TASK 5.1 (EO market overview)

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Euroconsult

2nd DISCOVERER General Assembly meeting – Master class

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 737183.

- General introduction
- Introduction to the EO market
- EO data market
- EO VAS market
- EO market by verticals
- High level profile of a sample of EO companies

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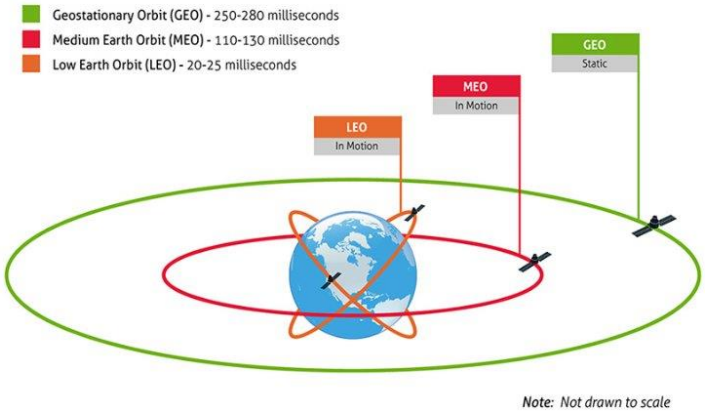
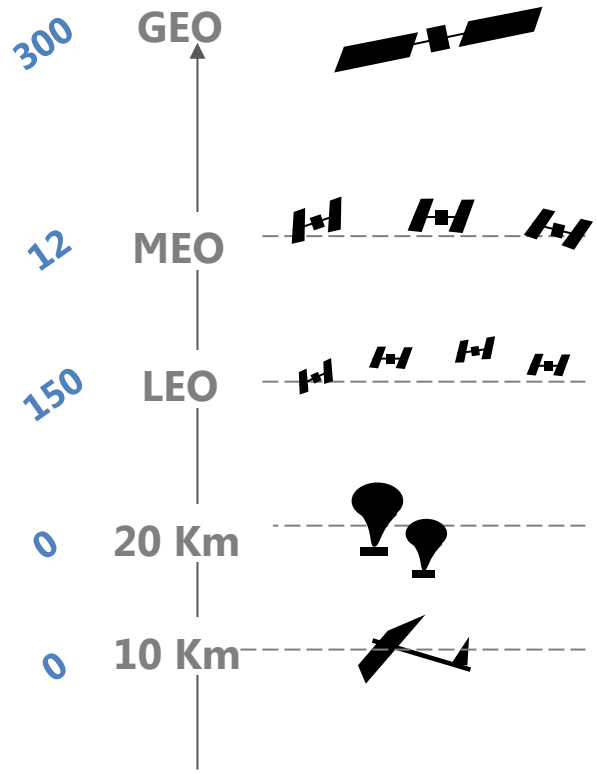
GENERAL INTRODUCTION



Type	LEO	MEO	GEO
Height	160-2,000 Km	7,000-30,000 Km	36,000 Km
Time in LOS	15 min	2-4 hours	24 hours
Merits	• Lower launch costs • Very short round trip delays • Small path loss • Higher resolution	• Moderate launch cost • Small trip delays • Moderate resolution	• Covers 42% of the Earth with one satellite • Constant visibility • No problems with Doppler (and no need of a terminal with tracking system)
Demerits	• Shorter lifetime • Smaller swath • Short LOS	• Round trip delays • Greater path loss	• Larger round trip delays • Greater path loss (constraints in terms of equipment)

of vehicles in operation today



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GENERAL INTRODUCTION

Key parameters	Affected parameters
Geographic coverage	• # of sats. • Payload FOV • Altitude • Orbit
Response time	• # of sats. • Altitude • # and locations of ground stations • Access regions • Communications • Re-scheduling & processing time
Revisit time	• # of sats. • Altitude • Access regions
On Ground resolution	• Wavelenght/Aperture (Optical) • Antenna Length/Bandwidth (SAR) • Altitude • Off-Nadir Pointing Angle
Swath	• Telescope FOV (optical) • Focal Plane Array Size • Data Rate • Satellite Agility (Optical) • Antenna Dimension (SAR)

Trade-off of orbital parameters when designing a EO mission

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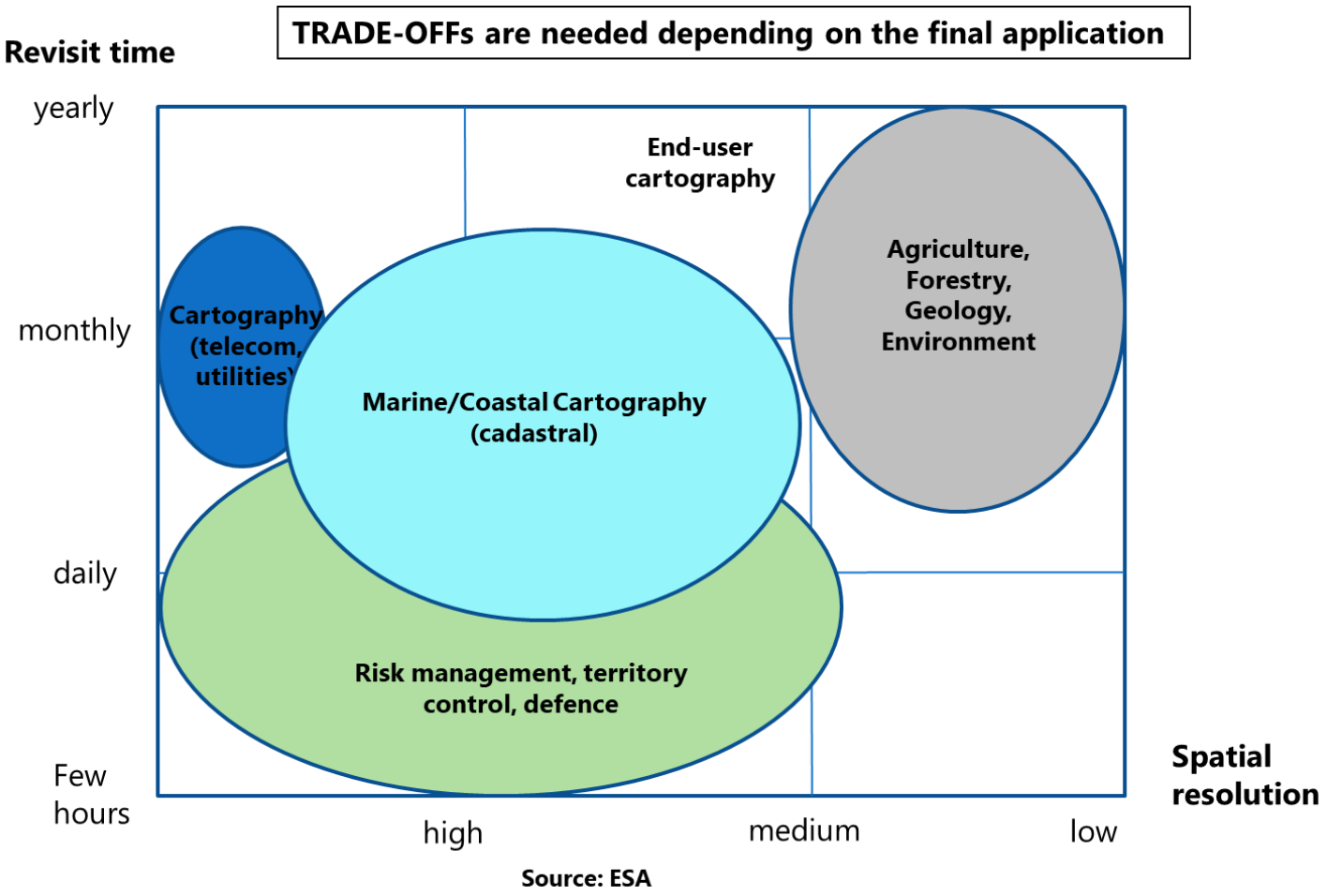
GENERAL INTRODUCTION



Source: ESA

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GENERAL INTRODUCTION

The geospatial revolution

- **Resolution matters** (spectral, temporal and spatial) but also geo-location accuracy, swath and other quality factors
- **Revisit**: a constellation of several satellites allow to fulfil the imagery requirements of the applications with interest for high-frequency change detection
- **Resolution/accuracy**: defense agencies need imagery intelligence (IMINT) to know the exact positioning of objects (buildings, armaments etc.) and post-processing of native resolution and accuracy is not an option
- **Spectral bands**: multispectral bands and panchromatic allow to serve most of the vertical markets
- If satellite data become a commodity, then **value is in data analytics** geared to the specific needs of numerous vertical markets (defense and security, O&G, agriculture, environment, infrastructure, LBS, ...)

