World Health Organization's 2021 Air Quality Guidelines & 2022 Ambient Air Quality Database

Air Quality Advisory Committee

May 24, 2022

World Health Organization

- World Health Organization (WHO) is an United Nations agency focused on international public health
- Connects nations, partners and people worldwide to: promote health; keep the world safe; and serve the vulnerable.
- Leads and champions global efforts to achieve better health for all.
- Roles include advocacy and provision of technical assistance, setting international health standards and collecting data on global health issues, and serving as a forum for discussion of health issues

2021 WHO Air Quality Guidelines (AQG)

- Quantitative health-based air quality management recommendations which countries can use as a tool to assess their ground level air pollution and impact on its people and identify management strategies
- First developed in 1987 and were last updated in 2005
- In 2016 process to update the 2005 AQGs was begun by WHO staff and Expert Groups
  - Development of scope and key research questions
  - Systematic review of relevant peer-reviewed research papers on air quality and public health
  - Assessment of the level of certainty of these documents
  - Formulation of updated AQGs - lowest level of exposure for which there is evidence of adverse health effects and Interim Target levels -incremental steps on way to achieve AQGs
  - Formulation of other support documents

2021 AQG Recommendations & Interim Targets

(micrograms/cubic meter or ug/m^3)

Pollutant	Averaging Time	Interim 1	Interim 2	Interim 3	Interim 4	2021
$PM_{2.5}$	Annual	35	25	15	10	5
	24-hour	75	50	37.5	25	15
PM_{10}	Annual	70	50	30	20	15
	24-hour	150	100	75	50	45
Ozone	Peak season	100	70	-	-	60
	8-hour	160	120	-	-	100
NO_2	Annual	40	30	20	-	10
	24-hour	120	50	-	-	25
SO_2	24-hour	125	50	-	-	40
CO	24-hour	7 milligrams/cubic meter (mg/m^3)	-	-	-	4

24-hour and 8-hour – 99th percentile (i.e., 3 – 4 exceedances per year)

Peak Season – Average of daily maximum 8-hr mean ozone concentration in the 6 consecutive months with the highest 6-month running average concentration

World Health Organization - 2021

2005 and 2021 AQG Recommendations

(micrograms/cubic meter or ug/m^3)

Pollutant	Averaging Time	2005	2021
$PM_{2.5}$	Annual	10	5
	24-hour	25	15
PM_{10}	Annual	20	15
	24-hour	50	45
Ozone	Peak season	-	60
	8-hour	100	100
NO_2	Annual	40	10
	24-hour	-	25
SO_2	24-hour	20	40
CO	24-hour	-	4 milligrams/cubic meter (mg/m^3)

World Health Organization - 2021

Comparing AQGs & NAAQS

Pollutant	Averaging Time	AQGs	NAAQS
PM2.5	Annual	5 ug/m3	12 ug/m3
	24 Hours	15 ug/m3	35 ug/m3
PM10	Annual	15 ug/m3	-
	24 Hours	45 ug/m3	150 ug/m3
Ozone	Peak Season	30 ppb	-
	8 Hours	49 ppb	70 ppb
NO2	Annual	5 ppb	53 ppb
	24 Hours	13 ppb	-
	1 Hour	-	100 ppb
SO2	24 Hours	15 ppb	-
	1 Hour	-	75 ppb
CO	24 Hours	3 ppm	-
	8 Hours	-	9 ppm
	1 Hour	-	35 ppm

Peak Season – Average of daily maximum 8-hr mean ozone concentration in the 6 consecutive months with the highest 6-month running average concentration

