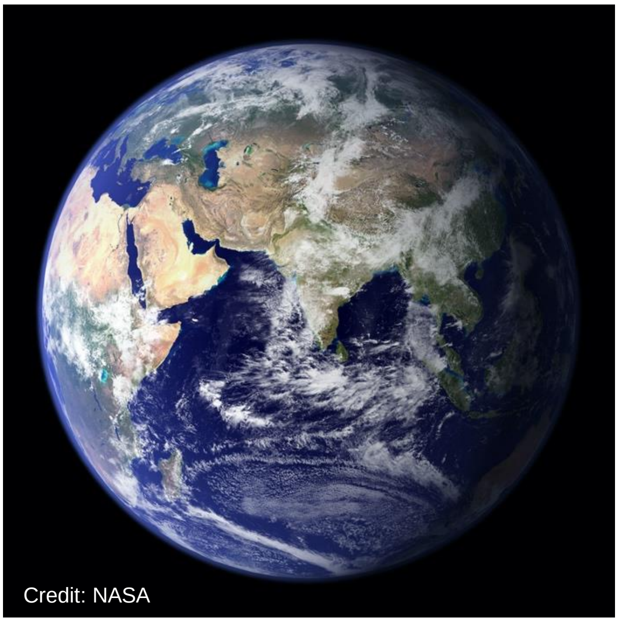
Space In Focus

Issue 2, May 2020

Earth Observation: a tool for a more resilient and sustainable world?

By Romain Esteve

As the world restarts and enters the next phase of the global pandemic, the question of "how to avoid the next crisis?" emerges. In this second issue of Space in Focus, Romain Esteve explores how EO data can be used to inform post-COVID-19 policy and meet the world's climate mitigation objectives. Technical barriers that prevent the wider uptake of EO applications are also discussed.



Credit: NASA

Related LE studies:

State of Commercial Earth Observation

Value of satellite-derived Earth Observation capabilities to the UK Government

IPP – Economic return to the UK

IPP – Cost-effectiveness analysis

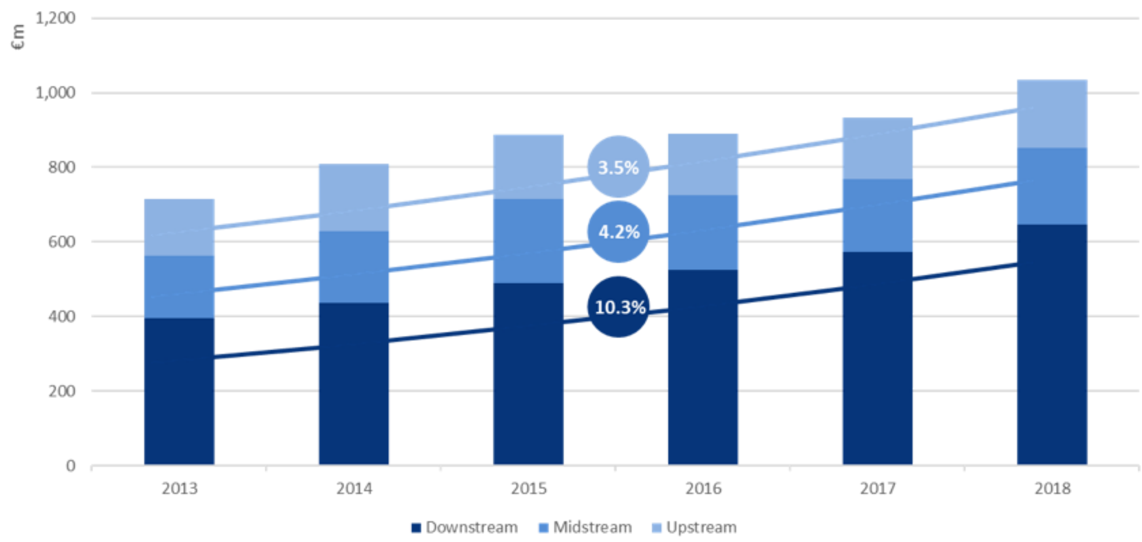
Economic evaluation of the Space for Smarter Government Programme

The state of Earth Observation

The Earth Observation (EO) industry has witnessed a fundamental change in the last decade. Commercial (NewSpace) constellations orbit alongside publicly owned satellites, generating unprecedented levels of data and contributing to a growing ecosystem of EO data and value-added services (VAS) for government and commercial customers.

Collectively, existing database are expected to exceed hundreds of petabytes globally: Planet forecasts that, upon completion of the next Dove constellation, up to 40 terabytes of data will be received every day, and the Sentinel constellation is estimated to produce more than 20 terabytes of data per day.

