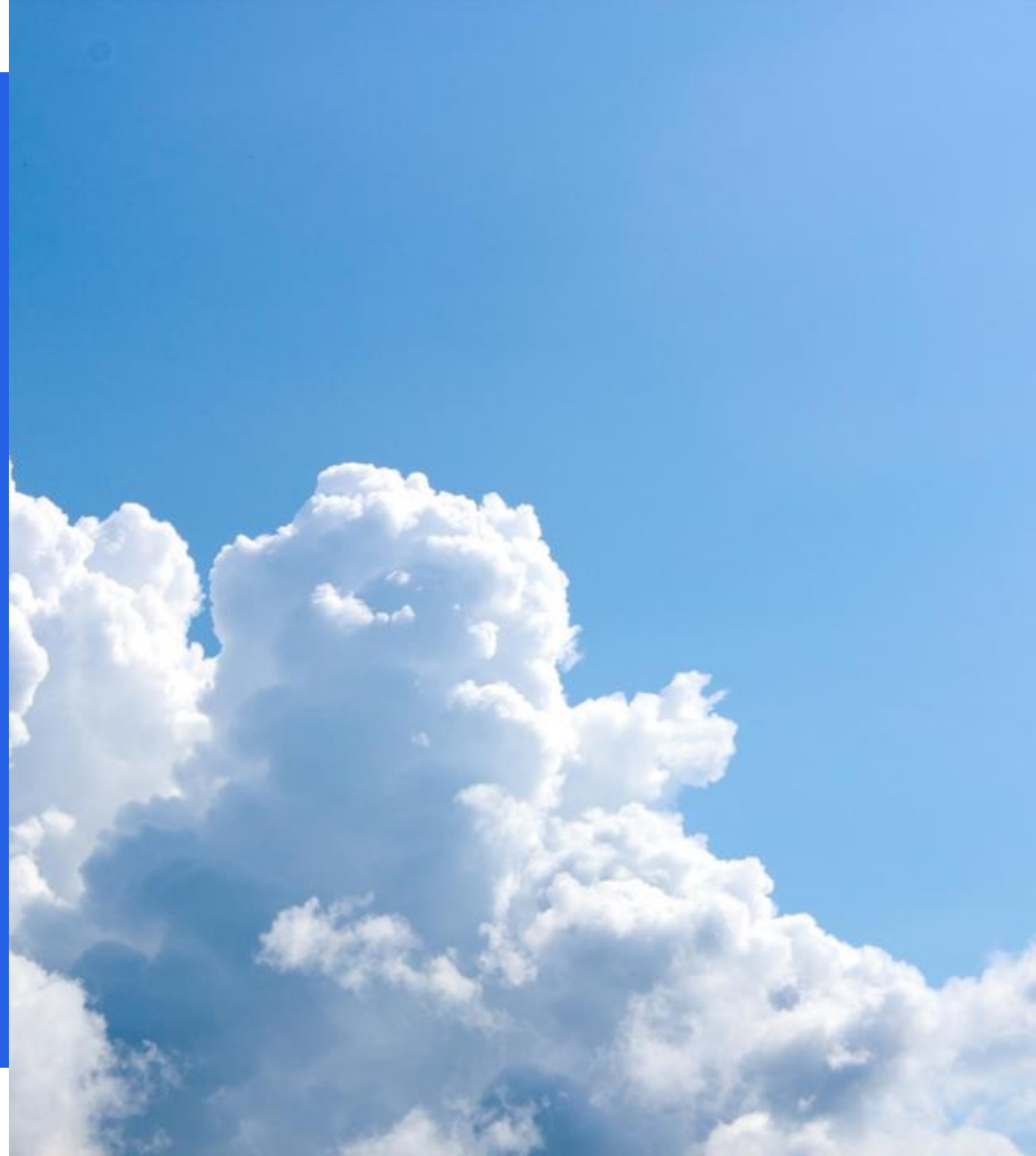
The Bureau of Meteorology

WGSIP25

WCRP aligned activities: APARC

Debbie Hudson

Nov 2024



APARC

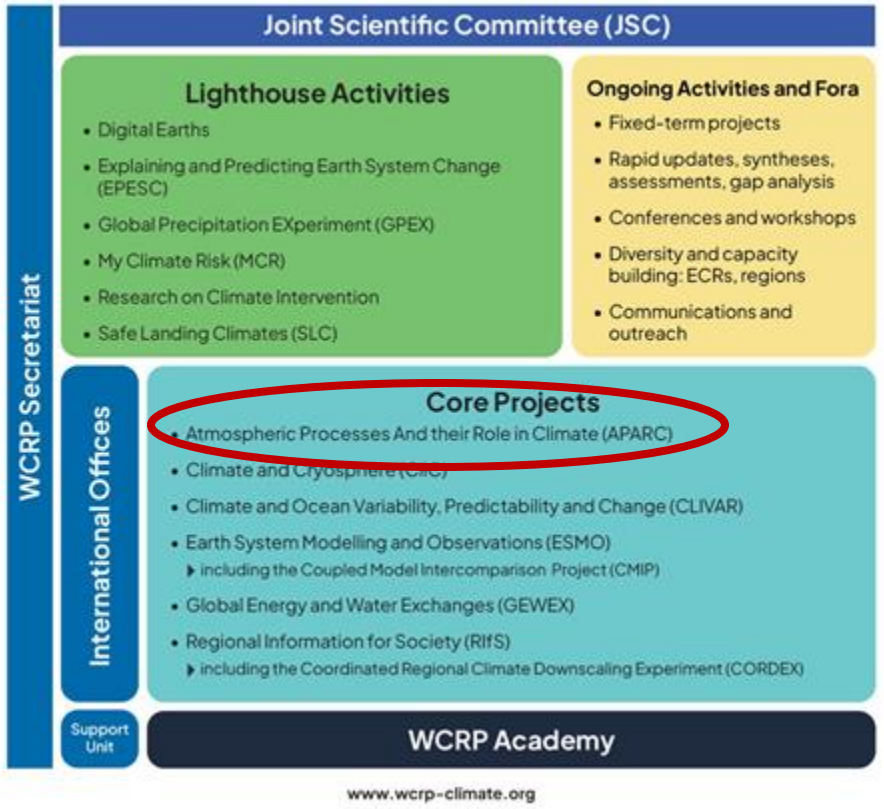
Atmospheric Processes And their Role in Climate

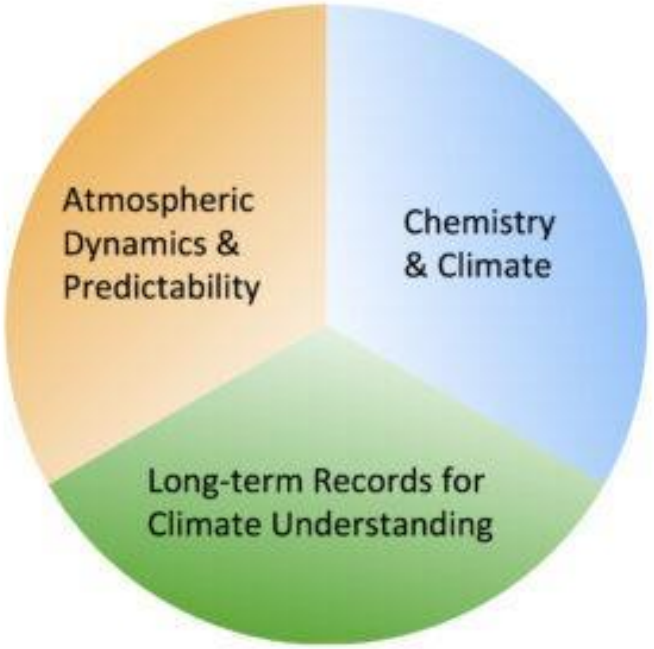
https://www.aparc-climate.org/

WCRP World Climate Research Programme

APARC promotes and facilitates cutting-edge international research activities on how chemical and physical processes in the atmosphere interact with climate and climate change

