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Changes of daily surface ozone maxima in Switzerland in all seasons from 1992 to 2002 and discussion of summer 2003

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Abstract. An Analysis of Covariance (ANCOVA) was used to derive the influence of the meteorological variability on the daily maximum ozone concentrations at 12 low-elevation sites north of the Alps in Switzerland during the four seasons in the 1992–2002 period. The afternoon temperature and the morning global radiation were the variables that accounted for most of the meteorological variability in summer and spring, while other variables that can be related to vertical mixing and dilution of primary pollutants (afternoon global radiation, wind speed, stability or day of the week) were more significant in winter. In addition, the number of days after a frontal passage was important to account for ozone build-up in summer and ozone destruction in winter. The statistical model proved to be a robust tool for reducing the impact of the meteorological variability on the ozone concentrations. The explained variance of the model, averaged over all stations, ranged from 60.2% in winter to 71.9% in autumn. The year-to-year variability of the seasonal medians of daily ozone maxima was reduced by 85% in winter, 60% in summer, and 50% in autumn and spring after the meteorological adjustment. For most stations, no significantly negative trends (at the 95% confidence level) of the summer medians of daily O_3 or O_x (O_3+NO_2) maxima were found despite the significant reduction in the precursor emissions in Central Europe. However, significant downward trends in the summer 90th percentiles of daily O_x maxima were observed at 6 sites in the region around Zürich (on average −0.73 ppb yr^{-1} for those sites). The lower effect of the titration by NO as a consequence of the reduced emissions could partially explain the significantly positive O_3 trends in the cold seasons (on average 0.69 ppb yr^{-1} in winter and 0.58 ppb yr^{-1} in autumn). The increase of O_x found for most stations in autumn (on average 0.23 ppb yr^{-1}) and winter (on average 0.39 ppb yr^{-1}) could be due to increasing European background ozone levels, in agreement with other studies. The statistical model was also able to explain the very high ozone concentrations in summer 2003, the warmest summer in Switzerland for at least ~150 years. On average, the measured daily ozone maximum was 15 ppb (nearly 29%) higher than in the reference period summer 1992–2002, corresponding to an excess of 5 standard deviations of the summer means of daily ozone maxima in that

period.

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