living planet symposium | BONN 23–27 May 2022

TAKING THE PULSE OF OUR PLANET FROM SPACE

Merging and Analyzing Fishing Data for Science and Management Whilst Remaining Secure and Confidential

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27 May 2022

Privacy Preserving Machine Learning Project

Goal: Use machine learning to harness the power of EO data, while protecting sensitive data sets

start: May 2021

end: Jan 2023

1. Land applications:
   a. Socio economic mapping
2. Ocean applications:
   a. vessel detection
   b. bycatch prediction

Partners

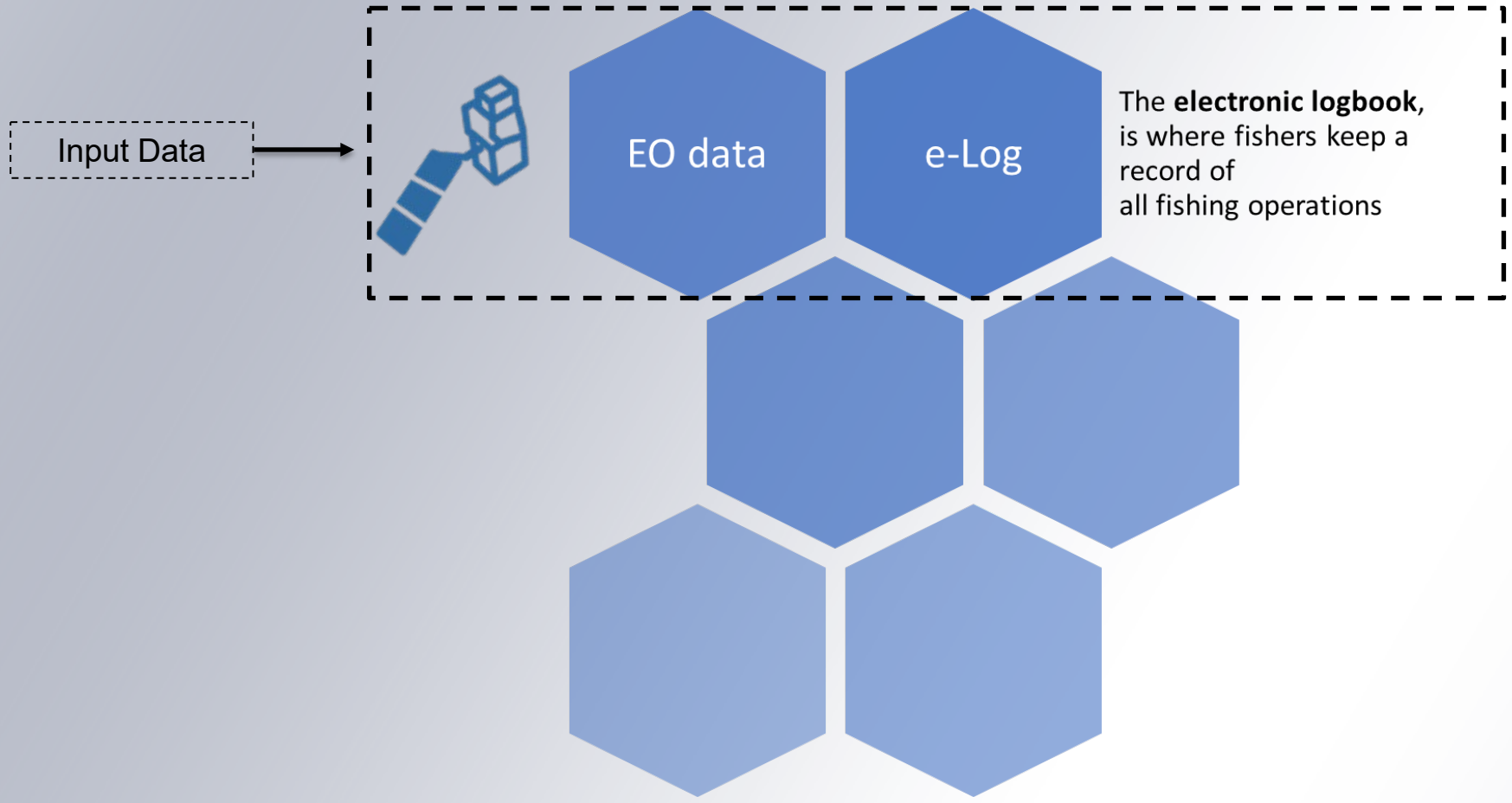
WFP World Food Programme

OLSPS International

SCONTAIN

This project has received funding from the European Space Agency Contract No. 4000134424/21/I-NB.

