

# The Earth System Grid and other Initiatives from the SciDAC Program (*aka You're not Alone!*)

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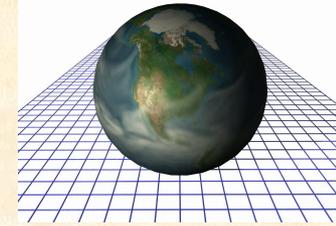
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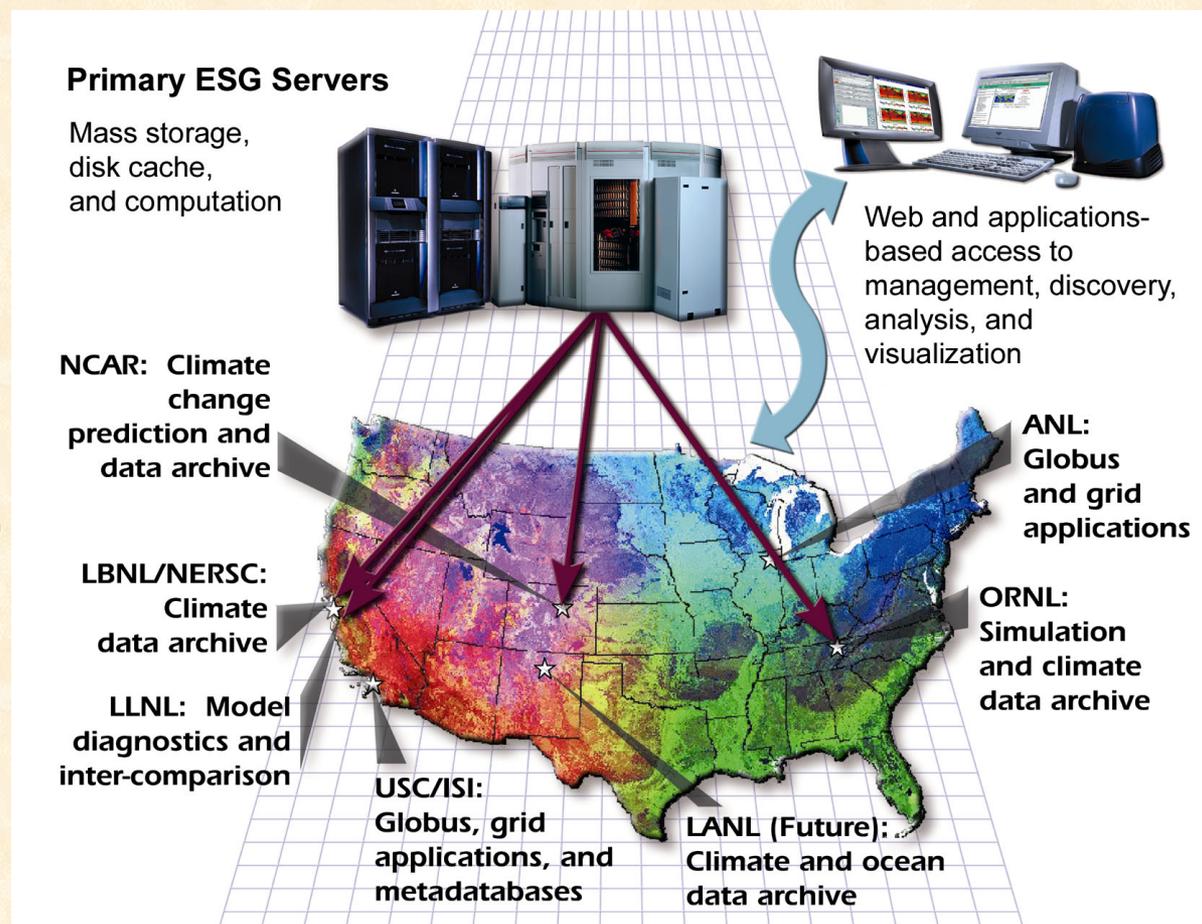
<http://www.csm.ornl.gov/~bernhold/>

