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CNES MAG

SPRING/SUMMER 2026

Launchpad

#100 — SPRING/SUMMER 2026

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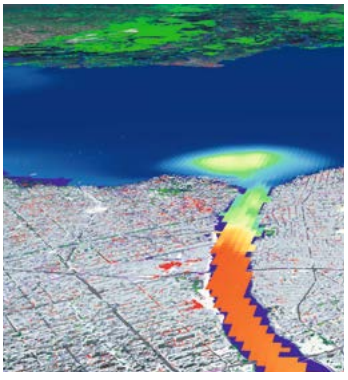

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Jean-Marc Delvit

Jean-Marc Delvit, who heads CNES's Innovation & Connect sub-directorate, has spent his career building links between satellite data and their applications. He is passionate about Earth observation, having developed his expertise at CNES in satellite image quality and applications for both civil and military users. Since 2024, he has been accompanying the ecosystem to chart the future of space in its technological, economic and social dimensions.

Laurence Monnoyer-Smith

Professor Laurence Monnoyer-Smith is CNES's sustainable development officer and former interministerial delegate for sustainable development. Today, she is supporting the ecological transformation of space activities and the agency's corporate social responsibility (CSR) efforts, working with all ecosystem stakeholders. In this issue, she explains the ins and outs of this high-stakes area.

Michel Margery

Today a senior military space expert, Michel Margery's career at CNES has taken many turns, spanning radiocommunications, Earth observation, search and rescue, and downstream services, enabling him to build a broad range of skills. After a secondment as France's space policy expert to the European Commission, he has returned to CNES to work on dual-use research planning. Space has proved a fertile terrain to quench his thirst for knowledge.

Mioara Mandea

The head of CNES's scientific coordination sub-directorate, Mioara Mandea is a geophysicist by training. As a renowned scientist who combines her functions at the agency with research work, she has succeeded in forging ties across the space ecosystem, both in the fields of Earth observation and universe sciences. She communicates her passion through leading programmes aimed at sustaining the pipeline of future doctoral and post-doctoral graduates. For CNESMAG, she takes us behind the scenes to see how science works.

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Horizons

"100 ways of talking about CNES"

Marie-Claude Salomé
Director of communication

In nearly 30 years, CNESMAG has had time to evolve and reinvent itself. But in that time, it has always maintained the same course, bringing the passion and thrill of what CNES is and does to the wider public.

This was our guiding principle in putting together this 100th issue. It gives a panorama of the benefits of space and our agency's role in a landscape that holds key strategic intelligence challenges for France and Europe. It also spotlights our recognized scientific excellence and vibrant space ecosystem, with real-world examples and tangible results.

At a time of climate disruption, this issue also underlines the key role of satellite data informing public policies and how they are aiding us in our daily lives.

The feature section of the magazine focuses on these pillars, embodied by the people who are contributing to space today and working to shape its future.

As a bonus, we've also sprinkled references from pop culture throughout the magazine. See if you can spot them.

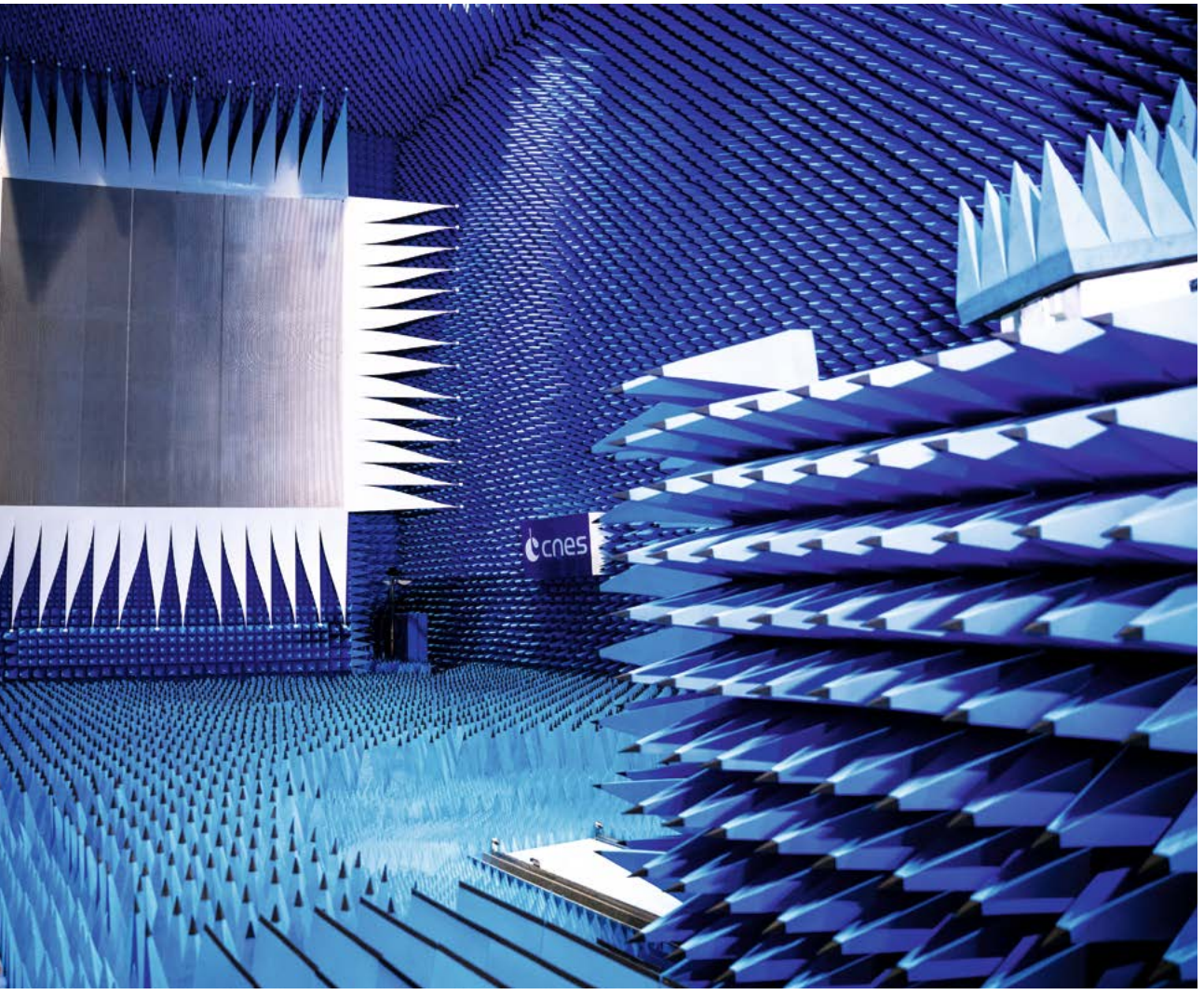
We hope you enjoy reading this anniversary issue.

