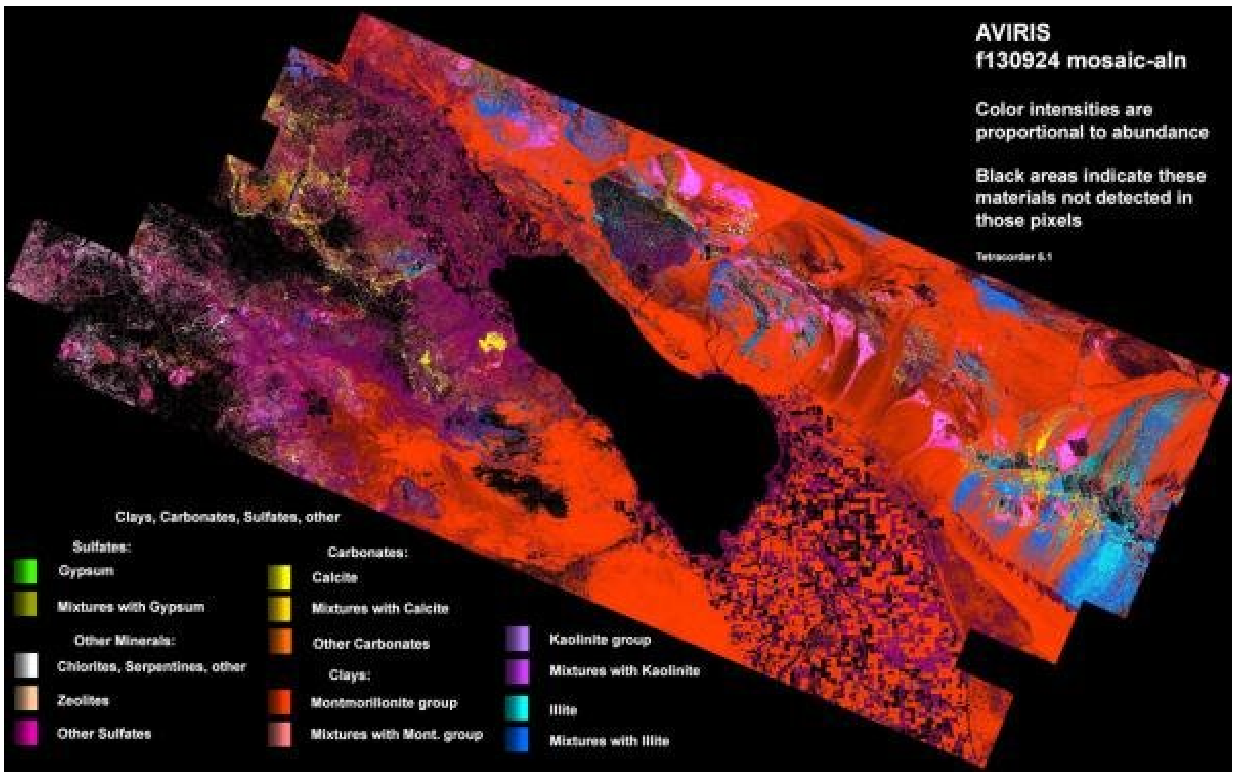
EMIT instrument will help researchers model climate effects of dust

July 15 2022



Mineral mapping results of the Salton Sea area in California, USA from Tetracorder analysis of NASA Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) data. EMIT has similar capabilities as AVIRIS. Each color on the image represents identification of a specific mineral or group of minerals in this Tetracorder standard product. Tetracorder produces maps of hundreds of materials so this is one of many summary products. The EMIT team will use the identifications of minerals in arid regions to study the climate impacts of dust. Credit: R. Clark, PSI

A new instrument headed to the International Space Station (ISS) will help researchers learn how dust storms heat or cool the planet. NASA's Earth Surface Mineral Dust Source Investigation (EMIT) mission, which launched today, will greatly broaden scientists' view of areas affected by mineral dust.

