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[WP6 e-Infrastructures]

D6.4 MaRINET 2 e-Infrastructure Pilot

Project Reports

Status: Final
Version: 1.0
Date: 12/August/2019

MaRINET2

Deliverable 6.4
e-Infrastructure use cases and guidelines

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 731084.

Document Details	
Grant Agreement Number	731084
Project Acronym	MaRINET2
Work Package	e-Infrastructures
Task(s)	6.1 Scope and Design
Deliverable	D6.4
Title	MaRINET2 e-Infrastructure Pilot
Authors	Thierry Carval (Ifremer), Peter Tijsse (Maris), Christopher Ariyo (CSC – EUDAT)
File name	MaRINET2-D6.4.docx
Delivery date	12/08/2019
Dissemination level	
Keywords	

Document Approval Record		
	Name	**Date**
Prepared by	Thierry Carval	08/08/2019
Checked by	Merete Badger	12/08/2019
Checked by		
Approved by	Merete Badger	12/08/2019

Document Changes Record			
Revision Number	**Date**	**Sections Changed**	**Reason for Change**
1.0	08/04/2019	-	Initial document
1.0	12/08/2019	§1.1	Presentation of the pilot
1.0	12/08/2019	§3.2	Introduction of the use cases

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D6.4 MaRINET2 e-Infrastructure Pilot

1 Introduction

The WP6 objective is to design and implement the MaRINET 2 e-infrastructure. Within WP6, two key issues are addressed: “Data preservation” and “Data sharing within a VRE” (Virtual Research Environment) leading to these objectives:

- Data preservation: a common policy compliant with international standards (RDA – Research Data Alliance) and European standards for Marine data (SeaDataNet)
- Data access and service : a Virtual Research Environment (VRE) workplace based on common national and European e-infrastructures (such as SeaDataCloud)

The MaRINET 2 e-infrastructure supports these via the following actions:

- Collection and storage of MaRINET 2 experiment descriptions and results to secure their interoperability and long-term preservation
- Discovery, visualization and downloading of MaRINET2 experiment descriptions and results/datasets (previous and ongoing) to support R&D and inform device design
- Provide secure and controlled access to datasets and virtual tools for joint research activities

This document describes and explains how MaRINET2 WP6 organises the long-term data preservation, and data discovery, access and use.

1.1 e-Infrastructure Pilot

This document is a follow-on of D6.2 “Design specification for MaRINET 2 interfaces and tools”. Based on D6.2 design, the D6.4 pilot have beeen implemented :

- Long term data preservation and DOIs
  A series of datasets (e.g. Round Robin test) have been published with DOI and cross-references within test-site description, datasets, publications, identification of authors and contributors, registration in MaRINET2 OpenAIRE project catalogue.
- Data-metadata and standard
  The initial MaRINET2 NetCDF CF format for data and metadata was published.
  The inventory of existing and relevant standard for MaRINET2 was completed.
  The need for a MaRINET2 vocabulary server has been identified and may be implemented in during the project.
- Data sharing on VRE (Virtual Research Environment): discovery, access and data usage
  A MaRINET2 VRE was setup on Ifremer HPC (High Performance Computer) Datarmor.
  It features :

- user registration
- data provision from user trough OwnCloud
- JupyterHub and notebooks for code sharing and use. The proposed languages are : Python, Java, R, Octave and Matlab (compiled code)
- Initial codes on round-robin datasets : data visualization

2 Long-term data preservation and DOIs

Publishing datasets and citing them with DOIs is a policy compliant with international standards (ISO 26324:2012) and supported by international and European bodies such as DataCite, RDA – Research Data Alliance, and the SeaDataNet Marine data infrastructure. More information on the DOI standard:

- ISO 26324:2012 Information and documentation -- Digital object identifier system

2.1 Preserve datasets with DOIs

We recommend using DOIs to preserve, identify, access and cite MaRINET2 datasets.

