

CNES MAG

EN
FR

SPACE • INNOVATION • SOCIETY

#78

November 2018

FRENCH GUIANA

A LAUNCH BASE
LIKE NO OTHER

cnes
CENTRE NATIONAL
D'ÉTUDES SPATIALES



INSIDE



06

05 EDITORIAL

06 ROUNDUP

All about the Guiana Space Centre (CSG), its history and accomplishments, and how it operates

12 #COMMUNITY

CNES's followers are closely watching operations in French Guiana

13 Q & A

Rodolphe Alexandre, President of the French Guiana regional authority (CTG), reflects on the presence of space



13

16 IN PICTURES

Jewels in the Guianese crown

18 IN FIGURES

CNES in French Guiana: key figures

19 CNES IN ACTION

Education, environment and regional development: CNES steps into the breach in French Guiana

27 MATERIALS

Space propellants

28 TIMELINE

Highlights of the guided tour of the CSG



16

30 HORIZONS

- Damien Chevallier, CNRS researcher at the Hubert Curien Multidisciplinary Institute
- Luana Ierone, Payload Facilities Manager at the CSG
- Gérald Grucker, range safety specialist at the CSG

33 ETHICS CORNER

Safe passage, by Jacques Arnould

34 INSIGHTS

Exhibitions, books and events produced and supported by CNES

36 SPINOFF

Sentinel delivering services from the sky

PARTNERS

Mentioned in this issue: European Space Agency (ESA) p. 7-10-11-26; ArianeGroup (majority shareholder in Arianespace) p. 10-11; Roscosmos, the Russian federal space agency p. 9; UEBS, the launch base employers' confederation p. 9-10; French Guiana regional authority (CTG) p. 13 to 15; ONCFS, the French national hunting and wildlife commission p. 17-24; GIP FCIP public consortium supporting continuous education and employment p. 23; Canopée des sciences p. 23; ONF, the French forestry commission p. 24-29 and the GEPOG non-profit association p. 24.

Cover: ©Pascal Garnier

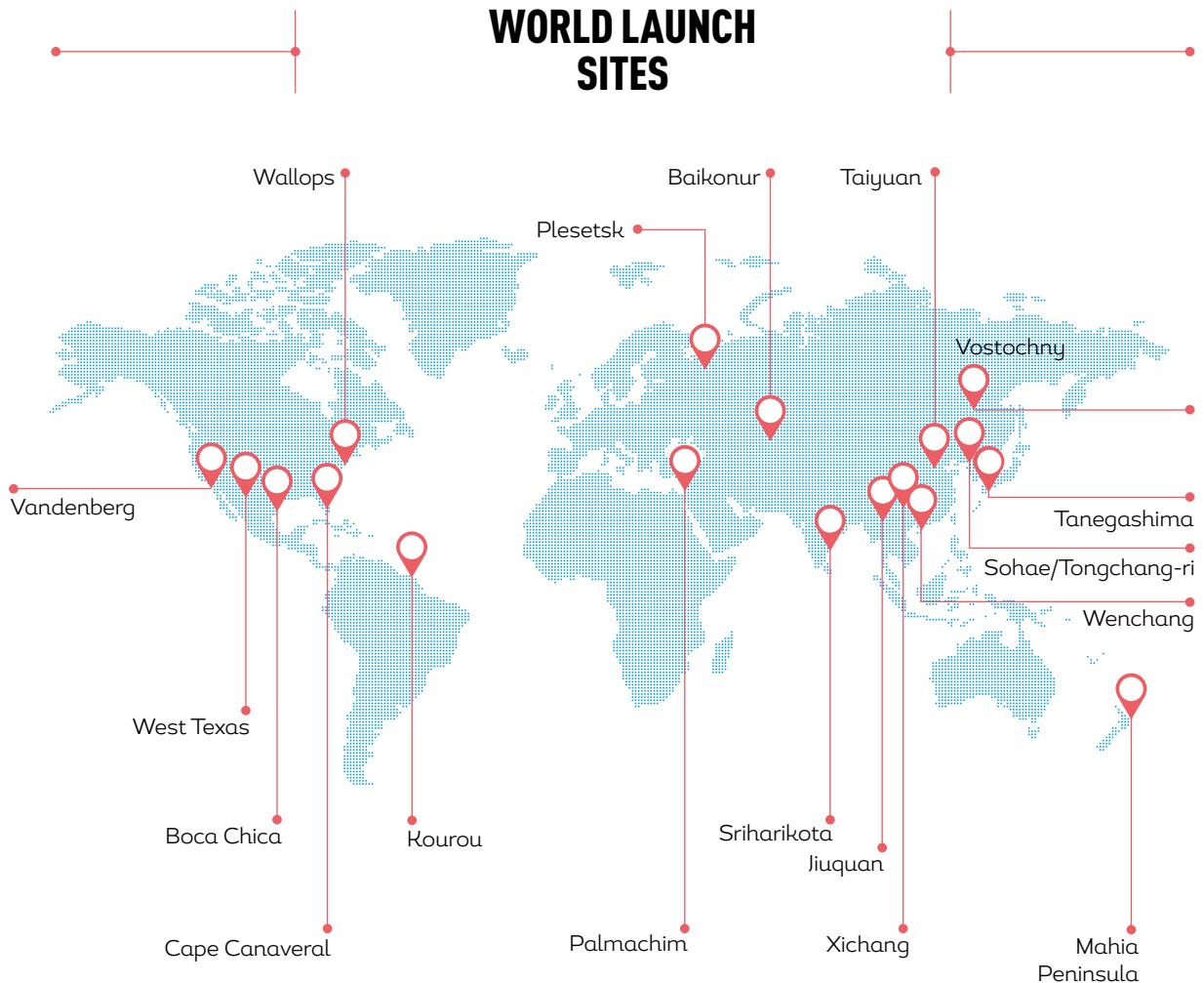


WWW.CNES.FR

More content
in this new issue on line
at cnes.fr/cnesmag



WORLD LAUNCH SITES





CONTRIBUTORS



PASCAL GARNIER

After starting his career as a comic strip artist and then as a stylist for Pierre Cardin, since 1980 Pascal Garnier is an illustrator and storyboarder in great demand. His works are on show in Paris, New York and London. After an exhibition on Benin commissioned by Air France, we gave him carte blanche for this issue on French Guiana.



KAROL BARTHELEMY

After living for 17 years in French Guiana, Karol Barthelemy recently published the first book devoted entirely to the Guiana Space Centre. She was an obvious choice as copywriter for this issue. Drawing on her long stint as our overseas correspondent, she delved back enthusiastically into her notes and called former colleagues to bring some history and anecdotes to the magazine, and to open a window on the region's future.



TYPHANIE BOUJU

As press and news coordinator at the Guiana Space Centre, Typhanie Bouju works with all the industrial and institutional structures at the launch base and has forged close ties with local stakeholders. Her network of contacts proved a precious aid, putting us in touch with the right people and facilitating meetings.



PHILIPPE BAUDON

After crossing the Sahara several times on his motorbike, Philippe Baudon headed to French Guiana where he's been shooting space activities for the last 20 years, having joined the team of photographers at the Guiana Space Centre's video and photo department. This time-lapse photography expert's motto is 'Beware of amateurs!' He shot many of the photos in this issue.

