

The Earth Observation Geo Spatial evolution : next technology challenges over the value chain and new business models

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The ESA Earth Observation Φ -week

EO Open Science and FutureEO

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Space Technologies and Services – a new era

- The fast transformation of the space industry is largely driven by new service and applications made possible through innovations in launch and satellite manufacturing technology and in the incredible growth in the big data analytics processing and computational capabilities
- The state of technology within the satellite industry is evolving rapidly. On one hand, improvements in launch systems, sensors and other input technologies, and innovations such as the smallsat architecture are driving down costs.
- On the other hand, more sensors and a greater diversity of sensor types mean greater spatial resolution, higher temporal cadence, and richer spectral coverage. Fundamental ingredients for the EO and geo information domains to provide Information Products to traditional and emerging user communities



Cadillac 60s



Saturn late 60s



Tesla mid 10s



SpaceX reusable rocket



The Space Sector – from exploration to SDGs

- The Space sector has contributed to open new technological frontiers due to the extreme and demanding nature of **operating in deep space environment** as well as today to address new missions and innovative requirements and **new** markets for a new space economy on our planet Earth



AGRICULTURE	FORESTRY	GEOLOGY	CADASTE / LAND MGT
 <ul style="list-style-type: none"> • ACS-GIS Solutions • Parcel Reference Systems • Subsidy Controls • Assistance to Administrators and Farms • Agro-Risk Management 	 <ul style="list-style-type: none"> • Forest Mapping • Forest Inventories • Biomass and Carbon Stock • Biodiversity Inventories • Forest Management Systems 	 <ul style="list-style-type: none"> • Geological Mapping • Mining Management • Hydrocarbon Exploration • Groundwater Exploration • Administrative Support 	 <ul style="list-style-type: none"> • Land Administration • Cadastres • Water Management • Land Information Systems • Intersectoral Land Management
ORTHOM & CARTOGRAPHY	INFRASTRUCTURE	RISK MGT, LAND PROTEC	ENVIRONMENT
 <ul style="list-style-type: none"> • Satellite Data • Aerial/Satellite Orthorectification • Technical Cartography • Digital Terrain Models • Land Use and Land Cover 	 <ul style="list-style-type: none"> • Transportation Systems • Utility Management • Facility Management • Communication Solutions • Location Based Services 	 <ul style="list-style-type: none"> • Landslides • Forest Fires • Floods • Seismicity 	 <ul style="list-style-type: none"> • Environmental quality analysis • Subsidence • Coastal zone management • Land Use Planning • Watershed Management • Disaster Management • Environ. Capacity Building
MARITIME ENVIRONMENT	GEO INFO SYSTEM	SECURITY	INTEGRATED GIS
 <ul style="list-style-type: none"> • Oil spills • Ship detection • Marine water quality • Surveillance of off shore extraction activities 	 <ul style="list-style-type: none"> • Geographic Information Systems • GIS Applications for territory management 	 <ul style="list-style-type: none"> • Maritime surveillance • Rapid mapping for humanitarian aid • Activities Monitoring 	 <ul style="list-style-type: none"> • City • Plan



The new Space Economy



Investors Can Get an Eye in the Sky

BY BRADLEY HORN

The latest technological innovation for data-hungry hedge funds is a fleet of five dozen shoe-box size satellites.

A company called Planet Labs Inc. has launched a small constellation of what it calls "cubesats" that can deliver much more frequent imagery of economically sensitive spots than traditional satellites. These spots include retailers' parking lots, oil storage tanks or farmland.

The company, founded by three former NASA scientists, has now signed an agreement to supply data to Orbital Insight Inc., which mines satellite imagery for trading tips for hedge funds.

Next year, if Planet Labs succeeds in a plan to launch an additional 40 or so cubesats, Orbital will have access to daily images of every piece of land on earth.

"Almost all economic activity is change," said Jim Crane, CEO of Google Earth, a former Google executive who founded Orbital.

Tiny Rover
Earth-imaging companies are turning to small satellites about the size of a shoebox to increase the availability of photos. Planet Labs orbits dozens of its Dove cubesats in orbit to provide images of a more frequent basis.

Scale comparison
Dove satellite
Human
NASA satellite

Dove satellite
10-cm (4-in) diameter

Optical Camera
1 meter diameter

Solar panels
Spring loaded panels fold out on deployment

Earth
Each Dove orbit to complete the arc

TECNOLOGIA

I Big data arrivano dall'alto dei cieli

L'accordo di Leonardo con Spaceflightx rafforza la presenza italiana nel settore dei minisatelliti, sempre più strategici e rilevanti per la raccolta di dati dallo spazio. Risoluzione, flessibilità e frequenza delle immagini sono i punti di forza della raccolta di informazioni visive che diventano un indubbio valore nella space economy emergente

18/08/2011

Lettera n.4. Bloomberg Businessweek 26 GEN 2015 da pag. 82

simple device for use by individuals and public and commercial buildings, such as schools, stores, and hospitals. It will act as a kind of local Internet hub connecting with nearby devices via Wi-Fi or a cellular signal.

"You don't have to buy an antenna," Wyler says. "You just have to be near a school or a health center, and your phone or tablet will log on." He expects the antennas to start at about \$200 each and promises they'll be durable and easy to use. "This thing can sit in the road for months on end. It's waterproof, and it has no buttons," he says. "You should not need any wires to figure out how to turn this on."

There will certainly be some overlap between OneWeb and Qih, but Wyler sees them as complementary services that cater to different markets. Qih will be more business-to-business, offering large amounts of bandwidth to countries, cities, and large ships. If a ship is within range, Qih can give it capacity that would be difficult for OneWeb to match. OneWeb, though, will have much broader coverage and serve both business customers and consumers. Wyler remains a large shareholder in Qih.

On another level, OneWeb could function as a global Internet backup system. If a branch of fiber cables gets cut and a region loses its Internet connection, OneWeb can pick up the slack. The network should also deliver much faster Internet service to airplanes, and it would be of great use in a natural disaster when terrestrial communication systems are suddenly wiped out. OneWeb could theoretically drop off boxes of its antennas, point them skyward, and establish instant Internet for emergency workers and others.

