

Aerial surveillance and airborne remote sensing techniques in Guardia di Finanza: an operational experience

Guardia di Finanza and CRdC BENECON, police officers and university researchers to protect and safeguard social fairness and legality

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Abstract— On the basis of the Co-operation Agreement between Italy and Albania, which was signed in Tirana on 19th July 2007, a Guardia di Finanza and University researchers task force was carried out to locate and monitor cannabis plantations in the Albanian territory. This was due to the interest of both countries to reinforce their bilateral co-operation against organized crime and mainly to contrast drug trafficking. In addition, according to an operative Protocol, which was signed in Tirana on 16th May 2012, between the Italian Department of Public Safety within the Ministry of Internal Affairs – International Police Service Co-operation (Servizio Cooperazione Internazionale di Polizia) and the Albanian Police Headquarters, a new kind of aerial surveillance was introduced with the aid of military aircrafts in order to locate areas intended for the cultivation of cannabis in Albania. Guardia di Finanza air surveillance, enhanced with airborne remote sensing capability, was aimed at locating hidden areas through a scientific characterization of natural and anthropized environment with visible, thermal and hyperspectral analysis.

Keywords—Guardia di Finanza; airborne remote sensing; economic finance police; aerial surveillance;

I. INTRODUCTION

Following the outstanding air surveillance campaign in 2012 conducted by Guardia di Finanza Air-naval Operative Command (Fig. 1), 255 plantations of cannabis were discovered in the albanian territory [1]. Therefore, Central Department of Criminal Police (Direzione Centrale della Polizia Criminale del Ministero dell'Interno) and International Service Police Co-operation decided to refinance the mission assigned to Guardia di Finanza for 2013.

II. CO-OPERATION AGREEMENT BETWEEN ITALIAN GOVERNMENT AND ALBANIAN MINISTRY COUNCIL AGAINST TRANSNATIONAL ORGANIZED CRIME: AN INTERNATIONAL CALL FOR GUARDIA DI FINANZA

The above resulted in additional financial resources: this strengthened the already tested operational synergy regarding



Fig. 1. Some of the vessels and aircraft available to the Guardia di Finanza Air-Naval Operational Command

the specific mission. This task force involves air crew and aircrafts from Guardia di Finanza Air Maritime Exploration Squadron (Gruppo Esplorazione Aeromarittima – Fig. 2) and researchers from Benecon Research Centre [2], in accordance with the institutional co-operation treaty signed on 21st March 2011 between this research body and Guardia di Finanza renewed on 24th February 2014. Thanks to a well accomplished risk analysis and useful experience gathered from the previous mission in 2012, Gruppo Esplorazione Marittima was able to carry out all the necessary measures in order to ensure the safety of air operations by performing aerial surveys and acquisitions from a safe flying altitude [3]. Both civil and military personnel were protected by diplomatic guarantees according to art. 8 of the Co-operation Agreement between Italy and Albania against organized crime, which was signed in Tirana on 19th July 2012. Alike the previous mission, optical and hyperspectral sensors could be used. Civil and military consultants were also allowed to be taken on board for specific technical and scientific purposes. Therein, for this specific mission, the configuration of Piaggio P166 DP1 aircraft with ITRES CASI 1500 and ITRES TABI 320 used in 2012 originally approved by Armaereo - n. AER.1C-U-166C-113 following a technical modification proposed by



Fig. 2. From the bottom left to the up right: Piaggio P180, Piaggio P166 DP1 and ATR 42MP are the aircrafts available to the Guardia di Finanza Gruppo Esplorazione Aeromarittima based in Pratica di Mare (Rome). They are used every day for maritime patrolling in national and open waters, search and rescue missions, tactical transportation, special operations and airborne remote sensing exploration



Fig. 3. Guardia di Finanza Piaggio DP1 flying in Remote Sensing Configuration

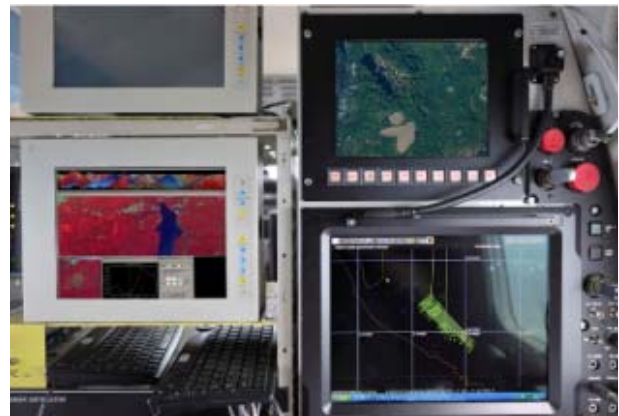


Fig. 4. Internal Guardia di Finanza Piaggio DP1 Remote Sensing Configuration devices