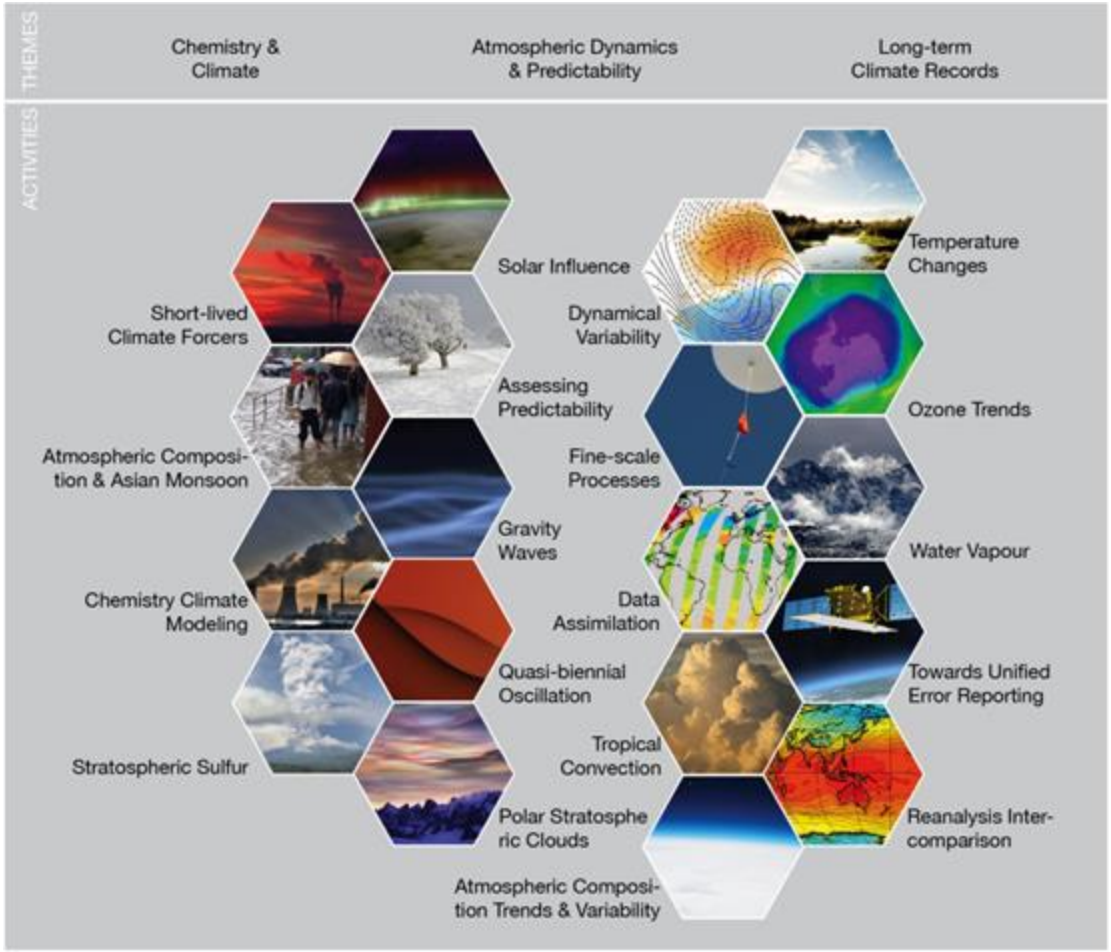
Jan 2024: SPARC (Stratosphere-troposphere Processes And their Role in Climate) transitions to APARC





APARC has three overarching themes

Activities



APARC activities

- Atmospheric Composition and the Asian Monsoon (ACAM)
- Assessing predictability (SNAP)
- CCM initiative (CCMI)
- Composition Trends And Variability in the Upper Troposphere and Lower Stratosphere (OCTV-UTLS)
- Dynamical variability (DynVar)
- Fine-scale Processes (FISAPS)
- Gravity waves
- Hunga Tonga-Hunga Ha'apai stratospheric impacts (HTHH)
- Attribution of Dynamically-driven extremes (LEADER)
- Ozone Trends (LOTUS)
- Quasi-biennial oscillation (QBOi)
- Reanalysis intercomparison (A-RIP)
- Solar influence (SOLARIS-HEPPA)
- Stratospheric sulfur (SSiRC)
- Temperature changes (ATC)
- Towards Unified Error Reporting (TUNER)
- Very Short-Lived Substances (VSLS-MIP1)

APARC working group

- Quasibiennial oscillation and Ozone Chemistry interactions in the Atmosphere (QUOCA)

Activities most likely relevant to WGSIP

- Stratospheric Network for the Assessment of Predictability (**SNAP/SNAPSI**)
- Quasi-biennial oscillation (**QBOi**)
- WG on Quasibiennial oscillation and Ozone Chemistry interactions in the Atmosphere (**QUOCA**)
- Dynamical variability (**DynVar**)
- Attribution of Dynamically-driven extremes (**LEADER**)

Thanks to Yaga Richter (APARC SSG) for providing info on updates

SNAP (Stratospheric Network for Assessment of Predictability)

Leads: **Chaim Garfinkel**, Amy Butler, Blanca Ayarzagüena

Second SNAP paper on biases in stratosphere-troposphere coupling processes in S2S models submitted to Weather and Climate Dynamics. A third paper is underway.

