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

Report on Finalization of remote sensing facility

(related to: IO1.4.1 - Finalization of remote sensing facility)

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TABLE OF CONTENTS

SUMMARY

In this document we report on the progress of Activity 1.4 "Enhancement of ECCSEL Aircraft facility" of ECCSELLENT WP1 in relation to the achievement of the intermediate objective "IO 1.4.1 Finalization of remote sensing facility".

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 1.4.1 in charge of the operation unit "O.U.1" aims to enhance the remote sensing facility, which will be implemented to strengthen its remote sensing data acquisition capabilities. The proposed improvement consists in the purchase of remote sensing systems from drones, which use different types of sensors: laser scan sensor, high resolution photo/video cameras, thermal sensors and a hyperspectral camera. This new instrumentation will allow to model very precisely the coast, from a topographic point of view, thanks to laser scanning and high resolution photographs. On the other hand, through hyperspectral and thermal sensors, it will be possible to study the effects that CO_2 losses can have on vegetation, as well as monitor the leakage points on the seabed, which have repercussions on the surface.

2 CHARACTERISTICS OF THE PROPOSED INSTRUMENTATION

The proposed instrumentation consists of a DJI Matrice 300 drone, equipped with a laser scan system, a hyperspectral camera and a high resolution photo/video camera.

Figure 1 - Drone DJI Matrice 350, with (from left to right):
laser DJI L2, Hyperspectral camera Cubert Ultris x20 plus and Foto/Video DJI P1.

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: DJI L2

- Laser safety classification: Class 1 (Eyesafe).
- Maximum measurement range (natural targets): the scanner must measure objects with 10% reflectance up to 190 meters and with 80% reflectance up to 450 m.
- Speed in points: minimum speed 200,000 points/s (single return) – 400,000 points/s (multiple return).
- Accuracy: no more than 3 cm.
- Inertial unit with minimum frequency 200 Hz.
- Camera with minimum resolution of 20 mpxl, interfaced with the laser system, for coloring the points.

Hyperspectral sensor: Cubert Ultris X20 plus

- Spectral range: 350-1000 nm.
- Minimum number of spectral bands: 160.
- Minimum resolution 1500 x 1500 pxl.
- Weight less than 700 grams.

4k photo/video sensor: DJI P1

- Full frame sensor.
- 50mm lens.
- Minimum photo resolution 40 mpxl.
- 4k video resolution.
- Interchangeable lenses.

3 EQUIPMENT PURCHASE PROCEDURE

The achievement of objective 1.4.1, which is related to the implementation of the remote sensing facility, was expected within the BM6 (September – October 2023) of the project at a cost of 114.754,10 €. 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 finally published and the company Microgeo s.r.l. has been selected as winner.

The contract was signed in March 2024 with Atto n. 11 ADW dated 17/01/2024.

As can be seen from the previous chronology, the original timetable was not fully respected and IO 1.4.1 has not achieved in BM6. This was mainly due to delays in the management of tender processes and the accumulation of all purchases by the administrative offices. However, other activities have been completed earlier the timing scheduled in the proposal, i.e. activity 1.4.2 and 1.1.6.

4 IO 1.4.1 FINALIZATION OF REMOTE SENSING FACILITY

The objective is considered fulfilled after the finalization of purchase, acquisition, and test of the above mentioned instrumentations, which has been delivered from 6 to 10 May 2024. During these days, OGS personnel were also able to follow the training course, held by the Microgeo company, during which they tested the purchased instrumentation and learned how to correctly use it.

The training course focused on the installation of sensors on board the drone, utilization of flight planning software, data collection phase and finally the processing of data on the PC.

Figure 2 - Phases of the training course: flight planning, GCP positioning, data acquisition

For flight planning, the UGCS software was used, which enables the flight routes to be determined precisely, considering the underlying DEM. Several flights were performed in all available configurations with the different sensors.

The laser data was processed using the system's own software, DJI Terra, while the hi-res images were mosaicked using the Agisoft Metashape software. Finally, it was taught how to import hyperspectral images into ENVI and how to make the necessary corrections.

Consequently, IO1.4.1 can be considered completely fulfilled.