A STUDY OF OZONE EXPOSURE ACROSS EUROPE: 2004 – 2010

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Summary

This study presents an assessment of exposure to ozone exceedences across Europe using a new methodology based on the Eurostat degree of urbanisation (DEGURBA) classification, which provides the ability to categorise exposure into 'Urban' ('densely populated'), Suburban ('intermediate density') and Rural ('thinly populated') areas. The study considers exposure to a range of regulatory standards for ozone as set out in the 2008 Ambient Air Quality Directive 2008/50/EC. It finds that although concentrations may be higher in rural areas, numbers of population exposed to exceedences of the standards are significantly higher in both urban and suburban areas.

Introduction

Ozone is a particularly problematic pollutant to manage effectively due to its complex chemistry and its transboundary nature. Concerns about exposure to high ozone concentrations have typically focussed on rural areas where, due to lack of fresh NOx emissions to break down the ozone, concentrations generally exceed those in urban areas. However, with much greater numbers of people living in both suburban and urban areas, and with growing evidence to suggest that urban ozone concentrations are increasing this work provides a timely reminder that if pollutant thresholds are to be taken seriously, then urban ozone management requires more serious attention.

Methodology and Results

The exposure analysis was based on three main data sources:
1. Hourly average ozone concentrations obtained from the EMEP Eulerian Photoxidant Model for the years 2004-2010[1].
2. 1km resolution gridded population data from Geostat representing 2006 populations for 26 Member States and the four EFTA countries[2].
3. Eurostat 'Degree of Urbanisation' (DEGURBA) classifications for LAU2 administrative areas for EU-27 countries[3].

Due to data limitations, and to be able to clearly ascertain the differences in exposure caused by year-to-year variation in ozone concentrations, only the modelled ozone data was varied, with population figures and DEGURBA classifications remaining constant. Exposure was assessed in terms of time series for the whole of the EU (or that part that was coincident with all three datasets), as well as estimates of total and percentage populations exposed for each individual country.
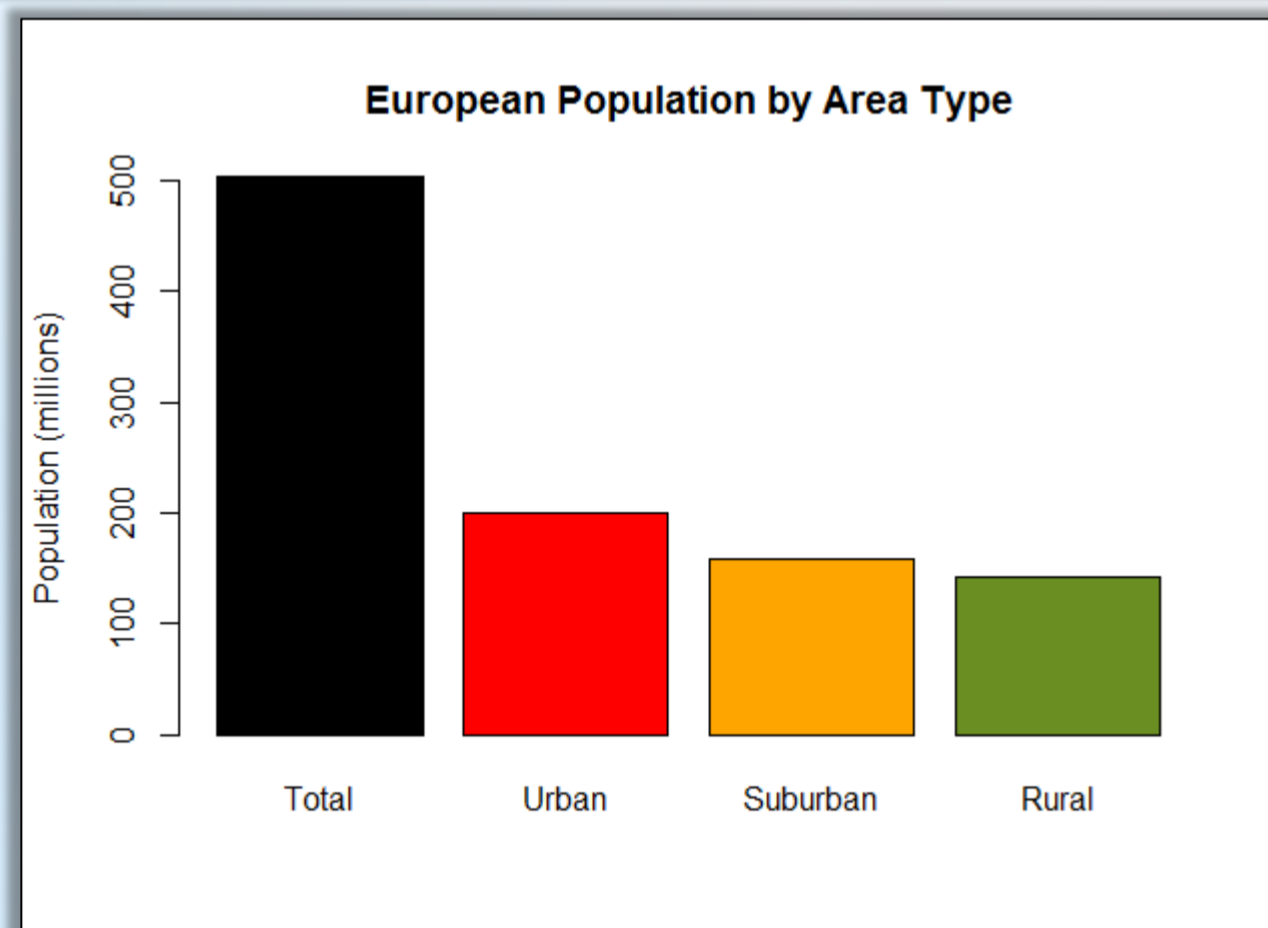

