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SPACE IS MORE CRUCIAL THAN EVER TO THE HIGH STAKES OF THE DECADE AHEAD

What are the main strategic aims of the agency's "New Spaces" Objectives and Performance Contract covering 2022-2025 in response to the fast-changing space landscape?

It's clear that global competition in science and technology is rapidly gaining pace, while space is more crucial than ever to the high stakes of the decade ahead. With this in mind, the new Objectives and Performance Contract (OPC) signed with our overseeing ministries for 2022-2025 is founded on four pillars: sovereignty, i.e. France and Europe's strategic independence; scientific cooperation, working to project France's influence; climate; and economic competitiveness, bringing new players into the fold to make France's space industry more competitive.

The new OPC also puts the emphasis on changing how we work. Over the next four years, we must achieve more subsidiarity and agility in everything we do, while taking the benefits of our actions to a broader base and enhancing our technical skillset. These changes will enable CNES to refocus its efforts on missions that deliver high added value and on disruptive innovation.

With France and Europe's strategic independence one of the key stakes of the new OPC, what is CNES's strategy to strengthen our national sovereignty in an increasingly complex global environment?

Guaranteeing France's and more broadly Europe's independent access to space is how we will strengthen our national sovereignty. Our first goal in this regard is to get Ariane 6 off the ground and ensure its future commercial success. We must also lay plans for the future by starting work on the launchers of tomorrow, notably reusable launchers with the lowest possible operating costs, while making the Guiana Space Centre the world's leading spaceport. Strengthening national sovereignty also implies supporting the ramp-up of our military space capability.

What role does CNES have to play addressing growing concerns about climate change and social issues?

As a government agency, CNES has a clear corporate social and environmental responsibility. We've set out a CSR strategy aligned with the United Nations Agenda 2030 and France's roadmap for attaining the UN Sustainable Development Goals. This strategy commits us to curbing our environmental footprint, preserving biodiversity and fostering greater gender equality at all levels of management.

We're also engaging our efforts through projects delivering ever more data vital to support work on biodiversity and climate science. Space is the thermometer of our planet and an effective way to tackle the issue of global warming that concerns us all.

Riding on the momentum from the historic launch of the James Webb Space Telescope at the end of last year, 2022 is set to see a wealth of scientific projects and joint missions. What areas of cooperation do you intend to focus on in the years ahead?

First of all, I want to congratulate all of the teams at CNES and our partners for the successful launch of JWST by Ariane 5 last 25 December from the Guiana Space Centre. The precision of the launch has already extended Webb's service life by several years before it even starts operating. I want CNES to continue structuring partnerships vital to space science: at national level, by maintaining close ties with the entire French ecosystem, from research laboratories and industry to ministries, local government and start-ups; at European level, by continuing to lead France's contribution to the European Space Agency's science programme; and at international level, by pursuing development of the strategic projects engaged by our many partners in space.

We're hearing a lot right now about returning to the Moon and later possibly sending crewed missions to Mars. What role should Europe and in particular CNES be playing in these new ambitions?

Thomas Pesquet's ISS missions and the leading space powers' projects to build bases on the Moon and possibly Mars are fantastic for the space sector's visibility. CNES is enabling France to play a key role in these endeavours through ESA's European Exploration Envelope Programme (E3P), which affords regular flight opportunities to the ISS and in the near future to the Gateway or the lunar surface. Europe's project must be inspired by this conquering spirit of space exploration, which is why developing human spaceflight missions in Europe is something that merits being reconsidered.

Since taking the helm at CNES you've emphasized the new challenge of exploiting space data. Can you set out your vision in more detail?

Space data have become an essential feature of our lives. The space value chain is shifting further downstream with the countless services we're supplying to industry and citizens. Be it for research, business or the environment, digital and space technologies will be driving growth in the years ahead. We must therefore nurture and support businesses and start-ups that need space data to invent new services.

With CNES celebrating its 60th anniversary this year and signing a new OPC with its overseeing ministries, how does it stand between its heritage and future horizons?

CNES's long history of success is something we can be proud of. In 60 years, we've cultivated a world-renowned space science community, built a European agency with our partners federating the efforts of all and spawned manufacturers that are today world leaders in their field. Our role today is not the same as it was in the past, and we're now poised to write a new chapter. But the common thread linking past, present and future is our ability to work together and go the extra mile as we serve the nation through our shared passion for **space**.





