« EU: no CO2 improvement in cars in 2017AQI: air quality confusion (2) »

AQI: air quality confusion (1)

This is part 1.
Click on the links below for the other parts.

Part 2, 3, 4, 5.

Luxembourg's Environmental Agency has joined the AQI-train and published a smartphone app called "Meng Loft" (= my Air) which gives an air quality index (AQI) for Luxembourg and/or sub-regions of the country. There are many different AQI's around the world, and in this **multi-part** comment I try to clarify a bit the overwhelming number of country/administration specific definitions.

1. What's an index?

An index is a single number which should simplify a more complex situation. A good example is the UV-Index (UVI) which represents by a single number (in practice between 0 and about 12) the "dangerosity" of solar UVB irradiance. The biological effect of UVB is expressed as a dose intensity in the biological effective unit MED/h (minimum erythemal dose per hour). A person of a certain skin complexion (phototype II) is assumed to have a reddening of the skin (an erythema) after having received this dose. Physically speaking the dose represents an energy (a number of Joule per m2), and the instruments measuring UVB measure a dose per time unit: our UVB Solarlight biometer at meteoLCD measures MED/h per m2. The UVI is defined as a biologically effective UVB irradiance of 25mW/m2 where UVB extents to wavelengths between 298 and 320 nm. So here we have an index that represents simply a scale-factor for the physical unit: **the UVI is strictly proportional to the physical unit of the relevant phenomenon.**

2. What's air quality?

The air we inhale is a mixture of many components, where some are considered as potentially harmful above a certain level (or concentration). The **three core "pollutants" are ground ozone (O3), nitrogen dioxide (NO2) and fine particles (PM10**, PM2.5). Please note that all theses substances exist in every type of air and have both natural and anthropogenic origins. So the qualifier "pollutant" is slightly misleading: theses substances should be seen as "pollutants" if their concentration exceeds certain levels. Besides these 3 core substances many others are often considered, mainly CO, SO2 and NO etc…

One real problem is the measurement of theses substances and the units used. O3 for instance is measured by the big expensive sensors by its absorption of certain UVB wavelengths (e.g. our previous O341M sensor by Environnement SA); other sensors use chemical reactions that change an electrical current (amperometric sensors as our CAIRSENS) and so on. The concentration of O3 and NO2 can be expressed as a sub-volume in a reference volume (usually in ppb =parts per volume) or as a mass in a reference volume (microgram per m3 = ug/m3). The big advantage of the ppb unit is that it is independent of ambient pressure and temperature; the big disadvantage of the ug/m3 unit is that it depends on a standard pressure (1013.25 hPa) and a standard temperature (usually 25°C, but also 20°C). Many countries like the USA use the ppb (or ppm), but the EU has decided to use the ug/m3 unit. As the standard temperature for gases in the EU is often taken as 20°C (but frequently also as 25°C) there is much room for confusion. The conversion factors from ppb to ug/m3 are the following (see here):

O3: to change ppb to ug/m3 multiply by 1.996 if standard temp. is 20°C and by **1.962** if standard temp. is 25°C

NO2: to change ppb to ug/m3 multiply by 1.913 if standard temp. is 20°C and by **1.880** if standard temp. is 25°C

The concentration of fine particles (PM10, PM2.5) is universally given as mass per volume (ug/m3). PM10 are particles up to a size of 10 micrometers, PM2.5 up to 2.5 um. On-line measurement principles are either the attenuation of beta radiation or the scattering of light (laser light); these techniques all must be done in known gas conditions and dry air (measurement with new low-cost sensors as the Nova SDS011 give absolutely wrong results outside a very narrow humidity range). PM2.5 are much more difficult to measure so that many stations keep to PM10's.

3. Not one but many AQI's

Every pollutant has its own AQI, and usually it is defined by a "break-point" table relating concentration to this AQI. The resulting graph is a polygone, so that over its full range there is no proportionality between concentration and AQI. The numerical range of the AQI varies enormously from country to country: for instance 0-500 in the US and 0-100 in many EU countries. This numerical range is divided into quality levels (e.g. Excellent to Hazardous) and the number of these levels and the precise wording also is not standardized.

