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Modes of Lorenz atmospheric energetics under different CMIP6 climate scenarios

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This aim of this study is to examine whether different climate scenarios, as they are adopted in Phase 6 of the Coupled Model Intercomparison Project (CMIP6), lead to different modes of the energetics components of the Lorenz's energy cycle which would therefore have an impact on the "rate of working" of the climate system. In particular, the study focuses on four energy forms, namely the Zonal and Eddy components of both the Available Potential and Kinetic Energies, the permissible conversions between these forms of energy, the diabatic generation of Available Potential Energy as well as the dissipation of the Kinetic Energy.

The CMIP6 climate projections in the 85-year period from 2015 to 2100 produced by the HadGEM3-GC3.1 model have been used. These projections are driven by a set of Shared Socioeconomic Pathways (SSP's) based on new future pathways of societal development but also incorporating the previously used Representative Concentration Pathways (RCPs). In this respect, the following three concentration-driven scenarios under Tier 1 of ScenarioMIP are used:

ssp126: A scenario with low radiative forcing by the end of the century, following the RCP2.6 global forcing with SSP1 socioeconomic conditions; radiative forcing reaches a level of 2.6 W/m^2 in 2100;

ssp245: A scenario with medium radiative forcing by the end of the century, following the RCP4.5 global forcing with SSP2 socioeconomic conditions; radiative forcing reaches a level of 4.5 W/m^2 in 2100;

ssp585: A scenario with high radiative forcing by the end of century, following the RCP8.5 global forcing with SSP5 socioeconomic conditions.

For comparative purposes, the corresponding historical 85-year dataset, preceding the time period covered by the climatic projections has been used. In this respect, data from the same cohort in the period 2029 to 2014 form also part of this study.

The energy balance and time series of the energetics components under different SSP-based scenarios show that different scenarios yield diverse energetics regimes, consequently impacting the Lorenz's energy cycle and its underlying physical processes.