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# Joint Effects Model (JEM) Environmental Services Research and Development

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# Project Background



- **What: NCAR/RAL providing Environmental Research and Development (R&D) support to JEM program via DTRA/JSTO.**
- **Why: Transition R&D technologies and datasets, produced through DTRA/JSTO Weather Services R&D Project, into JEM system. Particular objectives include:**
  1. Assist with integration of DTRA Next Generation Meteorological Data Server (MDS) Application Programming Interface (API) into JEM.

Assist JSTO and JEM program manager with Testing & Evaluation / Verification & Validation of JEM with meteorological data from the MDS.
  2. Upgrade and and incorporate new environmental datasets.

Assist JSTO with quality assurance of all environmental data and tools in JEM.



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Project Objective #1  
DTRA Next Generation  
Meteorological Data Server  
(MDS) Integration

# Legacy MDS Requirements



- Provide simplified access to real time meteorological forecast model and observational datasets from a variety of sources for HPAC.
- Minimize bandwidth requirements for requested/retrieved datasets through spatial and temporal domain sub setting.
- Reformat data sources into HPAC specific weather formats.

All in all, these requirements have been met....BUT....

# Legacy MDS Issues



- **PERFORMANCE:** User base has substantially grown.
  - **Struggling to cope with expanding user load.**
- **RELIABILITY:** Hardware and software configuration is antiquated.
  - **Based on 1990s technologies. Require extensive manpower to maintain.**
- **STOVE-PIPED:** HPAC centric system and interface.
  - **System not intended for general access by other software clients.**
- **SECURITY:** Originally used unsecured FTP for client server communication, with users given system accounts.
- **EXPANDABILITY:** System not easily expandable to support wider variety of data sources.
- **INDUSTRY STANDARDIZATION:** No industry standardization.

# NexGen MDS Requirements



- Provide simplified and **GENERALIZED** access to real time, plus **ARCHIVED**, meteorological forecast model and observational datasets from a variety of sources.
- Minimize bandwidth requirements for requested/retrieved datasets through spatial and temporal domain sub setting.
- Reformat data sources into HPAC specific weather formats and **OTHER INDUSTRY STANDARD** formats.

Plus...

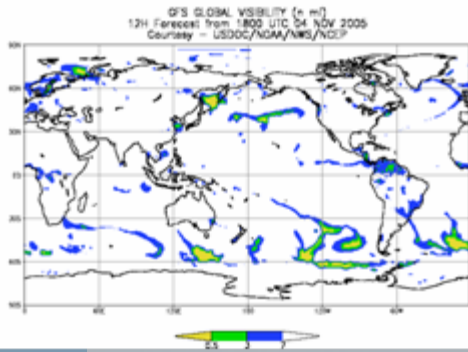
- **PERFORMANCE**: Improve performance to meet requirement of fulfilling 100 user requests in under 3 minutes.
- **RELIABILITY**: Increase reliability using high availability technologies.
- **SECURITY**: Improve user authentication and data transfer security using PKI and secure data transfer methodologies.
- **EXPANDABILITY**: Provide mechanism for easily expanding types of available data sources and formats.
- **INDUSTRY STANDARDIZATION**: Utilize web services standards for data access.

