Stratosphere- Troposphere Processes and their Role in Climate

An overview of SPARC activities and plans

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GEWEX SSG meeting

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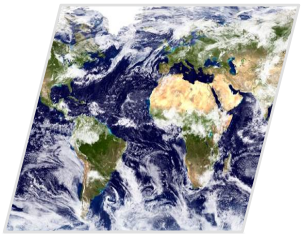
SPARC science

SPARC has three main science themes:



- Atmospheric Dynamics & Predictability

- Chemistry & Climate

- Long-term records for Climate Understanding

SPARC structure

SPARC is organized in a bottom-up approach:

currently 18 activities (two ending this year), proposed by community

- self-organized
- provide network opportunities centered on topical research
- held activity and cross-activity workshops
- Limited life-time; only extended, if new science questions arise
- Highly productive:
  - community papers,
  - reports published by SPARC
  - Major contributions to IPCC and to UNEP/WMO Ozone Assessments, CMIP (forcing data sets, MIPs)

SPARC capacity building

SPARC capacity building:

- involving ECR in activity leadership
- organization of training schools
- travel support opportunities for ECR

3rd ACAM training school, Kuala Lumpur, June 2019 (in collaboration with IGAC)

CCMI Summer School 'Earth System Modelling and Observations to Study Earth in a Changing Climate' Hong Kong, August 2019

SPARC activity details

SPARC activities with focus on data records, analysis & evaluation

- ACAM – international research campaigns, such as StratoClim
- ATC – assessing causes, trends and variability of atmospheric temperature records
- DynVar – analysis of model and observational data to understand atmospheric variability
- FISAPS – assessment of observations & model data to improve understanding of fine-scale processes; improvement of availability of high-resolution observations (HVRRD)
- GW – analysis and process understanding of GW generation in observations and models
- LOTUS – assessment of uncertainties and trends in long-term records of ozone
- OCTAV-UTLS – atmospheric composition: assessment of data quality and comparability; data evaluation focussed on the UT/LS
- PSC – analyse PSC data sets to synthesize PSC climatology
- QBOi – analysis of QBO variability
- SATIO-TCS - understanding of the stratosphere-troposphere dynamical coupling in the tropics with focus on convection
- SOLARIS-HEPPA - clarifies the effects of solar influence on climate
- SSiRC - encourages and supporting new instrumentation and measurements of sulfur-containing compounds, such as COS, DMS, and non-volcanic SO2 in the UTLS globally
- TUNER – assessing completeness and consistence of, as well as providing information on uncertainties of satellite data sets
- WAVAS II – data quality assessment for water vapour data; evaluation of impacts of changing UTLS water vapour

SPARC activity details

SPARC activities with focus on model development

- ACAM - monsoon representation in models
- CCMI – coordination of inter-model comparisons & analysis with focus on chemistry-climate interaction
- DynVar - promotes development & use of coupled atmosphere-ocean-sea-ice general circulation models; contributions to CMIP
- GW – improvement of parameterization and representation of gravity waves in models
- PSC – improves PSC characteristics for global models
- QBOi - provides a 'recipe book' for simulating a reliable QBO; contribute to CMIP
- SNAP - assess forecasting skills through organised intercomparison of stratospheric forecasts and impact of tropospheric predictive skill (S2S)
- S-RIP – provides guidance on appropriate usage of various reanalysis products, and provide basis for improvement
- SOLARIS-HEPPA - recommendations for the solar irradiance and solar proton flux data used to drive middle atmosphere and climate models
- SSiRC - initiates new model/data intercomparisons

