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# SUSTAINABLE JAPAN MAGAZINE

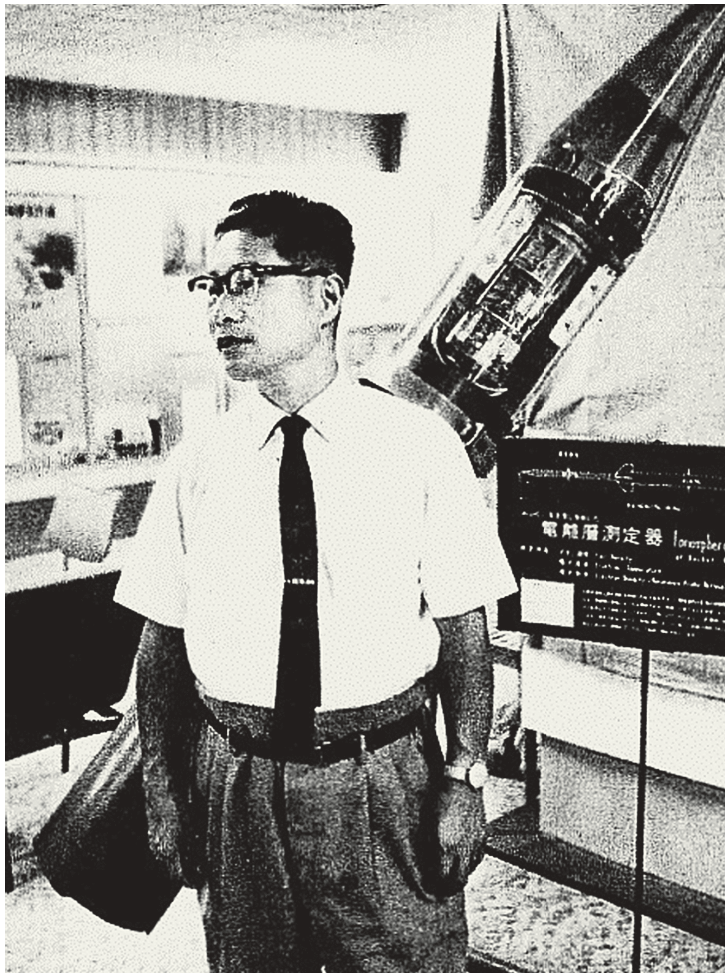
Saturday, January 29, 2022

We are  
“Space brothers”  
(僕たちは“宇宙兄弟”です)

## Next leaps for all humankind







Starting with pencil rockets, Hideo Itokawa (1912-1999) pioneered rocket development in Japan and became known as the country’s “father of space development.”

1955  
Hideo Itokawa

TIMELINE

1955	Experimental launch of pencil rocket by professor Hideo Itokawa, University of Tokyo
1963	Science and Technology Agency conducts first launch of small rocket
1964	Science and Technology Agency establishes Space Development Promotion Headquarters
1968	Tanegashima Space Center opened National Space Development Agency of Japan (NASDA) established
1970	Japan becomes fourth nation to successfully launch a satellite, Osumi, after the Soviet Union, the U.S. and France)
1972	Tsukuba Space Center opened
1975	Launch of upper atmosphere observation satellite Taiyo NASDA's first satellite, Kiku-1, launched
1977	Launch of geostationary meteorological satellite Himawari-1
1987	Launch of Japan's first ocean observation satellite, MOS-1
1990	Toyohiro Akiyama becomes the world's first civilian to travel in space
1992	Astronaut Mamoru Mohri becomes the first Japanese to crew the space shuttle Endeavor
1997	Astronaut Takao Doi becomes the first Japanese to conduct a spacewalk
2003	Japan Aerospace Exploration Agency (JAXA) established Launch of asteroid exploration spacecraft Hayabusa
2005	Hayabusa arrives at the asteroid Itokawa and succeeds in taking a sample of its surface
2008	Basic Space Law enacted
2016	Space Activity Act, Satellite Remote Sensing Act come into force
2017	Axelspace launches private small satellite, Winsat-1R
2019	Hayabusa2 successfully touches down on the asteroid Ryugu twice Interstellar Technologies becomes the first private Japanese company to reach outer space with its Momo-3 spacecraft
2021	Astroscale successfully launches ELSA-d, which starts mission to remove space debris

Feature HUMAN HARMONY

# HISTORY

## How Japan became the world’s second-largest investor in space ventures

By ARINA TSUKADA

On Dec. 23, Japan’s H-IIA Launch Vehicle No. 45 was launched from the Tanegashima Space Center in Kagoshima Prefecture carrying a British communications satellite. Out of its 45 launches to date, the H-IIA, which was developed by JAXA and Mitsubishi Heavy Industries, has succeeded 44 times, giving it a success rate of 98%, one of the highest in the world.

Last year was also the year in which space tourism became a reality. Beginning in July, three American space start-ups launched spacecraft carrying private customers in quick succession. Then, in December, Yusaku Maezawa, the founder of the Japanese fashion e-commerce site Zozo, made a trip to the International Space Station on the Russian spacecraft Soyuz — and attracted much media attention.

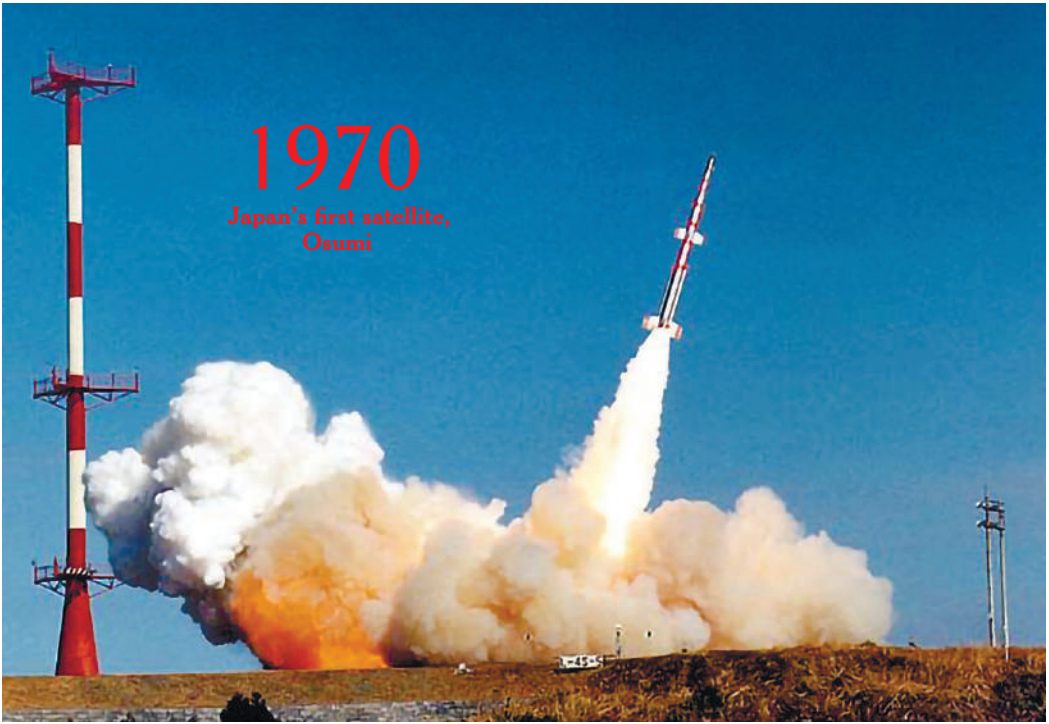
Japan’s recent activities are based on many decades of work by researchers. It all started in 1954, when Hideo Itokawa, the “father of Japanese space development,” brought together researchers in electronics and flight mechanics in the newly formed center for rocket development at the University of Tokyo. Itokawa, who had been involved in airplane development before the war, became interested in spaceflight during his stay in the United States after the war, and was the first person to conduct rocket research in Japan. In 1955, Itokawa’s team, which

had only a small budget, began conducting experimental launches of pencil-type rockets with a total length of about 23 centimeters. In 1958, he expanded his focus to atmospheric observation with the larger Kappa 6 rocket, which was launched to the target altitude of 60 kilometers. The period from 1957 to 1958 happened to coincide with International Geophysical Year, an international project that saw scientists from all over the world cooperate on space observation, and Japan was invited to participate for the first time on the basis of the data it had captured with Kappa 6. This marked the moment when Japan joined the ranks of countries conducting space development.

