Common Air Quality Index - CAQI in Europe

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CITEAIR’s proposed common index

- Makes the cities comparable across Europe
- Attractiveness for the public, the authorities and the media
- Easily usable by any city
PUBLIC DISPLAY OF AIR QUALITY INFORMATION:
European context and potential for developing a common index
Public information:

- **EU requirement**: EU directives and Aarhus convention
- needed for local policies

Dissemination of modelled or monitored air quality data:

- mostly on the internet
- most widespread way: index ranging from good to bad

Information available for air quality experts:

- Ozone Web (see Ozone Web, ozone.eionet.eu.int)
- AirBase (see airbase.eionet.eu.int)
European context

However:

- **for general public, comparisons are difficult to make:**
  - Different presentations
  - Different interpretation criteria
  - Based on different typologies of stations, not often clearly explained
  - Different methodology of calculation, not often detailed
  - Which monitoring method is being used (e.g. for PM 10) …?
Example: public information in 4 CITEAIR’s cities

- three out of four cities have an index:
  - Scale:
    - Two cities range from 1 to 10
    - The other from 1 to 100
  - Classes:
    - Two cities have 10 classes
    - One has 5
    - One has 4
  - Description of air quality:
    - Two in terms of “good” and “bad”
    - The fourth in terms of pollution levels
    - One in terms of health
  - Class boundaries:
    - Some take into account EU alert thresholds but not for the same class
    - UK index based on health effects
Example: public information in 4 CITEAIR’s cities

- Comparison of the air quality of those 4 cities at a given moment:
  - 4 completely different presentations & qualifications
  - need to search 4 websites

  almost impossible for the general public

E.g.: Local indices compared to the proposed common index on a day of relatively poor dispersion conditions

<table>
<thead>
<tr>
<th>Own city index</th>
<th>Pollutant</th>
<th>Own city classification</th>
<th>CAQI</th>
<th>Pollutant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leicester</td>
<td>4</td>
<td>Ozone</td>
<td>low-moderate</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>PM10</td>
<td>mediocre</td>
<td>64</td>
</tr>
<tr>
<td>Rome</td>
<td>79</td>
<td>Ozone</td>
<td>mediocre</td>
<td>60</td>
</tr>
<tr>
<td>Rotterdam</td>
<td>-</td>
<td>PM10</td>
<td>bad</td>
<td>59</td>
</tr>
</tbody>
</table>
Advantages of air quality indices:

- Simple information **more understandable** by the general public (instead of µg/m³ or ppb)
- **Many of them already available** in different countries / cities
  - provide an homogenous information inside of a country
  - may allow comparison of cities inside of a country

**BUT** such an AQI does not exist at the European scale

- Despite EU common regulations
- Different AQI even sometimes inside of a same country

**CITEAIR’s proposes a common index**
THE COMMON AIR QUALITY INDEX (CAQI):
A compromise
The common index: A COMPROMISE

Between a number of objectives:

- Communication to the general public (target group)
- Scientifically reasonably rigorous
  - presented in different symposiums and to experts for feedbacks
  - representativeness initially tested through one year data from 4 CITEAIR cities
    (van den Elshout et al, 2006)
- Common agreement, at first between the CITEAIR’s partners and review at the end of the project
- Easy to join for any city
The common index: A COMPROMISE

Between existing indices:

- Developed after a review of existing indices
  (UK, Brussels’ POLLUMETER, South African index, French ATMO, US EPA’s AQI…)

- Resembles existing ones
  - the Brussel’s POLLUMETER,
  - the German index
  - and the French ATMO,
The common index: A COMPROMISE

Between technical issues:

CITEAIR can not solve technical issues such as:

- Uniformity in PM measurements
- Data quality control, e.g. site selection of monitoring stations
THE COMMON AIR QUALITY INDEX (CAQI):
Three time scales comparable
The common index: 3 time scales

