



Blue-Cloud

Piloting innovative services for Marine Research & the Blue Economy

Blue Cloud Aquaculture Monitor Demonstrator

“Webinar Automating cage detection”

IFREMER, CLS, FAO



Blue-Cloud has received funding from the European Union's Horizon Programme call BG-07-2019-2020, topic: [A] 2019 - Blue Cloud services, grant Agreement number 862409.



Blue-Cloud

Agenda

- **11:00 - Introduction, Blue-Cloud Vision and Mission**
Cécile Nys, Ifremer
- **11:10 Aquaculture Atlas Objectives and tasks**
Anton Ellenbroek, FAO
- **11:20 Aquaculture Atlas Activities and Tools**
Emeric Lavergne and Jérémy Augot, CLS
- **11:40 Services Harmonisation, Standardization, Integration using Blue-Cloud Data Access and Processing Services**
Gilbert Maudire, Ifremer
- **11:45 Questions & Answers**
Anton Ellenbroek, FAO

Vision

Blue-Cloud




- Thematic Cloud of EOSC
- Reference for the “*Blue Community*” : Data, Analytical tools & Computing resources
- Shaping future landscape : Marine research & Blue economy



Blue-Cloud

Mission

Pilot a cyber platform

-  multidisciplinary data (observations & models)
-  analytical tools and services
-  computing and storage facilities

Support research to better understand and manage the many aspects of **ocean sustainability**

Demonstrators of relevance for marine societal challenges

Community-oriented roadmap

Five real-life demonstrators

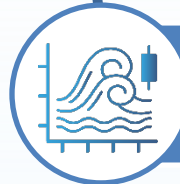
Biodiversity



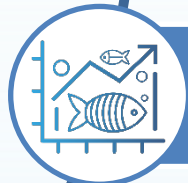
Zoo- and Phytoplankton EOV products



Plankton Genomics



Marine Environmental Indicators



Fish, a matter of scales



Aquaculture Monitor

Aquaculture

Five real-life demonstrators

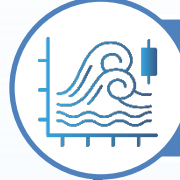
Biodiversity



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Marine Environmental Indicators



Fish, a matter of scales

Aquaculture



Aquaculture Monitor

Aquaculture Monitor

- Managed by FAO & CLS
- Ambition
 - ➔ deliver tool to produce national aquaculture overviews
- Expand remote sensing analytic capabilities – Aquaculture Atlas Production System (AAPS)
- Provide robust & replicable environment



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A VRE to manage data

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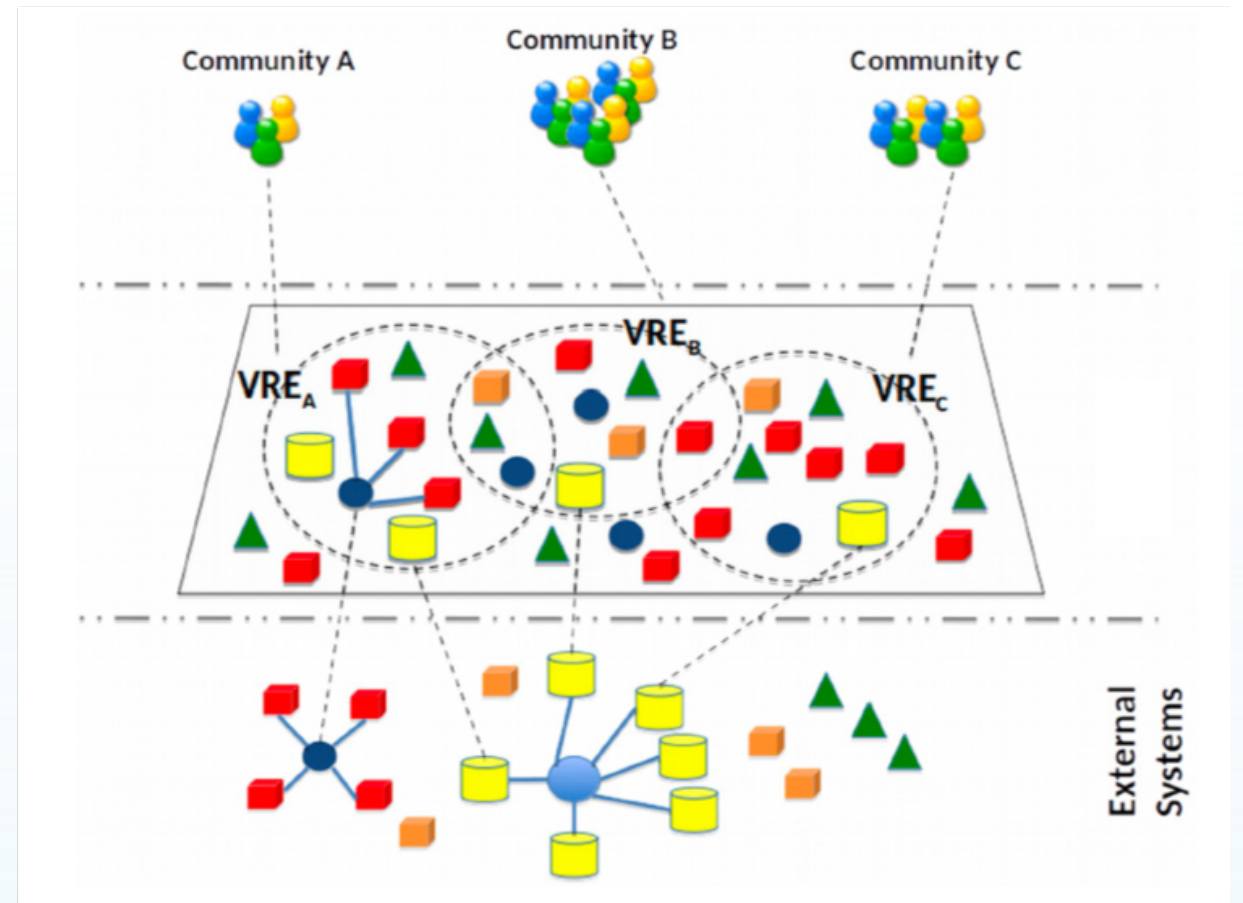


