



Informing you on ambient air quality
in the Belgian Regions

An Air Quality App for Belgium using data from SWE services

Olav Peeters
peeters@irceline.be

Bram Vandeninden
vandeninden@irceline.be

Belgian Interregional Environment Agency (IRCEL - CELINE)

Content

- Existing geodata services
- New components within our infrastructure
- Citizen science
- The air quality app

irCEline
Informing you on ambient air quality
in the Belgian Regions

NL EN FR DE
Search Site

Air Quality Documentation About Us Forum

You are here: Home

Belgian Interregional Environment Agency (IRCEL - CELINE)

Current Air Quality Measurements:

Last update: Wednesday 25 June 2014, 13:00

change time

NO₂ - hourly mean PM₁₀ - running 24 hour mean O₃ - hourly mean

good moderate bad

The **relATMO** index

	yesterday (observation)	today (forecast)	tomorrow (forecast)
Belgium	fairly good - 4	fairly good - 4	fairly good - 4
Flanders	fairly good - 4	fairly good - 4	moderate - 5
Brussels	fairly good - 4	fairly good - 4	moderate - 5
Wallonia	moderate - 5	fairly good - 4	moderate - 5

Subscribe to our mailing list

Email Address * indicates required

First Name

Last Name

SMOG

☐ English
☐ Nederlands
☐ Français
☐ Deutsch

Email Format

☐ html
☐ text

Subscribe

Forecast

today:

NO₂ (maximum daily 1-hour mean) PM₁₀ (daily mean) O₃ (maximum daily 1-hour mean)

tomorrow:

NO₂ (maximum daily 1-hour mean) PM₁₀ (daily mean) O₃ (maximum daily 1-hour mean)

News - nieuws - nouvelles - Neuigkeiten

Gaat het met luchtkwaliteit in ons land effectief de slechte kant op?

May 04, 2014

Annual Report Air Quality in Belgium 2011

Mar 26, 2013

More...

Site Map Accessibility Contact

The Plone® Open Source CMS/WCM is © 2000-2014 by the Plone Foundation and friends. Distributed under the GNU GPL license.

This Plone Theme brought to you by Simples Consultants.

IRCEL – CELINE

<http://www.irceline.be>

- Real-time data
- All major pollutants (incl. BC)
- Forecasts
- Information about pollutants
- Publications
- *etc.*

Integration of OGC-services
(download and viewing)
into website

... and tables with (real-time) data:

irCEline
Informing you on ambient air quality
in the Belgian Regions

NL EN FR DE
Search Site

You are here: Home / Air Quality / Measurements / Nitrogen Dioxide

Nitrogen Dioxide

RIO interpolation map table with detailed info per monitoring site

search for address...

Measurements

- Particulate Matter
- Ozone
- Nitrogen Dioxide
 - Information
 - Last 15 days
 - Exceedances
 - History
 - Forecast
 - RIO-IFDM annual mean 2012
- Air Quality Index
- Meteorological Observations
- Monitoring Stations

Nitrogen Dioxide

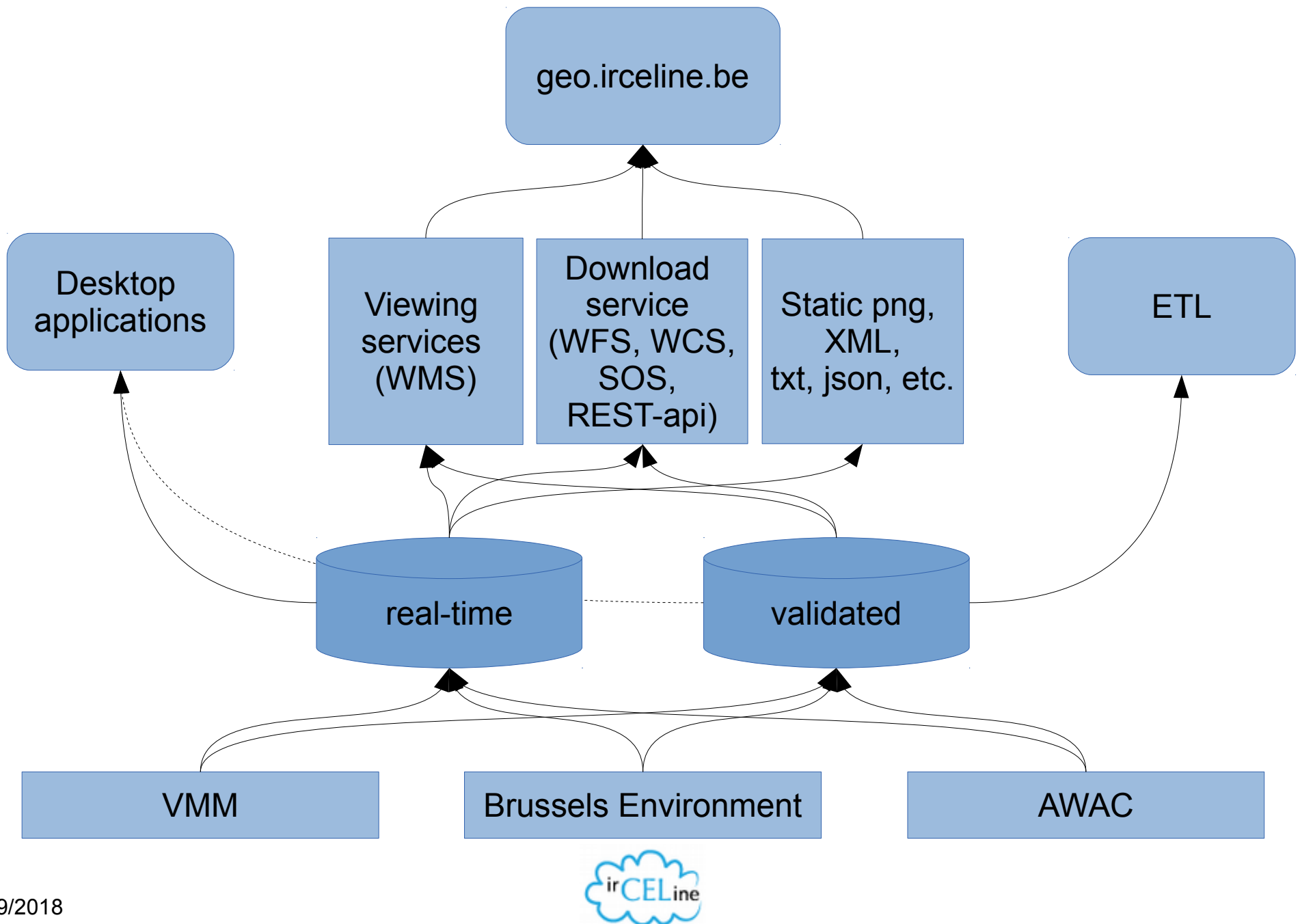
RIO interpolation map table with detailed info per monitoring site

Tuesday 19/11/2013: 16u00 update (local time)
for detailed information click on station codes

STATION			Actual values	highest 1-hour average today	data received	
code	city	region	µg/m³	at (local time)	till (local time)	
41B004	Brussel (Sint-Katelijne)	Bxl	45	70	10:00	16:00
41B006	Brussel (EU Parlement)	Bxl	53	65	11:00	16:00
41B008	Brussel (Bellardstraat)	Bxl	81	95	10:00	16:00
41B011	Sint-Agatha-Berchem	Bxl	34	67	10:00	16:00
41MEU1	Neder-Over-Heembeek	Bxl		49	10:00	14:30
41N043	Voorhaven (Haren)	Bxl	43	81	09:00	16:00
41B001	Sint-Jans-Molenbeek	Bxl	56	69	10:00	16:00
41B002	Elsene	Bxl	84	91	10:00	16:00
41B012	Ukkel	Bxl	34	53	11:00	16:00
41W011	Sint-Lambrechts-Woluwe	Bxl	56	71	10:00	16:00
41G013	Vorst	Bxl	39	52	10:00	16:00
40C001	Oostrozebeke	Vla	18	33	01:00	16:00



Geodata services at IRCEL-CELINE



Documentation open data endpoints

<http://www.irceline.be/en/documentation/open-data>

https://github.com/irceline/open_data

The screenshot shows the 'Open data' section of the irCEline website. The header includes the irCEline logo, navigation links (Air Quality, Documentation, About Us, Forum), and a search bar. The 'Open data' sidebar is highlighted. The main content area explains that data is published via open data endpoints under the Creative Commons Attribution 4.0 license. It provides a list of data viewers and their corresponding URLs, such as http://geo.irceline.be/www/pm10_24hmean_EN.html. It also includes a list of abbreviations and a list of used abbreviations. A code snippet for an iframe is provided: `<iframe height="600" width="100%" src="http://geo.irceline.be/www/pm10_24hmean_EN.html"></iframe>`. The footer contains logos for Air Climat, Vlaamse MilieuMaatschappij, and social media links.

The screenshot shows the GitHub repository page for 'irceline / open_data'. The repository has 16 commits, 1 branch, 0 releases, and 1 contributor. The file list includes 'datasets', 'readme.md', and 'link measurements.md'. The 'readme.md' file is selected, showing the title 'Open (geo)data IRCEL-CELINE', the license 'https://creativecommons.org/licenses/by/4.0/', and the catalog service for the web (CSW). The metadata is hosted via <http://geo.irceline.be/csw> (under construction). The documentation specific CSW implementation is <http://geonetwork-opensource.org/manuals/trunk/eng/users/index.html>. The general documentation of the OGC standard for CSW is <http://www.opengeospatial.org/standards/cat>.

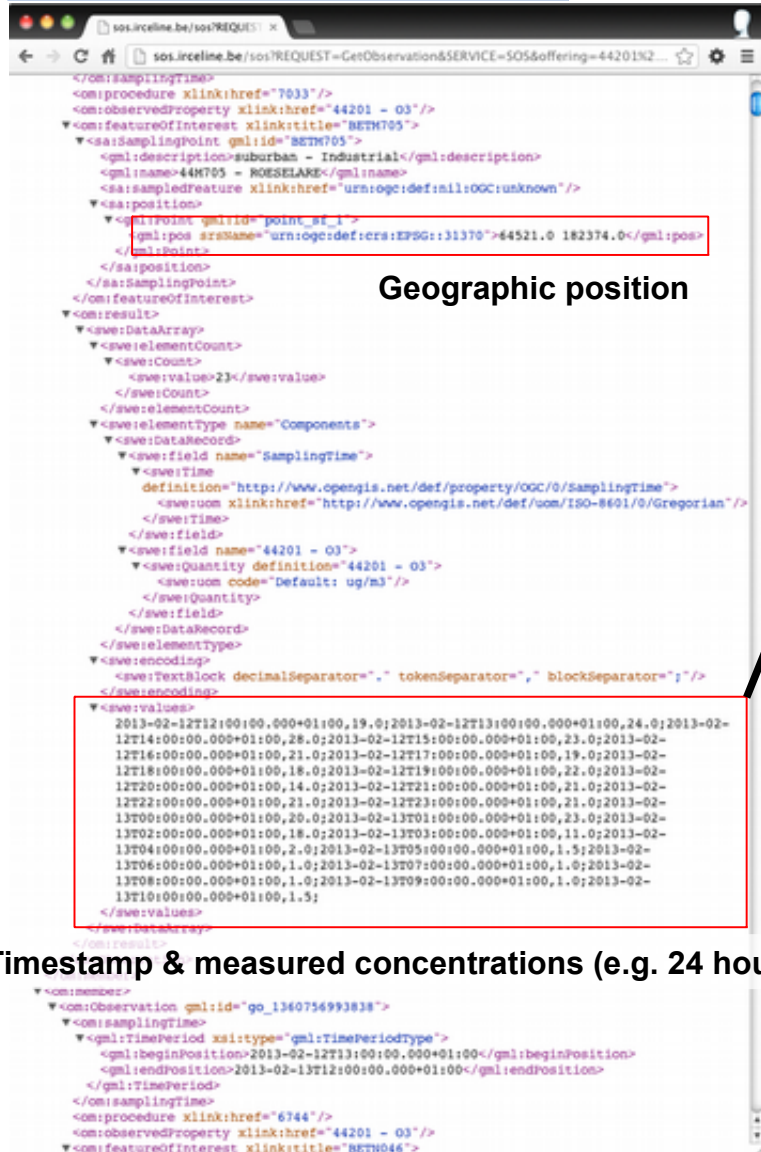


Sensor observation services (SOS)