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GENERAL INTRODUCTION

- Different levels of imagery depending on end-users' needs

Data Product Level	Description
Level 0	Reconstructed, unprocessed instrument data at original resolution, time ordered, all communications artifacts removed
Level 1A	Level 0 data time referenced and annotated with ancilliary information, including radiometric and geometric calibration coefficients and georeferencing parameters (i.e. platform ephemeris) computed and appended, but not applied to Level 0 data
Level 1B	Radiometrically corrected and geolocated Level 1A data that have been processed to sensor units
Level 1C	Level 1B data that have been spatially resampled
Level 2	Derived geophysical parameters at the same resolution and location as Level 1 data from which they are derived
Level 3	Geophysical parameters derived from level 1 or 2 data that have been spatially and/or temporally re-sampled to a global grid
Level 4	Geophysical parameters derived by assimilating Level 1, 2 or 3 data into a land surface model

Source: NASA

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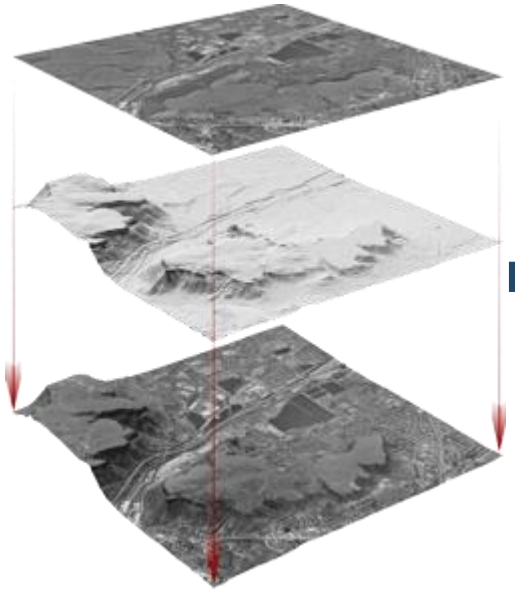
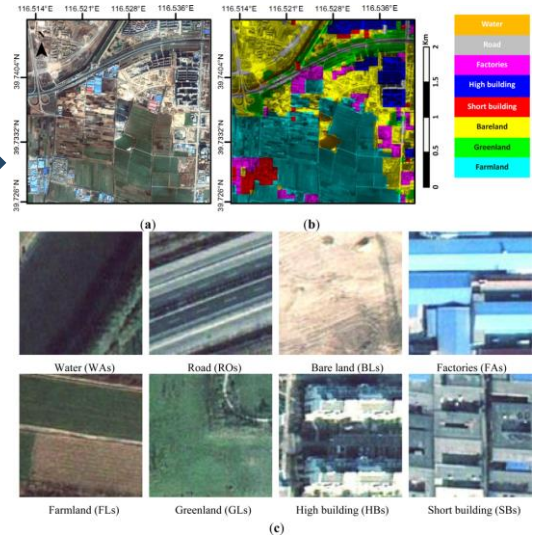
GENERAL INTRODUCTION

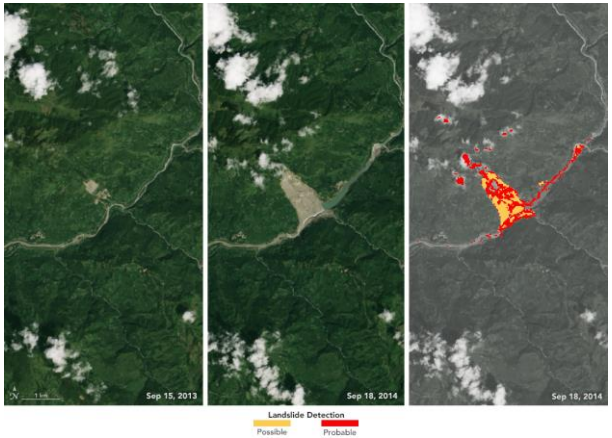
- Different levels of imagery depending on end-users' needs

Level 2 to 4



From images to applications (VAS)





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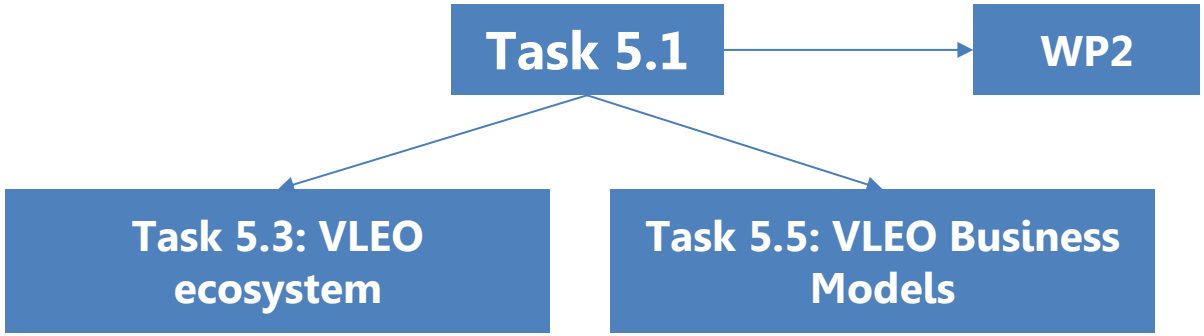
GENERAL INTRODUCTION

- Objective of task 5.1 (Market overview)



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- EO data market
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- High level profile of a sample of EO companies

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INTRODUCTION TO THE EO MARKET

Main definitions

- **Commercial EO data market**: business based in the sale of EO raw data or low level rectified imagery (e.g. Level 1) from satellites.

- **Value added services (VAS)**: considers the value brought by taking data (commercial, free, scientific) and developing a product, service or research through analysis and image processing. The point of what is considered “value-adding” can vary by company. Indeed, moving data from raw imagery to a geo-rectified product is adding value; however; for the purpose of this study, value added is considered the point that imagery moves to something application/vertical market specific: **level 1 products to something more applied**.

