THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN

High Performance Computing Applications, Tools, and Support

Today's research environment is faced with complex challenges — more data, increasingly complex simulations, and overwhelming analysis and storage requirements that make it nearly impossible for the researcher to accomplish the science mission efficiently. Many model simulations are no longer feasible without high performance computing (HPC) clusters or even more complex hardware acceleration systems like GPUs, cell or field programmable gate arrays (FPGA). Rapid technology change burdens the scientist using these systems with regular requirements for reporting, optimizing, and modernizing their science applications; while ever tightening budgets force the scientist to continually do more with less.

Whether you have an existing HPC system or are just adopting the technology, Northrop Grumman has the skills and experience that you need to make the most of your HPC investments. From building and operating cloud assimilation systems to simulating adaptive remote collection and processing systems, Northrop Grumman has the staff and technology to successfully complete your most complex science and engineering projects. We provide support, tools and applications to leverage HPC and high performance networking (HPN) to meet the mission requirements of customers throughout the Department of Defense (DoD), Intelligence Community, NASA, National Oceanic and Atmospheric Administration (NOAA), National Institutes of Health(NIH), Department of Energy(DOE), and other government agencies and research organizations. The following are selected examples of our capabilities and experience:

Earth System Modeling Framework (ESMF)

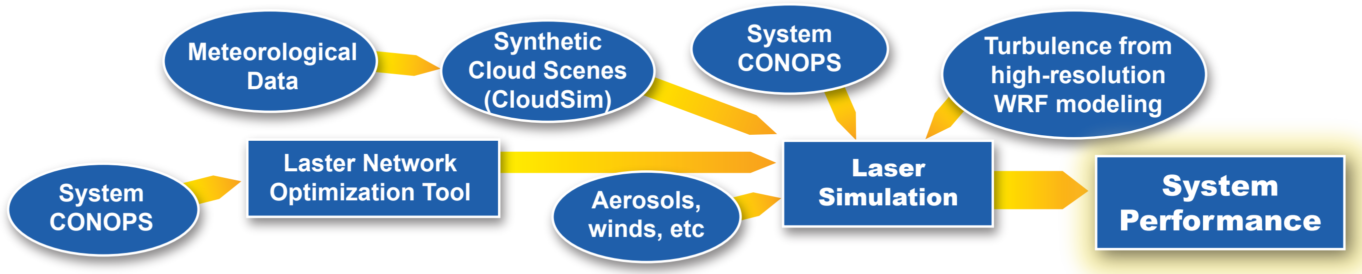
The ESMF is a community framework for building scientific models that run primarily within parallel computing environments. We worked with NASA to provide technical guidance and direction from initial conception to implementation and adoption, as a standard framework within the earth sciences community. We have also supported the integration of ESMF into parallel HPC models from NOAA (NCEP & GFDL), NASA (GMAO LIS & GMI) DOE LANL, NCAR and University of California Los Angeles (UCLA).

Optical Communication through the Atmosphere

When NASA/JPL was considering the problem of laser communications from Mars, they came to us to help them understand how to minimize communication disruptions during missions. Predicting the effects of the atmosphere on free space optical communications systems requires not only an understanding of laser communication systems, but a detailed knowledge of the atmosphere and how its clouds, dust, smoke and other pollutants effect the propagation of different wavelengths of light. Northrop Grumman uses HPC and atmospheric modeling to develop unique capabilities to assimilate high-resolution cloud properties and analyze effects on optical systems, including a historic database of atmospheric optical conditions from around the globe.

Experiment Design and Management

The time required to setup and manage scientific experiments and analyze the results can become a major bottleneck in the research process. Northrop Grumman adapted a workflow engine to automate the repetitive steps of climate modeling and data assimilation processes. We augmented the system with new capabilities that enable experiment configuration storage and management, search and comparison of experiments, flexible secure access to multiple HPC systems, and real-time monitoring



of experiment execution and results through a single intuitive user interface. This software system is currently being extended with the capability to provision dedicated on-demand circuits over optical networks, creating low latency and high bandwidth connections that can dramatically reduce the time required to setup and stage experiment applications and their associated datasets.

Global Modeling Initiative (GMI)

Integrating model components from across a community of atmospheric chemistry researchers into a single cohesive model requires both scientific understanding and well developed software design capabilities. Northrop Grumman assumed development of the GMI model in 2004. We have modernized the code, removing Fortran common blocks, establishing a regression test suit, and reorganizing the code into clearly defined ESMF model components while simultaneously adding new features and capabilities. Experiment production was automated using the experiment design and management system discussed previously. These steps greatly increased our efficiency at integrating new components from the community and reduced the staffing necessary to support the project by nearly half — saving the government hundreds of thousands of dollars each year.

pFUnit and the Fast Fortran Transformation Toolkit (FFTT)

Fortran is a key implementation language for scientific applications due to its impressive performance on mathematical algorithms. However, the software engineering tools that have revolutionized the development process for languages like Java and C++ have not been available for the Fortran developer community. Northrop Grumman is an innovator in bringing modern software design and development practices to bear on science problems and is a key contributor to the design of pFUnit, an open source parallel unit-testing framework for Fortran, and FFTT, a toolkit supporting re-factoring and modernization of legacy Fortran applications.

Giga-Particle Trajectory Project

Taking a scientific model prototype that works for a thousand particles and scaling up to a billion can be a daunting task without the right support. Northrop Grumman analyzed and converted an IDL-base particle trajectory prototype, redesigned its structure and re-implemented it in C++ using modern agile development processes and delivered it with a complete set of regression tests and integrated documentation. The application is fully object-oriented and designed to be easily modified and extended with new features and functionality. A real-time visualization capability was easily added with less than two man-weeks of effort. The resulting code executes in parallel, runs 798 times faster than the original code, and scales to over a billion particles.

Sensor Web Simulator Project

Large complex multi-discipline modeling and simulation projects require a combination of experts to succeed. Northrop Grumman worked from pre-concept studies to current implementation of the Sensor Web Simulator, a system designed to evaluate the impact of adaptively targeted observations on the weather prediction capability of atmospheric models. Partnering with NASA in a joint research effort to develop this capability, we provide the project with expertise in satellite, ground and airborne remote sensing, data retrieval, data assimilation, weather forecasting, communications and networking, HPC, software and system design, and discrete time driven modeling and simulation environments. We analyze and document the requirements, perform project design, and bring innovative implementation approaches that deliver cost saving necessary to meet a tightly constrained budget.

Leverage our expertise

Your mission's success depends on incorporating sophisticated HPC technologies seamlessly into your existing scientific or research development environment. Northrop Grumman uses HPC both internally for our own projects and for external customers. We have the domain knowledge and proven experience you need to achieve mission success.

Contact Us

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