

**KiboCUBE:  
THE COOPERATION PROGRAMME  
BETWEEN UNOOSA AND JAXA  
ON CUBESAT DEPLOYMENT  
FROM THE INTERNATIONAL  
SPACE STATION (ISS) JAPANESE  
EXPERIMENT MODULE (Kibo)**



On the right: Original cover image  
Cover: Japanese Experiment Module,  
"Kibo", on the International  
Space Station  
Credit: JAXA



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UNITED NATIONS  
OFFICE FOR OUTER SPACE AFFAIRS

K i b o C U B E

EXPANDING  
POSSIBILITIES  
FOR SPACE  
EMERGING  
COUNTRIES



UNITED NATIONS  
Vienna, 2020





“UNOOSA STRIVES TO BRING THE BENEFITS OF SPACE TO EVERYONE, EVERYWHERE AND HELPS DEVELOPING COUNTRIES IN PARTICULAR LEVERAGE SPACE APPLICATIONS TO ACCELERATE SUSTAINABLE DEVELOPMENT. KIBOCUBE IS A FANTASTIC OPPORTUNITY FOR SELECTED INSTITUTIONS TO ACQUIRE THE SKILLS NEEDED TO DEVELOP A SATELLITE, ALONG WITH KNOWLEDGE OF INTERNATIONAL SPACE LAW AND ASSOCIATED GUIDELINES. THIS LONG-STANDING COOPERATION WITH JAXA PROVIDES DEVELOPING COUNTRIES WITH THE OPPORTUNITY TO BECOME SPACEFARING NATIONS, FOSTERING INNOVATION AND TECHNOLOGICAL ADVANCEMENT.”

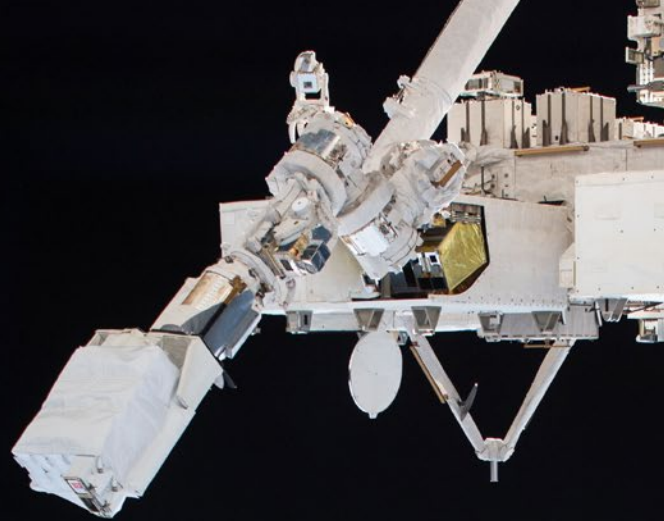
**SIMONETTA DI PIPPO,  
DIRECTOR, UNITED NATIONS OFFICE  
FOR OUTER SPACE AFFAIRS**

"AS MANY PLAYERS CONTINUE TO EMERGE IN THE FIELD OF SPACE, ENABLING ACCESS TO SPACE AND BRINGING THE BENEFITS OF SPACE TECHNOLOGY TO ALL COUNTRIES IS IMPORTANT FOR ENSURING THE SUSTAINABILITY OF FUTURE SPACE ACTIVITIES. JAXA IS PLEASED TO BE ABLE TO CONTRIBUTE TO EXPANDING ACCESS TO SPACE AND BUILDING CAPACITY IN DEVELOPING COUNTRIES THROUGH THE KiboCUBE PROGRAMME TOGETHER WITH UNOOSA, BY UTILIZING THE UNIQUE CAPABILITIES OF THE JAPANESE EXPERIMENT MODULE KIBO. WE WELCOME ALL NATIONS TO PARTICIPATE IN THE KiboCUBE PROGRAMME TO ACHIEVE THEIR AMBITIOUS GOALS."