- The DOI (Data Object Identifier) provides an unambiguous persistent identifier of datasets with a commitment for long-term preservation.
- DOIs are efficient for data citation, bibliographic surveys and credits to scientists (with crosslinks with ORCID, the researchers and organizations persistent IDs).
- DOIs facilitate data access, usually with a one-click download. However a DOI does not solve the re-use of datasets, only the identification. For the re-use we need metadata, semantics and standards and this will be dealt with later.

The guideline is to assign DOIs to data and publications, with the proper metadata for OpenAIRE automatically harvested under the MaRINET2 project. DOI publication in Seanoe or Zenodo, makes it automatically available to OpenAire, good for uptake from MaRINET2 results.

When applicable, data and metadata will be converted into NetCDF CF files, in MaRINET2 implementation. The NetCDF converter will be shared and available from a MaRINET2 GitHub.

It is important that in the end the data from MaRINET are available for EOSC (European Open Science Cloud).

2.1.1 MaRINET2 data preservation policy

A common policy compliant with international standards (RDA – Research Data Alliance) and European standards for Marine data (SeaDataNet)

- Preserve, identify, access, cite datasets, projects and scientists
  The use of DOI (Data Object Identifier) is strongly recommended

- Unambiguous persistent identifier with a commitment for long-term preservation
- Efficient for data citation, bibliographic surveys, credits to scientists (ORCID), credit to MaRINET project (OpenAIRE)
- Simple: data downloaded in one click

2.1.2 MaRINET2 best practice for data preservation

- One persistent DOI per MaRINET2 test site
- One persistent DOI per dataset to be preserved, with OpenAIRE metadata
- Cross references between test sites – datasets – scientists – projects – publications

2.1.3 MaRINET2 prototype for site catalogue: Boulogne-sur-Mer

As a use case, the Boulogne-Sur-Mer MaRINET2 site test is described in a publication with a specific "site" DOI.

Gaurier Benoit, Germain Gregory, Facq Jean-Valery, Bacchetti Thomas (2018). ***Wave and current flume tank of IFREMER at Boulogne-sur-mer. Description of the facility and its equipment****. 19CSMBL18. https://doi.org/10.13155/58163*

This publication DOI is the persistent identifier of Boulogne-sur-Mer test site.

Boulogne-sur-Mer MaRINET site DOI landing page

All MaRINET2 datasets related to Boulogne-sur-Mer test site are listed in the "Related datasets" by way of each individual dataset DOI.

The attribution of dataset DOIs is documented In the next chapter.

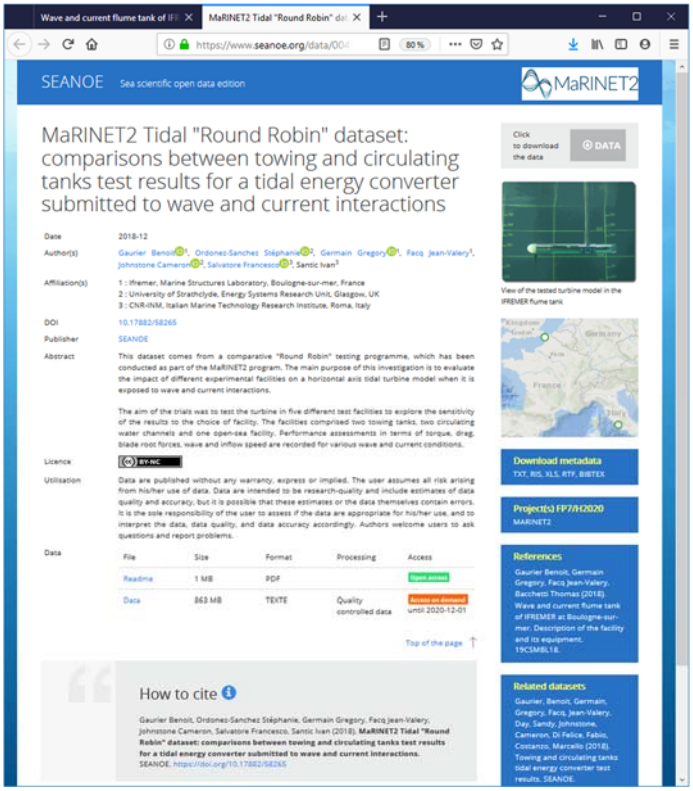
2.1.4 MaRINET2 prototype for data preservation : Round-Robin dataset involving Boulogne-sur-Mer site