In a data Infrastructure

Autonomous components

Distributed

Open



Assante, M., Candela, L., Castelli, D., Cirillo, R., Coro, G., Frosini, L., Lelii, L., Mangiacrapa, F., Marioli, V., Pagano, P., Panichi, G., Perciante, C., Sinibaldi, F.
The gCube System: Delivering Virtual Research Environments as-a-Service. Future Generation Computer Systems (Vol. 95)



Blue-Cloud

With loads of flexible integration

A swiss army knife for nerds



• Method available as-a-Service,



• Invoked via communication standards (WPS)



• Higher computational capabilities



• Automatic creation of a Web interface



• Provenance management



• Storage of results on a high-availability system



• Collaboration and sharing



• Re-usability, Reproducibility, Repeatability, also from other software

Demonstrator Objectives

Strengthen **methodologies** and **tools** in support of Aquaculture Atlases

- **An Aquaculture Atlas; Not for FAO, but for global community**
 - A comprehensive overview of aquaculture features in a region for SDG's 2 and 14
- **Methodology: Development through co-creation of a community**
 - 1. Delineate the area
 - 2. Detect cages and try to infer activity (resting / stocked) over a season
 - 3. Describe the cage clusters (name, cage types, species, using other sources)
 - 4. Disseminate the estimate statistics
- **Tool: Virtual Lab as an Aquaculture Atlas:**
 - Start from the FAO/CLS H2020 Aquaculture Atlas
 - Develop into integrated Demonstrator: #5 – Aquaculture Monitor



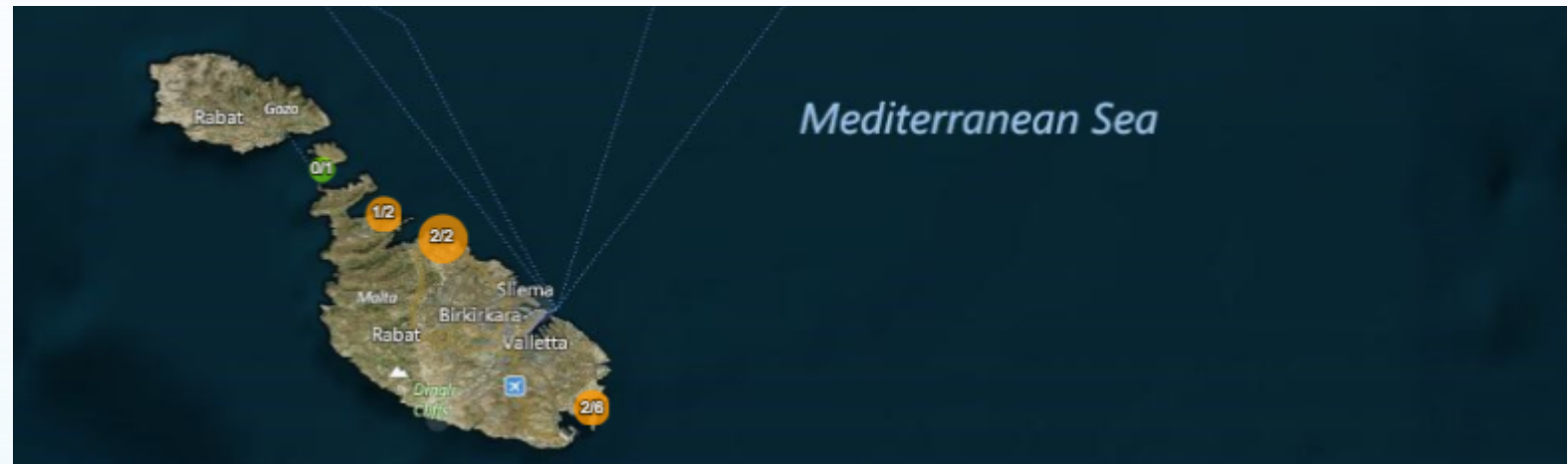
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Aquaculture Atlas Demonstrator

