Blue-Cloud

Piloting innovative services for Marine Research & the Blue Economy

WEBINAR

Blue-Cloud Demonstrators - helping translate marine research into innovation for the blue economy

Friday, 19th June 2020

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.

The Agenda

- 11h00 : Introduction to the Blue-Cloud project - **Sara Garavelli (Trust-IT Services & Blue-Cloud Project Coordinator)**
- 11h10 : Zoo & Phytoplankton EOV products - **Patricia Martin-Cabrera (VLIZ - Flanders Marine Institute)**
- 11h15 : Plankton Genomics - **Guy Cochrane (European Bioinformatics Institute - EMBL-EBI)**
- 11h20 : Marine Environmental Indicators - **Massimiliano Drudi (CMCC Foundation)**
- 11h25 : Fish, a matter of scale - **Anton Ellenbroek (FAO of the United Nations)**
- 11h30 : Aquaculture Monitor - **Anton Ellenbroek (FAO of the United Nations)**
- 11h35 : Questions & Answers
- 12h00 : End of webinar

Blue-Cloud

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The Blue-Cloud Project

Sara Garavelli, Trust-IT Srl & Blue-Cloud Coordinator

Trust-IT Services

Communicating ICT to markets

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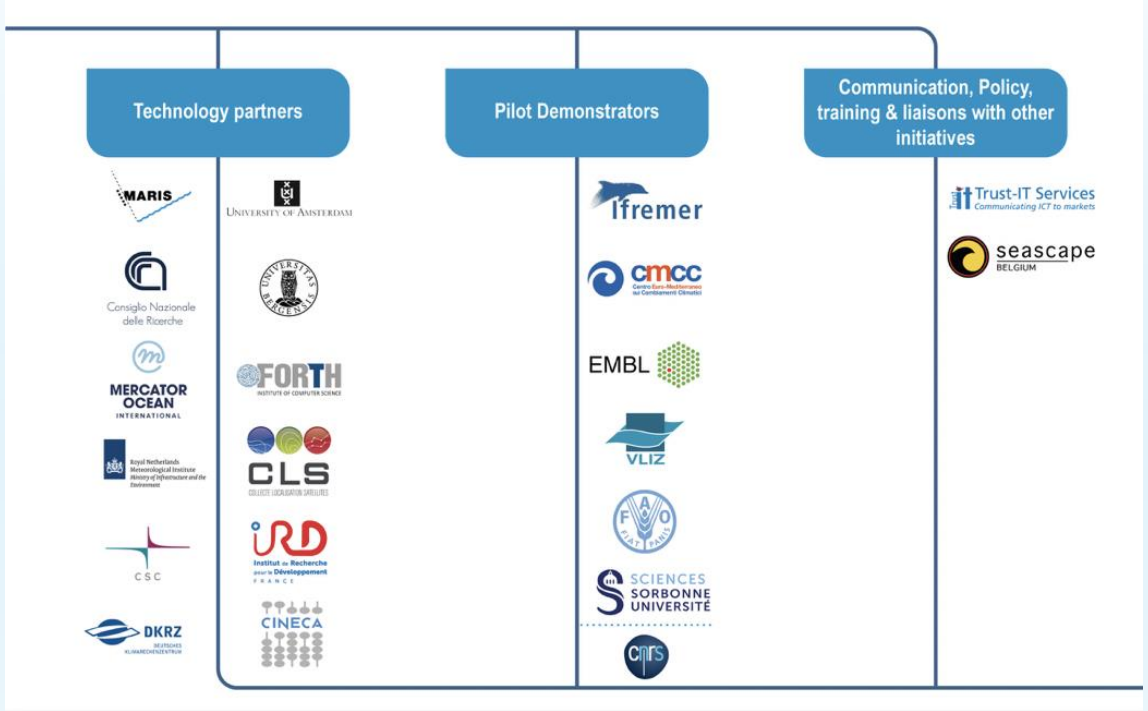
Blue-Cloud in numbers

- **Funding:** H2020: The 'Future of Seas and Oceans Flagship Initiative' (BG-07-2019-2020) topic: [A] 2019 - Blue Cloud services
- **Timing:** 36 Months (start October 2019)
- **Budget:** 5.9 Million Euro
- **Partnership:** 20 partners
- **9 Blue federated Infrastructures**



The vision

Blue-Cloud aims to become the reference point for the "*Blue community" in the need of data, analytics tools and computing resources* **in EOSC and in the future Blue Economy & marine research landscape**

The European Open Science Cloud (EOSC)

EUROPEAN OPEN SCIENCE CLOUD

https://bit.ly/2NbPBAd

The EOSC Vision

- EOSC will offer scientific communities a **virtual environment for working with research data across borders and disciplines** to design and deploy a **Web of FAIR Data and Related Services for Science**
- EOSC will mean:
  - data can be easily made **findable, accessible, interoperable, reusable**
  - publications, data, and software can be **shared easily**
  - an **acceleration of cross-disciplinary science**

Mariya Gabriel, the European Commissioner for Innovation Research Education and Youth, at the February 2020 All Atlantic Ocean Research Forum highlighted Blue-Cloud as one of the key projects contributing to the establishment of EOSC

www.blue-cloud.org/news/towards-global-blue-cloud

The mission

Blue-Cloud aims to **pilot** a cyber platform bringing together and providing access to:

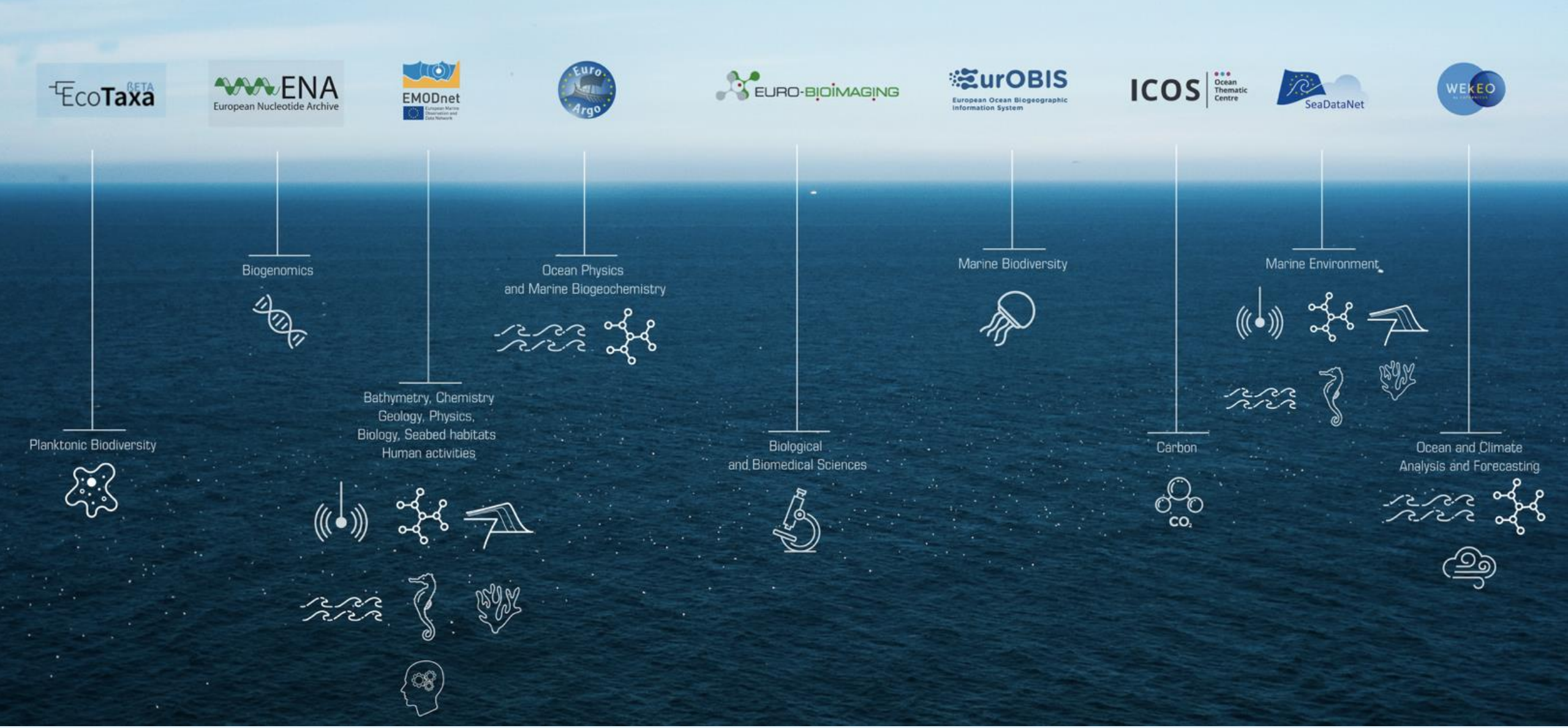
1) **multidisciplinary data** from observations and models,
2) **analytical tools**, &
3) **computing and storage facilities**

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

It will federate the resources of most key infrastructures in the marine domain offering access to an unprecedented wealth of multi-disciplinary data resources and added-value services

Thematic

EUROPEAN OPEN SCIENCE CLOUD



opernicus Europe's eyes on Earth DIAS

D4SCIENCE INFRASTRUCTURE

EUDAT Collaborative Data Infrastructure

The Blue-Cloud assets

- A **data discovery and access service** to facilitate sharing with users of multi-disciplinary datasets
- A **Blue Cloud Virtual Research Environment (VRE)** to facilitate the orchestration of computing and analytical services to build specific applications

Source: European Parliament

A community-oriented Roadmap for the future strategic development of the Blue Cloud

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Piloting innovative services for Marine Research & the Blue Economy

Five, real-life demonstrators

- Biodiversity
- Environment
- Fishery
- Aquaculture

Zoo- and Phytoplankton EOV products

Plankton Genomics

Marine Environmental Indicators

Fish, a matter of scales

Aquaculture Monitor

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Thank you!

www.blue-cloud.org

s.garavelli@trust-itservices.com

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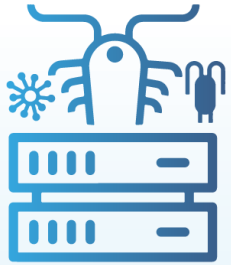
Piloting innovative services for Marine Research & the Blue Economy



Zoo & Phytoplankton EOV products

Patricia Martin-Cabrera - VLIZ - Flanders Marine Institute

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Why plankton?

- **Plankton** is the foundation and vital component of most marine **trophic webs** and key in most **biogeochemical fluxes.**
- **Phytoplankton** contributes **50%** of the global earth photosynthesis.
- **Zooplankton** helps to understand the **dynamics of food availability** for commercially exploited fish species.

Why plankton?

