# Climate100: Scaling the Earth System Grid to 100Gbps Network

***Progress Report for the Period***
***January 1, 2011 through February 28, 2011***

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## 1. Overview

The climate community has entered the petascale high performance computing era and faces a flood of data as more sophisticated Earth system models provide greater scientific insight on complex climate change scenarios. With many petascale data warehouses located globally, researchers depend heavily on high performance networks to access distributed data, information, models, analysis and visualization tools, and computational resources. In this highly collaborative decentralized problem-solving environment, a faster network—on the order of 10 to 100 times faster than what exists today—is needed to deliver data to scientists and to permit comparison and combination of large (sometimes 100s of TB) datasets generated at different locations. This extreme movement and intercomparison of data is not feasible using today's 10 Gigabit per second (Gbps) networks. Therefore the Earth System Grid Center for Enabling Technologies (ESG-CET) architecture needs to be ensured that it scales to meet the needs of the next generation network speeds of 100 Gbps.

The Climate100 project based on ARRA will integrate massive climate datasets, emerging 100 Gbps networks, and state-of-the-art data transport and management technologies to enable realistic at-scale experimentation with climate data management, transport, and analysis and visualization in a 100 Gbps, 100 Petabyte world. The result of the Climate100 project will improve the understanding and use of network technologies and transition the climate community to a 100 Gbps network for production and research.

This document gives a brief overview on the technical progress in Climate100 project for the period from January 1, 2011 to February 28, 2011.

## 2. ESG Gateway and Data Node Deployment

We have actively participated in the ESG-CET (Earth System Grid Center for Enabling Technologies) community to learn specific needs and support data management requirements of Climate Research over 100-Gbps networks. Our participation in climate community enables us to provide real-life data and real use cases for testing and also experimenting underlying network infrastructure for Climate100.

A new ESG Gateway with a Data Node at LBNL/NERSC has recently been brought to production with IPCC AR4 CMIP3 datasets. LBNL/NERSC Gateway on esg.nersc.gov is now one of the recognized first-class gateways in the ESG federation. Our effort includes deployment, testing, and preparation of necessary components for a production-level system. LBNL/NERSC ESG Gateway will be administrated and supported by NERSC Science Gateway team.

When IPCC AR5 CMIP5 datasets are available, those datasets will ne available on NERSC ESG Gateway and Data Node.

### 2.1. Summary

Recent Progress includes

- Active participation in ESG community for deployment of ESG services,
- Completed ESG federation of ESG-NERSC Data Node and Gateway with CMIP-3 dataset publications,
- Active participation in ESG federation testing.

Future Activities include

- Delegation of ESG systems support to NERSC Science Gateway team.

## 3. Progress towards RDMA based data movements

The Remote Direct Memory Access (RDMA) is the protocol that data movements on 100Gbps network may benefit from. We have studied open fabric and data transfers over RDMA over InfiniBand (IB) and RDMA over Ethernet (RDMAoE) on NERSC Magellan ANI testbed. We also have studied Internet Wide Area RDMA Protocol (iWARP) as an alternative, and performed some experiment on ANI test machines.

We have explored softiWARP on ANI tabletop testbed. This softiWARP approach may help us use the RDMA protocol in data movements on client machines without RDMA and iWARP enabled cards in them. We have prepared several data movement test cases for wide-area network.

We have continued our collaboration with ANI FTP100 group as well.

### 3.1. Summary

Recent Progress includes

- Studied RDMAoE, iWARP and SoftiWARP,
- Continued collaboration with ANL GridFTP team and Ohio State University RDMA team (GridFTP over RoCE),
- Experimented with SoftiWARP on ANI test machines,
- Continued collaboration with ANI FTP100 group.

Future Activities include

- Experiment SoftiWARP over WAN,
- Enhancement of simple client and server application, based on test results from SoftiWARP over WAN,
- Integration with FTP100 data transfer server with RDMAoE in the client application tool,
- Continue collaboration with ANI FTP100 group and ANL GridFTP team.

## 4. Large-scale climate simulation analysis on Cloud Computing

We previously have experimented large-scale climate simulation analysis on ANI Magellan Science Cloud. We explored different techniques of job coordination algorithms and effects of faster network environment in cloud computing, and identified a few test cases for climate analysis. I/O intensive climate analysis may be in need of different techniques of coordination in faster network environment than CPU intensive climate analysis.

In collaboration with NERSC Magellan team, we plan to explore different types of job coordination techniques, such as Hadoop MapReduce with different backend file systems on flash disk drives as well as spinning disks, batch systems in combination of Hadoop or MPI, and an external job coordination service, with local or remote dataset access. This will allow us to explore further study in the intelligent analysis framework support for climate datasets depending on the analysis characteristics and data access environment including network performance.

### 4.1. Summary

Recent Progress includes

- Studied different job coordination algorithms,
- Identification of climate analysis test cases,
- Collaboration with NERSC Magellan team.

Future Activities include

- Experiment climate analysis test cases and compare performances,
- Continue collaboration with NERSC Magellan team.