



Koninklijk Meteorologisch Instituut

Institut Royal Météorologique

Königliches Meteorologisches Institut

Royal Meteorological Institute

WOW-BE reboot :

RMI's renewed citizen-science infrastructure

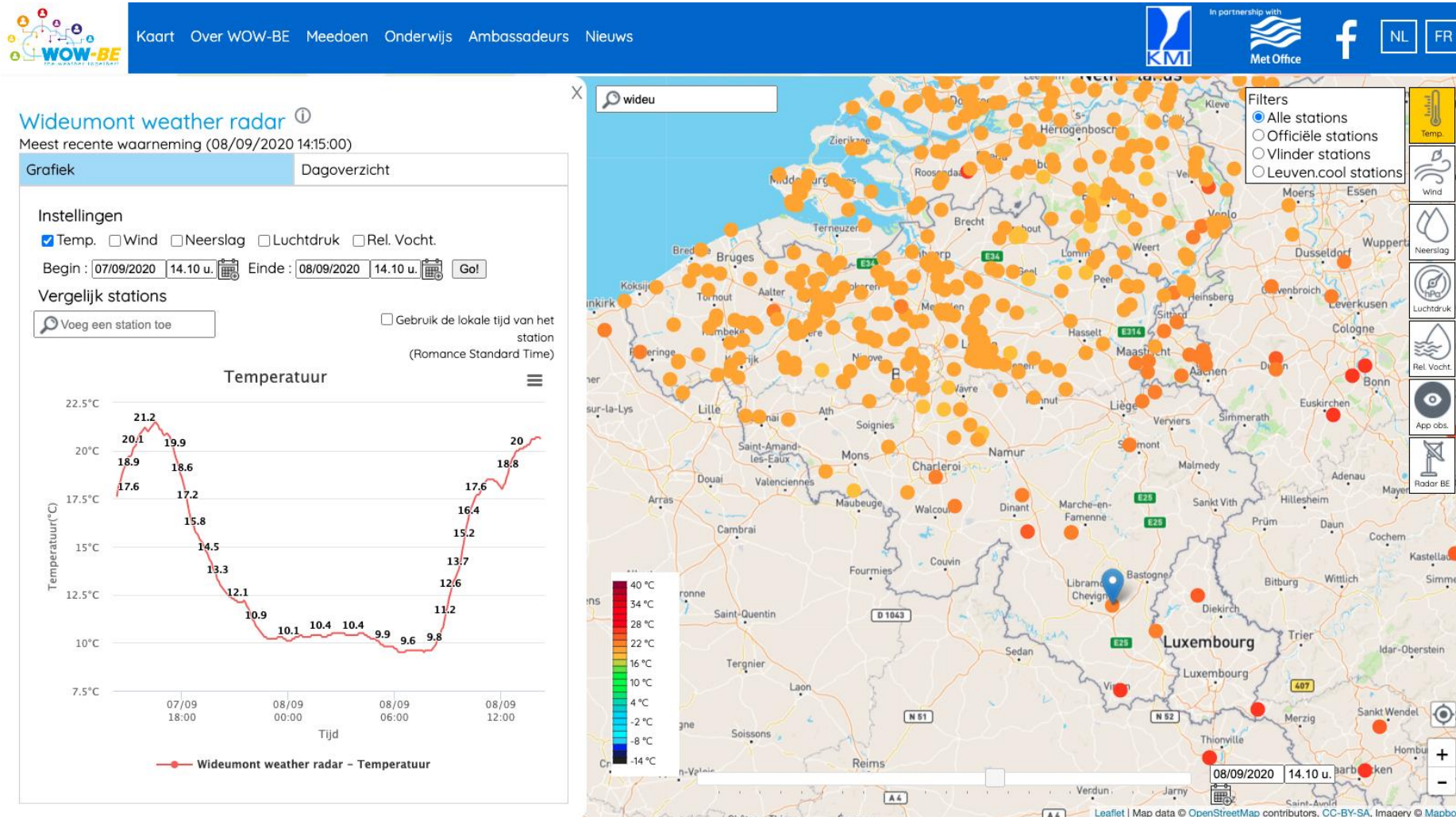
Jonathan Beliën and Maarten Reyniers

RMI seminar, 21-Jan-2026

Contents

1. A bit of history
2. Old and new setup
3. User perspective
4. Developer perspective
5. Conclusion & outlook

WOW (Weather Observations Website) is a cloud-based platform that allows members of the public to share meteorological observations with the world: wow.meteo.be



WOW: a bit of history

April 2015: launch of WOW-NL at KNMI

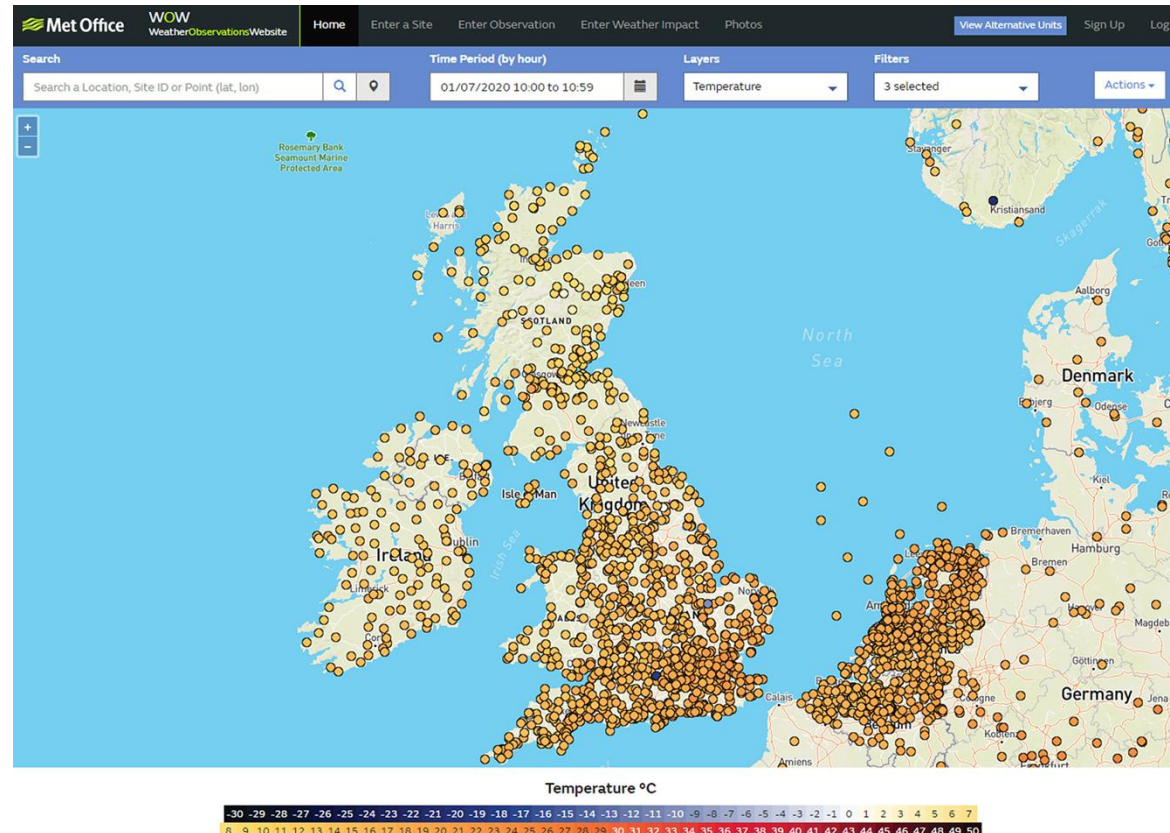


Source: <https://wow.knmi.nl/nieuws/nieuws-item-02> - KNMI

WOW: a bit of history

Four years earlier (2011): launch of WOW by the UK Met Office.

Started as service for climatological observers to share observations.
Quickly evolved to system that was able to receive automatic uploads.





WOW: a bit of history

Why would RMI join the WOW initiative?

- Way to engage with weather enthusiasts
- Educational value
- Scientific value

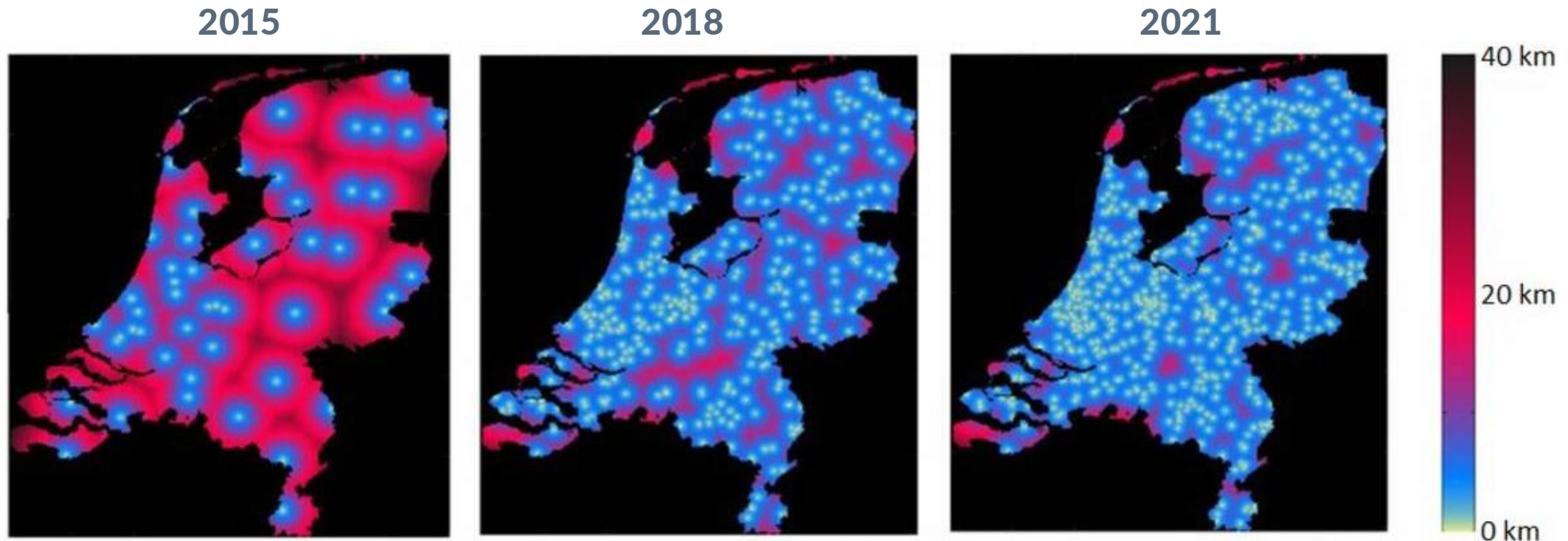
WOW: a bit of history

November 2017: launch of WOW-BE by RMI at the “24ste Vlaams Congres van Leraars Wetenschappen”



