

INCITE

From **SENSOR** To **SOLDIER**

How Satellite Imagery Transforms
Intelligence, Surveillance & Reconnaissance



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AN OVERVIEW

Recent years have seen the fall of traditional combat structures and the rise of agile enemy groups, a rapid increase of infrastructure in politically sensitive regions and enormous immigration crises. The role of Geospatial intelligence (GEOINT) has transformed from an asset in mission planning and assessment, to a critical tool in complex analysis and rapid decision making.

Soldiers carrying terminals that can send and receive mission critical intelligence have become commonplace in well-equipped armies around the globe. The need for fresh intelligence from multiple traditional and non-traditional GEOINT data sources during the planning and execution phases of any mission has never been higher.

The modern commander can now be equipped with advanced computer aided analysis, artificial intelligence, massive amounts of data and virtual 3D simulations in order to save lives, secure defences and ensure mission success.

Earth observation data from satellites sits at the forefront of traditional GEOINT analysis and has become an indispensable tool for future innovations within Intelligence Preparation of the Operational Environment (IPOE) initiatives.

What is Intelligence Preparation of the Operational Environment?



Intelligence Preparation of the Operational Environment (IPOE) is a required process in understanding any mission critical location. This deep understanding allows commanders to set an effective course of action.

Input regarding political, military, economic, social, information, and infrastructure (PMESII) elements form the core data within IPOE. These attributes can describe an area of interest at a regional or individual conflict level.

Very High Resolution (VHR) optical satellite imagery can be an essential tool in defence and intelligence as it offers recurrent information from both a local and global scale. By combining data sources with artificial intelligence and machine learning, further insights can be gained autonomously and in a timelier manner. Advances in these technologies is increasing the affordability for most users, making the exploitation of remotes sensing data more ubiquitous.

VHR optical satellite imagery can provide benefits to applications such as mission planning and responsiveness, monitoring critical infrastructure, maritime domain awareness and damage assessment.



“When integrated with other forms of monitoring data, satellite imagery can provide further levels of confidence.”

**RICHARD BRITTAN, FOUNDER & MANAGING DIRECTOR,
ALCIS**

ATTACKING OPIUM

ASSESSMENT OF OPIUM CULTIVATION IN AFGHANISTAN

In 2018, the U.S. Air Force released videos depicting the destruction of dozens of opium laboratories across Afghanistan. The attacks intended to make a dent in the international drug trade as well as cut off funds to the Taliban who benefit from these labs.

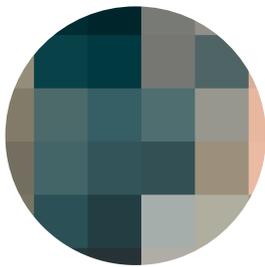
Using VHR satellite imagery from the WorldView constellation combined with other data sources collected in the field, the geospatial analytics company, Alcis, was able to determine that the attacks were largely ineffective and costly in civilian casualties. Because of the level of detail contained in 30 cm satellite imagery, they confirmed that a number of labs had little to no activity during the attacks.

Alcis continued to investigate the opium industry in the region with the aid of satellite imagery. They discovered that between 2014 and 2018, the number of solar powered water reservoirs in Afghanistan increased exponentially from 200 to over 50,000. The adaptation of this technology has significantly boosted the cultivation of illicit opium. This information has led to more reliable intelligence about where illegal opium cultivation is taking place so that a more strategic approach for controlling it can be implemented.

WHAT IS VHR SATELLITE IMAGERY?

Very High Resolution (VHR) satellite imagery are images of Earth taken from space in sub-meter resolution – that is every pixel of the image is under one metre in width and height. VHR imagery can be delivered in different combinations of multispectral bands allowing the user to see more detail than possible with the human eye.

European Space Imaging utilises the Maxar WorldView Constellation from their ground station in Munich, Germany to acquire imagery at 30 – 50 cm resolution with rapid revisit. Rapid revisit refers to the ability of the satellites to collect imagery over the same area within a short time frame.



10 M

Suitable for large land area coverage but will not provide any details – for example analysing infrastructure damages



1 M

Provides some level of detail but will hinder detection and identification objectives – vehicle and activity analysis will not be clear



30 CM

The highest amount of detail commercially available and necessary for projects relating to object identification

What can multispectral bands do for me?

The WorldView satellite constellation has 16 multispectral spectral bands that are focused on a part of the light spectrum and sensitive to a particular feature on the ground. By arranging these multispectral bands in various combinations, additional information can be extracted that is invisible to the human eye, such as material composition, camouflage identification and water depth.



WHAT SOLUTIONS CAN SATELLITE IMAGERY PROVIDE?

The power of 30 cm resolution satellite imagery in combination with frequent revisits and rapid delivery are crucial in making informed decisions. The ability to capture detailed images of any place on earth multiple times per day from multiple angles can make or break the success of a mission.

