International Space Station Open-Source Data

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The International Space Station (ISS) is a world-class laboratory in low Earth orbit, supporting research investigations in biological sciences, physical sciences, human health, Earth and space science, technology development, and educational engagement. Data from many investigations are available in open-source science databases, providing unprecedented opportunity to leverage the unique environment.

On November 2, 2020, the International Space Station (ISS) celebrated a remarkable anniversary in human history: 20 years of continuous human presence aboard the orbital outpost. Traveling at 17,500 miles per hour, the 500-ton spacecraft makes 16 orbits of Earth every 24 hours.

Onboard, an international crew lives and works to operate the station and to conduct science at the edge of space. Crew members have completed more than 3,000 research investigations in biological sciences, physical sciences, human health, Earth and space science, technology development, and educational engagement. A comprehensive list of all ISS investigations is located at the Space Station Research Explorer App and website: https://www.nasa.gov/mission_pages/station/research/experiments/explorer/.

Researchers around the world, however, do not necessarily have to plan a spaceflight experiment to utilize the power of the ISS as an orbiting laboratory; the data from many of these investigations are in open-source science databases, where the data are available for all to download and reuse without cost to the user.

The value of the ISS as a research platform lies in its unique conditions, which scientists can leverage to perform research that is difficult if not impossible to conduct on Earth. With an orbital vantage point 250 miles above Earth’s surface, the ISS orbital path takes it over 90% of Earth’s population, offering a wide range of viewing geometries and perspectives from which to study our home planet. Instruments include those for studying the environment, the atmosphere, heliophysics, astrophysics, and other weather phenomena. The space station also provides access to extreme environmental conditions, including exposure to extreme temperatures, vacuum, atomic oxygen, high-energy radiation, and high-speed micro-meteoroid and/or orbital-debris impacts. Testing and qualification of materials, sensors, and component subsystems exposed simultaneously to these extreme conditions provide data to enable design of novel materials and manufacturing of hardened components that exhibit improved reliability and performance for extended use on Earth as well as in space, in some of the world’s most sophisticated satellite and spacecraft components.

Perhaps the most intriguing offering to researchers, however, is sustained microgravity. Microgravity has profound effects on both physical and biological systems that manifest at different scales. Surface tension and capillarity dominate fluid behavior in the absence of gravity, buoyancy-driven convection is eliminated—and from microbes to cells to animals and humans, there are profound changes in living organisms brought about by exposure to microgravity.

NASA utilizes the ISS to understand not only fundamental phenomena but also the effects of spaceflight on humans and machines, to buy down risk for future space exploration efforts. Moreover, in an effort to expand the research opportunities of this unparalleled platform, the ISS was designated as a US National Laboratory in 2005 by the United States Congress, enabling a broad range of commercial, academic, and government users access to space research and development. The ISS National Laboratory has since held responsibility for managing all non-NASA research, for investigations that require the use of microgravity and other ISS-specific experimental conditions for Earth benefits. Today, this platform is leveraged by US researchers from small companies, large research institutions, Fortune 500 companies, government agencies, and others, all interested in accessing space to solve complex problems on Earth.

Much information from these NASA and non-NASA investigations can be gleaned from the roughly 2,000 peer-reviewed journal articles (from more than 4,000 scientists) that detail ISS research results. Furthermore, US government policy mandates that much of the resulting data be archived and available so that these data may fuel entrepreneurship and innovation for years to come. Thus, several tools exist that host publicly available and open-source data, ripe for mining, at NASA’s Open Data Portal (https://data.nasa.gov), including:

**EarthData** (earthdata.nasa.gov): The NASA Earth Observing System Data and Information System (EOSDIS) provides Earth science data to users from satellite, airborne, and ISS missions for long-term global observations of the land surface, biosphere, solid Earth, atmosphere, and oceans. This coordinated approach enables an improved understanding of the Earth as an integrated system.

**HICO - NASA Ocean Color Database** (https://oceancolor.gsfc.nasa.gov/data/hico): The Hyperspectral Imager for the Coastal Ocean (HICO) was an imaging spectrometer that sampled selected coastal regions at 90 m with full spectral coverage (380 to 960 nm sampled at 5.7 nm) and a very high signal-to-noise ratio, to resolve the optical complexity of...
the coastal ocean. HICO collected more than 10,000 images of Earth during its 5 years of operations (September 2009–September 2014).

**GeneLab** ([https://genelab.nasa.gov/](https://genelab.nasa.gov/)): GeneLab is a comprehensive space-related omics database that provides access to data from experiments that explore the molecular response of terrestrial biology to the spaceflight environment.

**Life Sciences Data Archive** ([https://lsda.jsc.nasa.gov/](https://lsda.jsc.nasa.gov/)): The Life Sciences Data Archive (LSDA) is a publicly accessible active archive of data from spaceflight, flight-analog, and ground-based life sciences research investigations.

**Physical Science Informatics** ([https://www.nasa.gov/PSI](https://www.nasa.gov/PSI)): The Physical Science Informatics (PSI) is a data repository for physical science experiments performed both on the ISS and on space shuttle flights and free-flyers.

At 20 years and counting, research and technology development continues onboard the ISS at an increasing rate and with increasing complexity. NASA, the ISS National Laboratory, and international partner agencies will be conducting research onboard the ISS until 2024—and advocacy is growing to continue existing partnerships and space-based investigations through 2028.

Beyond the mid- to late-2020s, commercial entities have already expressed interest and intent to continue operation of the space station and/or future platforms, transitioning the accessibility of low Earth orbiting platforms from a government-funded to a commercially funded and operated activity. Because of this commitment to sustaining a research platform in space—and the democratization of access to results though open-source data sharing—scientists who have yet to be born will share the same unprecedented opportunity afforded to the research community today. One of the enduring legacies of our laboratory in low Earth orbit will be amazing discoveries for many years to come.

**About the International Space Station**

The **International Space Station** (ISS) is one of the most ambitious engineering feats ever attempted, involving the United States, Russia, Canada, Japan, and the participating countries of the European Space Agency. On November 2, 2020, the ISS celebrated a remarkable anniversary in human history: 20 years of continuous human presence aboard the orbital outpost. A world-class laboratory in low Earth orbit, the ISS has supported numerous discoveries, scientific publications, unique opportunities, and historic breakthroughs. This research not only helps us explore farther into space, it also benefits humanity back on Earth.