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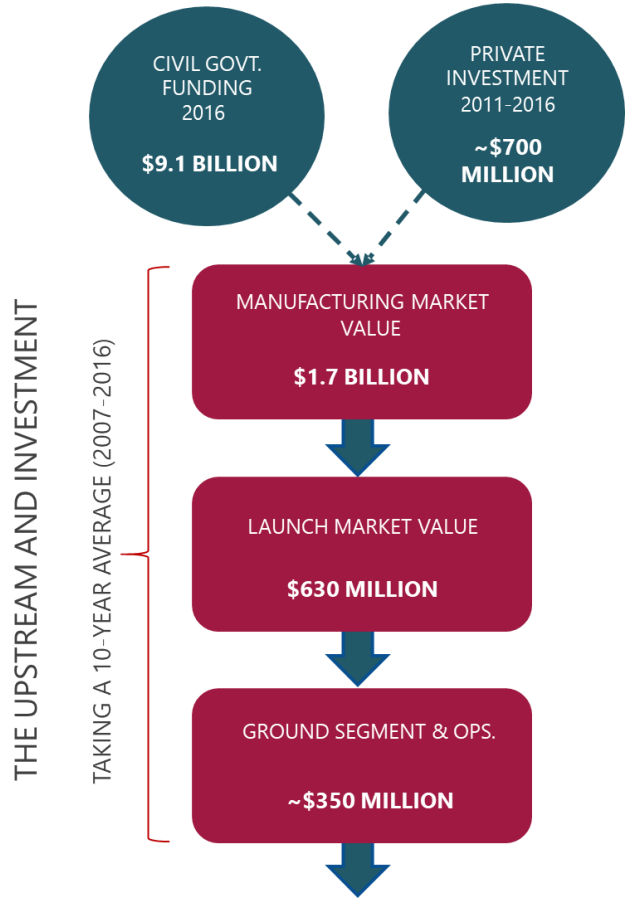
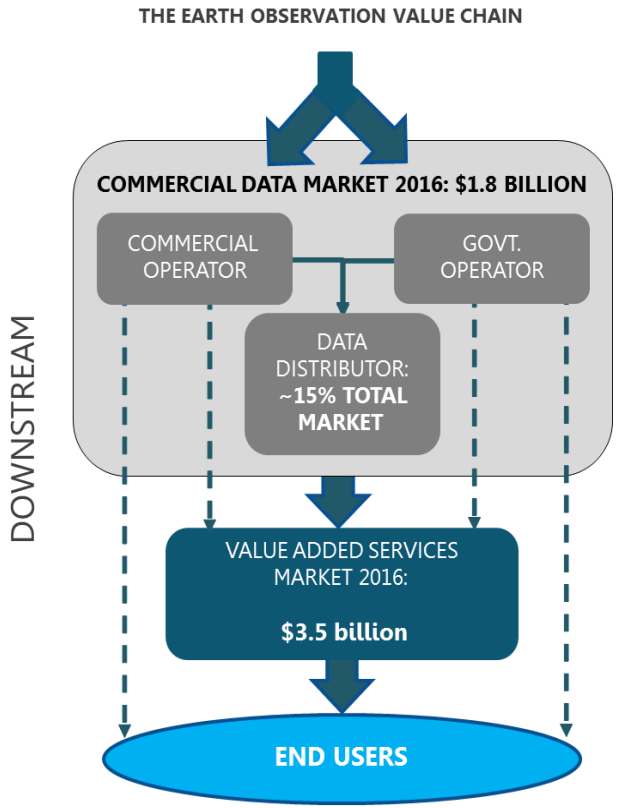
INTRODUCTION TO THE EO MARKET

- The EO value chain





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INTRODUCTION TO THE EO MARKET

- The EO market in figures

	2007-2016	2017-2026
Type of prominent operator	Governments	Commercial operators
# Countries with EO sats.	35 + ESA	48 + ESA
Total launched EO sats. (>50 Kg)	181	601
Manufacturing Revenues	$17.4 billion	$33.6 billion
Cumulated Commercial data revenues	13.5	25
Cumulated VAS revenues	22.6	47

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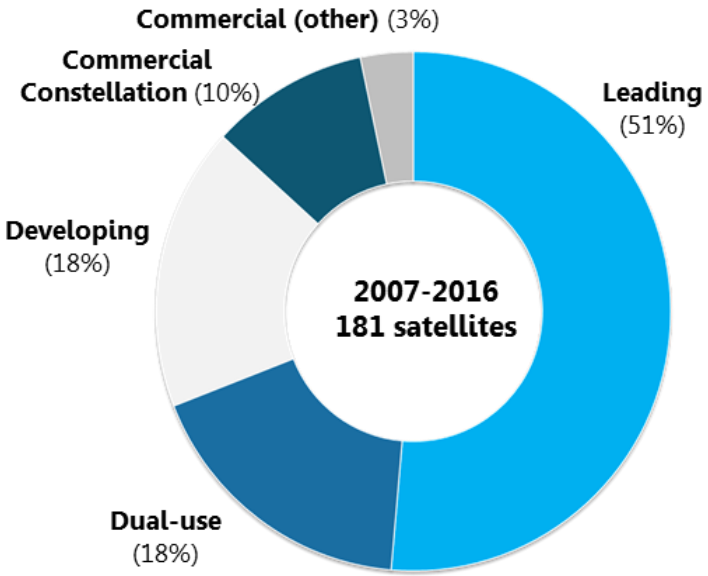
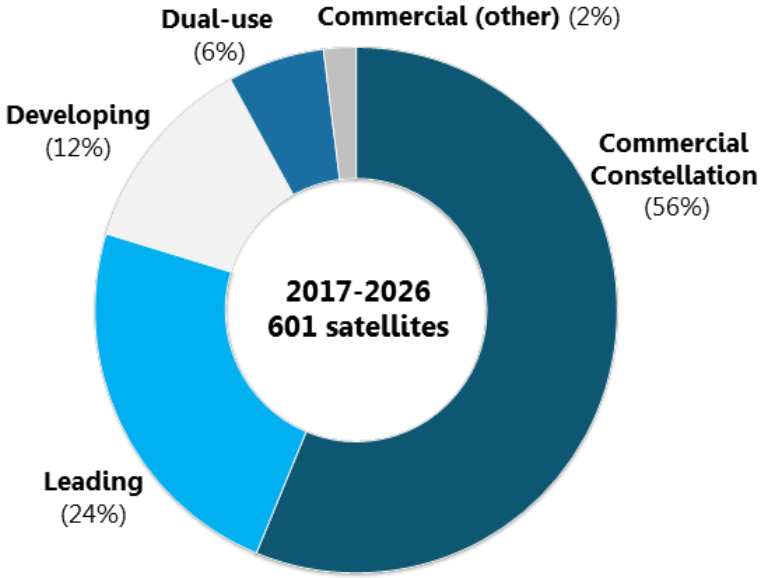
INTRODUCTION TO THE EO MARKET

- The EO market in figures - # of satellites





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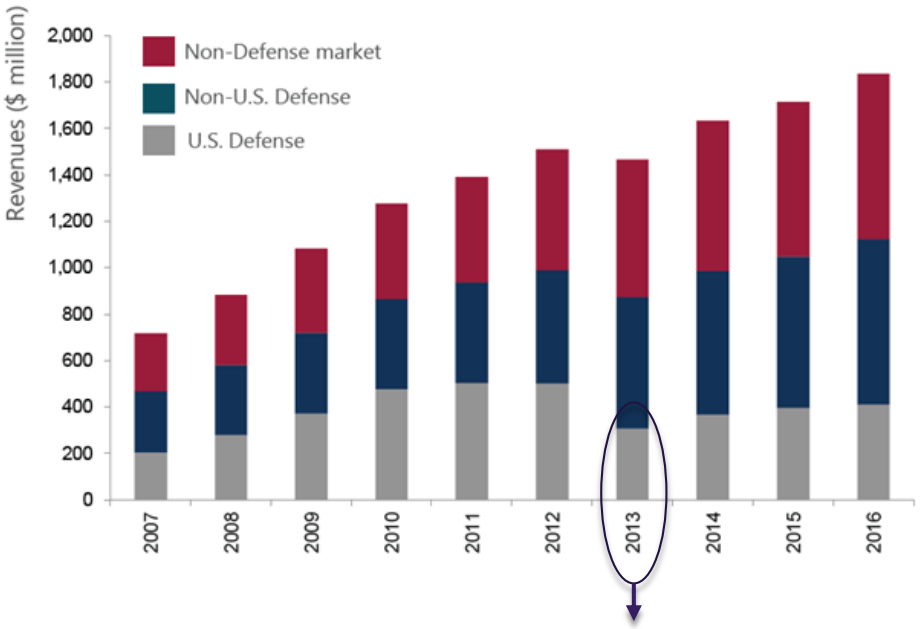
EO DATA MARKET

