

# UV Network News



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**W**elcome! 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/>

## ***In this issue...***

Ultraviolet radiation can enhance the toxicity of certain compounds, particularly those associated with an oil spill. Learn about some of the issues involved in measuring enhanced phototoxicity.....2.

Just in time for summer vacation - Protecting children from the skin-damaging effects of UV radiation.....3.

*In the news:* continuous vs. intermittent exposure to UV, detecting ozone recovery, and a new UV effects resource.....4.

## ***Park Profile: Glacier National Park***

Researchers in Glacier National Park are studying UV-B radiation to assess its effects on amphibians. These scientists use portable UV-B monitoring devices to optically profile small ponds for their ability to screen out damaging UV rays. The data collected provide information on the biological and ecological effects of UV at a local scale. This information will help scientists better understand the global relationship between UV and ecosystem sensitivity. For more information, visit the Glacier Field Station site at <http://www.mesc.nbs.gov/glacier/uvb-monitoring.htm>.

We will continue to pass along resources related to UV monitoring and research at the parks as we become aware of them. If you have information you'd like to include, please contact Amy ([amy@srrb.noaa.gov](mailto:amy@srrb.noaa.gov); 303 497-6417) or Betsy ([betsy@srrb.noaa.gov](mailto:betsy@srrb.noaa.gov); 303 497-6653).

## *UV-Enhanced Toxicity*

Although ultraviolet radiation can be harmful by itself, researchers have also linked UV wavelengths to photoenhanced toxicity. Photoenhanced toxicity is an increase in toxicity under natural sunlight conditions. It is determined by exposure to both chemicals and sunlight, particularly UV.

The evidence for photoenhanced toxicity abounds. In investigating the survival rates of shellfish embryos in spill-contaminated water, Ho et al. (1999) found that all the embryos exposed to three-day-old spill water under UV light were killed, while 60 percent of those exposed to three-day-old spill water under fluorescent light (low UV output) survived. Additional studies have shown that sunlight causes a 2- to greater than 100-fold increase in the toxicity of oil and petroleum products to aquatic organisms (Pelletier et al., 1997; Calfee et al., 1999).

One group of chemical compounds, called polycyclic aromatic hydrocarbons (PAHs), have been found to be especially phototoxic. PAHs are organic compounds that contain a benzene ring (C<sub>6</sub>H<sub>6</sub>) or have chemical properties similar to benzene. They are often found in petroleum products and do not easily partake in reactions. The bioaccumulation of these compounds is therefore an area of concern. PAHs can rapidly accumulate in the tissues of aquatic organisms, but are eliminated relatively quickly when exposure ceases (Barron, 1995). Not all PAHs are alike in their reactions with sunlight: anthracene and fluoranthene are phototoxic, while naphthalene and phenanthrene are not. Research concerning PAH phototoxicity is ongoing, and can provide important information for spill countermeasures and oil recovery operations.

The degree of photoenhanced toxicity relates directly to both the intensity and the spectral distribution of incident light. Within the water column, longer wavelengths (e.g. UVA, 320-400 nm, and visible, 400-700 nm) penetrate more effectively than the shorter wavelengths (e.g. UVB, 280-320 nm).

Water type can also impact levels of UV radiation. The depth of water required to remove 99 percent of UVB ranges from 20 meters in clear ocean water, to less than 3 meters in most coastal waters, to a few centimeters in brownish lakes and rivers (Kullenberg, 1980; Kirk, 1994b). Calkins and Thordardottir (1980) found that one percent of the surface UVB penetrated to 10 meters in waters off Iceland. Even these small amounts of UV can induce photoenhanced toxicity (Little et al., 2000).

In general, much more enhanced phototoxicity research needs to be done in order to protect fragile ecosystems and species. Issues include identifying locations and times of year where oceanic and atmospheric conditions support UV exposures and bioaccumulation in organisms. Work must also be completed to determine the habitats, aquatic organisms, and life stages most at risk.

### References:

- Barron, 1995. Bioaccumulation and biomagnification. Chapter 30. *Handbook of Ecotoxicology*. Lewis Publishers, Chelsea, Michigan.
- Calkins and Thordardottir, 1980. Penetration of solar UV-B into waters off Iceland. In J. Calkins (ed.) *The Role of Solar Radiation in Marine Ecosystems*. Plenum Press, New York.
- Ho et al., 1999. The chemistry and toxicity of sediment impacted by the North Cape oil spill in Rhode Island Sound. *Mar. Poll. Bull.* 38(314-323).
- Kirk, 1994. Optics of UV-B radiation in natural waters. *Arch. Hydrobiol. Beih. Ergebn. Limnol.* 43:1-16.
- Kullenberg, 1980. Note on the role of vertical mixing in relation to effects of UV radiation on the marine environment. In: J. Calkins (ed.) *The Role of Solar Radiation in Marine Ecosystems*. Plenum Press, New York.
- Little et al., 2000. Assessment of photoenhanced toxicity of a weathered petroleum to the tidewater silverside. *Environ. Toxicol. Chem.* In press.
- Barron, 2000. Potential for photoenhanced toxicity of spilled oil in Prince William Sound and Gulf of Alaska waters. Final report for the Prince William Sound Regional Citizens Advisory Council.
- Pelletier et al., 1997. Phototoxicity of individual polycyclic aromatic hydrocarbons and petroleum to marine invertebrate larvae and juveniles. *Environ. Toxicol. Chem.* 16:2190-2199.