Very High Resolution satellite imagery is an essential element of Intelligence, Surveillance & Reconnaissance (ISR) with the ability to identify vehicles, see through camouflage using multispectral analysis and accurately map the finest details of any critical situation.

Beyond the details, satellite imagery has the added advantage of access to anywhere in the world. There is no border too remote or ocean too vast to capture enormous strips of imagery or pinpoint a narrow area of interest. It allows government and private users to monitor any situation without expensive and dangerous field work.



Monitor Infrastructure

Near real-time observation of infrastructure to assess weak points, monitor new construction and evaluate change in activity



Mission Preparation

Accurately map features and create virtual training environments to understand the terrain before boots hit the ground



Blue Force Tracking (BRT)

Perform near real-time damage and deployment assessments and update terminals with mission critical intelligence



Digital Elevation Model

Stereo VHR satellite imagery is used to make 3D models of terrain, vegetation and structures which prove crucial for facilities engineering and active deployment environments.



Tipping & Cueing

A widely used technique that provides fast and cost-effective results. SAR data is used to monitor large areas and identify possible sites of interest. VHR satellite imagery is then collected over these sites for analysis.



SWIR

Short-Wave Infrared (SWIR) allows you to see through thick smoke, detect heat from thermal emissions and identify materials such as metal, plastic, paint, geological minerals and various chemicals.



SECURING RIO

Security Measures for the 2016 Olympics

Safety for both the athletes and attendees of the 2016 Olympics in Rio de Janeiro was of the utmost priority leading up to the games. Brazil was relatively known for its high rate of murder and street crimes as well as for large slums surrounding Rio de Janeiro. In the midst of it all, the city was a hotbed for the mosquito-borne virus, Zika.

In addition to increased officers on the ground, security officials utilised the highest resolution satellite imagery commercially available from the WorldView constellation to plan and map every possible contingency. The imagery focused not only on specific venues but the city as a whole.

They were able to map, with incredible detail, areas of increased risk, mosquito infested neighborhoods, possible security breaches for VIP visitors and escape routes in the event of emergencies. They even used the most advanced Digital Elevation Models (DEM) to evaluate the “Line of Sight” between key areas throughout the event.

Why not just use Google?

Google Maps is one of the most widely used services on the internet and allows high quality data free of charge. Google Earth has significantly lowered the barriers to accessing high resolution satellite images, however it does come with limitations.

- Ⓞ Data is not current and Google has no publicly available schedule of updates
- Ⓞ Populated areas are imaged more frequently than rural or coastal areas
- Ⓞ Images extend only a short distance off-shore – i.e. no images in open waters
- Ⓞ It is not possible to download geo-referenced images from Google
- Ⓞ Multispectral band combinations cannot be changed to reveal additional insights

HOW DO I GET VHR IMAGERY?

Traditionally VHR satellite imagery could be obtained via an order processing system whereby a user contacts an Earth Observation company. The user either requests a specific area of interest and date from the catalogue or order satellite tasking for a future image to be collected.

This method of obtaining data is useful for users who require infrequent data or who need new collections. For more demanding users who need continuous access to the whole archive catalog, SecureWatch is the smarter and more cost-effective option that allows users to view satellite imagery right in a web browser or integrate into their preferred software through an Application Programming Interface (API).

European Space Imaging offers both traditional and cloud-based imagery delivery options combined with personal customer support to guide users to the perfect image.



Traditional Order Processing

- ✓ Search the catalogue dating back to 1999 or request a new image collection
- ✓ Pay for each image upon delivery
- ✓ Global coverage – no geographical restrictions, simply define area of interest from available global coverage
- ✓ Average delivery in less than 48 hours
- ✓ Ability to order imagery with different processing methods (band combinations, pan-sharpening and atmospheric compensation)
- ✓ Satellite Tasking – the ability to request a new image collection at specific location
- ✓ Smarter model for tailored projects or if new collections are needed



SecureWatch: Cloud-based

- ✓ Stream full resolution imagery dating back to the year 1999
- ✓ Subscription based service – a yearly price to view, stream and download
- ✓ Global coverage – no geographical restrictions, simply define area of interest from available global coverage
- ✓ Instant access to imagery via a user friendly web interface or API
- ✓ Ability to enhance imagery on screen (band combinations, atmospheric compensation, adding layers and making annotations)
- ✓ Set alerts that notify you when new data is collected in your area of interest
- ✓ Perfect for customers who need a regular access to archive imagery or integration into software solutions

APPLICATIONS



Rapid Terrain Data

Reality modelling is a key part in determining a relevant course of action during any mission.

3D models of operational environments aid in mission preparation allowing key questions to be answered such as: Does our equipment fit down this street? Can a helicopter land on that building? What is the line of sight from that specific location?

European Space Imaging, in partnership with GAF AG utilises VHR satellite imagery to capture and deliver rapidly generated 3D models of any critical area of interest.