Itokawa and his colleagues, who threw

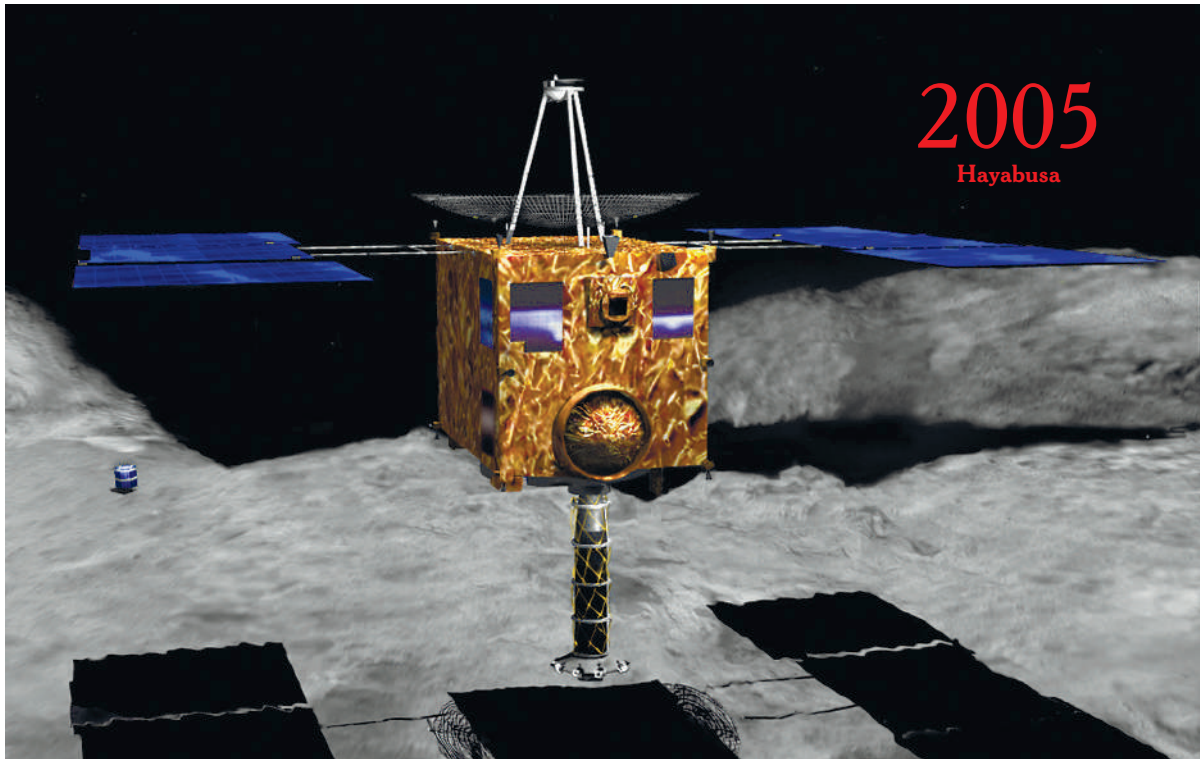


The lunar lander to be used in Mission 1 of Ispace’s private lunar exploration program, Hakuto-R. © ISPACE, INC.



Japan’s first satellite, Osumi, was launched in 1970 on a Lambda rocket. Equipped with sounding devices, its main purpose was to test technologies for putting satellites in orbit with the next-generation Mu rockets. © JAXA





The asteroid explorer Hayabusa, which was launched in 2003. In 2005, it collected samples from the asteroid Itokawa and then later delivered them to Earth, the first time samples of a celestial body outside of the Earth's gravitational sphere were collected.

themselves into a wide range of endeavors, began developing satellites in 1962. In 1966, they began launching the Lambda carrier rockets, for satellite delivery, in spite of budgetary and environmental limitations. However, the launches failed four times, resulting in repeated negative media coverage. In 1970, three years after Itokawa retired from the University of Tokyo, Japan succeeded in launching its first satellite, Osumi. For the first time, the country operated its own satellite in orbit. After that, the achievements of Itokawa, the nation's leading space pioneer, were passed on to the National Space Development Agency of Japan (NASDA) and then the current Japan Aerospace Exploration Agency (JAXA).

In 2003, the same year that Osumi was retired after 30 years of service, JAXA's asteroid explorer Hayabusa was launched in the first attempt ever to send a spacecraft to a celestial body other than the moon and then bring it back to Earth. Its target asteroid was named Itokawa in Hideo Itokawa's honor. For a short time the spacecraft lost communication with Earth and the mission looked in peril, but in 2010 it began its return voyage complete with a collected sample, and the project garnered many supporters. On the day of its arrival back on Earth, June 13, the live online broadcast of its entry into the atmosphere totaled more than 1 million views, and the news filled Japanese newspapers the following day. Three films eventually were made about the Hayabusa mission, and related goods became sudden hits. Hayabusa remains popular to this day, and it stands as a symbol of Japan's space development.

Now, more than a decade since Hayabusa's return, space development is no longer the exclusive domain of JAXA and heavy industry. Growth of the private space sector, which started in the early 2000s in the United States, accelerated rapidly in the 2010s, including through prominent companies like Elon Musk's Space X. The Japanese government formulated its New Space Basic Plan in 2015 and set a goal of increasing the domestic space industry to a cumulative value of ¥10 trillion (\$90 billion) within a decade. In addition, when the Space Activity Act, concerning the launch and management of satellites, and the Satellite Remote Sensing Act, on the use of satellite data,

were passed by the Diet in 2016, a slew of new private companies emerged. As a result, whereas in the mid-2010s Japan had just 10 or so private space venture companies, there are now more than 60, and some say the country ranks second in the world for the total amount invested in space businesses.

"In Japan right now, space ventures with world-class technology are appearing rapidly," explained Mizuki Komasa, who has long supported investment in space ventures through his venture capital fund, Real Tech Fund, and serves as the representative of Space Foodsphere. "For example, Ispace, which is now working on the private-sector lunar exploration program Hakuto-R, is a pioneer in the field of small moon lander technology among Japanese companies. Meanwhile, Astroscale was the first company in the world to develop technology specializing in the removal of space debris." The quality of their respective technologies is evidenced in Ispace having raised a cumulative total of about ¥21.8 billion in funding,

and Astroscale ¥33.4 billion.

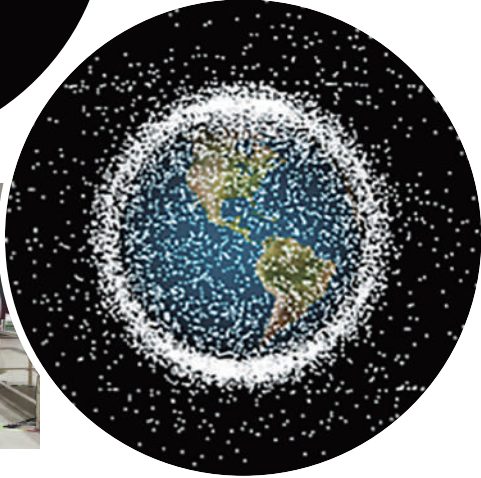
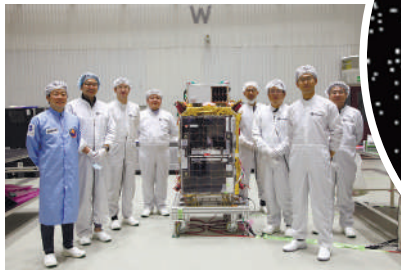
"It's essential that these space businesses be connected to the sustainability of the Earth and humankind," Komasa said. Both companies contribute to the sustainability of the entire space business. Ispace's goal is the creation of a sustainable economic zone that brings the moon and Earth together as a single ecosystem in which the moon's water resources can be utilized. Meanwhile, Astroscale plans to remove hundreds of millions of pieces of orbiting debris. In addition, Synspec, which works on small-satellite development and data analysis, analyzes satellite data such as ground movements and flood damage from disasters, and also captures and analyzes complex geographical information to contribute to the achievement of carbon neutrality. Advanced technology and Earth observation from space will be indispensable for the survival of the Earth and humankind. In this special feature, we introduce the current state of Japan's space business.



2021  
ELSA-D

A visual representation of space debris that is accumulating around the Earth. Compared with 1950, there was countless debris in 2021.

© ASTROSCALE



## ● Summary

日本の宇宙開発の歴史。  
ロケット～宇宙ベンチャーまで。

2021年12月23日、H2A ロケット45号機が鹿児島県の種子島宇宙センターから打ち上げられた。JAXAと三菱重工が開発するH2A ロケットは世界でも最高水準の成功率98%を誇っている。

躍進を続ける日本の宇宙開発だが、現在に至るまでには長き歴史があった。1954年、東京大学の糸川英夫が先

陣を切って日本のロケット開発がスタート。1970年、日本初の人工衛星「おおすみ」が打ち上げに成功。2003年に打ち上げられたJAXAの小惑星探査機「はやぶさ」は、世界初となる月以外の天体からのサンプル採取と地球帰還に成功し、日本の宇宙開発のシンボルとなった。日本政府が2015年に策定した「新宇宙基本計画」は、

さまざまな民間企業が宇宙開発に関わるきっかけをつくった。日本の宇宙ベンチャー企業も現在は60社を超え、投資額も世界二位に迫る勢いに。宇宙ゴミの除去や月面探査を目指す小型衛星開発などのベンチャーへの注目は厚く、宇宙視点の技術は、これからの地球や人類のサステナビリティにも広く貢献していくことだろう。



日本語全文はこちらから

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## COVER PHOTO

"Space Brothers" is a Japanese manga by Chuya Koyama that follows the story of two brothers who one day hope to be astronauts. This scene, set on the surface of the moon, is from volume 40.