But how to you define a single AQI out of an ensemble of for instance 3 core pollutants? Here the methodology is the same everywhere on the world: **the defining AQI is the highest sub-AQI**. An example: if O3-AQI = 80, NO2-AQI = 60 and PM10-AQI =50 then the published AQI is 80. This definition often leads to difficult to understand results. If O3 levels are normally high at a pure air mountainous station, but NO2 and PM levels low, that station may be qualified as poorer than a city with slightly lower O3 but much higher NO2 and PM concentrations.

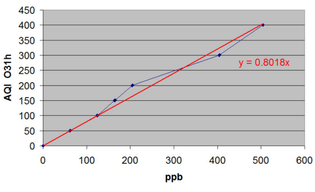
4. The EPA AQI

Let us start with the US EPA (Environmental Protection Agency) AQI, as defined in the last revision. Here is the "break-point" table which defines the specific "sub-AQI's" for the different pollutants considered by the EPA (in yellow the 3 core pollutants):

These Breakpoints…	EPA 2015 AQI's						…equal this AQI	…and this category
O_3 (ppm) 8-hour	O_3 (ppm) 1-hour[1]	$PM_{2.5}$ (µg/m³) 24-hour	PM_{10} (µg/m³) 24-hour	CO (ppm) 8-hour	SO_2 (ppb) 1-hour	NO_2 (ppb) 1-hour	AQI	
0.000 - 0.054	-	0.0 – 12.0	0 - 54	0.0 - 4.4	0 - 35	0 - 53	0 - 50	Good
0.055 - 0.070	-	12.1 – 35.4	55 - 154	4.5 - 9.4	36 - 75	54 - 100	51 - 100	Moderate
0.071 - 0.085	0.125 - 0.164	35.5 – 55.4	155 - 254	9.5 - 12.4	76 - 185	101 - 360	101 - 150	Unhealthy for Sensitive Groups
0.086 - 0.105	0.165 - 0.204	(55.5 - 150.4)[2]	255 - 354	12.5 - 15.4	(186 - 304)[2]	361 - 649	151 - 200	Unhealthy
0.106 - 0.200	0.205 - 0.404	(150.5 – 250.4)[2]	355 - 424	15.5 - 30.4	(305 - 604)[2]	650 - 1249	201 - 300	Very unhealthy
([3])	0.405 - 0.504	(250.5 - 350.4)[2]	425 - 504	30.5 - 40.4	(605 - 804)[2]	1250 - 1649	301 - 400	Hazardous
([3])	0.505 - 0.604	(350.5 - 500.4)[2]	505 - 604	40.5 - 50.4	(805 - 1004)[4]	1650 - 2049	401 - 500	Hazardous

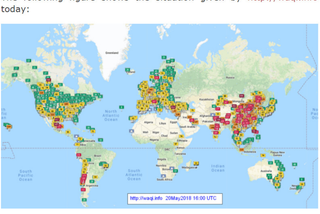
To approximately convert either O3 or NO2 to ug/m3, use a multiplier of 2.

A first problem is that lower 1 hour O3 levels do not have an EPA AQI, what is unfortunate because usually all measurement stations give at least one measurement per hour. To simplify let us take break-points 0…62 and 63…124 for the O3 1h series. Clearly the steps corresponding to the concentration are not of the same magnitude: an AQI [0…50] corresponds to concentrations [0…54 ppb] whereas the same AQI step of 50 [1001…150] corresponds to [125…164 ppb], a much lower concentration increase . The graphical representation is a polygon: there is a proportionality between concentration and AQI from one break-point to the next, but no proportionality from 0 to maximum concentration as shown in the next graph (the red line is a calculated trend-line with its equation to show the deviation with the polygon):



The EPA AQI has 6 quality levels, from GOOD to HAZARDOUS, and runs from 0 to 500. Many on-line sites give a real-time view of the EPA AQI for the entire world, the local measurements being converted according to the EPA standard:

The following figure shows the situation given by http://waqi.info today:



Zooming into the figure allows to inspect individual stations and the time series of the last two days.

