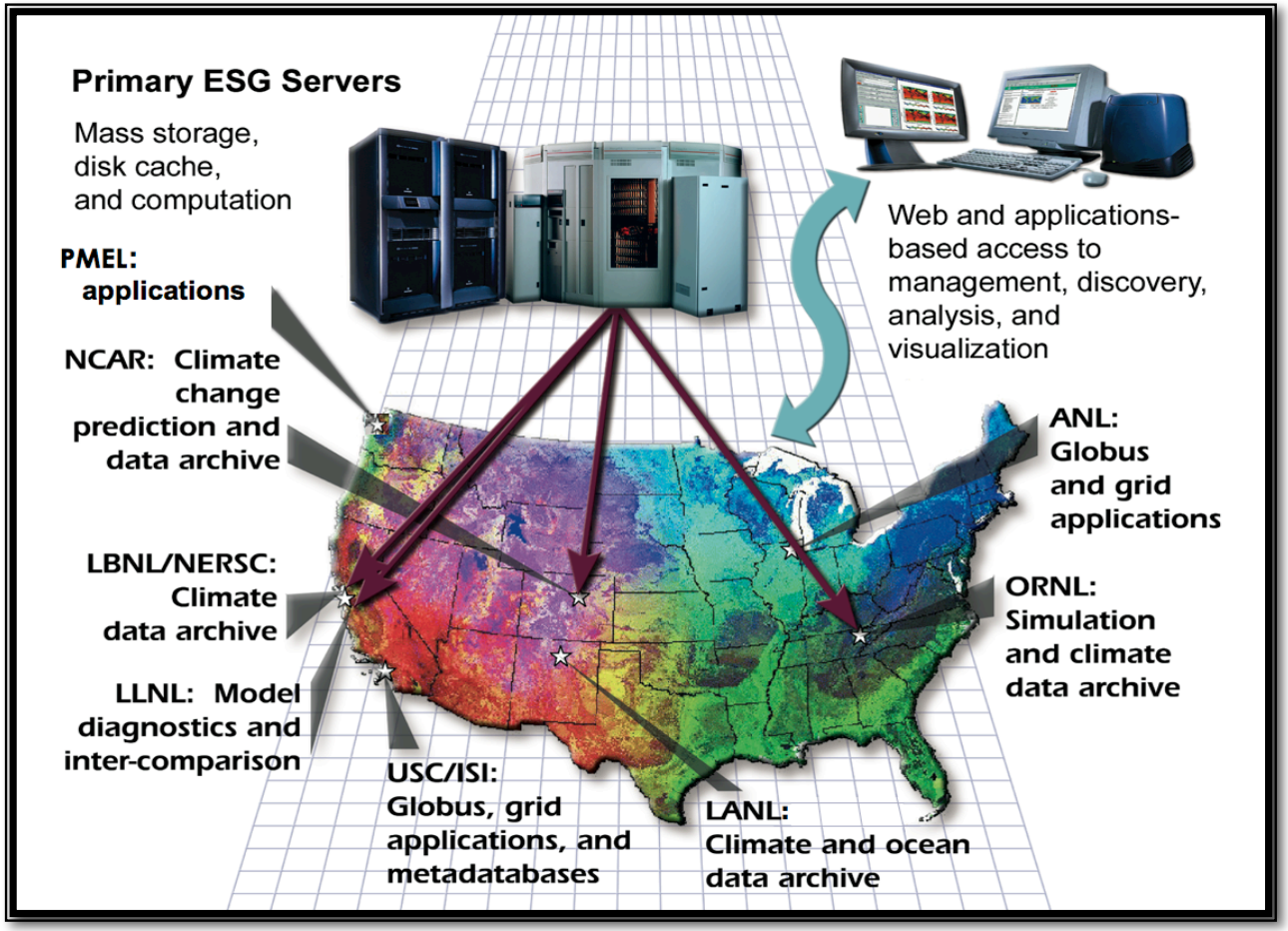
Climate 100: Scaling the Earth System Grid to 100Gbps Networks