CNESmag

CNESmag, the magazine of the Centre National d'Etudes Spatiales, 2 place Maurice Quentin, 75039 Paris cedex 01. For all correspondence, write to: 18 avenue Edouard Belin, 31401 Toulouse cedex 9. Tél. : +33 (0)5 61 27 40 68. Internet: <http://www.cnes.fr>. This review is a member of Communication&Entreprises. Subscriptions: <https://cnes.fr/reabonnement-cnesmag>. **Publication director:** Jean-Yves Le Gall. **Editorial director:** Marie-Claude Salomé. **Editor-in-chief:** Brigitte Alonzo-Thomas. **Proofreading:** Céline Arnaud. **Editorial staff:** Brigitte Alonzo-Thomas, Karol Barthélémy, Liliane Feuillerac, Éric Médaille. **Photos and iconography:** Marie-Claire Fontebasso. **Photo editor:** Nicolas Tronquart. **Photo credits:** p. 4 P.Garnier, CNES/N.Tronquart, CNES/J.-M.Guillon, CNES/G.Barbaste; p. 5 CNES/C.Peus; p. 6 CNES/ESA/Arianespace/Service optique CSG, S.Martin; p. 7 Airbus DS (top), S.Caron (right); p. 8 CNES/ESA/Arianespace/G.Barbaste (right); p. 9 ESA/S.Corvaja; p. 10 CNES/ESA/Arianespace/Optique Video CSG/P.Baudon (right and left); p. 11 CNES/ESA/Arianespace/Optique Video CSG/P.Baudon (top), CNES/ESA/Arianespace/Optique Video CSG/J.-M.Guillon (bottom); p. 13-14 AFP/G.Van Der Hasselt; p. 16 CNES/Service Optique du CSG, P.Baudon; p. 17 P.Baudon; p. 18 Getty Images; p. 27 CNES/A.Cercueil; p. 33 J.Arnaud; p. 34 CNES/T.Bouju (top right), Lycée Balata, CAP CBAB (bottom left); p. 36 Sentinel/A.Arveiller. **Illustrations:** David Ducros (p. 8), Pascal Garnier (p. 1, 19, 20, 22, 25, 26), Robin Sarian (Idx) (p. 9, 28-29), Jean-Marc Pau (p. 30 to 32). **Webmaster:** Sylvain Charrier, Mélanie Ramel. **Social media:** Mathilde de Vos. **English text:** Boyd Vincent. **Design and pre-press:** Citizen Press - Camille Aulas, Stéphane Boumendil, David Corvaisier, Alexandra Roy, Vianney Bureau. **Printing:** Ménard. ISSN 1283-9817. **Thanks to:** Typhanie Bouju, Meritxell Clanet, Philippe Collot, Nathalie Costedoat, Emline Deseize, Françoise Maurel, Hervé Graindorge, Monia Zamor.



EDITORIAL



“This is the Operations Director. Final countdown: 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, ignition!” Anyone with even a cursory interest in space has at some point in their lives experienced the thrill of these magic words coming from the north coast of South America to announce the lift-off of a launcher, since today the Guiana Space Centre is among the world’s leading space launch bases. That’s why we decided to devote this issue of CNESMAG in its entirety to French Guiana and to the fantastic technological, industrial and commercial success of what has become Europe’s spaceport. It also gives us the opportunity to remind ourselves that the challenge set by President Charles de Gaulle to build a space centre at the equator has above all else been an extraordinary human adventure in which people from the world of space have played their part over the past 50 years in French Guiana. They have succeeded in creating an uncanny alchemy that has fuelled the technological feats behind the long series of Ariane, Soyuz and Vega launches, and as a result of which the space centre continues to prove its remarkable performance in an increasingly competitive environment. In a space sector that is constantly reinventing itself, the base in French Guiana is more than ever a key asset—if not THE key asset—of Europe’s space programme. But it is most of all a great advert for French Guiana and its people, who in 50 years have put their region firmly on the world space map.

JEAN-YVES LE GALL
CNES PRESIDENT

A large Ariane 5 rocket stands on a launch pad, surrounded by palm trees. It is launching, with a massive plume of white smoke and fire billowing from its base. The rocket is white with blue and orange markings. In the background, a tall metal tower with 'esa' written on it stands next to a tall cylindrical structure.

In the late morning of 25 July, the last flight of Europe's Ariane 5 launcher in its ES configuration placed four satellites into orbit for the Galileo constellation.

HISTORY

Looking back on half a century of launches

It's now 50 years since the first space launch from French Guiana. After its creation by President Charles de Gaulle in 1961, CNES was tasked with finding the ideal site to enable France—forced to leave its base in Hammaguir, Algeria—to establish its independent launch capability. The decision to build a new launch base in French Guiana was taken in 1964, after an in-depth survey of 16 potential sites. As Europe's spaceport, the Guiana Space Centre has been instrumental in its conquest of space and is today a key strategic asset. A half-century of launch operations has been marked this year by emblematic launches like those of the latest Galileo satellites on 25 July and Ariane 5's 100th flight on 25 September.



ROUNDUP



SPACEFARING EUROPE FEDERATING FOCUS

To serve France's ambitious national strategy, the launch base was opened from the outset to its European partners. This opportunity was quickly grasped by Europe's then-nascent space programme, supported by ELDO¹ and ESRO². After the setback of the failure of its first Europa rocket in 1971, spacefaring Europe regrouped around the Ariane programme to build a new and cheaper launcher put forward by CNES. ELDO and ESRO subsequently merged in 1975 to form a single European Space Agency (ESA), which would fund the Ariane programme and its launch pad in French Guiana and become the base's partner by co-funding its operations. ESA is also the launch customer for 30% of flights. Today, the Guiana Space Centre is Europe's only gateway to space. Working in concert, ESA and CNES have shared scientific successes like Rosetta, and technological successes such as the ATV, and are supporting European institutional missions like Galileo.

1. European Launcher Development Organization

2. European Space Research Organization



5°

At its latitude of 5° North, the base benefits from the slingshot effect imparted by Earth's rotation to boost launchers' velocity by roughly 460 m/s. As well as its geology suited to space facilities, French Guiana has a clear and sparsely populated stretch of coastline.

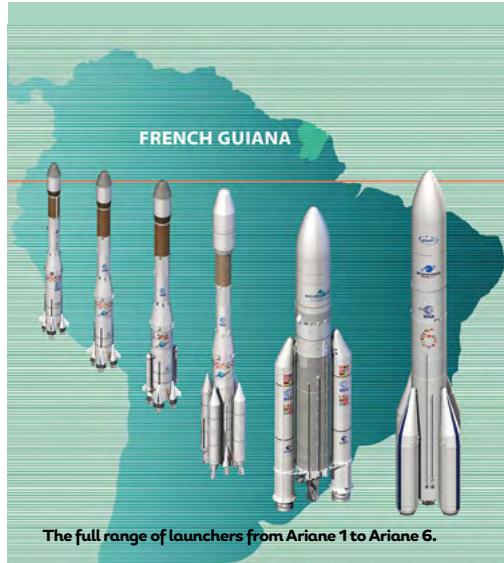
MILESTONE VERONIQUE SCORES FIRST SUCCESS



IIn less than four years, an operational launch site rose from the Guianese savannah and a new town was built in Kourou, previously a small settlement of fishermen and farmers. On 9 April 1968, the launch of the small Veronique sounding rocket marked the new base's first success. After a 45-second burn and a 12-minute flight, the nose cone was recovered from the sea, 30 kilometres offshore. There would be 353 more sounding rocket flights from the Guiana Space Centre up to 1981. While they lacked the velocity to reach orbit, they nonetheless played a key role in maturing space technology and the launch pad, as well as in studying atmospheric turbulence. And on 10 March 1970, the first genuine space launcher Diamant B lifted off from the base to orbit Germany's Wika satellite.



ROUNDUP



ARIANE EUROPE'S PRINCESSES OF SPACE

Ariane is the programme that tied Europe's space effort together after the failure of Europa. Named after Ariadne's thread, the project got off to a rough start. To develop all the facilities it would need, the Guiana Space Centre (CSG) went into hibernation for nearly four years. The reward for this period in the wilderness came on 24 December 1979, when Ariane 1 soared skywards and put Kourou on the world map. From Ariane 1 to 5, and soon Ariane 6, the CSG has constantly adapted to the vagaries of its flagship launcher, in the process making Europe the world's leading commercial space launch provider. For Ariane is more than a programme; it's also a strategy built around a family of launchers whose successive evolutions were planned and budgeted even before the latest in the series made its first flight. There have been a few failures along the way, but spacefaring Europe has pulled together to build the reliable, high-performance technologies behind the success stories of Ariane 4 and Ariane 5 ECA.

BUSINESS TOP-FLIGHT LAUNCH BASE

With Arianespace, CNES invented the concept of a space operator offering turnkey launches. Initially motivated by the need to fund series production of Ariane, this decision would enable the space business to transition from the government sector to the commercial market. Today, the CSG is renowned for its satellite reception facilities, with satellites arriving in French Guiana by plane, and for the reliability of the launch vehicles it operates. CNES has designed no fewer than nine launch complexes at the CSG, including four for the Ariane series and also for Europe's Vega light launcher and Russia's venerable Soyuz. The CSG routinely completes a dozen launches a year and, like French Guiana, is an international and multicultural facility.



The orbiters for the BepiColombo mission to Mercury undergo integration on site.



Aerial view of the Soyuz launch complex.

