

Challenges:

Challenge 1 - "User Applications: Fishermen's App"

Keywords: citizen/community science, smartphone app, socio-economic data, AI-based image annotation, near-realtime data

Mentors (on site): Björn Fiedler, Ivanice Monteiro (OSCM), N.N. (UTA)

available data/materials:

- incoming app data reports (approx. 700 reports so far, numerical, *.csv)
- incoming pictures (*.png)
- App source code (R)

Scope:

The goal of this challenge is to practice the sifting, cleaning, merging and visualization of already collected and frequently incoming marine data and to enable the further use of the data currently collected in near-realtime with the help of a smartphone app used by artisanal fishermen. Data include socio-economic parameters (e.g., costs for fishing effort), parameters on catches (e.g., weight) as well as biodiversity data (pictures of species).

Solutions ideally also include a roadmap for optimized integration of new/future data and options to provide immediate information to stakeholders. Further development of the app is not an explicit goal, but would be technically possible.

Potential fields of activity during the project week:

- Transforming fish catch images into information (AI / Annotation / Classification)
 - Could ease the information collection for fishers
 - Could improve the quality of the provided annotations
 - Could result in recommendations to collect "better" images
- Software-Engineering Designing and prototyping an architecture for actual use of the data (Database, Backend / API, Frontend(s))
 - Feedback portal for fishermen (e.g., stats on expenses spent on fishing, catches per week/month/year)
 - Develop a pilot marketplace to inform buyers of available catch (like this: <https://www.fischvomkutter.de/moeltenort.html> or <https://abalobi.org/>)
 - Link to challenge 2

Challenge 2 - "Scientific Applications: Marine Data Fusion"

Keywords: data fusion, FAIR data, prediction, imputation, uncertainty, visualization

Mentors (on site): Willi Rath, Nuno Vieira (?), Lucileida Ramos (UTA) (?). Matthias Schaber (?)

available data:

- hydroacoustic biomass data (XY campaigns)
- bathymetry data
- CVOO time series data (biogeochemical data (ship), currents/temp/sal/o2 (mooring))
- autonomous surface vehicle (Saildrone/Wave Glider) data: temp/sal/bgc
- gridded atmospheric, hydrographic and biogeochemical [Copernicus Marine Data products](#)
- gridded high-resolution ocean-circulation data [VIKING20X](#)

Scope:

The goal of this challenge is to practice the integration of existing marine data sets (in-situ point data, in-situ time-series, gridded fields, along-track data) that allows for joint analysis. The study region around the Cape Verde Islands serves as a specific example used in the hackathon but should not limit the scope of solutions to only those applicable in the tropical oceans. Solution can include visualization with existing infrastructure (e.g. Digital Earth Viewer, BELUGA), as well as further analysis using, e.g., machine learning methods. Particular attention should be paid to linking existing biomass data, hydroacoustic and (simulated) ocean circulation data. It would also be desirable to develop a blueprint for the integration of new/further data.

Potential fields of activity during the project week:

- Integration of as many as possible of the [Copernicus Marine Data products](#) for the Cape-Verde region as context for local in-situ observations
- ML/AI-driven Biomass prediction based on location, hydrographic parameters (temperature / salinity) and bio-geo-chemical parameters (oxygen, nutrients, ...)
- ML/AI-driven imputation of data
- Uncertainty estimation based on data from different sources

Challenge 3 - "Conceptual Framework: Digital Twin Cabo Verde"

Keywords: Stakeholder engagement, Digital Twin Framework, Narrating the integrative Cabo Verde data story, Establishing operational feedback loops

Mentors (on site): Timm Schoening, DSU GEOMAR, Estanislau Lima (UTA)

Scope:

All digital twins need observation data, interactive models and simulation data, dynamic visualization interfaces as well as feedback mechanisms to transfer knowledge generated to stakeholders to put into action for the benefit of society and nature.

The goal of this challenge is to design an overarching framework for the implementation of future digital twins of Cabo Verde. These sustainably built twins shall be able to access all required data to address specific what-if questions around the archipelago. Infrastructure and data workflow requirements are important here. Yet, the main focus shall lie on establishing an effective feedback loop among data interpreters and decision makers.

Potential fields of activity during the project week:

- Infrastructure requirements
 - Which key infrastructures are required?
 - Which infrastructures exist locally?
 - Which infrastructures from elsewhere are available?
 - Which infrastructures need to be implemented?
 - Who has access to which infrastructures?
- Requirements for sustainable monitoring activities around Cabo Verde
 - Enabling uncertainty quantification of existing data sources
 - Providing the means to create necessary data (where to sample next? What to sample next?)
- Establishing a narrative, pitching the Digital Twin vision to regional stakeholders:
 - Collection of what-if questions to be addressed by DTs
 - Collection of scientific, societal and industrial gains
 - Highlighting the DT potential of informing the necessary stakeholders about risks, uncertainties and potential actions
- Facilitating an operational feedback loop with society, industry and government:
 - Who are the local stakeholders?
 - What are their roles (legislation, oversight, monitoring, data provisioning)?
 - How do they interact?
 - Do they have means to operate a twin or ingest twin results?
 - Are stakeholders missing (agencies, NGOs, interest groups)?
- Your ideas of actions towards a Cabo Verde Digital Twin framework:
 - Go beyond the bullets above
 - Think in interactions
 - Embrace the effectivity and efficiency of DTs for the benefit of the Cabo Verde archipelago and its people