Alex Sim, CRD, LBNL
Dean N. Williams, PCMDI, LLNL

100Gbps Network and Climate Community

- **High performance network for Earth System Grid**
  - Data replication around the world
    - "Core dataset" – The Coupled Model Intercomparison Project, Phase 5 (CMIP-5) used for the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) is estimated to 600TB-1.2PB in 2010
    - Climate model data is projected to exceed hundreds of Exabytes by 2020 (BES Science Network Requirements Workshop, 2007)
  - Data analysis
    - Climate analysis requires dataset
    - Large amount of data movement and management is needed
- **Climate100**
  - Research and integration effort for 100Gbps network from data intensive applications point of view

Earth System Grid

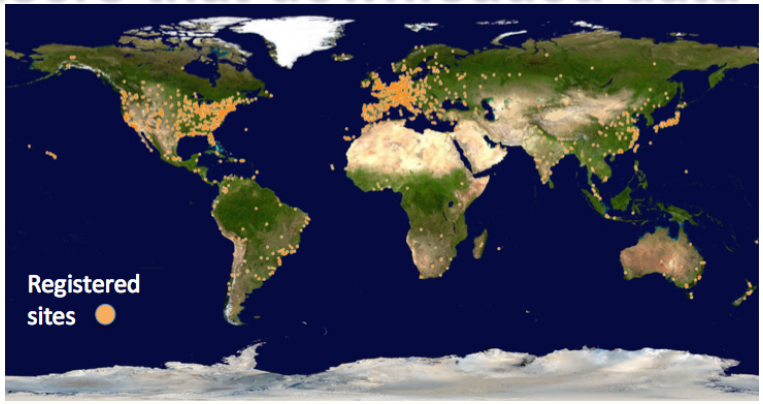


ESG-CET Executive Committee E-mail:
- Dean N. Williams, Ian Foster, Don Middleton
- esg-xc@earthsystemgrid.org

ESG-CET Scientific Production Portals:
- NCAR: http://www.earthsystemgrid.org
- LLNL: https://esg.llnl.gov:8443/index.jsp
- ORNL: https://esg2.ornl.gov:8443/

ESG current statistics

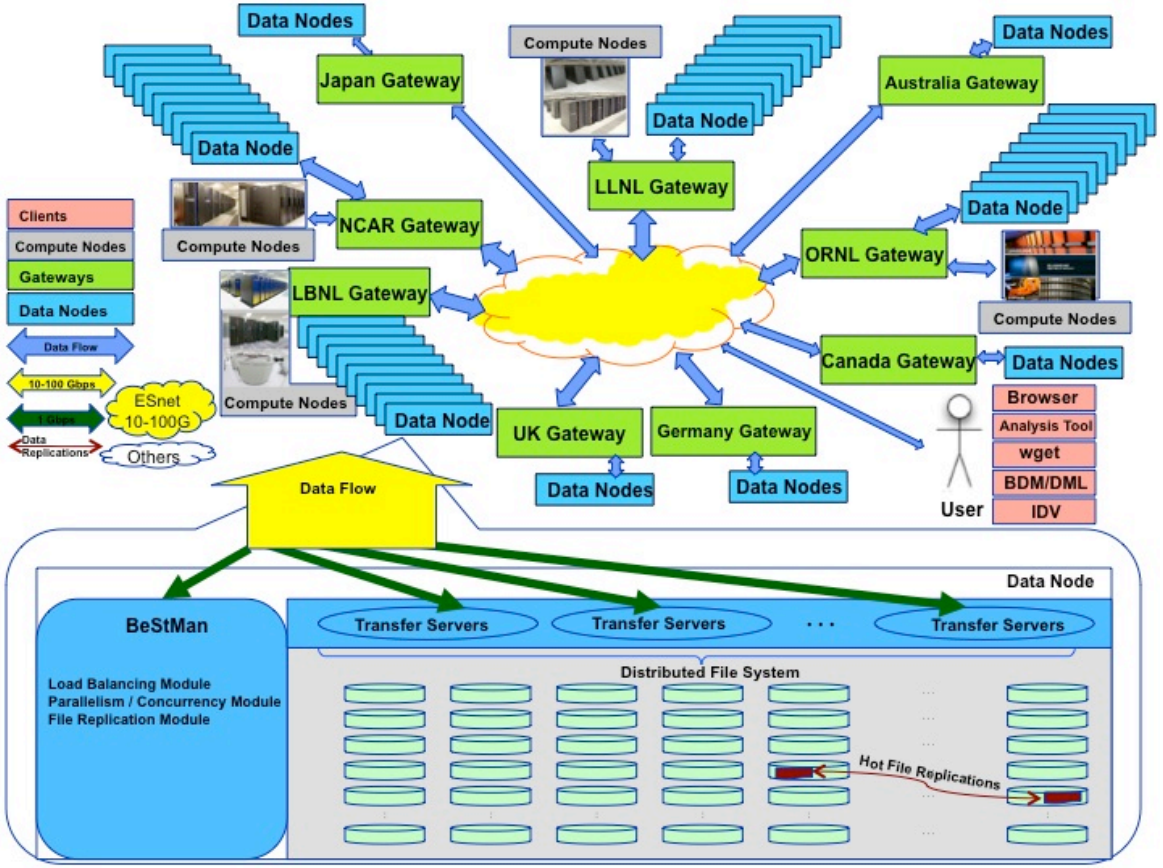
- **NCAR ESG portal**
  - 237 TB of data at four locations (NCAR, LBNL, ORNL, LANL)
    - 965,551 files
    - Includes the past 7 years of joint DOE/NSF climate modeling experiments
- **LLNL CMIP-3 (IPCC AR4) ESG portal**
  - 35 TB of data at one location
    - 83,337 files, model data from 13 countries
    - Generated by a modeling campaign coordinated by the Intergovernmental Panel on Climate Change (IPCC)
    - Over 530 scientific peer-review publications
- **Geographic distribution of the users that downloaded data from ESG web portals**
  - Over 2,700 sites
  - 120 countries
  - 16,000 users
  - Over 850 TB downloaded