Gruppo Esplorazione Aeromarittima (PMR - Proposta di Modifica di Reparto) n. P166DP1-001-2010 Rev. 2 (Fig. 3 and 4) issued in 24th January 2012 has been implemented by Maintenance Supervisor Officer with a new technical prescription. This was done by introducing a high resolution digital camera inside the bottom hatch door where TABI 320 had been previously placed. In detail, the high resolution of the Phase One iXA 180 digital camera gives a perfect vision of the hyperspectral images taken by the CASI 1500 sensor. The operative-scientific partnership between Guardia di Finanza and the Benecon Research Centre allows to create high resolution thematic geo-referenced cartography, very useful also in the search for cannabis plantations that allowed to give to Albanian Special Forces the exact coordinates in order to eradicate illicit plantations hidden in the vast and often inaccessible Albanian territory (Fig. 5).

III. FOCUS ON GUARDIA DI FINANZA SCIENTIFIC AND TECHNOLOGICAL PARTNER: BENECON RESEARCH CENTRE

A. Agreements between Guardia di Finanza and Benecon Research Centre: from 21st March 2011 to 24th February 2014

Benecon Research Centre is among the ten Specialized Centres promoted by Campania Region: this public capital consortium, includes Federico II University, Sannio University, Salerno University and above all the Second University of Naples. Benecon Research Centre, in order to fulfil its scientific and research projects, was able to gather sophisticated equipments for monitoring, analysis and environmental study, both from ground and air [4]. Guardia di Finanza contracted an Agreement with on 21st March 2011 in order to take on board its aerial means the sensors. This allowed Guardia di Finanza to take advantage of the scientific knowledge of the researchers from Naples universities. It must be said that Gruppo Esplorazione Aeromattima had already been performing sensor aerial surveys with the aid of its own technological means, Daedalus AAA3500. Following the renewed and reinforced co-operation between Guardia di



Fig. 5. Albanian Delta Forces during a cannabis plantation eradication

Finanza and Benecon Research Centre on 24th February 2014, a new Agreement was stipulated in its headquarters. The operative Protocol, in its updated version also, allows Guardia di Finanza and Benecon Research Centre to melt their technologies and professional assets. In particular, Grifo 10 P166 DP1 aircraft was implemented with the installation of ITRES CASI 1500 sensors on board together with Phase One iXA180 digital camera owned by Guardia di Finanza.

B. Geo-intelligence capabilities for an effective economic-financial police

Those technological, professional and scientific synergies, will help in the short run to outline an experimental definition of a technical-operational Protocol on multi-dimensional territory knowledge as an essential instrument for a deeper economic-financial investigation and its relation to the socio-urban fabric in order to achieve fiscal equity and social justice. In other terms, an extension of aerial surveillance and investigation Guardia di Finanza capabilities, achieved with the aid of specialized personnel and innovative airborne sensors, creates an operational means to enhance the monitoring in all different international scenarios. All this through the connection between the economic-financial police purpose and the daily fight against offences to our environment and our society. This kind of aerial survey, on the basis of the operative Protocol, allowed the use of the above mentioned technology in order to explore Albania via air: in details, that mission has been and is focused to locate plantations of cannabis sativa that organized crime picks up, transports and distributes directly in European market poisoning our youth and society as a whole.