**HIROSHI YAMAKAWA,  
PRESIDENT, JAPAN AEROSPACE  
EXPLORATION AGENCY**







## The importance of accessing space

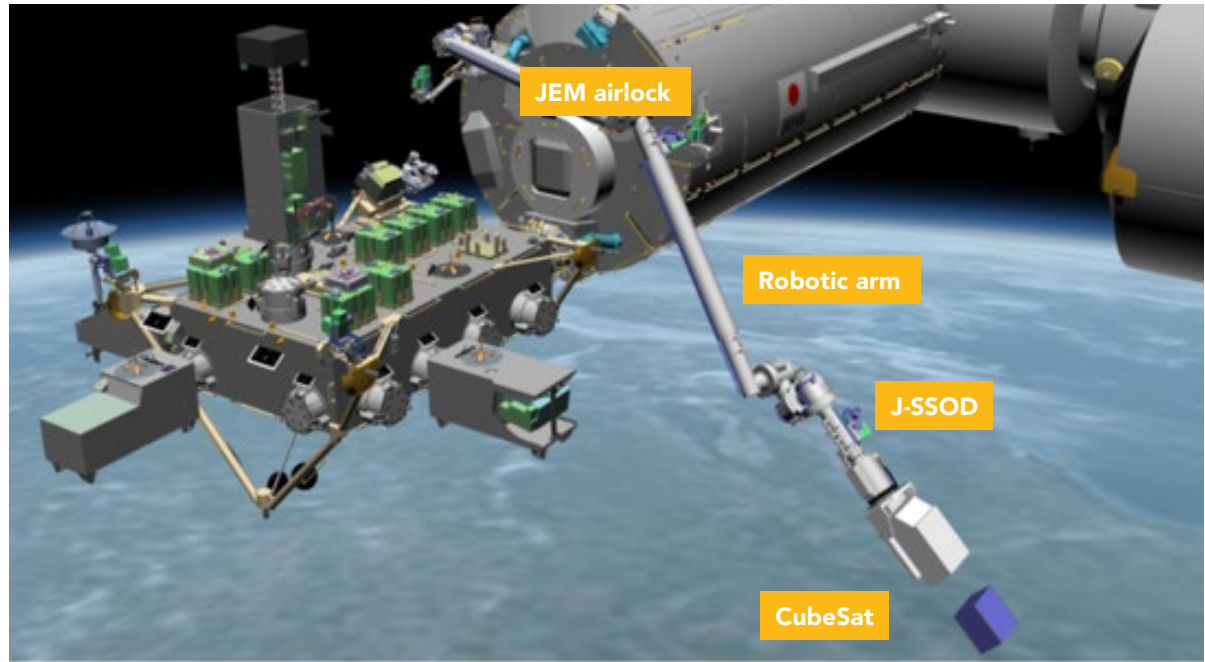
The endeavour of accessing space is a driver of innovation that attracts talented individuals to pursue highly skilled jobs: for example, in a survey of 800 scientists who have published work in the renowned journal *Nature*, more than 50 per cent of them stated that space missions (Apollo) were the inspiration that led them to pursue a scientific career. (*Nature*, 2009)

Space technologies affect many areas of our lives and their spin-offs have a vast array of applications here on Earth, ranging from medicine to food security, greatly benefiting our economy and society in general. The return on investment in space is calculated to be around 600 per cent. (various sources)

## What is KiboCUBE?

KiboCUBE is the collaboration programme between the United Nations Office for Outer Space Affairs (UNOOSA) and the Japan Aerospace Exploration Agency (JAXA) that provides educational and research institutions from developing countries with the opportunity to develop a cube satellite (CubeSat) and have it deployed from the Japanese module "Kibo" of the International Space Station. This type of deployment has advantages when compared to using rockets, such as a lower vibration environment during launch. Thus, KiboCUBE lowers the threshold for countries to enter space activities and contributes to national capacity development in spacecraft engineering, design and construction, inspiring new generations of scientists and engineers. KiboCUBE is a founding project of the UNOOSA Access to Space for All Initiative, aiming at providing hands-on opportunities in cooperation with various partners.

