

# The NOAA Operational Model Archive and Distribution System NOMADS



## Overview and Plans

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NOMADS PI

National Oceanic and Atmospheric Administration  
National Climatic Data Center

Earth Science Portal Meeting  
GFDL Princeton, NJ  
June 8, 2004





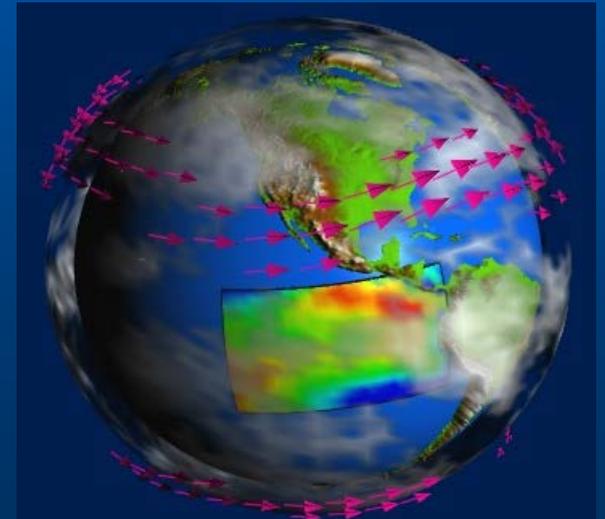
## Overview



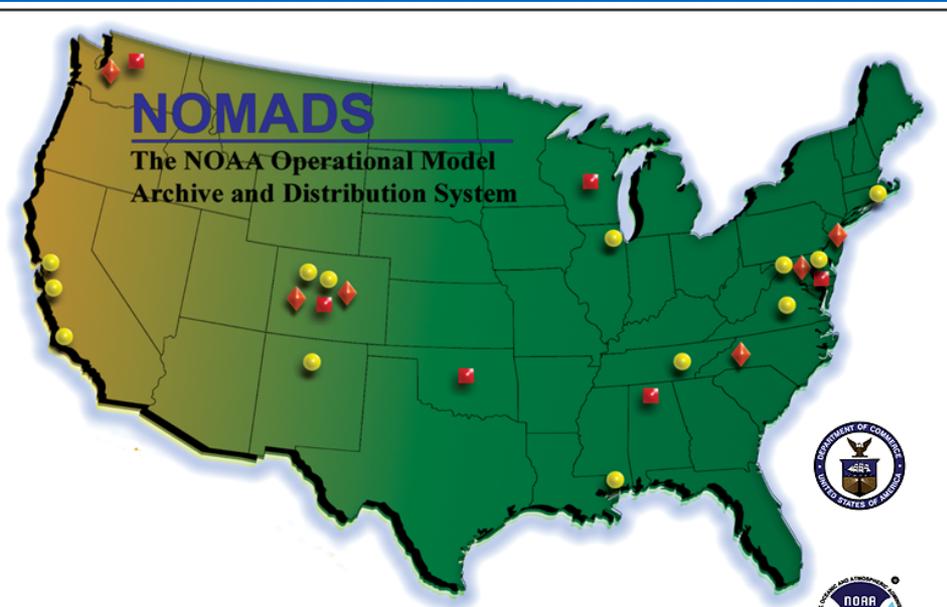
➤ Until now there existed no long-term archive for Climate and Weather models.

➤ University and Institutional research goes largely untapped by NOAA scientists. Effort is wasted on data receipt and format issues with no infrastructure to collaborate.

➤ Retrospective analysis and model inter-comparison are necessary to verify and improve short term NWP models, seasonal forecasts, climate simulations, assessment and detection efforts.



- To overcome this deficiency, some of the Nations top scientists are actively engaged in a grass-roots framework to share data and research findings over the Internet
- NCDC, NCEP and GFDL initiated the NOAA Operational Model Archive and Distribution System.
- NOMADS is a distributed data services pilot for format independent access to climate and weather models and data.



**Core NOAA NOMADS Collaborators**

- ◆ Climate Diagnostics Center (CDC) Boulder, CO
- ◆ Geophysical Fluid Dynamics Laboratory (GFDL) Princeton, NJ
- ◆ National Climatic Data Center (NCDC) Asheville, NC (Project Lead)
- ◆ National Centers for Environmental Prediction (NCEP) Camp Springs, MD
- ◆ Pacific Marine Environmental Laboratory (PMEL) Seattle, WA
- ◆ NOAA Forecast Systems Laboratory (FSL) Boulder, CO

**External Core Collaborators**

- Center for Ocean-Land-Atmosphere Studies (COLA) (Maryland)
- Department of Energy's Argonne, Los Alamos, Oak Ridge, Lawrence Berkley, Livermore National Laboratories & Information Sciences Institute (ISI), University of Southern California under the Earth System Grid Project
- National Center for Atmospheric Research (NCAR) Colorado
- Unidata Program Center (UCAR/Unidata) Colorado
- LLNL Program for Climate Model Diagnosis and Intercomparison
- NASA's Global Change Master Directory (GCMD) Maryland
- National Coastal Data Development Center
- University of Rhode Island (OPeNDAP Consortium)

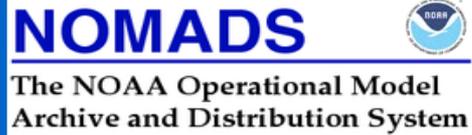
**External Collaborators include**

- Center for Earth Observing and Space Research (CEOSR), NASA-GSFC Maryland
- George Mason University (NASA SI-ESIP), Virginia
- National Severe Storms Laboratory (NSSL), Oklahoma/SSEC University of Wisconsin
- Universities of Alabama (Huntsville), California (Santa Barbara), Washington & Iowa St.
- National Science Foundation (NSF) CyberInfrastructure

**International Participants**

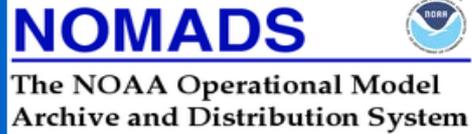
- British Atmospheric Data Center, Oxfordshire, United Kingdom)
- UK's Natural Environment Research Council (NERK DataGrid Project)
- Committee for Earth Observing Satellites (CEOS) Grid Project
- Climate Action Partnership (CAP), BOM Australia (US Depts. of Commerce, Energy, State, and EPA)





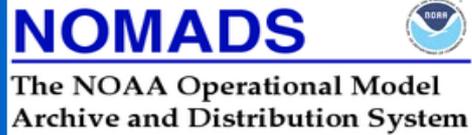
## *History of ESP*

- Early on in the development of NOMADS, participants saw a need for a more technical forum to coordinate various distributed data access and Web and grid portal efforts.
- Thus the original NOMADS team formed the Earth Science Portal (ESP) effort.
- One of the initial requests from this group to NOMADS was “Glenn- you need to build an archive interface”
- The NOMADS is now an operational at NCDC!



## *Scientific Data Networking?*

- The users experience is often frustrating—
  - What data of interest exist?
  - Are they going to be useful to me?
  - How can I obtain them in a usable form?
- Time and effort are wasted on data access and format issues.
- As a result atmosphere/ocean/climate data are under-utilized. Model inter-comparison nearly impossible.



## *Scientific Data Networking...*

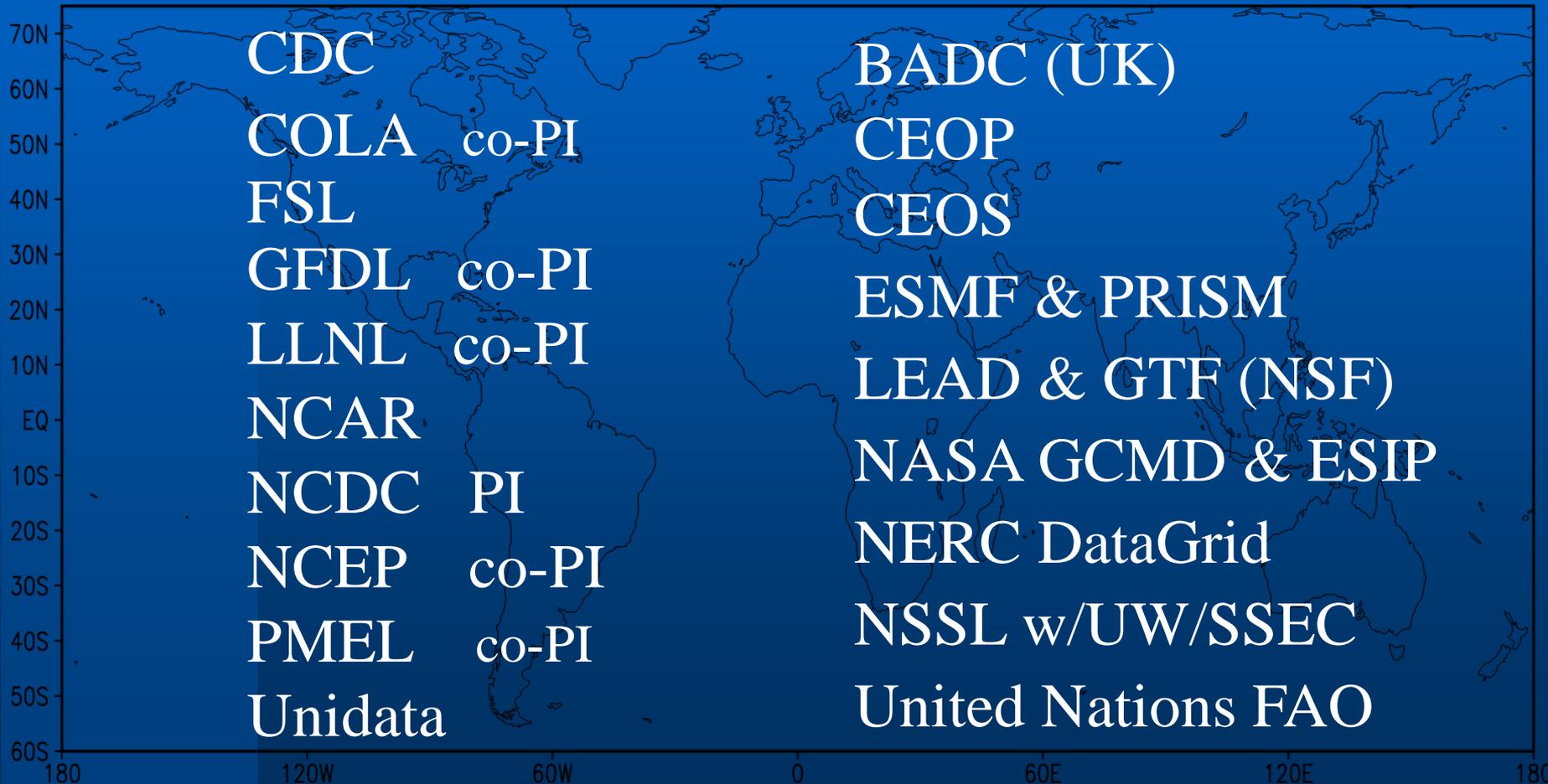
NOMADS simplifies scientific data networking, allowing simple access to high volume remote data, unifying access to Climate and Weather models:

