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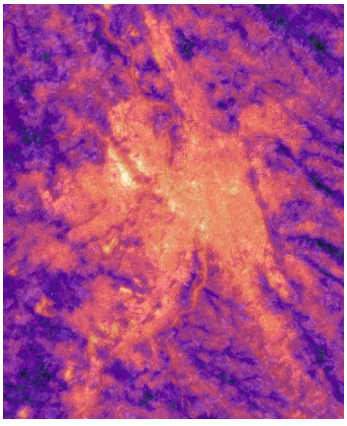
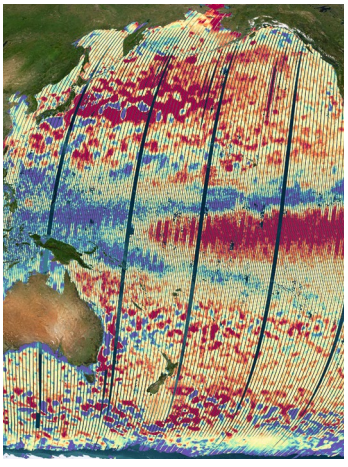
#98 AUTUMN 2025

Satellites: a game changer for climate change

Launchpad

#98 — AUTUMN 2025





To read the magazine online

Crew

Frédéric Bretar

SCO Project Leader, a chief engineer from France's prestigious IPEF bridge, water and forest corps, Frédéric Bretar works at the crossroads of science, policymaking and international climate efforts. At the helm of the Space for Climate Observatory (SCO), he brings together institutions, research scientists and economic stakeholders to turn satellite data into readily usable tools for territories. His career has taken him from academia to science diplomacy, before he joined CNES in 2019. In this issue, he lifts the veil on SCO projects.

Céline Tison

Deputy head of Data Campus sub-directorate. Céline Tison began her career in radar and now focuses on Earth observation and satellite data. Data processing is the final step in the value chain stretching from satellites in space to real-world applications here on Earth. This is the thinking behind the Data Campus, whose doors she opens up to us inside this issue. Céline is on a mission to combine her 20 years of space expertise with climate change adaptation.

Selma Cherchali

Head of Earth research and observation sub-directorate. Adapting to our changing climate is both a necessity and a matter of urgency. In this issue, Selma Cherchali shares her vision and firm belief that to be able to make reliable projections for the future, it's vital we step up global investment in science now. She is also active in the field, leading the Space4Ocean Alliance (S4O) project for CNES, detailed in Space Take.

Laurent Boisnard

Head of Earth-observation missions, data and applications sub-directorate. Laurent Boisnard's 30-year career at CNES and the European Space Agency (ESA) has spanned Earth observation to universe sciences. A project management specialist, he was notably in charge of system aspects on the CoRoT space telescope, studies for Euclid and the architecture of the CSO military programme. Today, his sub-directorate intersects CNES's traditional missions and support for new space players.

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Publication director: François Jacq. **Editorial director**: Marie-Claude Salomé. **Editor-in-chief:** Mélanie Ramel. **Proofreading:** Céline Arnaud. **Copywriters:** Dominique Fidel, Aude Borel, Alexia Attali, Mélanie Ramel. **Photos and iconography:** Loïc Octavia, Orianne Arnould, Lauren Lacau (Photon).
Photo credits:
Cover: © CNES/Mira Productions/Sébastien Gentet p.4: CNES/Thierry De Prada, CNES/Frédéric Maligne; p.5: CNES/Christophe Peus; p.6: CNES; p.7: CNES/Mira Productions/Sébastien Gentet; p.8: Safer Occitanie; p.9: ICube-SERTIT; p.10: CNES/Stéphane Louvel (bottom), TerraNis (top); p.11: CNES/Adrien Ribet (top), CNRS/Edward Salameh/Damien Desroches (middle), Getty Images (bottom); p.12: Niko Tavernise - Netflix - Bluegrass Films - Hyperobject Industries; p.13: Centropolis En-tertainment / Lions Gate Films; p.14-16: Alexandre Ollier; p.17: SDIS31 - Yohan Visentin (top), Hydr'Avatar consortium (bottom); p.18-19: CNES/CLS, p.18 (bottom): CNES/Distribution Airbus DS; p.20: USSF 30th Space Wing/Steven Gerl; p.21: Airbus DS/Dominique Marques (bottom), CNES (top); p.22: CNES/Frédéric Lancelot; p.23: ESA/Copernicus Sentinel data; p.24: ESRI/CNES (top), TerraNis (bottom); p.25: ESA/Copernicus Sentinel data; p.26: CNES/Distribution Airbus DS; p.32-33: CNES/Distribution Airbus DS, Collectif Argos/Jérômine Derigny,Getty Images; p.34: SCO/Ultra Noir (top), CNES; p.35: CNES/Game in Society
Illustrations: Citizen Press and Anne Cresci for Constellation. **Webmaster:** Mathilde Tournier. **Social media:** Aurélie Marmu, Hermine Chaumulot, Marie Dupont (Citizen Press), Mélissandre Lacaille (La Netscouade). **English text:** Boyd Vincent. **Design and pre-press:** Citizen Press – David Corvaisier, Alexia Attali, Stéphane Boumendil. **Printing:** Ménard. ISSN 1283-9817. **Thanks to:** Olivier Queyrut, Aurélien Sacotte, Delphine Leroux, Vincent Lonjou, Carole Deniel, Solange Lemai, Adrien Deschamps, Selma Cherchali, Yannice Faugère, Stéphane Louvel, Laurence Monnoyer-Smith, Jérôme Chave, François Jocteur-Monrozier, Pascale Ferrage, Emilie Bronner, Pascale Ultre-Guérard, Laurent Boisnard, Céline Angelelis, Céline Tison, Raquel Rodriguez-Suquet, Frédéric Bretar, Jacques Arnould, Frédéric Huynh, Goneri Le Cozannet, Kévin Decludt, Sébastien Dorgan, Pascal Correia and Maxime Brient.

Horizons

“Sharing satellite data”

Marie-Claude Salomé
Director of communication

Adapting to climate change is today a fact of life, as summer wildfires and extreme weather events remind us every year. Once we have accepted this, it is our duty to act—and that is where satellite data come in. They are the basic “building block” of every Earth-observation mission, without which there would be no science results and no applications to help us adapt to climate change.
They provide objective input for scientific models and a reliable and evidence-based way of tracking change over time.
Satellite data are also a valuable learning aid for projects dedicated to youngsters, showing them the importance of a scientific approach in making sense of the world they live in.
Inside this issue, you will learn all about teams at CNES for whom satellite data are the core activity.
Our responsibility as a government agency is to highlight how these data are serving citizens and to do everything we can to combat climate misinformation.

I hope you enjoy reading the magazine.

PARTNERS

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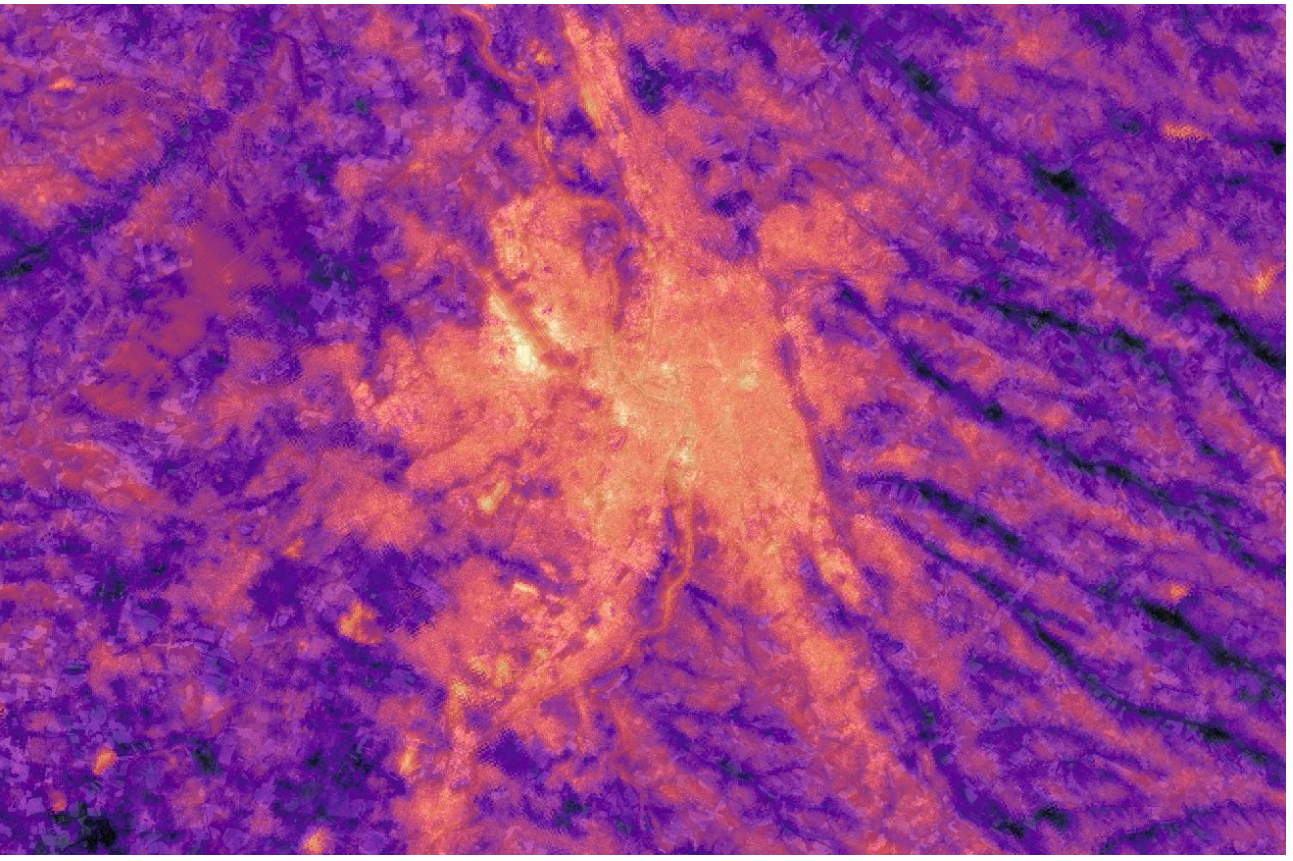
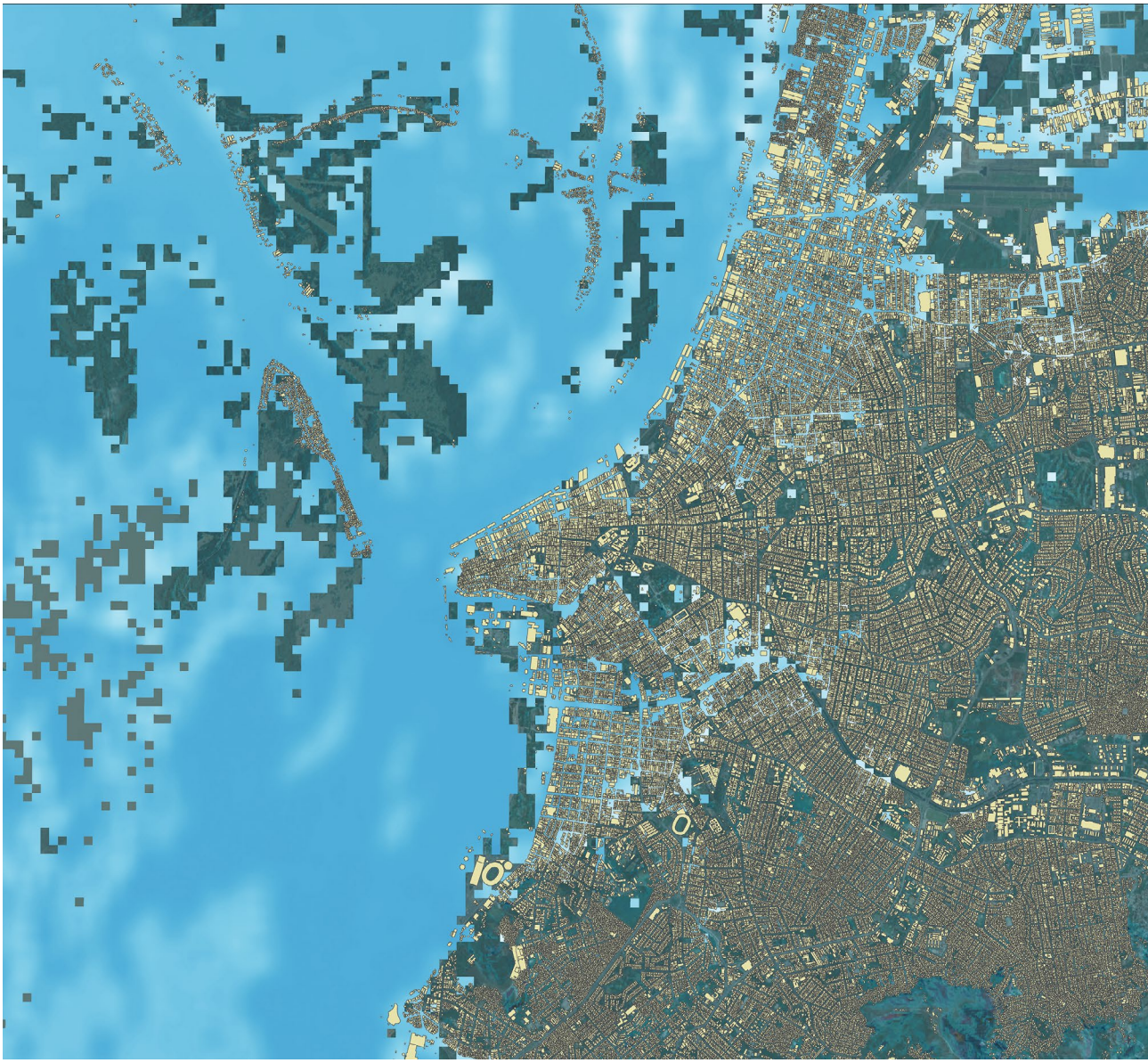
Thermocity reveals urban heat in new light

