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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evolution of NO_x emissions in Europe with focus on road transport control measures" *by* V. Vestreng et al.

V. Vestreng et al.

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Response to referee #2

We appreciate that the referee find that our paper combine very interesting results from evaluating emission data with a consistent and convincing analysis of the underlying causes for the trends observed.

Specific Comments:

Comment: Are data before ca. 1950 useful? Note that the longest "regime" mentioned in the manuscript is the period 1880-1950. Is it not just lack of data that makes the period look homogeneous?

Response: We do understand the concerns put forward by the referee, but argue that it is also important to include the emissions calculated for the period before 1950.

The trend depicted in the first emission regime serves as a good background for the analysis of road transport that follows, and gives the reader a more complete picture of how NOx emissions have developed over historical times. In comparison with data from van Aardenne et al. (2001) (Fig. 1 and 2), we can conclude that the two inventories compare very well for the period 1880-1950. We do not agree that this is only due to lack of input data for the calculation. The referee is correct in that there is a lack of specific emission factors for this time period (as we also address on page 10702, line 16), but we would argue that it is a reasonable assumption that the average emission factors do not change considerably due to technological developments over this period. The emission trend is therefore considered to be well represented by the trend in the solid fuel consumption. The consumption of solid fuels is one of the more certain input parameter to the calculations which is reflected in the good agreement between different inventories. We will aim at strengthening the rational for including the historical emissions in the final version of the paper.

Comment: Why does one of the most important abatement technologies find no mention, i.e. NOx reduction by adding NH3 in the stacks of industry and power plants? It is clear from Fig. 1 that since 1975 the non-transport NOx emissions have been decreasing continuously in OECD Europe.

Response: We agree that the addition of ammonia is an important abatement technique, but from our data, we could not distinguish between reductions due to technological developments from the trend in fossil fuel consumption. This is in contrast to the road transport sector where the effect of technological abatement measures is well traceable. We propose to discuss this issue in the conclusions in the final version of the paper.

Comment: Focus on transport NOx and on the period after 1950 (or even after 1980). Other NOx emission sources should be treated as a background only, with reference to the appropriate documents (EURONOX, RETRO) currently missing. This will also allow considerable shortening of the paper, which is urgently needed.

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Response: We will shorten the paper, by increased focus on the development in road transport at the expense of other sectors. This could be done by e.g. moving some of the details regarding emission factors to footnotes to table 1, less discussion on biofuel emission estimates as well as the apparent over estimation of Czechoslovakian emissions.

Comment: Page 10720, line 18: In 2000-2005 emissions decrease by 11% over 5 years compared to 23% over the period 1990-2000: should this not be regarded a consistent trend rather than a change?

Response: The five emission trend regimes are based on development in road transport. We agree that based solely on the percentage emission reductions for the whole of Europe in the two last periods it might seem obsolete to separate the fourth and the fifth emission trend regimes. However, the regional emission trends are distinctively different between the fourth regime (1990-2000) and the fifth regime (2000-2005). In the fifth emission regime, the fuel consumption starts to increase in Eastern Europe and is associated with an emission increase. This Eastern European increase partly compensates the continued steep Western European decrease in road transport emissions. In fact, the Western European decrease in transport emissions over the last 5-year period is equally large to the decrease seen in the preceding 10-years period (about 23% in both Eastern and Western Europe). In our opinion it is essential to separate between a fourth and a fifth regime for our analysis of the effectiveness of policy regulations in the transport sector.

We propose to reformulate the sentence in the final version of the paper to: In the period 2000-2005, road transport emissions in Europe continue to decrease. The total European emission reduction in this five year period is 11% comparable to the preceding regime, but with important differences in Easter and Western Europe.

Comment: Page 10720, line 14: While it is conceivable that Luxembourg and Austria sell a considerable fraction of their fuel into their much larger neighbour countries. How

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can Ireland do that to small Northern Ireland?