© CHUYA KOYAMA/KODANSHA

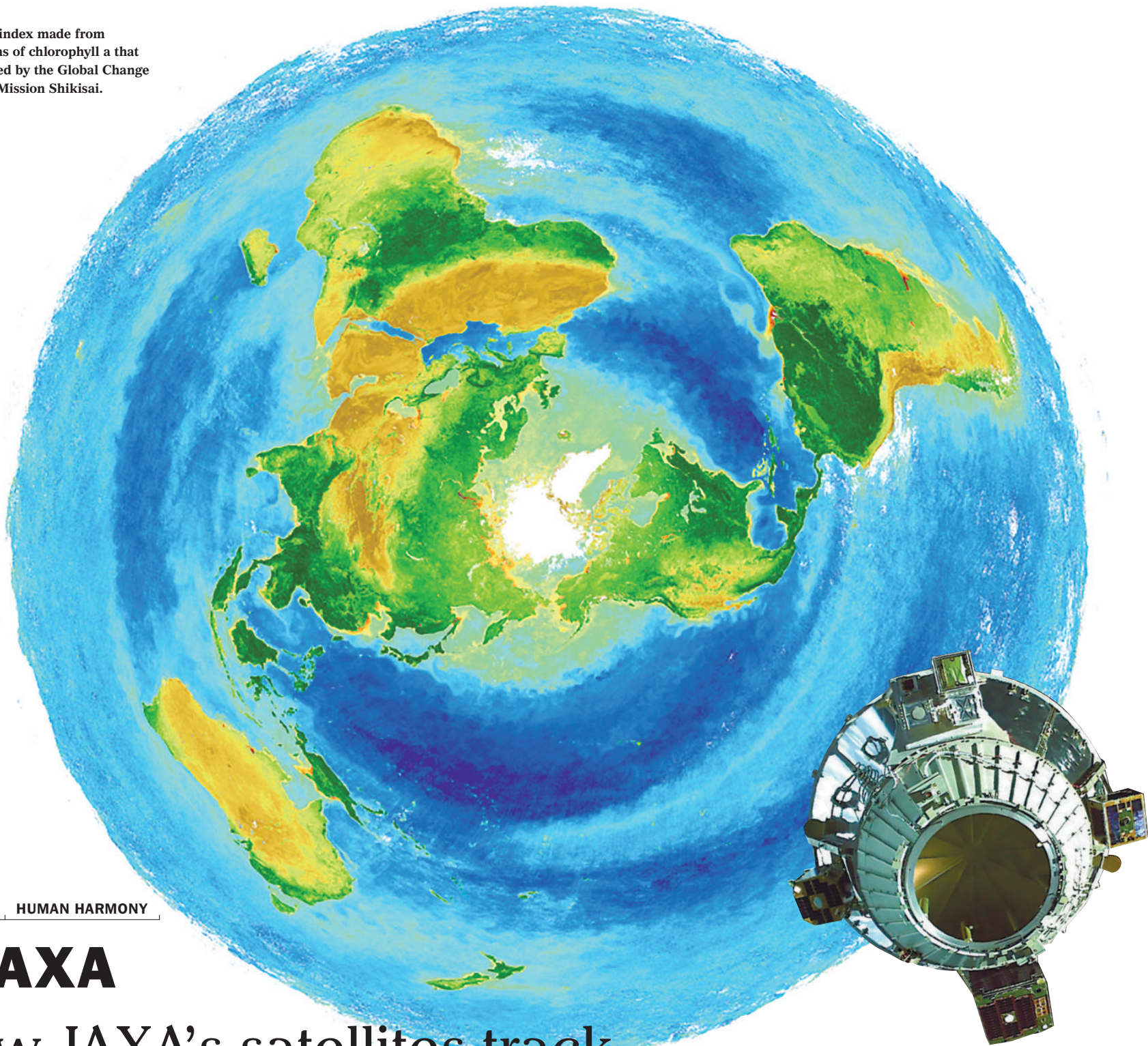


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A vegetation index made from concentrations of chlorophyll a that were measured by the Global Change Observation Mission Shikisai.  
©JAXA/EORC



The greenhouse gas observation satellite Ibuki during its deployment.  
©JAXA

Feature HUMAN HARMONY

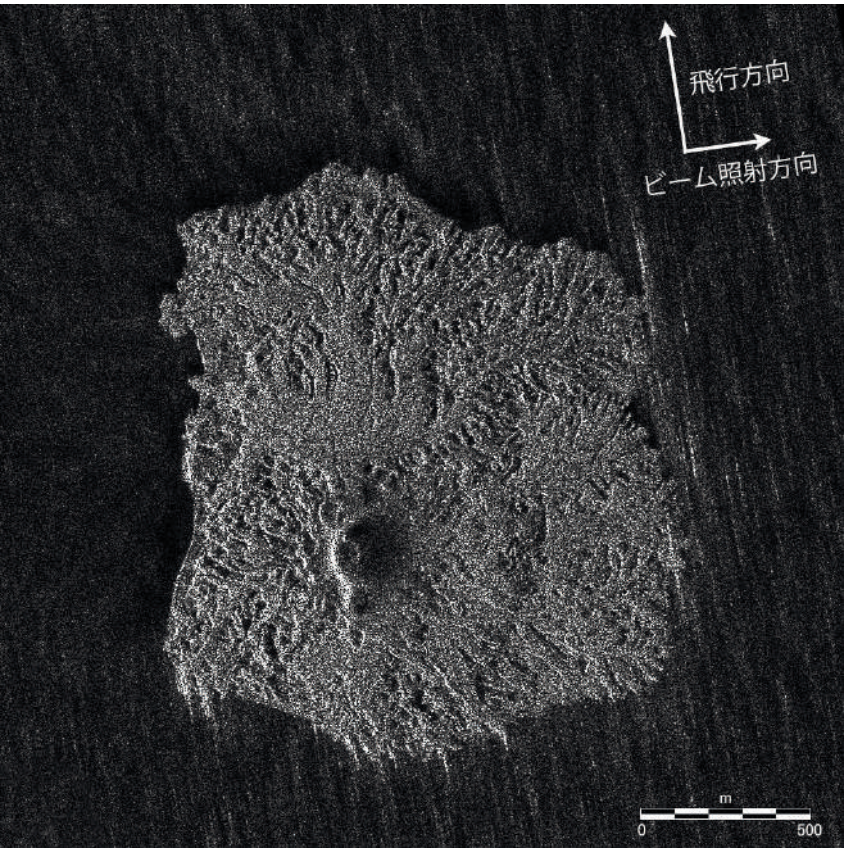
# JAXA

## How JAXA's satellites track emissions and more

By ARINA TSUKADA

The volcanic island of Nishinoshima, which continues to expand, as observed by the technical satellite Daichi-2, which observes land area.

©JAXA



It was in 1987 that MOS-1, Japan's first satellite to observe the Earth for environmental conservation and other purposes, was launched. Since then, JAXA has used the satellite to observe the state of the global environment and changes occurring to it with an eye to solving various global issues. "JAXA's mission is not only to disseminate the scientific knowledge obtained from satellites, but also to tackle social issues in collaboration with various partner organizations around the world," said JAXA's senior chief officer of Earth observation missions, Takeshi Hirabayashi.

For example, following the adoption of the Kyoto Protocol in 1997, the world's first satellite specializing in greenhouse gas observations, GOSAT, was launched in 2009 and has been in operation ever since. It has long been known that concentrations of carbon dioxide and methane in the atmosphere are rising steadily, but until recently satellite data has not been used in emissions reporting. However, GOSAT has showed that satellites can objectively observe each country's emissions with transparent scientific evidence, and as a result, in 2019, the efficacy of satellite data was recognized for emissions reporting. The Global Stock Take (GST), which is stipulated in the Paris Agreement and is scheduled to take place 2023, is an opportunity to check the progress of each country's greenhouse gas reduction efforts. JAXA is working with international organizations and related organizations in Japan and

overseas to capitalize on its 12 years of data and know-how so that satellite data can be counted as scientific evidence in that process.

Japanese satellites also contribute to green innovation business by offering a wide range of observational data. For example, in the field of renewable energy, they can capture topographical and solar radiation data that can help in determining suitable locations for wind, hydroelectric and solar power generation. Early warning systems have been established using data from Japanese satellites that observe changes to forests and check for illegal logging in 77 countries, including in the Amazon, where about 6 million hectares of rainforest is lost annually. In Japan, there is a movement to conduct satellite-based observation of forests for local governments in areas where it is difficult to conduct ground-based surveys due to personnel shortages. A pilot program began with Ibaraki Prefecture in 2019.

In addition, in the fishing sector, satellites are being used to provide data on daily sea surface temperature changes. This is relayed to the fishing information center, giving fishermen useful information and allowing them to conduct their work more efficiently.

The other area JAXA is focusing on is providing information during emergencies such as natural disasters, and in addition predicting disasters. For example, monitoring for slight changes in the



shape of a mountain to determine volcanic eruption alert levels and predicting areas of likely inundation during floods can both be conducted more efficiently with satellites than by helicopter, especially at night and during bad weather. Also, as the risk of serious accidents and disasters due to aging infrastructure has become more pronounced, JAXA is proceeding with efforts to monitor changes in infrastructure such as flood embankments to assist with preventive maintenance.

Based on achievements in these areas, the use of satellite data was officially included in the government's disaster prevention basic plan in 2017, and the Ministry of Land, Infrastructure, Transport and Tourism as well as some local governments have formalized the use of satellite data in disaster response.

In addition to disaster response, Hirabayashi explains JAXA is also focusing on forecasting efforts, working for example with the University of Tokyo to develop a simulation system, Today's Earth, that will predict flooding more than 30 hours in advance. "JAXA alone cannot make all the predictions in response to all global environmental issues. In the future, we plan to collaborate with a wider variety of institutions to investigate the processes and causal relationships of various phenomena," he said.



Ibuki-2 observes carbon dioxide and carbon monoxide, which together allow an estimate of total carbon emissions.  
©JAXA

● Summary

宇宙から環境保全に貢献する  
JAXA 地球観測技術の歩み

日本で初めて、環境保全に向けて地球観測を行う衛星が打ち上げられたのは1987年。以来JAXAでは、地球規模の課題解決を目的に多様な観測を行ってきた。温室効果ガスの観測に特化した世界初の衛星「いぶき」は、2009年の打ち上げから今日まで観測を続けている。今後JAXAは12年間のデータとノウハウ蓄積の強みを活か

かし、国内外の機関と協力関係を築いている。また再生可能エネルギー分野では、衛星から得られた地形データや日射量を活用して風力発電や水力発電、太陽光発電に適した設置場所の検討のために衛星データを提供するほか、熱帯雨林地域では対象77カ国の森林変化を観測し、違法伐採の監視に協力するなどの早期警戒シ

ステムを構築している。さらには災害発生など緊急時における情報提供にも貢献。2017年には政府の基本計画に衛星データの活用が正式に盛り込まれた。現在は東京大学と共同で洪水の危険度を予測するシミュレーションシステムの実装を進めるなど、将来予測に向けた取り組みにも注力している。



日本語全文はこちら

Times Capsule



This article was published on May 31  
in The Japan Times



BRAND  
HISTORY  
& ARCHIVE

## Japan Times staff, readers lead rescue of the battleship Mikasa

**M**ikasa! The name of the powerful Japanese battleship is well known to the world's naval historians.

The Mikasa's highly acclaimed victories at sea over a century ago are largely overshadowed by the history of subsequent repeated efforts to preserve the ship. In the past, lack of funding, international treaty agreements and simple oblivion have caused old steel-hulled vessels to fall into disrepair and even be threatened with dismantling. Nevertheless, every time such a crisis occurred, a group of supporters was set up to fight for the protection of the ship.