PARTNERS

In this issue:
CEA p.7; ESA p.10, 14, 16, 19, 36; MaiaSpace p. 11; Sirius Space Services p. 11; Latitude p. 11; HypPrSpace p.11; French Space Command p. 11, p. 20, p. 30; Elles bougent p. 13; ISAE-Supaero p. 16, p. 31; Bpifrance p. 17; DGA p. 20; NATO p. 20; CNES Science Programmes Committee p. 21, 28; Airbus Defence & Space p. 23; The Exploration Company p. 24; Space Fresco p.25; LISA/CNRS p. 28; TOSCA p. 28; CERES p. 28; CLS p. 29; Ifremer p. 29; Kineis p. 29; BA 101 p. 30; US Space Command p. 30; Ecole de l'Air de Salon de Provence p. 30; ENSEEIHT p. 30; Alliance New Space p. 31; NASA p. 31; IRD p. 32; LEGOS p. 32; SCO p. 36; Space 4Ocean Alliance p. 36

Mysteries from the blue chamber

This could easily be mistaken for a science-fiction film set, but we're in fact inside CNES's BCMA antenna test chamber in Toulouse. This is where antennas for satellites and other systems are put through their paces in a controlled electromagnetic environment. The pyramidal foam lining the walls absorbs electromagnetic radiation so that measurements can be acquired free from reflected interference, including for classified projects.



Big balloons and small cells

August 2025, Timmins balloon launch base, Ontario. The latest Strato Science flight campaign led by CNES and the Canadian Space Agency (CSA) is in full swing. In less than a month, four heavy stratospheric balloons have been launched, carrying 26 instruments to acquire measurements and run tests in near-space conditions. One of the gondolas was flying instruments for the French atomic energy and alternative energies commission CEA and its industry partners to calibrate photovoltaic cells designed for future satellite solar panels.

Space to the rescue

End November 2025, torrential monsoon rains brought widespread landslides and flooding to Indonesia. To keep track of the situation and support emergency response teams, the International Charter Space and Major Disasters swung into action for the 1,006th time, mobilizing 18 satellites to cover 46 disaster-hit areas. This international collaboration tool founded 25 years ago federates space agencies and data suppliers, and is today able to call on some 300 satellites when needed in the event of a crisis.

Stellar year for Ariane 6

CSO-3, Metop SG-A1, Sentinel-5A and Sentinel-1D, Galileo FOC, FM29 and FM30… Since July 2024, Ariane 6 has accomplished five successful launches, showing a remarkable ability to ramp up its launch rate for a heavy-lift launcher.
All systems are go for Europe's flagship space launcher. Eight launches are scheduled this year, including the first flight of the Ariane 64 four-booster variant that successfully orbited satellites for the Amazon Leo constellation in February.

ESA secures record budget

With the European Space Agency (ESA) celebrating its 50th anniversary last year, the ESA Ministerial Council meeting on 26-27 November (CMIN25) approved a record €22.1 billion in funding for Europe's space programmes over the 2026-2028 period, up 30% on the 2022 budget. Member states thus sent a strong political signal that space remains, more than ever before, a lever of power, competitiveness and sovereignty. Securing Europe's independent space launch capability, through sustained support for Ariane 6 operations and the Guiana Space Centre, was among the priorities confirmed at this summit, as was the European Launcher Challenge[1] initiative, which obtained funding commitments well in excess of expectations. Science also featured in prime position, with increased funding to consolidate ESA's position spearheading European science through its Cosmic Vision and Voyage 2050 programmes. Also of note was the new European Resilience from Space programme aimed at strengthening the continent's security capabilities.

1. ESA competition to select and promote new launch operators.

Carbon footprint
on track with emissions stable

Every two years, CNES publishes its BEGES greenhouse gas emissions assessment. Released early in December 2025, the latest assessment is something of a mixed bag. With some 245,000 tonnes equivalent of CO_2 (CO_2e), more than 100 tonnes per employee, the agency's direct and indirect emissions remain broadly stable. This apparent status quo is explained largely by an increase in the agency's activities, tending to dilute the impact of its efforts, notably with respect to renewable energies and business travel. CNES's low-carbon strategy will henceforth be adjusted to step up these efforts and bring into line indirect emissions from contracted services.

Boosting micro- and mini-launch services

In a complex and still fledgling micro-/mini-launcher market, CNES is positioning itself as the number one customer for French manufacturers. Following a request for proposals in 2023 under the France 2030 investment plan, four contracts have been awarded to MaiaSpace, Sirius Space Services, Latitude and HyPrSpace. The agency is buying demonstrations of micro-/mini-launch services planned for 2027-2028, for which it shares part of the initial risk. At stake is the ability to spark viable commercial launch services offering flexible, robust and available access to space for small satellites.

France

sets space course

"A space power is an independent power" according to French President Emmanuel Macron, unveiling the nation's space strategy last November at the official inauguration of Space Command. These words reflect the tone of a document that for the first time sets out a structured framework for space as a linchpin of national sovereignty. Crafted under the supervision of the Secretariat General for National Security and Defence, with extensive input from CNES, this strategy hinges on five pillars: independent access to space; the European dual-use space economy; system security and resilience; science, research and exploration; and international strategy.

Budding scientists in the spotlight

Last autumn in Toulouse, CNES's JC2 young researchers' forum marked its 25th anniversary, making it almost the same age as the participants presenting the results of their research. Aimed at young researchers starting the third year of their PhD or first year of postdoc studies, the forum offers them the opportunity to showcase their work, meet peers and space professionals, and start building a network for themselves. JC2 has long been a historic pillar of the agency's commitment to the scientific community, and one of the high points of the PDoc+ doctoral and postdoctoral programme initiated in 1986, which has already aided more than 3,200 bright young talents through research grants.

Space Professionals in Pop Culture

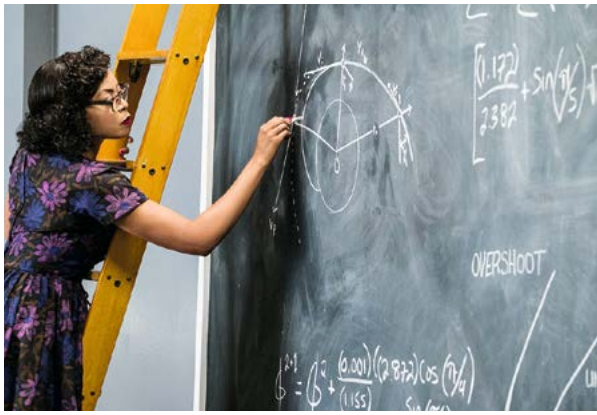
Rockets, countdowns, spectacular feats… When we talk about space, we instinctively think of awe-inspiring adventure. Yet in reality, behind these iconic images are the people who make it all happen and the jobs they do—a lot of different jobs. Film, music, comics and video games often reveal far more than we might expect about the men and women driving the space adventure.

For a long time, space professionals remained out of frame. Popular culture tended to spotlight the 10 seconds of lift-off rather than the hours of calculations, the sleek silver suits rather than the sensor-laden test benches. In recent decades, however, various films have shifted the focus to places the collective imagination hadn't been before, sometimes challenging a few clichés on the way. *Hidden Figures* (Theodore Melfi, 2016) is a reminder that, without female African-American mathematicians and engineers, no capsule would ever have made it back to Earth.

