This subtopic seeks advances in tools, techniques, and technologies for distributed information systems and large-scale numerical simulation. The goal of this work is to create an efficient and effective information and computing environment that enables NASA scientists to work naturally with distributed teams and resources to dramatically reduce total time-to-solution (i.e., time to discovery, understanding, or prediction), vastly increase the feasible scale and complexity of analysis and data assimilation, and greatly accelerate model advancement cycles. Areas of interest are described below.

### Distributed Information Systems

- **Supercomputing environment simulation**, to identify or anticipate bottlenecks in the environment and to effectively engage all supercomputing program resources. The simulation could include models of application behavior, the full computing and data workload, computing and data systems, local and wide area networks, data analysis and visualization systems, the interface to various facility and user services personnel, and the interface to the remote user at their desktop.

- **Services** (autonomous software systems) for automated, scalable, and reliable management of distributed, dynamic, and heterogeneous computing, data, and instrument resources. Services of interest include those for authentication and security, resource and service discovery, resource scheduling, event monitoring, uniform access to compute and data resources, and efficient and reliable data transfer.

- **Science portals** for cross-disciplinary discovery, understanding, and prediction, encapsulating services for single sign-on access, semantic resource and service discovery, workflow composition and management, remote collaboration, and results analysis and visualization.

### Large-Scale Numerical Simulation

- **Tools** for automating large-scale modeling, simulation, and analysis, including those for managing computational ensembles, performing model-optimization studies, interactive computational steering, and maintaining progress in long-running computations in spite of unreliable computing, data, and network resources.

- **Tools** for computer system performance modeling, prediction, and optimization for real applications.
• Techniques and tools for supercomputing application porting, parallelization, debugging, scaling, performance analysis, and optimization.

• Tools for effective load balancing, and high reliability, availability, and serviceability (RAS) in commodity clusters and other large-scale computing systems.

• Novel supercomputing approaches using FPGAs, graphics processors, and other novel architectures and technologies.