



RÉPUBLIQUE
FRANÇAISE

*Liberté
Égalité
Fraternité*



2021



IN NEED
OF SPACE





FOR 60 YEARS,

CNES has been leading France's space policy and contributing to major projects through European and international partnerships—a French ambition serving citizens everywhere.







EDITORIAL

Jean-Yves Le Gall

CNES President

CNES HAS BEEN INNOVATIVE FOR INDUSTRY, THE MILITARY AND RESEARCH FOR 60

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Jean-Yves Le Gall

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Before turning to 2021, a look back at 2020 and the extremely tough period experienced due to the COVID-19 health crisis. CNES worked hard to provide assistance and solidarity and to adapt its work procedures and arrangements. How do you see the current situation and its consequences for the agency's people and more broadly for the space community?

I would like first of all to thank all of CNES's people and everyone in our leadership chain of command. Thanks to their commitment and professionalism, we have stood firm. My thoughts go in particular to our employees who have suffered severe health consequences, and to the one employee who unfortunately died to whom I would like to pay a final tribute here. From the start of this health crisis, our prime concern was to protect everyone's health and we organized our response to do that. Despite the context, we have conducted our missions with no significant impacts. We have also provided extensive support to our industry partners affected by the crisis, notably to help them preserve their business. CNES also contributed to the response effort by giving up its stocks of medical equipment and making our engineers and production capacity available to the health authorities. We have effectively assisted the national effort through innovative solutions, even if we are still in a very serious situation. In the final analysis, we have held up, we are holding up and we will prevail together.

We are coming to the end of our Objectives and Performance Contract (OPC) for 2016-2020. What is your perspective on the results achieved?

All the objectives set in this OPC that we entitled Innovation & Inspiration have been reached, proving CNES's efficiency. We have fulfilled our missions by applying appropriate solutions alongside new and disruptive approaches, which was no easy task in a space landscape undergoing seismic change. At national and European level, CNES is arguably among those that have best weathered the transformations underway by adapting to the fast-changing environment and continuing to lead the way in many domains.

We are now planning for the next OPC for 2021-2025, which for the first time will be overseen by three ministries (Industry, Armed Forces and Research). What changes can we expect to see?

This next OPC will reflect the key transformations in space and CNES's continuing evolution. It will be predicated on the mantra of 'space for growth', with three main lines of action guiding the agency's efforts over the coming five years to serve the nation's space policy: space as a driver of economic growth, strategic independence and sustainable development. These three priorities will enable France and Europe to meet the economic, strategic, political and intellectual challenges of the new space arena, while grasping the partnership and growth opportunities now emerging.

TING TARY YEARS

2021 is also set to be a very busy year for science (with Solar Orbiter, Perseverance, etc.) and launches (James Webb Space Telescope, PHARAO, Strateole 2, etc.). Can you put all of these projects into context for us?

In 2021, we shall start reaping the dividends of our strategy. First, from the perspective of large infrastructures where we continue to play a leading role with the European Space Agency, the European Commission and the Ministry for Armed Forces. Second, through our niche strategy contributing French know-how to major international partnership programmes, the best example being the SuperCam instrument, a core element of NASA's \$2.5-billion Perseverance Mars rover mission. That is kind of the hallmark of our cooperation efforts. And third, we shall continue to explore new frontiers by increasingly helping our partners to innovate. I am thinking especially of what we have achieved with the ANGELS nanosatellite, which will be central to the new military space strategy illustrated by the siting of the new Space Command (CDE) at the Toulouse Space Centre. The experience garnered from ANGELS will also drive development of start-ups like Kineis.

Thomas Pesquet, ESA's French astronaut, will be embarking this year on his second mission on the International Space Station, where he will be conducting 15 experiments controlled by CNES. What are the stakes for this new flight?

We strongly advocated for Thomas Pesquet to fly on the station again with greater responsibilities this time, thanks to our key

role at the European Space Agency and our exceptional relationship with NASA. This second flight for Thomas will be completely different to the first. He will be departing from Florida aboard one of the new crew vehicles set to become the workhorse for the United States in the years ahead, notably for its Artemis lunar programme. And he will be acquiring new skills on the station, standing him in good stead to be chosen as one of the European astronauts likely to set foot on the Moon around 2025-2030.

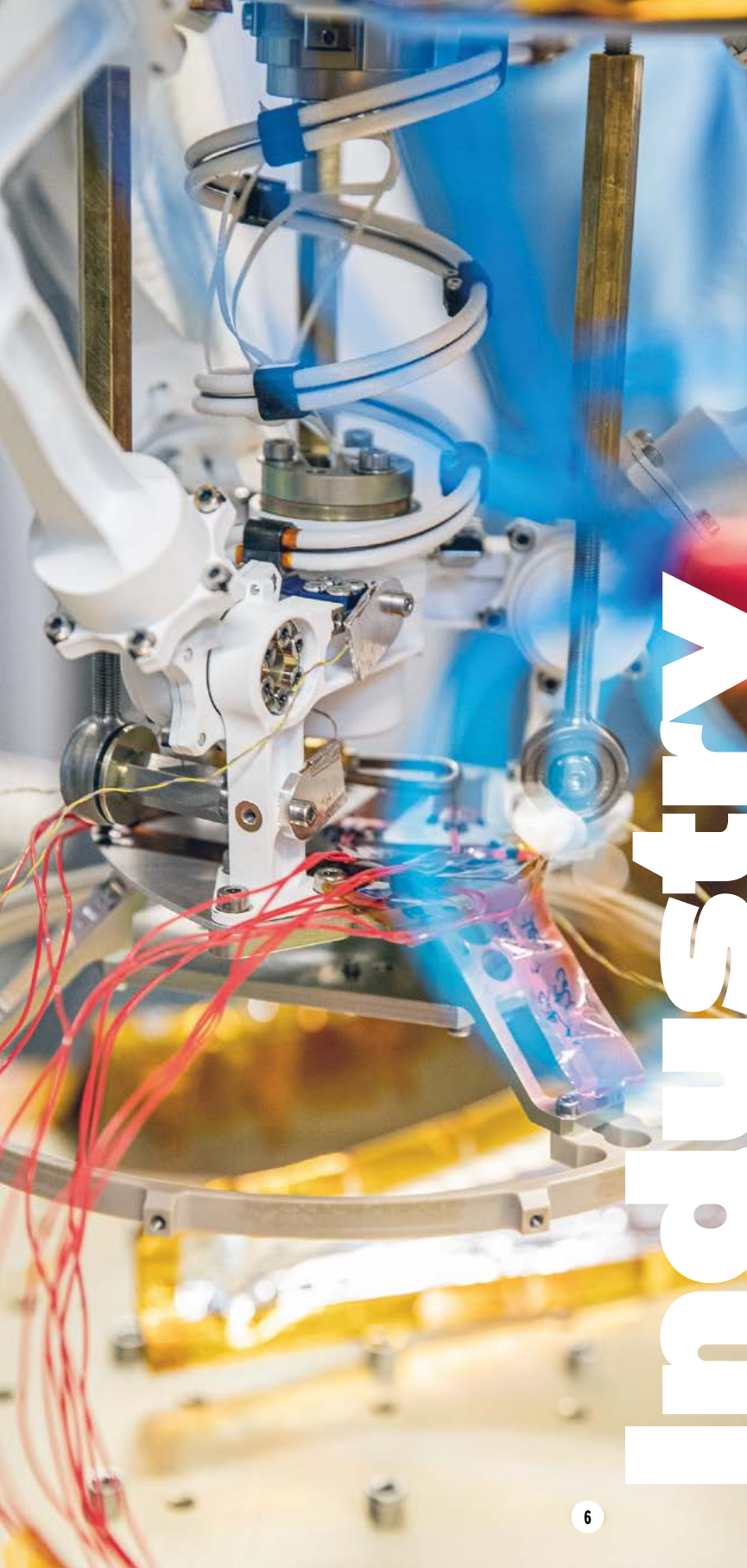
How does CNES intend to ensure a broad and consistent sustainable development strategy?

