

January 2022

Discussion on EO potential evolution, based on 2021 observations

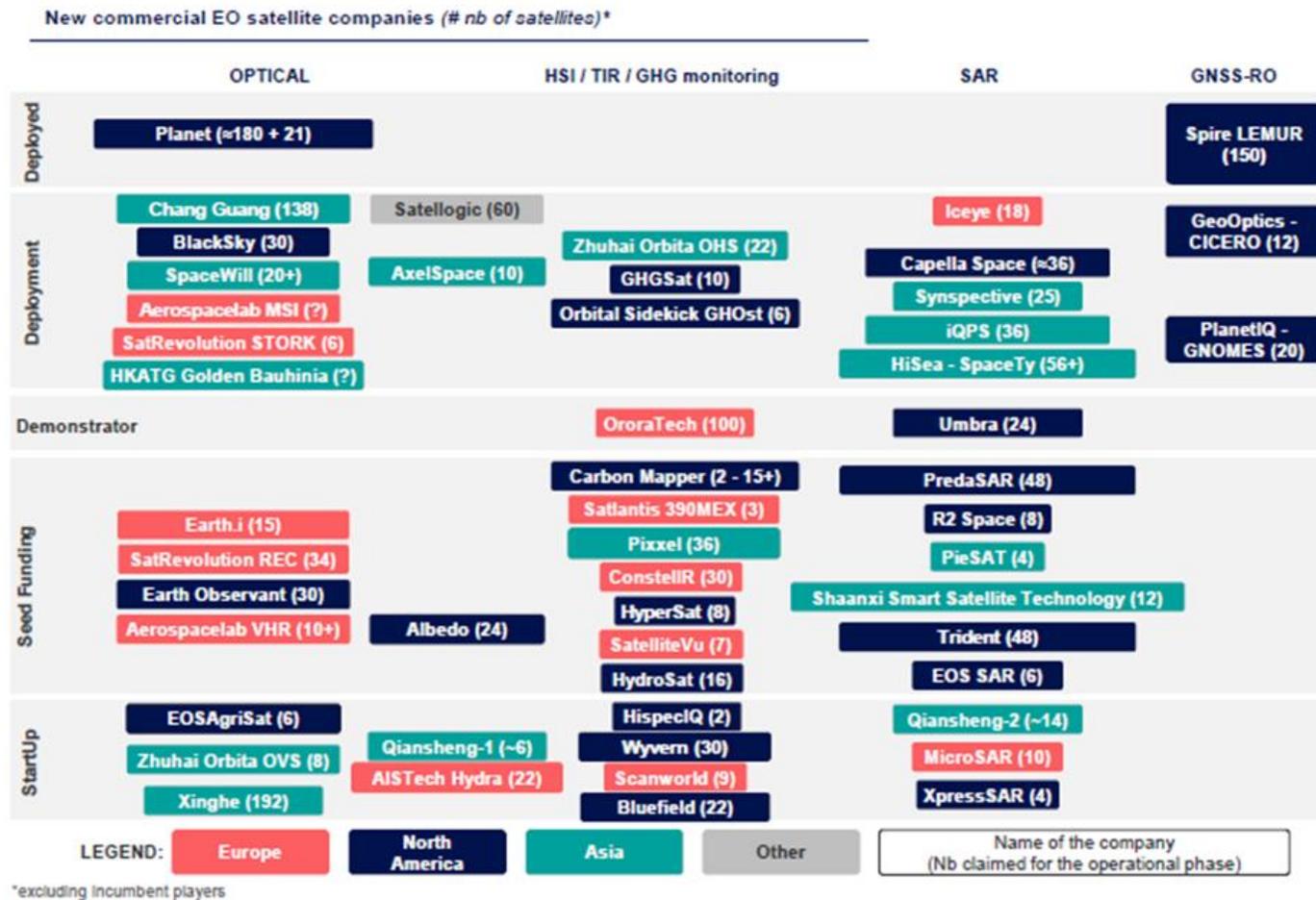
2021 was a good year for EO

All market components experienced growth

The EO downstream industry is developing on all continents

New constellations projects and record numbers of launches

In a positive mood for projects financing



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- Year has been good, perspectives are great and the whole EO ecosystem finally takes off (at last!)
- On going deep transformations (AI at all steps, generalysed platformization, simplified access for users) allow to cover larger uses and reach non expert users (at last!).

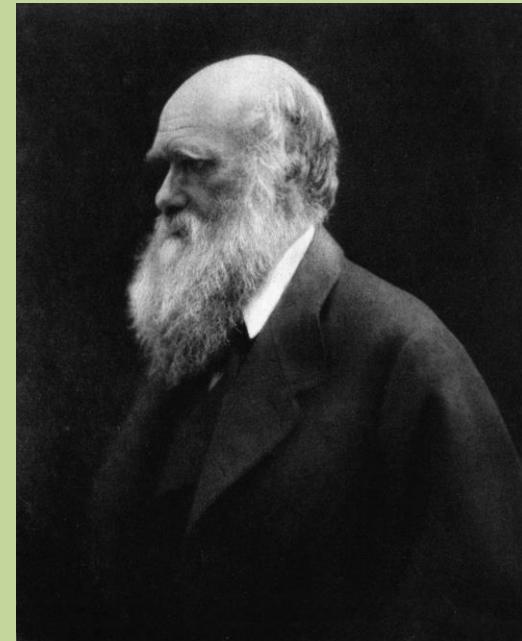
2021 Motto for EO



Everything is fine!

- OK, everybody agrees that there are too many
- Constellations projects,
 - EO platforms,
 - EO market places,
 - EO data spaces,
 - or digital twins.

But a little bit of natural selection and vital competition should solve that.



There were insightful papers published during the last two years

Acta Astronautica 166 (2020) 431–443

Contents lists available at ScienceDirect

Acta Astronautica

journal homepage: www.elsevier.com/locate/actaastro

From new space to big space: How commercial space dream is becoming a reality^{a,*}

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ARTICLE INFO

Keywords:
 NewSpace
 Innovation
 Space economy
 Space ecosystem
 Start-ups
 Venture capital

ABSTRACT

New space is a misleading expression. Many new trends steer the evolution of space activities. Development of commercial space, with start-ups and space ventures, is one of the most visible trends in space. Stimulated by the first initiatives related to space tourism, access to space and the growing use of small satellites, space activities have attracted new entrepreneurs, both start-ups and big web actors, with an historical investment capacity. This revolution started in the 2010s, today and spread worldwide. Start-ups have attracted around \$2.18 billion of investment from 2010 to 2018. It is far below the actual institutional budgets but the pace gained momentum since 2006 and especially 2012.

Between teenage crisis and age of reason, New space is now old: the first startups shall confirm their promises, while new players pop up and try to find their way. It shakes the legacy players but they demonstrate resilience and adaptation capacity. It is now the right time to take stock of the first lessons learnt. Start-ups disrupt the established industry? In most of a simplistic doctrine, this paper reports an "organizational ecology" study. With a deliberate industrial viewpoint, its intention is to help understanding complex evolutions in the space ecosystem.

The first part of the paper introduces the current ecosystem, its actors, the key trends and the main types of activities. Through facts and figures on technology, investments and markets, the second part reviews how "new space" model are preparing the advent of big space. The third part summarizes lessons from other industries and typical disruption scenarios that could affect space activities. The dream of New space are discussed in section four. The last part is a thought exercise, discussing possible evolutions and impacts, it means and opportunities. The decisive role of institutional actors, and the a new space with more and more spacefaring nations is also highlighted.