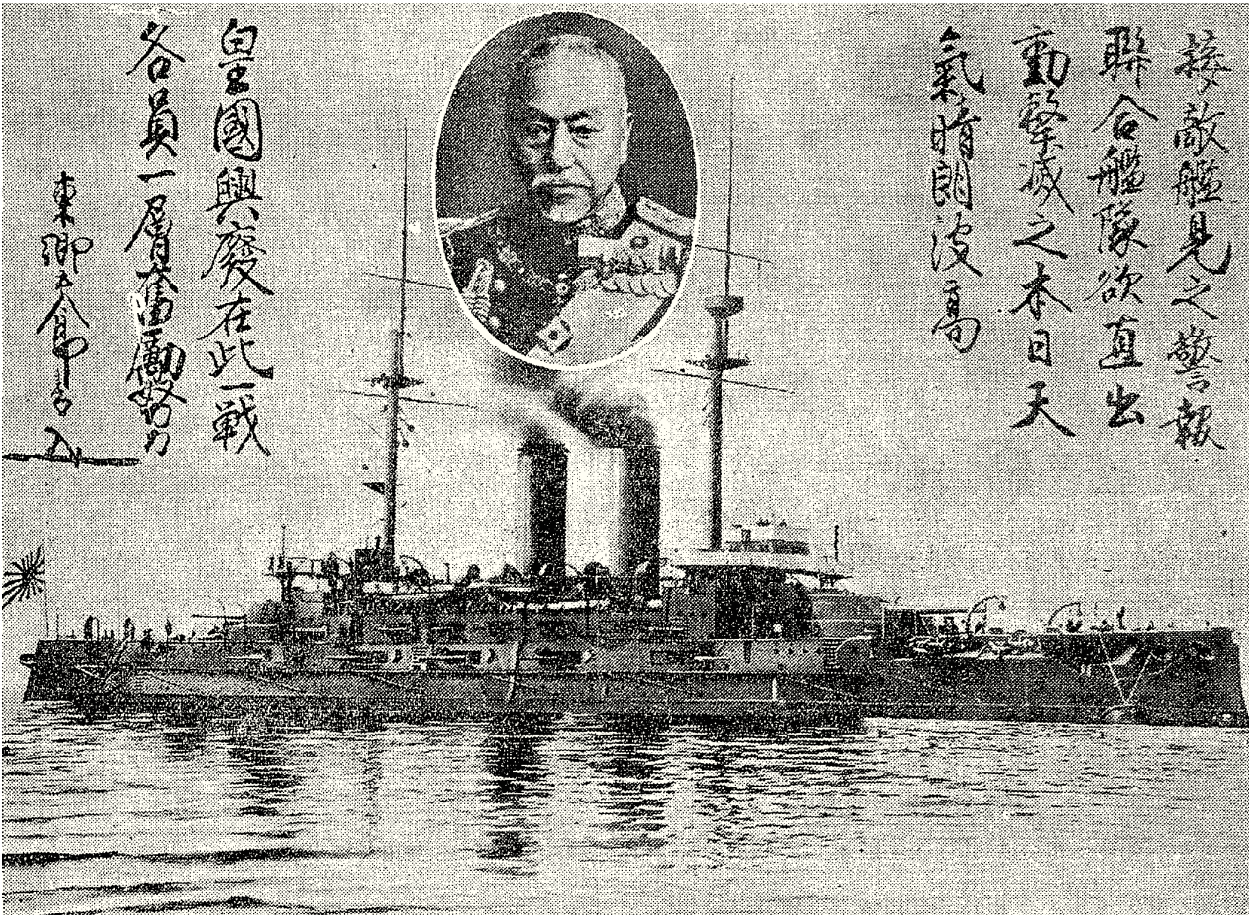
Perhaps surprisingly, the community has been led by The Japan Times staff and readers twice, in the 1920s and 1950s.

● Summary

ジャパントाइムズのスタッフと  
読者が戦艦三笠の救出を主導

世界の海軍史家にその名を知られる日本の戦艦「三笠」100年以上前の海戦での勝利が語られる三笠だが、その後の度重なる修復・保全活動の歴史はあまり知られていない。かつて、資金不足や戦艦保有に関する国際条約、そして人々の関心が薄れたことから老艦は荒廃し、解体の危機にさらされたこともあった。しかし、そのような危機が起こるたびに船を守ろうとする支援団体が結集され、三笠は守られてきた。

1920年代と1950年代には、ジャパントाइムズのスタッフと読者が復元保全運動をリードした。





“The Earth was blue.” These are the words of Soviet cosmonaut Yuri Gagarin, who in 1961 became the first person to complete a space flight. Human beings later acquired the first images of the Earth as seen from space. Now, over half a century later, we are in an age when anyone can work in real time with images of the Earth and stars as viewed from space.

One such initiative is a space entertainment project launched by Sony in 2020 that aims to develop an array of art, education and entertainment programs based on satellite images. Why did Sony embark on this project? Yoshihiro Nakanishi, head of Sony’s space entertainment promotion bureau, cites as a catalyst the enthusiasm of staff members who at some point in their lives had become enthralled by outer space.

“It started in 2017, when space aficionados working at Sony got together and an initiative to develop space-related business programs began,” he said. “Actually, as a young child I dreamed of being an astronaut, and for a long time I yearned to see the Earth from space. There were many staff members and engineers at the company who had dreamed of space, too. In 2019, Sony entered into a joint development agreement with JAXA and the University of Tokyo. In 2020, our company established an organizational plan and

Images from a space satellite were used in an educational program at Yanagawa High School in Fukuoka. Using a satellite simulator, students discovered a wide variety of scenes on Earth.



embarked on the development of a satellite with the aim of putting the plan into practice.”

The satellite, which will be equipped with a Sony camera currently in development, will allow for highly flexible camera work. When it meets conditions such as passing over an antenna on the surface, it will be operable from Earth in near-real time. The photos and videos taken with it will be used in collaborations now underway with partners such as artists and educational institutions.

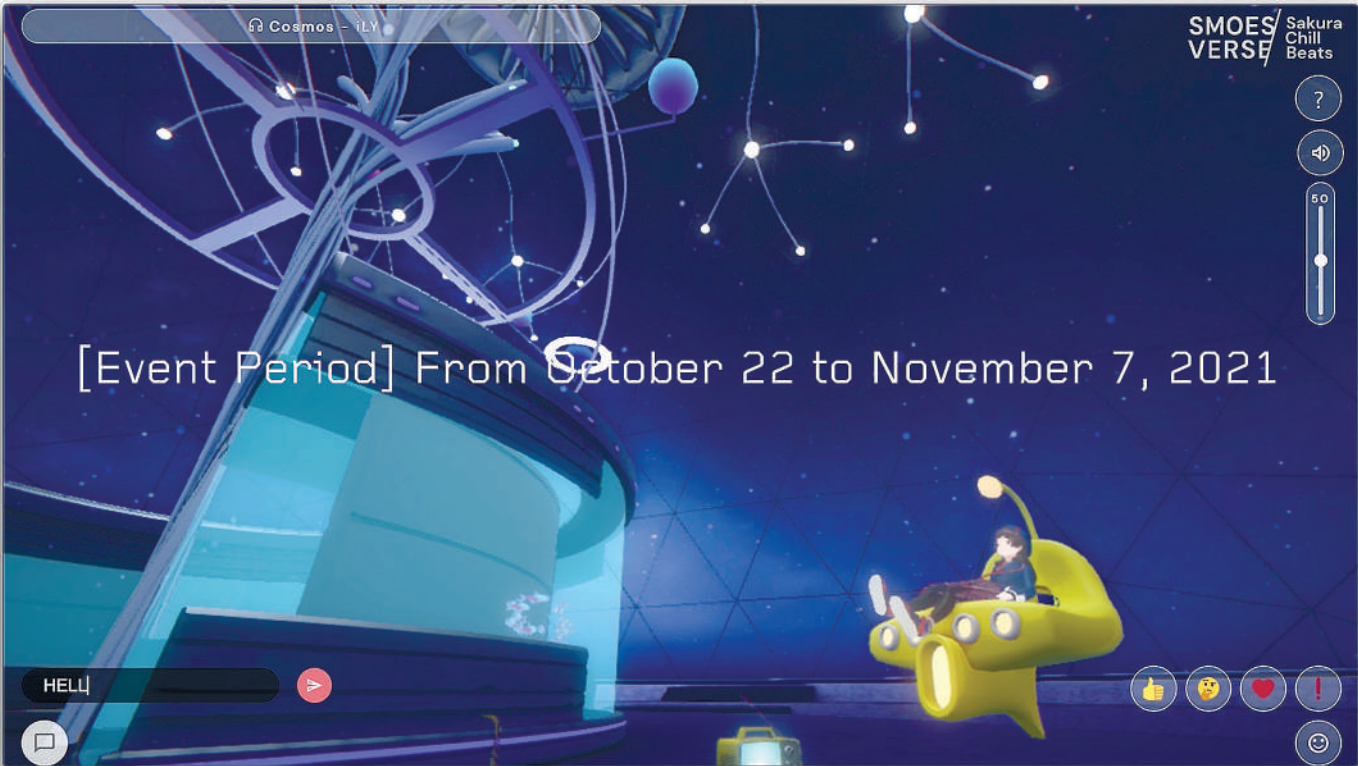
Yoshihisa Ideguchi, a member of both Sony Music Entertainment and Sony’s space entertainment promotion bureau, said, “By gaining perspectives on space, we hope to feel a stronger connection with life and the Earth, and create opportunities leading to changes in individual behavior.”