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# The Earth System Grid



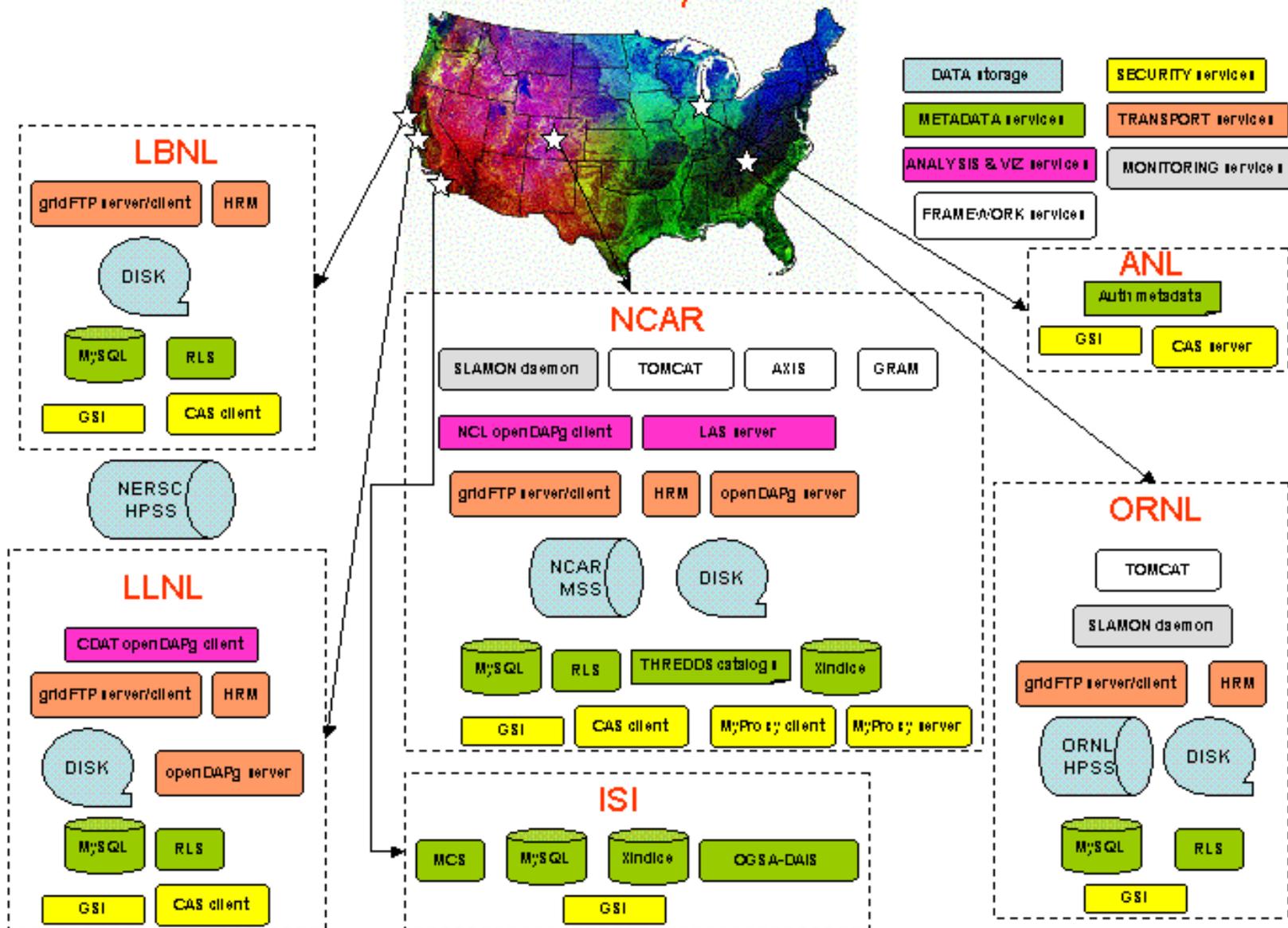
- A “data grid” project to facilitate widespread access to climate (simulation) data
- A few sites in the US generate climate data
- Dozens to hundreds use it at various levels
- Datasets are TB-scale, in 10,000+ individual files
- Users typically need only a fraction of the data



# ESG Strategies and Focus Areas

- Move data a minimal amount, keep it close to computational point of origin when possible
  - Data access protocols, distributed analysis
- When we must move data, do it fast and with a minimum amount of human intervention
  - Storage Resource Management, fast networks
- Keep track of what we have, particularly what's on deep storage
  - Metadata and Replica Catalogs
- Harness a federation of sites
  - Globus Toolkit -> The Earth System Grid -> The UltraDataGrid

# The Earth System Grid



# ESG Web Portal

**Earth System Grid - Netscape**

File Edit View Go Bookmarks Tools Window Help

Back Forward Reload Stop <https://dataportal.ucar.edu:8443/esg/index.jsp> Search Print

Mail AIM Home Radio Netscape Search Shop Bookmarks ACD CNN ESG GAZZETTA GLOBUS NETS SCD VETS UCAR

Earth System Grid

## ESG @ WORK APPLICATIONS INDEX

### Data Search and Discovery

- ▶ **ESG Data Discovery**  
*This integrated application allows identification of data (logical files and replica locations) based on a query to the ESG Metadata Catalog and Replica Catalog, display of logical files and logical collections metadata, and transfer of files.*
- ▶ **Browse ESG Data Catalogs**  
*Hierarchical browsing of ESG Data Catalogs in THREDDS format, and display of associated metadata.*
- ▶ **Query ESG Metadata Catalog**  
*Query of static and user defined attributes associated with logical collections or logical files in the ESG Metadata Catalog.*

### Data Management

- ▶ **Data Transfer**  
*Web interface to HRM (Hierarchical Resource Manager). HRM allows high speed, reliable, parallel streams, multiple files transfer between permanent storage systems and ESG nodes.*
- ▶ **Metadata Extraction**  
*Web Service for the automatic extraction of metadata in NcML format from any network retrievable netcdf file.*

### Data Analysis and Visualization

- ▶ **DODS**  
*Access to the ESG DODS servers.*
- ▶ **LAS**  
*Access to the ESG LAS servers.*
- ▶ **CDAT**  
*Access to the ESG CDAT servers.*

### ESG System

- ▶ **Monitor Status**  
*Monitor the status and availability of the resources comprising the ESG system.*
- ▶ **Query Logs**  
*Interactive query of log files recording ESG access and usage.*

**ACKNOWLEDGMENTS:** ESG applications are based on a variety of computing and information technologies. In particular, we wish to acknowledge the use of Globus technology and related COG (Commodity Grid Kit) toolkits.