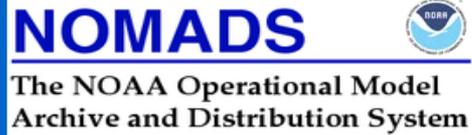
- **Data access (client)**
  - Access to remote data in the users normal application
    - IDL / IDV / Matlab / Ferret
    - GrADS (GRIB/BUFR w/ GDS)
    - Netscape / Excel / http (wget)
    - CDAT (PCMDI)
    - **Any netCDF application** (i.e., AWIPS)
  - **Don't need to know the format in which the data are stored.**
- **Data publishing (server)**
  - **Can serve data in various formats**
    - netCDF / GRIB / BUFR / GRIB2
    - HDF (3-5) / EOS
    - SQL / FreeForm
    - JGOFS / NcML
    - DSP
    - ascii, others...
  - **Spatial and temporal sub-setting and host side computations on the fly.**



**NOMADS**   
The NOAA Operational Model  
Archive and Distribution System

# *The Partnerships*





## *Collaborating Programs*

CAP Climate Action Partnership

CDP Community Data Portal

CEOSGrid Committee on EO Satellites

CEOP Coordinated Earth Obs Period NOAA Representative

EPA Air Quality Models

ESP Earth Science Portal

European PRISM

NASA GCMD

NERC DataGrid

NSF Cyberinfrastructure

**NSF LEAD GTF GeoScience Tech Forum**

NVODS / US GODAE / GOOS

Unidata THREDDS, NSDL, DLESSE

WCRP World Climate Research Program

DOC DOE EPA State Dept

NCAR

NOAA Representative

NOAA Representative

(in progress)

Member

Science Advisory Board

Advisory Committee

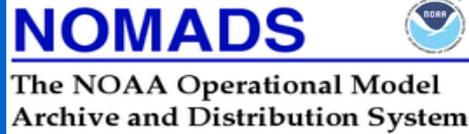
Member

Planning Committee

Data Provider

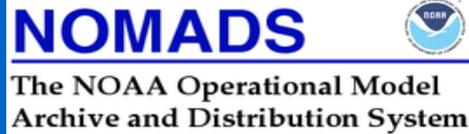
Data Provider

JSC/CLIVAR



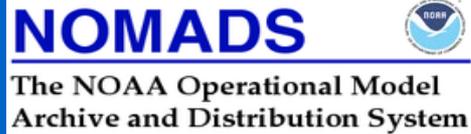
## *Uses*

- Climate model output and observations are vital to providing timely assessments of climate change and impacts.
- Assess the affect of inadequate spatial and temporal sampling.
- Models can be used to guide the spatial and temporal sampling frequency for observing network design and operation to resolve distributions for specific variables.
- Accurate estimates of future climate variability and trends.
- Long-term protection of climate simulations and NWP analysis.



## *Uses (cont.)*

- NCEP Numerical Weather Prediction (NWP) re-run capability.
- Model input Data Assimilation fields for Regional model boundary initialization (e.g., regional climate models, WRF, MM5).
- Historical analysis of NWP for operational forecaster training.
- Third-world internet access to NWP for forecast operations.
- Collaboration between Global Climate Model (GCM) and NWP researchers using large data volumes of data.

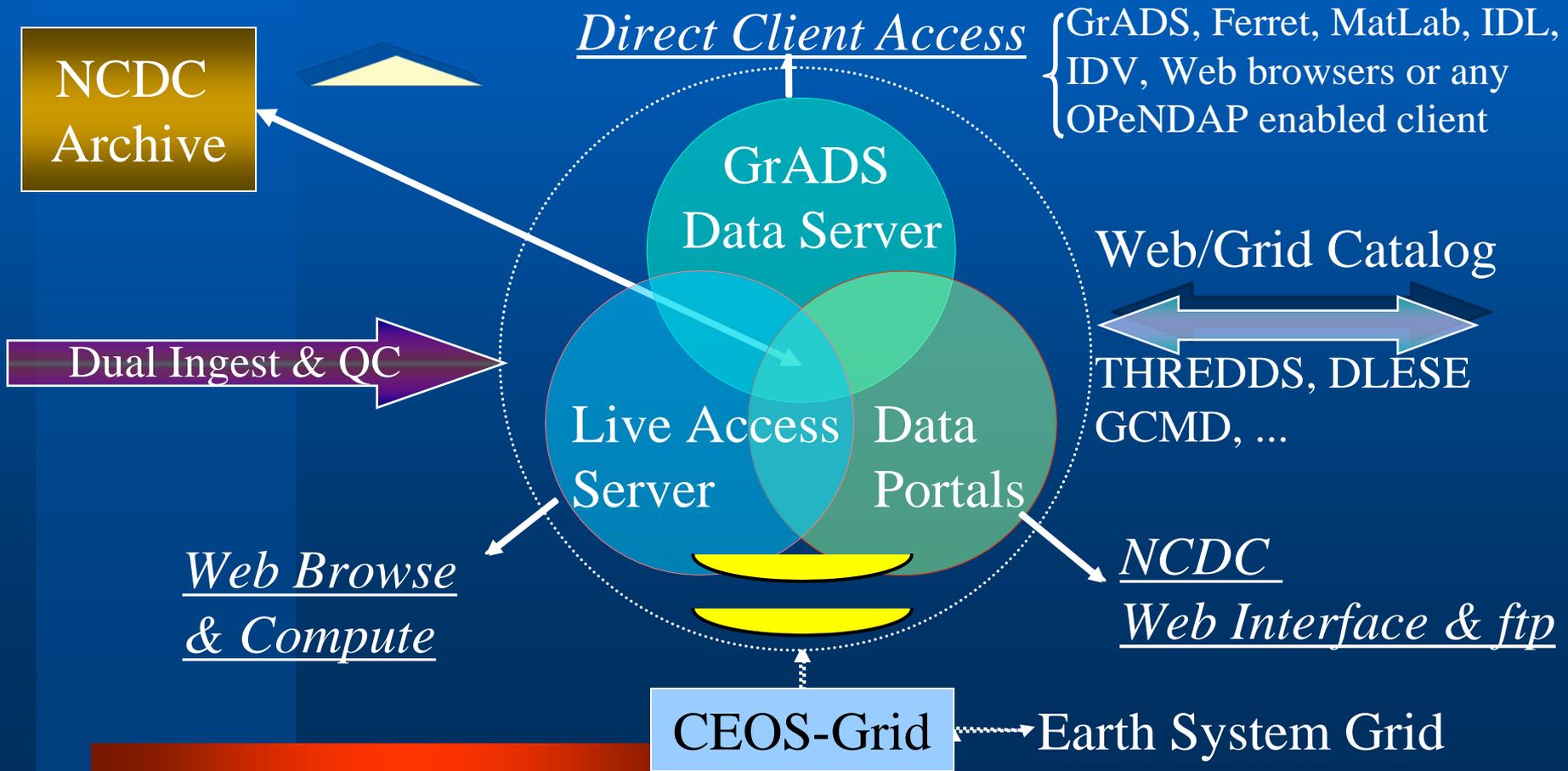


## *Uses (cont.)*

- The departure of observations from an external reference state can help identify time-dependent changes in the observing system.
  - NOMADS can provide high-frequency reference states from NWP models and low-frequency references from fixed climatologies.
  - In the observing system circa 2000, the NWP reference is of high quality due to model improvements - and heavily constrained by wide variety of observations on a global scale. Thus, NWP reference is more independent today than in the past.