Context and Motivation



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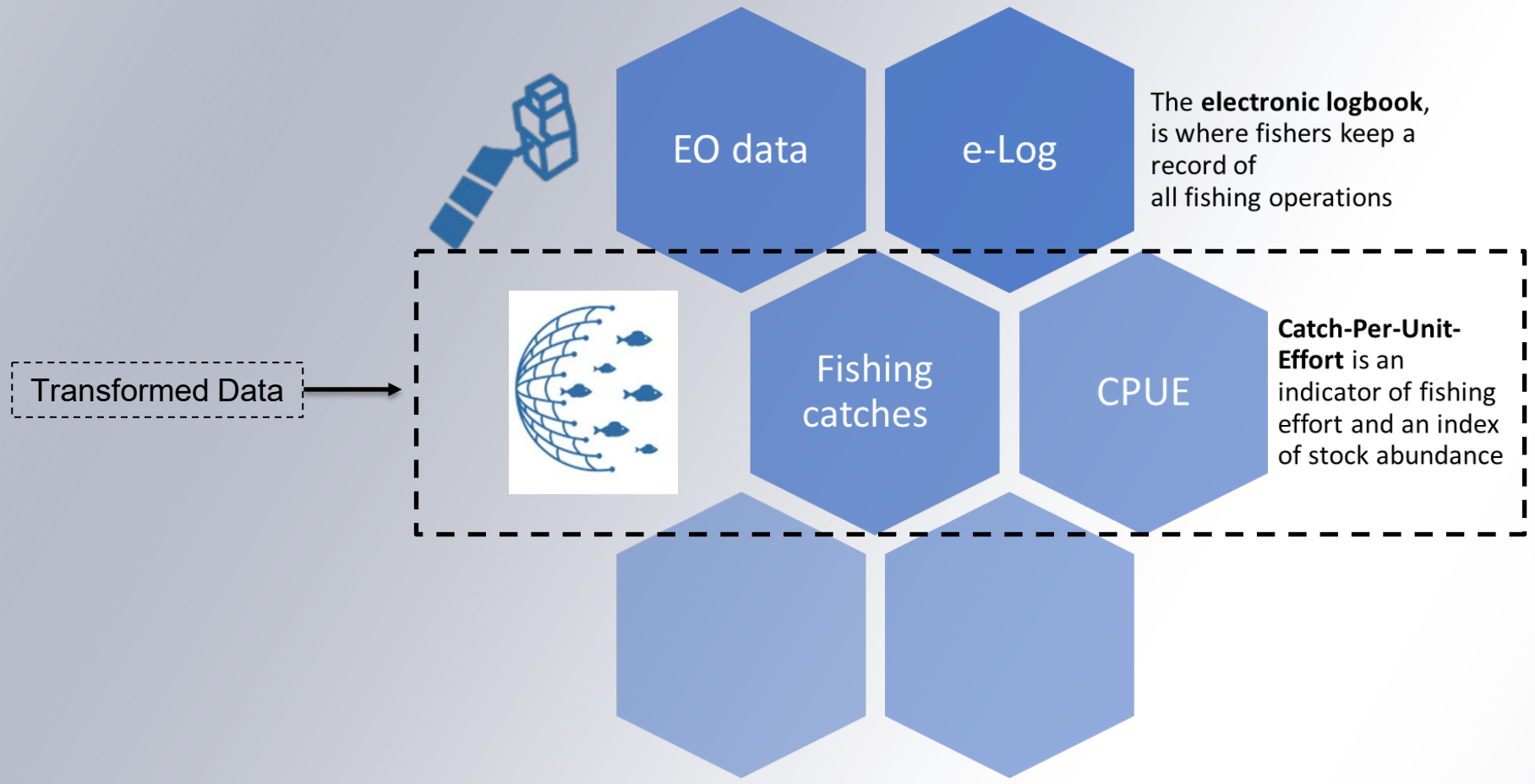