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# ESG Web Portal

## Data Discovery and Movement

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https://dataportal.ucar.edu:8443/esg/dataDiscovery.jsp?collectionName=PCM/B06.20/atm

Search

Print

Earth System Grid

ESG Home ESG Login CAS proxy ESG Logout ESG @ Work:

### ESG DATA DISCOVERY

INSTRUCTIONS: This interface allows search and discovery of data through association performed to the **MCS (Metadata Cataloguing Services)** to retrieve all matching locations (Replica Location Services) to find all registered replica locations, sizes, and access disk or remote storage (**HPSS, MSS**) and transfer them with the **SRM (Storage Resource Manager)** served by distributed **striped gridFTP openDAP** servers. Optionally, the user may also logical collection or logical file. Please note that currently the query supports only a

Earth System Grid - Netscape

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https://dataportal.ucar.edu:8443/esg/HRM/hrm.jsp

Earth System Grid

### HRM WEB INTERFACE

INSTRUCTIONS: Please check all physical files that you wish to transfer. The **HRM (Hierarchical Resource Manager)** is a product of the Scientific Data Management Research Group at the Lawrence Berkeley National Laboratory. HRM allows fast, reliable, tunable transfer of files to/from disk and remote storage (HPSS, MSS) through the gridFTP protocol and implementation. This prototype web interface is being developed by the Earth System Grid collaboration.

#### QUERY FORM

LOGICAL COLLECTION NAME:  (required)

VARIABLE NAME:  (optional)

START YEAR:  (required)

STOP YEAR:  (required)

SESSION ID: 00AFCA2870A97FD8E572993D94F1688B

DN: CN=proxy,CN=proxy,CN=proxy,CN=Globus User,OU=Network Engineering and Test Center for Atmospheric Research,OU=

Document: Done (0.271 secs)

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#### DATA TRANSFER FORM

PHYSICAL FILE		SIZE	SERVICE
<input checked="" type="checkbox"/>	/raid/f1/ESG_SC2002/PCM/B06.20/atm/B06.20.atm.1980.nc	268722384	DISK@NCAR
<input checked="" type="checkbox"/>	/dataportal.ucar.edu/PCM1/pcm/B06.20/atm/B06.20.atm.1981.nc	322461980	MSS@NCAR
<input checked="" type="checkbox"/>	/hpss.ccs.ornl.gov/home/asim/esg/sc2002/pcm/b06.20/atm/B06.20.atm.1982.nc	322461980	HPSS@ORNL
<input checked="" type="checkbox"/>	/archive.nersc.gov/nersc/gc5/asim/esg/sc2002/pcm/b06.20/atm/B06.20.atm.1983.nc	322461980	HPSS@LBL
<input checked="" type="checkbox"/>	/data/esg/sc2002/PCM/B06.20/atm/B06.20.atm.1984.nc	322461980	DISK@LBL

INPUT FILES:

OUTPUT DIRECTORY:

USER ID:  (user@host)

gridFTP PARAMETERS:

Block size:

TCP buffer size:

Number of streams:

Transferring data from dataportal.ucar.edu...

start VETS\_REPORTS CDP Earth System Grid ... Earth System Grid ... Microsoft PowerPoint 3:28 PM

Live Access to Climate Data - Netscape

http://dataportal.ucar.edu/esg-las/main.pl?

Home Help Options

THE EARTH SYSTEM GRID  
**ESG**  
Scientific Discovery through Advanced Computing

**Data Sets**

- B06\_20\_atm\_1980.nc
- Average of Cloud when omega is < 0 (up)
- Average of Omega when omega is < 0 (up)
- BEVAP
- BTRAN
- CH4VMR
- Clearsky net longwave flux at surface
- Clearsky net longwave flux at top
- Clearsky net solar flux at surface
- Clearsky net solar flux at top
- Cloud fraction
- CO2VMR
- convective adjustment tendency of water vapor
- Convective precipitation rate
- Convective snow rate (water equivalent)
- Counter-gradient coefficient on surface kinematic fluxes
- DMI
- East-west gravity wave drag surface stress
- Effective cloud fraction
- F11VMR
- F12VMR

B06\_20\_atm\_1980.nc  
Average of Cloud when omega is < 0 (up)

Select view: xy (lat/lon) slice

Select:  single variable  comparison

Go: Full Region

87.8638000

180.0 W 180.0 E

87.8638000

Zoom In Zoom Out

Select depth: 4.8092999458313 4.8092999458

Select time: 05-Mar-1980 05-Mar-1980

Select product: Shaded plot (GIF) in 800x600 window

DATA SET: B06\_20\_atm\_1980.nc

Sea level pressure (Pa)

# ESG Web Portal Visualization

QBOT

QDRAI

QINFL

QOVER

Random over...

amount

Reference hei...