WOW: a bit of history

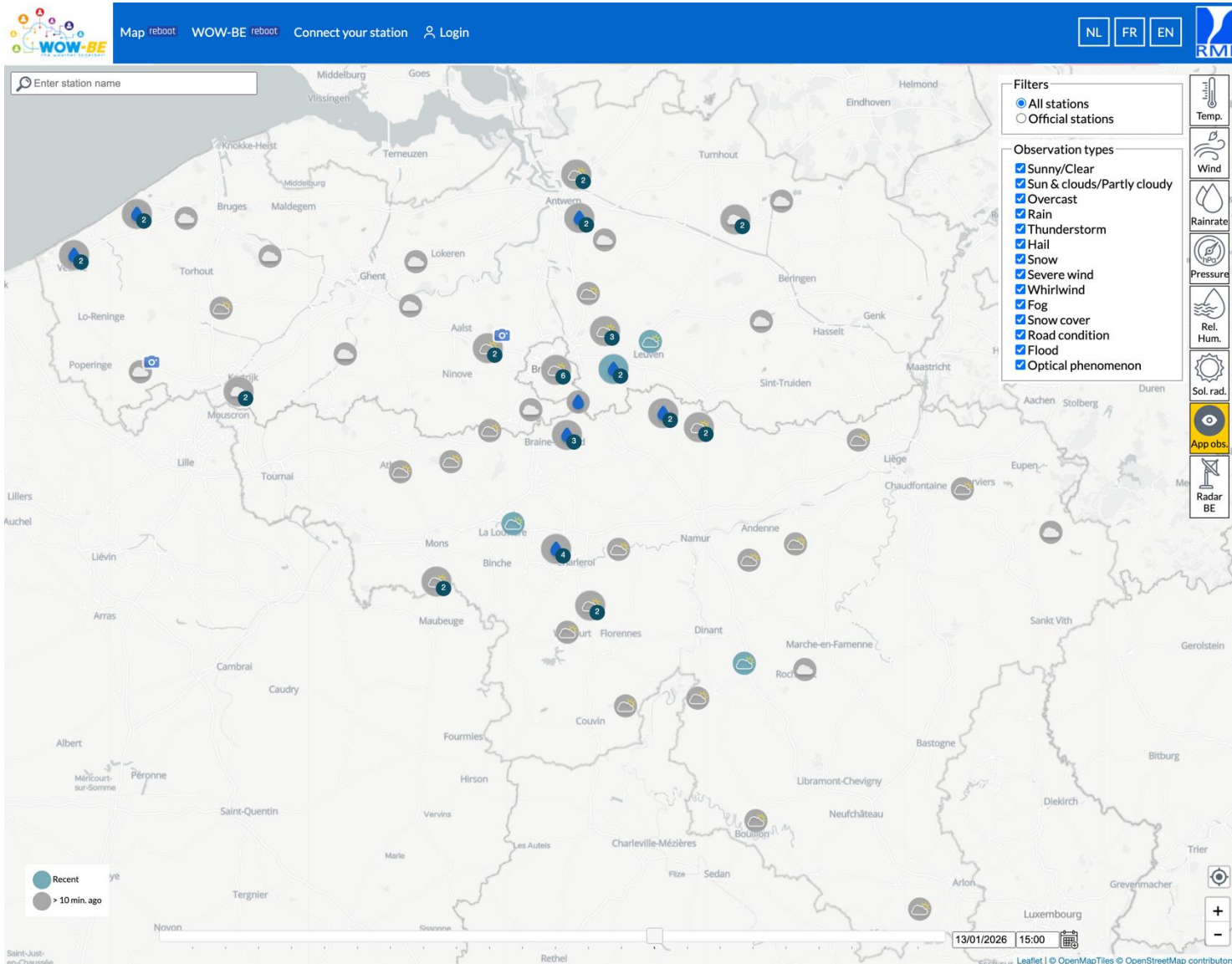
WOW network increase in the Netherlands



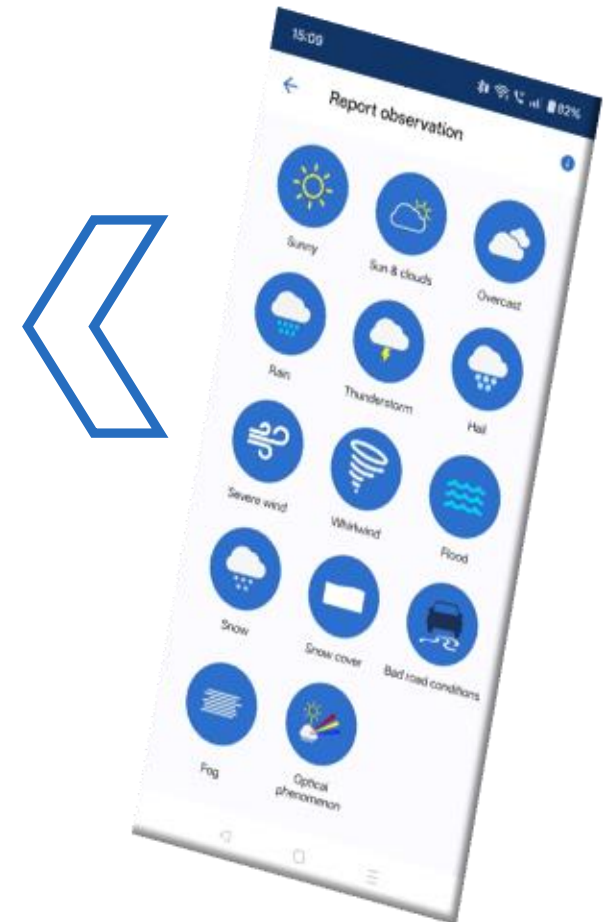
Source: <https://www.knmi.nl/over-het-knmi/nieuws/weernetwerk-wow-valt-in-de-prijzen>

Globally more than 30,000 users and receiving over 1 million observations a day.

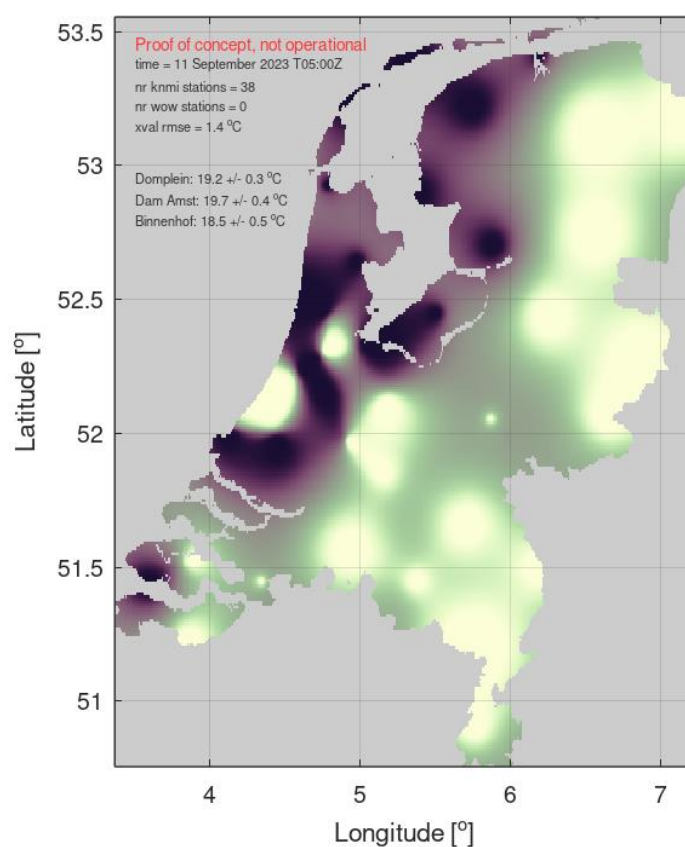
WOW: a bit of history



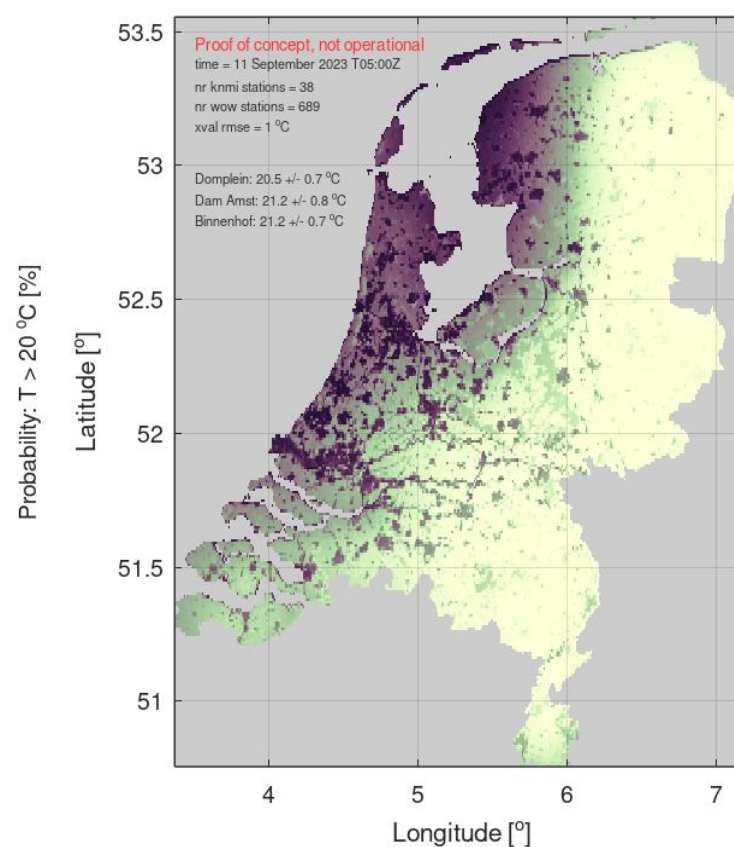
2019: RMI smartphone observations added as extra layer to WOW-BE portal.



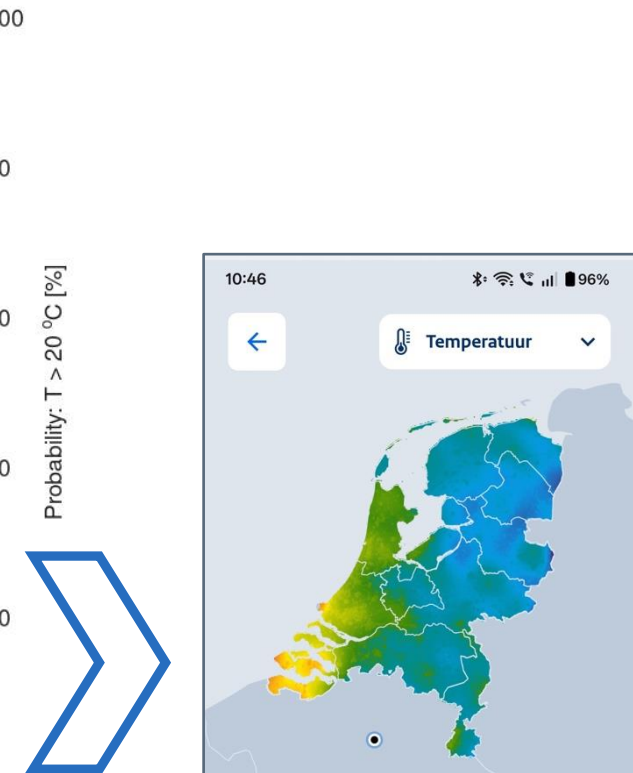
“Was it a tropical night or not?”



KNMI stations only



KNMI+WOW stations combined



KNMI-app



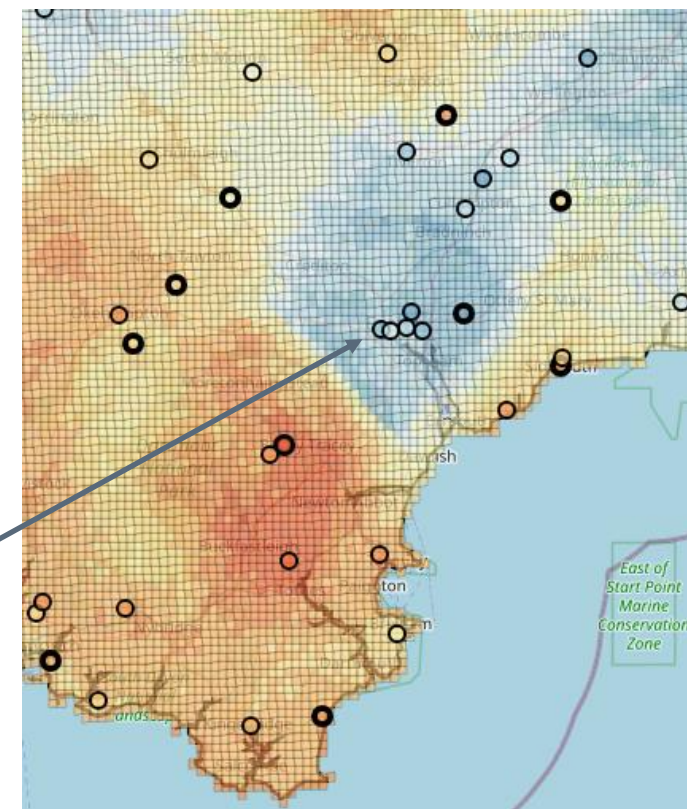
WOW: scientific value

Wintertime cold pool in the UK (1st Dec 2016)

HadUK-Grid, with MO sites shown.
Exeter Airport observation rejected.