Wyler says he's not trying to compete as a global telecommunications company, but rather to use in the wholesale end of the business, selling antennas and satellite service to existing telcos around the world, who would then resell the services to their customers.

Wyler, who's put in \$1 million of his own money so far, expects it will take more than a billion to get OneWeb going. The company has lined up Virgin Group and Qualcomm as investors, with each putting in "tens of millions," according to Virgin founder Richard Branson, who's joined the OneWeb board. "We have the capability to put up nearly 1,000 satellites," Branson says. "If we have our figures right, this will be a highly profitable business that will deliver a much needed service."

OneWeb up and running by 2016. In the expanding effort to connect people had at one point looked to fund the company's broad Internet cable and Google CEO Larry Page decided to Google is charging ahead with its own high-gain weather balloons rigged with 40-foot above remote areas to create a sort of a number of antennas, too, and taking from drones and lasers to connect in rural areas to bridge gaps in connectivity.

Wyler's the only person to have thought it over and acquired the International to provide Internet service from space, a competing thing," says Branson, who's of Branson wants to get into this area, she'll be in the eye with us."

In an interview with Wyler in addition, the reputation as brilliant but flighty. "I am thinking that he's good at figuring out the right team, attracting investors, is excellent. With OneWeb, Wyler might be one of the best of past winners. Once he gets it done, the mission he gave himself after his mother died. "This is the second Internet," he says. "It will be there for everybody."

i leads consortium to develop on-processing for video imagery from

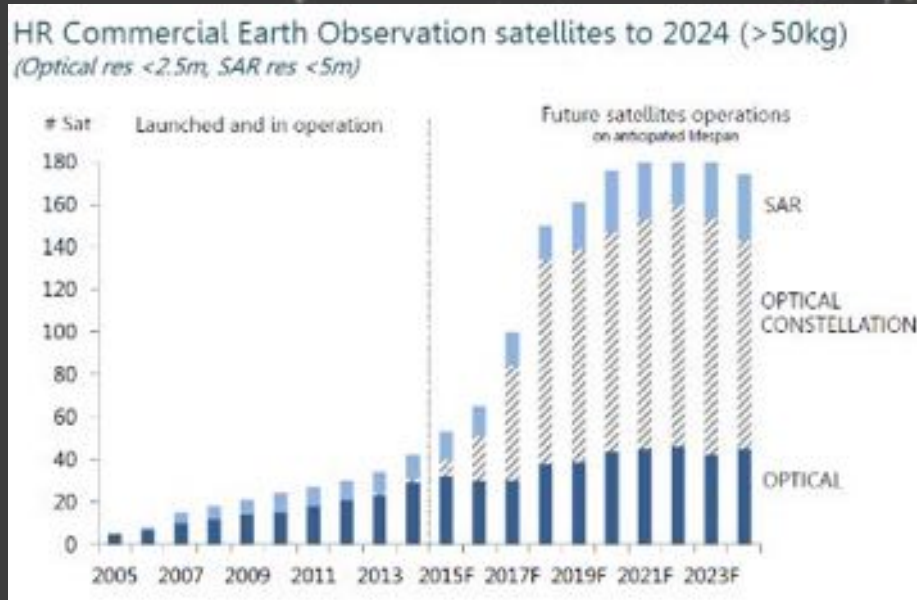
July 14, 2014

Facebook Twitter G+ Pinterest



Space Economy – Geo Information evolution

many satellites in orbit today
and the number is growing fast



+66%

680

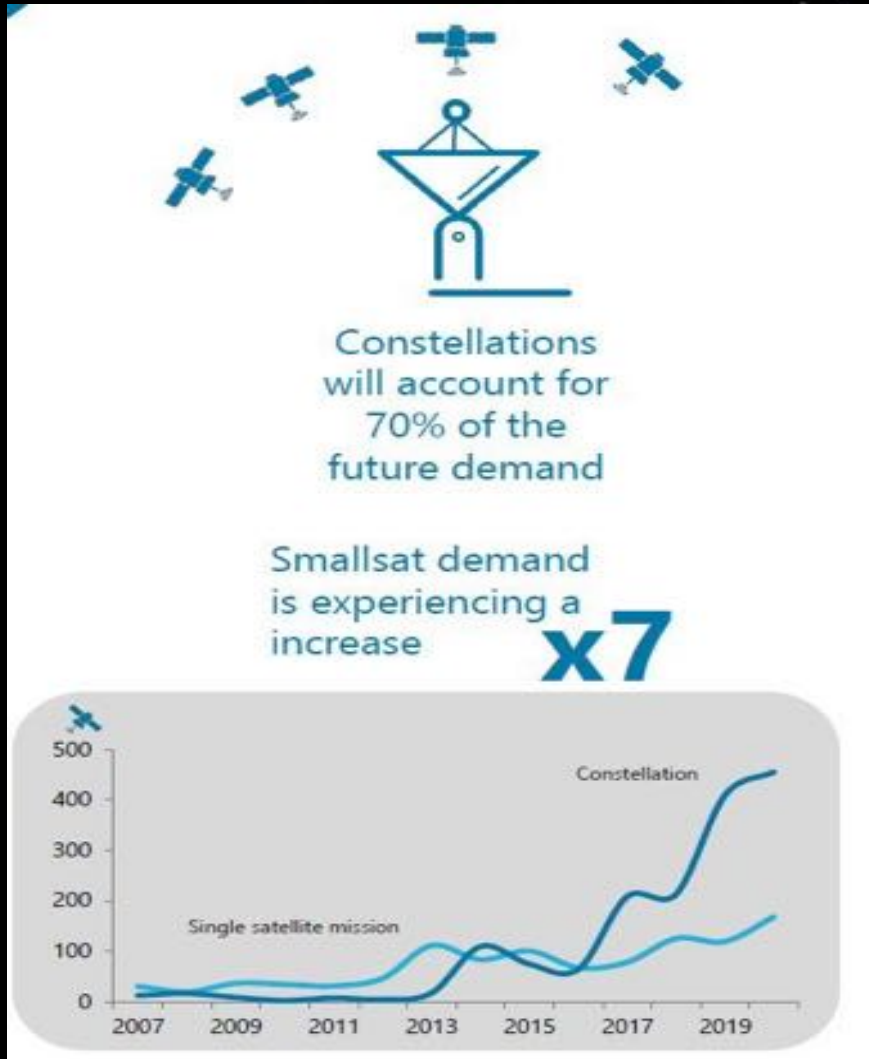
EO Satellite in orbit
(2017)*

>1,740

Satellite expected
(2017 – 2024)

