

# Changes made by the new daily air quality index

The new UK daily air quality index was launched on 1<sup>st</sup> January 2012 and made changes to the following:

1. The health advice associated with the short-term health effects of air pollution.
2. The pollutants included in the index.
3. The exposure thresholds associated with index levels to align them more closely with World Health Organisations Guidelines, UK air quality objectives and EU Limit Values.
4. The exposure period associated with the indexes for O<sub>3</sub> and PM<sub>10</sub>
5. Introduced indicative “triggers”

Changes to the UK index followed recommendations made by the Committee on the Medical Effects of Air Pollutants (COMEAP) in their 2011 report (COMEAP, 2011).

## Calculation of predicated values for the daily air quality index for PM<sub>2.5</sub>, PM<sub>10</sub> and O<sub>3</sub>

An air quality index should aim to tell people about their pollution exposure as a pollution episode develops. Such early warning enables at risk people to take action and enables pro-active measures to decrease pollution emissions.

Evidence for health impacts of air pollution has always been based on retrospective analysis of air pollution measurements. The mainstay of the evidence for the health effects of O<sub>3</sub> is based on accumulated exposures over eight hours and those for PM<sub>2.5</sub> and PM<sub>10</sub> are based on exposures over one day. An index based on this information alone would only enable us give information about a pollution episode once it is fully developed. This difficulty was recognised by the COMEAP, 2011 who recommended the use of so-called triggers based on hourly pollution measurements. These triggers indicate that current pollution levels are likely to bring about exposure at a greater index level than currently being experienced and can therefore be used for short-term predictions of the air quality index.

Triggers are activated if pollution reaches the identified hourly threshold (time  $t_0$ ) and remains at or above this level in the next hour (time  $t_{+1}$ ).

Having undertaken the original work for COMEAP to calculate the hourly triggers for moderate, high and very high bands we have extended our work to calculate triggers for each of the index levels.

## Index reporting

### *O<sub>3</sub>*

The new index for O<sub>3</sub> is based on exposure over a rolling 8 hours rather than the mixture of hourly and rolling 8 hour exposure used prior to 2012. The thresholds for indices 5-10 have been lowered. The index based on the measured 8 hour rolling average is reported unless an hourly based “trigger” has been activated for a **greater** index level, in which case this is reported.

The following precedence for real time reporting is applied:

- a. An index based on a measured 8 hour rolling average
- b. A predicted higher index based on an activated “trigger” if this is greater than a). “Triggers” for O<sub>3</sub> remain active for the next 5 hours (t<sub>+1</sub> to t<sub>+5</sub>).

It should be noted that the 8 hour rolling exposure is the definitive measurement of air quality and takes precedence over the “trigger” results for retrospective analysis, the “triggers” are only indicative for advance warnings.

### *PM<sub>10</sub> and PM<sub>2.5</sub>*

The index for PM<sub>10</sub> is now based on a fixed midnight to midnight exposure period rather than the previous rolling 24 hour exposure. This means that there is a break point at the start of each day so that the previous evening’s measurements have no impact on the new day’s index. The thresholds for all indices have been lowered. The same criteria have been applied to the indexing of the newly added PM<sub>2.5</sub>. The PM<sub>10</sub> measurements must also be EU reference equivalent.

Once activated the PM<sub>10</sub> and PM<sub>2.5</sub> triggers remain active for the rest of that day, i.e the reporting period.

The near real time reporting of indices for PM<sub>10</sub> and PM<sub>2.5</sub>, is particularly challenging because the measured index is not available until the end of the day (or until a representative 75% data capture has been achieved for the day). This leaves un-reportable the situation where insufficient data is available to report the daily average and no triggers have activated. Sticking with COMEAP’s desire to move away from the previously used rolling 24 hour rolling average we have therefore devised the following reporting regime for those hours not covered by COMEAP’s index definition (as accepted by Defra) or our extended triggering:

Initially it is assumed that each new day will be an average day based on the mean pollution concentration during the previous year. As measurements are made these average hours are replaced by actual measurements, making adjustments from the average day.

e.g if the annual average PM<sub>10</sub> or PM<sub>2.5</sub> for a site is X then we start by assuming that the new day will be an average of 24 hours at the annual mean concentration i.e

X<sub>1</sub>, X<sub>2</sub>, X<sub>3</sub>, X<sub>4</sub>, X<sub>5</sub>, X<sub>6</sub>, X<sub>7</sub>.....X<sub>24</sub> Predicted daily mean

As we collect data each average hour  $X_t$ ....etc, is replaced with actual measurements so after three hours with readings A, B, C the predicted daily mean concentration will be:

A, B, C,  $X_4, X_5, X_6, X_7$ ..... $X_{24}$

### ***In scientific notation***

If the annual average  $PM_{10}$  or  $PM_{2.5}$  for a site is Y then we start by assuming that the new day will be an average of 24 hours at the annual mean concentration i.e

$$\text{Predicted daily mean} = \frac{1}{24} \sum_{t=1}^{24} X_t$$

Where  $X_t = Y$

As we collect data each average hour  $X_t$ ....etc, is replaced with actual measurements so after three hours with readings A, B, C the predicted daily mean concentration will be:

$$\text{Predicted daily mean} = \frac{1}{3} (A + B + C) + \frac{1}{21} \sum_{t=1}^{21} X_t$$

So the predicted new day is assumed to be average until we know differently and is constantly adjusted as we know more, reacting to the most recent measured pollution.

As with the index itself these calculations are based only on reference equivalent concentrations for  $PM_{10}$ .

The following precedence for real time reporting is applied:

- a. The index based on predicted daily average as detailed above if data based on b) or c) is not available.
- b. A predicted index based on an hourly trigger being activated.
- c. The index based on a representative daily mean if this is greater than a) or b)
- d. Final index when all data for the day has been collected

It should be noted that the measured full day exposure d) is the definitive measurement of air quality and takes precedence over a), b) and c) for retrospective analysis; these are only indicative for advance warnings.

## **CO**

This was dropped from the index due to the dramatic reduction in outdoor concentrations. CO remains an important hazard for indoor air pollution.

## **SO<sub>2</sub>**

No change.

## **NO<sub>2</sub>**

Threshold levels for all indexes were reduced to match WHO Guidelines, the EU hourly mean limit and the UK air quality strategy objective.

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