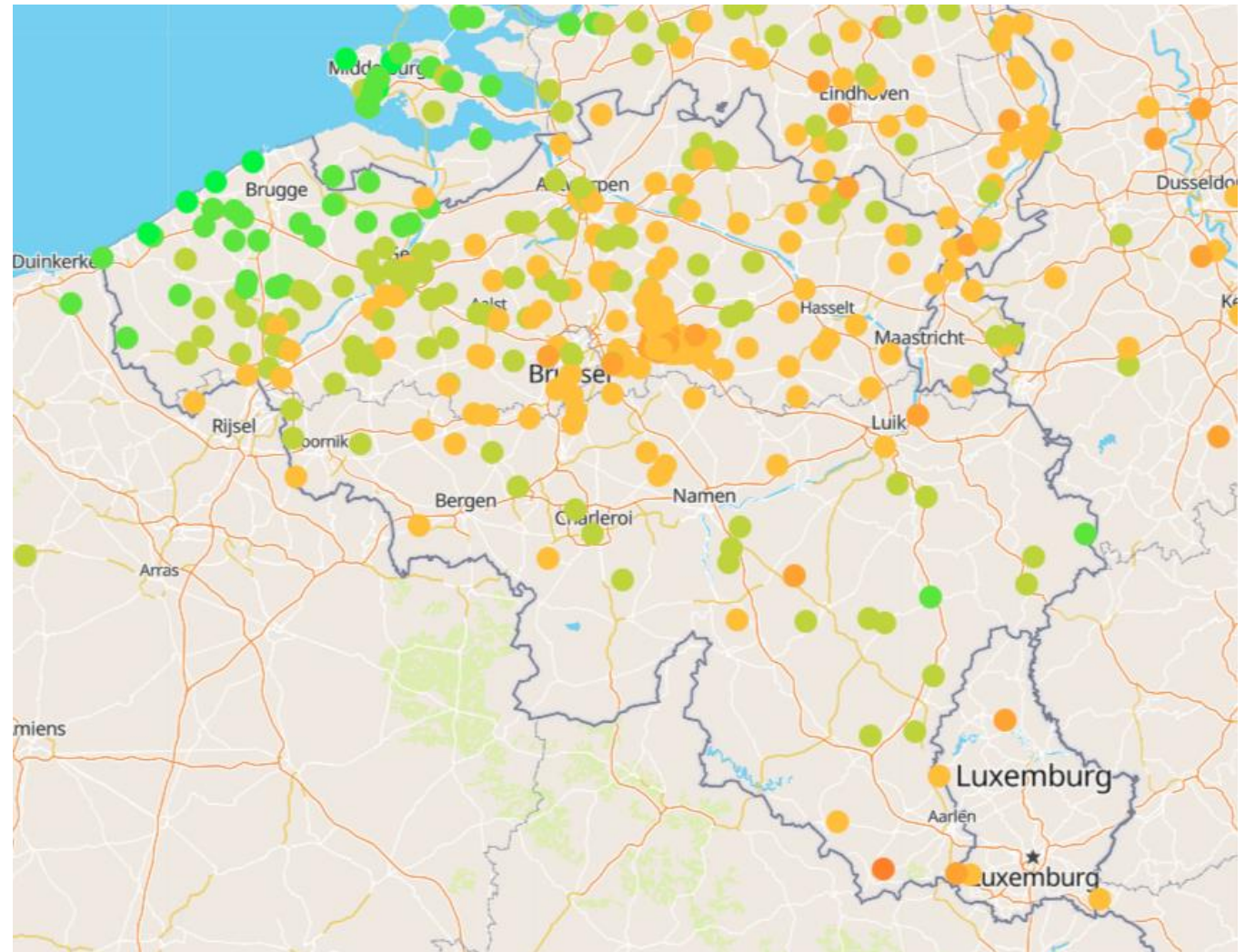


WOW sites in/around Exeter provide additional support to this observations –
grid includes these & captures Exe & Culm Valley cold pools → “Crowd-Grid”.



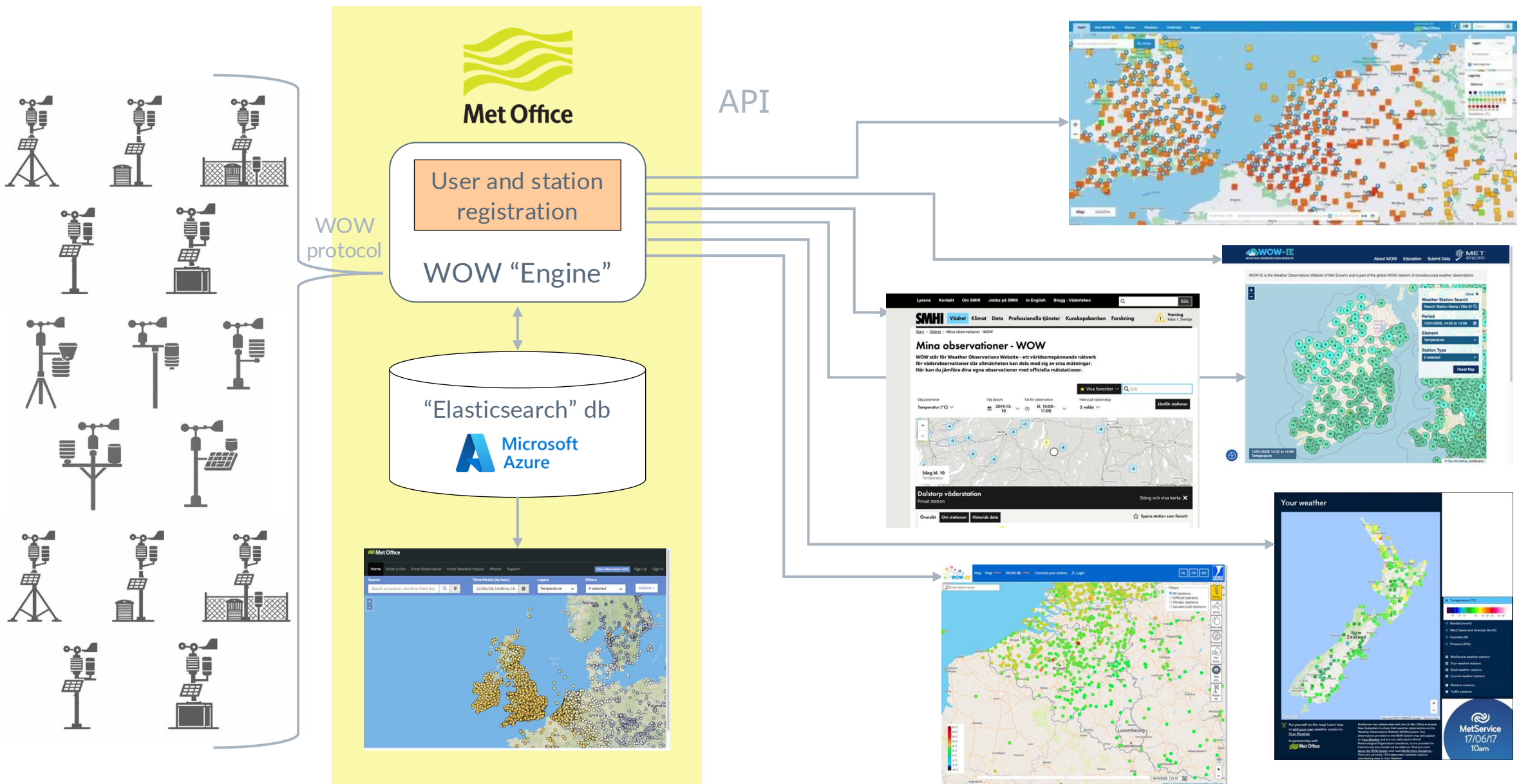
WOW: a bit of history

- In the beginning of 2025, the platform hosted around Belgian 350 PWS.
- Large contribution of two academic projects:
 - VLINDER (~60 stations)
University of Ghent & RMI
 - Leuven.cool (~100 stations)
KU Leuven & RMI



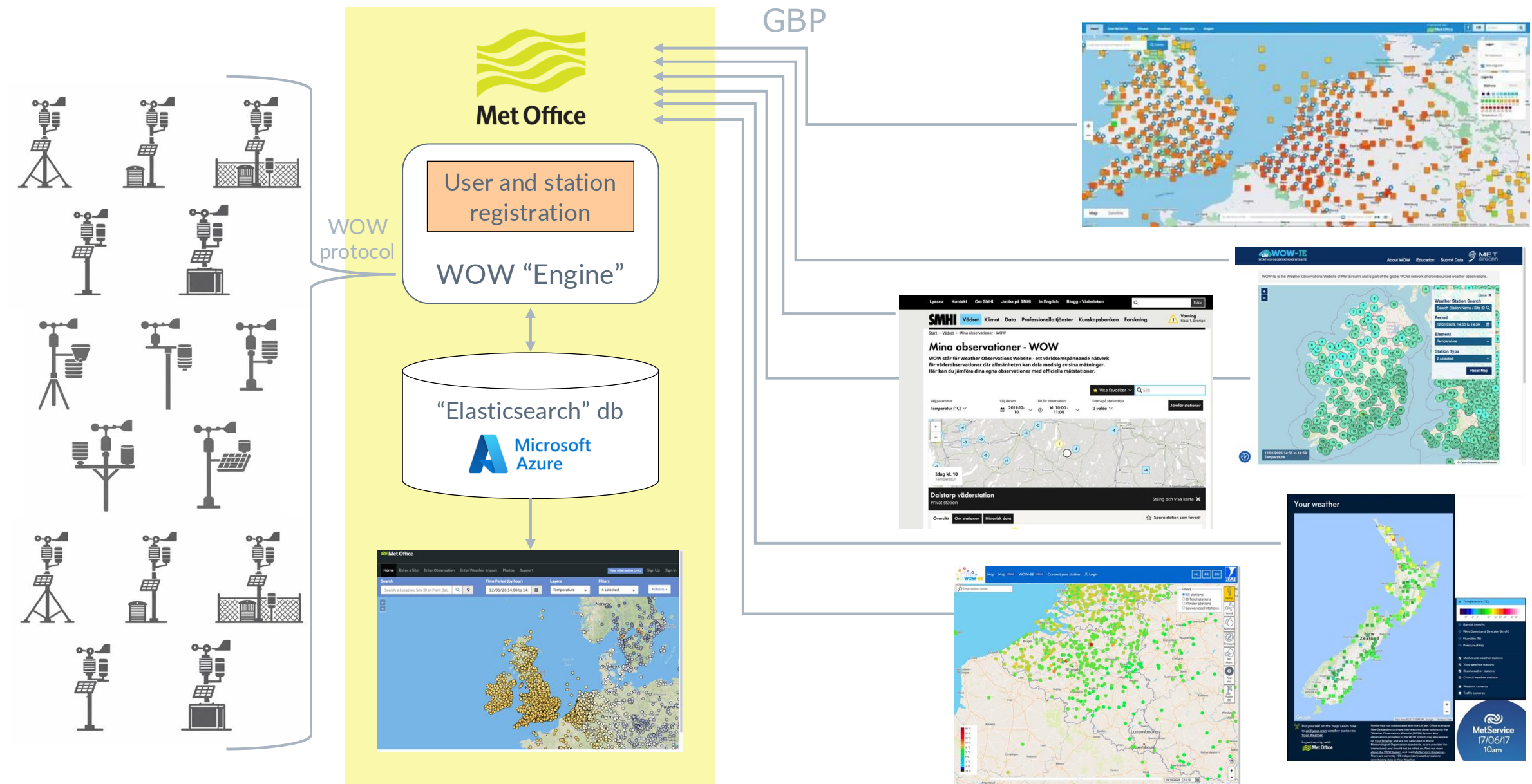


WOW: original setup





WOW: original setup



WOW(-BE) challenges in 2025

- ✗ Service termination by UK Met Office in 2026 with transition to commercial data acquisition
- 📁 Open data but no open data repository