SEANOE (seanoe.org) is an European data publisher, hosted by Ifremer, used by individual scientists, institutions or infrastructures, such as ODATIS, the French ocean observation data infrastructure (https://www.odatis-ocean.fr/en/) or the European EMODnet Ingestion infrastructure (https://www.emodnet-ingestion.eu/)

The MaRINET2 datasets should be published on SEANOE or equivalent data publishers able to ensure a long term preservation of datasets and provide a specific DOI for each dataset with proper links with MaRINET2 sites DOIs and program (OpenAIRE metadata).

As a use case, the following dataset was published on SEANOE and assigned the DOI 10.17882/58265.

Gaurier Benoit, Ordonez-Sanchez Stéphanie, Germain Gregory, Facq Jean-Valery, Johnstone Cameron, Salvatore Francesco, Santic Ivan (2018). ***MaRINET2 Tidal "Round Robin" dataset: comparisons between towing and circulating tanks test results for a tidal energy converter submitted to wave and current interactions****. SEANOE. https://doi.org/10.17882/58265*



Round robin tidal dataset involving Boulogne-sur-Mer, University of Strathclyde and CNR-INM sites

With a proper publication on SEANOE, a series of cross-reference links are activated:

- Link “MaRINET2” toward the project home page http://www.marinet2.eu/

- Link "DATA" : the one click download of the dataset, or request form when embargo applies
- Link to each authors curriculum (ORCID)
  Example : Gaurier Benoit link to https://orcid.org/0000-0001-9860-6470
- Link to the dataset licence
  Example : CC BY-NC https://creativecommons.org/licenses/by-nc/4.0/
- "How to cite" statement
- Link to dataset metadata in various standards
  TXT (text), RIS (Research Information Systems), XLS (Excel spreadsheet), RTF (Rich Text Format), BIBTEX (bibliographic text format)
- Link to OpenAIRE EXPLORE MaRINET2 registration
  https://explore.openaire.eu/search/project?projectId=corda__h2020::c1957405f8d8bf48e1ac0f8326209d8b
- Link to OpenAIRE EXPLORE Round Robin dataset metadata
  https://explore.openaire.eu/search/dataset?datasetId=r341eb926ae9::a4b8a4299ca1ba870cae99743dab827f
- Link to Boulogne-sur-Mer Marinet2 test site presentation
  https://doi.org/10.13155/58163
- Link to related Round Robin datasets from the former Marinet project
  https://doi.org/10.17882/57450

2.2 MaRINET2 dataset catalogue

As a use case, it was implemented a simple, robust and sustainable MaRINET2 dataset catalogue based on:

- One persistent DOI per MaRINET2 test site
- One persistent DOI per dataset to be preserved
- One Marinet2 catalogue referencing these
- Use of ORCID to credit individual scientists and organizations
- Link DATA DOIs with publications (having a publication DOI)
- Each dataset described with standardised metadata

It is important to facilitate in this way the cross references between test sites – datasets – scientists – organization – publications.

Such a catalogue organization based on cross referenced DOIs is a strong implementation of FAIR data principle:

- Findable
  Project, site and datasets DOI metadata harvested and registered by the major search engines (Google, Qwant) or science discovery services (OpenAIRE, ORCID)
- Accessible
  A one click download from dataset DOIs

- Interoperable
  Dataset DOIs with rich metadata
- Reusable
  Machine readable dataset DOI licence

An automated data catalogue built on FAIR cross-referenced DOIs (Data Object Identifiers)

2.3 Data preservation infrastructure

It is advised that as a basis of the MaRINET2 system each institution has their own repository of data for long-term preservation, including DOI provision. There are several suitable DOI providers available in the community.

The initial data preservation use case is based on SEANOE data publisher.

Alternative data publishers providing DOIs are also available : EU Zenodo, SeaDataNet national data centres (UK BODC, Italy OGS, France SEANOE) , Germany Pangaea.