**Multiple paths to format independent data access:**





**NOMADS**  
 The NOAA Operational Model  
 Archive and Distribution System

# NCDC System Architecture

NOAAPort



## Data Ingest

Obs, Eta,  
GFS, RUC

Hi-Res  
GFS, Eta,  
NARR and  
GDAS

Dual  
Redundant  
Ingest

## Data Management

- Data & Directory structures “merged”
- Daily Data Ingest inter-comparison
- QC and R/T Monitoring
- Index File generation
- Control and OPeNDAP metadata generation
- CVS Backup (code)
- NCDC Archive Interface

## Data Access

Earth System  
Grid &  
CEOS-Grid

NOMADS  
Web/DODS

NCDC  
Archive

NCEP ftp  
GigaPOP

Unidata IDD



# NCDC System Architecture

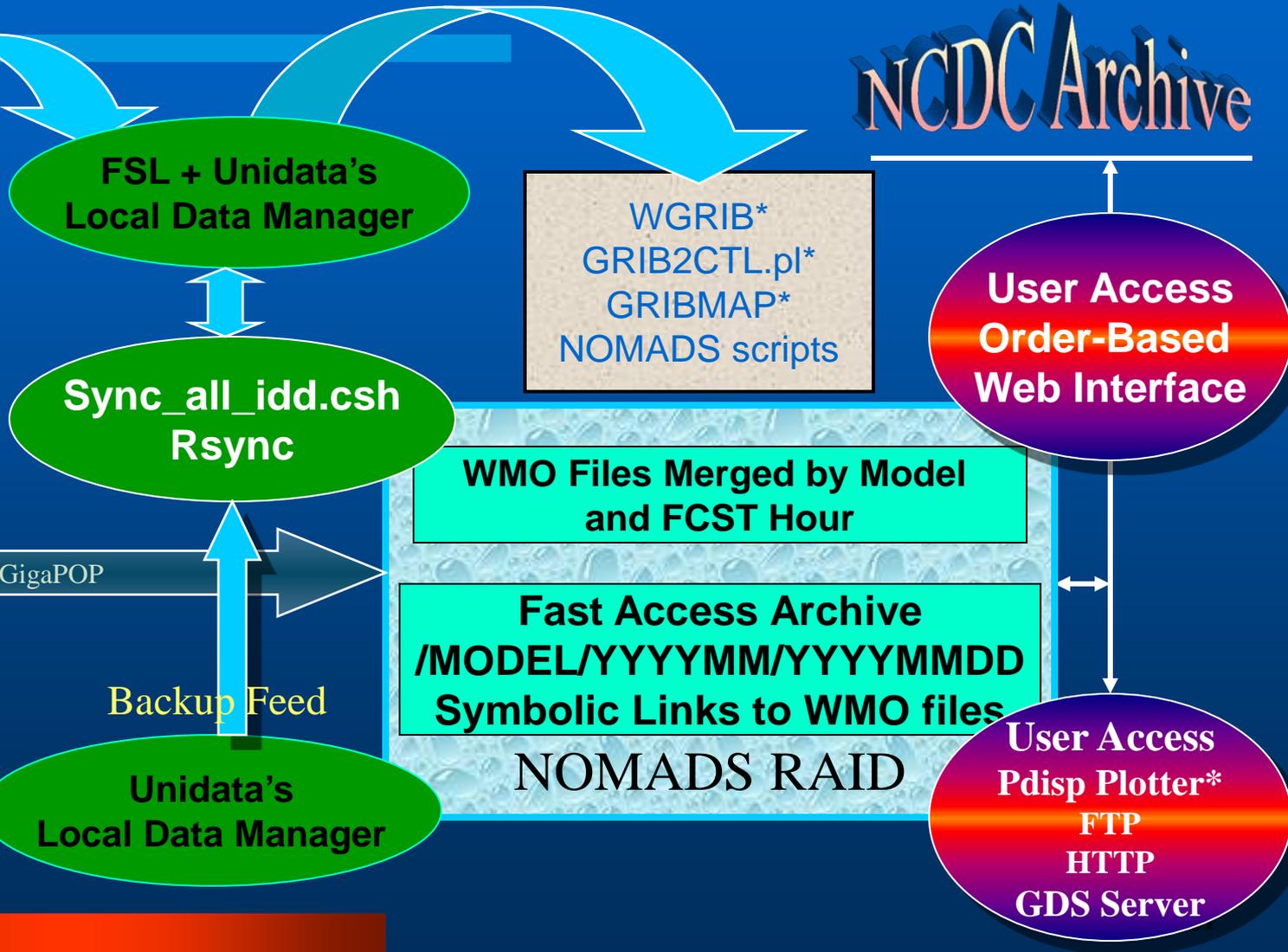


NOAA Port

HiRes Data

NCEP ftp

Unidata IDD



NCDC Archive

FSL + Unidata's  
Local Data Manager

Sync\_all\_idd.csh  
Rsync

WGRIB\*  
GRIB2CTL.pl\*  
GRIBMAP\*  
NOMADS scripts

User Access  
Order-Based  
Web Interface

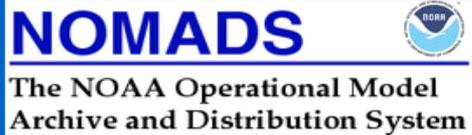
WMO Files Merged by Model  
and FCST Hour

Fast Access Archive  
/MODEL/YYYYMM/YYYYMMDD  
Symbolic Links to WMO files

NOMADS RAID

Unidata's  
Local Data Manager

User Access  
Pdisp Plotter\*  
FTP  
HTTP  
GDS Server



# Dynamic Ingest Monitoring

Dual Site Ingest and Dynamic error reporting for a serially complete archive. QC architecture discovered NOAAPort labeling errors.

## ARCHIVE STATUS PAGE (2004 / 05) 31 d --- NCEP HI-RESOLUTION ETA & GFS

Full Cycle Available	A Few Missing FCT hours	Significant Missing Data
Extra Files Found	Cycle Currently Being Processed	Cycle Not Available

| # CTL files / # Fct Hrs | --- Files received for each cycle

### Month Navigation

<< [ASR](#) | [JAN](#) | [FEB](#) | [MAR](#) | [APR](#) | [MAY](#) | [JUN](#) | [JUL](#) | [AUG](#) | [SEP](#) | [OCT](#) | [NOV](#) | [DEC](#) | >> 2004

MESO ETA HI - Grid 218 - Status

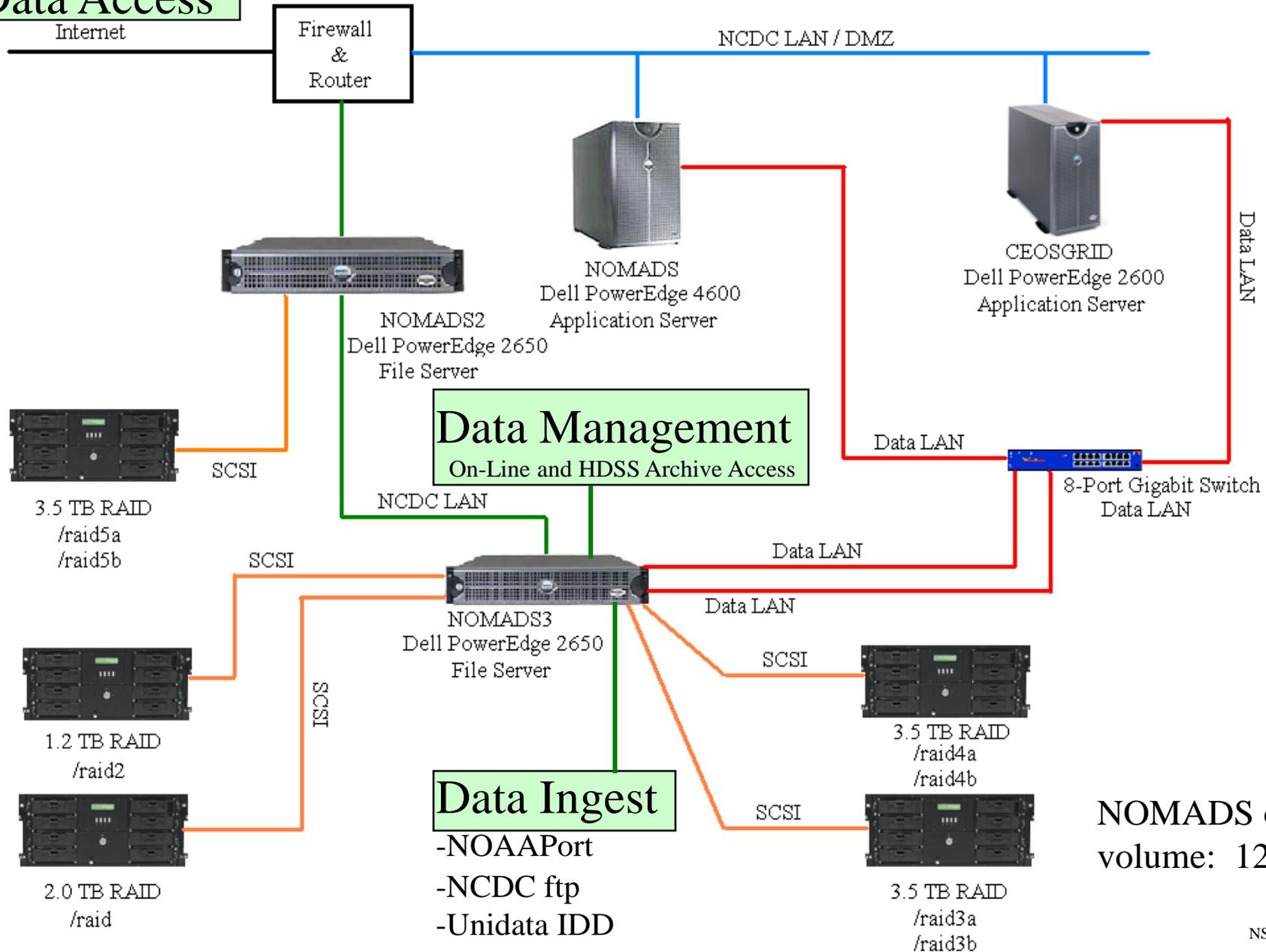
DAY	0000 Z	0600 Z	1200 Z	1800 Z
31				
30				
29				
28				
27	1/21	1/21	1/21	0/0
26	1/21	1/21	1/21	1/21
25	1/21	1/21	1/21	1/21
24	1/21	1/21	1/21	1/21
23	1/21	1/21	1/21	1/21
22	1/21	1/21	1/21	1/21
21	1/21	1/21	1/21	1/21
20	1/21	1/21	1/21	1/21
19	1/21	1/21	1/21	1/21
18	1/21	1/21	1/21	1/21
17	1/21	1/21	1/21	1/21
16	1/21	1/21	1/21	1/21
15	1/21	1/21	1/21	1/21
14	1/21	1/21	1/21	1/21