60 years for the future

Sixty years ago, France formed its space agency to federate national efforts. CNES (Centre National d'Etudes Spatiales) has been a key player in the space adventure ever since its inception on 19 December 1961 and is today gearing up to

face new challenges. With its eye on preserving Europe's independent access to space, notably through the Ariane programme, CNES continues to innovate in working towards cheaper and reusable future launchers and is poised to usher in Ariane 6, while also developing and modernizing the Guiana Space Centre. Over the years, our agency has partnered with French and European research laboratories and manufacturers of all shapes and sizes to build scientific excellence, strategic independence and

economic competitiveness for the nation and for Europe. Thanks to our vigorous cooperation policy and solid technical expertise, CNES has succeeded in cultivating a space ecosystem of excellence in France. Through the synergies thus created, we have achieved major world firsts and developed vital tools to address issues shaping the future such as climate change, health and safety, while also advancing knowledge and furthering human deep-space exploration. Our role is therefore to contribute through our topflight skills to our ecosystem so that it can innovate, prepare us for

"I want to tell you how proud France is to have an agency like CNES for 60 years now, to express the nation's thanks for the dedication of its people, for the diversity and excellence of their skills, and an unwavering commitment to their noble mission."

> Jean Castex, Prime Minister, 15 DECEMBER 2021

the changes ahead and keep pace with international competitors in the fast-moving New Space arena. For six decades now, CNES has paved the way for applications and new uses of space. Space data are set to change our lives in so many ways, supporting increasing numbers of social and economic stakeholders, and are more than ever central to our agency's strategy. But what makes CNES above all is its people, who for the last 60 years have gone the extra mile while adapting continuously to

carry forward large-scale projects for the benefit of all, fired by their shared passion for space.

The government has entrusted us with a key role in its space policy from the outset and is today renewing its faith through our Objectives and Performance Contract for 2022-2025.

#CNESat60 #PrideinCNES



OPC 2022-2025 NEW SPACES

Every five years, the government and CNES set the agency's roadmap in its Objectives and Performance Contract (OPC). Under the banner of "New Spaces", the OPC for 2022-2025 comes at a time of increasing competition in the fields of space science and technology.

Sovereignty, scientific cooperation, climate science and economic competitiveness will subsequently form the four strategic pillars of France's space policy. In charting its course towards these "new spaces", CNES is committed to operational goals that will further excellence and ambition, enabling space to fuel a broad spectrum of the economy and a wide range of government policies.

CNES is boosting the French space industry's competitiveness, helping the ecosystem's stakeholders to diversify not only through development of disruptive technologies but also by establishing new partnership and co-funding models with industry. We are thus supporting the transition from an infrastructure-based economy to a data-driven model, as we seek to advance new applications and services.

Pursuing our remit to serve science, CNES is leading ambitious missions and extending French excellence in Europe and worldwide through its efforts to sustain space science research and a vigorous cooperation policy.

To sustain

France's national sovereignty, CNES is engaged in the Ariane 6 programme, helping industry and entrepreneurs to conceive the low-cost reusable launchers of the future. We are supporting the ramp-up of military space capabilities and playing a prime role in acquisition and processing of satellite data.

And in a world increasingly prone to climate disruptions, CNES is making climate science a top operational priority and consolidating its commitments, notably through its Earth-observation programmes and the Space Climate Observatory (SCO). We are also leading by example in reducing our environmental footprint and being a socially responsible employer.

The pace of change in the space sector and the new landscape are also changing the way CNES works, with more subsidiarity, more stakeholders and more agility, while preserving and honing our technical expertise.

CNES has always moved with its times, and is committed alongside its overseeing ministries to meeting these new challenges to serve science, progress and national and European sovereignty.

BUDGET

Every year, CNES's budget is voted by our board of directors and our accounts are signed off by our auditors. In line with the agency's objectives, our income and expenditures are examined by independent bodies mandated to ensure they are used as intended, notably for the benefit of France's industry, scientific community and space ecosystem.

In 2020, CNES's budget remains high, showing the strong priority given to space and enabling the agency to continue engaging new activities despite the large number of programmes already underway.

2022 BUDGET: **€2,566m**

SUBSIDY FOR ESA CONTRIBUTION: NATIONAL PROGRAMME SUBSIDY:

OWN RESOURCES: STIMULUS PLAN: PIA FUTURE INVESTMENT PLAN:

WHO FUNDS CNES?