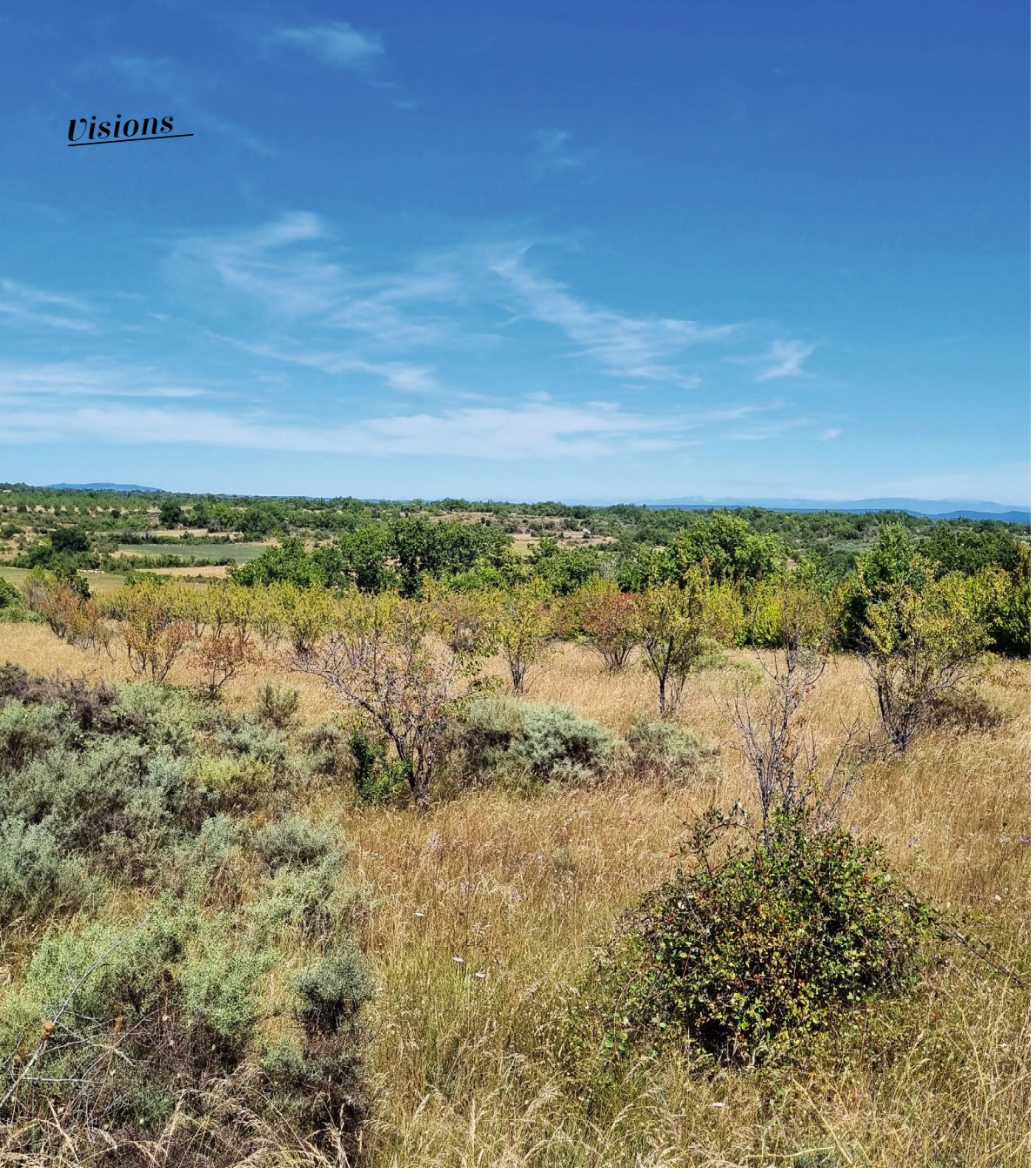
With the Thermocity project, teams at CNES's Lab'OT Earth-observation laboratory mapped urban heat islands and heat losses in the city of Toulouse, combining data from thermal and optical satellites. They were also able to establish a new heat vulnerability index, a first of its kind that could help devise ways to adapt the city to rising temperatures.





Satellites documenting disasters

In the spring of 2024, devastating floods swept through southern Brazil, affecting more than two million people. With its wide-swath radar instrument, SWOT was able to map the flooding in two dimensions, showing water height and extent—a key step forward in monitoring the impact of climate change on surface waters.



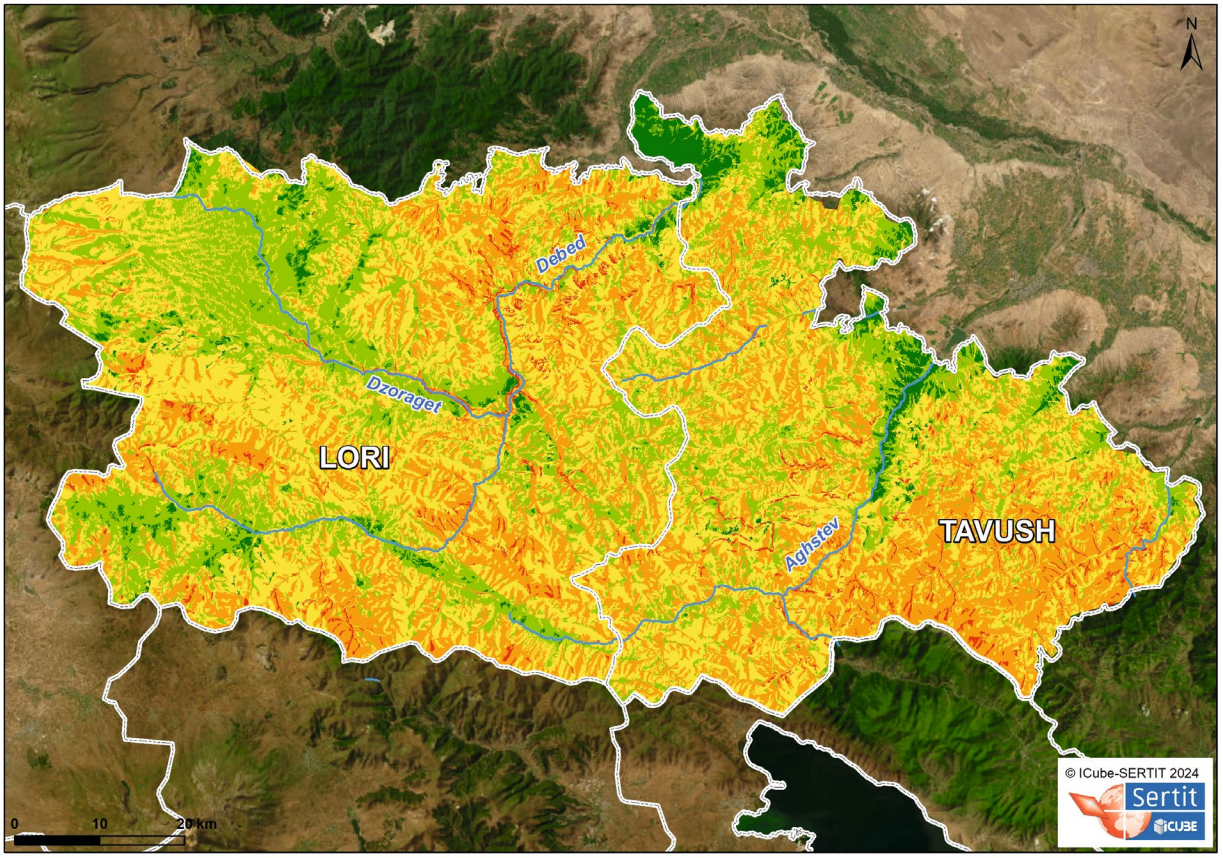
Izifriche claiming back farmlands

Led by the Safer Occitanie land agency through the Space for Climate Observatory (SCO), the Friches Agricoles project identifies idle farmlands using the Sentinel-2 and SPOT-6&7 satellites. The project has given birth to Izifriche, a decision-support tool to help reclaim such idle spaces.