Left: Deployment of 1KUNS-PF and Irazu Cubesats. Credit: JAXA



## Satellite deployment through ISS/Kibo

CubeSats to be deployed from Kibo arrive in one of the cargo resupply vehicles that take equipment, food and water to the International Space Station. CubeSats are then deployed using Kibo’s J-SSOD (Japanese Experiment Module Small Satellite Orbital Deployer) airlock and robotic arm. Compared to direct deployment from a launch vehicle, this method of transport significantly reduces the environmental stress that CubeSats have to endure, such as vibration or temperature variations. This also minimizes the CubeSat’s design and testing requirements, making it an easy entry point to orbit for space emerging countries.

Item	Specifications
Installable satellite size	CubeSat size 1U, 2U, 3U or 6U
Installable satellite mass	1.33 kg or less per 1U 6U size satellite is 14 kg or less
Insertion orbit	Elliptical orbit with altitude of 380 km–420 km (depends on ISS altitude) Inclination: 51.6°
Ballistic coefficient	120 kg/m <sup>2</sup> or less (to make satellites decay faster than ISS orbit)
Insertion direction	Nadir-aft 45° from the ISS nadir side, in terms of ISS body coordinate system (to avoid collision with the ISS)
Insertion velocity	1.1 – 1.7 m/s
Life expectancy on orbit	About a year (depends on ballistic coefficient, released altitude, solar activity, etc.)



## Why CubeSats?

Despite being as small as 10 cm x 10 cm x 10 cm, CubeSats offer a large variety of applications. For example, they can capture images of the Earth; they can be used as testbeds for new technologies; or help us understand the space environment.

Developing a CubeSat can also be the first step for a country in the acquisition of the skills and know-how needed to develop a more ambitious space programme.

CubeSats are affordable to develop and launch, and therefore represent an achievable entry point to space activities.

Top: Deployment of a CubeSat from J-SSOD. Credit: JAXA  
Above: Quetzal-1, Guatemala, CubeSat. Credit: UVG



## KiboCUBE for the Sustainable Development Goals

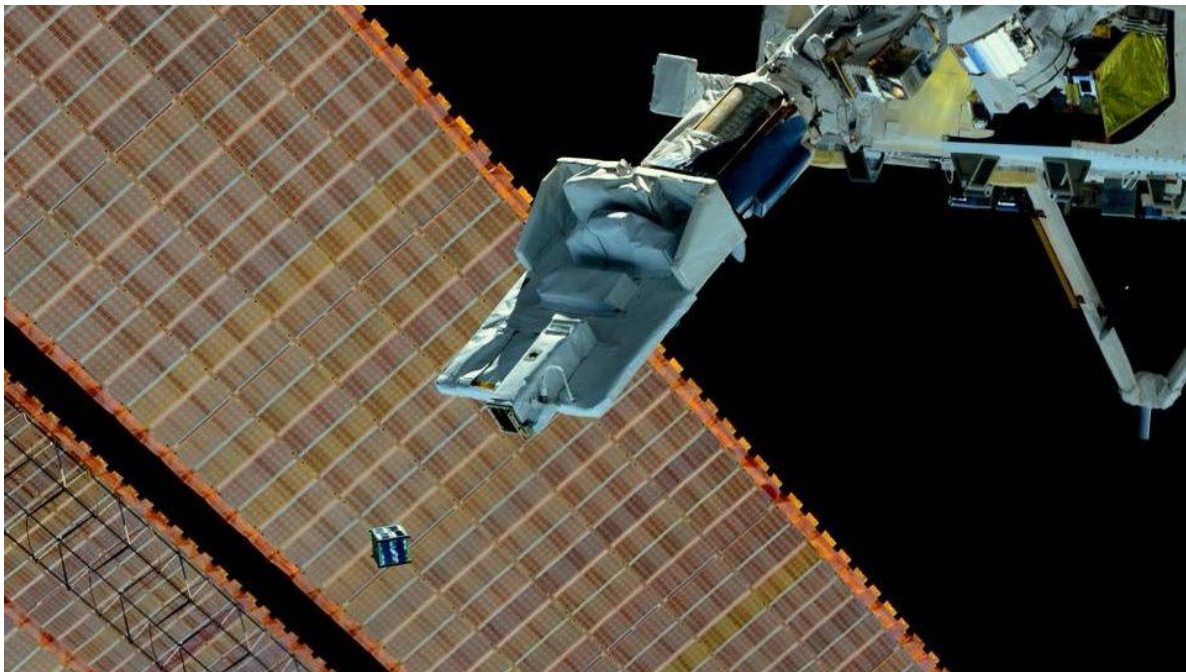
Previous winners of KiboCUBE have used the opportunity to build skillsets and develop technologies that support the achievement of the Sustainable Development Goals (SDGs). KiboCUBE may contribute to SDG4 “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all”, SDG 8 “Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all” and SDG 9 “Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation” by promoting technological advancement and supporting education and training on skillsets for developing cutting-edge technology.