GFS AVN HI - Grid 3 - Status

DAY	0000 Z	0600 Z	1200 Z	1800 Z
31				
30				
29				
28				
27	1/61	1/61	0/0	0/0
26	1/61	1/61	1/61	1/61
25	1/61	1/61	1/61	1/61
24	1/61	1/61	1/61	1/61
23	1/61	1/61	1/61	1/61
22	1/61	1/61	1/61	1/61
21	1/61	1/61	1/61	1/61
20	1/61	1/61	1/61	1/61
19	1/61	1/61	1/61	1/61
18	1/61	1/61	1/61	1/61
17	1/61	1/61	1/61	1/61
16	1/61	1/61	1/61	1/61
15	1/61	0/41	1/61	1/61
14	1/61	1/61	1/61	1/61

# NOMADS Hardware Configuration

## Data Access





## NOMADS

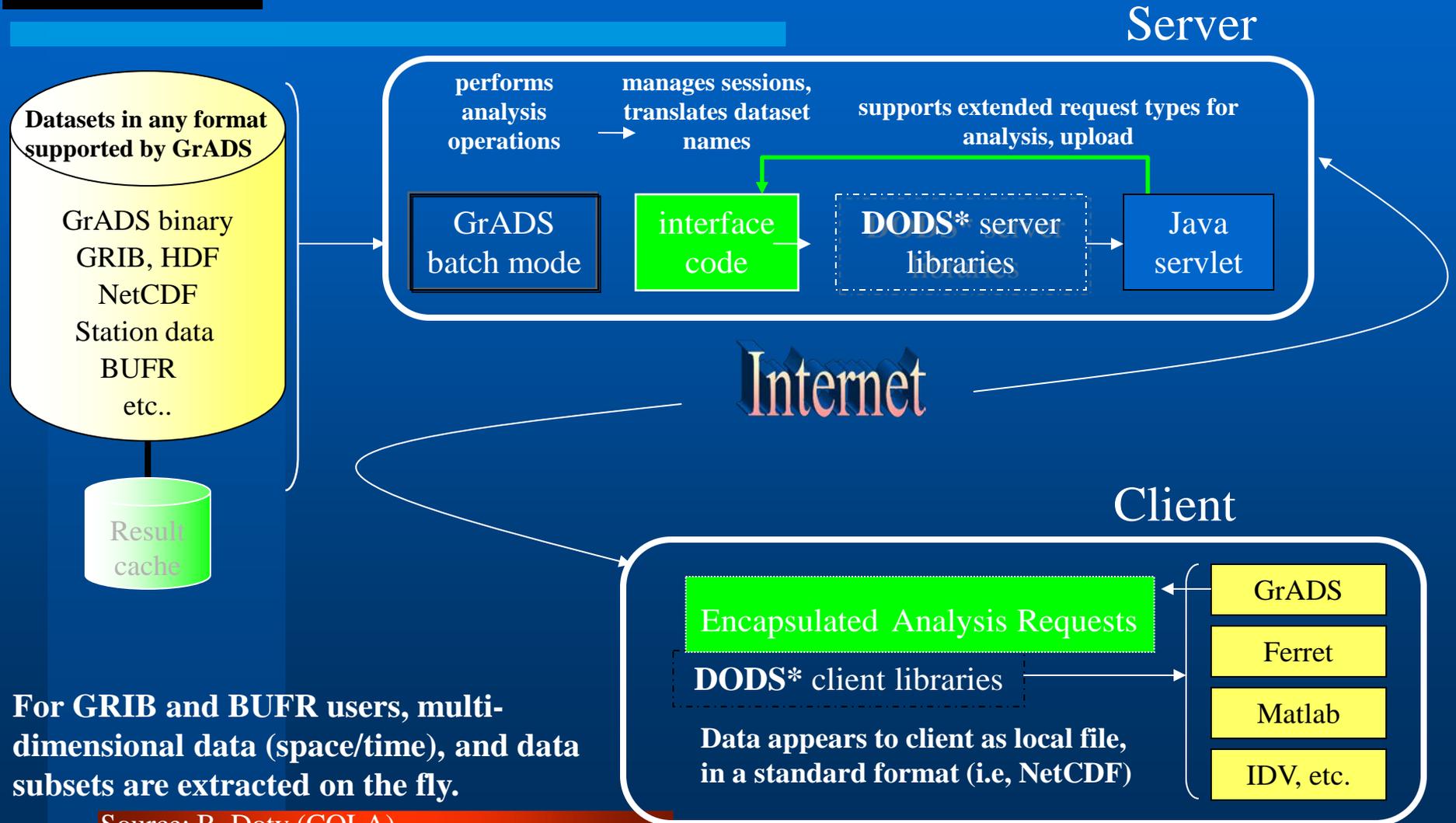
The NOAA Operational Model  
Archive and Distribution System



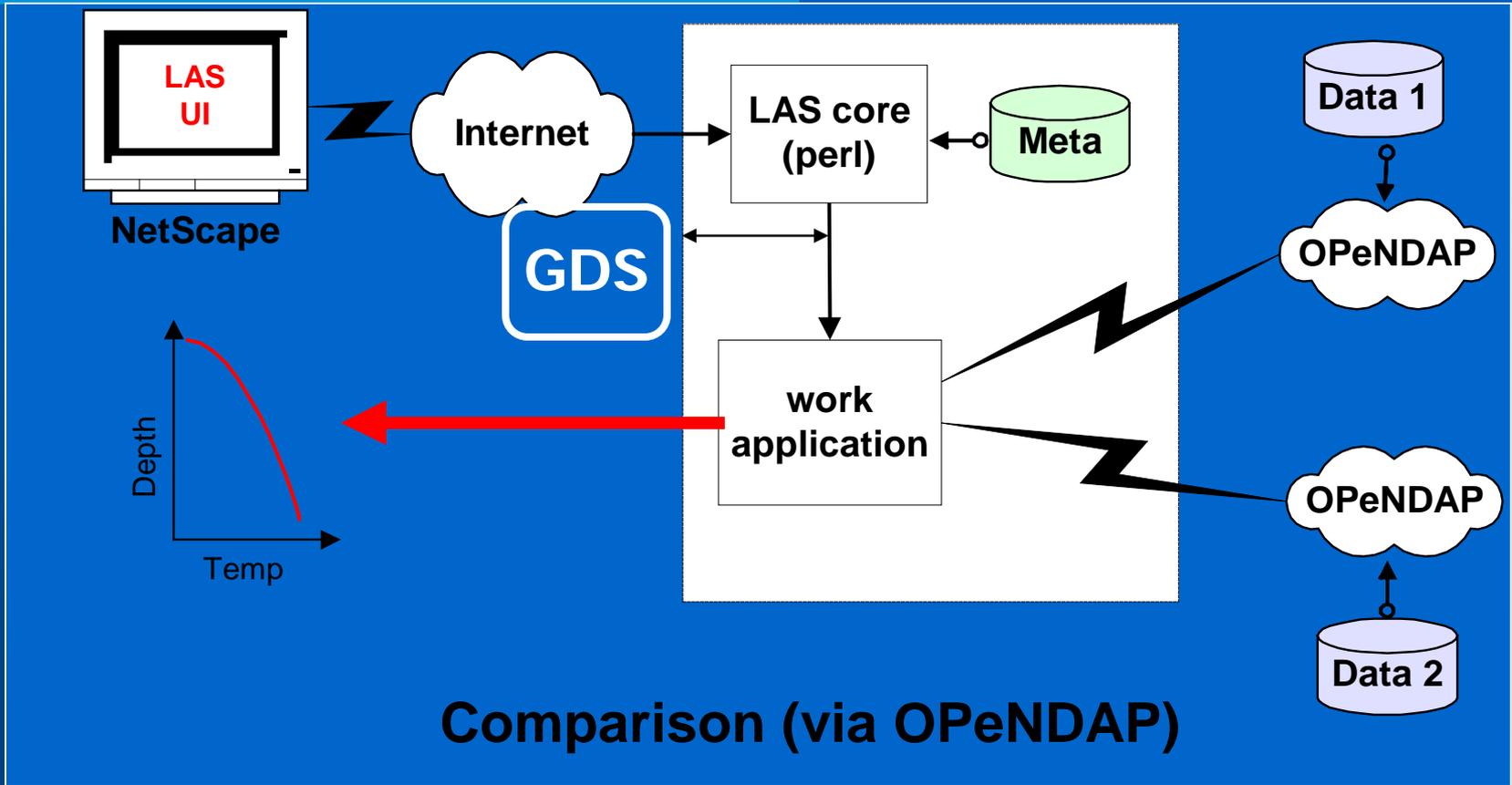
## *Core Systems / Applications*

### NOMADS Core:

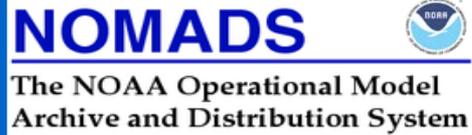
- Inexpensive PC Linux and LINUX Clusters
- Fast IDE Level 5 RAID NFS Read only behind firewall
  - Red Hat
  - OPeNDAP (DODS) + THREDDS Catalog
  - GrADS-Data Server -GDS
  - Live Access Server -LAS
  - LAS/CDAT-Climate Data Analysis Tools (LLNL)
  - Globus (Earth System Grid –ESG)



For GRIB and BUFR users, multi-dimensional data (space/time), and data subsets are extracted on the fly.