Figure 1: Split of population between Densely Populated (Urban), Intermediate (Suburban), Thinly Populated (Rural) areas

The Urban, Suburban and Rural populations are not completely equal with 40% resident in LAU2 areas classed as Urban, 32% in Suburban areas and, 28% in Rural areas (this could also be seen as 72% in 'Non-Rural' areas). Figures 1 and 2 show the Urban/Rural/Suburban split derived from the Geostat and Eurostat data for the whole of the study area, and by individual country.
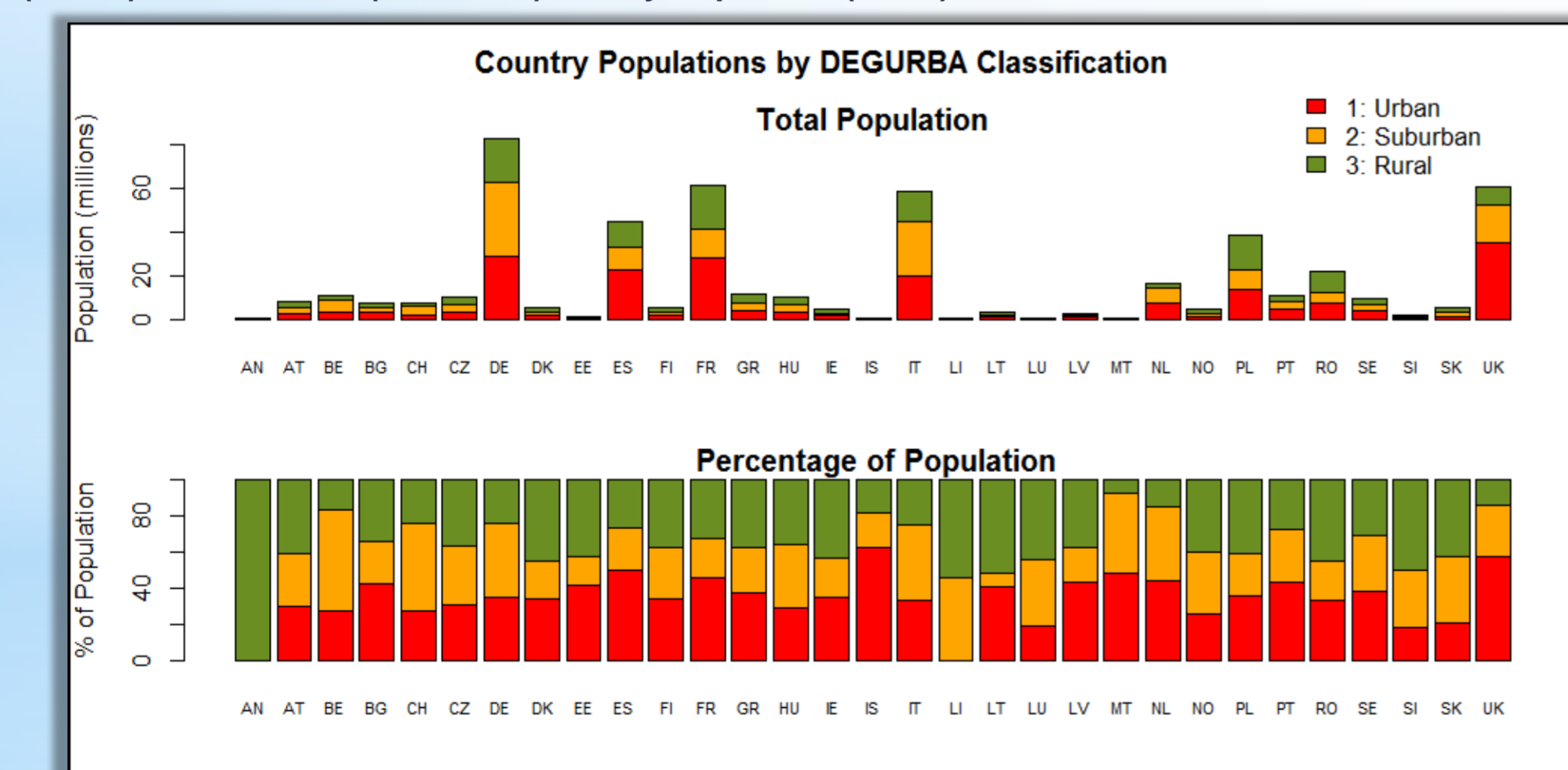