Relative humid...

RSW

Sea level pres...

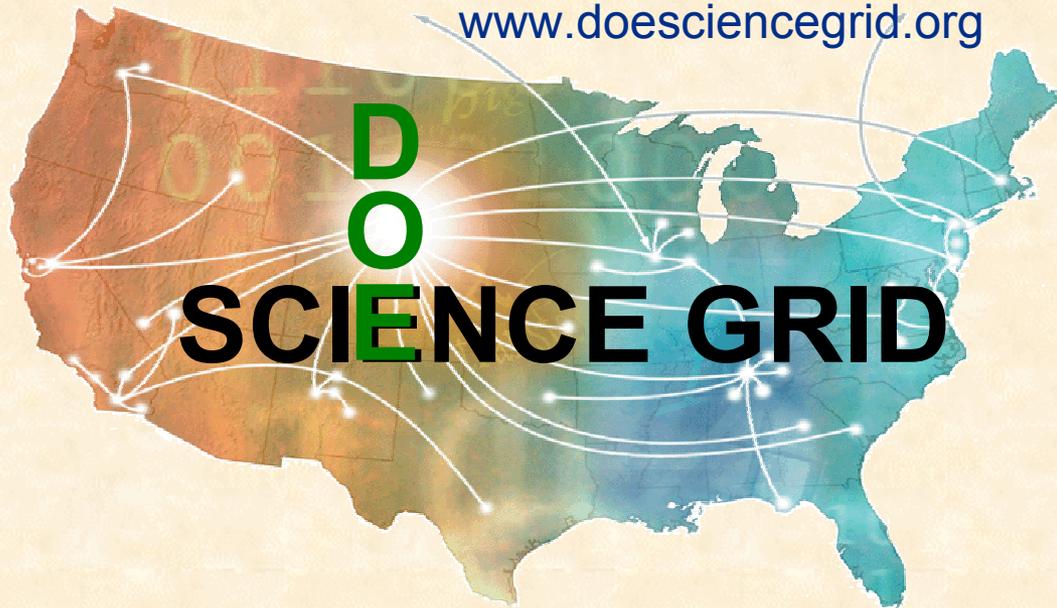
Solar heating

Solar insolation

specific humid...

[Modify plot](#)

[www.doesciencegrid.org](http://www.doesciencegrid.org)



## Two Primary Goals →

Build a DOE Science Grid that ultimately incorporates computing, data, and instrument resources at most, if not all, of the DOE Labs and their partners.

Advance the state-of-the-art in high performance, widely distributed computing so that the Grid can be used as a single, very large scale computing, data handling, and collaboration facility.

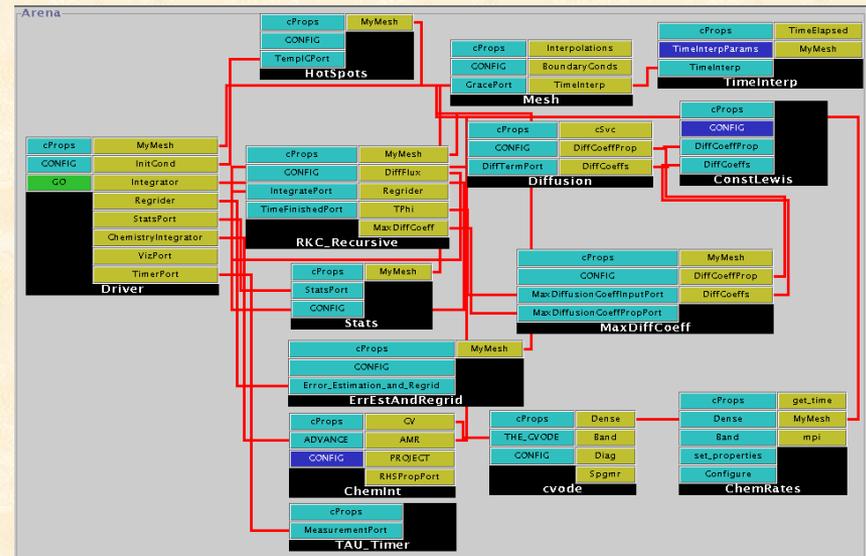
Grid services provide uniform access to many diverse resources