2022 WHO Ambient Air Quality Database

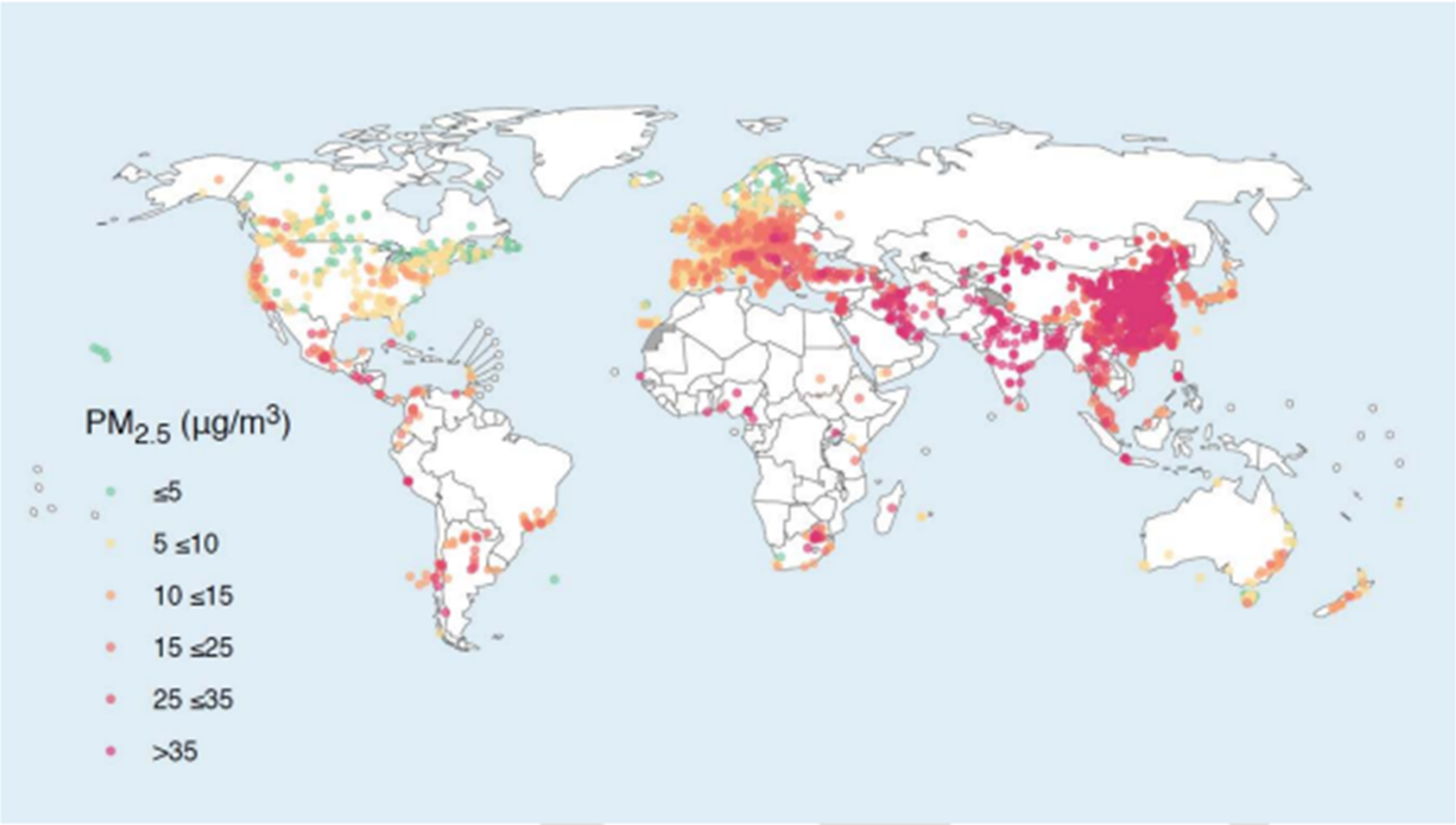
- Way to look at the state of world's ground level air pollution
- Used to track indicators associated with UN Sustainable Development Goals
- Database was developed in 2011 and updated in 2014, 2016, 2018 and 2020-2021
- Database contains annual (2010 – 2019) mean concentrations for $PM_{2.5}$, PM_{10} and NO_2 from 6,743 population centers from 117 countries around the world
  - Population centers range from individual cities to metropolitan areas
  - Data for metropolitan area is aggregated from individual monitors into an annual mean – representing an average for city or area as a whole
- Database does have limitations – different monitor coverage, measurement methods, consistency of collection by responsible agency

Total Population Centers in Database

WHO Region	Population Centers	Countries with Data
Africa	59	12
Americas	781	22
South-East Asia	398	9
European	3,654	48
Eastern Mediterranean	158	14
Western Pacific	1,693	12
Total	6,743	117
High Income Level	4,226	51
Low & Middle Income Level	2,517	66
Total	6,743	117

Income breakdown from World Bank

Location of Population Centers with data on $PM_{2.5}$



WHO Ambient air quality database 2022 update – Draft Status report April 2022

Population Centers complying with 2021 Annual Mean PM AQG*

Based on Latest Data Available

WHO Region	Population Centers Complying	Population Centers by Region
Africa	2	59
Americas	180	781
South-East Asia	0	398
European	475	3,654
Eastern Mediterranean	0	158
Western Pacific	51	1,693
Total	708	6,743

*Population centers that complied with WHO AQG targets for Annual mean PM – if had $PM_{2.5}$ and PM_{10} data, went with $PM_{2.5}$ data and that AQG

