Project SUN (Students Understanding Nature)

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Preface:

Project Sun Is part of NASA's "Mission to Planet Earth" education outreach effort. Project Sun is based on the development of low cost, scientifically accurate instrumentation and computer interfacing, coupled with old Apple II computers as dedicated data loggers. Included in a "SUN" klt , besides the instruments and Interfacing, is appropriate software and curriculum, a detailed operating manual and a system of' inservice training at the school sites. Secondary students all over the world will be contributing to the long term, time resolved monitoring of both visible and UV solar surface radiation. The following article was written by the students and teacher at Alta Loma High School, the first "SUN" school.

Introduction:

Students in Project SUN (Students Understanding Nature), began collecting data from Alta Loma High School In January 1995, however preparations to bring this project to Alta Loma High School began as early as October of 1994, Aside from obtaining the necessary equipment for collecting data, a team of students with the necessary scientific and academic backgrounds needed to be assembled. This team was chosen by the faculty involved in the project. The purpose of this project is to collect data on the effects of clouds and other atmospheric conditions on ultra violet and visible solar radiation.

Richard Huynh, Marcos Rodriguez

Procedure:

In order to acquire both the UV and visible solar energy, a silicon pyranometer cell must be placed on a level surface. There should be no interference between the pyranometer and the sun. After setting this up, the computers must be setup and calibrated. Calibration of the VIU is necessary In order to receive the correct value for Incoming visible, and UV radiation.

Heather Lemkau

At 7:00 AM the two pyranometers are set up by the students on the roof while the technical team sets up the computers. These instruments remain on the roof for a seven hour period, and are removed at the end of the day. UV radiation is calibrated in milliwatts per square meter and visible is calibrated in watts per square meter. The instruments were first calibrated by Dr. Yanow by comparing the Instruments to a more sensitive device. The date, time, and file name are then recorded in the station journal. Each member of the team is responsible to record the data In their personal journal.

Jared West

Student Responses:

My part in this project is to come in at 7:00 AM on Wednesday morning, and measure the temperature, relative humidity and note the type of clouds. I also will note any other conditions such as smog, fog, cloud coverage, sky color, wind direction and speed. and record them in the station journal. We have noticed some interesting things iike some clouds increase the UV radiation but do not effect the visible. So far it has been a very interesting project, I see great potential for this project, I am glad to be a part of it.

Jenelle Gaxiola

Project SUN enables us to enhance our observation skills. We manually take accurate readings of weather conditions such as temperature, relative humidity, wind speed and direction. Our time out of doors also enables us to study the structures of clouds and observe how clouds effect our readings in the computer.

For instance on clear days or days with onty thin clouds, a smooth graph is present meaning there is no interference In the atmosphere, such as smog, dust, or clouds. Thus on clear days the UV and visible solar radiation gradually Intensify and peak at noon when the sun is directly over head. Then the graphs drop off or dip later in the afternoon. On days when there have been iow clouds and/or cloud types such as stratocumulus and altostratus, we have noticed a corresponding jagged graph. This seems to be due to the fact that the solar energy and UV radiation have been reflected off the clouds and back into the atmosphere. This occurrence can be seen in the sudden drops on the graph. As time progresses, as the clouds move, there are areas of thinner cloud covering where more UV and solar radiation penetrate through, resulting in an inclination on the graph. Higher humidity aiso seems to cause a jagged graph from the interference of water molecules. On clear days with low humidity, the curve of the graph is very smooth. Another factor Influencing the shape of the graph, is the color of the sky, the deeper the blue of the sky, the higher the UV radiation.

Yani Chang, Megan Gaiefsky, Priya Philipose

After gathering the data produced by the UV equipment, Project SUN students analyze, store, and share their findings with Dr. Gilbert Yanow, "Gil", 01 JPL educational outreach.

Aita Loma

He, like Project SUN students, records and observes the conditions in which the UV index fluctuates. Both of the discoveries of the students of Project SUN and Gil are studied, researched, and compared to the results of experimentation in schools in L.A., Australia, and Canada.

Mack Anderson

Teacher Comments:

When Gil came out for his second visit, he gave a presentation to the students on Project SUN, Ohm's Law and black body radiation. The students were so charged up after the presentation that they wanted to get started the next morning. That morning the students worked in groups and came up with their own plan. **They decided to break up into four teams, two morning teams and two afternoon teams.**

In December right before the winter break Gil came out for his third visit to help the students set **up the equipment. The technical team stayed** with hlm until 5::30 PM working on the software and other equipment, at this time the pyranometers were not on the roof . The next step was to find a suitable location on campus **for the instruments. After a brief meeting with** all teams present the roof on building A was selected.

When Gil cared back in January, Project SUN **was off and running! It was** an exciting time for the students because now they could compare **their data to that of a real live physicist. The** students then met in the conference room and discussed their findings with Dr. Gil Yanow.

