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EXCEEDING THE EUROPEAN NO_2-LIMIT VALUE IN BELGIUM: CAN WE SOLVE THE PROBLEM IN A SHORT TO MEDIUM TIME FRAME?

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Abstract: The European Directive on Air Quality (2008/50/EC) states that annual average NO_2-concentrations should be below 40 µg/m³ at every location from 2010 onwards. However, it was possible to get time extension till 2015. In the meantime, it became clear that the limit values were exceeded in 2015 at three different monitoring sites: one in Flanders and two in the Brussels Capital region. This abstract examines the causes of this compliance failure and assesses which measures are needed in order to be compliant with the European limit value within the shortest possible time frame.

While the European limit value is, in general, assessed at monitoring locations, compliance should be reached also at locations were no measurements are available. Therefore, we apply the RIO-IFDM-model, an extensively validated combination of an intelligent interpolation tool and a local scale bi-gaussian dispersion model. With this model, it was estimated that in 2020 the NO2 annual mean concentrations will still be exceeded in a very densely populated region of 5.41 km² (0.018% of Belgium). We assume a worst case scenario for EURO 6 conformance in real world driving situations. The effect of street canyons is not taken into account, hence the limit value will be exceeded even more frequently. As the regions with exceedances of the NO2 limit value are closely linked to major roads, a backcast simulation was performed in order to calculate the appropriate emission reductions necessary to be in compliance on these roads. It was estimated that emission reductions up to 80% are needed in order to be in compliance with the annual mean limit value. When areas close to tunnel exits are excluded, emission reductions of more than 50% are still needed at some locations. Therefore, it can be concluded that only harsh measures, such as a complete shift of passenger cars from diesel to less NO_x emitting vehicles (gasoline, CNG, EV, …) combined with significant traffic volume and emission reductions in other sectors, will be needed to be in compliance in the short to medium time frame. Quick win measures, likespeed limit reductions on highways will not be sufficient.

Key words: *NO2 limit, deadline extension*

INTRODUCTION

The European Directive on Air Quality (2008/50/EC) states that annual average NO_2-concentrations should be below 40 µg/m³ at almost every location from 2010 onwards. However, it was possible to demand an extension of this deadline to 2015. In the meantime, it became clear that the limit values were exceeded during the year 2015 at three different measurement locations in Belgium, one in Flanders and two in the Brussels. This abstract examines the causes of this failure and assesses which measures are needed in order to be compliant with the European limit value as quickly as possible.

MODEL DESCRIPTION

An integrated model chain has been set up to assess the air quality at the local scale, including both regional variability as well as local variation in sources of air pollution. The MIMOSA4.3 emission model (Mensink et al., 2000; Vankerkom et al., 2009) is used to calculate local traffic emissions. In order to take into account the new findings of Ligterink et al. (2013), for NO_x, the CAR EURO6-emissions of diesels are taken to be equal to the CAR EURO4-emissions of diesels. The resulting spatially and temporally distributed emissions are used in the bi-Gaussian model IFDM (Lefebvre et al., 2011a; 2011b). These results are coupled to the background concentrations. The background concentrations for 2020 are obtained by rescaling the RIO-background (Hooyberghs et al., 2006; Janssen et al., 2008) for 2009 using the evolution of the Chimere data. More in detail, the background for 2020 is obtained by applying the relative difference observed in the Chimere data between 2009 and 2020 to the 2009 RIO-data using an exponential trend (Veldeman et al., 2015). A method to avoid double counting of the (local) emissions by the different models is applied (Lefebvre et al., 2011b).

To describe the local weather parameters correctly on a national level, we use hourly assimilated meteorological data, with total spatial coverage at a 1x1 km² resolution for 2009. No street canyons are taken into account.

BASECASE 2020

The highest concentrations of the highly traffic-dependent pollutant NO_2 is found close to the main city centers and close to the main highways. Especially around Brussels, Antwerp and Ghent high concentrations are observed, but also all other regions in the vicinity of major highways show significant increases compared to their surroundings.