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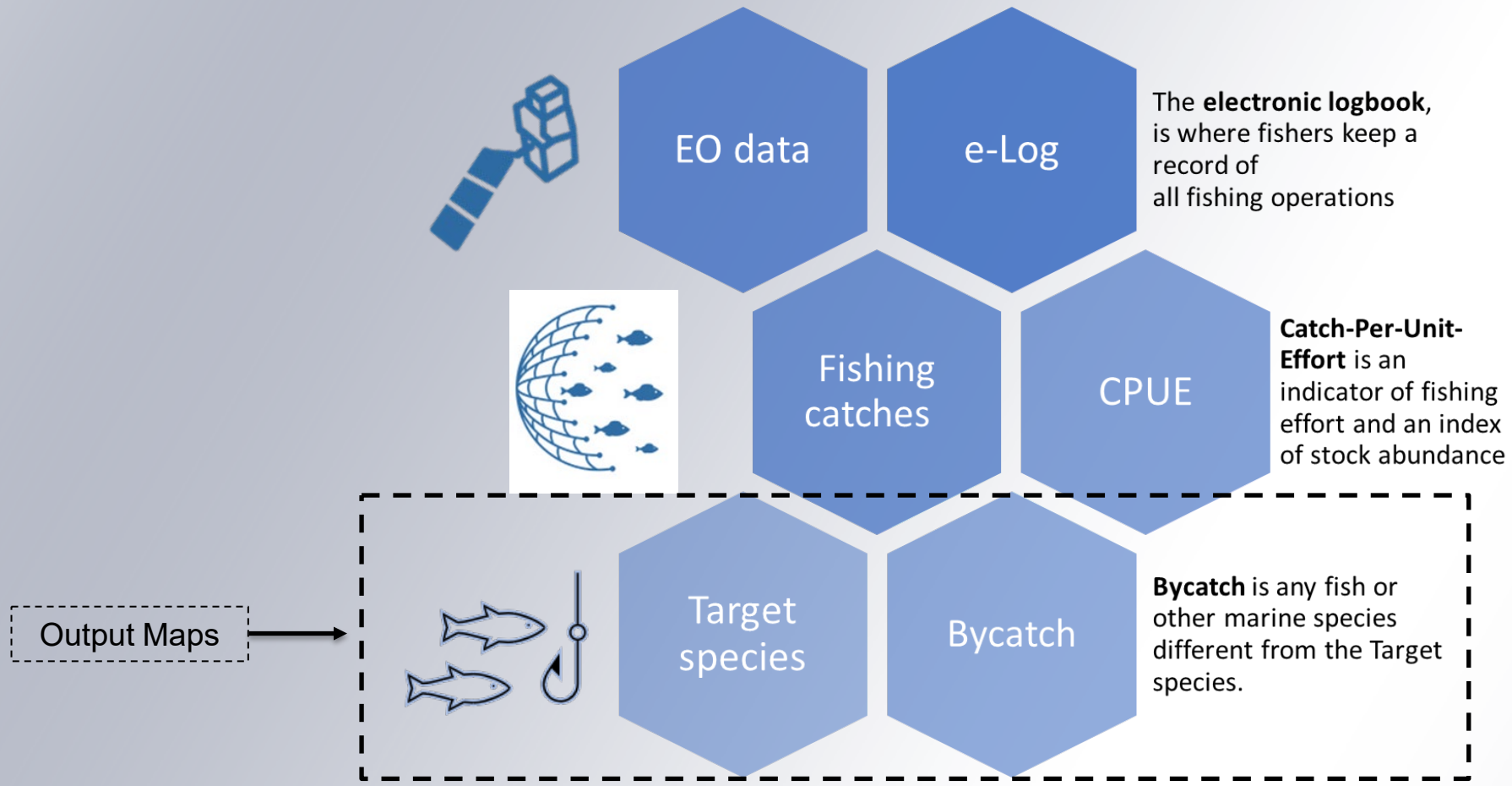

