

# *FROM GROUND TO ORBIT:*

COMBINING IN-SITU AND SATELLITE MONITORING OF WATER AND FOREST  
RESOURCES FOR ADAPTATION TO CLIMATE CHANGE”

**10TH NOVEMBER 2025**

ERIC BREL

Espace pour la Guyane  
Centre Spatial Guyanais

L'ÉCOSYSTÈME SPATIAL FRANÇAIS EN CHIFFRES

**3 milliards €**

Le budget spatial institutionnel français en 2024, ce qui représente :



**45 €**

par an et par  
habitant

**5<sup>e</sup>**

pays, après USA,  
Chine, Japon et la  
Russie

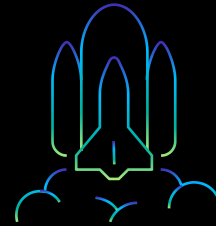
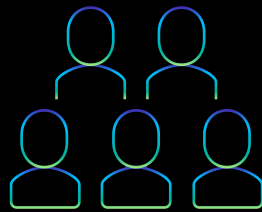
**1<sup>er</sup>**

budget national  
en Europe

**70 000**

**personnes**

travaillent dans la filière spatiale en France, dans  
l'industrie manufacturière et de services et le  
secteur académique.



**1 000**

entreprises françaises dans la  
filière spatiale, qui représentent

**1 500** établissements

**90 %** de PME et ETI (entreprises  
de taille intermédiaire)

Plus de

**80**

formations académiques  
spécialisées dans le spatial



Plus de

**15**

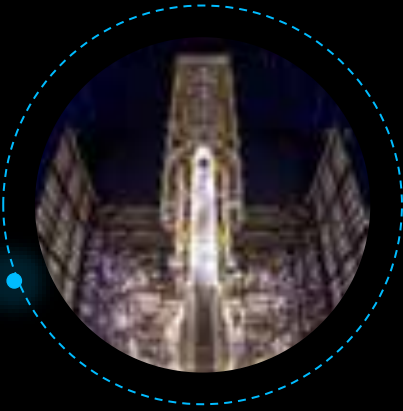
Centres Spatiaux Universitaires  
collaborant avec le CNES

**1<sup>er</sup>**



pays européen en terme  
**d'investissements  
privés** dans le spatial

# OUR 4 STRATEGIC PRIORITIES



© CNES/ESA/Arianespace/Optique  
Vidéo CSG/S Martin, 2023

## **STRENGTHEN** **SUPPORTING**

our strategic autonomy



© CNES/DE PRADA Thierry, 2022

the competitiveness of  
the space ecosystem



© CNES/Distribution Airbus DS,  
2020

## **COMMIT**

to a sustainable world



© CNES/GRIMAUDT Emmanuel,  
2021

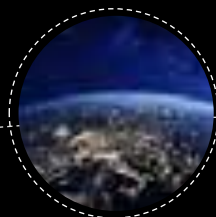
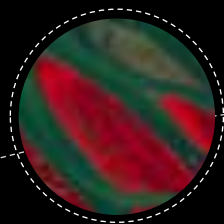
## **SHOWCASE**

our scientific excellence

CONTRIBUTE TO  
TERRITORIES  
**RESILIENCE**

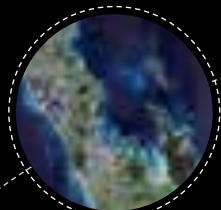
IMPLEMENTING  
AN AMBITIOUS  
**CSR** POLICY

