# Notebooks to support the growth of sea-based renewal energy sector

Simon Chabot [1] Nicolas Raillard [2]

[1]Logilab, Paris. [2]Ifremer, RDT, F-20280 Plouzané, France.

## Resourcecode project

Resourcecode is an Ocean ERA-NET project, ended early 2022, coordinated by EMEC, UK with the participation of the French sea research institute Ifremer to support investment and growth in the wave and tidal energy sector by providing marine data and associated models and software tools through an innovative online platform.

This project aims to make marine data and processing tools more accessible, facilitate collaboration between scientists and software developers, and encourage the adoption of open science practices.

Logilab was tasked by Ifremer to design and implement a part of that online platform, and the python module allowing to play with the data.

## The application step by step

1. select a study point on the map using the web application.
2. have a preview of the data at this point. The preview is generated using *Jupyter Notebooks*, and written by Ifremer scientists.
3. start *Jupyter Notebooks* on binder from a Gallery maintained by the Ifremer, in their own GitLab forge, and analyse more deeply the selected point.
4. use the `resourcecode` python library to locally analyse the data using *state of the art* codes. Use existing *Jupyter Notebooks* as a starting point. The library provides many functions to run analysis.

## Web Application

The Web Application is an user-friendly interface that allows users to search for and select the marine data they want to process.

It offers a map-based interface that lets users visualize data and apply filters to narrow down their search.

The web application was developed using *Typescript* and the *React* framework.

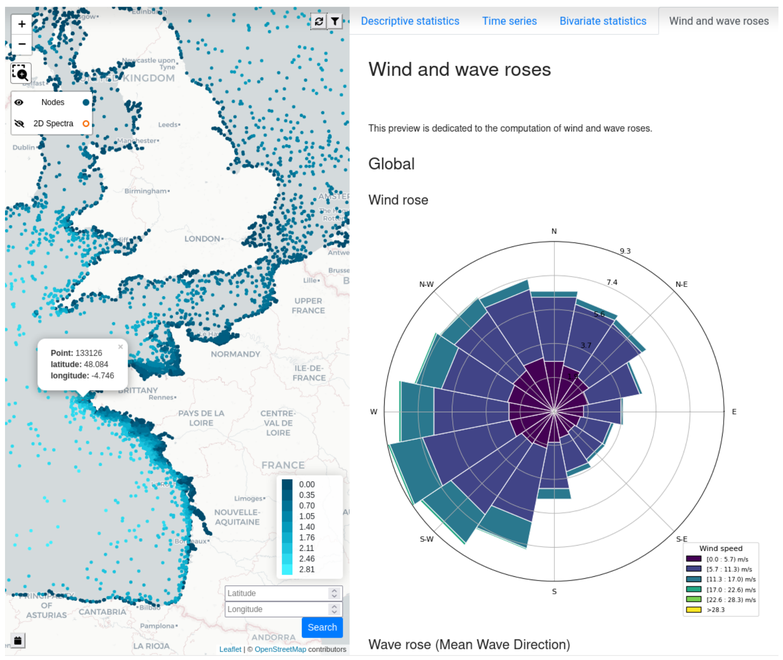



Figure 1. The data selection interface

On the left part, the map interface is used to select a point. All classical map features (zoom, gps coordinate selection, etc) are implemented.

On the right part, it the data preview of the current selection. Each tab corresponds to a *Jupyter Notebook*.

The notebooks are seen as functions, executed using the current user selection.

An URL is associated to each selection. This URL can be reused to visit the same point later, or to locally download the point data using the `resourcecode` python library.

## Resourcecode Library

The Resourcecode Python library [1] provides a programmatic interface for downloading and processing marine data. Users can download data using the Resourcecode library and convert it into a Pandas DataFrame, a popular data structure for data manipulation and analysis in Python. This library is particularly useful for users who want to process data offline or who have more specialized processing needs.

```
>>> from resourcecode import Client

>>> client = Client()
>>> data = client.get_dataframe_from_url(
...   "https://resourcecode.ifremer.fr/explore/?pointId=42"
...)
>>> data  # this is a Pandas DataFrame
                     fp     hs
2017-01-01 00:00:00  0.074  0.296
2017-01-01 01:00:00  0.072  0.400
...                    ...    ...
2017-01-31 22:00:00  0.096  0.612
```