# Available Model Data

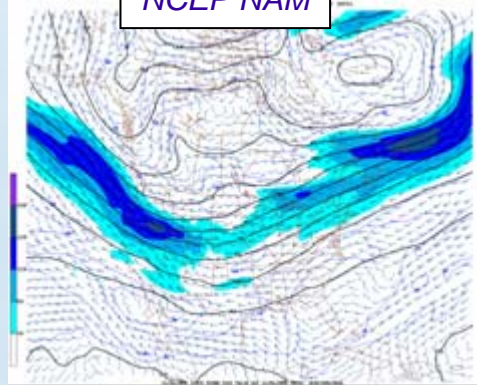


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NCEP GFS



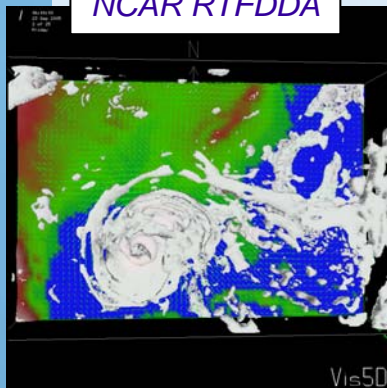
NCEP NAM



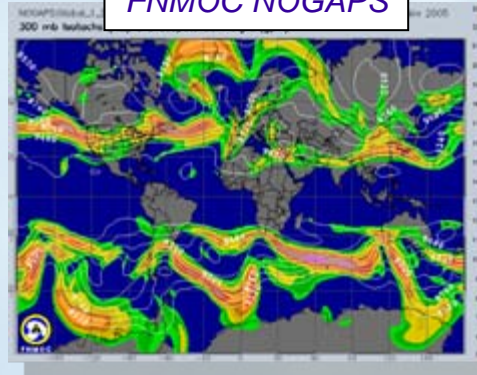
FNMOC COAMPS



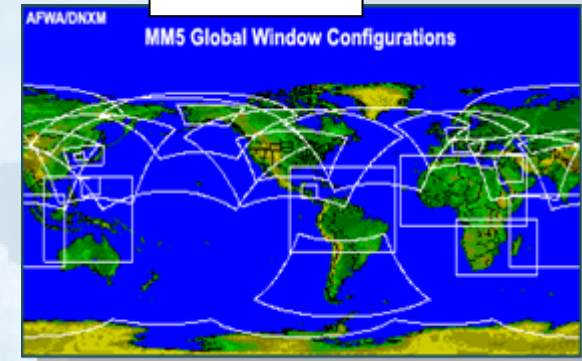
NCAR RTFDFA



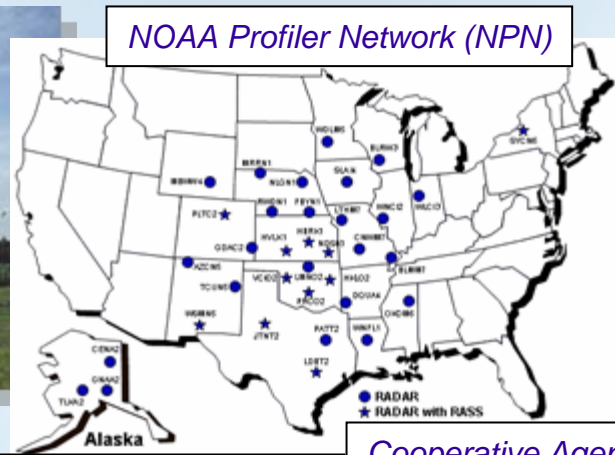
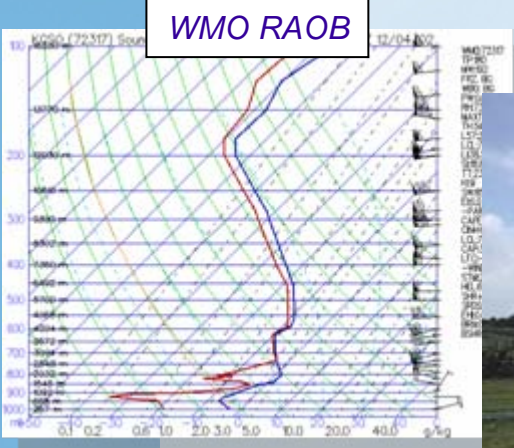
FNMOC NOGAPS



AFWA MM5



# Available Observational Data

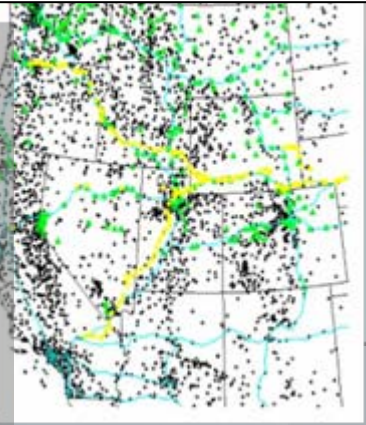


WeatherFlow

University of Utah Mesowest

Cooperative Agency Profilers (CAP)