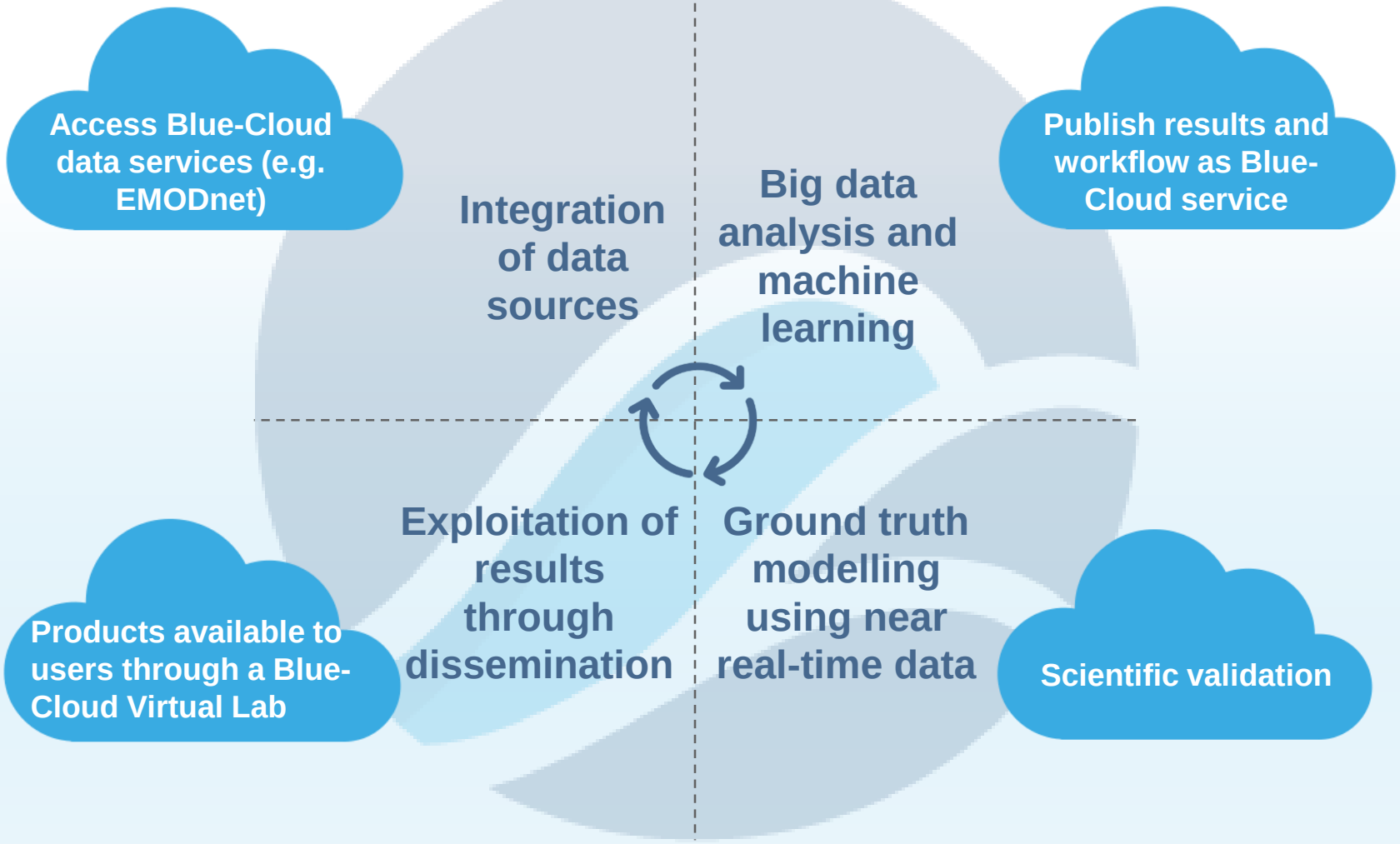
- Indicators of the health of the marine ecosystem.
- Used within several descriptors of the **EU Marine Strategy Framework Directive** (MSFD).
- Phyto-Zooplankton **abundance and diversity** tagged as:
  - **Essential Ocean Variables** (EOV) by the GOOS,
  - **Essential Climate Variables** (ECV) under the GCOS.

Figure OSPAR

The Global Ocean Observing System

GCOS GLOBAL CLIMATE OBSERVING SYSTEM

Demonstrator workflow



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Zoo & Phytoplankton EOV products

Data inputs

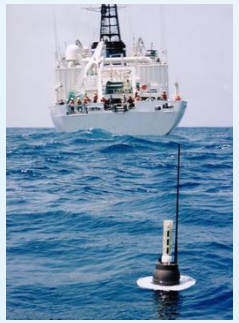
EurOBIS
European Ocean Biogeographic Information System

SeaDataNet

EMODnet

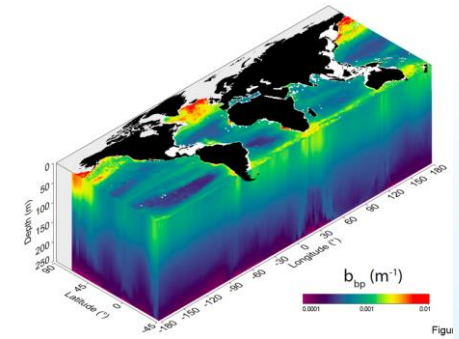
Copernicus
Europe's eyes on Earth

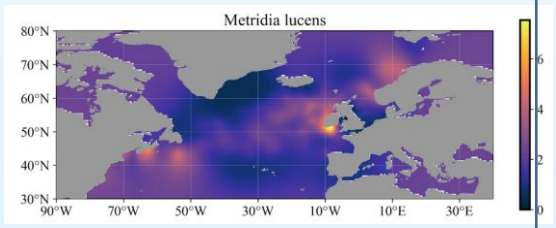
LifeWatch
BELGIUM

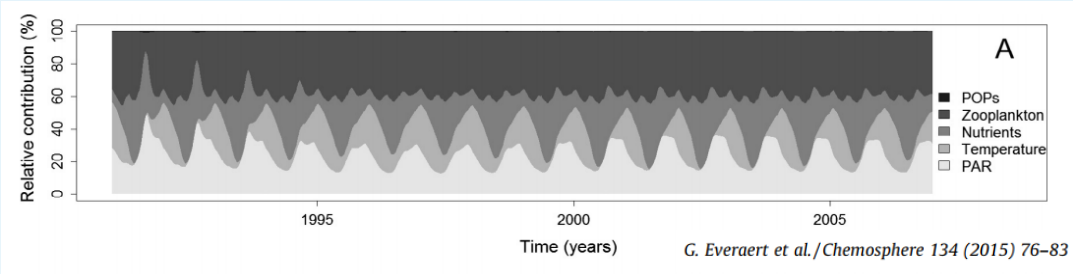


Neural network model

Data outputs







Scientific modelling

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Zoo & Phytoplankton EOV products

THANK YOU!

To know more about this Demonstrator, please visit:

www.bluecloud.org/demonstrators/zoo-and-phytoplankton-eov-products

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Plankton Genomics

Guy Cochrane, EMBL-EBI

EMBL-EBI

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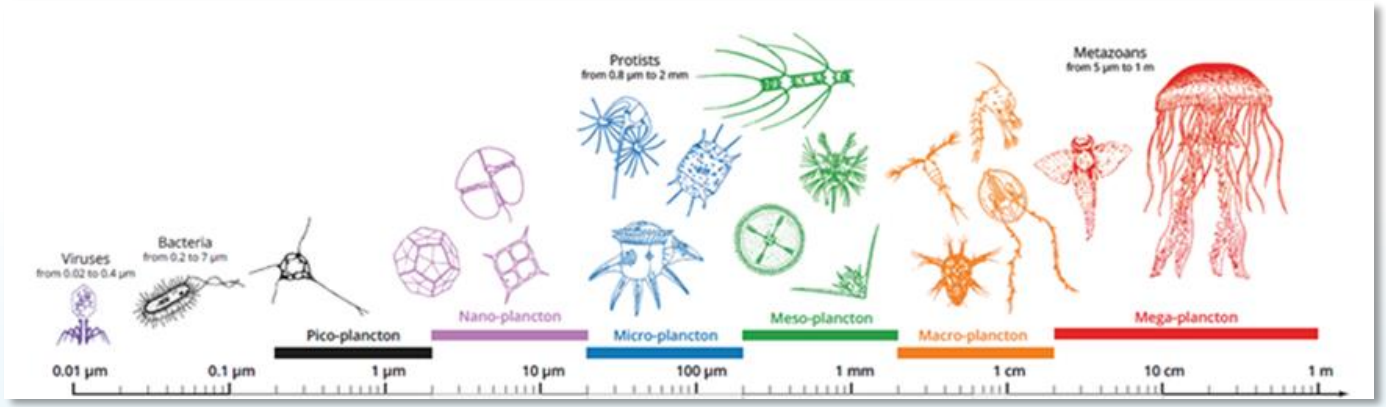
Scientific context



Plankton represent 60% of the biomass in the global ocean

Plankton feed all life in the ocean - the seafood we eat also depends on it.

Plankton drive the carbon pump in the ocean - the Earth's climate depends on it.

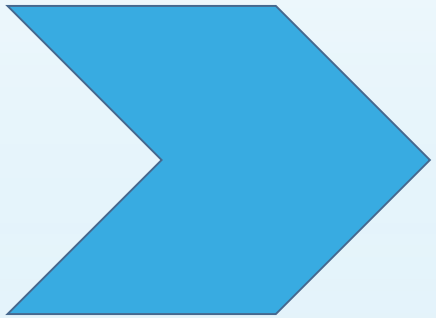
Plankton are largely unknown - >50% of their diversity remains to be discovered

Two «Notebooks»

VRE Notebook 1
Exploration of “dark” ‘omics

Plankton occurrences
Georeferenced occurrence tables of taxonomies & functions

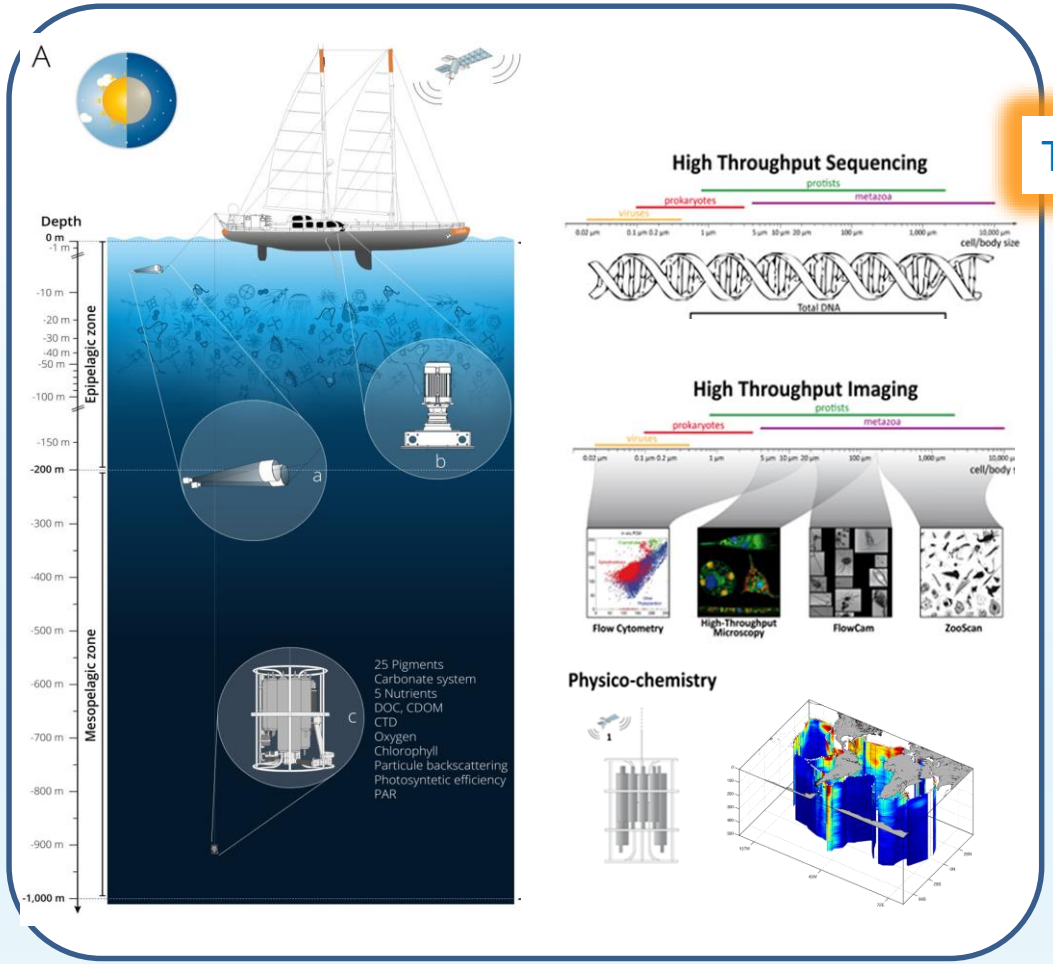
Plankton/environment correlations
Correspondence matrices of taxonomies, functions and environmental parameters



