Customer Success Story

> **Industry**
Environment

> **Application**
Predictions in Climate Changes

> **Product**
PV-WAVE

The Hadley Centre for climate prediction and research, which is part of the Met office, provides a focus in the United Kingdom for the scientific issues associated with climate change. It currently employs around 100 staff and uses two Cray T3E supercomputers. Most of its funding comes from contracts with the Department for Environment, Food and Rural Affairs (DEFRA), other United Kingdom government departments and the European Commission.

Met Office

Visual Numerics
Developers of IMSL and PV-WAVE

> PV-WAVE® Used to Predict Global Climate Changes

"Before we had PV-WAVE, it was difficult to pick out relevant details from the data. Flexible data manipulation allows you to get the 'big picture,' then to zoom in on the interesting features. With PV-WAVE it's not a case of can I do it, but simply how do I do it."

Mark Webb, Cloud Specialist
Hadley Centre, UK Meteorological Office

| Quick Facts |

Climatologists at the Hadley Centre for Climate Prediction use PV-WAVE from Visual Numerics, to analyze their data and make climate predictions. Using PV-WAVE, large amounts of data can be manipulated and presented as visual images for analysis by scientific and support staff.

| The Problem |

Joint funding by the Department of the Environment and the UK Meteorological Office has allowed the creation of the Hadley Centre for Climate Prediction and Research in Bracknell. Its mission is to predict climate changes over the next 100 years. With terabytes of data to be analyzed, the centre has turned to visual data analysis to speed up the process.

Output from climate simulations runs on supercomputers combined with data from satellites, and data records, going back many decades, presents the Climate Prediction Centre with terabytes of data (that is data measured in trillions). The problem is not finding such data -- it's finding methods to analyze it.

When scientists want to analyze data as voluminous as this, there isn't a simple formula that can be used to find a simple answer. Even the most powerful supercomputer in the world will not pop out a simple yes/no answer to the most critical question ever asked -- Are we heading for a climate change or not?

The Hadley Centre would, of course, be the first to know if it were that straightforward. At their disposal is one of the most powerful supercomputers in the world - a Cray® Y-MP.

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> **PV-WAVE Key Benefits**

- Climate prediction made easy
- Large amounts of data can be manipulated
- Ability to present visual images for analysis
- Capable of mapping model data onto satellite observations
- Flexible data manipulation
- Extremely interactive environment

| The Solution |

Climatologists at Hadley use advanced visual data analysis (VDA) software, PV-WAVE from Visual Numerics, to analyze their data and make predictions. Using PV-WAVE, large amounts of data can be manipulated and presented as visual images for analysis by the most powerful interpretation machine in the world -- the human brain.

Scientific staff use powerful HP® Series 700 workstations to analyze their data. According to Alastair Sangster, the workstations must cope with some demanding tasks. "Our network configuration is such that each workstation also supports a single X-terminal, i.e., normally two users share a single CPU. This can put a heavy load on the host machine, particularly when both users are using graphics packages."

Within the Hadley Centre are approximately 100 scientific and support staff. They are divided into groups, with each group looking at different aspects of climate and climate modeling, working with different sets of data.

Mark Webb and Andy Jones, for example, are cloud specialists. It is well known that clouds can have both a warming effect and a cooling effect. They act as a blanket, keeping in warmth, but also as a barrier, stopping sun from reaching the earth's surface. To be able to provide an accurate prediction of average global temperature, the action of the clouds must be understood and built into the model. Webb and Jones use PV-WAVE software to visualize the effects. Model data can be mapped onto satellite observations, giving insight into the relationships between clouds and radiation.

| Return On Investment |

"It may sound straightforward," said Webb, "but there are many, many variables. Clouds can be bright or dark, and both long- and short-wave radiation must be considered. Before we had PV-WAVE, it was difficult to pick out relevant details from the data. Flexible data manipulation allows you to get the 'big picture,' then to zoom in on the interesting features. The interactive environment is also a great improvement, allowing the development of new analysis techniques in a fraction of the time previously required. With PV-WAVE it's not a case of can I do it, but simply how do I do it," concluded Webb.

Another area of research is the interaction between ocean and atmosphere. Simon Tett is looking at the reasons why in some years the temperature of the sea surface in the Eastern Pacific is significantly warmer than average and in other years the temperature is cooler than normal. By using PV-WAVE, Tett and others aim to build more accurate models of the oceans and understand the effects of the oceans on the climate of the world. "El Niño is a good example of this effect," commented Tett. "It is an oscillation in the temperature of the East Pacific. Depending on its status, Australia will have a wet or dry year."

Jonathan Gregory is involved in prediction of sea levels. It is a complicated problem, as several effects have to be taken into account. As the world warms, the expansion of the sea will make sea level rise. Glaciers will eventually melt, and the permanent ice sheets at the poles may eventually melt too. However, as the atmosphere warms, greater amounts of moisture will be held in the air. It is also possible that in the short term, snowfall may increase in Antarctica, producing more ice there.

The results of the Hadley Centre's work are published via technical papers and journals. Included in the work are constantly updated predictions of climate change to the end of the 21st century.

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| World Class Products, Services and Support |

For over 30 years, Visual Numerics, with its PV-WAVE and IMSL product families, has provided trusted visualization and numerical analysis tools to thousands of technical professionals in a broad range of industries around the world. Scientists, researchers, educators, engineers, developers, Intranet managers, testers and analysts use Visual Numerics' development tools to solve problems, identify trends and share results.

The PV-WAVE Family has all of the functionality you need in one tool, including an open software environment allowing for integration with new technologies, and the IMSL Library which delivers over 370 mathematical and statistical routines, creating the most powerful data analysis software available. The IMSL libraries can dramatically accelerate development by reducing programming time by up to 95%.

The PV-WAVE Family provides a broad range of easy to use, high performance solutions for any type of data challenge, while delivering significant return on investment through maximum productivity.

Visual Numerics partners with its customers to provide world-class products, services and support. We have unparalleled technical support that can answer the hard questions fast, and responsive consultants that can provide in-depth expertise and timely delivery of time-critical solutions.