**GOAL: Retrieving and Using GRIB/BUFR through GDS and LAS**

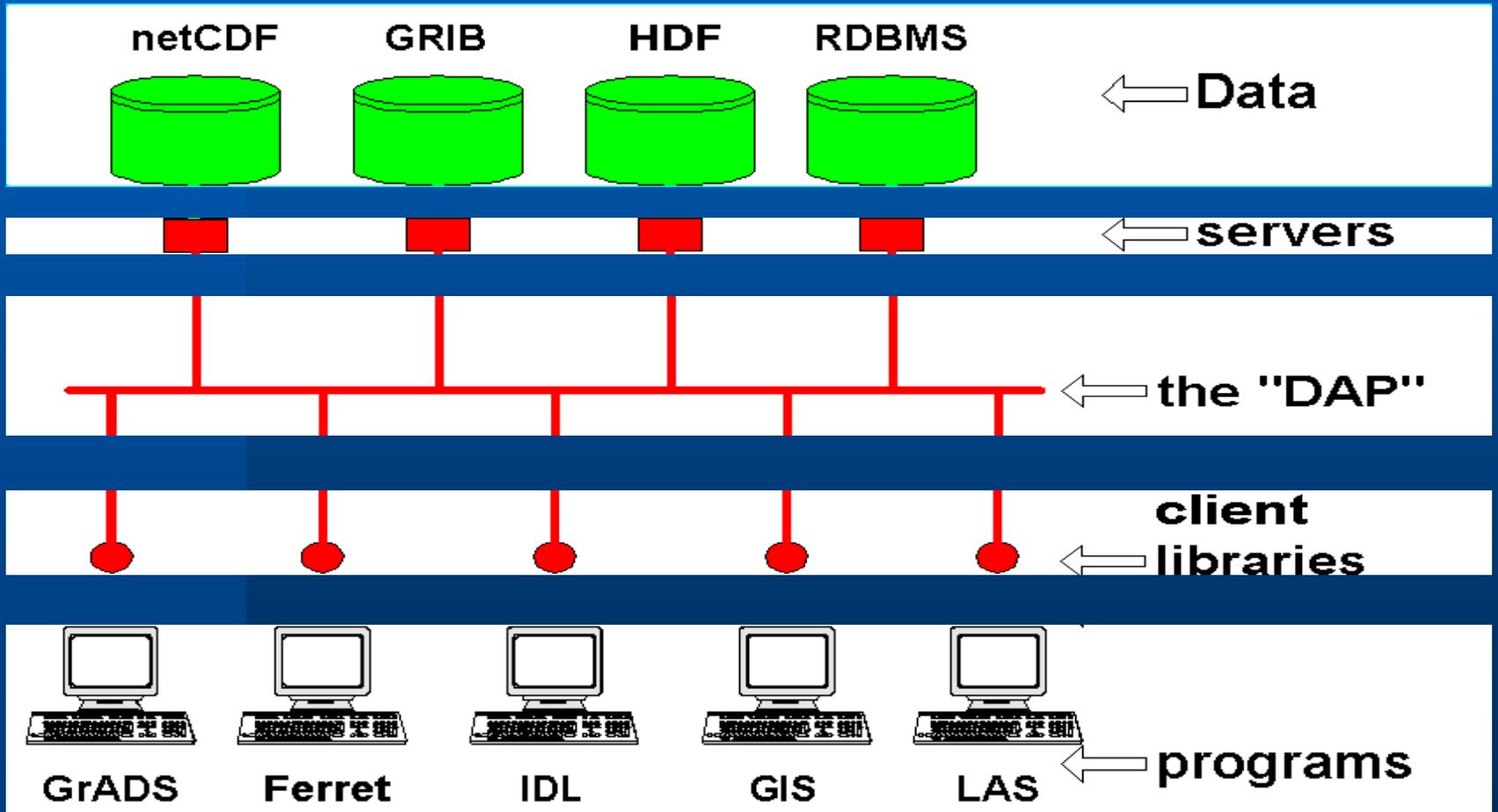


## *Framework*

- NOMADS uses the Open Source XML based OPeNDAP.
- OPeNDAP is a binary-level protocol designed for the transport of scientific data subsets over the Internet. Provides server side data manipulation on-the-fly (e.g., GrADS-DODS).
- Data formats: GRIB, GRIB2, BUFR, HDF, NetCDF, ascii...  
Conventions: COARDS, CF, FGDC, DIF...libraries built as necessary.
- APIs: JAVA-OPeNDAP, C++-OPeNDAP, NetCDF, GRIB, BUFR, THREDDS, Python.



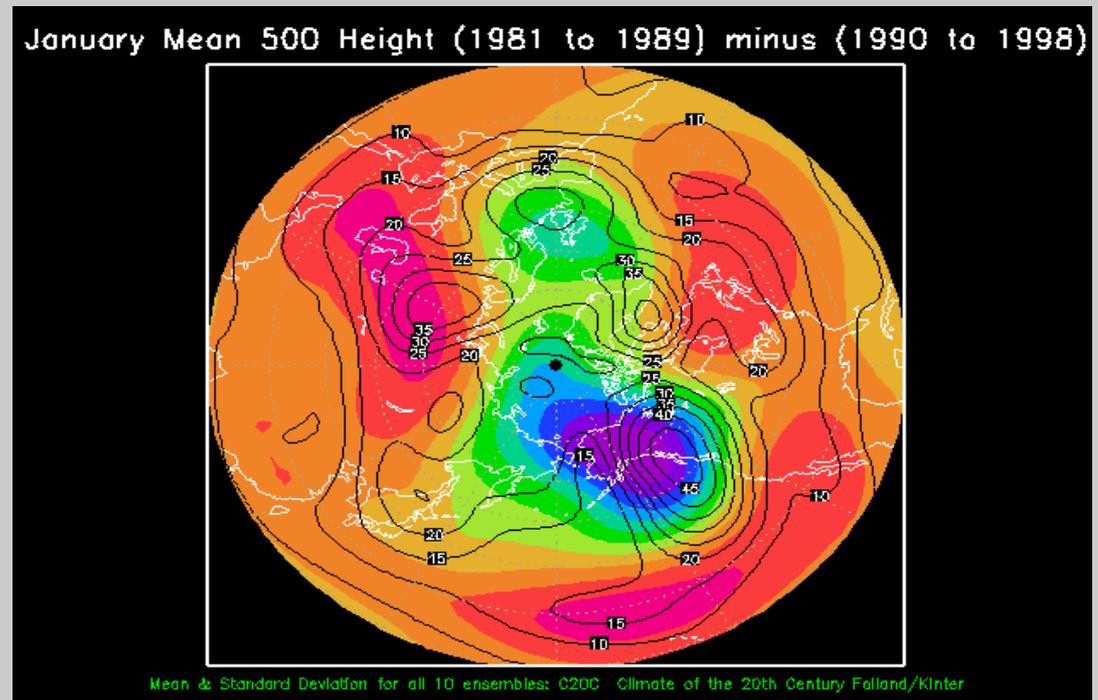
*Utilize Binary data and metadata through OPeNDAP ...*



At left is the complete GDS script for generating mean and sdev at 500mb analyzing 18 years of “Climate of the 20<sup>th</sup> Century” over the Internet:

