycock (University of Leeds)
• April 2016 workshop in Graz (Austria) with focus on new topics

Seidel et al. 2015

Two climate data records derived from SSU – much better agreement
S-RIP: SPARC Reanalysis Intercomparison Project

• coordinated activity to:
  o understand differences between reanalyses in the stratosphere;
  o provide guidance on appropriate usage;
  o contribute to future improvements in reanalysis products.
• 2016 S-RIP Interim Report with four basic chapters in preparation
• ACP Special Issue on the S-RIP approved

Comparison of reanalysis ozone with that from the Aura MLS near 20km, 50hPa
• Three 2015 papers investigating the solar signal in CMIP5
• Paper describing CMIP6 solar forcing to be submitted to GMD CMIP6 special issue.
• SolarMIP for CMIP6 has been merged with DAMIP, with the experiment to include only solar cycle forcing
• Working group established to assess the solar signal in stratospheric ozone
• 2015 Workshop in Boulder and workshop planned for June 2016 in Helsinki

Time series of historic (1850-2014) and projected (2015-2100) total solar irradiance (TSI) recommended for CMIP-6 (Matthes et al., in prep.).
• Active discussion on how to best participate in CMIP6 -> DynVarMIP
• Additional model output requested by DynVarMIP will be archived on the Earth System Federation Grid to address the following key questions:
  o How do dynamical processes contribute to persistent model biases in the mean state and variability of the atmosphere?
  o How does the stratosphere affect climate variability at intra-seasonal, interannual and decadal time scales?
  o What is the role of dynamics in shaping the climate response to anthropogenic forcings?
  o How do dynamical processes contribute to uncertainty in future climate projections?

DynVar Workshop in Helsinki, 2016 - main goal:
Develop focussed analyses of the CMIP6 experiments
Review paper on stratospheric aerosol

Very active in pre-CMIP6 activities related to developing forcing data set and modelling (VolMIP)

New: archival of historic stratospheric aerosol measurements

April 2016 SSiRC workshop in Potsdam

2017 Chapman conference in planning

Contribution to GC on “Clouds, Circulation and Climate Sensitivity” and GC imitative on proposed GC on “Near-Term Climate Prediction”

Activity supported extensive balloon campaign (BATAL-15 in summer 2015 throughout India (Gadanki, Hyderabad, Varanasi) and in Saudi Arabia (Thuwal).
Promoting international cooperation on research on Asian monsoon

2\textsuperscript{nd} ACAM workshop took place from 8-10 June 2015 in Bangkok, Thailand, with participation from \textasciitilde170 scientists from 22 countries

Coupled with a training school for students and early career researchers

Another planned for 2017.

Aerosols, cirrus particles and H\textsubscript{2}O over the Tibetan plateau during the Asian Summer Monsoon season. (Unpublished data presented by Jianchun Bian at the 2\textsuperscript{nd} ACAM workshop)
AerChemMIP approved:

a) diagnose climate forcings and feedback in CMIP-6 models;
b) understand past and potential future evolution of the chemical composition of the atmosphere;
c) estimate the global-to-regional climate responses to these changes

CCMI simulations being analysed

New focus groups on (1) tropospheric OH and ozone budgets, (2) specified dynamics simulations, and (3) ocean-atmosphere coupling in CCMI models.
SPARC assessment

- Under review
- To be presented to Parties of Montreal Protocol in November
- Prepared jointly by people connected with scientific and technical assessments

Atmospheric concentration of $\text{CCl}_4$: problem is that it is going down much slower than anticipated:

- Unreported emissions?
- Unrecognized loss process?
• Series of workshops to
  (i) assess all available measurements (satellite, balloon and ground)
  (ii) check model performance

_Gruan radiosonde data from Ny Alesund – coldest Dec-Jan stratosphere on record_

_By far, largest formation of ice PSCs_
Papers, papers, papers (ACP/AMT special issue) ... and a SPARC report planned

Mainly measurement characterisation, including upper troposphere humidity

Top: Time series of MLS near Boulder (~1000 km).
Bottom: Time series of MLS zonal mean for 30-50N.
The values and patterns are similar, showing that Boulder is representative (in some ways).
Topics of future interest
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- Chemistry
- Climate
- Long-term Records for Climate Understanding
- Atmospheric Dynamics & Predictability
- Regional Predictability
- Tropical Processes
- Near-term Clim. Forcers
- Storm Tracks
- Blocking & Extremes
- High Resolution Soundings
- Temperature Variability
- Data Assimilation
- PSC
- CCMI
- SOLARIS-HEPPA
- SSIRC
- CCI4
- QBOi
- SNAP
- S-RIP
- SSRC
- NEW Topics of future interest
Organisation

Future meetings
Products
Capacity development
SPARC SSG 2016
Office future
Upcoming workshops

Atmospheric Temperature Changes
25-26 April, Graz, Austria

Stratospheric Sulfur and its Role in Climate Workshop
25-29 April, Potsdam, Germany

