

Globe Grows Darker as Sunshine Diminishes 10% to 37%

By KENNETH CHANG

In the second half of the 20th century, the world became, quite literally, a darker place.

Defying expectation and easy explanation, hundreds of instruments around the world recorded a drop in sunshine reaching the surface of Earth, as much as 10 percent from the late 1950's to the early 90's, or 2 percent to 3 percent a decade. In some regions like Asia, the United States and Europe, the drop was even steeper. In Hong Kong, sunlight decreased 37 percent.

No one is predicting that it may soon be night all day, and some scientists theorize that the skies have brightened in the last decade as the suspected cause of global dimming, air pollution, clears up in many parts of the world.

Yet the dimming trend - noticed by a handful of scientists 20 years ago but dismissed then as unbelievable - is attracting wide attention. Research on dimming and its implications for weather, water supplies and agriculture will be presented next week in Montreal at a joint meeting of American and Canadian geological groups.

"There could be a big gorilla sitting on the dining table, and we didn't know about it," said Dr. Veerabhadran Ramanathan, a professor of climate and atmospheric sciences at the University of California, San Diego. "There are many, many issues that it raises."

Dr. James E. Hansen, director of the NASA Goddard Institute for Space Studies in Manhattan, said that scientists had long known that pollution particles reflected some sunlight, but that they were now realizing the magnitude of the effect.

"It's occurred over a long time period," Dr. Hansen said. "So it's not something that, perhaps, jumps out at you as a person in the street. But it's a large effect."

Satellite measurements show that the sun remains as bright as ever, but that less and less sunlight has been making it through the atmosphere to the ground.

Pollution dims sunlight in two ways, scientists theorize. Some light bounces off soot particles in the air and goes back into outer space. The pollution also causes more water droplets to condense out of air, leading to thicker, darker clouds, which also block more light. For that reason, the dimming appears to be more pronounced on cloudy days than sunny ones. Some less polluted regions have had little or no dimming.

The dynamics of global dimming are not completely understood. Antarctica, which would be expected to have clean air, has also dimmed.

"In general, we don't really understand this thing that's going on," said Dr. Shabtai Cohen, a scientist in the Israeli Agriculture Ministry who has studied dimming for a decade. "And we don't have the whole story."

The measuring instrument, a radiometer, is simple, a black plate under a glass dome. Like asphalt in summer, the black plate turns hot as it absorbs the sun's energy. Its temperature tells the amount of sunlight that has shone on it.

Since the 50's, hundreds of radiometers have been installed from the Arctic to Antarctica, dutifully recording sunshine. In the mid-80's, Dr. Atsumu Ohmura of the Swiss Federal Institute of Technology in Zurich sifted through the data to compare levels in different regions. "Suddenly," Dr. Ohmura said, "I realized it's not easy to do that, because the radiation was changing over time."

He recalled his reaction, saying, "I thought it is rather unbelievable."

After an analysis, he was convinced that the figures were reliable and presented his findings at a scientific conference.

Asked about his colleagues' reaction, Dr. Ohmura said: "There's no reaction. Very disappointing."

At that time, Dr. Gerald Stanhill of the Israeli Agriculture Ministry noticed similar darkening in Israel.

"I really didn't believe it," Dr. Stanhill said. "I thought there was some error in the apparatus."

Dr. Stanhill, now retired and living in New York, also looked around and found dimming elsewhere. In the 90's, he wrote papers describing the phenomenon, also largely ignored. In 2001, Drs. Stanhill and Cohen estimated that the worldwide dimming averaged 2.7 percent a decade.

Not every scientist is convinced that the dimming has been that pronounced. Although radiometers are simple, they do require periodic calibration and care. Dirt on the dome blocks light, leading to erroneous indications. Also, all radiometers have been on land, leaving three-fourths of the earth to supposition.

"I see some datasets that are consistent and some that aren't," Dr. Ellsworth G. Dutton, who heads surface-radiation monitoring at the National Oceanic and Atmospheric Administration, said. "Certainly, the magnitude of the phenomenon is in considerable question."

Dr. Beate G. Liepert, a research scientist at the Lamont-Doherty Earth Observatory of Columbia University, has analyzed similar information and arrives at a smaller estimate of the dimming than Drs. Stanhill and Cohen. Dr. Liepert puts it at 4 percent from 1961 to 1990, or 1.3 percent a decade. "It's a little bit the way you do the statistics," she said.

A major set of measurements from the Indian Ocean in 1999 showed that

air pollution did block significant sunlight. Following plumes of soot and other pollution, scientists measured sunlight under the plumes that was 10 percent less bright than in clear air.

"I thought I was too old to be surprised by anything," said Dr. Ramanathan, who was co-chief scientist of the projects.

Dr. Ohmura said he hoped to finish his analysis of the numbers since 1990 by late next month or early July.

"I have a very strong feeling that probably solar radiation is increasing during the last 14 years," he said. He based his hunch, he said, on a reduction in cloud cover and faster melting rates in glaciers.

But clearer, sunnier days could mean bad news for global warming. Instead of cloudiness slowing rising temperatures, sunshine would be expected to accelerate the warming.

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