WHO Ambient air quality database 2022 update – Draft Status report April 2022

St. Louis MO-IL - WHO Database Entry

Year	Annual $PM_{2.5}$ (ug/m^3)	Annual PM_{10} (ug/m^3)	Annual NO_2 (ug/m^3)
2010	-	-	22.9
2011	-	-	16.7
2012	12.2	46	22.8
2013	-	25.9	21.1
2014	-	-	20.4
2015	-	27.8	17.9
2016	-	18.7	-
2017	-	27.3	17.8
2018	-	24.8	17.8
2019	-	22.8	-

WHO Ambient air quality database 2022 update

How St. Louis MO-IL WHO Database Entries Match Up with AQGs

- Compliance with 2005 AQGs
  - $PM_{2.5}$ – 0 out of 1 year with data
  - PM_{10} – 1 out of 7 years with data
  - NO_2 – 8 out of 8 years with data
- Compliance with 2021 AQGs
  - $PM_{2.5}$ – 0 out of 1 year with data
  - PM_{10} – 0 out of 7 years with data
  - NO_2 – 0 out of 8 years with data
- FYI – For $PM_{2.5}$, PM_{10} and NO_2 NAAQS - St. Louis MO-IL is classified as in attainment

WHO Air Quality Standards Interactive Map

World Health Organization National Air Quality Standards Swiss TPH

Interactive map | More info and data source | Terms of use

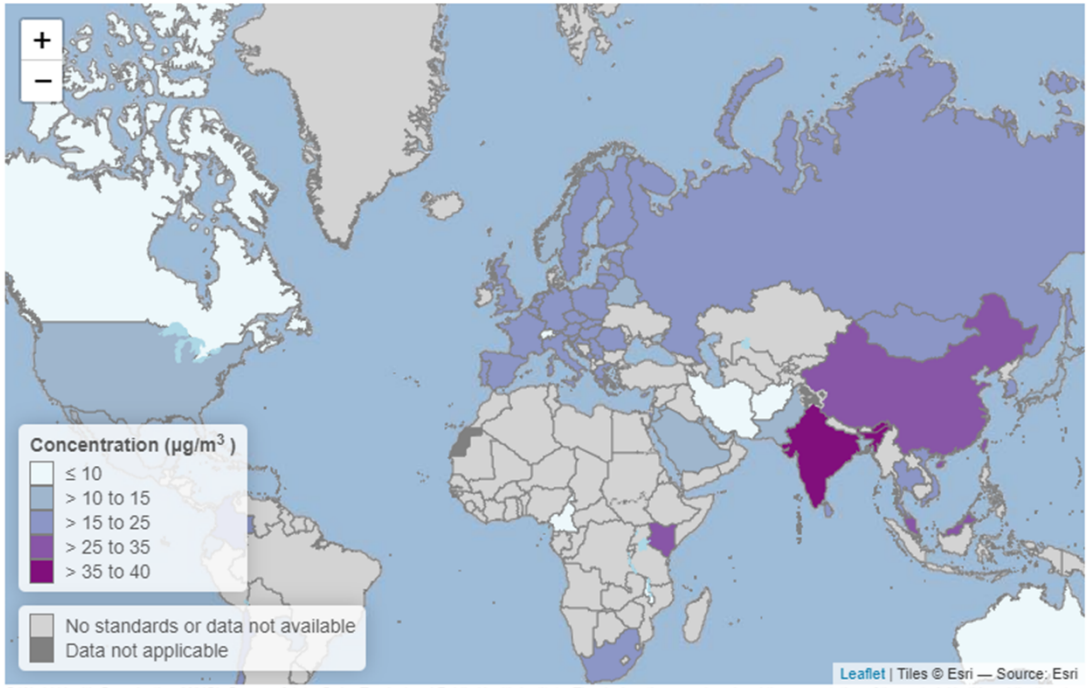
Pollutant

- ◉ $PM_{2.5}$ (*)
- ○ PM_{10} (*)
- ○ NO_2 (**)
- ○ O_3 (†)
- ○ SO_2 (‡)
- ○ CO (□)

Averaging period

- ◉ 1 year
- ○ 24 hours
- ○ 8 hours (daily max)
- ○ 8 hours
- ○ 1 hour

* 1 year, 24 hours
** 1 year, 1 hour
† 8 hours, daily maximum
‡ 24 hours
□ 24 hours, 8 hours, 1 hour



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https://whoairquality.shinyapps.io/AirQualityStandards/

For More Information

- WHO Air Quality Guidelines
  - https://www.who.int/publications/i/item/9789240034228
- WHO Ambient Air Quality Database
  - https://www.who.int/data/gho/data/themes/air-pollution/who-air-quality-database
- WHO Ambient air quality database 2022 update – Draft Status report April 2022
  - https://cdn.who.int/media/docs/default-source/air-pollution-documents/air-quality-and-health/who-air-quality-database-2022---v7.pdf?sfvrsn=c6d52e7b_7&download=true