UV Network News

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Welcome! to *UV Network News*, a newsletter for those involved with the UV-monitoring network operated by the U.S. Environmental Protection Agency (EPA) and the National Park Service (NPS). UV Network News is distributed monthly to provide up-to-date information on UV radiation and effects and on measurement efforts at EPA/NPS and other monitoring sites.

About the EPA/NPS UV network:

EPA and NPS operate a network of Brewer spectrophotometers at locations throughout the U.S. Fourteen of the monitoring sites are located in national parks in conjunction with PRIMENet (Park Research and Intensive Monitoring of Ecosystems Network) measurement efforts. An additional seven sites are located in urban areas. Together, these sites comprise the largest spectral-UV network in the world.

The network data are used for a variety of scientific studies including assessments of the effects of UV on frog populations and other ecosystems, verification of the NOAA/EPA UV Index for predicting human exposure levels, and for monitoring changes to the global environment. The data are available to interested parties via the following web sites:

EPA's Ultraviolet Monitoring Program, UV-Net
http://www.epa.gov/uvnet/

The National UV Monitoring Center home page
http://oz.physast.uga.edu/

The National Park Service PRIMENet page
http://www2.nature.nps.gov/ard/prime/index.htm

The Central UV Calibration Facility (CUCF): An Overview

Meaningful measurements of the UV radiation reaching the earth's surface would be impossible without accurate instrument calibrations. When not properly calibrated, the Brewer spectrophotometers can produce values that are off by more than 20 percent. With trends in UV for most regions estimated at 20 percent or less, such large drifts would be disastrous for any scientific analysis of the data.

The Central UV Calibration Facility (CUCF) was established in the mid-1990s to provide high-quality, routine calibrations and bandwidth characterizations for UV network instruments, including the EPA/NPS Brewer spectrophotometers. The numbers generated by the CUCF are recognized as the highest quality UV instrument calibrations available worldwide.

CUCF scientists Patrick Disterhoft and Kathy Lantz of the Cooperative Institute for Research in Environmental Sciences provide significant expertise relevant to calibration and other issues. The CUCF is also closely associated with scientists in the Optical Division at the National Institute for Standards and Technology (NIST) who provide radiometric standards and expertise in calibration methodology.

Central UV Calibration Facility, continued

Several government agencies, including the U.S. Department of Agriculture, the Environmental Protection Agency, and the National Science Foundation, support the CUCF. The facility provides calibration information for UV-B monitoring efforts in the U.S., including NOAA's Integrated Surface Irradiance Study (ISIS) and Surface Radiation Budget (SURFRAD) networks, and networks operated by the U.S. Department of Agriculture, the U.S. EPA and NPS, the National Science Foundation, and the Smithsonian.

CUCF scientist Patrick Disterhoft, shown here working with the portable field calibrator, has travelled to each of the EPA/NPS sites to audit the Brewer instruments.

The CUCF's mission is to ensure accuracy of UV measurements made by the various monitoring networks. This goal is achieved through an assemblage of laboratory radiometric equipment and qualified personnel capable of characterizing and calibrating a variety of instruments. The techniques used must meet the high quality standards established by the National Institute of Standards (NIST), to ensure that only the highest quality instrumentation and most rigorous evaluation procedures are instituted.

For more information, visit the Central UV Calibration Facility web site at http://www.srrb.noaa.gov/calfacil/calpage.htm

The indoor laboratory of the CUCF, known as the Calibration/Characterization Laboratory, performs measurements of a radiometer's spectral response function and angular response. The information is used to track the radiometric stability of UV monitoring instruments. The Calibration/Characterization Laboratory also produces horizontally calibrated quartz-tungsten lamps that are used to calibrate field spectroradiometers using the NOAA/NIST portable field calibrator.

The Table Mountain Test Facility, located on a mesa ten miles north of Boulder, Colorado, is home to the 'standard' UV radiometers and UV spectroradiometer. The site also serves as the location for intercomparisons of network instruments. The intercomparison campaigns, hosted by the CUCF in 1994, 1995, 1996, and 1997, provide a baseline reference for measurement comparability among the different networks. The gathering of experts and exchange of technical information often results in valuable improvements to existing instruments, ideas for new instrumentation, and the development of new and more accurate monitoring methods.

A standard UV lamp field calibration performed at night during the September '94 intercomparison.

UV Radiation and Effects on Plants

The effects of increased UV on plant life has been an area of much scientific research. Laboratory studies indicate that different types of plants respond differently than others to UV. These UV sensitive plants usually experience reductions in plant and root growth, leading to smaller leaf size and lower plant yields. Studies show that of over 50 soybean varieties studied, 2 of every 3 were found to be UV sensitive. Yield in the sensitive varieties was reduced by 19 to 25 percent. Similar reductions in growth were observed in rice, which is among the most important food consumption crops in the world. Of 16 varieties tested for UV sensitivity, one-third showed reductions in plant size.

UV radiation can also exert detrimental influences on sugarbeets, cucumbers, and other agricultural plants. Studies indicate that increased UV levels may leave these plants more susceptible to diseases. Sugar beet plants infected with *Cercospora beticola* and exposed to enhanced UV experienced large reductions in leaf chlorophyll content, and the fresh and dry weight of total biomass. Exposure of three cucumber varieties to enhanced UV before infection with *Colletotrichum lagenarium* or *Cladosporium cucumerinum* resulted in greater disease development. The effects of disease development depended on the cucumber variety and tissue age, and on the timing of the UV exposure (WHO, 1994).