Post-flood view from space

May 2024: in the wake of catastrophic flooding in northern Armenia, the Recovery Observatory—led by CNES at CEOS[1]—sprang into action to help authorities assess damage, locate debris, simulate floods and develop a landslide susceptibility index, using maps generated with imagery from the Pleiades and Pleiades Neo satellites and from drones. The observatory has already been activated six times since 2020.

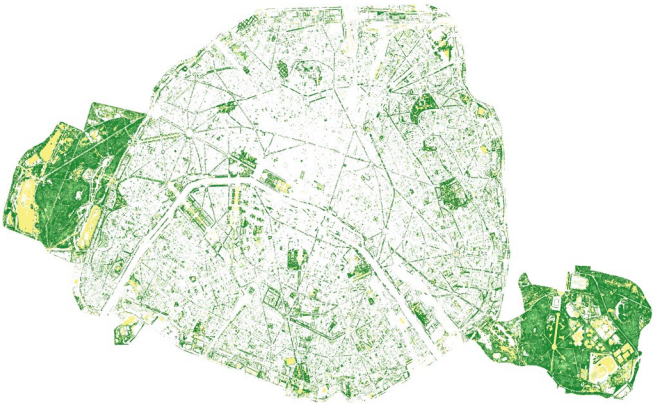
1. Committee on Earth Observation Satellites.



Balloons on a climate mission

The Strato Science 2025 flight campaign staged out of the Timmins base in Canada in late summer saw 160 people—in science and operations—and four stratospheric balloons in action, the largest spanning up to 75 metres. This campaign led by CNES in partnership with the Canadian Space Agency (CSA) flew up to eight instruments on each balloon gondola, notably to analyse greenhouse gas concentrations and to measure atmospheric aerosols and high-altitude cloud composition. The main value of these flights is their ability to stay aloft for several hours in the same air mass, ideal for acquiring fine atmospheric readings. This latest Strato Science campaign is pursuing the twofold objective of testing new instruments, like radiometers or lidar[1], and re-using certain experiments to compare data with those obtained from previous flight campaigns.

1. For Light Detection and Ranging. A lidar uses a laser beam to precisely measure distances (or range). The technology is used to generate finely detailed 3D terrain, vegetation and infrastructure models.



Canopy height in the city

Under a partnership between CNES and the City of Paris, the agency's Lab'OT Earth-observation laboratory (see p. 21) has helped compile a map of vegetation height across the city. The aim is to estimate a canopy index from Pleiades satellite imagery, using CNES's CARS and Bulldozer tools to assess tree cover and inform planning decisions. After a conclusive initial trial in 2023, the method is being used again this year to validate its ability to track changes in the canopy over time.

IASI-NG sounding the atmosphere in high definition

The IASI-NG atmospheric sounding instrument flying aboard the MetOp-SG A1 satellite launched this summer by Ariane 6 is one of the most sophisticated of its kind. Succeeding IASI, in operation since 2006, it will measure temperature, humidity and concentrations of numerous greenhouse gases with great vertical precision, even at very low thresholds. Affording twice the spectral resolution and half the radiometric noise of its predecessor, IASI-NG is paving the way for finer detection of substances present in the air.

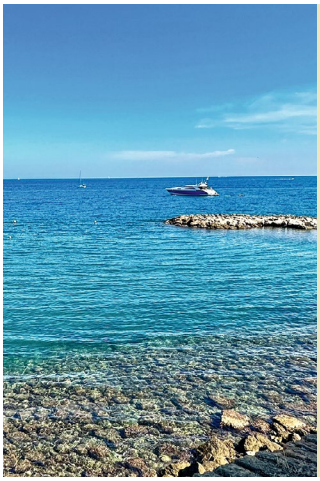
MicroCarb the carbon tracker

Launched this summer, MicroCarb is Europe's first satellite dedicated entirely to measuring concentrations of carbon dioxide (CO_2) in Earth's atmosphere. Designed by CNES and with an instrument built by Airbus Defence & Space, this science mission aims to quantify CO_2 fluxes between oceans, vegetation and the atmosphere. The compact 180-kilogram satellite, featuring a new spectral band to afford more precision and sent into orbit from Kourou by a Vega-C launcher, also received contributions from the United Kingdom Space Agency (UKSA) and the European Commission. Complementing the Japanese GOSAT and U.S. OCO-2 missions, MicroCarb is also paving the way for the future CO2M constellation for Europe's Copernicus programme—a new step towards gaining deeper insights from space into one of the main contributors to climate change.

SWOT

mapping Earth's waters as never before

Since being launched in late 2022, the SWOT satellite (Surface Water and Ocean Topography) has surpassed all expectations, mapping oceans and continental hydrology in unprecedented detail. Developed by CNES and NASA, with contributions from the United Kingdom and Canada, the mission is already proving capable of detecting eddies only a few kilometres across and irrigation channels less than 100 metres wide, with a vertical accuracy of up to 20 centimetres. SWOT data, initially reserved for a restricted scientific community, are freely available since June 2024 via the hydroweb.next (hydrology) and AVISO (oceanography) platforms. Research scientists, industries and local and regional authorities are lining up to use them for ocean forecasting and climate change adaptation.



A global space alliance watching over the oceans

Launched in Nice during the UN Ocean Conference (UNOC), the Space4Ocean Alliance (S4O) initiative is the culmination of more than a year's efforts led by CNES. Its main ambition is to achieve closer coordination and interaction between the space and maritime domains. The stakes encompass ocean monitoring to development of services for monitoring pollution, fish stocks and marine protected areas. In particular, the idea is to support least-developed countries and small-island developing states, which are feeling the brunt of the challenges facing coasts but without the space assets to address them. The coalition has already garnered 20 signatories from space agencies, science institutions, international organizations and UN bodies.

Climate change: not just Hollywood hype

Since the 2000s, climate disruption has become a recurring theme in cinema. While the plots of these disaster or climate-apocalypse movies may once have seemed far-fetched, they now feature aspects that, if not probable, are at least within the realm of possibility.

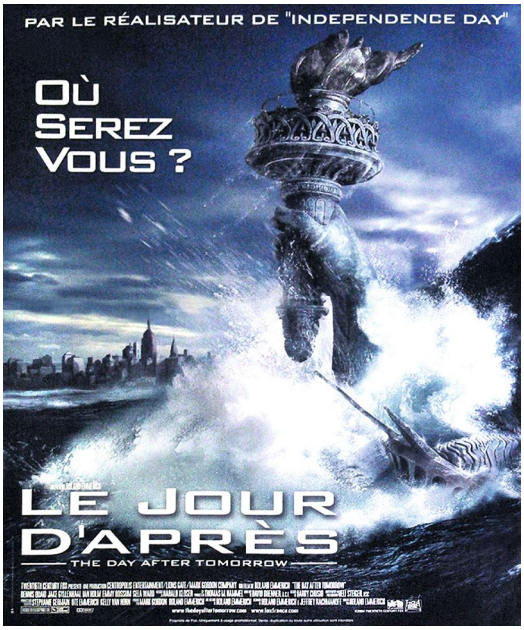
In *Don't Look Up*, a giant comet hurtles towards Earth. In six months, the collision will wipe out humanity—that's the discovery made by the scientists played by Leonardo DiCaprio and Jennifer Lawrence in Adam McKay's feature film, released on Netflix in 2021. The pair try desperately to warn the world of the impending disaster, but they're met with denial and mockery from political leaders, media and public alike. The movie reignited debate around the voice of science in the conversation about climate change in society today. "This film is undeniably a powerful metaphor for the current climate crisis," noted climatologist Michael E. Mann in an interview with *Le Monde*. In *Ouest France*, fellow scientist Jean Jouzel lamented that "scientists just haven't been believed about climate change".

A wave of climate denial

Scientific voices are increasingly met by climate scepticism, amplified by social media, parts of the broader media landscape and political instability. The Sixth IPCC Report (2023) is clear: in every emissions scenario, global warming will reach 1.5°C by the early 2030s. Heatwaves, extreme rainfall, droughts, rising sea levels: climate risks will intensify and become more frequent. And managing them will become more complex. These climate projections are reflected in *The Day After Tomorrow (*2004), directed by Roland Emmerich. In the film, a climatologist tries to warn about a sudden climate disaster that unleashes chaos on a global scale: Tokyo is battered by giant hailstones, New York is submerged by floodwaters and the Northern Hemisphere is plunged into a new ice age. While the storyline was criticized for being somewhat over-the-top, it now resonates disturbingly with actual science, and with good reason: in 2024, Dutch researchers put forward the hypothesis that the Atlantic Meridional Overturning Circulation (AMOC)—one of Earth's major ocean currents—could collapse, potentially causing a temperature drop of 2 to 3°C in Northern Europe.

Raising awareness about global change

Even if some of these movies may lack scientific rigour or realism, they play a valuable role in drawing attention to the climate emergency,



a major challenge that calls for collective awareness and strong political leadership. How can we prepare for this changing world? And what adaptation strategies can we put in place to better mitigate the risks?

Insight

Laurence Monnoyer-Smith,
HEAD OF SUSTAINABLE DEVELOPMENT AT CNES

"We must combat misinformation"

Is it plausible that Earth may one day no longer be habitable?
Some populations are already living this kind of disaster scenario. Certain regions are experiencing extreme heat, heavy rainfall events and more frequent typhoons. Many of us feel like we're living somewhere between *Don't Look Up* and *Black Mirror*. The projected scenario of +4°C by the end of the century is extremely concerning.

What are the dangers of climate denial?
This anti-science propaganda can take on highly ideological forms and lock people into long-term rejection of science. For this reason, national research bodies with access to the latest findings must now more than ever share that knowledge and actively combat misinformation.

What role should the space sector play in adapting to climate change?
A multifaceted role, using several levers. The SWOT mission is monitoring global water reserves, while Biomass is tracking the state of biomass, soil conditions and water stress. The use of Earth-observation data helps regions develop their climate adaptation strategies. Finally, initiatives like the Space for Climate Observatory (SCO) and Connect by CNES provide tools for monitoring the impacts of climate change.

Leading light

JÉRÔME **CHAVE**

Research Director, Biodiversity and Environment Research Centre (CRBE/CNRS)

“Satellites give us a clearer picture of forest health”

Jérôme Chave studies the health of forest ecosystems and how they respond to climate change. His research relies heavily on satellite remote sensing to quantify biomass, the carbon-rich organic matter that makes up the world’s forests.

How are our forests adapting to climate change?

Many tree species can't cope with climate change as intense as what we're seeing today. That means there can be quite a lot of die-off globally, including among species of animals living in forest ecosystems. Moreover, global warming is going to fuel increasingly intense wildfires, reducing the biosphere's capacity to store carbon in the long term.

How are satellites helping to preserve forests?

Satellites can inform public and private management strategies by helping to better locate forests and gauge their health. The synoptic view of forests afforded by satellite-borne instruments in near-real time is so valuable. They're extremely precious "eyes in the sky" that enable us to respond quicker. I'm thinking in particular of the Biomass satellite launched in April this year that's going to map global forest carbon stocks at a resolution of 200 metres, notably in the tropics. The scientific community is eagerly awaiting the data this revolutionary technology is set to deliver.