IV. FROM FLIGHT PLANNING TO A MASSIVE IDENTIFICATION OF ILLICIT PLANTATIONS

The second mission in Albania, which was ordered by Air-Naval Operational Command, took place on 3rd June and lasted until August 7th 2013. A *on task* lab was set up for all flying, pre and post processing activities in order to elaborate and evaluate huge amount of mission data. At the top of a building in Tirana, in the absence of a Permanent Station, a GPS antenna was placed as a materialization of an '*ad hoc*' Station (Fig. 6). This was aimed at allowing a thorough geo-referencing of the data in the absence of a geodetic network in Albania. Part of the personnel from Gruppo Esplorazione Marittima and two researchers from Benecon Research Centre performed flying activities and data processing. In the last week of the mission an expert from MARSEC – Mediterranean Agency for Remote Sensing and Environmental Control – who was sent by the University, collaborated on complementing all data from the aerial platform used by the team with satellite images by EROS B, managed by the Agency. This additional co-operation and a



Fig. 6. GPS antenna, materialization of an '*ad hoc*' Station.

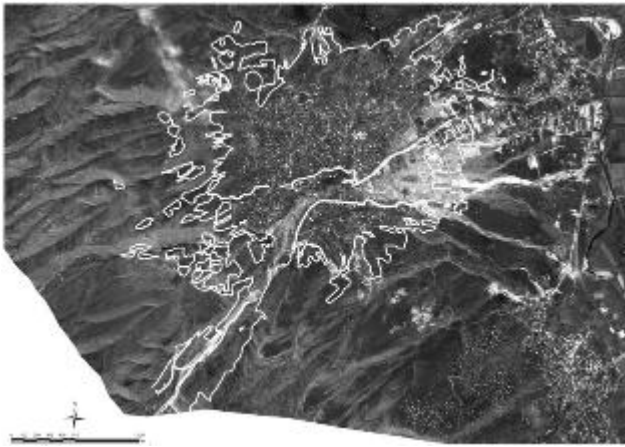


Fig. 7. Lazarat from EROS B digital satellite image

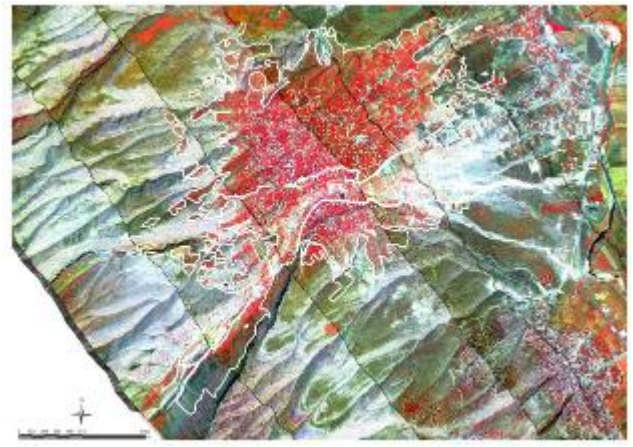


Fig. 8. Lazarat in mosaicking strips acquired by CASI 1500

more refined method of data post-processing is leading the way to the definition of an algorithm of the identification of the spectrometric response of *cannabis sativa* [5]. This will allow to abandon the image photo-reading and photo-interpretation method in favor of a semi-automatic system that could outline the presence based on their spectral characteristics. Air surveillance carried out during the mission headed towards those areas which are more characterized by illegal cultivations of cannabis, such as the Prefecture of Shkoder (Scutari), Gjirokaster (Argirocastro) and Vlore (Valona). It was decided to use, from an high altitude, optical and hyperspectral sensors for data collection, as well as implementing geo-referenced thematic maps of the area with the aid of GIS systems (Geographic Information System) [6] [7]. Previous aerial patrolling operations over Albanian territory made by helicopters have caused accidents: in the early nineties some shots of Kalashnikov were fired against an Italian helicopter from the ground. These shots didn't have any unpleasant outcomes for flying crew.

A. Law enforcement, International Co-operations and scientific research: a perfect trinomial

As said before on Lazarat (a little town in Argirocastro

district) in particular, the acquisition of data from airborne platform was implemented with digital satellite images from EROS B satellite[8] (Fig. 7), managed by MARSEC. The implementation of these images with the ones gathered by Guardia di Finanza aircraft at a 5 centimetres pixel resolution, allowed to photograph the city of Lazarat like never before. It is important to highlight that the introduction of the Phase One iXA 180 digital camera in the configuration of the Piaggio DP1 Airbone Remote Sensing allows to compare, near realtime, the CASI hyperspectral images with the HI-RES images in the field of the visible (Fig. 8). In addition, the integration and contextual acquisition with both sensors enabled the actors to geo-reference the digital images by giving an exact GPS position of each observed plantation (Fig. 9). During the 25 flight missions (Fig. 10) undertaken by P166 DP1 aircraft – Grifo 10, that was equipped with CASI 1500 sensors and, since 12th July, with the high definition nadir Camera Phase One iXA 180, an area of 3.618 Km² was monitored, almost 12,5% of Albanian territory. 675 Gigabyte of hyperspectral data and 680 Gigabyte of high resolution images were acquired. Post processing of these data allowed to locate 304 plantations of cannabis, that extended up to 4,5 hectares and were able to make 32 tons of narcotics ready to be introduced in the European market. It must be added the