The alternate-history series *For All Mankind* (Apple TV, 2019) shines a light on a whole universe of little-known roles like systems engineers, programme managers steering schedules and budgets, maintenance teams and communications specialists responsible for showcasing missions. A deep dive into a less-glamorous reality, echoed in video games such as *Kerbal Space Program*, where players become space engineers grappling with gravity, orbit calculations and repeated failures. Here, an explosion is all part of the learning curve.

Demythologizing space

As these jobs come into view, our perception of the space sector shifts. Space becomes what it truly is: a demanding workplace—sometimes routine, often high-pressure. Back in 1979, Ridley



Scott's *Alien* was already moving in this direction: the crew of the *Nostromo* look less like warriors and more like a team of employees tasked with keeping an industrial spacecraft up and running. In *Moon* (2009), Duncan Jones takes this demythologizing up a notch: the astronaut is portrayed as an isolated employee, assigned to a lunar base much as you might be posted to a declining industrial site. Little glory, plenty of routine.

And what about astronauts? Ever since Hergé's *Destination Moon* (1953, part of the *Tintin* comic series), they've taken centre stage as the emblematic figures of space exploration. But they're not always modern-day heroes. Some fail, like Major Tom, the protagonist of David

Bowie's *Space Oddity*, condemned to drift endlessly through the cosmos. Others reject the role altogether, like Elton John's *Rocket Man*, who sums up his situation in the now-famous line: "It's just my job, five days a week." As for the protagonists of *Planètes*—the cult 2000s manga published in partnership with CNES—they conquer nothing. They clean up Earth's orbit, by hard graft and at risk to their lives. Sometimes, there are those magic moments when reality meets fiction head-on. Like that day in May 2013 when Canadian astronaut Chris Hadfield performed *Space Oddity* from the International Space Station. Weightless, guitar in hand, the real-life astronaut brought Major Tom vividly to life.

Insights

Frédérique Meyer Lassalle,
DEPUTY HEAD OF CNES'S TALENT MANAGEMENT SUB-DIRECTORATE

"A multitude of roles spanning a broad range of disciplines…"

Popular culture often portrays the space sector as slightly daunting, made up largely of high-level engineers and scientists. What's it really like at CNES?
At first glance—when 85% of our workforce is engineers, scientists and managers—you could be forgiven for thinking CNES confirms the stereotype. But what that image doesn't convey is the variety of fields here. CNES encompasses a multitude of roles across a broad range of disciplines, spanning the entire space value chain.

Could you give us a few examples?
We have data and imaging specialists; experts in optics and telecommunications; civil engineers; safety and environmental engineers; space systems architects; and meteorologists for our launches and balloon activities. We also have people whose role is to steer complex projects or lead international negotiations, working with lawyers, communications professionals and many others. Yes, there are a lot of engineers and managers—but there are also technicians, every bit as passionate and just as vital to CNES's missions.

In popular culture, women in the space sector have long been confined to supporting roles. Is that under-representation reflected in reality?
We monitor recruitment very closely to promote equality, especially in technical roles, where our ambition is to exceed the proportion of women graduating in those fields. To do that, we invest in organizations like *Elles Bougent*, which encourages girls to consider careers in space. We make sure our job offers are written in inclusive language. And we act early, starting in schools, to ensure equal treatment and opportunities. From ninth-grade work experience onwards, we apply strict gender parity.

SOPHIE **ADENOT**

French aviator, engineer and European Space Agency astronaut

“We’re taking a piece of France with us into space”

In February, Sophie Adenot became France’s second female astronaut on the International Space Station (ISS) for the εpsilon mission. Following in the footsteps of her role models, she is helping to showcase the nation’s space effort. She talked to CNESMAG before embarking on this new adventure.

“My mission is to further knowledge, pave the way for future crewed space exploration and engage young people.”

In 1996, Claudie Haigneré departed for the ISS on her Cassiopée mission. 25 years on, it’s now your turn. What does this space adventure mean for you?

I’m absolutely thrilled to be taking a piece of France into space! I’m fortunate and very proud to be representing my country and the dedicated CNES teams who’ve been working on these space missions since the first French human spaceflight with Jean-Loup Chrétien in 1982. The weight of history is there and I can feel the energy of the people who witnessed the first French space missions carrying me. It’s a team adventure and I’m a link in this legacy. So I’ll be doing my utmost to make sure everything goes smoothly and to honour the memory of my predecessors and of everyone working to make this mission a success. The ISS is also a place I’ve dreamed of going to since I was a little girl, fired by all of these space adventures.

How have you prepared for this mission with CNES’s teams?

We’ve been training for three years now, under the supervision of experts who’ve been sending astronauts into space for more than 20 years. First off, CNES’s teams helped me get to grips with the scientific experiments I was going to be conducting during my eight-month mission. I got together with them in Toulouse, Houston and Cologne. Depending on the location and the goal of my training, the instructors and teams showed me the equipment and procedures—everything I’ll need to know to accomplish these experiments. We train on simulators, starting in nominal conditions before learning to deal with emergencies. Our instructors make sure we’ll be ready to handle a loss of pressure, a fire or a plumbing leak, for example. I’m qualified as a specialist for the station’s Japanese and European modules, so in the event of a fault I’m the one who’ll be tasked with maintenance operations. The aim of this training is to ensure we work effectively during all mission phases, but even if we’re well prepared, even if we know the procedures, there’ll always be unknowns, so I’m curious to see how things will go once we’re actually aboard the station.

You joined the French Air and Space Force in 2005. How has your military career prepared you for space?

Being an aviator has taught me how to work at a very fast operational tempo. As a helicopter pilot, I’ve learned to handle complex systems, pressure and crew stress, which all come into play when you’re an astronaut. On the ISS, we work with cutting-edge technologies and we’re in permanent contact with ground teams and control centres around the world. So the operational side of things is ever-present.

What experiments are you going to perform on the station?

The crew will be contributing to some 200 scientific experiments, so we’ll be devoting a lot of our time to science! CNES has developed ten innovative experiments. We’ll be using technologies to study

Getting to grips with MultISS, a multimodal imaging tool for analysing surface bio-contamination aboard the ISS.

2004
Graduates from ISAE-SUPAERO engineering school.

2018 Becomes France's first female helicopter test pilot.

2022 Joins ESA's astronaut corps

2026 First flight to International Space Station on Epsilon mission.

"I can feel the energy of the people who witnessed the first French space missions carrying me."

the effect of weightlessness on the crew's organs, physiological parameters and blood flow. CNES will be tracking all of these experiments from its CADMOS control centre in Toulouse. My mission is to further scientific and medical knowledge, pave the way for future crewed space exploration and engage young people, notably through the ChlorISS experiment.

What are you looking to pass on to young people?

I got where I am today because there were role models for me, so I think it's only natural to want to give something back. I hope to be as generous as possible with my time—as much as the mission allows—to explain the scientific experiments and technology aspects for them, as well as daily life on board. Every youngster will be able to sift through my social media posts to find what they need and gain inspiration. That'll also help those still finding their way to see the diversity of fields and career paths out there. We need to encourage both girls and boys and to help them find something that inspires them and that they can identify with.

What past events or cultural icons related to space have inspired you?