You are the coordinator for GEO-TREES, a global network of forest inventories validating these satellite data. How important is your field work for estimating stored carbon?

Biomass has to be measured in the field and we can't really get a handle on these ecosystems without observing them directly. The aim of GEO-TREES is to collect data from 100 representative forest sites around the globe, to gain a clearer picture of the diversity of forest landscapes. These data will enable us to precisely validate measurements from the Biomass satellite. It's a very ambitious project involving numerous countries, with strong backing from CNES.

"Satellites are extremely precious "eyes in the sky" that enable us to respond quicker"

What different types of forests are being studied around the globe?

There's an extraordinary variety of forests around the world: some are rainforests, some are drier, with different degrees of biodiversity, and more or less dense canopies. In French Guiana, the tropical rainforest is one of the best protected of the Amazon. For GEO-TREES, we're studying it at two research stations in Paracou and Nouragues. We're monitoring forests, tree growth and mortality, how they're responding to climate change, and studying all other forms of life in the ecosystem. But Europe's forests and boreal forests are equally important.

How can we square the science cycle with the climate emergency?

The climate emergency is a reality and the scientific community must be ready to meet the major environmental challenges facing society. However, there's a mismatch between the long cycle of acquiring reliable and rigorous knowledge and the political and decision-making cycle. Another aspect of the problem is that today, science and technology offer diagnostics but not immediate solutions. We're acutely aware of the need to comprehend these realities not only from a science perspective, but also as citizens and human beings living on this planet of ours.

Since 2006:
Science manager at Nouragues ecological research station in French Guiana

Since 2010:
Science and technology officer at CEBA Amazonian biodiversity research centre

2014:
Member of Academia Europaea

Since 2022:
GEO-TREES programme coordinator

2023:
Member of French Academy of Sciences

“We must continue to rely on scientific rigour, to view global issues on a global scale and in their social dimension”

In a geopolitical context that is challenging science and tying its hands, what are the risks for climate science, the scientific community and our societies?
Ditching the thermometer and denying climate change isn’t a viable long-term strategy, and it doesn’t make much political sense either. Science has always had to battle against the “naysayers”. We must continue to rely on scientific rigour, to view global issues on a global scale and in their social dimension. That includes not ignoring climate justice issues. Europe and North America have a significant historical responsibility in this regard, as they’ve grown rich by emitting large amounts of greenhouse gases, thus compounding structural and social inequalities. Today, the communities most vulnerable to climate change are those that haven’t seen the benefits of economic growth.

What are your thoughts on climate misinformation being spread on social media and by politicians?
All climate change denial efforts are politically motivated. We need to speak up as citizens and recall that climate change is already a reality for everyone living on this Earth. The work of the IPCC clearly shows that climate change is happening. However, scientists are not supposed to be some sort of demiurge; they also have to be able sometimes to show science’s limits.

Pointers

Wildfires and services for the future

CNES selected eight projects for its Ambition Aval (Downstream Ambition) call for expressions of interest issued in 2022. Two of them concern wildfires and are laying the groundwork for applications using sensors on the new CO3D and Trishna satellites: JUFEO (Thales) is dedicated to detecting conditions conducive to the start and spread of wildfires, while SEVERI 3D (Sertit-Descartes Underwriting) will help to assess post-fire impacts.

Hydr'Avatar: a digital twin of rivers

Led by a French consortium headed by Hydro Matters with the national research institute for agriculture, food and the environment INRAE and the national scientific research centre CNRS, Hydr'Avatar models the behaviour of water courses in 2D and 3D, based on discharge, soil permeability, flood management and other factors. The aim is to create a digital twin of rivers and streams to be able to simulate floods and help planners anticipate them. The project is a laureate of an ESA request for proposals and is supported by CNES, which is helping its partners turn satellite data into actionable land-planning information.

Satellite data just a click away with GEODES

Officially rolled out at the end of last year, GEODES is CNES's new Earth-observation data platform. It provides a central repository for data from CNES satellites and the Copernicus programme, making them easier to explore and use. Interconnected with the Data Terra national research infrastructure, GEODES offers a range of advanced services including data visualization, downloading, and on-demand or interactive processing. Local authorities, research scientists and public or private stakeholders can thus derive useful information from these data or develop new applications, notably through CNES downstream programmes (Ambition Aval, SCO, France 2030, FP-CUP: see Planet CNES p. 18).

993

activations

Since 2000, the International Charter Space and Major Disasters has been activated 993 times in 144 countries[1]. Severe weather-related events—flooding, storms, wildfires, etc.—account for a large proportion of activations: 79% versus 60% ten years ago.

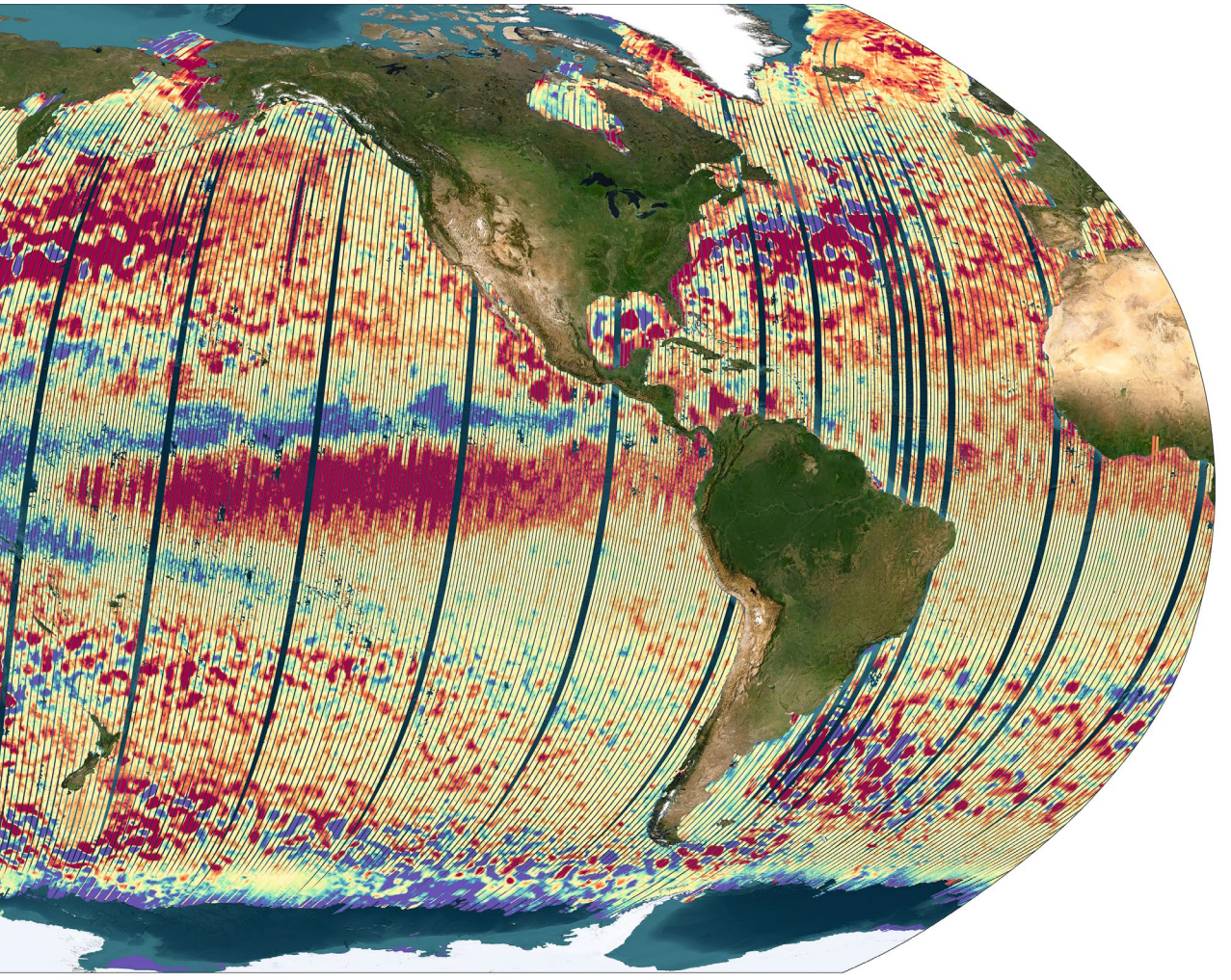
1. As of 27 August 2025

Earth-observation data swing into action

In response to the ever-growing needs of regions and economic stakeholders, CNES is moving the needle for applications of satellite data. Whether for measuring, modelling or planning, data are being turned into real-world tools for users addressing climate, industrial and geopolitical challenges.

Flooding in Porto Alegre viewed by the Pleaides satellite.

CNES has been conceiving satellite data processing chains that help us to understand the key balances sustaining our planet, anticipate their likely evolution and apply actions in the field for more than 60 years now. Only ten years ago, the goal was to prime the research pipeline; but today, we're seeing a step change in the scale of demand. Whether from government ministries, agencies and operators, local authorities, insurance companies or energy specialists, requests for data are no longer solely science-driven but also coming from the field, calling for readily interpretable and comparable data that



Ocean topography measured by the SWOT satellite in November 2023.

can be conjugated with other sources.
This shift supposes a profound rethink. "Our role is to ensure consistency between programmes being driven by very different expectations, and between scientific research, immediate applications and anticipating future trends," explains Pascale Ultré-Guérard, CNES's Deputy Director of Strategy. "CNES is the architect of this value chain, spanning mission design to structuring of applications. We bring together research scientists, engineers, manufacturers and end-users to foster services built around satellite data." SWOT is an emblematic example. Designed with NASA, notably to analyse Earth's water cycle, this mission is built around an instrument developed for research purposes. But from the word go, CNES engaged a SWOT Early Adopters programme to foster uptake of its complex yet promising data by the water community. The first applications are being rolled out in fields like hydrology, water reserves, irrigation and shoreline monitoring, working with stakeholders like the French HydroVenture space hydrology consortium and BWI, a spin-off from Hemeria, another French firm developing a complementary altimetry constellation.

SWOT satellite in the clean room before its launch in December 2022.

Ten demonstrators for tomorrow

This same forward-looking rationale also underpins projects being pursued under the France 2030 investment plan, for which CNES is the operator. Ten demonstrators are today in development in domains as varied as maritime surveillance, coastal ecosystem management, wildfire prevention or precision agriculture. One of them is addressing the unprecedented challenge of establishing economic indicators from satellite data combined with weather, agricultural and socio-economic time-series. The objective is to monitor activity more closely, detect hiatuses early, and estimate their impacts and time needed to get back on track at a level of detail not seen before.

As use cases firm up, the approach is evolving. "France 2030 offers the opportunity to demonstrate the utility of space technologies outside their usual applications," says Laurent Boisnard, who heads CNES's Earth-observation Missions and Data sub-directorate. The Ministry of the Interior and the Ministry for the Ecological Transition are joining the discussion. CNES is also working with public operators, regions and civil protection stakeholders on locally grounded services like post-disaster mapping, coastal dynamics, early flood detection and monitoring of large-scale farming practices.