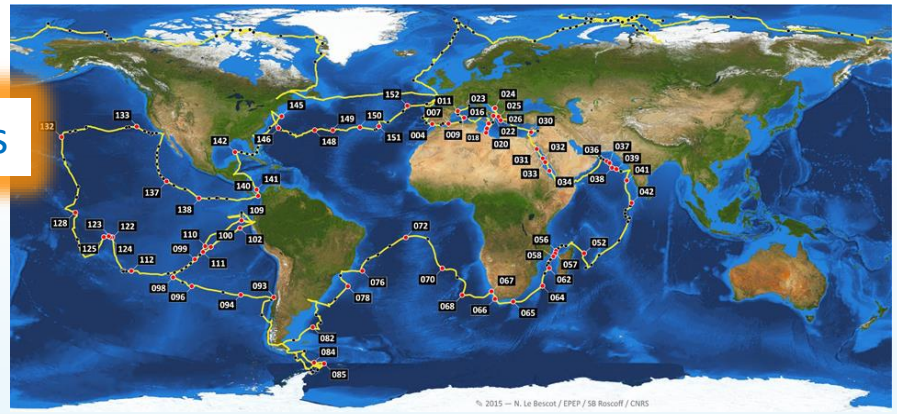
VRE Notebook 2
Plankton biogeography

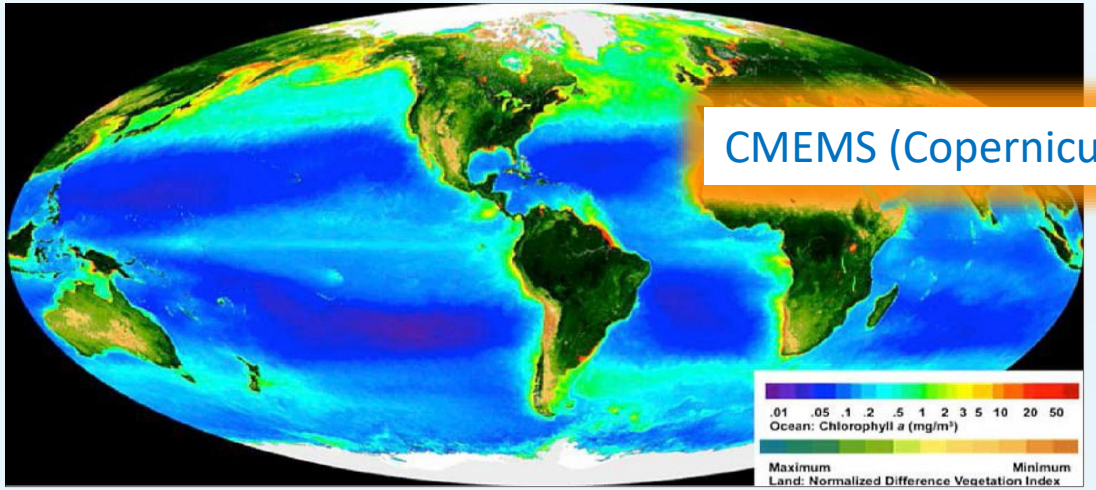
Plankton biogeography
Global maps of the predicted distribution and abundance of selected plankton taxonomies and functions

Source data



Tara Oceans



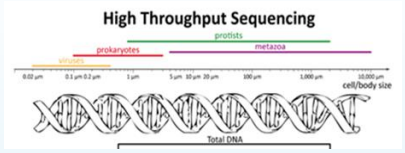


CMEMS (Copernicus)

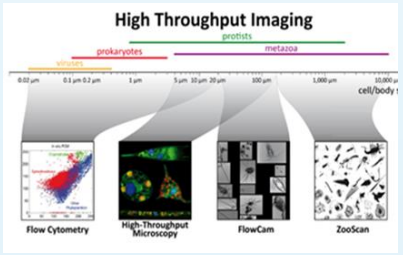
Notebook 1 – Exploration of “dark” omics

Data Inputs → Interface → Data Processing in the VRE → Data Outputs

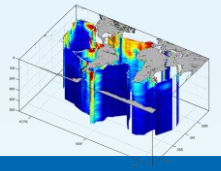
Genomic data (CNRS/Genoscope)



Imaging data (SU/EcoTaxa)



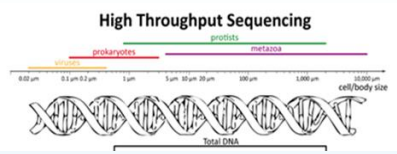
Environmental data (PANGAEA)



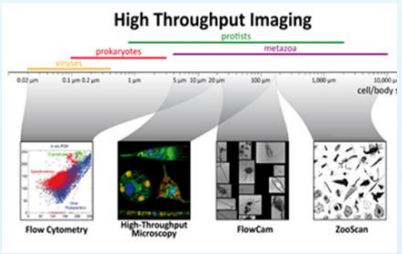
Notebook 1 – Exploration of “dark” omics

Data Inputs → Interface → Data Processing in the VRE → Data Outputs

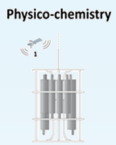
Genomic data (EBI-ENA)

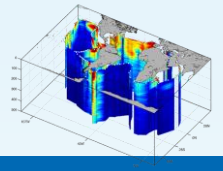


Imaging data (EBI-BioImage)



Environmental data (EBI-BioSamples)





Notebook 1 – Exploration of “dark” omics

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Plankton Genomics

Data Inputs → Interface → Data Processing in the VRE → Data Outputs

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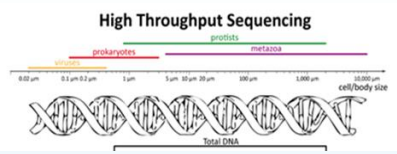

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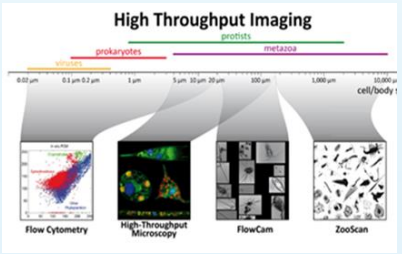

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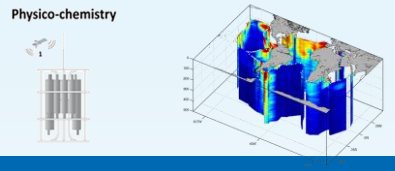

[64 Go RAM) computing node]

Rstudio (v3.7+) / Python

Taxonomic analysis & visualisation
Packages: Krona, igraph, ggplot, NetworkX
(e.g. Ocean Gene Atlas, MGnify)

Functional analysis & visualisation
protein families, morpho-types & fluorescence
Packages: gephi, igraph, cytoscape

Environment analysis & visualisation
of taxonomies & functions, RDA/CCA plots
Packages: vegan, igraph, ggplot, NetworkX
(e.g. Ocean Gene Atlas, MGnify)

Notebook 1 – Exploration of “dark” omics

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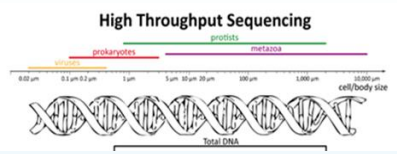

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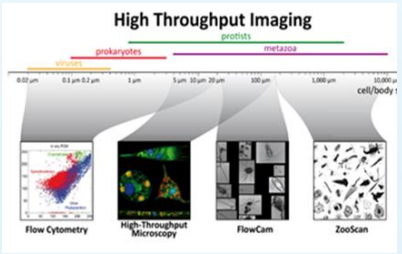

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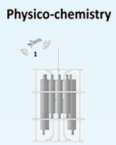

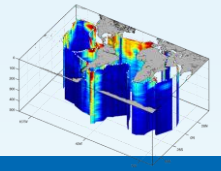

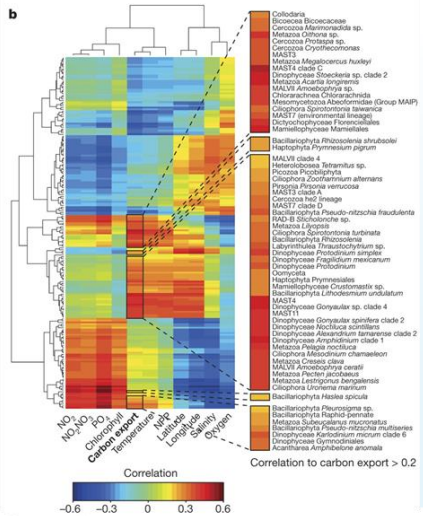

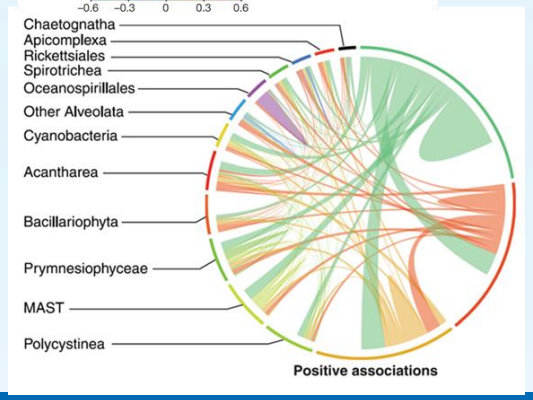

Notebook 1 – Exploration of “dark” omics

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Plankton Genomics

Data Inputs

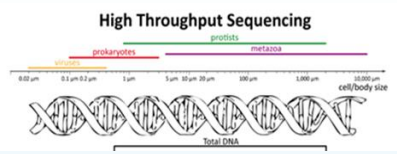
Interface →

Data Processing in the VRE

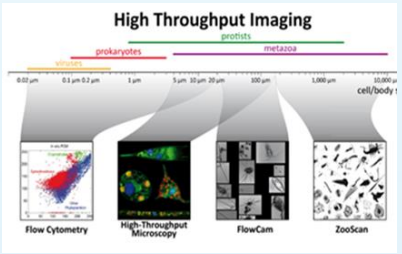
Interface →

Data Outputs

Genomic data (EBI-ENA)



Imaging data (EBI-BioImage)



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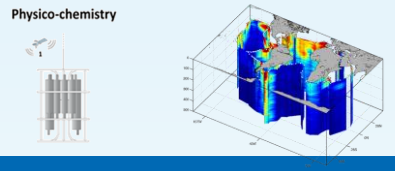
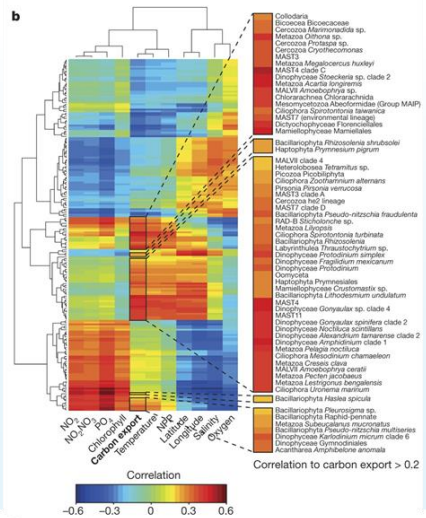
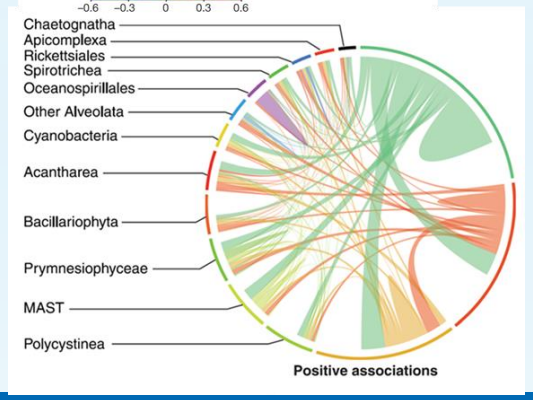






Plankton occurrences
Georeferenced occurrence tables of taxonomies & functions

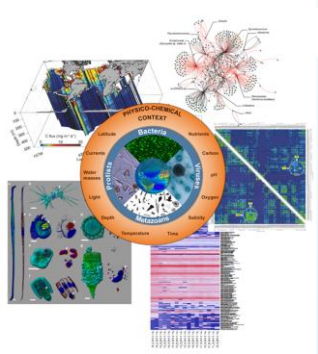
Plankton/environment correlations
Correspondence matrices of taxonomies, functions and environmental parameters

zenodo
OpenAIRE
BioStudies.
ENA
European Nucleotide Archive

Notebook 2 – Plankton biogeography

Data Inputs → Interface → Data Processing in the VRE → Data Outputs

Plankton occurrences
Plankton/environment correlations
Output of Notebook 1



Environmental climatologies
CMEMS (Copernicus)
9 km (1/10 degree) resolution
(e.g. Chla, T°C, S‰, NO_3, NO_2, O_2)

Notebook 2 – Plankton biogeography

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Plankton Genomics

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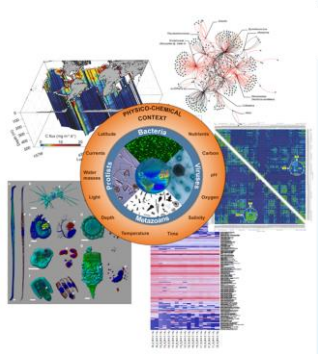

zenodo

BioStudies.