CNES resolved to tackle this issue well before it began to garner world attention. You could almost say we have been committed to studying our planet and its changing climate ever since our inception. Our involvement at global level moved up a gear in 2015 with the COP 21 conference and the Paris Agreement on climate. Alongside our commitment to the International Charter Space and Major Disasters, which marked its 20th anniversary in 2020, we are working to support concrete actions like the Space Climate Observatory (SCO) initiated through the One Planet Summit initiated by President Macron, to which 27 space agencies and governmental organizations have already signed up. We have also instituted a number of environmental measures in house, starting with our waste and consumables reduction policy as well as our drive towards paperless procedures. More recently, we took on board the 17 Sustainable Development Goals (SDGs) that French government operators are required to subscribe to. CNES is thus today

a prime mover in the fight against climate change and we are in the process of creating a new directorate dedicated to addressing these key challenges.

One last question about CNES, which will be marking its 60th anniversary at the end of 2021: How do you see our agency, its evolution and its prospects for the future?

The agency's results are impressive indeed. Faithful to the mission assigned to it by President Charles de Gaulle at its inception, CNES has been innovating for industry, the military and research for 60 years and we will be showing that again throughout this anniversary year that holds many more successes in store.



Industry



▲ Galileo

Galileo detects and locates ships to ensure their safety.





Bruno Le Maire
Minister of the Economy,
Finance and the Recovery

BUILDING THE FUTURE OF SPACE

Innovation has always been a core focus for CNES since its inception. As the federator of France's space ecosystem, the agency is working ever harder to forge partnerships with industry and build a future where space serves everyone.

Space-based tools are geared towards making Earth a safer place and enhancing our knowledge, as well as offering real-world solutions to improve people's daily lives, public services and business performance. Conceiving useful applications requires not only mature space technologies but also a solid understanding of their potential uses and the ability to get project promoters from often very different horizons to work together effectively. This is the role of CNES, whose expertise serving society is bringing the benefits of space to the widest number.

Shaped by the digital revolution, disruptive technologies and NewSpace, the world today is in a constant state of flux as the space sector undergoes deep transformations driven by the daily challenge of innovation. A challenge we are meeting by mobilizing French start-ups, top-tier manufacturers, research centres and training systems within a 'space team France' to boost our competitiveness and invent solutions scaled to users' needs.

But that is not all we are doing. In line with the missions outlined by the government in our five-year Objectives and Performance Contract (OPC), we are also encouraging our international partners to "think France" and turn to the nation's manufacturers to assist them in developing their own systems.

With its unmatched know-how of space technologies, CNES is proposing projects, investing, reaching out and nurturing new expertise with the specific goal of building the future of space.

5G THE NEW FREQUENCY

THAT MOBILE PHONE OPERATORS ARE NOW RELYING ON TO BRING USERS FASTER CONNECTIONS, WORKING WITH SPACE AGENCIES INCLUDING CNES.

"For France and Europe to stay ahead in the innovation stakes and create jobs and prosperity for everyone, we must invest massively in innovation."

2021 Budget €2.335bn

Every year, CNES's budget is voted by parliament and our accounts are signed off by our auditors. In line with the agency's objectives, our income and expenditure are examined by independent bodies mandated to ensure they are used as intended, notably for the benefit of France's industry and scientific community. Our budget for 2021 is €2.335 billion, maintaining the very high level of funding for the agency over the last two years.



ESA CONTRIBUTION:

€1,075m

NATIONAL PROGRAMME:

€719m

OWN RESOURCES:

€495m

PIA FUTURE INVESTMENT
PROGRAMME:

€46m

WHO FUNDS CNES?

To accomplish our mission to pursue space activities on behalf of the government, CNES receives funding from the budget lines provided for in our Objectives and Performance Contract (OPC), from the PIA future investment programme and from external sources for programmes where we have delegated responsibility (DGA, ESA, Eumetsat, etc.).

70

**COUNTRIES AND
INTERNATIONAL
ORGANIZATIONS**

TODAY ARE WORKING WITH CNES ON PROGRAMMES
OF VARYING NATURE AND SCALE.

SPACE ECONOMY

Observatory

In a fast-changing environment, it is vital to help the companies making up the space ecosystem stay competitive and develop their business. It is with this aim in mind that CNES has created the Space Economy Observatory, which through its cross-cutting vision is sharing insights into how current evolutions are impacting the French space sector and the players driving it. In response to the COVID-19 health crisis, the Space Economy Observatory has set up weekly meetings with more than 180 key players from the national space manufacturing and services industry, as well as research laboratories, through a network of regional council, competitiveness cluster and booster partners.

A status report is sent to the agency's overseeing ministries to tailor solutions to the difficulties businesses are encountering, like for example government-guaranteed loans, extended delivery deadlines or deferred payments. CNES has already adjusted 100 contracts to help key suppliers to preserve their cashflow.

The dialogue the Space Economy Observatory has instituted with firms also assisted in drafting the government's recovery plan announced on 3 September. The planned budget will help sustain the space industry's R&D investment capacity, which is being constrained by losses of revenue estimated at between 20% and 25%.