The quality levels of EPA are relatively "generous": an 8h O3 concentration of 100 ug/m3 still qualifies as GOOD, whereas in Luxembourg is runs under "MEDIUM".

(to be continued)

Click here for part 2

« AQI: air quality confusion (1) AQI: air quality confusion (3) »

AQI: air quality confusion (2)

This is part 2. *Click on the links below for the other parts.*

Part 1, 3, 4, 5.

In the first part of this blog on AQI I finished with the definition of the US EPA AQI, which has 6 quality levels and AQI numbers of to 500. Before going to Europe, let us begin this part with the Chinese AQI.

5. The PRC Chinese AQI

China uses for defining air quality the same 6 pollutants as does the US EPA (see **here**): O3, NO2, PM10 and PM2.5, CO and SO2. It also uses 6 quality levels albeit with different wording: EXCELLENT to SEVERELY POLLUTED. The Chinese sub-AQI's (called IAQI = individual AQI) run from 0 to 500, as do the EPA sub-AQI's. And the highest IAQI defines the published AQI. Most of the times PM2.5 is the primary pollutant with the highest IAQI, but during summer time O3 may have the highest IAQI.

The break-points for PM's differ from those of EPA (link, attention: this blog has a completely wrong table comparing US and China other AQI's):

AQI Score	Description	PM10 (US) µg/m3 24 hr	PM10 (CHINA) µg/m3 24 hr	PM2.5 (US) µg/m3 24 hr	PM2.5 (CHINA) µg/m3 24 hr
0-50	Excellent	0	0	0	0
51-100	Good	50	50	15	35
101-150	Slightly Polluted	150	150	40	75
151-200	Lightly Polluted	250	250	65	115
201-300	Moderately Polluted	350	350	150	150
>300	Heavily Polluted	420	420	250	250

Table 1. US and China AQI breakpoints for PM10 and PM 2.5. Note: the Descriptions in column 2 are based on the Chinese AQI standards, not the US's.

The qualifiers ("Description") in this table are the Chinese ones, and obviously China is much more tolerant for PM2.5 as is the EPA (notice that the first Chinese break-points are considerably higher). The same remark holds for some of the other pollutants as shown in this comparison table which uses 1996 EPA break-points (link):

AQI (China)	AQI (USA)	China & USA AQI	Pollutant Concentrations (µg/m³)											
			SO_2 (24h Average)		NO_2 (24h Average)		CO (24h Average; mg/m3)		O_3 (1h)		O_3 (8h Average)		PM10 (24h Average)		PM2.5 (24h Average)	
Excellent	Good	0-50	50	40	40	-	2	5	160	-	100	116	50	50	35	15
Good	Moderate	51-100	150	377	80	-	4	11	200	-	160	147	150	150	75	35
Light Polluted	Unhealthy For Sensitive Groups	101-150	475	187	180	-	14	14	300	321	215	186	250	250	115	65
Moderately Polluted	Unhealthy	151-200	800	797	280	-	24	18	400	400	265	235	350	350	150	150
Heavily Polluted	Very Unhealthy	201-300	1600	1593	565	2260	36	35	800	792	800	755	420	420	250	250
Severely Polluted	Hazardous	301-500	2620	2615	940	3760	60	58	1200	1184	-	-	600	600	500	500

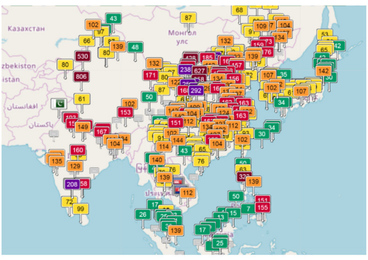
First one should note that China uses ug/m3 as concentration unit. Second it calculates NO2 pollution only using a 24h average, whereas EPA uses 1h values, which makes comparison impossible. Third where comparison can be made, the break-point numbers are very close for O3, CO and PM10 but differ for SO2 (24h), NO2 (24h) and PM2.5 (24h).

Chinese AQI's are often calculated as the average from readings of multiple stations around a city, whereas US EPA AQI's allways come from a single station.

