With its Copernicus constellation of satellites, the European Union is considered a world leader when it comes to earth observation technology. The challenge now is to develop services at an affordable cost for potential commercial users like farmers or public services such as natural disaster response teams.
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A defining moment in space exploration is the first image of Earthrise – watching the Earth come over the horizon – taken by an astronaut on Apollo 8 as it ventured on its historic trip to circle the moon.

Since that photo in December 1968, Earth observation has rapidly progressed to the point where satellites orbiting the Earth can monitor forests, methane emissions, glaciers, sea levels and many other parts of the climate.

The last decade in particular saw rapid progress, with a massive boost in navigation, telecommunication and, crucially, observation technology. The data provided allows scientists, NGOs and private companies to build an idea of the current state of the Earth and help decision-makers guide climate policy.

Data from satellites is vital to addressing the climate challenge, according to Patrick Child, deputy director-general at the European Commission’s research and innovation branch and co-chair of the Group on Earth Observation.

“Earth observation and our work in space can help us develop effective responses to the impacts of climate change. This is a core aim of the European Green Deal, to ensure that the climate transition is tackled in a holistic way, including through both mitigation and adaptation measures,” Child said at a conference on climate science from space, hosted by Portugal, which holds the EU’s six-month rotating presidency.

“Combined with other sources of data from satellites is vital to addressing the climate challenge, according to Patrick Child, deputy director-general at the European Commission’s research and innovation branch and co-chair of the Group on Earth Observation. [Free-Photos / Pixabay]
data, for example, on our health, or metrological data, we’re able to assess the planet and set priorities for our resources and actions,” he told the conference, which was organised by the Portuguese ministry of science, technology and higher education, with the support of the European Commission.

The EU has three major programmes serviced by satellites – Galileo, which focuses on navigation; the European Geostationary Navigation Overlay Service (EGNOS) which provides navigation for aviation, maritime and land-based users; and Copernicus, a network of dedicated satellites collecting data on the atmosphere, land, marine, climate change, security and emergency management.

COMBINING SPACE AND DIGITAL TECHNOLOGY

Space technology has developed rapidly since those first, tentative steps in the mid-twentieth century that led to the first picture of Earthrise. Space observation can now use digital technology to help tackle climate change, for example by creating “digital twins” of the Earth to help adaptation and preparedness.

But it requires strengthening data processing, including the creation of advanced algorithms to produce information that is useful to scientists and private companies, said Massimo Comparini, deputy CEO at Thales Alenia Space, an aerospace manufacturer specialising in the space industry.

“We don’t have a planet B. We need to address the challenges to build up a sustainable planet, and we need to use the best of our available technologies today,” he said.

Recent years have also seen a significant drop in the price of satellites and launching equipment. That means the arrival of smaller, cheaper satellites, which increase the amount of data being collected.

But while more data is useful for scientists, there is also growing concern that the Earth’s orbit is becoming cluttered.

Carla Filotico, managing partner at the SpaceTec Partners consultancy, called for a circular economy in space technology, including recovering material from disused satellites.

“We have spoken before about new space, about the emerging new constellations with thousands and thousands of satellites being put in orbit, so there is a clear need also to clean space,” she added.

Governance and access to data are also questions still hanging over the sector. Until now, space has been considered a public asset, but there is now increasing privatisation in the field.

“One of the things that we need to be cognisant of is how can we take advantage of the benefits of this rate of low-cost innovation and the ubiquity that it provides,” said Azeem Azhar, Founder of Exponential View, a highly-regarded newsletter on the future.

This requires an coordinated way of dealing with space management at international level, including clean-up of debris which are cluttering the Earth’s orbit.

“We need to have some form of Commons governance, rather than a first come first serve governance to particularly low Earth orbit but also further afield,” Azhar said, adding that the privatised side can drive costs down.
Space experts: Cheaper ‘real-time data’ needed for earth monitoring services

By Kira Taylor | EURACTIV.com

Satellites can help track things like extreme weather, forest stocks and methane emissions, but more and cheaper “near real-time data” is needed for next generation applications to emerge, say Miguel Bello and Ricardo Conde.