Something big is happening in space. While it is too early to depict the new landscape, this study shows that the future picture will not be black and white but more colorful. The size and the speed of the company are less important than agility, resilience, ability to manage risks and to cooperate. A big vision for the future, from entrepreneurs or from nations, is also needed.

1. An organizational ecology of new space

2.1. Taking stock of new space trends and impacts on industry

This paper reports a first study on the evolution of the main, new or older, stakeholders of space activities in the context of New Space and growing weight of commercial space activities. The main objective is to provide an overview of new trends in space activities and an assessment of the impacts and possible evolutions of commercial space and its relation with institutional actors. Many papers address new space in a specific domain (Earth Observation, Insurance, etc.). Without providing a new in-depth sectorial analysis, the original dimension of this study is to focus on interfaces and dependencies between the stakeholders of the space ecosystem. This is an "organizational ecology" study who sets the new research: How do they affect the existing companies and what is their impact on the market? How will

^a Special thanks to François Auger, Nicolas Chenuy, Jean Daughin, Pierre-François Deschê, Arnaud de Turenay, Serge Flamentstein, Bruno Le Stum, François Lombard (Atlas Defense and Space), Isabelle Sauthier-Vergier (CNRS), Arthur Soutary (Orbita Montaigne), Mandy Star, Janice Stankov (Space Space and Technology).

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iaI Istituto Affari Internazionali

Space and the Future of Europe as a Global Actor: EO as a Key Security Aspect

by Jean-Pierre Darnis, Xavier Pasco and Paul Wohrer

FONDATION pour la RECHERCHE STRATÉGIQUE

ABSTRACT

Earth Observation (EO) data has become a strategic asset for the European Union. It is a backbone of the European Union external projection capabilities, enabling the monitoring of maritime, land and atmospheric environments, and climate change projections. It is also instrumental in conducting two non-scientific missions, providing emergency management and security services. The economic benefits provided by Copernicus have been estimated to 15.5 billion euro in less than ten years. However, new technologies and data management capabilities may hinder the benefits it provides to European service companies: most Copernicus data are exploited by non-European industries, able to leverage most of the benefits thanks to a robust data storage and analysis infrastructure. Increased economic and security benefits could be extracted from Copernicus data thanks to technological and policy solutions. The technological solution would consist in a European Cloud Infrastructure providing storage and analytical capacities to European small and medium enterprises. The policy solution should push for better space data regulation, to guarantee their integrity and use, especially for security services. This paper explores the emerging need of a European space and digital security posture, able to ensure continuity and growth of EU space-based capabilities. While European Space Agency (ESA) EO programmes are growing, the new European Commission DG "Industry, Defence and Space" shall play a key role to reinforce this framework.

This research has been supported by a grant from the European Space Agency.

Space policy | Earth observation | Satellite | Space security | European Union satellite cooperation

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STUDY
 Requested by the ITRE committee

European Parliament

Space Market

How to facilitate access and create an open and competitive market?



Policy Department for Economic, Scientific and Quality of Life Policies
 Directorate-General for Internal Policies
 Authors: Mark WHITTLE, Andrew SIKORSKI, James EAGER
 and Elias NACER
 PE 695.483 - November 2021

EN

**The new
« newcomers »
benefit from an
unprecedented
situation**

**A unique and
worldwide
combinaison of
instant access to:**

- Technologies,
- Launch,
- Financing.

And this supports the most heard marketing narrative of 2021

9:30 AM



- « This information should be verified »

11:05 AM

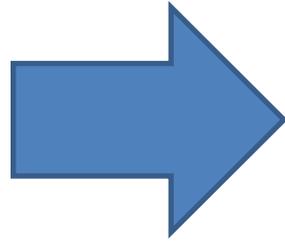


- « Image has been acquired at 10:10 am
Here is the interpretation »

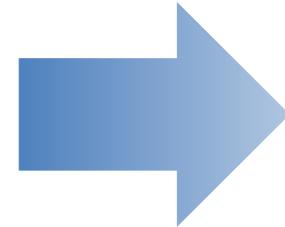
A new context for the new « newcomers »

A unique and worldwide combinaison of instant access to:

- Technologies,
- Launch,
- Financing.



Potential for the emergence of profitable commercial services in parallel with the development of key actions for sustainable development



Unprecedented potential for the development of irresponsible and useless activities at all levels of the chain

Reflections anchored in a written impressionist note (in French)

Des résolutions de plus en plus troubles

Des algos à tous les niveaux

Des modèles économiques qui s'affinent mais ...

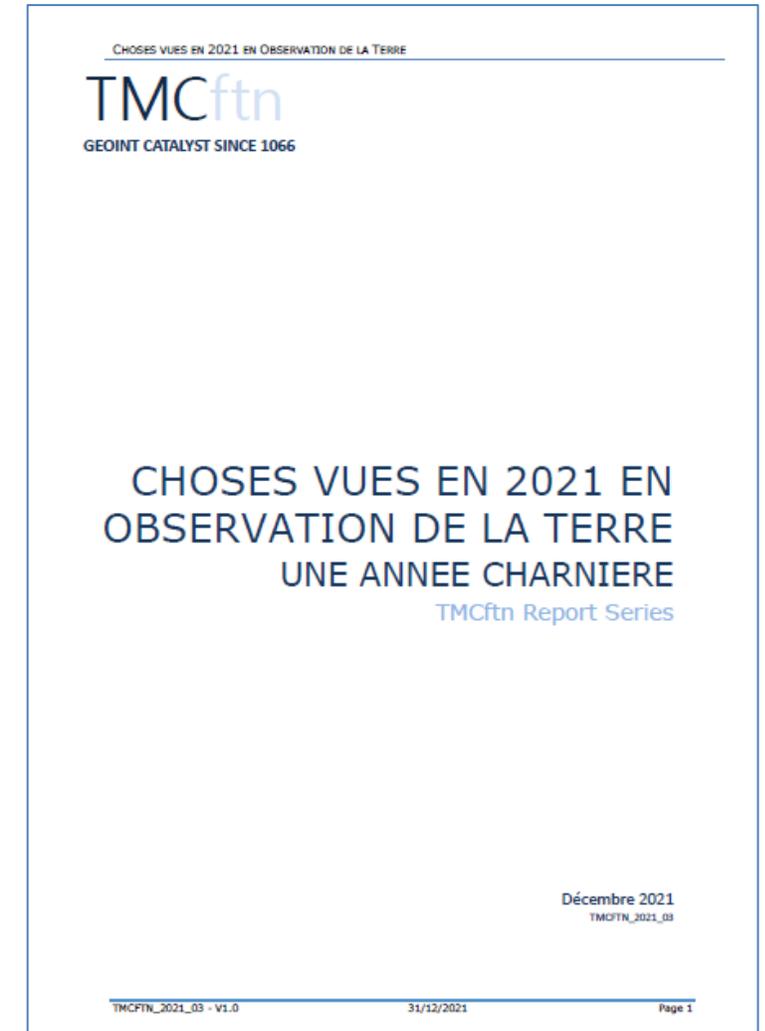
2021, l'année du radar ?

La remontée en puissance des GAFAM et les enjeux des plateformes

Financements innovants, vraie solution ?

La consécration de nouveaux utilisateurs

Une année charnière



[Download the note](#)

China: Preparing for Phase 2?

Growing political instrumentalization

Relevant but not assumed technological breakthroughs

A partially bogus debate on the role of GAMAx

SPAC for EO: Greater Caution in the Financial Markets

Discussion on EO potential evolution, based on 2021 observations

CHINA: PREPARING FOR PHASE 2?