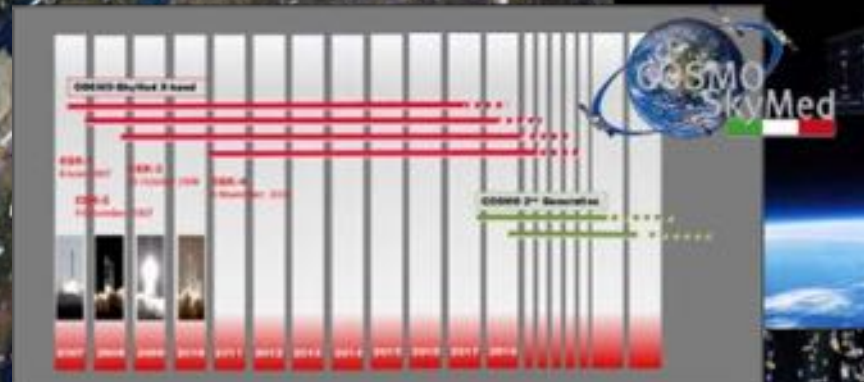
Frost & Sullivan's 2018 first quarter update of the 'Small Satellite Launch Services Market' estimates that over 11,000 small satellites will be launched by 2030. The central value proposition offered by these commercial players to end-users is real-time imagery and seamless global connectivity.

Space Economy – Geo Information evolution



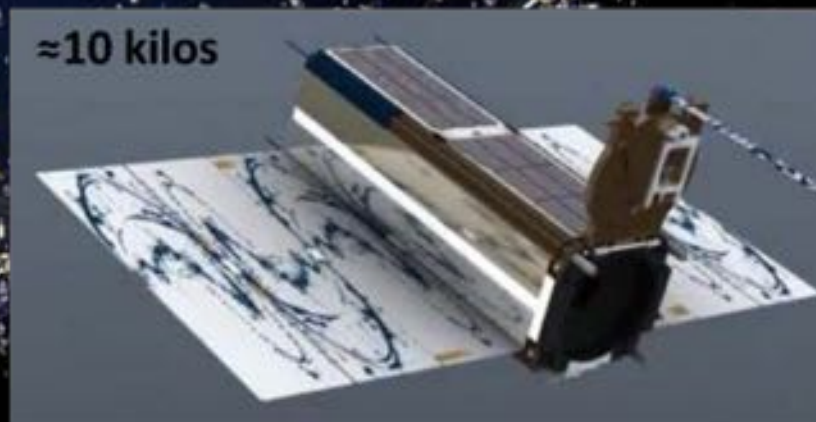
evolution of large infrastructure (high end sensors few sats)

≈2 tons

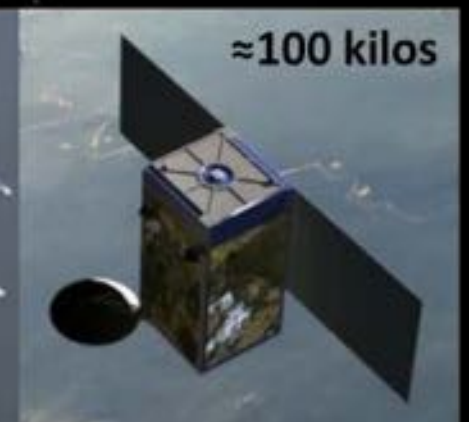


emerging constellations (low end sensors/many sats)

