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Mechanisms of atmospheric circulation regimes and their future changes

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The concept of atmospheric regimes describes the preferred organisation of large-scale anomalies and their impact on low-frequency climate variability. But whether atmospheric flow regimes exist is an issue of ongoing debate among the scientific community.

To prove the hypothesis of the existence of atmospheric flow regimes one has to understand the underlying dynamical mechanisms. An overview will be given on possible mechanisms for the generation of regimes which have been identified from studies with a hierarchy of atmospheric models. Based on these studies (found in the literature and including own studies), we hypothesise the existence of atmospheric flow regimes and study the regime behaviour simulated by atmosphere-ocean general circulation models for present day conditions and future climate scenarios by two different methods, by the analysis of a probability density function in a low-dimensional state space and by cluster analysis.

The regime analysis of model simulations which have been performed for IPCC AR4 reveal 4 Northern Hemisphere regimes for the present-day simulations (EA/WR-, PNA-, AO+, PNA+/NAO-) in accordance with regimes analysed from observations. The response to the additional external forcing of the scenario simulations SRESA1B lead to changes in the frequency of occurrence, to slight changes in the regime structure and to the appearance of two additional regimes.