"Currently, the dust impacts of climate change are based on about 5,000 samples of soil for the entire Earth. EMIT will collect more than 1 billion usable measurements for the arid regions of the world," said Planetary Science Institute Senior Scientist Roger Clark, a Co-Investigator on the EMIT mission. "The mineralogy will be sampled every 60- by 60-meter area in arid regions of the Earth, not just a small lab sample, and will measure more than a billion locations, giving us a far better picture of the minerals in dust-generating regions."

Blown by wind across continents and oceans, dust does more than make skies hazy, congest lungs, and leave a film on windshields. Also known as mineral dust or desert dust, it can influence weather, hasten snowmelt, and fertilize plants on land and in the ocean. Particles from North Africa can travel thousands of miles around the globe, sparking phytoplankton blooms, seeding Amazonian rainforests with nutrients, and blanketing some American cities in a veil of grit also absorbing and scattering sunlight.

"Understanding the dust composition is key to understanding the warming versus cooling and by how much, both on regional and global scales. Depending on the composition of the dust, it can cool or warm the planet. Dark dust, including dust with iron oxides may cause warming, whereas light dust may result in cooling. Dust also plays a role in ecosystem and human health," Clark said. "Dust can deliver nutrients to ecosystems thousands of miles away. Dust can also cause respiratory problems in humans as well as animals."

EMIT, which will be attached to the ISS, is an imaging spectrometer built by the Jet Propulsion Laboratory that will identify and map the mineralogy in arid regions that generate dust. An imaging spectrometer is like a digital camera with much greater capability. A digital camera records images in only three colors. EMIT will record images in 288 colors, or wavelengths, from the ultraviolet to the infrared. The fine detail in wavelength discrimination enable precise composition to be measured remotely, whether solid, liquid, or gas.

EMIT will use a software system called Tetracorder, developed by Clark and colleagues at the U.S. Geological Survey that continues to be developed at PSI. Tetracorder is a public-domain analysis program that is used to identify and map specific materials using spectroscopic data. It also may be used to assist in the identification of materials measured using laboratory spectrometers. An important feature of this program is the identification of materials. Clark and his team estimate they have put about 100 person-years into the development of the Tetracorder software and the spectral libraries that form the knowledge base of spectral signatures of materials.

"Tetracorder is an identification and mapping system that will play a crucial role in EMIT's success," Clark said. "In some ways, Tetracorder is like the tricorder on the science fiction series Star Trek, in that it identifies materials remotely. But the tricorder only pointed the direction to the detected compounds. With imaging spectroscopy and Tetracorder analysis we've surpassed the Star Trek tricorder in that we produce maps of compounds."

Data from the EMIT instrument will be downlinked to the Jet Propulsion Laboratory, where it will be calibrated and fed to Tetracorder. The minerals detected by Tetracorder that are important for dust modeling will then be fed to climate models so scientists can understand their role in warming or cooling the planet.

Tetracorder will produce many other results that researchers may use in other studies. A Tetracorder analysis can result in maps of hundreds of materials, mineral mixtures, man-made materials, vegetation and vegetation health.

Tetracorder has been used all over the Solar System, discovering and mapping water on the Moon, and mapping minerals and compounds on Mars and the satellites of Jupiter and Saturn using spectrometers on spacecraft. It has also been used to map ecosystems and geology on the Earth with aircraft-mounted instruments, and also was used in mapping the debris in the World Trade Center disaster and to derive the amount of oil on the ocean's surface in the 2010 Deepwater Horizon oil spill. Tetracorder is also being used on PSI's NASA SSERVI TREX project where it is operational on a new-generation rover being developed by Carnegie Mellon University. Tetracorder running on the rover analyzes data from a spectrometer providing real-time compositional analysis that enables the rover to help make decisions on where to go.

More information: More information on Tetracorder can be found at tetracorder.psi.edu/

Provided by Planetary Science Institute