BEST UNDERSTAND OF  
**CLIMATE CHANGE**



# COMMIT TO A SUSTAINABLE WORLD

PROMOTE  
A **SUSTAINABLE**  
USE OF SPACE



© Copernicus Sentinel Data, 2022



© CNES/ILL/DUCROS David, 2022

**DECARBONER**  
THE SPACE SECTOR



© CNES/DUCROS David, 2016



© CNES/Distribution Airbus DS,  
2020

# SERVICES FOR EVERYONE

Lunar economy

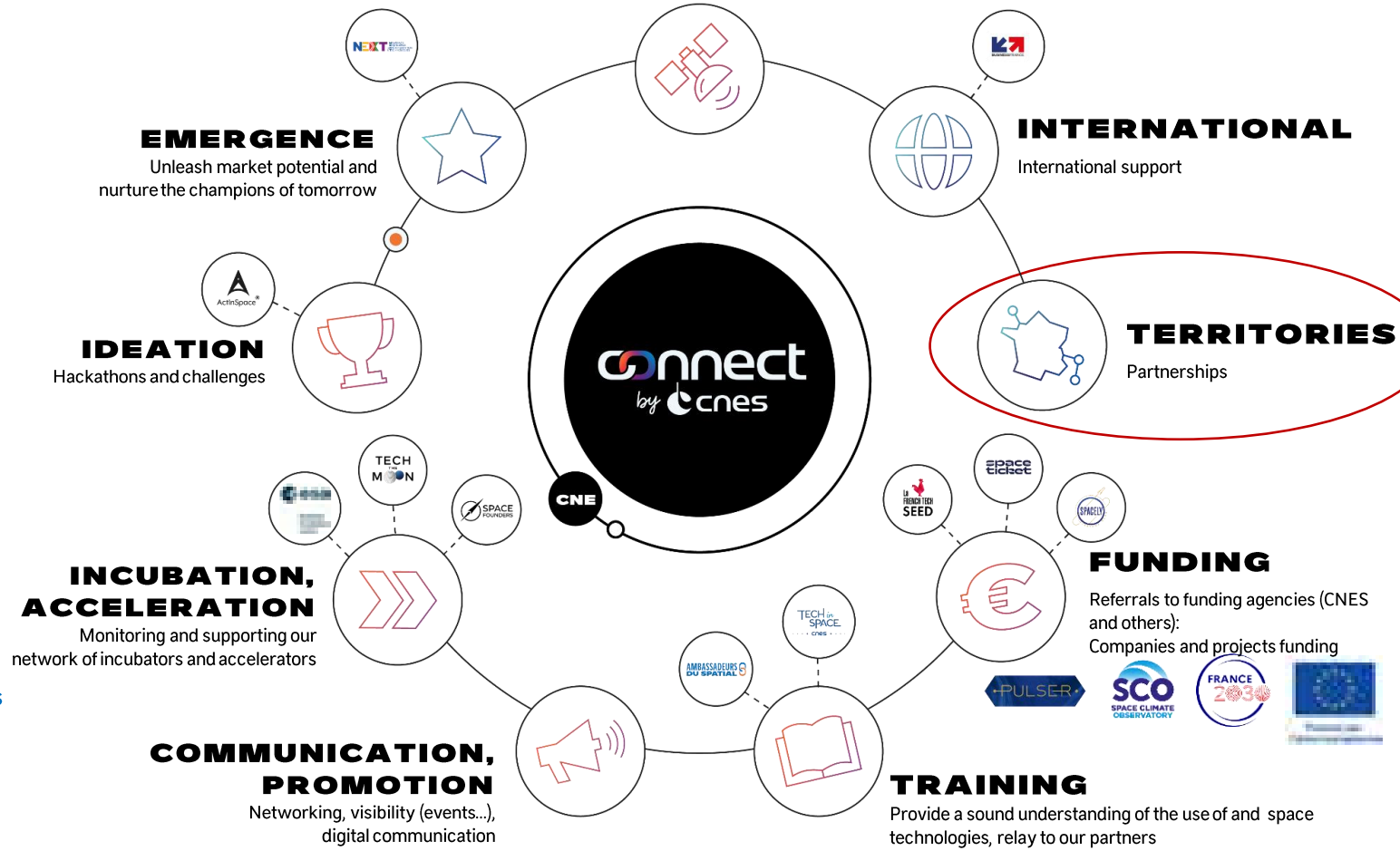
Space logistics

Constellations

In orbit services

## EXPERTISE, TECHNICAL RESOURCES,

Meet our experts for personalized support, get in touch with our laboratories, their technical resources and space data, our industrial patents



# FOR PRIORITY SECTORS

Télécom.