He continued: “In cooperation with contemporary artist Hiroshi Sugimoto, a project for the creation of artwork using satellite photos is now underway. According to Mr. Sugimoto, ‘Ancient people had more time to gaze at the sky than we do today, so they had a rich perspective on the universe, but these feelings have atrophied significantly in modern people.’ I believe that cultivating diverse perspectives on space will help change our consciousness about space and the Earth’s environment.”

Starting with this idea, Sony partnered with Fukuoka Prefecture’s Yanagawa High School, known for its innovative educational policies, and implemented “virtual space travel” using a simulator for operating the satellite. When students were asked what video they would wish to capture — memorable images of Earth to show to extraterrestrials — they sug-

gested many scenes far from the course of daily life, such as vast areas of deforested land in tropical rainforests and nighttime views of cities in which buildings’ light reaches up into space. In a collaboration with Kyoto University of the Arts, an in-school competition was held on the theme “space entertainment of the future.” Many of the ideas made space feel more familiar, such as fashion in zero-gravity settings and buzzwords for a time when space travel has become common.

One plan for the future is to produce experiences in which multiple users view images of space simultaneously through media such as metaverse spaces. What concepts and perspectives will emerge from a younger generation who have come to feel that space is a nearby presence? The launch of Sony’s first artificial satellite is planned for the autumn of 2022.



Feature HUMAN HARMONY

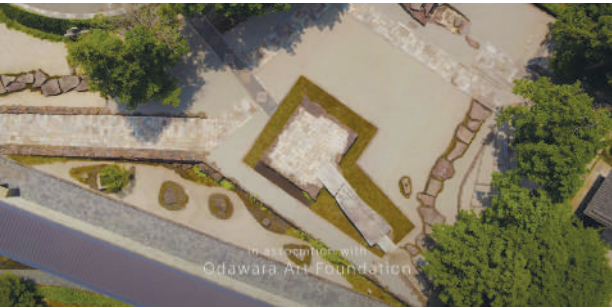
# ENTERTAINMENT

## Sony space project fosters diverse perspectives

By ARINA TSUKADA

SMOES VERSE / Sakura Chill Beats

A video created for the popular YouTube music channel Sakura Chill Beats depicting scenes on Earth as viewed from a spaceship was the starting point for a proof-of-concept project carried out in October and November 2021 in which users communicated with one another in an online metaverse — a virtual three-dimensional. In other content soon to be developed, multiple users will watch a satellite video in real time in the metaverse.



### 科学から空想へ

A project on the theme of human culture, civilization and society in the future is planned in collaboration with contemporary artist Hiroshi Sugimoto. Starting from a series of conversations with various guests, space will be perceived through the lens of human imagination and emotion in regard to space development, which up to the present has focused mainly on science.

#### ● Summary

宇宙への多様な視点を育むソニーの宇宙エンタメ事業

「地球は青かった」と語ったのは、1961年人類初の有人宇宙飛行に成功した旧ソ連の宇宙飛行士ユーリイ・ガガーリンだ。それから半世紀以上経ったいまでは、宇宙からの衛星画像を誰でも扱えるような時代となった。ソニーが2020年に始動した新事業は、人工衛星による宇宙の映像を元に、さまざまなアートや教育、エンタテ

インメント事業への展開を試みるプロジェクトだ。現在開発中のソニー製カメラを搭載した人工衛星は、自由度の高いカメラワークを可能とし、一定条件を満たせば地上からの操作も可能となる。ここでの衛星写真や映像を使って、杉本博司をはじめとする多様なアーティスト、教育機関などのコラボレーションが進められて

いる。福岡県の柳川高校とは、衛星操作作用のシミュレーターを用いた「バーチャル宇宙旅行」を実践し、京都芸術大学とは「これからの宇宙エンタメ」をテーマとした学内コンペを実施した。宇宙を身近に感じるようになったとき、今後どんな発想や視点が生まれるのか。ソニー初の人工衛星の打ち上げは2022年秋を予定している。



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Roundtable

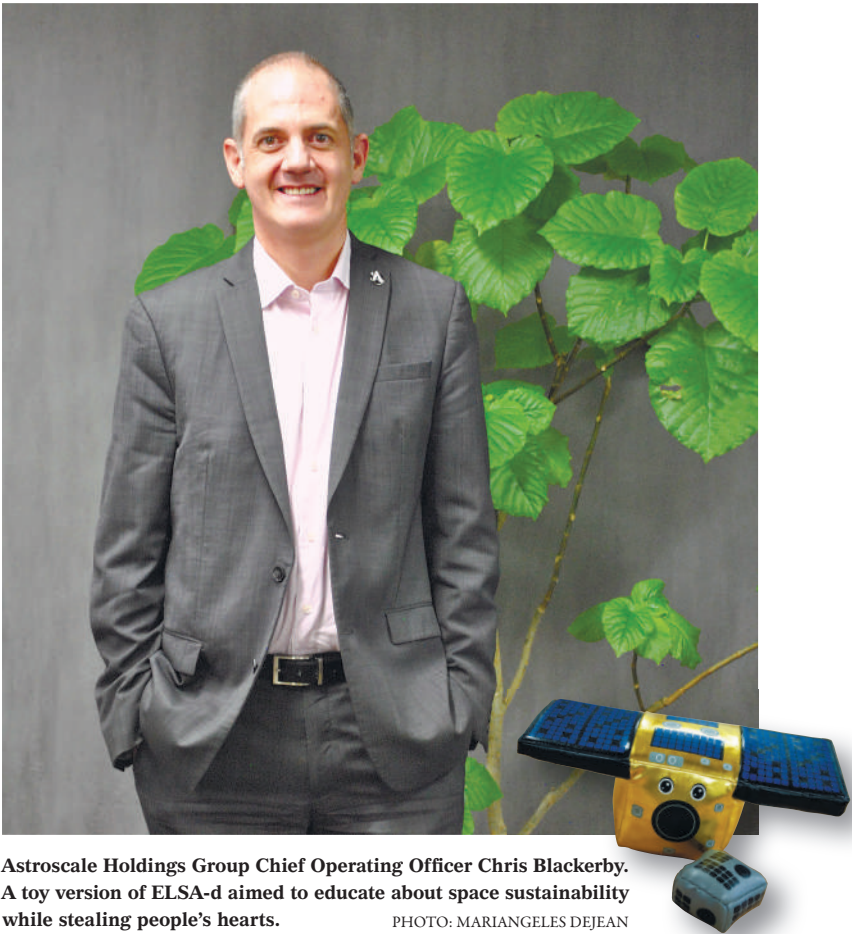
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This article was published on Nov. 22  
in The Japan Times



# Green frontiers: The sustainability mission in space

By TIMOTHY SCHULTZ CONTRIBUTING WRITER



Astroscale Holdings Group Chief Operating Officer Chris Blackerby. A toy version of ELSA-d aimed to educate about space sustainability while stealing people's hearts.

PHOTO: MARIANGELES DEJEAN

An earnest, 40-something executive leans forward, speaking into the tabletop microphone. The camera catches the flash in his eyes as he poses this era's most popular question: "How can we change? How can we move away from a society where we use it once, or use it for a short period of time, and then throw it away? To one where we service it and extend its life, or repair it?" His question is often asked about plastic, in the hope of cleaning up our oceans. But Chris Blackerby is talking about something different. He is talking about satellites. To save the Earth, he is trying to clean up space.

The Japan Times Sustainability Roundtable, hosted by Ross Rowbury, is an English-language interview series with some of the most interesting people in Japan. Available on the Sustainable Japan site as well as its YouTube channel, this past year it has featured many guests, like a U.N.-trained ocean activist, a green finance consultant and an architect carefully documenting Japan's ecological past. In each hourlong episode, Rowbury delights in learning the details of their efforts and their personal stories. The series showcases sustainability in all its many forms, and how those who practice it are making the world a better place.

## Startup Astroscale takes off

The October guest took the conversation higher. Blackerby is the group chief oper-

ating officer of Astroscale, a Japanese company that seeks to secure the safe and sustainable development of space itself. With offices in Tokyo, Harwell Oxfordshire, Denver, Tel Aviv and Washington, Astroscale is a privately held business that has (pardon the metaphor) achieved orbit. It operates on a global scale to develop technologies, influence policies and, as Blackerby explained, "keep the highways of space clean and safe." And while the mission itself is unexpected, the details of their efforts and the seriousness of the challenge are even more surprising.

Rowbury and Blackerby helped frame the conversation by revealing some facts: High above our heads, moving between six to eight times the speed of a bullet, are many, many objects. Some are incredibly precious to us; others are incredibly dangerous. Today there are roughly 3,000 active satellites, ranging in size from a toaster to a small car. They enable all of modern society's critical functions, such as food production, travel and medicine.