A process-based evaluation of biases in extratropical stratosphere-troposphere coupling in subseasonal forecast systems

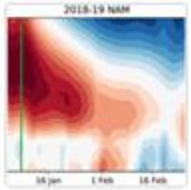
Chaim I. Garfinkel, Zachary D. Lawrence, Amy H. Butler, Etienne Dunn-Sigouin, Irene Erner, Alexey Yu. Karpechko, Gerbrand Koren, Marta Abalos, Blanca Ayarzaguena, David Barriopedro, Natalia Calvo, Alvaro de la Cámara, Andrew Charlton-Perez, Judah Cohen, Daniela I. V. Domeisen, Javier García-Serrano, Neil P. Hindley, Martin Jucker, Hera Kim, Robert W. Lee, Simon H. Lee, Marisol Osman, Froila M. Palmeiro, Inna Polichtchouk, Jian Rao, Jadwiga H. Richter, Chen Schwartz, Seok-Woo Son, Masakazu Taguchi, Nicholas L. Tyrrell, Corwin J. Wright, and Rachel W.-Y. Wu

SNAPSI: sub-project of SNAP

- Nudging to isolate the role of the stratosphere on predictability and extremes in operational
  S2S forecast models during three sudden stratospheric warmings (Hitchcock et al. 2022).

- Special Collection at GMD/WCD/ACP on "Stratospheric impacts on climate variability and predictability in nudging experiments" where we expect all the SNAPSI papers will go. Expecting 6 publications

Stratospheric Nudging And Predictable Surface Impacts (SNAPSI): a protocol for investigating the role of stratospheric polar vortex disturbances in subseasonal to seasonal forecasts



Peter Hitchcock, Amy Butler, Andrew Charlton-Perez, Chaim I. Garfinkel, Tim Stockdale, James Anstey, Dann Mitchell, Daniela I. V. Domeisen, Tongwen Wu, Yixiong Lu, Daniele Mastrangelo, Piero Malguzzi, Hai Lin, Ryan Muncaster, Bill Merryfield, Michael Sigmond, Baoqiang Xiang, Liwei Jia, Yu-Kyung Hyun, Jiyoung Oh, Damien Specq, Isla R. Simpson, Jadwiga H. Richter, Cory Barton, Jeff Knight, Eun-Pa Lim, and Harry Hendon

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SNAP/SNAPSI Beyond 2025

Leads: Chaim Garfinkel, Amy Butler, Blanca Ayarzagüena

- Pursuing the possibility of SNAPSI like simulations
  but focused on the **role of stratospheric ozone and water vapor** in
  S2S forecast models.

- May also pursue a SNAPSI 2.0, which would add, e.g., **strong**
  vortex cases or other **extreme stratospheric events** to the SNAP simulations.

- **Seasonal forecast models** (C3S): evaluation of atmospheric **biases**;
  how to use stratospheric information for seasonal **predictability**

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QBOi (Quasi Biennial Oscillation Initiative)

Leads: James Anstey, Neal Butchart, Yoshio Kawatani, Clara Orbe & Scott Osprey

- Phase 1: **climate-length experiments** focused on identifying common biases and looking at the QBO response in climate change; There were also initialized experiments looking at predictability of the QBO (all work completed and published)

- Phase 1.5 focused on **perpetual El Nino/La Nina** experiments (3 papers: 1 completed, 2 in draft to be submitted to WCD)

- Phase 2 focused on **nudged stratosphere** (100 yr sims): Progress on Phase 2 analysis papers to be submitted in 2024-2025 to joint WCD Special Issue on Nudging with SNAPSI,

- **New activity: Vertical resolution!** New experiment comparison agreed and new runs in progress (6 models participating)

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QUOCA: QUasibiennial oscillation and Ozone Chemistry interactions in the Atmosphere

Leads: Clara Orbe & Alison Ming

- New WG
- QUOCA formalized its experimental protocol in February 2024 (to be submitted to GMD)
- 8 modeling centers so far (GEOSCCM, GISS E2.2, ICON, MIROC-ES2H, LMDZ-Reprobus, CESM2-WACCM6, UKESM1-StratTrop, E3SM)

Next 3 years:

- First (virtual) workshop November 18-21 2024 to define working groups.
- Experiments will be completed mid 2025; analysis by working groups through 2027.