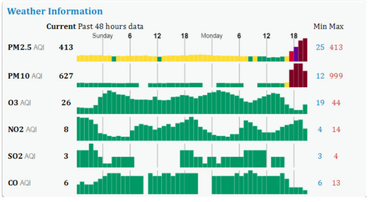
The US Embassies in China have their own measuring stations which use the EPA standard: see **here**.

There are a couple of smartphone apps to visualize real-time Chinese AQI's, but I did not find an official Chinese live map on the web based on Chinese AQI standards. The waqi.info web site shows Chinese air quality using EPA standards; the same holds for the website **aqicn.org.**

The next picture shows the situation today 21 May 2018 at 14:10 UTC:



Clicking on a label gives more information, as for instance for the City of Yulin:



We see that PM2.5 and PM10 situation is particularly bad, whereas O3 and NO2 levels are GOOD.

Comparing AQI's over China with those of other parts of the world clearly shows that bad air quality (mostly PM's) is a serious issue in many parts of mainland China.

Conclusion:

Be careful when reading AQI's for China, as often it is not clear on what standard they are based. The following paragraph (link) summarizes this well:

Summary: Discrepancies Between AQI Readings

So there are many reasons comparing the US embassy/consulates AQI to the official China AQI, or comparing one mobile app's AQI to another is like comparing apples to oranges. This is not due to false data reporting, but rather due to different standards and reporting methods. Questions to ask include:

Chinese and US AQI

- Is this AQI value based on the US or China standard?
- Is this AQI value derived from the PM2.5 concentration or another pollutant's concentration?
- Is this AQI value derived from a real-time measurement or a 24-hour average?
- Is this AQI value derived from a single test site (if so which one), or an average of results from several monitoring stations?

(**go to part 3**)

« AQI: air quality confusion (2) AQI: air quality confusion (4) »

AQI: air quality confusion (3)

This is part 3.
Click on the links below for the other parts.

Part 1, 2, 4, 5.

6. The UK revised DAQI

In the UK the Department for Environment, Food and Rural Affairs (DEFRA) publishes since 2013 the revised **Daily Air Quality Index** (DAQI); the first DAQI was introduced in 2012. The DAQI has 4 quality levels (from best to worst: LOW, MODERATE, HIGH, VERY HIGH) and the index runs from 1 to 10. It is based on concentrations of O3, NO2, SO2 and PM's (PM10 and PM2.5) measured in ug/m3 (CO has been removed in the revised DAQI).

The following table gives the break-points (link):

Table 1: The revised Daily Air Quality Index.

Band	DAQI Index	Ozone Running 8 hourly mean µgm^{-3}	Nitrogen Dioxide hourly mean µgm^{-3}	Sulphur Dioxide 15 minute mean µgm^{-3}	$PM_{2.5}$ Particles (EU Reference method) 24 hour mean µgm^{-3}	PM_{10} Particles (EU Reference method) 24 hour mean µgm^{-3}
Low	1	0-33	0-67	0-88	0-11	0-16
	2	34-66	68-134	89-177	12-23	17-33
	3	67-100	135-200	178-266	24-35	34-50
Moderate	4	101-121	201-267	267-354	36-41	51-58
	5	122-140	268-334	355-443	42-47	59-66
	6	141-160	335-400	444-532	48-53	67-75
High	7	161-187	401-467	533-710	54-58	76-83
	8	188-213	468-534	711-887	59-64	84-91
	9	214-240	535-600	888-1064	65-70	92-100
Very High	10	241 or more	601 or more	1065 or more	71 or more	101 or more

The first comment should be that the "band" qualifiers correspond to the numerical index, and that "Low" means low index = good air quality conditions. The break-points are not proportional to the concentration: note that for O3 index 2 spans over 33 ug/m3, whereas that index 4 extends over 20 ug/m3. The pollutant with the highest index defines the published DAQI.

