THE JONAS VIRTUAL RESEARCH ENVIRONMENT: A SCIENCE GATEWAY FOR NOISE MAP VISUALIZATION AND DATA PROCESSING IN THE NORTH-EAST ATLANTIC REGION

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INTRODUCTION

As part of the JONAS (Joint Framework for Ocean Noise in the Atlantic Seas) project, PLOCAN developed a Virtual Research Environment (VRE) for noise map visualisation and data processing in the north-east Atlantic region. The main purpose of this Science Gateway is the capitalization (gathering) and dissemination of the results generated by the different JONAS Work Packages. The most important results generated by the Work packages were: noise maps of the Atlantic Arc, high-resolution noise maps of the six Jonas areas (see figure 1), Species maps, Risk maps, a risk assessment methodology, and six case studies. These maps were uploaded to a high-performance computing facility, for processing and display as required by the stakeholders. In order to cater for the different needs of the JONAS users, the JONAS VRE contains to main applications: JupyterHub and QGIS, the former is aimed at scientists and the latter to legislators and general public. Another important feature of the JONAS is its capability for processing acoustic data to generate different statistics. Figure 1 shows the area of study for the JONAS project, which comprises the North-East-Atlantic region. There are six areas of special importance to the project which are designated as Jonas 1 to 6 and shown in the same figure. Theses areas are: 1- Ireland-West of England-. 2- East of France. 3- The Azores. 4- Canary Islands. 5- South of Portugal. 6- North of Spain. In this poster we will briefly describe the three main steps incurred in creating the JONAS VRE: 1- Capitalization requirements. 2- Capitalization development. 3- Legacy.

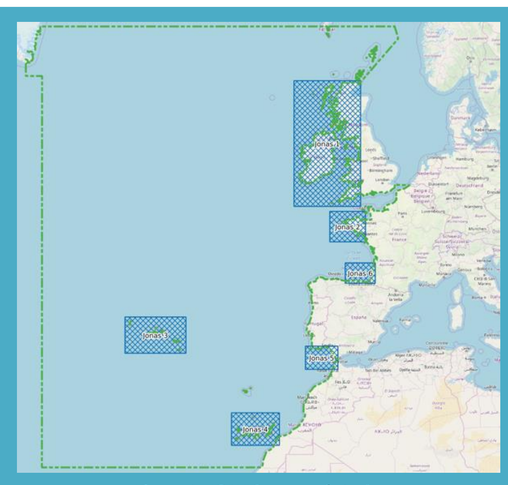

Figure 1. JONAS areas of study.

DEVELOPMENT OF THE VIRTUAL RESEARCH ENVIRONMENT

REQUIREMENT ANALYSIS AND VRE FUNCTIONALITIES

According to (Candela et al., 2013)*, VREs are:

1. Web-based environments.
2. Designed to serve a community of practice.
3. Provide tools and services to accomplish the community's goals.
4. Open and flexible.
5. Promote fine-grained controlled sharing of both intermediate and final research results by guaranteeing ownership, provenance and attribution.

The objective of this first step is to establish the core requirements for the JONAS virtual research environment (VRE) and integrate needs expressed by the user community and results available from past and concomitant projects and initiatives, with JONAS activities. The analysis encompasses key capabilities and functionalities of the VRE, to foster use of data and data products, noise and risk assessment methods, and case-studies for usability beyond the project.

The JONAS VRE is based on two main applications: JupyterHub and QGIS. By using these two applications (JupyterHub and QGIS) we were able to fulfill the three JONAS use cases (Diaz & Delory, 2021):

- Visualization of noise maps to support reporting and policymakers
- Ocean noise and risk-based approach experimentation with notebooks
- Acoustic data inventory

* Candela, L., Castelli, D., & Pagano, P. (2013). Virtual research environments: An overview and a research agenda. Data Science Journal, 12. https://doi.org/10.2481/dsj.GRDI-013.

DEVELOPMENT OF VIRTUAL RESEARCH ENVIRONMENT (VRE) HOSTED BY A SUSTAINED E-INFRASTRUCTURE BASED ON JONAS THEMATIC ACTIVITIES

The objective of the second step is to describe the process of development of the JONAS VRE and validate the results against the requirements set in previous step (Requirement analysis and VRE Functionalities). This phase details the entire process, from the very first steps of decision making, going through the development stages, and finalising with the validation of the requirements.

We began with some background information on Kubernetes, k3s, JupyterHub and QGIS, to provide the reader with basic information, which is intended to give a general idea about these underlaying software packages, as we could not accommodate all the information in this document neither was it our purpose. We followed with the process of deployment of the Kubernetes cluster, JupyterHub and QGIS, giving justification for the decisions made.

Then, we described the process of development of the Jupyter notebooks, emphasising the work done on processing the NetCDF files, as this is the standard file format for maps in the JONAS VRE, used for porting most of the processed data. We continued describing the folder structure of the VRE. Also, we detailed the VRE functional requirements as described in the first step, and explained how the VRE fulfiled each requirement.