SPARC activity details

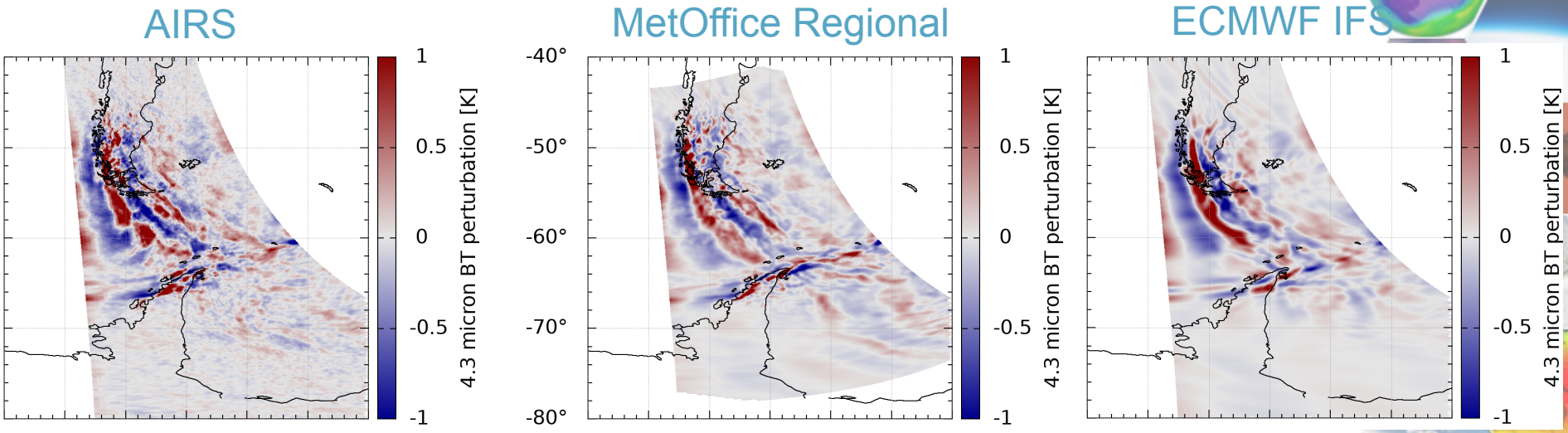
SPARC Networking

SPARC activities with focus on networking:

- ACAM – building international collaborations within monsoon research
- Data Assimilation – connecting experts from measurement, modelling and user communities through workshops
- DynVar – promoting connections to ocean & sea ice communities (coupled circulation models)
- S-RIP – activity is an example in connecting base research communities with operative centres and agencies around the globe.
- SOLARIS-HEPPA - bringing together scientists involved in atmospheric modelling and scientists involved in the analysis and generation of satellite data
- SSiRC - providing a coordinated structure for the various individual activities already underway in different research centres

recent SPARC achievements

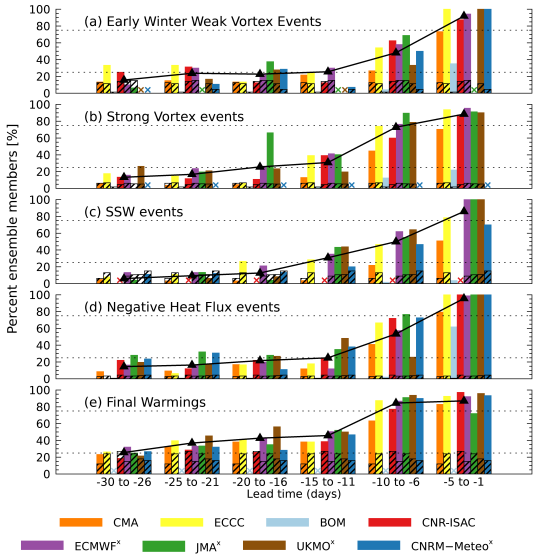
- Two successful summer school (ACAM & CCMi)
- Reanalysis Intercomparison report: Full report submitted; currently in review. (S-RIP)
- Research activity on New Quantitative Constraints on Orographic Gravity Wave Stress and Drag supported by International Space Science Institute (ISSI)



Gravity Wave analysis: High-resolution model (OSSE) validation – detailed comparisons to observations.

recent SPARC achievements

- Two community papers published on the predictability of the stratosphere and strat.-trop. coupling on S2S timescales (SNAP)
  - *The role of the stratosphere in subseasonal to seasonal prediction. Part I: Predictability of the stratosphere*
  - *The role of the stratosphere in subseasonal to seasonal prediction Part II: Predictability arising from stratosphere - troposphere coupling*