WHO'S IN CHARGE? CNES'S MULTIPLE ROLES

Under mandate from the French government, CNES is the owner of the CSG. The Ground Development Sub-directorate (SDS) of the agency's Launch Vehicles Directorate (DLA) has developed and overseen numerous construction projects there, designing all of the infrastructures needed to operate a space launch base. Projects in Kourou—launch complexes, an engineering centre, a control centre, tracking stations and so on—and outside the base, for example to extend the airport runway, build the port of Pariacabo and re-lay the surface of the RN1 main road from Cayenne to Kourou. In charge of operating the base, CNES guarantees the safety of the facilities, the people working there and the environment on behalf of the French government. The French Space Operations Act (FSOA) that came into force in 2010 confirmed CNES's role policing the launch base and assuring that regulations are correctly applied at the CSG by all concerned.

3 launchers

are currently operated from the CSG: Ariane 5, Soyuz and Vega. Arianespace thus has a full range of launchers for telecommunications, navigation, Earth-observation, science and space exploration missions.

1,700 employees

from 39 firms are hard at work at the CSG, performing a broad range of tasks in administration, production, launcher and satellite operations, maintenance and safety, 33% of them engineers, 50% highly qualified technicians and 17% blue-collar workers, covering 50 different jobs.

18 stations

around the globe contribute to the telemetry, tracking and control network for launches from French Guiana. The Galliot main station at the CSG centralizes all data from the other antennas along the launcher's trajectory. While standard commercial launches only require five stations (Kourou, Natal, Ascension, Libreville and Malindi), the network is extended to cover atypical missions for Ariane, Vega and Soyuz.

CSG MILESTONE AGREEMENTS

14 APRIL 1964



Government order to build a launch base in French Guiana.

30 MAY 1975



Creation of ESA and go-ahead for Europe's Ariane programme, initially dubbed L3S.

26 MARCH 1980



Birth of Arianespace, the world's first space transport operator.

18 OCT. 1990



Firms at the CSG come together under the banner of UEBS, the launch base employers' confederation.

23 MAY 2003



ESA and the Russian federal space agency Roscosmos sign an agreement to launch Soyuz from French Guiana.

2 DEC. 2014



Decision to develop Ariane 6 and Vega-C at ESA Ministerial Council meeting in Luxembourg.

17 MAY 2017



Airbus Safran Launchers (formed in January 2015) becomes Arianegroup, with a majority holding in Arianespace.



ROUNDUP



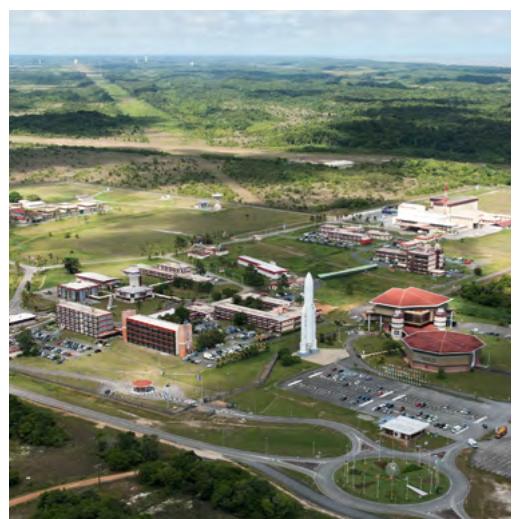
LAUNCHER PRODUCTION ASSEMBLY CHOREOGRAPHY

As Ariane achieved increasing commercial success and steadily ramped up its launch rate, part of the production of Ariane 5 and Vega was located on site. The largest launcher elements arrive from Europe and Russia by sea. The specially designed MN Toucan and MN Colibri, two ships operated by the Compagnie Maritime Nantaise, regularly dock in the port of Paracoubo, in Rourou. At the launch base itself, four manufacturers are at work: the UPG propellant plant produces solid propellant and fills Ariane 5's solid rocket boosters and Vega's main body, while Europropulsion assembles them and fits them out and ArianeGroup integrates the launchers and readies them for lift-off. Air Liquide Spatial Guyane supplies the base with the required gases and produces liquid oxygen and hydrogen propellant on site for Ariane 5 and, partly, for Soyuz. Alongside CNES, ESA and Arianespace, they form the French Guiana space industry community (CISG).

OPERATIONS A WELL-OILED INDUSTRIAL PLATFORM



The CSG is like an 'airport', only for space launches, funded by the European Space Agency (ESA) and France. ArianeGroup is in charge of the launcher (the 'plane'), while Arianespace takes care of the satellite customer (the 'passenger') and CNES the 'spaceport' (the launch base). To carry out their respective missions, these key stakeholders and the four manufacturers on site rely on an industrial ecosystem underpinned by competitive sourcing. By virtue of the geographic return principle, calls for tender are issued every five years and are open to all 22 ESA member states. As a result, a broad palette of European firms is present at the base, from France, Germany, Spain, Italy and Switzerland. To ensure consistency of operations, these 39 firms have come together under the banner of UEBS, the launch base employers' confederation, and all endorsed a unique agreement driven by CNES in 2006 to harmonize employment practices.





ALL ABOUT ANTENNAS

LAUNCHERS CLOSELY TRACKED

From the outset, CNES established a network of ground stations for launches from French Guiana. Three types of station support communications with the launcher to track it in flight and ensure it stays on the right trajectory. The stations' radars track each launch from lift-off until the signal is lost at an altitude of roughly 1,800 kilometres. Telemetry stations receive the signal from the launcher throughout its flight until completion of the mission when the satellite is injected into orbit. All of these data are received live at CNES's flight range safety control unit, which can send a destruct command to the launcher if necessary during the first minutes of the flight (see Horizons p. 32). The launcher centre and the control centre at the CSG also receive these data in real time. Some telemetry stations, like those in the standard downrange network, are owned by ESA and managed, maintained and operated on its behalf by CNES. The others are foreign stations (Jeju, Lucknow, Awarua, etc.) with which CNES has negotiated one-off agreements for ESA.

JUPITER II

WE HAVE LIFT-OFF

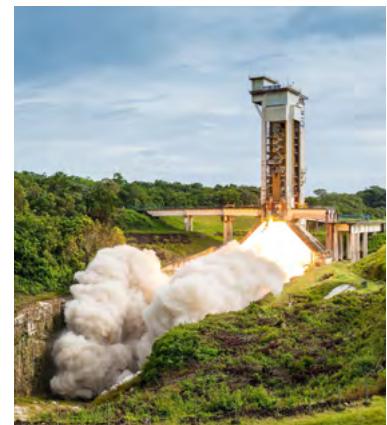
Thills are always guaranteed at a launch live from the Jupiter II control centre. In the hushed atmosphere of the small amphitheatre with seating for 250 people, spectators have a direct view through the glass panel of the 40 operators posted at their consoles with their eyes on the wall screen. Just above, there's even a viewing terrace to see the launch outside. Once the glow from the Vulcain 2 engine has faded in the distance, the wall screen takes over and tracks the flight in real time. And when confirmation arrives that the satellite has reached orbit, teams hug and congratulate each other and the pressure is off. End 2017, the control centre was completely redesigned with intuitive, touchscreen human-machine interfaces—a first for a space launch base.

COMING SOON...

ARIANE 6 AND VEGA-C SET TO SHINE

To keep pace with competition from NewSpace¹ players, spacefaring Europe decided at the end of 2014 to develop Ariane 6 and Vega-C. The two launchers are geared to offering the same level of reliability and services at a lower cost for all types of institutional and commercial missions. To meet this competitive challenge, ESA has tasked the European launcher industry with building the new launchers from development through to commercialization. To optimize costs, the P120 engine will serve both as a booster on Ariane 6 and as the main body for Vega-C. The new engine successfully completed its first hot-fire test on the BEAP solid booster test stand at the CSG on 16 July.

1. NewSpace, or entrepreneurial space, encompasses a range of private initiatives driving a paradigm shift in the space industry.





COMMUNITY

Every day, CNES engages with you on social networks and you share your thoughts and questions with us. Join the conversation!



@THOM_ASTRO
ESA Euro-French spacecraft pilot, back from 6-month ISS mission

Found this photo in my archives: construction of the Ariane 6 launch site underway in Kourou !
Things have come on a lot since. I visited Europe's spaceport in January . Maybe one day I'll lift off from there! 🚀



← ↻ * ⋮



@DUTCHSPACE
Engineer;working for a Space Agency Tweets/
Opinions are my own

#CSG base protection:-)



← ↻ * ⋮



@TRAVELMOTIV
CSG Guiana Space Centre

🚀 To infinity and beyoooond!
🚀 Visited the Guiana Space Centre and saw some amazing things there!



← ↻ * ⋮



@MUTCHAT
A child fascinated by the stars...
An adult who's become a space systems design engineer...

