Anmeldung eines Themas für ein/e

Forschungsseminar	**X**	
Methodenseminar	**X**	
Masterarbeit	**X**	(bitte eines oder mehrere ankreuzen)

Thema Datum	**The Polar Vortices under future climate change scenarios** **12.7.2021**
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Zweitgutachter	Prof. Johannes Quaas
Kurzbeschreibung:	It is still an open research question of how different characteristics of polar vortices (size, location, strength etc.) will be affected under various climate change scenarios. In this thesis, the candidate will analyse the data produced by the Stratospheric Aerosol Geoengineering Large Ensemble (GLENS) project. By using the NCAR Community Earth System Model with the Whole Atmosphere Community Model as its atmospheric component (CESM1(WACCM)), the GLENS project consists a 20-member ensemble of stratospheric sulfate aerosol injection simulations between 2020-2099 and a 20-member ensemble of control simulations over a reference period between 2010-2030. All simulations follow the same RCP8.5 (which is a high anthropogenic emission scenario) pathway. The output of the GLENS simulation is a set of unique model dataset aiming at identifying significant global, regional and seasonal climate changes as a consequence of strategically performed geoengineering in the presence of internal climate variability. It also aims at narrowing the uncertainties in what geoengineering can and cannot do to the future climate change. In this thesis, the candidate will use the GLENS simulation dataset to investigate how different characteristic of both tropospheric and stratospheric polar vortices are influenced under solar radiation management and high-emission climate change scenario (RCP8.5). A more detailed description is given below.
Literatur:	GLENS project description, including references: https://www.cesm.ucar.edu/projects/community-projects/GLENS/

The Polar Vortices under future climate change scenarios

The slow rate of decarbonization of economic growth and slow progresses in negative emissions technologies are deterring barriers in stopping the constant increase in the global atmospheric greenhouse gas concentration. Previous studies suggest that the near-term impact of the current commitments under the 2015 Paris Agreement on limiting temperature rise would not be sufficient to limit the global mean temperature threshold of 2°C (compared to the pre-industrial period).

Alongside mitigation and adaptation, geoengineering is increasingly becoming the third pillar of climate policy. A particular type of geoengineering, named Solar Radiation Management (SRM), has received particular attention because it is cheap and the impact on the global temperature is almost instantaneous. Theoretically, it can be achieved by injecting reflective sulfur aerosols into the stratosphere and reflecting some of the inbound sunlight back to space, mimicking the cooling effects of episodic volcanic eruptions.

The SRM can potentially lower climate change risks (by reducing the global temperatures), however, it poses its own climate-related risks. Still, research is needed for a better understanding of the effects of geoengineering and its potentials and limitations.

The term polar vortex is most commonly used as an abbreviation for circumpolar vortex and refers to a planetary-scale westerly (west to east) flow that encircles the pole in mid or high latitudes. There are two quite different polar vortices in the Earth's atmosphere: a tropospheric and a stratospheric polar vortex, and the two are not directly connected. The location of circumpolar vortex in the troposphere is particularly important because some extreme weather events are related to displacement of the edge of the tropospheric polar vortex.

It is still an open research question of how different characteristics of polar vortices (size, location, strength etc) will be affected under various climate change scenarios. In this thesis, the candidate will analyse the data produced by the Stratospheric Aerosol Geoengineering Large Ensemble (GLENS) project. By using the NCAR Community Earth System Model with the Whole Atmosphere Community Model as its atmospheric component (CESM1(WACCM)), the GLENS project consists a 20-member ensemble of stratospheric sulfate aerosol injection simulations between 2020-2099 and a 20-member ensemble of control simulations over a reference period between 2010-2030. All simulations follow the same RCP8.5 (which is a high anthropogenic emission scenario) pathway. The output of the GLENS simulation is a set of unique model dataset aiming at identifying significant global, regional and seasonal climate changes as a consequence of strategically performed geoengineering in the presence of internal climate variability. It also aims at narrowing the uncertainties in what geoengineering can and cannot do to the future climate change. In this thesis, the candidate will use the GLENS simulation dataset to investigate how different characteristic of both tropospheric and stratospheric polar vortices are influenced under solar radiation management and high-emission climate change scenario (RCP8.5).

The work will be achieved under the mentorship of Prof. Christoph Jacobi and Dr. Khalil Karami