Tends of air pollutants at the Sonnblick Observatory, National Park „Hohe Tauern"

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Keywords

Air pollutant transport, air pollutant trends

Summary

The Sonnblick Observatory, situated in the centre of the "National Park Hohe Tauern", contributes to the Global Atmosphere Watch Programme (GAW) of the World Meteorological Organization (WMO) since 1996. The aim of GAW is to study the large scale chemical composition of the atmosphere and to serve as an early warning system to detect air pollution trends. Air pollutants may have strong impacts on sensitive eco systems. Changes in the chemical composition of the atmosphere are therefore of special importance to protect both, the biological balance and the climate of national parks.

The Austrian contribution to GAW consists of measurements performed by the Federal Environmental Agency (ozone, carbon monoxide and -dioxide, nitrogen oxides), the Technical University Vienna (aerosols), the University of Natural Resources and Applied Life Sciences, Vienna (UV-B and ozone column) and the meteorological measurements.

The sampling periods of the ozone and the carbon dioxide concentrations are sufficient to calculate trends. Fig. 1 gives an overview about the annual means of the ozone and the CO2 concentrations at Sonnblick since the beginning of the measurements up to Dec. 2007. The linear trends, based on deseasonalised monthly averages and their significancy are listed in Tab. 1. The significancy is calculated with the Mann-Kendall and the t-test (Rapp, 2000). Due to frequently missed CO2 data before 2001, the CO2 trend is only calculated for the period from May 2001 to Dec. 2007.

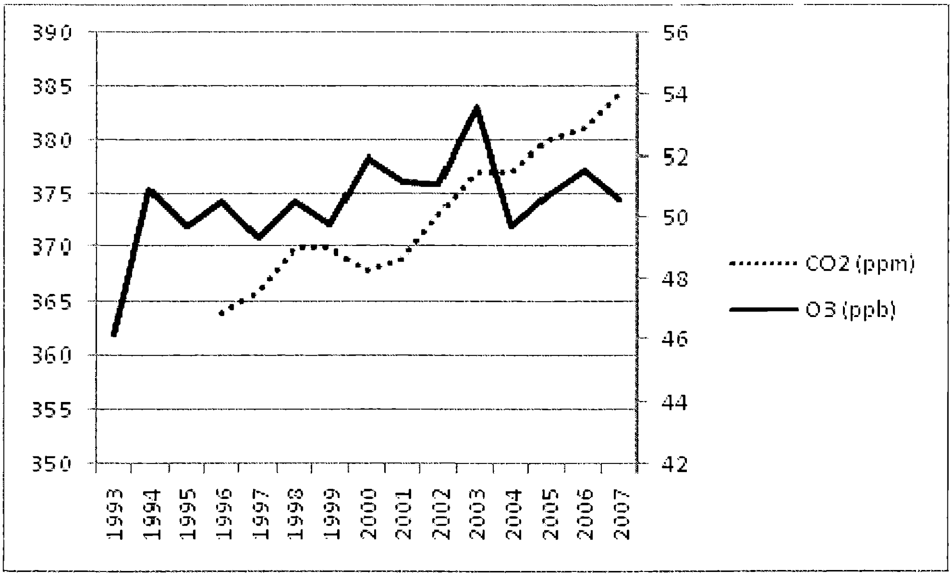

Figure 1: Annual ozone (continuous) and CO2 (dotted) concentrations at Sonnblick

Both, ozone and CO2 show a significant increasing trend (Tab. 1). Whereas the CO2 trend is more or less continuous (Fig. 1) and a consequence of the increasing emissions (Umweltbundesamt, 2008), there are two outstanding years with low ozone concentration in 1993 and high values in 2003 (Fig. 1).

Table 1: Trends in the deseasonalised monthly mean ozone and CO2 concentrations at Sonnblick (ppb/month). Investigation period ozone: Jan 1993 – Dec 2007, CO2: May 2001 – Dec 2007.