WOW-BE 2025 dilemma

Option 1: give up WOW-BE

or

Option 2: Manage the back-end ourselves

Strengths

- Cost savings on longer term
- Better performance and stability
- Flexible data analysis and aggregation
- Full control over data and licensing
- We know our users and can contact them
- Metadata enables deeper scientific use

Weaknesses

- One-time development cost and recurring maintenance costs
- Potential loss of users at start

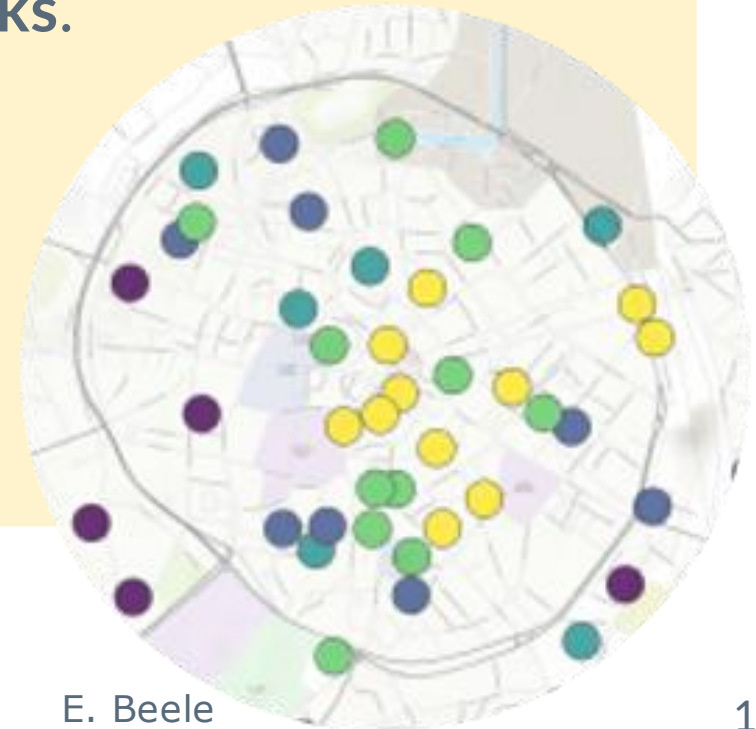
Opportunities

- Citizen weather networks are growing, offering opportunities for partnerships
- Keep access to non-WMO locations
- RMI visibility: position as a scientific & policy-relevant platform
- Talented developer showed interest 😊

Threats

- Loss of international context
- Platform fragmentation
- Users losing interest or migrating to alternative solutions

- Maintain a **trusted, non-commercial platform** for (Belgian) Personal Weather Station (PWS) owners, allowing them to **contribute to science** in a meaningful and transparent way.
- Enable **academic and regional organisations** in Belgium to easily deploy and manage their **own weather networks**.
- For RMI
 - Preserve **relationship** with **PWS owners** and partner organisations.
 - Ensure continued access to valuable observations from **non-traditional locations**.

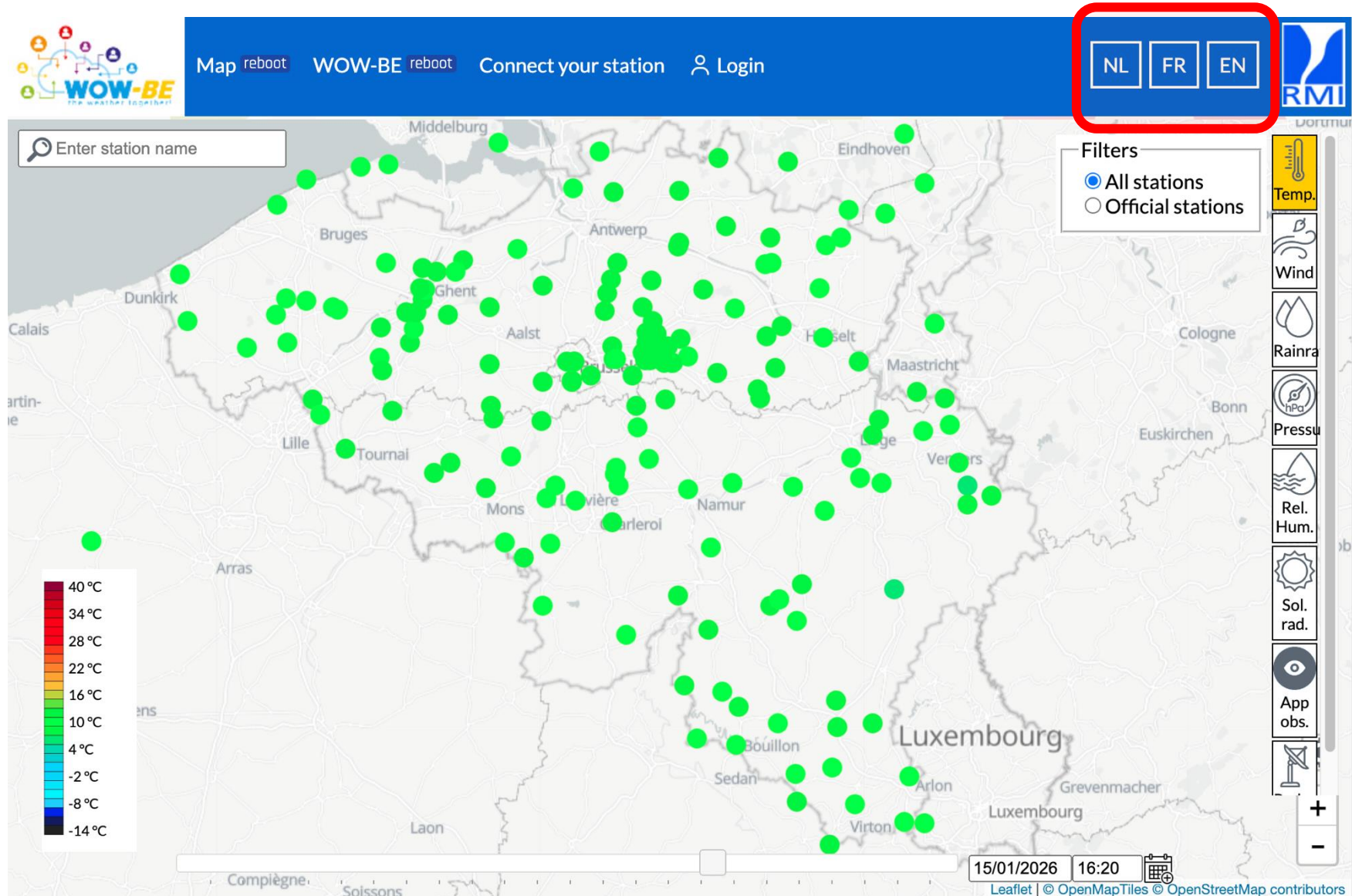


WOW-BE : setup ?

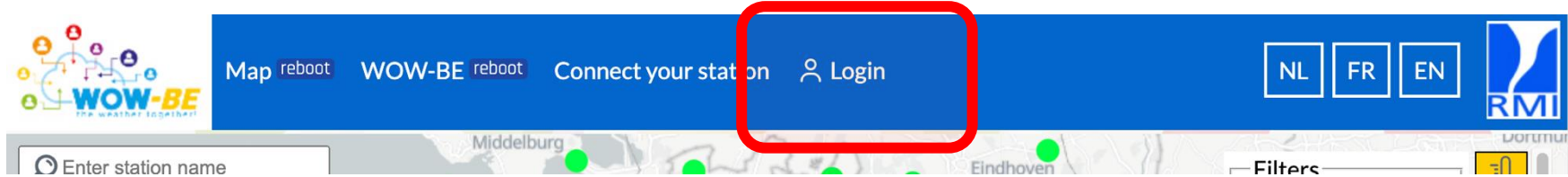




User perspective: language selection



User perspective: user registration



Login

Login with your Google or your GitHub account.

 Login with Google

 Login with GitHub

Or continue with

Email address

maarten.reyniers@meteo.be

Password [Forgot password?](#)

.....

☐ Remember me

Log in

Don't have an account? [Sign up](#)

Français • Nederlands • English

 Login with Google

 Login with GitHub



User perspective: personal dashboard



WOW-BE

Menu

 Dashboard

 Register a site

 Dashboard

ID 	Short ID	Name 	Location	Created at 	Obs. count 	Latest observation 
--	----------	--	----------	--	--	--

No results.

User perspective: station registration


WOW-BE

Menu

Dashboard
Register a site

Register a site

1. Site location

Please enter either longitude and latitude values directly in the form or use the map to select a location. You can either search for a location or click on the map to define the location.
This information will be shown publicly.

Longitude
Latitude
Altitude



2. Site details

Site name is how others will see your Site on WOW-BE. Timezone is also mandatory – all other fields are optional.

Name
Timezone
Personal website of your station
Brand and model of the station
Software used to upload data to WOW-BE

3. Site picture

You can upload a picture for your site. The picture should be in JPG or PNG format and should not exceed 5MB in size.
This information will be shown publicly.

Add picture
Choose file No file chosen

4. Site authentication

You need to define an authentication key for your site. This key is used to authenticate your site while sending observations. You can use a PIN code (6 digits) or a password. If your station allows, use a password and not a pincode as authentication key. If you want to change your authentication key later, you can do so.

PIN code / Password
MAC address of the station

Submit

- Site location
- Site details
name* timezone*
- Site picture
- Authentication key



User perspective: personal dashboard



WOW-BE

Menu

Dashboard

Register a site

Dashboard

ID	Short ID	Name	Location	Created at	Obs. count	Latest observation	
d07436fc-dddc-ea11-bf21-0003ff595f95	48de1818	Ede Veluwse Poort	 5.6926, 52.0364	September 7, 2025 at 17:00	690005	 January 15, 2026 at 16:54	...
d26ca323-dc43-e711-9401-0003ff597480	12d36374	Cielle	 5.557198, 50.191272	September 7, 2025 at 17:00	0	 No observations	...
79a9451e-a36c-e611-9400-0003ff59aed0	15c04c7a	Oppuurs Pandgatheide	 4.228476, 51.05917	September 7, 2025 at 17:00	554879	 January 15, 2026 at 16:54	...
01992488-bb95-7335-98db-6fd7f446e407	6f75be47	Kessel-Lo Vijverpark	 4.721495, 50.889775	September 7, 2025 at 16:16	426079	 January 15, 2026 at 16:54	...

- Copy site ID
- Copy site Short ID
- Edit
- Delete



User perspective: station connection

Three options:

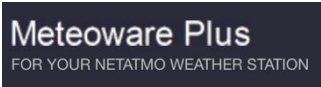
1. Use 3rd party software on a (mini-)PC
2. Use WOW-BE **reboot**-ready station
3. DIY with WOW-BE **reboot** API

User perspective: station connection

Three options:

1. Use 3rd party software on a (mini-)PC

Built-in support for **WOW-BE** reboot in these software packages:

	Meteobridge	€	https://www.meteobridge.com/
	CumulusMX	free	https://www.cumuluswiki.org/
	WeeWX	free	https://weewx.com/
	Weather Display	\$	https://www.weather-display.com/
	MeteoWare Plus (for Netatmo stations)	€	https://plus.meteoware.com/ (Coming soon...)

User perspective: station connection

Three options:

2. Use WOW-BE **reboot**-ready station

- Allows a “custom upload”
- Supports one of the following protocols
 - WOW protocol
 - Weather Underground protocol
 - Ecowitt protocol



Eurochron EFWS2900
= Alecto WS-5500



Ecowitt WS2910
& friends

15:02 66%

< Customized

Select Protocol Type:

Protocol Type Same As : Wunderground

Setting Server: Reset

Server IP / Host Name:

http:// wow.meteo.be

Path:

/ /api/v2/send?