To accomplish our mission on behalf of the government, CNES receives funding from multiple sources: public service subsidies, the PIA future investment programme, the stimulus plan and external sources for programmes where we have delegated responsibility (DGA, ESA, Eumetsat, etc.).

Space stimulus plan

To support a quick and lasting recovery for the French economy hard hit by the COVID-19 health crisis, the government has deployed an exceptional stimulus plan worth €100 billion. Under this plan's Competitiveness budget line, more than €365 million in new funding is being injected across the French space industry through CNES.

To ensure rapid results from this plan, three initial budget lines for contracts were put in place in 2021 via targeted calls for projects for SMEs and mid-tier firms, collaborative calls for consortia and innovative calls for start-ups and SMEs.

This year will see the nanosatellite plan come to fruition to bolster and structure this emerging ecosystem. Projects selected will be required to demonstrate or flight-prove innovative equipment by no later than mid-2023.

CNES has sole responsibility for executing this space stimulus plan. Its implementation is also overseen by a steering committee composed of DGE, the French enterprise agency, and the Budget Directorate, for the Ministry of the Economy, Finance and the Recovery; DGA, the French defence procurement agency, for the Ministry of the Armed Forces; and DGRI, the French research and innovation agency, for the Ministry for Higher Education, Research and Innovation (DGRI).



FRANCE 2030 "PLAYING OUR FULL PART IN THE NEW SPACE ADVENTURE"

To meet this challenge, the government's France 2030 investment plan is deploying \in 30 billion over five years, of which \in 1.5 billion devoted to space will from 2022 be supporting reusable mini-launchers, microsatellites and minisatellites, constellations and technology and service innovations.

A GO-TO PARTNER

While space is a commercially competitive arena, it also offers fertile ground for collaboration, especially in science and exploration. As a pivotal player in space cooperation, CNES intends to pursue and step up foundational collaborations with its European partners and the world's major space powers, as well as with new entrants. Our partnerships aim to foster scientific, technological and industrial relations in support of the strategic aims of France's foreign policy.



DIPLOMACY IS THE KEY

International relations are all about diplomacy, and space is no exception. Our space advisors 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 day to day in close contact with their local contacts, they assist France's ambassadors in all matters pertaining to space.

CNES HAS BILATERAL AND MULTILATERAL PARTNERSHIPS WITH NO FEWER THAN

COUNTRIES AND INTERNATIONAL

1 - LiteBird project agreement signing with CNES Chairman & CEO P. Baptiste and JAXA President Dr. Hiroshi Yamakawa

Economic competitiveness

2022

CNES's mission is to tap into the full potential of space to fuel economic growth and industrial competitiveness, a task that has gained in importance in recent years as a new paradigm has deeply transformed the landscape, giving birth to New Space. Driven forward by the disruptive methods of new players from the digital sphere and sustained by massive investment, this shift is bringing space to greater numbers with a wealth of data feeding into ever more innovative applications. In this context, CNES's role is to help the French space ecosystem move with these new trends and stay competitive. As French industry's longstanding partner, we are extending and stepping up our support to all areas of the private sector.

Space data: the black gold of the 21st century

Space data enable development of new services that are revolutionizing applications and are set to do so even more in the future. With its public and private partners, CNES's role is to qualify these data and ease access and uptake across all sectors. We are thus helping to seed and mature a data-driven economy in France and Europe.

GALILEO

EVER MORE RELIABLE, EVER MORE PRECISE

In late 2021, two new satellites joined the Galileo constellation, which will have 24 operational satellites in orbit by the spring of 2022. Europe's satellite navigation system already offers the best service on the market: with one-metre accuracy, Galileo is twice as good as GPS and provides positional fixes for more than two billion smartphones. Declaration of initial Galileo High Accuracy service and Open Service Navigation Message Authentication (OSNMA)—two free services geared towards applications requiring an accuracy of up to 20 centimetres and authenticated Galileo data—is expected in 2023. These evolutions will benefit many sectors such as agriculture, geomatics, rail, road transport, shipping and aviation.

CNES operates Galileo search-and-rescue resources on behalf of the EU Agency for the Space Programme (EUSPA). This EU contribution to COSPAS-SARSAT now enables distress calls to be detected and located anywhere in the world in a matter of minutes. We are also coordinating for EUSPA the independent assessment of Galileo and EGNOS navigation performance, involving 13 EU nations and Norway.