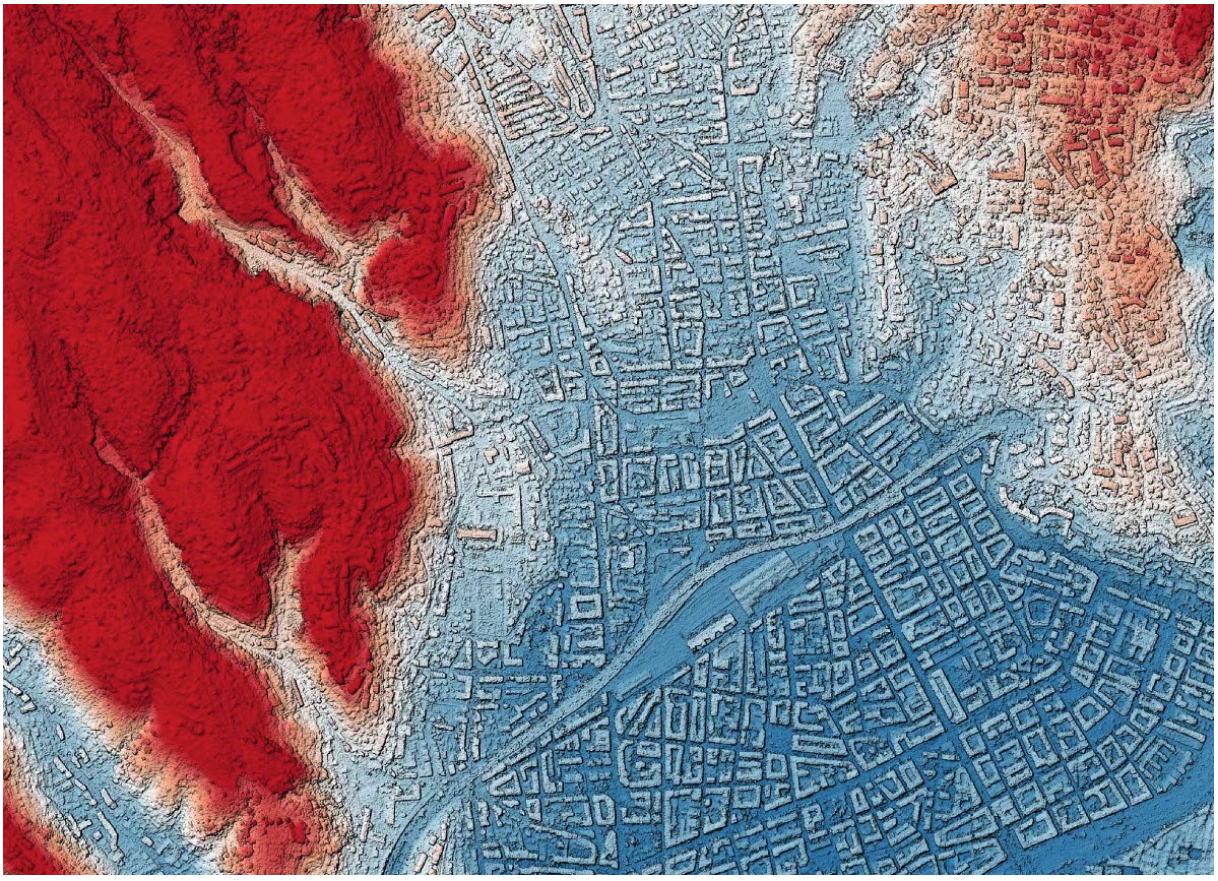
To inject more momentum, CNES is applying an ecosystem perspective. "Since 2018, the Connect by CNES programme has been forging ties with business, public stakeholders and local authorities to test real-world use cases they would never have imagined possible with space solutions," says Céline Angelelis, Associate Director for Ecosystems at CNES. Data Campus laboratories like Lab'OT, science outreach tools and downstream support activities are also gravitating in the programme's orbit.

But such advances are coming in a shifting landscape. For example, the fate of the AOS[1] mission conceived with NASA is now hanging on political decisions. "If Europe is to sustain high-quality Earth observation, it will need to ensure its scientific and engineering continuity. To this end, CNES is driving proposals at the crossroads between climate and industry challenges in a complex international context," concludes Pascale Ultré-Guérard.

1. Atmosphere Observing System

IASI-NG key to future forecasting

To better forecast weather and monitor climate, we need to probe each layer of the atmosphere. IASI-NG, developed by CNES for EUMETSAT and national weather service Meteo-France, will measure more than 100 parameters from its perch on the three MetOp-SG satellites, the first of which is planned to launch this year.



Simulation of a CO3D digital surface model (DSM) of the city of Nice.

A chain of expertise supporting satellite data

CNES's Data Campus combines most of the technical expertise required to process satellite data.

16

Team members at Lab'OT

CNES's laboratory dedicated to Earth satellite remote-sensing data and technologies.

Its 100-strong team turns raw mission data into high-quality products to inform public policies, research and innovation. The Campus works closely with numerous research laboratories, fostering unique synergies to imagine new applications and address environmental and climate challenges. Lab'OT is another 100%-CNES laboratory completing this ecosystem. Its 16-strong team works to

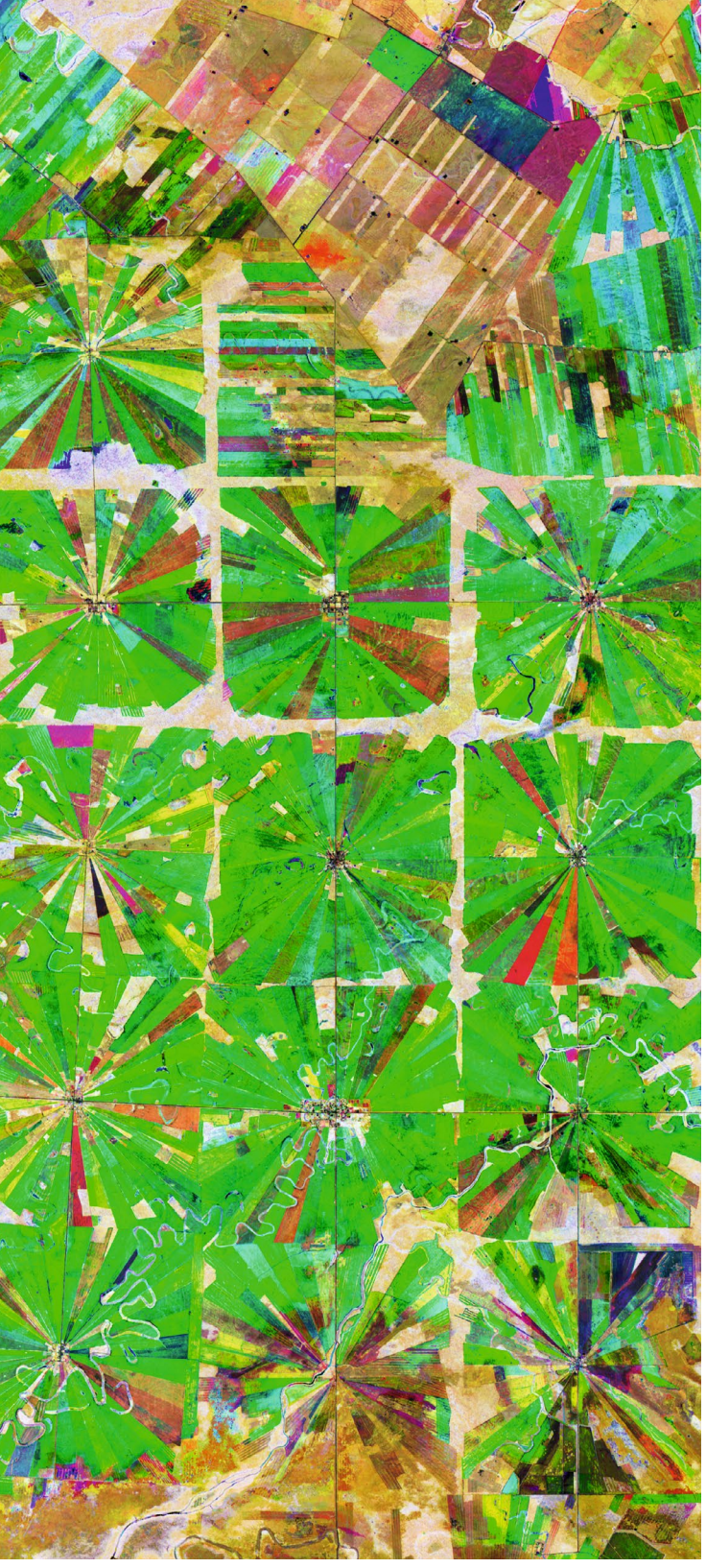
Satellite data processing and exploitation experts at Data Campus.

remove technical barriers slowing uptake of Earth-observation data. Lab'OT is a true catalyst mobilizing its expertise to turn needs into real solutions, addressing public stakeholders, businesses and scientists looking to incorporate satellite data in their projects. For example, it's currently pursuing work on 3D modelling of coastal zones and the use of artificial intelligence to detect destroyed buildings in disaster areas. The lab is also the technical expert for the agency's Connect by CNES and Ambition Aval (Downstream Ambition) programmes. Connect by CNES helps practitioners—from start-ups to large primes and local authorities—to structure services leveraging satellite data, particularly for projects with a strong climate or environment component, as well as for business-driven initiatives. Ambition Aval, meanwhile, aims to lay the groundwork for missions like CO3D or Trishna, by encouraging early adopters of new applications that will use their data as soon as they come on stream.

Data getting ever smarter

In recent years, the space sector has gone through an unparalleled digital revolution, with data volumes increasing exponentially and data processing capacity supercharged by artificial intelligence. AI gives us the ability to describe situations by simplifying complex physical models, to predict short-term shifts and make long-term projections. Two emblematic CNES projects in this regard are AI4Geo, generating 3D maps incorporating information for urban planning and resource management, and FloodML, detecting and monitoring floods using rapid mapping with satellite imagery and machine-learning algorithms[1].

1. Techniques enabling an IT system to learn from a set of data and perform tasks without explicit instructions.



Sentinel-2 satellite image showing forest cleared for farming in Bolivia.

SCO driving climate change adaptation

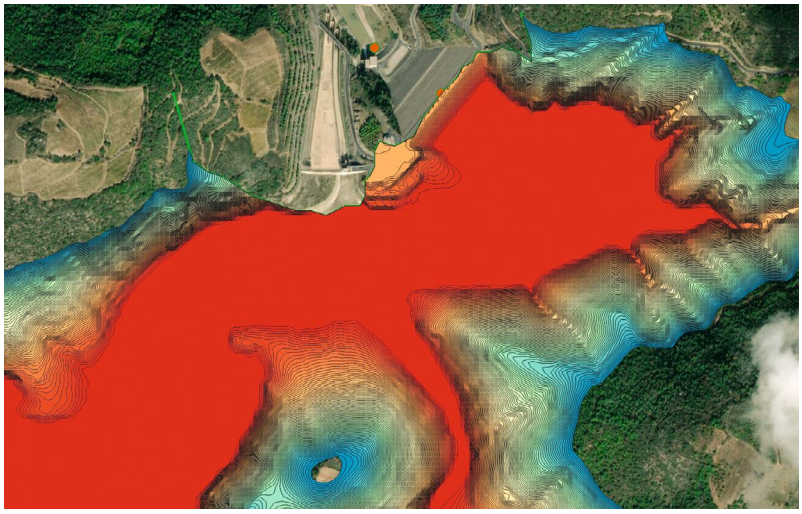
Initiated by France and CNES, the Space for Climate Observatory (SCO) has become a key international alliance, illustrating the strength of space cooperation in the face of climate challenges.