Continuity

- High level launch activity and capacity building
- Parallel activism of institutions, regional and commercial actors
- Significant fundraising (Adaspace is the most interesting)
- Growing number of downstream actors (Analytics)

New Trends

- A Radar year
- Associations between institutional players and new players on key programs
- Heavy support for on-board AI processing
- Closer ties between the Space ecosystem (civilian & military), the Security ecosystem and the Digital Giants

Preparing for Phase 2?

Operational capabilities in all spectral bands foreseen for 2023/24

On going rationalization between « traditional » and « new » projects

The Security ecosystem brings a needed set of capabilities (ground and airborne sensors, cloud, AI/ML)

Greater control on Digital Giants created parasite effects (e.g. Tencent setbacks) but create long term opportunities

China had so far limited international success (both on commercial and on Silk Road projects).

This could change, starting in 2023, with those evolutions.

Discussion on EO potential evolution, based on 2021 observations

GROWING POLITICAL INSTRUMENTALIZATION

It starts with an Olympic style ranking last April. NGA says...

Zero information on:

- Methodology
- Criteria
- And even category choices



This ranking brings significant attention and media coverage

NGA warns U.S. lead in geospatial intelligence is being challenged

by Sandra Erwin — March 2, 2021

Analysis: China, satellite imaging

by Charles Beames — June 17, 2021



An image taken Aug. 9 over the BlackSky's current fleet of six

Via Satellite

Search

IIOT

January 11, 2022

Eutelsat and Senet Partner on Terrestrial and Satellite LoRaWAN IoT Connectivity

Government/Military

January 11, 2022

HawkEye 360 Wins \$15.5M US Air Force ISR Deal

5G

January 11, 2022

Telesat to Trial 5G Connectivity With ENCQR in Canada

Business

January 10, 2022

Momentus President Fred Kennedy Steps Down

Government/Military

January 10, 2022

Dr. Katherine Calvin Named NASA's New Chief Scientist, Senior Climate Advisor

NGA plans annual survey of international Earth imagery

Imagery and Sensing

Foreign Players Catch Up to US in Commercial GEOINT Competition, Official Says

By Calvin Biesecker | October 8, 2021



NGA notes advantages of unclassified commercial data

by Debra Werner — November 15, 2021

The Future of Geospatial Intelligence: A Dispatch from GEOINT



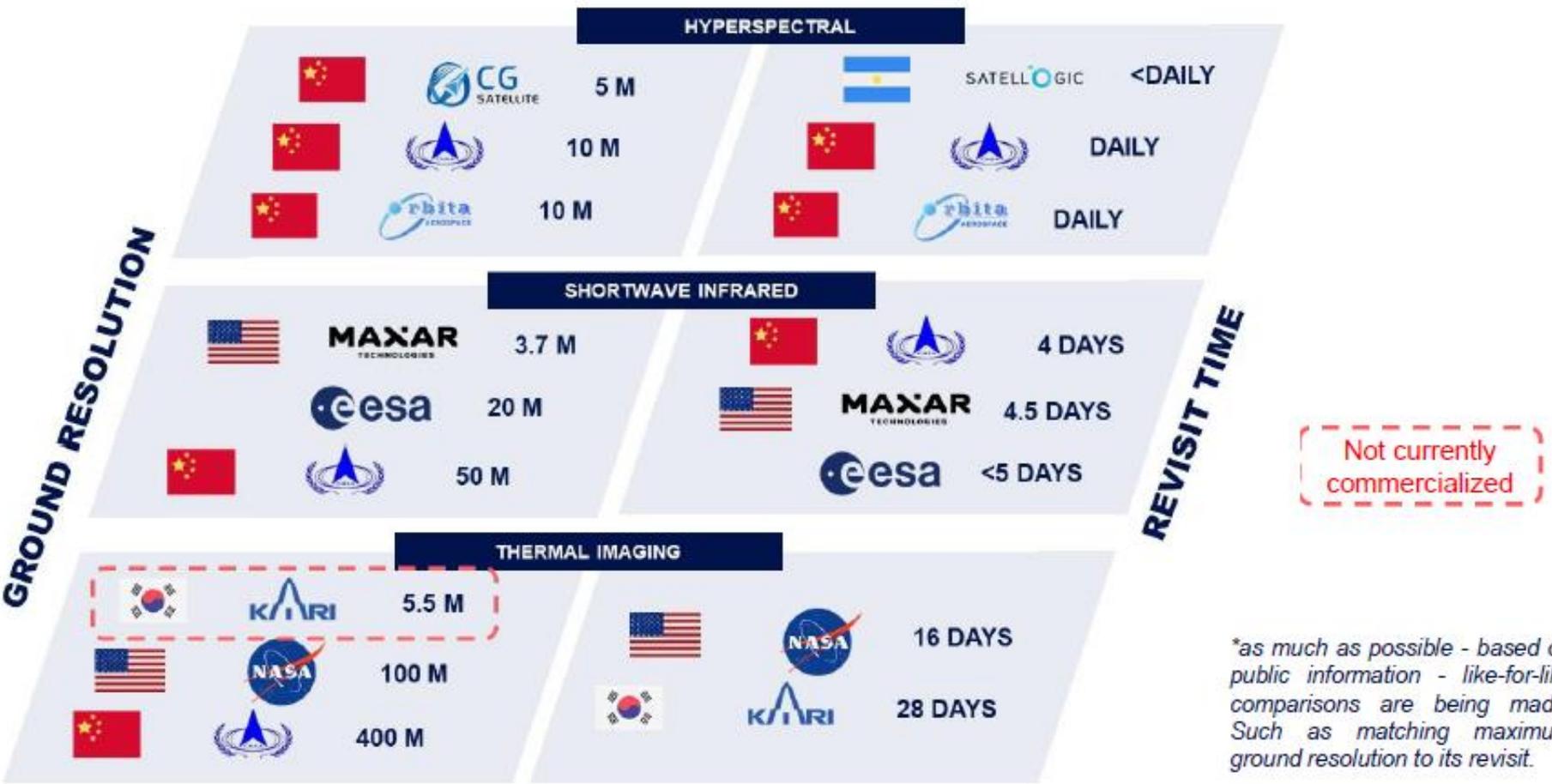
ST LOUIS...
the num...
soon be...
being m...

Dave Gauthier, director of NGA's Commercial and Business Operations Group, discussed unclassified commercial geospatial data during a Nov. 15 GovExec TV program. Credit: GovExec screenshot

And very soon, it becomes a « standard » presentation...



BENCHMARKING TECHNOLOGY: CURRENT SITUATION



In fact, there is no worldwide up to date compendium on EO capabilities

[CEOS](#)

ESA's [EO Portal](#)

WMO's [Oscar](#)

USGS's [JACIE](#) Online
Compendium

[NOAA NESDIS](#)
[Tiering Document](#)

NGA ?

Bryce

Euroconsult

[Nanosats.eu](#)
[NewSpace Index](#)

[Gunter's Space](#)

[Union of Concerned](#)
[Scientists](#)

It has consequences on the licensing process

Satellite or Constellation	Country	Resolution (type) ¹ Spectral or Other Information	Number of Satellites (advertised revisit rate) ²
PANCHROMATIC (PAN)^{3,4}			
KOMPSAT-3A	S. Korea	0.40 meter (m) (spatial) ⁵ (0.54 m raw)	1 (2.7 days <20° off nadir)
KOMPSAT-3	S. Korea	0.50 m (spatial) ⁶ (0.7 m raw)	1 (2.7 days <20° off nadir)
SuperView	China	0.50 m (spatial)	4 (24 hours)
Pléiades	France	0.50 m (spatial)	2 (24 hours)
EROS-B	Israel	0.70 m (spatial) ⁷	1 (5–6 days)
Jilin-1 Optical	China	0.72–1.06 m (spatial)	23 (4 hours) ⁸
Best US	US	0.25 m (spatial)	4 (<1 day)

Extract document

[Remote Sensing License Tiering 2021 Q3](#)

© NESDIS NOAA 2021

¹ Resolution types listed in this column refer to spatial resolution, measured in meters (m), spectral resolution, measured in nanometers (nm), thermal accuracy or resolution, and measured in Kelvin (K). As other types of resolution become relevant to the listed capabilities, they will be added to this column.