As a little girl, I was a big fan of anything to do with adventure and exploration: space adventures, sporting accomplishments, aviator odysseys, that sort of thing. I've always been fascinated by people who push the limits. I closely followed every French astronaut's space mission and read their biographies as soon as they came out. Claudie Haigneré was a major source of inspiration for me. I was 14 at the time of her first spaceflight and I think seeing her depart was when things fell into place for me: I decided I would dedicate myself to becoming an astronaut. A few years later, in 1999, I was sitting my baccalaureate exam as Jean-Pierre Haigneré embarked on his Perseus mission… I kept his mission patch in my pencil case. They all fired my passion for aerospace.

Pointers

Europe seeks sovereign connectivity with IRIS²

In recent years, surging demand for connectivity has seen private megaconstellations in low Earth orbit (LEO) like SpaceX's Starlink and soon Amazon Leo impose their solutions and create new dependencies without sufficient security guarantees. It is in this context that the European Commission, with support from ESA, has launched IRIS², Europe's future secure connectivity constellation. Planned to enter service in 2030, IRIS² will cater for government, military and crisis-management requirements, while also offering commercial services for businesses. The 12-year public-private partnership contract to develop and operate the constellation has been awarded to the SpaceRise consortium (SES, Eutelsat, Hispasat). Some 300 satellites, mostly in LEO, will provide global coverage and low latency. Three control centres will operate the system, one of which is to be located at CNES's Toulouse field centre, thus also helping to drive uptake by French users.

FRANCE 2030

22

requests for proposals led by CNES have been initiated since the end of 2021 through the space track of the France 2030 investment plan, as well as four calls for expressions of interest and five calls for projects led by public investment bank Bpifrance. These mechanisms have chiefly targeted micro- and mini-launchers, in-orbit services, space surveillance, telecommunications, Earth observation and satellite data serving public policies.

"CNES's Space Observatory is an analytics tool geared to provide valuable insight into trends shaping the space sector. Its ten-strong team covers a broad range of fields: foresight studies to highlight industrial, government, geopolitical and social dynamics; economic research into space markets; and analytics focused on disruptive areas like mega-launchers or in-orbit data centres. Their work informs the decisions of CNES and its overseeing ministries, and is also shared on a case-by-case basis with the space ecosystem and academia."

Caroline Amiot-Bazile,
HEAD OF STRATEGIC INSIGHT & OBSERVATORY SUB-DIRECTORATE

Everything you've always wanted to know about CNES

In space parlance, we talk of 'missions' and 'payloads'. Such terminology is significant, as satellites do many practical things for us. In this section, we cast a light on how CNES is working behind the scenes—enhancing our security, advancing knowledge, supporting planners and conceiving new services—to aid us in our daily lives.

CNES supporting Europe's strategic independence and France's security

Through access to orbit, sovereign capabilities and a dedicated organization, CNES coordinates a well-knit chain of resources and expertise in the increasingly contested environment of space.

A growing proportion of today's essential weather, navigation, connectivity and surveillance services rely on satellites. So the ability to orbit satellites and control them in the long term is becoming a major strategic stake, as a nation that depends on foreign infrastructures is vulnerable. In this context, CNES assures a key mission providing independent access to space for France and European stakeholders. And here, the Ariane 6 programme is more than ever the linchpin. "With five successful launches in the space of 18 months, Europe's heavy-lift launcher has quickly established a solid track record," says Philippe Pujes, CNES's head of launch system programmes. "Teams are ready to ramp up the launch rate, with seven to eight flights scheduled this year, including a first commercial flight that will also be the first for the four-booster Ariane 64 variant." At the same time, Europe's launcher portfolio is expanding with the arrival in 2028 of Vega-E and the development of new private systems under ESA's European Launcher Challenge (see Space take, p.10). CNES, meanwhile, is nurturing new micro- and mini-launchers, while also investing in reusable first stages through the Prometheus, Themis and

ELM multi-launcher complex at the Guiana Space Centre.

Callisto demonstrators. "But the issue of independent space access encompasses more than just launchers," underlines Philippe Pujes. "The Guiana Space Centre remains more than ever a strategic asset for Europe." As major refurbishment work to modernize the launch base nears completion, CNES's role has been consolidated through the France-ESA agreement assigning it key functions for the future of Europe's spaceport, including management of its launch manifest.

Key defence partner

With geopolitical tensions rising, space is a contested domain supporting crisis management and informing political decisions and military strategy. "Without its own space assets, France would be dependent on data from foreign nations and/or commercial suppliers, with no guarantee as to their integrity or availability," affirms Philippe Steininger, military adviser to CNES's Chairman & CEO. As a result, CNES plays a singular role in providing its expertise and resources to the armed forces to develop and operate space systems, surveil space and prepare future military capabilities.

One of the spearheads of France's military space strategy is the CSO system. "CSO has reached full operational capability since the launch of CSO-3. It's a very-high-resolution optical Earth-observation constellation giving the French government a sovereign imaging capability for intelligence gathering, situational analysis and support for policymaking and military strategy," explains Paul Arberet, CNES project leader. The French defence procurement agency DGA has delegated oversight of the space segment of this strategic programme to the French space agency. "CNES has end-to-end responsibility for the system, from early-stage work, design and fabrication up to operations and through-life support for the satellites," notes Paul Arberet. It also assures provision of data, supplying tools to turn raw imagery into readily usable products and training military users to interpret them.

In recent years, CNES's longstanding ties with the military have become even closer with the standing up of France's Space Command in Toulouse. "This facility is bringing our military personnel quickly up to speed, working closely with CNES's experts," says Philippe Steininger. "Integrated teams are today controlling our military satellites and ensuring continuity of in-orbit operations." The siting of NATO's Centre of Excellence for space in Toulouse adds an allied dimension to this transition.

The secrets of a historic refusal

For any nation state, being able to rely on its own intelligence clearly strengthens its independent decision-making ability and sovereignty. In 2003, during the Iraq crisis, France noted that imagery from its satellites was showing no trace of an arsenal of weapons of mass destruction invoked by the United States to justify an invasion. This lack of evidence formed the basis of an independent analysis that finally led Paris to refuse to countenance a military engagement. Some months later, then U.S. Secretary of State Colin Powell conceded that the intelligence they had relied on was wrong.

Biomass satellite inside the fairing of the Vega launcher at the Guiana Space Centre.

CNES advancing science

Launched end 2022, operational since 2023 and winning over the scientific community as soon as its first data became available, the Surface Water and Ocean Topography (SWOT) satellite is a prime illustration of successful collaboration between CNES and research scientists.

12

scientific dignitaries

make up CNES's Scientific Programmes Committee (CPS), six men and six women. They serve a five-year term, representing the various fields of science in which the agency is active.

The adventure officially got underway in 2009, at CNES's Science Survey Seminar (SPS) in Biarritz, where Biomass[1] also came into being. At this landmark event convened every five years, the French scientific community comes together to debate priorities and nurture collective ambitions, some of which make the cut and become space missions. The agency's Science Programmes Committee (CPS) then takes the lead, helping to mature projects selected and guarantee long-term scientific consistency.