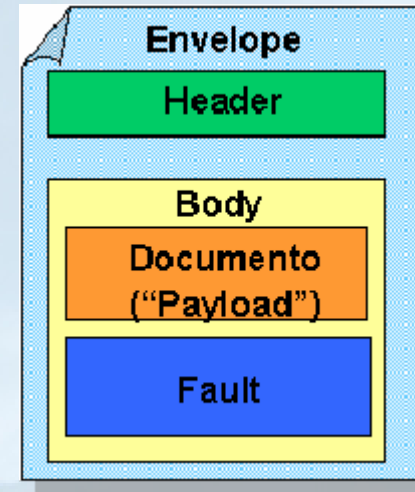
NWS Ships/Buoys





# SOAP Access

- Supports Web Services Simple Object Access Protocol (SOAP) via HTTP and HTTPS.
- Allows requests for a specific data source, output variable, vertical level, horizontal domain, and temporal domain.
- Includes metadata query capability to determine what data, variables, etc.. are currently available on system.



# Java API



- Java Application Programming Interface (API) serves as primary MDS interface.
- Authenticates users via Public Key Infrastructure (PKI) techniques.
- Supports the reprojection, interpolation, and reformatting of raw datasets.
- Currently provides datasets in NCAR Meteorological Data Volume (MDV) and HPAC specific formats.

```
edu.ucar.rap.mds.client
Class WxDataRequest

java.lang.Object
└ edu.ucar.rap.mds.client.WxDataRequest

All Implemented Interfaces:
  java.lang.Cloneable
```

---

```
public class WxDataRequest
  extends java.lang.Object
  implements java.lang.Cloneable

Represents a single request for weather related data. Sample usage: see TestDemo
```

---

Field Summary	
java.lang.String[]	<b>fieldName</b> Names of requested fields or null.
int	<b>fieldset</b> field selection type: one of FIELDSET*.
double	<b>latMax</b> max latitude, decimal degrees (negative for S of the equator)
double	<b>latMin</b> min latitude, decimal degrees (negative for S of the equator)
double	<b>lonMax</b> max longitude, decimal deg (negative for W of Greenwich UK)
double	<b>lonMin</b> min longitude, decimal deg (negative for W of Greenwich UK)
java.lang.String	<b>modelName</b> Preferred model: One of "best", "NOGAPS", "GFS", "ETA", etc., or null.
java.lang.String	<b>outfile</b> Name of the output file.
int	<b>outFormat</b> Requested format of output file.
int	<b>outType</b>

# MDS Components



- Efficiently distribute user requests to Server systems
- Serve as firewall between MDS public and private network