Mobility

Health

Insurances

Forests

Agriculture

Energy

Territories management

Maritime



02

**APPLICATIONS  
IN ALL  
SOCIO-ECONOMIC FIELDS**





SOC

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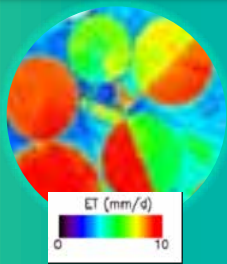
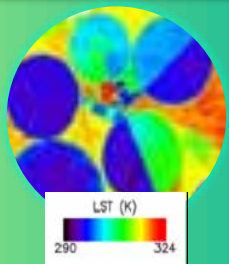


# 03

## **SPACE MISSIONS**



Ground surface temperature  
and daily evapotranspiration



Launch scheduled in 2026-27

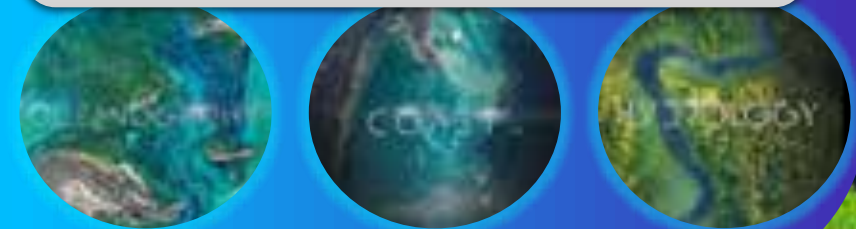
## Bilateral programs devoted to water

Land, Coastal, Ocean  
Water

Satellite precursors  
LSTM, S3-NG TOPO  
Downstream Programs



First global survey of  
Earth's surface waters



Launched Dec 16, 2022





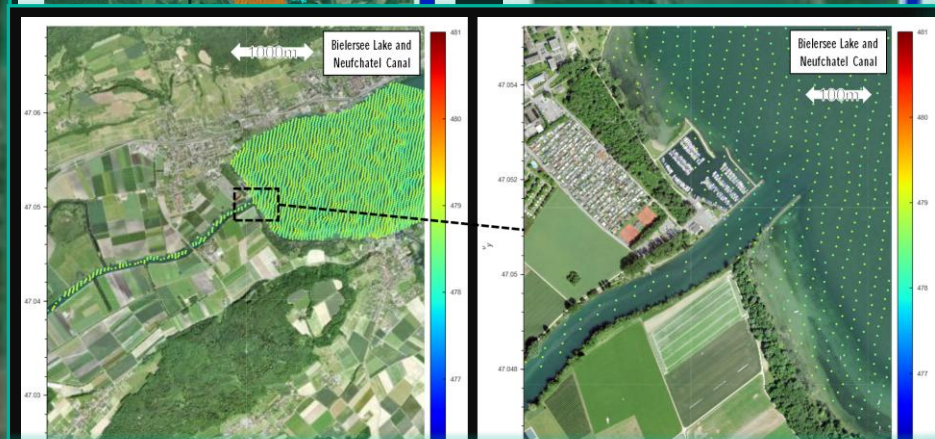
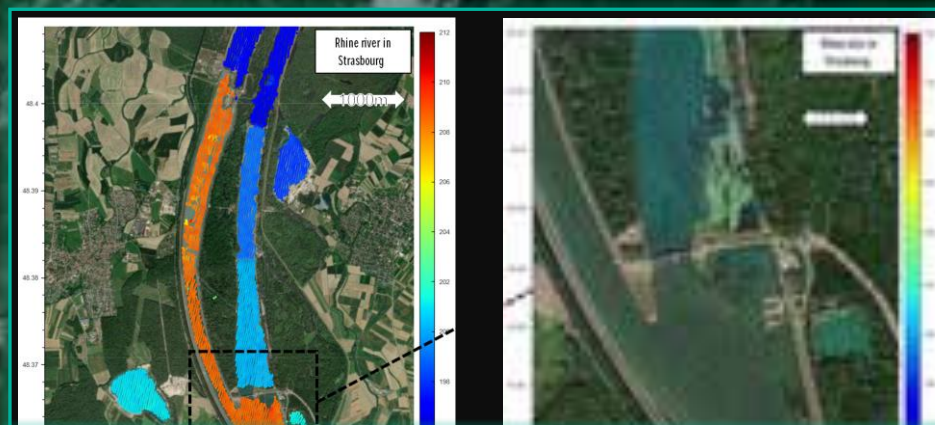
- **SWOT** works extremely well on large lakes & rivers
  - 100 m rivers & (250 m)<sup>2</sup> lakes
  - Mission requirements
  - Global inventory of surface water (21-day cycle)