Figure 2: Country populations by Eurostat 'Degree or Urbanisation' (DEGURBA) classification

Each 1km population cell (with DEGURBA classification) was linked by its centroid to the relevant cell of the EMEP 50km grid in order to assess the exposure of that population to exceedences of the thresholds, objective and target value.
A number of analyses of the predicted exposure were then undertaken:
1. Year-to-year variation in total exposure across the study area for the four thresholds presented as time-series (Figure 3).
2. Numbers and percentages of exposed populations by DEGURBA classification and by individual country.
3. Maps of the most extreme exposure for each country (number of people exposed, and percentage of that country's population), to highlight, for example, where 100% of a small country's population might be exposed) (Figure 4).
4. Graphs to show population exposure by country for each threshold, for each relevant year, split by DEGURBA classification.
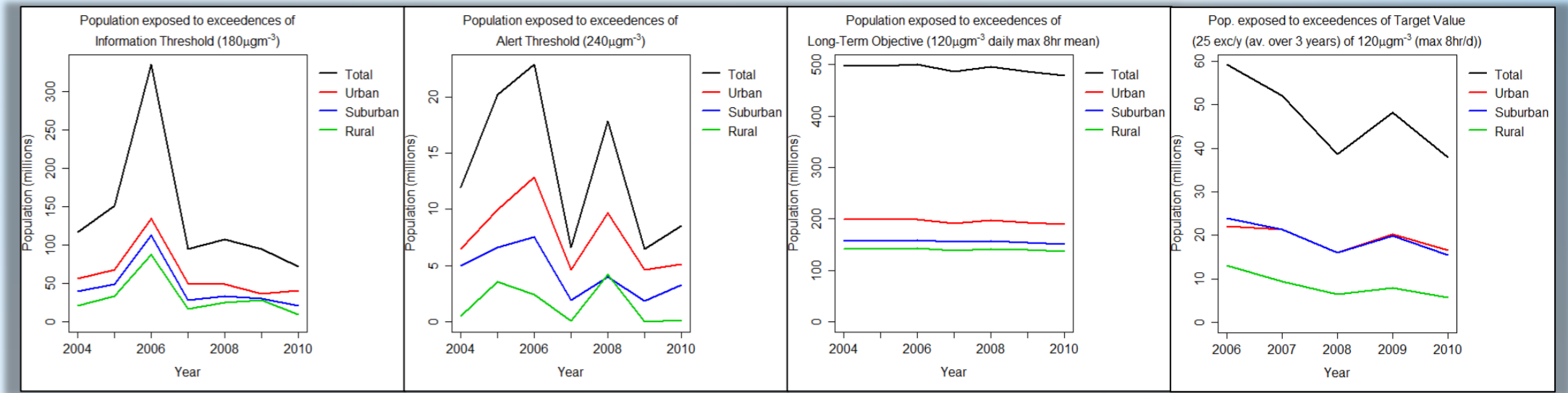

