

The Arctic Observatory CD-ROM: An Interactive Approach to Access and Demonstrate Scientific Data and Information

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This paper is an introduction to the Arctic Observatory CD-ROM that accompanies this special issue. The data and information upon which this CD-ROM is based was derived from a prototype geographical information system (GIS). A simple graphical user interface (GUI) was developed specifically for the presentation of the GIS data and information in an educational environment. However, the utility of efficient access to a large volume of browse data of multiple parameters extends beyond the educational context. This effort is an example of how researchers can place their data and information in a format that is available for examination by others in the field, non-experts, and students interested in the field of study. To demonstrate the utility of the Arctic Observatory CD-ROM for research purposes, we analyzed a specific anomaly in ice concentration values which came to our attention during our tests of the GUI. © 1997 Published by Elsevier Science Ltd. All rights reserved

Introduction

The CD-ROM, called The Arctic Observatory was targeted for the educational community and deals with Arctic phenomena and processes. It allows the user to investigate questions about interrelationships between several physical aspects of the Arctic region. The CD-ROM is available from the United States Global Change Research Information Office by sending an electronic mail message request to help@gcrio.org. The contents of the CD-ROM can also be downloaded from the World Wide Web at <http://www.circles.org/ESSC/resources/resources.html>.

The Arctic Observatory, was developed as a proof-of-concept multimedia science tool designed to enable investigations of Arctic processes. Users can examine relationships between surface temperature, ice concentration, near surface winds, ice velocity, and cloud cover over a six year period. Although the number of

parameters is limited to five, users can pursue a variety of questions using these data. The Arctic Observatory provides the user with contact points on the World Wide Web which can add to the user's resources for a research project or a student laboratory exercise. The CD-ROM also contains HTML files that range from a glossary of terms to published articles by scientists from the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (Parkinson *et al.*, 1987).

CD-ROM Installation and Operation

The CD-ROM can be run on a Macintosh platform or an IBM PC compatible with Microsoft Windows 3.1 or Microsoft Windows 95. For operation on a Macintosh platform, operating system 7.1, a 68030 processor, and 8 Megabytes of RAM are minimum requirements. For Windows operations, a 80486 processor and 8 Megabytes of RAM are minimum requirements.

To install the software under Windows, quit all other software applications, then run the Arctic Observatory installer program. The installer program will set up and install NCSA Mosaic on the computer for use with the Arctic Observatory. NCSA Mosaic is a World Wide Web browser which is included on the CD-ROM to enable access to documents which are in the HTML format. NCSA Mosaic is installed in a 'standalone' mode, so that the user need not be connected to the Internet.

To install the software under the Macintosh operating system, quit all other software applications, then double click on the Arctic Observatory icon on the CD-ROM. It is not necessary to install NCSA Mosaic or other files to the hard disk drive.

The CD-ROM enables the user to view five satellite-derived parameters related to the Arctic environment including surface temperature, sea ice concentration, cloud amount, near surface winds, and sea ice velocity.

The dual-screen interface enables the user to compare and investigate relationships among these parameters in a number of ways, including comparisons of a given parameter on different dates, comparison of different parameters on the same date and time-series animations of a single parameter.

Some of the control features are described here, however, the user is directed to the 'readme' files available on the CD-ROM for further explanation. A 'visualize' button allows the user to view data for a single parameter in a specific month and year. The viewed parameter is changed by clicking on the current parameter, which opens a panel that lists five parameters, then selecting the desired parameter to view. Similar operations are associated with the month and year. Once selections are made, clicking on the 'Do It!' button executes the selection. Similarly in operation is the 'animate' button which allows the user to view one parameter over time.

There are five buttons to the left of the Observatory data viewing windows, arranged vertically. These allow the user to view different thematic maps of the Arctic region in addition to access some detailed information about the data being viewed in the Observatory by launching NCSA Mosaic and linking to the appropriate text pages. All resource documents on the Arctic Observatory CD-ROM are available as HTML files and can be viewed by using any World Wide Web browser. NCSA Mosaic is included on the CD-ROM and will launch automatically from within the Observatory if properly installed with sufficient available memory.

Each browse image pixel on the CD-ROM represents a 25 kilometer square and an associated value can be read using the 'sample' button. This feature is insufficient for some investigations of the data for which original images and ancillary software is required.

These are available on the World Wide Web at <http://www.circles.org/ESSC/resources/resources.html>.

Browse data visualizations can be misleading to the lay person. A quantitative approach must be noted as the only approach from which conclusions can be drawn. One issue easily noted is that visualizations may originate from different sensors and satellites.

Conclusion

Unfortunately, anyone using the Arctic Observatory CD-ROM may come to an invalid conclusion based upon the data visualizations provided. This highlights a problem that may occur when other Earth Observing System (EOS) data and information is made available through a readily usable format, such as the Arctic

Observatory, to the general public and decision makers.

Only after a more detailed analysis using proper statistical techniques does it become evident that visualizations can mislead to invalid conclusions. For example, examination of the visualizations on the Arctic Observatory may lead a lay person to conclude that there is an increase in sea ice extent, during the month of July, between the years 1985 and 1990. Counterintuitively, there also appears to be a decrease in the sea ice extent in the Arctic during the years 1979 and 1986 in the month of December (Geller, 1996).

Statistically valid conclusions may appear to be contradictory. There may be explanations available of which the user is not cognizant. Thus, in our example, the apparent increase in sea ice extent in the summer months was discovered not to be statistically significant. Simultaneously, it is not contradictory to the fact that there was a decrease of sea ice extent in the winter. Neither conclusion alone confirms nor denies a global warming effect. These facts may yet be indicative of global warming, as it has been reported, 'a warmer atmosphere contains more water vapor which may lead to increased snowfall and a larger ice sheet' (Gurney, 1993).

Public presentations need to express that which can be explained by the data and those issues for which further investigation is required. Only by presentation of all the facts can there be an educated public with educated public officials making educated decisions. The Arctic Observatory takes one small step towards this goal by making a variety of data available for ready comparisons within an interdisciplinary context.

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