Besides monitoring the effects of the COVID-19 pandemic, the Space Economy Observatory is also looking to the longer term and crafting a shared vision of competitiveness and development challenges ahead.



ENTRY INTO SERVICE OF **Ariane 6** AND ELA-4 LAUNCH COMPLEX

The transition to ensure continuity between the still operational Ariane 5 and its successor Ariane 6 is now well underway. This new-generation launcher is leveraging a 40-year heritage while also affording increased modularity and reducing costs. Combined tests of Ariane 6 at the launch base with all launcher elements are poised to go ahead. A dress rehearsal is also planned before the first flight from the ELA-4 launch pad, a unique infrastructure built under the supervision of CNES's Launch Vehicles Directorate (DLA).



Vega-C

Vega-C is the first major upgrade to the latest in the line of Europe's launchers developed since 2012 by our Italian partners ASI and Avio. The new P120C booster stage set to greatly enhance the launcher's performance is undergoing ground testing and will soon be qualified thanks to CNES's close involvement and unstinting efforts. This performance boost will give the launcher an extra edge in a fiercely competitive marketplace. With its high production rate and commonality between Vega-C and Ariane 6, the P120C will be crucial to controlling costs while confirming Europe's unique expertise. Together, the two launchers form the foundation that will assure our access to space in the years ahead.



FUTURE LAUNCHER

demonstrators and studies

FROG/APTEROS, CALLISTO, THEMIS AND ARIANE NEXT

Committed to conceiving and developing future generations of European launchers, CNES is already working to define the main outlines of the Ariane Next programme. A flexible and reusable launch system is envisioned to cut production costs, built around the new-generation Prometheus engine that will begin testing in 2021. Our approach is both pragmatic and economic, predicated on a programme of increasingly ambitious technology demonstrators, with the FROG platform, Callisto and the Themis test stage providing a solid development base. At the end of 2019, ESA committed €2.238 billion in funding to launcher programmes.

CSG-NG

Spanning 700 sq.km and with three operational launch complexes, the Guiana Space Centre (CSG) is poised to bring the ELA-4 launch pad into service for Ariane 6. The future of the launch base is also assured through the **CSG New Generation** programme that got the go-ahead at the end of 2019 in Seville. These investments will renew the infrastructures and networks while meeting the base's Sustainable Development Goals (SDGs) and modernizing its facilities and operational processes.

The CSG is thus supporting the leap in competitiveness Ariane 6 and Vega-C must make to face growing global competition. The base's attractiveness and reputation for excellence with customers from around the world will be maintained with the highest level of quality, reliability and availability.

Construction work has begun on the new **Operations Centre** (CDO) to house all launch support facilities under a single infrastructure.

ESA
HAS COMMITTED

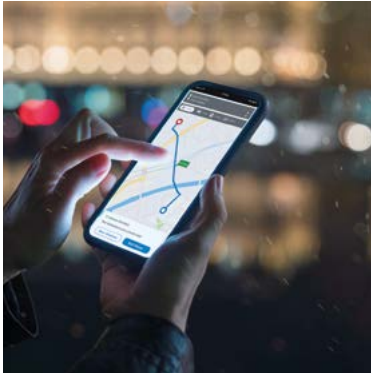
2.238

**BILLION EUROS TO
LAUNCHER PROGRAMMES**



Applications

GALILEO, KINEIS, CONNECT BY CNES

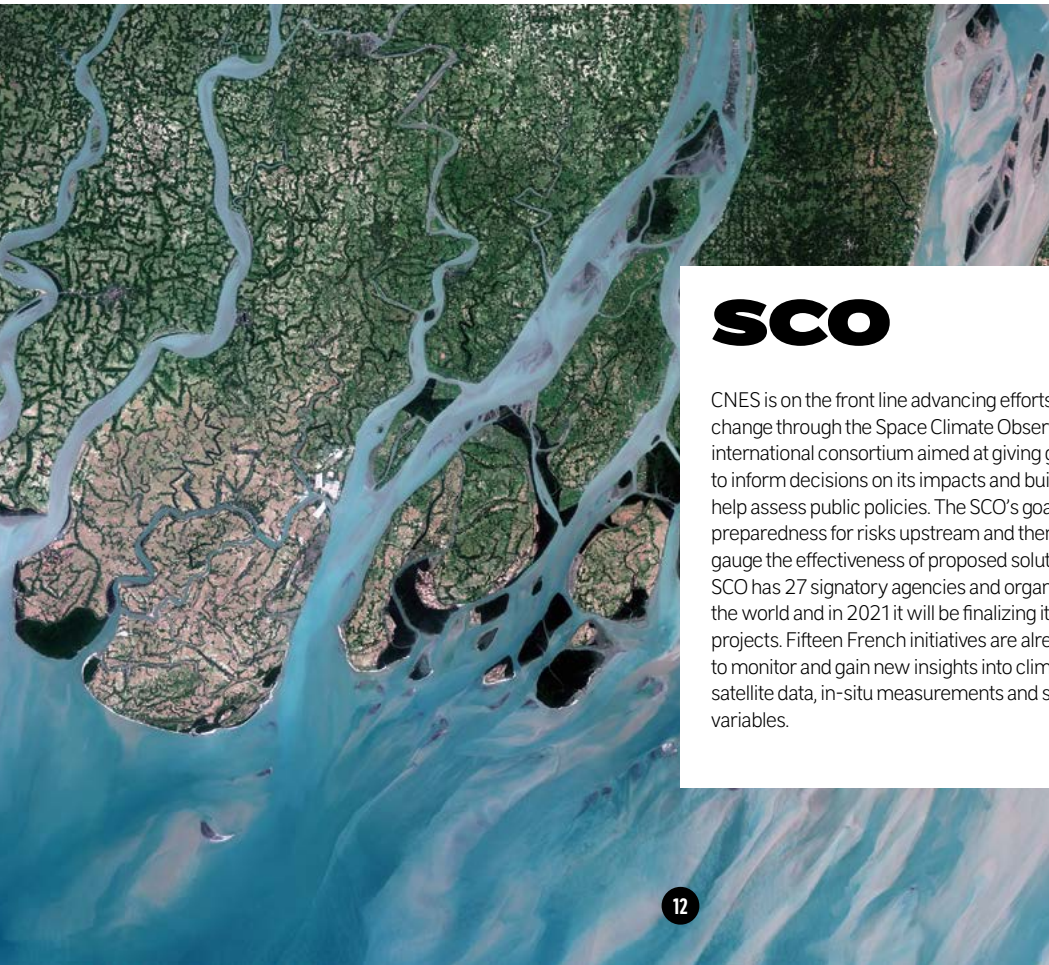


Space-based tools are finding applications in our daily lives and have great business potential. CNES is tailoring its strategies to meet this challenge and is directly involved in key projects like the European Union's Galileo positioning constellation (28 satellites by 2021) and its 1.5 billion smartphone users worldwide.