Courtesy: Gary Strand - NCAR

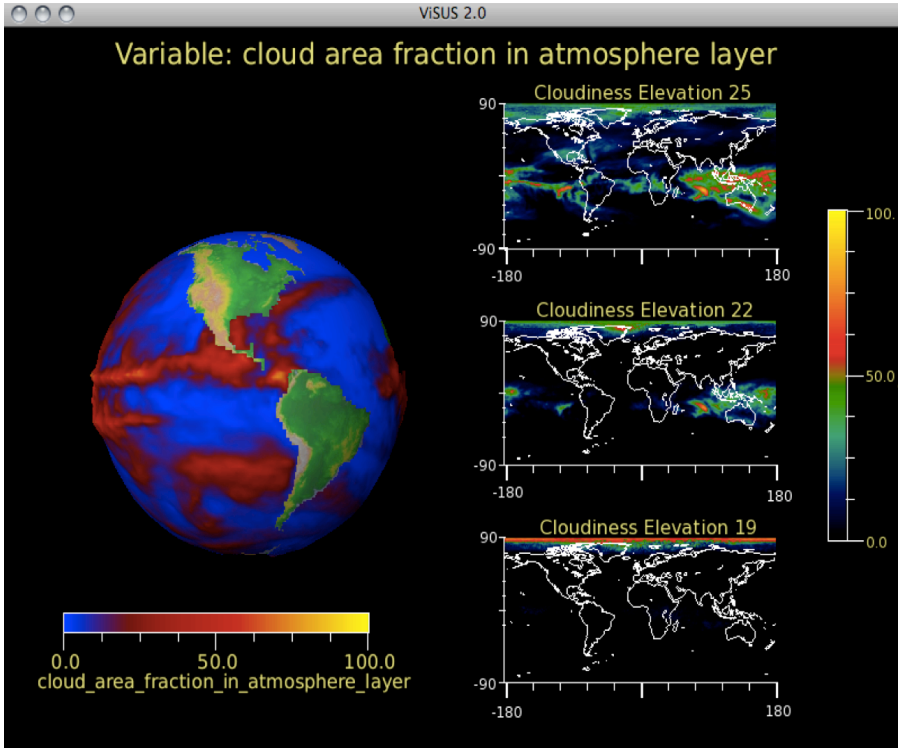
Network Challenges in ESG

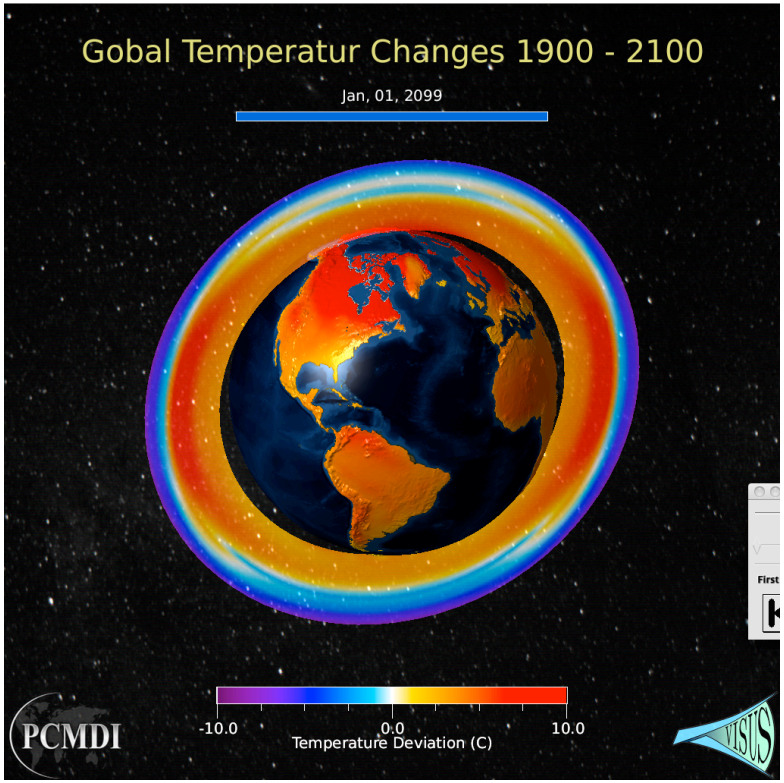
- ESG plans to move vast amounts of data to and from sites
- ESG plans to utilize current ESnet's 10 Gbps network for its federated architecture, and move onto 100Gbps when ready
- perfSONAR, NetLogger and SciDAC CEDPS troubleshooting technique to help monitor network performance
- Berkeley Storage Manager (BeStMan) and replication management to provide load balancing across a large number of Data Nodes



As the results...

- **Enable new capabilities for analysis of data and visual exploration**
  - Visualization of uncertainty and ensemble data
  - Exploration of climate modeling data with ViSUS (LLNL VACET team) and CDAT (LLNL PCMDI)
- **Help scientists understand long-term climate impact**





Timeline - Phase 1

- 10 Gbps Virtual Circuits, LLNL and LBNL connection
- ESG Data Nodes at LBNL and LLNL
  - Distributed file systems for a large disk space accessibility
  - Enhanced BeStMan and Bulk Data Mover components
  - Multiple transfer servers with GridFTP
  - Multiple ESnet 10 Gbps connections
- Goal
  - Move beyond the current machine hardware capability of 10 Gbps with multiple 10 Gbps connections
  - Prepare extension to higher data transfer performance with the coming ESnet 100 Gbps network and multiple distributed storage systems

Timeline - Phase 2

- **Phase 1 + ORNL and ANL connection**