Participants: *LBNL*, NERSC, PNNL, ANL, ORNL

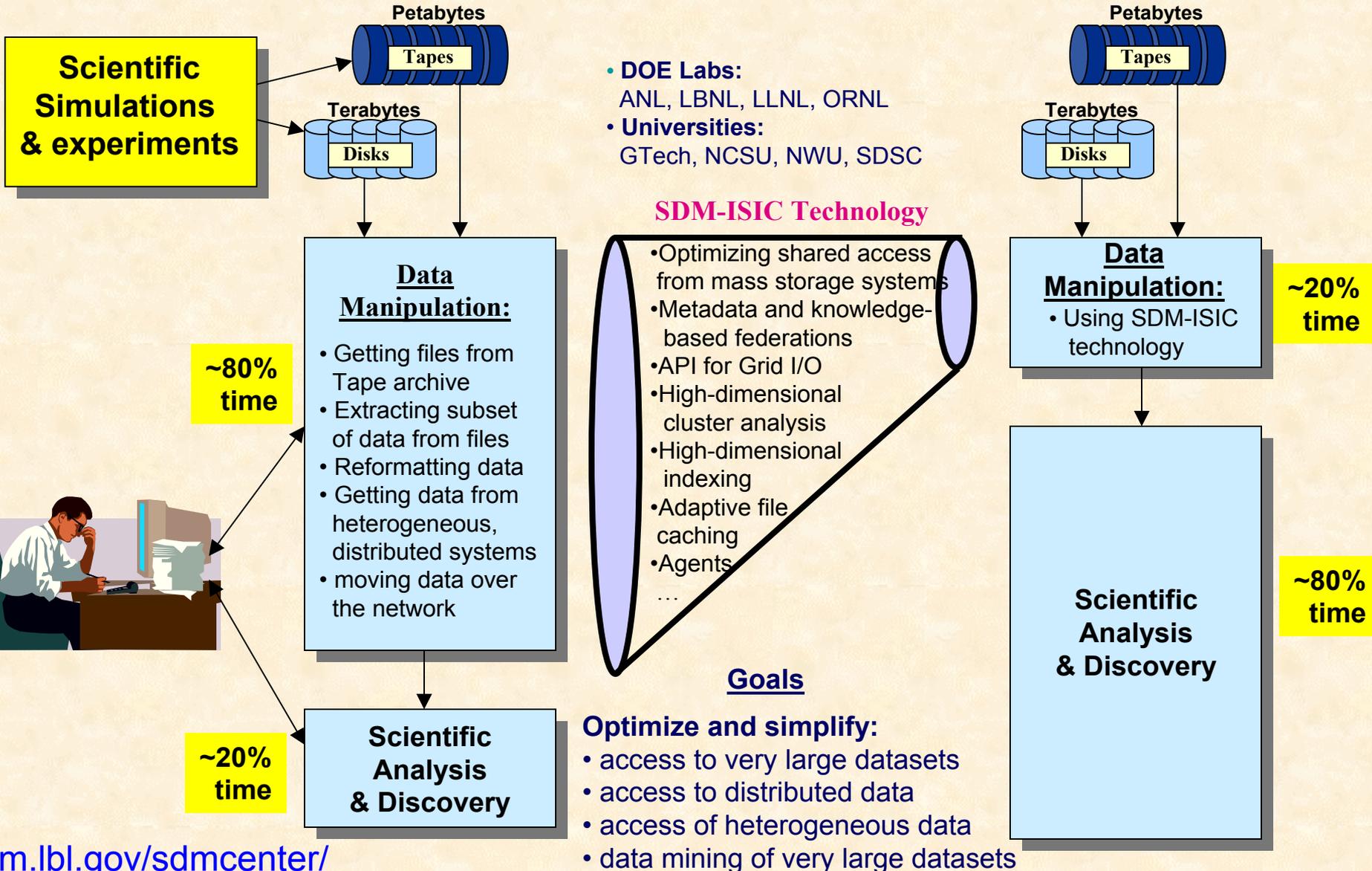
# The Common Component Architecture

- “Plug and play” application development for high-performance scientific computing
  - Many “libraries” will be available as off-the-shelf components
- Supports both parallel and distributed computing
  - Most current users have HPC/parallel focus
- Participants: *SNL*, *ANL*, *Indiana*, *LANL*, *LLNL*, *ORNL*, *PNNL*, *Utah*

- New effort focusing on using CCA with instruments/sensors in distributed environment (*Indiana*)
- *ESG* may use CCA to support user-provided filters/processing at data location instead of client location



# Scientific Data Management ISIC



[sdm.lbl.gov/sdmcenter/](http://sdm.lbl.gov/sdmcenter/)