... an INSPIRE compliant downloading service

<http://geo.irceline.be/sos>

- Efficient transmission of time series



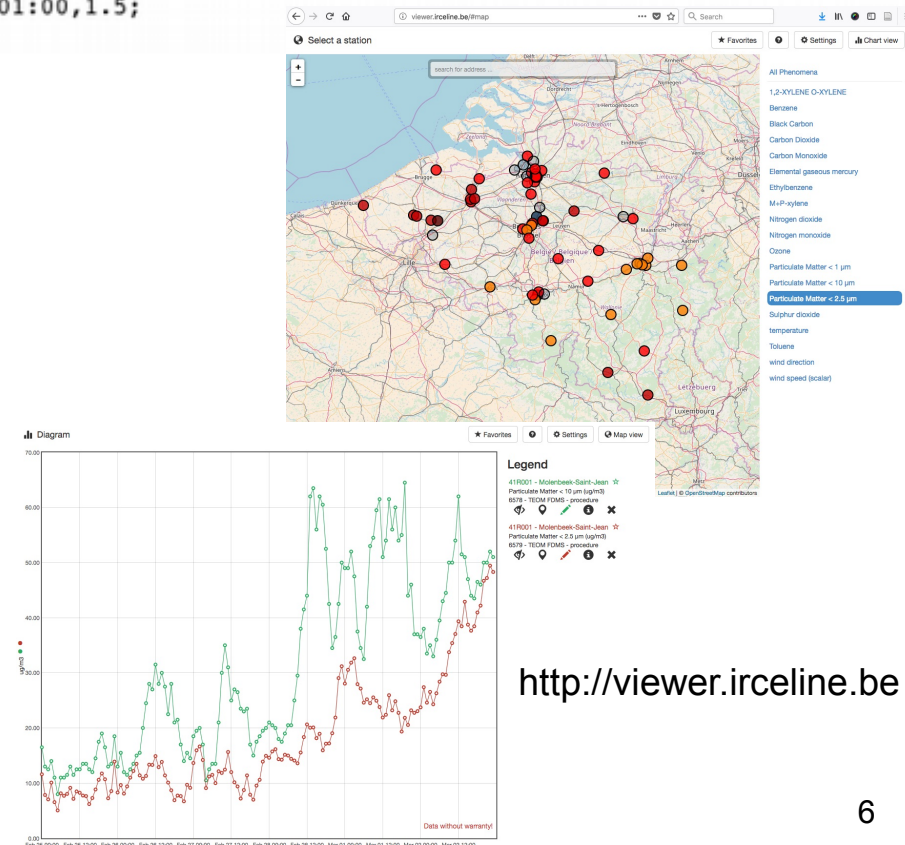
Geographic position

Timestamp & measured concentrations (e.g. 24 hours)

```
<swe:encoding>
  <swe:TextBlock decimalSeparator="." tokenSeparator="," blockSeparator=";"/>
</swe:encoding>
<swe:values>
  2013-02-12T12:00:00.000+01:00,19.0;2013-02-12T13:00:00.000+01:00,24.0;2013-02-
  12T14:00:00.000+01:00,28.0;2013-02-12T15:00:00.000+01:00,23.0;2013-02-
  12T16:00:00.000+01:00,21.0;2013-02-12T17:00:00.000+01:00,19.0;2013-02-
  12T18:00:00.000+01:00,18.0;2013-02-12T19:00:00.000+01:00,22.0;2013-02-
  12T20:00:00.000+01:00,14.0;2013-02-12T21:00:00.000+01:00,21.0;2013-02-
  12T22:00:00.000+01:00,21.0;2013-02-12T23:00:00.000+01:00,21.0;2013-02-
  13T00:00:00.000+01:00,20.0;2013-02-13T01:00:00.000+01:00,23.0;2013-02-
  13T02:00:00.000+01:00,18.0;2013-02-13T03:00:00.000+01:00,11.0;2013-02-
  13T04:00:00.000+01:00,2.0;2013-02-13T05:00:00.000+01:00,1.5;2013-02-
  13T06:00:00.000+01:00,1.0;2013-02-13T07:00:00.000+01:00,1.0;2013-02-
  13T08:00:00.000+01:00,1.0;2013-02-13T09:00:00.000+01:00,1.0;2013-02-
  13T10:00:00.000+01:00,1.5;
</swe:values>
```

- queryable:

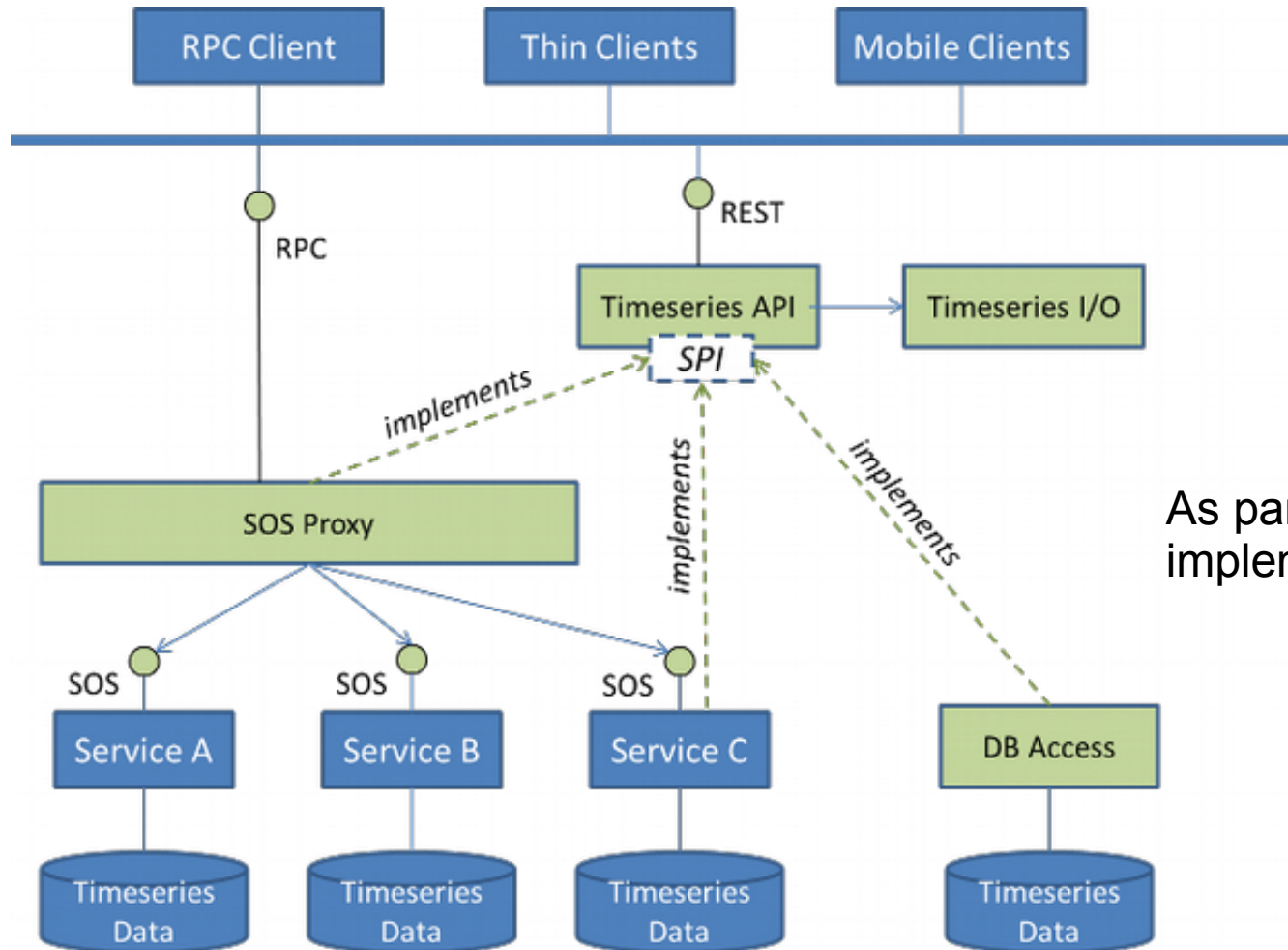
Extended for
e-reporting
since version
4.3.x



Faster data access via a REST-api

<http://geo.irceline.be/sos/api/v1/>

<http://geo.irceline.be/sos/static/doc/api-doc/> (documentation)



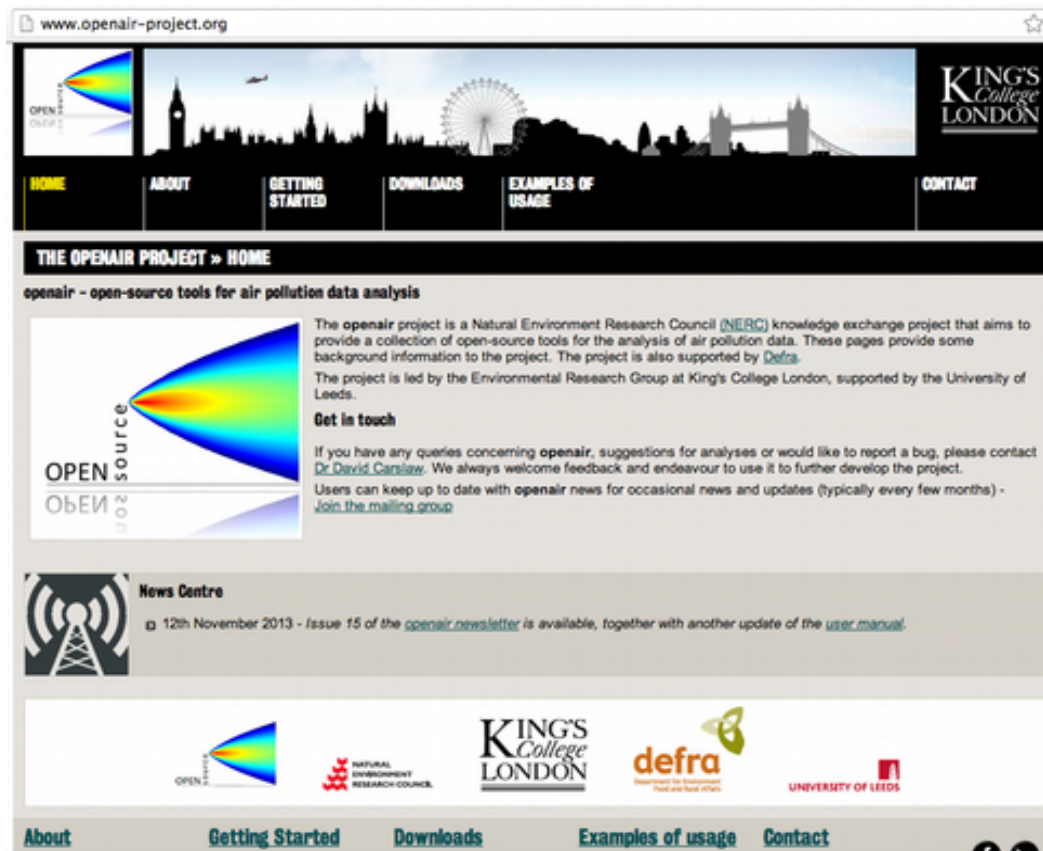
As part of the SOS implementation of 52°North



<https://github.com/52North/helgoland>
<https://github.com/52North/series-rest-api>

Shiny webapps for advanced interactive R-analyses

<http://www.openair-project.org>



A package for R specifically for the **air quality** community

How to integrate the power of R into an SDI?

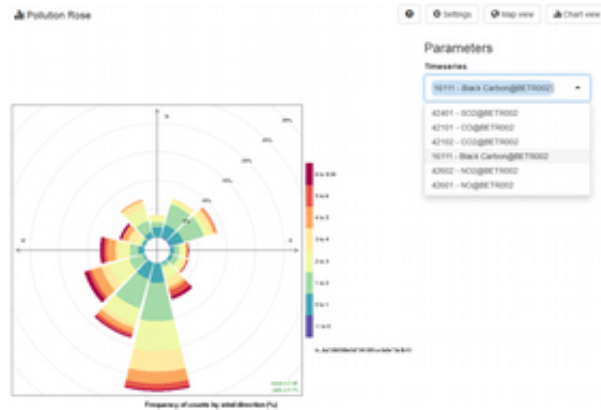
- SOS4R: existing SOAP (xml) based implementation → too slow for longer time series