The growth of the EO market reflects this expanding volume of data. Our most recent study of the European EO industry shows that NewSpace companies have grown revenues from €700m in 2013 to €1,000m in 2018 (+7.6% CAGR). The value-added services (VAS) segment has been a particularly strong performer over this period, with revenues growing at +10.3% CAGR (see the Figure below).



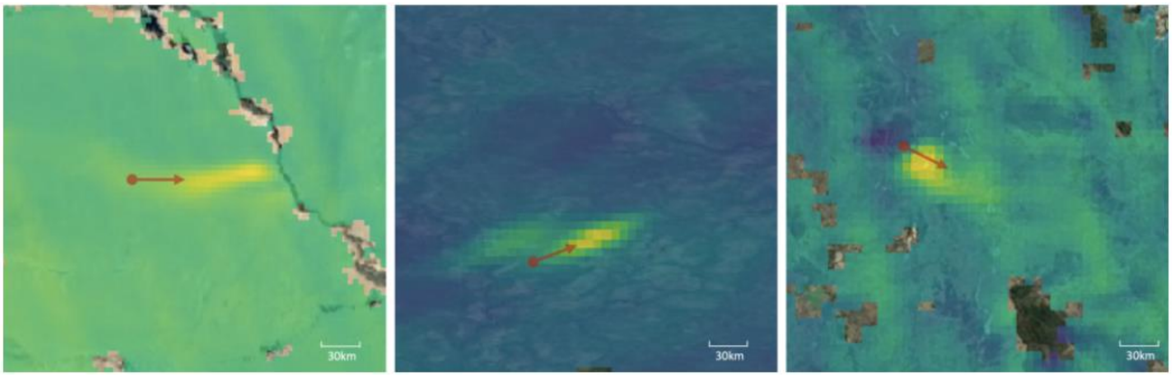
Source:* *London Economics (2020). The State of Commercial EO

The challenge and the promise

This growth in the VAS segment also reflects the application of more advanced transformation techniques such as AI and machine learning to extract more intelligence from raw data. These capabilities enhance our understanding of the planet at a time when decision-makers need unprecedented levels of intelligence to develop and enforce policy in the face of critical challenges such as climate change, environmental degradation and health crises. In some cases, these challenges are linked: habitat loss due to deforestation for agriculture, mining and urban settlement increases interactions between humans and exotic species, exacerbating the likelihood of zoonotic disease outbreaks like COVID-19.

In an open letter, the Bank of England warns about the future risks and economic consequences of climate change. The authors emphasise the need to place climate change at the heart of financial and societal decision making and the importance of identifying key climate-related decision metrics to inform these decisions. Space-based data can contribute to this effort: 35 out of 45 essential climate variables are already monitored from space.

Such space-based metrics may help support the UK and other countries meet carbon neutrality targets by informing policies about how best to achieve these targets and to support the enforcement of them. For example, the European company Kayrros has developed an innovative pollution monitoring technology that can track and quantify methane emissions back to their source using a mix of Sentinel, social media and ground sensor data, as shown in the figure below. Innovations like these demonstrate how important space-based sources of data will be for mitigating climate change.



Source: Kayrros – Mapping of methane emissions and wind direction (red arrow)

EO as a cost-effective tool to support environmental objectives

The UK Space Agency's International Partnership Programme (IPP)[1] has also demonstrated how EO can be a cost-effective way of supporting climate change objectives by helping to inform actions that protect the carbon sink (forests) or to support more effective resilience to climate-induced disasters.

The pressure from industrial activity and agriculture reduces wildlife habitat and our planet's critical carbon sinks.

EO technology can be used to monitor deforestation and human activity in general. The expansion of urban area and the reduction of natural habitat can be mapped with precision, providing authorities with a tool they can use to monitor and manage this activity.

Natural catastrophes are very hard to predict as their occurrence is mostly random. But technology enables prevention and preparedness. For instance, research undertaken within the IPP[2] has shown that satellite technologies contribute to country mitigation, preparedness, and response to natural disasters:

Emergency Management Life Cycle

Source: LE Europe, European GNSS Agency

"Space solutions can enhance this capacity [mitigation, preparedness, and response] by providing intelligence to focus efforts and public spending on the areas that face the greatest risks. For example, the wide coverage of EO can be