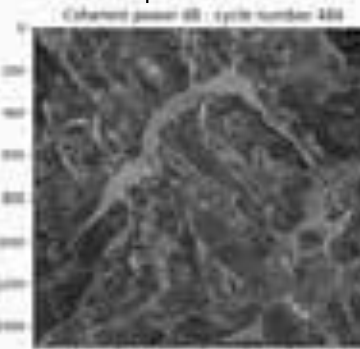
- **SWOT** outperforms its optional goals
  - 50 m rivers & (100 m)<sup>2</sup> lakes
  - Better monitoring of water cycle
  - 6 million lakes are monitored



- **SWOT** delivers on frozen lakes & rivers
  - Ice is bright enough for heights
  - Frozen/Liquid state from  $\sigma_0$
  - 1-day phase captured thaws



SWOT captures the lake thaw (left)



Confirmed with local webcam (right)



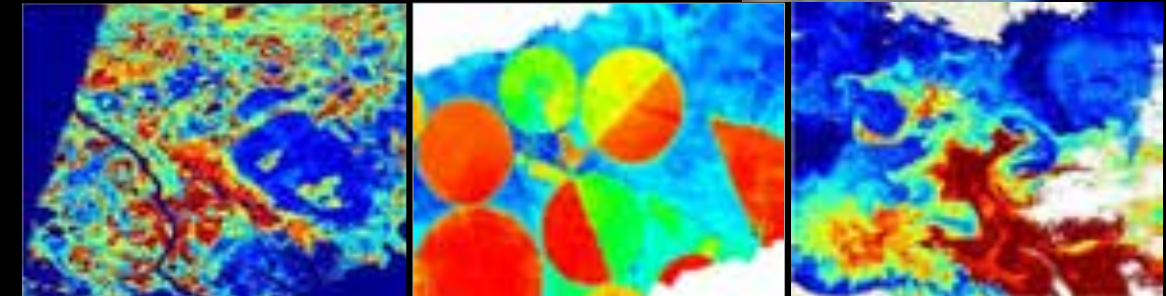
# MEASURE THE SURFACE TEMPERATURE

The Franco-Indian TRISHNA mission and its frequent high-resolution measurements address major scientific, economic, and societal challenges through the five main themes which the mission addresses from research perspective and application development. These five main themes are:

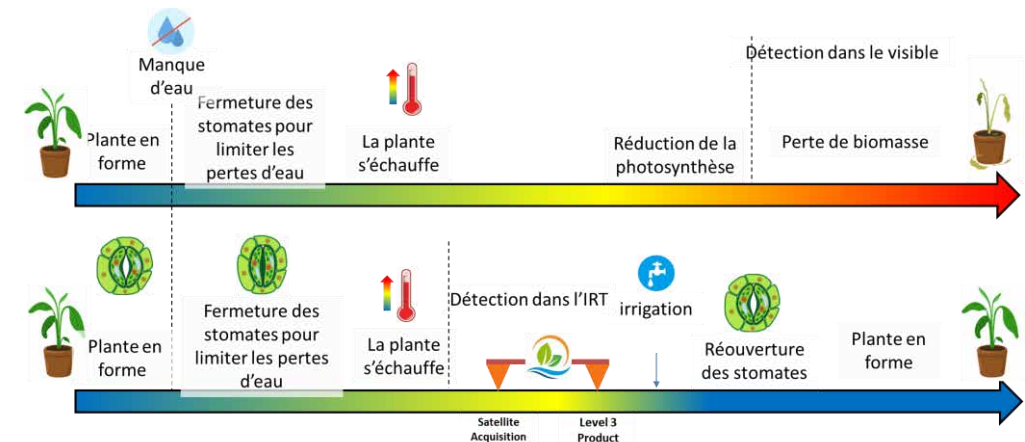
- ECOSYSTEM MANAGEMENT AND WATER STRESS DETECTION (ADJUSTING IRRIGATION NEEDS AS BEST AND AS EARLY AS POSSIBLE)
- MONITORING OF COASTAL AND INLANDS WATERS
- URBANIZATION AND URBAN HEAT ISLANDS
- ATMOSPHERE (AEROSOLS, WATER VAPOR, CLOUDS)
- CRYOSPHERE (SNOWMELT RUNOFF)

## Mission characteristics:

- Lifetime 5 years
- Global land and coastal coverage
- 3-day revisit, 60 m resolution
- Equator crossing: 12:30 PM & AM
- Variable viewing angles up to 38 degrees
- VNIR-SWIR (7 bands) – TIR (4 bands)
- NeDT 0.2K instrument output, 0.5°K at 1C level
- Linked with ESA mission: LSTM to be launch in 2029 – A and 2030 – B
- Free and open data:
  - Level 2: surface reflectance, **surface temperature**, emissivity, plant-related variables, evapotranspiration flux
  - Level 3: **'Daily evapotranspiration product by interpolation'**



## Focus on the contributions of TRISHNA in agriculture



(Philippe Gamet, CESBIO/CNES)

# TROPICAL FOREST

Beyond Carbon : Changes in forest affect the benefits we gain from forests.

