Anmeldung eines Themas für ein/e

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

Thema Datum	**Assessing the impact of climate change scenarios on atmospheric blockings** **12.7.2021**
Betreuer (mit Kontaktdaten)	Prof. Christoph Jacobi jacobi@uni-leipzig.de
ggf. weitere Kontaktperson	Dr. Khalil Karami Khalil.karami@uni-leipzig.de
Zweitgutachter	Prof. Johannes Quaas
Kurzbeschreibung:	The main aim of this thesis is to examine and document the changes of the atmospheric blocking under solar radiation management and high-emission climate change scenario (RCP8.5), with the hope that the results might give useful information to decision-makers about its potentials and limitations. To achieve the objectives of the thesis, the candidate will do a comprehensive literature review to identify the methods to objectively detect the local blocked condition on a gridded field of the GLENS (Geoengineering Large Ensemble) data (blocking index). This includes the location, frequency, intensity and duration of the blocking episodes. Then he/she will apply the diagnostic tools to the GLENS output (both SRM and RCP8.5 scenarios) and will investigate how the above-mentioned blocking statistics will change under the above-mentioned climate change scenarios. A more detailed description is given below.
Literatur:	GLENS project description, including references: https://www.cesm.ucar.edu/projects/community-projects/GLENS/

Assessing the impact of climate change scenarios on atmospheric blockings

Slow progresses in decoupling anthropogenic emissions from economic growth and negative emissions technologies are the main reason for continuation of the increase in the global atmospheric greenhouse gas concentration. Even optimistically assuming that country-dependent Intended Nationally Determined Contributions (INDCs) reduce emissions perfectly as promised under the 2015 Paris Agreement, the near-term impact on limiting temperature rise would be generally negligible. This suggests that the temperature threshold of 2°C (compared to the pre-industrial period) will not be achievable by the current climate proposals. The temperature threshold of 2°C is considered as an indicator for a dangerous and irreversible climate change.

Alongside mitigation and adaptation, geoengineering is increasingly becoming the third pillar of climate policy. Previous researches suggest that the solar geoengineering can be viewed as part of an overall strategy (complementary response to mitigation and adaptation approaches) for meeting the 2°C Paris target. A particular type of geoengineering, named Solar Radiation Management (SRM), has received particular attention. By injecting the reflective aerosols into the stratosphere, stratospheric geoengineering aims to reduce the amount of incoming solar radiation reaching the troposphere and hence mimicking the cooling effect of volcano eruptions. Although SRM should not be considered as an alternative to emission reduction policies, however, it is an only known approach to quickly (within a couple of years) slow, stop or even reverse the global temperature from rising. Currently the risks of stratospheric geoengineering is uncertain, however it is also unclear if the risks of breaking the 2°C exceeds or fall short of SRM risks.

Still, research is needed for a better understanding of the effects of geoengineering and its potentials and limitations. The review of previous researches indicates the mid-latitude atmospheric blocking can change under climate-change scenarios. Atmospheric blocking is a mid-latitude weather pattern that describes a quasi-stationary, long-lasting, high pressure systems that represent some of the most high-impact weather patterns (such as extreme temperature and precipitation) in the mid-latitudes. Blocking of the westerly flow can divert the jet stream northward or southward, potentially affecting the weather in remote locations.

To the best of our knowledge no paper has considered the possible changes in the global blocking patterns under the SRM scenario. In this thesis, the candidate will analyse the data (specifically 500hPa geopotential height) 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.

The main aim of this thesis is to examine and document the changes of the atmospheric blocking under solar radiation management and high-emission climate change scenario (RCP8.5), with the hope that the results might give useful information to decision-makers about its potentials and limitations. To achieve the objectives of the thesis, the candidate will

do a comprehensive literature review to identify the methods to objectively detect the local blocked condition on a gridded field of the GLENS data (blocking index). This includes the location, frequency, intensity and duration of the blocking episodes. Then he/she will apply the diagnostic tools to the GLENS output (both SRM and RCP8.5 scenarios) and will investigate how the above-mentioned blocking statistics will change under the above-mentioned climate change scenarios.

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