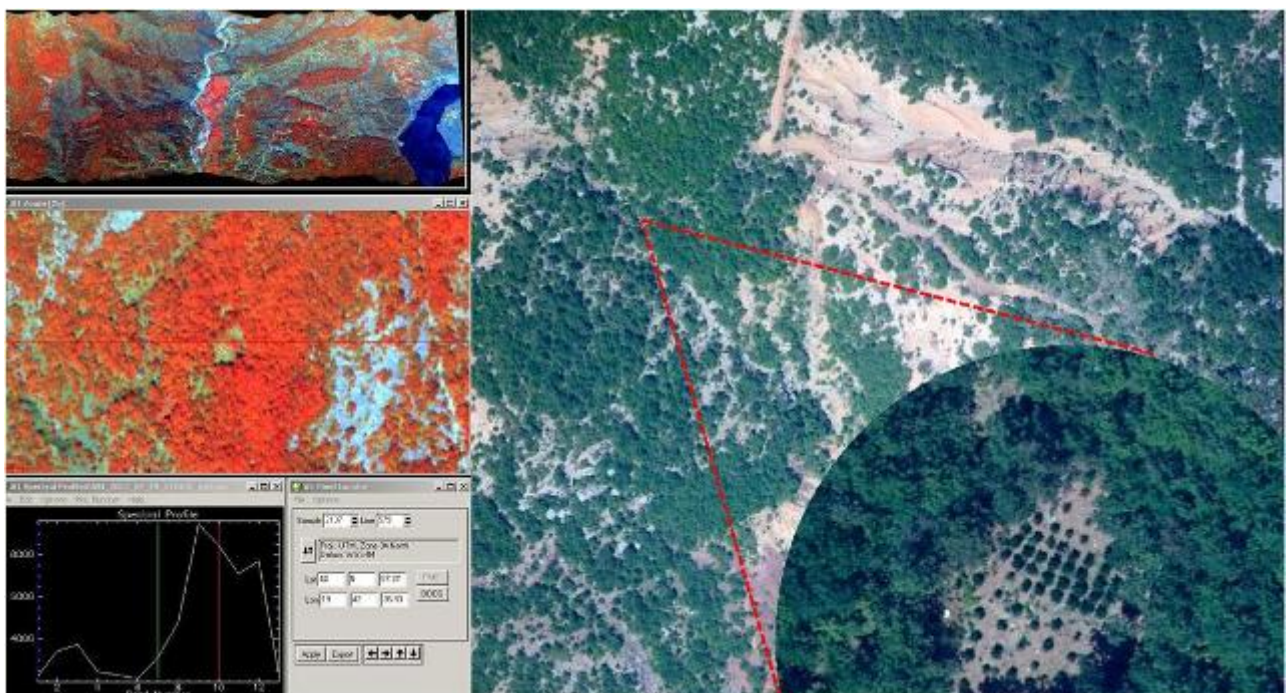


Fig. 9. A runline CASI 1500 evaluated with a Phase One Hi-Res image

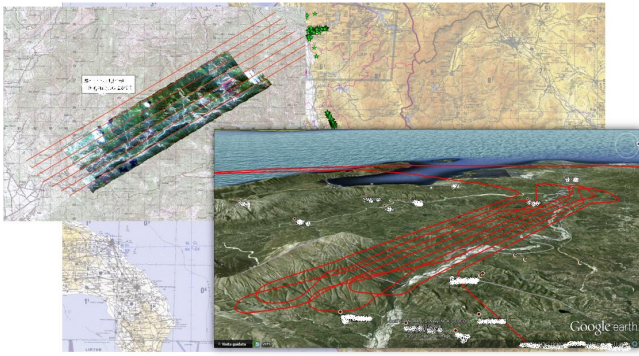


Fig. 10. Some images of an acquisition flightpath

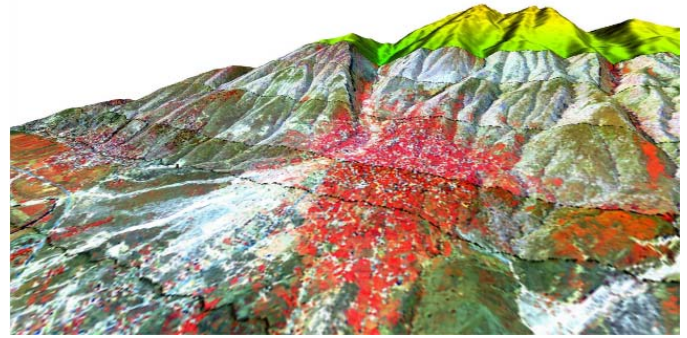


Fig. 11. Every pixel of a georeferenced enhanced data base would be strictly related to geographic coordinates: that pixels would represent a multiple layer matrix with undefined dimensions and diachronic entries of social, environmental, medical or fiscal information useful to be associated together.

city of Lazarat also, prefecture of Argirocastro, that looks like a huge plantation of cannabis from up above. This covers an area of 319 hectares and alone is able to produce 900 tons of narcotics. The remote-sensing of that location, which is protected and inaccessible to the Albanian police, allowed to estimate that the current production is much bigger than known so far. In this case also, the acquisition of the 80 Megapixel high resolution images by the Phase One camera allowed the immediate and unambiguous validation of the scientific hyperspectral data and the geo-referenced extract from CASI 1500 images. With the aid of these detailed spatial and cartographic data, Albanian authorities will be able to program an efficient action plan to contrast a problem that involves our country and the rest of the European continent. The operative international mission, with the purpose of pinpointing illegal plantations in the area, led to the gathering of a massive amount of data. This huge digital database could be used in many ways in order to monitor the territory and in aiding local government. Such valuable informations will be useful as a starting point for a possible conversion of the crops. The acquisition of 12,5% of the Albanian territory became possible thanks to the 25 operative missions for a total of 59 hours and 40 minutes flying time. These new achievements carried out during the mission in Albania in 2013 show how the ongoing refinement of the specialized capacities and both human and technological synergies are leading the Remote Airborne Sensing system potentials towards new challenges. The operating procedures to find and conduct a census of the plantations of cannabis in Albania became consolidated operating practices, so much so that a workflow of activities was conceived and it represents a real work protocol. This co-operation amplifies the aggregate amount of human and technological resources employed and allowed to