Step 1: Area Delineation

🌀 For who is this tool?

- 🌀 Areas with large number of Cages: For example Greece (previous project)
 - 🌀 IT works also on smaller numbers => see Malta for example below
 - 🌀 IT works with statistical analysis => False positives / False negatives have an impact
- 🌀 With a monitoring need => Integrate technology in Blue Cloud (2020)
 - 🌀 Not on individual cages, but observe a trend in large samples
 - 🌀 We cannot and do not want to track each cage







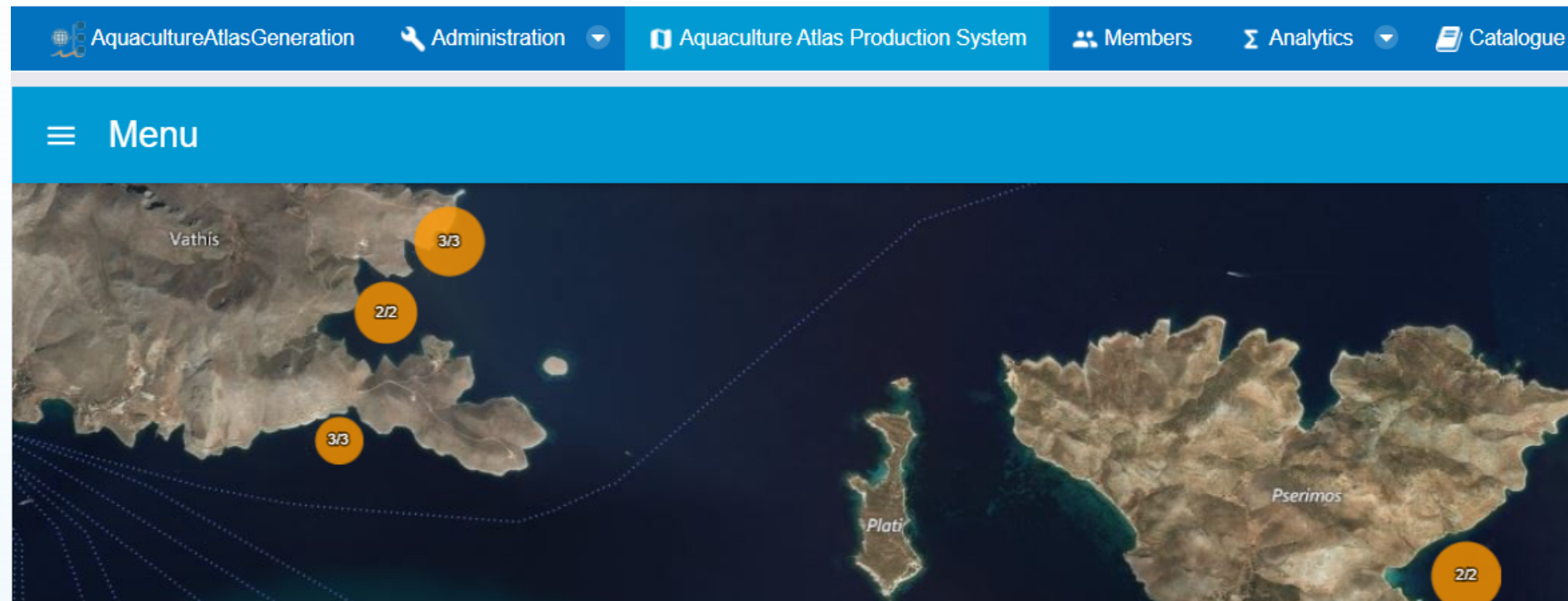
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Aquaculture Atlas Demonstrator