Response: Ireland has documented the effect of fuel tourism with an approach accepted by the Implementation Committee (IC) of the UNECE. The IC has accepted that Ireland is in compliance with the NOx protocol based on the lower emissions reported adjusted for fuel tourism. The methodological framework is outlined below and highlights the importance of diesel sales also to other EU counties. In developing a model to estimate petrol related fuel tourism the following assumptions were made:

1. Petrol sold on the entire island of Ireland (IRELAND and NI) will be consumed on the island; net movements between the island and the rest of the EU will be negligible.

2. There is no significant difference in the fleet profile of petrol motor vehicles in Ireland and NI between private motorcars and other classes of motor vehicles.

3. There is no significant difference in per vehicle fuel consumption between Ireland and NI. Based on these assumptions all island fuel sales can be distributed between Ireland and NI on the basis of vehicle numbers in the respective jurisdictions to give fuel consumption figures. Exports from Ireland are then calculated as the difference between estimated consumption and actual sales.

A different approach to that for petrol was considered to be appropriate in the case of diesel. This is because a number of the assumptions on which the petrol estimate is based do not apply to the diesel market.

1. Because of the substantial volume of road freight between the island of Ireland and the UK/other EU countries there is potentially a significant volume of fuel tourism between Ireland and regions of the EU other than NI, in particular Great Britain. The assumption that all island sales equate to all island consumption is therefore not sufficiently robust.

2. Examination of vehicle registration statistics indicate a significant difference in the fleet profile of diesel motor vehicles between Ireland and NI and this difference varies

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over time as the fleet profile in both jurisdictions changes. For these reasons a methodology based on national statistics as opposed to an all island methodology was developed

Comment: Page10728, line 14: How can new regulations on stationary sources have a "more instant effect" on NOx emissions than similar regulations on mobile sources, when power plants have a lifetime of 20 years at least and commissioned installations maintain their permit?

Response: We agree that the sentence might be misleading, and are prepared to delete the sentence, or reformulate to be more concise. We refer to the effect of measures after their implementation. When cleansing technologies are installed in a number of large combustion plants, the emissions from these plants will decrease drastically from one year to the next, as opposed to the introduction of the EURO standards.

Comment: What is the reason for the difference between the sum of emissions from Europe (Fig. 4/Table 3) and the total of East and West Europe (sum of Fig. 1 and Fig. 2)? For Transport, this is 9 Tg vs. roughly 7 Tg, for total emissions 25 Tg vs. 18 Tg for the year 1985.

Response: The reason is that not all countries are included in Figure 1+2. This is unfortunate, but we decided to compare by EDGAR regions to avoid differences in inventories due to inclusion of different countries (The van Aardenne et al. (2001) and RETRO inventory is not readily available per country). The counties not included in either figures 1 nor 2 is: Armenia, Azerbaijan, Belarus, Cyprus, Estonia, Georgia, Kazakhstan, Latvia, Lithuania, Republic of Moldova, Russian Federation, Turkey and Ukraine. As pointed out by the referee the transport emissions from these countries together amount to about 2 Tg, while the total emissions amount to about 7 Tg for the year 1985. In order to pinpoint which countries that are included in the two regional groups European OECD and East, we propose to mark in Table 2 the countries

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included in the different groups.

Comment: Why are off-road emissions "exploding" in 1975 at the expense of residential emissions? (Fig. 4) - or is this just an artifact?

Response: We will change the explanation on Page 10816, line 29 in the final version of the paper to: While we find the decrease in residual oil for heating plausible, we suspect that the detailed statistics we have used on diesel consumption in the off-road sector prior to 1975 might be defective.

Unfortunately we do not have available an alternative set of detailed statistics to fully resolve the question at this stage

Comment: The authors may also wish to find user friendly ways of representation of Fig. 3 (hatched area) and Fig. 7 (complex graphic is extremely difficult to read due to arbitrary sorting of countries).

Response: We will remove the hatch area from figure 3, as the source of data is already mentioned in the figure text. Figure 7 is sorted after the largest IEFs in 1990. We will play with other ways of sorting the countries to improve the readability, or alternatively present the figure in colours.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 10697, 2008.

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Interactive Comment