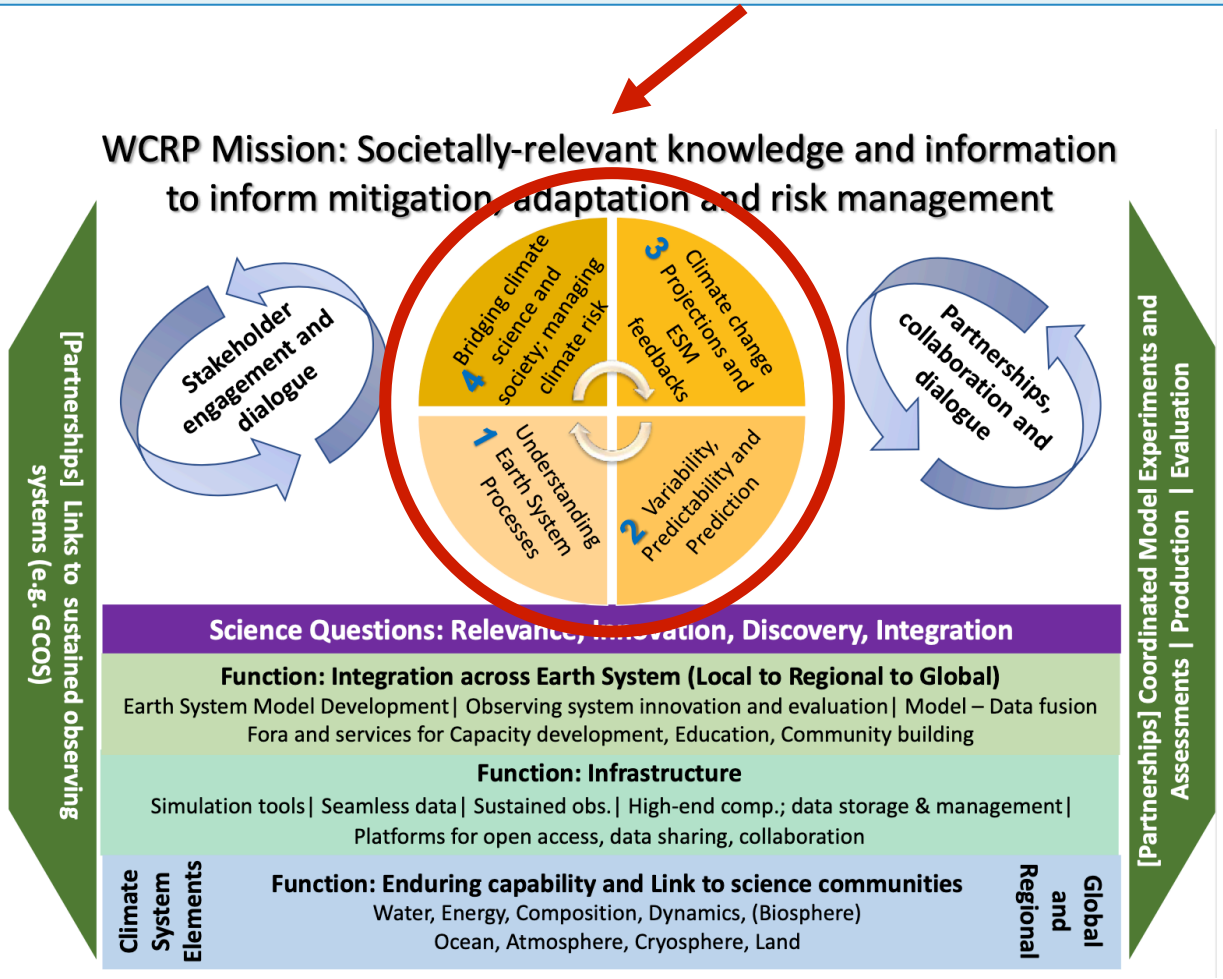
SNAP analysis:
The average across all events of the percentage of ensemble members as a function of lead time [days] that detect the event within ± 3 days of the observed event. Patterned black bars give the "false alarm rate" (events that were predicted but not detected at the given lead times).

recent SPARC achievements

- Long-term Ozone Trends and Uncertainties in the Stratosphere (LOTUS) SPARC report published
- SSiRC has initiated a new activity to develop an index for rapidly relating the climate significance of a volcanic eruption
  - developed a wiki page (182 members) as an interactive way to communicate (observationalists and modelers) when a volcanic eruption happens → e.g. Mt Agung, Ambae, and Raikoke eruptions
  - initiated a rapid responsive modeling activity that indicated that the Raikoke eruption in June 2019 would not have a significant climate impact.
- Screened WAVAS-II satellite data sets in homogenized format (quantity, vertical gridding) has been made publicly available on data server, and a DOI has been received. The WAVAS special issue in ACP/ will remain open until mid-2020.

Towards SPARC Implementation Plan (2021-2025)