An **hourly index** for today (D)
- calculated every hours
- **Only concerns the cities able to provide hourly values**
  but of MAJOR INTEREST for the public, the authorities
  and the media

A **daily index** for yesterday (D-1)
- Based on **maximum hourly concentrations of the past day**
- Calculated **once a day**
- Displayed at D on the CITEAIR common website
- Concerns **most cities taking part in this website**
  - *the worst pollutant determines the index*
## The common index: 3 time scales

### Hourly and daily index

#### Common air quality index calculation grid

<table>
<thead>
<tr>
<th>Index</th>
<th>Class</th>
<th>Main Pollutants</th>
<th>Additional Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NO₂</td>
<td>O₃</td>
</tr>
<tr>
<td>Very High</td>
<td>&gt; 100</td>
<td>&gt; 400</td>
<td>&gt; 240</td>
</tr>
<tr>
<td>High</td>
<td>100</td>
<td>400</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>200</td>
<td>180</td>
</tr>
<tr>
<td>Medium</td>
<td>75</td>
<td>200</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>Low</td>
<td>50</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Very Low</td>
<td>25</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- NO₂, O₃, SO₂: hourly value / maximum hourly value in µg/m³
- PM₁₀: hourly value / daily average in µg/m³
- CO: 8 hours moving average / maximum 8 hours moving average in µg/m³
The common index: 3 time scales

Hourly and daily index

CAQI August 2003, Paris agglomeration

Weekly pattern

Index value

Traffic
Background

day of the week (1 = monday)
Comparison of the daily Common AQI (traffic and background) in 4 cities through 1 year of data (April 2004/2005)

Rome:
- Seasonal pattern
  - Winter dominated by PM10 and NO2 (lesser extend)
  - Summer O3

Leicester

Rotterdam

Rome

Paris
The common index: 3 time scales

A year average index
- better takes into account long term exposure
- based on EU annual limit value / target values,
- Concerns all cities taking part in this website

- a distance to reach the EU directives
  (distance to target index
  where targets are derived from the directives).

- the average of the main sub-indices determine the city index.
### The common index: 3 time scales

#### Annual index

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Target value / limit value</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₂</td>
<td>Year average is 40 µg/m³</td>
<td>Year average / 40</td>
</tr>
<tr>
<td>PM10</td>
<td>Year average is 40 µg/m³</td>
<td>Year average / 40</td>
</tr>
<tr>
<td></td>
<td>Number of daily averages above 50 µg/m³</td>
<td>#50 / 35</td>
</tr>
<tr>
<td>Ozone</td>
<td>The target is an 8-hour average value of 120 µg/m³</td>
<td>Max. 8-hour average / 120</td>
</tr>
<tr>
<td>SO₂</td>
<td>Year average is 20 µg/m³</td>
<td>Year average / 20</td>
</tr>
<tr>
<td>Benzene</td>
<td>Year average is 5 µg/m³</td>
<td>Year average / 5</td>
</tr>
<tr>
<td>CO</td>
<td>-</td>
<td>Not calculated</td>
</tr>
</tbody>
</table>

**Calculation basis for the year average index**

- **NO₂**: Year average is 40 µg/m³
- **PM10**: Year average is 40 µg/m³
- **Number of daily averages above 50 µg/m³**: #50 / 35
- **Ozone**: The target is an 8-hour average value of 120 µg/m³
- **SO₂**: Year average is 20 µg/m³
- **Benzene**: Year average is 5 µg/m³
- **CO**: Not calculated
Examples of calculation of the year average index based on air quality data in the cities of Lintz and Munich.
THE COMMON AIR QUALITY INDEX (CAQI):
Comparison of 2 types of public exposure
Two different indices:
Representative of two types of exposure

- An urban background index
  ➔ Representative of the *average background situation of the city*