² CRSRA currently reports revisit rates as advertised by the constellation operators or, in absence of operator information, as advertised by resellers.

³ India's Cartosat-3 satellite collects PAN imagery with up to 0.25 m resolution and MSI at 1.1 m but does not meet the criterion for availability (data access is "very constrained") therefore it cannot be used as a commercial benchmark. Source: <http://database.eohandbook.com/database/instrumentsummary.aspx?instrumentID=917>

⁴ TripleSat (DMC3, SSTL S1-4) was removed. Although SSTL S1-4, the fourth satellite in the constellation, was initially launched in 2018 into a lower (580 km) orbit versus DMC3A/B/C (645 x 670 km orbit) the overall performance of the constellation is advertised as 0.80 – 1.0 meter. At 80 cm, it is no longer benchmark level.

⁵ Kompsat-3A equipped with 80 cm aperture AEISS camera, 8.6 m focal length telescope. 528km altitude. Kompsat-3A native resolution is 54 cm and the oversampled data is processed to produce 40 cm resolution at nadir. Source: ESA EO Portal. Retrieved Sept 22, 2021

⁶ Kompsat-3 equipped with 80 cm aperture AEISS camera, 8.6 m focal length telescope. 625km orbit. Native resolution is 70 cm, the oversampled data is processed to 50 cm resolution at nadir. Source: ESA EO Portal Retrieved Sept 22, 2021

⁷ Apollo Mapping reports EROS-B data as 70 cm for both PAN and Night-Time imaging.

⁸ The Jilin constellation operated by Charming Globe contains a variety of satellite types, including, as of March 4, 2021, 11 high-resolution optical, 12 video, and 2 hyperspectral. The values here are as reported by Charming Globe and Apollo Mapping. The revisit rate for Jilin-1 varies by product.

Allows the multiplication of lies and half-truths in international competition

Yes, a long time ago, Digital Globe explained to its customers that the use of Pléiades would lead to « potentially devastating errors ».

But the growing number of lies or half-truths by newcomers is « legitimized » by biased analysis of their national institutions.

Our best-in-class accuracy is precise and actionable



DigitalGlobe Accuracy



Customer Impact:
Accurate and precise actions

Closest Satellite Competitor



Customer Impact:
Potentially devastating errors

The perfect illustration that the game is now extremely political



2019

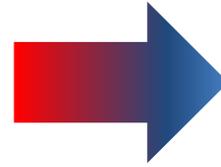
Satellogic selects China Great Wall to launch satellite constellation

by Jeff Foust — January 15, 2019

The project, called “WeEarth” is a partnership between Tencent Cloud, Satellogic, Luokung Technology and China Aerospace Science & Industry Corp Haiying Co Ltd. It aims to deliver 300 remote-sensing satellites capable of offering Earth observation services to industries ranging from agriculture to forestry, the company said.

Argentine start-up seals rare China space imaging deal

Backing from Tencent helps give Satellogic an advantage in embryonic but expanding market



2021

Satellogic signs multi-launch contract with SpaceX

by Jeff Foust — January 20, 2021

Earth observation company Satellogic expands partnership with Amazon Web Services

by Sandra Erwin — October 8, 2021

Satellogic Announces Upcoming Appointment of Six New Board Members

New appointments to Board of Directors will enhance Satellogic's leadership and expertise as company prepares for public listing

Members to bring extensive relevant experience from NASA, Boeing, Google, Cloudera, Massachusetts Institute of Technology, Caterpillar and MercadoLibre

JANUARY 18, 2022

Secretary Steven Mnuchin's Liberty Strategic Capital to Invest \$150 Million in Satellogic and CF Acquisition Corp. V (Nasdaq: CFV)

Discussion on EO potential evolution, based on 2021 observations

RELEVANT BUT NOT ASSUMED TECHNOLOGICAL BREAKTHROUGHS

New possibilities

Ability to offer "the same" resolution through a diverse range of possible orbital, satellite and instrument choices

On Board Pre-Processing or Processing



New tools (beyond Shannon) to improve spatial resolution (x 1,5 to x 10)



New tools allowing to improve image readability and its potential for interpretation



Data preparation for algorithmic processing (ARD...)



Improved metadata and cataloguing tools (STAC...)