Miguel Bello is CEO of the Air Centre, which seeks to solve climate change and ocean pollution through space monitoring. Its member countries are from all around the Atlantic.

Ricardo Conde is President of the Portuguese Space Agency, Portugal Space, which is looking at promoting and developing the industry and fostering new space programmes, including through Portugal’s recovery plan.

“Recent advances in space monitoring allow gathering data about the earth, such as the evolution of ice caps, forest cover and methane emissions. What do we now know about the Earth that we didn’t know before?”

Conde: Europe is a leading continent in observation worldwide, particularly with the Copernicus programme. But we need more, we need to evolve for the next generation and to increase the capabilities to develop downstream applications.

We still have a lot of barriers, particularly the costs of high-resolution data. Particularly near real-time data is something we need to increase the availability of.

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Bello: The existing fleet of satellites, the American NOOA/NASA, the European Copernicus, already demonstrate the acidification of the ocean, that sea level is increasing at an unprecedented rate, and also the ice reduction in the poles. There are many phenomena that need more frequent data. One of the things we want to do in collaboration with Portugal Space is to develop a constellation of satellites – smaller ones, but more – so that we get more frequency. We get data every couple of hours because there are many phenomena, especially in the ocean, which need this frequency. Also for disaster monitoring, you want to have a tsunami alert, you need monitoring.

Smaller satellites are more and more capable. Today with immediate reception, small satellites are very powerful.

How precise is the data at the moment and how can it influence policymaking?

Bello: For instance in agriculture, you can use an infrared signal to detect illness in the vegetation, to improve production. You can recommend watering. You can recommend fertilisation. There is proof that you can improve productivity by 30% and reduce the cost because there is less fertiliser needed. This means you get cheaper production while reducing pollution from fertiliser use.

Regarding forests, we can monitor deforestation and measure if someone is doing illegal deforestation. There are many, many fields where satellites can play a key role. Most of these can be related to climate because deforestation has an effect on it.

Conde: This will improve the fight against forest fires. This is one of the advantages of having high resolution and also more frequency in terms of time, so satellites are in the same position.

Looking ahead to the next decade, how can satellite imagery help the EU reach its climate goals for mitigation and adaptation?

Bello: First of all, you need to take measurements, you need to observe. The only way to get synoptic measurements, global measurements along on the planet, is from space. Then the satellites will be the measurement of what we’re doing and we’ll check if what we’re doing goes in the right or the wrong direction. It is very important to be testing that what we’re doing is going in the right direction and that the effects of climate change are really reverting.

Secondly, it gives us data to implement the best policies and to optimise the use of resources. Satellites by themselves cannot reverse climate change, but it is one of the most important tools that we have to measure what is going on to optimise the resources and to take decisions according to the information that we are getting.

Conde: All the models that we can build need data. Today we have powerful computation machinery. We also have other tools available like artificial intelligence, machine learning all combined to increase the knowledge of our environment and, of course, predicting with more accuracy what we could have in the near future.

Predictions are one of the things that are really important to protect our population. We need more data, more capabilities for computing and processing.

The European Commission is already focusing on increasing the capacity of forests to act as “carbon sinks”. How would you be able to build up a database of forests?

Bello: A catalogue of world forests is something already produced at low resolution. Every day we get better and better resolution and better and better data. There is a nice project in the European Union and European Space Agency called Digital Twin Earth.

It is a full replica of ocean, land and forest, which is done with models and with data. The data is basically space data. We can make a kind of a virtual replica. In this virtual replica, which will behave like our planet, we can test policies. We can implement the policy and see the result without the need of doing it in the real world and we can see what policies work, which policies could not work because we have this full model.

Has the Commission been interested in seeing how their policy interacts with Digital Twin Earth or is it something that still isn’t linked to decision making?

Conde: I think it is linked, but you know that we take some time to get some decisions here in Europe because the nature of our political organisations. But I think this is evolving and policymakers are now conscious because we have this ambition in Europe to be carbon neutral in 2050.

What are the cost of satellite imagery?