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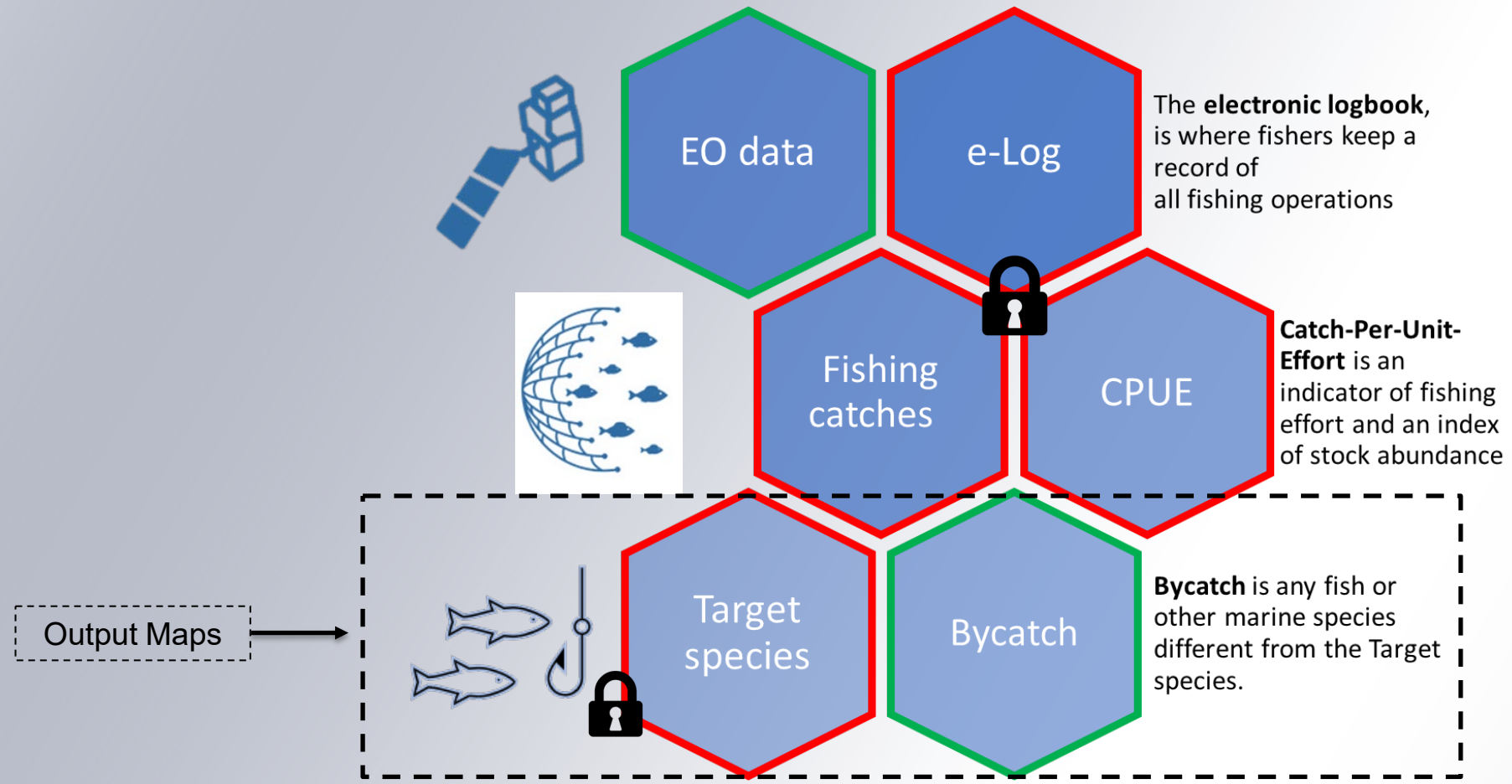


Solution

Combine geolocated catch per unit effort (CPUE) with EO data (CHL, SST, etc.)