Developer and user friendly APIs

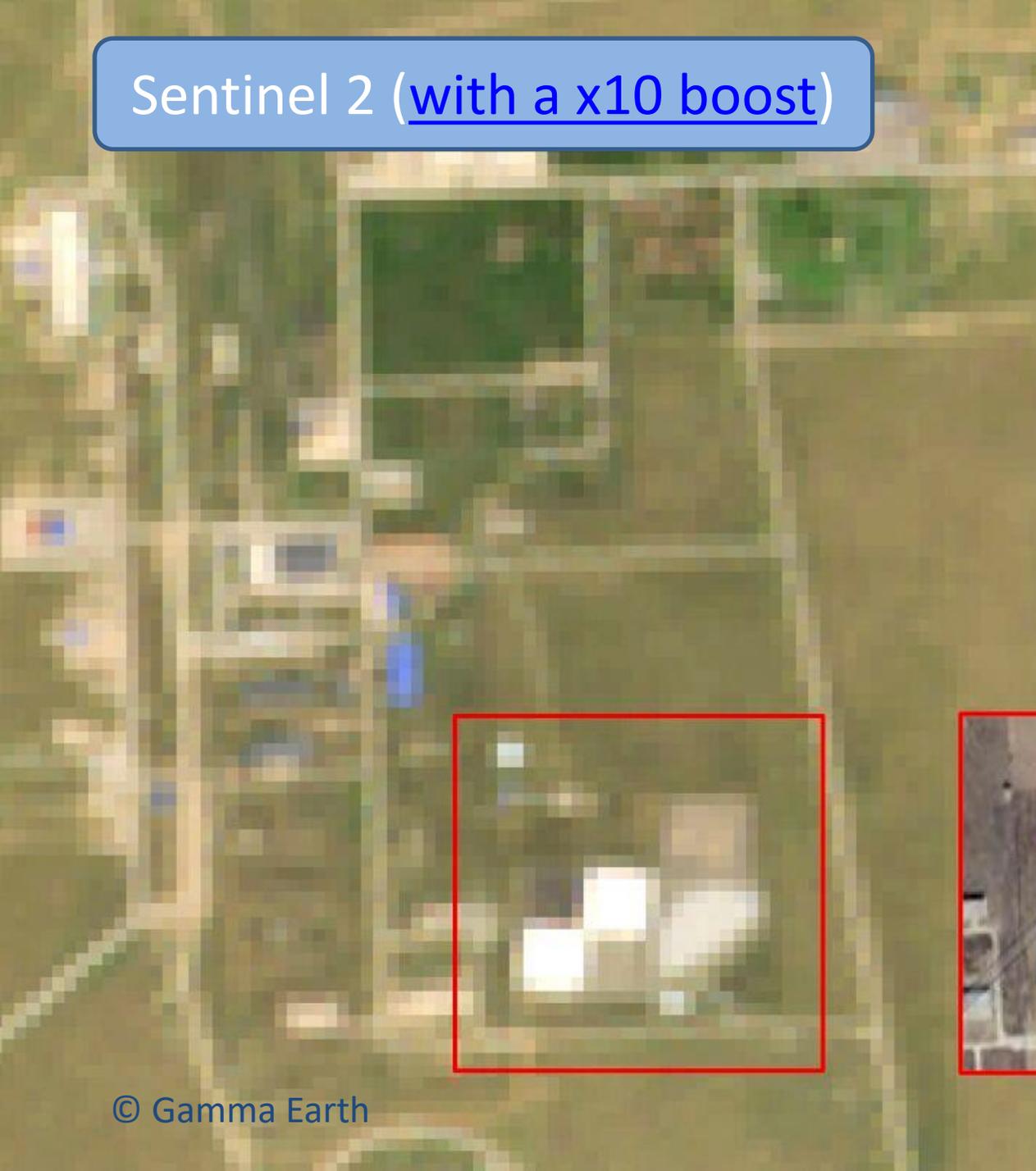
* STAC : Spatio Temporal Asset Catalog

Pléiades Néo (angle 3°)

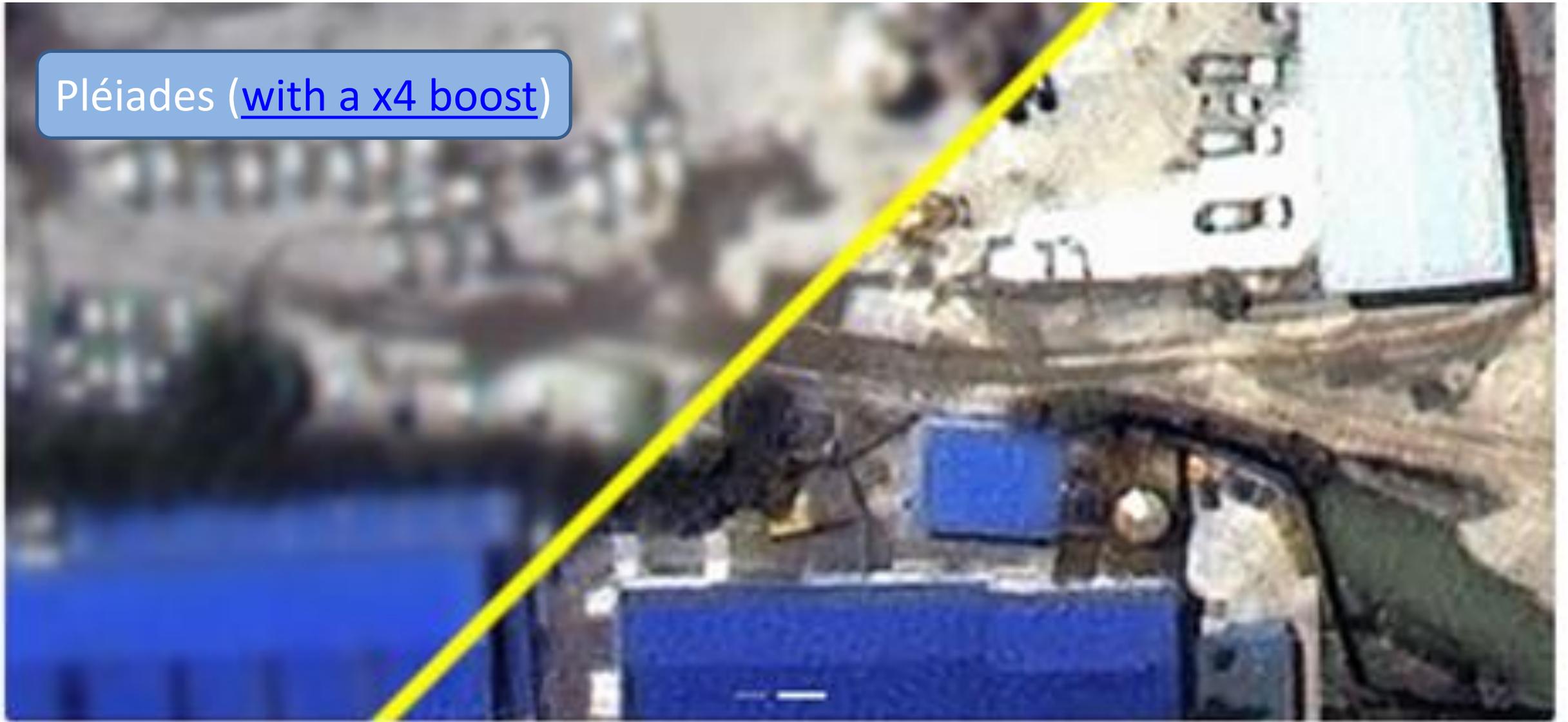
© Airbus DS



Sentinel 2 (with a x10 boost)

