

EGU22-11951

<https://doi.org/10.5194/egusphere-egu22-11951>

EGU General Assembly 2022

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



Stratospheric composition feedbacks in a changing climate: a review

Gabriel Chiodo and Marina Friedel

ETH Zurich, Atmospheric and Climate Science, Environmental Systems Science, Zurich, Switzerland

(gabriel.chiodo@env.ethz.ch)

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. Here, we are providing a review of recent work highlighting the importance of such interplay on a broad range of time-scales, encompassing short-term variability to long-term climate change. First, we will show that increasing carbon dioxide levels lead to substantial changes in the ozone layer, and that these changes have a substantial effect on the circulation response to that forcing in both hemispheres (Chiodo & Polvani 2017; 2019). Then, we will review recent work on stratospheric water vapor (SWV) feedbacks under global warming, showing contrasting results concerning the effects on surface climate. Lastly, we will explore the connection between Arctic ozone and surface climate, highlighting the impacts of springtime ozone depletion on surface climate, and the sizable contribution of ozone feedbacks. Such findings demonstrate that stratospheric composition feedbacks play a key role in shaping climate response to anthropogenic forcings and stratosphere-troposphere coupling, both via radiative and dynamical processes. However, the coupling between ozone, SWV and climate is still subject to large uncertainties. We will discuss sources of uncertainty and model limitations, and implications for CMIP6.