**Traditional** vs. **NOMADS** method:

Volume transported:	100Gb	vs.	2Kb
Time to access data:	days	vs.	60 sec
Code development:	days	vs.	minutes
Fortran based LOC:	~1000	vs.	50 LOC



```
* January Mean 500 Height (1981 to 1989) minus (1990 to 1998)
* Mean & Standard Deviation for all 10 ensembles
* Time required: 60 secs
'reinit'
'date'
* baseURL = 'http://motherlode.ucar.edu:9090/dods/_expr_'
* GKR 2/13/03 New NCAR URL
baseURL = 'http://dataportal.ucar.edu:9191/dods/'
expr = 'ave(z,t=387,t=483,12)-ave(z,t=495,t=591,12)'
xdim = '0:360'
ydim = '20:90'
zdim = '500:500'
tdim = '1nov1978:1nov1978'
'sdfopen 'baseURL'_expr_{C20C/C20C_A}' {'expr'} {'xdim','ydim','zdim','tdim'}'
'sdfopen 'baseURL'_expr_{C20C/C20C_B}' {'expr'} {'xdim','ydim','zdim','tdim'}'
'sdfopen 'baseURL'_expr_{C20C/C20C_C}' {'expr'} {'xdim','ydim','zdim','tdim'}'
'sdfopen 'baseURL'_expr_{C20C/C20C_D}' {'expr'} {'xdim','ydim','zdim','tdim'}'
'sdfopen 'baseURL'_expr_{C20C/C20C_E}' {'expr'} {'xdim','ydim','zdim','tdim'}'
'sdfopen 'baseURL'_expr_{C20C/C20C_F}' {'expr'} {'xdim','ydim','zdim','tdim'}'
'sdfopen 'baseURL'_expr_{C20C/C20C_G}' {'expr'} {'xdim','ydim','zdim','tdim'}'
'sdfopen 'baseURL'_expr_{C20C/C20C_H}' {'expr'} {'xdim','ydim','zdim','tdim'}'
'sdfopen 'baseURL'_expr_{C20C/C20C_I}' {'expr'} {'xdim','ydim','zdim','tdim'}'
'sdfopen 'baseURL'_expr_{C20C/C20C_J}' {'expr'} {'xdim','ydim','zdim','tdim'}'

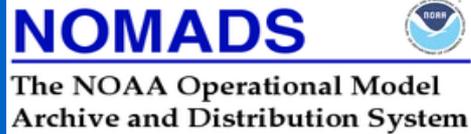
'define resa = result.1'
'define resb = result.2'
'define resc = result.3'
'define resd = result.4'
'define rese = result.5'
'define resf = result.6'
'define resg = result.7'
'define resh = result.8'
'define resi = result.9'
'define resj = result.10'
say 'got data'

'set lev 500'
'set lat 20 90'

'define mean = (resa + resb + resc + resd + rese + resf + resg + resh + resi + resj)/10'

'define d1 = (pow(resa-mean,2)) ; 'define d2 = (pow(resb-mean,2))'
'define d3 = (pow(resc-mean,2)) ; 'define d4 = (pow(resd-mean,2))'
'define d5 = (pow(rese-mean,2)) ; 'define d6 = (pow(resf-mean,2))'
'define d7 = (pow(resg-mean,2)) ; 'define d8 = (pow(resj-mean,2))'
'define d9 = (pow(resi-mean,2)) ; 'define d10 = (pow(resj-mean,2))'
'define stddev = pow((d1 + d2 + d3 + d4 + d5 + d6 + d7 + d8 + d9 + d10)/10,0.5)'

'set gxout shaded'
'set mproj nps'
'display mean'
'draw title January Mean 500 Height (1981 to 1989) minus (1990 to 1998)'
'set string 3 bc 1'
'draw string 5.5 .5 Mean & Standard Deviation for all 10 ensembles:
'C20C Climate of the 20th Century Folland/Kinter'
*cbarn'
'set gxout contour'
'set ccolor 0'
'display stddev'
'date'
```



## *Data Availability Overview*

CDC: Reanalysis, climate weather models, in-situ

GFDL: Coupled Models, Control and Perturbation Integrations and historical 20th century simulations using solar, volcano, GHG and aerosol forcings.

FSL: MADIS mesoNets, Hi-Res RUC-II

NCAR: Community Climate System Model / Land Surface CO2 predictive models (VEMAP), Reanalysis / Eta

NCDC: Archive for NCEP model input/output / Select NCDC Observation datasets, Ocean/Ice WAVE, NARR, SST's...

NCEP: Real-time Input/Output, Reanalysis (I&II), Ensembles, Sea Ice Ocean, CDAS, Hourly Eta, Climate Forecast Models...

LLNL: AMIP / Probabilistic information

PMEL: Ocean and Climate datasets



## NOMADS



The NOAA Operational Model  
Archive and Distribution System

## *NCDC and NCEP Data*

- **NCDC NOMADS Archive**

- NWP from NCEP

- POR: 2002 to Real-Time
- **Eta** (12km); **GFS** (1 degree); **GDAS**; **NARR** 12km 30yrs
- RUC-II 20/40km; Ocean and Ice WAVE Models
- NCDC Reference Data Sets (Reynolds SST's, GHCN...)
- NCDC Mirror site to NCEP NOMADS for Eta & GFS

- **NCEP Real-Time NOMADS**

- Global Forecast System GFS 1 degree
- **Hourly Eta** at 12km
- Regional Spectral Model (RSM) and Ensembles
- Climate Data Assimilation System (CDAS)
- AMIP Climate Monitoring, Climate Forecast Model
- NCEP/NCAR Global Reanalysis 1&2



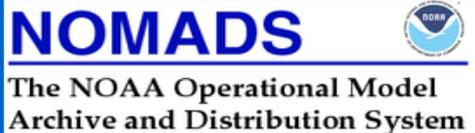
## NOMADS

The NOAA Operational Model  
Archive and Distribution System



## *Model Input: NCEP GDAS*

- NOMADS saves the minimum data necessary to regenerate model output products as close as possible to NCEP operations.
- The analysis files will be in the models own coordinate system.
- Files are constructed with computer and computational efficiency in mind, and not in standard coordinate systems.
- Programs to convert these files are available upon request:
  - spectral to gaussian
  - gaussian to lat/lon
  - sigma to pressure

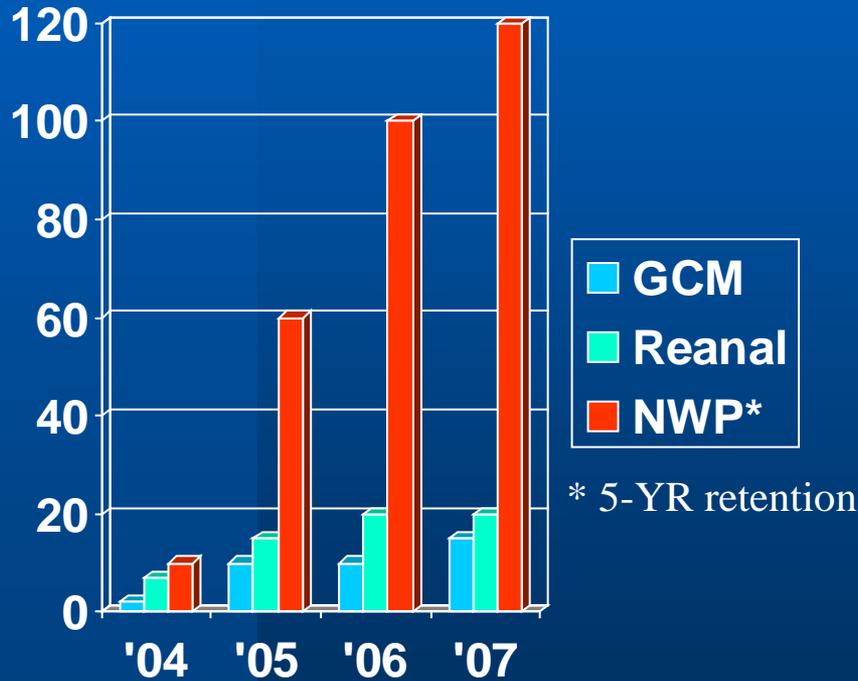


## *Archive and User Statistics*

- **Data Philosophy and Retention**
  - Data are free.
  - NWP forecast data are retained for five years.
  - All other data are retained for long term stewardship.
- **Data Users**
  - Resolution of IP addresses indicate a broad range, and consistent use of NOMADS available data:
    - U.S. Agencies, Academic Institutions: K-12 to Research
    - International governments, (Italy, Japan, countries within South America and Africa. Many others).
    - Private Sector and Non-Government Organizations NGO's
    - World Bank, United Nations (FAO), others.

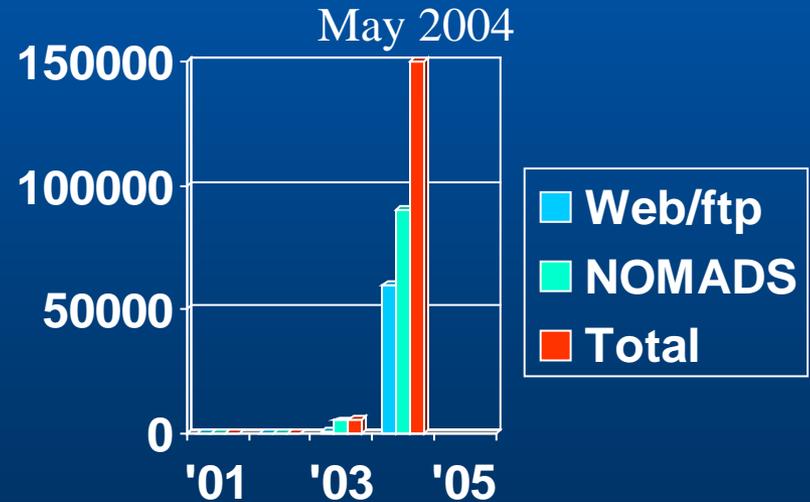


**NCDC Volume Tb/Yr**



Existing and Projected Volume

**NOMADS Users Stats  
 Hits + Downloads / Yr  
 Operational Aug '03**



2004 Stats are Jan thru May only!



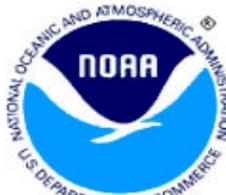
# NOMADS



The NOAA Operational Model  
Archive and Distribution System

## NOMADS Main Page

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	<p><i>The NOAA Operational Model Archive and Distribution System (NOMADS) is a pilot project designed to provide real-time and retrospective format independent access to climate and weather model input and output data.</i></p> <p><a href="#">About NOMADS</a>   <a href="#">FAQ</a></p>	
<p><a href="#">Status Reports</a></p>	<p><b>NOMADS</b> </p> <p>The NOAA Operational Model Archive and Distribution System</p>	<p><a href="#">Program Plan and Data Management Vision</a></p>
<p><a href="#">Using NOMADS</a></p>	<p><a href="#">NOMADS Data Portals</a></p> <p><a href="#">NOMADS Web Interface</a></p>	<p><a href="#">Participants</a></p>