ALL SET FOR LAUNCH A MINIATURIZED TECHNOLOGY DEMONSTRATOR

After spacecraft buses for microsatellites weighing less than 200 kilograms and for those under 50 kilograms, the NESS demonstrator to be launched in the second half of 2022 is scaling down even further to just five kilograms. Built by start-up U-Space with CNES as prime contractor, this nanosatellite will validate technologies in orbit designed to detect and locate ground sources of interference thanks to a miniaturized instrument developed by Syrlinks.

ARGOS 4

WATCHING OVER NATURE

Operated by Kineis, a subsidiary of CLS based in Toulouse, the Argos system and its transmitters support numerous applications like measuring variations in ocean temperature, currents and salinity, monitoring volcanic activity, tracking ice cover and wildlife migration, and supporting shipping. In 2022, the first two instruments of the next Argos 4 generation will be sent into orbit with the Oceansat3 (ISRO) and HopS (NOAA/USAF) satellites, designed for marine biology and ocean-observing and monitoring applications. Argos 4's objective is to assure continuity of the Argos 2 and Argos 3 missions while improving performance and capacity.

Created in 1978 on the initiative of CNES and the U.S. National Oceanic and Atmospheric Administration (NOAA), Argos remains the only global satellite-based location and data collection system of its kind dedicated to studying and protecting the environment.

FAST FACT



20,000

ARGOS TRANSMITTERS ARE

CURRENTLY TRACKED BY 7 SATELLITES.

SPACE TELECOMS FLECTRIC BUSES TAKE OFF

All-electric satellites have revolutionized space communications, a shift that CNES has anticipated through its support for French manufacturers, notably its Electrification and NEOSAT programmes funded by the government's PIA future investment programme. After the launch in late 2021 of SES-17 and Syracuse 4A, 2022 will see the launches of two satellites built around Thales Alenia Space's Spacebus-Neo platform, while HotBird 13F will be the first satellite based on Airbus Defence & Space's Eurostar NEO spacecraft bus.

French primes have achieved a record 50% share—in numbers of satellites ordered—of the commercial GEO satcom market over the last five years, rising to 70% if only fully open competitive bids are taken into account. These very good results are down notably to the support for satcom innovation provided by CNES and the PIA future investment programme, which have helped Airbus Defence & Space and Thales Alenia Space to offer flexible and competitive products closely tailored to operators' needs at a time when market forecasts remain very uncertain.



Taking up the New Space challenge

Fuelled by massive investments and disruptive innovations, New Space has reshaped the space landscape, quickening the pace of technological and industrial change and spawning new applications. We are now seeing an economic revolution equivalent to that of the Internet in the 1990s—a revolution that CNES is irrigating and supporting through its Connect by CNES structure. Our message to all is clear: we want to hear your new ideas!

o station K



CONNECT BY CNES

Earth observation, communication and telecoms are just some of the limitless potential applications of space. Our job at CNES is to bring together entrepreneurs from very different horizons to spawn new services. This is the philosophy behind our Connect by CNES initiative, which is fostering exchanges with other sectors, initiating competitions and calls for projects, leveraging funding and forging ties with incubators and competitiveness clusters.

In 2022, Connect by CNES is continuing to support the downstream sector and the environment, mobility and health domains. It will be putting special emphasis on developing activities upstream, notably deployment of infrastructures in low Earth orbit, as well as on readying the French ecosystem for future lunar exploration.

www.connectbycnes.fr



CNES AND ITS PARTNERS ARE HELPING TO CREATE

SPACE TECH START-UP EVERY WEEK IN FRANCE.

COSMICAPITAL

FIRST CAPITAL-INNOVATION FUND DEDICATED ENTIRELY TO NEW SPACE

As it shifts towards a "space as a service" model, the space industry today offers some great opportunities to be grasped. Led by Karista, CosmiCapital is an innovation investment fund with €38 million at its disposal designed to incubate French and European New Space champions. It is being funded notably by CNES, as its initiator, and by the FNA 2 seed fund managed on behalf of the government by public investment bank Bpifrance under the PIA future investment programme, and in partnership with the European Space Agency (ESA).

We accelerate tropean space h startups.

SPACEFOUNDERS TURBOCHARGING START-UPS

Initiated and co-managed by CNES and Bundeswehr University Munich (UniBw), the SpaceFounders programme is supporting the best and brightest European space tech start-ups. In 2022, two classes of ten start-ups each will be receiving ten weeks of coaching and support in Toulouse and Munich. Candidates selected will get specific mentoring from world-class experts, preferred access to public and private funding, CNES's extensive network and infrastructures, and support from exclusive partners like ESA and the German space agency DLR.