Diamant-B launch room at @CNES's Guiana Space Centre in Kourou 🚀 Hats off to all the engineers who came before us for what they accomplished 🎉🎉



← ↻ * ⋮



Q & A

RODOLPHE ALEXANDRE

RODOLPHE ALEXANDRE, THE PRESIDENT OF THE FRENCH GUIANA REGIONAL AUTHORITY (CTG), doesn't dodge any of the issues surrounding Europe's space presence in French Guiana. While recognizing the obvious benefits trickling down to all areas of the region's economy, he also sounds a cautionary note on the current model's limits.



Q & A

WHAT PLACE DOES SPACE OCCUPY IN FRENCH GUIANA'S ECONOMY?

Rodolphe Alexandre:

Space is unquestionably what's driving French Guiana's economic development. Its importance is very clear, as is its strong contribution to the region's development in the broad sense through key infrastructures like the Kourou main road and the Larivot Bridge.

WHICH SECTORS ARE MOST IMPACTED BY SPACE?

R. A.: There are many: the digital and IT sectors, education (through the IUT technology institute), transport and Cayenne harbour to name a few. In fact, I'd say that all economic activities in French Guiana are impacted by space. And that's not how it should be. A region like ours can't afford to be dependent on a single sector for its development. We absolutely have to find other sources to sustain our economic growth. I'm thinking of sectors with potential for organic growth like timber, agriculture, gold and oil. Today, French Guiana finds itself at a crossroads. We've now grasped this fact and we're striving to find sectors ripe for development alongside space to achieve the right balance for our region.



RODOLPHE ALEXANDRE

PRESIDENT OF THE FRENCH GUIANA REGIONAL AUTHORITY (CTG)

"THE RELATIONSHIP BETWEEN CNES AND THE FRENCH GUIANA REGIONAL AUTHORITY IS FRANK, LOYAL AND DIRECT."

WHAT DOES SPACE CONTRIBUTE IN TERMS OF JOBS?

R. A.: Space today represents more than 15% of French Guiana's gross domestic product (GDP), so the sector has a major bearing on employment. A survey by France's national statistics office INSEE on space's impact on French Guiana's economy conducted in November last year, covering 2014, showed that the sector sustains 800 direct jobs, 2,500 indirect jobs and

1,300 induced jobs. In total, space activities in French Guiana generated 4,600 jobs in 2014, that's 8.3% of the region's active population. The presence of all these people has a positive effect on the Guianese economy by boosting consumer spending in hotels, restaurants and shops.

WHAT OTHER INDIRECT IMPACTS OF SPACE DO YOU SEE IN GUIANESE SOCIETY?

R. A.: Space activities, through CNES, are helping to promote tourism in partnership with the French Guiana tourist board. The Space Museum is the most-visited tourist attraction in the region and launches from the base draw tourists from all over the world. CNES is also helping to create and support businesses, and more broadly working to sustain local actions as part of French Guiana's economic and social development. It's a key stakeholder in operational programmes and the government/regional authority development plan. In short, CNES's expertise is serving French Guiana.

IS SPACE'S SHARE OF THE REGION'S ECONOMY GROWING OR DECLINING TODAY?

R. A.: It has stabilized thanks to the good health of the space launch base in Kourou, and to construction work for Ariane 6.



Q & A

It's a burgeoning sector that's set, I hope, to see a new lease of life with the PHEDRE 2 plan.

HOW ARE YOU WORKING WITH CNES TO DEVELOP THE REGION?

R. A.: The relationship between CNES—and more broadly the Guiana Space Centre (CSG)—and the French Guiana regional authority (CTG) is frank, loyal and direct. Neither party is subordinate to the other. Guianese citizens should realize just how lucky we are to have a space launch base here and appreciate its role in the European and international arena. However, its marvels of technology haven't held all their promises and we must stop living with the sense of repentance and regret at what is perceived as the laying waste of the Malmanoury area where the CSG is sited. That time is behind us now and I want us to move on and overcome the divide still felt by the people of French Guiana. The social unrest of March and April last year made that quite

"IN SHORT, CNES'S EXPERTISE IS SERVING FRENCH GUIANA."

clear. We need to cultivate a new relationship and new symbols to see space differently in our daily and future lives.

WHAT ARE YOU THINKING OF IN PARTICULAR?

R. A.: We need to build new partnership relationships. I don't have a miracle solution. It will take time and everyone concerned will need to talk to each other. We need to initiate a new form of dialogue and bring new cultural, economic and structural values to the table. French Guiana must no longer be viewed from the perspective of individual or communal projects, but as a whole. The CTG intends to play a full role in this new relationship. For example, the IUT could become a key international hub for students.

HOW DO YOU SEE THIS PARTNERSHIP EVOLVING WITH THE LAUNCH OF THE PHEDRE 2 PLAN?

R. A.: CNES funding from the PHEDRE 2 plan, which amounts to €10 million, will increase the agency's total contribution to the region's development to €50.936 million over the

2014-2020 period. This additional budget envelope is intended chiefly for schools, higher education and research. These plans are welcome, but I regret that the regional authority wasn't involved in the choices made. And I regret that the CTG will no longer be playing a lead role in executing PHEDRE 2. I was fortunate enough to be involved in initiating PHEDRE 1 alongside Elie Castor when he was President of the general council, and that plan was more ambitious and more attentive to our region's needs and challenges.

Profile

1999

Doctorate in Law and History, after his thesis on Gaston Monnerville's role in French Guiana

2008

Elected Mayor of Cayenne

2011

Organizes first indigenous peoples day (Amerindian and Bushinengué)

2015

Elected President of the French Guiana regional authority (CTG)

"WE'RE STRIVING TO FIND SECTORS RIPE FOR DEVELOPMENT ALONGSIDE SPACE TO ACHIEVE THE RIGHT BALANCE FOR OUR REGION."



IN PICTURES



OFF THE SHORES OF KOUROU

Lying off the coast of Kourou, Ile Royale, Ile Saint-Joseph and Ile du Diable (Devil's Island) form a chain known as the Salvation Islands. This was the site of the notorious penal colony long associated with French Guiana. As the islands' owner, CNES is investing in their upkeep and faithfully restoring the ruins to preserve this valuable heritage. The Salvation Islands are listed historic monuments and the leading tourist attraction in French Guiana, drawing some 50,000 visitors a year. As they are directly beneath the launch trajectories from the base, they are evacuated on launch days.



IN PICTURES



LARGE WILDLIFE STRIKES THE POSE

French Guiana's majestic wildlife—jaguars, pumas, giant anteaters, tapirs and more—remains hard to observe and therefore poorly understood. Under an agreement with CNES, ONCFS, France's national hunting and wildlife commission, has set up automatic cameras at various points at the Guiana Space Centre. The results have exceeded all expectations, so the agreement has been renewed to track jaguars fitted with collars and herds of peccaries (wild pigs). Just before the Ariane 6 launch complex is fenced off, a beat will scare off any wildlife still present and temporary flaps will allow stragglers to escape.



IN FIGURES

RICH ECOLOGY

464 species of bird, 58 of them migratory, have been counted at the Guiana Space Centre (CSG). This big survey in 2016 also found 48 species of mammal, 19 species of reptile and 33 species of amphibian. The rivers and streams running through the CSG are just as rich in wildlife: Karouabo Creek is home to 44 species of fish, while the Malmanoury River has 59, almost as many as the Kourou River, whose catchment basin is 20 times larger.

22

GUIANESE BOROUGHS

—that is, all of them—have signed an agreement with CNES. The budget allocated to each depends on the population and development needs, with the minimum threshold for 2019-2020 set at €30,000. The goal is to provide support for economic development and education where it's most needed.