ID:

/ **Short station ID**

Key:

/ **Authentication key**

Port:

: 80

Select Upload Interval:

Upload Interval : 60 s

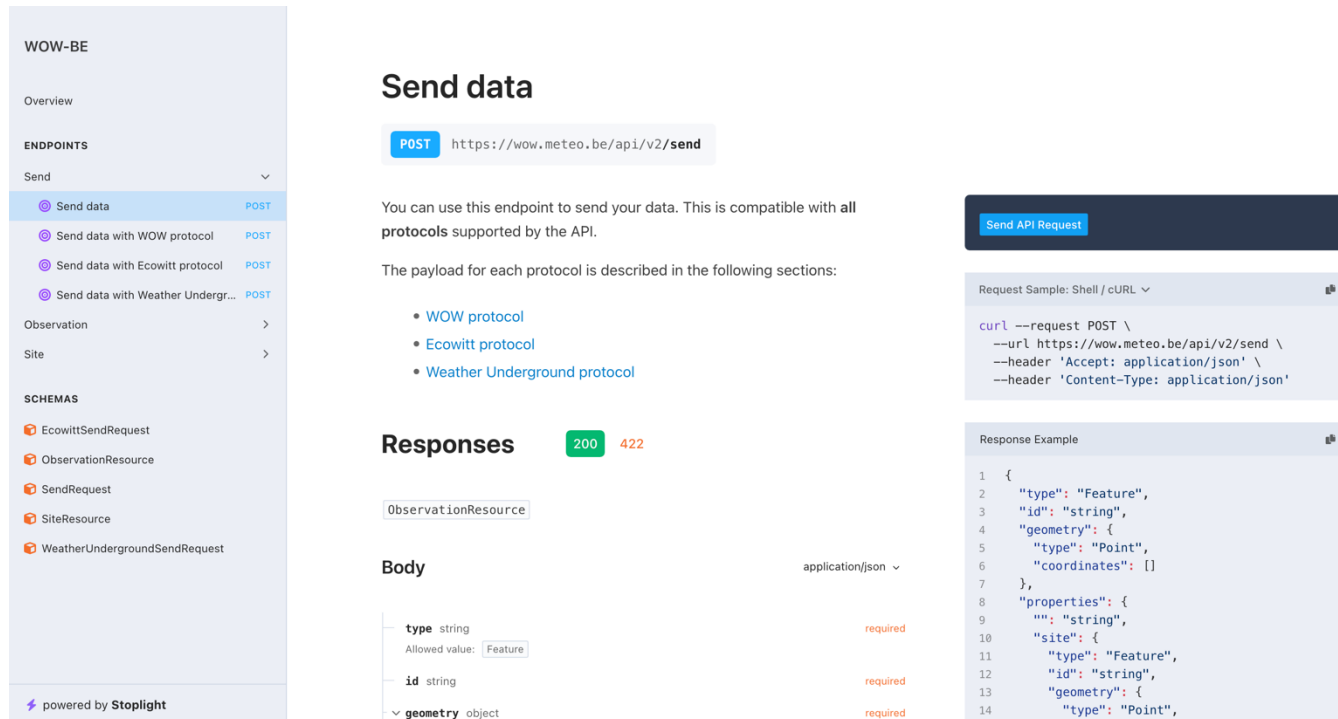
User perspective: station connection

Three options:

3. DIY with WOW-BE **reboot** API

Endpoint: <https://wow.meteo.be/api/v2/send>

Docs: <https://wow.meteo.be/docs/api/#/operations/send>



The screenshot shows the API documentation for the 'Send data' endpoint. On the left is a sidebar with a navigation menu. The main content area is titled 'Send data' and shows a POST request to 'https://wow.meteo.be/api/v2/send'. Below this, it explains that the endpoint is compatible with all protocols supported by the API and lists three protocols: WOW protocol, Ecowitt protocol, and Weather Underground protocol. The 'Responses' section shows a 200 status code for 'application/json'. The 'Body' section shows a schema for 'ObservationResource' with fields 'type', 'id', and 'geometry'. On the right, there is a 'Request Sample' section with a cURL command and a 'Response Example' section with a JSON object.

WOW-BE

Overview

ENDPOINTS

Send

- Send data (POST)
- Send data with WOW protocol (POST)
- Send data with Ecowitt protocol (POST)
- Send data with Weather Undergr... (POST)

Observation >

Site >

SCHEMAS

- EcowittSendRequest
- ObservationResource
- SendRequest
- SiteResource
- WeatherUndergroundSendRequest

powered by **Stoplight**

Send data

POST `https://wow.meteo.be/api/v2/send`

You can use this endpoint to send your data. This is compatible with **all protocols** supported by the API.

The payload for each protocol is described in the following sections:

- WOW protocol
- Ecowitt protocol
- Weather Underground protocol

Responses

200 422

ObservationResource

Body `application/json`

`type` string **required**
Allowed value: Feature

`id` string **required**

`geometry` object **required**

Request Sample: Shell / cURL

```
curl --request POST \
  --url https://wow.meteo.be/api/v2/send \
  --header 'Accept: application/json' \
  --header 'Content-Type: application/json'
```

Response Example

```
1 {
2   "type": "Feature",
3   "id": "string",
4   "geometry": {
5     "type": "Point",
6     "coordinates": []
7   },
8   "properties": {
9     "": "string",
10    "site": {
11      "type": "Feature",
12      "id": "string",
13      "geometry": {
14        "type": "Point",
```

User perspective: station connection

Three options:

3. DIY with WOW-BE **reboot** API

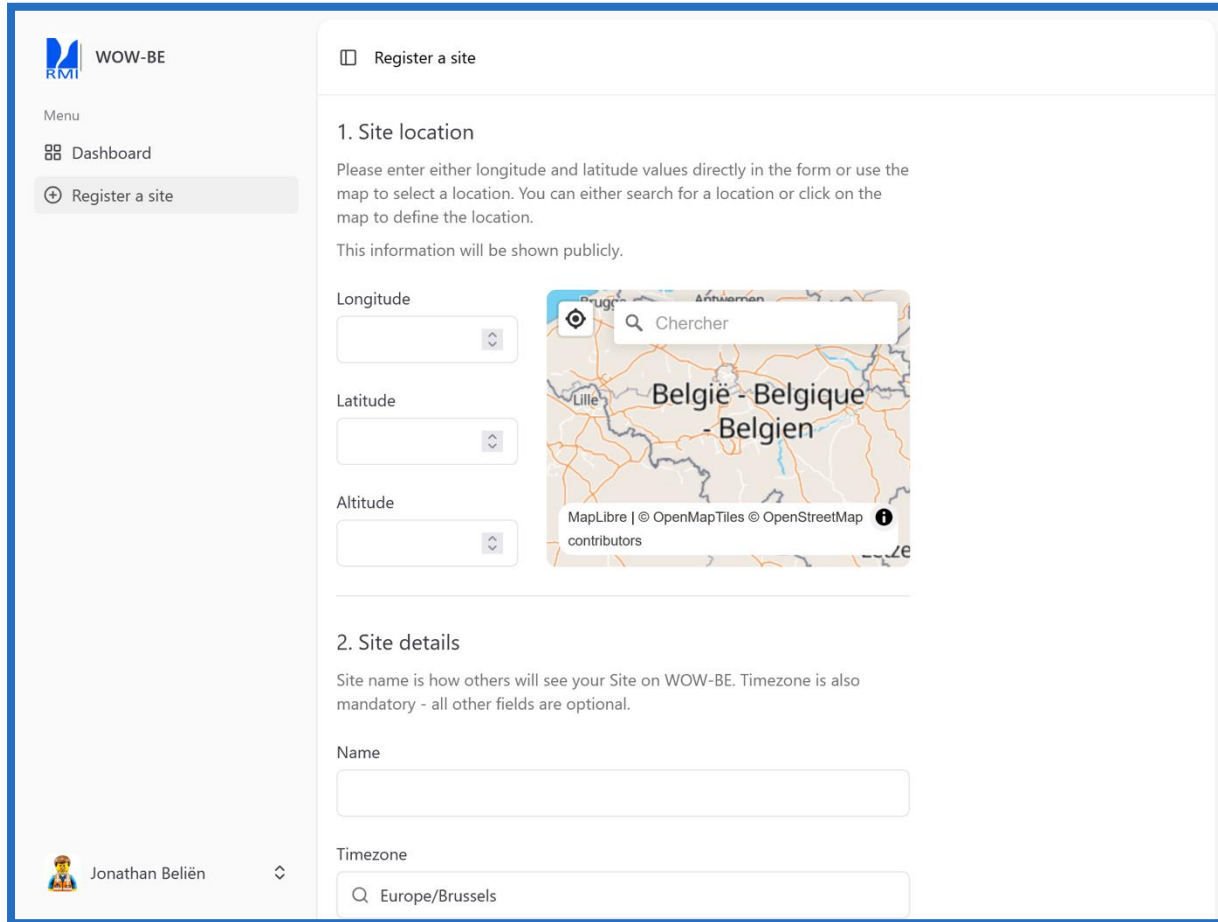
Endpoint: <https://wow.meteo.be/api/v2/send>

Docs: <https://wow.meteo.be/docs/api/#/operations/send>

Some parameter clarifications with respect to the old WOW-protocol:

- **solarradiation** added
- **rainin** always interpreted as instantaneous rainfall rate in inches per hour
- **baromin** always relative pressure (pressure adjusted to sea level)
- **absbaromin** always absolute pressure (raw measurement at the station's location)

Backwards compatibility – Registration form



The screenshot shows the 'Register a site' form in the WOW-BE application. The form is divided into two main sections: '1. Site location' and '2. Site details'.

1. Site location

Please enter either longitude and latitude values directly in the form or use the map to select a location. You can either search for a location or click on the map to define the location.

This information will be shown publicly.

Longitude:

Latitude:

Altitude:

A map of Belgium is displayed, showing the location of the site. The map includes a search bar with the text 'Chercher' and a list of locations: 'Lille', 'België - Belgique', and 'Belgien'. The map is credited to 'MapLibre | © OpenMapTiles © OpenStreetMap contributors'.

2. Site details

Site name is how others will see your Site on WOW-BE. Timezone is also mandatory - all other fields are optional.

Name:

Timezone:

The form is part of the WOW-BE application, as indicated by the logo and text in the top left corner. The user's name, Jonathan Beliën, is visible in the bottom left corner.