Step 2: Farm detection

Detect locations of floating cages

-  Test Area: Greece (previous project) => Develop technology (2018)
-  Test Area: South Atlantic (Chile) => Integrate technology in Blue Cloud (2020)







Aquaculture Atlas Demonstrator

Step 3: Infrastructure integration

Collaboration within Blue Cloud (Ongoing)

OGC Standard data access (WCS / WFS / WMS) for:

-  EO data: satellite images, derivate products (eg CMEMS)
-  Environmental monitoring data (eg SeaDaNet/EMODnet chemistry / physical data)

Domain specific development




Standardize data processes:

-  To enable CLS satellite data analyses as standard processes (e.g. S1 data analysis in DIAS)

Apply R generic workflows

-  To bind upstream processes with GIS (meta)data publication to OGC services

Consolitate data visualization & analysis tools in a strong infrastructure

-  Data viewer – development with Demonstrator 4 Fisheries Atlas => re-use of components
-  Data analytics: Geospatial data processes (WPS)
-  Data enrichment involving EO and Environmental monitoring data from other demonstrators (2021)



Demonstrator Objectives

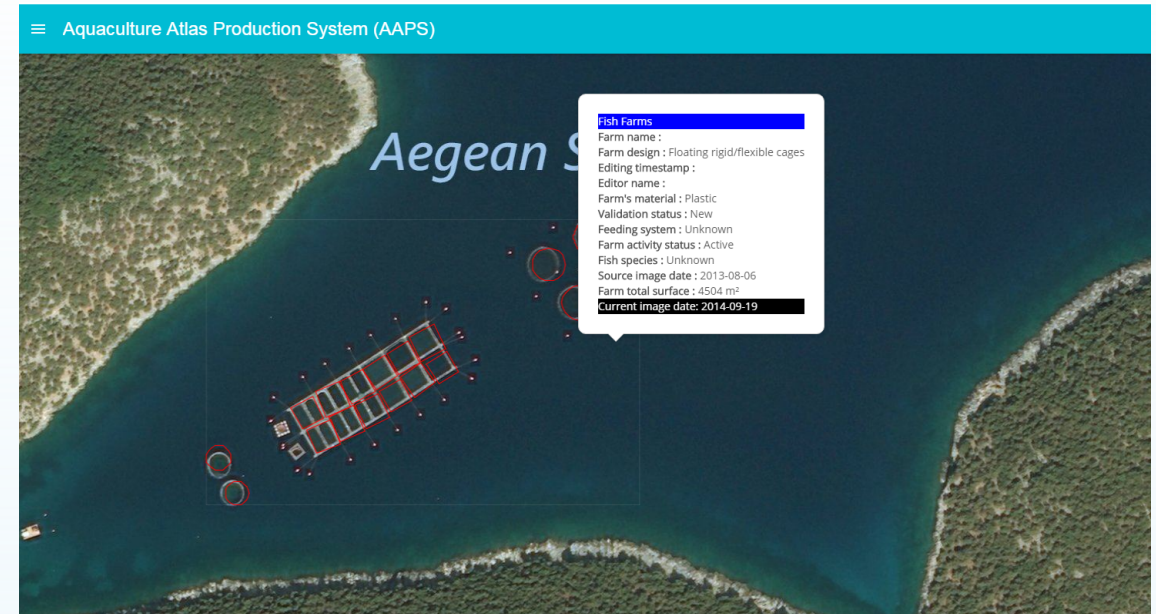
Step 3: Describe Cage Cluster Features

Methodologies

- International Standards: ISO, OGC => Edit features of a layer
- Add features through a FAO Developed OpenFairViewer (OFV)
- Used in Multiple VREs

Results

- An inventory of cage clusters
- An inventory of cage occupancy (2021)
- => The Atlas