IMPACTS



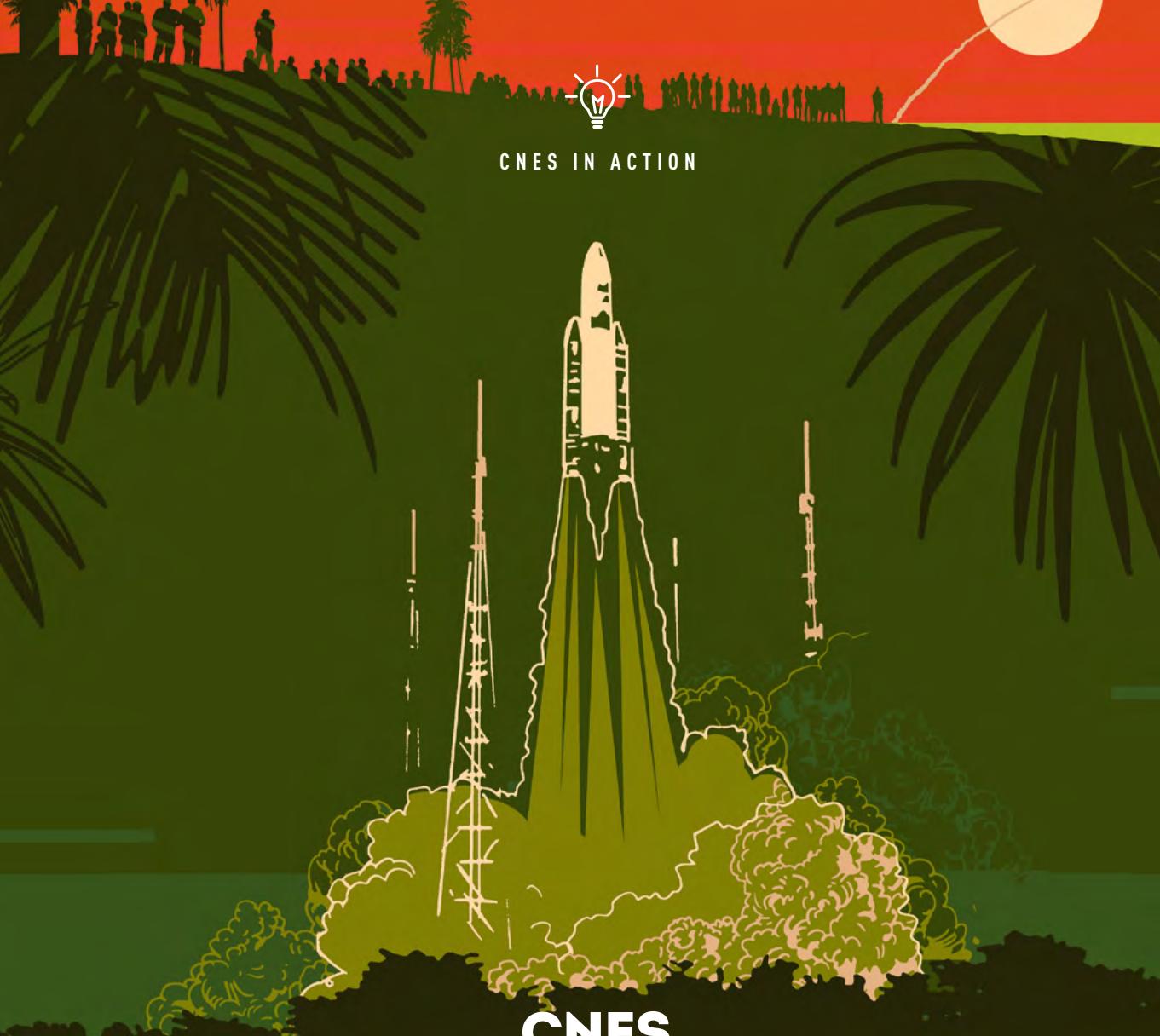
600 readings currently serve to gauge the environmental impact of launch activities. They involve monitoring air and water quality, as well as measuring the impact of launches on flora and fauna at the base. Chief among these are measurements of hydrochloric acid and alumina, the two main combustion residues from Ariane and Vega launchers. Readings show that levels of these residues are not only

very low but also limited to a small area around the launch pad. Barely two hours after an Ariane 5 launch, birds are already back in their nests.

16,650

visitors came through the CSG's doors in 2017. While most of them finished their tour at the Space Museum, 441 opted to discover the remarkable biodiversity of the base's savannahs.





CNES IN ACTION

CNES STEPS INTO THE BREACH

FAITHFUL TO THE FRENCH GUIANESE COMMUNITY, CNES IS WORKING WITH THE GOVERNMENT TO MEET THE REGION'S NEEDS. THE AGENCY IS PROVIDING EXPERTISE AND FUNDING FOR ITS EDUCATION, DEVELOPMENT AND ENVIRONMENT, WHILE ALSO READYING THE SPACEPORT FOR THE FUTURE.



CNES IN ACTION

Getting a space launch base off the ground in Amazonia was no mean feat. It was a titanic effort that relied on rigour and ingenuity, and the sweat and toil of mostly foreign labour. "When CNES arrived in French Guiana in 1964, the region was kind of awakened from its slumber by such a momentous endeavour," recalls Didier Faivre, the Director of the Guiana Space Centre (CSG). Back then, it was vital to build the infrastructure—roads, bridges, ports, airport and so on—needed to support the future launch facilities. And planning to accommodate the people who would work at the base was also a priority. CNES thus built, through government plans and with its own funds, most of the accommodation in the town and provided vital facilities like the hospital and IUT technical institute. It was decided from the outset to encourage the space sector's close integration in French

15%

of French
Guiana's
GDP

is generated
by space and
its impact is felt
in all sectors of
the economy
(industry,
services,
transport, etc.).

Guiana—today 80% of the CSG's personnel is recruited locally—and to ensure that its know-how would serve the region. To this end, the CSG created the Guiana Mission in 2000, a sub-directorate dedicated to managing funding for activities outside the scope of space. These funds come from France's contribution to operational European programmes and CNES funding for the agreements the agency has signed with Guianese councils.

SENSE OF AMBIVALENCE

For Didier Faivre, "the initial cuts have pretty much healed, but there's still some ambivalence between a feeling of pride in a region turned towards the future—after all, space is the stuff of dreams—and a sense of frustration that the launch base hasn't delivered everything the population was expecting from it. The needs are real, but CNES can't replace government action."





CNES IN ACTION

The social unrest of March 2017 was felt as far as Paris, and the demands were very clear. They concerned health, security and education. "There's clearly a disconnect between the region's needs and the high-tech space industry. This crisis was bound to come, because French Guiana is still lagging behind while its population continues to grow. And part of that population feels left out. The space industry obviously isn't the cause of that, but it was targeted symbolically to get the government's attention," notes Didier Faivre. The government's response was to allocate a billion euros, essentially to infrastructure, education and health. It also gave the go-ahead for the PHEDRE 2 plan, which gave CNES an extra budget envelope to support major structural projects. "Space is driving progress and attracting attention and visitors from all over the world, but French Guiana must dig deep and find its own source of strength and other avenues for development," concludes Didier Faivre.

MORE SPACE FOR FRENCH GUIANA WITH PHEDRE

The first PHEDRE¹ plan funded a number of infrastructures in the region from 1990 to 1997. Today, with PHEDRE 2, CNES is injecting an additional €10 million in French Guiana for 2017-2020, taking its contribution to the region's development to €50.936 million for the same period. "As CNES doesn't pay certain taxes in French Guiana, President Macron proposed using this money to step up space's local contribution, and he spontaneously dubbed this plan PHEDRE 2," explains Alex Agapit, Deputy Director of Administration, Real Estate and Property at the CSG. After a series of reports and inspections, the Minister for Overseas Territories delivered a three-pronged action plan designed to increase the space sector's economic and social contribution to French Guiana, make this contribution clearer and more effective and get the Guianese people and their representatives more closely involved in space's efforts for the region.

On the strength of this strategy, CNES is

CLOSE-UP

THE PHEDRE 2 PLAN

The PHEDRE 2 plan is devoting €10 million to four priority areas:



€4.3m
for schools,
higher education
and research



€3.7m
for the space environment:
funding for the Kourou
medical and surgical
centre, refurbishment of the
Cité du Stade district and
the Piste Mélanie, an old
track leading to gardens
and pastures on the
outskirts of the town



€2m
for promotion of
tourist sites under
CNES's responsibility



€100,000
additional budget for
regional and digital
development

rethinking its funding and involvement. "We now have rules for how funding is used and, with the exception of major structural projects, things are put in the hands of local elected representatives. CNES is maintaining its commitments and raising the profile of its actions, while refocusing on its domains of expertise and ensuring a fairer distribution of funds to councils," says Alex Agapit (see In Figures p. 18).

1. Partenariat Hermès au Développement RÉgional (Hermes partnership for regional development). Abandoned in 1992, the Hermes space shuttle project was one of ESA's first three human spaceflight programmes.



CNES IN ACTION



EDUCATION **BETTING ON** FRENCH GUIANA'S FUTURE

Education and support for the younger generation feature strongly among CNES's missions. And what stands in metropolitan France stands even more so in an overseas territory where the education system is failing. To help remedy this situation, the agency is opening its doors to the widest number and reaching out to local youngsters living in remote areas.



