



National Aeronautics and
Space Administration



PARTNERING AND LICENSING WITH

GODDARD

SMALL SATELLITES

How to Leverage Goddard's SmallSat Capabilities



CAPABILITIES

Put to the Test: Facilities at NASA's Goddard Space Flight Center and Wallops Flight Facility

The accelerated pace of small satellite missions can present some unique challenges to developers: "Every week that goes by can be 1 percent of your schedule," says Chuck Clagett, head of the Component and Hardware Systems Engineering Branch at Goddard. For any mission big or small, testing represents a crucial part of mission planning. Goddard has a variety of facilities in Greenbelt, Maryland and Wallops Island, Virginia to support SmallSat missions at various stages of development.

Small Satellite Development Lab

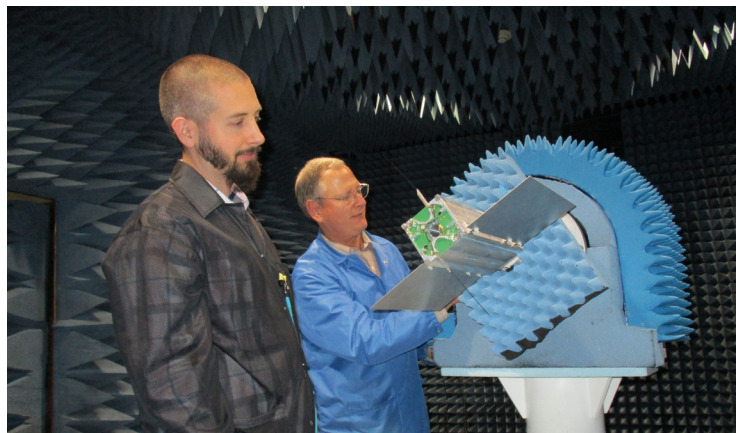
Located at Goddard's Greenbelt campus, the Small Satellite Development Lab (SSDL) includes a "flat-sat," or a collection of components that can represent a mission's hardware for testing purposes. Developers run tests and software on the flat-sat while working to purchase components, saving the mission valuable time. The SSDL's flat-sat can be configured for each mission utilizing the lab, also saving cost.

Mission Planning Lab

Since 2014, the Mission Planning Lab at Wallops has worked with NASA SmallSat developers and their partners to provide services in systems engineering, 3D modeling, simulation, flight trajectory information and more. Engineers study SmallSat mission concepts for a week, providing scientists with a valuable packet of information detailing the technical specifics of their mission. This lab has completed more than 20 conceptual design CubeSat studies to date.

Small Satellite Integration and Test Lab

This lab, based at Wallops, has 630 square feet of space dedicated to the assembling and testing of small satellites. It is electrostatic discharge (ESD) ready and equipped



CubeSat IceCube undergoes antenna testing at Wallops. Image Credit: NASA.

with a laminar flow bench, thermal chamber and several work stations for simultaneous activities. It is conveniently located near Wallops' thermal vacuum, antenna pattern and electromagnetic interference (EMI) testing facilities, as well as open office space for teams to conduct business outside of the lab.

Other Integration and Testing Capabilities

Goddard's Greenbelt and Wallops campuses harbor an assortment of facilities and equipment suitable for testing small spacecrafts, instruments and other components. The facilities include a variety of integration labs and cleanrooms, thermal vacuum chambers, vibration tables and an acoustic chamber, electromagnetic compatibility and antenna test facilities.

Working with Wallops

On Virginia's Eastern Shore next to scenic Chincoteague Island, Goddard Space Flight Center's Wallops Flight Facility inhabits a strip of land where balloons take flight, scientific instruments are built, and rockets launch into the sky. As NASA's only rocket launch range, Wallops supports a diverse array of missions and projects. The facility has launched more than 16,000 rockets since beginning operations in 1945.

Wallops collaborates with other government agencies, academic institutions and companies in the private sector. With unique facilities and capabilities available for use, businesses can work with Wallops to accomplish space and aeronautics research objectives. Companies looking for collaboration opportunities are invited to take stock of the assets Wallops has to offer.

Launch Range

NASA's only launch range juggles an assortment of orbital and suborbital launches each year. The rocket range can support experiments conducted by NASA, other government agencies, academia and commercial entities. As part of Wallops' launch range services, the facility can provide range safety, surveillance, vehicle tracking and communications, command systems and launch vehicle integration facilities.

Scientific Balloons

NASA launches scientific balloons that float hundreds of thousands of feet above the ground to collect information on a range of topics, anything from atmospheric research to astrophysics. NASA's scientific balloon flight program conducts 10 to 15 balloon flights per year from facilities around the world, including Wallops.

Aircraft

The airfield at Wallops hosts a number of aircraft that can carry small payloads on journeys up to 35,000 feet in elevation. Flights can last for a few minutes or up to an hour, depending on the needs of the mission.

Other Facilities

Wallops has additional facilities of potential interest, including an unmanned aerial systems runway. The Wallops Launch Range has the capability to send mobile assets around the world to support launches in offsite or remote locations to support mission requirements.

