

**Understanding the impact of seasonal variability in
transport on ozone changes in the tropical mid-
stratosphere**

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Abstract

An unexpected decline of O₃ has been observed in the tropical stratosphere at altitudes around 30-35 km within the period 2004-2012. An analysis of local changes from the SCanning Imaging Absorption SpectroMeter for Atmospheric CHartography (SCIAMACHY) showed that O₃ decrease is associated with an NO₂ increase. This coupling between stratospheric O₃ and NO₂ is well recognized, with the latter being the major ozone-depleting substance in the altitude range 25-40 km. However, the driver for the observed change in NO₂ was not yet clearly identified.

To identify the causes of the observed changes in the tropical mid-stratosphere we used observational data for O₃ profiles retrieved at the University of Bremen from SCIAMACHY. We also used the output from the TOMCAT global offline 3-D chemistry-transport model (CTM). The model contains a detailed description of stratospheric chemistry and it is driven by ERA-Interim reanalysis from European Centre for Medium-Range Weather Forecasts (ECMWF). We performed TOMCAT simulations with different chemical and dynamical forcings for different sub-periods during the time span 2003-2018 to interpret their possible changes and impact on stratospheric ozone.

This study discusses the impact of both dynamical features (via age-of-air simulations) and chemical processes that lead to the change in the tropical mid-stratospheric O₃. This study also investigates possible reasons for the seasonal variability in the speed of vertical transport in the tropical mid-stratosphere.