QOS2016-274, 2016
Quadrennial Ozone Symposium of the International Ozone Commission

The Underestimated Role of Stratosphere-to-Troposphere Transport on Tropospheric Ozone

T. Trickl (1), H. E. Scheel (1), M. Sprenger (2), and H. Vogelmann (1)

(1) Karlsruher Institut für Technologie, IMK-IFU, Garmisch-Partenkirchen, Germany (thomas.trickl@kit.edu), (2) ETH Zürich, Zürich, Switzerland

The atmospheric composition is strongly influenced by changing atmospheric dynamics, in potential relation to climate change. A prominent example is doubling of the stratospheric influence on ozone at the summit station Zugspitze (2962 m a.s.l., Garmisch-Partenkirchen, Germany) between the mid-seventies and 2005, roughly from 11 ppb to 20 ppb. Systematic efforts for identifying and quantifying this influence have been made since the late 1990s (e.g., H. E. Scheel in: http://www.forst.tu-muenchen.de/EXT/LST/METEO/staccato (2002)) based on data filtering ozone, relative-humidity (RH) and 7Be measurements. Meanwhile, routine lidar measurements of ozone and water vapour carried out since 2007, combined with radiosonde data and trajectory calculations, have revealed the presence of stratospheric intrusion layers on up to 80 % of the yearly measurement days. The pronounced seasonal cycle for deep intrusions disappears if one looks at the entire free troposphere, which confirms the results of Beekmann et al. (J. Atmos. Chem. 28 (1997), 29-44). The mid- and upper-tropospheric intrusion layers seem to be dominated by very long downward transport up to a full tour around the northern hemisphere. These layers remain considerably dry, typically with RH $\leq$ 5 % at the centre of the intrusion. In 59 % of the deep intrusion cases with subsidence times up to six days the minimum relative humidity (RH) was 1 % or less (Trickl et al., Atmos. Chem. Phys. 14 (2014), 9941-9961). It is interesting to note that, in recent years, most pronounced ozone maxima have been related to a stratospheric origin rather than to long-range transport from remote boundary layers. It is difficult to answer the question if this fact is related to improving air quality in the most relevant source regions.