A regional modelling perspective on the significance of gravity wave activity in a changing climate

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A quantitative understanding of processes that determine the dynamics in the middle atmosphere and its coupling to the troposphere are essential to ensure reliable projections of Earth's future climate. However, discrepancies between observational evidence and climate model simulations on the changes of the Brewer-Dobson Circulation over the last decades prevent a conclusive assessment of the impact of increasing greenhouse gas concentrations on stratospheric climate. Here, we present one component of the recently started project MACClim that pursues some key aspects of the SHARP BDC working group, investigating gravity wave characteristics and their impact on climate model simulations.

An analysis of EMAC model simulations from the ESCiMo initiative shows the spatial and temporal variability of the gravity wave drag and its relation to stratospheric temperatures and winds in transient climate change simulations with fully coupled atmosphere chemistry.

We present our future plans to investigate the sensitivity of climate simulations with respect to the representation of gravity waves in current model parameterisations. We will compare the gravity wave drag between simulations of the EMAC model and the gravity wave-resolving nested model MECO(n) in certain model domains, that also allow an evaluation of the model results with observational records from measurement campaigns. Moreover, sensitivity studies with these models of different complexity and resolution will be conducted in order to analyse the influence of various model parameters on the intermittency, the source function, the launch spectrum and the geographical distribution of gravity waves as well as on the mechanisms of their dissipation. This assessment of gravity wave activity and its variability in the past, as well as in the changing climate of the future, will allow us to better understand and quantify the impacts of changes in the middle atmosphere on surface weather and climate.