Augmented Analytics

It's estimated that 96% of intelligence related imagery isn't analysed. The solution comes in the form of machine learning tools that manage large data sets, collate relevant information and even search imagery for specific targets. Combined with human insights, the capability of making faster and more informed decisions has already been proven.

Machine learning systems rely on massive amounts of training data. European Space Imaging holds access to an archive containing billions of square kilometres of VHR satellite imagery dating back to 1999 which makes for an ideal training data set.



Dark Vessel Detection

Maritime vessels turning off their AIS location signal remains the predominant barrier in preventing illegal activities at sea.

When authorities need to locate or confirm the identity of a vessel at sea, tipping and cueing services combined with vessel detection software are the essential tools.

Only VHR satellites have the ability to deliver near real-time images of ships in open water with a level of detail that allows ship identification and complex analysis of activities.



Unauthorised Sea Entry

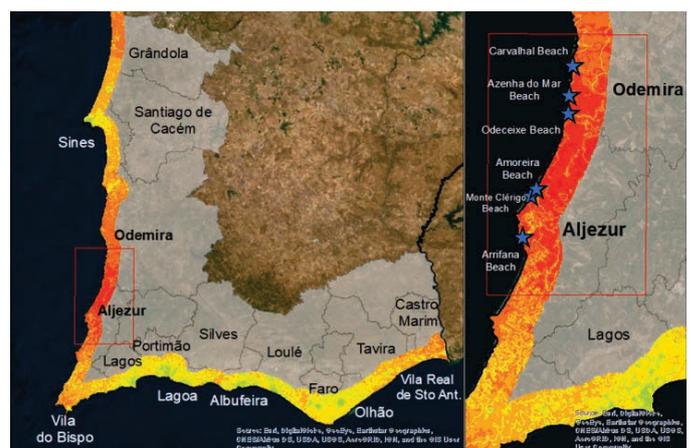
Assessment of Portuguese Coast Permeability

Immigration is a complicated topic with heavy impact on political, economic and cultural structures. Nonetheless, border control agencies are tasked with enforcing immigration laws and securing possible points of entry along unimaginable lengths of terrain and coastline.

Europe sees over 100,000 illegal immigrants every year. As security tightens throughout the Mediterranean, hopeful migrants must search for new entry points. A tool to evaluate the permeability of the southern Portuguese coastline has been developed utilising satellite imagery and techniques employed by the EU Joint Research Centre (JRC) and the EU Satellite Centre (SATCEN).

The tool determines the best and worst locations for an illegal immigrant to enter the coastline and make their way undetected inland.

The assessment evaluates factors such as active border controls, coastal terrain, inland vegetation and access to road networks. Significant areas of weakness were found on the Alentejo coast. This allows officials to mark possible entry points for expanded security measures.



Heat map depicting results from the MARFRONT model described in this article.

CONCLUSION

Seeing The Big Picture From Space

By remotely sensing from their orbits high above the Earth, satellites provide us with much more information than would be possible to obtain solely from the ground.

In particular, Very High Resolution satellite images offer a unique view of what lays in, on and around potential conflict zones. It provides a cost-effective and simple method of monitoring wide areas both locally and globally and is an indispensable tool for managing the actions and events that impact security.

From this data you can gain insights for better planning, monitoring and responding within the defence and intelligence industry.

The Future of Satellite Imagery

In recent years there has been a surplus of satellite imagery available. Advances in technology have seen data analytics leverage the power of Artificial Intelligence (AI), cloud computing and machine learning.

These advances have a huge potential to disrupt traditional business and provide enormous benefits in the long term. Ultimately the future lies in cloud based multi-source data platforms that have high powered analytics integrated within. SecureWatch is an example of a satellite imagery platform incorporating features pertinent to Earth Observation and providing the user with a tremendous array of analytical tools at their fingertips.

In the past we only had traditional methods of ordering imagery from Earth Observation companies, however the future of satellite imagery lies in the cloud – that is delivery of images via web browser or API.

This interface provides the user with instant access to satellite imagery that can be immediately analysed and manipulated. This is especially important for time sensitive projects and firms with limited geospatial intelligence resources.

Arming yourself with the right tools is the first step for any intelligence organisation and one of those tools should be VHR satellite imagery.

An aerial photograph of an airport tarmac. Two large blue commercial aircraft are parked on the tarmac. The background shows airport buildings, parking lots, and a road. The image is used as a background for the entire page.

About European Space Imaging

Since the launch of the first commercial VHR satellite, we at European Space Imaging have committed ourselves to providing much more than the world's highest quality satellite imagery.

We provide solutions. Utilizing our multi-mission ground station at the German Aerospace Center, the team of geospatial experts at European Space Imaging are able to bring together unique partnerships, innovative techniques and tailored services to achieve results for any project.

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