December 2017: President Emmanuel Macron brings together 50 heads of state in Paris for a One Planet Summit, seeking to find new ways of tackling climate change. The summit called for nations to sign up to 12 commitments, one of which was to create a space climate observatory. "This initiative, led by France and CNES, aimed to establish a network federating space agencies, academia and business to develop tools for understanding and adapting to climate change, drawing on Earth-observation data," explains Frédéric Bretar, SCO project

TropiSCO surveying deforestation

Developed through the SCO out of a research project at the CESBIO biosphere space research centre, the TropiSCO platform relies on Sentinel-1 satellite imagery to supply weekly maps of deforestation to local stakeholders in French Guiana, Suriname, Guyana, Gabon, Vietnam, Laos and Cambodia. Also freely accessible at Tropisco.org, it enables loss of forest cover to be traced back to 2018 with an accuracy of 10 metres.

84
PROJECTS
already initiated through SCO France.



Digital elevation models (DEM) from the StockWater project to monitor reservoir levels.

leader at CNES. Eighteen months later, the SCO international alliance was officially launched at the Paris Air Show.

Since then, the alliance's member countries have each developed their own network of academics, businesses, non-profit associations and government agencies. SCO France has led the way, with 400 signatories, 84 projects initiated and 38 already completed. "A call for projects is issued every year," adds Frédéric Bretar. "We receive between 20 and 30 proposals for each call, and 10 to 15 are selected. Some get funding from CNES, which may also provide technical expertise or access to data. Most projects run for two years, to encourage tangible and proven science results that can be scaled up quickly."

Among SCO France's emblematic projects are SeSaM, focused on modelling mats of sargassum seaweed; Greenspace, aiming to optimize planting of tree species in cities in anticipation of climate change; and StockWater, seeking to achieve global monitoring of reservoir water stocks. "Thanks to the close involvement of a CNES engineer, StockWater is now an operational service monitoring 300 reservoirs in France on a daily basis," notes Frédéric Bretar.

In time, the SCO has fledged into a vast international community, and its Charter, signed in 2022, now has 54 signatories, including 30 nations and six international organizations. National SCO offshoots are taking shape in China, Gabon, Slovakia, South Africa, Sweden and the United Kingdom. "123 projects have been accredited, covering a range of topics from urban climate adaptation to natural disaster preparedness, biodiversity and land occupancy," adds Frédéric Bretar. Each new local initiative underlines how Earth observation can be a game-changer for regions all over the world, portending a future in which international cooperation and technical innovation join forces to respond to climate challenges.

Vegetation in the Grand Nancy conurbation observed by the Green Urban Sat project.

When science and observation come together

Earth observation from space is vital to understand and anticipate climate change. "It's impossible to adapt effectively without founding decisions on rigorous science and reliable data shared by the scientific community," stresses Selma Cherchali, who heads CNES's Earth Research and Observation (EOT) sub-directorate. Optical, radar and lidar satellite data, combined with in-situ readings and modelling provide reliable and up-to-date indicators to distinguish natural variability from trends being fuelled by human actions.

Data continuity is crucial. Exploratory satellites like SWOT, Pleiades and soon MicroCarb and Trishna are blazing the trail for future operational missions that will guarantee long-term time-series of data. These satellites' highly precise data provide the basis for climate models used to simulate different climate change scenarios. "To be able to conceive the right adaptation scenarios scaled to each territory, it's vital that we have regular measurements and models that are constantly being adjusted, validated and updated to deepen our knowledge of the Earth system's key mechanisms," notes Selma Cherchali.

CNES is contributing to this international dynamic by providing data to match the requirements of the Global Climate Observing System (GCOS), which has identified 55 essential climate variables (ECVs), a large proportion of which are derived from space-based observations. These contributions are backed by constant dialogue with the scientific community, through science survey seminars and specialist committees, to guide future missions and fill gaps in our data.
"In a context of global climate disruptions, the pursuit of France and Europe's investments in proven, interoperable observation systems validated by the scientific community is vital to inform adaptation policies," concludes Selma Cherchali.

A seminar for the future

In October 2024, CNES held its Science Survey Seminar in Saint-Malo. Drawing on the work of the TOSCA Earth, oceanography, land surfaces and atmosphere committee, the seminar set priorities for the future of space-based Earth-observation research. These include furthering our understanding of climate cycles, studying vulnerability to global change, the relationships between the inner and outer Earth, and digital twins to mention a few. They will inform the work of CNES's Science Programmes Committee (CPS).

Hurricane Dorian (2019) seen from space.

Back to the future

Satellites to the aid of disaster-hit populations

For a quarter of a century, the International Charter Space and Major Disasters has brought satellites to the aid of emergency responders in the field. It's proving a vital tool at a time when climate-related events are becoming ever-more severe.

Satellite images of Mamoudzou before and after Cyclone Hidaya in Mayotte.

MILESTONES

July 1999
ESA and CNES put forward the idea of an international solidarity platform

November 2000
Charter enters operational service

2012
Universal Access enables nations anywhere in the world to activate the Charter

2017
Charter wins William T. Pecora Award[1]

2025
Charter celebrates its 25th anniversary

1. This yearly award honours outstanding contributions in the field of remote sensing and its application to understanding Earth.

The initial idea was simple: in the event of a disaster, why not share available satellite imagery to help emergency response teams gain a clearer picture of the situation on the ground? The European Space Agency (ESA) and CNES laid the foundations of this space-based solidarity platform in 1999. A year later, the International Charter Space and Major Disasters became fully operational and available for activation free of charge by all authorized nations and organizations.

Over the years, the nature of activations has changed somewhat. In addition to earthquakes and volcano eruptions, the Charter is responding increasingly to disasters triggered or amplified by climate-related events such as flooding, tropical storms and wildfires. In 2024, it was activated a record 85 times, and a majority of these events were weather-related.

Today, 17 space agencies and eight private data providers are ready to stand alongside disaster-hit regions, and some 270 satellites can be called into action. The French SPOT, Pleiades and Pleiades Neo satellites are among those spearheading the scheme, supplying nearly one-third of post-disaster maps alone. In many cases, only a few hours elapse from the time an activation request is logged to reception of the first images at a resolution down to 30 centimetres, thanks to a system staffed by teams working round the clock. One of the key links in this operational chain is ICube-SERTIT, the rapid mapping expertise centre and CNES partner with a pivotal role in the Charter.

New advances in technology are set to further consolidate the Charter's utility in the future, with artificial intelligence helping to pinpoint critical zones faster, 3D maps helping to estimate flood depths, and spaceborne thermal sensors capable of detecting fire-starts.

Talking ethics

Jacques Arnould
Science historian and theologian, CNES ethics officer

Our house is burning

By mastering vertical access to space, we've taken on a new kind of responsibility—towards humans, now all neighbours, and towards our environments. So, what are we doing with it?

More than 30 years ago, Régis Debray wrote: "In moving from old-style globes to the appliance section or audiovisual aisle of department stores, planet Earth has become both miniaturized and domesticated. It can now be delivered to your home, like a fridge or vacuum cleaner." Debray's metaphor is more relevant today than ever: while our "homes" have been reduced to our phones, we have access to immeasurable amounts of data. Which leads to the obvious question: what are we doing with it?

An early pioneer of aviation, Clément Ader formulated his own answer, both aspirational and visionary: "He who masters the air will be master of the world". It's easy to see why: the real challenge or danger lies in how we think about and handle this mastery of the world.

It began with the steep and rugged paths of knowledge. *Ad astra per aspera*—through hardship to the stars, as the Ancients said. The launch of Sputnik during the International Geophysical Year proved that Earth sciences could rely on space technology. But the question remained: what should we do with this new-found knowledge?

At the Johannesburg Earth Summit nearly half a century later, President Jacques Chirac addressed the international community—and each of us—in scathing terms: "Our house is burning and we're looking the other way. (...) We won't be able to say we didn't know." In the meantime, Earthlings had already landed in the Sea of Tranquility and humankind triumphantly exclaimed: "We've walked on the Moon!" But what have we done for a planet whose rise we gazed upon from the lunar surface? We may fear that, while sending up multiple "eyes" into Earth orbit and accumulating vital knowledge about our planet and its health, we've failed to develop the practical capabilities and, more importantly, the shared resolve to act decisively to protect it. Yet we shouldn't expect help from the heavens or a *deus ex machina:* the fate of our home truly lies in our own hands. Knowing isn't enough—we must also choose to act, together, while we still can!

DATA TERRA RESEARCH INFRASTRUCTURE

"An observation system constantly taking Earth's pulse"

FRÉDÉRIC HUYNH

Director

"I specialize in space applied to scientific knowledge and informing government decisions," says Frédéric Huynh, Director of the Data Terra national research infrastructure. After graduating from the Ecole Centrale engineering school in 1992, he soon began using satellite data to survey the impacts of climate change and aid adaptation efforts. Working at the IRD development research institute, he spent five years in French Guiana at the helm of a research laboratory specializing in space remote sensing devoted to monitoring the environment, and coastal and forest ecosystems. It was here that his path crossed CNES's. He also conducted environmental impact studies for the Ariane 5 launch facilities. "My job was to characterize the vulnerability of all the habitats that were going to be affected by the launcher's operations," he explains. With his team, he devised the first methodology to use satellite data to measure the amount of carbon stored in a rainforest system. In 1999, Frédéric Huynh was appointed Space Affairs Officer for IRD, leading the project to set up the SEAS ground station in French Guiana receiving real-time data from the SPOT satellites and radars. This station proved a key asset for monitoring shorelines, gold panning and ecosystems. "All these projects helped to make the use and value of satellite imagery more intelligible in the field," he explains. Now at Data Terra, which he has headed since 2017, Frédéric Huynh is overseeing unified access to all in-situ and satellite data generated by research infrastructures, laboratories and observatories. "Data Terra stores and distributes data and develops tools for processing them." The goal is to gain new insights into the interactions between the Earth, biodiversity, the oceans and water sciences, to inform public policies in France and Europe, and to tackle the major climate challenges facing us. In all, 34 organizations—among them CNES—are helping Data Terra to build a sovereign science data infrastructure, a strategic issue in the light of Donald Trump's assault on science. To enable sustainable transitions, these data and associated expertise must be shared with society and public stakeholders. "It's a civic and a scientific responsibility," affirms Frédéric Huynh. "Data Terra is pulling all of this information together to provide an observation system that's constantly taking the pulse of the Earth system."