SWOT was born out of this dynamic. The science concept was turned into a mission project to study Earth's ocean topography and surface waters at an unprecedented scale and level of accuracy. The

Extent of the Aral Sea seen by the SWOT satellite.

satellite would carry a wide-swath radar altimeter, providing for the first time a continuous view of water dynamics. In 2011, CNES, backed by the government's PIA[2] investment programme, began working on multimission data and their applications to encourage early adoption of SWOT by the scientific, institutional and industrial communities, and to nurture new services based on them. This early-stage work is today bearing fruit: SWOT data are already helping to refine ocean forecasts and paving the way for concrete applications in water management and risk management. Its results are already feeding into future European satellite altimetry missions, notably Sentinel-3 NG Topo, that are set to consolidate the advances made possible by SWOT.

1. Satellite launched in April 2025 to map forest biomass and estimate stored carbon.
2. This programme funds innovative and strategic projects for France.

Kader Amsif, programme manager

"I act as the interface between scientists and CNES teams for everything related to my field, which is the Sun, heliosphere and magnetosphere[1]. I'm involved from the outset, including foresight and phase 0, to turn scientific priorities into mission projects, before gradually handing over to project leaders. I then continue to track projects to ensure they match initial science goals. I currently have a portfolio of 12 missions in different stages of development, among them Plasma Observatory and M-MATISSE."

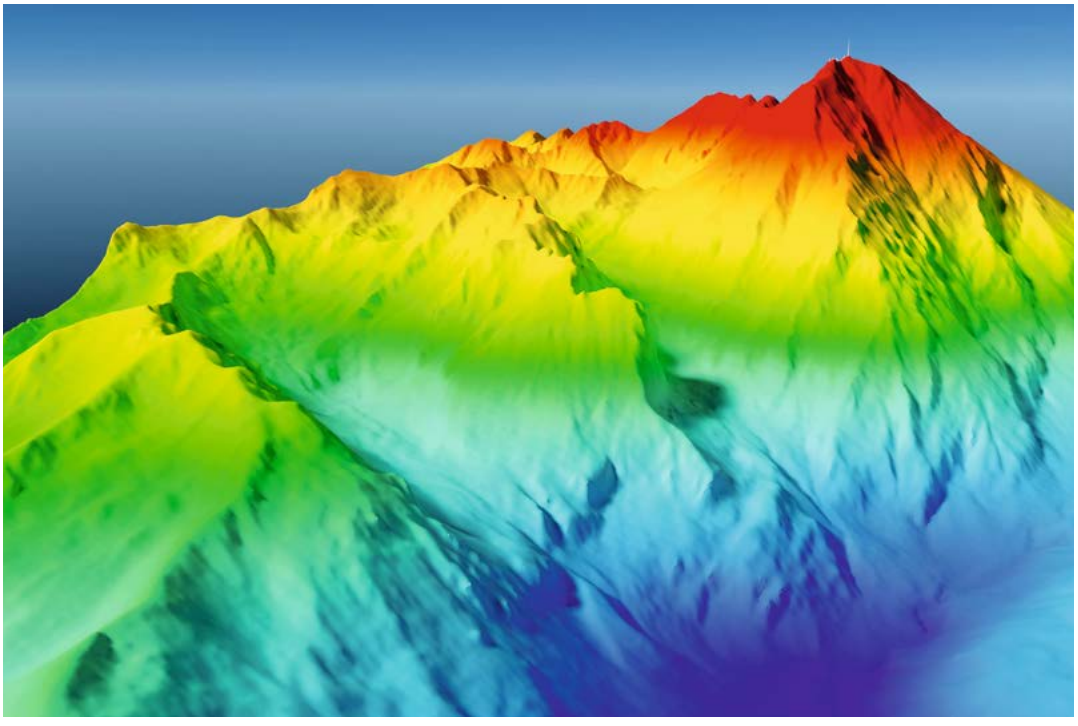
1. Region of space encircling Earth that contains the planet's magnetic field.

CNES furnishing satellite data to serve applications on Earth

From satellites to operational services, CNES is sustaining an ever more competitive space ecosystem.

Boosting the French space ecosystem's competitiveness is a strategic mission for CNES, and that means it is engaged at several levels, from early-stage technology maturation to fostering new downstream services. "We serve those conceiving satellites as well as those who need data from them," says Jean-Marc Delvit, head of the agency's Innovation & Connect sub-directorate. Support comes in many forms, through the provision of expertise, demonstrators, business coaching, training, and mobilizing user communities, for example.

By expanding the range of possibilities with unique data likely to fuel new services, space missions are playing a key role driving this effort. The CO3D constellation, launched last July, is a case in point. The result of a public-private partnership between CNES and Airbus Defence & Space, "it will generate 3D maps of the globe's land surfaces with metric accuracy and provide coverage of around 40



Digital surface model of the Pic du Midi generated from CO3D data. Higher elevations are in red, lower elevations in blue.

million sq.km a year, as well as offering new capabilities like night vision and video," says Laurent Lebègue, CO3D system performance manager. This mission holds out fresh prospects for developing high-added-value services, such as tracking vegetation distribution or studying volcano plumes. Since 2021, the roll-out of the France 2030 investment plan has given extra weight to CNES's role as a catalyst for the space ecosystem. "The aim is to nurture tomorrow's champions in emerging space markets," explains Jean-Marc Delvit. To this end, a call for expressions of interest from public stakeholders was issued three years ago to identify their needs for services incorporating satellite data, followed by competitive requests for proposals. The goal is to produce demonstrators likely to transition quickly to operational solutions. One such example aims to improve ecological or socio-economic monitoring of France's coastlines, while another is focused on urban lighting and light pollution. "These demonstrators will take full advantage of CO3D's new capabilities," notes Laurent Lebègue. And that is precisely where a key part of space's utility is playing out, at the intersection between missions, public policies and economic development.

Frédéric Adragna, head of Connect by CNES

——— "Every year since 2018, the Connect by CNES programme has supported 200 organizations of all sizes—companies, local authorities, operational services—pursuing projects related to space. Designed as a one-stop shop, it offers 360° support from ideation to fundraising. And it can point to some great success stories, like The Exploration Company, which designs space freight capsules. We supported them when they were starting out, and today it's a company with 400 employees that's considering going public."

4
satellites
form the CO3D constellation, launched in July 2025.

Riyadh city centre, Saudi Arabia, seen at night by a CO3D satellite.

2005

The year the SEAS station in French Guiana started operating,
directly receiving satellite data to inform public policies, notably towards the environment.

CNES working for a more sustainable world

Space is a high-tech sector with long production cycles and multiple environmental constraints. This is precisely why CNES is taking a multi-pronged approach to sustainability, starting with a decarbonization roadmap set out with all space sector stakeholders. This roadmap unveiled last June has calculated for the first time the French space industry's carbon footprint—1.8 Mt CO_2eq, i.e. 0.3% of the nation's total emissions—and identifies 12 levers for reducing emissions, encompassing energy, transport, infrastructures, industrial processes and data.

CNES is also applying this cross-disciplinary decarbonization approach to its own activities. One of the main measures put in place is the effort to limit business trips and an internal price for offsetting carbon emissions. Other examples include the systematic use of life-cycle analysis and eco-design principles, and factoring in environmental criteria in decision processes.