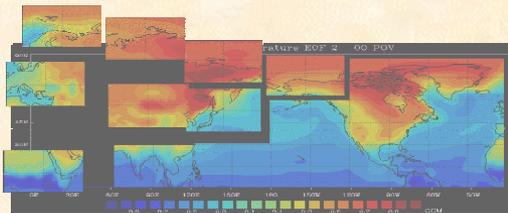
# SDM Distributed Data Analysis

**RACHET is designed for Scientific Data that is:**

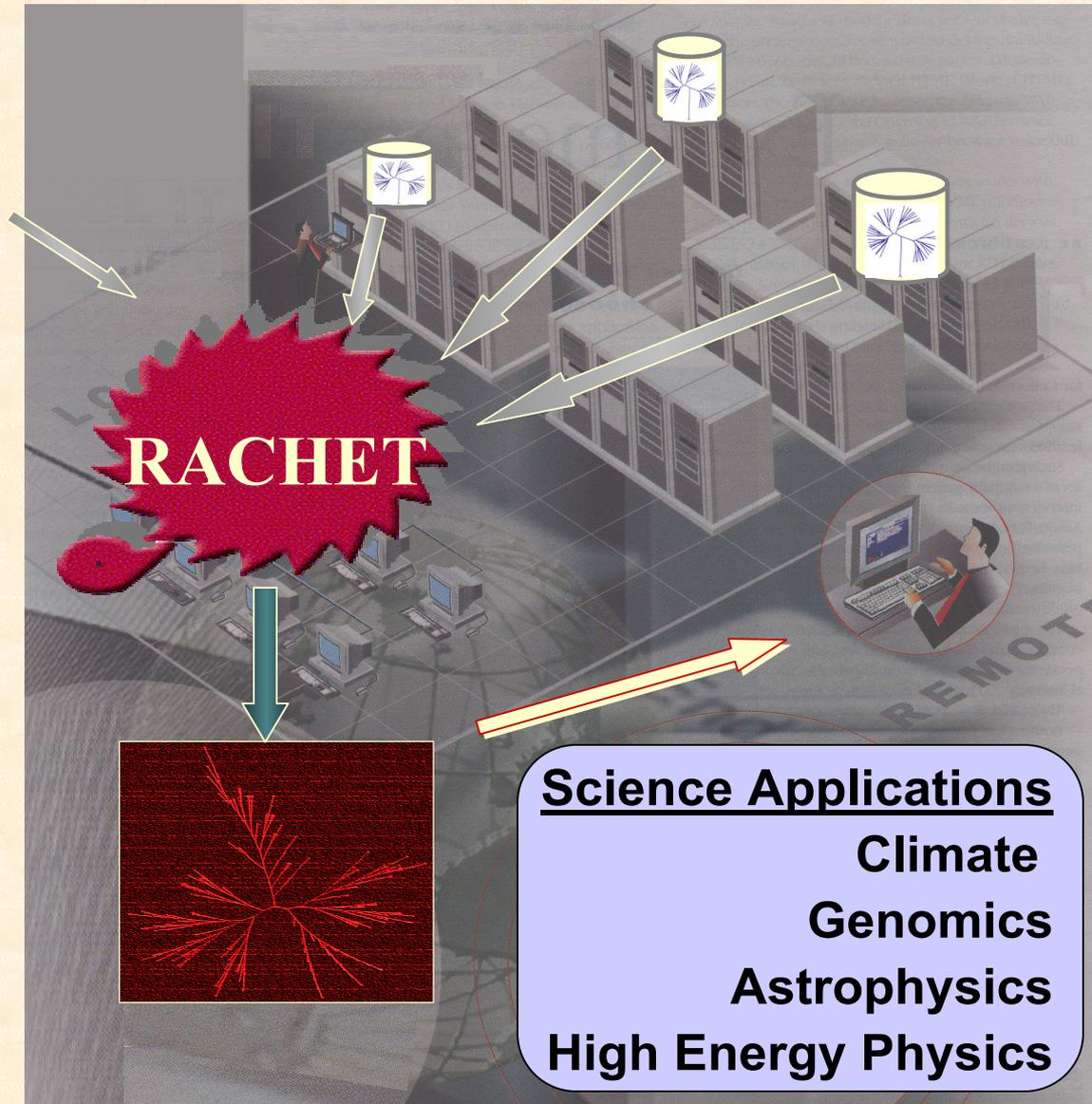
- Massive
- Distributed
- Dynamic and
- High-dimensional

**Highly Scalable Approach**

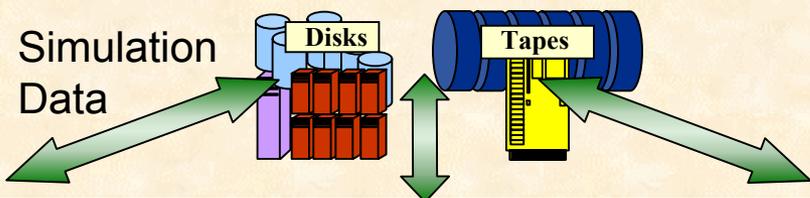
- Compute local analyses
- Merges info with minimum data transfer
- Visualize global results



