

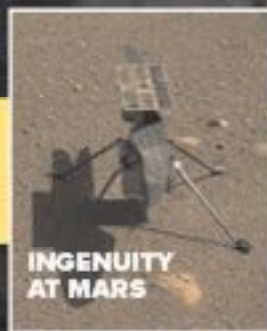
AEROSPACE

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2021 Year in review



247 kilometers on one charge
and dozens of other breakthroughs



INGENUITY
AT MARS



BILLIONAIRES
IN SPACE

Altitude-controlled balloons in development for Earth and planetary missions

BY PAUL VOSS

The **Balloon Systems Technical Committee** supports development and application of free-floating systems and technologies for buoyant flight in the stratosphere and atmospheres of other planets.

NASA's **Jet Propulsion Laboratory** and **Near Space Corp.** completed a series of indoor flight tests of their subscale prototype Venus aerobot in August in the Tillamook, Oregon, airship hangar. The aerobot, or robotic balloon vehicle, is based on a metalized Teflon design in which helium pumping between an interior pressurized reservoir and an outside zero-pressure balloon modulates buoyancy and controls altitude. The testing is a prelude to a potential **future long-duration mission in the clouds of Venus.**

Following the ending of Project Loon, South Dakota-based **Raven Industries** continued to work on the technology of station seeking using variable-altitude balloons. This ability for a balloon to remain within a useful radius of a target area continues to improve as prediction algorithms improve. Raven is adding a fusion of weather data from multiple sources to its station-seeking system. In August and September, an **Aerostar** balloon completed a two-month mission over **wildfires in California and Colorado** to evaluate the effectiveness of these platforms in helping firefighting efforts.

▼ The prototype Venus aerobot floated in the Tillamook airship hangar in Oregon during indoor flight testing this year.

Jacob Izraelievitz/NASA's Jet Propulsion Laboratory and Near Space Corp.



The **NASA Balloon Program Office** and the **Columbia Scientific Balloon Facility** resumed balloon campaigns this year after the pandemic cancellations of 2020. Early in the year, NASA launched three balloons from Fort Sumner, New Mexico. NASA conducted its **Balloon-Borne Chirp-sounder demonstration flight** on a new hand-launch system, and two Columbia Scientific Balloon Facility test flights carried numerous piggyback missions, including the **All-Sky Heliospheric Imager**, the **Balloon Observation of Microburst**

Scales and the **Balloon-Based Observations for Sunlit Aurora**. NASA flew another eight missions later in the year. It flew the 15th High Altitude Student Platform in September.

JPL flew numerous missions, including the **Submillimeterwave Limb Sounder** (a heterodyne radiometer-spectrometer that measures the thermal emission spectra of gases in the Earth's upper atmosphere), **Remote** (an experiment to study stratospheric chemistry and stability of the ozone layer) and the **Water Hunting Advanced Terahertz Spectrometer on an Ultra Small Platform**. The second flight of the **Planetary Imaging Concept Testbed Using a Recoverable Experiment-Coronagraph** mission from **University of Massachusetts Lowell** imaged exoplanetary dust and debris around stars. This mission used the Wallops Arc Second Pointer, a gondola designed to assist pointing telescopes at specific astronomical objects.

The **Physical Science Laboratory at New Mexico State University** partnered with **Stratodynamics Aviation Inc.** of Canada and **UAVOS** of California to perform a series of stratospheric flights with **HiDRON**, an **autonomous aircraft dropped from a balloon**, at Spaceport America in New Mexico. The mission objectives were to advance new systems for forward-sensing turbulence detection on board aircraft at near-space and commercial flight altitudes. The Physical Science Lab provided launch logistics. The system includes a novel, high-altitude aerial platform with multihole wind probe and infrasonic microphone sensors. Researchers tested HiDRON in three balloon flight drop tests in restricted airspace in June. NASA's **Flight Opportunities Program** funded the campaign to advance turbulence detection sensors developed by the **University of Kentucky** and **NASA's Langley Research Center** in Virginia.

The French space agency **CNES** completed a series of **climate research balloon flights** at Esrange Space Center outside Kiruna in northern Sweden. Through four balloon flights in August, carrying a total of 17 research instruments, the researchers measured the concentration of greenhouse gases at different levels in the atmosphere.

In March, **Smith College** flew a major upgrade of its **Controlled Meteorological balloons** as part of the Isotopic Links to Atmospheric Water's Sources campaign to study cold-air outbreaks near Svalbard, Norway. These altitude-controlled balloons have accrued thousands of flight hours in diverse environments from the Amazon to Antarctica; their closed-cycle buoyancy control and high energy efficiency inspired the basic design for the prototype Venus aerobot. ★

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