Figure 3: Urban/Suburban/Rural exposure to exceedences of information and alert thresholds, long-term objective and target value (2004-2010)
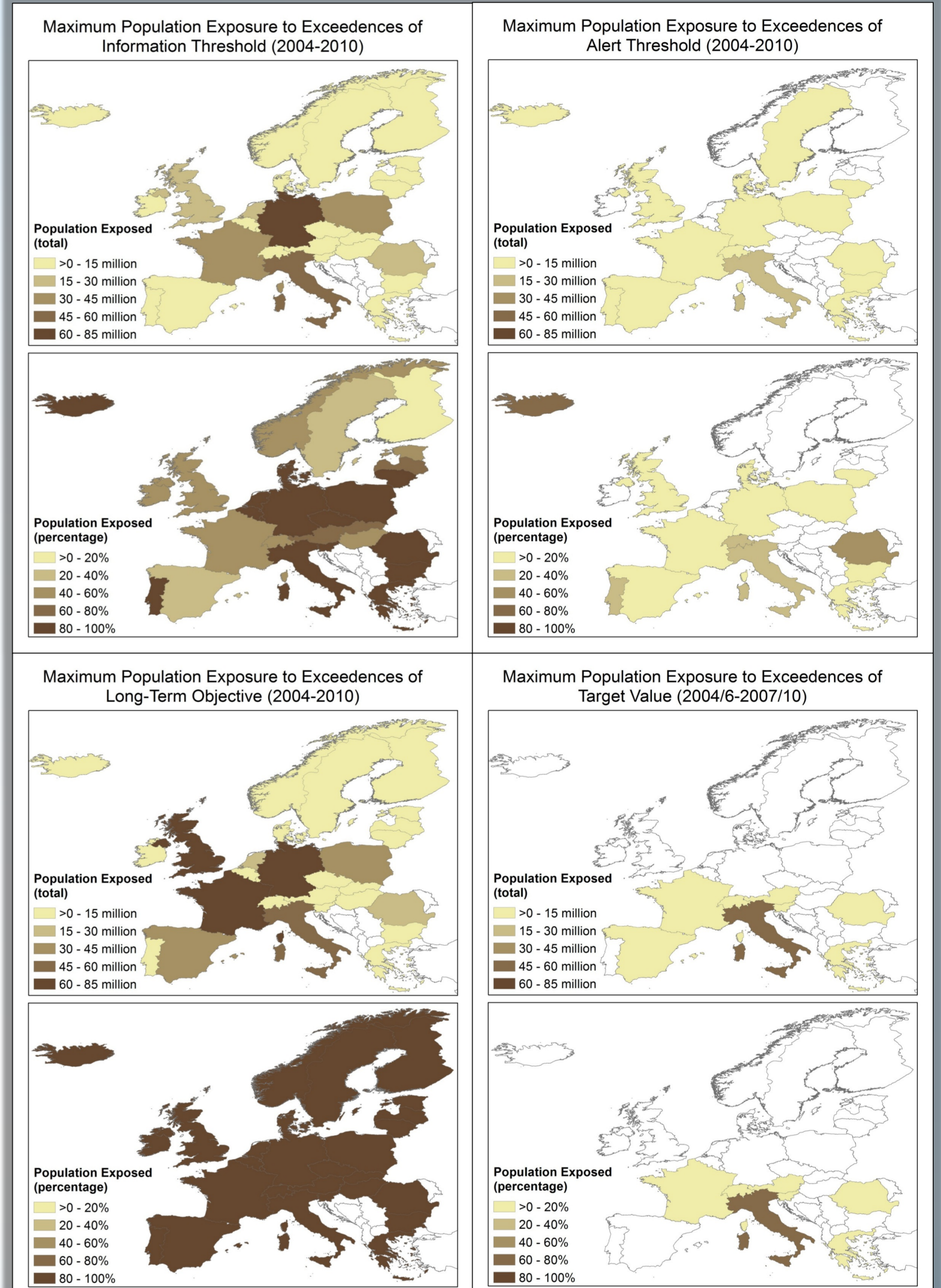

Figure 4: Maximum annual population exposure to exceedences of the information threshold (180 μgm[-3]), alert threshold (240 μgm[3]), long-term objective (120 μgm[-3] maximum daily 8-hour mean) and target value (<=25 exceedences/yr (averaged over 3 yrs) of 120 ugm[-3] (max 8hr/d)) 2004-10 by country

Conclusions

Although absolute ozone concentrations may be higher in rural areas absolute numbers of people exposed for each of the standards considered is higher within both urban and suburban areas than for rural areas. Particularly in light of evidence that suggests that NOx management strategies may be leading to increases in urban ozone concentrations, this work raises significant questions about the need for advances in how we manage ozone and its precursors.

Further work will be undertaken to compare these outcomes with exposure predictions made using a different methodology by the European Environment Agency. Also, an estimate will be made of the difference in estimated exposure that results from using the new 25km EMEP grid developed to provide better representation of urban areas.

References

[1]EMEP Eulerian Photoxidant Model: http://www.emep.int/ozone/eul_pho/index.html
[2]GEOSTAT population grids:
http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Population_grids
[3]Eurostat Degree of Urbanisation:
http://ec.europa.eu/eurostat/ramon/miscellaneous/index.cfm?TargetUrl=DSP_DEGURBA