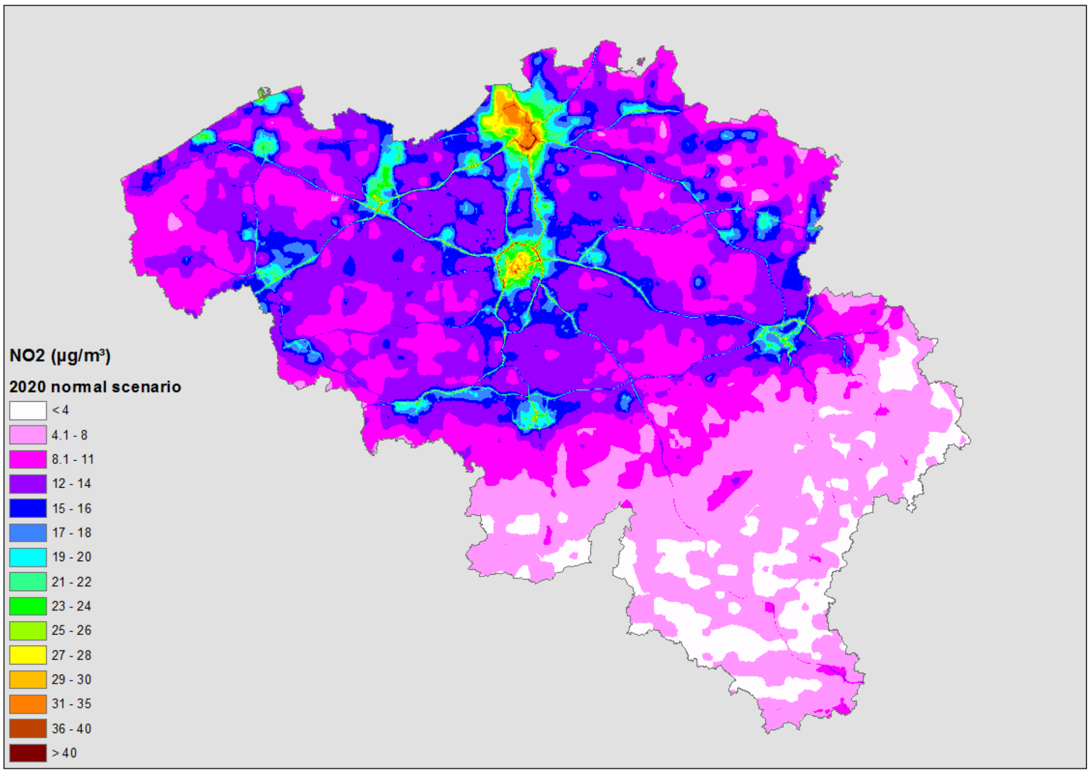

Figure 1: Annual averaged concentrations of NO_2 for 2020 in µg/m³.

There remain a small number of spots at which the yearly threshold of 40 µg/m³ is exceeded. These exceedances are, of course, observed at the locations with the highest NO_2-concentrations, i.e. close to the major highways and roads. In total, the threshold is exceeded in 0.18 ‰ (5.41 km²) of the grid cells, hence only a very small part of the area is exposed to values larger than the EU-standard. Nevertheless, these areas are in some cases densely populated.

The major regions with exceedances, amongst other, include

- A series of major tunnel exists
- Major parts of the Antwerp and the Brussels Ring Roads and their immediate surroundings
- Parts of the Brussels city center.

It should be noted that the exceedance of the limit value in 2015 was measured only at three locations. This shows both the strength and drawbacks of using only measurements or only model values in order to test the exceedance of the limit values. Indeed, the measurement location in Flanders where exceedances of the European limit values are still measured is located in a street canyon, which have not been taken into account in this modelling exercise. On the other hand, no measurement locations in the Flanders region are currently located close to a major highway.

BACKCASTING

The emission reductions are obtained using a backcasting procedure. In a first step, the grid cells for which the concentrations are too high are appointed and binned into several zones based on the magnitude of the exceedance. For these zones, the base case concentration is split into a share related to the background concentrations and a share related to the local traffic. Thereafter, we determine the reduction needed in the latter share such that the total concentrations are below the EU-standards. The traffic emissions for all pollutants for the road segments in and close to the zones are subsequently reduced in the equivalent way and the new emissions are used as input for new IFDM-simulations. The whole procedure is repeated iteratively (using the results of the simulations with the reduced and the total emissions as input) until the intended concentrations have been reached.

The emission reductions for the different road segments of this scenario are shown in **Hiba! A hivatkozási forrás nem található.**2. The four road segments with the highest reductions are all linked to tunnel exits with four tunnels between 83 and67%. The most important non-tunnel exit road segments are all highways or major roads in the Antwerp or Brussels area with reductions of more than 50% (and up to more than 60%).

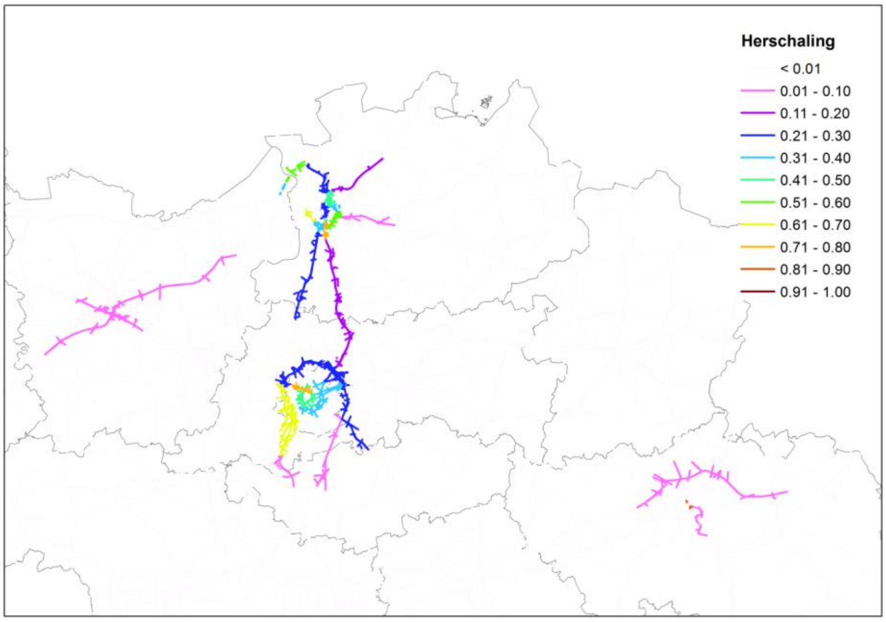

Figure 2: Needed local emission decreases (in %) in order to reduce the annualy averaged NO_2-concentrations in 2020 below the 40 µg/m³ limit.

CONCLUSIONS

It is shown that very large reductions of traffic emissions are needed if the European NO_2-limit is to be met at all locations in Belgium, despite the relatively small area at which it is still exceeded at the moment. Therefore, it can be concluded that only harsh measures, such as a complete shift for passenger cars from diesel to less NO_x emitting cars (gasoline, CNG, …) combined with strong traffic reductions and emission reductions in other sectors, will be needed if the limit values are to be reached in a short to medium time frame. Quick win measures, such as reductions of speed limits on highways will not be sufficient.

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