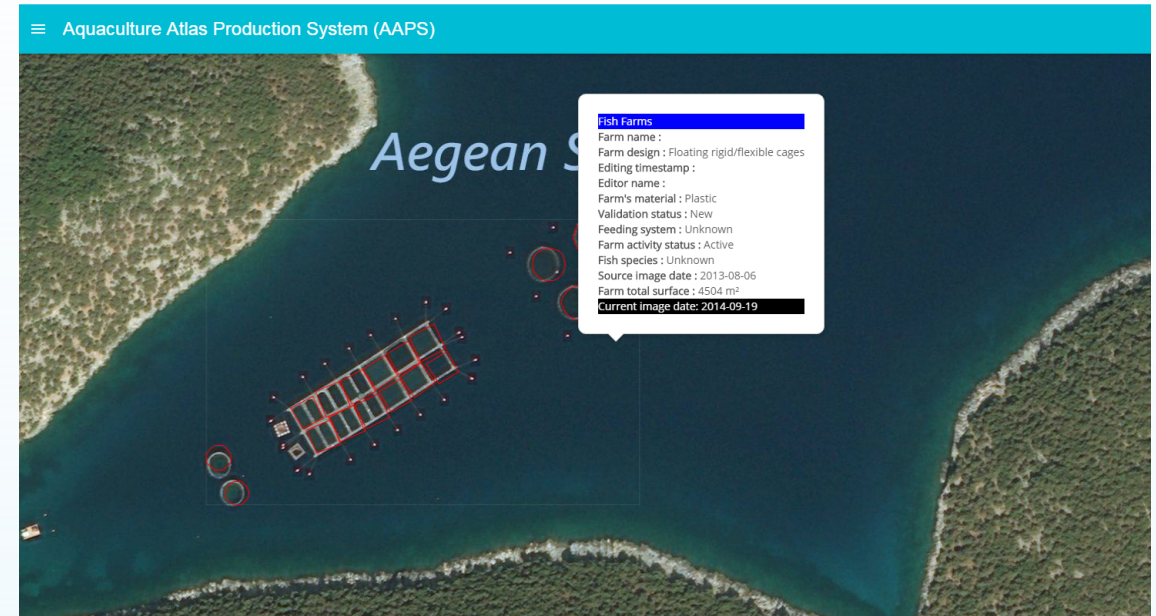
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Demonstrator Objectives

Step 4: Disseminate in an Atlas

Dissimination options

-  Through the OpenFairViewer (OFV)
-  In a Geoserver and GeoNetwork (other demonstrators can use them too)
-  In custom reports / storylines (2021)





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Agenda

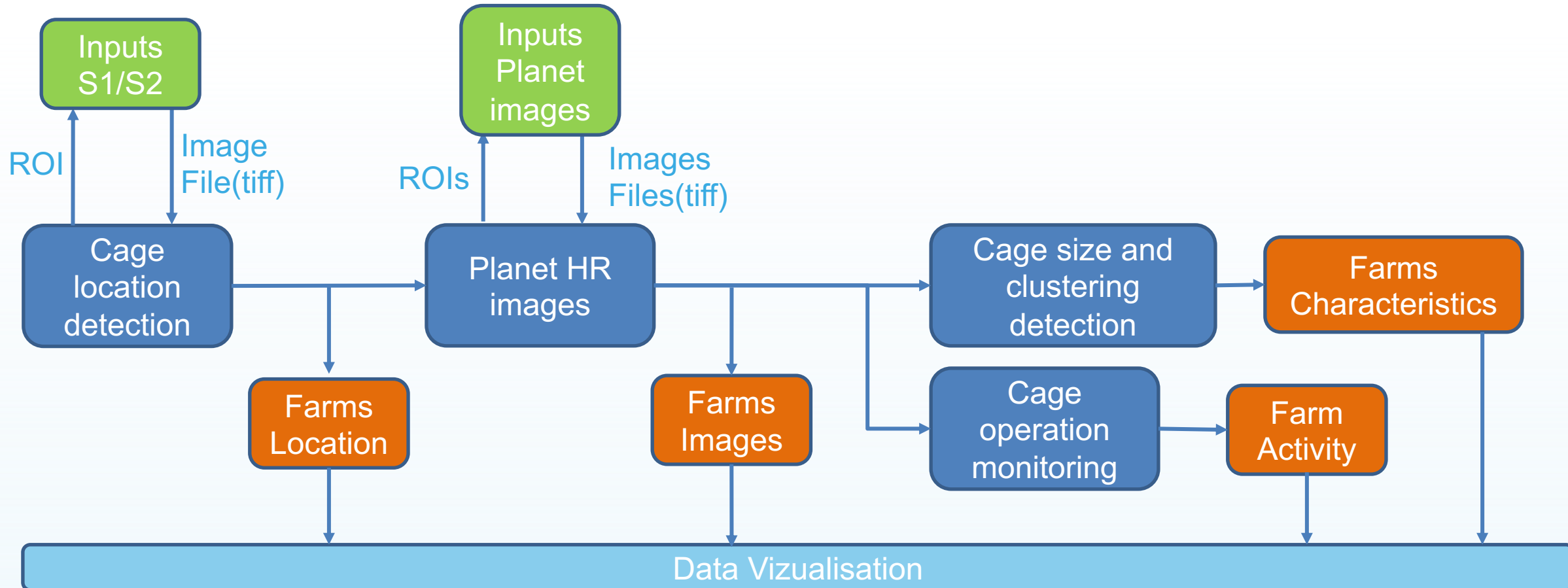
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Calculation Methodology