The agency is also supporting innovation through the firm Kineis and its eponymous constellation dedicated to the Internet of Things (IoT).

The Connect by CNES platform offers expertise in space data and technologies, and is promoting their uptake with French Tech innovators and a range of industry sectors.

Lastly, CNES is also boosting the economy by exploiting satellite data and processing services derived chiefly from national and European research programmes.



SCO

CNES is on the front line advancing efforts to tackle climate change through the Space Climate Observatory (SCO), an international consortium aimed at giving governments tools to inform decisions on its impacts and building models to help assess public policies. The SCO's goal is to ensure better preparedness for risks upstream and then down the line to gauge the effectiveness of proposed solutions. Today, the SCO has 27 signatory agencies and organizations around the world and in 2021 it will be finalizing its second call for projects. Fifteen French initiatives are already underway to monitor and gain new insights into climate change using satellite data, in-situ measurements and socio-economic variables.



Telecommunications

With the **THD-Sat** satellite, we are supporting innovation to bring ultra-fast broadband Internet connectivity to all. Over the last 10 years, our R&D programme has seeded new technologies able to deliver Internet service just as well as optical fibre and with a tenfold increase in power over previous-generation satellites. Ready to enter service in 2021, these innovations will feature on the future **Konnect VHTS** satellite. By providing ultra-fast broadband connections to 300,000 homes in rural and remote areas, they will eliminate the last remaining 'not-spots' in France and help to bridge the digital divide.

ALL-ELECTRIC satellites

Electric propulsion is driving a revolution in the space industry, significantly reducing telecommunications satellite mass and cost of ownership. We are working very closely with European manufacturers to develop this new generation of spacecraft. Projects include the first all-electric satellite from the **Neosat** programme (**Spacebus NEO**) initiated by CNES and ESA to support the competitiveness of European industry. The first in the **Konnect** series of satellites is designed to deliver broadband Internet services to Africa and Western Europe. It will be followed in 2021 by **Hot Bird Next** (on a **Eurostar NEO** bus).



MORE **space** FOR NEW APPLICATIONS

Combined with big data and artificial intelligence, space is spawning dozens of new services for the environment, mobility, healthcare, agriculture, climate science and many other key economic and social sectors besides. These new applications are driving strong development of innovative firms.

Connect by CNES is encouraging uptake of satellite data by start-ups, SMEs, big manufacturers and public players. Our mission is to accompany and federate this community through a portfolio of services and to give them access to our solid partnership network in France and abroad.

More than ever before, our goal in 2021 is to fuel technology spin-off and nurture future business champions.



Defence



▲ French Rafale fighter aircraft



▲ CERES



Florence Parly
Minister for Armed Forces

STRATEGIC INDEPENDENT SPACE LAUNCH CAPABILITY

In its dual capacity as space agency and technical field centre, CNES is uniquely positioned as the key link between research laboratories, industry and users to better serve strategic military needs.

Since its inception in 1961, CNES has worked closely with the French military to plan for the future and lead military and dual-use space programmes, lending its expertise and resources to the nation's defence policy as well as assisting space surveillance and tracking and satellite operations.

The agency has thus been contributing for decades to French forces' operational capabilities and to the security of our citizens.

Space is a core capability in a world facing increasingly serious, unpredictable and technological threats. With new players emerging all the time as access to space becomes easier, it is more important than ever before to establish 'rules of the road' and virtuous practices.

France intends to preserve its strategic space capability, for which it relies on CNES to develop programmes on behalf of DGA, the national defence procurement agency.

Our involvement in military space programmes was recently in the spotlight with the launches of key reconnaissance satellites like the CSO series. This trend is set to continue in 2021 and will be confirmed with CERES, the first operational space signals intelligence programme, and the Syracuse IV-A military telecommunications satellite.

Space's technological excellence makes it a vital tool supporting military strategy. Our mission is therefore to provide high-performance solutions, working in partnership with industry to preserve an independent space launch capability and field strategic space systems.

26
FRENCH SATELLITES
ARE UNDER SURVEILLANCE BY CNES
FOR CONJUNCTION ASSESSMENTS.
IN ALL, 119 SATELLITES ARE COVERED
ACROSS EUROPE.

“In 1960, space was a new frontier; today, I believe it is the last technological frontier to be reached and conquered.”

▲
Address on military space strategy,
July 2019.





▲
Satellite view of the Toulouse Space Centre.