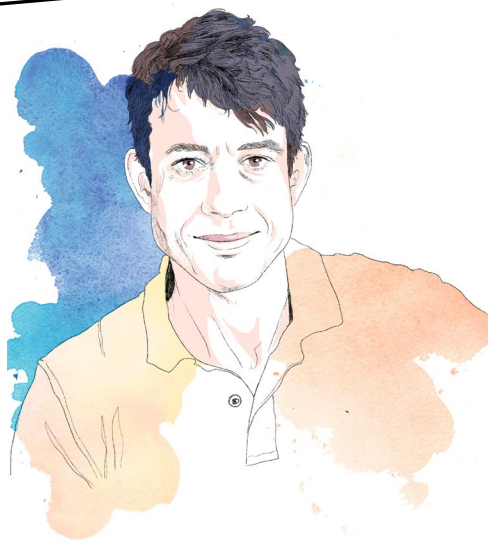
FRENCH GEOLOGICAL SURVEY BRGM

"Today, our main challenge is to shift the perspective from observation to adaptation"

GONÉRI LE COZANNET

Research scientist, co-author of the Sixth IPCC Report and member of the French High Council on Climate

Altimetry satellites have been continuously surveying sea level rise since 1993. According to the Sixth IPCC Report (2023), it rose 20 centimetres on average around the globe between 1901 and 2018. "For scientists, satellite altimetry provides input data for measuring sea level, which is a key indicator for studying climate change in coastal regions," notes Gonéri Le Cozannet, an engineer at the French geological survey BRGM who specializes in coastal risks. After graduating from the ISAE-Supaero aerospace engineering school, he joined BRGM to work on space remote-sensing applications. "Radar interferometry is able to detect ground displacements with millimetre accuracy," he explains. It's a useful technology for measuring relative sea level rise, "which includes a climate component, but is also affected by ground deformation." Between 2010 and 2015, Gonéri Le Cozannet worked on the CECILE research project focusing on the impacts of sea level rise on coastal environments, led by Anny Cazenave, a research scientist emeritus at the LEGOS space geophysics and oceanography research laboratory, expert for CNES and Fellow of the French Academy of Sciences. "Our methods enabled us to go back as far as 1950, using among other things satellite data and modelling." With these archived data, the team mapped erosion in areas most affected by sea level rise. After completing his PhD, Gonéri Le Cozannet switched his attention to shorelines and submersion, while extending the scope of his research to climate adaptation. A co-author of the Sixth IPCC Report, he subsequently joined the High Council on Climate in 2024. "Space can help us to monitor adaptation, but we need to think carefully about what we want to measure exactly. In other words, what type of adaptation do we want to observe? What do we consider the right kind of adaptation in situ?" he notes. One possible avenue is to identify essential adaptation variables, similar to the essential climate variables tracked by the IPCC, like ocean surface temperature. For Gonéri Le Cozannet, a new perspective is called for: "we're no longer at the stage where we can simply stand by and observe the impacts of climate change; today, our main challenge is adapting to them."



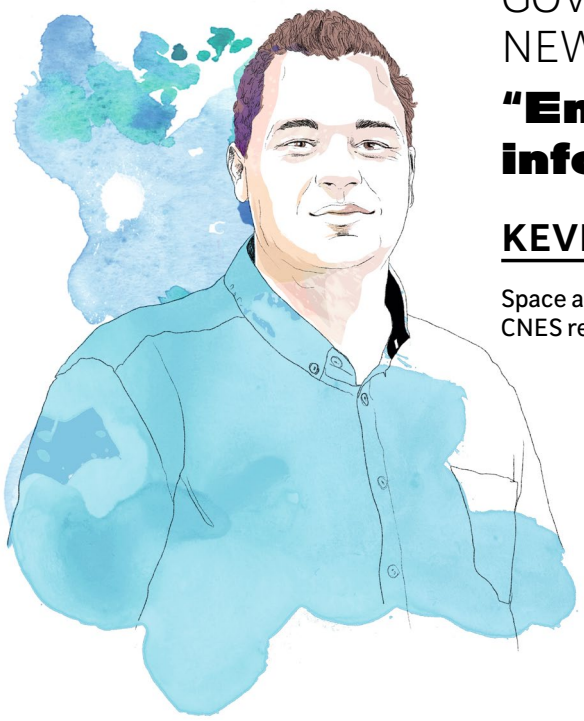
ABSOLUT SENSING

"We're supplying a system to measure methane emissions"

SÉBASTIEN DORGAN

Chief Technical Officer

14 January 2025. GEN1, the demonstration satellite for GESat, is lofted into orbit from SpaceX's launch facility. GESat is a constellation of nanosatellites being deployed by Absolut Sensing, a firm that specializes in detection of greenhouse gases. "We've been selected to supply a system to measure methane emissions for Europe's Copernicus Contributing Missions programme," explains Sébastien Dorgan, the company's CTO. He has an engineering background, having worked previously at Noveltis, Thales, CS Group and Capgemini, and has rubbed shoulders with CNES on a number of projects focused on atmospheric research, Earth observation and flight dynamics. In 2023, the agency opened its clean rooms to Absolut Sensing to test GEN1 before sending it into space. "The algorithm used to calculate methane concentration is being developed in collaboration with the LMD dynamic meteorology laboratory affiliated to CNES," adds Sébastien Dorgan. Since the start of the industrial era, methane accounts for some 30% of the global rise in temperatures. "It's a greenhouse gas 80 times more potent than CO_2 in terms of its impact on the greenhouse effect," he notes. Absolut Sensing's solutions for measuring greenhouse gases complement the institutional Sentinel-5P, MicroCarb and MERLIN missions monitoring Earth's atmosphere. "Space is the only place that gives us a broad picture of the planet, a country or continent." The firm complements this global perspective with finer detail of local phenomena. "Our instrument is capable of zooming in to see what's going on at a drilling site or waste processing plant, for example." It can also address deeper issues like: How can we analyse the mean concentration of methane in Europe? What impact have regulations had on emissions? Or how do we adjust industrial policies to curb methane emissions? "Merging all these data enables us to compile custom archives," says Sébastien Dorgan. "The longer the data record we have, the better we'll be able to make projections for the future." And sharing data between missions also helps to refine the parameters of this methane-measuring technology. "CNES is providing quality assurance for our data," he stresses. Absolut Sensing plans to send 12 satellites into space between now and 2028.



GOVERNMENT OF NEW CALEDONIA

"Enabling quick and informed decisions"

KEVIN DECLUDT

Space and innovation project officer, Connect by CNES representative in New Caledonia

Rising seas pushing back shorelines, coastal erosion, landslides… "We have a lot of climate hazards to cover," warns Kevin Decludt, space and innovation project officer for the Government of New Caledonia and local representative of the Connect by CNES programme since 2024. "Connect by CNES aims to promote uptake of space data and technologies by businesses, institutions and researchers," he explains. "I serve as a go-between, a facilitator fostering dialogue between CNES and the local ecosystem." New Caledonia is where Kevin Decludt was born and raised, so he knows it like the back of his hand. After obtaining his two-year BTS diploma in mechanical engineering, he set off in search of pastures new, to France and then the United Kingdom. After securing a second diploma in digital design and innovation and a Master of Science degree, the local lad returned to home ground: "I wanted to put what I'd learned to use for New Caledonia." He initially worked at the Koniambo Nickel SAS plant and then for consulting firms in Nouméa before becoming a civil servant. In April 2024, the Government of New Caledonia adopted its climate change strategy, detailing a series of actions designed to prepare for and cope with climate hazards. Meanwhile, to meet territories' needs and support policymakers in their adaptation efforts, CNES, NASA and the National Oceanic and Atmospheric Administration (NOAA) engaged SCOast-DT, a project initiated through the Space for Climate Observatory (SCO) to assess change of coastal zones from models, climate projections and satellite, drone and in-situ data. "The idea is to leverage these shared resources to build a digital twin simulating land submersion risks during cyclones, which could intensify with rising seas and the changing coastline," notes Kevin Decludt. The project attracted the interest of the Government of New Caledonia and an agreement with CNES was signed to run through to 2026. "This solution will enable quick and informed decisions," he forecasts. "Over the last year, we've forged close ties. I hope this agreement will be extended and grow to bring more space into our projects, and to craft a long-term vision for New Caledonia."

TAHATAI: expanding with the SCO

From conception to implementation, the story of one project that's leveraging satellite data to manage the Polynesian coastline.

Faced with the challenges of climate change, French Polynesia has launched a pioneering initiative to monitor and manage its vast coastal areas. Accredited by the Space for Climate Observatory (SCO), the TAHATAI and now TAHATAI Neo projects

The search for funding

With maritime surveillance a growing concern, French Polynesia's DRM began with a review of European calls for tender on the theme of "sea and coastline", with a view to procuring new tools with which to monitor its vast ocean expanses and anticipate future hazards. But the complexity of the procedures involved made them a non-starter.

Game-changer

That's when DRM turned to Bluecham, a Nouméa-based company specialized in the processing of geospatial data to support environment decision-making. By leveraging Bluecham's mining-related experience in New Caledonia, the two partners were able to identify key possible solutions.

SCO as business accelerator

On Bluecham's advice, the DRM applied for SCO France accreditation to accelerate the tool's development. Drawing on the SCO's key areas of interest, the partners identified two priorities: monitoring of fishing and pearl farming activities, and tracking of algae blooms. TAHATAI would initially focus on the island of Tahiti and Arutua atoll in the Tuamotu archipelago.

leverage space-based observation tools to meet local needs. Developed by Bluecham SAS, the tool combines data from satellites, such as Sentinel-1, 2 and 3, Pleiades/Neo, SPOT and Unseenlabs, with advanced analytics to provide decision-makers with key information for predicting coastal hazards, preserving marine biodiversity and tracking human activity in the lagoon area. Spearheaded by the French Polynesian department of marine resources (DRM) and several French and Australian partners, TAHATAI perfectly embodies the SCO's broader mission to provide practical tools for understanding and mitigating the impacts of climate change on a local scale.

Safeguarding our oceans and vessels

With technical support from CNES engineers, the new tools were integrated into the Bluecham platform and went live in 2022. The tool interface enables users to track changes in water quality and human pressure on the coastal and lagoon environments, mainly via automated boat detection.

New horizons

TAHATAI was so well-received that DRM and Bluecham have continued working together to launch TAHATAI Neo, which also has SCO accreditation. The goal now is to incorporate new features and expand the tool's use beyond Tahiti, with several Pacific nations already expressing a keen interest.