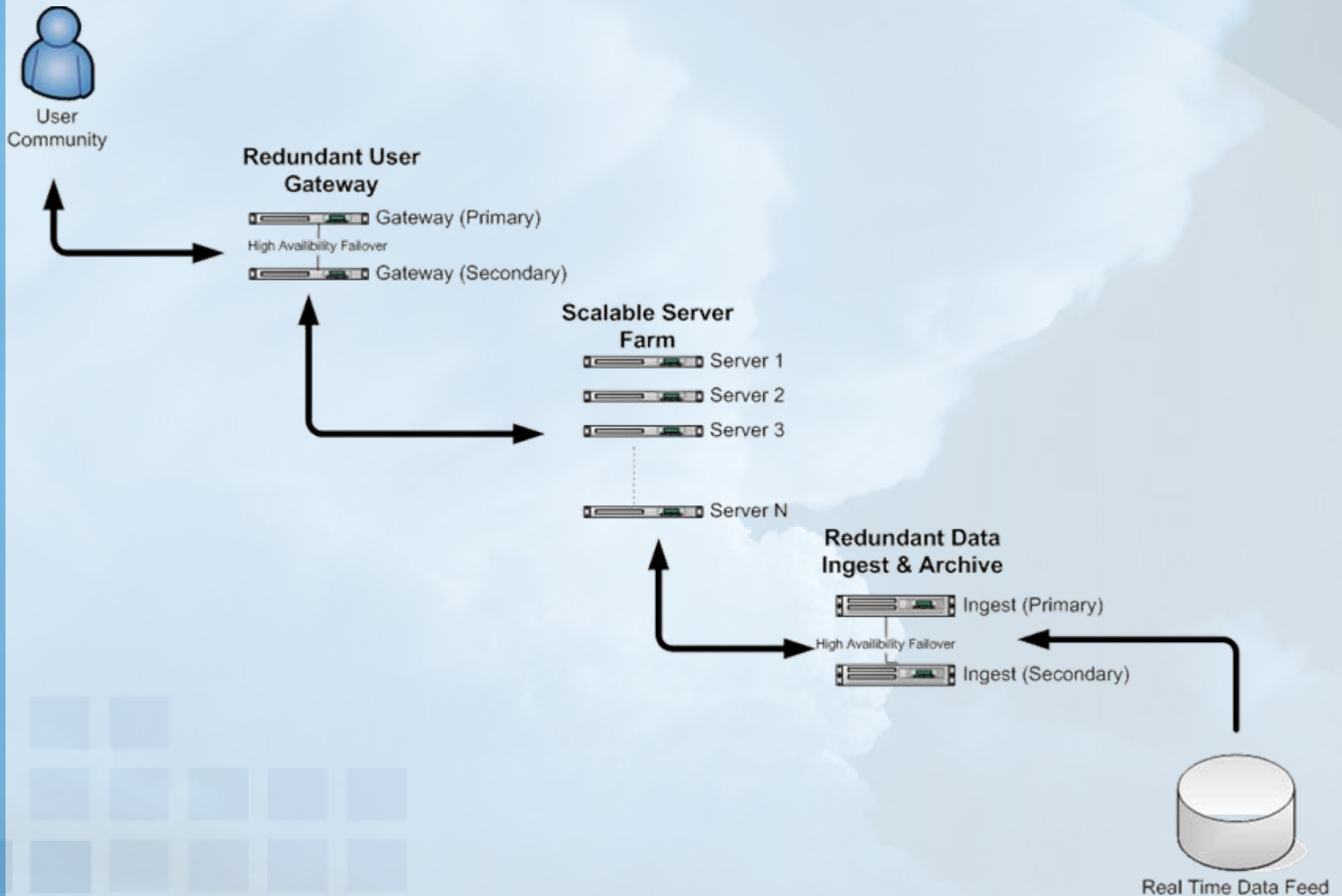


- Authenticate user requests
- Process user requests
- Extract and deliver real time data sources upon request
- Forward requests for archived data sources to Ingest system