VRE Output Examples

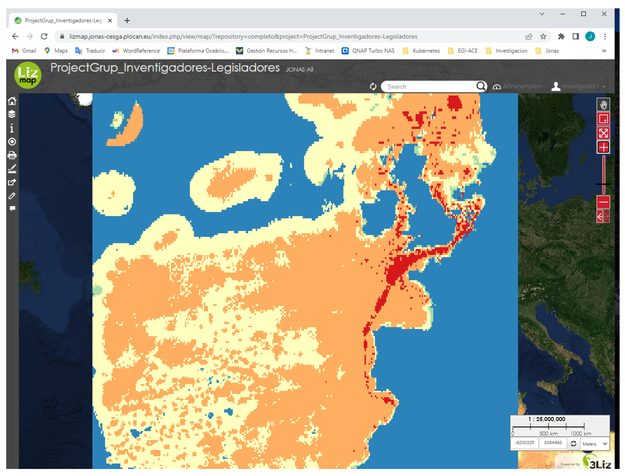

Figure 2. Noise map of the Noth-East Atlantic in the Lizmap web application.

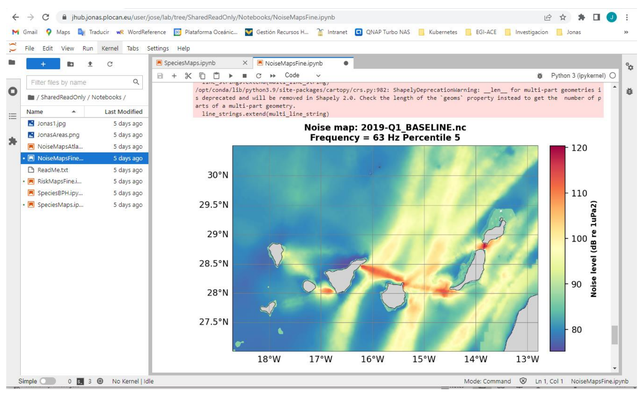

Figure 3. High- resolution noise map of the Canary Islands generated in JupyterHub.

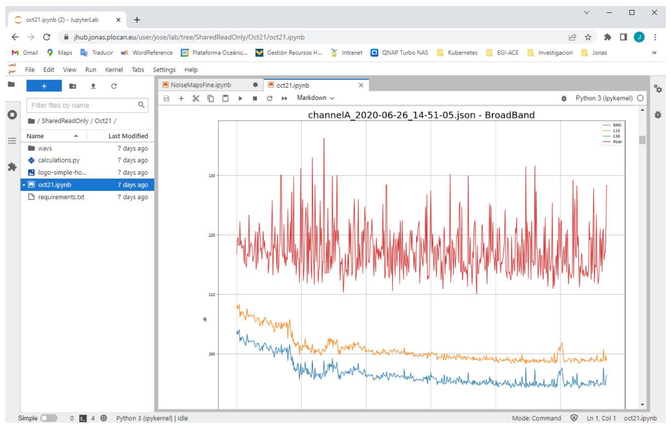

Figure 4. Statistics of raw data as generated in JupyterHub.

DELIVERY OF FORMATTED UNDERWATER NOISE DATA PRODUCTS TO SUSTAINED EU OCEAN OBSERVING INITIATIVES, BASED ON DATA AND DATA PRODUCTS DEVELOPED IN THEMATIC ACTIVITIES

The objective of this final step is to describe the overall structure of the JONAS VRE. In order to achieve our goal, a simplified diagram of the JONAS VRE was created where we show the two JONAS main applications (JupyterHub and QGIS), their inputs and outputs, which are described in detail in the document

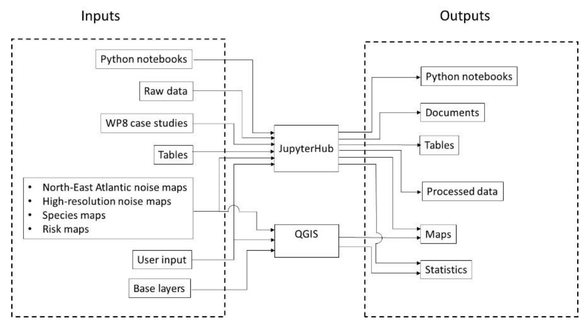

Figure 5. VRE simplified diagram.

CONCLUSIONS

The development of the VRE is an ambitious undertaking that will result in a potentially large number of requirements and expectations, which in turn will eventually give rise to a large system. In the case of the JONAS VRE, since our resources were limited, both economically and in person-hours, it was necessary to split the VRE requirements into binding and optional requirements, this is, the requirements that were mandatory for the VRE as expressed by the stakeholders in the JONAS workshop, and the desired requirements for the VRE.

The development of the JONAS VRE required a platform on which we could make experiments and develop the Python notebooks for visualising the outputs provided by the different WPs. In our case, this platform needed to be installed on high-performance servers (locally or in the cloud) and consisted of: Kubernetes, JupyterHub and QGIS. The deployment of Kubernetes in our local servers was not a straightforward process, consuming a considerable amount of time and effort.

Python proved to be an appropriate tool for the required purposes, providing all the functions and modules needed to fulfil the use cases, while QGIS required some extra work to transform the noise maps to an appropriate format to be able to display the JONAS maps.

At this time, the mandatory requirements have been implemented and some of the optional requirements.

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