As important as they are, these fragile linchpins of our lives are in constant danger. They travel within a rapidly growing sea of orbital debris. For starters, there are the 5,000 inactive satellites circling the Earth in different orbits and at different speeds. Around these bigger objects are over 30,000 pieces of space debris larger than a baseball. And objects smaller than 10 centimeters — a metal screw,

or a flake of paint — are estimated to number 10 million. Blackerby explained that the consequences of these numbers could be grave. "One dead satellite gets hit, or collides with another ... and instantly, that's a thousand more threats out there. And once those objects fan out, across their orbit, how many more collisions would follow? See, the problem quickly becomes exponential."

## Don't litter ... in space

For a long time, such debris wasn't seen as a problem. "Even within the few orbital bands that we use, there is of course still a lot of space between these objects," Blackerby said. "But not caring ... that was the same logic we once used for oceans. As in, 'Stick a piece of plastic in there, no problem, right?' Now there's a shift to see our orbital highways as natural resources, places which need to be kept clean and safe. Unfortunately cleaning them up won't be easy." For once during the conversation, Blackerby's energy dimmed as he considered the problem.

It is in these efforts that Astroscale shines. "For us, it's about 'prepare, remove and repair,'" Blackerby said. "Prepare' is about building satellites with the capacity to be easily removed. 'Remove' is about taking the debris out — like the many 2- or 3-ton rocket bodies just floating around in upper orbit. And then finally there is 'repair' — the refueling, maintaining and altitude control of existing and functioning satellites." Astroscale treats each of these three missions as a separate business, with engineers, policy analysts and software all built to overcome challenges and service different clients.

## Introducing 'space Roomba'

To bring their efforts to life, Blackerby brought along a sidekick to the Roundtable: a small model of Astroscale's first satellite, named ELSA-d. This small cleanup satellite was built in Kinshicho ("It's the Cape Canaveral of Tokyo," exclaimed a delighted Rowbury), then carried to space on a rocket launched in Kazakhstan. In

August, ELSA-d passed the first of a series of increasingly difficult tests: It caught its first debris — or, more specifically, it played catch with one piece.

Blackerby explained that ELSA-d was launched with a piece of test debris attached to its side. The test debris has a small magnetic docking plate, the kind that Astroscale and many other companies now advocate all satellites be launched with. In August ELSA-d's robot arm let go of the test debris, then found it and secured it using the plate. The next tests will see ELSA-d releasing the debris for longer periods, spinning it and completing other types of maneuvers. Each test will prove how soon an army of ELSA-d satellites might autonomously clear the mistakes of past generations from our orbital space.

The conversation with Blackerby ranged across many subjects, from the politics of space to the constellations of tiny satellites now being launched by corporations like SpaceX. Since this single article cannot cover it all, those interested should watch the hourlong episode. You will learn how sustainability principles are urgently needed in the most unlikely places, and how one Japanese company in a Tokyo suburb is making a difference that could one day affect us all.

Towards the end of the conversation, Blackerby spoke about the challenges ahead. "On Earth, there are shared resources, there are national borders. Space doesn't have that! In lower orbit, every 90 minutes the objects are circulating the Earth. What we need is government and industry, jointly solving the problem. On the positive side, a lot of governments are recognizing this. But on the negative side, there are so many groups studying, advising and being involved. We now have people around the world focused solely on the policy side of this issue." Rowbury exclaimed that the many challenges of Astroscale seemed rather complex. His COO guest, still boyish in his energy, raised his hands and laughed. "That's right! It's technology, it's economics, it's policy. It's all interconnected. That's what makes my job so fun!"

## Summary

独自の人工衛星で宇宙ごみを除去、地球と暮らしを守る。

米国と英国、イスラエルにオフィスを構える日本のスタートアップ、Astroscale Holdingsは「宇宙ごみ（デブリ）の掃除屋」だ。独自の人工衛星を使用し、宇宙空間を浮遊する使用済み人工衛星やロケットの残骸を捕獲して取り除く。

宇宙には約3000機の人工衛星が稼働しているとされる。それらに数ではるかに上回るデブリが衝突すれば、食料生産から人の移動、医療まで、私たちの生活に重大な障害が生じる可能性がある。

Astroscaleは2021年3月、技術実証衛星「ELSA-d」を打ち上げた。8月にはテスト用デブリの捕獲に成功。高度な自律動作を目指し、現在も実験を継続中だ。デブリ除去以外にも、使用後の回収を想定した衛星の設計や、打ち上げ後の燃料補給と保守管理、軌道制御といったサービス開発に取り組んでいる。「宇宙には国境がない」とGroup COOのChris Blackerbyはいう。「宇宙ごみ問題解決のため、(各国)政府と産業界が協力する必要がある」。

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<https://en.misopotakyoto.jp/>





Exhibits in the museum, with the Vostok space capsule visible in the background. Spacecraft and spacesuits on loan from NASA are also on display.

COURTESY: COSMO ISLE HAKUI

Feature HUMAN HARMONY

# MUSEUM

## How Hakui's economy received an extraterrestrial boost

By TOSHICHIKA IZUMI

In April 2020, the U.S. Department of Defense released three videos shot by the U.S. Navy in 2004 and 2015. They depicted objects in flight that they admitted they were unable to identify. In December, Congress ordered the secretary of defense and the director of national intelligence to submit a report on UFOs, and it was published in June 2021. According to the report, 144 sightings of unidentified objects by military pilots and others had been examined,

The lunar rover used starting with Apollo 15 is on display.



with one determined to have been a balloon. The nature of the remaining 143 could not be determined due to lack of information. With the U.S. government thus neither confirming nor denying the existence of UFOs, the public's long-held fascination with aliens and flying saucers only grew.

Simultaneously in June 2021, there was movement on the UFO front in Japan, with the establishment of the International UFO Lab in Iino, a former town that is now part of the city of Fukushima. The news caught the eye of Japan's business community when it was reported in the Nikkei newspaper. But Iino's association with UFOs predated the Lab. In 1992, after a large number of sightings in the area, an exhibition facility for UFOs was established as part of an attempt to revitalize the flagging regional town. It soon became hallowed ground for UFO fans.

Another Japanese town has also attempted UFO-led revitalization. Hakui, in Ishikawa Prefecture, boasts a space museum called Cosmo Isle Hakui, which opened in 1996 and features many spacecraft and rockets that have actually been

used in outer space. The driving force behind the facility was Josen Takano, a TV producer and broadcast writer who returned to his hometown of Hakui at the age of 30 and set up the revitalization project while serving temporarily as a public servant. He is currently an adviser to the facility and a Buddhist priest with the Nichiren sect.

"At the time, I was in charge of a seminar on ancient documents at the local public hall, and I learned about references in Heian Period (794-1185) documents to a mysterious object known as *sōhachibon* [from a kind of Buddhist cymbal] that had been seen flying in the sky in the Hakui region. I had previously produced a TV program on UFOs, so it occurred to me that this mysterious object would nowadays be described as a UFO. And that's how the revitalization program was born," Takano explained. He wasted no time putting the plan into action. In 1990, Gerald Carr, the captain of NASA's Skylab 4, was invited to hold an international symposium on space and UFOs sponsored by Hakui, and it attracted 50,000 people over nine days. The event's success spurred

### Cosmo Isle Hakui

Hakui City Public Museum. Approximately one hour by car or train from Kanazawa. 25 Menda, Tsuruta-machi, Hakui-shi, Ishikawa Prefecture. Open from 8:30 a.m. to 5 p.m., closed Tuesdays (or the next business day when Tuesday is a holiday). TEL: 0767-22-9888 Entrance fee: ¥500 <http://www.hakui.ne.jp/ufo/> (Japanese only)



Josen Takano worked on a UFO-related TV program in Tokyo in the 1980s while in his 20s. On returning to his hometown of Hakui, he planned a UFO-themed city revitalization event while he was a temporary civil servant and contributed to the establishment of Cosmo Isle Hakui.



### ● Summary

UFOで町おこしをした街、羽咋を知っていますか？

2020年4月、米国防総省が海軍撮影のUFO映像を公開。2021年6月には国家情報長官室がUFOに関する調査報告書を公表し144件の目撃情報を検証、143件について情報不足で結論が出せないという説明で終わった。この発表で米政府がUFOの存在を否定もしなかったことにUFOに対するロマンや関心は益々深まったといえる。

そんなUFOで町おこしをしている所をご存じだろうか？ 石川県羽咋市に「コスモアイル羽咋」という宇宙博物館がある。この施設誕生の立役者が高野誠鮮氏。臨時公務員として町おこしを仕掛けた人物である。「この羽咋地方に関する古文書には、空を飛ぶ謎の物体に関する記述があります。20代の頃、テレビ局でUFO番組の

制作をしていたので、書かれているのはUFOだと思い町おこしに結びつけました。

宇宙博物館をつくる際は、レプリカではダメ、本物を展示してこそ魅力が伝わると、ロシアから「ポストーク宇宙カプセル」などを購入。その表面には大気圏突入時にできたであろう焼け焦げた跡も見られる。



日本語全文はこちら



## ESG Talk

jt

This article was published on Dec.27  
in The Japan Times

# Startup Euglena has global goals for its microalgae

By TOMOKO KAICHI CONTRIBUTING WRITER

Euglena Co., established in 2005, is the world's first company to succeed in growing large amounts of the microalgae euglena for human consumption in an outdoor facility, a feat once believed to be effectively impossible. The company operates businesses that use euglena to make products from health foods to biofuels.

"The mission of a startup is to create something from nothing," founder Mitsuru Izumo said. "If you're going to start a company, you should take on the most difficult challenge in Japan or the world. That is a startup's reason for existence."

During summer vacation in his freshman year in college, Izumo visited Bangladesh and was shocked to witness the plight of children suffering from malnutrition. He wished to "find something nutritious that can make the children healthy" and began studying nutrition. This led him to learn about euglena. He continued his studies, taking advantage of the "treasure mountain of knowledge" accumulated at the university, and eventually established the technology to grow large amounts of euglena outdoors. Until then, the microalgae could only be grown in indoor labs.