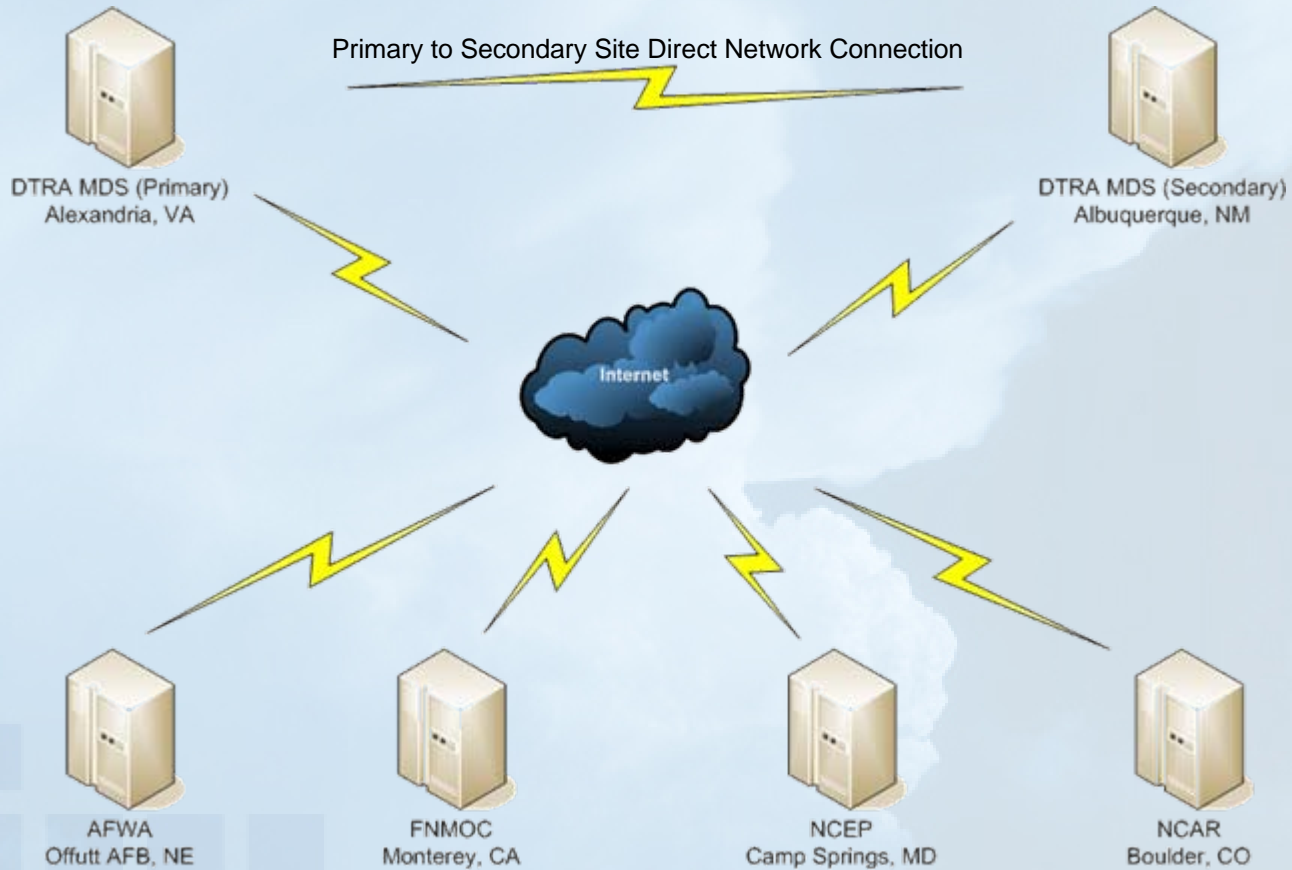


- Ingest all incoming data sources
- Reformat raw model products into model data repository
- Reformat raw observational products into observational database
- Extract and deliver archived data sources upon request