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**Why is it worth so much investment and what’s going to be the wider societal benefit of it?**

**Bello:** The cost depends on the resolution. There is a market for satellite data. Everybody in the world can download data from the Sentinel satellites at no cost. If you want very high-resolution data of the order of one metre or less, this has a cost obviously because those are companies investing in sophisticated satellites.

But prices are going down very quickly because satellites are smaller and smaller. The cost of those systems – a one-metre resolution satellite cost €1 billion 20 years ago, 10 years ago it cost €100 million. Today, you can do it for much less.

But this is nothing compared with the profit that we get out of it. The public investment in the Copernicus earth observation programme is an important investment. There is a report that found the profit generated in Europe for this constellation of satellites is in the order of €20 billion because of the improvement in agriculture, and the lives saved for applications like disaster monitoring, fires, earthquakes, or tsunamis.

**What new business models are we going to see emerge from this? Is it going to trigger new industries or rather support already existing ones?**

**Bello:** We believe that the combination of more data with artificial intelligence is going to generate new products and open new markets. Every day there are more and more markets for the downstream use of satellite data.

At the beginning, it was only defence. Then came agriculture, forests, oil and gas. There is a company in the US, who can guess the monthly sales of Walmart by monitoring the cars in the car park by satellite. They discovered there is a direct correlation and that they can get the estimation of sales before the real figures are published.

**Should EU regulators stimulate competition for commercial space applications between EU companies or rather encourage partnerships and industries across borders? What is the right balance between those two?**

**Conde:** This is really difficult. You remember for example in 1991 when we started to deal with navigation signals like the American GPS system. GPS is a military service, but then there was potential to evolve for user applications and it became very democratic.

There are similar concerns regarding Earth observation, particularly when it comes to high resolution pictures, but I think that they can be overcome. When Europe launched the Galileo satellite navigation system, some services were available only for the public sector or institutions.

I have no doubt that we should do something similar for the high-resolution data for Earth observation. For sure it needs some regulations, but don’t forget that we have EU member states and external countries taking part.

**Bello:** Apart from this aspect of the regulation of the market, there is a security aspect. Can you develop a system of a satellite, make an image of a military base in Europe or maybe in South Korea and sell this image to North Korea? Some regulation is needed in order to avoid this type of cases.

**What are the next steps for the industry and what are the barriers to overcome in the coming years?**

**Bello:** The next step will be going through constellations to give more data, going to smaller systems. Then, there is a big problem, which is space debris. There are more and more satellites in orbit, with 20,000 objects considered as pure debris. We have to manoeuvre to avoid collisions and we have to regulate this, with space traffic management.

**Conde:** There is also one issue that policymakers should be aware of in particular, which is to promote new spaceports and new launchers. Because if we are looking for European sovereignty, digital sovereignty and resilience, we need to have the complete chain.

We need to have access to space not only with heavy launchers but also small launchers. Of course international cooperation will continue to be needed to launch our rockets and satellites. But we also need to produce our own rockets in Europe in order to produce European services and promote satellite constellations from European soil.
Becoming..., but looking forward!

**Manuel Heitor, Portuguese Minister for Science, technology and Higher Education.**

Why should we debate climate science from a space-based perspective?

This is a question that should concern all of us because of the unprecedented times we are living in. Dealing with uncertainty, risk and ignorance about the future, which the new coronavirus SARS-CoV-2 so promptly came to warn us about, is becoming a changing factor of all modern societies and the best we can pass on to future generations. It requires learning more, with more solidarity and intergenerational debate, understanding respect for others, regardless of gender, age, ethnicity, or sexual orientations.

**Manuel Heitor is the Portuguese Minister for Science, technology and Higher Education.**

But it also definitely requires we all understand three basic issues, including: i) new knowledge to effectively address the challenges of green transition making use of the opportunities driven by digital transitions across all disciplinary areas; ii) institutional innovation, across our current institutional landscape and diversified stakeholders, building the necessary economic resilience, but also addressing the social context and,
above all, the inequalities that persist across our societies; and iii) guarantee new observation methods making use of low-orbit satellite systems, which are needed to better guide our common future and to better understand and act on our common living pathways and their ecological impacts.