A shared culture also needs to be developed to transform an entire sector. Supported by CNES through its eco-challenge, the Space Fresk has adapted the principles of the Climate Fresk to the specific characteristics of space. This collective intelligence tool, based on participative workshops, aims to help decision-makers make the jump from understanding decarbonization issues to actual actions.

Lastly, this shift is embodied everywhere CNES is present, particularly in French Guiana. Two emblematic programmes are Bio-Plateaux, which is generating vital hydrology data for managing water, forests and river transport; and SEAS, through which satellite imagery is serving land planning and the preservation of coastal ecosystems.

Liliane Sebas, CNES Director of Human Resources

"Last spring, CNES employee representatives signed a framework ecological transition agreement. We're now following the same path on diversity, through collective negotiations. The stakes are the same: to move beyond one-off actions and chart a common course. With this framework in place, we'll be able to measure the gap between intentions and reality, before applying concrete actions. Because diversity isn't an end in itself; it reflects our ability to include people and evolve our working practices in the long term, to boost attractiveness and spur innovation."

Back to the future

SPOT's eyes on the planet

SPOT-1 was the first Earth-observation satellite conceived and designed by CNES teams, blazing the trail for an entire generation of civil and military remote-sensing satellites. Here's the story of how it came into being.

Amour Mountains (Djebel Amour), Algeria - SPOT-1 - 23 February 1986.

MILESTONES

1978
Launch of European SPOT programme, the first ever dedicated to Earth observation, by France, Belgium and Sweden

1986
Launch of SPOT-1 satellite

2002
Launch of SPOT-5 satellite

2015
SPOT-5 de-orbited and SPOT programme terminated by CNES

2025
Roll-out of Spot World Heritage website offering free access to SPOT satellite data

On 22 February 1986, Ariane 1 lofted SPOT-1, France's first civil Earth-observation satellite, into orbit. "At the time, there was a will to secure sovereignty and gain proficiency with this technology," recounts Hervé Jeanjean, in charge of the European Copernicus programme for CNES. SPOT-1 would compete with the U.S. Landsat satellite in service since 1972 and Russia's Resurs-01 (1985). The French newcomer quickly got itself noticed with its steerable mirrors, giving it the ability to view on either side of the ground track and to revisit the same point on the globe every two to three days. "Its 10-metre resolution made it somewhat avant-garde," notes Hervé Jeanjean. In April, SPOT-1 acquired the first black-and-white image of the destruction left behind in the aftermath of the Chernobyl nuclear disaster. Some years later, SPOT-4 would mark a turning point with its short-wave infrared (SWIR) sensor. "This satellite was also carrying VEGETATION, a very-wide-swath instrument able to acquire daily images of the entire globe." SPOT-5 would subsequently usher in a new revolution with its 2.5-metre resolution, opening up a broad range of applications in mapping, agriculture, land planning, environmental monitoring, hazard management and defence to name a few. As a result, the satellite imagery market took off. The successors of SPOT-1 include the Copernicus programme's Sentinel-2, the SPOT-6, SPOT-7 and Pleiades-Neo commercial satellites, and Helios, France's first military reconnaissance satellite, followed by CSO. The CO3D constellation, launched in July 2025, belongs to this lineage. "We've developed unique expertise. France's very-high-resolution optical sector is recognized for its excellence the world over," underlines Hervé Jeanjean. Ensuring that the world is not deaf or blind to the stakes of space here on Earth.

Talking ethics

Jacques Arnould
Science historian and theologian, CNES ethics officer

On the Art of Navigation

To ensure the success of deep-space missions and long-duration programmes, CNES has built up expertise and embraced a distinctive set of values. And those same qualities are essential if space is to serve our citizens.

"Given ships or sails adapted to the breezes of heaven, there will be those who will not shrink from even that vast expanse. Therefore, for the sake of those who [...] will presently be on hand to attempt this voyage, let us establish the astronomy, Galileo, you of Jupiter, and me of the Moon."

The author of these words is the astronomer Johannes Kepler. In the spring of 1610, he sent them to his colleague Galileo, who had just revolutionized Western cosmology by observing the heavens through a telescope he had built. While intrepid sailors were setting out to explore our planet by sea, Kepler was already dreaming of celestial navigation—what we would now call astronautics. But it would be more than three centuries before such long-distance voyages beyond Earth would be undertaken.

Sailing the high seas or "braving the empty spaces" of the heavens requires more than just the right technology. We need to cultivate an art—one very similar to that of any institution pursuing goals over many years or decades. Here, of course, I am thinking in particular of our public institutions.

This art consists first and foremost in choosing, determining—or accepting—an objective to be attained, a mission to be accomplished. The corporate purpose that most companies now adopt should not only serve as a mere branding statement, but also as a means of evaluating and judging the soundness and legitimacy of our achievements. To omit it, to reject it, is to risk turning our institutions—our teams—into ghost ships, condemned to drift amid the whirlpools of our societies. Serving a country and its citizens is a noble task, but we must also be clear about the substance and the ultimate end of these services.

All navigation relies on charts, beacons, lighthouses—in other words, on legal reference points and philosophical values, like those inscribed on the pediments of our public buildings. Not in order to cling to them (no boat ever moors itself to a buoy or lighthouse then never leaves), but rather to define the space within which decisions and standards of conduct are possible. As early as the 19th century, one author had imagined an artificial "moon" to help sailors plot their courses.

Any form of navigation must take account of currents and winds. There is no point in resisting them—still less in ignoring them; it is better to confront them, work with them and even, if possible, take advantage of them. And currents of ideas—ideologies and political projects—are among the most powerful of all.

Reefs and storms of every kind spare no sailor. Whether foreseeable or anticipated, mapped or not, avoidable or not, they pose a danger that sailors must assess, so they can be better prepared to avoid them, face them and, if necessary, repair the damage sustained.

When CNES embarked on its voyage more than 60 years ago, it was for the long haul, in order to provide French citizens—and many others—with services, knowledge, protection and defence. But what do they make of it?

LISA (CNRS)

"Helping CNES define its space strategy"

GILLES BERGAMETTI

Research Director, former Chair of CNES's Science Programmes Committee

In 2009, geophysicist Gilles Bergametti was approached by the French space agency to take over the helm of its TOSCA Earth, oceanography, land surfaces and atmosphere committee. "I'd been involved with CNES through my work overseeing atmospheric chemistry at the national scientific research centre CNRS, but I was a bit of a neophyte on space," he confesses. For four years, he chaired this committee specialized in Earth sciences. Together, TOSCA and the CERES space science research and exploration committee are the "arms" of the agency's Science Programmes Committee (CPS). With a college of 11 members from France's top research laboratories, the CPS shapes scientific thinking and helps CNES to define its space strategy. In 2019, Gilles Bergametti was appointed its chair. Every four years, the committee organizes a survey seminar to determine priorities in universe and Earth sciences. "This seminar produces a roadmap to establish a hierarchy of missions that will be selected and funded," he explains. "I think it's proof of CNES's high level of confidence in the scientific community in helping it to define space science priorities." Landmark programmes marking his tenure include SEIS, which acquired the first seismic measurements on Mars; the Sentinel Earth-monitoring missions; IASI, supporting weather forecasting and close study of the composition of Earth's atmosphere; and SWOT, mapping our planet's sea level and surface waters. This experience gave him the opportunity to learn more about universe sciences, develop precious contacts and get to grips with managing a science project. He recalls above all "the rigour and strategies required to get space projects done within often very tight time, funding and engineering constraints." He has since transposed this working method to his own research unit, the LISA inter-university laboratory for the study of atmospheric systems, where his work is focused on modelling dust transport from deserts. His lab has forged close ties with the French space agency, which supplies vital satellite data. "Science helps CNES to conceive innovative approaches, including from a technical perspective. We must preserve this win-win relationship," concludes Gilles Bergametti.

