

Global Monitoring for Environment and Security and Africa (GMES and Africa)

**IGAD Climate Predictions and Applications Centre Consortium** 

CONCEPT NOTE

# Earth Observation for Land and Water Challenge Leveraging DUNIA Platforms & Resources









# **Background and Context**

Observing our planet from space offers an unprecedented opportunity to monitor changes on the earth surface. Space technology allows us identify patterns overtime, understand trends and monitor our planet to better manage, conserve and adapt to or changing environment.

The Global Monitoring for Environment and Security and Africa (GMES and Africa) is a flagship programme of the African Union Commission (AUC) under the African Space Policy and Strategy. This programme aims at improving the capacity of African decision-makers, planners, scientists, businesses, the private sector, and the public to design and implement national, regional, and continental policies, and to promote the sustainable management of natural resources through the use of Earth Observation data and derived information.

As part of this programme, the **GMES & Africa – ICPA Consortium** is implementing the **"Earth Observation for Sustainable Land and Water Management in East Africa"** project. The project supports East Africa countries to use Earth Observation (EO) data and technologies to monitor natural resources. Through this project, two operational services were developed and operationalized:

- Service 1 Natural Habitat Monitoring and Assessment
- Service 2 Rangeland Seasonal Monitoring, early Warning and Assessment
- Service 3 Forest monitoring

The Consortium is engaged in the promotion of new technologies and solutions which can make it possible and easier to access and process EO data in order to generate information and products in support to decision making. Cloud Computing is nowadays one of these solutions which can be considered as the key to innovation that makes possible to exploit a large volume of data in a short period of time to generate information resources and decision support tools.

To promote a better handling and appropriation of this Cloud Computing technics and solution the IGAD Climate Prediction and Applications Centre (ICPAC) as the leader of the GMES & Africa - ICPAC Consortium is organising a "Land & Water Mapping Challenge". This challenge aims to address the critical need for accurate land and water mapping and monitoring in the region using geospatial data and DUNIA cloud-based computational platform.

Dunia is an all-in-one, easy-to-use data processing and dissemination platform that also works on smartphones. By providing access to Copernicus Sentinels data in formats and protocols adapted to low bandwidth and fast data processing, the Dunia service will help improve data accessibility and use, facilitating the development and operation of applications over Africa. Users can choose from a wide range of African Earth Observation (EO) products and Copernicus satellite missions, and search, filter and view the data of their choice. Thanks to innovative solutions, they can obtain the datasets they want to analyse locally without worrying about bandwidth or endless download times.

ICPAC and Dunia partnership is a true opportunity to provide planners and decision-makers with Earth Observation (EO) derived information, adapted to their needs and meeting their expectations, with a view to improving natural resources management and supporting decision-making.



The Land and Water Mapping Challenge will give the opportunity to students from the East African region and countries to explore the power of geospatial data and Dunia cloud computing platform to accurately map Land and water features. By leveraging satellite imagery and other relevant datasets, participants will develop coherent and consistent approach, relying on Jupyter Lab environment, to classify different land and water types and generate maps for different years.

# **Objective of the Hackathon**

The main objective of the competition on the Land & Water Mapping Challenge is to produce accurate resource maps using EO and cloud computing resources and technologies.

Specifically, the competition will focus on the relevant way to leverage the potentials of remote sensing data (preferably Copernicus data), geospatial resources, and machine learning technics to set up a robust classification approach, and thus, to generate accurate land and water maps, sustained by all the accuracy assessment metrics.

By generating such detailed land and water maps for multiple years, the competition seeks to contribute to provide to decision makers, water, and conservation managers with and improved decision support tool in the conservation field, and further, to enhance resource monitoring and support sustainable development in the region.

Through the competition, participants are encouraged to develop innovative solution that harness the potential of satellite imagery and associated *in situ* and ancillary datasets to effectively classify and map different water and land types. For the competition, a platform will be provided to the students to showcase their skills, creativity, and problem-solving abilities while addressing real-world challenges related to land and water Management. Indeed, they will have access to the DUNIA platform, which offers a wealth of remote sensing data, including multi-temporal satellite imagery (Sentinel, Landsat etc.) and climate data. The participants will thus have the opportunity to explore advanced data processing techniques, develop robust models, and employ cutting-edge algorithms to achieve accurate Land and water classification and mapping results. They will be supported by a set of training materials (videos, notebook, manuals, etc.) on which they can rely to develop their map.

