

Population exposure to fine particles

Database documentation

Air pollution is one of the most pressing environmental and health issues across OECD countries and beyond. Fine particulate matter (PM_{2.5}) is the air pollutant that poses the greatest risk to health globally, affecting more people than any other pollutant (WHO, 2018). Chronic exposure to PM_{2.5} considerably increases the risk of respiratory and cardiovascular diseases in particular (WHO, 2018). For these reasons, population exposure to (outdoor or ambient) PM_{2.5} has been identified as an OECD Green Growth headline indicator.

The underlying PM_{2.5} concentration estimates are taken from the Global Burden of Disease (GBD) 2017 project. They are derived by integrating satellite observations, chemical transport models and measurements from ground monitoring station networks.

The concentration estimates are population-weighted using gridded population datasets from the Joint Research Center Global Human Settlement project. These are produced by distributing population estimates from the Gridded Population of the World, version 4 from the NASA Socioeconomic Data and Applications Center according to the density and distribution of built-up areas.

The underlying boundary geometries are taken from the Global Administrative Unit Layers (GAUL) developed by the FAO, and the OECD Territorial Classification, when available.

The accuracy of these exposure estimates varies considerably by location. Accuracy is poor in areas with few monitoring stations and in areas with very high PM_{2.5} concentrations such as Africa, the Middle-East and South Asia. Accuracy is generally good in regions with dense monitoring station networks (such as most advanced economies).

In addition to the source data changes, there has been a minor change in the calculation methodology from that described in Mackie et al (2016). The population datasets are no longer interpolated to match target years, instead, the closest available year is used: 1990 & 1995 values use GHS Pop 1990, 2000 & 2005 values use GHS Pop 2000, 2010-2017 values use GHS Pop 2015.

For further details on the methodology please consult the references below:

Shaddick, G., Thomas, M., Amini, H., Broday, D.M., Cohen, A., Frostad, J., Green, A., Gumy, S., Liu, Y., Martin, R.V., Prüss-Üstün, A., Simpson, D., van Donkelaar, A., Brauer, M. (2018) Data integration for the assessment of population exposure to ambient air pollution for global burden of disease assessment. *Environ Sci Technol.* 2018 Jun 29. [doi:10.1021/acs.est.8b02864](https://doi.org/10.1021/acs.est.8b02864)

Note: This paper details the methodology for GBD 2015 and GBD 2016 exposure estimates, there have been minor changes for GBD 2017 (corresponding publication is forthcoming).

European Commission, Joint Research Centre (JRC); Columbia University, Center for International Earth Science Information Network - CIESIN (2015): GHS population grid, derived from GPW4, multitemporal (1990, 2000, 2015). European Commission, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/jrc-ghsl-ghs_pop_gpw4_globe_r2015a

FAO (2015), The Global Administrative Unit Layers (GAUL) 2014 dataset, implemented by FAO within the CountrySTAT and Agricultural Market Information System (AMIS) projects. Available at <http://www.fao.org/geonetwork/srv/en/main.home>.

Mackie, A., I. Hašćić and M. Cárdenas Rodríguez (2016), "Population Exposure to Fine Particles: Methodology and Results for OECD and G20 Countries", OECD Green Growth Papers, No. 2016/02, OECD Publishing, Paris.
<http://dx.doi.org/10.1787/5jlsqs8g1t9r-en>

WHO (2018) Factsheet on ambient air quality and health. Available at [http://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](http://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

Last update: August 2018. Please note these estimates update and replace previous estimates.

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Two distinct datasets are presented:

Population exposure to PM_{2.5} in countries and regions.

At three spatial levels: Country, macroregion, and microregion, these indicators are calculated using the 2014 FAO Global Administrative Unit Layers (GAUL)¹. Codes for macro- and microregions correspond to those used by the GAUL administrative level 1 and 2, respectively. The database covers 231 countries and territories and 13 country group aggregates (incl. OECD, BRIICS, World, EECCA, MENA, ASEAN, LAC, etc.). Indicators are presented at the national and sub-national levels (macro region, micro region, metropolitan area) and cover the years 1990, 1995, 2000, 2005 and all years from 2010-2017.