Sounding Rockets

NASA uses sounding rockets because they are simple, quick and cost-efficient platforms for conducting preliminary research and testing. These suborbital missions send payloads into space for a brief amount of time, typically under 30 minutes. In some cases, the payload returns to Earth on a parachute and can be recovered.



The Mid Atlantic Regional Spaceport is located at Goddard's Wallops Flight Facility in Wallops Island, Virginia. Image Credit: NASA

COMMUNICATIONS

Ultra High Frequency Ground Station at Wallops Flight Facility

One ground station at NASA's Wallops Flight Facility currently supports seven CubeSat missions, providing an invaluable resource to the CubeSat community. Specifically, the Ultra High Frequency (UHF) band ground station supports CubeSat developers who use UHF radios.

"CubeSat missions use UHF-band radios primarily because of the low cost," explains Steve Bundick, an engineer who works with the ground stations at Wallops.

ELFIN A, and STF-1 – currently utilize the UHF ground station in some capacity.

As Goddard works to add CubeSat support to the capabilities of the Near Earth Network, this ground station serves an important purpose by helping CubeSat missions successfully transmit science data from space to the ground.

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"CubeSat missions use UHF-band radios primarily because of the low cost."

"The UHF band is an amateur band, which makes it easier to get FCC licensing."

For small satellite missions operating in the UHF band, the Wallops UHF ground station can facilitate SmallSat downlinks and uplink commanding. Seven missions – HaloSat, Dellingr, TEMPEST-D, CubeRRR, Shields-1,



The UHF ground station is based at Goddard's Wallops Flight Facility. Image Credit: NASA.

Ground station started supporting CubeSats in: **2009**

Passes per week: **100**

Length of antenna in meters: **18**

Antenna gain to noise temperature: **11**

CubeSat missions currently supported: **7**

Megabit downlink speed: **3**

NASA's Space Communications and Navigation Program

Provides Essential Mission Support

In spring of 2019, a little satellite called SeaHawk flew above the verdant waters of Monterey Bay and took an image of the California coastline. The next day, SeaHawk passed over the **NASA Near Earth Network** receiving station on Wallops Island, Virginia. As the satellite flew by, its radio broadcasted data to antennas at Wallops, which successfully captured the image files and transferred them to NASA's Goddard Space Flight Center. The result: a beautiful picture of California's blue ocean waters, bright green vegetation, and puffy white clouds.

SeaHawk is the first CubeSat to connect to the Near Earth Network, a collection of ground-based tracking stations that **relay data from spacecraft to mission operations centers all over the world**. CubeSats have become increasingly appealing platforms for technology demonstrations and science experiments. Historically, though, they haven't connected to the communications networks used by larger missions.

As CubeSats adopt higher quality flight radios, Near Earth Network managers are preparing to support upcoming NASA CubeSat missions. By connecting to the Near Earth Network — which is managed, operated, and maintained by Goddard — CubeSats will be able to **tap into a vast network of tracking stations** to transmit science data quickly and securely. Of Goddard's upcoming CubeSat missions, petitSat, GTOSat, and BurstCube likely will be supported by the Near Earth Network. Going



Part of Goddard's Near Earth Network is located in White Sands, New Mexico. Image Credit: NASA.

forward, Goddard will continue identifying Near Earth Network compatible radios and antennas while supporting CubeSat missions in their transition to these systems.

The Near Earth Network is part of NASA's Space Communications and Navigation (SCaN) program. The SeaHawk mission is led by the University of North Carolina Wilmington, with John M. Morrison as principle investigator.

300

Max Data Rate in Mbps

36

Number of Antennas

16

Number of Ground Stations

About SCaN

- Provides communications services to NASA's space flight missions
- Consists of three networks: Deep Space Network, Near Earth Network, and Space Network
- Supports more than 100 NASA and non-NASA missions
- Explores enabling technologies, including optical communications
- Serves NASA, other government agencies, and private companies

CONNECTIONS

Technology Internships with Goddard

“The skills I learned will be useful in a future career as I’ll have experience applying the engineering process in an actual work environment.”

Nathan Spicer-Davis, 2018 Wallops intern

College students Kimberly Whaley and Nathan Spicer-Davis spent the summer of 2018 working at NASA’s Wallops Flight Facility as interns for John Hudeck, deputy program manager of the Small Satellite Project Office. Hudeck says that CubeSats provide unique opportunities for undergraduate and graduate students to gain hands-on experience with spaceflight technology. The relatively short time-frame of CubeSat missions makes them ideal educational tools in addition to their scientific capabilities.

NASA internships, fellowships, and scholarships leverage NASA’s unique missions and programs to enhance and increase the capability, diversity and size of the nation’s future STEM (science, technology, engineering and math) workforce.

Basic eligibility requirements include U.S. citizenship, 3.0 or higher GPA, at least 16 years of age at the time of application, and a current student status of accepted or enrolled in an accredited U.S. college or university.

