Documentation for the Annual PM2.5 Concentrations for Countries and Urban Areas, 1998-2016

April 2021

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Abstract

The Annual PM2.5 Concentrations for Countries and Urban Areas, 1998-2016, consists of mean concentrations of particulate matter (PM2.5) for countries and urban areas. The PM2.5 data are from the Global Annual PM2.5 Grids from MODIS, MISR and SeaWiFS Aerosol Optical Depth (AOD) with GWR, 1998-2016. The urban areas are from the Global Rural-Urban Mapping Project, Version 1 (GRUMPv1): Urban Extent Polygons, Revision 02, and its time series runs from 1998 to 2016. The country averages are population-weighted such that concentrations in populated areas count more toward the country average than concentrations in less populated areas, and its time series runs from 2008 to 2015.

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We appreciate feedback regarding this data set, such as suggestions, discovery of errors, difficulties in using the data, and format preferences. Please contact:

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I.   Introduction

The Annual PM2.5 Concentrations for Countries and Urban Areas, 1998-2016, are annual average concentrations of particulate matter (PM2.5) for countries and urban areas.

The Global Annual PM2.5 Grids from MODIS, MISR and SeaWiFS Aerosol Optical Depth (AOD) with GWR, 1998-2016 data set utilizes NASA's Moderate Resolution Imaging Spectroradiometer (MODIS), Multiangle Imaging SpectroRadiometer (MISR), and the Sea-Viewing Wide Field-of-View Sensor (SeaWiFS) Aerosol Optical Depth (AOD) data to produce a collection of 18 gridded data files for annual concentration (micrograms per cubic meter) of ground-level fine particulate matter (PM2.5) – dust and sea-salt removed – one for each year during 1998 to 2016, at a spatial resolution of 0.01degrees (i.e. grid cells 1.1 km on a side at the equator).

The urban area is the Global Rural-Urban Mapping Project, Version 1 (GRUMPv1): Urban Extent Polygons, Revision 02 which includes new settlements and represents the first time that SEDAC has released polygons (in Esri shapefile format) with the settlement name (or name of the largest city in the case of multi-city agglomerations). Only named urban extents were included in this data set.

II.   Data and Methodology

Details on the input data can be found in their respective data set documentation PDFs.

Input data

Input data includes Global Annual PM2.5 Grids from MODIS, MISR and SeaWiFS
Aerosol Optical Depth (AOD) with GWR, 1998-2016 (van Donkelaar et al., 2018) and
the Global Rural-Urban Mapping Project, Version 1 (GRUMPv1): Urban Extent
Polygons, Revision 02 (CIESIN et al., 2021a, 2021b).

Methods

The country PM2.5 exposure measures the average annual concentration of PM2.5 to
which the typical citizen of each country is exposed. The country averages are
population-weighted. The population data, Gridded Population of the World, Version 4
(GPWv4): Population Count (CIESIN, 2016a, 2016b) was resampled at the same 10 x 10
km spatial resolution as the annual global surface PM2.5 concentrations, and then the
fraction of country population in each grid cell was calculated. The fraction of the
country's population in each grid cell was multiplied by the PM2.5 concentrations in that
grid cell. The individual grid cell results were summed over the entire country to create
population-weighted ambient concentrations of PM2.5.

The country PM2.5 exceedance measures the percentage of a country's population
exposed to annual concentrations of PM2.5 that exceed World Health Organization
(WHO) guidelines at four different levels: 10, 15, 25, and 35 µg/m3. GPWv4: Population
Count data were intersected with spatial masks representing the four different
concentration levels for the annual global surface PM2.5 concentrations, and the
population within the areas above the respective thresholds was summed for each
country. The population within the areas of exceedance was then divided by the country
population to arrive at the percentage of population in areas exceeding each threshold.

The urban PM2.5 exposure was calculated using zonal statistics. The urban extents were
the zone layer and the particulate matter concentrations for each year were the value
layers. Average PM2.5 concentrations for the urban areas were calculated and joined to
the urban extents with the Urban ID number (URBID).

III.   Data Set Description(s)

Data set description: Country Population-Weighted PM2.5 Exposure from 1998 to
2015, Country PM2.5 Exceedance from 2008 to 2015, and Urban Area PM2.5 Exposure
from 1998 to 2016.

Data set web page:
SEDAC URL:
https://sedac.ciesin.columbia.edu/data/set/sdei-annual-pm2-5-concentrations-countries-urban-areas-v1-1998-2016

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Documentation for the Annual PM2.5 Concentrations for Countries and Urban Areas, v1
(1998-2016)

Permanent URL: https://doi.org/10.7927/rja8-8h89

Data set format:
The data are available as vector polygon files in Shapefile (SHP) and as tables in
Microsoft Excel (XLSX) format. The downloadables are compressed zip files containing:
1) SHP of annual concentrations of PM2.5 for urban areas (1998-2016), or XLSX of
country population-weighted PM2.5 exposure (2008-2015), country PM2.5 exceedance
(2008-2015), and urban area PM2.5 exposure (1998-2016), and 2) PDF documentation.