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<http://www.ncdc.noaa.gov/oa/climate/nomads/nomads.html>

Created by [Glenn.Rutledge@noaa.gov](mailto:Glenn.Rutledge@noaa.gov)



# NOMADS



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Archive and Distribution System

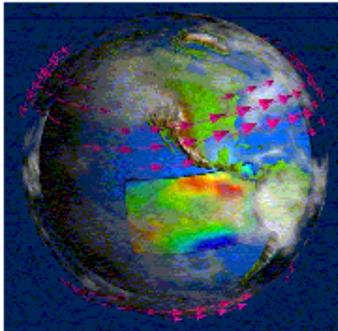
## NCDC Web Interface

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## Model Resources



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## The NCDC Web Plotter & Interface originally developed at NCEP:

**NCEP NWP Model Datasets in NCDC Repository**

model	grid/scale	freq	plot	ftp	http	nomads gds	contact 1	contact 2
<b>GFS Analysis and Forecasts</b>								
GFS-AVN	<a href="#">201</a>	00,06,12,18Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
GFS-AVN	<a href="#">202</a>	00,06,12,18Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
GFS-AVN	<a href="#">203</a>	00,06,12,18Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
GFS-AVN	<a href="#">211</a>	00,06,12,18Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
GFS-AVN	<a href="#">213</a>	00,06,12,18Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
GFS-MRF	<a href="#">201</a>	00Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
GFS-MRF	<a href="#">202</a>	00Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
GFS-MRF	<a href="#">203</a>	00Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
GFS-MRF	<a href="#">205</a>	00Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
<b>ETA Analysis and Forecasts</b>								
Early-ETA	<a href="#">212</a>	00,12Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
Meso-ETA	<a href="#">211</a>	00,12Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>
Meso-ETA	<a href="#">212</a>	00,06,12,18Z	<a href="#">plot</a>	<a href="#">ftp4u</a>	<a href="#">http</a>	<a href="#">gds</a>	<a href="#">Glenn Rutledge</a>	<a href="#">T</a>

Variable:

- capes 1 level \* Convective Available Potential Energy (Surface) [J/kg]
- cins 1 level \* Convective Inhibition (Surface) [J/kg]
- cp 1 level \* Total Precipitation [kg/m^2]
- pc 1 level \* Convective Precipitation [kg/m^2]
- ps 1 level \* Surface Pressure [Pa]
- pwat 1 level \* Entire Atmosphere Precipitation [kg/m^2]
- rh2m 1 level \* Meter Relative Humidity [%]
- slpe 1 level \* Sea Level Pressure, ETA re...
- t2m 1 level \* Meter Temperature [K]
- u10m 1 level \* Meter U Winds [m/s]
- v10m 1 level \* Meter V Winds [m/s]

Note: Some of the above listed variables may not be available at the time or model level. To see what data is present, use your Back button to return to the main page and use the review links at the bottom of the page or see the variable list on the right.

Level:

extra operation 1:  2:

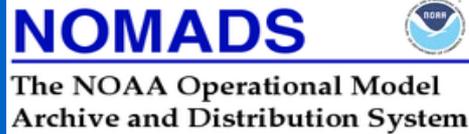
Data available from 00Z 28 dec 2003 to 06Z 29 dec 2003 at 6 hour intervals

Time

Map projection:  only for custom maps long:  long:  lat:  lat:

Draw:  Contour interval:  white:  Plot size:

NOMADS leverages efforts across the community.



# NOMADS “Web Plotter”

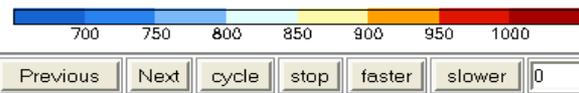
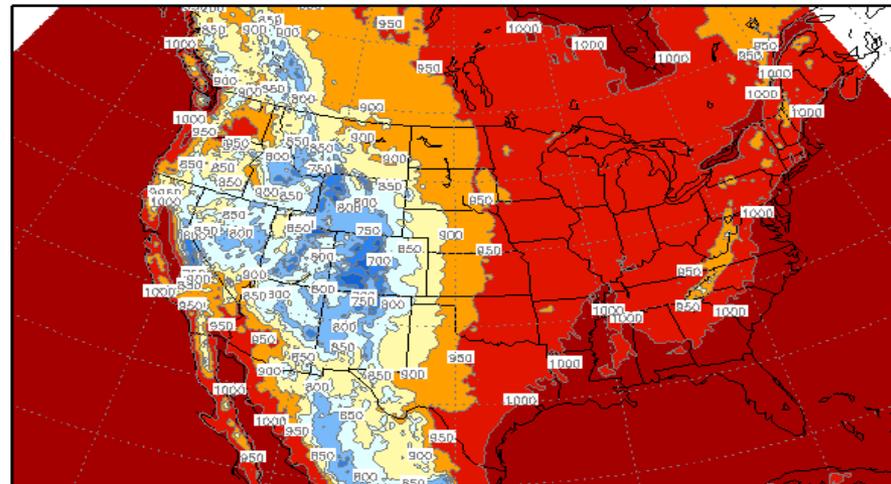
- NCDC ingest 150K grids/day.
- POR 2002 to present.
- Any one of these accessible in seconds  
Via: OpENDAP  
GDS  
ftp  
Web Plotter  
LAS (soon)

NOMADS Interactive Web Plotter - Order # 1052 ./meso-eta-hi\_218\_20040529\_1800\_fff.cti

PRESsfc 1000

18Z29may2004 to 06Z01jun2004

PRESsfc 18Z29MAY2004





# NOMADS



The NOAA Operational Model  
Archive and Distribution System

*Providers: NCEP*

N.O.M.A.D.S.

## N.O.M.A.D.S. NOAA Operational Model Archive Distribution System



[Real Time NOMADS NCEP Component](#)

Caution: this web server is in testing mode. Applications are being developed and we are using it for live testing.

Forecasts may not be current and historical data set may not be complete.

[Comprehensive forecast archives and reanalysis-2 daily archives on this machine.](#)



# NOMADS



The NOAA Operational Model  
Archive and Distribution System

*Providers: GFDL*



geophysical fluid  
dynamics laboratory

[About Us](#) | [Research](#) | [Products and Services](#) | [References](#) | [Technical Services](#) | [Meetings and Seminars](#)

### Spotlight on NOMADS

NOMADS is being developed as a Unified Climate and Weather Archive to provide Web access to model information so that users can make decisions about their specific needs. This spans time scales from days (weather), to months (El Nino), to decades (global warming). For more, see NCDC's [nomads](#) page.

### Spotlight on ESP

The Earth Science Portal (ESP) is a

[gfdl's home page](#) > [products and services](#) > data portal

## gfdl's data portal

### Our Data Portal Services

Public data sets from GFDL are made available through the GFDL Data Portal. The data portal is designed to provide access to: data attributes, and graphical display the data. Download provides "http" access to download complete files. Display of data attributes includes global attributes and the variables available in the files. Graphical display uses the Live Access Server to graphically display the data.

### Our Public Data Files

Registration for the GFDL Data Files is free. Users are requested to complete the Registration Form for Public Data Files (found on the data portal) first begin using the data portal. Information from this form will be used to provide registered users with news on when additions and when corrections are made to existing public data. The information gathered will not be used for any purposes other than to provide Data Portal Services.

### Data Storage

The data files on the data portal are stored in netCDF (network Common Data Form), and can be identified by the suffix ".nc". To comply with the COARDS convention for the standardization of netCDF files. More information about netCDF is available at [http://www.cgd.cornell.edu/netcdf/](#)



# NOMADS



The NOAA Operational Model  
Archive and Distribution System

*Providers: FSL*

FSL NOMADS Data Portal

## Forecast Systems Laboratory NOMADS Data Portal



The [Forecast Systems Laboratory \(FSL\)](#) has made available the following data as a [NOAA Operational Model Archive and Distribution System \(NOMADS\)](#) [Data Access Protocol \(OPeNDAP \(Formerly DODS\)\)](#)-enabled clients may be used to access and display these data:

- [Meteorological Assimilation Data Ingest System \(MADIS\)](#) (restricted)
- [20km Backup Rapid Update Cycle \(RUC\)](#)
- Coastal Storms Initiative (CSI) (coming soon)

---

[Forecast Systems Laboratory \(FSL\)](#)

[NOAA Operational Model Archive and Distribution System \(NOMADS\)](#)

[Open source project for Network Data Access Protocol \(OPeNDAP\)](#)

[Distributed Oceanographic Data System \(DODS\)](#)



# NOMADS

The NOAA Operational Model Archive and Distribution System



## Collaborators: NCAR CDP



NCAR

### Community Data Portal

UCAR

- CDP Home
- Search
- Browse
- Applications
- Data Providers
- Support
- Login



The Community Data Portal (CDP) is a collection of earth science datasets from NCAR, UCAR, UOP, and participating organizations in the following research areas:

- oceanic
- atmospheric
- space weather
- turbulence

#### Search for Datasets

Search for Earth Science datasets by metadata keyword:

[Search Tips](#)

#### Browse Dataset Catalogs

- NCAR
  - ACD/MOZART Model
  - ACD Model Evaluation Data
  - ATD campaigns
  - CGD/CAS Climate Analysis Data
  - CGD/CCSM Model
  - SCD/DSS Section
  - SCD/VETS Section
  - WACCM Model
- UCAR
  - Unidata
- Universities
  - ENLIL Heliospheric Model

#### Login

Login with your Gatekeeper account for one click access to NCAR Mass Store downloads.