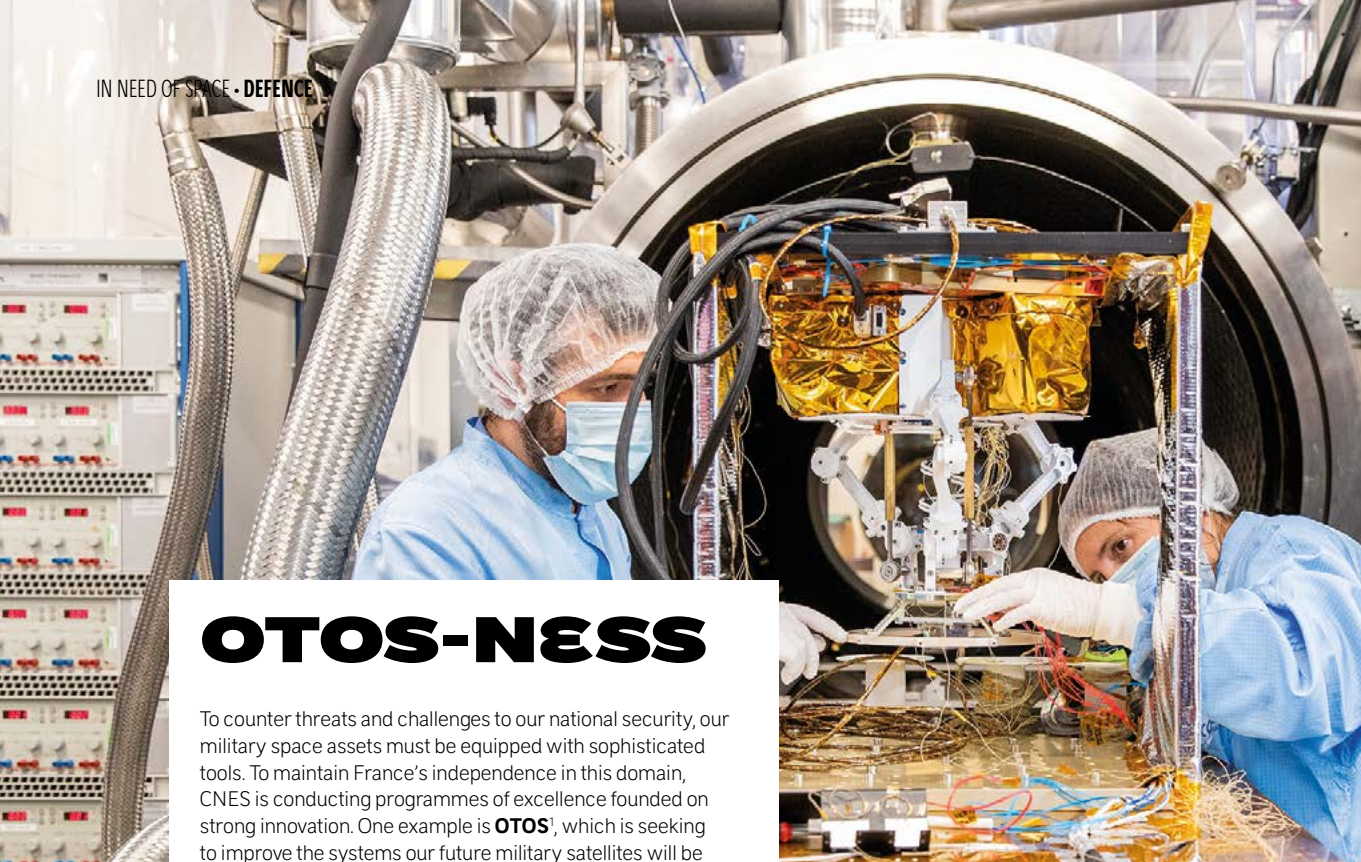
New Space Command IN TOULOUSE

In July 2019, Florence Parly, the Minister for Armed Forces, outlined France's Military Space Strategy. This strategy directed and approved by President Emmanuel Macron is geared towards "defending our assets in space and through space".

With this goal in mind, a new Space Command (CDE) under the authority of the French Air Force has been set up at the Toulouse Space Centre. The CDE will ultimately be staffed by a cadre of 400 military personnel by 2025 and is tasked with federating and coordinating the nation's military assets, conducting military operations and helping to shape military space policy.



◀ Minister for Armed Forces Florence Parly visits the Toulouse Space Centre to meet the first Air Force personnel staffing Space Command (CDE).



OTOS-NESS

To counter threats and challenges to our national security, our military space assets must be equipped with sophisticated tools. To maintain France's independence in this domain, CNES is conducting programmes of excellence founded on strong innovation. One example is **OTOS**¹, which is seeking to improve the systems our future military satellites will be carrying. We will also be testing the new **NESS**² platform in orbit in 2021. This highly promising cubesat will provide global surveillance of civil radiofrequency spectrum in L-band and S-band, and analyse sources of jamming.

¹ Observation de la Terre Optique Super-résolue

² Nanosat 3U pour la Surveillance du Spectre civil





CSO-Syracuse CERES

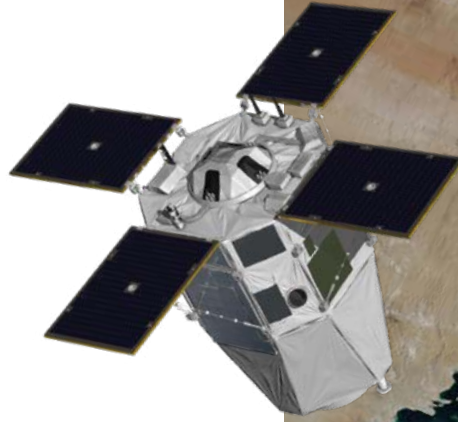
The CSO¹ satellites from the core of our optical intelligence-gathering ecosystem. The constellation's deployment is being pursued with the entry into service of **CSO-2**, capable of acquiring super-resolution imagery at low altitude.

The last satellite in the constellation, **CSO-3**, will lift off late 2021 to offer faster revisits and increase the system's potential. This year will also see the launch of the trio of **CERES**² signals intelligence satellites. Flying in formation, these light spacecraft will constitute the first orbital system of its kind in Europe designed to detect and locate electromagnetic emissions. CERES is drawing on the advances achieved over the last decade with the ELISA satellites to strengthen our armed forces' capabilities.

Secure communications are the backbone of any military strategy. CNES, in partnership with DGA, is working on the **Syracuse** programme that is set to debut a new generation of satellites in 2021 with the launch of Syracuse IV-A by Ariane 5. A second satellite will be lofted into geostationary orbit a year later. Together, they will significantly boost data rates while affording an extra guarantee through their jam-proof capability.

¹ Composante Spatiale Optique

² Capacité d'Écoute et de Renseignement Electromagnétique Spatiale





Research



▲ James Webb Space Telescope (JWST)

1.4

MILLION KM

FROM EARTH IS WHERE THE U.S.-EUROPEAN JAMES WEBB SPACE TELESCOPE (JWST), THE SUCCESSOR TO HUBBLE, WILL ORBIT. IT HAS TAKEN 20 YEARS TO BUILD AND WILL BE LAUNCHED BY A SPECIAL VARIANT OF ARIANE 5.

Perseverance



◀ SuperCam



Frédérique Vidal
Minister for Higher Education,
Research and Innovation

WORLD- RENOWNED TECHNOLOGICAL EXPERTISE

Solar system exploration and the study of the universe are undoubtedly where international cooperation is the most mature, with space technologies enabling many discoveries and constantly pushing the boundaries of human knowledge.

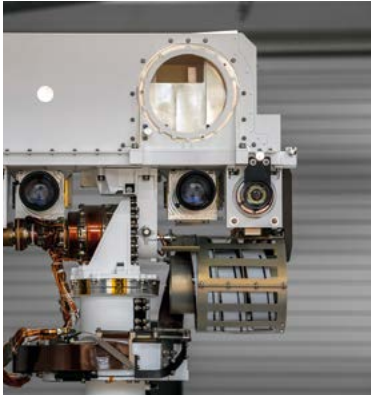
CNES is contributing to numerous European space science and Earth-observation programmes, working with all space nations in this field and providing our partners with world-renowned scientific and technological expertise that draws on a heritage of more than half a century in robotic and crewed space exploration.

