Verner Edward Suomi, a friend and colleague of many people around the world, died on 30 July 1995. A tribute to Vern was published in the October 1995 issue of the Bulletin. At the suggestion of several people, Richard Anthes submitted a personal essay based on some of his interactions with Vern that he wrote for the Fall 1995 issue of the UCAR Quarterly. It is reproduced below in its entirety.

A Tribute to Verner Edward Suomi

On 3 April 1995, a Pegasus rocket launched a small research satellite into a circular orbit of about 750 kilometers altitude. The disk-shaped satellite, which circles the earth every 100 minutes, carries a laptop-sized GPS (Global Positioning System) radio receiver to demonstrate sensing of the terrestrial atmosphere by a limb sounding technique. Each time this receiver rises and sets relative to the 24 operational GPS satellites, the GPS radio waves transect and are bent (refracted) by successive layers of the atmosphere before they reach the receiver. Thus, during each occultation, a vertical profile of refractivity is obtained. The refractivity is a function of pressure, temperature, and water vapor; GPS/MET (GPS/Meteorology) thus provides information on these variables that has the potential to be useful in weather prediction and weather and climate research. The GPS/MET story is being told elsewhere; in this essay I describe one aspect of this program that touched me personally. GPS/MET was responsible for a renewal of my friendship and collaboration with the pioneer of satellite meteorology, Verner Suomi, who died at the age of 79 on 30 July 1995.

My first significant interaction with Vern was in 1965 at the University of Wisconsin—Madison in a graduate seminar in satellite meteorology. In those days satellite photographs from the TIROS series of satellites were mailed to Madison from Washington; they usually arrived a day or two after they were taken. But even with this delay and the relatively poor quality of the photographs, Vern’s enthusiasm and vision about the future of satellites and their unique role in studying the atmosphere were contagious and compelling.

Over the next 30 years our paths crossed from time to time, especially during Vern’s tenure as a UCAR trustee from 1983 to 1988. My last interactions with Vern began in January 1995, when I visited him in Madison to discuss the GPS/MET experiment. Even before the successful launch, Vern was a strong and effective advocate of the experiment and was planning far ahead for his participation in the development of improved retrieval algorithms and the analysis of the data.

We continued our discussions over the next few months, and in May Vern participated in the production of a video describing GPS/MET and its potential. His excitement and enthusiasm came across strongly in this video, in spite of his deteriorating health.

My last contact with Vern was by telephone on 25 July, when he was in the hospital and was not expected to live for more than a few more days. He had asked that there be no further treatment or extraordinary measures taken to prolong his life. In our conversation, which lasted almost an hour, Vern was way ahead of me, as usual.

After expressing warm greetings and thanks for calling him, he jumped into a discussion of GPS/MET, saying the first results were extremely exciting and encouraging to him. He was, however, concerned about the loss of signal in the lower troposphere due to water vapor creating multiple radio wave paths. He thought we could make a guess at the water vapor and temperature structure, compute the ray path that would occur given this structure, and then select, based on this guess, the nearest path from the several that might be the actual one.

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He then launched into a minilecture on how his experimental floating instrument to measure heat flux over the ocean was working—very well, he said, measuring the fluxes with an accuracy of 2–3 W m$^{-2}$. The only problem was that birds used the instrument to rest on, and this adversely affected the measurements.

Finally, he returned to a topic of lifetime interest to him: the hydrologic cycle. He reminded me of how important water vapor and evaporation are in the earth’s surface energy budget by telling me of his experience in Nebraska many years ago. On 21 June, with the sun as high in the sky as it gets, the daily temperature range over a dark green, wet cornfield was 15°C. Later that season, in September, when the sun was much lower in the sky but after the field and atmosphere had dried out, the daily temperature range was 30°C—twice the June value.

Enthusiastic and positive to the end, Vern’s voice was strong and his confidence and intellect as great as ever. He closed by saying that he had enjoyed his life immensely, had no regrets, was leaving many other competent scientists behind to carry on, and was ready to say good-bye.

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Description of a Complete (Interpolated) Outgoing Longwave Radiation Dataset

1. Introduction

Estimates of outgoing longwave radiation (OLR) from National Oceanic and Atmospheric Administration (NOAA) polar-orbiting satellites (Gruber and Winston 1978; Gruber and Krueger 1984) are often used to distinguish areas of deep tropical convection and to estimate the earth’s radiation budget. The National Environmental Satellite Data and Information Service (NESDIS) of NOAA archives the data onto 2.5° lat x 2.5° long grids. The two grids per day correspond to the daytime and nighttime orbits. The local equatorial crossing times have changed over the years (Gruber and Krueger 1984).

One problem in using these data is that missing grids, and missing values within grids, are often present, presumably owing to satellite problems, archival problems, or incomplete global coverage. When a grid is incomplete, but not entirely missing, the missing values are completed by a nearest neighbor spatial interpolation. These interpolated values are flagged as negative. Missing values tend to occur in “swaths.” Thus, when the number of missing values is large, the resultant errors are large as well, because of the large distance over which a value is interpolated. This problem is evident in Fig. 1a, which shows the NESDIS estimate of the OLR field for the daytime pass of 24 January 1979. On this date 6837 (out of 10 224) values were flagged as interpolated. Clearly, the field is too smooth east of 90°E. Figure 1b shows the field after missing values have been interpolated by the algorithm described below, in which missing data are primarily interpolated in time. This field is seen to appear more realistic and at least captures the low-frequency phenomena.