## Space for the Sustainable Development Goals

The importance of the role of Earth observation (EO) and geolocation (provided by GNSS) in supporting the achievement of the development goals is recognized by the United Nations (General Assembly resolution A/RES/70/1: Transforming our world: the 2030 Agenda for Sustainable Development). However, the potential of space for supporting the SDGs is much wider. Space-based services and technologies are key to understanding climate change and during all phases of the disaster management cycle. These are only two examples among countless applications to which space can contribute.

The Office for Outer Space Affairs has launched the Space4SDGs initiative to emphasize and recognize the role that space technologies, data and applications play in supporting the Sustainable Development Goals. KiboCUBE is a fantastic example of a space programme that provides such support.



Left: Deployment of a CubeSat from J-SSOD. Credit: JAXA



## Paving the way to the Kenya Space Agency

Kenya started its journey into space in March 2016, when the University of Nairobi applied to KiboCUBE. The proposed satellite, 1KUNS-PF (First Kenya University Nano-Satellite – Precursor Flight), was deployed into orbit on 11 May 2018, making Kenya a spacefaring nation. The 1KUNS-PF mission is a technology demonstration, developed through collaboration between the University of Nairobi and the University of Rome La Sapienza, with the objective of testing technology in orbit.

“The first time we heard about this opportunity was during the fiftieth session of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS),” said Dr. John Kimani, former Acting Director General, Kenya Space Agency. “One of the biggest achievements derived from our participation in KiboCUBE is awareness. We explained to primary schools, secondary schools, colleges and universities that we were working with the University of Nairobi to develop and launch our first CubeSat. That created a lot of excitement in schools and it encouraged students to start thinking about subjects they could focus on to work in the space technology industry.”