Besides the emblematic programmes that have studded CNES's 60-year history in the domains of astrophysics, robotic planetary missions and the study of our own planet, the development of scientific experiments and instruments not only breeds new knowledge but also brings economic, social and environmental benefits. New applications are now being opened up by space technologies and solutions in association with big data and artificial intelligence. Such multi-disciplinary research is crucial and one of the keys to success in many areas.

By pushing back the limits of what we can achieve and pooling our competencies, we have succeeded in fostering synergies that are the envy of the world. And space-related disciplines need more engineers, research scientists and entrepreneurs.

In fulfilling this role as a catalyst, we are forging partnerships to build technology bridges between nations, while sharing and exploiting our shared know-how.

“Research is one of the pillars of the French space sector helping to further its international influence, and the science community today relies extensively on space data in numerous fields of investigation. We still have many new chapters in space research to write together.”



Mars2020

Launched in July 2020, NASA's Perseverance rover will land in Jezero Crater in February 2021, where it will spend several years searching for signs of life, notably by collecting and caching samples to be retrieved and subsequently returned to Earth by a later mission. CNES is providing its technical contribution and overseeing the international teams operating the SuperCam instrument. With its three spectrometers, laser, high-resolution camera and microphone, SuperCam is the core element of this international mission.

A few thousand kilometres from Jezero, the SEIS precision seismometer, a key French contribution to NASA's InSight mission, is nearing the end of its first Martian year—687 Earth days—acquiring measurements and detecting new 'marsquakes' with ever-increasing precision.

Alpha MISSION

European Space Agency (ESA) astronaut Thomas Pesquet from France is all set to fly to the International Space Station (ISS) in spring 2021. In France, our teams at the CADMOS centre for the development of microgravity applications and space operations and at the MEDES space clinic, based in Toulouse, are ready to support this new six-month mission. They are vital to enable the astronaut to conduct his programme of science experiments in medicine, biology and fluid physics. He will be performing 14 French scientific experiments on the station. CNES is also assisting four teams of students who have prepared Generation ISS experiments. An entire 'team France' is thus accompanying this Alpha mission, on which Thomas Pesquet will become the new record holder for time spent in space by a French astronaut.



FIRST RESULTS FROM **Solar Orbiter**

After its successful launch in February 2020, ESA's Solar Orbiter mission will pass every seven months on an orbit taking it close to the Sun.

CNES supplied the mission's RPW (Radio and Plasma Waves) instrument and is involved in most of the other 10 planned experiments. The science mission will get underway on 26 November 2021, after two flybys of Venus and one of Earth. Solar Orbiter will approach to within about 40 million kilometres of the Sun and be the first probe to observe its poles directly.

7 MONTHS
FOR EACH ORBIT
OF SOLAR ORBITER



Hayabusa-Mascot

SAMPLE RETURN

The tiny particles collected from asteroid Ryugu by Japan's Hayabusa2 mission will be the subject of extensive scientific investigation starting in 2021. To retrieve them, the probe descended twice to brush the asteroid's rocky surface in a high-risk 'touch-and-go' operation. CNES's teams have played an active part in this six-year adventure, which in addition to collecting samples set down the French-German MASCOT rover on Ryugu in October 2018. The dust brought back to Earth will be compared to readings obtained by MASCOT's instruments.

James Webb

SPACE TELESCOPE

The launch from French Guiana of the James Webb Space Telescope (JWST) will be a bellwether event for space astronomy in 2021. At CNES, our teams are preparing for the launch of JWST by an Ariane 5 with NASA, ESA and the Canadian Space Agency (CSA). The telescope will be positioned in an orbit around the L2 Lagrange point of the Sun-Earth system. The successor to the Hubble Space Telescope (HST) will then deploy its 18 mirrors and 20-metre sunshield to begin its mission to discover the most distant galaxies ever seen.

18
MIRRORS
AND A 20-METRE
SUNSHIELD

PHARAO ATOMIC CLOCK

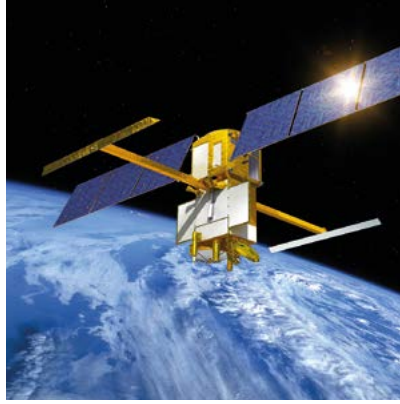
The PHARAO cold-atom clock is one of the tools most eagerly awaited by scientists the world over. The first instrument of its kind to be operated in orbit, it will be attached outside the European Columbus module on the International Space Station in 2021. In partnership with several research laboratories, CNES is leading ESA's ACES (Atomic Clock Ensemble in Space) project.

DECLIC-Evolutions

After more than a decade of experiments on the International Space Station (ISS), the research programme using the DECLIC¹ instrument is set to evolve. Refurbished by CNES, the new DECLIC will be reinstalled on the ISS in 2021. This mini physics laboratory, controlled from CADMOS, will observe material phase transitions. Like its predecessor, DECLIC-Evolutions is a joint project of CNES and NASA, which is responsible for its launch and installation on the ISS.

¹ Dispositif d'Étude de la Croissance cristalline et des Liquides Critiques





SWOT

The **SWOT** (Surface Water and Ocean Topography) satellite, the result of a partnership between France, the United States, Canada and the United Kingdom, is set in 2022 to advance the science of hydrology. With its impressive KaRIn radar interferometer instrument supplied by CNES, it will yield unique data on surface water height in lakes, rivers and flood zones. Performance gains are also expected to refine ocean and climate forecasting models from this three-year mission.



HEMERA-3 AND STRATEOLE-2 Balloons

The upper atmosphere is a relatively uncharted but nonetheless prolific territory for research. In 2021, we are preparing the **Hemera-3** zero-pressure stratospheric balloon campaign. With funding from the European Commission, 31 proposals from 10 countries are being assessed by a selection committee before the flights. The first **Strateole-2** science flight campaign will begin late in 2021.

In partnership with several international research laboratories, we will be releasing a flotilla of very-long-duration stratospheric superpressure balloons that will stay aloft for 3 to 18 months, circumnavigating the globe at the equator to gather a wealth of science data.

CO3D

2021 will mark the 35th anniversary of SPOT 1, which revolutionized satellite imagery and mapping. In 2022, we will be entering a new era with **CO3D**¹, a constellation of four satellites in preparation with Airbus Defence & Space set to produce 25 million sq.km. of digital surface models with unmatched precision every year.