Keep the structure of the existing API to avoid any breaking change and facilitate the switch to **WOW-BE reboot**

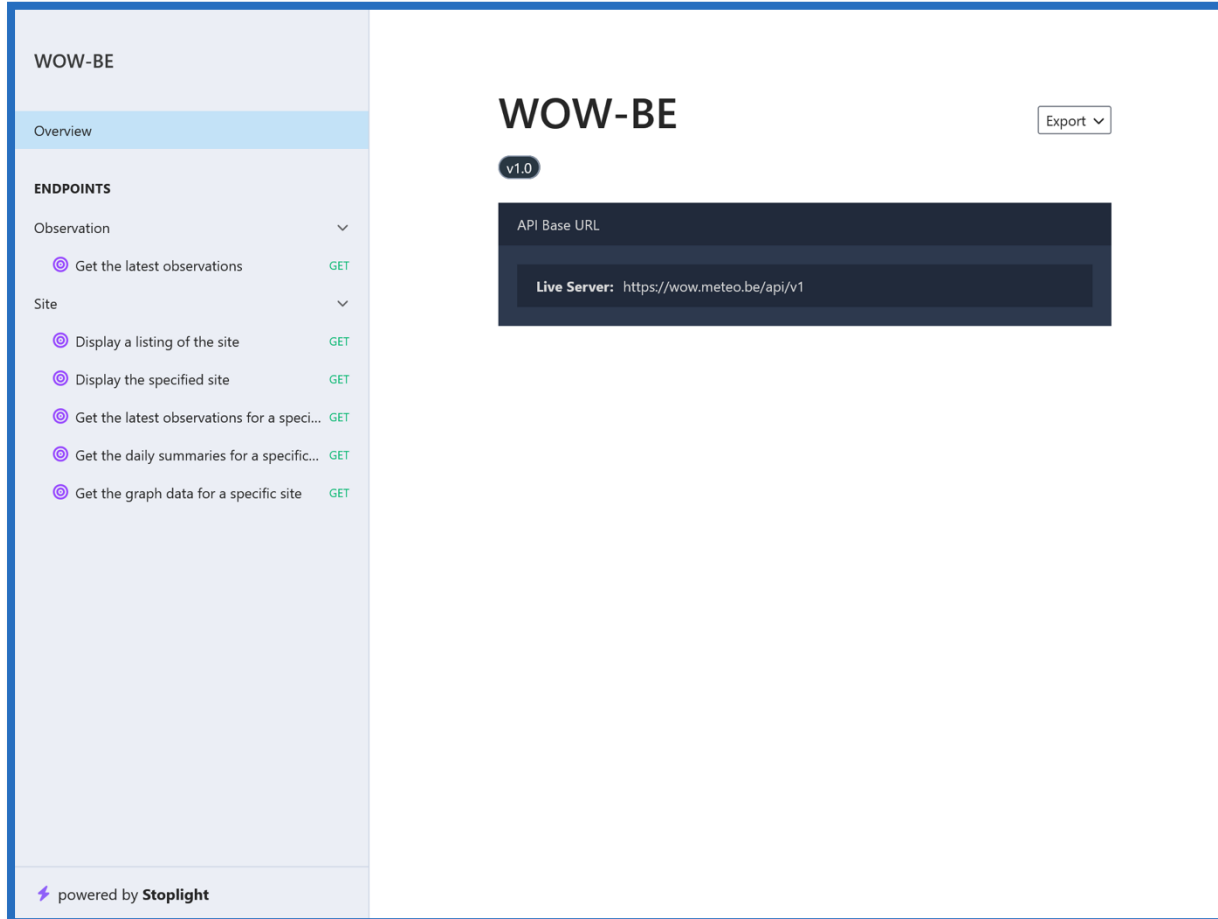
Required actions for the migration:

- Registration of the station
- Update URL

Solution:

- Analyze current registration form
- List useful fields
- Create new registration form
- Improve & simplify user experience

Backwards compatibility - API



The screenshot shows the API documentation for WOW-BE. On the left, there is a sidebar with a navigation menu. The main content area displays the API endpoints for version v1.0. The endpoints are categorized into 'Observation' and 'Site'. Each endpoint is listed with its method (GET) and a brief description. The 'Live Server' URL is also provided.

WOW-BE Export

v1.0

API Base URL

Live Server: <https://wow.meteo.be/api/v1>

ENDPOINTS

Observation

- Get the latest observations GET

Site

- Display a listing of the site GET
- Display the specified site GET
- Get the latest observations for a speci... GET
- Get the daily summaries for a specific... GET
- Get the graph data for a specific site GET

powered by **Stoplight**

Keep the structure of the existing API to avoid any breaking change and facilitate the switch to **WOW-BE** *reboot*

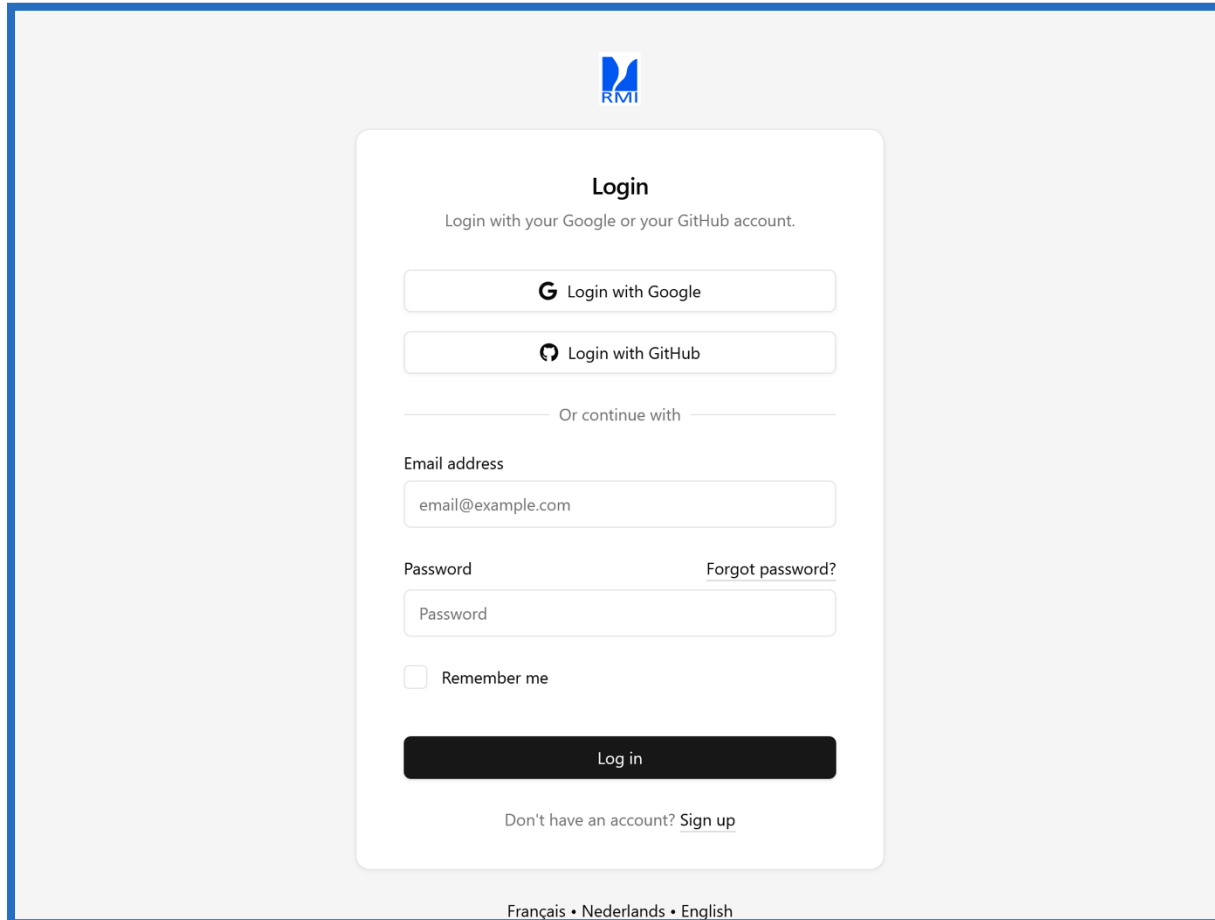
Required actions for the migration:

- Registration of the station
- Update URL

Solution:

- Analyze all requests made to MetOffice API
- Reverse engineer data structure, API endpoints, ...
- Create backwards compatible API
- Improve performances
- Publish API documentation

Simplified user registration

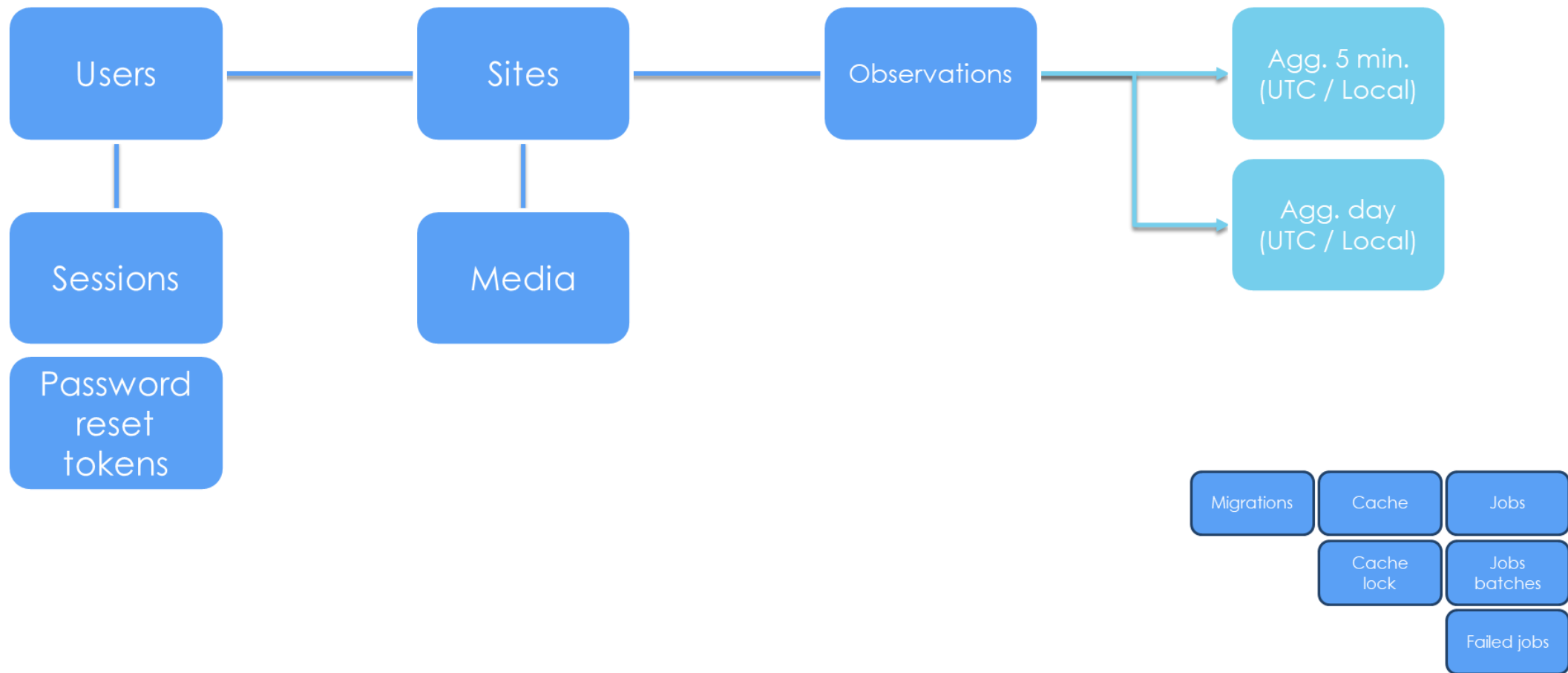


The screenshot shows a login form with the RMI logo at the top. The form is titled "Login" and includes the instruction "Login with your Google or your GitHub account." Below this are two buttons: "Login with Google" and "Login with GitHub". A separator line with the text "Or continue with" follows. The form then has fields for "Email address" (containing "email@example.com") and "Password" (containing "Password"). A "Forgot password?" link is next to the password field. Below the password field is a checkbox labeled "Remember me". A large black "Log in" button is at the bottom of the form. At the very bottom of the page, there is a link "Don't have an account? Sign up" and a footer with the text "Français • Nederlands • English".