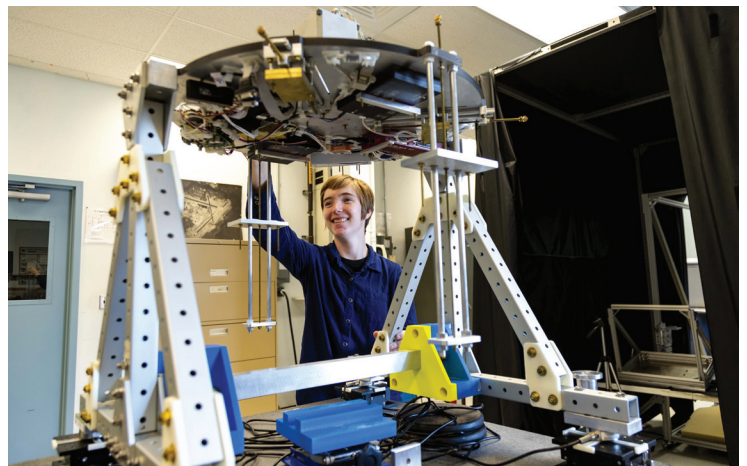
“This internship ... taught me how to slow down, think about what I’m doing, and consider all of the factors in order to find the best solutions to problems.”

Kimberly Whaley, 2018 Wallops intern

Goddard offers hundreds of internship opportunities each year across four campuses located at:

- **Goddard Space Flight Center, Greenbelt, Maryland**
- **Wallops Flight Facility, Wallops Island, Virginia**
- **Goddard Institute for Space Studies, New York City**
- **Independent Verification and Validation Facility, Fairmont, West Virginia**

Interested students should submit an application through <https://intern.nasa.gov> and should indicate availability for spring, summer, and fall.



Kimberly Whaley gained hands on experience during her summer internship.
Image Credit: Berit Bland

Five Ways to Work with Goddard's Strategic Partnerships Office

The Strategic Partnerships Office at NASA's Goddard Space Flight Center connects Goddard's world-class technologies, capabilities and expertise with industry, academia and other government agencies. Goddard technologies can provide the foundation for a new business, add products to a company's portfolio, or complement and enhance existing products.

There are many ways you can work with Goddard's Strategic Partnerships Office and take advantage of the technology resources available to you, but the following list of options is a great place to start.

- 1. License Goddard technology.** If patented or patent-pending technologies listed in this pamphlet meet your technology needs, work with the Strategic Partnerships Office to begin the licensing process. First, get in touch with a Goddard technology manager to troubleshoot your requirements and agree on a suitable technology to fit your requirements. Then, fill out an application through NASA's Automated Technology Licensing Application System (ATLAS). After submitting your application in ATLAS, a staff member from Goddard's Technology Transfer Office will get in touch for next steps.
- 1 Search patent portfolio 2 Find your tech
 3 Hit "Apply Now!"
 Let ATLAS help with the rest!



Automated Technology Licensing Application System
- 2. Apply for Startup NASA.** Startup companies can take advantage of additional benefits by participating in our Startup NASA initiative. NASA waives licensing fees for participants, removing some of the barriers encountered by tech entrepreneurs looking to secure intellectual property rights. Learn more about this opportunity at <https://technology.nasa.gov/startup>.
 - 3. Check out our online software catalog.** Goddard has 143 programs available online to fulfill your software needs, free of charge. Categories include business systems and project management, environmental science, and data and image processing. To request NASA software, go to software.nasa.gov and select the "Request Software" button to begin the process. Some codes and mobile apps offer direct download, while others require a completed request form for processing through Goddard's Software Release Authority. For assistance completing software requests, email gsfc-software@mail.nasa.gov
 - 4. Explore Space Act Agreements.** Established in 1958, the National Aeronautics and Space Act allows NASA to form Space Act Agreements (SAAs) with various partners to make progress on shared goals. SAAs facilitate advancements in numerous industries – for example, in 2016, Virginia Electric and Power Company signed an SAA with Goddard to allow researchers to study the effect of Geomagnetically Induced Currents (GICs) on the U.S. power grid. SAAs can play a role in license agreements by allowing Goddard scientists to support technology transfer, as long as it doesn't interfere with their job responsibilities. This arrangement also permits partners to reimburse Goddard for its time.
 - 5. Leverage your Small Business Innovation Research or Small Business Technology Transfer (SBIR/STTR) award.** Companies with SBIR/STTR awards or government contracts can utilize Goddard technology to enhance their research objectives. Your contracting officer or contracting officer representative can assist you in adding new technology to your list of Government Supplied Equipment.

To learn more about the Strategic Partnerships Office, please visit <https://partnerships.gsfc.nasa.gov>.

To connect with a technology manager, please email techtransfer@gsfc.nasa.gov.





CubeSats HaloSat, Dellinger, GTOSat and IceCube (from left to right) provide valuable scientific insights on a smaller platform than traditional satellite missions. Image Credit: NASA

NASA's Goddard Space Flight Center

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