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Impact of horizontal atmospheric transport on the observed trends of the surface ozone concentration over Europe

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Atmospheric transport plays an important role in causing variability on different temporal and spatial scales for a host of atmospheric compounds. A special case is ozone of course. Its great importance for the photochemistry and for the environment coupled with a most complex behavior renders close scrutiny necessary. One issue is that in spite of the measures undertaken in a range of developed countries to control precursors emissions, background concentrations of surface ozone are continue to grow. For example, it was found that for mountains sites (3000-3600 m asl) in Europe the value of surface ozone trend is the most significant is winter reaching 0,53$\pm$0,25ppb/year and for elevated sites (1000-2000 m asl) for the same season reaching 0,56$\pm$0,23ppb/year for the period 1992-2002 (Ordóñez et al., ACP, 2005). It appears that the change of lower stratospheric ozone was likely to be one of the main reasons for the background ozone variability and trends in the 1990s.

On the other hand, the long-term variability can also be connected with features of horizontal air transport. As it was shown qualitatively in one of our previous studies the trend of the surface ozone concentration at a high mountain site in the Caucasus mountain (Kislovodsk High Mountain Station) can be connected with a change of the air transport patterns at the site. Moreover, we found earlier a strong correlation between transport pattern anomalies and the same value for the surface ozone concentration.

To give our finding a more solid, quantitative conclusion we have developed a new approach to investigate the impact of horizontal advection on the surface ozone trends.

For this aim measurements from the European ozone network of EMEP project were analyzed. Daily 2D trajectories sectors estimated for EMEP sites (www.emep.int) on the basis of 96h back trajectories were used to describe horizontal advection patterns. For the period 1990-2004 we estimated the surface ozone anomalies connected with a changing frequency of the different sectors at each individual site based on the mean seasonal cycle of the surface ozone in each sector. The anomalies obtained are directly "transport associated", and their long term variability was defined as "dynamical" trend. It was found that total trends of the surface ozone concentration are mainly positive over Europe, confirming the previous findings of the other authors. Dynamical trends are also positive over the most of Europe and their spatial pattern is similar to the one observed for total trends. Spatial kriging procedure provides the maximal surface ozone trends up to 0,5 ppb/year without division into seasons. The value of the trend connected with air transport sectors re-distribution can reach half of the totally observed trend. Also seasonal features of the trends will be discussed in the presentation.

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