CNES 2022

Sovereignty

Space is instrumental in assuring France and Europe's strategic independence. To strengthen France's national sovereignty, CNES is working to ready the launchers of the future and to fly Ariane 6, the latest in the Ariane line, while also making the Guiana Space Centre the world's leading spaceport.

At the same time, we are assisting with the ramp-up of operations at the new Space Command to give the nation the military space capabilities needed to protect our space assets.

Ariane 6 & future launchers

With Ariane 6 set to make its maiden flight in 2022, CNES's number one goal with the launcher's manufacturers is to ensure its success in a fiercely competitive market and to maintain an independent launch capability. Other dedicated teams are working on the launchers of the future.

ARIANE 6 PRIMED FOR LAUNCH

As the new spearhead of Europe's space effort, Ariane 6 will afford a launch system that allies performance, flexibility and competitiveness to cover both institutional and commercial needs.

Conceived with new generations of satellites in mind and offering an upper stage restart capability, Ariane 6 is a modular launcher that employs two or four solid-rocket boosters to orbit mid-sized to large payloads. CNES's Launch Vehicles Directorate-DLA, now the Directorate of Space Transportation (DTS)-and its industry partners have designed ELA-4, a made-to-measure launch complex at the Guiana Space Centre (CSG). Based on an eco-design concept and combining the best elements of the other launch pads at the base, it was officially inaugurated at the end of September 2021. Combined tests now mark the final step to subject the launch system to real-life conditions with a dedicated launcher. Ariane 6 will be making its maiden flight in 2022.

CNES's first ever mission was to find a site for a space launch facility. It chose French Guiana, and 60 years later ELA-4 is the ninth launch pad built by the agency at the CSG. We are also currently refurbishing the former Diamant launch pad to conduct tests on the Callisto reusable launcher stage and to accommodate micro-launchers.

FAST FACT

REDUCTION IN LAUNCH COSTS FOR ARIANE 6 VERSUS ARIANE 5

COMPANION TO ARIANE 6

With its maiden flight planned for 2022, the C variant of the Vega light launcher will increase its lift capacity while reducing costs, a feat accomplished largely thanks to the new P120C stage, which CNES was closely involved in developing and qualifying. This booster, which serves both as the first stage for Vega-C and as a strap-on for Ariane 6, will be key for Europe to keep pace in a highly competitive arena.

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CSG-NG SIGHTS ON THE FUTURE

A space launch base has a direct bearing on how competitive its launchers are. Through refurbishments and innovations, the CSG is pursuing its modernization started in 2020 and making the transition to renewable energies. Thanks notably to 4.0 technologies, its facilities and operating processes will gain in flexibility to meet the requirements and launch rates of Ariane 6 and Vega-C, as well as to accommodate other New Space players.



PROMETHEUS, CALLISTO AND THEMIS

EVALUATING AND TESTING REUSE





Committed to conceiving and readying future generations of European launchers, CNES is leading with ESA and its partners the Ariane Next programme to develop a flexible, reusable launch system with a smaller environmental footprint. We are pursuing a pragmatic and economic approach, using demonstrators to identify the most promising paths for reusable launcher elements. The very-low-cost Prometheus engine is already going through its paces on the stand, while Callisto will soon start testing the utility of returning and reusing a launcher stage with a flight profile matching the first stage of a real launcher. This engine and stage will equip the Themis reusable demonstrator, the first article of which will be assembled in 2022 for take-off and landing tests.



Seeing, hearing & communicating

In four years, three fleets of eight satellites in total have been deployed to strengthen France's military space capability. As the host centre in Toulouse of the Space Command formed in 2019, CNES is more than ever working with the French defence community, a longstanding partner.

SYRACUSE 4 THE MILITARY'S VOICE

Syracuse 4B will join its twin Syracuse 4A in geostationary orbit in mid-2022. This new generation of French military communications satellites is designed to maintain links at all times, in peacetime and in the event of a crisis or major disaster. With its new antennas and ground control centres and wider frequency bands, Syracuse 4's innovations offer greater communication capacity, flexibility, security and anti-jamming.

MILITARY EYES IN THE SKY

Placed in different polar orbits, the trio of CSO optical military satellites have a dual mission of reconnaissance from an altitude of 800 kilometres and identification from 480 kilometres for more precise definition and analysis. Built to an identical design, they acquire very-high-resolution imagery day and night in a range of viewing modes that cover a broad spectrum of requirements.



