Geophysical Research Abstracts
Vol. 13, EGU2011-11973-1, 2011
EGU General Assembly 2011

Twenty Years of Lidar Studies of Tropospheric Ozone at Garmisch-Partenkirchen

Thomas Trickl

Karlsruher Institut für Technologie, IMK-IFU, Kreuzeckbahnstr. 19, 82467 Garmisch-Partenkirchen, Germany (thomas.trickl@kit.edu)

The introduction of lidar sounding of tropospheric ozone at IMK-IFU in 1990 has made possible a number of important atmospheric studies, extending the capability of the local in-situ stations at Garmisch-Partenkirchen (745 m a.s.l.) as well as at the Wank (1780 m a.s.l.) and the Zugspitze (2962 m a.s.l.) summits. The research started with investigations of the transport of ozone and aerosol in the Alpine wind system, but got more and more oriented towards examining the impact of long-range atmospheric transport on the vertical distribution of ozone. Lidar measurements have been carried out during more than 70 stratospheric air intrusions [e.g., Trickl et al., 2010]. Combined with high-resolution model simulations these investigations have led to a renaissance in the field of stratosphere-to-troposphere transport (STT) studies. The ozone soundings have recently been complemented by lidar measurements of free-tropospheric water vapour [Vogelmann and Trickl, 2008]. Relative humidities of 0 to 2 % have been found even in rather thin intrusion layers, which suggests that very little mixing with the surrounding tropospheric air occurs during the long travel from the Arctic to Central Europe. The role of STT for the tropospheric ozone budget has often been strongly underestimated [Scheel, 2005; Trickl et al., 2010]. The lidar measurements have also led to the detection of long-lasting wide high-ozone layers in the middle and upper troposphere that are mostly caused by STT in the vicinity of the subtropical jet stream. This kind of transfer could be shown to occur over the Pacific and all the way back to the Atlantic.

After the first detection of elevated ozone from the United States over Garmisch-Partenkirchen in 1996 [Stohl and Trickl, 1999; Trickl et al., 2003] detailed investigations of the relevant pathways have been carried out. It has turned out that all major source regions for air pollution can contribute. Asian air pollution is much more difficult to identify since these contributions, frequently travelling in the vicinity of the jet stream, are mostly masked by American or stratospheric air masses as discussed above. In one case the presence of air from the Asian boundary layer could be clearly verified by huge amounts of aerosol from an Asian dust storm.

References:

H. E. Scheel, pp. 61-71 in: ATMOFAST, Project Final Report, T. Trickl, Co-ordinator, funded by the German Ministry of Education and Research within the programme “Atmosphärenforschung 2000“, 130 pp., 2005 (in German)

A. Stohl, T. Trickl, A textbook example of long-range transport: Simultaneous observation of ozone maxima of stratospheric and North American origin in the free troposphere over Europe, J. Geophys. Res. **104** (1999), 30445-30462

T. Trickl, O. C. Cooper, H. Eisele, P. James, R. Mücke, A. Stohl, Intercontinental transport and its influence on the ozone concentrations over central Europe: Three case studies, T. Trickl, O. C. Cooper, H. Eisele, P. James, R. Mücke, A. Stohl, J. Geophys. Res. **108** (2003), 8530, doi: 10.1029/2002JD002735, STA 15, 23 pp.

T. Trickl, H. Feldmann, H.-J. Kanter, H. E. Scheel, M. Sprenger, A. Stohl, H. Wernli, Deep stratospheric intrusions over Central Europe: case studies and climatological aspects, Atmos. Chem. Phys. **10** (2010), 499-524

H. Vogelmann, T. Trickl, Wide-range sounding of free-tropospheric water vapor with a differential-absorption lidar (DIAL) at a high-altitude station, Appl. Opt. **47** (2008), 2116-2132