Lead: Nagiza Samatova, ORNL

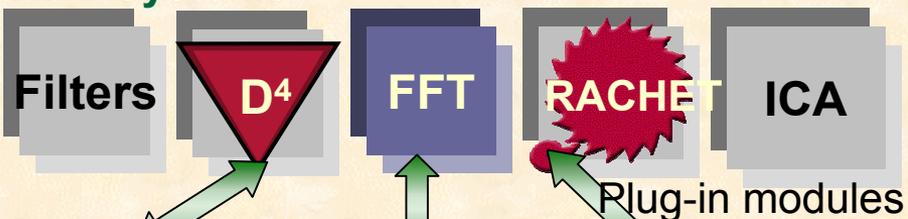


# SDM: Data Stream Monitoring & Analysis

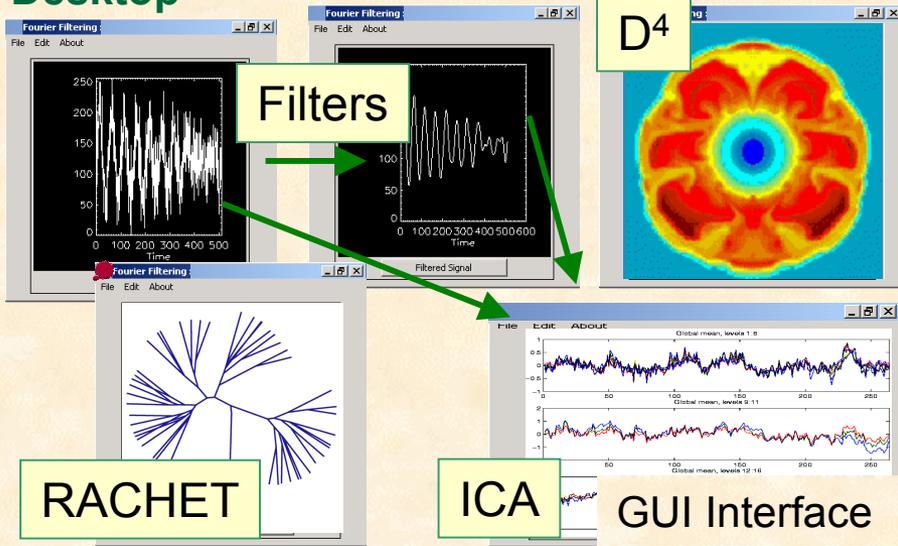


## ASPECT

### HPC Systems



### Desktop



## ASPECT's advantages:

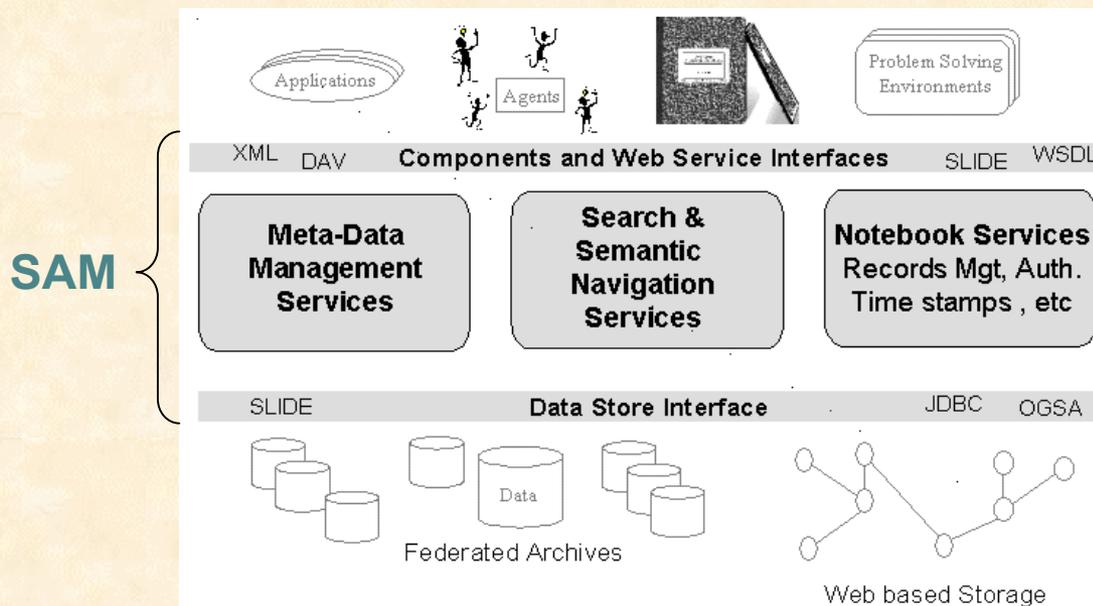
- No simulation code instrumentation
- Single data — multiple views of data
- No interference w/ simulation

## Examples:

- adaptive streaming data compression of factor 200
- Linear dimension reduction of streaming data through fusion of incremental updates

Lead: Nagiza Samatova, ORNL

# Scientific Annotation Middleware



[www.scidac.org/SAM/](http://www.scidac.org/SAM/)