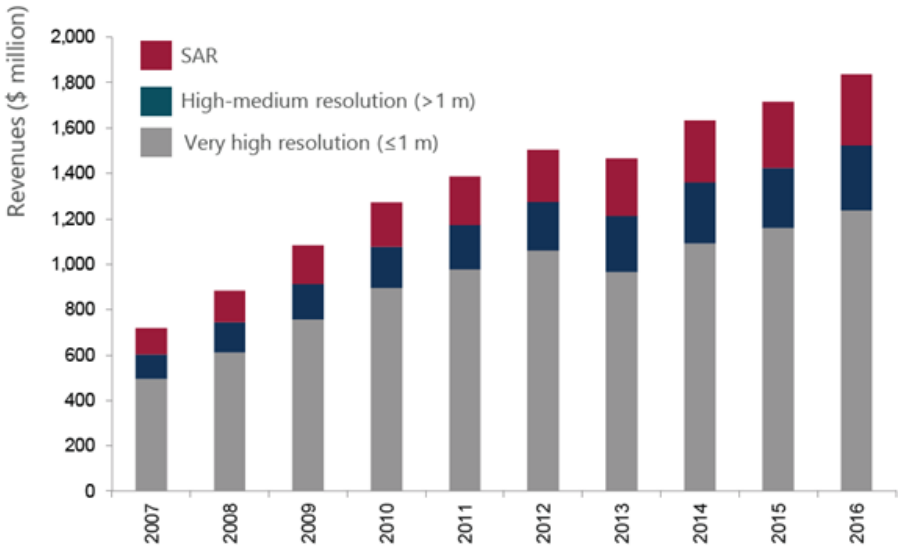
- The EO data market in figures – who used what so far

EO data sales by customer



Reduction of US DoD spending

EO data sales by data type



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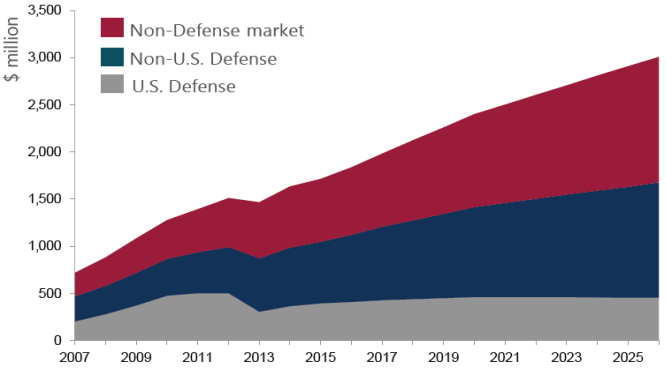
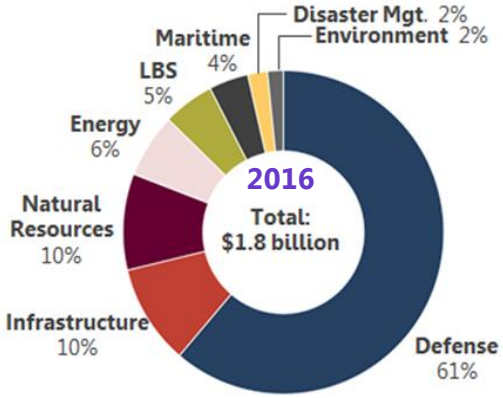
EO DATA MARKET

- The EO data market in figures – who will use what in the future

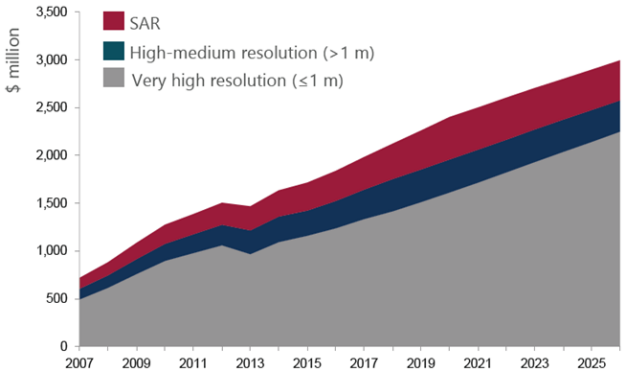
Forecast of EO data sales by customer

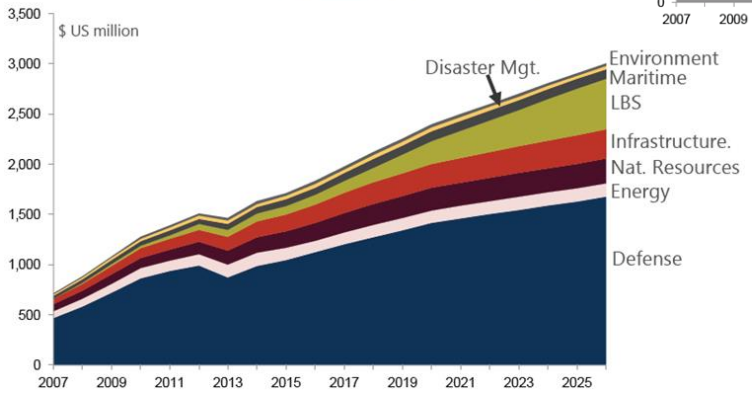


Breakdown of EO data sales by vertical market



Forecast of EO data sales by data type





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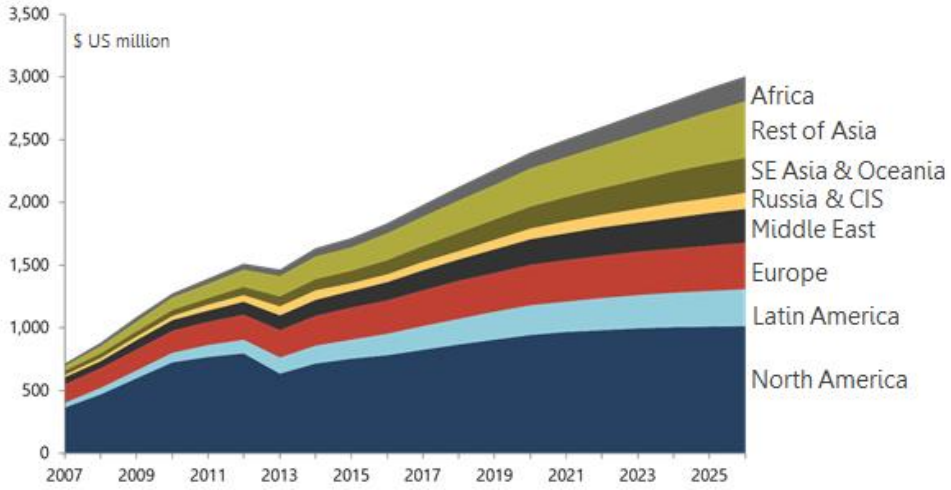
EO DATA MARKET

- The EO data market in figures – where is the demand

Forecast of EO data sales by region



Summary of main findings

	2007-2016	2017-2026
Cumulated all commercial data revenues	$13.5 billion	$25 billion
Main vertical market	Defense	Defense
Main data type	VHR	VHR
Main customer	U.S. DoD	U.S. DoD
Main customers region	North America	North America

