UV-B Monitoring and Research Program
USDA

Natural Resource Ecology Laboratory

Colorado State University
Knowledge to Go Places

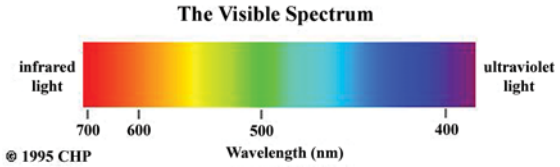
USDA UV-B: Data Collection and Monitoring

http://uvb.nrel.colostate.edu/UVB/

Why should we be concerned about ultraviolet radiation?

Radiation from the sun reaching the Earth's surface between 290-320 nanometers is defined as UV-B radiation. This radiation has potential harmful effects on humans, agricultural crops, forests and livestock.

The diagram below shows the wave lengths of ultraviolet light, in relation to the visible (what we see) and infrared (heat), to be a small part of the electromagnetic spectrum. Changes in the Earth's atmosphere, including changes in the ozone layer, lead to more ultraviolet light at the Earth's surface. USDA has determinded that long term measurements of UV are critical to understanding trends, geographical distribution and factors influencing atmospheric transmission of ultraviolet light.



Photosynthetically Active Radiation (PAR) for Agricultural Research

PAR is visible light from the sun which drives photosynthesis in plants. The ratio of PAR to UV-A and PAR to UV-B are critical factors in plant development. Research is being conducted at the Beltsville Agricultural Research Service to quantify these relationships.

- Accurate measurement of PAR at 30 sites in the United States
- More PAR measurements based on shadow band data
- Provide ground truth to NASA satellite measurements of global PAR

Beltsville Agricultural Research Center, MD, South Farm. Red Circle shows location of UVMRP instruments. November 2004.

Precision Farming and Air Quality Studies Use Corrected Data

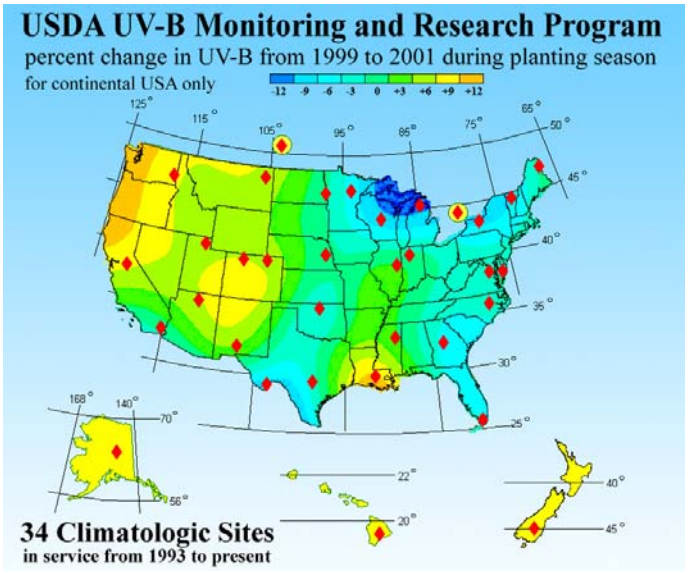
- Atmospheric Correction using USDA data provided to NASA
- Air quality studies performed over rural areas and urban areas
- Ground truth provided for satellite measurements of aerosol, cloud cover and ozone

UVMRP network is working with Spectral Science Incorporated and NASA to develop state-of-the-art corrections that remove the influence of aerosols from remote sensing images of cropland and forested ecosystems.

With these corrections more accurate data on the health of crops and ecosystems are possible. This technique allows farmers to apply the precise amount of fertilizer or insecticide (not too little, not too much) to increase profits and improve runoff water quality.

Remote sensing images also allow forest managers to distinguish healthy from unhealthy forests that suffer from insects, disease, air pollution or drought.