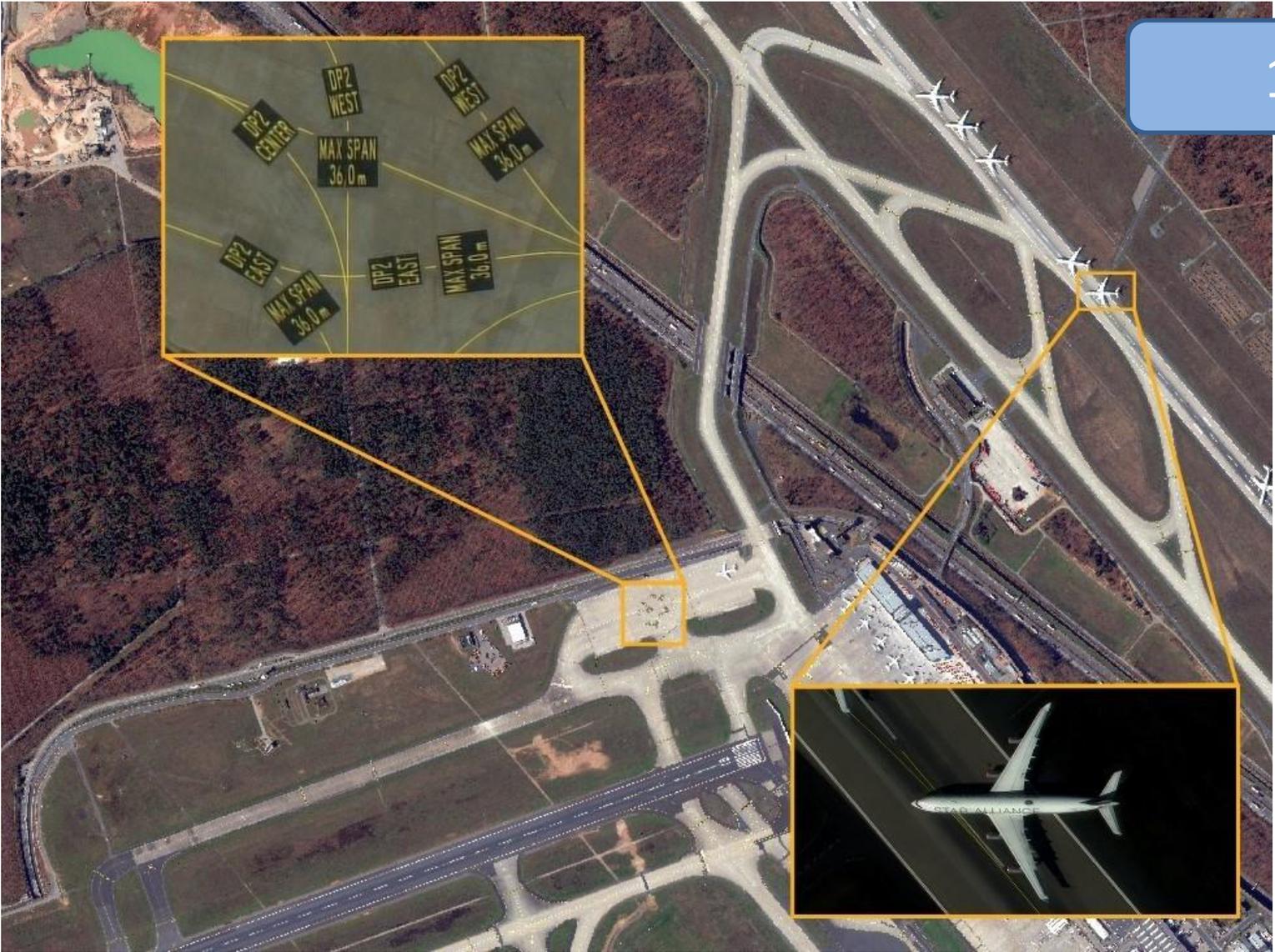


Pléiades (with a x4 boost)



© UP42 / Aventior

And even the biggest market player has included it in a standard offering



15 cm HD Maxar

© Maxar, 2021

What are the consequences

No need to criticize these new tools which each have their own logic and bring solutions, but ...

Notions (e.g., resolution) that seemed clear and shared become somehow fuzzy

2 users working on the same situation based on the same image will end up with different interpretation, depending on their streaming provider

Purely technical answers on those issues (e.g., metadata, STAC) will not really address the challenge (especially in NRT activities)

It already becomes complex for expert users. What about the non experts (the main new target of all EO marketing efforts)?

Could this drive to simplify everything for the user create an added trust issue on the data?

* STAC : Spatio Temporal Asset Catalog

Will we need an
organic label for
imagery?



Discussion on EO potential evolution, based on 2021 observations

A PARTIALLY BOGUS DEBATE ON THE ROLE OF GAMAX

GAFAM are everywhere in the 21st Century Economy. We let them become as or more powerful than states

Ok, but what is the specific situation in our EO domain?

And what do we do about it?

Involvement of GAMAx (Google Amazon Microsoft Alibaba and Co)

	Involvement in								
	EO Sats	Com Sats	Ground Reception	Cloud Infra	Analytics Platform	Research Education Platform	Market Place	EO Apps	Digital Twins
									
									
									
									
									
<i>Tencent</i>									

Our EO data are now everywhere

Analytics or
Insight Providers

Data Spaces

Platforms &
Market Places

Infrastructure IaaS

Satellite Operators

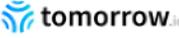
Ubiquitous access through multiple ways

Multiple platforms, data spaces and market places (public, commercial, dual) at different levels of the value chain

In fact, there are so much overlapping development that it became the favorite activity for consultants : define a typology and classify the different platforms

Earth Observation: Operating Stack

INTELLIGENCE

Layer	Description	Business Model	Examples (non-exhaustive)
 Application	Develop software for end users solving a industry-specific problem with EO data being one of many technologies used in the solution	Software-as-a-Service (Domain Experts)	           
<i>Abstraction layer for the Earth observation industry</i>			
 Insights	Convert satellite-based analytics into insights, for a specific industry or domain, with EO data being the forefront of the solution	Insights-as-a-Service (Quasi Domain Experts)	         
 Analytics	Transform satellite imagery into information using AI and remote sensing techniques, applicable across multiple industries / domains	Analytics-as-a-Service (Domain Agnostic)	          

DISSEMINATION

 Platforms / Marketplaces	Offer computing environment allowing access to aggregated data / algorithms and infrastructure to derive analytics based on analysis-ready data	Platform-as-a-Service (Data Agnostic)	        
 Infrastructure	Provide scalable cloud infrastructure and supporting tools for storing and processing satellite data	Infrastructure-as-a-Service (Data Agnostic)	       

ACQUISITION

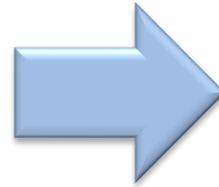
 Data	Build and launch satellites with different sensors to collect different kinds of data from space for a variety of use cases	Data-as-a-Service (Vertically Integrated)	            
---	---	--	---

**Non-exhaustive*

But most of those platforms, places, spaces have a limited future

Peter Thiel's criteria on « How to judge a potentially true monopoly »

- Proprietary Tech
- Competitive edge: x10
- Network Effects
- Economy of Scale
- Branding



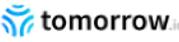
If we look at the european platforms, data spaces or marketplaces using those criteria...

... very few (none ?) will ever have a significant impact.

Nevertheless, the European ecosystem (both public and private) pushes for the creation of new projects every month.

© Peter Thiel, 2014

INTELLIGENCE

Layer	Description	Business Model	Examples (non-exhaustive)
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 Analytics	Transform satellite imagery into information using AI and remote sensing techniques, applicable across multiple industries / domains	Analytics-as-a-Service (Domain Agnostic)	          

Which platform could really play the role of Gate Keepers*?

Abstraction layer for geospatial & remote sensing industry

DISSEMINATION

 Platforms / Marketplaces	Offer computing environment allowing access to aggregated data / algorithms and infrastructure to derive analytics based on analysis-ready data	Platform-as-a-Service (Data Agnostic)	        
 Infrastructure	Provide scalable cloud infrastructure and supporting tools for storing and processing satellite data	Infrastructure-as-a-Service (Data Agnostic)	       

Abstraction layer for the space industry

ACQUISITION

 Data	Build and launch satellites with different sensors to collect different kinds of data from space for a variety of use cases	Data-as-a-Service (Vertically Integrated)	           
---	---	--	---

* See the European Digital Market Act (DMA)

*Non-exhaustive

And their leadership goes beyond purely business activities

Google Earth Engine

[Platform](#) [Datasets](#) [Commercial](#) [Timelapse](#) [Case Studies](#) [FAQ](#) [Sign Up](#)



Earth Engine for Commercial Use: Now in Preview with Google Cloud

 Microsoft | [Planetary Computer](#) [Explore](#) [Data Catalog](#) [Hub](#) [Applications](#) [Documentation](#) [Request access](#)

Insights for a more sustainable future
Understand and tackle critical sustainability challenges like
water management



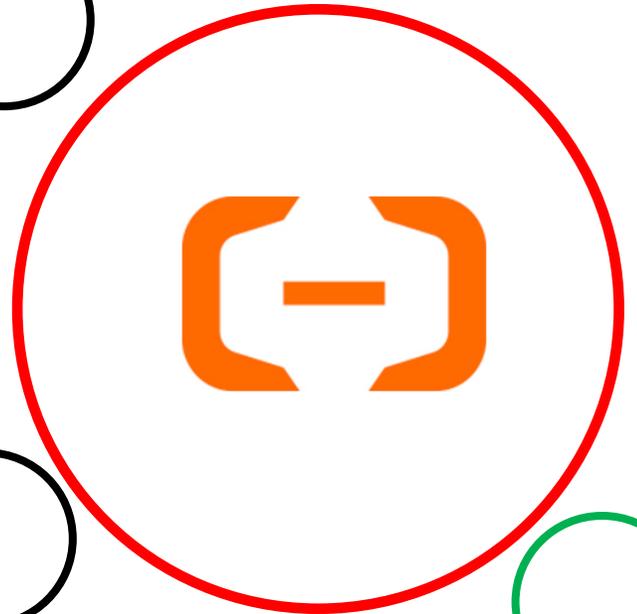
A Planetary Computer for a Sustainable Future