	Trend (ppb/month)	Mann-Kendall	t-test
Ozone	0.01564159	99.9840469	99.9961395
CO2	0.18202534	100	100

There are different processes that may rule changes in the ozone concentration: Changing emissions of the ozone precursors, photochemical ozone production or changes in the air flow regimes, causing transport of air masses with different ozone content to the measurement sites. GILGE et al. (2009, in preparation) show that there are no significant trends in the concentrations of the ozone precursors. Fig. 2 shows annual means of the ozone concentration and the sunshine duration measured at Sonnblick. The similarities of both curves are impressive, suggesting that the increasing ozone concentration is ruled by the increasing photochemical production to a high degree. But there are two outstanding years (1993 and 1997) with relatively low ozone concentration but with average (1993) or above average sunshine duration (1997). To understand the reasons of air pollution trends the knowledge of the origin of the polluted air masses is essential. KAISER et al. (2007) studied the origin of NOx, ozone and CO for the GAW-DACH sites. The ozone concentrations at the high Alpine GAW sites are influenced by the boundary layer during summer, but, during winter, air masses that sink down from high elevation contribute to the high ozone concentrations at these sites. AUER et al. (2006) found that the increasing sunshine duration is connected with a large scale increase of air pressure over the Alps during the last years and they assume an increase of the anticyclonic weather conditions. Anticyclones are connected with sinking air masses. Therefore the increasing frequency of the anticyclones may result in an increase of sinking air masses and may be an additional factor causing an increase of the ozone concentrations at elevated Alpine sites at least during the cold season (winter, perhaps also sometimes during autumn and spring).

Thus the increase of the background ozone concentration at high elevated Alpine sites seems partially to be due to the increasing sunshine duration; additional, a higher frequency of sinking air masses from high elevation may favour the elevated ozone concentrations during the cold season. For more details please see KAISER et al., 2009 (in preparation).

However, analyzing the reasons of air pollution trends is challenging. Analyses of the influence of changes in the air flow regimes on the air pollution trends at the high Alpine GAW-DACH sites will be the objective of further studies.

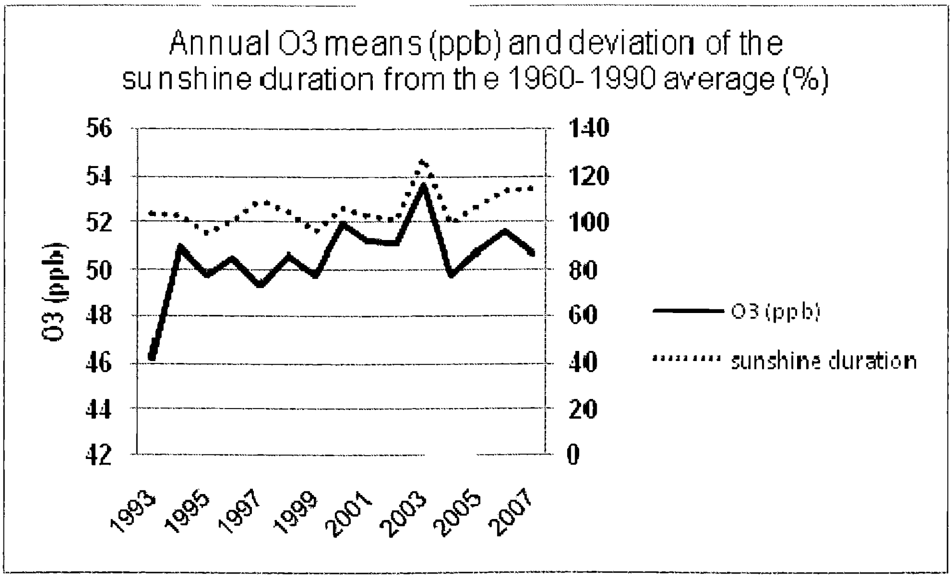

Figure 2: Annual mean ozone concentrations (continuous) and annual anomalies of the sunshine duration (dotted) from the 1960-1990 average at Sonnblick.

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