Population exposure to PM_{2.5} in metropolitan areas.

Metropolitan areas based on the OECD-EU definition of functional urban areas (FUA)². These boundaries are available for metropolitan areas in 30 countries. The metropolitan data are complemented by the national average and cover the years 1990, 1995, 2000, 2005 and all years from 2010-2017.

Exposure to fine particles is reported as:

Mean population exposure to outdoor PM_{2.5}: calculated as the mean annual outdoor PM_{2.5} concentration weighted by population living in the relevant area, that is, the concentration level, expressed in µg/m³, to which a typical resident is exposed throughout a year.

This is often the preferred indicator, for two reasons: as a continuous variable it allows capturing even minor changes in exposures, and it allows summarising exposure of the entire population of a country. On the other hand, the indicators listed below might be easier to communicate.

Percentage of population exposed to more than 10 µg/m³: the proportion of people living in areas with annual concentrations exceeding the WHO Air Quality Guideline (AQG) value of 10 micrograms per cubic meter.

Percentage of population exposed to more than 15 µg/m³: the proportion of people living in areas with annual concentrations exceeding the WHO Interim target-3 value of 15 micrograms per cubic meter.

Percentage of population exposed to more than 25 µg/m³: the proportion of people living in areas with annual concentrations exceeding the WHO Interim target-2 value of 25 micrograms per cubic meter.

Percentage of population exposed to more than 35 µg/m³: the proportion of people living in areas with annual concentrations exceeding the WHO Interim target-1 value of 35 micrograms per cubic meter.

¹ See <http://www.fao.org/geonetwork/srv/en/metadata.show?id=12691> for further information and access to the underlying geometries.

² See <http://www.oecd.org/gov/regional-policy/all.pdf>.

WHO Air Quality Guidelines and Interim Targets

WHO provides air quality guidelines based on scientific evidence and expert advice. Such guidelines were first produced in 1987 and later updated in 1997 and 2005. The current guidelines and interim targets for PM_{2.5} annual mean concentrations are shown below.

	PM _{2.5} (µg/m ³)	Basis for the selected level
Interim target-1 (IT-1)	35	These levels are associated with about a 15% higher long-term mortality risk relative to the AQG level.
Interim target-2 (IT-2)	25	In addition to other health benefits, these levels lower the risk of premature mortality by approximately 6% [2–11%] relative to the IT-1 level.
Interim target-3 (IT-3)	15	In addition to other health benefits, these levels reduce the mortality risk by approximately 6% [2–11%] relative to the IT-2 level.
Air quality guideline (AQG)	10	These are the lowest levels at which total, cardiopulmonary and lung cancer mortality have been shown to increase with more than 95% confidence in response to long-term exposure to PM _{2.5} .

Source : WHO (2006) WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide - Global update 2005 - Summary of risk assessment. Available at: http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf

Additional variables are included to facilitate the interpretation of the indicators:

Percentage of population covered: The proportion of population residing in areas for which we have PM_{2.5} concentration data, i.e. population accounted for in the indicators above.

Percentage of exposure to PM_{2.5} from dust or sea salt: This is an estimate of the contribution to total PM_{2.5} that dust and sea-salt make to the total exposure. This can be useful for separating the more directly anthropogenic contribution (e.g. combustion) from the less directly anthropogenic (e.g. wind-blown desert dust). It is calculated by separately estimating exposure using the same methodology but using concentration data³ which have had the estimated contribution of dust and sea salt removed. The *Percentage of exposure that is dust or sea salt* is the difference between the two exposure estimates for each output region, expressed as a percentage of total exposure.

³ Produced as part of the same project

Flags

B: Break in series
C: Confidential
E: Estimated
I: Incomplete
N: National estimate

Null values

Null values are either unknown or incalculable from the input data. Zero values are true zeroes based on the input data.