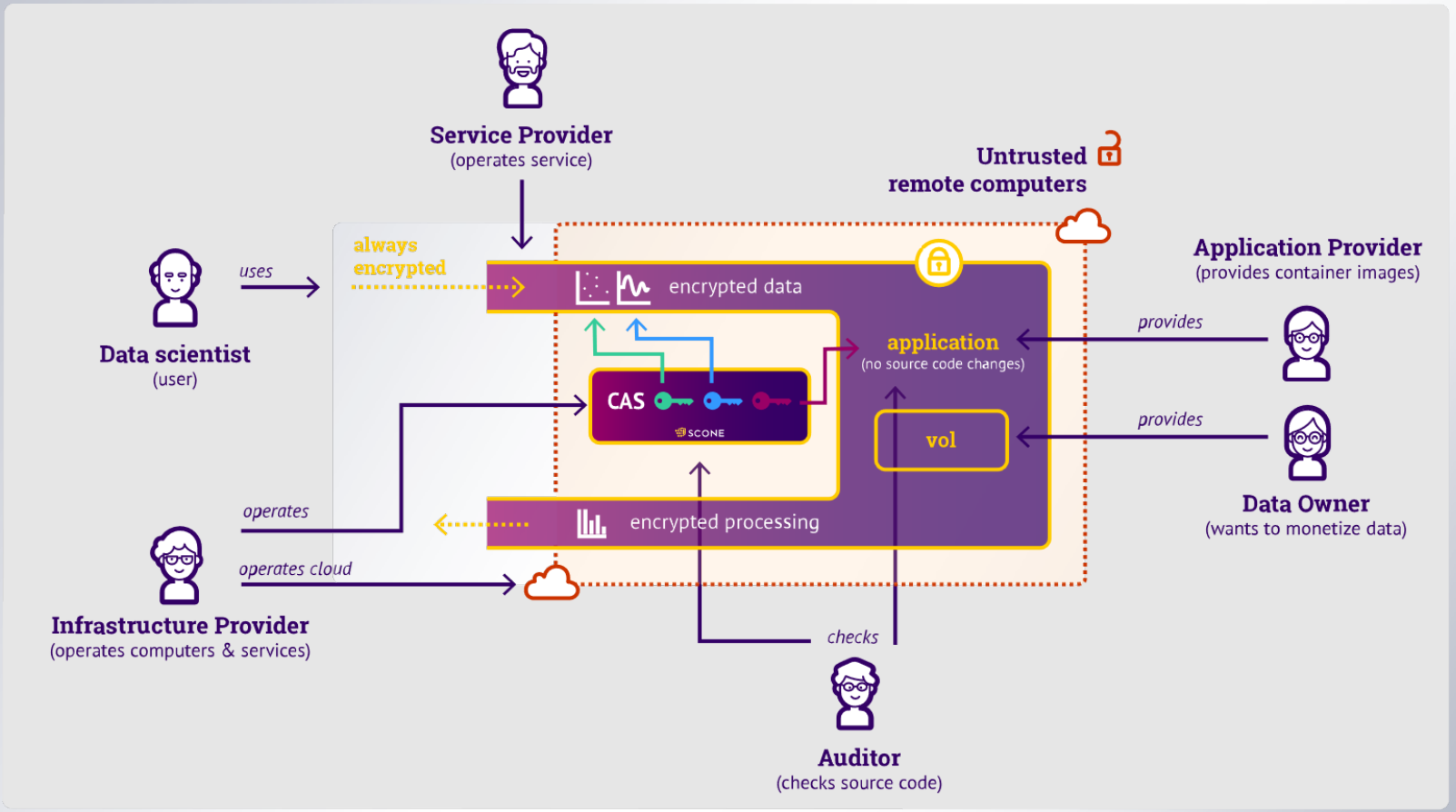
Predict areas where unintentional bycatch is concentrated using NRT EO Data

While protecting the fishing data set

Employ a Trusted Execution Environment (TEE) to protect both the reference dataset and the ML application

Trusted Execution Enviroment

- Protect data
- Security policies (store in CAS component)
- Data owner verifies security policies



EO Data

Variable	Type	Spatial Resolution	Temporal Resolution	Time Range	Geographical Coverage	Processing level	Update frequency	File Format
Sea Surface Temperature	Satellite observation NRT	0.05° (approx. 5-6 km)	Daily	1981-10-01 to present	Global	L4	biannually	NetCDF-4
Chlorophyll-a	Reanalysis	4 km	Daily	1997-09-04 to present (2021-01)	Global	L4	annually irregular monthly	NetCDF-4
Bathymetry		15 arc second (100 to 500m in the equator)	static	not applicable	89° 59' 52.5''N, 179° 59' 52.5''W to 89° 59' 52.5''S, 179° 59' 52.5''E	not applicable	annually	NetCDF GeoTiff Esri ASCII
lunar index	Real time computation	Global	daily	depends on function used	Global	not applicable	not applicable	not applicable

