Coalition of
Academic
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Centers

C A S C

HIGH PERFORMANCE COMPUTING RESTORES AND PROTECTS WATER QUALITY

High performance computing is playing a critical role in developing cost-effective strategies for preserving and restoring the quality of our nation's water supplies.

Run-off from farm chemicals and fertilization, industrial pollutants, timbering, road gas and oil, and sewage disposal are among the factors that may threaten commercial fishing and other food sources, contaminate drinking water and potentially disrupt the ecological balance that supports important forms of life.

Attempts to address these problems through traditional experimentation have been costly, time-consuming, and may run the risk of further environmental damage. Relationships between ground water flow patterns and complex geological formations are not yet fully understood, nor is the impact of ground and surface water contaminants on key biological processes.

High performance computer simulation and visualization is providing the most precise information ever available on these phenomena, enabling scientists working with university-based supercomputing centers to test the efficacy of various anti-pollution and clean-up strategies at reasonable cost and low risk:

-- Researchers at the National Science Foundation's Center for Research on Parallel Computation (CRPC) are working with the Department of Energy and other research organizations to examine various options for removing toxic waste from ground water basins -- before the ground is ever reached by contaminants.

In using massively parallel computers for petroleum research, the CRPC team recognized that their software and 3-D modeling methods could have similar applications for environmental concerns. By providing highly detailed visual and analytical information to environmental engineers and scientists, new ground water modeling methods are reducing time, cost and risk factors associated with the delicate and complex task of ground water cleanup.

-- An environmental engineering team at Cornell University has been a pioneer in applying advanced high performance computing to the detoxification of contaminated ground water. Their efforts are leading to cost-effective methods to clean up ground water by computing time-varying rates of pumping.

This team has produced an animation illustrating the impact of natural and chemical biological processes on ground water cleanup and the efficacy of various clean water programs. Such presentations are crucial for providing better understanding to diverse audiences involved in setting environmental policy.

-- When a major break occurred in a sewage outfall off the San Diego coastline in 1992, geologists at the San Diego Supercomputer Center used high performance computer-generated numerical models to simulate the movement of particles and assess sewage impact on coastal waters. They considered such variables as ocean tides, fresh water inflows from rivers, basin bathymetry, salinity distribution and meteorological conditions. This effort demonstrated how city engineers might use computer models to predict, prevent and mitigate similar accidents in the future.

The type of modeling used in the San Diego situation also can be applied in selecting preferred locations for sewage pipelines, and to studying the effects of sewage, oil or other potential pollutants transported along coastlines.

Supercomputing is the ideal tool to handle the complexities of clean water research. Ground water flow regions, for example, can be a mile or more across, yet have features such as wells and pollution sites which are a yard or less in size. Only truly advanced computers can handle this diverse range.

Likewise, supercomputer models can provide the analysis required to distinguish an urgent site from a relatively benign one. The economic benefits of such priority-setting are enormous, as are the implications for developing sound public policy.