## Global architecture

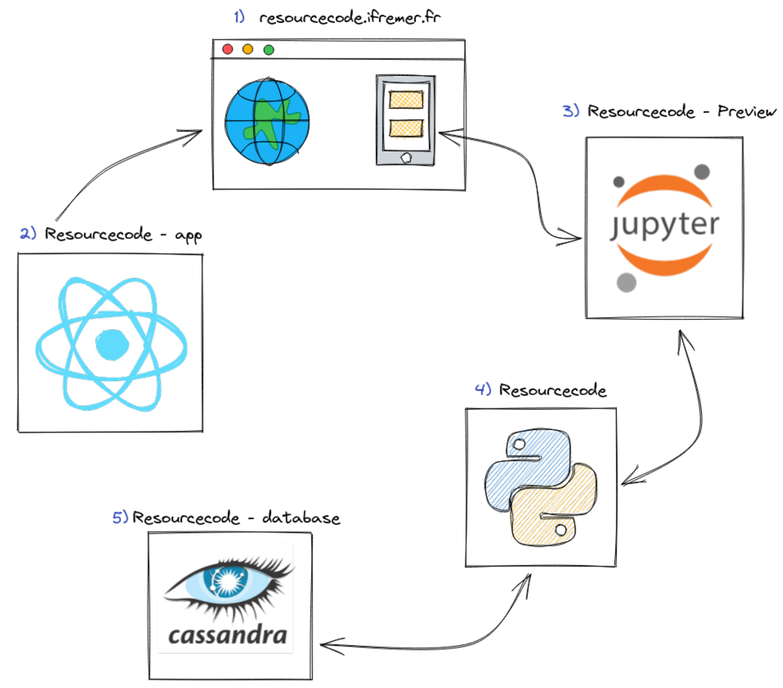



Figure 2. Simplified sketch of the project architecture.

The website (1) is composed of:

- (2) the *resourcecode-app* which contains the website global source code (all the pages, the map, etc).
- (3) When a node is selected on the map, some information and computation related to this point are shown. The rendering is made with *Jupyter Notebooks*. The notebooks are rendered with an OpenFaas function (*"Functions As A Service"*).
- (4) the preview notebooks use python functions defined in the `resourcecode` module, which provides a simple interface to get the data and analysis codes taylored to scientific needs.
- (5) the *resourcecode-database* stores all the data, and provides a HTTP API wrapped by the python module.
- Finally, the resourcecode web application and previews are be deployed on a virtual machine with ansible (*not shown on the picture*).

## The GitLab Forge

### The repositories

The Ifremer's forge is used to host all the Resourcecode project's code. There are several repositories for :

- the website (*Typescript* and *React* mainly)
- the previews notebooks (*ipynotebooks*)
- the notebooks gallery (each notebook in the gallery must be in a specific repository, placed in a specific group.
- the `resourcecode` module (*python*).

### The Continuous Integration

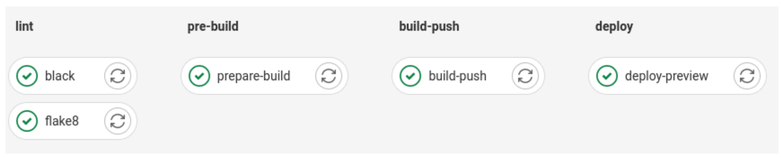


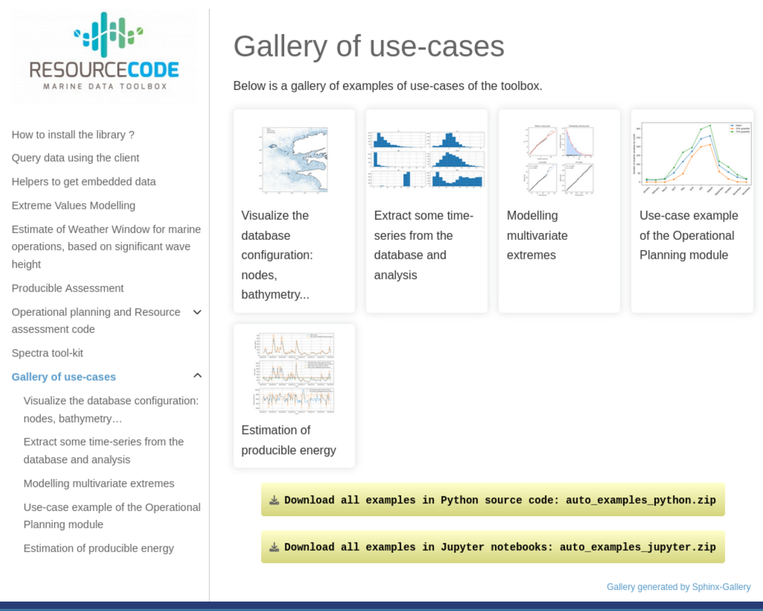

Figure 3. Screenshot of the Continuous Integration pipeline that lints, builds and publishes the set of notebooks to render the user selection preview.

Each repository uses the GitLab Continuous Integration (CI) to check the submitted merged requests to lint and tests when possible, then it builds the applications and publish the release.

The website and previews are update using an Ansible recipe.

### The project documentation

The Continuous Integration is also used to publish the `resourcecode` module documentation. It is published using the *GitLab pages* feature.




## Jupyter Notebooks

The Resourcecode platform includes a series of Jupyter Notebooks that provides pre-defined tools for processing selected marine data. These notebooks are maintained by scientists in a GitLab Forge hosted by the IFREMER. Jupyter Notebooks are interactive computing environments that allow users to run code, visualize data, and share their work with others. By using Jupyter Notebooks, Resourcecode offers an intuitive and flexible way for users to process data without requiring extensive coding knowledge.