The space sector's presence definitely generates direct impacts, but in a territory as unique as French Guiana it also needs to nurture development of the local economy. Likewise, while science and technology education is a core element of its efforts, CNES is going beyond its original mandate in this area. "The ministerial delegation came to the same conclusions as us," points out Monia Zamor, Head of the Guiana Space Centre's Communications Office. "Refocusing on structural projects for the region starts with the younger generation and therefore



CNES IN ACTION

education at all levels. For projects falling outside the scope of our outreach mission, we've decided to direct funding from PHEDRE 2 through two agreements being administered and executed by our partners."

The first agreement, with the University of French Guiana, allocates additional funding to build infrastructures and laboratories, and to create a doctoral chair for space. The second, signed with the GIP FCIP public consortium supporting continuous education and employment in French Guiana, will enable digital teaching to continue and subsequently manage the new grant envelope. "We're adding a dozen new grants for second- and third-year undergraduates to the nine yearly grants for excellence for fifth-year undergraduates, to help French Guiana train the middle managers it currently lacks," notes Monia Zamor. Lessons and digital resources will also be provided for science projects in primary schools, as well as support for 15 or so apprenticeships a year in and outside French Guiana, in addition to the internships constantly on offer at the launch base. Many employees from the base also take it upon themselves to teach for higher-education courses.

SPACE ALONG THE RIVER

Like for the rest of France, CNES is conducting a range of science and technology outreach actions in French Guiana, with school visits to the base and to the Space Museum, invitations to launches, construction and launching of micro-rockets, certifications for teachers and more besides. But French Guiana is 95% forest lying between the two rivers that form its natural boundaries: the Maroni, which it shares with Suriname, and the Oyapock, which also extends into Brazil. For youngsters unable to reach the space centre, CNES initiated the Space Along the River operation in 2007. Every year, a team from the Canopée des Sciences¹ association goes up river in a dugout to meet the children from six or seven villages. "The educators conceive projects for all levels and spend a day or two opening the children's minds.

They give teachers methods and resources to pursue learning in class. Without this initiative, children along the river would miss out on the important science and technology opportunities available to families living on the coast," says Monia Zamor. Past workshops have involved building water rockets and a model of the solar system, and Mars rover competitions, but the latest attraction is a drone workshop that gives the children the thrill of seeing their village from the air. CNES is also working with the French Guiana education authority to develop digital satchels, for in equatorial France, 8,000 kilometres from Paris, digital technologies are key to driving development and education.

¹Non-profit association devoted to promoting science, technology and industry culture.



schoolchildren

visited the CSG in 2017. A further 1,000 youngsters a year are also reached by the Space Along the River operation, on the Maroni and Oyapock rivers. In 10 years, more than 17,000 schoolchildren living on the banks of these boundary rivers have been introduced to science and technology. The dugout's visit is always eagerly awaited by the children and adults alike, for whom it's a great way to alleviate their isolation.



**of French
Guianese
youngsters**

have difficulty reading and 33% leave school without any qualification. The figures are alarming, which is why CNES is stepping up its actions for schools and higher education through the PHEDRE 2 plan (see p. 21).



CNES IN ACTION

ENVIRONMENT GOING THE EXTRA MILE

The biodiversity at the Guiana Space Centre is every bit as rich as what you would expect to see in a nature reserve. Mitigating the impact of space operations on the environment is clearly vital, and every effort is being made to achieve this.

Contrary to what you might think, space operations have little impact on biodiversity. The industrial facilities at the launch base only occupy 10% of its surface area, and it's in fact a vast safe haven where both flora and fauna are flourishing.

EFFECTIVE COMPLIANCE CHECKING

Here, most facilities have an ICPE environmental protection classification; indeed, seven are Seveso 3 sites subject to strict regulations regarding preparedness for and prevention of major industrial risks. CNES and Arianespace have also obtained ISO 14001 2015 certification for their environmental management systems. "This standard demands a broad perspective of a facility's life cycle—its carbon footprint, recycling and so forth—in order to mitigate its environmental impacts. All firms under contract at the launch base are required to comply with it," notes Sandrine Richard, an environmental engineer at the Guiana Space Centre (CSG). As the authority in charge of range safety, CNES is required to measure the impacts of launches on air and water quality, as well as on flora and fauna. For each launch, it all starts in the office with a digital simulation of the combustion cloud and continues in the field using the instruments specified in the environmental monitoring plan deployed by external laboratories. The

results of these measurements are freely consultable¹. All analyses show a limited and very local impact inside a radius of less than one kilometre around each launch pad. Wildlife shows no signs of being disturbed by the base's activities; in fact, it's not uncommon to come across armadillos, monkeys and giant anteaters there.

Over the years, CNES has forged close ties with scientific partners like the forestry commission ONF and the national hunting and wildlife commission ONCFS, and with specialist consulting engineers (Biotope, Antea, Hydreco, etc.) and non-profit associations.

"The Ariane 6 project has led us to develop new expertise together," says Sandrine Richard. "When we saw that protected species like the giant anteater were present, we moved the location of the launch site. And to offset some of the unavoidable impacts, we're conceiving support measures to eradicate invasive plants from the CSG and monitor species about which not a lot is known, like certain orchids, the butter frog (lesser foam frog) or birds like the bearded tachuri."

IN THE FIELD

ERADICATING THE TEA TREE

Through its agreement with ONF, in charge of managing the CSG's natural heritage, CNES allows certain scientific studies in this protected environment and invites its peers to sustain a virtuous industry. According to Sandrine Richard, "there's an increasing awareness of just how exceptional this environment is, and greater consideration is given to environmental factors in the preliminary project stage." She's also glad to see that "conservation is now part of our mindset; for example, we look to use areas where there's already a human presence for new projects." And efforts are underway to get rid of invasive plant species like the paper-bark tea tree, which is slowly choking parts of the savannah at the CSG and their initial biotope. CNES is working with non-profit association GEPOG to define how best to eradicate the tea tree.



CNES IN ACTION



MELIPONA THE STAR OF THE SHOW

To confirm the findings of environmental impact studies, at least one 'bio-indicator' has to be monitored regularly. From the outset, environmental monitoring plans have therefore included provisions for capturing species from the CSG's rivers and streams and from its bird population. As bird feathers have revealed nothing in particular, the focus is on breeding vitality, for example by monitoring eggshells at 500 nesting sites. CNES went one step further in 2016, selecting the proposal of research laboratory NBC to study the organism and behaviour of bees to monitor air quality.

The star of the show is an endemic, stingless species of bee called Melipona that produces only small amounts of honey. An entomologist captures a few specimens four times a year from 18 hives, some of them sentinels and others located at key distances from



of the
savannah
in French Guiana,
home to an
astonishing
degree of
biodiversity,
is inside the
perimeter of the
CSG. Over a total
surface area
of 700 sq.km,
nearly 1% of the
territory, there
are 12 natural
formations.

production and launch facilities. Analyses conducted in Guadeloupe concentrate on the bees' abdomen, the hairs of which attract all particles and molecules in the surrounding air by electromagnetism. So far, these analyses have confirmed only a small impact limited to the launch pad area. "Everything we've found matches the 'background noise' of French Guiana, with a few rare molecules only produced by human activities but in trace amounts. The same goes for the bees' honey, which is safe to eat," says Célie Losada, an environmental engineer at the CSG. "A micro-camera has even revealed that the bees seem oblivious to launches. The guard bees hover at the entrance to the hive while the workers go calmly about their business."

1. At Kourou and Sinnamary town hall, and on the websites of the CSG (cnes-csg.fr) and S3PI, the industrial pollution prevention secretariat.



CNES IN ACTION



VISION INVENTING THE FUTURE LAUNCH BASE

To ready for the arrival of the much-awaited Ariane 6, the Guiana Space Centre is working on necessary upgrades to the launch base in the years ahead. Unsurprisingly, digitization and automation are high on the agenda.



The last major upgrades to the Guiana Space Centre (CSG) were completed at the time of the investment plan deployed for the arrival of Ariane 5 in the 1990s. With Ariane 6 and Vega-C on the horizon, the launch base now needs to get up to digital speed. CNES has been working for several years to get the future CSG ready for what awaits it in 2025-2030. At the end of last year, it compiled the 300 or so ideas produced by working groups or suggested directly by employees. “From the feedback people here are giving us, our key areas of focus are a satellite operations complex, digitization and automation, an energy strategy and industry 4.0,” notes Ian Droz, the CSG’s Deputy Director.