MaRINET2 institutions may also preserve their data with the EUDAT B2SHARE service which can mint DOIs. Today's limit on B2SHARE data records that can be uploaded is 20gb per record and 10 gb per file.

3 Data-metadata formats and standards

MaRINET2 manages within the experiments a fair diversity of data types. We identify below initial categories of data with common standardization policies. These categories will be further expanded during the project. Six categories of data, detailed in chapters 3.2 are now

addressed.
Other categories will emerge, as the TNA experiments deliver new datasets.

3.1 MaRINET data and metadata standards

3.1.1 NetCDF CF format for data and metadata

The favoured data format for MaRINET datasets is NetCDF CF, a widely agreed format for science data and metadata (see http://cfconventions.org/).

A dedicated implementation of NetCDF CF for MaRINET community is published on:

- *MaRINET NetCDF format reference manual V1, https://doi.org/10.13155/60863*

This is an initial version, that will be expanded and enriched during the project.

3.1.2 MaRINET2 vocabulary server

MaRINET metadata include specific terms, ideally common to all providers, typically used in NetCDF files.

To manage, publish and provide FAIR machine to machine services, the need for a specific MaRINET community vocabulary server has been identified.

As mentioned on SeaDataNet vocabularies web page, the *"Use of common vocabularies in all metadatabases and data formats is an important prerequisite towards consistency and interoperability. Common vocabularies consist of lists of standardised terms that cover a broad spectrum of disciplines of relevance to the oceanographic and wider community. Using standardised sets of terms solves the problem of ambiguities associated with data markup and also enables records to be interpreted by computers. This opens up data sets to a whole world of possibilities for computer aided manipulation, distribution and long term reuse."*
See https://www.seadatanet.org/Standards/Common-Vocabularies

Although not addressed in MaRINET2 proposal, the implementation of a specific MaRINET community vocabulary server will be investigated.

3.2 MaRINET2 data and metadata use cases

A series of 7 uses cases was identified and listed in the subsequent sub-chapters.

They will be implemented between M27 and M48. The implementation of the use cases will be reported in D6.5.

3.2.1 Round-robin tests

A round-robin test is an inter-laboratory test (identical measurement, analysis, or experiment) performed independently several times. These experiments will deliver data of all types.

Within MaRINET WP2, in relation with WP6, standardization and publication of round robin tests are addressed.

The first MaRINET2 round robin test is now published as:

Gaurier Benoit, Ordonez-Sanchez Stéphanie, Germain Gregory, Facq Jean-Valery, Johnstone Cameron, Salvatore Francesco, Santic Ivan (2018). ***MaRINET2 Tidal "Round Robin" dataset: comparisons between towing and circulating tanks test results for a tidal energy converter submitted to wave and current interactions****. SEANOE. https://doi.org/10.17882/58265*

3.2.2 Marine in-situ environmental data

A small proportion of MaRINET2 data are ocean in situ observation data. This specific subset may be published (after initial storage in the Marinet2 environment) for re-use in SeaDataNet data centres, dedicated to ocean in situ data preservation. It is recommended to follow this path for this type of data.

One MaRINET2 – SeaDataNet node may be created to publish MaRINET2 specifically ocean in situ datasets on the SeaDataNet infrastructure. This can be facilitated by MARIS and IFREMER who are deeply involved in SeaDataNet.

SeaDataNet (represented by Marinet2 partners MARIS, IFREMER)) will provide support to manage and standardise marine validated/historical in-situ environmental data as stored by the partners in an early stage. Important standards available that will need to be applied:

- Common Data Index metadata format (ISO19115/19139 compliant) to describe the observation datasets
- List of vocabularies for physical, chemical and other parameters (sea water temperature, salinity, oxygen…)
- NetCDF data and metadata format, ASCII format (ODV – Ocean Data View)

References: https://www.seadatanet.org/Standards

By using these standards early in the workflow, the re-use of the data will be much easier.

3.2.3 Wind Lidar data use case

DTU is actively working on Wind Lidar data standardization.