- A traffic index
  ➔ Showing *typical roadside situation* in the city

Depending on the city’s choice, the index calculation is either based:
- on 1 station
- or on an average of stations,
  solution to be preferred to avoid lack of data
Pollutants taken into account:

- **Main pollutants** (data mandatory):
  - For traffic stations: PM10 and NO2
  - For background stations: O3 ozone is added

- **Additional pollutants** (only if data available):
  - Traffic stations: CO
  - Background stations: SO2

- **Future development**: PM2.5 to be included
CITEAIR’s proposed common index

- Make the cities comparable across Europe
- Attractiveness for the public, the authorities and the media
- Easily usable by any city
A common index linked to people’s preoccupations:

- what is the air quality where I am living compared to where I am traveling
- exposure caused by the traffic vs background conditions
- class borders related as much as possible to EU limit values and alert thresholds: main concern for sensitive people
- long term exposure taken into account through the annual index based on distance the target set by the EU annual limit values (linked to WHO recommendations and health protection)
Attractiveness of a common index

- An index easy to consult
- Through a common international platform
- In addition to local website
- With a standard presentation and interpretation:

www.airqualitynow.org

<table>
<thead>
<tr>
<th>City Name</th>
<th>Roadside Index</th>
<th>Background Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin</td>
<td>36</td>
<td>57</td>
</tr>
<tr>
<td>Brussels</td>
<td>-</td>
<td>36</td>
</tr>
<tr>
<td>Leicester</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Paris</td>
<td>52</td>
<td>64</td>
</tr>
<tr>
<td>Prague</td>
<td>83</td>
<td>-</td>
</tr>
<tr>
<td>Rome</td>
<td>-</td>
<td>78</td>
</tr>
<tr>
<td>Rotterdam</td>
<td>23</td>
<td>27</td>
</tr>
</tbody>
</table>

Legend:
- Air Quality Index Value
  - Very Good: 0 - 25
  - Good: 25 - 50
  - Medium: 50 - 75
  - Bad: 75 - 100
  - Very Bad: > 100
Attractiveness of a common index

- **Value added of a new common index:**
  - A simple, comparable and up to date AQ information
    - from different cities across Europe
    - for the pollutants of main concern
    - inspired by EU regulations

- **An index technically innovative:**
  - Traffic and urban background are presented separately:
    - which currently only exists for Brussels
  - 3 time scales for a better understanding: hourly, daily and annual
A dynamic index to entice repeated visits

- Hourly index, hourly updates for the current day
- Class borders chosen to allow for changing pollutants determining the index.

But class borders are not linked with short term health effects to avoid an index:

- always low and not dynamic enough
- which would be confusing when local communication is based on hot spots and exceedences of the EU regulations
CITEAIR’s proposed common index

- Would make the cities comparable across Europe
- Attractiveness for the public, the authorities and the media
- Easily usable by any city
The Common Air Quality Index has been made easy for the cities to join in.

- **An hourly index** when possible

- **To avoid a restricted participation**: a daily and a yearly index have been developed enabling cities with particular monitoring devices or validation procedures to join in.

- **Data from one station or from several ones** (to be preferred)

- **Data transfer is automated and the procedure is easy to use**

- **Index calculation is automatically made** by the common web site

- **A link to the local monitoring network is provided** for detailed information on the local air quality conditions
But:

- We take for granted what is provided by the cities
- CITEAIRS’ common index makes comparisons possible but will not replace the existing and more detailed local information
  - people are used to their own index,
  - local indices are adjusted to local situations
- The proposed indices and its supporting common web site are not designed for compliance checking, but to give a dynamic picture of the environmental situation in each city
CITEAIR will not solve existing technical issues, but…

- Would make the cities comparable across Europe
- Takes into account 2 types of exposure: traffic and background
- Made attractive for the public and the media: hourly updated
- Enables hourly, daily and annual comparisons possible
- Is easily usable by any city: independently of the monitoring devices and the validation procedure used
Thank you for your attention

www.airqualitynow.org