Flight crews have a much higher exposure to radiation, necessitating a method to assess and analyze space weather. Space Environment Technologies' ARMAS Flight Module provides real-time tracking of solar events so that pilots can make more informed decisions.

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On any given day, nearly 2 million Americans board an airplane to get to their desired destinations. Although plenty of stressors come with flying, space radiation and space weather probably aren't two of those worries. Though it has always existed, to most people, space weather is a relatively new concern. It can influence the atmosphere, including the constant bombardment from cosmic rays and charged particles from solar storms that affect radiation levels on Earth and in space.

PROJECT
Automated Radiation Measurements for Aerospace Safety (ARMAS)

MISSION DIRECTORATE
Science

PHASE III SUCCESS
Follow-on Phase III contract with NASA worth $100,000; commercial sales of $100,000. Near-term value is in increased health and safety of commercial aircrew and passengers.

SNAPSHOT
Los Angeles-based Space Environment Technologies has leveraged the NASA SBIR program to create ARMAS – a system that uses an instrument flight module, Iridium satellite links, and ground servers to monitor space radiation levels at commercial aviation altitudes.

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Particles that make up space radiation may increase the risk of cancer development or other harmful health effects. Commercial airline employees, such as pilots and flight attendants, are the only occupationally-exposed group that is not monitored in any systematic way. NASA, which regularly funds the early R&D work that transcends to the commercial aviation industry, was interested in finding out how space weather and increased radiation exposure affects all those who fly.

Beginning in 2004, scientists at NASA Langley Research Center developed the NAIRAS model (Nowcast of Atmospheric Ionizing Radiation System) as a space weather decision support tool designed to study radiation impacts on crew and passengers of long-range aircraft. This data would be used to change the schedule of flights and pilots accordingly, in order to keep their radiation doses below monthly and annual limits in the event of a solar storm. Looking to the future, NASA wanted to combine physics-based models with real time measurements. So in 2011, when the agency put out a Small Business Innovation Research (SBIR) solicitation, it included a topic area for in situ airborne, surface and submersible instruments for Earth Science. A solution was proposed by California-based Space Environment Technologies that fit this objective – and the result was the Automated Radiation Measurements for Aerospace Safety (ARMAS) Flight Module. ARMAS has evolved with the help of SBIR and is currently involved in a Phase III project with NASA, and is generating demand in the worldwide commercial aviation industry.

"This represented a new area for us; at the time of the solicitation, we saw this as a great opportunity to broaden and expand the expertise of our company," reflects W. Kent Tobiska, President of Space Environment Technologies, LLC. "There was no real-time data set out there that measured the

ARMAS took measurements of the radiation environment for first launch of NASA's Rad-X balloon – a project that provided first-time indications of how cosmic rays deposit energy in the upper atmosphere

radiation environment. And we came to realize though this project that for aviation crew, passengers, and commercial space travelers, radiation plays a major role."

One of the findings revealed is that for every ten hours spent flying, radiation exposure was equivalent to one chest x-ray. For pilots and flight attendants who regularly make these long-haul routes, this is a personal health issue that needs to be monitored. If that same flight is made while a particularly severe solar event is happening, suddenly that one flight could equal up to five chest x-rays. But how do pilots know if a solar event is happening? That is what Space Environment Technologies sought to answer. Through Phase I, II and Phase IIE SBIR projects, the company made it its mission to detect these events with the same accuracy we've come to expect with other weather phenomena such as thunderstorms and wind shear.

"SBIR has given us the resources we needed to expand into an entirely new area"

W. KENT TOBISKA
PRESIDENT
SPACE ENVIRONMENT TECHNOLOGIES, LLC

"You can't do anything about the galactic cosmic ray background but we are able to treat the solar proton events similar to a volcanic ash cloud," explains Tobiska. "Planes don't want to fly though ash because the particles rip up the engine. During a radiation event, there are regional areas that you can avoid and you can significantly reduce the exposure by flying at lower altitudes or slightly more equatorward. Every 6,500 feet the plane drops, radiation is cut in half."

This technology also allows radiation to be an air traffic issue that can be managed from regional centers. For the crew members, this technology means that they don't reach their monthly dose limits in one flight. The ARMAS flight module, now in its 6th generation, completed testing last year when the company monitored aircraft simultaneously over Hawaii, California, and Antarctica. The instruments were flown on aircraft and real-time data was sent down every five minutes. Today, 138 flights have flown with the equipment. The data streams are being evaluated by four separate agencies: The Federal Aviation Administration (FAA), the National Oceanographic & Atmospheric Administration (NOAA), NASA and the National Science Foundation (NSF). Commercially, Space Environment Technologies has sold two of its units to the Korean Space Weather Agency.

With units averaging about $50,000 each, Space Environment has its sight set on the private jet community, where it will unveil its handheld and WiFi-enabled FM6 business jet unit later this year. With new research and buzz on space weather alerting more flyers on the dangers of radiation, the FAA may soon be seeking a ubiquitous solution in accordance with international civil aviation standards. NASA also has plans for ARMAS by implementing the unit in a future launch of a high-altitude balloon project that provides new indications of how cosmic rays deposit energy in the upper atmosphere.

"SBIR has given us the resources we need to expand into an entirely new area," adds Tobiska. "Real-time radiation monitoring is something that nobody has ever done. It not only enabled us to take on that task, but it also created a new capability for the nation as well as helped to raise awareness on an issue that needed to be discussed."

NASA

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