Also deployed in 2022, the CERES signals intelligence (SIGINT) constellation is the final piece in France's military intelligence capability. The trio of satellites operates in low Earth orbit, collecting signals intelligence free of overflight restrictions and in all weathers, over areas out of reach of surface sensors. With CERES, French armed forces will be able to detect and precisely locate electromagnetic signals from radiocommunication systems and radars.

CDE & ASTERX 2 SPACE TACTICAL TRAINING



Charged with executing France's military space policy, Space Command (CDE) is continuing to ramp up its operations at the Toulouse Space Centre. In 2022, it is re-running the AsterX exercise designed to test the capability to protect French satellites from threats or malicious manoeuvres. This tactical training, for which CNES provides technical support, involves the CDE's C3OS space operations command and control centre in Paris, CMOS military satellite observation centre in Creil and COSMOS military space surveillance and tracking operations centre in Lyon, as well as CNES and its French and international industry partners.

Scientific cooperation

The challenges that studying, understanding and exploring the universe present are coming into sharper focus as we envision human sojourns on the Moon and even Mars. Such missions are being conducted through the European Space Agency or with other international space agencies, but always in close collaboration with the science teams that conceived them. CNES is playing a pivotal role promoting French space science and sustaining its excellence, leading the scientific community and structuring these partnerships.

Probing our universe

From low Earth orbit to the edge of the universe, CNES is involved in the most high-profile robotic and human exploration missions, aboard the International Space Station, on Mars or around Jupiter, all the while keeping the stars in its sights.

ALPHA MISSION

GREAT JOB, THOMAS!

Thomas Pesquet spent six months aboard the International Space Station for his Alpha mission, conducting some 200 experiments during his stay. Most of the 12 experiments developed by the CADMOS centre for the development of microgravity applications and space operations at CNES are continuing after his return to Earth. These include the Telemaque tweezers capable of capturing small objects in levitation inside an acoustic vortex and the Lumina instrument, which will measure radiation levels on the ISS using optical fibre for at least a year.

2022 marks the 40th anniversary of the first spaceflight of a French astronaut, Jean-Loup Chrétien, selected by CNES in 1980. The flight on a Soyuz spacecraft ferried him to the Salyut 7 space station for a mission lasting 43 days.

FAST FACT



CASPEX CAMERA FOR SPACE EXPLORATION

Having already proved themselves on CNES's Eyesat nanosatellite and on 100 OneWeb satellites, the CASPEX cameras are set to be France's first eyes on the Moon. The result of a partnership between CNES and 3DPLUS, two models will be flying on the Emirates Lunar Rover (ELR) towards the end of 2022. Later, in 2024, a pair of identical imaging cameras will depart on the MMX rover built in partnership with the German space agency DLR and the Japan Aerospace Exploration Agency (JAXA) to observe Mars' moon Phobos up close. CASPEX has also been selected for the innovative Yoda geostationary space surveillance nanosatellites.



JAMES WEBB SPACE TELESCOPE BIGGER, FURTHER, MORE PRECISE

Launched by Ariane 5, the United States' James Webb Space Telescope (JWST) was sent aloft at the end of 2021 to succeed the Hubble and Spitzer telescopes. On 24 January 2022 it reached its destination at the L2 Lagrange point 1.5 million kilometres from Earth (whereas Hubble is only 570 kilometres above our heads), a point in space affording the clearest possible view. Once its instruments have been calibrated, it will be fully operational by mid-2022.

JWST is a marvel of technology set to delve deeper and date the many discoveries of its venerable predecessors, like the first galaxies and molecules in the atmospheres of exoplanets.

To achieve its goals, JWST packs a number of innovations, including the first—and largest—deployable mirror ever to be unfurled in space. France developed with CNES oversight the telescope's MIRI iMager (MIRIM), capable of blocking out light from a star to see planets in its vicinity more clearly.

PERSEVERANCE

HAPPY BIRTHDAY!

18 February 2021, the Mars 2020 mission's Perseverance rover landed in Jezero Crater, carrying with it the French-U.S. SuperCam, a greatly enhanced version of the ChemCam instrument operating on the NASA MSL mission's Curiosity rover on Mars since 2012. Between them, SuperCam and ChemCam have now fired more than **one million laser shots** on Mars, a symbolic and remarkable milestone in this technological and scientific adventure that has already yielded a wealth of results.