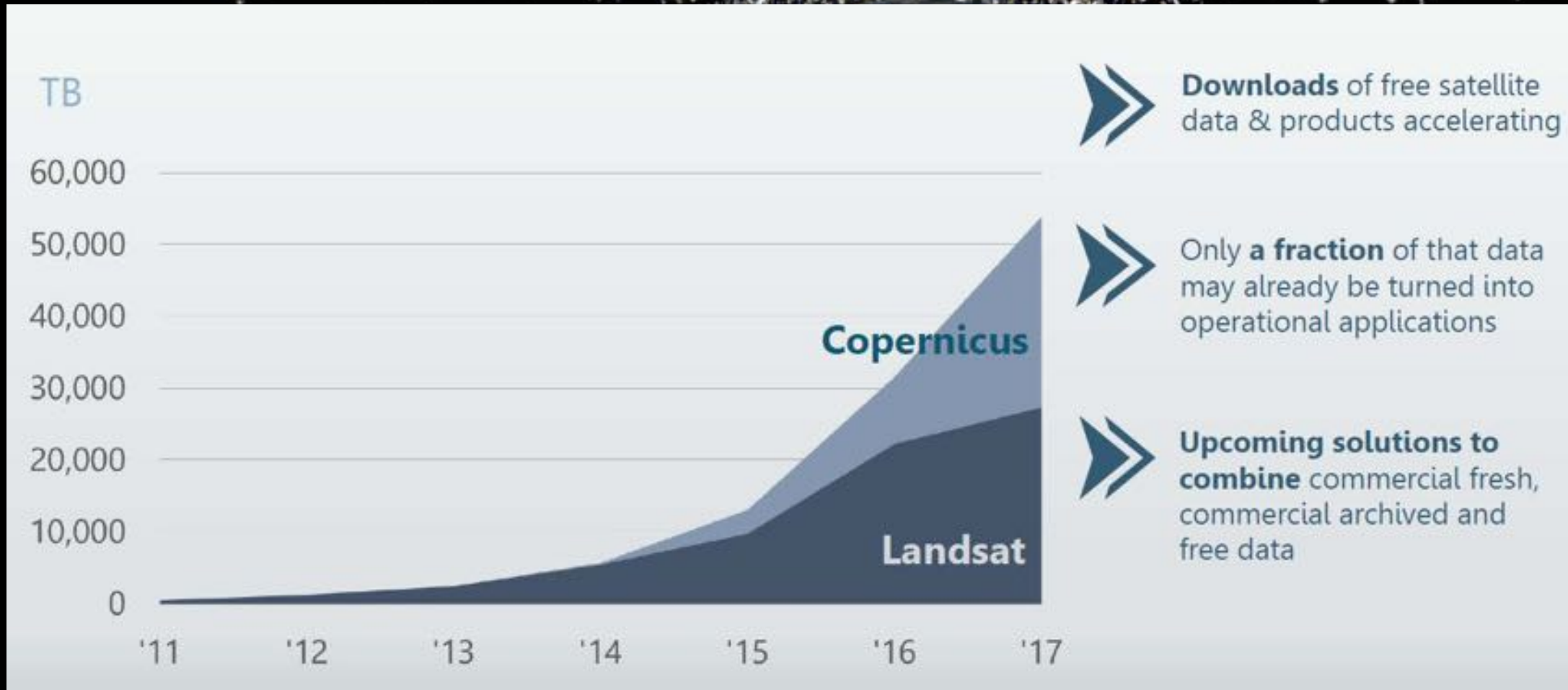
≈10 kilos



≈100 kilos

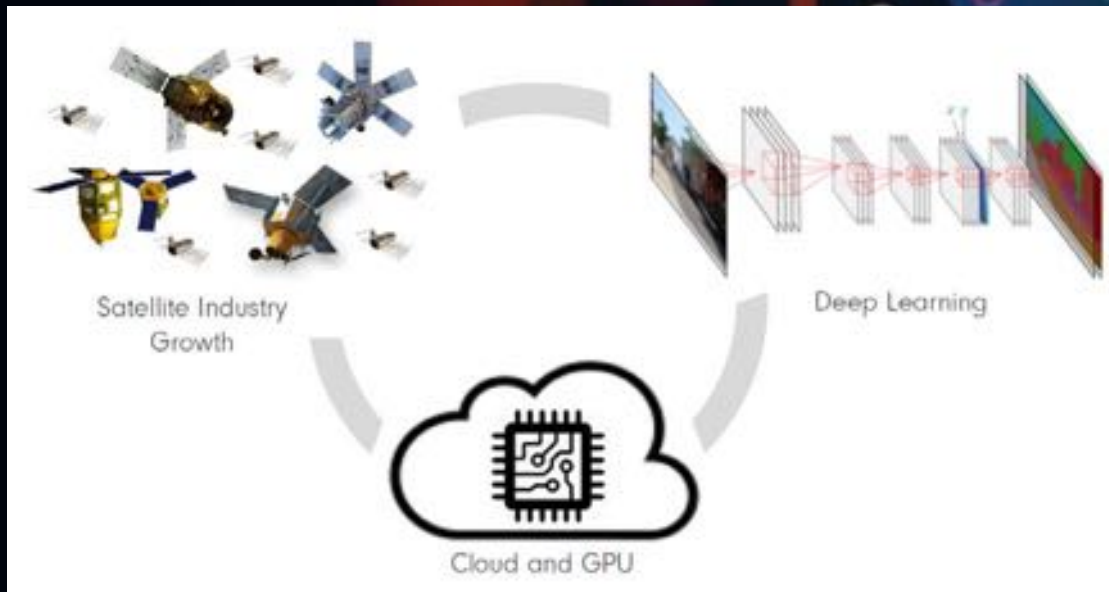


Space Economy – EO space data explosion



The new space race – global geospatial

- The possibility to complement Earth Observation space systems based on large space infrastructure and very high end performance sensors allows as well in Earth Observation to conceive **very high revisit observation capabilities**, in perspective to realize a **quasi-persistent surveillance** and in general to feed with an exponential growing amount of data a new class and generation of service and application platforms



CARBON MONITORING
NATURAL DISASTER RESPONSE
MARITIME MONITORING
AGRICULTURE HEALTH MONITORING
FINANCIAL TRADING INTELLIGENCE

**EXPLOITATION REQUIRES
REAL TIME
ACCESS TO THE DATA WITH
FREQUENT
REVISIT**

MINING OPERATIONS MONITORING
INSURANCE MODELLING
OIL STORAGE MONITORING
HUMANITARIAN AID
OIL & GAS INFRASTRUCTURE MONITORING

7

The convergence of IoT, cloud, and big data create new opportunities for self-service analytics

Space and Democratization

From data 

Generating information 

To customized platforms 

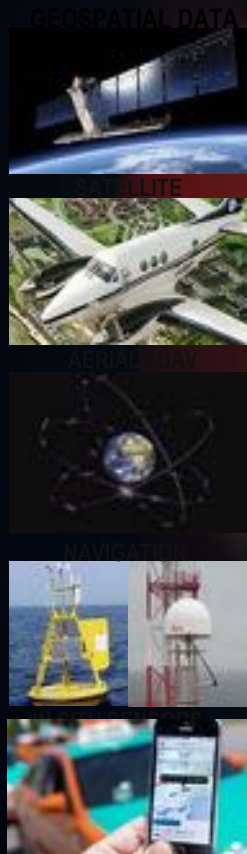
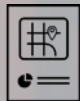


