The response of the ozone layer under abrupt 4xCO2 in CMIP6

Gabriel Chiodo, **William Ball, Peer Johannes Nowack, Clara Orbe, James M Keeble, Mohamadou Diallo and Birgit Hassler**, (1)ETH Zürich, Institute for Atmosphericand Climate Sciences, Zurich, Switzerland, (2)Delft University of Technology, Department of Geoscience and Remote Sensing, Delft, Netherlands, (3)University ofCambridge, Cambridge, United Kingdom, (4)NASA Goddard Institute for Space Studies, New York, NY, United States, (5)Forschungszentrum Jülich GmbH, IEK-7, Jülich,Germany, (6)German Aerospace Center (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany

Abstract Text:

Previous studies indicate a possible role of stratospheric ozone chemistry feedbacks in the climate response to 4xCO2, either via a reduction in equilibrium climate sensitivity (ECS) (Nowack et al., 2015), or via changes in the tropospheric circulation (Chiodo and Polvani, 2017). However, these effects are subject to uncertainty. Part of the uncertainty may stem from the dependency of the feedback on the pattern of the ozone response, as the radiative efficiency of ozone largely depends on its vertical distribution (Lacis et al., 1990). Here, an analysis is presented of the ozone layer response to 4xCO2 in chemistry–climate models (CCMs) which participated to CMIP intercomparisons. In a previous study using CMIP5 models, it has been shown that under 4xCO2, ozone decreases in the tropical lower stratosphere, and increases over the high latitudes and throughout the upper stratosphere. It was also found that a substantial portion of the spread in the tropical column ozone is tied to inter-model spread in tropical upwelling, which is in turn partly tied to ECS (Chiodo et al., 2018). Here, we revisit this connection using4xCO2 data from CMIP6, thereby exploiting the larger number of CCMs than in CMIP5. In addition, we explore the linearity of the ozone response, by complementing the analysis with simulations using transient CO2 forcing (1pc/year). We show that the pattern of the ozone response in is similar to CMIP5. In some models (e.g. WACCM), we find larger ozone responses in CMIP6 than in CMIP5, partly because of the larger ECS and thus larger upwelling response in the tropical pipe. In this presentation, we will discuss the relationship between radiative forcing, transport and ozone, as well as further implications for CMIP6 models.