¹ Composante Optique 3D

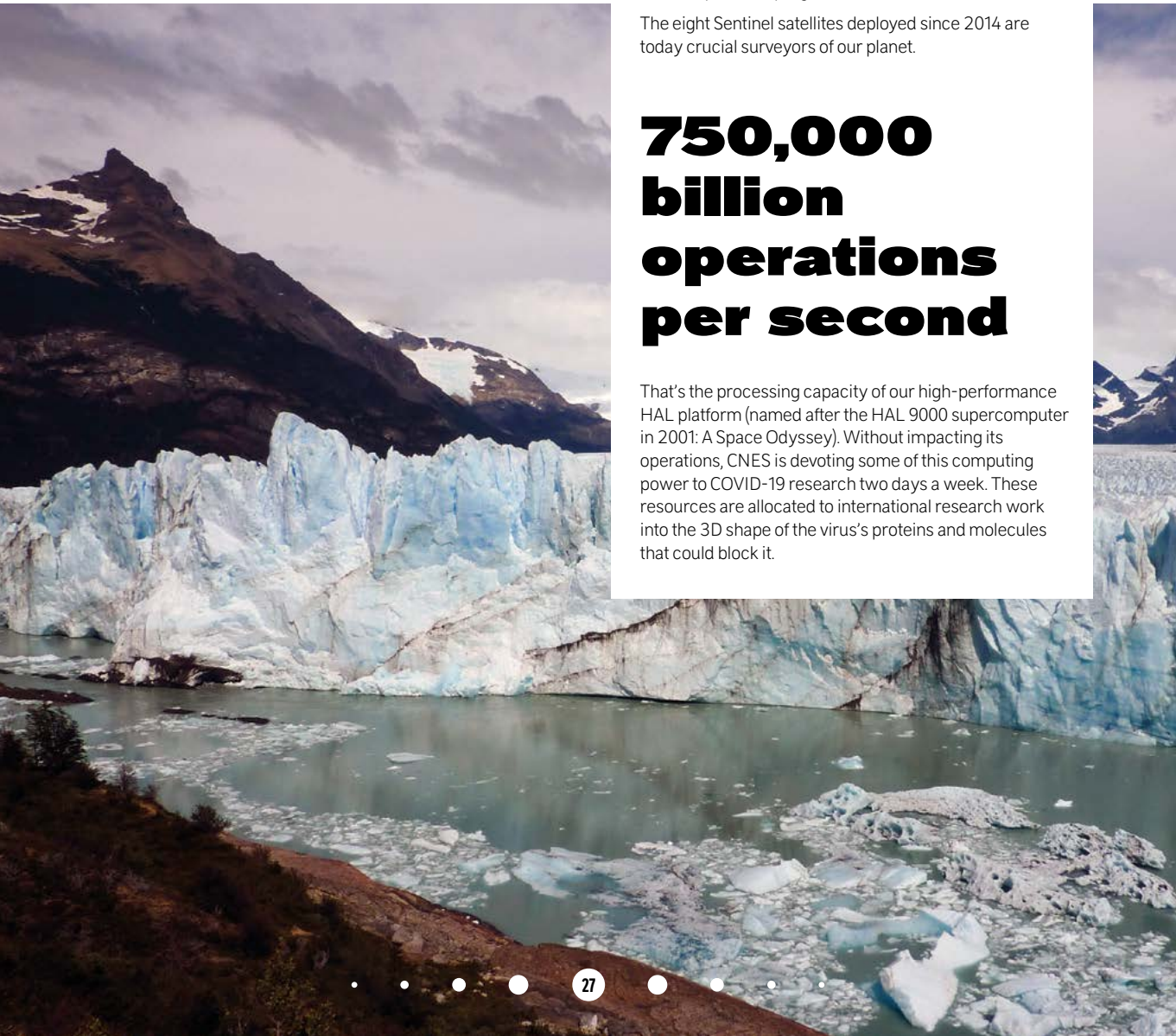
Sentinel-6 & Copernicus

Orbited in November 2020, the Sentinel-6A Michael Freilich satellite will be delivering its first ocean topography data in 2021. We are a key contributor to this mission, notably with the DORIS instrument and our expertise in assessing the satellite's altimetric performance. Alongside the European Union, ESA and our industry partners, CNES is also playing a central role in the Copernicus programme.

The eight Sentinel satellites deployed since 2014 are today crucial surveyors of our planet.

750,000 billion operations per second

That's the processing capacity of our high-performance HAL platform (named after the HAL 9000 supercomputer in 2001: A Space Odyssey). Without impacting its operations, CNES is devoting some of this computing power to COVID-19 research two days a week. These resources are allocated to international research work into the 3D shape of the virus's proteins and molecules that could block it.





To execute the nation's space policy, CNES relies on strong shared values like excellence, enthusiasm and the desire to rise to the challenges that lie ahead. Our 2,357 men and women are working hard to lay plans for the future, make French industry more competitive and sustain scientific and operational excellence. With our four centres in Paris, Toulouse and French Guiana, we are helping to extend the influence of French space policy.

Four centres OF EXCELLENCE

HEAD OFFICE: SPACE POLICY.

Our experts in Paris Les Halles have two key missions: to map out French space policy and to craft and coordinate CNES's national, European and international programmes. Every year, CNES signs tens of multilateral agreements, laying the foundation for new science and technology partnerships. The agency also works of course with military, academic, scientific, industrial and business partners in France.

Head Office, 2, place Maurice Quentin, 75039 Paris Cedex 01, Tel.: +33 (0)1 44 76 75 00

LAUNCH VEHICLES DIRECTORATE (DLA): LAUNCH SYSTEMS.

Paris Daumesnil is home to DLA, a key player behind the success of Europe's Ariane 5 and Vega launchers and Soyuz in French Guiana. Ariane 6 poses an important new challenge for CNES, which is prime contractor for all of the ground support facilities in French Guiana, its chief objective being to bring down operating costs. Drawing on the Ariane programme's 40-year heritage, DLA's experts are working to invent the launchers of tomorrow.

Launch Vehicles Directorate, 52, rue Jacques Hillairet, 75612 Paris Cedex, Tel.: +33 (0)1 80 97 71 11

TOULOUSE SPACE CENTRE (CST): ORBITAL SYSTEMS AND OPERATIONS.

Our engineers in Toulouse conceive, design, develop, build, position, control and operate orbital systems. Their work also involves encouraging uptake of satellite data for the benefit of all and innovating and creating to imagine tomorrow's space systems. To this end, our teams are tasked with supporting all users of space solutions and bringing space applications into our daily lives where they are needed most. With 800 employees from external contractors also on site, the CST is CNES's largest technical and operational field centre.

