Complete PostScript: An Archival and Exchange Format for the Sciences?

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Despite the rapid expansion of the Internet and the promise of easy and fast dissemination of information, much of the results of science are published in a form similar to a paper journal article, albeit online. In particular, it is often very difficult or impossible for readers to check the validity of the author’s claims, since the software used and the raw data analyzed are not necessarily available.

Admittedly the Web has made it possible for authors to post links to data sets and programs, and many journals allow additional material to be posted in conjunction with the publication of an article. But in reality, it is still difficult to verify author results without expending a considerable amount of effort. The Web has opened up new avenues for interactive presentations of knowledge in which the user can explore new theories or data sets, but only a small group of authors have the technical resources to present their results in such an interesting fashion.

Very often, scientific illustrations convey the essence of scientific results. However, while the illustration may display how a data set or model predictions vary, it is difficult to “back out” this information from the illustration unless data and programs are available from the journal’s or author’s Web site. Worse, years later, it may be hard to find a version of the script or program that works in the original way. To facilitate the exchange of scientific ideas and results, I propose that all information needed to re-create a scientific illustration be part of the illustration file. One implementation of this ideal goal is presented here.

Apart from photographs and remotely sensed imagery, the Encapsulated PostScript File (EPS) is the dominant format for scientific illustrations. Numerous tools exist for making such files from diverse data sets. A useful property of EPS files is the ability to contain comments. This opens up the possibility of storing all the needed information—programs, scripts, data—as highly compressed PostScript comments. The resulting EPS files are called Complete PostScript files (CPS), and the recipient of a CPS file can easily extract all the information needed to recreate the original illustration. Scientists may then scrutinize the results, modify parameters, perform exploratory data analysis, and even easily employ the published data in their own research.

An electronic supplement to this article containing more details about the CPS package may be viewed at http://www.agu.org/eos_elec/000381e.html. This is SOEST contribution 6219.

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FORUM

Comment on “Are Noctilucent Clouds Truly a ‘Miner’s Canary’ for Global Change?”

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A recent Eos article [von Zahn, 2003] has challenged the notion that Noctilucent Clouds may be a “miner’s canary” of global change [Thomas, 1996]. We first note our terminology: We use the generic term Mesospheric Clouds (MC) to denote this phenomenon encompassing both the terms Polar Mesospheric Clouds (PMC) and Noctilucent Clouds (NLC). In this article, we address his specific criticisms on a point-by-point basis. We critically address his assertion that available data sets derived from satellite measurements of cloud radiance are too short for assessing long-term trends. We argue that his inference of large and irregular natural variability of MC is based on statistically-unreliable “without provision of a convincing argument.” However, we note that the authors themselves [Fogle and Haurwitz, 1966] stated that “the apparent variation in the number of NLC reported per year is likely due more to the fluctuating interest in NLC over the years than to a real variation in NLC activity.” Given the systematic differences between the three NLC data sets in von Zahn’s Figure 1, it is clear that they are not directly comparable. We question whether the authors or record support the claim that the “irregular” behavior of MC rules out the inference of long-term trends in current satellite data sets. In any case, the quality of surface observations should not be the basis for assessing the satellite data record.

A robust feature in all recent ground-based data sets is a 10–11-year periodic component in the long-term occurrence frequency. Since this variation is also observed in satellite data covering both hemispheres (considered here), this result is likely to be a global phenomenon. Far from being an “irregular behavior,” as von Zahn claims, this cyclic component is repeatable. We have previously shown [DeLand et al., 2003] that the solar UV variations are largely responsible. This component can be largely represented in existing time series by a conventional regression technique. Here we apply the same technique to an updated Solar Backscattered Ultraviolet (SBUV) data set for cloud albedo.

Panels (a) and (b) of Figure 1 show seasonally-averaged MC albedo in the nadir from a series of six polar-orbiting experiments, the SBUV and SBUV2 series. Shown also is the seasonally-averaged solar Lyman-α irradiance, the primary solar forcing for the upper mesospheric region (above 75 km). The SBUV spectrometers detect overlying MC as increases in the Earth’s UV albedo in the summertime polar regions. Cloud albedo is defined as (cloud brightness)/ (solar irradiance), both quantities measured at 252 nm. The seasonally-averaged albedo \( A_a \) was obtained from the data in the DeLand et al [2003] paper using the relationship

\[
A_a = A_{\text{max}} - 1/\beta
\]

\( \beta \) is the slope of the seasonally-averaged albedo distribution (a negative value). This equation is derived by integrating the exponentially-varying distribution (weighted by the albedo itself) over all values above a conservatively chosen threshold \( A_{\text{max}} \), which is the threshold used in calculating the values of \( \beta \) [DeLand et al., 2003]. In this article, we use albedo because it more easily compares with physical models than the usual frequency of occurrence. Panel (c) shows the results of fits to the albedo data using a three-term multiple regression: a constant, a term proportional to the solar irradiance, and a term linear in time. Highly-significant (99% confidence) trends are present in both the northern hemisphere (NH), \(+3\pm1%/\text{decade}\), and in the southern hemisphere (SH) \(+7\pm0.9%/\text{decade}\). The anti-correlation with the solar irradiance is also highly significant, for a time lag of 1.0 year (see DeLand et al [2003] for more details). Strong interdecadal trends are also present in additional independent sets of satellite data [Shettle et al., 2002a,b].