Deepening this problem is increasingly relevant as this new coronavirus has passed from animals to humans and although this process is far from known, we know that zoonotic diseases, or zoonoses, have been increasing due to the pressure that our societies and their economic development exercise in nature. It is a clear manifestation of the unbalanced influence of human beings on Earth, which is also expressed through climate change (e.g., Human Development Report, 2020, UNDP, 15th December). The eventual scientific demonstration of these relations with the pandemic with which we now live requires more knowledge to be able to ask more accurate and difficult questions and better understand the risks we run, as well as to evolve in this new geological era of the “Anthropocene”.

Looking to climate science from space-based systems and technology rely on continuous developments on Earth Observation systems and their integration with advanced information systems, including the increased use of artificial intelligence together with massive data sets about our living pathways and their ecological impacts. But it also depends on the way we face increasingly emerging scientific challenges to look at outer space and better understand Space Weather as a unique and advanced way to forecast climate change on Earth.

I focus this note on Earth Observation (EO) because the downstream market in Europe is undergoing important changes in business models with strong trends towards the systemic integration with advanced data systems, including Artificial Intelligence (AI), Near Real-Time (NRT) applications, cloud computing and integrated solutions to improve the value of data analytics.

As a future evolution of the Copernicus space component beyond the above missions, priority should be given to the need to incorporate and make fully available in the existing Copernicus program new types of data with a higher spatial and temporal resolution and a wider spectral resolution, such that the challenge imposed by the new trends in EO (Artificial Intelligence, cloud computing, near real-time applications) can be fulfilled and the downstream market segment can develop new applications for the benefit of the European citizens and taking all the potential to foster economic growth and high skill job creation.

It is under this context, that the current free and open Copernicus data policy should, in addition, be addressed in a broader context evolving towards a system of higher resolution data generation. A large number of spatial applications of Earth Observation require very high geometric resolution data, below 1 meter (cartography, urban and territory cadastre, urban planning, precision agriculture, security, intelligence, among others). The generation of this type of data by a new generation of Sentinel satellites, complementary to the High Priority Candidate Missions, or by teaming with other public or private European collaborative missions (as well as its incorporation into the Copernicus open and free data policy), shall foster the convergence of EO and AI, with due respect to security issues, to enable disruption in the space sector with the creation of new EO products and markets and important economic growth which directly translates in benefits for the European citizens.

The impact of the emerging European New Green Deal on turning Europe into the world’s first climate-neutral continent is a challenge that can only be achieved with the support of a sophisticated system to observe and act on our environment (atmosphere, land, oceans). Copernicus program is a unique asset to support this challenge. The development of innovative new services, including CO2 monitoring to protect citizen’s health from environmental degradation and pollution, as well as addressing air and water quality, are of paramount importance for the people, the regions and the economy. However, a CO2-only-focus approach would be detrimental. As an example, the preservation of adequate levels of biodiversity is absolutely critical, even with low CO2 emissions. Indeed, some European regions are experiencing a strong reduction in insect biodiversity and this has chain-reaction consequences beyond our current understanding which reach beyond the direct impacts on the food chain and on citizen’s health from environmental degradation and pollution.

The “Digital Twin Earth” concept emerging in Europe may
represent a very relevant, innovative and important objective towards the triple transition to green, digital and increased European sovereignty, promoting resilient economies and industries across Europe. It requires the creation of a **high precision digital model of the Earth** to visualize, monitor and forecast natural and human activity on the planet aimed to support sustainable development and adequately monitor and act on climate change and therefore to include Earth Observation, but equally other elements such as communication.

Within Europe, a number of opportunities and challenges present themselves. Space is seeing an evolution towards cost reduction, commercialization, more flexibility and agility, as well as more spin-in innovation including AI. It is also important to foster the creation and development of innovative SME’s in this “New Space” domain, either in the area of small micro or nanosatellites or in the field of private small launcher development, among many other elements associated with “New Space”. Stimulate links between space and non-space across Europe, foster space-related entrepreneurship and economic growth and strengthen a coherent European space policy with the optimization of the EU-ESA relationship – to make use of the instruments that both provide to the development of Europe and the Member States – are key challenges for space in Europe.