Schematic diagram





Blue-Cloud

Cage location processing chain

S2 image
%cloud < 10%

Time series of SAR
images (S1)

Object detection algorithm
Important CPU/GPU needed

Shapefile containing the
farm centroids

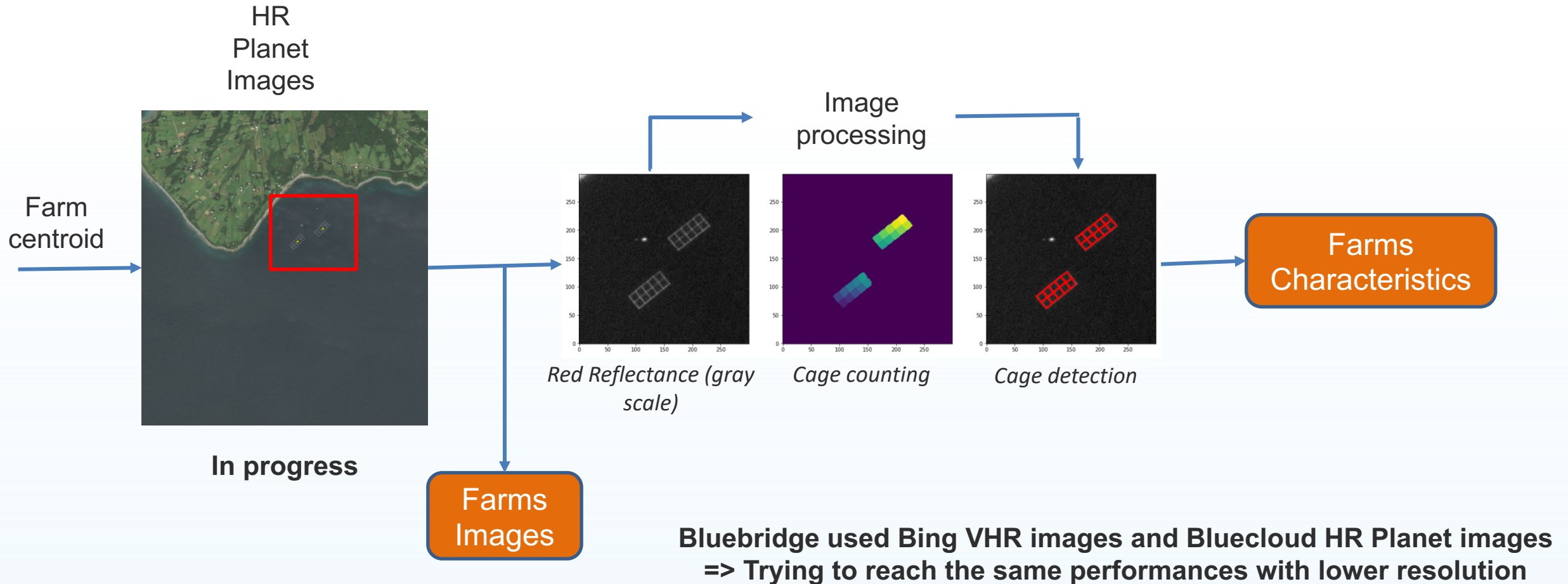
S1/S2 Images extraction
manually (waiting for
integration on bluecloud)

Centroids of
the detected
farms

Farms
Location

Overall performances more
than 70%

Cage size and clustering detection





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Blue Cloud Data Access and Processing Services

● Virtual Research Environment

● To help researchers to collaborate by providing

- Harmonize access to various data sets / data sources
- Discipline-specific tools, such as data analysis, visualization, ...

● The Blue Cloud implementation of VRE's : D4Science

● Developed by CNR, application to «Open Science» paradigm

● To allow

- Data Hosting and curation (metadata)
- Data Analytics and visualization (e.g. geospatial data)
- Software Dynamic Deployment
- Resources (data, software, ...) controlled sharing and accounting



D4 Science main features

Blue-Cloud

- **Metadata Catalogue (gCat)**
 - to publish and to search collections of metadata for items including data, services, and related information objects
- **Workspace (Storage Hub)**
 - to browse, to upload and to download user's files and folders
- **Data processing platform (named DataMiner)**
 - DataMiner online interfaces (harmonized for users)
 - Integration of new methods/algorithms
- **Spatial Data Infrastructure**
 - Spatial Data Storage and Publishing
 - Spatial Data Discovery and Access
 - SDI Services (OGC Compliant)
- **Integrated Users' Authentication and Authorisation framework**
- **Profile & Social Networking API**
 - to get user information and/or to boost content's reach by making easier to share it



Blue-Cloud

A guided user's interface

Access to the Data Space

The data space contains the set of input and output data sets of the users. It is possible to upload and share tables. Data sources can be chosen from those hosted by the infrastructure. Outputs of the computations can be even saved in this space.