Earth attractions

Enter the dreamlike world of SCOdyssey

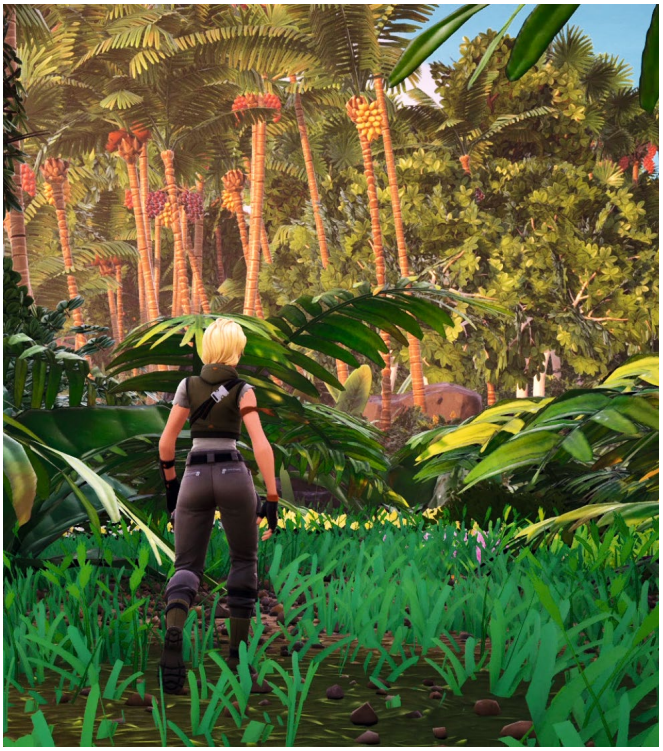
Developed on Spatial.io and in collaboration with digital agency Ultranoir, SCOdyssey is a 3D environment whose intrepid explorer is sent into orbit aboard their spaceship then teleported to four dreamlike worlds. Each world is coloured with one of the four elements—earth, fire, air and water—and inhabited by different totem animals relating to Space for Climate Observatory (SCO) projects. Designed as an evolving learning tool, SCOdyssey provides an offbeat and imaginative delve into climate issues.

Your all-weather friend

It's OK to have your head in the stars… so long as you keep it dry! And now you can, with our Constellation umbrella made from extremely hardwearing nylon canvas. The umbrella also doubles as a parasol, thanks to its special outer coating that protects you from the heat and sun. It's the perfect accessory for adapting to global warming in style.
€21.50 – Available on maboutique.cnes.fr

Get the big picture with *Terre en Vue(s)*

How do satellites see in the dark? How do we detect droughts from space? And what is Saharan dust doing above the Amazon? *Terre en Vue(s)* ("Earth in View") is a YouTube series of five-minute videos that explore just such issues, using spectacular imagery, expert commentary and a lively style to make complex issues accessible without over-simplifying. Co-produced by CNES, the sustainable development research institute IRD and the French national scientific research centre (CNRS), the series re-enacts some of the major environmental phenomena observed by our satellites. *Find all nine episodes on CNES's YouTube channel.*



Space to the Rescue, in multiplayer mode

Fortnite is well-known as the online video game whose 500 million users come to let off steam, weapons in hand. But it's also, and increasingly, an interactive adventure platform where entertainment meets activism. And CNES has now joined the fray, through an immersive map co-created with Game in Society and the AFV Rainforest Organization. Two chapters are already on line: Amazonia, Space to the Rescue and Save the Rainforest, with gamers able to explore the Guiana Space Centre and its local biodiversity and handle data inspired by the Space for Climate Observatory (SCO). It's an innovative way to introduce young people to space data from the comfort of their own homes.
Available free on PC, Xbox, PlayStation and Switch.

Open Planet Facts, in the palm of your hand

Open Planet Facts is like Yuka for the environment. Launched with French environment and energy agency ADEME, this CNES/OFB[1] project uses the Lucioles mobile app to help us understand the impact of different human activities on the environment so that we can take action at our own level. Based on local observations and grassroots activities, this new social network aims to be a game-changer by promoting learning, collective action and ethics while enabling citizens to reconnect with the world around them day to day. The plan is for the tool to expand and develop through the involvement of new members, to create a broad-based community of partners ranging from local authorities and associations to data providers and scientists, whose expertise, information and data will combine to create an unparalleled social network with a truly positive impact.

1. Office Français de la Biodiversité (the French biodiversity office)

DIARY

2026
LAUNCH OF TRISHNA, A FRENCH-INDIAN mission to track the water cycle at the Earth's surface.

2029
LAUNCH OF THE FRENCH-GERMAN MERLIN satellite, designed to measure concentrations of atmospheric methane and identify emission sources.

SCO at all latitudes

On all five cinq continents, Space for Climate Observatory (SCO) projects are mobilizing satellite data to offer real-world solutions for adapting to climate change.

SWEDEN | EO4WFD: MANAGING WATER IN RESPONSE TO CLIMATE

In Sweden, EO4WFD combines satellite imagery with field data to improve management of freshwater resources, using water quality indicators. This initiative is supporting implementation of the EU Water Framework Directive (WFD).

SENEGAL | STRATA: VISUALIZING COMPLEX RISKS

Led by the UN Environment Programme (UNEP), Strata is a web-based geospatial platform combining data from a range of satellites to identify hotspots where environmental, climate and security stresses converge with socio-economic vulnerabilities and instability.

PERU | EHOP: IMAGING HOTSPOTS AND RAISING AWARENESS

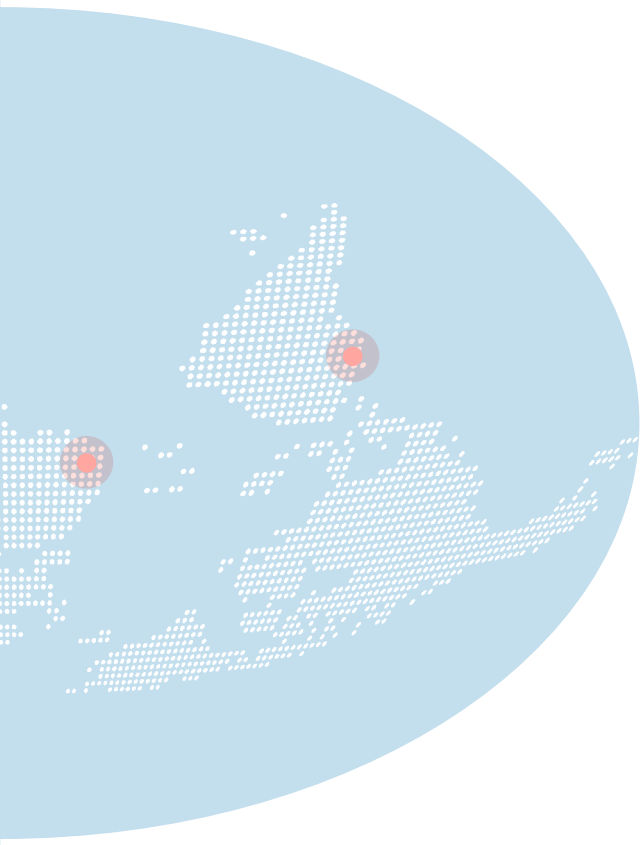
Via its Environmental Hotspots platform, EHOP is using satellite data to visualize major environmental changes. In Peru, for example, it is showing how the Coropuna glacier is melting, threatening thousands of people who rely on it for water.

CHINA | METHMINE: TRACKING METHANE EMISSIONS FROM COAL MINES

MethMine is targeting methane, a potent greenhouse gas emitted notably by coal mines. Using Sentinel-5P satellite imagery and models, the project aims to improve calibration of satellite data so that emissions can be monitored more reliably.

PHILIPPINES | DEW-PH: ANTICIPATING DROUGHTS

Employing a range of satellite data, mainly to record temperature, rain and vegetation, DEW-PH is improving drought monitoring and forecasting, thus helping to make the Philippines' farming sector more resilient and sustainable.



RÉPUBLIQUE FRANÇAISE

Liberté
Égalité
Fraternité

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CENTRE NATIONAL D'ÉTUDES SPATIALES

CNESMAG

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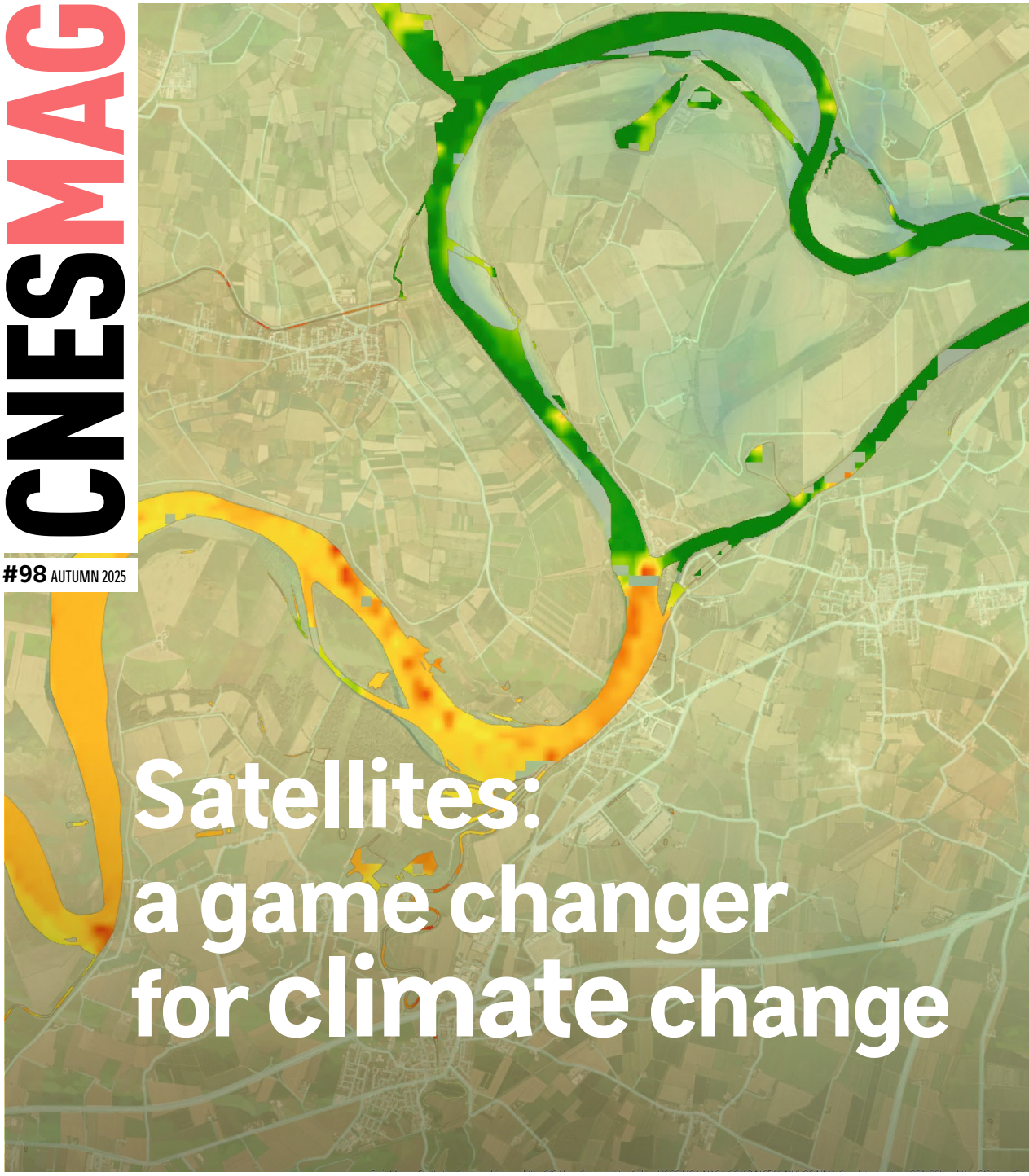

Satellites: a game changer for climate change