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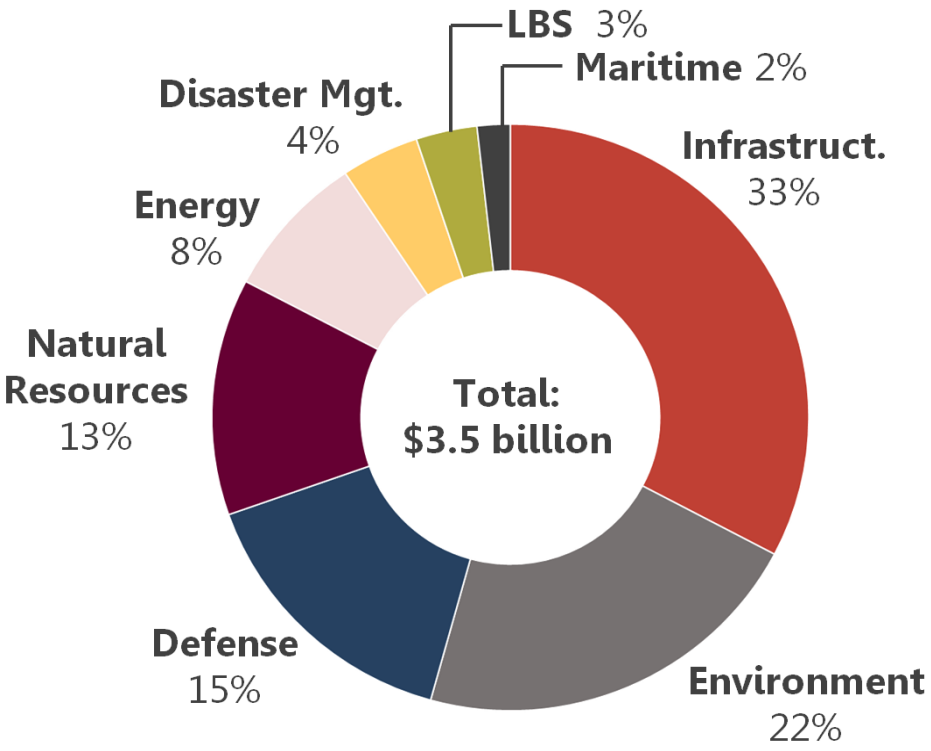
EO VAS MARKET

- The EO VAS market in figures – where are we today

EO VAS revenues by vertical market in 2016



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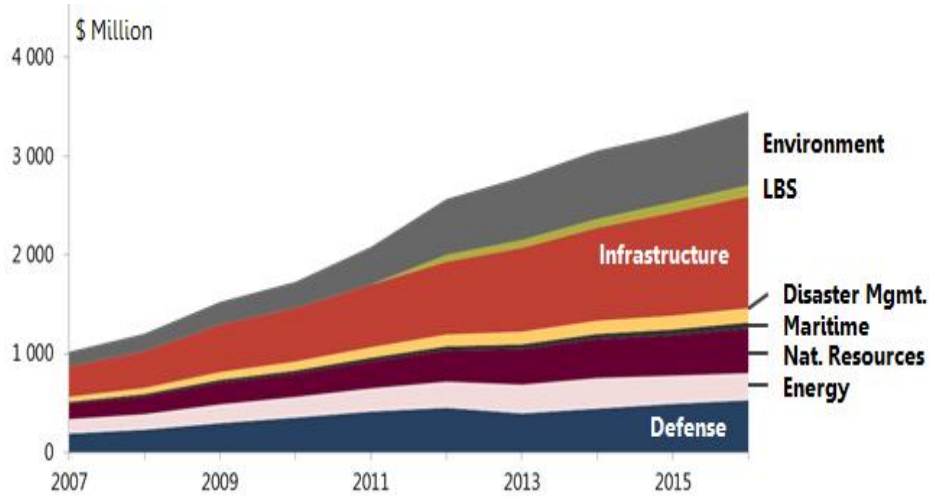
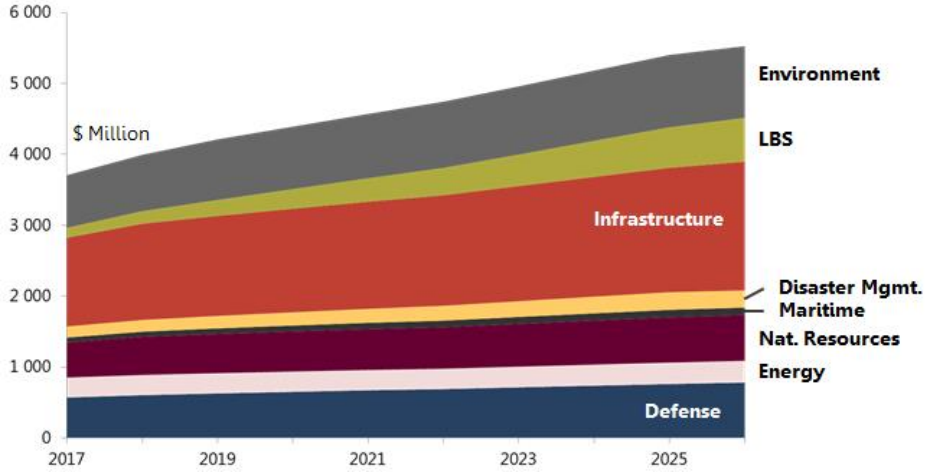
EO VAS MARKET

- The EO VAS market in figures – where do we go

Past EO VAS revenues by vertical market



Forecast of EO VAS revenues by vertical market



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EO MARKET BY VERTICALS

Objectives

In this section it will be described:

- the utility of different EO data types and its typologies
- key markets

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EO MARKET BY VERTICALS

- How many types of EO data can we have?

DIFFERING TYPOLOGIES OF DATA	
OPTICAL DATA	**Panchromatic**: Grayscale imagery sensitive to all wavelengths of visible light. Generally, systems offer greater higher-resolution data than multispectral solutions (as it is less heavy).
	Multispectral: Data collection in more than one spectral band. At minimum, this implies three bands representing visible light (red, green, blue). Further bands are added depending on the satellite's purpose; for instance, band selection into the infrared (particularly in the near infrared along the red edge) is used for vegetation differentiation.
	Hyperspectral: Hyperspectral sensors acquire imagery in many narrow, contiguous spectral bands, collecting data in 200+ channels. The computational power required to collect such data has limited ground resolution collection capability (Hyperion on EO-1, for instance, is 30 m). This also limits the system revisit.
RADAR DATA	**Synthetic Aperture Radar (SAR):** Uses the motion of its antenna over a target region to overcome the limitations of real aperture radars in which ground resolutions degrade with the slant range. SAR systems provide commercial imagery (e.g., RADARSAT, TerraSAR-X/TanDEM-X) and derived products, such as digital elevation models.
	Radar Altimetry (RA): Measures altitude by timing how long it takes a radio beam to reflect from the ground and return to the satellite. Such data is used particularly to measure ocean/wave height and to collect data on ocean currents, such as from the Jason series. The focus is primarily on inputs for environment-monitoring.
	Passive Radar: Radar such as SAR and RA are active systems. They transmit a signal that is then received. A passive system measures signals occurring in the environment in a given wavelength. Data is used to support environment-monitoring applications.

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EO MARKET BY VERTICALS

- Who is using each type of this EO data?

	SCIENTIFIC-FOCUS DATA	HIGH-MOD. RES. OPTICAL	VHR OPTICAL	SAR	HYPERSPECTRAL
DEFENSE	Moderate Use	Moderate Use	High Use	High Use	Moderate Use
NATURAL RESOURCE MON.	Moderate Use	High Use	Moderate Use	Moderate Use	Moderate Use
ENERGY	Low/No Use	Moderate Use	Moderate Use	Moderate Use	Moderate Use
ENGINEERING/INFRASTRUCTURE	Low/No Use	High Use	High Use	Moderate Use	Low/No Use
LBS	Low/No Use	Moderate Use	High Use	Low/No Use	Low/No Use
MARITIME	Low/No Use	Moderate Use	Moderate Use	High Use	Low/No Use
DISASTER MANAGEMENT	Low/No Use	Moderate Use	High Use	Moderate Use	Low/No Use
ENVIRONMENT MONITORING	High Use	Moderate Use	Low/No Use	Moderate Use	Moderate Use

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EO MARKET BY VERTICALS

- The use of EO data in the defense market

KEY APPLICATIONS	
Monitoring Activities	IMINT is gathered to support critical decision-making; applications include area mapping, target identification and reconnaissance
Mission Planning	Data used to support logistics of specific missions, run rehearsal scenarios, assess battle damage and evaluate infrastructure; defense analytics uncover patterns and perform change detection related to infrastructure and personnel, assisting in developing more effective tasking strategies and anticipating future activity
Infrastructure Surveillance	Data are used to monitor critical infrastructure, including airports and gas pipelines, to support counterterrorism intelligence
Border Monitoring	Monitoring of frontiers for illegal activity, such as immigration and trafficking. Includes cross-border surveillance and transportation
Coastal Security	Unrecognized vessels are monitored by using AIS and SAR to detect suspicious vessels before they reach coastal waters (closely related to maritime sector applications)

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EO MARKET BY VERTICALS

- Why do they need these requirements?