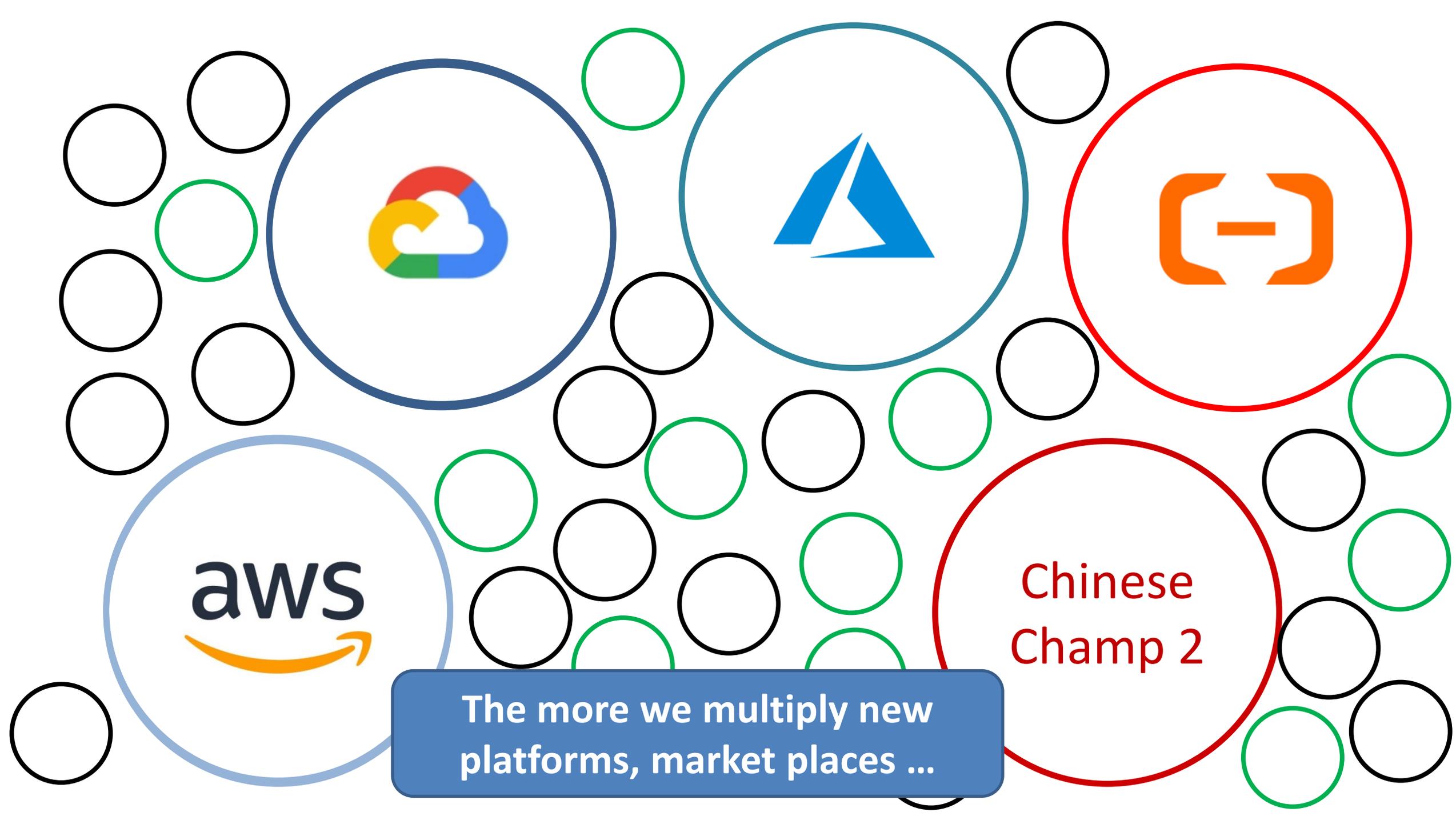
We will have 5 actors with worldwide ambitions



Chinese
Champ 2



The more we multiply new platforms, market places ...



The less we leave a vital space for
a possible European champion



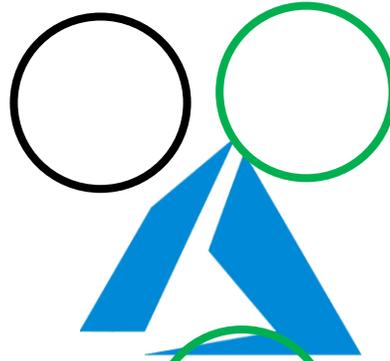
aws

The AWS logo, consisting of the lowercase letters 'aws' in a dark blue font with an orange arrow pointing to the right, is positioned inside a light blue circle.

European
Champ

Chinese
Champ 2

And at the end...



aws



Chinese
Champ 2



- **Large commercial actors have already chosen their strategy (Airbus, Planet or ESRI 2021 actions are good examples)**
- **Vertical projects with deep and real involvement in their business domain do have a future (but for the most part, they will rely on GAMAx for infrastructure and analytics tools).**
- **Projects that are poorly designed or without clear positioning are doomed to death.**

Rather than continuing the endless work of "platform mapping", it is time to clearly identify the duplication of efforts and projects overlaps and to draw lessons from them in terms of financing or support?

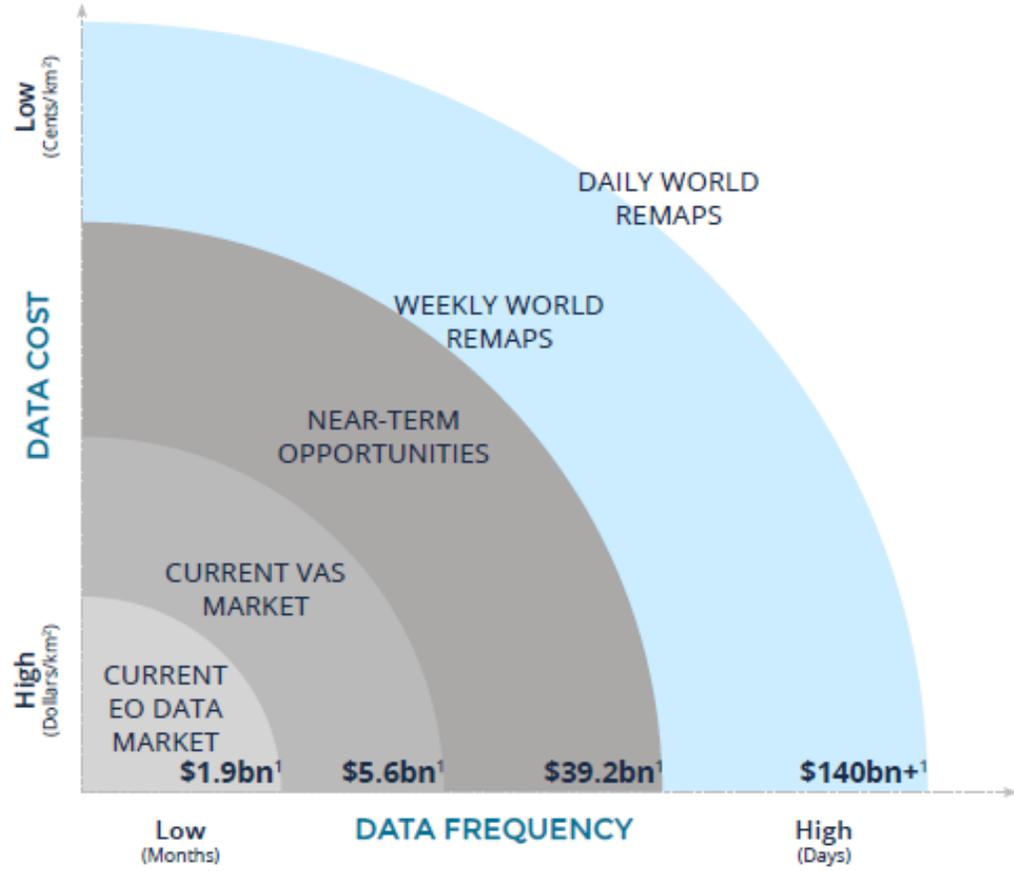
- **This debate on platforms, marketplaces and data spaces will very soon move to digital twins (with the exact same actors involved in the EO and IT communities).**