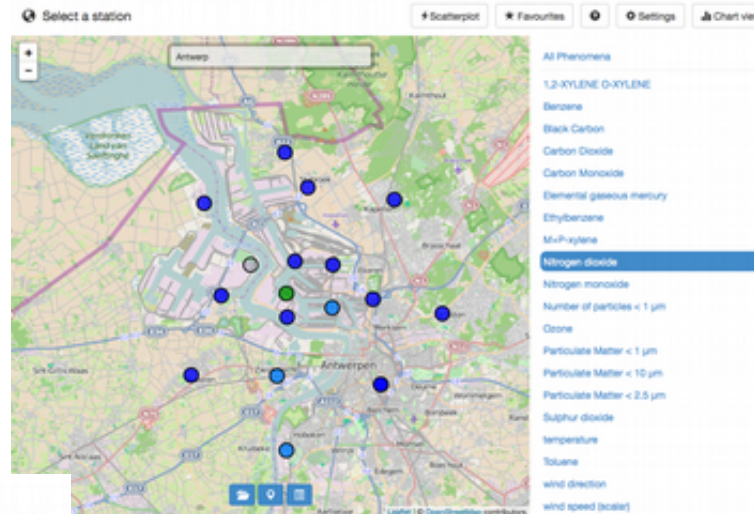
<http://shiny.rstudio.com/>

Shiny webapps for advanced interactive R-analyses

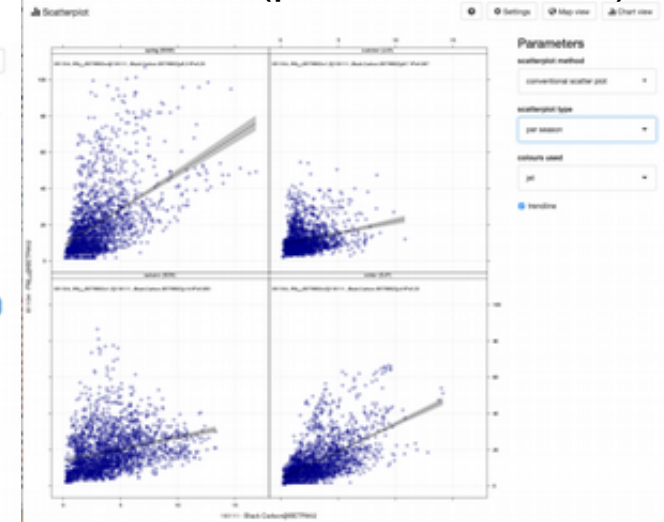
PollutionRose



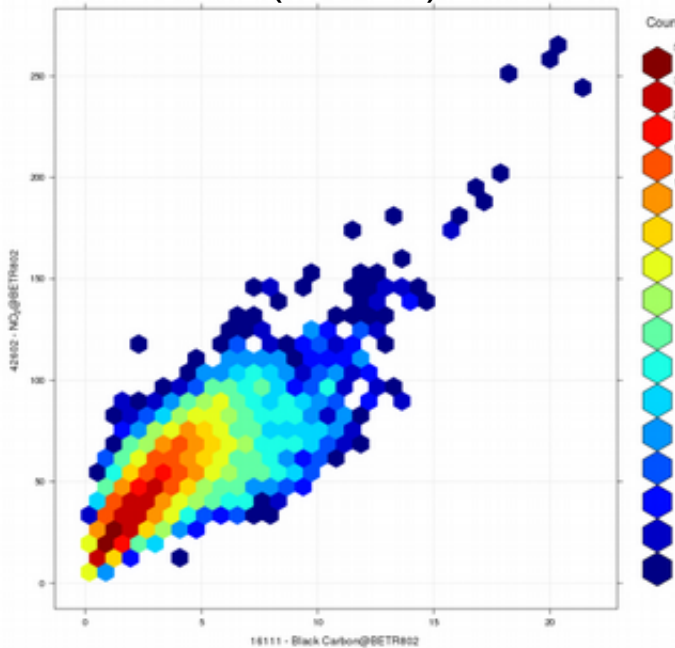
Select time series (jsClient)



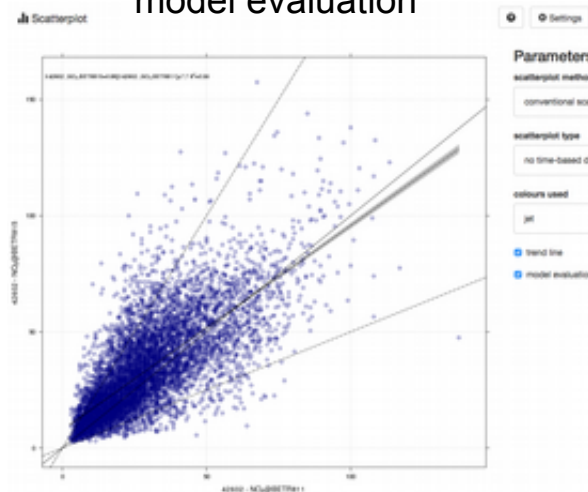
scatterPlot (per season, etc.)



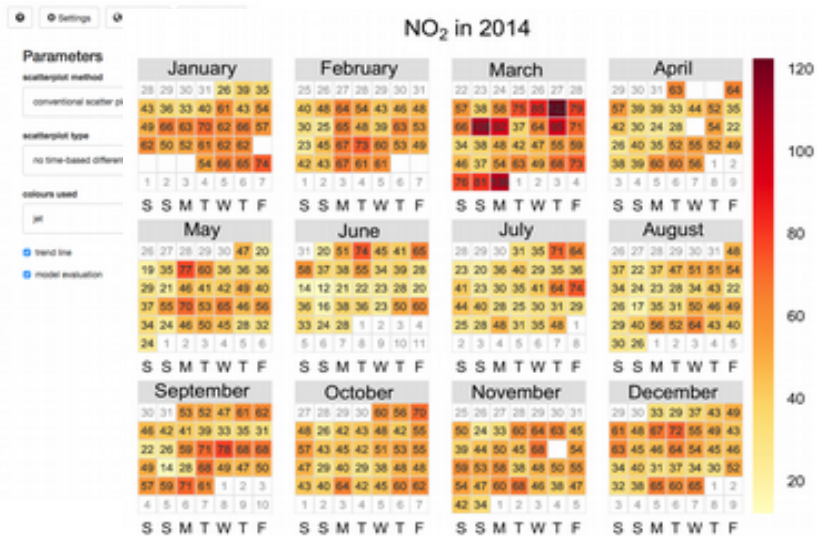
ScatterPlot (hexbin)



scatterPlot with model evaluation



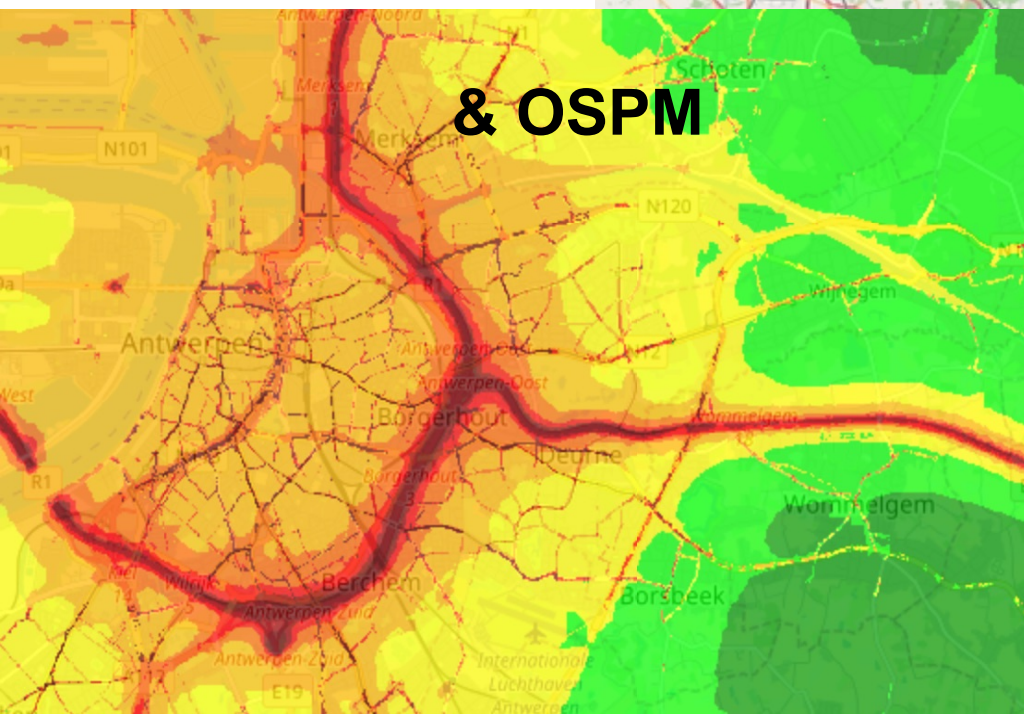
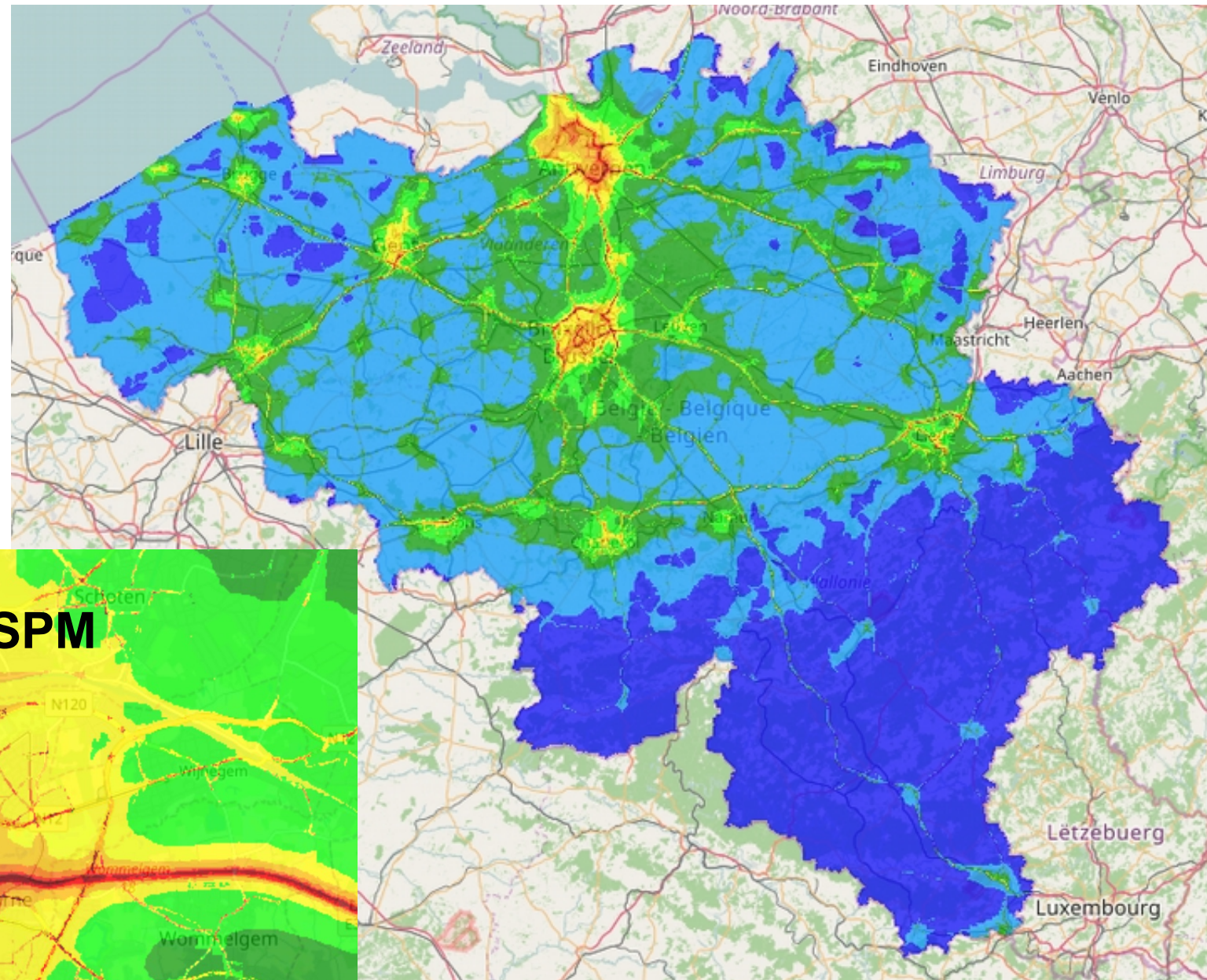
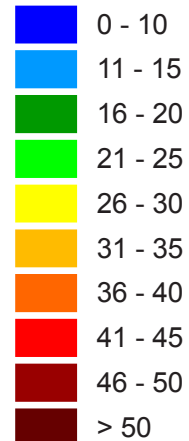
calendarPlot



Hi resolution model (RIO-IFDM)