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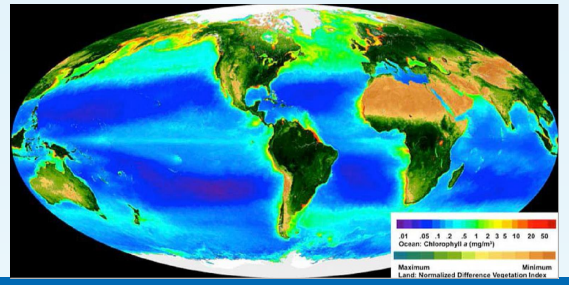

WEkEO
by COPERNICUS

Notebook 2 – Plankton biogeography

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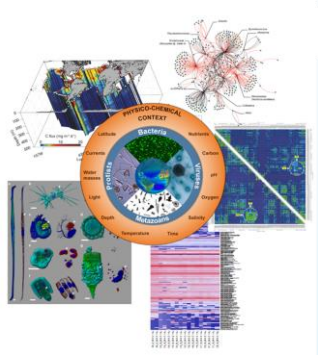

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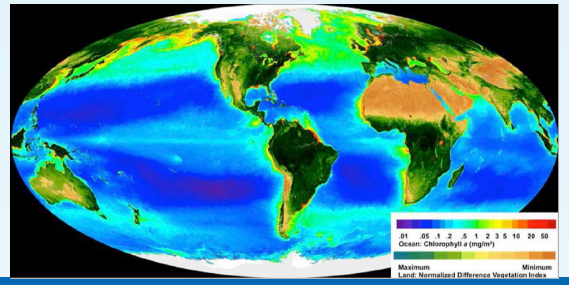

WEkEO by COPERNICUS

[100 GB of local disk space]
[>6 CPU cores & >8GB RAM]

Rstudio (v3.7+)

Habitat suitability modelling
Packages: tidyverse, xgboost, biomod2, geosphere, FactoMineR, vegan, ggplot2, caret, randomForest

Biogeography visualisation
Packages: Shiny, Leaflet, GDAL

Notebook 2 – Plankton biogeography

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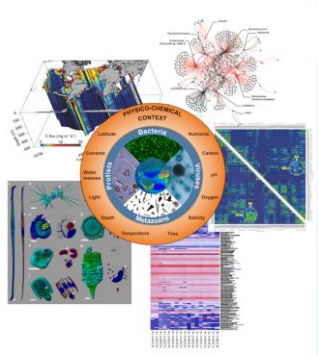
Plankton Genomics

Data Inputs → Interface → Data Processing in the VRE → Data Outputs

Plankton occurrences
Plankton/environment correlations
Output of Notebook 1

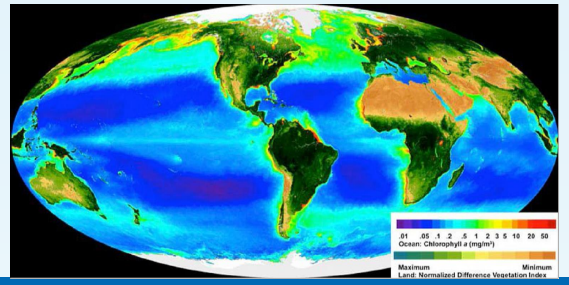


zenodo

BioStudies

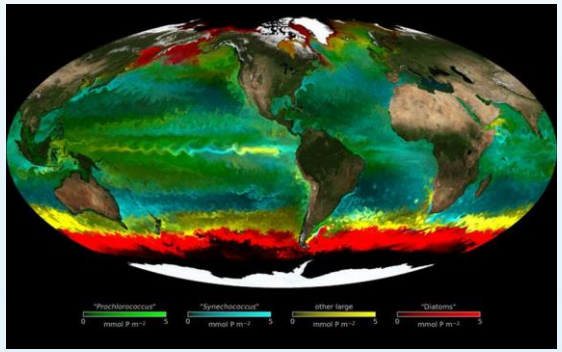
ENA
European Nucleotide Archive

Environmental climatologies
CMEMS (Copernicus)



WEkEO by COPERNICUS

Plankton biogeography



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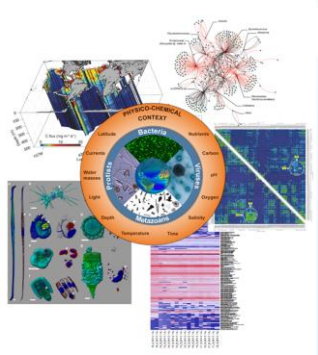

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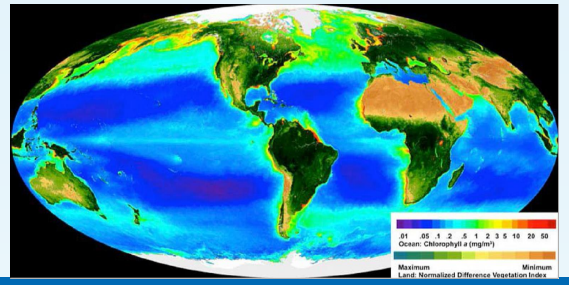

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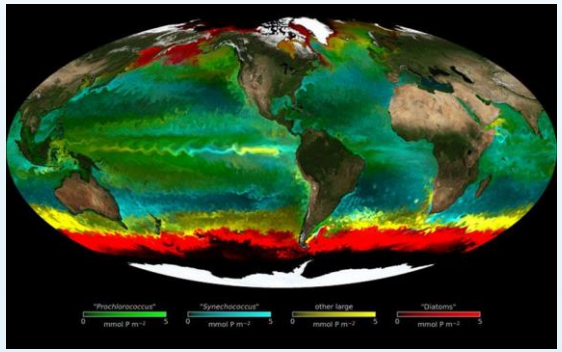
Plankton biogeography



Plankton biogeography
Global maps of the predicted distribution and abundance of selected plankton taxonomies and functions

BioStudies.
zenodo
OpenAIRE
EMODnet

Team

EMBL-EBI





SORBONNE UNIVERSITÉ




VLIZ


- Stéphane Pesant
- Peter Harrison
- Vishnu Kadhirvelu
- Jeena Rajan
- Guy Cochrane
- Jean-Olivier Irisson
- Sakina Ayata
- Eric Pelletier
- Lucie Bittner
- Lennert Schepers
- Patricia Cabrera

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Plankton Genomics

THANK YOU!

To know more about this Demonstrator, please visit:

https://www.blue-cloud.org/demonstrators/plankton-genomics

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Marine Environmental Indicators

Massimiliano Drudi - CMCC Foundation

Led by cmcc

Ifremer MERCATOR OCEAN INTERNATIONAL KNMI UNIVERSITAS BERGENSIS

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Marine Environmental Indicators

Partners

cmcc

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KNMI

UNIVERSITAS BERGENSIS

Expertise :

- Environmental Monitoring Services: Ocean, Atmosphere and Climate
- Blue Economy
- Numerical Modelling, Analytics and Machine Learning
- Environmental Data : from Models, Observations, Biological, Inorganic Carbon

Aims

- support international stakeholders in the MSFD and in the Blue Economy
- generate new knowledge on Ocean health as environmental indicators and information on the quality of the marine ecosystem
- develop of innovative flexible analytics capability for both the scientific investigation and the monitoring activities
- develop of innovative web interface for on-line and on-the-fly operations
- Copernicus DIAS + FAIR principles to foster a long-term sustainable Blue Economy roadmap

Users

- design based on requirements indicated by Environmental Agencies
- operations on the multi-source data sets,
  - such as selecting a portion of data for a specific area and period of time
  - performing analytics with several methodologies on the selected variables
  - displaying the available indicators by tables, map and graphics visualizations