APPLICATIONS REQUIREMENTS	
Ground Resolution	VHR is essential to applications where detailed feature detection, target identification and change detection are required.
Geolocation Accuracy	For the majority of defense applications, data offerings of < 10 m and sub-metric resolution products are required. U.S. defense (plus likely selective other countries) have strict requirements for native accuracy. Other departments are less stringent if it can be improved in post-processing.
Spectral Resolution	For numerous applications, optical panchromatic data will suffice. VHR multispectral data are used for specific applications such as concrete/vegetation differentiation. Hyperspectral data has the advantage of being able to delineate between camouflage/vegetation. SAR data has the advantage of producing all-weather imagery and identifying objects over water.
Temporal Resolution	Delivery as close to real time as possible is required. Securing direct access to the satellite is beneficial, both for tasking to the last minute, direct reception and local image production.

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EO MARKET BY VERTICALS

- The use of EO data in the infrastructure market

KEY APPLICATIONS	
Urban Development	Data are used for chart development, cadastre plots, cartography, density maps, etc.
Telecom. Network Planning	Elevation modelling and stereo imagery are used for radio frequency measurements to evaluate existing network performance and new network planning.
Transport/ Infrastructure Planning	Data are used to identify underlying surfaces, potential obstacles, etc.; elevation modelling is used to chart the best routes.
Project Monitoring	Data are used for continuous monitoring to chart environmental impact, subsidence, etc.

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EO MARKET BY VERTICALS

- Why do they need these requirements?

APPLICATIONS REQUIREMENTS	
Ground Resolution	The ground resolution used depends on the application but primarily requires high moderate resolution data. Wider-area mapping places greater emphasis on image swath using more coarse data. For more detailed mapping, higher-resolution (metric and sub-metric) datasets are required.
Spectral Resolution	Spectral resolution depends on the nature of the area of interest. Panchromatic data are often suitable. For larger scale projects and/or across varied terrain (such as wider transportation planning and rural projects), multispectral imagery is required to delineate land cover. SAR data are utilized to map subsidence in projects developed in areas with problematic geological dynamics.
Temporal Resolution	Archive data are usually sufficient given that infrastructure projects are usually slow to develop. Up-to-date, near-real-time data are a higher requirement for progress monitoring of remote infrastructure projects such as energy/mining facilities, pipeline development, etc.

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EO MARKET BY VERTICALS

- The use of EO data in the natural resources monitoring market

KEY APPLICATIONS	
Agriculture	Data are used for crop classification, assessing crop health, resources management, assessing farming practices, etc.
Land cover mapping	Data are used for field classification/change, mapping, monitoring pollution, etc.
Forestry	Data are used for forest inventory, change detection maps, monitoring illegal logging, carbon counting, assessing vegetation health, etc.
Water management	Data collected by satellite and in situ data (soil, meteorological and hydrogeological data) are required for water resource and quality assessments.

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EO MARKET BY VERTICALS

- Why do they need these requirements?

APPLICATIONS REQUIREMENTS	
Ground Resolution	Ground resolution requirements depend on the specific application being used. Multiple application areas, particularly those requiring the monitoring of vast land expanses and/or governmental national land cover reporting, tend to have a greater emphasis on image swath, with data sufficient at ground resolutions of 10 m or higher. Higher-resolution data would be preferred for more detailed mapping.
Spectral Resolution	Multispectral imagery is required for classifying crop health/type bands. Bands along the "red-edge" between visible red and NIR are essential given the relative absorption and reflection differences between the two. Increased spectral resolution can provide further information on crop/vegetation classification and health. Greater granularity in the NIR and SWIR (such as from hyperspectral solutions) allows for detection of chemical and biophysical vegetation properties. SAR data are used for specific applications such as assessing soil moisture and water content.
Temporal Resolution	Revisit time can vary from daily or weekly to annually or even multi-yearly depending on the specific application, and the trade-off between ground resolution and revisit (impacted by swath width) is key. In order to obtain land cover change maps, time series data are required to map variations; therefore, archive data are key inputs for assessing long-term trends.

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EO MARKET BY VERTICALS

- The use of EO data in the maritime market

KEY APPLICATIONS	
Met-ocean Assessment (Weather)	Data are used for monitoring ocean currents, waves and current predictions, sea-ice monitoring and detection and wind and wave forecasting.
Integrated coastal zone monitoring	Data are used for environment monitoring on near-coastal ecologies and gathering information on ocean colour through algal bloom detection, surface salinity, etc.
Pollution	Data are used for oil dumping/spill monitoring, estimating the size of the polluted area, evaluating the date/time of observation and determining wind speed and direction.
Ship Detection and Tracking	Data are used to serve operational services such as tracking, ship route planning or monitoring of illegal activities.

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EO MARKET BY VERTICALS

- Why do they need these requirements?

APPLICATIONS REQUIREMENTS	
Ground Resolution	As ships reflect strongly compared to surrounding waters (provided wind speeds are favourable), they can be identified using 30 m or higher resolution data. Lower-resolution data also have the benefit of an increased swath, which allows for wider-area coverage and a higher temporal resolution. The main benefit of high-resolution data is the increased accuracy for identifying the type of ship and its supposed direction and monitoring port/harbour activity.
Spectral Resolution	For SAR-based surveillance and tracking applications, both X- and C-bands are utilized. Other radar sources are also used to detect wave and current information (by altimeters), wind direction and speed (by scatterometers) and sea-ice conditions (by passive radar and SAR). Optical data require specific channels depending on the application. Bathymetric mapping utilizes blue channels and lower wavelengths. Ocean colour measurements require channels in the infrared. SWIR can also be used for ship detection.
Temporal Resolution	The timeliness of data delivery and continuity of data supply are critical to operational services such as tracking, surveillance and ship routing. In some cases, data tasking is required to provide near-real-time data collection one to three hours after the request.

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EO MARKET BY VERTICALS

- The use of EO data in the LBS market

KEY APPLICATIONS	
Virtual Globes	Data usage in LBS focuses on very high- to high-resolution optical data sets. Data is used to highlight specific areas of interest to support wider marketing. Data used to support virtual globes are regularly refreshed archive imagery.
New Services Areas	Numerous applications areas have the potential to emerge, including urban planning (traffic flow monitoring, urbanization and site monitoring for new construction); Retail/market intelligence (competitive intelligence, traffic flow monitoring through car parks and assessments of peak business hours).

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EO MARKET BY VERTICALS

- Why do they need these requirements?

APPLICATIONS REQUIREMENTS	
Ground Resolution	VHR ground resolution is required for individual site monitoring, such as that of construction sites, remote oil fields, or the monitoring of retail outlets. Coarser resolution data used in large scale land monitoring applications, such as for agriculture and environment monitoring.
Spectral Resolution	To date, spectral resolution has focused on true-colour optical – such as the data used in virtual globes like Google Earth, the data being more visual. Moving towards information products, the data used would be that required to fulfil the job – the visual nature being less important to the derived product. Advances in deriving datasets from a greater spectral range to support applications is therefore anticipated, potentially even to include SAR and later, hyperspectral.
Temporal Resolution	Reducing satellite revisit is a key component of LBS services, with some providers (such as Planet) expected to target down to hourly revisit. Being able to guarantee data to the daily level in order to derive services would already be a competitive advantage.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 737183.

