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Temporal changes in the structure of the UTLS and their potential impact on lower stratospheric ozone

Daniel Kunkel¹, Franziska Weyland¹, William Ball², and Peter Hoor¹

¹Johannes Gutenberg-University Mainz, Institute for Atmospheric Physics, Mainz, Germany (dkunkel@uni-mainz.de)

²TU Delft, Department of Geoscience and Remote Sensing, Delft, Netherlands

Although a general recovery of stratospheric ozone is expected after the successful implementation of the Montreal Protocol, strong indications for a decline in lower stratospheric ozone in the extratropics are still evident. Related studies attribute this decline to internal dynamic variability affecting the UTLS, in particular associated to the QBO and the exchange of air masses between tropical and extratropical regions. The dynamics affect the transport of ozone from the source region in the tropics into the extratropical lower stratosphere. More so, dynamics affect the structure of the lower stratosphere. In particular, the locations of the tropopause and of isentropic surfaces in the lower stratosphere, i.e., the region up to ~25 km altitude, affect the vertical profile of ozone and as such the integrated column ozone in the lower stratosphere.

This study aims to address the relation between the changing altitude of the tropopause and isentropic surfaces in the lower stratosphere and the declining ozone in the extratropical UTLS. For this we use reanalysis data from ECMWF and dynamic linear modeling to study trends of the dynamic tropopause and of the thermodynamical structure and the potential consequences of these trends for lower stratospheric ozone. In particular, we ask the question: do ozone trends still show a decline if we use a dynamic instead of a fixed coordinate system to calculate these trends?