UV Network News

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This and past issues available online at http://www.srrb.noaa.gov/UV/

November 2000

Welcome! to *UV Network News*, a newsletter for those involved with the UV-monitoring network operated by the U.S. Environmental Protection Agency (EPA), the University of Georgia's (UGA) National UV Monitoring Center (NUVMC), 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/UGA and other monitoring sites.

About the EPA/UGA UV network:

EPA, UGA, 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

In this issue…

John Streicher of the NOAA/EPA Atmospheric Sciences Modeling Division overviews new modeling tools to assess human exposure to UV.

Temperature, precipitation, and other climate statistics for each of the EPA/UGA UV monitoring sites.

An article by UV scientist William Grant summarizing new findings on the relation of UV and vitamin D to various types of cancer.

A site photograph...

The Brewer instrument at Denali National Park is shown here with the Central UV Calibration Facility's field calibrator.

3-D UV Exposure Modeling

John Streicher
NOAA/EPA Atmospheric Sciences Modeling Division

Scientists with NOAA's Air Resources Laboratory and the EPA's Atmospheric Sciences Modeling Division in Research Triangle Park, North Carolina, have completed proof of concept for computer graphics-based solar radiation exposure modeling. The three-dimensional graphics modeling software is used to display a near-photographic quality human model, and to illuminate the model with a simulated sun light source. The research goals of the modeling are to develop photobiology tools that enable quantification and anatomical resolution of sun exposure for scenarios of varying posture and duration. Lighting detail includes partitioning of direct beam and diffuse skylight, shadowing effects, and gradations in model surface illumination depending on model surface geometry and incident light angle.

The American Cancer Society reports that over 80 percent of skin cancers occur on the face, head, neck, and back of the hands. Therefore, modeling human exposure to solar radiation demands that exposure calculation be anatomically resolved. The calculation of light illumination for various receptor points across the anatomy (shown as red patches in figure 1) will provide information about differential exposure as a function of model posture, orientation relative to the sun, and sun elevation. In the near future, exposure research will be pushed to unprecedented precision. By integrating geodesic sun-tracking models with high resolution 3-D mathematical computer models of the human form, the instantaneous exposure [Watts per square meter] can be calculated, as well as the cumulative dose [Joules per square meter] received during a sun exposure scenario, at various monitoring areas on the anatomy. Illustration of exposure and/or cumulative dose is achieved using a false color rendering, mapping light intensity to color. Such analysis is essential to determine the reduction in exposure gained by wearing a hat or sun glasses. This kind of research will provide a "dose" factor needed to develop dose-response functions for skin cancer, immune system suppression, and cataract formation.

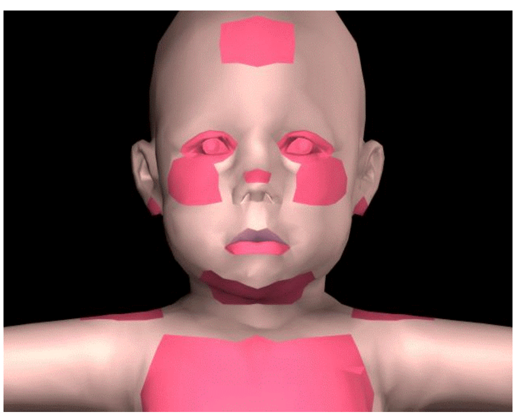

Figure 1. Three-dimensional graphic computer model with light monitoring receptor areas shown as red patches.

For more information on ASMD's UV modeling efforts, contact John Streicher at Streicher.John@epamail.epa.gov.

Climatological Data for EPA/UGA UV Sites

Previous articles (see the August 2000 issue) have addressed the importance of temperature corrections for the Brewer instruments. The temperature dependence of the Brewers is forced by fluctuations in the ambient temperatures at each of the monitoring sites. The magnitude of these fluctuations varies from site to site, as evidenced by the climatological data below. While individual site operators are familiar with the climate of their region, they may not be aware of similarities or differences that can occur at other sites. Knowing about the range of temperatures and precipitation amounts at the different sites can help foster some useful exchanges of information, especially when correcting each of the Brewers for its specific temperature dependence.