reach results far beyond expectations, as well as a further refinement of remote sensing techniques from aircraft: this development offers operating modes more and more convergent with those of the economic-financial police, core business of Guardia di Finanza. The extension of the investigation potentialities and aerial surveillance, as well as the implementation of the scientific knowledge, thanks to the experience in Albania, represents a unique example on a continental level of the knowledge and control of the territory. This provides a replicable model for different scenarios and will allow Guardia di Finanza to operate in ways far beyond the search for narcotics. Nowadays the Airborne Remote

Sensing represents an opportunity for widening operative context by going beyond drug trafficking: geo-intelligence may become the source and the preferential means for a systematic contrast against the criminal organizations and their strong control over its territory as an alternative to the state power. This systematic and precise scanning of territory will create a territorial data base useful for investigation activities and for a complete knowledge of the territory. Key words for the future in national and international techniques of investigations will converge towards the accomplishment of a geo-referred cartographic data base system that is able, diachronically, to implement every kind of information related to citizens, social welfare, economical fabric and environment (Fig. 11). With all these merged informations, geo-intelligence will open new frontiers for an effective economic and financial police activity pursuing welfare and social equity.

V. CONCLUSIONS

59 hours and 40 minutes flights operation, 12.5% of Albanian territory acquired, 304 plantations and a whole village identified totally dedicated to cannabis cultivation: those 323.5 acres doesn't represent only an important achievement for an international criminal police co-operation. Much more importance should be given to that great synergy created between a police force and university research centre, that thanks to technology, has been able to pool different and polyhedral resources for planning and achievement of international criminal police goals. Sharing high social aim target between institutions and universities must be encouraged and replicated: law enforcement should work daily with the most advanced security technologies and research capabilities.

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