JUICE EXPLORING THE JOVIAN SYSTEM

What are the conditions necessary for planets to form and life to emerge? How was our solar system born? These are fundamental questions that the JUICE mission will be attempting to answer when it sets off atop an Ariane 5 launcher in 2023 on its two-year journey to Jupiter. The probe will also explore three of the planet's moons, focusing particularly on Ganymede, thought to harbour a liquid ocean beneath its icy crust. For this mission conceived under ESA's Cosmic Vision 2015-2025 programme, CNES is supporting seven French research laboratories working to develop the satellite's scientific instruments.

While Ariane 5

FAST FACT

has built its reputation on commercial success, it's no accident it has been chosen for the most prestigious space exploration missions. The launcher's remarkable reliability is down to its original design, tailored to a human spaceflight programme that was subsequently shelved.



GAIA DR3 CATALOGUE IN FULL

STARS BORN EVERY SECOND

Launched on 19 December 2013, the European Gaia satellite is still pursuing its mission to map the galaxy. In 2022, publication of its third catalogue is set to reveal consolidated data—like distance, mass, velocity and temperature—on 1.8 billion stars in the Milky Way These observations tell us about our galaxy's formation, structure and history. They also constitute the largest catalogue of exoplanets ever compiled.



The threats looming over our planet's natural resources and their over-exploitation make a global sustainable development strategy an absolute necessity. Space is playing a key role increasing awareness of this issue, and as a climate-focused agency CNES is playing its part in tackling climate change. Our agency's renowned expertise in Earth observation means France is in the vanguard of this effort in Europe and around the globe. And through our ambitious corporate social responsibility policy, we are leading the way in the sustainable development of space.

Measurements and solutions

In a warming world where the environment is under threat, satellite-based Earth observation has never been more vital, helping us to take the pulse of our planet and develop tools to cope with changing conditions. Whether for surveying the oceans and surface waters, land surfaces, the atmosphere, poles and glaciers, biomass or temperatures, CNES's mission is to further uptake of satellite remote-sensing data.

SCO SPACE CLIMATE OBSERVATORY REAL-WORLD TOOLS FOR TERRITORIES

The effects of climate change conjure up pictures in everybody's minds. All around the globe, territories are calling for tools to inform their policies for coping with it. This is the goal of the international Space Climate Observatory (SCO), initiated in 2019 at the behest of CNES for the One Planet Summit. Mid-2022, its 36 members—space agencies and UN programmes—will be enshrining their commitment by signing the International SCO Charter, which they have drafted together under the aegis of the United Nations Office for Outer Space Affairs (UNOOSA).

The SCO's national offshoots boost development of local projects that clearly meet territories' needs. Teams then have 24 months to turn their projects into an operational and transposable tool, for example to simulate marine submersion, give early warning of diseases, increase resilience to extreme hydro-meteorological events, monitor deforestation or preserve biodiversity. These projects are built on solid scientific foundations supported by CNES and research bodies. Led by CNES, SCO France is extending its 2022 call for projects to all of Europe and setting the standard for other nations to follow in structuring their national SCO.

www.spaceclimateobservatory.org



SCO FRANCE

SVVOT SURFACE WATER AND OCEAN TOPOGRAPHY

The French-U.S. Surface Water and Ocean Topography (SWOT) mission is packed with the very latest advances in science and technology. Carrying a ground-breaking wide-swath Ka-band radar interferometer dubbed KaRIn, SWOT will be sent into orbit at an altitude of 891 kilometres in late 2022. The worthy successor to the TOPEX/Poseidon and Jason altimetry missions, it will observe ocean circulation with ten times more resolution and be capable of assessing variations in stocks of water in wetland areas, rivers and lakes. Through its early adopter programme, SWOT has succeeded in federating a broad ecosystem to lay the foundations for tomorrow's applications.

> SWOT will be relying on the DORIS precise orbit determination and positioning system created in 1990 with satellite altimetry in mind. DORIS is the result of a partnership between CNES, the national mapping, survey and forestry agency IGN and the space geodesy research centre GRGS.

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BALLOONING

AROUND THE WORLD STRATEOLE-2 AND STRATO-SCIENCE

The only vehicles capable of probing the atmosphere in situ for long periods at altitudes up to 40 kilometres, balloons have been a core competency at CNES for 60 years. Two survey campaigns involving these behemoths of the skies will be running in 2022.