Taxonomy and metadata for wind energy Research & Development
https://zenodo.org/record/1199489#.WrUZBWaZNBx

3.2.4 WindBench use case

CENER is actively working on the WindBench use case. In principle, its workflow is similar as round robin tests:

- Collect experiment data via Windscanner
- Publish data in NetCDF with DOI's with shared NetCDF conversion code

- NetCDF converter for the raw data is available, format is documented, dictionary used with default is CF, but others are allowed for parameters not available in CF (e.g. for the pitch of blades).
    - Converting tool is available on GitHub, as part of the e-infrastructure
    - Proposal to have a Marinet Github, create account, and collect the reference to all relevant codes for Marinet there. Fileformat checker could be published here as well.
        - Data stored in Windbench for benchmarking (could be in Jupyter notebook)
        - Create validated data: Could be published again
        - And that version could be compared with other data, like remote sensing again in Notebook
            - Store end results (graphics, statistics from Notebooks)

The use case will be developed on Ifremer infrastructure. Then when validated, start deployment of the MaRINET2 as a separate lab of SeaDataCloud, via CSC.

3.2.5 HF Radar data

The EU projects JERICO-NEXT, EU service Copernicus Marine services and SeaDataNet are proposing a data management standardization for HF radar observations, based on NetCDF files, CF compliant (Climate and Forecast), with SeaDataNet common vocabularies for metadata (easy generation of Common Data Index metadata files).

- European HF radar NetCDF data and metadata format

MaRINET2 HF radar data pushed on the e-infrastructure should comply with these standards.

3.2.6 Tidal data

This chapter will be expanded later on during the project.

3.2.7 Corrosion data

This chapter will be expanded later on during the project.

4 Data sharing on VRE: discover, access, use data

4.1 Ideas for the VRE

A Virtual Research Environment (VRE) or virtual laboratory is an online system helping researchers collaborate in processing and inspecting data. The VRE includes collaboration support (Web forum and wiki), document and data hosting, and some discipline-specific tools, such as data analysis, visualisation, publication management; teaching tools such as presentations and slides may be included. VREs have become important in fields where

research is primarily carried out in teams which span institutions and even countries: the ability to easily share information and research results is valuable. It also replaces the traditional need to download data first with an immediate option to work with the most recent version of data, with the most recent version of software.

The Virtual Research Environment (VRE) workplace is based on the SeaDataCloud VRE. This VRE (currently in development) offers a data analytics platform composed of:

- **Data storage and Computing clusters** from EUDAT or Ifremer (for initial validation/testing purpose)
- **Jupyter notebooks:** Online environment for running algorithms code, save and share notebooks
- A users dedicated **GUI web API**
- A data catalogue for data discovery
- Data visualization services
- Data subsetting services

The VRE module as proposed for MaRINET2 aims at interdisciplinary use of data from specific domains: tests sites - in situ – model – satellite.

An objective is to broadcast MaRINET2 data toward E-Infrastructures developed within SeaDataCloud, ENVRI, DIAS, EOSC.This will allow trans-disciplinary science, e.g. ocean, space, atmosphere, earth, …
Specific examples are:

- Environmental monitoring and forecasting: EU ocean-atmosphere models
- Calibration and validation with in-situ data: satellite missions
- Efficient workplace for advanced services

4.2 Data license

Data and products should be delivered with a human and machine-readable license. Among valid solutions, we recommend:

- Creative Commons licences
- SeaDataNet standard licenses

OpenAIRE recommends Creative Commons licences for research data (see https://www.openaire.eu/how-do-i-license-my-research-data).

4.3 Metadata on projects

The relevant standard for metadata on projects proposed by OpenAIRE were investigated.
See https://guidelines.openaire.eu/en/latest/literature/field_projectid.html

Such projects metadata enhance the visibility on projects data, publications and ongoing progresses.
MaRINET2 is now in the list of the many projects described on OpenAIRE, with proper links to published documentations and datasets.