Toulouse Space Centre, 18 avenue Edouard Belin, 31401 Toulouse Cedex 9, Tel.: +33 (0)5 61 27 31 31

GUIANA SPACE CENTRE (CSG): LAUNCH OPERATIONS.

The CSG in French Guiana guarantees Europe's independent space launch capability, with its 1,700 personnel from 40 European companies conducting launch preparations and operations. At the launch base, CNES's teams coordinate and co-lead launch operations, prepare satellites and are responsible for range safety and ensuring compliance with environmental regulations. With its modern facilities and three operational vehicles, the CSG is gearing up for the future as the chief asset of Europe's space strategy.

Guiana Space Centre, BP 726, 97387 Kourou Cedex, Tel.: +594 (0)5 94 33 51 11

60 years.

In December 2021, CNES will be marking the 60th anniversary of its inception. From 1961 to the present day, our agency has been party to the world's greatest space endeavours. With the European series of Ariane launchers, the first spaceflight of a European, the SPOT and Jason satellites, the ATV cargo spacecraft, the landing of Philae on comet Chury, the first 'snapshot' of the first light of the universe with Planck, the CSO satellite and the SuperCam instrument on Mars, we have gone from success to success. Our aim is to lead disruptive programmes offering innovative, cheaper and better solutions tailored to the challenges of the future: low-cost launchers, the battle to curb climate change, and Internet connectivity for all. While adapting to the new space landscape, CNES is pursuing its role as the backbone of Europe's space programme, forging partnerships of excellence with scientists, universities, schools, institutions, industry and reputed research laboratories.



Diplomacy

IS THE KEY

International relations are all about diplomacy, and space is no exception. Our representatives in **Brussels, Berlin, Washington D.C., Moscow, Tokyo, Bangalore, Abu Dhabi and Beijing** are constantly seeking to consolidate cooperation with the agency's longstanding partners. Working every day in close contact with their local contacts, they assist France's ambassadors in all matters pertaining to space.

GO-TO

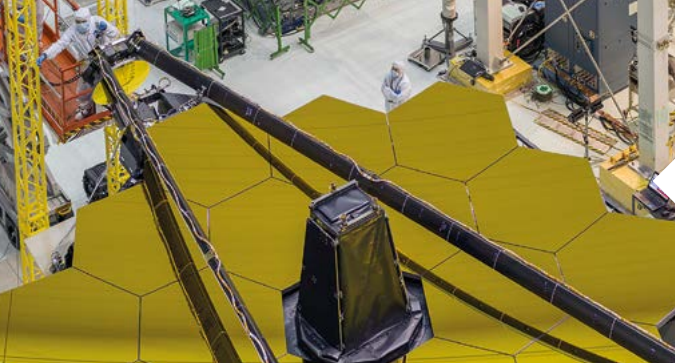
partner

Today, CNES has three types of international partnerships. European partnerships, through the European Space Agency (ESA) or the European Union (EU); historic, foundational partnerships with the world's leading space players outside Europe—**China, India, Japan, Russia and the United States**; and partnerships with new space powers—**Israel, Morocco, Singapore, South Korea and the United Arab Emirates**.

3

centimètres, c'est la précision des calculs de positions des satellites que peut fournir l'instrument Doris, installé sur plusieurs missions (Sentinel-3A et B, Sentinel-6, Swot...)

Centimetres is the precision of satellite positioning data from the DORIS instrument operating on several missions (Sentinel-3A and Sentinel-3B, Sentinel-6, SWOT, etc.).



1.4

million de km, c'est la distance à la Terre que doit atteindre en 2021 le télescope américano-européen James-Webb, successeur de Hubble.

Sa construction a nécessité 20 ans d'efforts et son lancement sera réalisé par une Ariane 5 spécialement adaptée.

Million km from Earth is where the U.S.-European James Webb Space Telescope (JWST), the successor to Hubble, will orbit. It has taken 20 years to build and will be launched by a special variant of Ariane 5.

800,000

tirs laser ont été réalisés sur Mars par l'instrument franco-américain ChemCam de Curiosity depuis son « atterrissage » en 2012.

Laser shots on Mars fired by the French-U.S. ChemCam instrument on the Curiosity rover since landing in 2012.



14.4

milliards d'euros de souscriptions pour l'Europe spatiale sur la période 2020-2022 (2020-2024 pour les programmes obligatoires) votés lors de la Conférence de l'ESA au niveau ministériel Space19+, fin 2019 à Séville.

Billion euros in funding secured for Europe's space programme for 2020-2022 (2020-2024 for mandatory programmes) at the Space19+ ESA Ministerial Conference in late November 2019 in Seville.



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sondes, véhicules et observatoires orbitaux à caractère scientifique ont été lancés depuis 50 ans du Centre Spatial Guyanais : de Gaia à Rosetta en passant par Spot, Planck, Herschel et ATV, le CNES a multiplié l'accueil de « passagers » emblématiques.

Orbital probes, spacecraft and observatories launched for science over the last 50 years from the Guiana Space Centre: from Gaia and Rosetta to the SPOT satellites, Planck, Herschel and ATV, CNES has hosted a plethora of emblematic 'passengers'.

250

jeunes sont accueillis chaque année au CNES dans le cadre de leur stage de fin d'études supérieures.

Young students hosted every year by CNES for their end-of-degree internship.



4,000

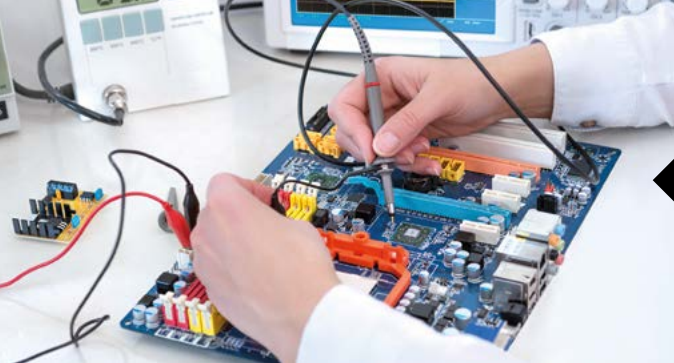
tonnes, c'est la masse du portique roulant d'Ariane 6, la plus grande structure du genre au monde.

Tonnes is the weight of the Ariane 6 mobile gantry, the largest of its kind in the world.

580

petits satellites supplémentaires seront mis sur orbite d'ici à 2022.

New small satellites set to be orbited between now and 2022.



82%

d'ingénieurs et cadres dont 37% de femmes travaillent au CNES.

Engineers and executives, 37% of them women, make up CNES's workforce.