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ARM Facilities Newsletter

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Advanced Ultraviolet Spectroradiometer

A specialized instrument used to measure a portion of the ultraviolet (UV) spectrum was recently installed at the SGP central facility. The instrument, called an advanced UV spectroradiometer, was developed by Dr. Lee Harrison of the State University of New York at Albany and is funded by the United States Department of Agriculture (USDA).

The sun emits a vast amount of energy in the form of electromagnetic radiation. We see some of this energy as visible light; UV and infrared radiation reach Earth's surface as well. UV radiation has a short wavelength (measured in nanometers [nm]; 1 nm = one billionth of a meter or 0.000000039 inches) and has more energy than radiation with longer wavelengths, such as visible light or infrared radiation. Because of its high energy, UV radiation can

penetrate substances including human skin and plant matter.

The UV spectrum is subdivided into three categories: UV-A (315-400 nm), UV-B (280-315 nm), and UV-C (less than 280 nm). Having the shortest wavelength, UV-C is most damaging type. Unlike UV-B and UV-C, UV-A radiation is generally not damaging to life forms. Fortunately for humans, UV-B and UV-C are intercepted and absorbed by the ozone layer high above Earth's surface. UV-C radiation is almost completely absorbed by the protective ozone layer, whereas UV-B is only partially absorbed. Although it is not as damaging as UV-C, UV-B can still be harmful to humans, plant life, and other organisms on Earth.

Because of indications that Earth's ozone layer is being depleted, it is important to investigate the transmission of UV radiation through the atmosphere to estimate the risk to life on Earth of a diminished protective ozone layer.

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Technical Contact: Douglas L. Sisterson

Editor: Donna J. Holdridge

Health risks are the most obvious danger associated with increased amounts of UV-B radiation reaching Earth's surface. Energetic UV-B radiation is absorbed by DNA in human skin cells, breaking apart the DNA's bonds and potentially resulting in skin cancers. In addition to the increased risk of skin cancer, UV-B radiation is also associated with human eye damage. The cornea of the eye is a particularly good absorber of UV radiation. High doses of UV light can cause clouding of the cornea and are linked to increased cataract formation.

Damage to marine and plant life is also possible. Increased UV-B radiation could decrease the amount of food and oxygen marine plankton provide for other marine life in the food chain. Agricultural plants show sensitivity to UV-B light as well, in the form of reduced growth and production. An increase in UV-B radiation can also increase ozone production in lower levels of the atmosphere. Although this might reduce the amount of UV-B reaching the surface, ozone is considered a pollutant and is harmful to both plants and humans when it is present in our living environment. Ozone is beneficial only when it is in the stratosphere high above Earth's surface.

In 1993, the USDA established its UVB Radiation Monitoring Program to provide information regarding UV radiation levels and their effects on food and fiber production in the United States. The USDA's original array of instrument sites, numbering 12 by 1994, has now expanded to 28 sites, including the ARM SGP central facility. The advanced UV spectroradiometer installed at the central facility in September 1999 is a unique, highly specialized instrument designed specifically to look at UV-B radiation with high spectral resolution.

The primary objective of the USDA program is to provide information to the agricultural community about the geographic and temporal climatology of UV-B radiation. Scientists also use the data to determine changes in stratospheric ozone levels, cloud cover, and aerosols as they pertain to UV-B radiation and to improve the understanding of factors that control transmission of UV-B radiation. Advances have been made in areas of agriculture, human health effects, ecosystem studies, and atmospheric science. ARM Program personnel are excited about being a part of such a worthwhile effort.

On the Internet

For information on UV-B radiation see:

http://uvb.nrel.colostate.edu/UVB/publications/uvb_primer.pdf

For information on ozone depletion see:

<http://www.epa.gov/docs/ozone/science/marcomp.html>

<http://www.epa.gov/docs/ozone/index.html>

<http://www.cmdl.noaa.gov/ozwv/ozsondes/spo/index.html>

For information on the USDA UVB Radiation Monitoring Program see:

<http://uvb.nrel.colostate.edu/>