ACIQLife

Once a model (CMAQ) run is completed, you will need to use some of the output variables, which are commented below to calculate the air quality indices.

Air quality indices: The AQ index is defined as a measure of air pollution seen in the context of its impact on human health. It provides an integrated assessment of the impact of the whole range of pollutants on human health and is calculated based on the concentration of various pollutants. To compute the AQI requires an air pollutant concentration from measurements or numerical modeling and converting the air pollutant concentration in to AQI varies by pollutant.

The index is defined in several segments, each of which is a linear function of the concentration of each the pollutant considered (EPA, 2009):

$$I = \frac{I_{high} - I_{low}}{C_{high} - C_{low}}(C - C_{low}) + I_{low} \qquad (1)$$

where:

I = the (AQ) index,

C = the pollutant concentration,

C_{low} = the concentration breakpoint that is $\leq C$,

C_{high} = the concentration breakpoint that is $\geq C$,

I_{low} = the index breakpoint corresponding to C_{low},

I_{high} = the index breakpoint corresponding to C_{high},

In that calculation the index falls in one of the ranges of the dimensionless scale. In each range index values are associated with an intuitive color code, a linguistic description and a health description.

Air Pollution Bandings and Index and the Impact on the Health of People who are Sensitive to Air Pollution

Banding	Value	Health Descriptor
Low	1–3	Effects are unlikely to be noticed even by individuals who know they are sensitive to air pollutants
Moderate	4–6	Mild effects, unlikely to require action, may be noticed amongst sensitive individuals.
High	7–9	Significant effects may be noticed by sensitive individuals and action to avoid or reduce these effects may be needed (e.g. reducing exposure by spending less time in polluted areas outdoors). Asthmatics will find that their 'reliever' inhaler is likely to reverse the effects on the lung.
Very High	10	The effects on sensitive individuals described for 'High' levels of pollution may worsen.

In different countries the indices of air pollution are different and have their different scales. US (0-500), Canada (1-10), Hong Kong (0-500), China (0-300), Singapore (0-400), South Korea (0-500), England (1-10). To present the AQ situation in European cities, all measurements are transformed into a single relative figure: the Common Air Quality Index (CAQI) in the frame of project Citeair and three different indices enable the comparison of three different time scale: an hourly index, a daily index and an annual index.

An hourly index, which describes the AQ, based on hourly values. A daily index, which stands for the general AQ situation of previous day, based on daily values.

These indices have 5 levels using a scale from 0 (very low) to > 100 (very high), it is a relative measure of the amount of air pollution. They are based on 3 pollutants of major concern in Europe: PM10, NO_2, O_3 and will be able to take into account to 3 additional pollutants (CO, PM2.5 and SO_2).

INDEX	O_3	NO_2	SO_2	CO	PM_{10}
	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
1	0-32	0-95	0-88	0-3.8	0-21
2	33-66	96-190	89-176	3.9-7.6	22-42
3	67-99	191-286	177-265	7.7-11.5	43-64
4	100-126	287-381	266-354	11.6-13.4	65-74
5	127-152	382-477	355-442	13.5-15.4	75-86
6	153-179	478-572	443-531	15.5-17.3	87-96
7	180-239	573-635	532-708	17.4-19.2	97-107
8	240-299	636-700	709-886	19.3-21.2	108-118
9	300-359	701-763	887-1063	21.3-23.1	119-129
10	> 360	> 764	> 1064	> 23.2	> 130

The total annual index is calculated by a different method, giving the deviation from the so-called threshold value derived from European Directives for annual air standards. When the index is larger than 1, this means that one or more contaminants limit value is not reached, i.e., there is excess of this standard. If the index is less than 1, this means that the threshold value has been reached i.e. no excess of the standard of any of the pollutants. This index evaluates the exposure to harmful air pollution influence for longer periods and is connected to WHO recommendations for human health protection.

The most commonly used AQ index is the UK Daily Air Quality Index. In Bulgaria the index, calculated in the frame of Bulgarian Chemical Weather Forecast System(Syrakov et al., 2009, 2011a,b, 2012, Etropolska et al, 2010), and follows the UK Air Quality Index. This index has ten points, which are further grouped into 4 bands: low, moderate, high and very high. The index is based on the concentrations of 5 pollutants. The index is calculated from the concentrations of Ozone, Nitrogen Dioxide, Sulphur Dioxide, PM2.5 (particles with an aerodynamic diameter less than 2.5 μm) and PM10.

Boundaries Between Index Points for Each Pollutant

Index	O_3 Running 8 hourly mean ($\mu g/m^3$)	NO_2 Hourly mean ($\mu g/m^3$)	SO_2 15 minute mean ($\mu g/m^3$)	PM10 Particles, 24 hour mean ($\mu g/m^3$)	PM2.5 Particles, 24 hour mean ($\mu g/m^3$)
1 (Low)	0-33	0-66	0-88	0-11	0-16
2 (Low)	34-65	67-133	89-176	12-23	17-33
3 (Low)	66-99	134-199	177-265	24-34	34-49
4 (Moderate)	100-120	200-267	266-354	35-41	50-58
5 (Moderate)	121-140	268-334	355-442	42-46	59-66
6 (Moderate)	141-159	335-399	443-531	47-52	67-74
7 (High)	160-187	400-467	530-708	53-58	75-83
8 (High)	188-213	468-534	709-886	59-64	84-91
9 (High)	214-239	535-599	887-1063	65-69	92-99
10 (Very High)	≥ 240	≥ 600	≥ 1064	≥ 70	≥ 100

The breakpoints between index values are defined for each pollutant separately and the overall index is defined as the maximum value of the index. Different averaging periods are used for different pollutants.

The reference levels and Health Descriptor used in the tables are based on health-protection related limit, target or guideline values set by the EU, at national or local level or by the WHO.

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