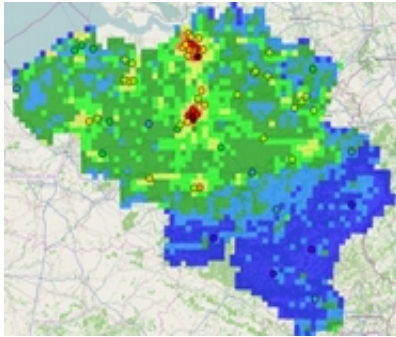
Nitrogen dioxide
(NO₂)
annual mean

microgram/m³



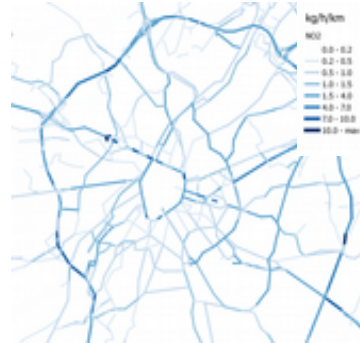
& OSPM

Hi resolution air quality model



RIO
background

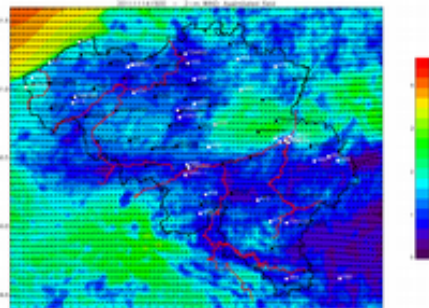
+



Line source
emissions



+

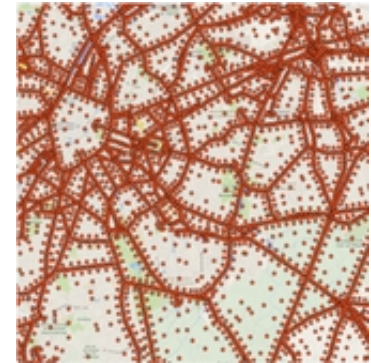


Assimilated meteo

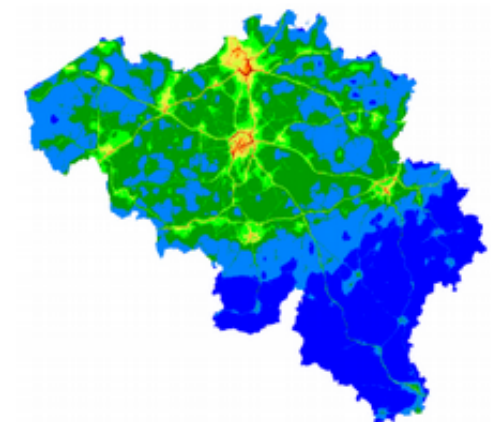
+



Point source
emissions

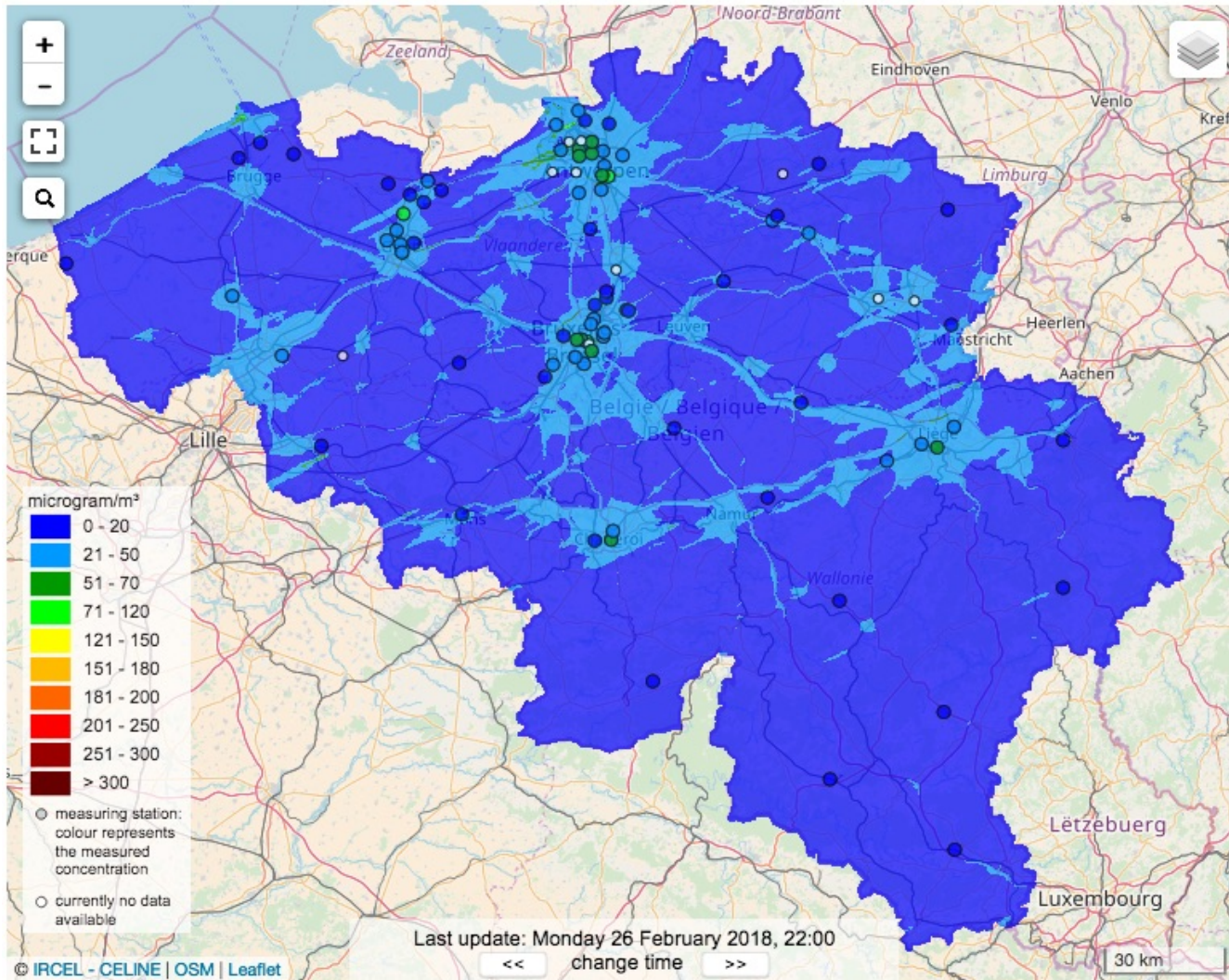


Grid of receptor
points



Hourly RIO-IFDM
Air Quality Index

real-time RIO-IFDM



Population Exposure Nitrogen Dioxide (NO₂)

concentration class	percentage inhabitants	cumulative percentage inhabitants
0 - 20	52.3	100
21 - 50	47.2	47.7
51 - 70	0.4	0.4

For the following pollutants:
BC, NO₂, O₃, PM₁₀ & PM_{2.5}

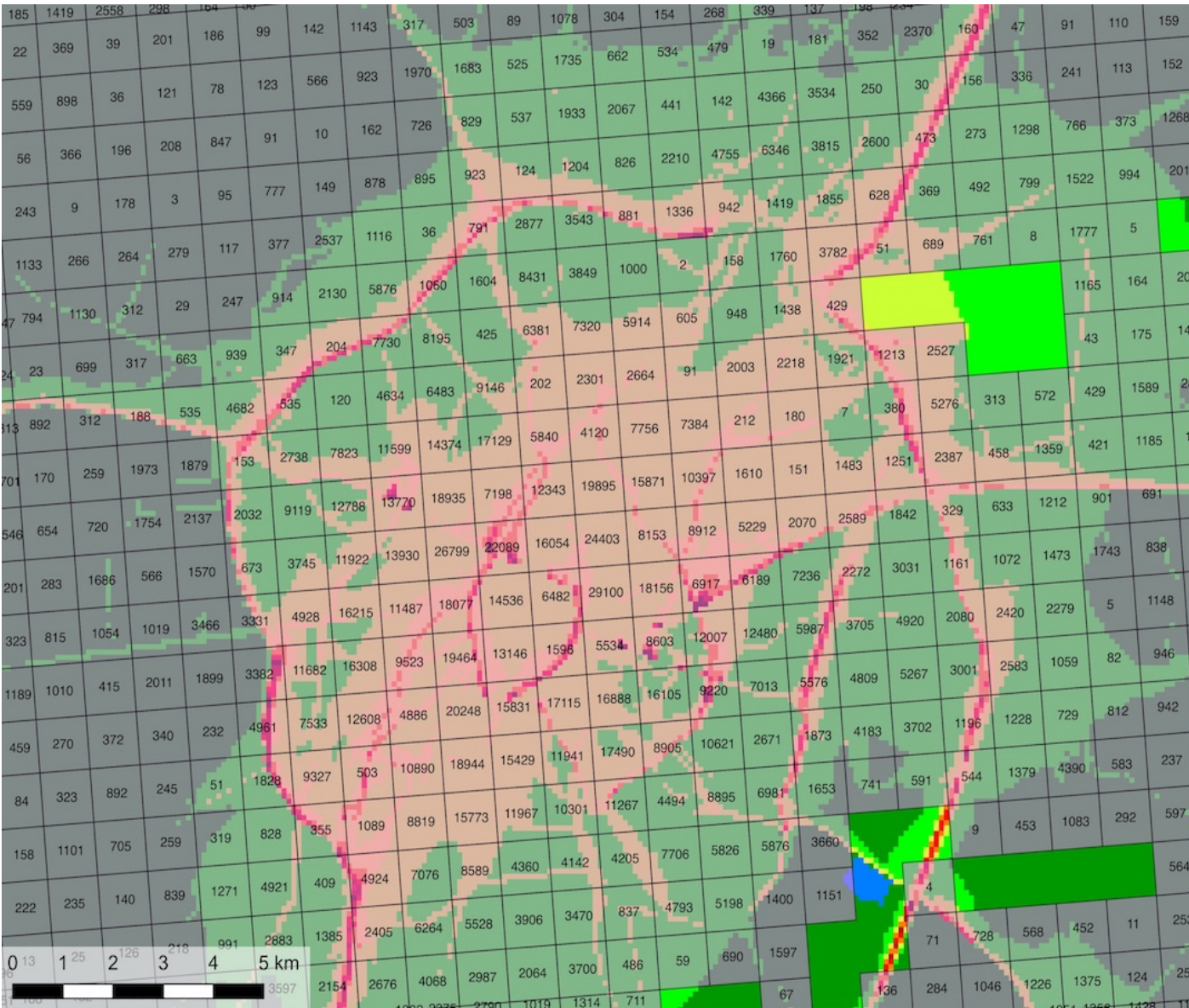
BUMBAir.be

<http://www.bumbair.be>

04/09/2018

last update: 2018-02-26 19:00:00+01

Population exposure



- the best population data set for the whole of Belgium: data from Census 2011 (Geostat – a Eurostat project)
http://census2011.fgov.be/idk/idk4_nl.html

- Bin RIO-IFDM to Geostat grid (mean concentration per grid cell)

- exposure calculated every hour for BC, NO₂, O₃, PM₁₀ & PM_{2.5}

http://www.irceline.be/air/pop_exp_bc.php
http://www.irceline.be/air/pop_exp_no2.php
http://www.irceline.be/air/pop_exp_o3.php
http://www.irceline.be/air/pop_exp_pm10.php
http://www.irceline.be/air/pop_exp_pm25.php

Under development:
XML and Json version

Web Coverage Service (WCS)

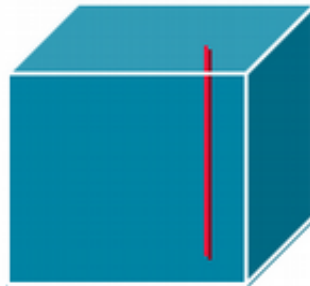
subset

=

trim

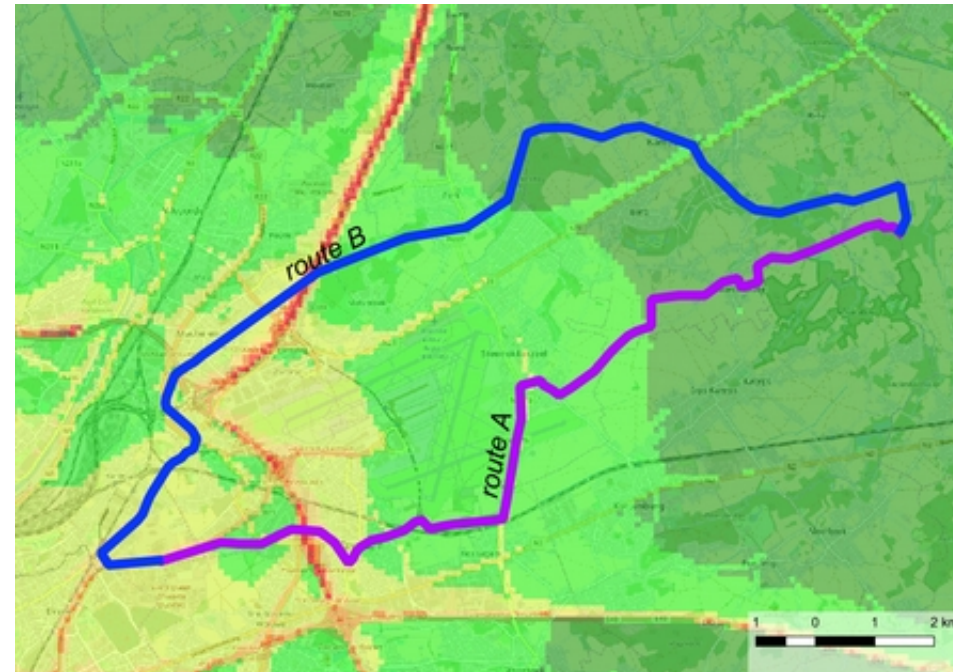


slice



- OGC-standard

- Can be used for further processing,
e.g. to calculate the healthiest route:



