Last update: 22/03/2024

METADATA – AIR QUALITY

Description	Poor air quality is caused by polluting substances present in the ambient air. One example is particulate matter, referring to all the fine microscopic particles suspended in the air. Particulate matter is often categorized as having a diameter smaller than 10 micrometres (PM_{10}) and having a diameter smaller than 2.5 micrometres ($PM_{2.5}$). Another example is nitrogen dioxide (NO_2), a harmful gas emitted alongside nitrogen oxide in combustion processes. Ozone (O_3) is another hazardous gas, formed in the atmosphere by chemical reactions under the influence of sunlight. The indicators considered here are: a) Long-term population exposure to PM_{10} b) Long-term population exposure to $PM_{2.5}$ c) Long-term population exposure to NO_2 d) Long-term population exposure to O_3 Exposure in local communities is calculated as the mean pollutant concentration in the statistical sector, the smallest geographical unit in Belgium. Exposure on national or regional scale is determined as a population-weighted mean concentration.
Rationale	Poor air quality constitutes the single biggest environmental health risk worldwide, responsible for millions of premature deaths and healthy life years lost. Exposure to air pollution has been associated with respiratory diseases, cardiovascular disorders, lung cancer, and diabetes, as well as perinatal, neurological and mental health effects. It disproportionally affects vulnerable groups, including women and their infants, children, the elderly and people with lung diseases and asthma. To improve air quality and public health, the WHO publishes the Air Quality Guidelines, which are a set of recommended limit values for specific air pollutants. The guidelines were last updated with recent scientific evidence in 2021, and contain recommendations for daily concentrations as well as long-term averages [1]. As air pollution levels in Belgium often exceed the WHO's guideline values, the need to develop indicators to monitor population exposure to relevant pollutants is evident.
Primary Data source	Exposure in local communities is based on pollutant data provided by IRCEL-CELINE, which in this case consists of high-resolution (10 x 10 m²) raster maps depicting the long-term average concentration in a given year. The pollution maps are the result of state-of-the-art models, calibrated against actual measurements but still subject to a degree of uncertainty. The data used for assessing PM_{10}, $PM_{2.5}$ and NO_2 consists of output from ATMO-Street, which is the interpolation-dispersion model RIO-IFDM (used for O_3) expanded with a street canyon module [2]. The gridded pollution maps are overlaid with a geographic vector map of the statistical sectors, maintained by Statbel [3]. Exposure on national and regional scale is approached by means of a population-weighted average concentration. The pollutant data used here consist of coarse-resolution raster maps (4 x 4 km²) of the long-term average concentration in a given year. These maps, provided by IRCEL-CELINE as well, are the result of the interpolation of air quality measurements using the RIO model. In contrast to the RIO-IFDM and ATMO-Street models, the RIO model generates output that is consistent over reference years, which allows to examine trends in air quality and population exposure. The population data used is provided by Statbel, in the form of tables containing of the number of inhabitants in each statistical sector [4]. The population table is linked to the vector map of the statistical sectors on the basis of each sector's unique identifier. For both the local and national/regional exposures, the following long-term concentration values are used: • the annual average concentration for PM_{10}, $PM_{2.5}$ and NO_2;

	• the mean daily 8-hour maximum concentration averaged over the months April to September for O_3.
Indicator source	Exposure in local communities is approached as the average pollutant concentration in their neighbourhood, in this case defined by the statistical sector. As these sectors are the smallest geographical unit in Belgium, and given that internal differences are limited, such a simple average can be considered representative of all inhabitants. Exposure in the population on a national or regional scale is approached as a population-weighted average concentration. For large areas, this is preferred over a simple average concentration, as this latter value can be biased in case its inhabitants tend to live in the more or the less polluted parts. The use of a population-weighted average concentration as a measure of exposure widely adopted, and is also used by the European Environment Agency for their air quality health risk assessments [5].
Periodicity	Both the IRCEL-CELINE air quality maps and the Statbel population data receive annual updates. New data are generally published in the course of the year following the year the data are referencing.
Calculation, technical definitions and limitations	Exposure in local communities is calculated as the average pollutant concentration in their statistical sector of residence. For this, the ATMO-Street and RIO-IFDM pollution maps are overlaid with the vector map of the statistical sectors, and a spatial function is applied that extracts, for each sector, the concentration values contained within its territory and then calculates their mean value. Exposure on a national or regional scale is calculated as the population-weighted average concentration. For this, the RIO pollution maps are overlaid with the vector map of the statistical sectors containing the population number for each sector. A spatial function is used to extract the (largest) overlapping concentration for each sector, and then a mean of all sectors is calculated where the population of the corresponding sector – as a fraction of the total population – serves as the weight. This operation can be carried out for the whole country (the result being the exposure value for Belgium), or limited to the territory of the regions (the result being the exposure value for the Flemish, Brussels Capital or Walloon Region).
International comparability	To ensure comparability of the population exposure values from Belgium to the other EU-14 countries, the values used in the international comparison are based on a European dataset provided by the European Environment Agency [5]. These values are publicly available and receive annual updates.

[1] WHO Global Air Quality Guidelines. World Health Organisation, 2021. https://www.who.int/news-room/questions-and-answers/item/who-global-air-quality-guidelines

[2] ATMO-Street. IRCEL-CELINE, n.d. https://www.irceline.be/en/documentation/models/atmo-street?set_language=en

[3] Secteurs statistiques - Statistische sectoren. Statbel, n.d. https://statbel.fgov.be/fr/propos-de-statbel/methodologie/classifications/secteurs-statistiques

[4] Structure of the Population. Statbel, 2022. https://statbel.fgov.be/en/themes/population/structure-population

[5] Air Quality Health Risk Assessments (NUTS3). European Environment Agency, n.d. https://www.eea.europa.eu/data-and-maps/data/air-quality-health-risk-assessments-nuts3/air-quality-health-risk-assessments-nuts3