IMAGE CONTENT



REPORTS



GEO CONTENTS



LAND



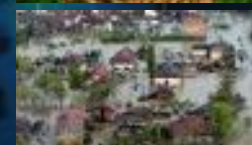
DEFENCE



MARITIME



AGRICULTURE



EMERGENCY



ENVIRONMENT

The new space race – global geospatial



global
coverage



Frequent
revisit



easy user
driven access



monitor daily



discover trends



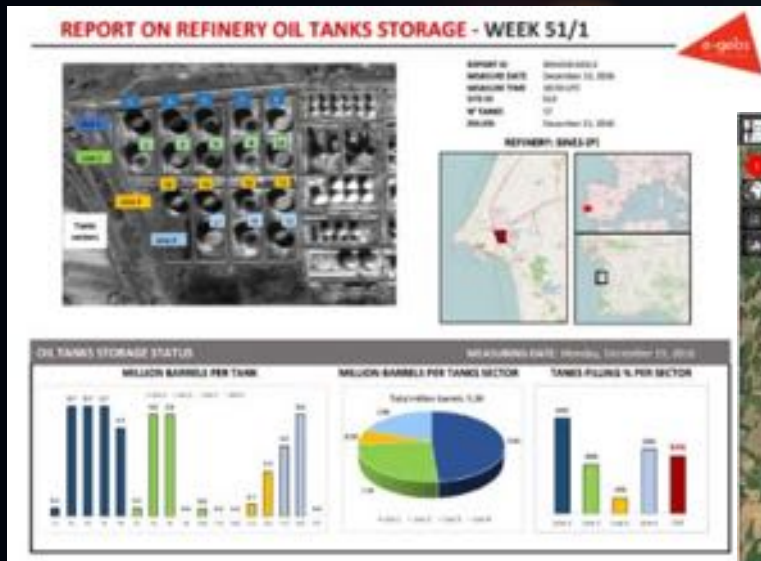
deliver insight

Space and Democratization

From data 

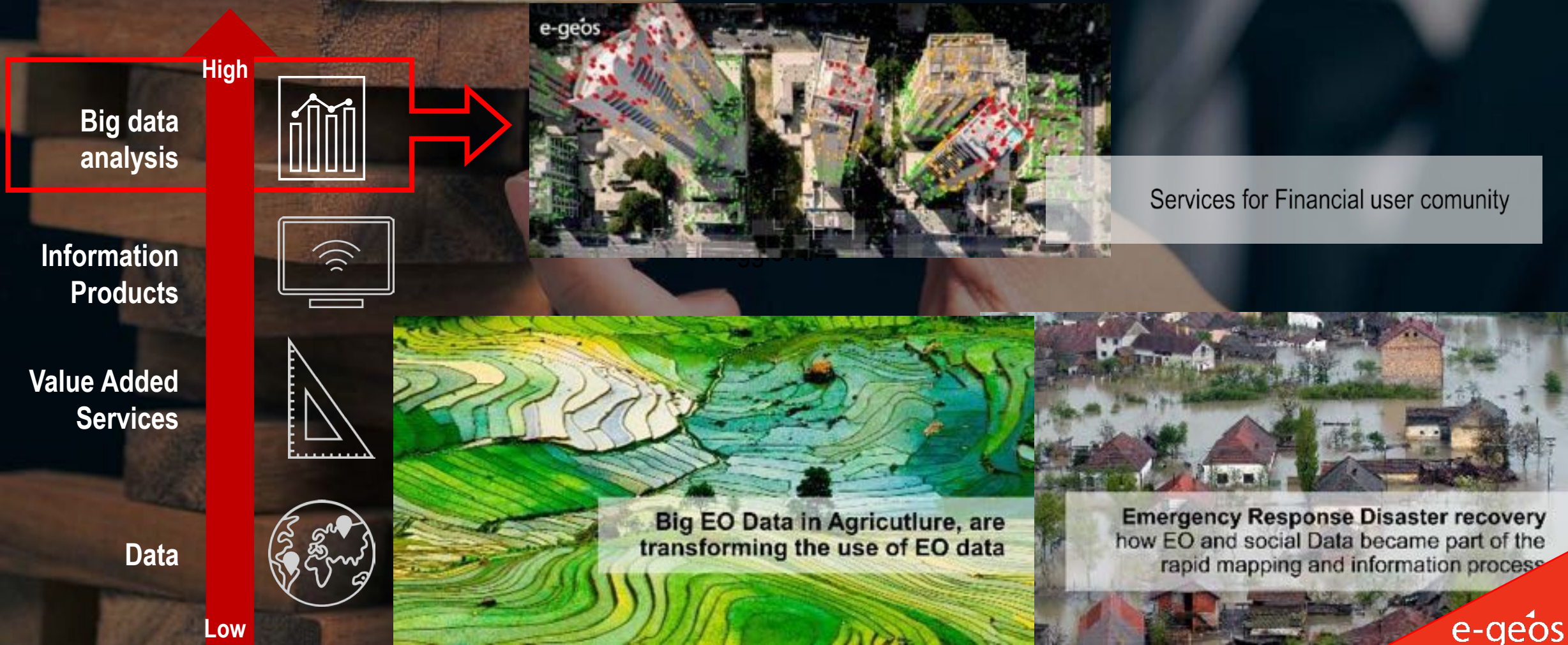
Generating information 

To customized Information Products and BDA 



THE VALUE CHAIN FOR THE NEW VALUE ADDED SERVICES

More value addition/processing to the raw data



AssetWatch

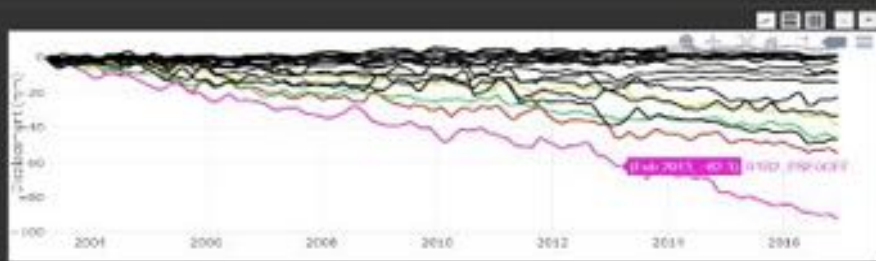
from punctual analysis
to areal behaviours

1M+

Years of time series
analysed

10+

Years of time series
analysed at the same time



Statistics

Selected PS	2346
Measures	36
Starting date	20160508
Ending date	20170425
Velocity	Min: -29.9000 Max: 13.6000 Mean: -0.7389 mm/year
Height	Min: 1012.4000 Max: 1218.1000 Mean: 1084.4307 m
Velocity stdev	Min: 0.2000 Max: 1.1000 Mean: 0.4890 mm/year
Coherence	Min: 0.6400 Max: 0.8900 Mean: 0.7285