- to compare measurement results

http://geo.irceline.be/rioifdm/no2_hmean/wcs/

SERVICE=WCS&REQUEST=GetCoverage&coverageid=rioifdm__no2_hmean&FORMAT=image/tiff
&subset=X,[http://www.opengis.net/def/crs/EPSSG/0/EPSSG:31370\(108950,138950\)](http://www.opengis.net/def/crs/EPSSG/0/EPSSG:31370(108950,138950))&subset=Y,[http://www.opengis.net/def/crs/EPSSG/0/EPSSG:31370\(108950,138950\)](http://www.opengis.net/def/crs/EPSSG/0/EPSSG:31370(108950,138950))&subset=time(%222018-02-26T09:00:00Z%22)&version=2.0.1

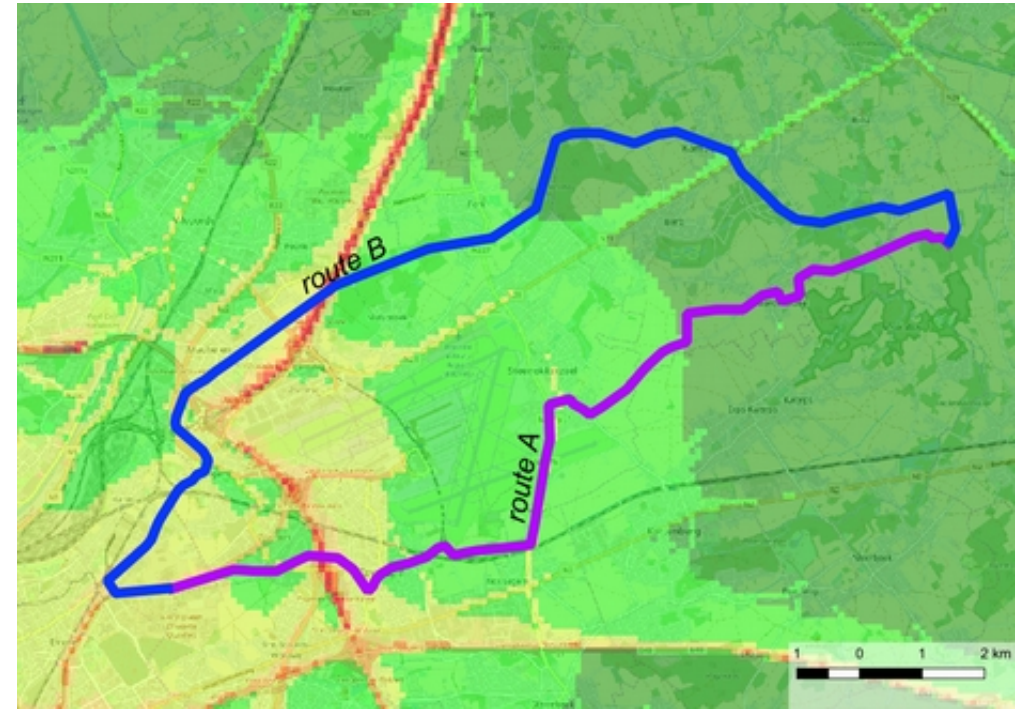


<http://docs.geoserver.org/latest/en/user/services/wcs/reference.html>

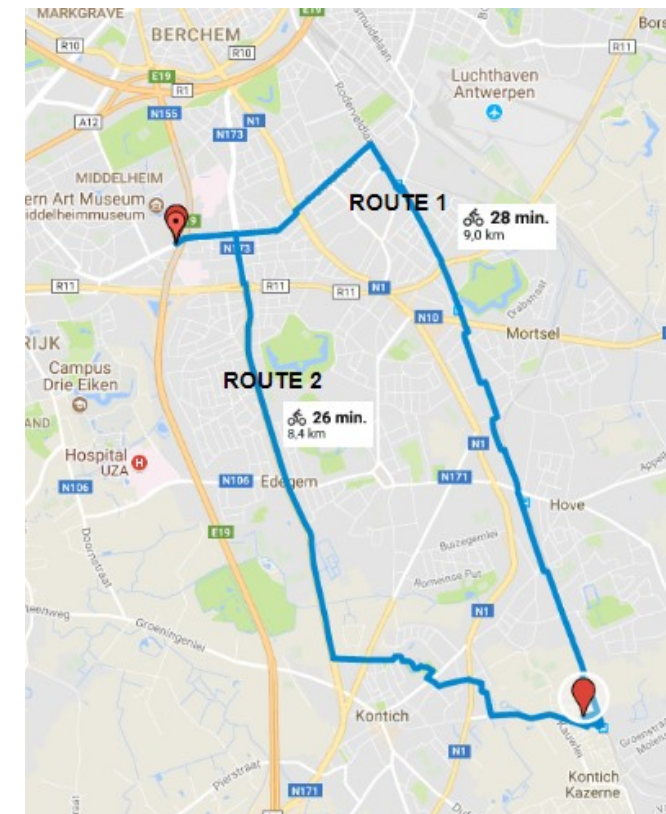
BE-GOOD

<http://www.nweurope.eu/begood>

- Focus open data
- API healthiest route
- Interreg NWE project
- Until 2020 (duration 4 years)
- BE-GOOD criteria
- Transnational exchange
 - Building an API in such a fashion that it can be implemented transnationally
 - We can adopt developments from other partners
- “Innovative procurement”

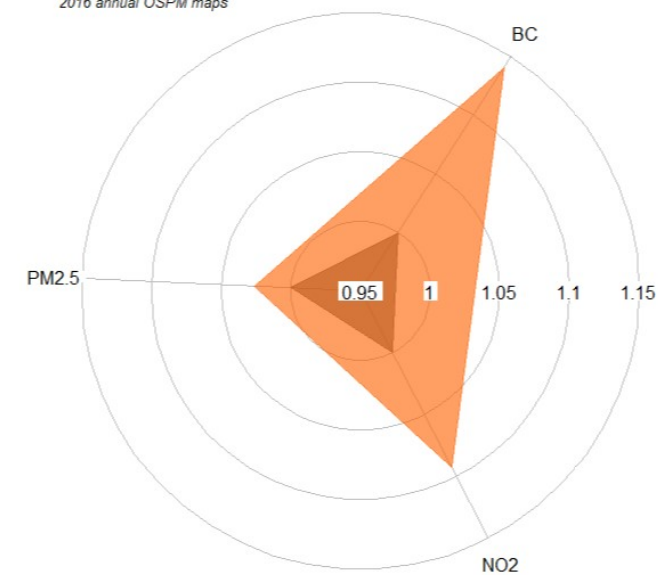
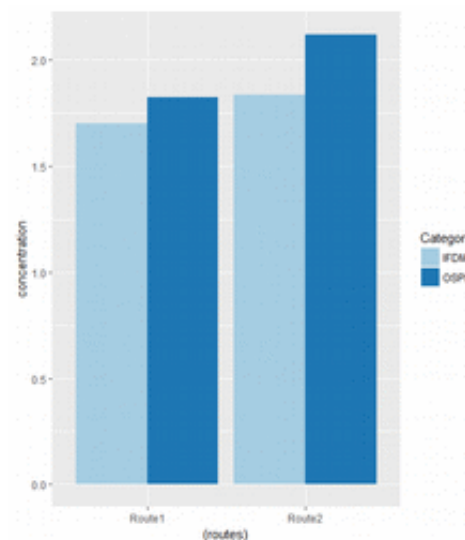
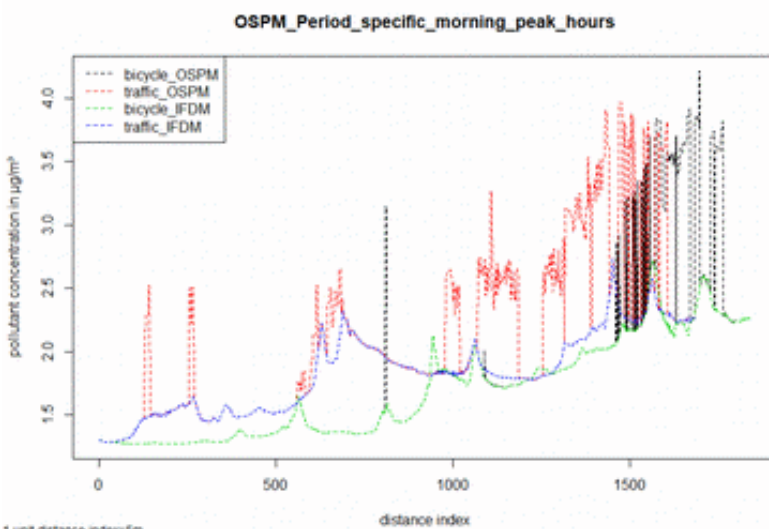


Validation of the route evaluation



Bicycle highway=1.0 for each pollutant
 Air pollution: Traffic road and bicycle highway by comparison
 2016 annual OSPM maps

Comparing with results of:
 Hofman, J. *et al.* "Cyclist exposure to black carbon, ultrafine particles and heavy metals: An experimental study along two commuting routes near Antwerp, Belgium." Environmental Research. Volume 164, July 2018, Pages 530-538



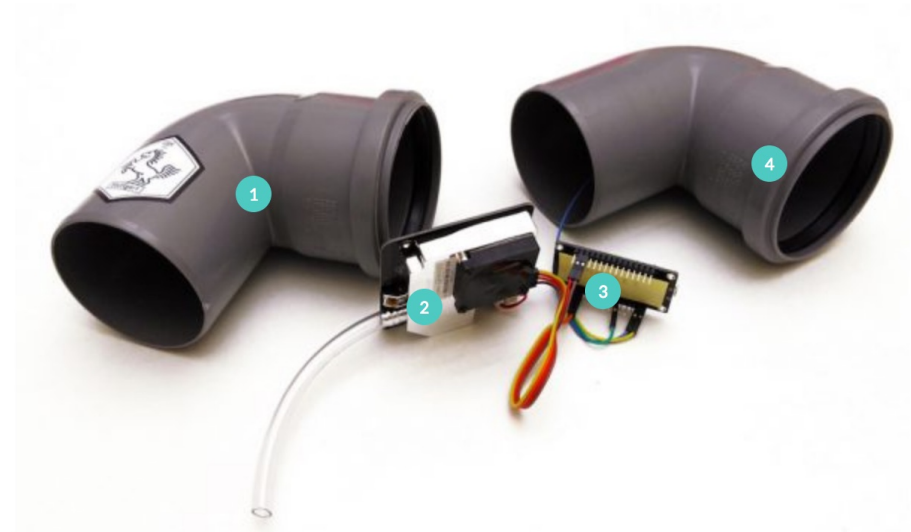
Corona-EU

- Partners: Irish EPA, Informatie Vlaanderen, NILU, VMM
- Improve user friendliness of open data
- Specific output:
 - Download button under every map/table within the context of the website of IRCELINE/VMM
 - A database for citizen science
 - Viewer to compare own measurements with reference measurements



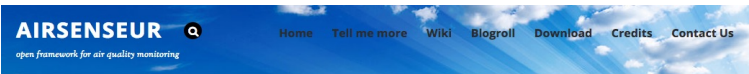
VAQUUMS

- Project partners: RIVM, ECN, VMM
- Low-cost measurements (citizen science, communes, etc.)
- Specific output:
 - Evaluation low-cost sensors (database with info)
 - Data acquisition
 - Web platform
 - SOP's for low cost sensors

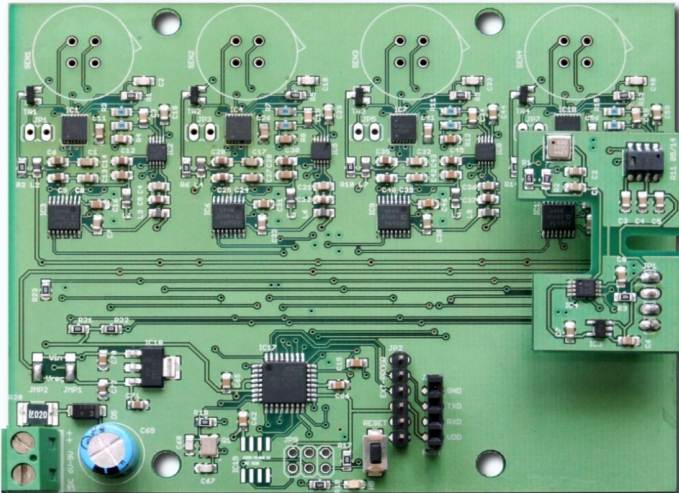


collaboration citizen science initiatives

<http://www.airsenseur.org/>



AIRSENSEUR SHIELD



The AirSenseur shield is the first of a set of shields composing the AirSenseur framework. The AirSenseur shield features four low cost three leads gas sensors and related programmable analog front ends plus analog to digital conversion stages. An ancillary board contains sensors for temperature, relative humidity and pressure measurements.

The AirSenseur shield is based on ATmega328 micro controller and is compatible with Arduino (TM) IDE. The AirSenseur shield is the best option for people searching an open, programmable, and accurate, platform for air quality and gas sensors measurements.