Site	Annual Mean Max Temp ºF	Annual Mean Min Temp ºF	Annual Mean Temp ºF	Deviation from normal	Mean July Max ºF	Mean January Min ºF	Days with max > 90	Days with min < 32	Total Annual Precip (inches)	Deviation from normal	Total Annual Snowfall (inches)
Sequoia/Kings Canyon	79.1	47.3	63.3	0.1	99,9	34.8	119	37	14.58	-10.88	0.00
Shenandoah	68.7	42.2	55.5	3.2	91.5	25.5	36	106	40.48	?	23.7
Olympic	59.2	45.2	52.2	2.8	72.2	35.9	0	24	34.88	?	0.00
Acadia	58.7	37.5	48.1	?	82.1	13.1	7	140	53.08	?	49.0
Big Bend	Incomplete record										
Everglades	84.1	65.2	74.7	?	89.7	57.8	76	0	63.58	?	0.00
Canyonlands	74.3	41.0	57.7	0.8	98.0	24.3	89	138	11.56	?	0.8
Hawaii Volcanoes	68.7	51.9	60.3	-0.5	72.2	49.3	0	0	97.95	11.01	0.00
Theodore Roosevelt	59.8	32.9	46.4	2.3	88.1	4.6	29	191	12.63	?	29.1
Virgin Islands	Incomplete record										
Glacier	54.8	33.4	44.1	1.6	76.9	22.3	4	198	22.70	?	116.4
Great Smoky Mountains	70.1	43.0	56.6	1.8	84.9	30.1	20	102	49.68	?	5.3
Denali	33.8	22.1	24.0	-2,3	65.4	-12.1	28	259	16.24	0.74	92.1
Rocky Mountain	Incomplete record										
Boulder, CO	66.2	38.1	52.2	1.9	88.7	22.8	20	157	18.83	3.43	53.3
Riverside, CA	80.4	51.1	65.8	0.9	93.8	42.9	110	0	4.24	?	0.00
Atlanta, GA	72.9	53.4	63.1	1.9	87.9	37.8	44	33	38.85	11.92	0.00
Chicago, IL	62.3	45.2	53.8	3.2	90.1	16.8	29	97	37.46	0.08	56.0
RTP, NC	71.5	48.2	59.9	2.0	89.7	32.0	45	75	61.25	15.23	0.00
Boston, MA	60.5	45.0	52,8	1.5	84.2	21.5	16	86	37.91	3.60	35.6
Albuquerque, NM	70.3	44.5	57.4	?	87.9	28.2	23	89	8.29	-0.59	0.00

*Data from the National Climatic Data Center, 1999 Annual U.S. Climatologies.

UV Radiation, Vitamin D, and Cancer

Dr. William B. Grant, Newport News, VA

A manuscript by William Grant and James Slusser has recently been submitted to the International Journal of Epidemiology investigating the links between ultraviolet radiation, vitamin D, and various types of cancer in the U.S. The study uses data from the EPA/UGA and USDA UV monitoring networks, along with Total Ozone Mapping Spectrometer (TOMS) observations, to explore UV's protective role against cancer through production of vitamin D.

Summary:
Mortality rates for several types of cancer in New England are about double those in the Arizona and New Mexico. Inadequate solar ultraviolet-B (UV-B) radiation and vitamin D have been associated as risk factors for such cancers as those of the breast, colon, ovary, prostate and rectum. This association is based on geographic distribution as well as on laboratory studies of vitamin D receptors of cancer cell lines and the effects of vitamin D analogues on cancer cell proliferation and differentiation. The present study confirms results reported during the past two decades and extends the analysis to several additional cancers (bladder, esophagus, kidney, stomach, and uterus), for a total of at least 14 cancers. For this study, UV-B (total, DNA- or erythemally-weighted) data from two ground-based monitoring networks and one satellite instrument for July are used, along with cancer mortality rates for state economic areas in the U.S. for the period 1970-1994. The cancer mortality rates are taken from the Atlas of Cancer Mortality (http://www.nci.nih.gov/atlas/mortality.html).

The statistical analysis finds that approximately 19,900 (95% C.I. 6,100-33,400) white and 2,000 (95% C.I. 600-3,300) black Americans died annually from cancer from 1970-1994 due to insufficient UV-B/vitamin D. These numbers are referenced to the region of maximum DNA-weighted UV dose (7-10 kJ/m^2). Urban dwellers are found to have a higher risk of cancer than rural dwellers for the same surface UV-B dose, likely due to reduced exposure from less time spent out-of-doors and less sun exposure near buildings. In addition, it is suggested that the reported finding that cancer incidence/mortality rates are inversely proportional to total serum cholesterol rises from less starting material, cholesterol, for formation of vitamin D with UV-B radiation.

While approximately 7,000 Americans died each year due to melanoma and other skin cancer, the statistical approach used here can only find that 1,100 of these are related to too much UV radiation. Since the general conclusion is that most other skin cancer and two-thirds of melanoma cases are related to UV radiation, the statistical approach employed here may significantly underestimate the number of lives that could be saved by additional solar UV and/or vitamin D.

These results are not to be taken as any reason why concern for stratospheric ozone depletion should be relaxed. The differences in UV-B radiation between the northeastern and northwestern U.S. are related to such factors as surface elevation, tropopause height, aerosol loading, surface albedo, and, perhaps, clouds. These factors will be investigated.

These results will be presented at the 15th National Conference on Chronic Disease Control and Prevention, held later this month in Washington, D.C. More information is available by contacting Dr. Grant at wbgrant@infi.net.

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- Any comments or contributions are welcome. -