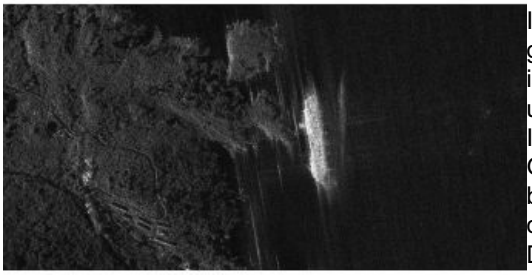
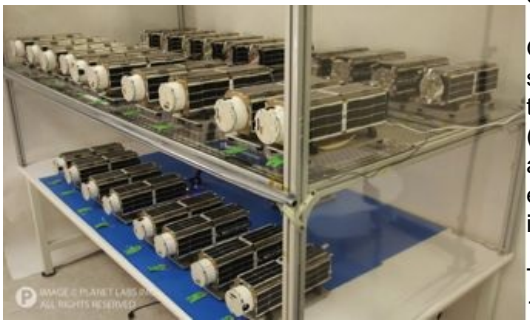
The Bright Era of Earth Observation Satellites





In helping overcome a wide range of global challenges, the geospatial industry is relying on satellite information to an unprecedented degree. In this article, Italian geospatial solutions developer Gianni Cristian Iannelli, provides a background to the satellite industry and discusses some of the exciting Downstream opportunities which are emerging through it.

Over the past 50 years, advances in satellite technology have contributed to the emergence of the Earth Observation (EO) revolution. The following is an attempt to identify the key milestone events, which have taken the geospatial industry to this data-rich point in time.

The first of these event occurred in July 1972, when a satellite called Landsat-1 was launched into space. This Earth-monitoring Landsat project signalled the beginning of an era in science which was focused on analysing from space the world and all its resources. The first Landsat satellite, which had a spatial resolution of around 70m, opened up a number of new opportunities for end users of the data. Landsat 1 and subsequent satellites enabled the scientific community to develop a range of applications in the fields of agriculture, environmental pollution, hydrology, and mineral resources, which are used to this day.

The next major milestone for the satellite industry occurred in 1986, with the development of the SPOT satellite by the Centre national d'études spatiales (CNES), the French Space Agency. The spatial resolution of this and the following six SPOT satellites range from 20-1.5m, and, today, these satellites enjoy “landmark” status in the EO field thanks to their provision of over 30 years worth of non-stop images of our planet.

The 1990’s was a significant time for satellite launches. This period featured a notable set of satellites such as the European ERS-1 (1991), the Japanese JERS-1 (1992), and the Canadian RADARSAT-1 (1995). Unlike the earlier Landsat and SPOT, these satellites carried a new sensor technology, known as Synthetic Aperture Radar (SAR), which was capable of acquiring radar images with spatial resolutions ranging between 10-100m. The SAR sensor was significant because it offered two notable advantages against optical data (i.e. day-and-night operation capability, and cloud penetration). It is also worth mentioning that RADARSAT-1 outlived its planned life with more than 17 years in operation.

Although RADARSAT was a commercial satellite project, the major milestone in terms of the privatisation of space occurred in 1992, with the incorporation of ‘WorldView Imaging Corporation’, later renamed ‘DigitalGlobe’. In 1999, the company launched IKONOS, the world's first sub-metre resolution imaging satellite. The IKONOS satellite, which was operational until 2015, was significant because it was able to collect panchromatic and multispectral images, at an impressive spatial resolution of 0.80m and 3.2m respectively.

The next major phase in the history of EO was rapid mapping at global-scale - something which was made possible through the MODIS satellite instrument (standing for Moderate Resolution Imaging Spectroradiometer). The instrument was first launched onboard NASA’s ‘Terra’ (1999) and ‘Aqua’ (2002) satellites. Despite its coarse spatial resolution from 250m - 1km, the major advantage of MODIS was the possibility to map the entire globe every one to two days; a capability which made it very useful for change analysis applications requiring high revisit times.