Username

Password

#### Applications

- Select Application -

#### Live Access Server

- Select Dataset -

#### CDP News

New [MOZART](#), [CCSM](#) Datasets



CDP is an NCAR Cyberinfrastructure Strategic Initiative led by the NCAR Scientific Computing Division. It is a collaboration between UCAR, NCAR, UOP, and the National Science Foundation. CDP is developed by NCAR/SCD/VETS and utilizes several software packages and standards including [LAS](#), [OPeNDAP](#), and [THREDDS](#).



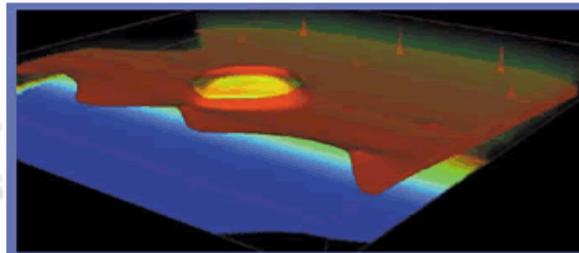
## NOMADS

The NOAA Operational Model  
Archive and Distribution System



*Collaborator: NASA GCMD*

A GCMD Portal to  
Model Output  
Data Sets



National Partnership for Advanced Computational  
Infrastructure  
Feature Image (3/08/00)

### Keyword Search

#### Agriculture

- [Forestry](#) - [Soils](#) - [more](#)

#### Atmosphere

- [Temperature](#) - [Winds](#) - [more](#)

#### Biosphere

- [Vegetation](#) - [Wetlands](#) - [more](#)

#### Cryosphere

- [Sea Ice](#) - [Snow Cover](#) - [more](#)

#### Human Dimensions

- [Environmental Impacts](#) -  
[Human Health](#) - [more](#)

#### Land Surface

- [Land Use / Land Cover](#) -  
[Soils](#) - [more](#)

#### Oceans

- [Temperature](#) - [Circulation](#) -  
[Coastal Processes](#) - [more](#)

#### Paleoclimate

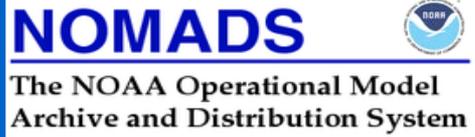
- [Ice Cores](#) - [Tree Rings](#) - [more](#)

#### Radiance / Imagery

- [Infrared Wavelengths](#) -  
[Radar](#) - [more](#)

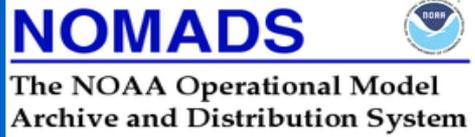
#### Sun-Earth Interactions

- [Solar Activity](#) -  
[Sunspots](#) - [more](#)



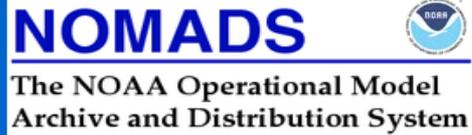
## *Next Steps*

- GDAS Availability: NOMADS can now handle BUFR (thanks to COLA)
- NARR: North American Regional Reanalysis
- NCDC to use NOMADS Operationally in the Customer Services Division: Model Data, the Natl, Digital Fcst Database, SRRS, and most graphics.
- AWIPS going NOMADS?
  - Phoncon: FSL indicates next AWIPS will be OPeNDAP enabled.
  - FSL drafting white paper to NOAA CIO (go NOMADS).
  - NOMADS to brief NOAA. Request NCEP and GFDL Participation.
- Work to Operatinalize NOMADS. How? (GTF Planning Member)
- Advance into Climate analysis and detection efforts
  - Science based user workshops and projects (still) needed.



## *Next Steps (cont.)*

- This grass roots effort extremely successful (look at participants).
- Funding is now required for...
  - Google like search engine.
  - Data Management and Science based tools to:
    - help verify content and location, and generation of metadata (i.e., reanalysis)
  - Advance, Support, and Coordinate various OPeNDAP projects:
    - allows climate / ocean / weather model inter-comparison and access.
    - Support software development at institutions (COLA, PMEL, OPeNDAP).
  - Do not over engineer this process. Build on simple successes with the existing efforts including a new NOMADS capability within CLASS & thru Scientific Data Stewardship (SDS). Also GTF effort.



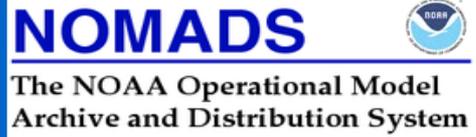
## *Closing Thoughts*

### ● So What?

## *“But I just want the Data”*

The idea of pulling information, not bytes or data, is new and hard to convey

- **NOMADS is a pull technology. Users can become data servers.**
- **Why transport millions of files if only a subset is needed?**
- **Will networks ever keep up with growing data sets?**
- **Data Management at the grass roots level with science driven requirements.**
- **Many efforts in distributed access. How best to coordinate efforts?**
- **Vision, planning, and cooperation needed w/ Agency attribution!**
- **A dynamic system, not over engineered and built upon existing users needs but extensible for future requirements.**



## *Closing Thoughts (cont.)*

NOMADS has become an internationally known project. It is a grass roots effort with no significant base funding. Acknowledgment for the foresight and support therefore is provided to all Center Managers keeping this effort alive particularly Tom Karl (NCDC), Louis Uccellini (NCEP), and Ants Leetma (GFDL).

However this high degree of success is mostly attributed to the people that have contributed both software and experience toward distributed data access. Special recognition to:

Brian Doty and Jennifer Adams	COLA
Steve Hankin and Jon Callahan	PMEL
Dean Williams and Mike Fiorino	LLNL
Jordan Alpert and Jun Wang	NCEP
Ron Stouffer and Chris Kerr	GFDL

## Geosciences Technology Forum

[Newsletter](#)[Mail lists](#)[Calendar](#)[Other ITR Efforts](#)[LEAD Internal](#)[National Conferences](#)[Public Relations](#)[Technology Links](#)[Grid Technology Links](#)[Meteorology Links](#)[Real Time Forecasts](#)

Working with National Agencies, professional societies and other appropriate entities, LEAD will establish the *National Geosciences Technology Forum (GTF)*. Similar in concept and with strong ties to the Open Grid Forum (OGF) and similar groups, the GTF will serve as a focal point for dialog on cyberinfrastructure in geosciences with particular emphasis on linking IT systems and sharing knowledge and resources.

The Planning Committee is working on the agenda of the first GTF meeting, which will be held on 18-19 October 2004 in the Washington DC area. The [GTF Concept Paper](#), prepared by the LEAD Principal Investigators, describes the GTF vision.

<http://lead.ou.edu/gtf.htm>



LEAD is funded by the [National Science Foundation](#).

# The Grid: An IT Infrastructure for NOAA in the 21<sup>st</sup> Century

*Mark Govett, Mike Doney, Paul Hyder*



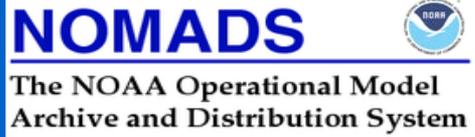
FORECAST  
SYSTEMS  
LABORATORY  
BOULDER, COLORADO

- To meet challenges facing NOAA in the next decade and beyond
  - 100 Fold Increase in Data Volume in 10 years
    - GOES-R, NPOESS, IEOS, Radar, GPS
  - More Complex Modeling Systems
    - higher resolutions, ensembles, data assimilation, more data
- Proposes an Integrated IT Infrastructure based on Grids
  - Build on existing NOAA Programs (e.g. CLASS, NOMADS)
  - Develop Compute, Data and Service Grids
  - Enable Dynamic Data Discovery, Access, Integration
  - Utilize / Develop Web Services, Grid Portals



## Some OPeNDAP *Portals*

CDC:	<a href="http://www.cdc.noaa.gov/cgi-bin/nph-nc/Datasets/">http://www.cdc.noaa.gov/cgi-bin/nph-nc/Datasets/</a>
COLA:	<a href="http://cola8.iges.org:9090/dods">http://cola8.iges.org:9090/dods</a>
FSL:	<a href="http://nomads.fsl.noaa.gov/">http://nomads.fsl.noaa.gov/</a>
GFDL:	<a href="http://nomads.gfdl.noaa.gov/">http://nomads.gfdl.noaa.gov/</a>
NCDC:	<a href="http://nomads.ncdc.noaa.gov/">http://nomads.ncdc.noaa.gov/</a>
NCEP:	<a href="http://nomad1.ncep.noaa.gov/">http://nomad1.ncep.noaa.gov/</a>
Unidata:	<a href="http://www.unidata.ucar.edu/cgi-bin/dods/datasets/">http://www.unidata.ucar.edu/cgi-bin/dods/datasets/</a>



*For more information...*

- For more Program Information see:

<http://www.ncdc.noaa.gov/oa/climate/nomads/nomads.html>

- To get data:

NOAA NCDC Main Page → Climate → *Model Resources*

<http://nomads.ncdc.noaa.gov>

- Or contact:

[Glenn.Rutledge@noaa.gov](mailto:Glenn.Rutledge@noaa.gov)