To protect fishing grounds, global maps are used

Olrac Tool

OLSPS International

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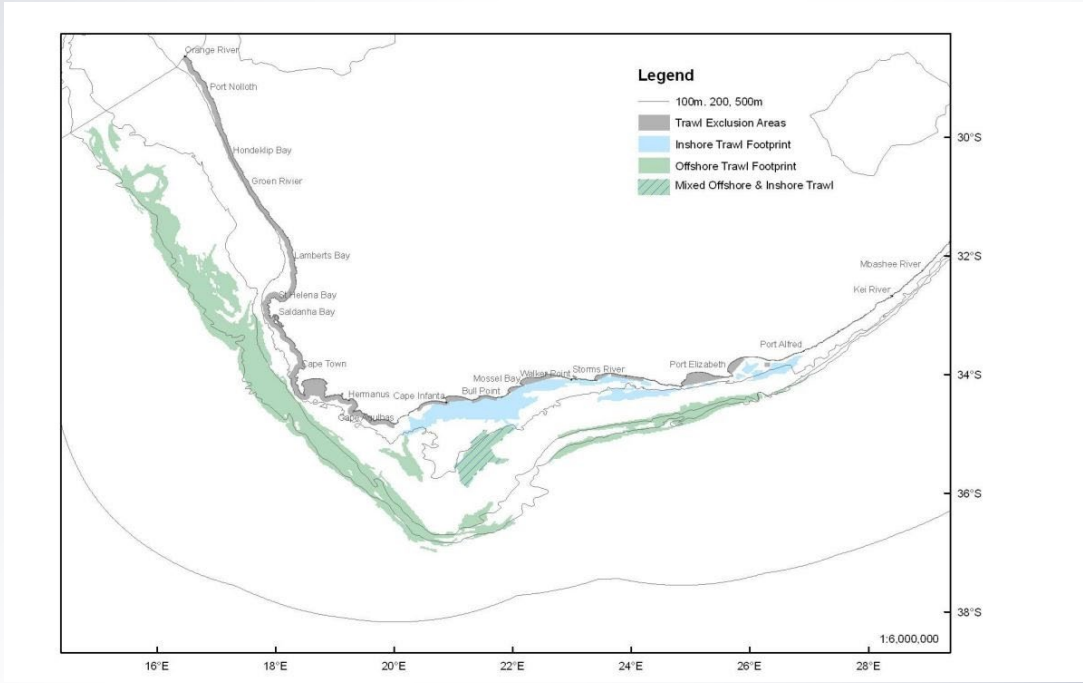
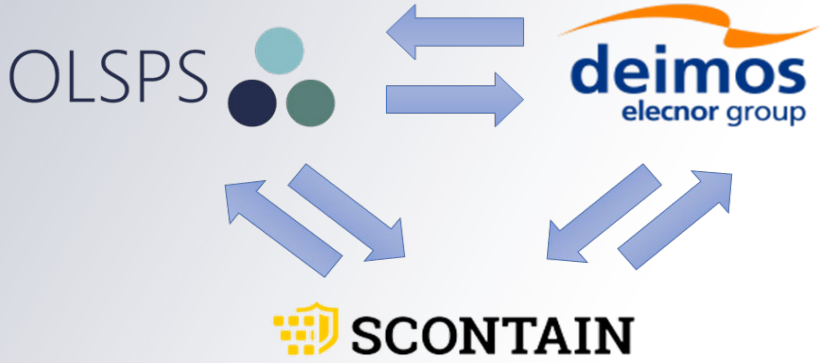
Reference data

- Permission granted by respective clients, conditioned by data remaining anonymous.
- Two hake species fished using otter trawl
- AOI: South Africa.
- TOI: 2009 to 2014
- 816 trips