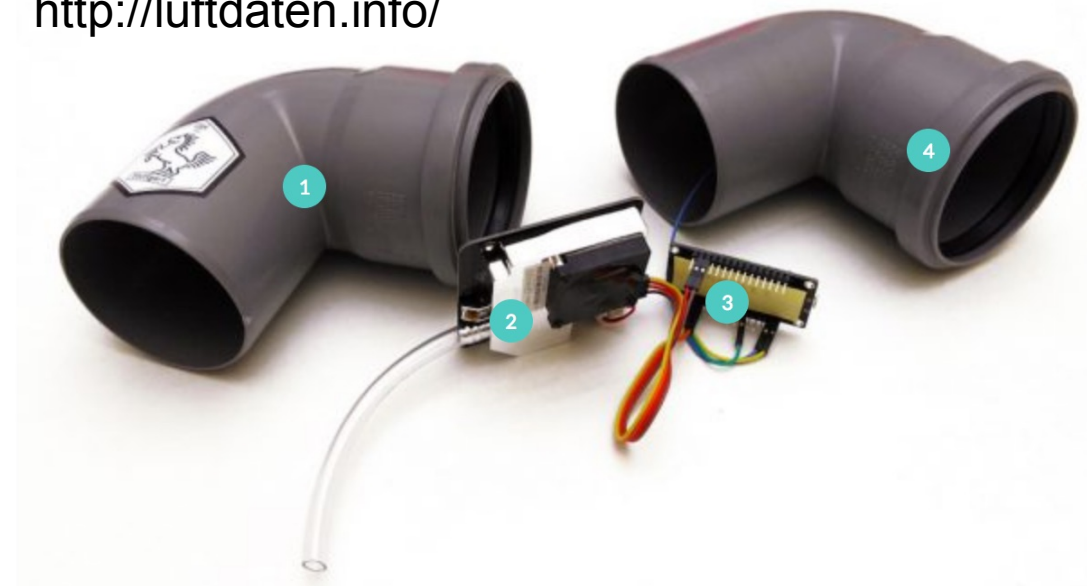
Here are the main technical characteristics:

- Four chemical sensor low noise, I2C programmable, analog front ends
- Four high speed, high precision, low noise analog front end
- Four low noise, low temperature drift, accurate four channel digital to analog converters to synthesise high precision references for analog front ends and analog converters
- Ancillary temperature, pressure and humidity, factory calibrated sensors
- Ancillary opto insulated USB 2 serial converter board provides connection with an optional external host
- Onboard ATmega328 with optiboot and Arduino(TM) USB2Serial connector compatible
- Onboard 5V linear supply

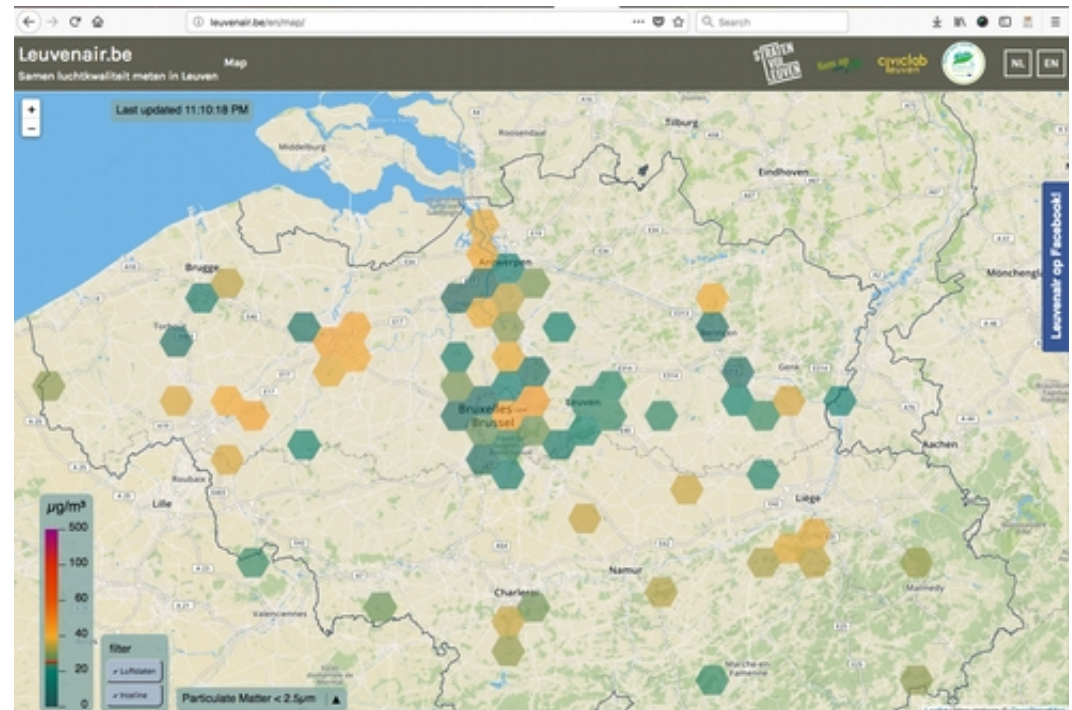
A deep analysis on AirSenseur features can be found on the official repository.

[DOWNLOAD REFERENCES](#)

<http://luftdaten.info/>

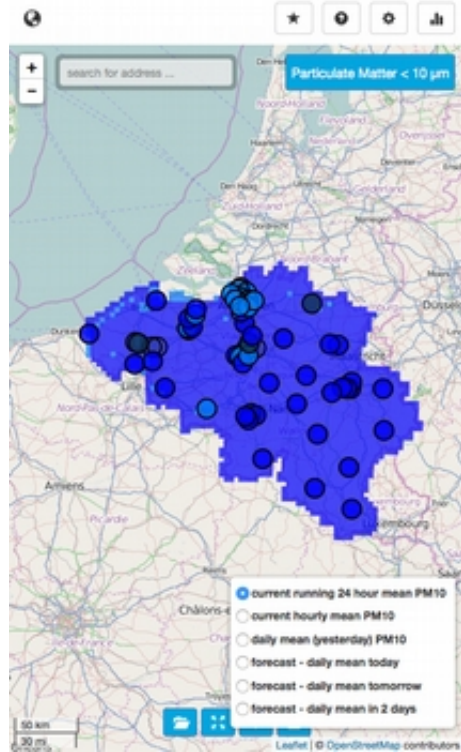


<http://leuvenair.be/>

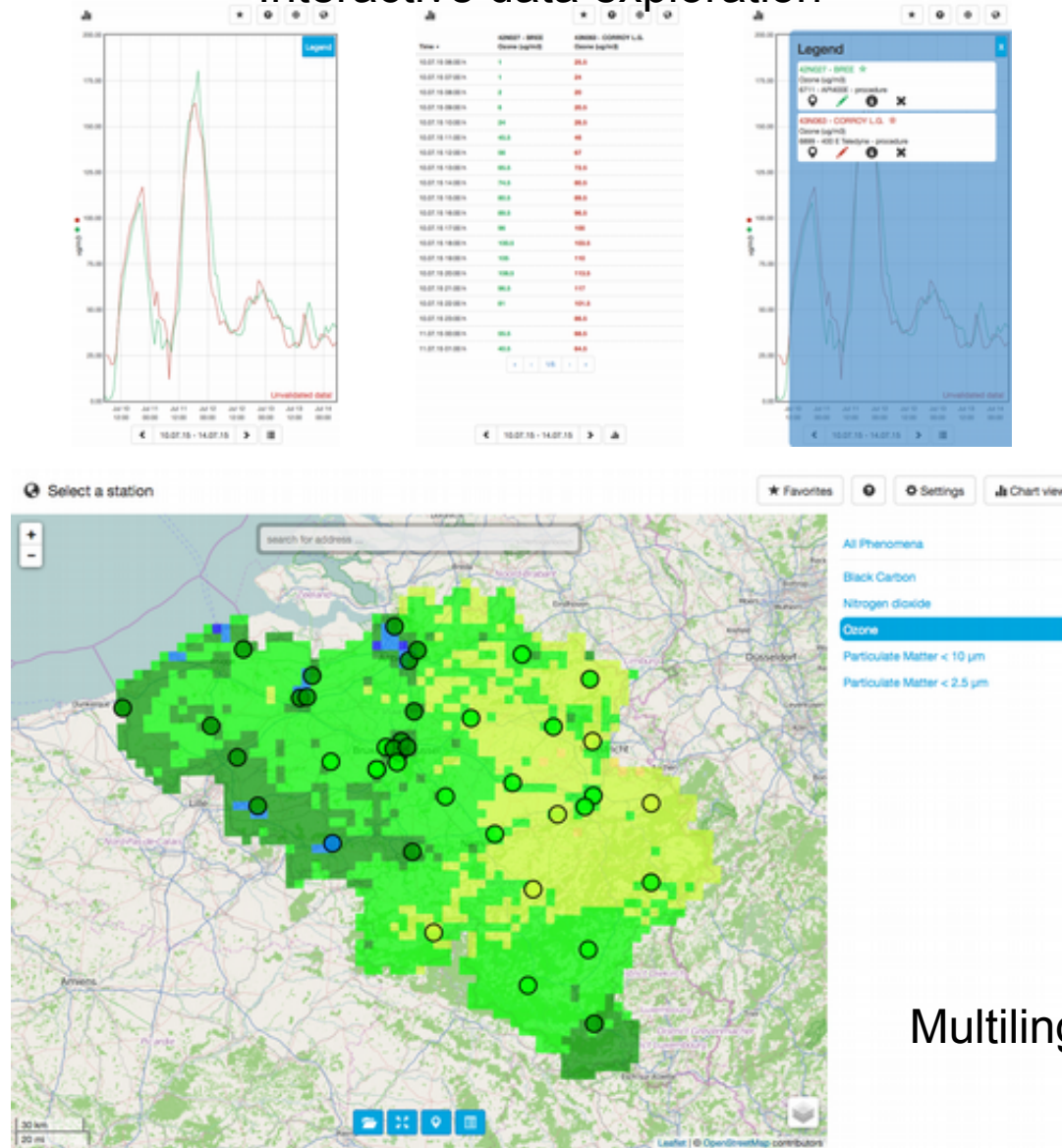


An air quality app (old version)

Real-time data



Interactive data exploration



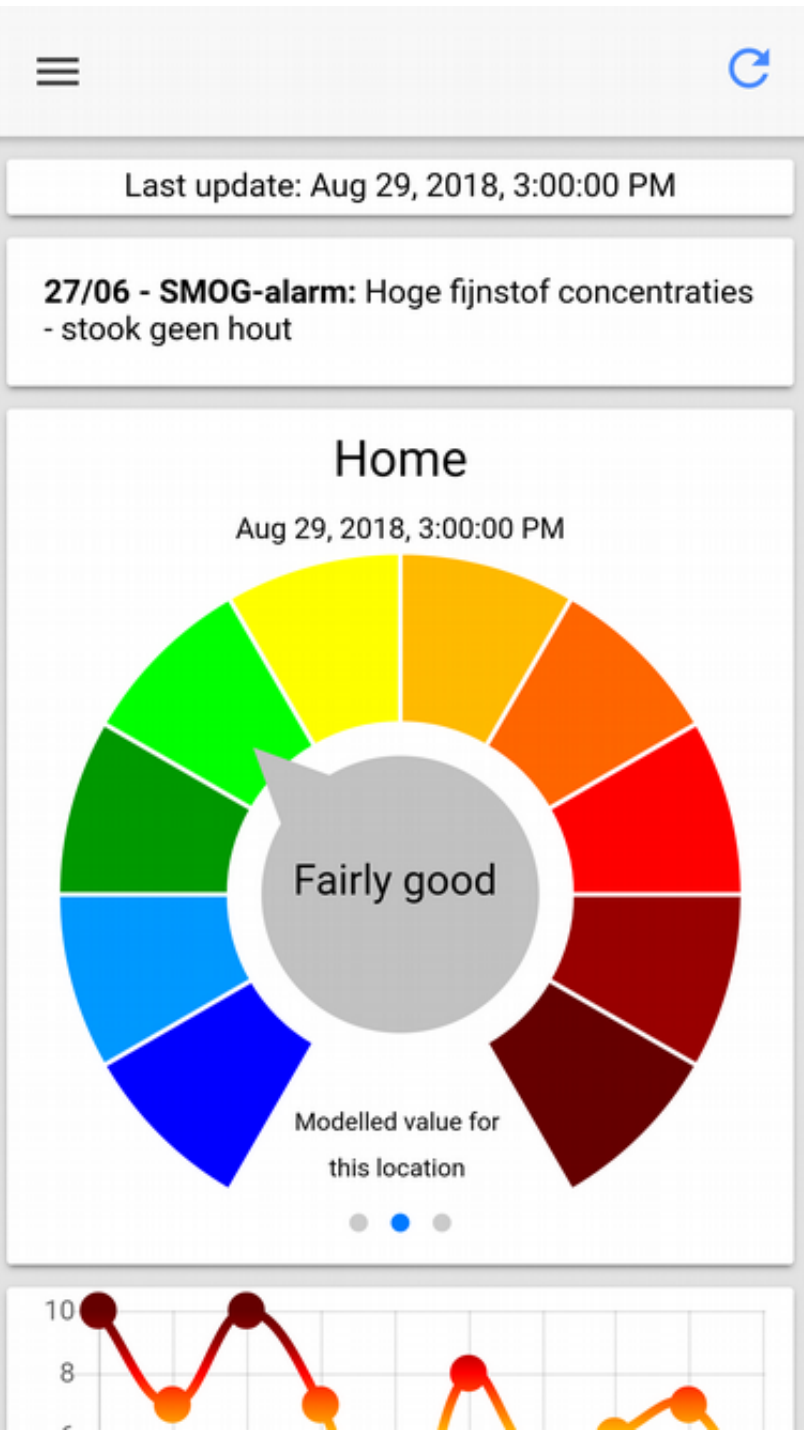
Forecasts



- Cordova
- Android, iOS & Windows Phone

Multilingual (EN, NL, FR, DE)