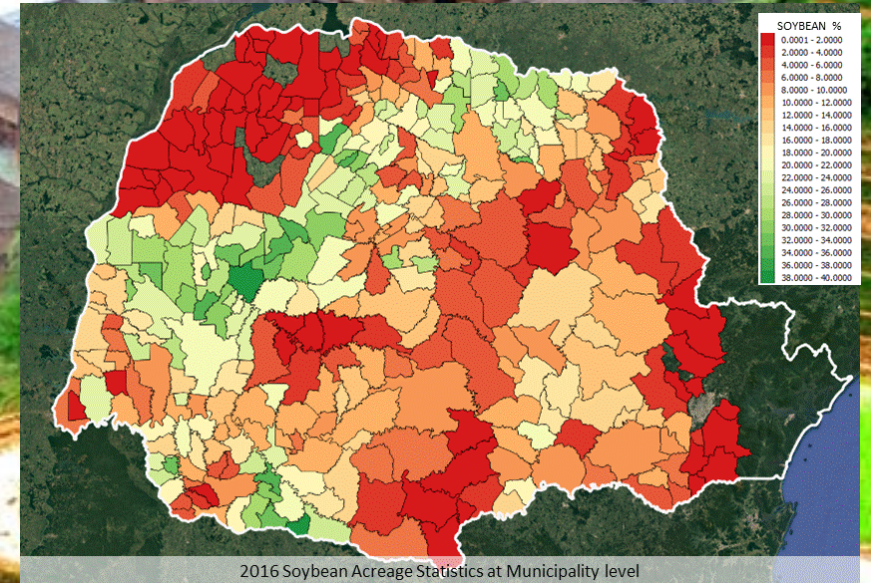
Filtering, Statistics and advanced analysis tools applied over hundreds of measuring points enables to move the analysis **from punctual analysis to areal behaviours**

AGRICULTURE AND FOOD PRODUCTION

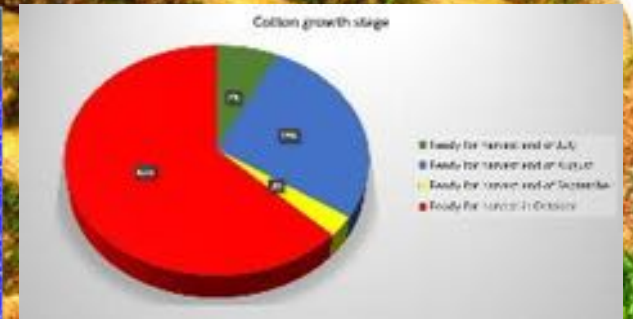


For supporting governments and farmers in the management of the **agricultural and food activities**, as well as the **crop lifecycle**

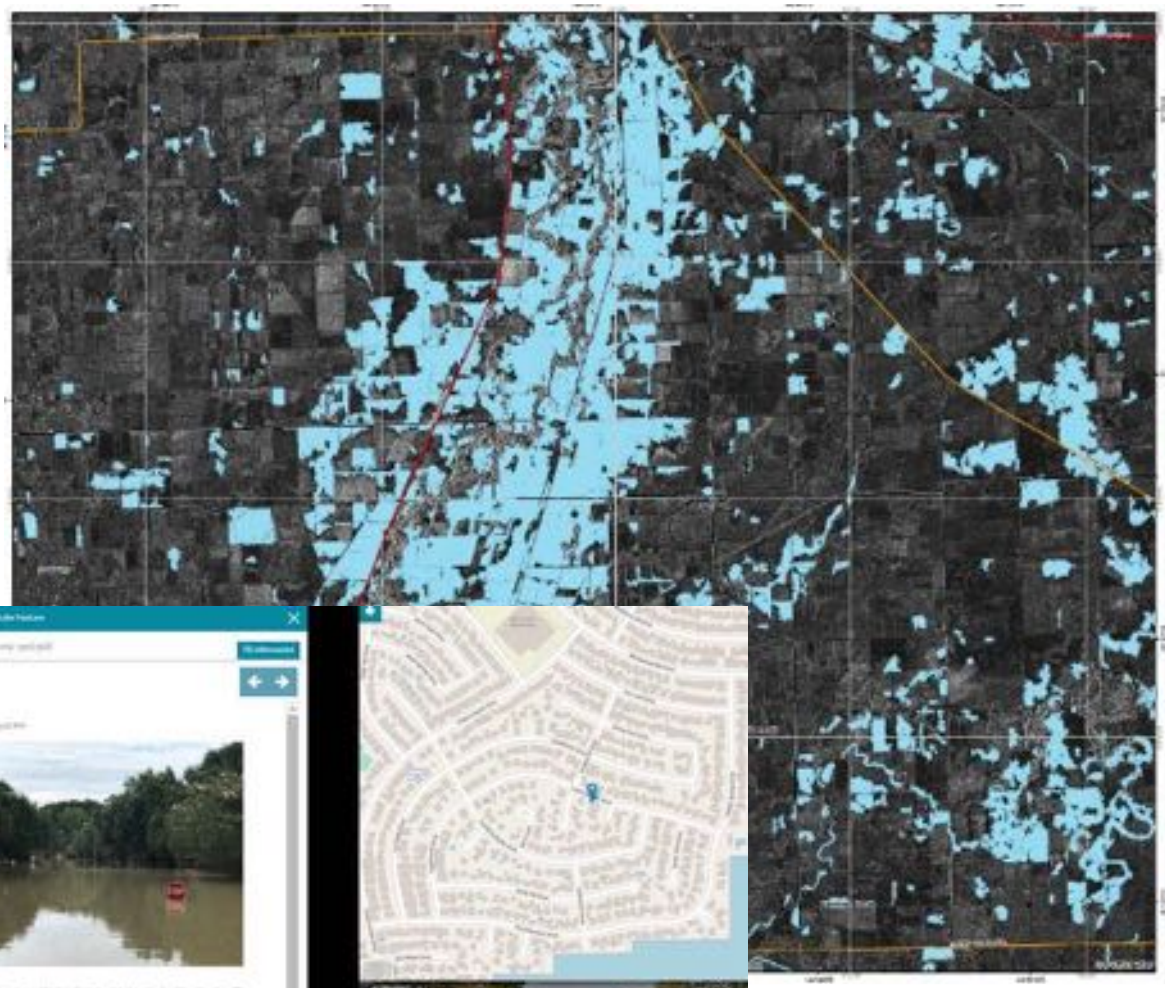
- Precision farming analysis
- Crop monitoring reports, acreage and crop yield assessment, for early estimation, analytics monitoring services
- Agro-Environment Geo-Information Products
- Services of crop monitoring for claim management, funding/subsidies management, production processes