## All 'five F's' of biomass

Since its foundation, Izumo said, the Euglena company has given top priority to developing the technology to produce the "five F's" of biomass — food, fiber, feed, fertilizer and fuel — using its name-sake microalgae and then promoting their use in society. The company has marketed foods and cosmetics derived from euglena and is working to develop animal feed, fertilizers and bioplastics. The company expects its next-generation biodiesel fuel, Susteo, will contribute to achieving Japan's goal of becoming carbon-neutral by 2050.

Susteo, made from used edible oil and oil from euglena, produces carbon dioxide when burned, but because euglena and the plants from which the edible oil is

derived absorb carbon dioxide through photosynthesis while they grow, the company says the fuel can contribute to making Japan carbon-neutral. Japanese regulations currently limit the use of biodiesel in mixed diesel fuel to no more than 5% because higher levels may cause engine trouble or lead to lower emission performance. The Euglena company, however, enlisted the assistance of Isuzu Motors Ltd. on engine tests and successfully developed the biodiesel, which can replace ordinary diesel entirely, eliminating the need for petroleum. Susteo is recognized as having the same grade and quality as ordinary diesel under both the Japanese Industrial Standards and the Act on the Quality Control of Gasoline and Other Fuels. The company says it can be used in engines of common buses and trucks safely and without worries.

## Reducing transport emissions

In Japan, emissions of carbon dioxide total about 1.1 billion tons annually. The power sector emits the largest amount, about 400 million tons. The Euglena company aims to reduce emissions in the transportation sector, the third-largest emitter at 200 million tons.

"There are many people who think biodiesel fuel doesn't contribute much to reducing CO2 emissions because they assume it can be used only 5% or lower in the mix," Izumo said. "But Susteo can entirely replace conventional diesel fuel."

He added: "We are convinced Susteo, which took us a decade to develop, can become a trump card for reducing CO2 emissions from the transportation sector. If relevant companies combine their respective strong technologies and work together, I am sure we can make Japan carbon-neutral by 2050, and we must do it."

Izumo predicts a "major shift in the values of society" will take place in 2025 and will drive solutions to key issues such as climate change and poverty. His prediction is based on the expected demographic shift in which millennials and the

following Generation Z will come to make up the majority of the working-age population between 15 and 64 years old. "Many millennials are skeptical of the conventional capitalism that places top priority on profits and wish to spend their lives contributing to solving issues for society," said Izumo, who was born in 1980, at the start of the millennial generation. What can businesses do to avoid becoming left behind in an age where millennials make "sustainable choices" as consumers? Izumo had a clear answer: "Take advantage of universities, young people, venture companies and startups."

## Greening and digitalization

"The key challenges for Japan are greening and digital transformation," he said. "There are many untapped technologies in universities that can help promote greening, and businesses should explore more opportunities to work with universities on joint research projects." He continued: "Digital transformation should come naturally to young millennials, because they are digital natives. Companies can buy venture companies or startups [with superior technologies and ideas] or work with other entities through open innovation. I'm sure greening and digital transformation can be achieved if we can develop a culture where companies are born one after another and take active roles."

Izumo's experience in Bangladesh, which led him to learn about euglena, also led to the launch of the Euglena Genki Program, which provides nutritious euglena-containing cookies to the country's children free of charge. A six-cookie package can compensate for the daily nutritional shortfall of Bangladeshi children, according to the company. Part of the sales of products from the Euglena group and partner companies, including foods and cosmetics, are used to fund the program. This allows consumers to participate by purchasing them. People who support the program have been gradually increasing. The program initially deliv-



Mitsuru Izumo, president of Euglena Co., established the company in 2005. It is the world's first company to succeed in growing large amounts of the microalgae euglena for human consumption in an outdoor facility. The Euglena Genki Program distributes nutritious euglena cookies to Bangladeshi children.

PHOTO: HIROMICHI MATONO

ered packages for 1,000 children a day, but the number has grown to 10,000.

Climate change and poverty are both global issues. If Japan succeeded in reducing its own emissions of carbon dioxide but other countries continued to discharge large amounts, the problem would remain. "We must actively export the initiatives and technologies that have proven successful in Japan and work to expand their use overseas," Izumo said. "I want to let the world know about the existence of Japanese startups that are working on global-scale issues."

## Summary

気候変動も貧困問題も。微細藻類で世界的課題に挑戦。

2005年創業のユーグレナ社は微細藻類ユーグレナ（和名：ミドリムシ）の食用屋外大量培養に世界で初めて成功し、健康食品からバイオ燃料まで、ユーグレナを活用した事業を幅広く手掛ける。創業者兼社長の出雲充は「ベンチャー企業の使命はゼロからイチを生むこと。世界一難しい課題にチャレンジするの

がベンチャー企業の存在意義」と言い切る。

「2050年カーボンニュートラル実現」に貢献すると期待するのは、ユーグレナを原料の一部として用いた次世代バイオディーゼル燃料の「サステオ」だ。軽油を100%代替可能で、運輸・交通分野のCO2削減の切り札と位置付ける。栄養価の高いユーグレナ

入りクッキーをバングラデシュの子どもたちに届ける活動は賛同者が徐々に増え、当初の1日1千食が1万食に増加した。

気候変動も貧困問題も地球規模の課題だ。解決には海外も含む幅広い連携が不可欠として「日本の成功例を積極的に輸出して展開したい」と意気込む。

# New Year, new start

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Feature HUMAN HARMONY

# FOOD

## Space Foodsphere plans down-to-earth answers

By ARINA TSUKADA

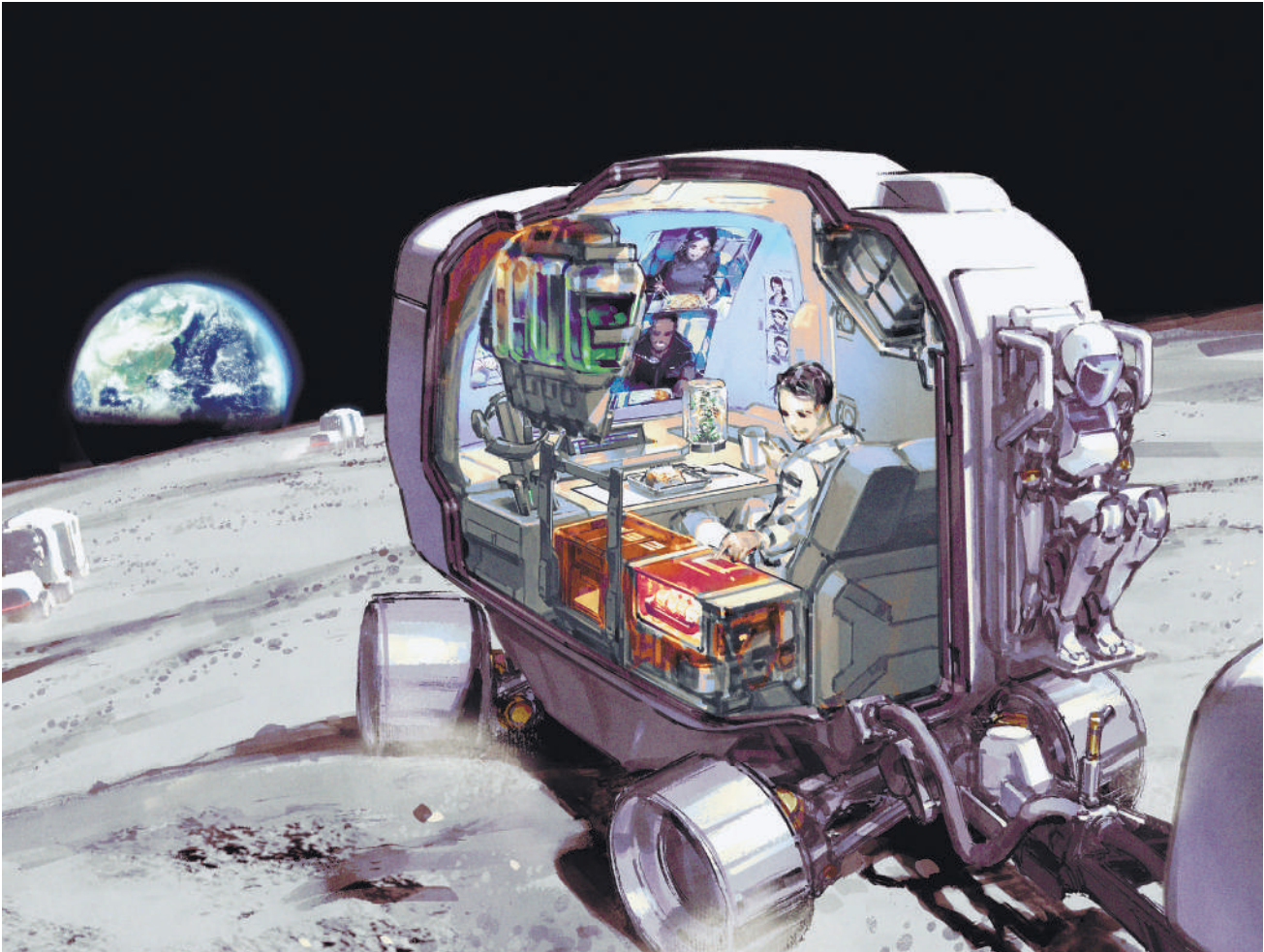
Mizuki Komasa is representative director of Space Foodsphere Association and growth manager of Real Tech Holdings Co. Ltd. In 2019, he established Space Food X, the world's first co-creation program for the space food market, in collaboration with more than 50 companies and organizations such as JAXA and Sigmazy.