The year 2007 marked a significant year for SAR imaging. RADARSAT-2, which was launched by the Canadian Space Agency, by then had an increased spatial resolution of 3m. In addition, the same year, two new sub-metre resolution SAR satellites were launched into orbit. The first of these satellites was TerraSAR-X, which was developed by a public-private partnership between the German Aerospace Center (DLR) and EADS Astrium. The second satellite, which was called ‘COSMO-SkyMed-1’ (CS-1), meanwhile, was developed by the Italian Space Agency. CS-1 and the three subsequent satellites in the constellation were significant for the EO industry because they had a significantly reduced short-revisit time (less than 12 hours).

In 2014, the European Space Agency (ESA) and EUMETSAT began launching its own constellation of satellites (called Sentinels) under the Copernicus Programme. The free and accessible remote sensed data shared through the Copernicus services addresses six main thematic areas, including atmosphere, land, marine, climate, security, and emergency. The programme is of significance to the EO

industry because it removes the (typically) high data procurement costs from the data acquisition process, and thereby encourages wider commercial use and EO - focused innovation.

Until recently, the development of EO satellites has been restricted to a few national space agencies and sovereign states. The reasons for this were mainly due to the high complexity and costs of development, deployment, and maintenance of spaceborne EO systems. The last five years, however, has, thanks to reduced barriers to entry, witnessed a number of private actors, investors and venture-capitalists enter the EO-market. This is noticeable - in particular due to the trends in the deployment of small-sized satellites such as ‘CubeSats’.

‘Skybox Imaging’ was one of these private companies, which in 2012 raised around US$91 million of private capital for the purpose of developing and launching a constellation of EO satellites. The significantly reduced size (100kg) and production cost (10 times lower than a common EO-satellite) of these satellites opened up big opportunities for the industry. The first two satellites, named SkySat-1 and SkySat-2, which were launched in 2013 and 2014 respectively, were important because of their capability to record video footage from space (90 second videos at 1m spatial resolution). Soon after launch, Skybox Imaging was purchased for US$500m by Google, which renamed the company as ‘Terra Bella’ in 2016.

The SkySat satellites were, however, just the beginning. The recent ‘Dove’ satellites, for example, which are developed by a US company called Planet Labs, are a mere 10x10x30cm in size and 4kg in weight. If this was not impressive enough, these satellites have a spatial resolution range of between 3-5m. Planet Labs currently have around 200 satellites in orbit, including 88 cubesats which were launched in one go, and the company has so far managed to acquire EO satellite companies Blackbridge in 2015, and Terra Bella from Google in 2017.

In terms of recent milestones in the EO industry, perhaps the most notable one is the recent acquisition of DigitalGlobe by MDA (MacDonald, Dettwiler and Associates). The US$2.4 billion deal, which represents the biggest acquisition in the Earth imaging market, indicates that the private sector will be a dominant force in the future EO industry. After all, DigitalGlobe recently launched WorldView-4, achieving a pixel size of 0.30m, and has planned two new intraday revisit satellite constellations called ‘Scout’ and ‘World View Legion’.

Aside from the abovementioned companies, the private industry is thriving, particularly in the area of optical and SAR satellites. Some major players include Iceye, Capella Space, Satellogic, Astro Digital, BlackSky, Urthecast, NorthStar, Hera Systems, Axelspace, and Spire. Satellites are becoming as accessible as drones, and it is now even possible to design and buy your satellite components online.

As more and more public and private sector players enter the increasingly crowded EO market, opportunities in the EO industry are shifting to the downstream market. While satellite companies are now using selling points such as spatial resolution, revisit time, spatial extent, sensor, and number of bands in order to differentiate themselves, the real opportunity for the geospatial industry lies in the commercialisation of the data collected by satellites. This is demonstrated by the likes of companies such as Orbital Insight and Descartes Labs, which have enabled the development of powerful tailored products and solutions for clients. My view: in the future, it is the companies which harness the significant processing power of cloud-based computing and machine learning technology which will profit the most.

Welcome to the bright era of Earth Observation satellites!

This article was published in GIS Professional June 2018

https://www.gim-international.com/content/article/the-bright-era-of-earth-observation-satellites