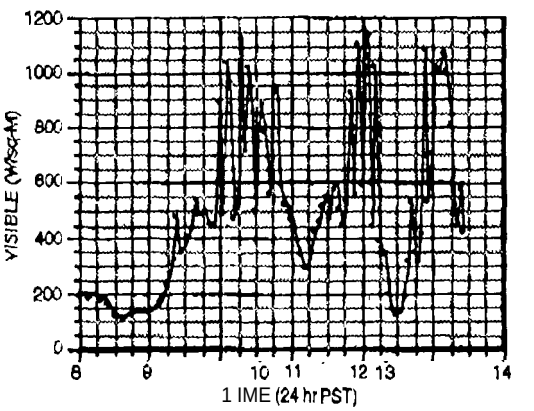
What is exciting for me as a science instructor is to observe the students doing SCIENCE. They are treated and respected as scientists. They have to come up with the questions and the answers, I am there as a resource to help them find the materials they need. One of the resources that the students are using is the internet. Information on local weather cloud coverage and the UV index are readily available daily on the internet.

Tom Curley

JPL Advisor Comments:

The students have been building their skills in the taking of data. It should be pointed out that the task they are doing is not easy and requires thought, skill, patience and a lot of critical thinking. Here is an example of data the students have been taking.

ALTA **LOMA HIGH SCHOOL 4 MAY 199S**



The above curve is **of** the visible light. As can be seen May 4, 1995 was a cloudy day. However, the

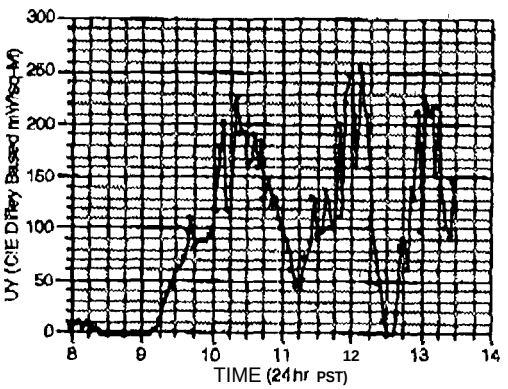
Sun did come out between 10:00 AM and 11:00 AM and again for a few minutes about 12:00 PM and 1:00 PM. When there are clear sky conditions, the maximum sunlight at about noon is usually 1000 W/sq-M or less. The very high values recorded were due to the enhancement of the surface radiation by reflection and refraction by the clouds.

The data for the ultraviolet shows generally similar behavior as the visible, but there are differences in detail and ,of course, value. The EPA daily predicts the UV index. This is the **average value of** U V predicted for the time period of 11:30 to 12:30 for a clear sky. Each unit of the UV Index is 25 milliwatts per square meter (mW/sq-M). Prediction for this date was 7 or 175 mW/sq-M. As can be seen when the clouds parted, the UV dramatically jumped in value, just as did the visible light. For a short period about noon, the cloud enhancement produced UV readings in excess of an index value of 10,

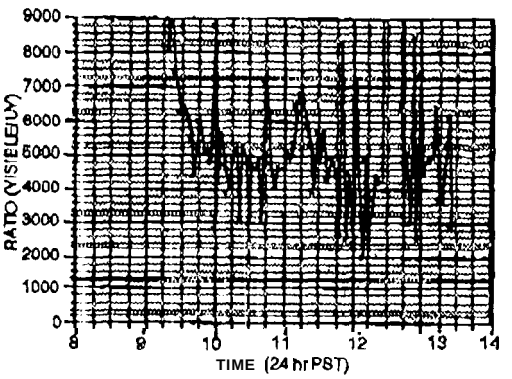
This short period jump in the UV radiation as been seen by many observers. One should be aware of this possibility because of possible eye damage. The students have reported the kind of cloud conditions that could give one warning that this phenomenon might appear, i.e. "On days when there have been low clouds and/or cloud types such as stratocumulus and altostratus, we have noticed a corresponding jagged graph."

The third graph is a plot of the ratio of the amount of visible light to UV radiation. On what might be thought of as a summer day in Los Angeles, one could record the maximum visible light reading at about 1000 watts/square meter and UV at about 250 milliwatts/square meter (a UV index of 10) to produce a ratio of 4000, If the value of the ratio is higher it means that the mix of surface radiation has less UV. On a winter day, one might still get near the same value of visible light, but the UV radiation could be down at 100 milliwatts/square meter or less (UV index of 4 or less), The ratio would then jump to 10,000,

ALTA LOMA HIGH SCHOOL 4 **MAY 1995**



ALTA LOMA HIGH SCHOOL 4 MAY 1995



As can be seen In the above graph, up to about 9:30 AM the ratio was

well in excess of 9000, indicating lower amounts of UV. However, for a short period of time with the sky condition of this date (shortly after noon) the ratio dropped to an amazing value of about 2000. To produce this on our "normal" summer day would require a UV index of 201

Dr. Gil Yanow, Jet Propulsion Laboratory