An air quality app (new version)



- Ionic framework (more “native” feeling on Android and iOS)
- Based real-time RIO-IFDM (hi-resolution modelled values)
- Alerting (different user profiles + user defined thresholds)
- “Street level” personalised information
- Potentially add healthiest route functionality later



Proto-type

<https://cloud.irceline.be/index.php/s/8yvzGLEJSY2qMLc>

or

<http://bit.do/aq-app-be>

See installation instructions in this Nextcloud directory



Last update: Aug 29, 2018, 3:00:00 PM

27/06 - SMOG-alarm: Hoge fijnstof concentraties
- stook geen hout

Home

Aug 29, 2018, 3:00:00 PM



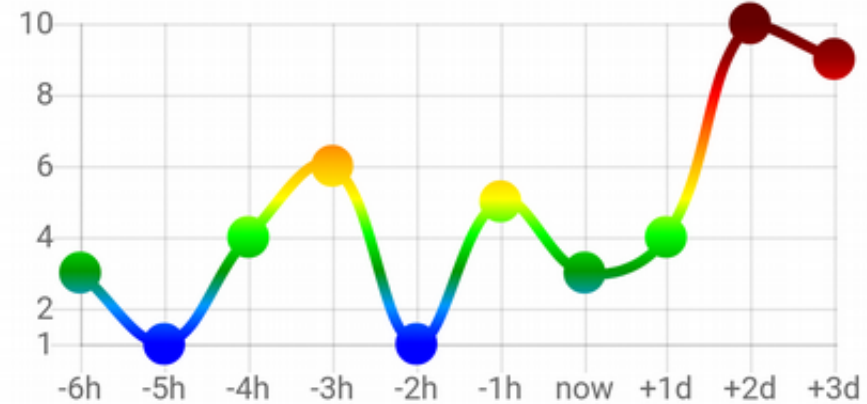
Implementation



- personalised index for user configured locations (home, work, school, etc.)
- push notifications
- user configured alerts

To do:

- personalised graph (last 6 hours + forecast)
- let the communication department do their thing

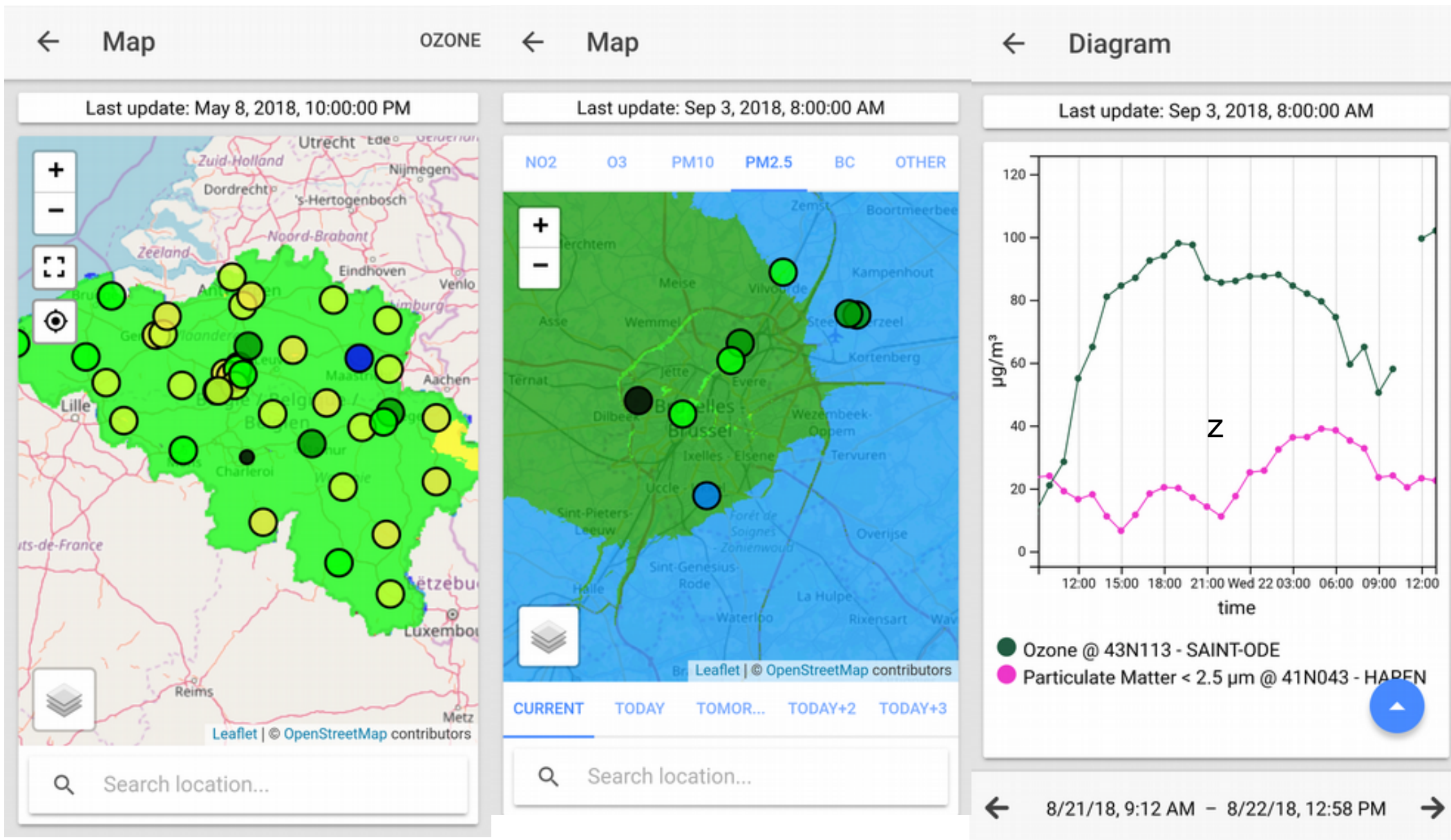


Nearest measuring station

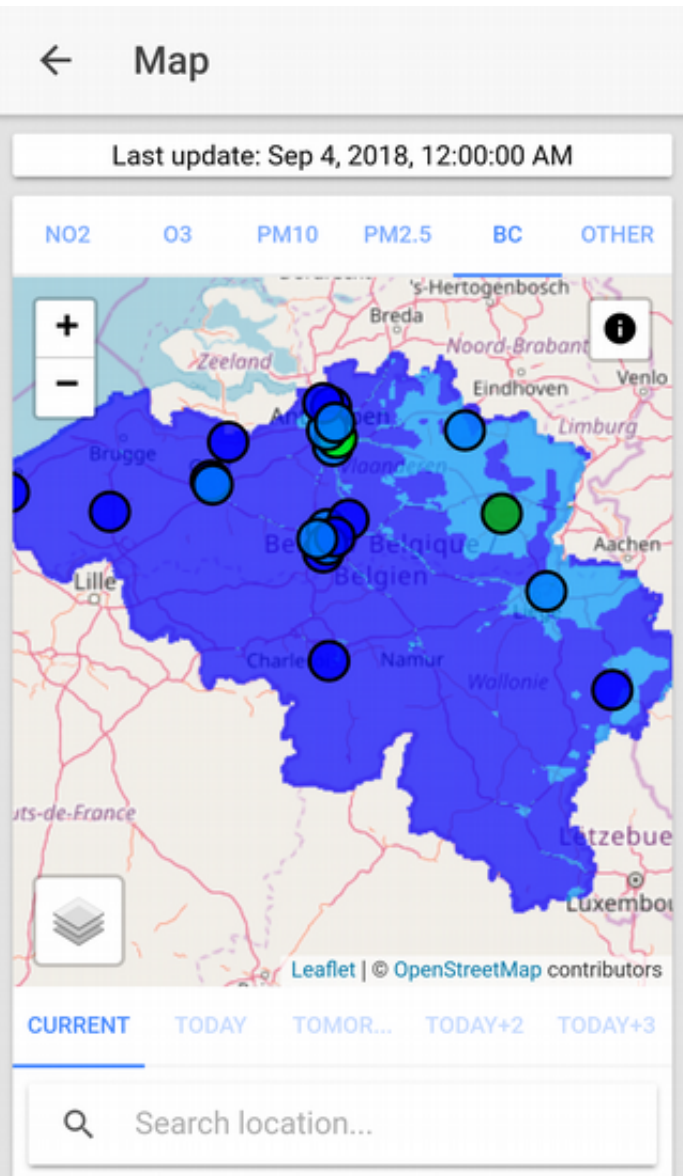
BC	NO2	O3	PM10	PM2.5
0.7µg/m³	31µg/m³	26µg/m³	20.7µg/m³	13.5µg/m³
15.5km	13.8km	13.8km	13.8km	13.8km
40SZ01 - STEENOKKERZEEL	42N035 - AARSCHOT	42N035 - AARSCHOT	42N035 - AARSCHOT	42N035 - AARSCHOT