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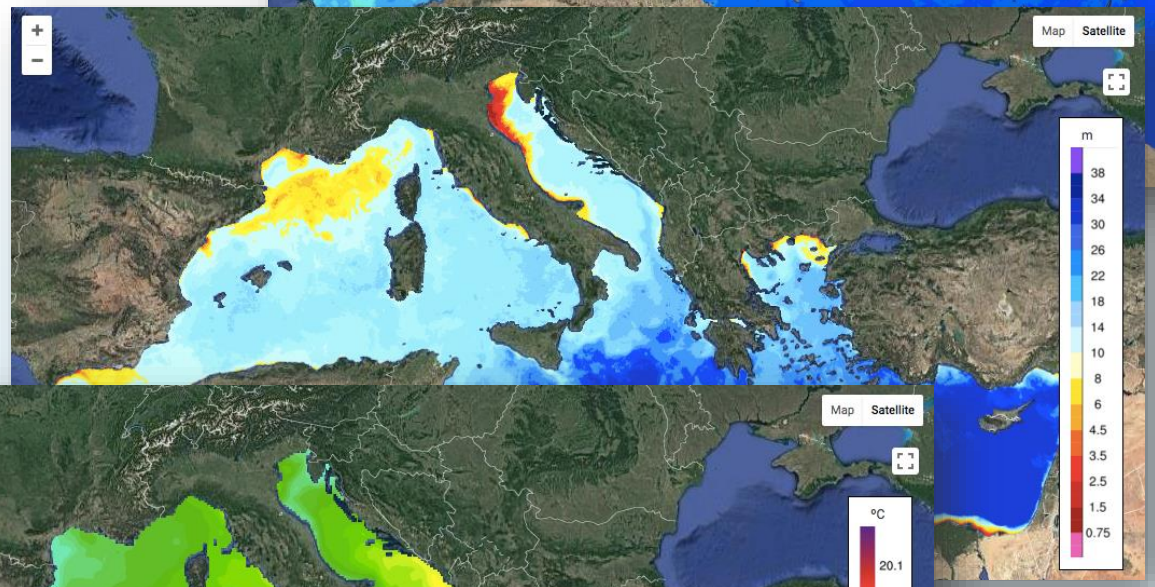
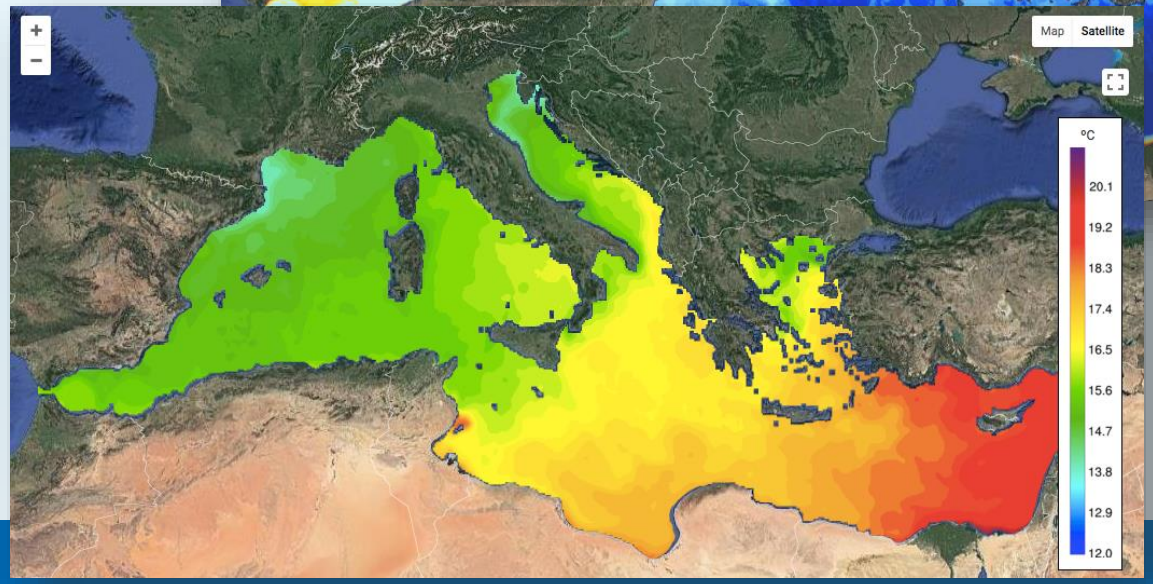
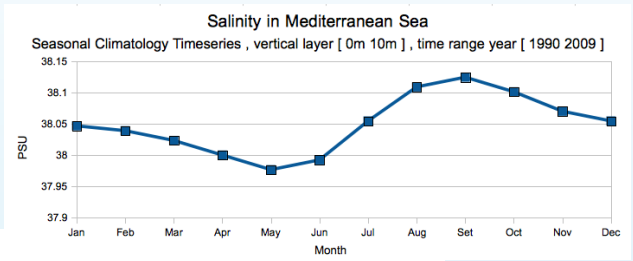
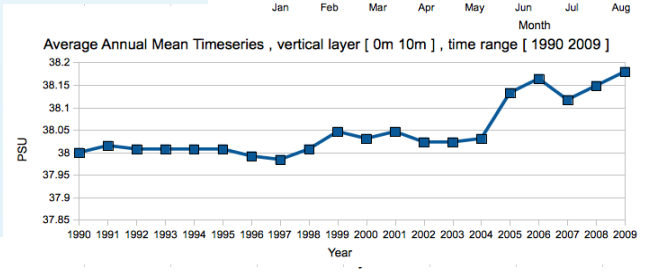


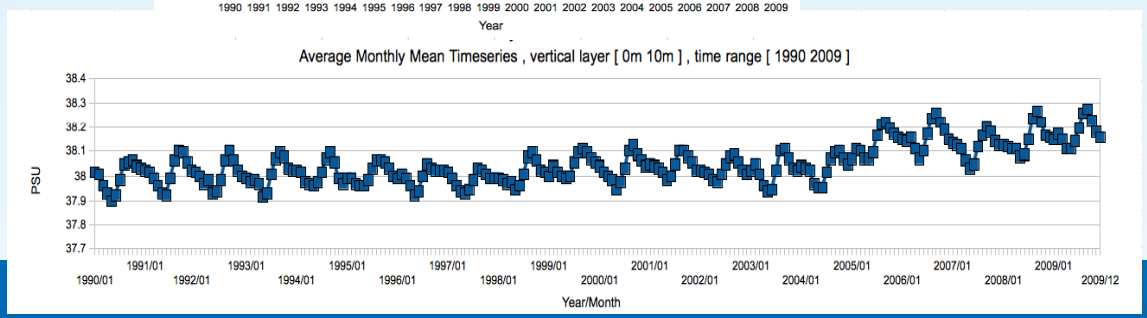


Catalogue

Marine Environmental Indicators







Planning

Integration Phase

- Integration of existing technology into Blue-Cloud
- Initial selection of environmental indicators
- First version within 2020

Development Phase

- Exploitation of Copernicus DIAS
- Exploitation of the Blue Data Infrastructure federation
- Capability Development
- Release within 2021

Blue Data Infrastructure

- CMEMS and C3S, for ocean and climate model data
- EMODnet, for physics, biology, chemistry data
- Euro-Argo and Argo GDAC, for salinity, oxygen, chlorophyll data
- ICOS-Marine, for inorganic carbon data
- SeaDataNet, for physics, biogeochemistry, biology data

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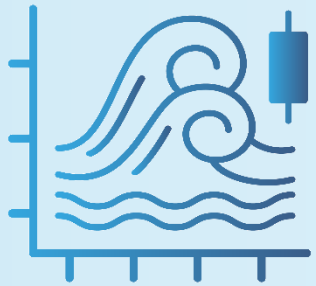
Data to Knowledge Development Roadmap

- Statistical Analysis
- Machine Learning and Uncertainty
- Ocean Physics
- Atmospheric and Biogeochemical
- Monthly Fields
- Daily Fields
- Mediterranean Sea
- Global Ocean



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Marine Environmental Indicators

THANK YOU!

To know more about this Demonstrator, please visit:

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Blue-Cloud

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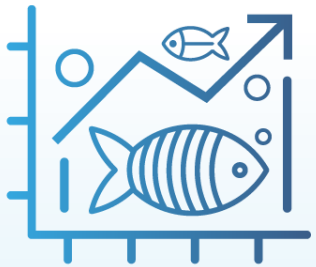

Fish a matter of scales

Anton Ellenbroek, Emmanuel Blondel, Aureliano Gentile, **FAO of the UN**

Yannis Marketakis, FORTH

Julien Barde, IRD - France

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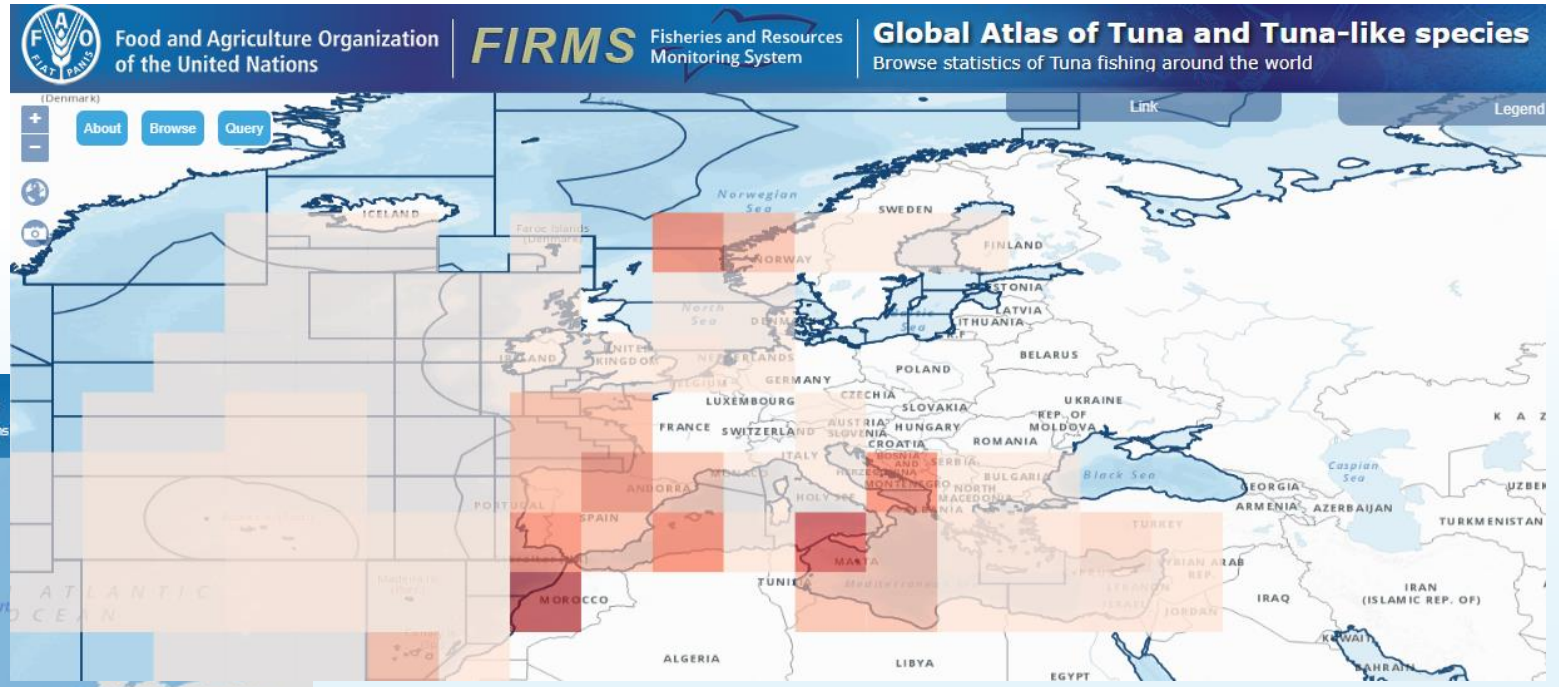
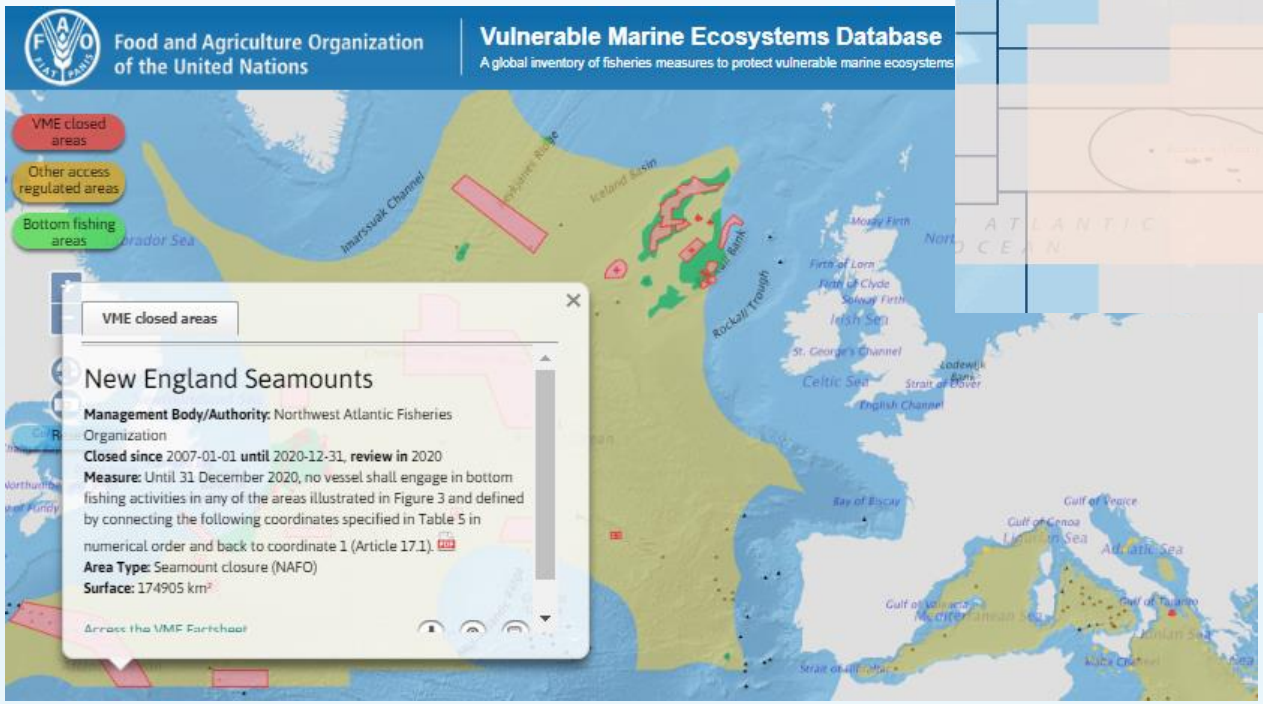
Fish, a matter of scale:
An online Atlas with **Fisheries Information**