CENTRALIZATION IS THE NAME OF THE GAME

Simplification and tele-operations will be the watchwords at this future CSG. For reasons of productivity, and to adapt to the climate in French Guiana, the conclusion is that a maximum of resources and functions should be located together under one roof. This will be the role of the future CDO operations centre, a massive data centre where all system information converges. The base will thus rely heavily on automation and a lot of operations will be remotely controlled. Ultimately, turnaround times between launches could be shortened by half to just one week. For Ian Droz, “this is the way we have to go. Certain jobs will change, but humans will vitally remain in the loop, if only to actually maintain the facilities.”

End 2019, CNES will ask the ESA Ministerial Council to fund a first phase designed essentially to carry out vital refurbishments, enhance the main payload preparation facility and make the base fit for purpose with the new CDO.

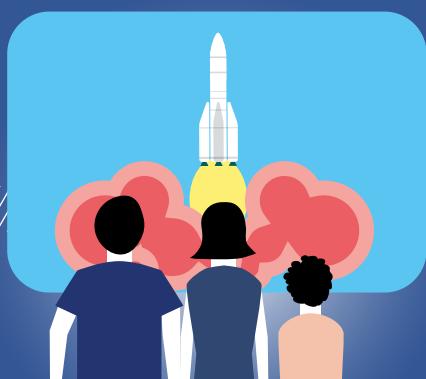
SPACE FUEL

CHEMICAL PROPELLANTS ARE WHAT POWER SOLID-ROCKET BOOSTERS. The UPG propellant facility in French Guiana fabricates thousands of tonnes of solid propellant in the form of a dough. For this it uses massive 1,800-gallon (7,000-litre) mixers (photo) into which it puts a polymeric binder, additives and solid charges that deliver the end-product's energy performance. The dough is then cast in segmented sections of casing that make up the boosters of Ariane 5 and Vega 1, with a conical core inserted along the length of the casing that influences the thrust curve. This core is removed once the propellant grain has been cured and the void left behind serves as a combustion chamber. Ten tanks of propellant are required to fill each 110-tonne segment and must be cast the same day to ensure the grain is homogeneous.



TIMELINE

T O U R I S M



DREAM

BY STEPPING ON THE LAUNCH PAD

At the CSG, visitors from as early as eight years old can tour the base on a bus, discover the Ariane 5 launch centre and Jupiter II Control Centre, and even set foot on the three launch pads, all in the company of a knowledgeable guide. Twice daily, from Monday to Saturday, the tour lasting roughly three hours takes groups on a trip into the past, present and future of an operating launch base. Tickets can be booked by e-mail or telephone 48 hours in advance, and valid ID is required to gain entry to the base.

THRILL

BY WATCHING A LAUNCH

Seeing a launcher lift off with your own eyes from the Jupiter II centre or one of the viewing platforms 7, 15 or 20 kilometres from the pads is an unforgettable experience. The blinding flash as the engines ignite is followed by a thunderous roar and your body shakes as the launcher soars skywards above Kourou. Each flight comes with a live commentary right up to the moment the launcher injects its payload into orbit. Invitations can be downloaded on line, but places are limited.



TIMELINE

OPERATING IN A PRESERVED AMAZON ENVIRONMENT, THE GUIANA SPACE CENTRE (CSG) IS A HIGH-TECH INDUSTRIAL FACILITY AND A MAJOR TOURIST ATTRACTION. MORE THAN THAT, IT'S THE ONLY LAUNCH BASE IN THE WORLD THAT OPENS ITS DOORS FREE TO THE PUBLIC. THE BEST PLACE TO START IS THE BASE'S WEBSITE (CNES-CSG.FR.).



UNDERSTAND BY VISITING A SPACE MUSEUM

Monday to Saturday, the Space Museum offers stunning models, holograms, animations and more for young and old alike, devoted to seven themes: the Universe, the conquest of space, Europe's launchers, human spaceflight, satellites, scientific payloads and the future of space. Twice a year, special events conceived by big science and technology culture venues like the Geode seek to get youngsters interested in science.

The planetarium takes visitors on a 30-minute voyage to the stars and their mythology, and is the museum's most popular attraction (entry €7, concessionary rate €4).

MARVEL AT THE BASE'S PRESERVED BIODIVERSITY

The CSG is home to a rich range of biodiversity including several rare and fragile species. Once a month, you can venture out in the tracks of a guide from the national forestry commission ONF, along the boardwalks that weave their way through the Guianese savannah. Three times a year, night visits are organized, the one in August being arranged to coincide with the Nuit des Etoiles stargazing event. Managed by ONF and with a wealth of information for visitors, the Montagne des Singes footpath is freely accessible and offers a commanding view of Ariane 5's launch pad.



HORIZONS

DAMIEN CHEVALLIER

CNRS researcher at the Hubert Curien Multidisciplinary Institute

“CNES is actively partnering our research
into sea turtles.”



Damien Chevallier and French Guiana stand at the point where two completely different paths meet: satellite orbits and turtle migration routes. His reason for spending so much time observing turtles is his interest in the species and the environment. “**Turtles are an excellent indicator of the health of our planet’s ecosystems,**” he says. However, global numbers of the three iconic species found in French Guiana—the leatherback, olive ridley and green sea turtles—have steadily declined in the last 40 years, and with no proven link to space activities. “I’d like to debunk that myth,” he continues. Pollution, climate change and loss of nesting habitats are

largely to blame, with 30% of nests destroyed every year by erosion. Human activity is a compounding factor. “**Thanks to Argos transmitters, space is giving us objective data on turtle movements** and how they correlate with ocean conditions, foraging requirements and survival strategies,” explains the researcher. “Argos-tagged turtles tell us about temperature, salinity, chlorophyll-a and sediment levels in the waters they cross, which can be thousands of miles at varying depths.” Different adaptation strategies have been discovered, such as swimming at depth to avoid hot surface temperatures and choosing feeding areas around eddies where biomass col-

lects. “Space data made available online is hugely helpful.” But space’s involvement goes even further. “**CNES has been fully supporting us for several years,**” he says. And the Guiana Space Centre (CSG) has co-funded three of his theses. He’s working on the third one now, which involves fitting turtles with cameras as well as sensors to record their behaviour in 3D. “This imagery should corroborate our theories and provide new insights with application far beyond French Guiana,” he concludes.



HORIZONS

LUANA IERONE

Payload Facilities Manager at the CSG

“It’s CNES’s showcase—and the attentive, personalized service we deliver adds real value...”



When a rocket soars skywards in a burst of fire and smoke, it's the happy end to another launch campaign. But it's only part of the story. It's a long road to the launch pad. Luana Ierone, Payload Facilities Manager (PFM) at CNES's Customer Support department, knows all the ins and outs of preparations. She started at the Guiana Space Centre (CSG) in 2014 and is right where she wanted to be—on the frontline. Her job is hands-on and rewarding, involving a whole range of different tasks and working closely with all the other parts of the CSG. Customer Support is involved at all stages of the process. “The hardware from the satellite manufacturer is shipped to the

CSG in containers,” says Luana. “Its arrival marks the start of the campaign, with payload testing starting immediately.” **In today's highly competitive launch market, Customer Support is the cornerstone of a facility like the CSG.** Procedures and work methods can differ from one customer to the next, and the PFM must adapt accordingly. Before the campaign, they must also ensure that all the right technical facilities the customer needs for its operations—mechanical systems, fluids, energy supply, etc.—are in place at the CSG. **“If the slightest thing is lacking, it can cause delays on a tightly run campaign.” This phase is especially strategic because cus-**

tomers come from all over the world. “We work with teams from the US, the UK, India, Japan, France and Italy to name a few. Negotiations call for a certain degree of diplomacy. And while it's rare, dealing with clients from some cultures can be tricky when you're a woman. So cultural adaptation is all part of the challenge,” she says. **One reason she's so attached to her job is because “in an open market, quality of customer care makes a big difference.** The feedback we've had shows that this kind of availability and adaptability adds real value to the premium service the CSG offers.” And for her, that means a lot.



HORIZONS

GÉRALD GRUCKER

Range safety specialist at the CSG

“Working with a close-knit team, I’m ultimately responsible for terminating the flight if there’s a major risk...”



