

ACTIVITY REPORT:

DynVar (Dynamical Variability)

Activity leads:

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28th SPARC SSG meeting

Part II: Activity reporting

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DynVar is an international working group on the modelling of the dynamics and variability of the stratosphere-troposphere system. DynVar focuses on 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 a hierarchy of models ranging from simplified general circulation models to coupled atmosphere-ocean-sea-ice general circulation models, with the atmospheric component extending to above the stratopause.

Committee members: Edwin Gerber (DynVarMIP coordinator), Amy Butler, Natalia Calvo, Andrew Charlton-Perez, Marlene Kretschmer, Eun-Pa Lim, Michael Sigmond, Isla Simpson, and Shingo Watanabe

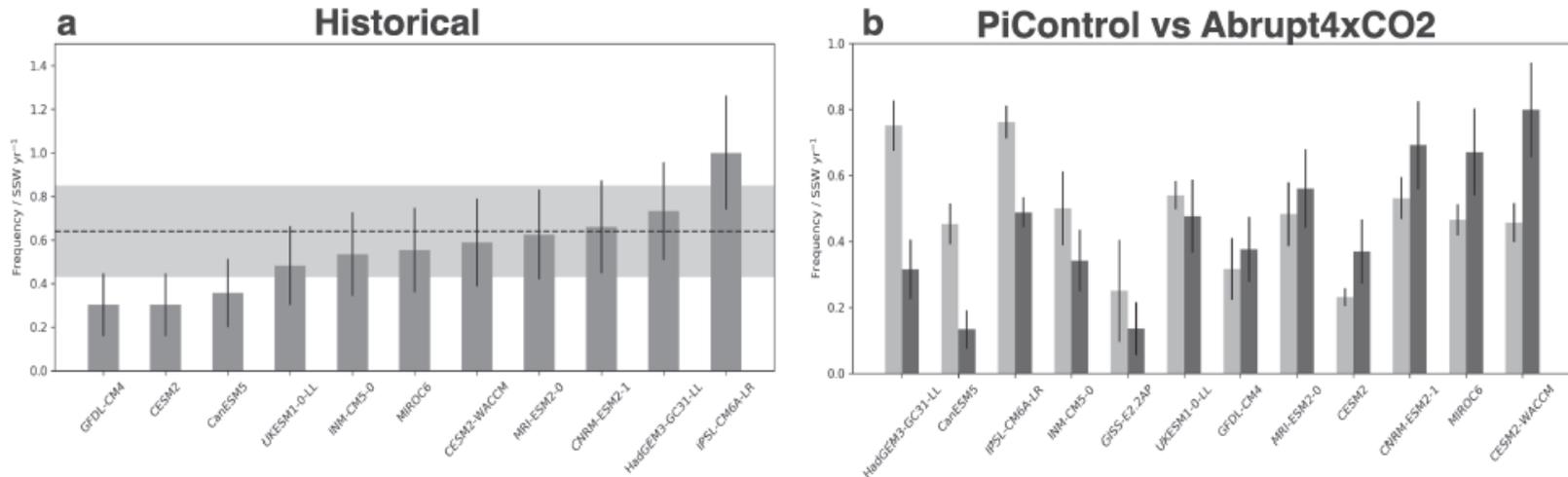
Achievements:

- Assessment of stratospheric mean climate, variability, and change, as well as of the stratosphere-troposphere dynamical coupling in climate models participating in the latest set of climate projections, carried out under the fifth Coupled Model Inter-comparison Project (CMIP5).
- On discerning the role of the stratosphere on intraseasonal time scales, initiatives within DynVar have focused on the stratospheric seasonal prediction hindcasts produced as part of WGSIP's Stratosphere Historical Forecast Project (SHFP).
- Ongoing activities are related to analysis of CMIP6 simulations, in particular those providing additional dynamical diagnostics as a part of DynVarMIP (Gerber and Manzini 2016).

Scientific results & publications

Ayarzagüena, B., Charlton-Perez, A. J., Butler, A. H., Hitchcock, P., Simpson, I.R., Polvani, L. M., et al. (2020). Uncertainty in the response of sudden stratospheric warmings and stratosphere-troposphere coupling to quadrupled CO₂ concentrations in CMIP 6 models. *Journal of Geophysical Research: Atmospheres*, 125, e2019JD032345. <https://doi.org/10.1029/2019JD032345>

Scientific results & publications



SSW frequency in historical (left) and piControl and Abrupt4xCO4 (right) simulations across DynVarMIP CMIP6 models. Figure demonstrates large model uncertainty in SSW response to climate change (from Ayarzagüena et al. 2020)

Publications in progress:

Abalos, M., N. Calvo, S. Benito, H. Garny, S. Hardiman, P. Lin and CMIP6 coauthors: The Brewer-Dobson circulation in CMIP6 models, in preparation

Karpechko A., Manzini E. et al: Northern hemisphere stratospheric change in CMIP6 models and implications for surface climate, in preparation

Workshops (in-person & online):

- DynVar contributed to organizing the workshop on Atmospheric Circulation in a Changing Climate, Madrid (Spain, 2019)
- DynVar organises community workshops approximately every 3 years. The next workshop is planned for year 2022 or potentially 2023, depending on COVID-related postponements of meetings in 2021. Information about date and venue will follow.

Capacity building activities:

Renewed activity committee including members from 4 continents, including 1 postdoc and 6 new members

- Collaborations and links within SPARC: CCMI, Gravity Waves, SNAP, S-RIP, and SOLARIS-HEPPA
- Collaborations and links outside of SPARC: WCRP Grand Challenges: Weather and Climate Extremes; Clouds, circulation, and climate sensitivity
- Collaboration takes place by organizing joint workshops (SNAP, S-RIP)
- Other possibilities for future collaborations: Invited talks at activity organized workshops & conference sessions; writing a white paper on the interface of dynamical variability and extremes jointly with the extremes community

The use of simplified models and more theoretical approaches to build the knowledge of two-way stratosphere-troposphere coupling is also an important component of the activity. DynVar is also extending its focus to tropospheric dynamics, storm tracks, jets, blocking, and their modes of variability, with the aim of reaching a comprehensive understanding of troposphere-stratosphere variability and change. Of particular focus is the understanding of the role of stratosphere-troposphere coupling and associated large-scale dynamical processes in generating extreme weather and climate events.

An example publication in this direction is e.g.

Domeisen & Butler (2020), Stratospheric drivers of extreme events at the Earth's surface, *Comms E&E*, <https://www.nature.com/articles/s43247-020-00060-z>

These DynVar activities connect most closely to the WCRP Grand Challenge on Clouds, Circulation, and Climate Sensitivity and the Grand Challenge on Weather and Climate Extremes, as well as the new lighthouse activities within WCRP.

- Leadership changes: D. Domeisen and A. Karpechko have taken over the leadership of DynVar from E. Manzini and E. Gerber.
- E. Gerber stays on as leader of DynVarMIP, a diagnostic model inter-comparison project endorsed by CMIP6.
- Workshop support requests: We are planning a workshop in 2022/23, financial support will be appreciated, especially for the participation of early career scientists and scientists from emerging countries. For a virtual, hybrid, or multi-hub version of the workshop, guidance and financial support for online tools and technical support will be appreciated.