- MaRINET2 OpenAIRE catalogue https://explore.openaire.eu/search/project?projectId=corda__h2020::c1957405f8d8bf48e1ac0f8326209d8b

Below is a machine readable list of EC projects (count: 40 823 in April 2018).
http://api.openaire.eu/oai_pmh?verb=ListRecords&set=ECProjects&metadataPrefix=oaf
There is also a global project list (count: 2351184 in April 2018)
http://api.openaire.eu/oai_pmh?verb=ListRecords&set=projects&metadataPrefix=oaf

5 The e-infrastructure components

This chapter lists the major components that will together build up the MaRINET2 e-infrastructure.

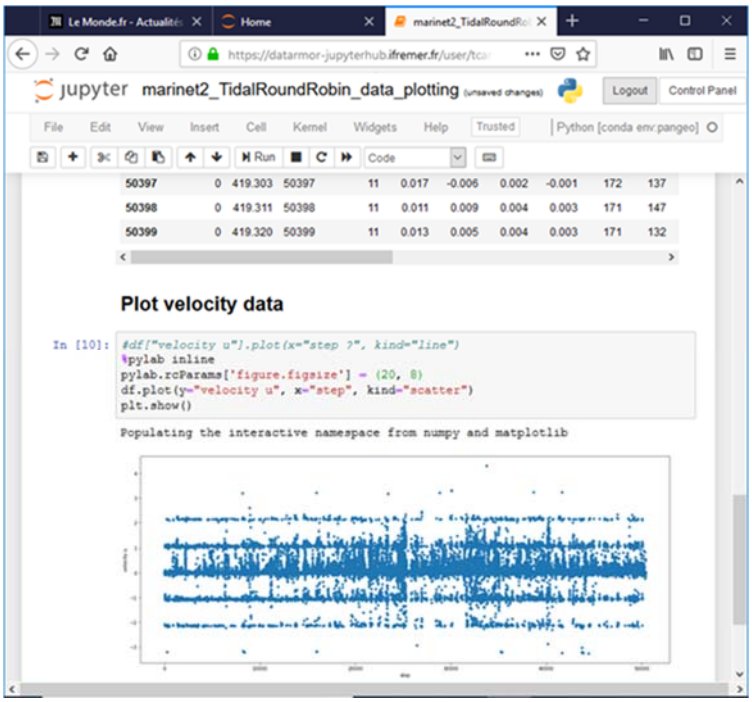
5.1 Jupyter Notebook

An important part of the VRE is Jupyter Notebook. The Jupyter Notebook is an open-source web application that allows researchers to create and share documents that contain live code, equations, visualizations and narrative text. Uses include: data cleaning and transformation, numerical simulation, statistical modeling, data visualization, machine learning, and much more.

Jupyter Notebook is promoted within MaRINET2 community for developing, running and sharing python, Julia, R or other codes.

Ifremer is hosting a MaRINET2 JupyterHub server available to the project members, as a testing facility for datasets access, computer notebooks for code sharing. The supported programming languages are : python, java, octave or matlab (compiled code).

- https://datarmor-jupyterhub.ifremer.fr
- Individual accounts are created on request to : sismer@ifremer.fr



Work with "Tidal Round Robin" doi 10.17882/58265 on JupyterHub, python code shared in a notebook

5.2 Nextcloud - B2DROP

MaRINET2 individual user's personal cloud storage space, distributed in institutions or hosted by EUDAT. B2DROP is a secure version of the widely used DropBox or GoogleDrive services.

It is a secure and trusted data exchange service for researchers and scientists to keep their research data synchronized and up-to-date and to exchange with other researchers.

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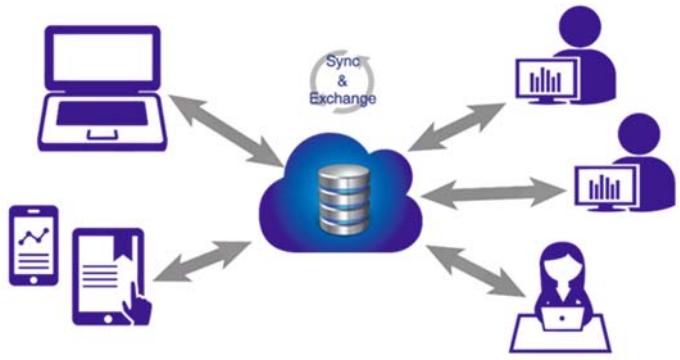

A solution to:

- store and exchange data with colleagues and team members,
- synchronise multiple versions of data,
- ensure automatic desktop synchronisation of large files.