Changes in forest have major effects on the socio-economics, material, energy, protective, biodiversity & cultural benefits offered by forests.

Through the BIOMASS mission, ESA and CNES will have a better understanding of tropical forest structure:

- Thanks to its P-BAND radar instrument, and by measuring forest biomass (AGB) and height, BIOMASS will be able to produce a **precise status of tropical forest throughout the world** (on covered area), and to quantify the role of tropical forests in carbon sequestration.
- Moreover, the P-BAND radar capability will enable **to map the area under the trees**, to give precious insight about topographic elements and water flux under the canopy.

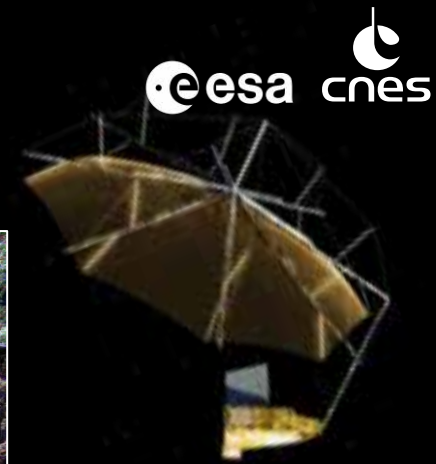
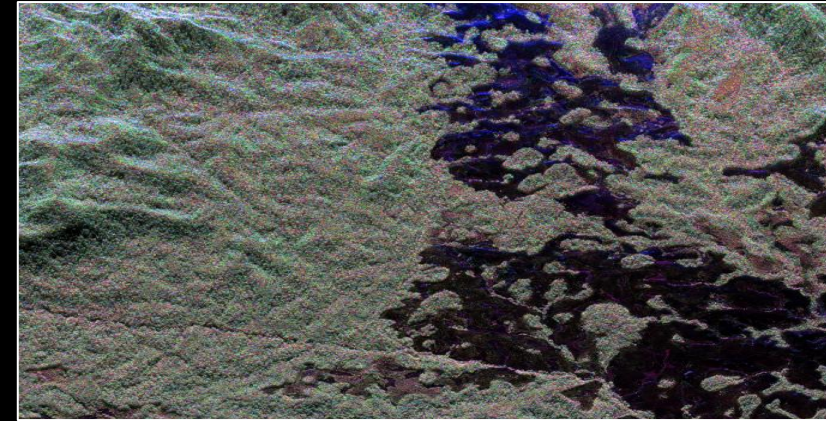
Partial coverage of the globe:

- **Red : priority**
- **Yellow : best effort**



7<sup>th</sup> Mission of ESA's Earth Explorer programme

- Launch on April 29, 2025 from Kourou on VEGA-C



## BIOMASS Products



200 m resolution  
(10 t/h for low biomass)