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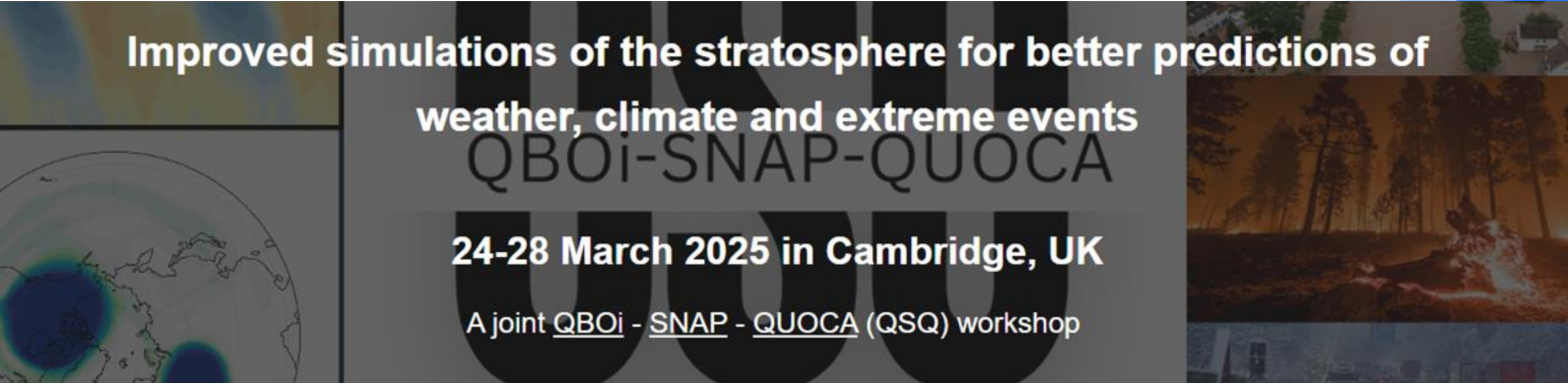

https://sites.google.com/view/qsq-workshop-mar-2025/home

The workshop's purpose will be to facilitate the sharing and discussion of the latest results on the role of the stratosphere in models relevant for enhancing predictability on all timescales.

The workshop will serve as the in-person kick-off for the new **QUOCA** project.

Invited speakers: Inna Polichtchouk, Aaron Match, Marlene Kretschmer, Eun-Pa Lim, and Seok-Woo Son

Abstract submission deadline: **2 December**
Registration will open after abstract acceptance notices have been sent out

Dynvar: Dynamical Variability

Leads: Daniela Domeisen & Kevin Grise

Next 3 years: Investigate both established and new dynamics topics in collaboration with other established communities:

- Synthesizing representation of **Rossby wave-driven teleconnection** patterns in the present-day climate and under **climate change**
- Connection between **Rossby waves, storm tracks, and extremes**
- **DynVarMIP**: CMIP7 investigations for the stratosphere and stratosphere – troposphere coupling
- Investigation of role of atmospheric dynamics for **cold air outbreaks** in a **changing climate**
- Defining **SSWs** and their surface impacts in **Southern Hemisphere**.

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LEADER

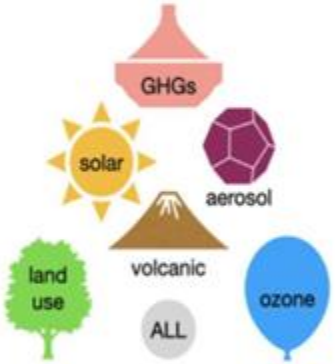
Large Ensembles for Attribution of Dynamically-driven ExtRemes

LEADER is a limited-term activity from 2024–2026 focused on analyzing the outputs of the Large Ensemble Single Forcing Model Intercomparison Project (LESFMIP), an ongoing extension of the Detection & Attribution MIP (DAMIP) protocol to more forcing agents and larger ensembles:

Large Ensemble

What are the characteristics of internal variability?

Single Forcing



What is the response to different forcings?

MIP

How well are current climate models doing?

Objectives of the LEADER activity:

- Provide a **process-based understanding** of recent annual to decadal climate changes
- Quantify the roles of **internal variability** and **external drivers**
- Assess predictability, sources of skill, drivers and mechanisms to increase **confidence in predictions and projections**
- Contribute to **IPCC** and **WMO Climate Update** and **State of Climate** reports

To

- **Leads**: Chaim Garfinkel, Scott Osprey
- In-person meeting in Busan, 2025
- Focus will be to discuss <u>operational decadal single forcing projections</u>.

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Thank you

Debbie Hudson

Debbie.Hudson@bom.gov.au