UV Data for Trend Detection



Other Data Users

- U. Nebraska, U. Maryland, Purdue, Mississippi State, Utah State, and Washington State are investigating UV-B effects on crops and other plants
- NASA to validate satellite retrievals of UV-B, aerosols, and ozone
- National Center for Atmospheric Research conducts air quality studies

USDA UV-B: Agriculture

http://uvb.nrel.colostate.edu/UVB/

Maintaining high agricultural yields is vital to our national economic and security interests. Yet changes in the Earth's climate and more frequent extremes in temperature, precipitation, UV-B radiation, air pollution from human activity and forest fires threaten our agricultural productivity by causing stress on plants, livestock, and forests.

Effects of Elevated UV-B on Plants:

- Reduction in yield
- Alteration in species competition
- Susceptibility to disease
- Changes in plant structure and pigment
- Decrease in photosynthetic activity

University and government researchers use UVMRP data in combination with measured plant response to evaluate the effects of elevated UV-B on agricultural crops and forests and to develop solutions that will allow plants to cope with these effects and ensure continued crop and forest productivity.

Response of cotton to enhanced UV-B studied at Mississippi State University

Results from research of UV-B impact on cotton, winter wheat, maize, soybean, sorghum and trees have been reported by UVMRP to a broad scientific community. Several UV radiation transfer models applied to agriculture have been developed and tested. The geographic distribution of UV-B radiation has also been studied.

In collaboration with the University of Illinois, Mississippi State University and the National Center for Atmospheric Research, the UVMRP is developing an integrated impact assessment system that couples the Earth-climate, ultraviolet-visible solar radiation and crop growth models, as well as assimilates satellite and in *situ* observations, to better understand and ultimately predict climate-crop interactions.

Dr. Rich Grant of Purdue University measures enhanced UV-B using a UVMRP sensor.

In particular, the UVMRP is developing a computer model to quantify the impacts of important environmental stressors (including temperature, moisture, nutrients, UV radiation, CO_2 concentration, aerosols and other air pollutants) on crop yield and quality. This will facilitate model sensitivity studies that provide information on crop responses to regional climate variability and changes. Model predictions will enable decision makers and producers to determine optimal cultural practices, assess potential risks, and identify risk management strategies. Model results will be directly validated using the UVMRP's UV, PAR, and radiation data.

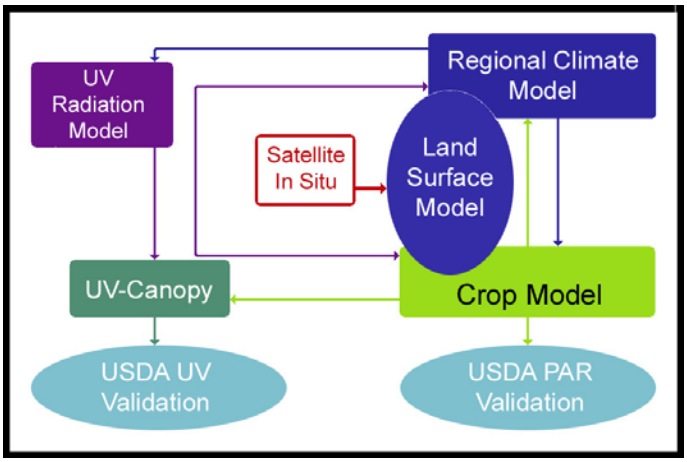


Diagram of coupled soil, plant, and atmospheric crop growth model

Scholarship

The senior staff of the UVMRP promote UV-B studies via peer-reviewed publications, graduate education, conferences, and workshops. The Director, Dr. James Slusser, and Research Scientist Dr. Wei Gao, have chaired a dozen national and international conferences on UV and Remote Sensing applications in agriculture, and are co-editors to several special journal issues on UV research.

UV-B Monitoring and Research Program
USDA

Natural Resource Ecology Laboratory

Colorado State University
Knowledge to Go Places