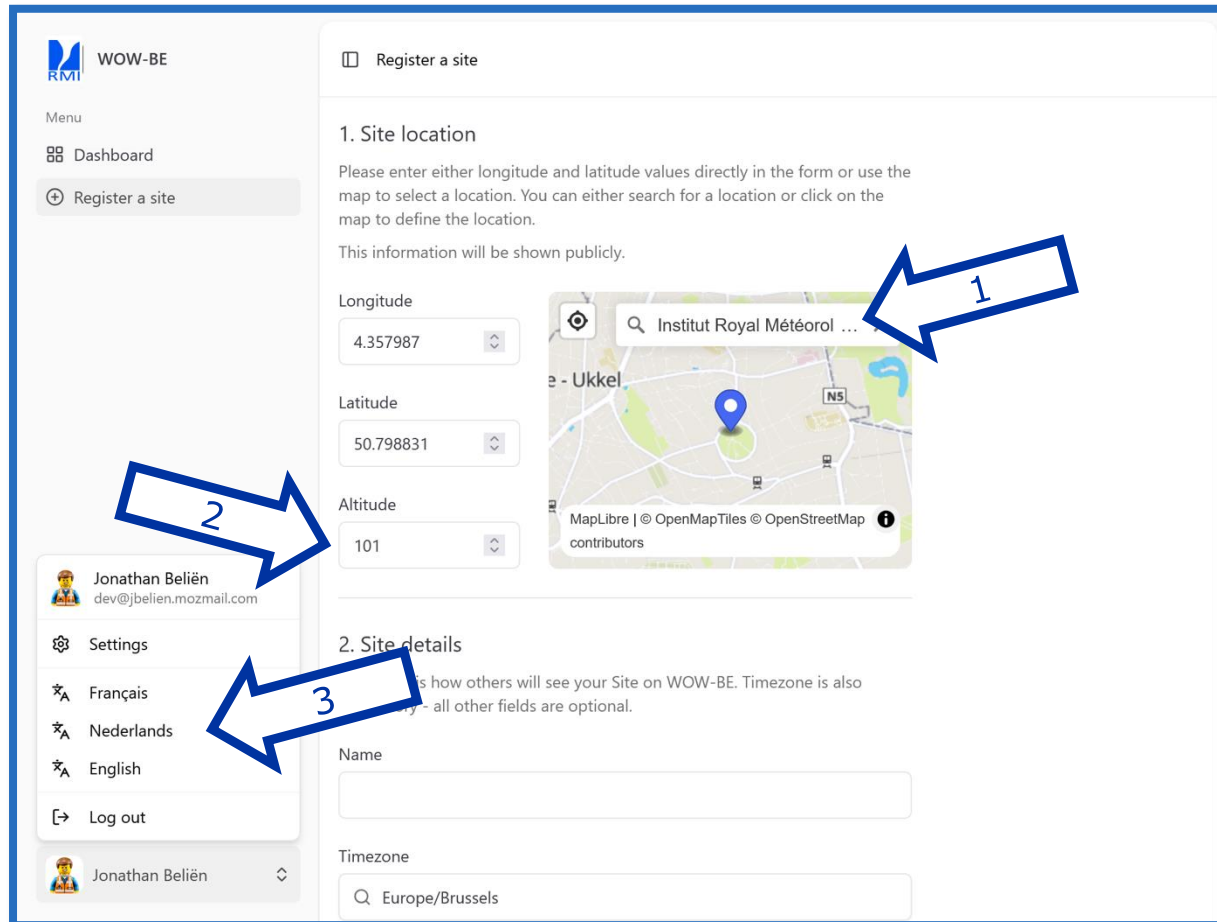
Two ways of registering as a user:

- Email address & Password
- OAuth 2.0 (Open Authorization)
 - Google
 - GitHub
 - ...

Database structure (simplified)



Simplified registration form



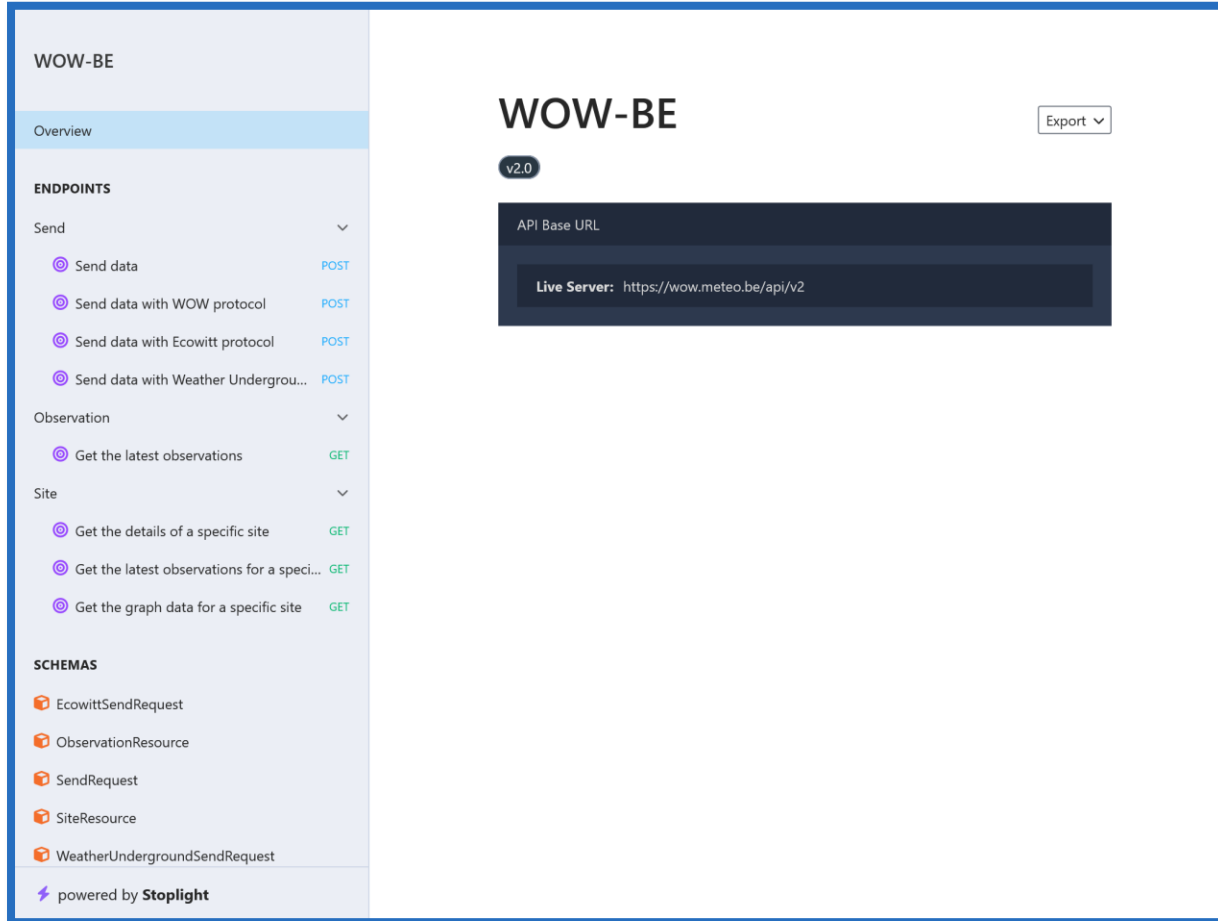
1 - Small map to help locate your station

- Search
- Click on the map
- Use your geolocation

2 - Compute altitude automatically (Open-Elevation API)

3 - Choose your language

Ready for the future



The screenshot shows the Stoplight API documentation interface for the 'WOW-BE' API version 2.0. The interface is divided into a left sidebar and a main content area.

Left Sidebar:

- WOW-BE** (Header)
- Overview** (Selected)
- ENDPOINTS**
 - Send** (Dropdown)
 - Send data (POST)
 - Send data with WOW protocol (POST)
 - Send data with Ecowitt protocol (POST)
 - Send data with Weather Undergrou... (POST)
 - Observation** (Dropdown)
 - Get the latest observations (GET)
 - Site** (Dropdown)
 - Get the details of a specific site (GET)
 - Get the latest observations for a speci... (GET)
 - Get the graph data for a specific site (GET)
- SCHEMAS**
 - EcowittSendRequest
 - ObservationResource
 - SendRequest
 - SiteResource
 - WeatherUndergroundSendRequest
- powered by **Stoplight**

Main Content Area:

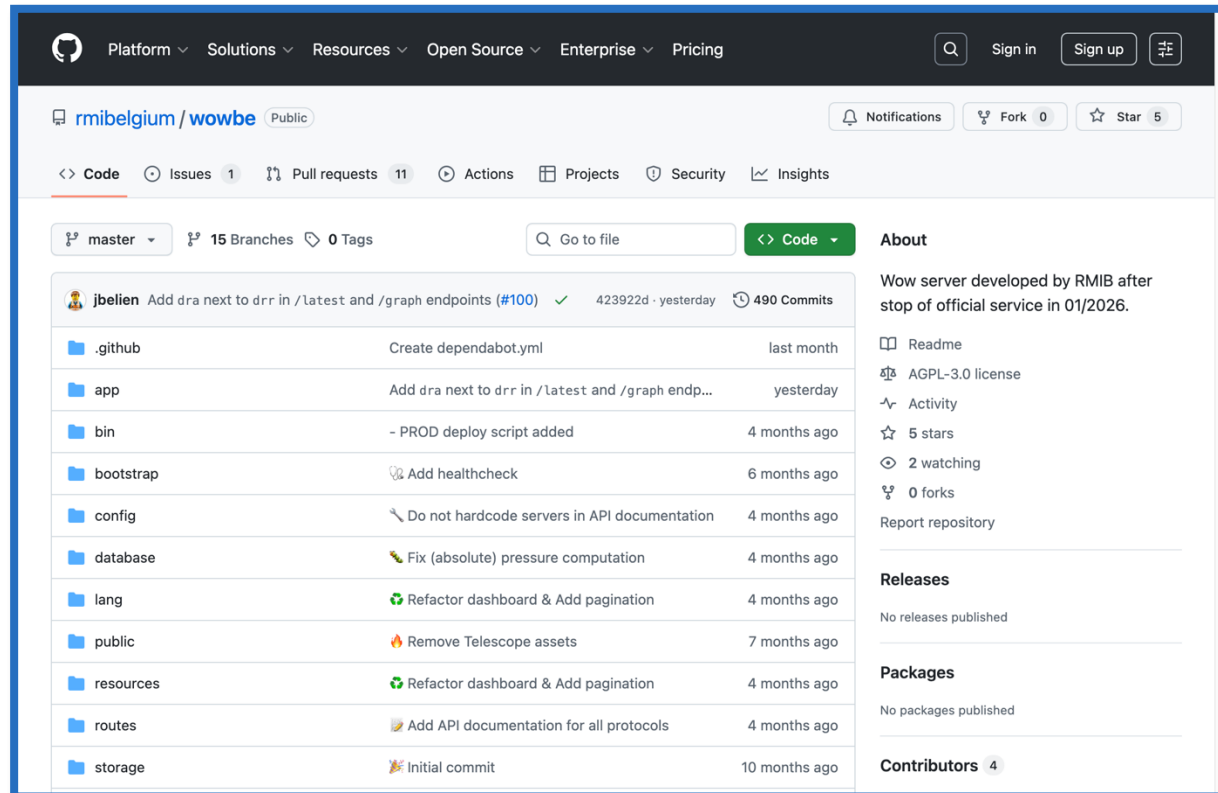
- WOW-BE** (Header)
- v2.0** (Version)
- API Base URL** (Text)
- Live Server:** <https://wow.meteo.be/api/v2>

Once we have a backwards compatible API, we can start having fun and plan for the future ...

API Version 2:

- Compatible with more protocols,
- Publishing of extra information,
- API that matches exactly what we need (full control),
- OpenAPI Specification
- GeoJSON Specification (RFC 7946)
- ...

Open to contributions



Source code of **WOW-BE** **reboot** is published under open-source GNU AGPLv3 license.

GNU Affero General Public License v3.0

GNU AGPLv3

Permissions of this strongest copyleft license are conditioned on making available complete source code of licensed works and modifications, which include larger works using a licensed work, under the same license. Copyright and license notices must be preserved. Contributors provide an express grant of patent rights. When a modified version is used to provide a service over a network, the complete source code of the modified version must be made available.

