MISSIONE 4
ISTRUZIONE
RICERCA

Development of ECCSEL-R.I. Italian facilities: user access, services and long-term sustainability

Report on *Multifunction system of UAVs for coastal monitoring*

(related to: IO1.1.6 - *Multifunction system of UAVs for coastal monitoring*)

Document Information Summary

Date	08/04/2025
Document title	Multifunction system of UAVs for coastal monitoring
Version	2
Responsible Partner	OGS
Main Author(s), Organization	Alessandro Pavan
Work package / Activity	WP1
Involved O.U.	O.U.1
Reviewer(s)	Cinzia De Vittor
Approved by	Valentina Volpi

Keywords ECCSELLENT, CCUS, Drones, Remote Sensing

Target audiences		
Deliverable nature	O Report	O Other (specify)
Dissemination level	O Public	☒ Restricted to participants

Revision history

Version	Date	Description
1.0	April 2025	First draft
2.0	08 April 2025	Final report

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TABLE OF CONTENTS

Finanziato dall'Unione europea NextGenerationEU
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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

PNRR "ECCSELLENT" - Missione 4, “Istruzione e Ricerca” - Componente 2, “Dalla ricerca all’impresa”
Linea di investimento 3.1, “Fondo per la realizzazione di un sistema integrato di infrastrutture di ricerca e innovazione”
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SUMMARY

In this document we report on the progress of Activity 1.1 "Enhancement of ECCSEL Panarea NatLab-Italy with geophysical technologies - OGS NATLAB" of ECCSELLENT WP1 in relation to the achievement of the intermediate objective "IO 1.1.6 Finalization of remote sensing facility".

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PNRR "ECCSELLENT" - Missione 4, "Istruzione e Ricerca" - Componente 2, "Dalla ricerca all'impresa"
Linea di investimento 3.1, "Fondo per la realizzazione di un sistema integrato di infrastrutture di ricerca e innovazione"
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1 INTRODUCTION

The main task of the ECCSELLENT project is to upgrade most of the Italian facilities that are part of ECCSEL ERIC and to expand the Italian node in order to promote the development and internationalisation of our country's research in the entire CCUS chain (carbon capture, utilisation, transport and storage). The planned actions are in line with the objectives of the PNRR and PNIR, which prioritise the consolidation and expansion of existing research infrastructures and new ones created in the European context, in order to provide the national research system with the appropriate tools to advance the frontiers of knowledge and address more effectively and efficiently the major challenges identified at Community level.

The activity 1.1, in charge of the operation unit “O.U.3”, aims to upgrade the NatLab Italy Panarea with geophysical methodology that would of primary importance in case of potential leakage from a CO2 storage site. Panarea natural lab offers a unique natural gas leakage situation that can be exploited to investigate this process. Any gas loss would lead to the formation of characteristic surface morphologies on the seabed that the synergistic use of different survey methods can easily identify. Therefore, we propose the implementation of the Eccsel NatLab-Italy laboratory in Panarea with the the purchase of geophysical equipment, including in particular:

- Quadcopter Drone with laser sensor
- VTOL drone with hi-res camera and multispectral camera
- Mini drone with thermal camera
- GPS receiver

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

PNRR "ECCSELLENT" - Missione 4, “Istruzione e Ricerca” - Componente 2, “Dalla ricerca all’impresa”
Linea di investimento 3.1, “Fondo per la realizzazione di un sistema integrato di infrastrutture di ricerca e innovazione”
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2 CHARACTERISTICS OF THE PROPOSED INSTRUMENTATION

The proposed instrumentation consists of a DJI Matrice 350 drone, equipped with Riegl MiniVUX laser scan system, a VTOL drone with a hyperspectral camera and a high resolution photo/video camera and a GPS ground station.

Figure 1 - left to right: DJI Matrice 350 with Riegl MiniVUX-3UAV, DJI Mavic 3T, Quanmtum Trinity F90+ and e-Survey - E300 Pro

The most important features of this equipment are listed below.

Quadricopter drone: DJI Matrice 350 RTK

- Minimum battery life of 40 minutes.
- Positioning accuracy with RTK: 1 cm.
- Obstacle detection system.
- Intelligent and self-heating lithium polymer batteries.
- Possibility of double remote control with full control.
- Suitcase with wheels, for storage and transport.

Laser sensor: Riegl MiniVUX-3UAV

- Lightweight airborne laser scanner.
- Designed for integration with UAS/UAV/RPAS.
- Up to 300 kHz pulse repetition rate
- Up to 100,000 measurements per second
- 360° Fied of View
- Simple integration with DJI Matrice 350.