Ozone concentrations are only taken as 8h running mean. The color levels used for the different bands and subdivisions are different from those of EPA and China, and the health messages attached reflect the differences between individuals at risk and the general population:

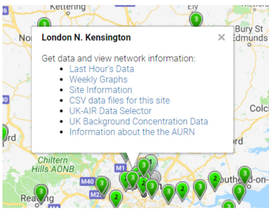
Band	Index	Health Message: Individuals at risk*	Health Message: General Population
Low	1	Enjoy your usual outdoor activities.	Enjoy your usual outdoor activities
	2		
	3		
Moderate	4	Adults and children with lung problems, and adults with heart problems, should reduce strenuous physical exertion, particularly outdoors, and particularly if they experience symptoms. People with asthma may find they need to use their relever inhaler more often. Older people should also **reduce** physical exertion.	Enjoy your usual outdoor activities.
	5		
	6		
High	7	Adults and children with lung problems, adults with heart problems, and older people, should **avoid** strenuous physical activity. People with asthma may find they need to use their relever inhaler more often.	Anyone experiencing discomfort such as sore eyes, cough or sore throat should consider reducing activity, particularly outdoors.
	8		
	9		
Very High	10	Adults and children with lung problems, adults with heart problems, and older people, should **avoid** strenuous physical activity. People with asthma may find they need to use their relever inhaler more often.	**Reduce** physical exertion, particularly outdoors, especially if you experience symptoms such as cough or sore throat.

There are at least two methods to view live DAQI data:

1. use a Google Earth KMZ file (link)

2. go to the interactive map (link):

Clicking on a station gives very detailed information, a shown below (all lines are active links):



Conclusion:

- Care should be taken to not confuse a "LOW" index with "low air quality".
- Not further subdividing the "Very high" category is a good decision.
- 10 different color-shades are in my opinion way too many: it is difficult to distinguish neighboring colors when the map is shown in a poorer resolution.

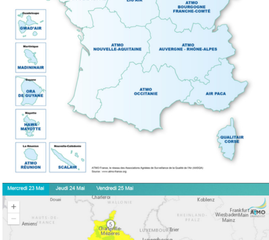
7. The French ATMO index

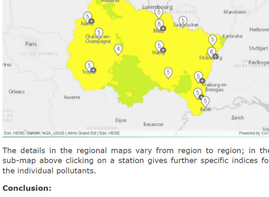
The "Fédération des Associations de la Surveillance de la Qualité de l'Air" (link) defines two indices:
– the **ATMO** is based on 4 pollutants (O3, NO2, SO2, PM10) and applicable for cities of more than 100000 inhabitants
– the **IQA** (Indice de Qualité de l'Air simplifié) is based on a subset of these 4 pollutants and used for cities with less than 100000 inhabitants

In the following, I will consider only the ATMO which extends from 1 to 10, uses 6 quality levels and only 3 different colors (GREEN, ORANGE, RED) as defined in the relevant "arrêté" (link). The break-points are based on 1h concentrations measured in ug/m3 (except PM10 given as the 24h mean); if several stations cover a geographic zone, the average is used. As for all previous indices, the highest sub-index defines the ATMO (link):

Indices	Echelle PM_{10} (µg/m³) Moyenne journalière	Echelle SO_2 (µg/m³) Moyenne horaire	Echelle NO_2 (µg/m³) Moyenne horaire	Echelle O_3 (µg/m³) Moyenne horaire
1	0 à 6	0 à 39	0 à 29	0 à 29
2	7 à 13	40 à 79	30 à 54	30 à 54
3	14 à 20	80 à 119	55 à 84	55 à 79
4	21 à 27	120 à 159	85 à 109	80 à 104
5	28 à 34	160 à 199	110 à 134	105 à 129
6	35 à 41	200 à 249	135 à 164	130 à 149
7	42 à 49	250 à 299	165 à 199	150 à 179
8	50 à 64	300 à 399	200 à 274	180 à 209
9	65 à 79	400 à 499	275 à 399	210 à 239
10	sup. à 80	sup. à 500	sup. à 400	sup. à 240

I did not find an interactive map covering France, but you may start here with the map of the regions (link) and click on a region to get more details, as shown for the Eastern Region of France (link):





The details in the regional maps vary from region to region; in the sub-map above clicking on a station gives further specific indices for the individual pollutants.