DataMiner

Execute an Experiment

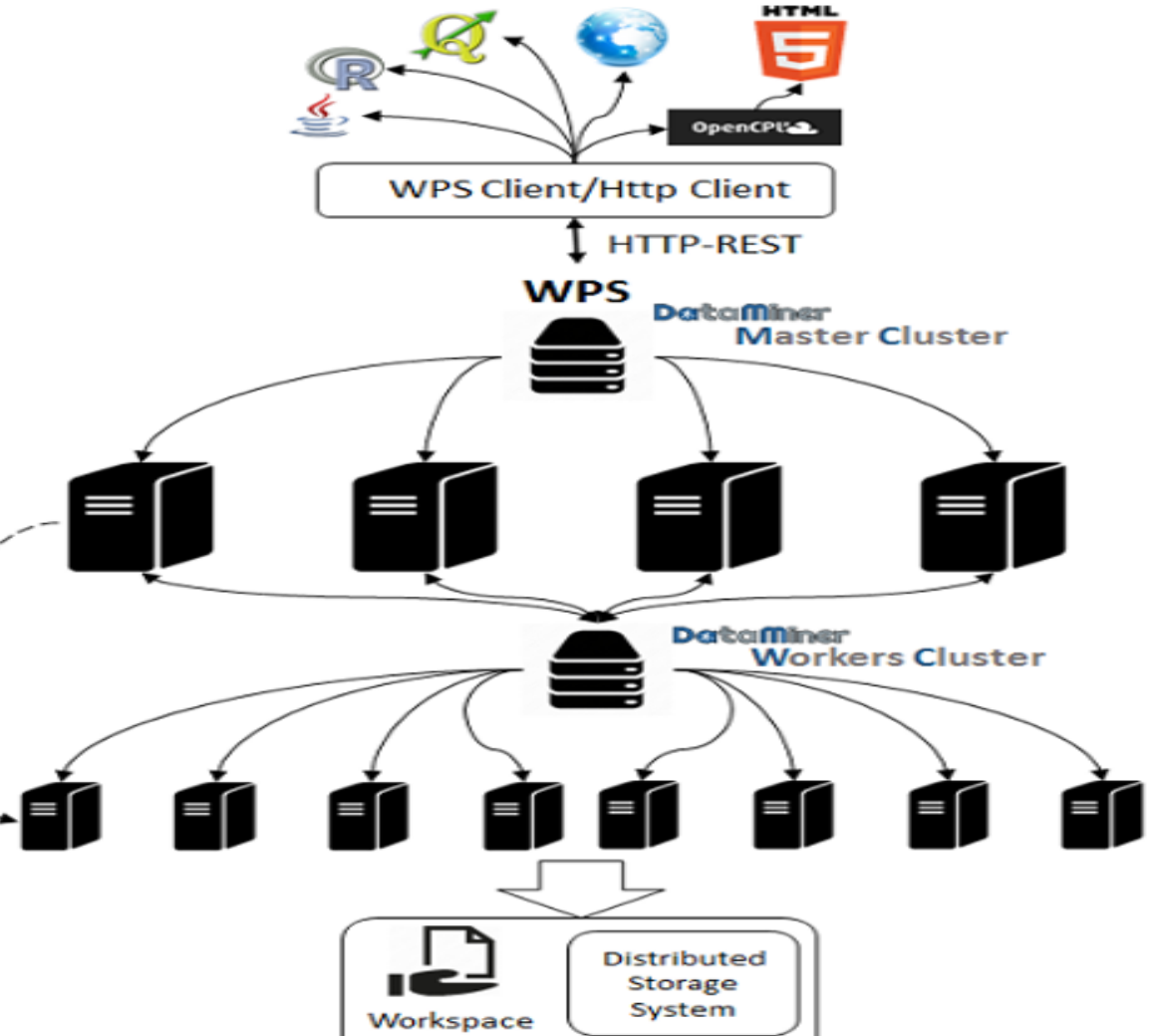
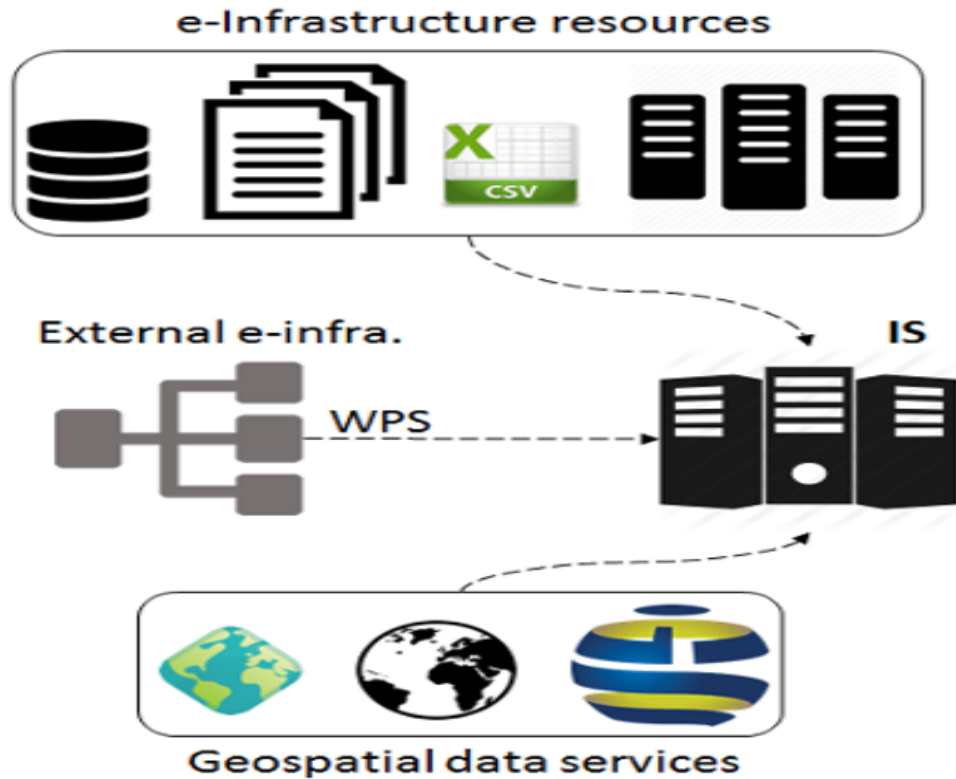
This section allows to execute or prepare an online experiment or method. The section is endowed with a list of algorithms for executing models for various application domains.