PHOTO: KOUTAROU WASHIZAKI



Bio-food reactors, plant factories and extended ecosystems might one day enable the production of a wide variety of crops in space. Various devices could be installed in a rover to let the occupant eat and remain in contact with fellow team members while working alone during lunar exploration.



© 2020 YUSUKE MURAKAMI / SPACE FOODSPHERE

The day when humans start living in space is not far off. NASA has announced that as part of its Artemis program, manned lunar exploration will be carried out by 2025 for the first time since the Apollo program in the 1960s and 1970s. Moreover, the plan hints at the creation of a new space station, Gateway, and for long-term stays by a thousand people on the surface of the moon to be possible by the 2040s.

Japan is participating in the program, and in 2020 a new budget of ¥7 billion (\$60 million) was allocated to the Cabinet Office-led Strategic Program for Accelerating Research, Development and Utilization of Space Technology (known as the Stardust Program), which is aimed at realizing long-term stays on the moon. The program has four divisions: construction, telecommunications, energy and food. The food division is under the jurisdiction of the Ministry of Agriculture, Forestry and Fisheries, and the contractor has already been named: Space Foodsphere Association (SFS), a group that hopes to address food supply problems both in space and on Earth.

SFS was established in April 2020. The association conducts research and development on food production and consumption in space, and also hopes to apply its findings to improve resource recycling in the production and supply of food on Earth. Mizuki Komasa, the representative director of SFS, says many companies and institutions that had not previously been involved in the space business are now getting involved in order to help solve issues related to food.

“Up until now, space development has mostly involved heavy industry, but our organization collaborates with various stakeholders, including food manufacturers, ecosystem and resource recycling technology, architecture and transportation companies,” Komasa said.

Resource recycling is the ultimate challenge for food production in space. The key is being able to make the most of scarce resources, and that means recycling organic waste and even human waste, which on Earth is simply discarded. For example, to grow plants in space, a farm factory is being envisaged that would not only enable fully automated harvest-

ing and transportation, but also reuse irrigation water and dispose of waste by breaking it down with microorganisms. In addition, to obtain sufficient protein, plans are underway for a bio-food reactor that would enable the production of cultured meat cells and algae that could be used as supplements. Komasa says that if these technologies become practical, they could also contribute to solving food problems on Earth.

“Food shortages will become a serious problem in the future, but we’re also told that if food waste could be reduced to zero, then there would be no more food shortages. In other words, optimizing food distribution is key,” Komasa said. “Right now what we need is a paradigm shift in thinking. In the future, we can’t just be thinking about developing new production methods, but we also must look at resource recycling and food distribution. By doing so we’ll create not only new technologies but a new culture as well.”

In addition, SFS is running programs to examine eating habits in space from the perspective of lifestyle and culture. “Until now, only highly trained astronauts went

to space, but in the future, space tourists, researchers and space-business people will also stay,” Komasa said. “In reality, space is not a magical realm of dreams, but a controlled environment that is highly dangerous. To help people survive in those conditions, we are proposing diverse food experiences and cultures.”



Space Foodsphere worked with professional cooks to develop recipes for meals to be served on a new space station. Work is being carried out to create as many different flavors and textures as possible from a limited variety of vegetables.

© SPACE FOODSPHERE

### Summary

宇宙の「食」から、地球と人の未来を描く

人類が宇宙に移住する日はそう遠くないのかもしれない。NASAのアルテミス計画では、2040年代を目標に月面1000人の長期滞在が示唆されている。この計画に日本も参画し、2020年には内閣府主導のスターダストプログラムに新規予算70億円が計上。このプログラムにおいて、農林水産省が管轄する食部門の受託事業者に決定し

たのが地球と宇宙の食の課題解決を目指す一般社団法人Space Foodsphere (SFS)だ。

SFSは宇宙環境における食糧生産や食生活を視野に開発・研究を進めることで、地球にとってサステイナブルな食のあり方にも貢献するプログラムを提案。微生物のコントロールによって農業用水の再生や廃棄物処理を行

える植物工場、細胞培養肉やサプリメントにもなる藻類の生産を可能とするバイオ食料リアクターなど、宇宙における効率的な資源循環の技術が実用可能になれば、地球上の食料問題の解決にも貢献できる。さらには技術的側面のみならず、宇宙環境での食生活をライフスタイルや文化的側面からも考慮するプログラムも進めている。



日本語全文はこちら



thejapantimes

*Destination Restaurants 2021*

AUTHENTIC JAPAN SELECTION

<http://authentic-japan-selection.japantimes.com>

## Why regional restaurants topped Destination list

By MINAMI NAKAWADA CONTRIBUTING WRITER

**D**estination Restaurants 2021 is a list of the best restaurants in Japan, published by The Japan Times in April 2021. To commemorate the announcement, a special talk session on the charm of Japanese food culture was held at The Japan Times' headquarters in December. The speakers were Yoshiki Tsuji, principal of the Tsuji Culinary Institute and a member of the Destination Restaurants selection committee, and Kei Tokado, representative director of Pocket Concierge, one of American Express' dining businesses and a sponsor of the Destination Restaurants list. The facili-



Tsuji and Tokado with the chair of The Japan Times, Minako Suematsu

tator was the chair of The Japan Times, Minako Suematsu.

Over the years, the Japanese have cultivated distinctive and rich food cultures suited to their particular local climates. They have also actively incorporated dishes from overseas and developed them into original dishes through the use of local ingredients and cooking methods. And yet, when it came to evaluating Japan's foods and restaurants, there was always a tendency for foreign criteria to be applied. The new list was born from a desire to demonstrate to the world how the Japanese evaluate and appraise their own food.

"At first, when The Japan Times asked me to join the selection committee, I worried that the list would be no different from the other guides and awards," Tsuji said. "But the more I heard about the plan, the more I realized it was different. This award was the chance for Japanese to proudly introduce restaurants selected when a Japanese filter is applied, based on Japanese culture and history. Other major awards to date, such as the

Michelin Guide and the World Best 50 Restaurants, evaluate food based on an international common language from a foreign perspective. But they can't capture everything that Japanese food has to offer. We seek out the artisans, and the local stories. Perhaps the difference between this list and others is that we don't make selections based solely on the taste of the food. We consider the surroundings leading to the creation of the restaurant, the chef's efforts to bring together the local environment, ingredients and producers, like an orchestra conductor." As a result, the restaurants that were ultimately selected were not in the big cities of Tokyo, Osaka and Kyoto, but in the regions, in locations you might visit for a night.

For curious customers venturing to these independently run regional restaurants, there is a service to help: Pocket Concierge (<https://pocket-concierge.jp/en/>). Pocket Concierge lists more than 1,000 famous restaurants all over Japan and allows you to make reservations and payments. You can even

make reservations in English as well as Japanese. With Pocket Concierge, not only can people from all over the world experience the best food culture that Japan has to offer, but they can make reservations at restaurants recognized by local foodies, and payments are smooth with their online pre-payment system. "Of course, for people visiting a restaurant the taste of the food is important, but I think the experience of the restaurant goes far beyond that. We see it as our role to provide that experience," Tokado said.

Although the number of inbound tourists to Japan has declined drastically amid the pandemic, this does not mean that Japan's diverse food culture and the technical skills of its chefs are being lost. Japanese food continues to yield rich discoveries. American Express members can make priority reservations for Destination Restaurants on a special section in the Pocket Concierge site. Don't waste any time going out to the countryside and enjoying a completely new food experience.

### ● Summary

日本発信のベスト・レストラン・リスト。その魅力を語る。

「Destination Restaurants 2021」は、ジャパントイムズが発表した日本のベストレストランを選定したリスト。それを記念し日本の食文化の魅力をテーマに特別セッションが行われた。ゲストは、辻調理師専門学校校長でリスト選考委員の辻芳樹氏と、リストのスポンサーで、アメリカン・エクスプレスのダイニング事業のひとつである「ポケットコンシェルジュ」の代表取締役、戸門慶氏。「このリストは日本人のフィルターを通して、外国人へ向け、誇りを

もってレストランを紹介するものです」と辻芳樹氏は語る。

そんなレストランとお客さんを繋いでくれるのが「ポケットコンシェルジュ」。予約から決済までを行えるオンライン予約サービスで、日本全国の名店を1000軒以上掲載。英語でも店の予約ができる。「おいしい」と感じていただくことは大切ですが、それ以上に店での体験が重要です。それを提供するのが私たちの役割だと思っています」。戸門慶氏は語る。



日本語全文はこちらから

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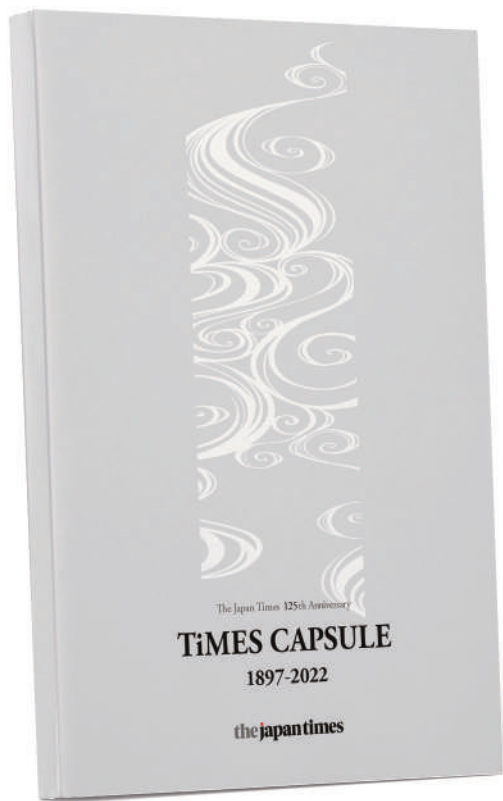


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