Discussion on EO potential evolution, based on 2021 observations

SPAC FOR EO: GREATER CAUTION IN THE FINANCIAL MARKETS

Market introduction: A complex (and rather schizophrenic) experience

© Euroconsult 2021



RESEARCHABLE EARTH¹

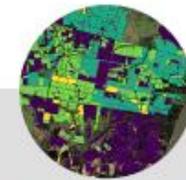


UPDATED CATALOG OF EVERYTHING ON EARTH

provide additional layers of insight...



Location



Predictive Models



Change Tracking

Driving better decision-making across industries to unlock a \$140Bn+ TAM²

¹ Based on full constellation of 300 satellites.
² Source: Euroconsult

A start that looks like a hazing...

- Very heavy redemption rate for EO SPACs (up to 95%)
- Analysts sensitivity to bad operational news
- Growing difficulties for new entrants after Spire, Planet and BlackSky poor performances





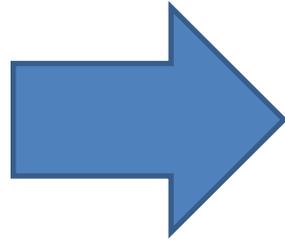
Discussion on EO potential evolution, based on 2021 observations

IN SHORT, WE ARE AT A CROSSROADS

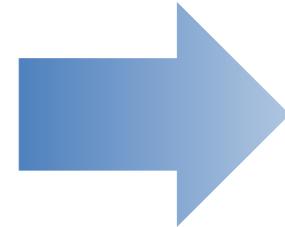
A new era starts, very different from what we saw in 2012-2019

A new, unique and worldwide combinaison of instant access to:

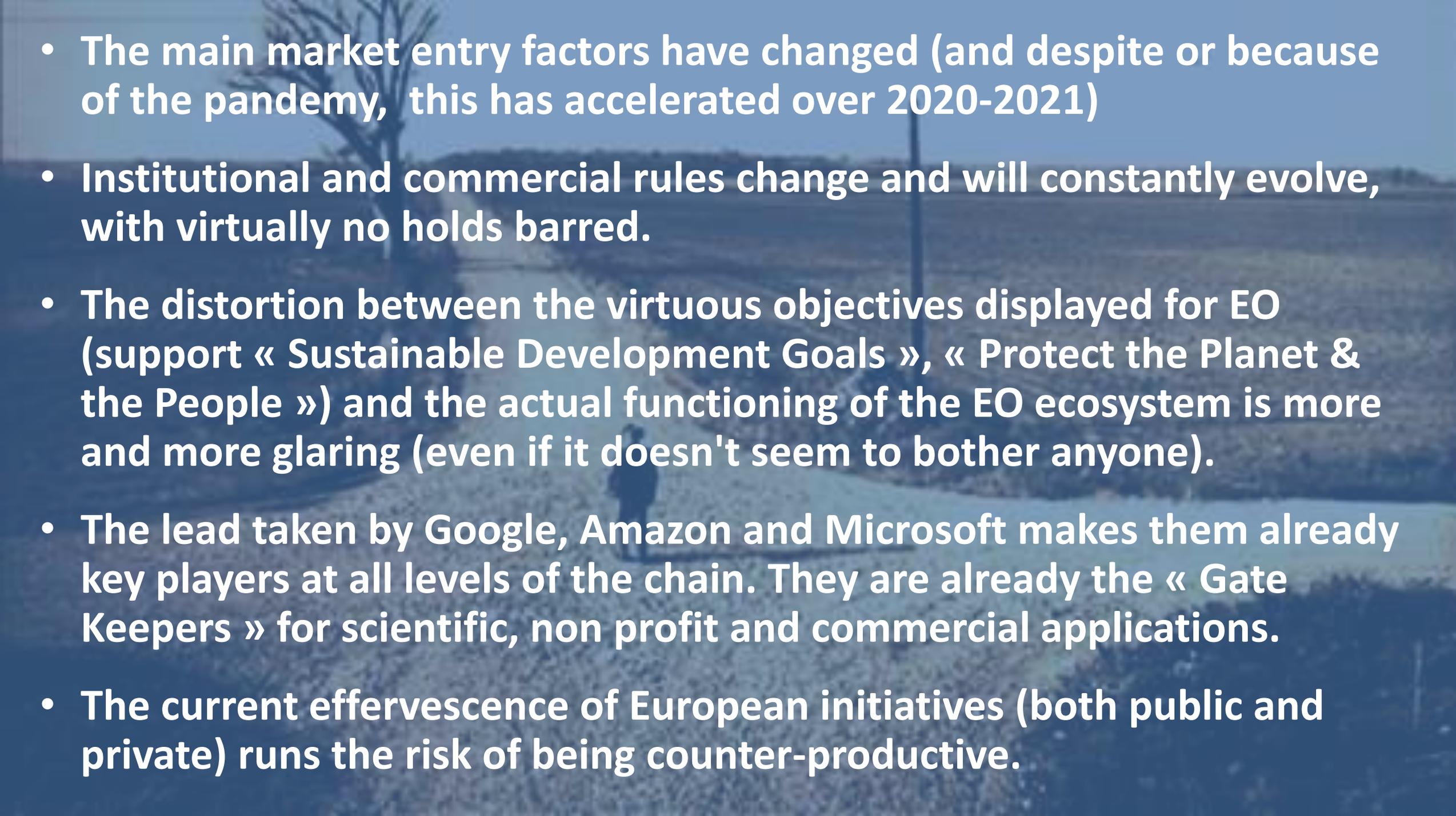
- Technologies,
- Launch,
- Financing.



Potential for the emergence of profitable commercial services in parallel with the development of key actions for sustainable development



Unprecedented potential for the development of irresponsible and useless activities at all levels of the chain

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- A person is walking on a dirt path that winds through a field. In the background, there are trees and a clear sky. The overall scene is peaceful and natural.
- The main market entry factors have changed (and despite or because of the pandemic, this has accelerated over 2020-2021)
 - Institutional and commercial rules change and will constantly evolve, with virtually no holds barred.
 - The distortion between the virtuous objectives displayed for EO (support « Sustainable Development Goals », « Protect the Planet & the People ») and the actual functioning of the EO ecosystem is more and more glaring (even if it doesn't seem to bother anyone).
 - The lead taken by Google, Amazon and Microsoft makes them already key players at all levels of the chain. They are already the « Gate Keepers » for scientific, non profit and commercial applications.
 - The current effervescence of European initiatives (both public and private) runs the risk of being counter-productive.



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Thank you for your attention