Strateole-2 will be releasing a flotilla of 20 balloons from the Seychelles up to April, at an altitude of between 18 and 20 kilometres, into the turbulent lower equatorial stratosphere. They will be carrying a suite of instruments capable of measuring a large number of variables such as wind strength and direction, air pressure and temperature, water vapour, concentration of the main greenhouse gases, and suspended ice and dust particles.

From the summer of 2022, other balloons will be sent aloft from the Timmins base in Canada for the Strato-Science campaigns. This programme is testing and proving new technologies as well as conducting scientific experiments in a near-space environment.



CNES 2022

Highlights in 2022

A YEAR FOR SPACE

FRENCH PRESIDENCIES

EU

FIRST HALF OF 2022

CEOS

CNES takes over the presidency of the Committee on Earth Observation Satellites (CEOS) in 2022 from the Indian Space Research Organisation (ISRO) and NASA. As the main representative of CEOS in the international community, CNES will be leading the organization's mission to ensure international coordination of civil Earth-observation programmes and promote sharing of data and indicators to meet social challenges and inform decisions. For the first half of 2022, France will be presiding the Council of the European Union. With CNES working alongside its overseeing ministries to build a stronger and more sovereign Europe, the French EU Presidency will revolve around the three notions of "recovery, power and belonging". France has made digital technologies and applications a top priority, as well as strengthening Europe's ability to defend its interests, including in space.

> FEBRUARY 2022

TOULOUSE, CAPITAL OF SPACE TWO DAYS, TWO RENDEZVOUS

On 16 and 17 February 2022,

Toulouse is hosting two key European space rendezvous: the Copernicus Symposium for the EU's Earth-observation programme, which will be held in virtual format with a livestream from Toulouse; and the Informal Ministerial Meeting (IMM), bringing together policymakers from the EU, ESA and its member states.

SEPTEMBER 2022



(INTERNATIONAL ASTRONAUTICAL CONGRESS) SPACEFOR@LL

Under this federating banner, the 73rd International Astronautical Congress (IAC) will be taking place in Paris, Porte de Versailles from 18-22 September. After leading France's candidacy,

CNES was chosen to organize this event bringing together space stakeholders from all over the world. We are therefore pulling out all the stops for this wonderful opportunity to extend the sphere of France and Europe's influence in space on the international stage.

NOVEMBER

2022

MINISTERIAL CONFERENCE IN PARIS REMAINING A PIVOTAL PLAYER IN SPACE

In a fast-moving global sector, spacefaring Europe must consolidate its position and make sure its industry stays competitive. On 22 and 23 November, space ministers from ESA's 22 member states will be convening in Paris. The ministers will be signing up to fund new programmes for 2023-2025 in the key areas of access to space, exploration, Earth observation, navigation, telecommunications, safety and security, and the mandatory science programme. As the second largest contributor to ESA, France is getting ready in concert with the government, CNES and its French scientific and industrial partners.



CNES

OUR FOUR CENTRES OF EXCELLENCE

To execute the nation's space policy, CNES relies on strong values like excellence, enthusiasm and the desire to rise to the challenges ahead. These are values shared by our agency's 2,348 people, who are striving every day to ready for the future, make French industry more competitive and sustain the nation's scientific and operational excellence.

> With our four centres in Paris, Toulouse and French Guiana, we are working to extend the influence of French space policy.



Head Office: space policy

Our experts in Paris Les Halles fulfil the two key missions of mapping out French space policy and crafting and coordinating CNES's national, European and international programmes. Every year, we sign tens of multilateral agreements, laying the foundation for new science and technology partnerships. The agency works with industrial, business, military, scientific and academic partners in France.

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



Space Transportation Directorate (DTS): launch systems of the future

In Paris Daumesnil, DTS is working to develop Europe's launch systems, notably as prime contractor for Ariane 6 ground support facilities, and to conceive future space transportation. The scope of its actions also covers human spaceflight, in-orbit servicing, advanced propulsion and active space debris removal. Drawing on the successful 40-year heritage of the Ariane programme, our experts are continuing to innovate and shape the space transportation systems of the future.

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



Toulouse Space Centre (CST): orbital systems

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 some 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

In French Guiana, the Guiana Space Centre (CSG) guarantees Europe's independent access to space. Its 1,700 personnel from 40 European companies conduct 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 compliance with environmental regulations. With its modern facilities and three operational launch 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





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