From Challenges to System Requirements

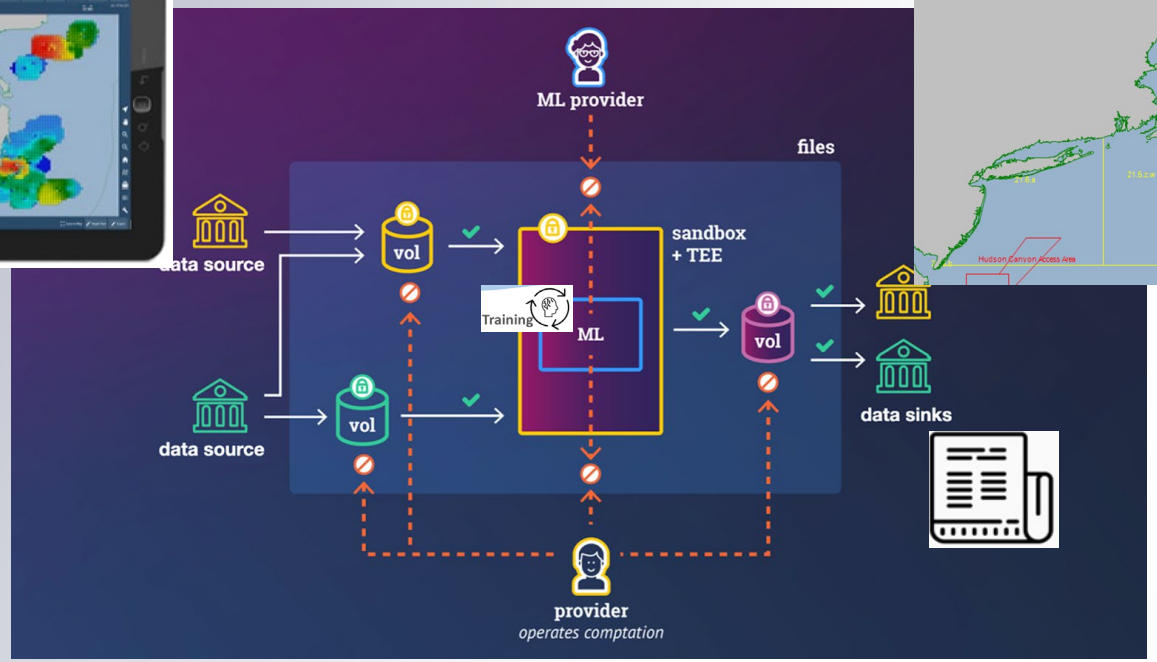
Requirements have a three-way nature

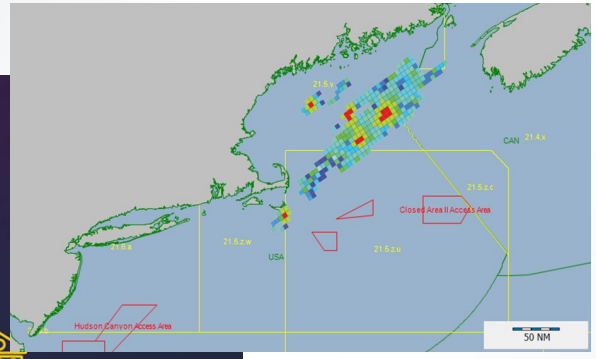


- Reluctance on sharingdata that can disclose good fishing grounds
- Fishing prediction models have commercial & strategic IP

- ML model and reference data shall be protected from unauthorized access at all times
- Reference data cannot leave the server (or cloud infrastructure) of its provider
- All communications shall be secure, ensuring that no data is leaked