  - ESnet plan on deployment of 100 Gbps for NERSC, ANL, and ORNL
  - Phase 1 case extends to ANL and ORNL
- **Goal**
  - Make use of the available 100 Gbps network capability between ESG Data Node sites in ANL, LBNL, and ORNL, with the designed data movement framework
  - Continue work on data transfers including LLNL

Timeline - Phase 3

- **Phase 2 + NCAR connection**
  - 100 Gbps networking would be commercially available
  - ESnet will be in the processes of integrating the 100 Gbps ANI network into ESnet's production SDN network.
  - We presume that NCAR will request funding at this time to upgrade their 10 Gbps connection.
  - Phase 2 case extends to NCAR possibly
- **Goal**
  - Extend high data transfer performance with 100 Gbps to broader ESG communities
  - Prepare these research activities with ESG production activities

Summary

- **Climate100**
  - Integrating the latest networks, computer systems, datasets, and software technologies
    - Enable at-scale experimentation and analysis of data transport and network use for peta- and exascale data
  - Will improve understanding of network technologies
    - Help climate community to transition to a 100 Gbps network for production and research
  - Will prepare application communities ready to handle 100+ PB data and 100+ Gbps networks
- **More information**
  - http://sdm.lbl.gov/climate100
- **Contact**
  - Alex Sim <ASim@LBL.GOV>
  - Dean N. Williams <Williams13@LLNL.GOV>