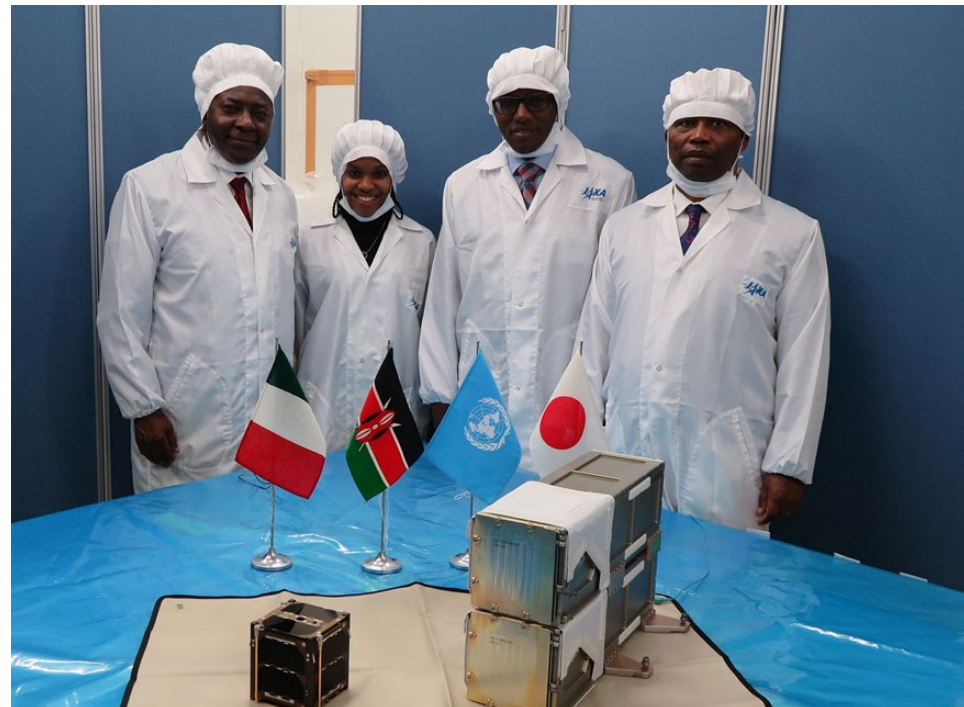
“In 2015, we came back home and informed our principals about the offer, which they found very exciting. To some extent, this helped them focus more on working to complete the creation of the Kenyan Space Agency. In fact, the Kenyan Space Agency was created through a legal notice in March

2017 but was not inaugurated until September 2018. And if you remember, the launch of the Kenyan CubeSat took place in May 2018.”

1KUNS-PF completed 10,000 revolutions around the Earth on 9 February 2020. More than 300 images have been downloaded from the satellite, an outcome surpassing all initial expectations, before the end of its mission on 11 June 2020.



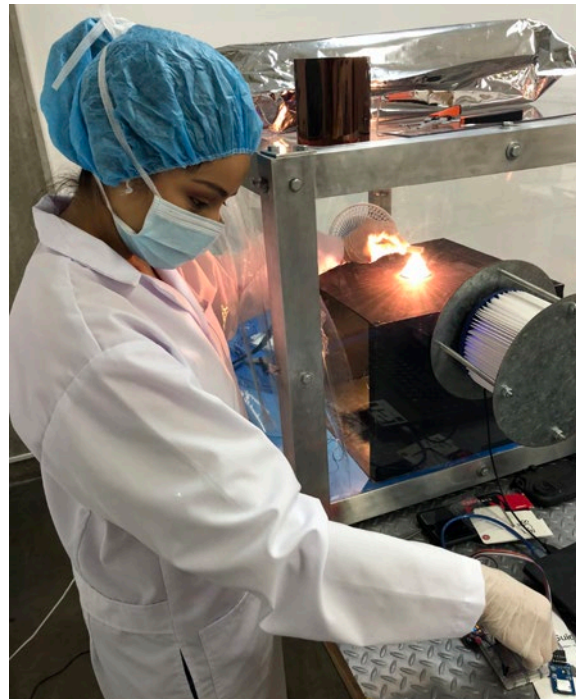
Top: Kibo Mission Control Room during deployment of 1KUNS-PF.  
Credit: JAXA



Left: Team from Kenya with 1KUNS-PF.  
Credit: Univ. Nairobi



Top: Team from Guatemala at the launch pad.  
Credit: Ivan Castro  
Right: Quetzal-1 testing. Credit: Ivan Castro



## Guatemala: Yes, it is possible!

The objectives of the winners of the second round of KiboCUBE, from Universidad del Valle de Guatemala, were to design, develop and operate the first ever Guatemalan satellite, Quetzal-1. Designed to test a multispectral sensor prototype, Quetzal-1 has opened up the field of space science and technology in Guatemala. This endeavour contributes to the development of the country's human capital and enables the independent acquisition of remote-sensing data for natural resource management.