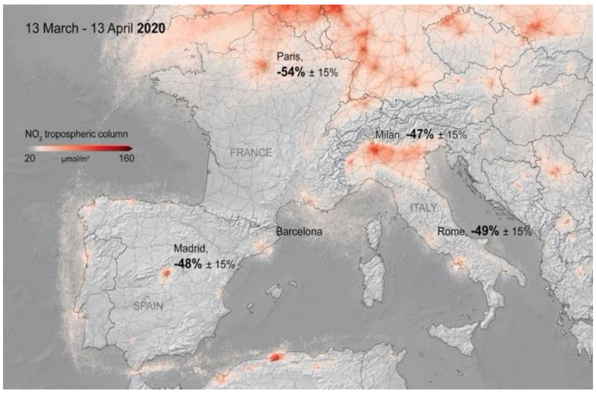
[1] IPP is a £30 million a year programme run by the UK Space Agency and focuses strongly on using the UK space sector's research and innovation strengths to deliver a sustainable economic or societal benefit to emerging and developing economies around the world.

[2] London Economics (forthcoming). Space for policy.

used to assess the vulnerability of populations and assets to natural disasters. This intelligence can help authorities to plan, predict, and observe natural disasters and their aftermath."

Geospatial analytics tools can be used to monitor and track diseases outbreak. For instance, remote sensing data are already used to predict malaria outbreaks. Preventive actions can be taken by analysing key mosquitos breeding factors and identifying regions where the risk is greatest. A similar approach may be possible for predicting zoonotic disease risk due to deforestation-induced species migration.

Satellite imagery can also help monitor other variables such as pollution and emissions. Mapping changes in concentrations of NO2 because of government imposed lockdowns, for example, may provide evidence to assess how such exposure affects the COVID-19 fatality rate.



Source: ESA – 2019-20 Difference in NO2 concentrations

In the aftermath of an outbreak, EO will be even more important. Data will play a crucial role in understanding what drives pandemics and help prepare for future outbreaks. For example, a combination of health, socio-economic, geospatial and disease outcome data can help us to better understand the mechanics of the transmission and trace the origin of transmissions.

EO data will also be critical in understanding the global economic impact of the crisis and help coordinating the next phase of society. The observation of airports, maritime transportation, road and industrial sites will contribute to our understanding of the global impact of the pandemic.

Policy response must embrace that potential and make sure that EO and other satellite data complement existing data sources. Ultimately, the pandemic will serve as a natural experiment which scientists, economists and policy makers can use to support the development of a more resilient society, but this requires global data and intelligence – EO can provide this data.

Will the EO market thrive in a near future?

The EO market could find itself feeding a virtuous cycle in which the growing demand for environmental information unlocks more innovation and business opportunities, increasing the information potential for policy. But this cycle is yet to be achieved.
Despite the wide variety of applications, the data processing step remains a sizeable technical barrier. There is an abundance of data but a much smaller volume that is 'Analysis Ready' and useful for the mass market of non-technical users.

Unlike other space-based data such as GNSS, the timeliness of EO data processing and interpretation is a major constraint to mass market penetration. The quantity of EO data is vast and increasing but gathering information about the same location can take days. Consequently, the niche for EO remains narrow, with applications focused on retrospective change detection and historic point-in-time snapshots of the environment. In other words, raw EO data is effectively a commodity whose value can only be unlocked with additional processing. This process presents lots of frictions to end users but could be mitigated with further vertical integration between data providers and application providers, much like Planet currently does.

The need for Analysis Ready Data is not the only challenge. Weather conditions make repeated observations uncertain. SAR data can partially offset the constraints of optical data under low visibility weather conditions, but this does not help those applications that rely on optical-only panchromatic data, like NDVI. The use of satellite data for specific applications may also be inhibited by regulatory standards for reporting. For example, EO data for air quality monitoring do not provide a like-for-like substitute to ground station networks. As such, it is not recognised as valid for European Air Quality monitoring objectives.

These technical challenges need to be addressed if the information potential of EO data is to be fully exploited.

Conclusion

The automated, repeatable, consistent, objective, potentially analysis-ready and wide-area coverage of EO mean that applications of EO are well placed to provide intelligence on a range of economic and environmental activities at lower cost compared to alternative methods of data collection. These advantages are critical to governments that face budget constraints, higher demand, increasing ecological pressures and growing public scrutiny.

Technical challenges remain, but the potential of EO in areas such as the environment merit actions to surmount these. The EO market should thrive when humanity's obligation to mitigate climate change and protect the environment becomes an existential necessity.

Romain Esteve is an Economic Consultant at London Economics' Space Team. He advises national governments, international organisations and space agencies on the economics of space, with expertise Earth Observation, GNSS, satellite telecommunications and Space Situational Awareness. He can be reached at: resteve@londoneconomics.co.uk