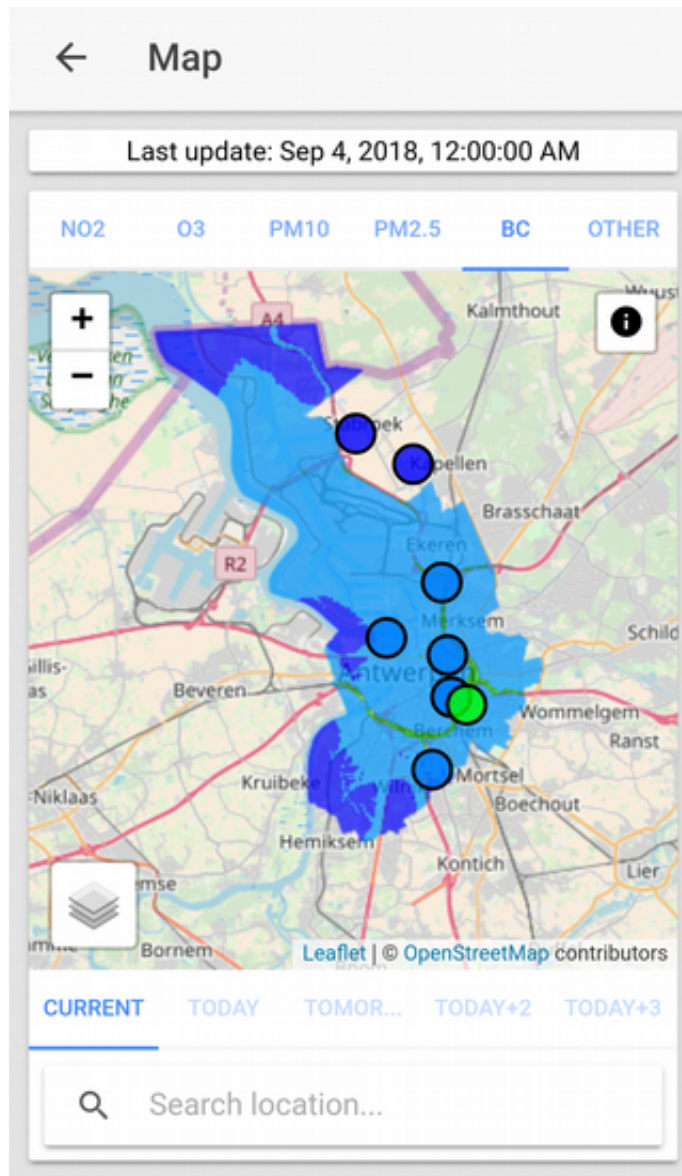
pages for the nerds



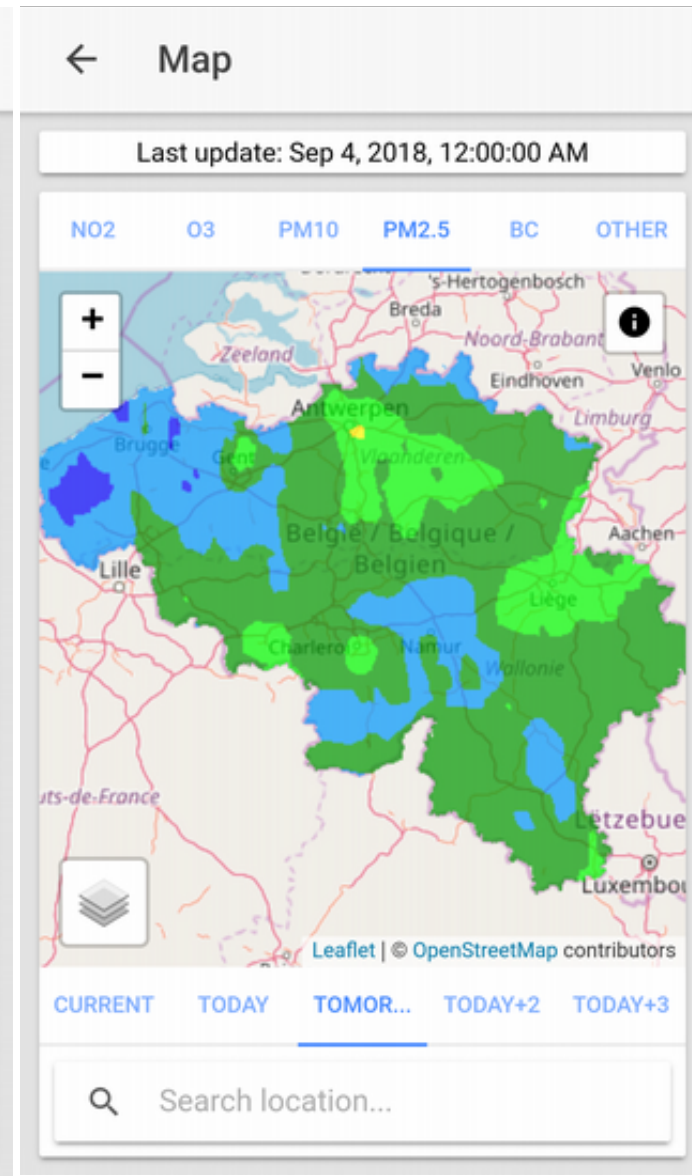
The map page



Real-time maps

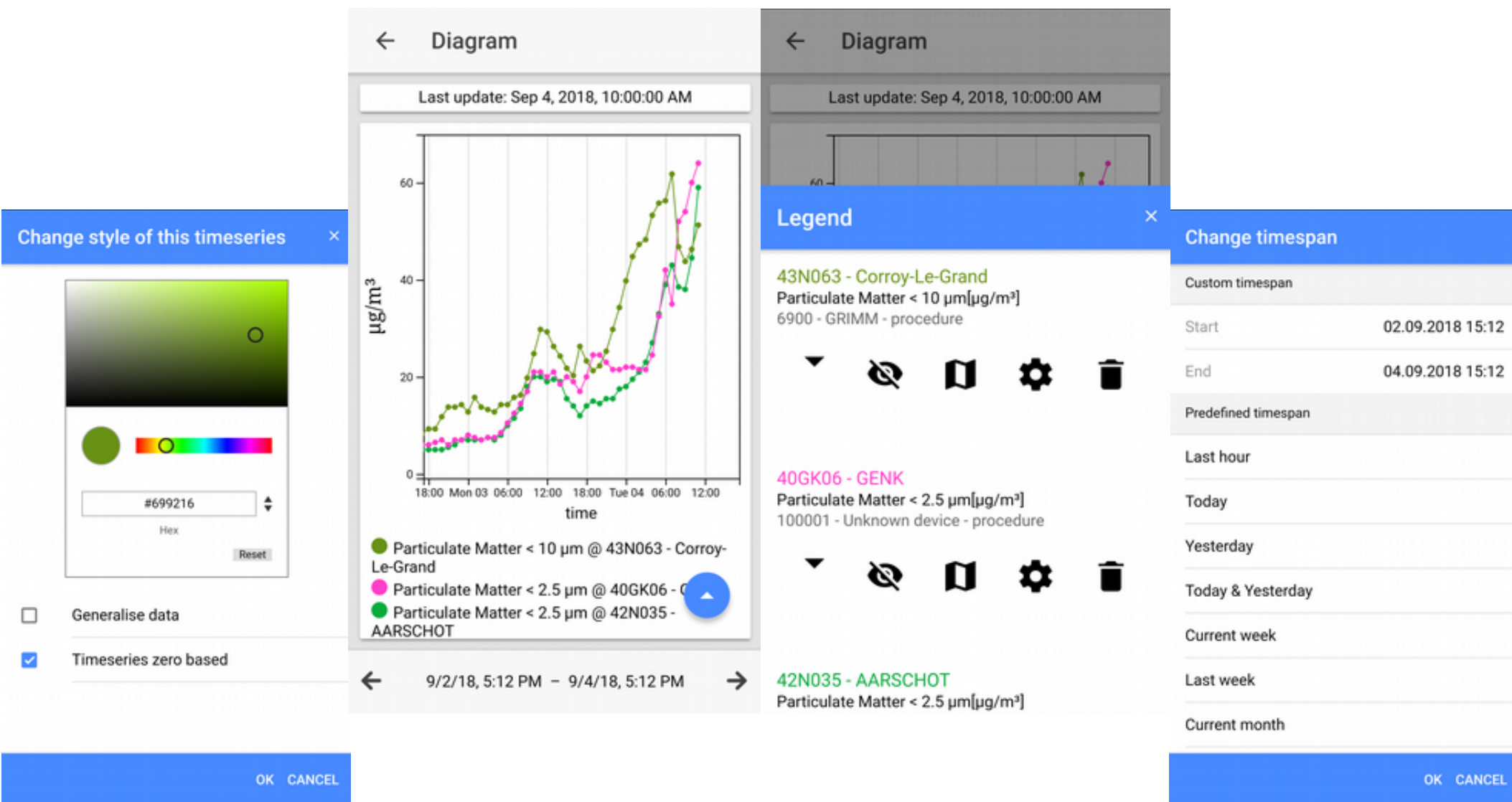


Limiting zoom in areas where emission data is less reliable



Forecast maps

The diagram page



Settings (notifications & locations)

← Settings

Common

Select a language

Show intro

User location

Create new location

Show current locations

Personal alerts

Hint: To use this functionality, the app needs to keep running in the background. Your location is determined once for the chosen time interval and then the air quality will be checked.

Activate

Alert interval

an hour

BelAQI level

1

English

Deutsch

Nederlands

Français

Personal alerts

Hint: To use this functionality, the app needs to keep running in the background. Your location is determined once for the chosen time interval and then the air quality will be checked.

Activate

Alert interval

an hour

BelAQI level

5

Health-related messages for individuals sensitive to air pollution

Notifications

Vlaamse Milieumaatschappij (VMM) - Dutch only

Agence wallonne de l'air et du climat (AwAC) - French only

Brussels Environment - Dutch and French only

Location list

Work

EDIT

REMOVE

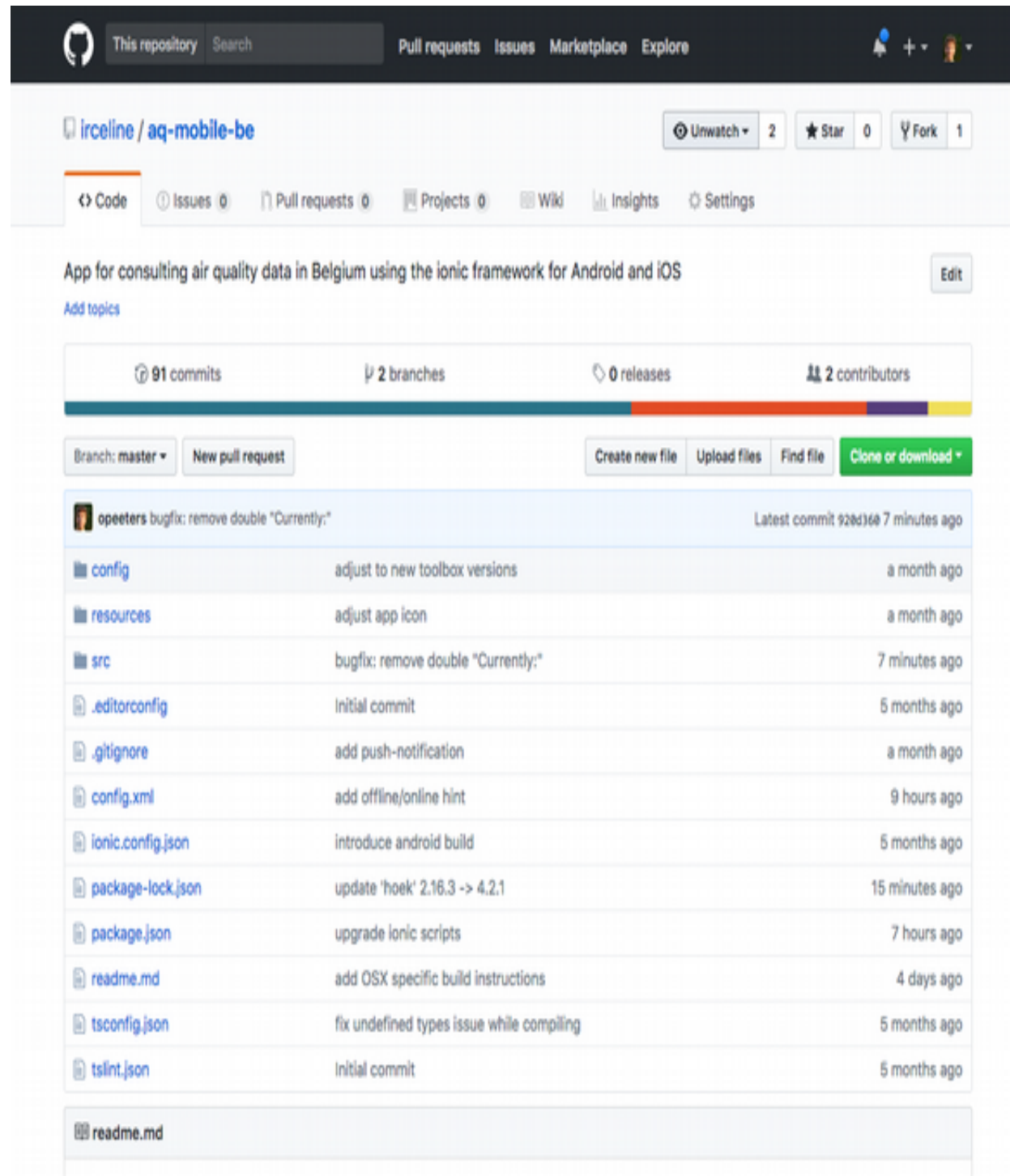
Home

EDIT

Health related messages

WHO "health"- concentration class	BelAQI	general	sensitive groups
A	1	It is very healthy today to be physically active outside. By reducing emissions, we get more of these healthy days and also decrease the effects of the low-term exposure.	
	2		
B	3	You do not have to adjust your usual physical activities because of the air quality.	If you experience discomfort, you can reduce heavy/long physical effort.
	4		
C	5	You do not have to adjust your usual physical activities because of the air quality.	Reduce your physical effort. Consult your doctor about appropriate changes to medication you might be taking.
	6		
	7		
D	8	Consider reducing heavy/long physical exertion.	Limit physical exertion. Consult your doctor about appropriate changes to medication you might be taking.
	9		
	10		

https://github.com/irceline/aq-mobile-be



GitHub repository page for **irceline / aq-mobile-be**. The repository is described as "App for consulting air quality data in Belgium using the ionic framework for Android and iOS". It has 91 commits, 2 branches, 0 releases, and 2 contributors.

Navigation tabs: [Code](#) (selected), [Issues](#) (0), [Pull requests](#) (0), [Projects](#) (0), [Wiki](#), [Insights](#), [Settings](#).

Buttons: [Unwatch](#) (2), [Star](#) (0), [Fork](#) (1), [Edit](#).

Branch: [master](#) | [New pull request](#) | [Create new file](#) | [Upload files](#) | [Find file](#) | [Clone or download](#).

Latest commit: **opeeters** bugfix: remove double "Currently:" (Latest commit 92ed36d 7 minutes ago)

File	Commit Message	Time Ago
config	adjust to new toolbox versions	a month ago
resources	adjust app icon	a month ago
src	bugfix: remove double "Currently:"	7 minutes ago
.editorconfig	Initial commit	5 months ago
.gitignore	add push-notification	a month ago
config.xml	add offline/online hint	9 hours ago
ionic.config.json	introduce android build	5 months ago
package-lock.json	update 'hoek' 2.16.3 -> 4.2.1	15 minutes ago
package.json	upgrade ionic scripts	7 hours ago
readme.md	add OSX specific build instructions	4 days ago
tsconfig.json	fix undefined types issue while compiling	5 months ago
tslint.json	Initial commit	5 months ago

[readme.md](#)



Informing you on ambient air quality
in the Belgian Regions

Vielen Dank!

Olav Peeters
peeters@irceline.be

Bram Vandeninden
vandeninden@irceline.be

Belgian Interregional Environment Agency (IRCEL - CELINE)