Atmospheric Gravity Waves: Sources and effects on weather and climate
16-20 May, State College, Pennsylvania, USA

Joint GAW/SPARC workshop on UTLS observations
24-27 May, Geneva, Switzerland
Upcoming workshops

SPARC DynVar + S-RIP Meeting
6-10 June, Helsinki, Finland

6th International HEPPA-SOLARIS workshop
13-17 June, Helsinki, Finland

“The QBO and it’s global influence – past, present, and future”
26-30 September, Oxford, UK

Joint SPARC Data Assimilation and S-RIP workshop
17-21 October, Paris, France
General Assembly

Kyoto October 2018

Back-to-back with the 2018 IGAC Conference
Products

Annual Reports

SPARC Science Reports

• Carbon Tetrachloride
• SPARC Data Initiative
• S-RIP Interim Report

Journal Special Issues

• Chemistry Climate Modelling Initiative
• Stratospheric Water Vapour
• S-RIP (approved)

All Open Access
SPARC eNews Bulletin

- Distributed via email every 2 months (~1000 people)
- Includes all recent news for the community

SPARC Website

- > 1000 users/month
- Portal to SPARC Data Centre
- Community Calendar
- Updated regularly
Biannual Newsletter

- ~2000 hard copies
- ~300 digital

Newsletter subscriptions

- > 500
- > 150
- > 50
- > 25
- > 1
- No Data
Capacity Development

The YOUNG EARTH SYSTEM SCIENTISTS (YESS) community is an independent, self-contained communication platform for young Earth system scientists. The YESS community
• is currently the only unified, international, and interdisciplinary early career Earth system network;
• initiates and strengthens collaboration across institutional and local boundaries, spreading initiatives and events, and providing opportunities for direct personal contact at meetings and conferences.

Pictures from ICYESS 2013, see icyess.eu

Regional Working Groups
Early Career Researchers
Training Schools
a) ACAM workshop and training school, Bangkok, June 2015  
b) Lunch-time session at the 11th International Conference on Southern Hemisphere Meteorology and Oceanography in Santiago, Chile  
c) South-East Asian School on Tropical Atmospheric Science, Bandung, Jan 2016
Capacity Development

Summer School on Atmospheric Composition and Dynamics

28 November – 3 December, 2016
Maïdo Observatory, Réunion Island

http://lacy.univ-reunion.fr/formation/summer-school
Other training schools

- **Training school on atmospheric dynamics**
  - Proposal submitted to IUGG Grant Programme by Elisa Manzini & Bernd Funke
  - 4 days after the IUGG Conference in Cape Town, South Africa in early September 2017
  - Topics to be covered: Tropospheric dynamics and climate, stratospheric dynamics and chemistry, stratosphere-troposphere interactions.

- **Belmont Forum-funded GOTHAM project (Globally Observed Teleconnections in Hierarchies of Atmospheric Models) training school**
  - To be held in Potsdam (organised by PIK), likely in summer 2017
  - 2 week intensive programme covering a wide range of topics, such as tropospheric and stratospheric dynamics, Rossby wave resonance, climate modelling, etc.
  - Definitely possibility to link with WCRP projects/Grand Challenges, e.g. extremes, detection and attribution topics, etc.

- **Tropical processes training school**
  - Shigeo Yoden is organising a summer school in August in Vietnam
  - Likely to be 2-3 days of lectures before/after a 2-day workshop
  - Main focus is to be on tropospheric dynamics
Next SPARC SSG Meeting

31 October – 4 November in Berlin, Germany

- Regional workshop (1 day) on cross-cutting issues related to SPARC and the Grand Challenges
The future SPARC Office

• Have tried a number of countries in Europe, SE Asia & Oceana.
• No joy so far.
• Not dead (but certainly not thriving) are
• Germany and UK – places willing to host an office, but only if high level support could be found
• Will need to think more laterally if nothing comes up soon
Model Development Needs

- Development of atmospheric models with tops above the stratopause that can be run in stand-alone mode or coupled to ocean and sea-ice models (DynVar)
- Future high-resolution model development should include a focus on in-line diagnostics for atmospheric momentum budget (in addition to cloud processes) (Gravity Waves/DynVar).
- Training need for scientist users of reanalyses to become more familiar with the modelling aspects (strengths/limitations) of reanalysis systems (S-RIP)
- Lack of technical capability to provide data to the ESGF (SNAP)
- Definition of the minimal requirements needed for radiative and photochemical schemes to adequately represent the solar signal (SOLARIS-HEPPA)
- Model training in WRF/WRF-Chem needed for ACAM participants (Nepal-India-China-Pakistan-SE Asia region)
Data Needs/Requirements

Overall

1. Continued improvement in meteorological re-analyses & past records
2. Continuation of existing core measurements – real funding pressure
3. Development of methodologies for robustly assessing uncertainties in long term records

Specific

• Lack of planned satellite limb observations
• Need for quick response field campaigns after volcanic eruptions
• Access to high resolution radio soundings to expand global record
Thank you