EO MARKET BY VERTICALS

- The use of EO data in the disaster management market

KEY APPLICATIONS	
Early Warning	Data are used to anticipate disaster events by monitoring soil, hydrology, geomorphology, burnt area mapping, etc., to support a variety of disaster-related applications. This includes drought prediction, wildfire prediction and flood monitoring.
Alert, Response and Recovery	Data are used in immediate/short-term actions to assist in recovery, including mobilizing civil protection/defense services and highlighting areas of special interest, such as identifying populated areas and further areas at risk.
Post-disaster Recovery	Data are used to assess damages, including insurance losses (such as to infrastructure and commodities [e.g.: forestry/agriculture])
Humanitarian Relief	Data are used for constant monitoring of longer-term humanitarian relief applications (such as for droughts, famines or refugee fallout) to mitigate further loss of life/damage.

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EO MARKET BY VERTICALS

- Why do they need these requirements?

APPLICATION REQUIREMENTS	
Ground Resolution	Higher ground resolutions are considered better for detailed feature identification. More moderate resolutions (such as RapidEye and Landsat) are also utilized, such as in wider-area monitoring.
Spectral Resolution	The focus is on optical visible data (for easy visualization). SAR data are also critical, particularly for events associated with high cloud cover, such as flooding.
Temporal Resolution	Data are nominally required as soon as an event has occurred and need to be regularly updated. In this regard, any single satellite has obvious constraints if the satellite path will not allow for subsequent images to be captured days after the first images. Increasing the number of data sources is therefore necessary to remain up to date. Archive data is also used for damage assessment by comparing before and after images.

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EO MARKET BY VERTICALS

- The use of EO data in the energy market

KEY APPLICATIONS	
Exploration	Data are used for base mapping and surface geology to assist in characterizing potential exploration plays. Following initial exploration activities, the data can be further used for logistics and mapping to support in situ activities, such as seismic data acquisition.
Renewable Energies	Data are used to support the placement of renewable energy plants, such as wind and solar plants, map hydroelectric sources, etc.
Operations Support and Monitoring	Data applications include applied meteorology/met-ocean solutions to support logistics (often in remote areas prone to sudden weather changes) and monitor production sites and critical infrastructure such as pipelines to ensure efficient and safe business practices.
Environment and CSR (Corporate Social Responsibility)	Data used to ensure safe exploration and extraction processes, including identifying and tracking oil spills, ground monitoring for corrosion, soil erosion and potential impacts on ecosystems.

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EO MARKET BY VERTICALS

- Why do they need these requirements?

APPLICATION REQUIREMENTS	
Ground Resolution	Applications usually require VHR to MR data. Higher-resolution, higher-commercial-value data tend to focus on detailed, precision mapping, such as on specific targets selected for increased exploration activities and in supporting logistics and infrastructure. In geological mapping, lower-resolution archive data suffice.
Spectral Resolution	Optical and SAR datasets are commonly used. For applications such as geological mapping, data are often combined to delineate based on their differing spectral attributes and textural differences using SAR data. Thermal bands are also used to detect subsurface features. Hyperspectral data are utilized in precision mapping to differentiate between specific minerals and detect potential surface alterations. SAR data are used in oil spill detection.
Temporal Resolution	Revisit requirements vary according to the application. Prospecting/exploration activities generally rely on less time-sensitive imagery (archive data). Historical time-series data are required to support the placement of energy sites. More timely data are required in operational logistics and monitoring of activities.

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EO MARKET BY VERTICALS

- The use of EO data in the environment monitoring market

KEY APPLICATIONS	
Ocean Environment	Ocean surface and subsurface monitoring, including temperature, salinity, sea level, etc. Linkages with atmospheric variables permit a better understanding of weather systems, such as through analyses of ocean surface winds.
Terrestrial Environment	Applications are primarily focused on land cover mapping, providing a basis to a number of other applications (such as composition maps of land-based ecosystems) and monitoring of land-surface changes (such as through the onset of urbanization or desertification). Terrestrial ECVs that are fully monitored include snow, ice cover and albedo effects; soil moisture; permafrost; and glacier/ice sheets.
Atmosphere Environment	Applications incorporate operational elements such as air quality, meteorology and R&D into longer-term atmospheric evolution. Includes monitoring of the surface (air temperature, precipitation, air pressure and water vapor) and at the upper air level (Earth radiation budget, temperature, wind speed/direction, water vapour and cloud properties) as well as atmospheric composition analyses.

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EO MARKET BY VERTICALS

- Why do they need these requirements?

APPLICATION REQUIREMENTS	
Ground Resolution	Requirements vary depending on the application: precision coastal monitoring requires higher-resolution data, whereas global/regional-scale land cover monitoring and ocean current/temperature measurements utilize lower-resolution data sets and take advantage of wide-area coverage due to the increased swaths.
Spectral Resolution	Imaging capabilities vary more than in other sectors due to the wide-ranging applications and the differing climate variables to be measured. Multispectral and hyperspectral data are required to delineate differing vegetation types and their health. Radar altimetry is used in oceanography to measure sea levels on a global scale and to carry out seasonal forecasting of ocean currents.
Temporal Resolution	Real-time, continuous data are required for specific applications such as operational weather services. The current systems' data delivery is the time it takes data to be received from GEO and processed. Depending on other applications, data are required regularly: (weekly/monthly/seasonally).

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EO MARKET BY VERTICALS

- Summary of revenues by vertical market

	COMMERCIAL DATA MARKET ($ million)			VAS MARKET ($ million)		
	2016	2026	VARIATION	2016	2026	VARIATION
Defense	1130	1690	50%	530	780	47%
Infrastructures	184	195	6%	1130	1810	60%
Natural resources monitoring	177	246	39%	450	645	43%
Maritime	73	98	34%	62	105	69%
LBS	95	500	426%	114	620	444%
Disaster management	36	32	-11%	146	243	66%
Energy	118	136	15%	276	308	12%
Environment monitoring	29	22	-24%	745	1010	36%

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- General introduction
- Introduction to the EO market
- EO data market
- EO VAS market
- EO market by verticals
- High level profile of a sample of EO companies

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HIGH LEVEL PROFILE OF A SAMPLE OF EO COMPANIES

The EO downstream landscape

There are several motivations for a commercial operator to **develop an extensive distribution network**. Commercial operators rely on distribution networks to expand their geographic footprint, reaching out to the maximum number of end users; they can also tap into existing client bases or leverage on vertical market expertise brought by partnering with exiting service providers.

- **Data resellers** imply no exclusivity
- **Value-Added Resellers** (VARs) procure data from the operators and derive products that they sell to the end users
- **Exclusive distributors** have exclusive distribution rights to sell data from a given commercial operator within a defined region (country or continent)
- **Business partners**: In synergy with the development of new big data and cloud and streaming technologies, the operators are starting to use such technologies to disseminate their data and promote their use
- **Direct Receiving Station** (DRS) contracts are considered to have the highest value and guarantees for the operator

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HIGH LEVEL PROFILE OF A SAMPLE OF EO COMPANIES

- List of companies profiled in task 5.1

10 EO company profiles	
Company	**Nationality**
UrtheCast	Canada
DigitalGlobe	USA (to become a subsidiary of MDA in 2017)
Airbus Defence & Space	Europe (participation of several countries)
Planet	USA (acquired Terra Bella from Google in 2017)
BlackSky Global	USA (subsidiary of Spaceflight Industries)
NorthStar	Canada
Satellogic	USA and Argentine
Hera Systems	USA
Planetay Resources	USA and Luxembourg
OmniEarth	USA

