Title: Stratospheric composition feedbacks and their relevance for tropospheric and surface climate

Abstract: The important role of stratospheric feedbacks for the climate system – most notably how the ozone layer responds to anthropogenic forcings and how that response then feeds back on the climate itself - remains largely unexplored, apart from the effects associated with gases regulated by the Montreal Protocol. This is because, to date, most models participating to CMIP inter-comparisons do not account for the complex interplay between stratospheric composition, dynamics and radiation. We here present some recent results illustrating the importance of such interplay in the case of abrupt 4xCO2 experiments from CMIP5. First, we show that increasing carbon dioxide levels lead to substantial changes in the ozone layer, and that the magnitude of these changes is highly model-dependent. Second, we demonstrate how these changes in the ozone layer can have a substantial effect on the circulation response to that forcing in both hemispheres, while barely altering the climate model sensitivity. Third, we explore the role of stratospheric water vapor (SWV) in the projected global warming. We quantify the SWV feedback in CMIP5 models, and show that feedbacks arising from stratospheric moistening are on the same order of magnitude as other notoriously important feedbacks, such as surface albedo and cloud changes. Such findings demonstrate that stratospheric composition changes play a key role in shaping the climate response to anthropogenic forcings, both via radiative and dynamical processes. The implications of these results for the upcoming IPCC-AR6 will be discussed.