CLS GROUP

"Understanding and protecting our planet, and managing its resources sustainably"

STÉPHANIE LIMOUZIN

Chief Executive Officer

"The entire history of CLS (Collecte Localisation Satellites) is wrapped up with Argos," explains Stéphanie Limouzin, the company's CEO. In 1986, CNES and the French oceanographic institute Ifremer formed CLS to operate the Argos location and environmental data collection system. "At the time, there was no GPS," she recalls. "A technology able to geolocate any mobile (boat, buoy or animal) fitted with a transmitter and beam back data via satellite was pretty revolutionary." CLS collects data from transmitters, formats them and distributes them to users. In the 1990s, satellite altimetry transformed forever our understanding of ocean dynamics.
The company played a key role driving this revolution, processing data from the French-U.S. TOPEX/Poseidon satellite. Stéphanie Limouzin joined the company's space oceanography team in 2009, which she went on to lead before heading its Energy department. She subsequently rose up through the ranks, becoming CEO in 2025. "When I started here, nearly 80% of our business was from satellite altimetry programmes led by CNES," she recounts. "Our day-to-day job was to receive, calibrate and generate these data as the basis for curves and maps showing mean sea level rise." The European Copernicus Earth-observation programme marked a turning point for the company. Using altimetry measurements from the programme's Sentinel satellites, CLS develops environmental and climate monitoring solutions and decision-support tools to aid adaptation. In 2024, Kineis, a collaboration between CNES and CLS, deployed Europe's first constellation dedicated to connected objects. The 25 Kineis nanosatellites augment the Argos system and strengthen global environmental monitoring. "Our compass is to understand and protect our planet while managing its resources sustainably," says Stéphanie Limouzin. This involves measuring variations in temperature and ocean currents, tracking wildlife migration, mitigating natural disasters and detecting marine pollution episodes.
"All of these applications studying our planet and gaining new insights into its biodiversity, animal behaviour and how they interact with climate change have been enabled by Argos."
In 17 years with CLS, Stéphanie Limouzin has seen landmark achievements for the scientific community: "I have the feeling of being part of a collective adventure to preserve our planet from space."

AIR
& SPACE BASE 101 GENERAL
ROBERT AUBINIÈRE

"Protecting and defending France's space assets"

LAURENT RIGAL

Colonel, base Commander

"Space has become a strategic domain because it's vital to the stability of our society and military apparatus," stresses Colonel Laurent Rigal, commander of BA 101, France's first air and space base. "The relationship between CNES and French Space Command (CDE) is founded on the dual-use principle," he adds. Established in July 2025, BA 101 hosts the CDE, the nerve centre of the nation's military space operations. Its proximity with CNES's Toulouse Space Centre (CST) is no accident. "Faced with the new challenges posed by security and defence, the CDE is honing its skills to manoeuvre satellites," explains Colonel Rigal. "CNES is helping us acquire this expertise and get our operators up to speed." As a symbol of this closer cooperation, BA 101 is named after General Robert Aubinière, aviator, French Resistance fighter and CNES's first Director General. The base's commander is in daily contact with the CST's site director to "coordinate our efforts and facilitate teamwork". He assures the security of the base and fosters synergies between local space ecosystem partners, with a dual goal in mind: "to assure vital space support for operations, and above all to protect and defend French space assets". Laurent Rigal has been working in this new theatre since 2019, the year of the CDE's inception. He was previously electronic warfare squadron leader, before heading the CDE's strategy office for its first commander, General Michel Friedling. In 2021, he moved to Colorado Springs to take up the post of French liaison officer at U.S. Space Command. "My mission was to foster the development of French-U.S. cooperation in the military space domain, particularly from an operational perspective," he recalls. After graduating from France's Ecole de l'Air air officer training school in Salon-de-Provence, Laurent Rigal began his career as a maintenance officer. After obtaining a master's degree in computer science and applied mathematics from the ENSEEIHT electrical engineering, electronics, computer science, hydraulics and telecommunications school, the aviator decided to specialize in development of air command and control systems. Taking over the helm of BA 101 marks a return to his roots in the Lot department of southern France, and "an honour to command this base in these transformational and highly charged political times".

ALLIANCE NEWSPACE FRANCE

"CNES's support is helping structure the development of New Space"

SAMUEL MAMOU

Director

For 20 years now, developing launchers is no longer the preserve of governments and space agencies, as private players have come onto the scene. "Ten years ago, the idea of space start-ups in France seemed pretty far-fetched," says Samuel Mamou. "But little by little, the ecosystem has matured and CNES has made the transition towards supporting New Space." Since 2023, this graduate of the ISAE-Supaero engineering school has been at the helm of Alliance NewSpace France (ANF), an association federating more than 50 French SMEs and start-ups who are working to make this transition a reality. Its mission is to lead efforts to structure New Space in order to foster government-industry contacts, and to address the major challenges facing the ecosystem to consolidate the sector's needs. "These new players are growing fast, they need private investment and have their own specific development methods," notes Samuel Mamou. "We've been advocating a vision for this emerging ecosystem to encourage the government and CNES to continue evolving their industrial policy and supporting New Space." Samuel Mamou's previous experience as deputy space adviser representing CNES at the French Embassy in the United States, in charge of bilateral cooperation and NASA-CNES ties from 2021 to 2023, helped smooth this dialogue between ANF and the space agency. "This experience enabled us to quickly establish a relationship of trust." Promoting New Space in export markets is part of his job. "CNES's support is spotlighted and recognized globally. For many players, it provides a foundation for developing business opportunities," he underlines. The New Space industry has received funding through the €1.5 billion space budget line of the France 2030 investment plan. "This new funding method has enabled development of significant industrial capabilities. The ecosystem has proven itself and we're entering a new phase." With the sector now undergoing a deep transformation, the next step looking further down the road is to give France the means to preserve its leadership position. At the end of November 2025, President Emmanuel Macron unveiled the nation's space strategy, reaffirming his commitment to buttress the strengths of legacy contractors and start-ups. "To foster European champions, we're going to have to build bridges between manufacturers across Europe. Some of those could be from the French space sector and New Space players could be among them," believes ANF's director.

Using Earth's digital twins to monitor, model and anticipate

Digital twins, or virtual replicas, have become strategic tools for supporting local climate change adaptation.