COUNTY	Cotton area		Flooded Cotton Area
	ha	%	
Uzbe	1924	58	13%
Vanoda	1773	0	3%
Kura, Dvina	1731	0	3%
Karaxil	1595	132	7%
Yaple Lake	1535	322	36%
Yast Berrant	1522	1473	43%
Wafin	648	218	44%
Yul'ara-Kovche	641	331	18%
Wharson	1461	721	19%
Yakim-Novosif	2964	822	49%
El'Compa	10193	538	5%
total	41358	3452	10%



FLOODED AREAS EXTRACTION



Australia - Victoria
Rochester
Flood Assessment Map - 2010

Legend

- Property Footprint
- Boundary Footprint
- Water Body
- Flooded Area
- Watercourse
- Watercourse Boundary

Information

This map was created using the Australian Flood Assessment Tool (FAT) on 11 January 2010. The map shows the flood assessment for the area shown on the map. The map is based on the flood assessment data for the area shown on the map. The map is based on the flood assessment data for the area shown on the map. The map is based on the flood assessment data for the area shown on the map.

Scale: 1:100,000

e-geos
AN IRIDIUM TELESPAZIO COMPANY

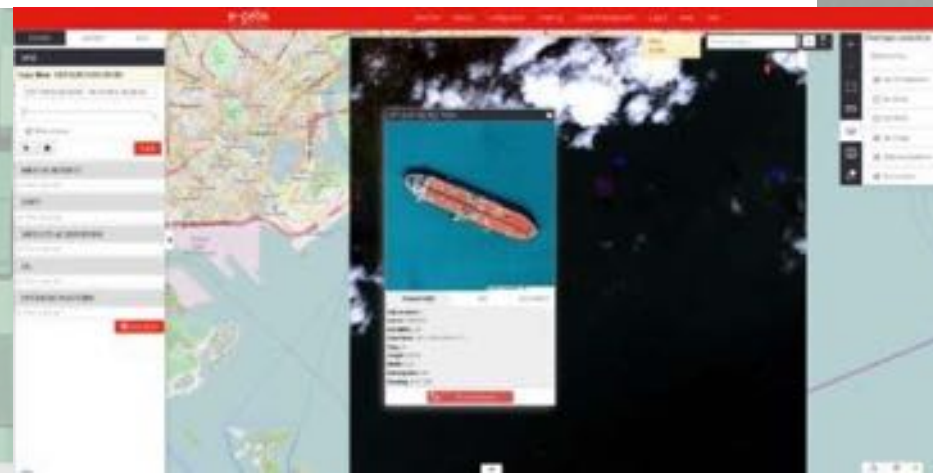
200+
Images Acquired

70+
Products generated
and delivered

- 2M+** social media data
- 1sec** Content validation
- 5sec** Accurate content Geolocalization
- 20k+** Crowd sourcing community for content enrichment



Integration of multi-source data for Maritime Awareness



AIS data, Vessel historical route and forecasting

Service Statistics

THE ECONOMY OF SHADOWS

OIL TANKS MONITORING



THE ECONOMY OF SHADOWS

OIL TANKS MONITORING



REPORT ON REFINERY OIL TANKS STORAGE - WEEK 51/1



REPORT ID: 8W-010-16511
 MEASURE DATE: December 19, 2016
 MEASURE TIME: 10:59 UTC
 SITE ID: 010
 N° TANKS: 17
 ISSUED: December 21, 2016

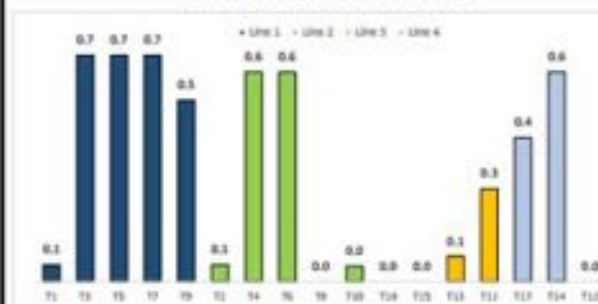
REFINERY: SINES (P)



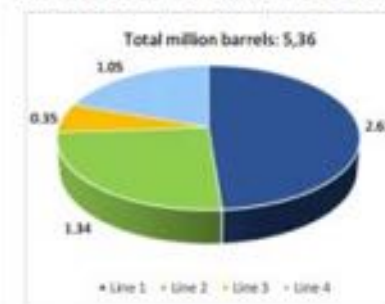
OIL TANKS STORAGE STATUS

MEASURING DATE: Monday, December 19, 2016

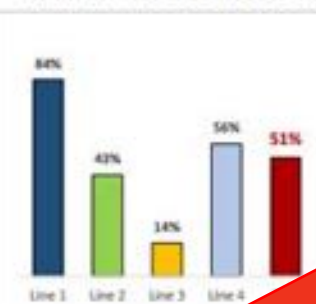
MILLION BARRELS PER TANK



MILLION BARRELS PER TANKS SECTOR



TANKS FILLING % PER SECTOR



Geo Spatial paradigms and Business Models are fast changing



- Data, more and more, are just a part of the game
 - High temporal resolution to complement high and very high spatial resolution sensors
 - Federation of existing and planned new assets through smart multi missions tasking platforms
- Convergence in the data analytics business for the EO
- Data derived information driven market
- EO Geospatial business as inherent part of IoT

(re)evolution of the entire eco-system
(business, value chain, technology,
partnership, public private cooperation, ...)