The project also aims to support the take-off of other high-tech projects in Guatemala, including in the field of aerospace, by raising awareness of the role that space science and technology plays in promoting sustainable development.

"Having this CubeSat in orbit changes everything," said Victor Hugo Ayerdi, co-principal investigator of Quetzal-1. "Five or six years ago, this was for us a project without much credibility. Now the question we get asked is when we are going to deploy another satellite. The project caused a change in attitude among university students; they no longer see these ideas as something illusory or unrealistic as they did before, but rather as something possible. The same thing is happening on a wider scale in Guatemala. The day the Falcon 9 took off with the CubeSat onboard, it was crazy in Guatemala, the entire country followed the event with so much pride. It really changed the perception that a developing country would not be capable of doing such a thing."

"Without any doubt, without KiboCUBE, we would not have been able to put our first satellite in orbit in 2020," said Luis Zea, co-principal investigator.



# SELECTED WINNERS



## KENYA

2016

Team from the University of Nairobi

CubeSat primary mission:  
Technology demonstration



## GUATEMALA

2017

Team from the Universidad del Valle de Guatemala

CubeSat primary mission:  
Water quality monitoring



## INDONESIA

2018

Team from Surya University

CubeSat primary mission:  
Technology demonstration and  
disaster mitigation



## MAURITIUS

2018

Team from the Mauritius Research and Innovation Council

CubeSat primary mission:  
Technology demonstration



## MOLDOVA

2019

Team from the Technical University of Moldova

CubeSat primary mission:  
Technology demonstration  
and education



## SISTEMA DE LA INTEGRACIÓN CENTROAMERICANA (SICA)

2020

Teams from Costa Rica, Guatemala, Honduras

CubeSat primary mission:  
Weather monitoring and early warning





# BRIEF HISTORY OF KiboCUBE

**2015**

Signature of the memorandum  
of understanding with JAXA

First round launched

**2016**

Kenyan team  
selected as winners

Development of satellite 1KUNS-PF  
(Kenya) CubeSat starts

KiboCUBE second round launched

**2017**

Guatemalan team  
selected as winners

Development of satellite Quetzal-1  
(Guatemala) CubeSat starts

Third round launched – possibility  
of launching two satellites





## 2018

Mauritius and Indonesian team selected as winners

Deployment in orbit of 1KUNS-PF – First Kenyan satellite in space!

Development of MIR-SAT1 (Mauritius) and Surya-1 (Indonesia) satellite start

KiboCUBE extended for two additional rounds

Fourth round launched

## 2019

Moldovan team selected as winners

Development of TUMNanoSAT (Republic of Moldova) CubeSat starts

Fifth round launched

## 2020

Deployment in orbit of Quetzal-1 – First Guatemalan satellite in space!

Sistema de Integración Centroamericana (SICA) selected as winners

KiboCUBE extended for two additional rounds

Sixth round launched



In partnership with: 

The text "In partnership with:" is in a black, sans-serif font. To its right is the JAXA logo, which consists of the letters "JAXA" in a bold, blue, sans-serif font. The letter "A" is stylized with a blue, curved line that sweeps upwards and to the right, crossing the top of the "A" and extending past the "X".





**THE UNITED NATIONS OFFICE  
FOR OUTER SPACE AFFAIRS (UNOOSA)**

IS RESPONSIBLE FOR ADVANCING INTERNATIONAL COOPERATION  
IN THE PEACEFUL USES OF OUTER SPACE AND HELPS ALL COUNTRIES  
USE SPACE SCIENCE AND TECHNOLOGY TO ACHIEVE  
SUSTAINABLE DEVELOPMENT.



**BRINGING THE BENEFITS  
OF SPACE TO HUMANKIND**