200 m resolution



50 m resolution



# 04

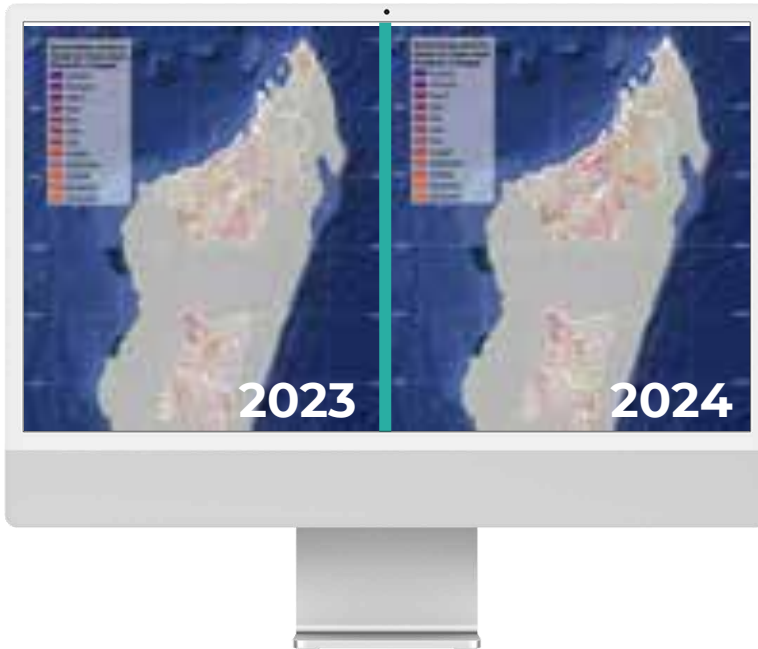
## APPLICATIONS



# USING SENTINEL 2, EXAMPLE :

This project GDA Madagascar project combined three complementary EO services:

## Fire Detection



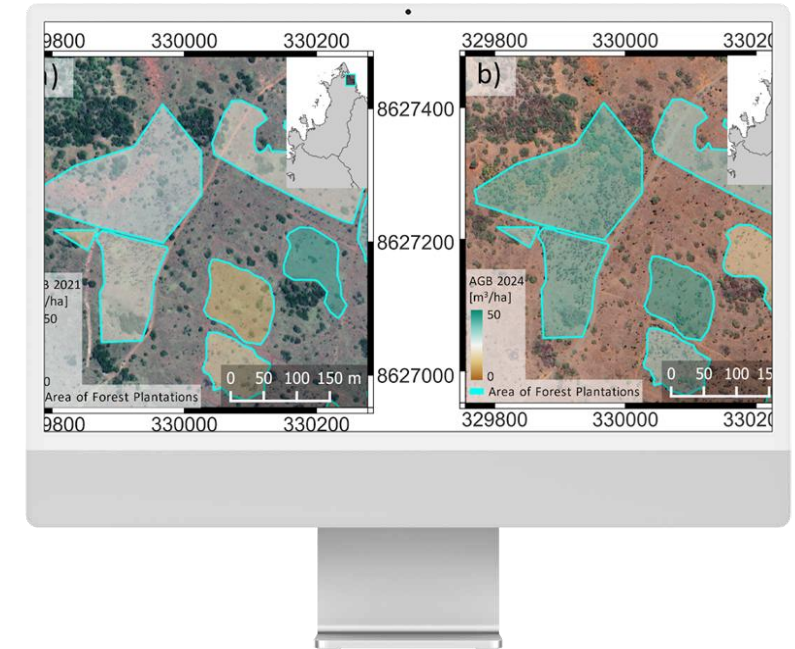
- Using Sentinel-2 imagery and the Normalized Burn Ratio (NBR) index, analysts mapped over 25,000 km<sup>2</sup> of burnt areas in 2023 and 30,000 km<sup>2</sup> in 2024.
- Temporal trends revealed seasonal peaks between May and November, aligning with Madagascar's dry season.

## Reforestation Monitoring



- Using NDVI time-series from Sentinel-2, the team monitored the growth and health of 587 reforested plots across the country.
- This approach quantified tree survival, growth rates, and disturbance events, enabling regional comparisons and adaptive management.

## Biomass Estimation



- Advanced modeling combined very-high-resolution imagery (WorldView, PlanetScope) with GEDI LiDAR to estimate aboveground biomass per hectare.
- This data supports carbon accounting and identifies regions where reforestation efforts are thriving or need reinforcement.

# OTHER APPLICATIONS



With France2030 investment plan, demonstration of hydrologic services for public water policies, 4 work packages:

- Surfaces and volumes of water bodies
- Surface water quality
- Irrigated plots and vegetation cover
- Single portal for visualization, exploitation and analysis



<https://hydroscopia.fr/>



A project to support decentralized state services in managing drought orders



ISCO is an international initiative to enhance the use of satellite data for climate action:

- IRRISAT-MOROCCO – irrigation water optimization support system using satellite data
- OpHySE – Operational Hydrology from Space and models in French Guiana
- TropiSCO – Map of deforested areas in near real-time
- SCoup – Annual maps of temperate forest dieback



- Proposal for a topographic and water flow model under the canopy by combining BioMass, SWOT and other space missions with calibrated airborne lidar measurements



# THANKS!