On launch day, as the rocket lifts off, Gérald Grucker is calm and collected. But even with 30 missions behind him, he still feels the weight of the responsibility on his shoulders. He alone has the power to abort the flight if safety limits are breached. His duty: “to protect people, the environment and property”. And in his six years in the job, he’s never failed. His knowledge and expertise is the result of years of highly specialized training—the kind you won’t see in an engineering school prospectus. It’s learned on the frontline and in successive stages. **From assistant to the immediate visual control officer to deputy range safety officer and team leader, it’s a con-**

stant learning curve, a combination of hands-on experience and continuous general and specific training. At the end of each stage, exams must be passed. Since 2013, Gérald Grucker has sat no less than 24. For all that, he says that managing the TSAR¹ safety telecommand system isn’t all down to him. “Given what’s at stake, I rely on a really close-knit technical team. It’s one of the things I love about my job. By launch day, we’ll have trained on an average of 40 disaster scenarios. **The purpose is to develop automatic reflexes so we can make the right decisions without hesitation or delay.**” Before each campaign, “we check that the trajectories sub-

mitted by the launch operator comply with the constraints imposed by French legislation on space operations. **Launchers sometimes fly over marine areas that need to be protected. And of course, environmental considerations are extremely important.**” After lift-off, the team continues to monitor the flight to “assess far-field risks and ensure each stage separates and falls back as it should”. Each launch is an adventure in its own right, with its share of thrills and excitement. And from 2013 to this day, there’s never been an error. A fact Gérald Grucker can be proud of.

1. Télécommande Sauvegarde Ariane

Jacques Arnould,
science historian
and theologian,
CNES ethics officer.



ETHICS CORNER



JACQUES ARNOULD

SAFE PASSAGE

Its gaze fixed on the starry skies, Europe's spaceport mustn't forget the land where it stands. After all, is French Guiana not an Earth in miniature?

In 1964, as part of his Névralgies collection, Guianese poet Léon Gontran Damas published *Grand comme un besoin de changer d'air* (lit. "Great as the need for a change of scene"). That same year, President Charles de Gaulle ratified the government order that established the Guiana Space Centre. Forced to leave the Hammaguir launch facility in Algeria, the French space community needed a new base. On 9 April 1968, a Veronique sounding rocket effectively inaugurated the launch pad in Kourou, marking the start of a new chapter in humankind's space adventure and discovery of Earth.

A PORT FOR HUMANKIND

The idea of sending vessels into the sky goes back to the time of the maritime expeditions to explore the New World. Indeed, it was Kepler who, studying the astronomical observations of his contemporary Galileo, declared interplanetary travel possible. That was 1610, but it took more than three centuries to realize Kepler's dream. Some saw astronautics—the art of navigating in space—as a way to escape the earthly condition, others saw it as an invitation to inhabit our planet more

reasonably and sensibly. For us, is not Earth a port, a haven so vitally important both now and for a long time yet that we should care for it most zealously? As such, it's significant that French Guiana should be home to "Europe's spaceport", since in many ways it reflects the wider state of our planet. From its rich natural resources and the challenges posed by managing them better, its cultural diversity and the tensions created by immigration to the juxtaposition of the most advanced technologies and most traditional human activities, who could fail to see French Guiana as a snapshot of the human condition today? It singularly reflects so many of our boldest dreams and cruellest disappointments. For some, the end of a journey; for others, an open door to a future yet to be discovered and built—French Guiana, more than ever, offers a port for humankind.

The space community has its place there, but that place comes with responsibilities. Through its projects and programmes, it can and must inspire people to dream of new frontiers, new places, new "flights". It must also ensure everyone gets there safely. Is that asking for the Moon, or simply a better Earth?



INSIGHTS

COMPETITION

MY GUIANA IN 2048

This was the theme of a journalism competition for high-school pupils run by ***Une saison en Guyane***. The Guiana Space Centre (CSG) partners this monthly magazine and hosted the prizegiving in the Jupiter control room on 28 May. The winners included a group of first-year students on a vocational course in construction at Balata high school in Cayenne, who submitted four articles about an eco-friendly French Guiana and the CSG. To illustrate their connection with this better future, they included their pictures in the compositions. Their prize? CNES has booked them a place in the control room later this year to watch a launch.



COMIC BOOK **GASTON GOES TO JAIL**

For his third travelogue in French Guiana, comic artist Gaston (re)visits the former penal colonies and with his usual humour tells the story of one of the darkest chapters in the region's history. Papillon, Dreyfus and Flag star in this foray into prison life, including on the infamous Devil's Island.

Published by Orphie, €12.



COFFEE-TABLE BOOK **BIRDS UNDER THE STARRY SKY**

Les Oiseaux de Guyane (Birds of French Guiana) by ornithologist and photographer Tanguy Deville looks at a host of rainforest species, their habits and interactions with the canopy. Prefaced by CNES.

Published by Biotope, €49.



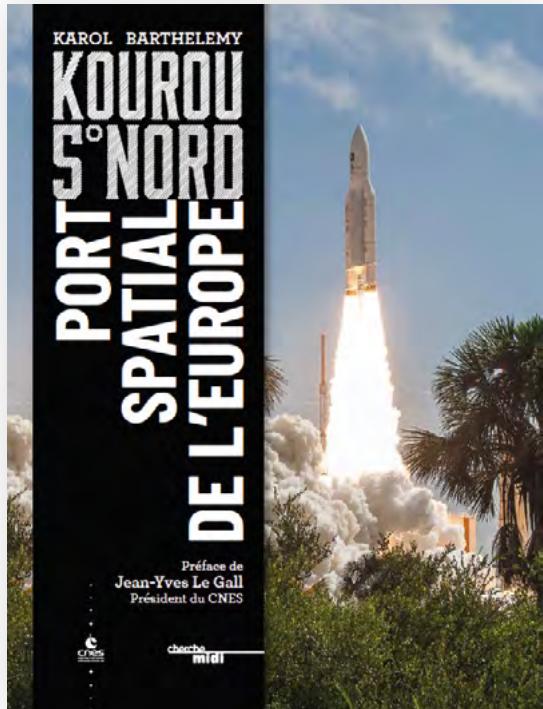
COMING TO A SCREEN NEAR YOU **Kourou on camera**

With three film crews at the Guiana Space Centre (CSG) in recent months, the autumn TV schedule has a distinctly Guianese flavour. An episode of *Échappées Belles* (France 5) is all about French Guiana. RMC Découvertes has made a documentary on the life of the Ariane 5 launcher, from the factory in Les Mureaux to the launch pad in Kourou. And France Ô is running two documentaries on biodiversity at the CSG and preparations for the launch of four Galileo satellites on 25 July.



INSIGHTS

COFFEE-TABLE BOOK FRENCH GUIANA AND SPACE



Barthelemy, our colleague for 10 years at Latitude 5, the CSG's quarterly magazine. Chapter 1 goes back to the early pioneers, with pithy quotes and anecdotes. The next sections trace the political and strategic journey over five decades that has shaped the CSG of today and its future. Richly illustrated pages offer a behind-the-scenes look at the workings of this incredible industrial complex. Lastly, readers are taken through the timeline of an Ariane 5 launch, complete with a quick course in orbital mechanics!

Published by Cherche Midi, €29.



DIARY

DECEMBER 2019
ESA Ministerial Council
meeting

INTERNET CSG's dedicated website



Cnes-csg.fr is your one-stop shop for everything about the Guiana Space Centre. Packed with facts and figures, video and photographs, it's a real gold mine of information, including how to book your place at a launch. And for dates of upcoming flights and pictures of current launch campaigns, check out the CSGCentreSpatialGuyanais Facebook page.

In the 50 years

since it opened, the Guiana Space Centre has launched more than half of all telecommunication satellites in service today.



SPINOFF

SENTINEL SERVICES FROM THE SKY

With its nine drones, the start-up Sentinel performs inspections, mapping and 3D modelling for the Guiana Space Centre. Everything appears so much easier from the air!

In normal circumstances, flying a drone over a sensitive site like the Guiana Space Centre (CSG) would be illegal. But that's just what Sentinel has been doing since 2016, as it is authorized to do. Over the last two years, its nine drones have been providing very reliable aerial services. Indeed, it has developed a broad range of 'on-demand' services for its customers, including filming, orthophotography, topographic surveys, technical inspections, aerial imagery and security.

SUCCESS STORY

From the outset, the start-up's founders, Antoine Arveiller and Guillaume Berthier, had a good head start. Drawing on their experience as engineers working for firms on the launch base, they knew the place inside out, so CNES's security charter held no secrets for them. They were also familiar with drone technologies through Guillaume's father, a drone engineer and co-founder of the company. Cast from the same mould, the two companions were keen to leave the nest and Sentinel provided the ideal opportunity. The start-up is now looking to develop a new drone shipping service and Ludovic Fraumar has joined the team to support its growing business. While the CSG remains its main customer, Sentinel is building on this momentum to expand its horizons and open up markets all over French Guiana and the French West Indies.



EN

72

Missions tasked to Sentinel in the first half of 2018. This figure is increasing all the time and the future looks bright for the start-up, with the promise of many new jobs.