Global fisheries layers

FAO Firms Tuna Atlas





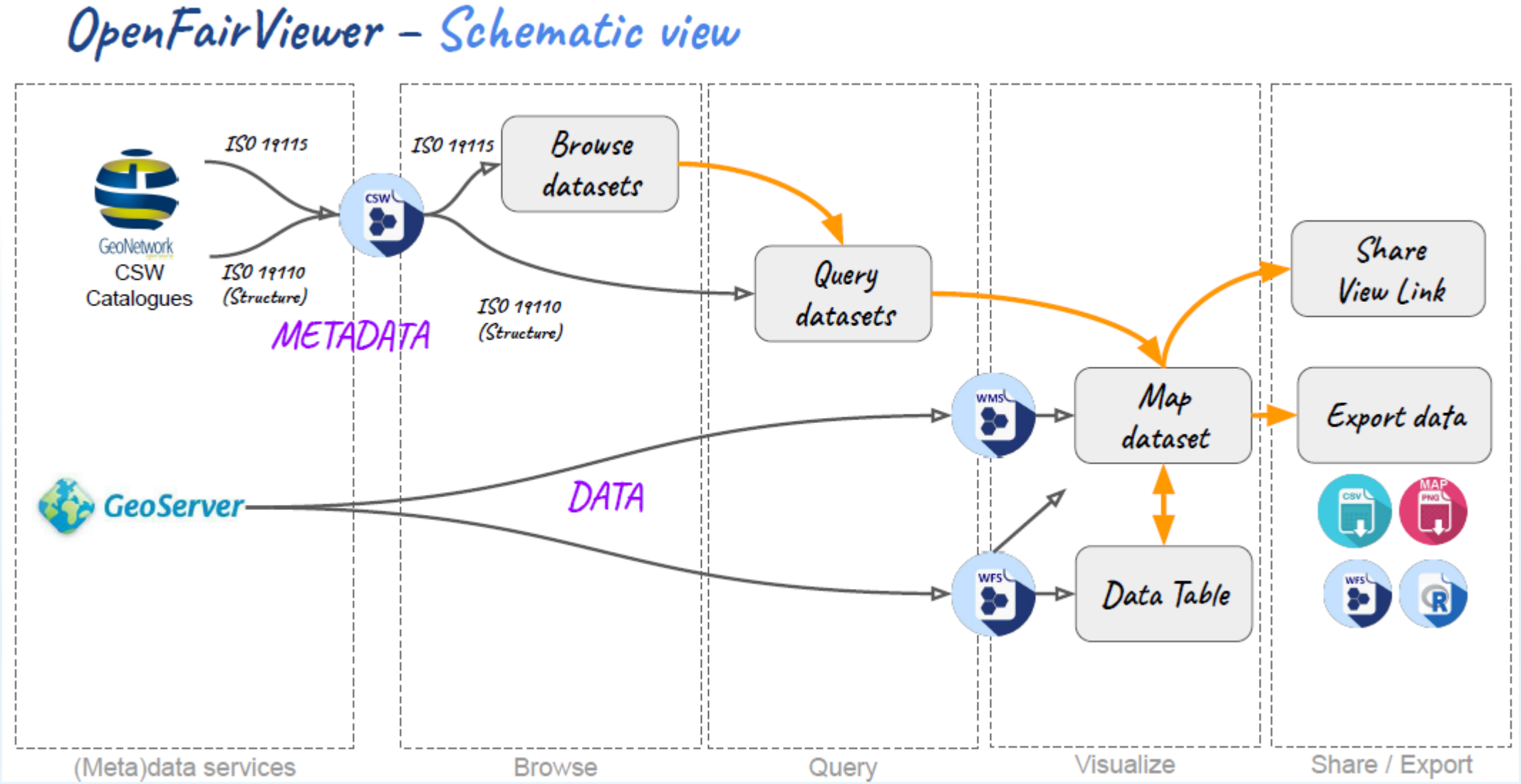
But also regulations and management

FAO Vulnerable Marine Ecosystems

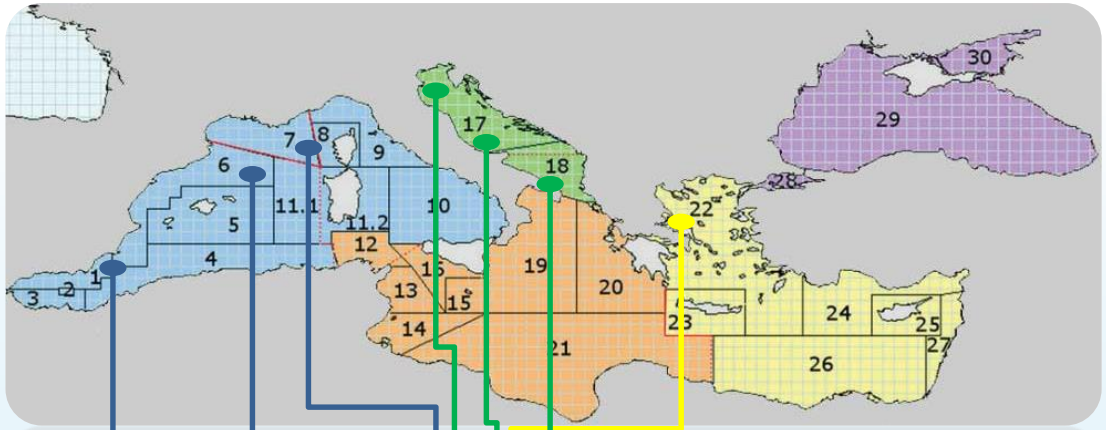
Fisheries Atlas; not a product but a flexible ISO/OGC data management solution

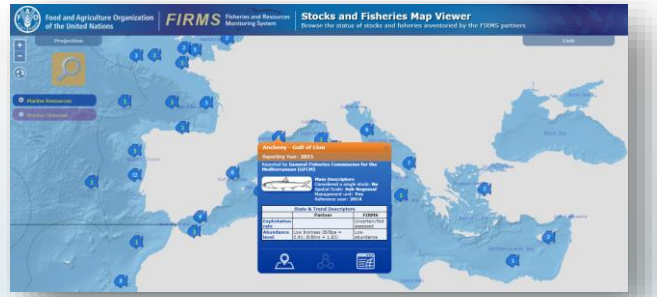
- Find and Access
  - Access data from fisheries organizations (e.g. Tuna Atlas)
  - Store in a ISO/OGC Map Backend based on Geoserver
- Interoperate and collaborate
  - Metadata driven feature-editing (Power to the users)
  - Metadata driven design of data flows (Flexible Viewers)
- Re-useable; publish / expose data
  - As a Map; to a embedded GeoNetwork
  - As a Service; to e.g. gCat service / CKAN registry

Fisheries Atlas; Visualization



Global Record of Stocks and Fisheries; (GRSF) an integrated Blue Cloud registry





GRSF – How it works

- Unique Identifiers
- Collated information

Anchovy - Adriatic Sea
Anchovy - Aegean Sea
Anchovy - Gulf of Lion
Anchovy - Northern Adriatic Sea
Anchovy - Northern Alboran
Anchovy - Northern Spain
Anchovy - Southern Adriatic Sea

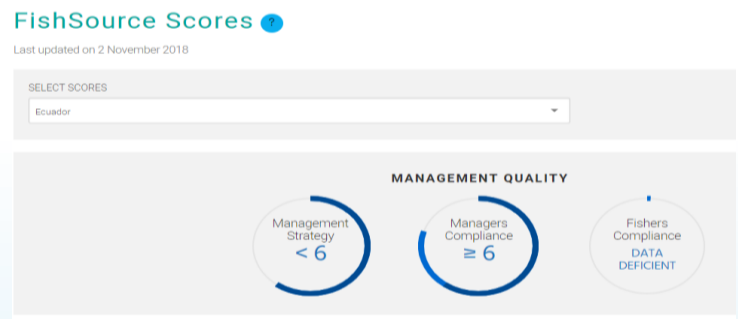
ID ANE + GSA17-18 **UUID** 6e44250b-fd04-337e-91d7-f7b6840bb862
ID ANE + GSA22 **UUID** 63d689ec-ef49-3b22-a37a-bb49d00e1638
ID ANE + GSA7 **UUID** a965318a-4b29-3b6f-b9a6-4ed6a676c779
ID ANE + GSA17 **UUID** 72a47857-eb5a-324f-8f69-78b622bc55e7
ID ANE + GSA1 **UUID** 834d0773-23ed-3d34-bbde-253a3ef5eaa6
ID ANE + GSA6 **UUID** e5de7186-6b88-325e-8cd1-68d933943cb4
ID ANE + GSA18 **UUID** 4c437c98-d37c-37a5-99d9-d5e4cd82360e

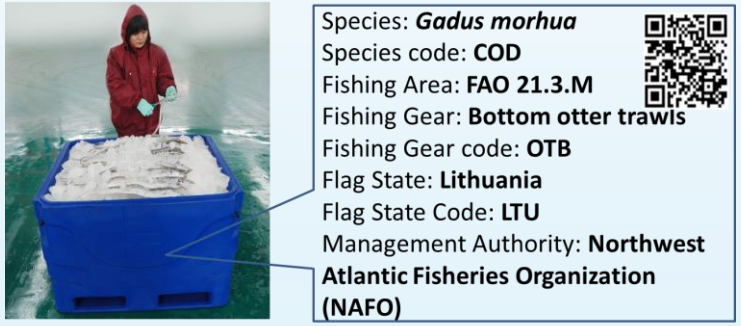
Stock name | Human readable semantic code | Machine readable code | QR code

- Stock status
  (reported at national, regional level)
  - SDG 14.4.1 indicator
- Traceability schemes

Global Record of Stocks and Fisheries; an integrated Blue Cloud registry

- Collect => From 3 global resources
  - Harvesting on demand
  - Semantically integrated in a KB
- Collaborate
  - Harmonize in the KB
  - Connect to geolocations
- Publish => For traceability & SDG14
  - In a browsable map-viewer
  - In a CKAN registry with gCat services