# **Competition Timeline**:

#### Application phase:

- Launch call for applicants: June 1<sup>st</sup>, 2024 June 10<sup>th</sup>, 2024 🛛 Social media (LinkedIn, Facebook, email, official website. Registration will be done through an application form.
- Evaluation and selection: June 10<sup>th</sup> and June 15<sup>th</sup>, 2024 [] selection of individuals/teams
- **Conduct hackathon**: July 1st to 5th, 2024 Conduct Hackathon, a dedicated team will conduct the evaluation and selection of winners, based on a set of criteria.



• Announcement of winners: July 5<sup>th</sup> 2024, [] winners will be announced and awarded. The 1<sup>st</sup> place winner on top of the award might attend the GMES and Africa regional Workshop in Madagascar.

# **Target groups**

- Students from Universities and high schools from various background;
- Early career professionals and startups familiar with cloud computing, Artificial Intelligence (machine learning, etc.).

# Venue

Kenyatta University (Main Campus)

# Organisation of the competition

- 1. Day 1:
  - DUNIA crash course.
  - Review on Jupyter notebook elaboration in notebook Jupyter Lab environment.
  - Team formation
- 2. Day 2:
  - Competition Kick-off and Introduction
  - Welcome participants and provide an overview of the competition.
  - Present the problem statement, goals, and evaluation criteria.
  - Introduce the dataset, including satellite imagery and associated data.
  - Provide access to the DUNIA platform and necessary resources.
  - Clarify any competition rules, submission guidelines, and code of conduct.
  - Challenge starts.

#### 3. Day 3:

- Challenge continues.
- Final submission Deadline.
- 4. Day 4:
  - Challenge continues.
- 5. Day 5
  - Team Presentation and submission of codes
  - Announcement of winners

All deadlines are at 11:59 PM UTC on the corresponding day unless otherwise noted. The competition organizers reserve the right to update the contest timeline if they deem it necessary.



### **Prizes:**

- 1st place Prize Euros 500
- 2<sup>nd</sup> place Prize *Euros 300*
- 3rd place Prize Euros 200

### **Evaluation**

The evaluation process will be conducted on a held-out test dataset that is not accessible to participants during the development of their solutions. The ground truth labels for this test dataset will remain undisclosed to ensure unbiased evaluation. Participants' submissions will be scored based on their model's Overall Accuracy, Kappa Coefficient, recall, and F1-score, including all the other relevant metrics.

Participants are encouraged to fine-tune their models and optimize hyperparameters to achieve the highest classification accuracy possible. It is important to provide well-documented code and a detailed report describing the approach, methodology, and results achieved.

#### Data

Participants will have access to a rich and diverse dataset provided by GMES and Africa and Dunia platform. The dataset includes:

- Copernicus data through Dunia platform
- Other EO data available on the eStation
- Any other relevant data that might be needed

#### 1. Task

The primary task of the challenge is to develop approach that can accurately classify different land cover types based on the provided satellite imagery and associated data. Participants will be required to generate land and water maps with high accuracy and spatial resolution for the years 2024.

To accomplish this, participants can explore various approaches, including but not limited to:

- Feature extraction and selection: Extracting relevant features from satellite imagery and climate data that can discriminate between different land types. Feature selection techniques can also be employed to optimize model performance.
- Machine learning and deep learning: Employing machine learning and deep learning algorithms to train models that can effectively classify land based on the extracted features. Participants are encouraged to experiment with different models, such as random forests, support vector machines, convolutional neural networks, and recurrent neural networks.
- **Transfer learning and ensemble methods:** Leveraging pre-trained models and transfer learning techniques to enhance the classification performance. Participants can also explore ensemble methods to combine multiple models and improve accuracy.



#### 2. Code and Documentation

Participants are required to submit their code as a python notebook along with a detailed report explaining their approach and methodology. The code should be well-documented and easily understandable. The report should provide insights into the preprocessing steps, feature engineering techniques, model architecture, training methodology, and any innovative aspects of the solution. Including visualizations and analysis of the results is highly encouraged.

#### 3. Teams and collaboration

You may participate in competitions as an individual or in a team of up to four people. When creating a team, the team can only have one submission.