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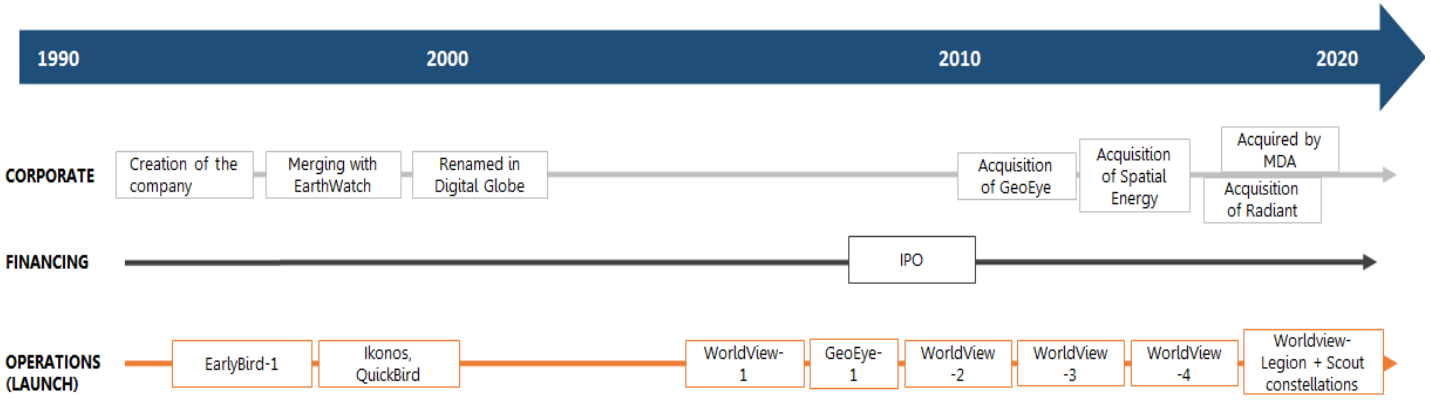
HIGH LEVEL PROFILE OF A SAMPLE OF EO COMPANIES

Digital globe – in a nutshell

Headquarters	Westminster, United States		
Founded	1992 by Walter Scott, Doug Gerull		
Investors	Publicly traded in New York Stock exchange. Acquired by MDA early 2017.		
Heritage	Initial heritage in mapping and data collection at federal research facilities. Additional heritage from mergers with Earthwatch and GeoEye		
Key Partners	• National Geospatial Intelligence Agency (NGA)	• Taqnia Space • SAAB • Timbr	• Radiant • Spatial Energy

Targeted markets
Defense
Infrastructure
Agriculture
Environment
Energy
LBS



Operational assets
Worldview-1
Geoeye-1
Worldview-2
Worldview-3
Worldview-4

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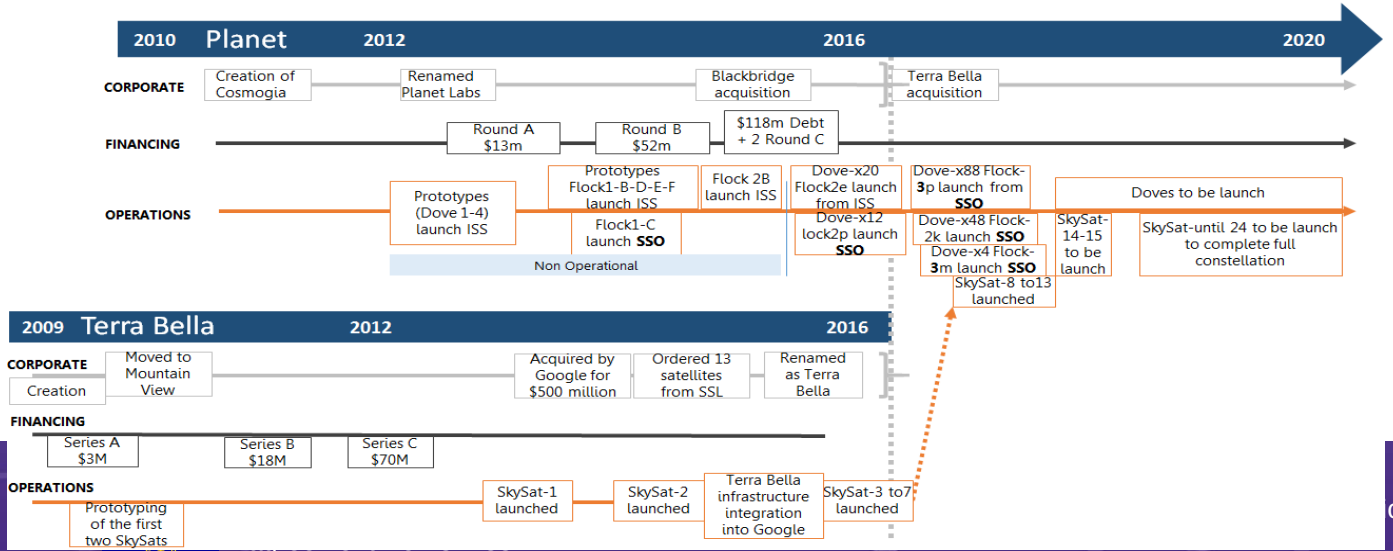
HIGH LEVEL PROFILE OF A SAMPLE OF EO COMPANIES

Planet – in a nutshell

Headquarters	San Francisco, USA		
Founded	2010 by Robbie Schingler, Will Marshall, Chris Boshuizen		
Investors	Dylan Taylor, Draper Fisher Jurvetson, Data Collective, AME Cloud Ventures, Ray Rothrock, Lux Capital		
Heritage	No previous heritage, fundamental shift in building satellites by adopting agile aerospace methodologies, lowering lead times, development cost. Acquired Blackbridge and its RapidEye constellation. Acquired Terra Bella satellites and EO operations in February 2017		
Key Partners	• Nanoracks • Blackbridge • Google** • SSL**	• RocketLab • MDA* • ECAPS** • KSAT**	• ESA* • Harris Corporation* • Japan Space Imaging** • European Space imaging**



Targeted markets
Agriculture
Defense
Infrastructure
Energy
LBS
Disaster management

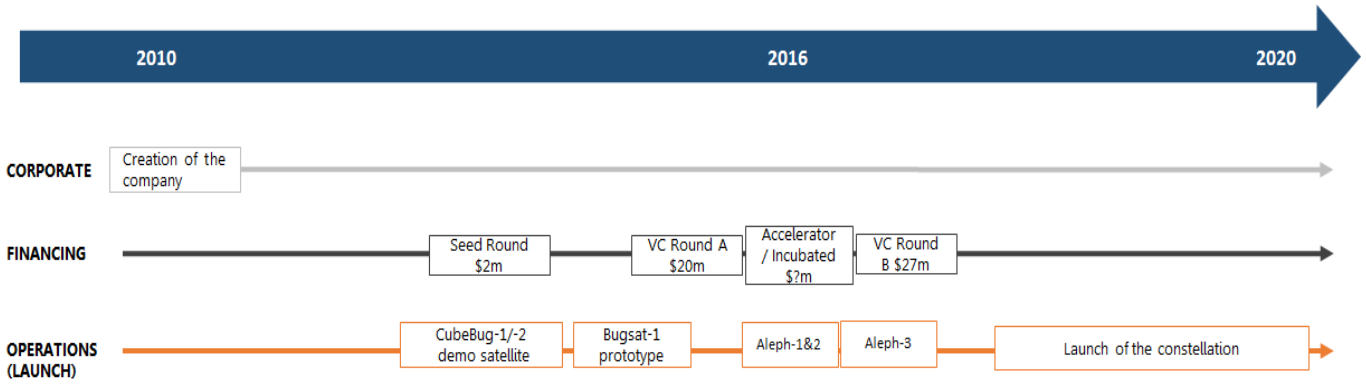
Operational assets
DOVE in ISS orbit
DOVE in SSO orbit
Rapideye
SkySat 1&2
SkySat 3 to 13

on programme under grant

HIGH LEVEL PROFILE OF A SAMPLE OF EO COMPANIES

Satellogic – in a nutshell

Headquarters	Palo Alto, United States	
Founded	2010 by Emiliano Kargieman	
Investors	Pitanga Fund, Tencent Holdings, Valor Capital Group	
Heritage	No previous heritage, fundamental shift in building satellites by adopting agile aerospace methodologies, lowering lead times, development cost	
Key Partners	• National Atomic Energy Commission	• INVAP



Targeted markets
Agriculture
Energy
Disaster management
Business inteligence
Infrastructure

Assets to come
Aleph (x300) of 37 Kg

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THANKS FOR YOUR ATTENTION

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