Southern Great Plains Newsletter

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Atmospheric Compensation Experiment Completed at SGP

The Atmospheric Compensation Experiment field campaign, held at the SGP June 6-12, 2005, focused on the use of hyperspectral imagery. The overall goal is to develop and test computer algorithms to correct for the effects of the atmosphere on remote sensing measurements.

Hyperspectral imaging, also known as imaging spectrometry, is a type of remote sensing used for many purposes. A hyperspectral imaging instrument measures sunlight reflected from surfaces on Earth in more than 200 spectral bands. In contrast, the traditional satellite imaging techniques use only 5-10 spectral bands. The ability of hyperspectral sensors to measure so many narrow, contiguous spectral bands generates very detailed information.

Spectral bands are groups of electromagnetic energy levels or wavelengths. The electromagnetic spectrum covers the extent of the spectral bands — from cosmic rays, gamma rays, and x-rays to ultraviolet, visible, and infrared radiation including microwave energy (Figure 1). Visible light, for example, is in the visible spectral band, with wavelengths of 0.4 to 0.7 micrometers.

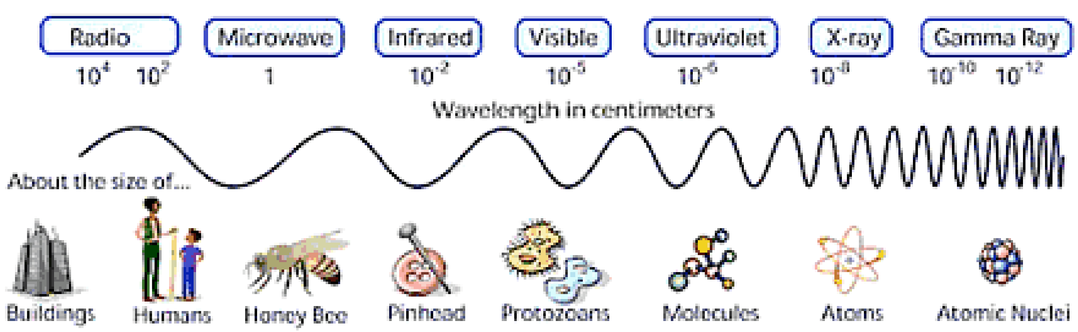

Figure 1. The electromagnetic spectrum (NASA graphic).

Different types of surfaces reflect energy in specific spectral bands, providing “spectral fingerprints” used to identify materials like grass, asphalt, and forests. The fingerprints can be unique enough to discriminate between species of trees. The ability of hyperspectral images to classify land ecosystems accurately leads to widely ranging applications in fields like mining, geology, forestry, agriculture, and environmental management.

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Technical Contact: James C. Liljegren
Phone: 630-252-9540
Email: jcliljegren@anl.gov
Editor: Donna J. Holdridge

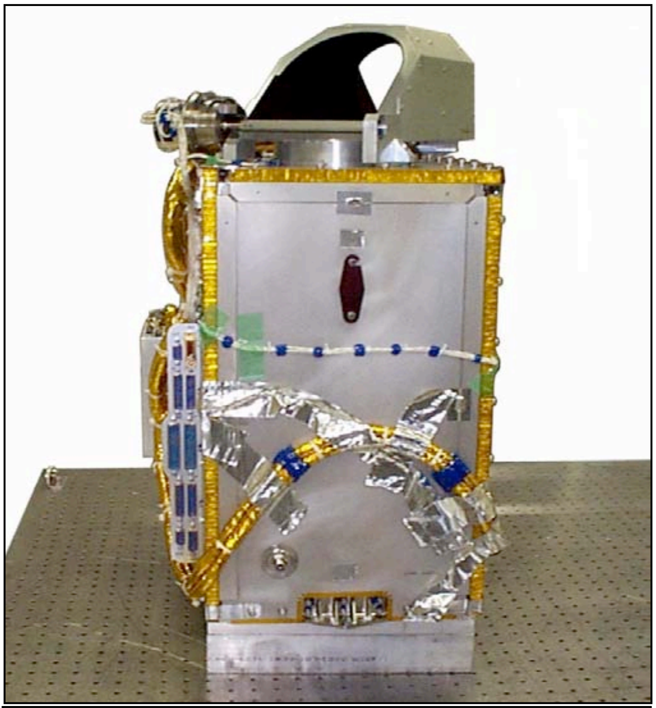

Figure 2. The Hyperion hyperspectral instrument, ready for installation on the EO-1 satellite (NASA photo).

A hyperspectral instrument can be flown on a research aircraft for smaller, more localized surveys or aboard National Aeronautics and Space Administration (NASA) satellites for long-term, large-scale use. The NASA Earth Observing-1 (EO-1) satellite launched into orbit in November 2000 has as its mission the development and testing of a set of advanced land-imaging technologies with unique capabilities and wide-ranging applications.

One of the instruments aboard EO-1 is the Hyperion (Figure 2), a hyperspectral instrument that measures 220 spectral bands and is providing a new class of observation data for improved characterization of Earth's surface. The data collected yield a detailed classification of land assets that will enable more accurate remote mineral exploration, better prediction of crop yields, and improved mapping. Hyperion is also sensitive enough to differentiate between healthy and unhealthy crops, including monitoring crops for pest infestation. Data from Hyperion have been used to accurately map and characterize temperature distributions of active lava flows and forest fire "hot spots," as well as to map vegetation species and mineral locations — all from space.

One of the many factors that must be considered in the use of hyperspectral measurements is the effect of the atmosphere between the instrument and Earth's surface. The molecules that make up the atmosphere divert and diffuse the reflected energy the sensor is trying to collect. Therefore, a correction factor — called atmospheric compensation — must be determined and applied to make the measurements accurate and useful.

The Atmospheric Compensation Experiment conducted at the SGP central facility focused on gathering hyperspectral data for several black or white panels (each 20 ft by 25 ft) deployed at the SGP (Figure 3). An aircraft carrying the hyperspectral sensor flew above the central facility at various altitudes. Although high winds permitted the launching of only one weather balloon to measure ozone over the site, and nighttime thunderstorms hampered data collection with the aircraft, two daytime flights

Figure 3. A white panel and a black panel used for the Atmospheric Compensation Experiment at the SGP central facility. A portable meteorology tower is at right (ACRF photo).

were successful. The data gathered will be used to develop and test atmospheric compensation algorithms for processing and interpretation of data, as well as for other scientific ventures.

The researchers conducting the Atmospheric Compensation Experiment were very pleased with the SGP site and the assistance and cooperation they received from SGP personnel.