### The Gallery

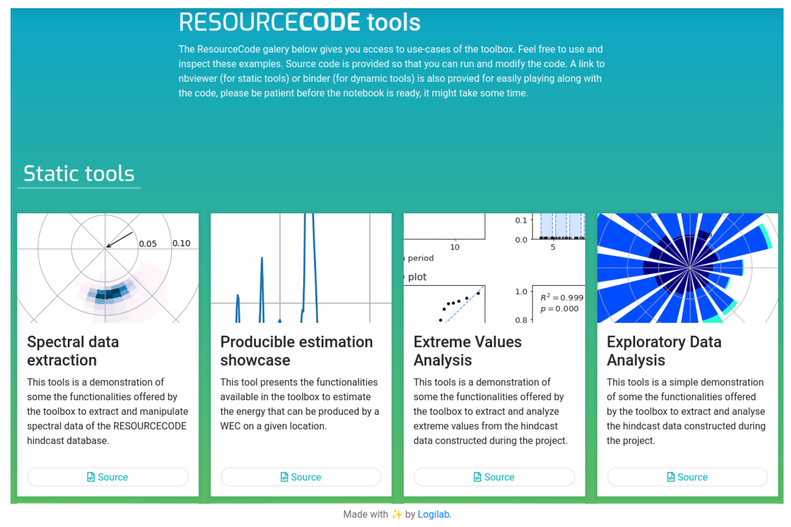



Figure 5. The notebooks gallery, visible on the website.

The website also offers a gallery of notebooks, written by the Ifremer too. There are two types of notebooks : the *statics* and the *dynamics*. The first kind is rendered using `https://nbviewer.org`, the second kind is rendered using `https://mybinder.org`. The list of notebooks is dynamically fetched from the Ifremer GitLab, and lively updated using to the Continuous Integration.

### Dynamic notebooks as application prototypes

Developing a full application can be expensive, even more when the final needs is still unclear. Moreover, for the same data, very different needs may exist. *Jupyter Notebooks*, using *ipywidgets*[a] and *Voilà*[b] enable to prototype application in a very efficient manner. The final web application can be used by a non-developer person.

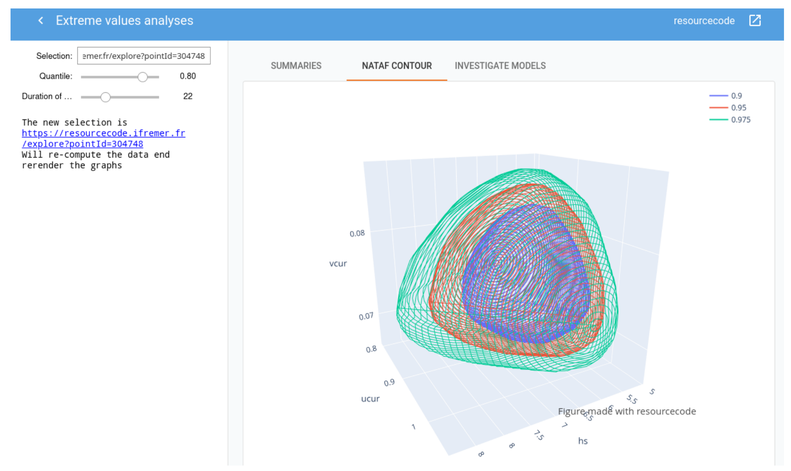



Figure 6. Example of simple application, with tunable parameters and dynamic recomputation of the results

## Conclusion

Resourcecode is an innovative project that provides an integrated platform for marine data processing and analysis. The combination of the web application, Jupyter Notebooks, and the Resourcecode library makes it easy for users with different levels of expertise to access and process marine data. Resourcecode also fosters collaboration between software developers and scientists by providing tools that are easy to use and maintain. By promoting the adoption of open science practices, Resourcecode is contributing to the development of sustainable marine energy and the management of marine resources.

## References

[1] Raillard, N. ; Chabot, S. ; Maisondieu, C. ; Darbynian, D. ; Payne, G. ; Papillon, L. : *Resourcecode Toolbox*. `https://gitlab.ifremer.fr/resourcecode/resourcecode`. Version: 12 2022

[2] Raillard, N. ; Chabot, S. ; Maisondieu, C. ; Darbynian, D. ; Payne, G. ; Papillon, L. : RESOURCECODE: A Python package for statistical analysis of sea-state hindcast data. In: *Journal of Open Source Software* 8 (2023), Nr. 83, 4366. `http://dx.doi.org/10.21105/joss.04366`. – DOI 10.21105/joss.04366

## Thanks

The ResourceCODE project has received support under the framework of the OCEANERA-NET COFUND project, with funding provided by national/regional sources and co-funding by the European Union's Horizon 2020 research and innovation programme.

[a] `https://ipywidgets.readthedocs.io/`
[b] `https://voila-gallery.org/`