

RAL

DESIGN & DISCOVERY

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RUTHERFORD APPLETON LABORATORY
SCIENCE AND ENGINEERING RESEARCH COUNCIL

Computer Graphics

As the power of computers increases, so does the difficulty of understanding the results they generate. Solving the problems now being tackled on computers such as the IBM 3090 and Cray X-MP at the Atlas Centre generates enormous amounts of information. An example is a program that models the whole of the world's ocean systems from 22 degrees South down to Antarctica predicting the currents, the temperature and the salinity at approximately 160,000 locations in 32 vertical layers.

To visualize this vast amount of information the scientist needs more than pen and graph paper. The power of the computer can be re-used to display the results, producing still or moving pictures rather than just numbers. Computer Graphics today involves some of the highest performance computing engines available, allowing the scientists and engineers to analyse and visualize the answers produced by their programs.

The systems you see in the Graphics Area demonstrate a number of ways in which Computer Graphics is helping SERC researchers. They show interactive work on graphics screens, colour hardcopy output from those screens and video output produced by the Atlas Video Facility. Each has its place in the range of facilities provided by RAL Atlas Centre to the UK academic community.

SILICON GRAPHICS WORKSTATION

This system, a relatively modern graphics workstation, is capable of handling pictures in three

dimensions (3D) and manipulating them very quickly - in hardware. This allows complex 3D models of *engineering models*, *molecular structures* and *fluid systems* to be displayed very conveniently. The programs being demonstrated illustrate these types of application.

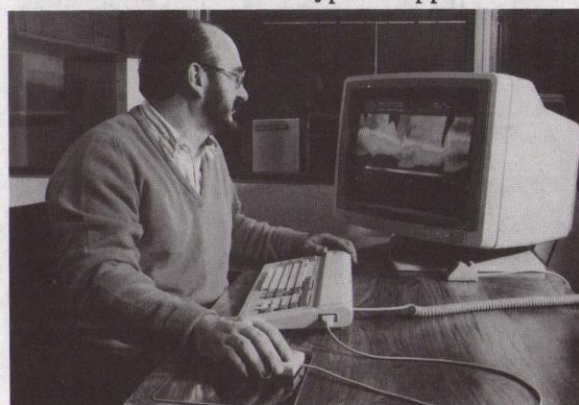


Figure 1. Simulating the ocean currents in the Southern Oceans: The FRAM (Fine Resolution Antarctic Model) runs on the Cray X-MP/416 at the Atlas Centre and simulates the behaviour of the oceans around Antarctica. Here the output is being analysed on the Silicon Graphics 3130 graphics workstation.

In addition, the Silicon Graphics is a fast device displaying images and output from the *oceanography* program FRAM. The Silicon Graphics system has recently been used by the BBC to help with the making of a new Oceanography course for the Open University.

GEOGRAPHICAL MODELLING - WANTAGE SIXTH FORM

For many years the Atlas Centre has welcomed members of various schools around Oxfordshire

into a number of collaborative development projects. Previously this was mostly through the provision of computing facilities on a Prime computer.

For this year and next, students from the Wantage Sixth Form will be working on a project combining aspects of geography, ecology and computing. They are bringing together information on *global warming*, the *greenhouse effect* and the *ozone layer depletion* and combining it with geographical information available at RAL. All this information is being presented both graphically and with accompanying text, using a Commodore Amiga computer system.

COLOUR HARDCOPY

While most scientists prefer the immediacy that working on a computer terminal provides, there are occasions when it is easier to take the results away on paper and study them - or show them to colleagues - at leisure. Colour hardcopy output can be produced from a variety of systems in the Graphics Area on the Mitsubishi printer - which handles A4 or A3 formats - or on the Versatec colour printer.

In the past there were many times when a program could be run but it produced output "in the wrong format". This problem is now being tackled by the use of the Computer Graphics Metafile (CGM) format, an international standard format for the exchange of pictures. RAL were very active in the ISO group that developed the CGM standard.

ATLAS VIDEO FACILITY

While it is possible to understand many problems from a picture seen on a screen or recorded onto paper, many more are too complex. Consider for example waves moving through a narrow channel. It is possible to show the strength of current at any one moment, but impossible to tell whether a fast current is temporary turbulence or a permanent whirlpool.

The Atlas Video Facility has been developed to solve this problem. It allows pictures of any complexity to be recorded onto video disk or tape in order, so building up animation sequences. The output may be posted back to users so that they can view it at their convenience. Alternatively the user can come to the Atlas Centre and view the output, forwards, backwards, fast or slow, directly off the video

disk and take a copy home on videotape at the end of the session.

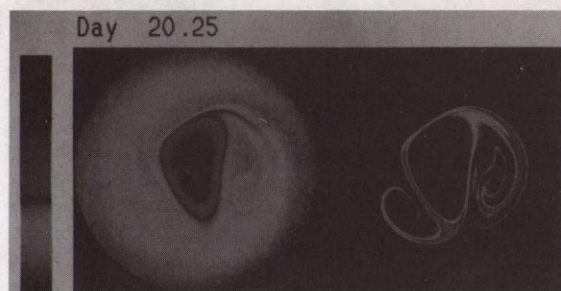


Figure 2. A simulation of chemical tracer released in the stratosphere: UGAMP (UK Universities' Global Atmospheric Modelling Project) are creating a hierarchy of models that predict the behaviour of Earth's atmosphere. Here the behaviour of a chemical tracer release in mid latitudes is shown in a frame from a video sequence made at Atlas.

In the area where the output from the video system is being shown, you will be able to see a number of video sequences produced by this facility:

1. *oceanography*, showing the way ocean currents form in the oceans around Antarctica;
2. a simulated *flight around the floor of the Indian Ocean* where three tectonic plates meet;
3. demonstration of the way chlorofluorocarbons (CFCs) cluster or disperse around the poles, affecting the *ozone layer*;
4. simulation of action of a *crank shaft*;
5. demonstrations of the behaviour of fluids, used to teach *computational fluid dynamics*;
6. *sculpture* that only exists in the memory of the computer!

COMPUTER SCULPTURES

The Atlas Centre is proud to be collaborating with the IBM Scientific Centre at Winchester, assisting William Latham in the production of animated sculptures. Some stills from William's latest work "The Evolution of Form" are shown on an IBM 5080 display. More of his work has recently been on show at the Natural History Museum in London. William uses the IBM computing facilities at Atlas to generate his sculptures and the Atlas Video Facility to preview them.