Other studies have indicated substantial decreases in flowering due to UV radiation and changes in the timing of flowering, entering and breaking dormancy, senescence, and other events. These changes affect not only the individual plant, but also how the plant interacts with other plants and animals. For instance, a shift in the timing of flowering can mean that a plant species may not have sufficient insect pollinators available either because insects are not present at the new time of flowering or because other plant species are attracting those pollinators (Caldwell et al., 1995).

Given these results, quantification of the effects of UV on global agriculture is difficult at best. There are many differences between laboratory and field studies, and many problems associated with separating UV effects from other factors affecting growth in the field. The extent to which plants may be able to repair damage done by exposure to UV radiation is also unknown.

Preliminary research does indicate that not only agricultural plants, but also plants growing naturally in forests and grasslands can be affected by UV. More UV-tolerant plants would be able to grow at the expense of less tolerant plants, which could eventually affect the species diversity of the area. Insects, birds, or other animals who used the UV-sensitive plants for home or food would be under stress. In this way, increased UV radiation can affect plants and animals in every part of the world.

UV radiation can also affect algae living in surface waters in lakes and the sea. Changes in these algae are likely to affect food supplies for fish, causing a ripple effect all the way up the food chain to humans. Considering that 30 percent of all animal protein for human consumption comes from the sea (WHO, 1994), damage to algae, plants, and other ecosystems may pose serious consequences for the world's growing population.

References:

Caldwell, M.M., A.H. Teramura, M. Tevini, J.F. Bornman, L.O. Bjorn, and G. Kulandaivelu, 1995. Effects of Increased Solar Ultraviolet Radiation of Terrestrial Plants, Ambio 24(3):166-173.

World Health Organization, 1994. Ultraviolet Radiation: An Authoritative Scientific Review of Environmental and Health Effects of UV, with Reference to Global Ozone Layer Depletion.

What a difference a month makes...

A Late Date for Easter: Easter is a moveable feastday, falling on a date from March 22 to April 25 as determined by the first full moon after the spring equinox. This year, Easter is celebrated on April 23, one of the latest possible dates on which it can occur. Because of its lateness, this year's Easter is farther into the spring season than the Easters of previous years. The late date of Easter can mean a large difference in the amount of UV people will be exposed to during their Easter egg hunts or other outdoor activities.

Changes in UV: The table below shows the mean relative daily areal exposures of erythemal (skin damaging) ultraviolet radiation for March 22 versus April 25. The results indicate significant differences in the levels of erythemal UV radiation between March 22 and April 25, particularly for the northernmost locations. Erythemal UV levels for Denver are observed to almost double during this time period, while the April 25 New York City values are more than twice the March values.

Year-to-year variabilities in UV amounts can be also be significant, as can day-to-day variabilites due to cloudiness and other factors. These differences can contribute to greater month-to-month variabilites. New York City has seen March-to-April increases as high as 300% in some years, and in Denver, the change between March and April UV levels has been observed to be greater than 400%.

Location	MARCH 22		APRIL 25		Increase in UV
	UV dose rate	UV Index	UV dose rate	UV Index	
San Diego, CA	160	6	230	9	48%
Denver, CO	96	4	190	8	99%
New York City, NY	53	2	110	4	100%

Table: Mean relative daily areal erythemal UV radiation (mW m^{-2}) for March 22 and April 25, averaged over years 1979-1993. Data are from the Total Ozone Mapping Spectrometer (TOMS) satellite instrument. Compiled by W. Straka, U. of Colorado.

The UV Index: The table also shows the UV Index values associated with the UV measurements. The National Oceanic and Atmospheric Administration and the U.S. Environmental Protection Agency forecast the UV Index daily to alert people to the dangers of exposure during that day's conditions. The UV Index helps people determine the risk of UV overexposure. A difference in UV Index values between 2 and 8, for example, represents the difference between minimal risk and high risk. For a UV Index value of 4, experts recommend wearing a hat and sunscreen; for a UV Index value of 8, people are best protected by wearing sunscreen, a hat and appropriate clothing, and by avoiding outdoor activities during the peak exposure hours between 10 a.m. and 4 p.m. These suggestions represent general guidelines; each individual's risk depends on a number of factors, including skin type, medications, age, and family history.

You can find out more about the UV Index and tips for sun safety, as well as view the daily forecast for your city by visiting http://www.epa.gov/ozone/uvindex/ or by checking with your local weather service office.

Reminder for a Safe Holiday: Easter's late date this year means that the Easter egg hunt or other outdoor activities might be better scheduled earlier in the day or more towards the evening hours to avoid UV exposure. Persons travelling to more southern locations should remember that UV levels are likely to be higher at their destination, and skiers and snowboarders should keep in mind that reflectance from snow can more than double the UV radiation reaching the face, neck, and other parts of the body.

UV Network News is a monthly newsletter for persons involved in UV monitoring and research. The newsletter is produced by the Cooperative Institute for Research in Environmental Sciences at the University of Colorado and the Surface Radiation Research Branch of NOAA's Air Resources Laboratory. Support is provided by the National Park Service and PRIMENet.
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- Any comments or contributions are welcome! -