The point of this note is to describe a dataset that is available to the public. Missing values have been removed by temporal and spatial interpolation, except for the gap between 17 March and 31 December 1978.

2. Preliminary analysis

Before interpolation, we remove any data that are likely to be erroneous, subject to the following criteria:

1) less than 50 W m$^{-2}$
2) from 90°–60°N, and from 45°–90°S; daytime values greater than 325 W m$^{-2}$; nighttime values greater than 300 W m$^{-2}$
3) from 57.5°N–42.5°S; daytime values greater than 400 W m$^{-2}$; nighttime values greater than 300 W m$^{-2}$.

The data are next subjected to a spatial “buddy” check, such that any value cannot deviate too far from the surrounding grid points. The criterion differs depending on how many of the surrounding values are missing. If none of the eight values (including the grid points on the diagonals) surrounding a grid point are missing, then the center value is set to missing if it is more than 49 W m$^{-2}$ above or below any of its neigh-
FIG. 1. OLR field for daytime crossing of 24 January 1979. Contour interval is 25 W m\(^{-2}\). (a) Missing values interpolated spatially by NESDIS. (b) Missing values interpolated temporally and spatially by technique described in text.

If one surrounding value is missing, the limit is ±52 W m\(^{-2}\), two missing =±55 W m\(^{-2}\), etc. This check continues until a maximum of five surrounding values may be missing, in which case the limit is ±64 W m\(^{-2}\). There is no check if six–eight points surrounding a point are missing. The rationale for increasing the difference limit as the number of surrounding values decreases is that we believe it is unlikely that if all surrounding values are close together, the value at the center point should deviate significantly from any of its neighbors. On the other hand, if a grid point is on the edge of a region of missing values, and it is also a region of large gradient (e.g., a land–ocean boundary), there is a distinct possibility that the value at a grid point should actually be quite different than its neighbors.

Figure 2 is a time series of the percent of missing values for each month from 87.5°N to 87.5°S for both daytime and nighttime crossings for 1974–94. The percent missing from 30°N to 30°S (generally considered to be the region where low OLR values are indicative of convection) is quite similar to the global value. Figure 3 shows the

![Figure 2](image_url)

**Fig. 2.** Time series of percent of missing values for each month. Solid curve represents daytime crossing and dashed curve represents nighttime crossing: (a) 16 March 1978–1 June 1994, (b) 1979–82, (c) 1983–86, (d) 1987–90, (e) 1991–94. Count includes values at poles (put on grid) and values deemed unrealistic (see text).
adjacent value present and continue to run that program until all missing values are filled. We then run the spatial buddy check once more to make sure there are no spurious values and if there are, fill them in with spatial interpolations. Finally, daily averages are computed from the complete twice-daily fields.

4. Description and availability of data

The datasets are available in both SUN binary and netCDF formats from the anonymous FTP site ftp.cdc.noaa.gov under/Datasets/interp_OLR. See the README file in that directory for more information. Any changes made to the algorithm described above will be explained in the README file. Further information also is available at the URL http://www.cdc.noaa.gov/cdc/data.interp_OLR.html.

Other available datasets are the twice-daily interpolated and uninterpolated fields, and interpolated daily averages, further interpolated onto a 128 x 64 Gaussian grid. Please contact the authors to access these datasets.

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References


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Comments on “Understanding the Greenhouse Effect and the Ozone Shield: An Index of Scientific Literacy among University Students”

The study by Morgan and Moran (1995) of the scientific literacy of the college educated population shows discomforting misinformation on issues entailing putatively upsetting consequences for life on our planet. It is my view that the confusion about the so-called greenhouse effect starts with a scientific misconception. The premise for information transport is to assign the correct word for a notion. Scientists have adopted the popular term “greenhouse effect” to define warming produced by gases transparent to solar radiation but opaque to terrestrial electromagnetic emission. This radiative filter elevates the average temperature of the earth surface nearly 20°C above that of a planet in the same solar orbit but without an atmosphere. Yet, this warming has nothing to do with the heating observed in a greenhouse. Whether the cover material is glass (opaque to terrestrial emission) or polyethylene (transparent to terrestrial emission), solar radiation warms greenhouses to the same temperature (Dayan et al. 1986). Businger (1963) explains that the cover material impedes convection quoting Wood (1909) for an early experimental proof for the true nature of the greenhouse effect. Stanhill (1991) already warned that the misnomer was not only a question of semantics, but a source of confusion that would affect the public perception of the problem. The article by Morgan and Moran proves that he was right.

The greenhouse effect is deeply encroached among atmospheric scientists as well as the scientifically literate public. But it is wrong. Bad habits can be rectified. I propose that journal editors encourage replacing greenhouse effect by “radiative filter effect” or any other appropriate terms that would convey more accurately the nature of the process.

References


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Reply

We wholeheartedly agree with Dr. Fuchs’s contention that the greenhouse analogy is seriously flawed and inappropriate. Furthermore, we make this point in lecture as well as in our survey-level textbook (Moran and Morgan 1994, p. 52). In an ideal world, greenhouse effect would be replaced with a more scientifically sound term such as Dr. Fuchs’s radiative filter effect. However, the term greenhouse effect has received considerable play in the popular and scientific media and pervades scientific and nonscientific discussions of global change. Hence, in surveying our students early on in the semester, we used terminology with which they were familiar. Later in the course, we address the failings of the analogy. Hopefully, our students leave the course with a better understanding of the radiative processes involved in elevating the planet’s surface temperature.

References


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