D4Science implementation

D4Science e-Infrastructure - VRE





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Community (your) Monitoring Objectives

Atlas discussion

Why is Blue Cloud a good platform for an Atlas with Monitoring Services

- Interoperable with the EOSC service catalogue
- Global coverage
- Cost effective

What can we estimate?

- Using high-res optical images, we observe different colors due to e.g. netting => very weak signal;
- Detect contrast between Active and Resting cages => based on random sample(in progress)
- An **average estimate** of active vs. inactive cages (in progress) and compare to e.g. last year

How can we estimate cage activity? (good question, that is our research)

- Using large number of cages, at least 10 clear images over a growing period, and multiple years
- Comparing average values by year, and compare with previous years to detect a trend
- Using VHR images possible but we cannot reliably see individual cage activity => little privacy concern



D4Science : some useful links




DataMiner overview: [Data Mining Facilities](#)

(https://wiki.gcube-system.org/gcube/Data_Mining_Facilities)

More about Data Miner (developers oriented) :

-  Developers website (commonly used APIs, ...): [Dev Web Site](https://dev.d4science.org/) (<https://dev.d4science.org/>)
-  Implementation of custom new algorithms for DataMiner: [Software Algorithm Importer](#)
(https://wiki.gcube-system.org/gcube/Category:Statistical_Algorithms_Importer)
-  Supported languages for new Methods/Algorithms for DataMiner: [Create a new project with SAI](#)
(https://wiki.gcube-system.org/gcube/Statistical_Algorithms_Importer:_Create_Project)
-  DataMiner online interfaces [DataMiner Manager](#)
(https://wiki.gcube-system.org/gcube/DataMiner_Manager),
-  Web Processing service: [Web Processing Service | OGC](#)
(<https://www.opengeospatial.org/standards/wps>).

Spatial Data Infrastructure capabilities

-  [SDI-Service](#)
(<https://gcube.wiki.gcube-system.org/gcube/SDI-Service>),
-  Spatial [Data Storage and Publishing](#)
(https://gcube.wiki.gcube-system.org/gcube/Spatial_Data_Storage_and_Publishing),
-  [Spatial Data Discovery and Access](#)
(https://gcube.wiki.gcube-system.org/gcube/Spatial_Data_Discovery_and_Access)



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