Permissions

- Commercial use
- Distribution
- Modification
- Patent use
- Private use

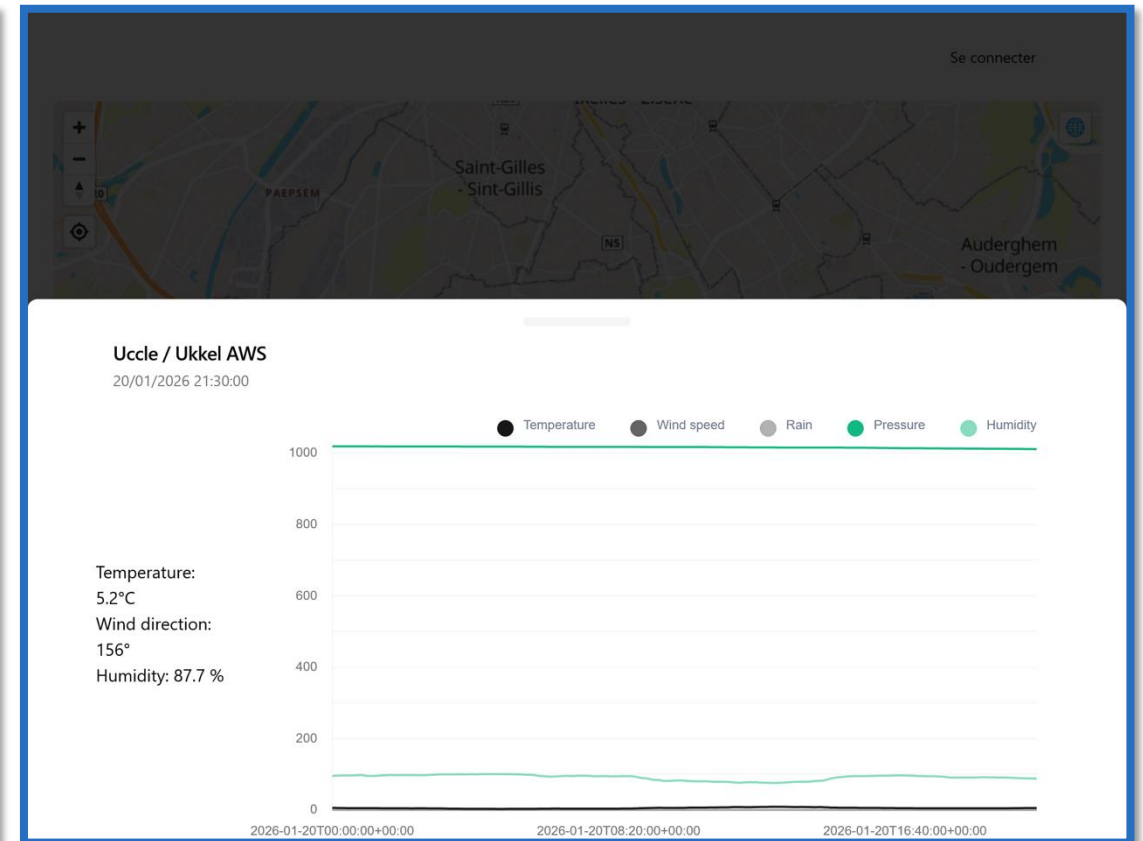
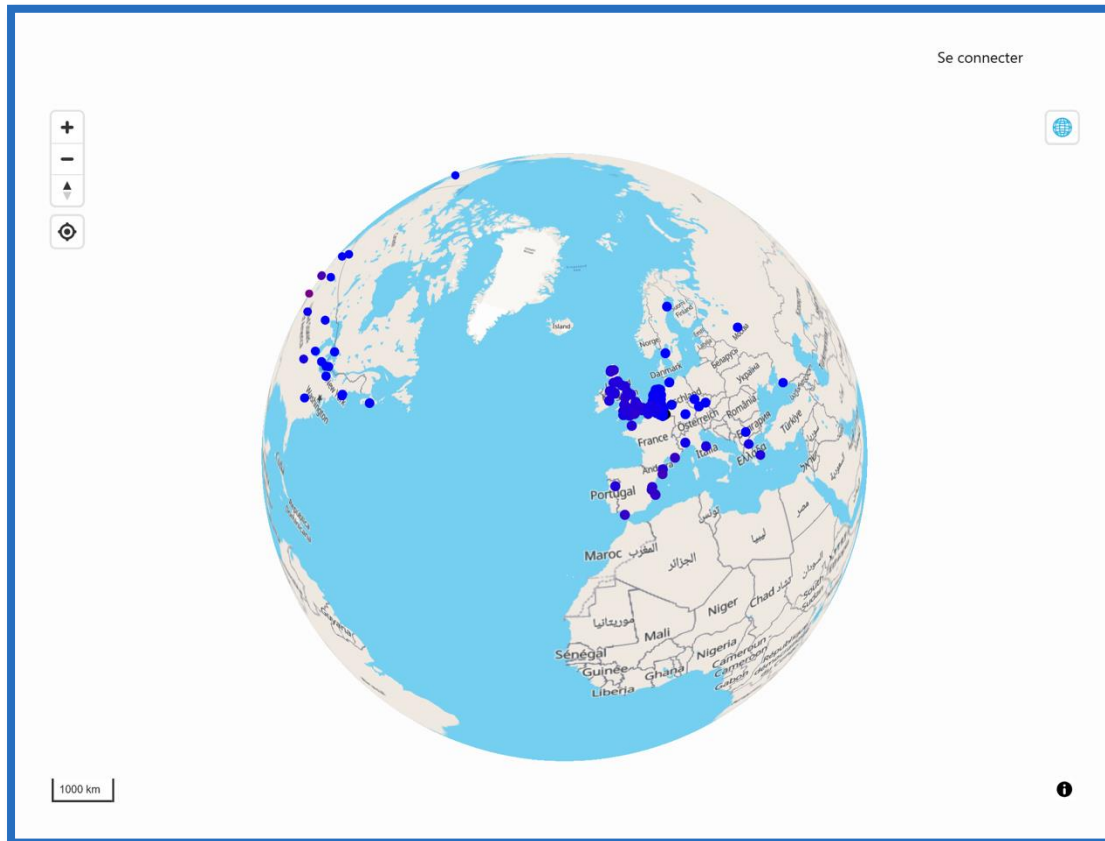
Conditions

- Disclose source
- License and copyright notice
- Network use is distribution
- Same license
- State changes

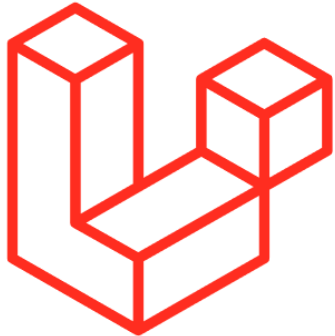
Limitations

- Liability
- Warranty

Open to contributions – New responsive frontend



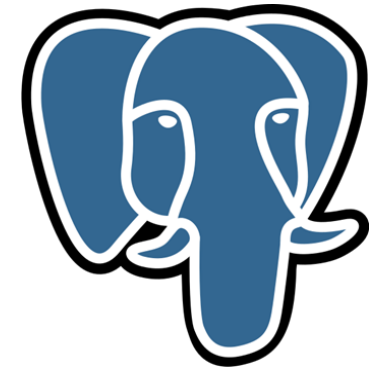
Technology stack



Backend: **Laravel**
Language: PHP



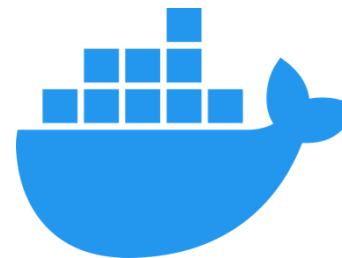
Frontend: **Vue.js & Inertia.js**
Language: TypeScript



Database: **PostgreSQL**
Language: SQL



WebServer:
FrankenPHP



Deployment:
Docker

WOW-BE ^{reboot} : development ideas

Alternative
units in
front-end

Basic quality control of
incoming data:
plausibility check, buddy
check, constant data, etc

“Federated” instances:
national WOW Reboot
instances that are able to
communicate and
exchange data

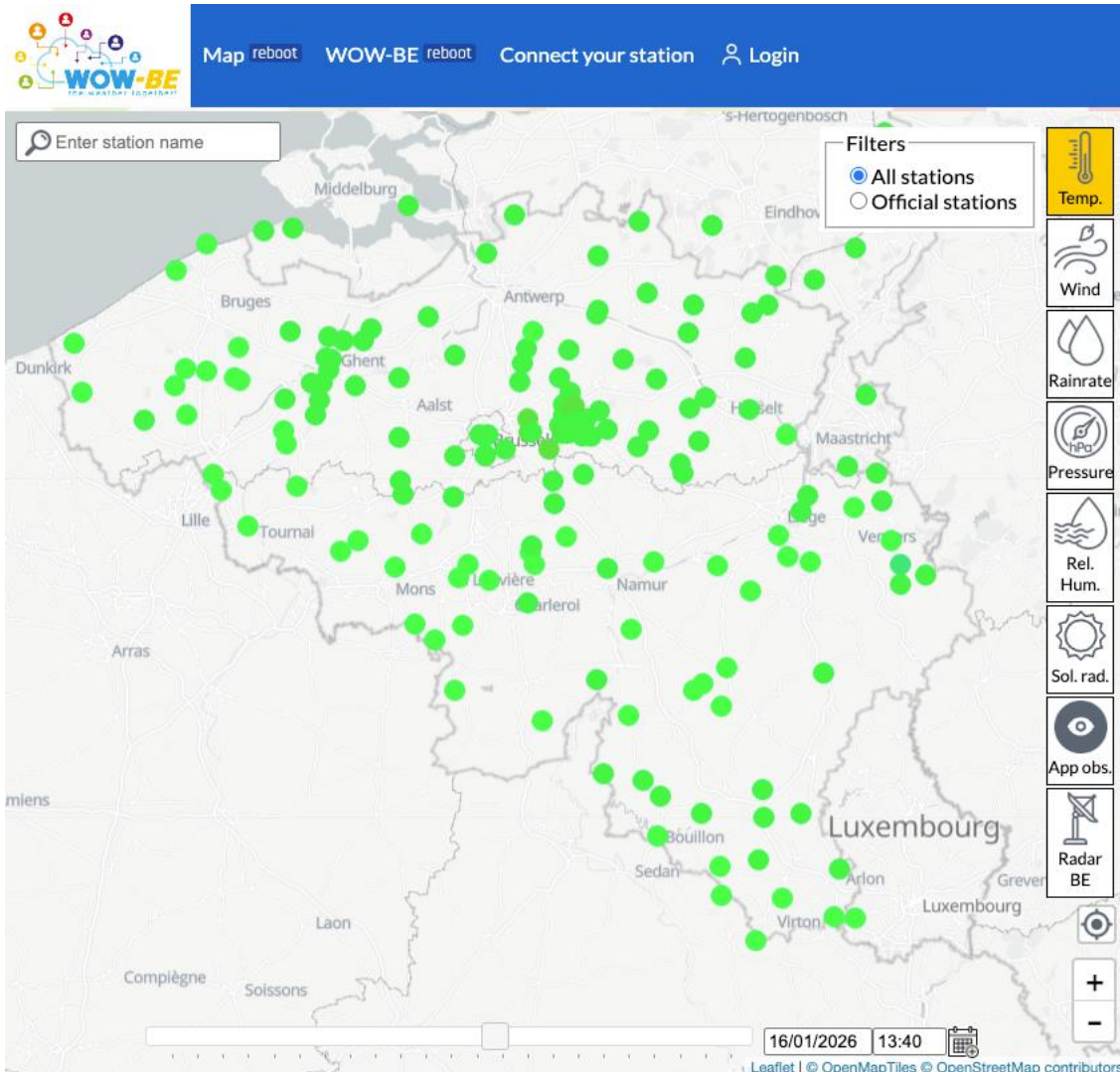
“WIGOS” like
identifier to identify
station duplication
across platforms

Admin dashboard
with overview of
all stations and
users

WOW-BE ^{reboot}
restyling

User notification
service when
station is offline

WOW-BE reboot : new features summary



Simplified user & station registration available in Dutch, French, and English

Introduction of short station ID

Weather variables:

- solar radiation added
- clear separation of relative vs. absolute pressure

More upload flexibility (three protocols) but backward compatible with old WOW

Fully open platform, offering open data and open-source software

Thank you!

The Royal Meteorological
Institute

Het Koninklijk Meteorologisch
Instituut

L'Institut Royal
Météorologique

Das Königliche
Meteorologische Institut



The RMI provides reliable public service realized by empowered staff and based on research, innovation and continuity.

Het KMI verleent een betrouwbare dienstverlening aan het publiek en de overheid gebaseerd op onderzoek, innovatie en continuïteit.

L'IRM fournit un service fiable basé sur la recherche, l'innovation et la continuité au public et aux autorités.

Vertrauenswürdige Dienstleistungen für Öffentlichkeit und Behörden begründet auf Forschung, Innovation und Kontinuität.