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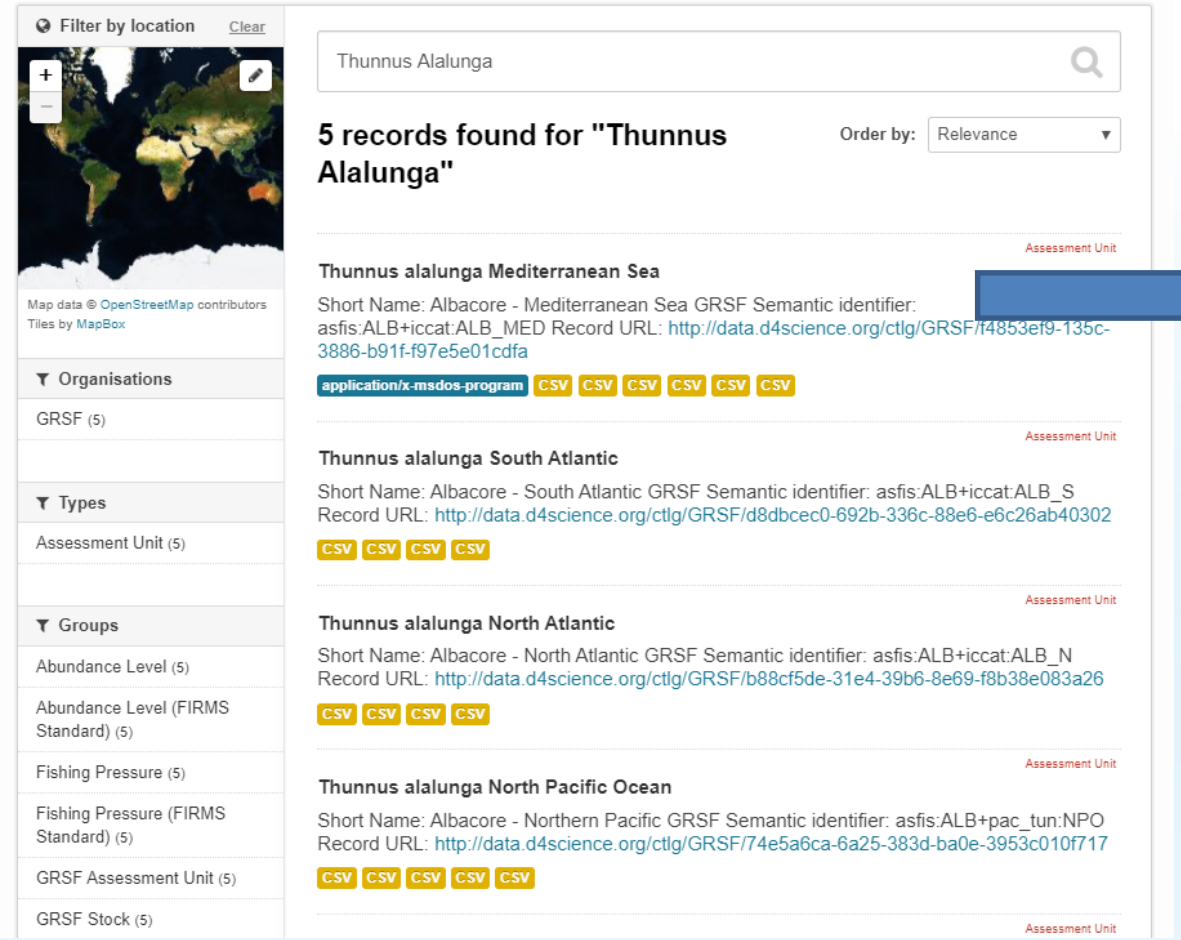

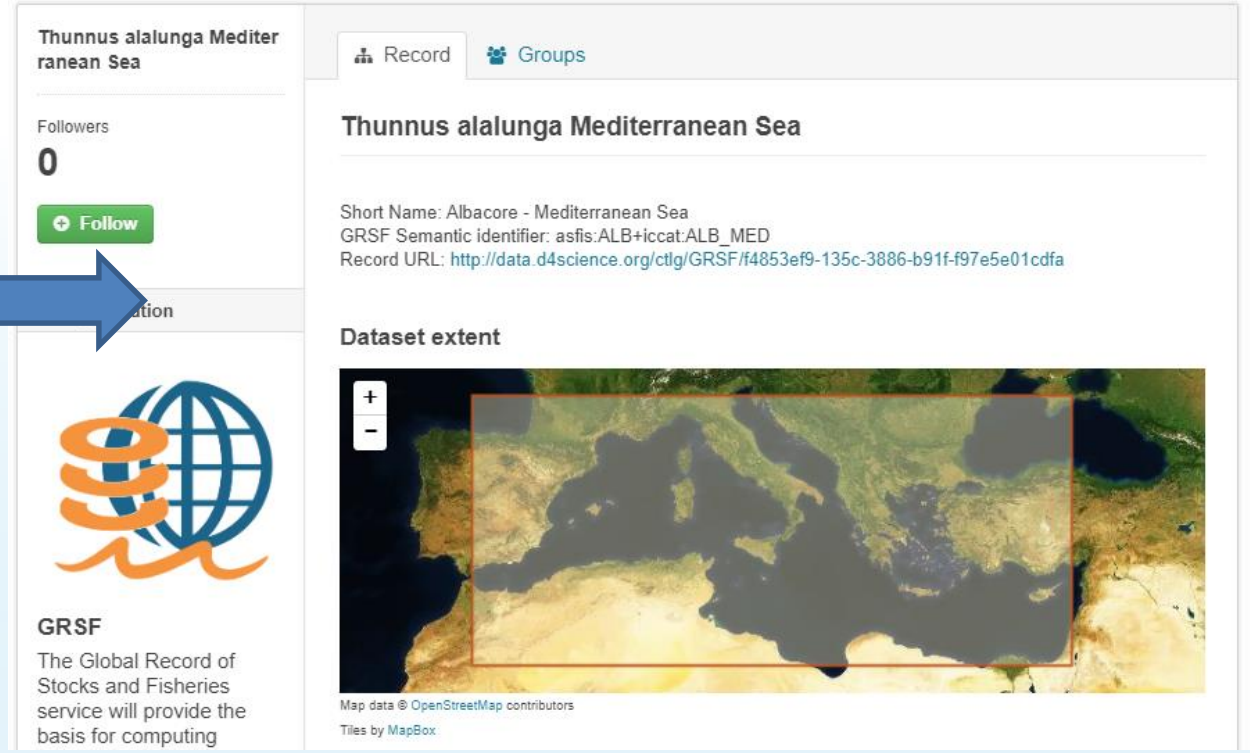

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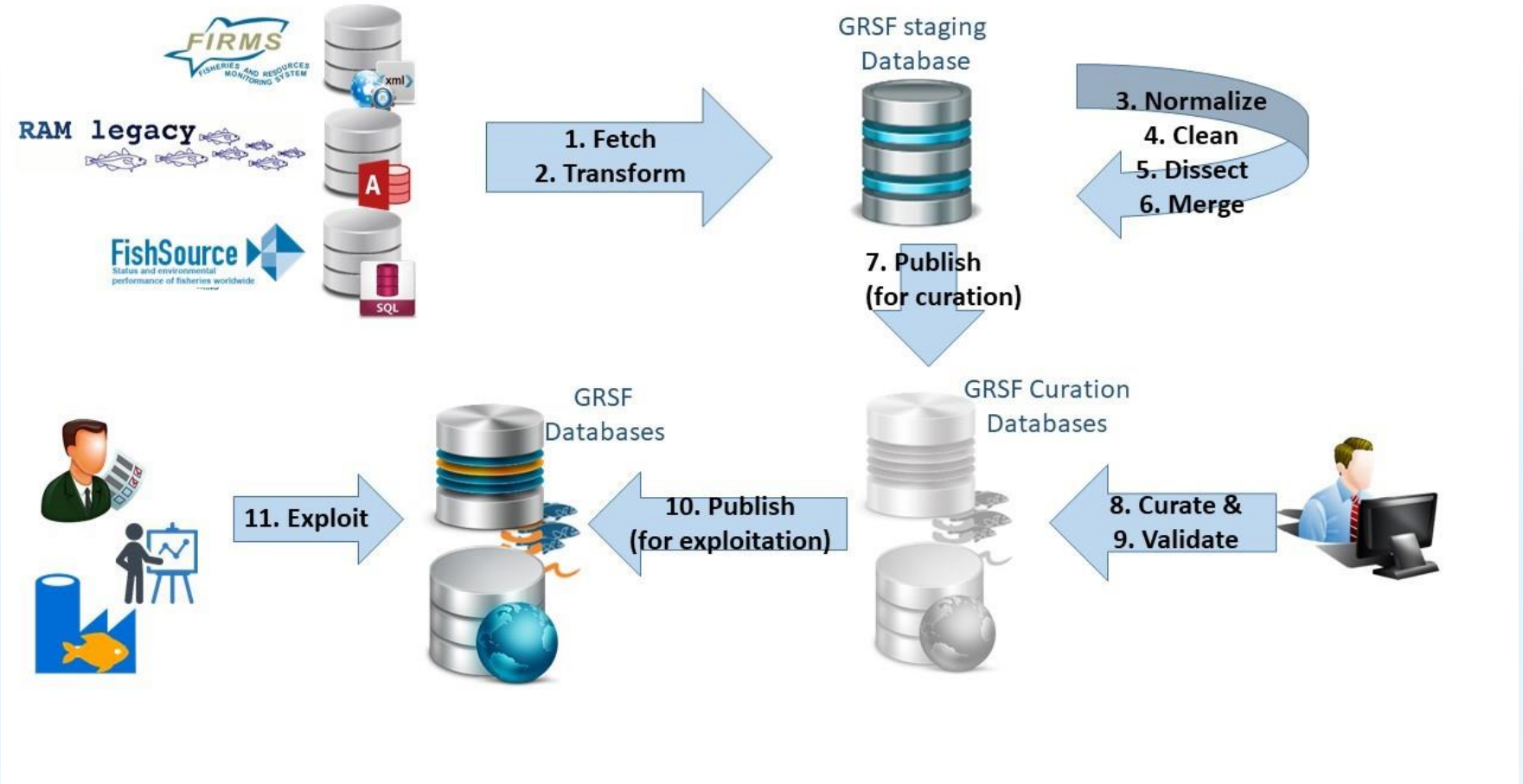

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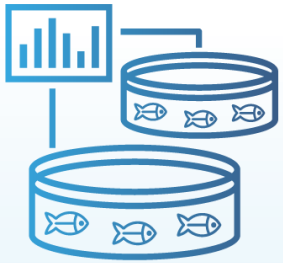

Aquaculture Monitor

Anton Ellenbroek, Emmanuel Blondel, **FAO of the UN**

Emeric Lavergne CLS - France

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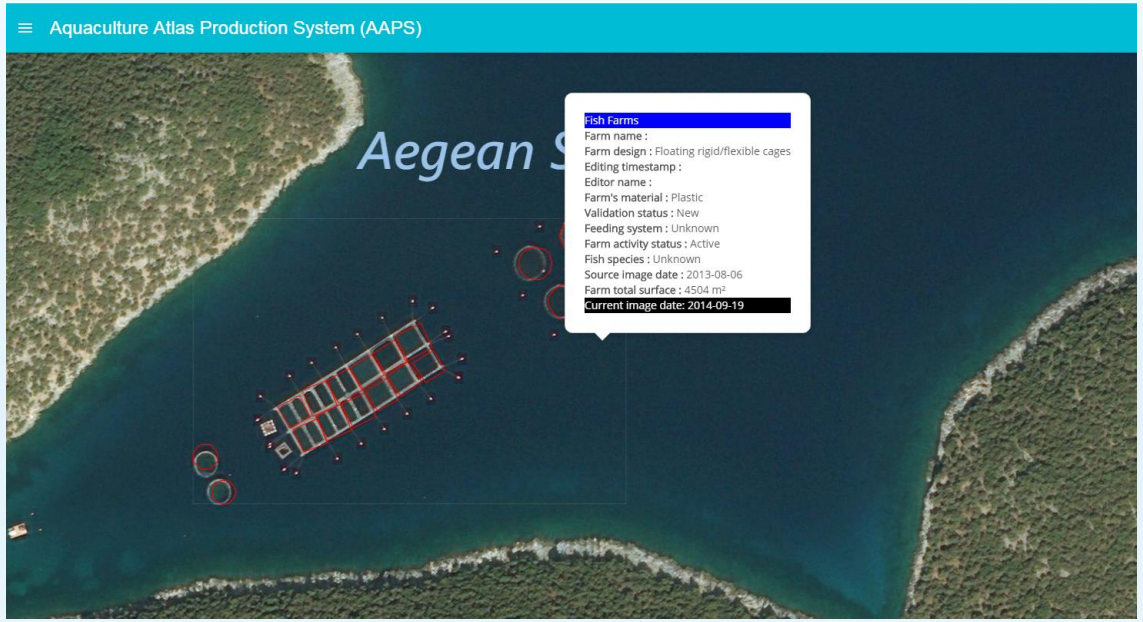
Web application examples of Aquaculture Atlas Production System (AAPS) for **location detection**