Conclusion:

- using only 3 colors makes an overall view easier
- the format for the individual regions is not exactly the same, which is slightly annoying. Besides the ATMO France often uses an AQI called CiteAir, which is based on a EU convention. The EU AQI's will be discussed in the upcoming part 4.

(go to part 4)

meteoLCD Weblog

A weblog on climate, global change and climate measurements

« AQI: air quality confusion (3) AQI: air quality confusion (5, last part) »

AQI: air quality confusion (4)

This is part 4.

Click on the links below for the other parts.

Part 1, 2, 3, 5.

7. The EU AQI's

As everything in Europe is complicated, so are the AQI's. The oldest index is the CAQI which has different quality bands names, color scheme and break-points than the newest EAQI.

7.1. The CAQI

The CAQI index was introduced by the CiteAir (Common Information to European Air) project in 2006. It was revised in 2012 and is meant as an index for the air in the cities. It uses the concentrations (measured in ug/m3) of 3 core pollutants (O3, NO2, PM10) with PM2.5, SO2 and CO as optional. The different sub-indexes run from 0 to 100 as defined in the following table (link):

Table 7: Pollutants and calculation grid for the revised CAQI (all changes in italics)

Index class	Grid	Traffic					City Background					
		core pollutants		pollutants			core pollutants			pollutants		
		NO2	PM10	PM2.5	CO		NO2	PM10	O3	PM2.5	CO	SO_2
			1-h. 24-h.	1-h. 24-h.				1-h. 24-h.		1-h. 24-h.		
Very low	0	0	0	0	0	0	0	0	0	0	0	0
	25	50	25	*15*	*15*	*10*	50	25	*15*	*60*	*15*	*10*
Low	25	50	25	*15*	*15*	*10*	50	26	26	*15*	*60*	*15*
	50	100	50	*30*	*30*	*20*	7500	100	50	*30*	*120*	*30*
Medium	50	100	50	*30*	*30*	*20*	7500	100	50	*30*	*120*	*30*
	75	200	90	50	*55*	*30*	10000	200	90	50	*180*	*55*
High	75	200	90	50	*55*	*30*	10000	200	90	50	*180*	*55*
	100	400	180	100	*110*	*60*	20000	400	180	100	*240*	*110*
Very high	> 100	> 400	>180	>100	> *110*	>*60*	>20000	> 400	>180	>100	>*240*	> *110*

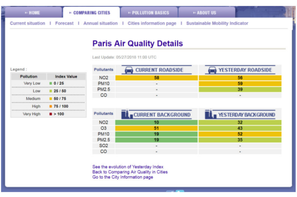
NO_2, O3, SO_2: hourly value / maximum hourly value in $\mu g/m^3$
CO: 8 hours moving average / maximum 8 hours moving average in $\mu g/m^3$
PM_{10}: hourly value / daily value in $\mu g/m^3$

* An index value above 100 is not calculated but reported as " > 100".

The table shows that the index break-points are not proportional to the concentrations for all pollutants as for instance for NO2 the "Very low" range [0..50] covers 0...50 ug/m3 whereas the "High" range [75...100] covers 200...400 ug/m3.

The names of the different categories relate to the magnitude of the index, and **not** the quality of the air. As customary, the highest sub-index defines the CAGI. Note that the sampling period usually is 1 hour. The CAQI can be viewed on-line at **http://www.airqualitynow.eu/**

Clicking a city gives more detailed information, as shown for Paris:



Clearly the CAQI is heavily "French" leaning, as the vast majorities of cities are in France.

This is probably the reason that the DG Environment commanded a research to Ricardo Energy & Environment which delivered in 2013 a paper defining an harmonized EAQI. The proposal was very similar to the EPA AQI, with an identical number of pollutants and an index running from 0 to 500; the names of the different categories were different. This project seems to have been a dead-end (due to it's US similarities?) and never has been officially applied.