By combining data from satellite images and in-situ sensors, digital twins enable us to produce a virtual replica of our environment, study how it works and predict how it will evolve. In 2025, CNES launched

Identify needs

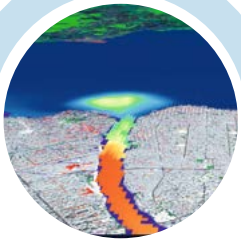
The first phase consists of mapping out the data, models and required uses. To identify the issues facing Nokoué Lagoon, teams from CNES's Digital Twin Factory (DTF) worked with the IRD sustainable development research institute and the LEGOS space geophysics and oceanography research laboratory to assess water quality and pollution as well as run-off and flood risks.

Build a digital replica

CNES then combined satellite imagery and in-situ measurements with geographic and socio-economic data to create a digital replica of Nokoué Lagoon that serves as a common basis for analysis and modelling.

its Digital Twin Factory, aimed at facilitating uptake of CNES Earth-observation satellite data accessible via the GEODES portal. It does this by providing the algorithmic building blocks needed to create virtual replica projects for specific regions or even the entire planet (data access, 3D modelling, variable correlation analysis, scenario planning). This set of tools is being shared with industry, research and government stakeholders to foster applications and services geared towards environmental and climate issues. One example is the SCOast-DT project dedicated to Nokoué Lagoon in Benin.

Scenario simulation and exploration



This digital replica was then combined with physical models to simulate currents, pollutant dispersion and biochemical changes. Testing different hypotheses makes it possible to construct potential scenarios and compare their effects over time. Nokoué Lagoon is connected to the ocean, so one of the key challenges is understanding changes to its salinity and flood zones caused by rising sea levels.

Inform public decision-making

The results of these simulations are being used to assess human and environmental risks and identify levers for action, such as updating land-use and risk-management plans. As such, Nakoué's digital twin has become an aid to decision-making, informing public policies for sustainable management of the lagoon.

Inspirational interviews: *Le Déclic*

Space exploration and the mysteries of the universe are fascinating topics that have greatly influenced pop culture. In a new series entitled *Le Déclic* (The Spark), CNES employees speak directly to camera, revealing their key sources of inspiration and how they influenced their choice of career.
Series available on the CNES YouTube channel and on cnes.fr

Houston, we've had a problem!

If Julien had to choose just one movie, it would be Ron Howard's *Apollo 13*. A radiation and components engineer, he describes the scene where the astronauts realise they don't have enough power to return. The programme director then tasks a group of engineers with finding ways to save power. What impressed Julien was how everyone worked together under pressure to overcome a major technical challenge and bring the crew back to Earth safe and sound.

Destination Moon!

Launcher engineer Paul has always been fascinated by *Destination Moon,* 16th volume in *The Adventures of Tintin*, which for him demonstrates the quasi-visionary genius of Belgian graphic novelist Hergé. Not least because Hergé's account of how Professor Calculus, Tintin and Captain Haddock develop a lunar rocket was written four years before the launch of the first satellite into space! When Paul first found himself standing at the foot of Ariane 6, at the Guiana Space Centre, he felt the same sense of wonder as those three characters on the album cover, looking up at their huge red rocket.

Leeloo Dallas Multipass

Luc Besson's movie *The Fifth Element* holds a special place in the heart of nanosatellite engineer Rémi. One scene in particular made a lasting impression, when the blue extraterrestrial Diva Plavalaguna performs her opera recital against a planetary backdrop, enthralling the space-cruiser audience and viewers alike. For Rémi, this scene captures the fascination we all have with the view of Earth's horizon from the International Space Station.

First thermal shock, with Captain Future

Part of an entire generation that grew up watching space animations like *UFO Robot Grendizer* and *Space Pirate Captain Harlock*, Nadège never missed an episode of Japanese anime *Captain Future*. A thermal engineer, she began her career on the Ariane 5 launcher and, while working on thermal analyses, had a flashback to the Captain's Cyberlab surrounded by a sort of reddish halo as it crossed the atmosphere on approaching a planet or in certain space environments. All in all, a pretty good approximation of a rocket's thermodynamics!

It's not magic!

As a child, Thomas could hardly wait to get home from school to watch his favourite TV programme, *C'est pas sorcier* (It's Not Magic). Generations of French children grew up watching this pop science series, but for Thomas it was something of a catalyst. Now a flight software engineer, he recalls an episode on space rockets featuring the launch of an Ariane 5. He can still see himself repeating the launch director's iconic words: "Attention everyone, this is Thomas. Get ready for the final countdown: 10-9…0, we have lift-off!"

Far-reaching projects

What do a reservoir in Brazil, beaches in the Maldives and galaxy NGC 6505 have in common? The role of CNES driving initiatives involving both Earth and the universe.

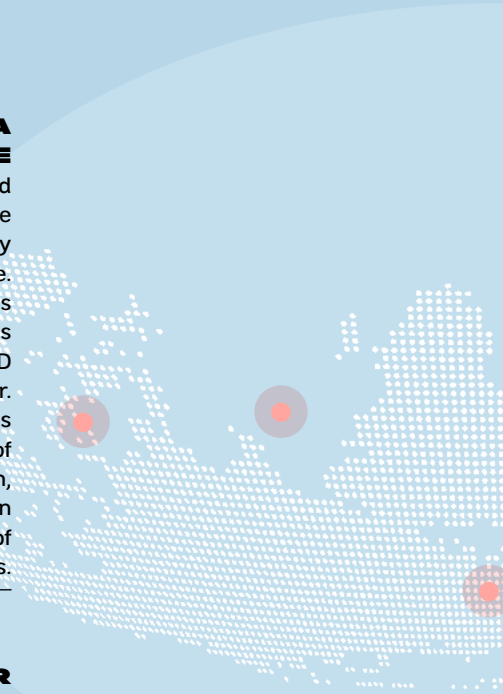
XTREMQUALITY: RESERVOIRS UNDER CLOSE WATCH

The Space for Climate Observatory (SCO) encompasses some 100 projects around the world using satellite data to aid adaptation to climate change. Unveiled at the COP30 conference, XtremQuality analyses water quality in man-made reservoirs in France and Brazil (surface areas, turbidity[1], chlorophyll-a concentration) to establish vulnerability indexes for climate episodes like drought. Its results will help to preserve water quality and support sustainable management of water resources.

1. Cloudiness or haziness of a liquid

FIRST EUCLID DATA RELEASE

Orbited in 2023, Europe's Euclid space telescope intends to probe the dark matter and dark energy making up 95% of the universe. It will record the shapes, positions and movements of billions of galaxies to produce the most extensive 3D map of the cosmos ever. The European Space Agency (ESA) is set to release the first catalogue of Euclid data this autumn, encompassing some 200 million galaxies covering an area of sky of 1,900 square degrees.



SPACE FOR VULNERABLE ISLAND COMMUNITIES

The Space4Ocean Alliance (S4O) brings together space agencies, scientific institutions and maritime organizations to provide space-based services dedicated to protecting the world's oceans. It is focused chiefly on island states and developing nations exposed to anthropogenic and climate-driven pressures. Launched in June 2025 with 20 members, this coalition today numbers 31 partners, including the Maldives and Philippines space agencies.