Data set downloads:
sdei-annual-pm2-5-concentrations-countries-urban-areas-v1-1998-2016-xlsx.zip
sdei-annual-pm2-5-concentrations-countries-urban-areas-v1-1998-2016-urban-areas-
shp.zip

Codebook:

Country PM2.5 Variable Code	Variable	Description
CODE	Code	UNSD country numerical code
ISO	ISO Code	3 letter country code
COUNTRY	Country Name	Country name
AVPMC_####	Country PM2.5 Exposure for year ####	PM2.5 Exposure for countries from 2008 to 2015. It is measured in micrograms per cubic meter, and is the average annual concentration of PM2.5 to which the typical citizen of each country is exposed. The country averages are population-weighted such that concentrations in populated areas count more toward the country average than concentrations in less populated areas. Blanks represent missing data.
PMEXDC_####	Country PM2.5 Exceedance for year ####	PM2.5 Exceedance for countries from 2008 to 2015. It measures the percentage of a country's population exposed to annual concentrations of PM2.5 that exceed World Health Organization (WHO) guidelines at four different levels: 10, 15, 25, and 35 µg/m3. Blanks represent missing data.

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Urban PM2.5 Variable Code	Variable	Description
URBID	Urban ID	Code of the urban extent polygons (not unique)
STNDRDNAME	Standardized City Name	Name of the Urban Extent, caps and concatenated. If the urban extents polygons include more than one settlement, the name of the urban extent is the name of the settlement with the highest population. The name of the urban extent is missing if no settlement was identified within or less than 3 meters than the urban extent.
NAME	City Name	Name of the Urban Extent. If the urban extents polygons include more than one settlement, the name of the urban extent is the name of the settlement with the highest population. The name of the urban extent is missing if no settlement was identified within or less than 3 meters than the urban extent.
ISOURBID	ISO Urban ID	Unique code of the urban extent polygons. It is created by concatenation of country ISO code and URBID.
SQKM	Area in SQ KM	Area of the urban extent polygon
ISO3	ISO 3 Code	3 letter country code
UNSDCODE	UNSD Code	UNSD country numerical code
COUNTRYENG	Country Name	Country name
CONTINENT	Continent	Continent name
AVPMU_####	Urban Area Mean PM2.5 for year ####	PM2.5 Exposure for named urban areas from GRUMPv1: Urban Extent Polygons, Revision 02, from 1998 to 2016. It is measured in micrograms per cubic meter, and is the average annual concentration of PM2.5 to which the typical citizen of each urban area is exposed. Blanks represent missing data.

IV.   How to Use the Data

The data are intended to be used in any geographic information system (GIS) or statistics software. The data set is global in coverage, and can be subsetted based on the country name or other characteristics included in the Codebook (Shapefile attribute table).

V.   Potential Use Cases

These data can be used for time series assessment of trends in PM2.5 concentrations and for comparative analysis of city and country PM2.5 exposure for health assessment. The WHO threshold for PM2.5 levels that may be threatening to people's health is 10 micrograms per cubic meter.

VI.   Limitations

The accuracy of the geographic location of the cities depends on the quality of latitude and longitude data available from the sources. At the time of data collection (i.e. 2005 – 2010), the georeferencing sources quality was low. This revision includes corrected georeferencing for a subset of cities.

The current data set has PM2.5 concentration values excluding dust and sea salt for the benefit of researchers focusing on anthropogenic sources of PM2.5. However, there is higher uncertainty in the PM2.5 values in regions (especially central Asia and northern Africa) with high contributions from mineral dust, mostly a result of sparse ground-based monitoring and challenging conditions for measurement retrieval and simulation. Hence, there are higher degrees of uncertainty in these regions compared to other parts of the world, even after excluding the natural sources.

Note that these estimates are primarily intended to aid in broad area studies. Gridded data sets are provided to allow users to aggregate data to spatial units that suit their needs. Data sets are gridded at the finest resolution of the information sources that were incorporated. These data are not intended for studies examining intra-urban differentials in PM2.5, for example, or other small area research. In situ data are more appropriate at those scales.

VII.   Acknowledgments

VIII. Disclaimer

CIESIN follows procedures designed to ensure that data disseminated by CIESIN are of reasonable quality. If, despite these procedures, users encounter apparent errors or misstatements in the data, they should contact SEDAC User Services at ciesin.info@ciesin.columbia.edu. Neither CIESIN nor NASA verifies or guarantees the accuracy, reliability, or completeness of any data provided. CIESIN provides this data without warranty of any kind whatsoever, either expressed or implied. CIESIN shall not be liable for incidental, consequential, or special damages arising out of the use of any data provided by CIESIN.

IX.   Use Constraints

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X.   Recommended Citation(s)

Data set(s):

Center for International Earth Science Information Network (CIESIN), Columbia University. 2021. Annual PM2.5 Concentrations for Countries and Urban Areas, 1998-2016. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/rja8-8h89. Accessed DAY MONTH YEAR

XI.   Source Code

No source code is provided.

XII. References

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https://doi.org/10.7927/H4B27S72.

XIII. Documentation Copyright and License

Appendix 1. Data Revision History

No revisions have been made to this data set.

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Appendix 2. Contributing Authors & Documentation Revision History

Revision Date	ORCID	Contributors	Revisions
April 2, 2021	0000-0002-8875-4864	Tricia Chai-Onn Alex de Sherbinin	This document is the 1st instance of documentation.

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