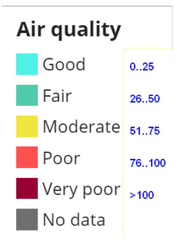
7.2 The EAQI

In November 2017 the EU introduced the EAQI = European Air Quality Index with a web-site showing the live-data. It is very difficult to find precise literature for this index which is somewhat similar to the CAQI, albeit with a different color scheme, a renaming of the categories and most important, different break-points. So most of the following information has been extracted from the excellent **airindex.eea.europa.eu**

First the naming of the 5 categories is now relevant to the air quality and not the magnitude of the index, the colors go from turquoise to brown and the indices from 0 to 100 relate to concentrations in ug/m3 as shown:

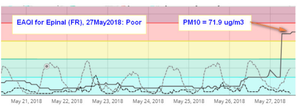
Pollutant	Index level (based on pollutant concentrations in µg/m3)				
	Good	Fair	Moderate	Poor	Very poor
Particles less than 2.5 µm ($PM_{2.5}$)	0-10	10-20	20-25	25-50	50-800
Particles less than 10 µm (PM_{10})	0-20	20-35	35-50	50-100	100-1200
Nitrogen dioxide (NO_2)	0-40	40-100	100-200	200-400	400-1000
Ozone (O_3)	0-80	80-120	120-180	180-240	240-600
Sulphur dioxide (SO_2)	0-100	100-200	200-350	350-500	500-1250

The numerical ranges of the indices are here (often the upper bound is given as equal to the lower bound of the following category which does not easy a decision for qualifying if by chance the data fall on a boundary):



I **wrongly** presumed that the break-points for each category are defined as they are for the CAQI.

The graph for the EAQI in Epinal (France) shows that the category is POOR as the PM10 concentration exceeds 71 ug/m3. As this is an 1h concentration, the EAQI break-point for PM10-POOR seems to be lower than in the CAQI table.



Finally after quite some detective-investigation, I found legends at the provisional web-site
www.eea.europa.eu/data-and-maps/dashboards/up-to-date-air-quality-data
which confirm those of the table at the start of chapter 7.2. See that here upper and lower bound values coincide!

Air quality	index	O3	NO2	PM10	PM2.5
Good	0...25	0...80	0...50	0...35	0...15
Fair	25...50	80...120	50...100	35...60	15...30
Moderate	50...75	120...180	100...200	60...90	30...40
Poor	75...100	180...240	?	90...180	40...90
Very poor	> 100	> 240	?	> 180	> 90
No data					

Note how different these break-points are from those of the CAQI, which adds one more level to the overall confusion!

Conclusion:

Hopefully the EAQI will be the definitive step in harmonizing an AQI. But I have some doubt that these break-points will be stable for the coming years. As the trend goes to an ever tightening of the tolerated levels, the chances for future stability seem poor.

The web site **airindex.eea.europa.eu** betters that of the CAQI enormously as it includes measuring data all over Europe and shows the time series for the different pollutants.

The last part 5 to be followed asap concludes this series with a discussion of the new Luxembourg AQI introduced a couple of weeks ago with a smart phone app called "Meng Loft" , and which shows that adding confusion is not a privilege of big countries!

(go to part 5)

« AQI: air quality confusion (4)
CO2 storage in superfast magnesite reaction? »

AQI: air quality confusion (5, last part)

This is part 5 (the last part).

Click on the links below for the other parts.

Part 1, 2, 3, 4.

8. The Luxembourg Menu Left AQI (LuxAQI)

8.1. An introduction to the LuxAQI

The 5th May 2010 (or minister of Environment presented a new app called "Mesq Lëft" (which means My AQI for smartphones (IOS and Android). The app has been developed by the company Kaferle Innove (from Capellen) together with the Environment Agency.

Kaferle Innove specializes in geo-based software and created an Europe AQ app. The Environment agency, to be shortened, the last update is from May 2014).

The AQI for Luxembourg City (LuxAQI) is quite different from the EAQI. There are 13 classes, from "Excellent" to "Extreme" (EAQI has only 6 classes, from "Excellent" to "Extreme") and also 19 color shadings.

The core pollutants used are O3, NO2 and PM10. Only 4 stations (2 in Luxembourg City, Esch-Alzette and Bettembourg) measure PM10, so that for instance the whole Northern part of the country of Luxembourg has no PM sensor.

The app is nicely designed, the following picture is a screenshot from my iPhone (latest used at Bettembourg, 28 May, 12:34 local time (13:34 UTC).