## UV and Children

Children can be especially vulnerable to the effects of UV radiation from the sun. Not only do children receive three times the sun exposure of adults, but this exposure often occurs without any kind of sun protection. It is no wonder, then, that the Skin Cancer Foundation reports that 80 percent or more of a person's lifetime UV exposure occurs before age 20.

The risks of sun exposure in young individuals can be severe. Babies' skin is especially sun-sensitive because the outermost layer is thinner than that of older children and adults. Children are likely to burn faster than adults, which increases their chances of serious skin damage. Young children also have more skin relative to their body mass, so sunburns are likely to cover a greater area than similar exposure for adults.

Medical experts warn that severe sunburn should be considered a serious health problem. If the sunburn is accompanied by pain, nausea, and chills, parents should contact a physician immediately.

The effects of UV are cumulative, and damage starts with the first exposure. Just one blistering sunburn during childhood can double the person's risk of skin cancer later in life. New studies also show a correlation between melanoma and intermittent sun exposure (that is, exposure occurring on weekends or during vacation). People soaking up the sun's rays during these periods of exposure risk serious skin damage as skin newly exposed to the sun is most sensitive to UV.

### Keeping Your Family Safe

The American Medical Association recommends these guidelines for keeping your children safe in the sun:

- ☉ Avoid the mid-day sun. Schedule outdoor activities for later or earlier in the day.
- ☉ Keep infants — especially babies under 6 months of age — out of the sun.
- ☉ Use a sunscreen. Choose one offering both UVA and UVB protection, and having a sun protection factor (SPF) of at least 15. Re-apply frequently.
- ☉ Wear protective clothing. Wide-brimmed hats, sunglasses, and proper clothing help shield the sun's rays.
- ☉ Beware of reflected light. Sand, snow, pavement, and other light-colored surfaces reflect large amounts of radiation. UV over-exposure is therefore a danger in the wintertime as well as in summer.
- ☉ Clouds are not UV protection. As much as 80 percent of the sun's radiation makes it through clouds. Thin or scattered clouds can scatter UV downward and cause surface levels to be higher than on a clear-sky day.
- ☉ Don't mix the sun with certain medications. Tetracycline and other medications can cause reactions in sunlight, so consult your physician.
- ☉ Set a good example. The same rules about protection apply to adults too.

The EPA's SunWise web site (<http://www.epa.gov/sunwise>) is an excellent source for sun protection information. For additional information or in cases of severe exposure, consult your physician.



### *Research Findings in the News...*

#### *Occasional versus continuous exposure to UV...new evidence in melanoma risk.*

Scientists have found that intermittent UV exposure can significantly increase a person's risk of melanoma skin cancer. In a study of 583 patients, ages 20 to 69 years, researchers found that intermittent or occasional exposure to UV, such as for indoor workers taking a beach vacation or participating in outdoor activities on weekends, can greatly increase one's risk of skin cancer. The results showed that intermittent UV exposure at age 18 translated to an adjusted odds ratio (OR) of 1.67. This odds ratio corresponds to a person's chance of developing skin cancer, and is based on age, sex and skin reaction. The value was then adjusted for behavior.

The results suggest that intermittent radiation exposure, particularly during adolescence, is associated with a higher probability of developing melanoma. These results confirm earlier studies exploring the risks of intermittent exposure (see IARC report). Dr. Maria Sofia Cattaruzza of Rome, Italy, reported these newest results, which were published in the June 2000 issue of Archives of Dermatology (vol. 136 no. 6).

#### Additional references:

Kricker, A., B.K. Armstrong, M.E. Jones, and R.C. Burton. Health, Solar UV Radiation and Environmental Change. International Agency for Research on Cancer (IARC) Technical Report No. 13, World Health Organization.

#### *Detection of ozone recovery unlikely in near future.*

Results forthcoming in the Journal of Geophysical Research indicate that recovery of the total column ozone (the amount of ozone overhead) may not be detectable for another 15 to 45 years.

The study, conducted by Dr. Elizabeth Weatherhead (U. of Colorado), and colleagues, suggests that ozone recovery is likely to show up earliest in the southern hemisphere near New Zealand, southern Africa, and southern South America. The time to detect recovery is based on full compliance with the Montreal Protocol and its amendments and no other complicating factors such as major volcanic eruptions or enhanced stratospheric cooling.

Dr. Weatherhead says that despite current evidence of a decrease in ozone-depleting substances in the atmosphere, detecting an ozone layer recovery remains crucial. "We can't really expect much of an improvement in the UV levels reaching the biosphere until we can detect an increase in total column ozone." For more information, contact [betsy@srrb.noaa.gov](mailto:betsy@srrb.noaa.gov).

#### *Plant Photobiology Notes — An Ecosystem Effects Resource.*

"The Plant Photobiology Notes" is a collection of notes and web links with information on the effects of visible and UV radiation on plants, and on methods and equipment used for studying these effects. The site is maintained by Pedro Aphalo and contains links to major publications and readings in the photobiology area. For more information, visit <http://cc.joensuu.fi/~aphalo/about.html>.

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*- Any comments or contributions are welcome. -*