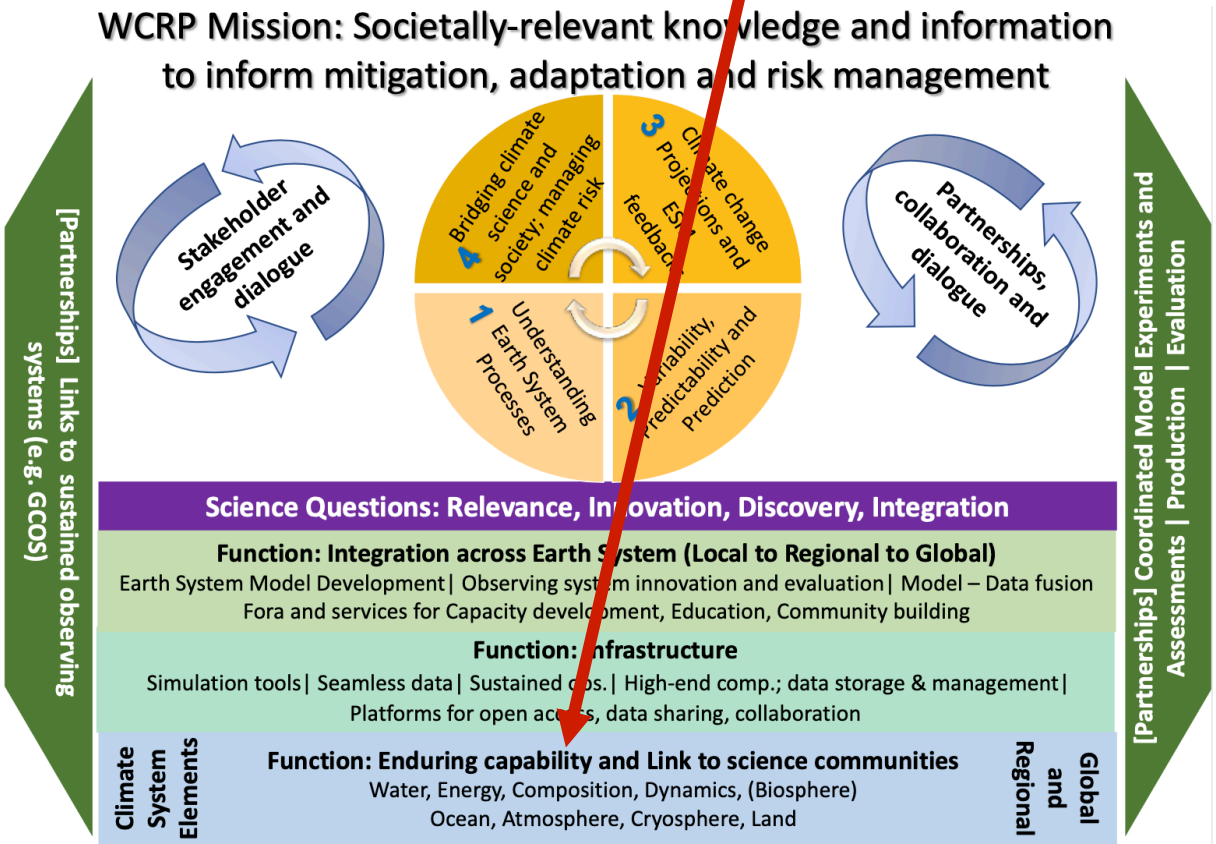
Need to map onto WCRP's SP/IP – using SPARC's bottom-up strengths, making sure that every new activity maps on WCRP's goals during WRCP transition



Towards SPARC Implementation Plan (2021-2025)