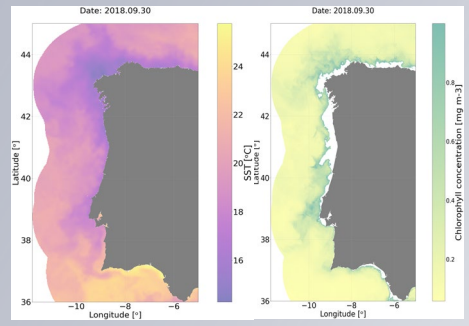
Current Status - MVP

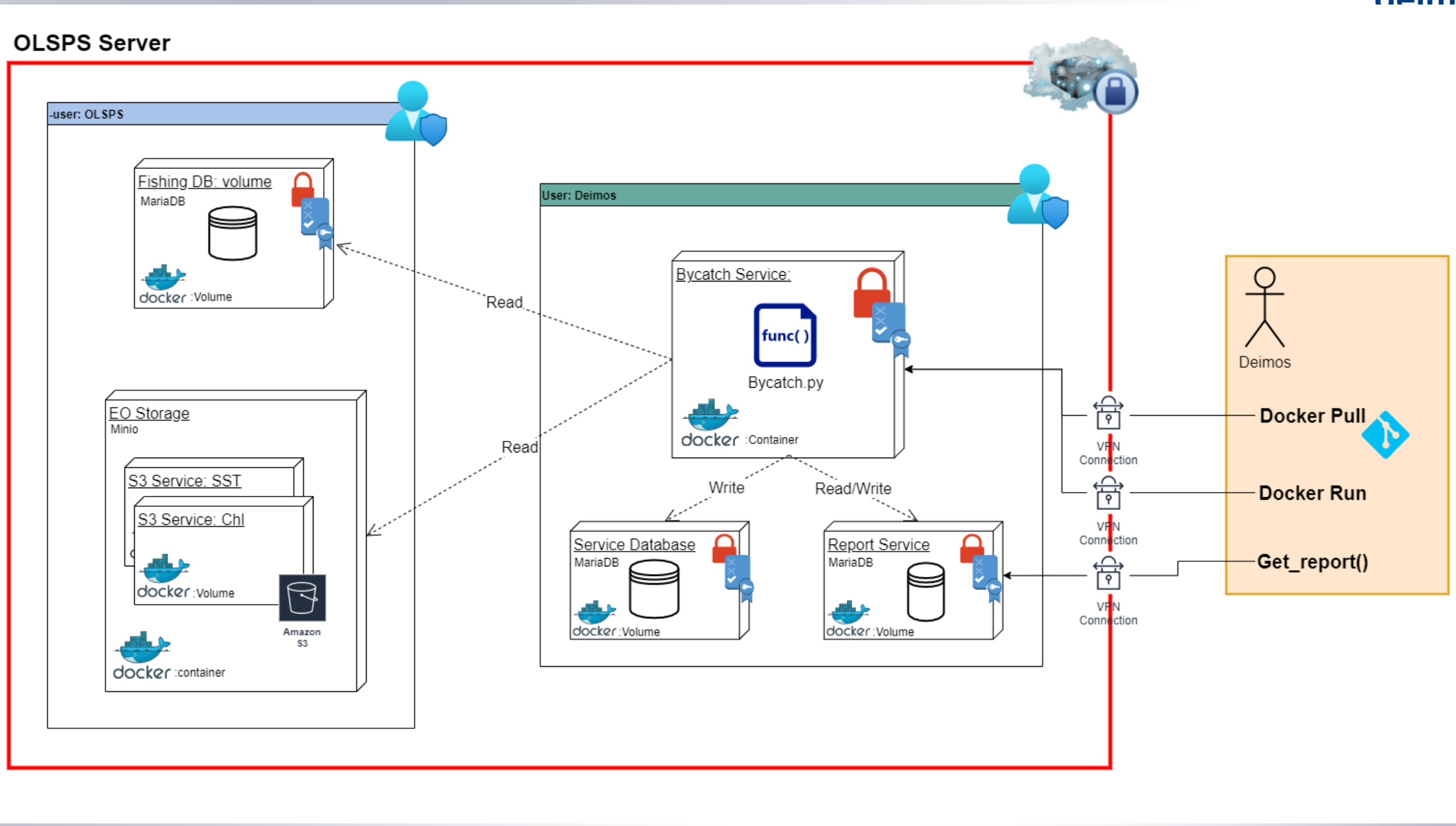




Sea Surface Temperature

Chlorophyll concentration




OLSPS Server
-user: OLSPS
Fishing DB: volume
MariaDB
docker :Volume
EO Storage
Minio
S3 Service: SST
S3 Service: Chl
docker :Volume
Amazon S3
docker :container
Read
Read
User: Deimos
Bycatch Service:
func( )
Bycatch.py
docker :Container
Write
Read/Write
Service Database
MariaDB
docker :Volume
Report Service
MariaDB
docker :Volume
VPN Connection
VPN Connection
VPN Connection
Deimos
Docker Pull
Docker Run
Get_report()

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Next Steps

- Fully test end to end deployment
- Test security setup

Conclusions

- TEE established (tecnhology developed outside of ML and EO)

- EO data needs to be downloaded:
  - Goes against trend of putting app in the data source
  - Download is expensive (time and resource)
  - **Using API may expose fishing grounds**

Conclusions

- Merging fishing grounds with EO data:
  - Resolution problems
  - Data input format
  - Needs strong pre-processing

- Collaboration of 4 different profiles:
  - Thematic expert
  - ML expert
  - EO expert
  - Privacy expert

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Thank you

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