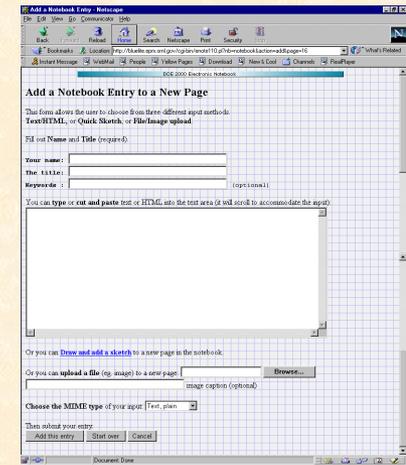
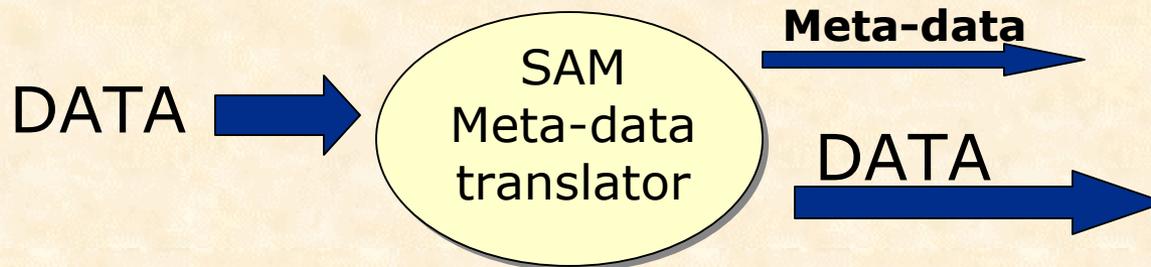
- Provides a means to **store, translate, and evolve metadata** such as data pedigrees, summary information, relationships to other data
- **Automatically associate** new software-generated metadata and relationships with existing data
- **Sharing of annotations** among scientific applications, portals, software agents, and electronic notebooks
- Electronic notebook as a records-oriented view of annotations from multiple sources

Participants: *PNNL*, *ORNL*

# Meta-Data Services in SAM

SAM meta-data services are being designed to store, translate, and evolve information such as

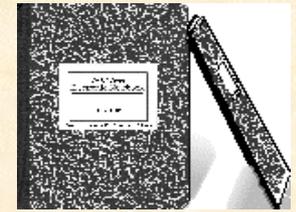
- data pedigrees (experiment parameters, system description, input files, version of software/algorithms used)
- summary information (low-resolution subsets, identified features)
- relationships to other data (e.g. part of a project or parameter study)
- arbitrary notes, comments, images, etc



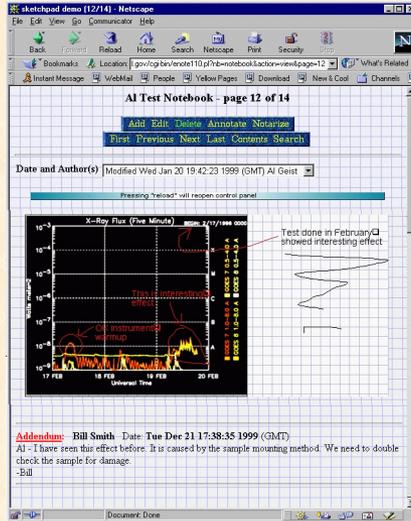
# ORNL Electronic Notebook

Shared electronic notebook

Accessible with password through secure web site



Reading entries



Drag and drop notes from private to shared notebooks



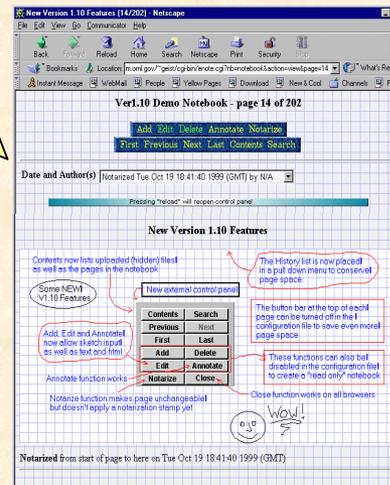
Annotation by remote colleagues

Personal (stand alone) notebook



## Advantages and Features

- look & feel of paper notebook
- access from any web browser
- no software to install
- can be shared across group or setup as personal notebook
- can run stand alone on laptop



## Input from

- Keyboard
- Files
- Images
- voice
- Instruments
- sketchpad

[www.csm.ornl.gov/~geist/](http://www.csm.ornl.gov/~geist/)

Lead: Al Geist, ORNL

# Experience with ELN Users

With hundreds of notebook installations what do we see?



The ORNL technology lends itself to a broad set of uses many of which don't require any special compliance

## Existing Uses Include:

- shared project notes
- proposal development
- meeting notes
- instrument logs
- centrally updated manuals
- (chemical) inventory
- distance learning
- teaching tool
- patient medical records
- medical research logs
- project tracking
- private notebooks

## HFIR Users

- Cam Hubbard
- Mohana Yethiraj

# People to Talk to at NeSSI

- Earth System Grid
  - David Bernholdt
  - Mei Li Chen
  - Line Pouchard
- DOE Science Grid
  - Al Geist
  - Mei Li Chen
- Common Component Architecture
  - David Bernholdt
- Scientific Data Management
  - Nagiza Samatova
  - Mladen Vouk
- Scientific Annotation Middleware
  - Al Geist
- Electronic Notebook
  - Al Geist
  - *Mohana Yethiraj (user)*