VTOL drone: Quantum Trinity F90+

- Max Take-Off Weight 11 lbs
- Max Flight Time 90+ Minutes
- Max Flight Altitude 9,842 Feet (3,000 m)

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PNRR "ECCSELLENT" - Missione 4, "Istruzione e Ricerca" - Componente 2, "Dalla ricerca all'impresa"
Linea di investimento 3.1, "Fondo per la realizzazione di un sistema integrato di infrastrutture di ricerca e innovazione"
Finanziato dall'Unione europea NextGenerationEU. CUP: F53C22000560006

- Command and Control Range 5 - 7.5 km
- Payload Max 700 grams
- Wind Tolerance (In Cruise) 12 m/s

Multispectral camera: Micasense Altum-PT

- Weight: 577 g
- Dimensions: 11.0 x 8.0 x 6.9 cm
- Sensor Resolution: 2064 x 1544 (3.2MP per MS band), 4112 x 3008 (12MP per PAN band), 320 × 256 thermal infrared
- Spectral Bands: Blue (475nm ±32nm), Green (560nm ±27nm), Red (668nm ±14nm), Red Edge (717nm ±12nm), NIR (842nm ±57nm)
- RGB Color Output: 12.4 MP (global shutter, aligned with all bands)
- Capture Rate: Up to 2 capture per second raw DNG - Capture rates vary based on write speed of USB storage device and user configuration settings
- 3 configurable GPIO: select from trigger input, PPS input, PPS output, and top of frame signals. Host virtual button. USB 2.0 port for WiFi. Serial. 10/100/1000 Ethernet. CFexpress for storage
- Field of View: 50° HFOV x 38° VFOV (multispectral), 46° HFOV x 35° VFOV (panchromatic), 48° x 39° (thermal)

Hi Res Photo Video: Sony RX1RII

- Max resolution 7952 x 5304
- Effective pixels 42 megapixels
- Sensor size Full frame (35.9 x 24 mm)
- Focal length (equiv.) 35 mm
- Max aperture F2
- Max shutter speed 1/4000 sec
- Format MPEG-4, AVCHD, XAVC S, H.264
- Storage types SD/SDHC/SDXC, Memory Stick Pro Duo
- USB USB 2.0 (480 Mbit/sec)
- Weight (inc. batteries) 507 g (1.12 lb / 17.88 oz)
- Dimensions 113 x 65 x 72 mm (4.45 x 2.56 x 2.83″)

GNSS e-Survey - E300 Pro

- Tracking: Supports GPS, BDS, GLONASS, GALILEO, QZSS, SBAS, L-Band, and IRNSS
- Accuracy: Static: H: 2.5 mm + 0.1 ppm RMS, V: 3.5 mm + 0.4 ppm RMS
- RTK: H: 5 mm + 0.5 ppm RMS, V: 10 mm + 0.5 ppm RMS

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PNRR "ECCSELLENT" - Missione 4, “Istruzione e Ricerca” - Componente 2, “Dalla ricerca all’impresa”
Linea di investimento 3.1, “Fondo per la realizzazione di un sistema integrato di infrastrutture di ricerca e innovazione”
Finanziato dall'Unione europea NextGenerationEU. CUP: F53C22000560006

- Positioning: Standard: H: 1.5 m RMS, V: 2.5 m RMS
- Battery: Rechargeable, built-in Lithium-ion battery, 7.2 V - 6800 mAh
- Operating temperature -30°C to +65°C
- Storage temperature -40°C to +80°C
- Resistance: IP67, shock resistant, vibration resistant
- Weight: 940 g

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3 EQUIPMENT PURCHASE PROCEDURE

The achievement of objective 1.1.6, which is related to the implementation of the remote sensing facility, was expected within the BM14 (January – February 2025) of the. Below are listed the main dates that marked the process of purchasing and acquiring the equipment.

In May 2023, the drafting of the technical specifications of the tender was completed and subsequently sent to the contracts office for approval. The contracts office requested clarifications and changes to the technical document, which has been promptly sent with the appropriate corrections.

In November 2023, the tender was published and the company Microgeo s.r.l. has been selected as winner. The contract was signed in March 2024.

In May 2024, the equipment was delivered and all functionality tests were carried out.

For this reason, IO 1.1.6 can be considered achieved within the initially established timeframe.

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

PNRR "ECCSELLENT" - Missione 4, “Istruzione e Ricerca” - Componente 2, “Dalla ricerca all’impresa”
Linea di investimento 3.1, “Fondo per la realizzazione di un sistema integrato di infrastrutture di ricerca e innovazione”
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4 IO 1.1.6 MULTIFUNCTION SYSTEM OF UAVS FOR COASTAL MONITORI

The objective is considered fulfilled after the accomplishment of the following targets:

- Call for tender and purchase for the following instrumentations: Laser UAV, multispectral sensors, hi-res Camera, CO2 sensor
- Mounting, testing, training for the above listed instrumentation

Figure 2 - The photos show the various phases of field testing of the purchased equipment.

In May 2024, all functionality tests were carried out in the presence of OGS staff and two representatives from the supplying company. All drones and their respective sensors were tested, and several flights were conducted to acquire test data. Subsequently, during the training course held at the OGS headquarters in Borgo Grotta Gigante, the data were processed to verify the correctness of the acquisition procedure. A GPS survey was also completed to test the GNSS station.

Consequently, IO1.1.6 can be considered completely fulfilled.

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

PNRR "ECCSELLENT" - Missione 4, “Istruzione e Ricerca” - Componente 2, “Dalla ricerca all’impresa”
Linea di investimento 3.1, “Fondo per la realizzazione di un sistema integrato di infrastrutture di ricerca e innovazione”
Finanziato dall'Unione europea NextGenerationEU. CUP: F53C22000560006