GEOSPATIAL
WORLD
FORUM

GEO4IR
A SUCCESS STORY WITH A STRONG FUTURE
- Evolution of the EO market -

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AN IRI TELESPAZIO COMPANY

THE BIG DATA PROMISE

GEO Big Data + IA + Analytics are changing the game in the data consumption

↑ AI
Machine learning
Deep learning

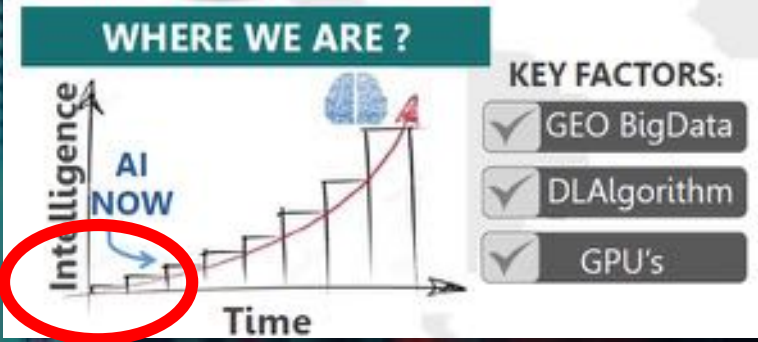
Big Data

Self Program

Predictive Analysis

Prescriptive Analysis

Automated action



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INTEGRATION

BIG DATA
SATELLITE IMAGES
INTERNET OF THINGS INFORMATION
TO GENERATE NEW PRODUCTS

- DEFENCE AND INTELLIGENCE
- MARITIME SURVEILLANCE
- AGRICULTURE AND FOOD PRODUCTION
- RISK AND ASSET MANAGEMENT
- LAND AND INFRASTRUCTURES MANAGEMENT
- CLIMATE CHANGE AND FORESTRY

From Earth Observation –
static imagery to **pattern of
life** monitoring

Thanks to Space Big Data, to faster
revisit time offered in both radar
and optical domain, we can answer
to much more questions that in the
past. The challenge is to design
advanced algorithms to generate to
process big data and to generate
info reports for each vertical
domain

Space Democratization

first space wave

Space as Political Power
Cold War



moon landing
1969

JFK Speech
1962

2nd space wave

Science and Exploration
Early Communications



1979

Navstar 1
1978



3rd space wave

DAB DBS
HTS
Comms LEO/MEO
Earth Observation
Navigation
Systems

mid 90's

mid 2010's



4th space wave

Democratization
Sharing Economy
In Space

2007-2010



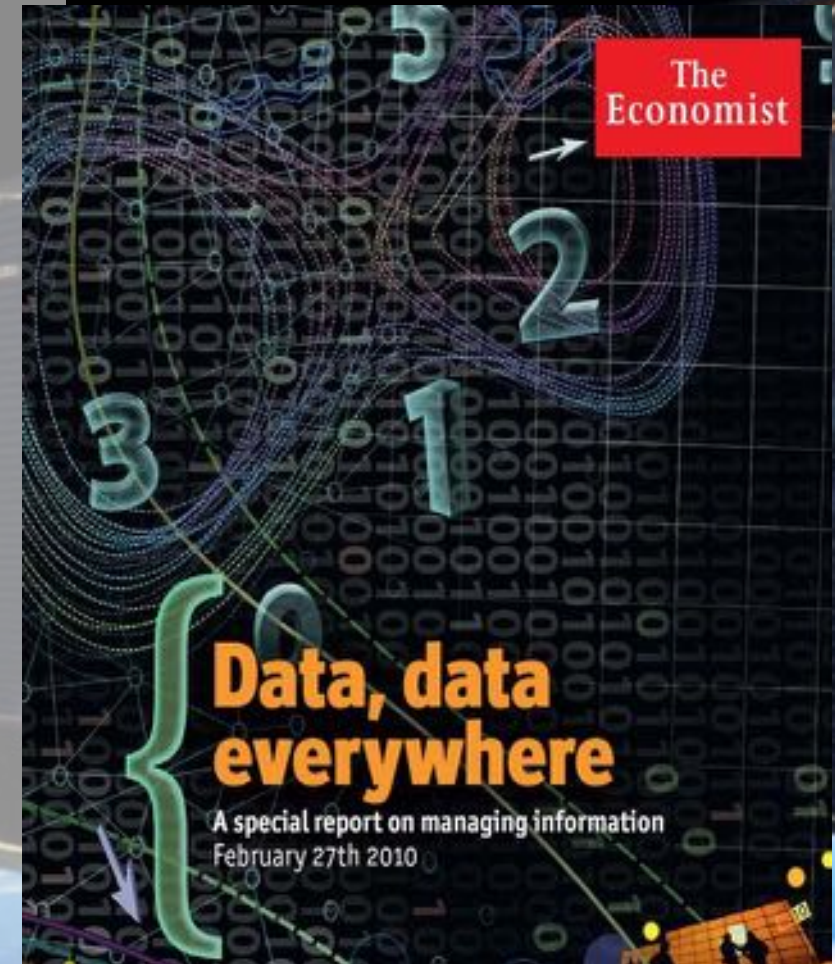
Earth Digital Twin



Pattern of life



- The space industry is fast moving to a new paradigm as consequence of breakthrough innovations in the space domain and in the data exploitation through a global connectivity infrastructure, incredible growing computing capabilities from mapping/imagery to continuous monitoring and information flow
- The evolution of a new class of satellites and constellations allows a new space economy, a space democratization based on a great number of new services to be offered
- New value propositions are enabled by paradigm shift in data and information exploitation through new data and services access platforms to address the need of a vast range of traditional and new users
- Customer base is moving to a wide community of users and Space dimension of IoT just started. IT will surely play a key role in this (r)evolution



WE SCAN THE EARTH

e-geos

EYES ON THE EARTH

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