Users can:

- define with whom to exchange data, for how long and how
- are offered up to 20GB of storage space for research data
- access and manage permissions to files from any device and any location.

The service is **simple to use and open to all researchers, scientists, communities alike to synchronise and exchange data** with one or multiple users.

5.3 B2SHARE

B2SHARE is a user-friendly, reliable and trustworthy way for researchers, scientific communities and citizen scientists to store and publish small-scale research data from diverse contexts. B2SHARE is a solution that facilitates research data storage, guarantees long-term persistence of data and allows data, results or ideas to be shared worldwide. The basic production service comprises the following features:

- self-service registration for any scientists and researchers,
- free upload and registration of stable research data,
- data access policy is defined by the data owner,
- metadata is openly accessible and harvestable,
- customized metadata handling and customized user interfaces (e.g. for metadata acquisition),
- data integrity is ensured by checksums which are calculated during data ingest,
- the data is kept online, the storage usage base on the principle of fair share.

5.4 Catalogues to publish and use data from

In addition to OpenAIRE (fed by MaRINET2 DOIs) , additional catalogues can be considered:

- B2FIND: The EUDAT metadata catalogue service. It harvests metadata directly from community catalogue software (SeaDataNet, Sextant, Pangaea).
- Sextant (by IFREMER): OGC-SWE catalogue for data sources used by Copernicus Marine, SeaDataNet and AtlantOS. It contains the metadata descriptions of the available datasources, aggregated datasets, data products. In the metadata URL's are provided to data access endpoints.
  10 main data sources: Argo, EMSO, Copernicus Marine in situ, SeaDataNet, World Ocean Database…

Other options are: Zenodo, B2SHARE, Pangaea, Seanoe, ...: publish and preserve scientific data, notebook or processed datasets on these infrastructures.

5.5 SeaDataCloud – EUDAT VRE

SeaDataNet and EUDAT are jointly building the SeaDataCloud Virtual Research Environment (VRE). The aim is to develop a common workplace for marine scientists to collaborate and seamlessly access and use Marine data sets and other commonly used marine science applications. See chapter 4.1.

B2ACCESS is the EUDAT federated cross-infrastructure authorisation and authentication framework for user identification and community-defined access control enforcement. It enables users to access EUDAT services with different authentication methods, such as Marine ID, GEANT/eduGain logins and ORCID id. B2ACESS will be used for the user authorisation and authentication within the VRE.

5.6 One MaRINET2 node for SeaDataNet

MaRINET2 will deliver als marine environmental data. The typical platform to publish the archived and validated marine data is the SeaDataNet infrastructure (www.seadatanet.org). The central system to publish the data for later use, and uptake by e.g. EMODNet is the SeaDataNet CDI system. Datacenters are distributed nodes of this system, publishing their harmonised metadata and datasets.
For MARINET one SeaDataNet node will be set up. Through this node (entry point), MaRINET2 marine in situ observations will circulate towards the SeaDataNet Marine data infrastructure. Partners IFREMER and MARIS will guide this process.

5.7 MaRINET2 APIs

An API (Application Programming Interface) is a set of subroutine definitions, protocols, and tools for building application software.

5.7.1 Data access APIs

A series of APIs dedicated to specific MaRINET2 categories of data will be developed.

DTU is developing an API to access Wind Lidar data; this ongoing work will be part of MaRINET2 e-infrastructure.

5.7.2 Vocabulary server

To manage, publish and provide FAIR machine to machine services, the need for a specific MaRINET community vocabulary server has been identified. Although not addressed in MaRINET2 proposal, the implementation of a specific MaRINET community vocabulary server will be investigated.

5.8 MaRINET2 GitHub

A public GitHub workspace is created for software code development and sharing.

The initial codes shared on GitHub include the NetCDF format converter developed by CENER.