

## A STUDY OF OZONE CONCENTRATIONS AND TRENDS ACROSS EUROPE: 1996-2010

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### Summary

This study reviews ozone concentrations from rural monitoring stations across Europe between 1996 and 2010 across a range of statistics with regard to the various objectives, target values and thresholds established by the 2008 Ambient Air Quality Directive 2008/50/EC. The findings reveal that whilst there have been complex and varied changes in patterns of ozone concentrations during the last 15 years, there are still extensive exceedences of the various regulatory standards and that while peak concentrations may have been decreasing, background concentrations are on the rise.

### Introduction

The Air Quality Directive 2008/50/EC established two target values for ozone, one based on the protection of human health ( $120 \mu\text{g}/\text{m}^3$  as maximum daily 8-hour mean, not to be exceeded more than 25 days per year averaged over three years) and another for protection of vegetation (AOT40 (Accumulated Ozone over a Threshold of 40 ppb)  $18,000 \mu\text{g}/\text{m}^3\text{-h}$  averaged over five years). The directive also established a long-term objective of  $120 \mu\text{g}/\text{m}^3$  as maximum daily 8-hour mean (no exceedences) and an AOT40 of  $6,000 \mu\text{g}/\text{m}^3\text{-h}$  (no achievement date defined). The 2008 Directive also set an information threshold of  $180 \mu\text{g}/\text{m}^3$  and an alert threshold of  $240 \mu\text{g}/\text{m}^3$  (both hourly averages).

### Methodology and Results

Data were collected from the European Airbase database (v6) and following screening of the data, 286 rural background stations were selected for analysis over a 10-year period from 2001-2010, and 186 stations for a fifteen year period from 1996-2001. The analysis covered both absolute concentrations, as well as long-term trends in concentrations calculated using Theil Sen slope estimates, following a methodology established by Wilson et al. (2012).

The findings of the analysis are that there is no clear single trend in ozone concentrations. However, the following points can be noted:

1. Mean concentrations tended to increase over the period 1996-2005, whilst decreasing 2001-2010;
2. During this latter period, mean and 5<sup>th</sup> percentile (background) concentrations tended to reduce, but this pattern was less obvious for 95<sup>th</sup> percentile (peak) concentrations;
3. Monitoring stations recording the highest mean ozone concentrations ( $>60 \mu\text{g}/\text{m}^3$ ) tended to show the greatest downward trends over the whole 15 year period;
4. Different spatial regimes exist for mean concentrations and trends, on the one hand and maximum 1-hour or 8-hour mean concentrations, on the other.
5. Any discernible downward trend in some of the exceedence statistics is relatively insignificant in the context of year-to-year variations due to changing meteorological conditions.
6. The extent to which trends are evident is highly dependent on the chosen measure, e.g. average concentrations or exceedences of particular thresholds.

### Conclusions

Patterns of ozone pollution over Europe are complex, and the EU monitoring network is only coming to the stage where widespread spatial trends can be evaluated. What becomes clear from the analyses undertaken is that it is unlikely that a 'one size fits all' policy will be suitable for all Member States, and therefore better information on the nature of any region's problem will be vital for effective management strategies.

### Acknowledgement

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### References

Wilson, R. C., et al. (2012) Have primary emission reduction measures reduced ozone across Europe? An analysis of European rural background ozone trends 1996–2005, *Atmos. Chem. Phys.*, 12, 437-454, doi:10.5194/acp-12-437-2012.

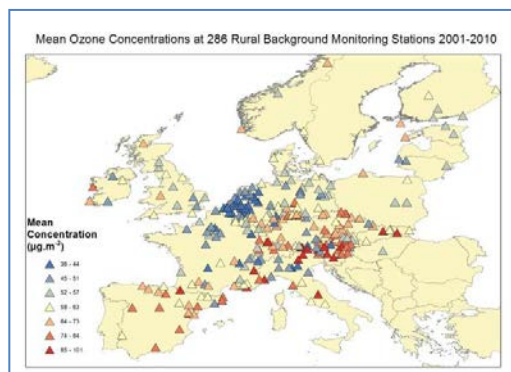


Fig.1 Mean ozone concentrations 2001-10

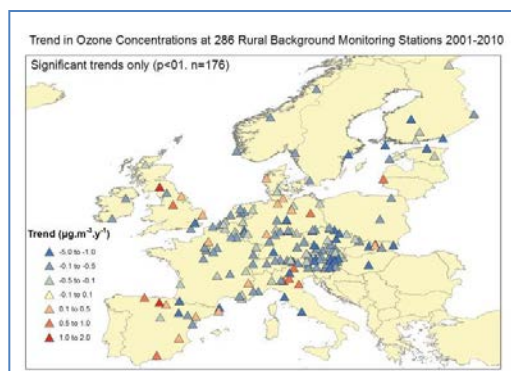


Fig.2 Trends in mean ozone concentration 2001-10