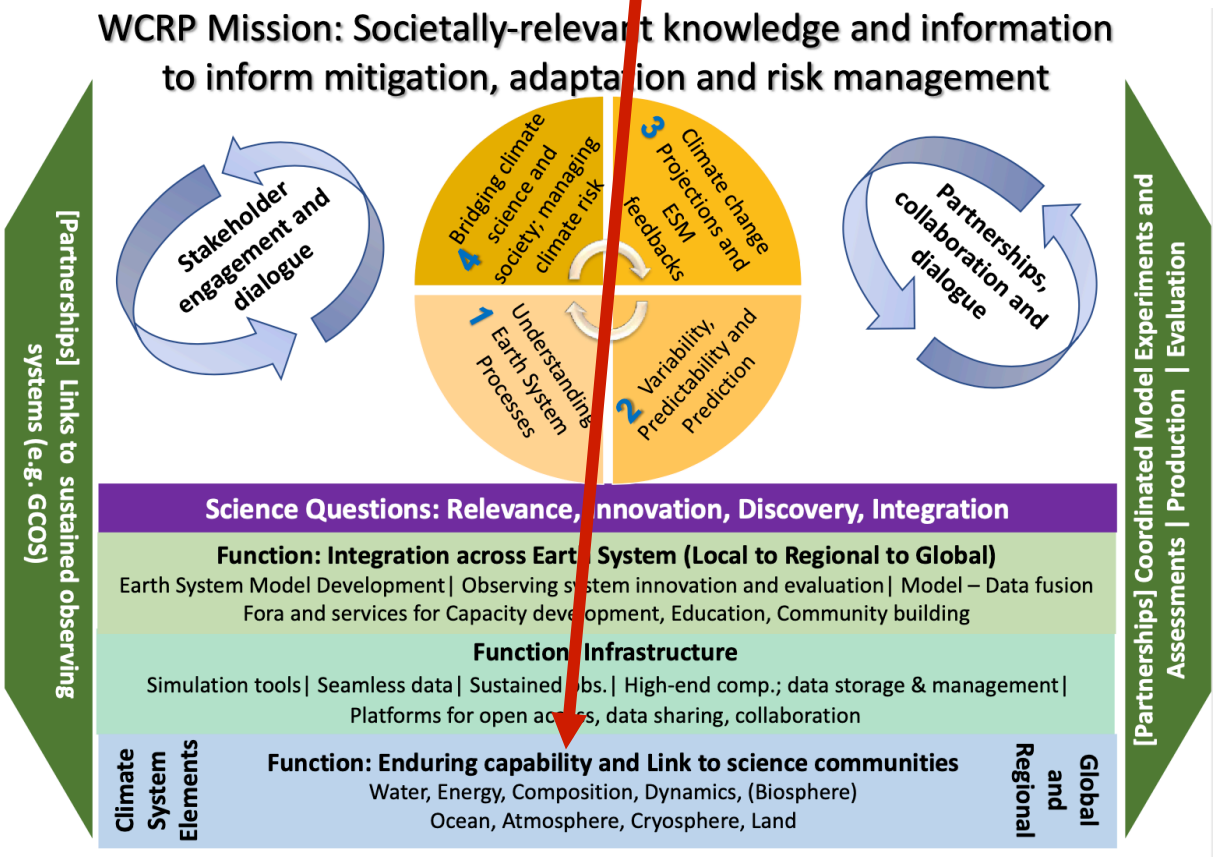
SPARC is strongly supportive of maintaining an atmospheric community within WCRP which includes dynamics, composition and long-term changes.

(Could be called SPARC – or not)



Towards SPARC Implementation Plan (2021-2025)

That community will support and/or lead initiatives of broader interest involving WCRP and non-WCRP groups



Towards SPARC Implementation Plan (2021-2025)

SSG Meeting discussion (December, 2019):

Overarching Science Questions? Mapping SPARC related science questions?

- **How and why is atmospheric composition changing over time and what are the impacts**
  - How do changes in atmospheric composition affect RF over time? (i.e. *Concentration, lifetimes, radiative forcing, metrics*)
  - How will varying spatial concentration and forcings impact regional weather and climate? (*i.e. ozone recovery, fires, pollution, land/sea emissions)*
  - What are the processes driving atmospheric composition change? (i.e., Dynamics, emissions, loss processes)
  - How will monsoons modify concentrations and transport of pollutants to the UTLS?
  - How will the stratosphere influence monsoons as climate changes? *(droughts, floods and food security)*
  - What are the impacts of proposed (atmospheric) geoengineering approaches? (Solar Radiation Management effects on the broader atmosphere including stratospheric O3)

SPARC future plans

Activity plans in the near future:

- Publication of the SPARC Reanalysis Intercomparison Project (S-RIP)
  - currently in review; aiming for publishing date in 2020.
- Preparation of the 5th ACAM workshop and 4th ACAM training school in 2021
- Increased focus on the troposphere and extremes (DynVar – planning of a workshop in 2022 to bring together the stratosphere and extremes communities)
- Future joint workshop of the Gravity Wave activity with Pan-GASS on Surface Drag Momentum Transport; next GW Symposium: 2021
  - Continuing fundamental work on gravity wave generation, propagation, dissipation, breaking

SPARC future plans

Activity plans in the near future:

- Research on transport barriers and Strat-Trop exchange, mixing processes across dynamical barriers, and climate impacts on long.-term changes in the UTLS (OCTAV-UTLS ; main focus on Ozone)
- Stratospheric and Tropospheric Influences on Tropical Convective Systems (SATIO-TCS): New full SPARC activity, focussing on process understanding.
  - Workshop: 21-25 February in Kyoto, Japan
- Continuation of VolRes activities (wiki) and research on effect of variability in strat. aerosol on temperature & precipitation (SSiRC)

The Core Project joint Initiative

- Proposed by the chairs of CLIVAR, GEWEX, SPARC, CliC and CORDEX at JSC 40 (May 2019)
- Goal: regional, cross-cutting and research activities among *all* CPs
- Criteria: (i) fundamental science, (ii) global climate and social relevance, (iii) tractable
- Regions and societal relevance:
  - Himalayas (Third Pole): Key contribution to water availability in that region
  - Andes (ANDEX): Impact of climate change on water supply and thus on local services
  - Arctic (Greenland ice sheet): Key contribution to sea level rise