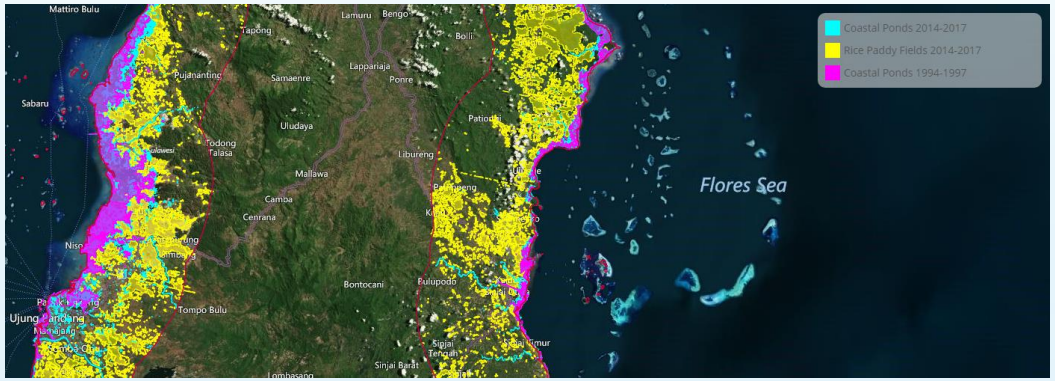
Farm identification and attributes in Greece

Image from Microsoft Bing Aerial – Derived products will be available under the Open Database Licence © Open Street Map



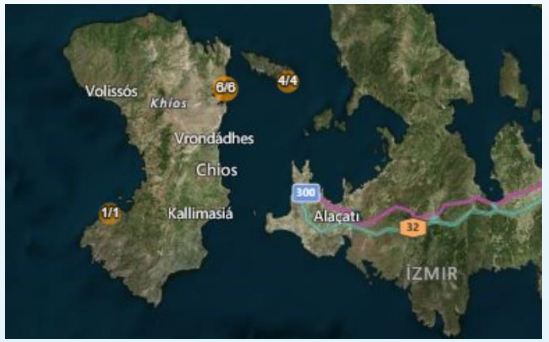
Rice paddy vs shrimp pond distribution in South Sulawesi (Indonesia)

Based on Sentinel 2 and Sentinel 1 imagery

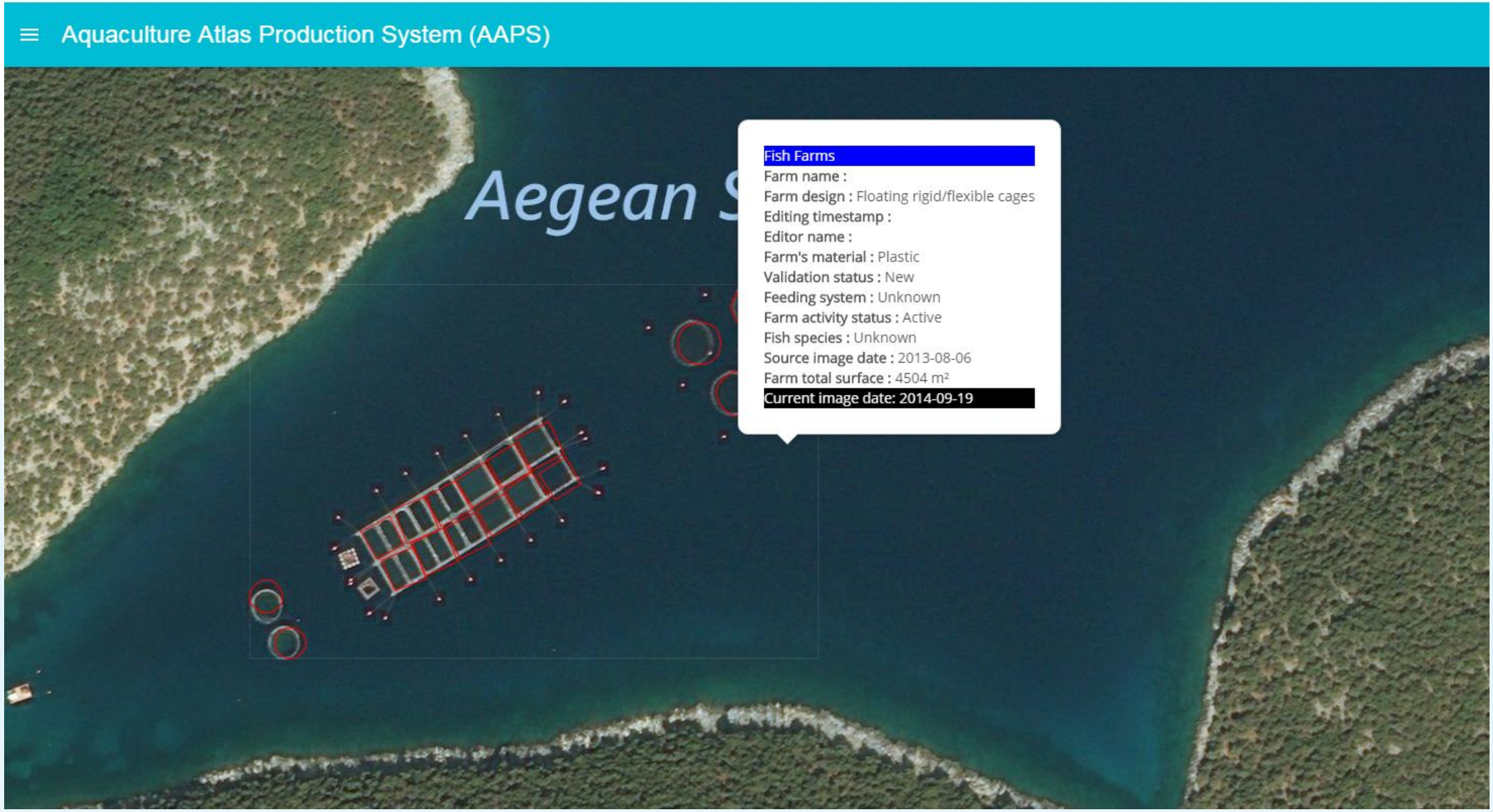


AAPS in Greece; what can it do?

- A global Map
  - With detected / validated locations
  - Stored in a ISO/OGC Map Backend
- Zoom in to region
  - Discover numbers and locations
  - Current maps over Greece and Malta
- Zoom in to Farms
  - See an image of the cage-cluster
  - Edit the cluster features
  - Validate your changes



AAPS in Greece; edit cage clusters

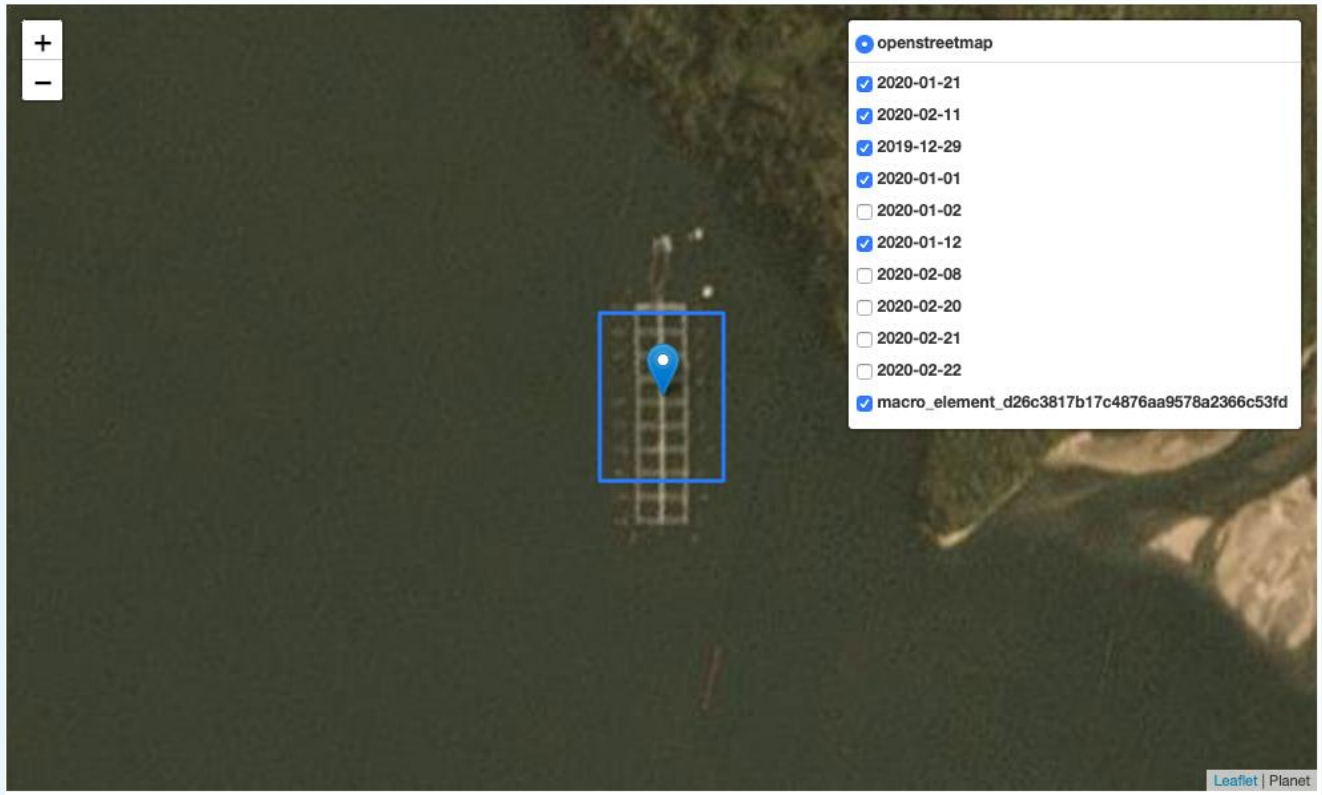


AAPS; From inventory to monitoring

- Blue cloud; Innovative monitoring of marine aquaculture
  - Based on timeseries of images to detect cage activity
  - AI and deep learning define which cages are active; to compute statistics: active cages and area estimates
  - Overlay with other Blue Cloud maps for spatial planning
    - EMODNet, CMEMS Copernicus marine, OBIS, and Essenstial Ocean Variables
  - Other culture systems in 2021; coastal ponds

From location detection (done) to production monitoring (2021)

- Monitoring requires High Resolution images at frequent intervals (approx. weekly)
- Key challenge: use AI and deep learning to monitor activity



Collaboration opportunity

- Fisheries Atlas and Global record
  - We want to include more stocks and fisheries; coastal small scale
  - We want to connect fisheries to downstream markets (traceability)
  - We want to connect fisheries to environmental services
- Cage detection and validation of workflow implementation
  - We have limits in coverage of areas => free optical VHR data
  - We have limitation in ground-truthing => farm inventories specialists
  - We want to develop fully automated cage detection using Deep learning technics on Sentinel data (cages get moved around …)
    -> Condition for making a workflow to repeat on the same area (e.g. Malta)

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Fish a matter of scales

To know more about this Demonstrator, please visit:

https://www.blue-cloud.org/demonstrators/fish-matter-scales

Aquaculture Monitor

To know more about this Demonstrator, please visit:

https://www.blue-cloud.org/demonstrators/aquaculture-monitor

THANK YOU!

Any questions?

Register: Blue-cloud project @ D4Science Infrastructure

Demo Application for authenticated users: Secure Aquaculture Atlas Generation

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Questions & Answers

Zoo & Phytoplankton EOV products

Patricia Martin-Cabrera - VLIZ - Flanders Marine Institute

Marine Environmental Indicators

Massimiliano Drudi - CMCC Foundation

Plankton Genomics

Guy Cochrane - EMBL-EBI

Fish a matter of scales

Aquaculture Monitor

Anton Ellenbroek - FAO of the UN

Thank you for joining

Stay tuned for regular updates

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