# System Architecture

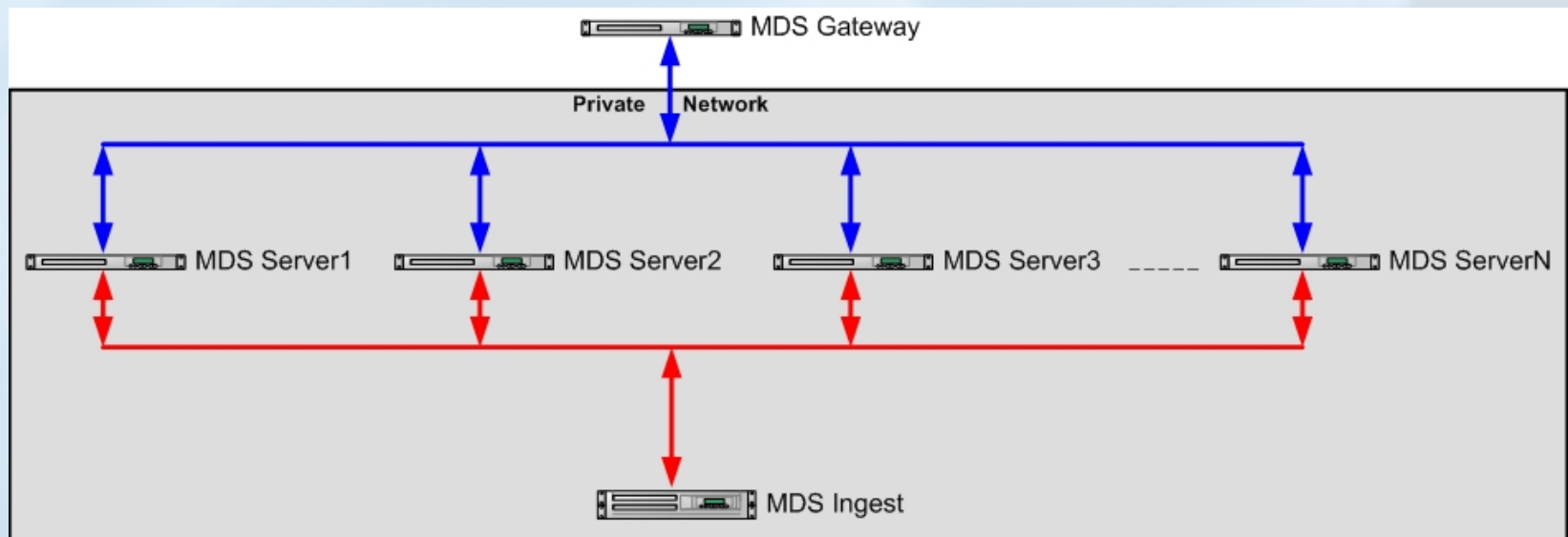


# Redundant Server Locations



# Server Farm

- Currently have 3 servers
- Can be expanded to N Servers



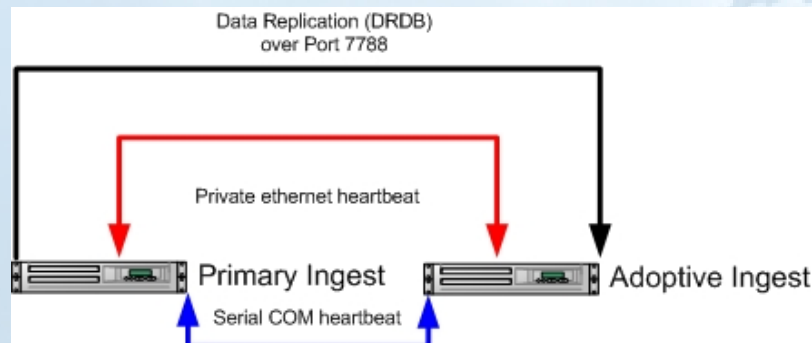
# High Availability

## Gateways Systems



- Hot adoptive system
- Active / Passive Mode
- Real-time data replication on Ingest Systems

## Ingest Systems



# Project Objective #1 Status and Plans



- MDS v1.0 delivered March 2006 and currently operational.
- MDS v1.1 on schedule to be delivered ~January - February 2007.
- MDS API successfully integrated into latest JEM baseline and undergoing testing by Northrop Grumman.
- MDS v1.2 development beginning.
  - New Data Sources:
    - AFWA and FNMOC KQ METARS
    - FSL MADIS
    - NCEP SREF, WRF-NMM, and GENS
  - Improved API
    - Support JMBL formatted requests
    - Utilize CBRN data model XML schemas
  - Expand Retrievable Data Formats
    - HPAC NexGen MEDOC
    - NATO METGM
    - WMO GRIB
    - Unidata netCDF
  - Enhanced Security
    - 2-way DoD PKI Authentication





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# Project Objective #2 Environmental Database Enhancement and Integration

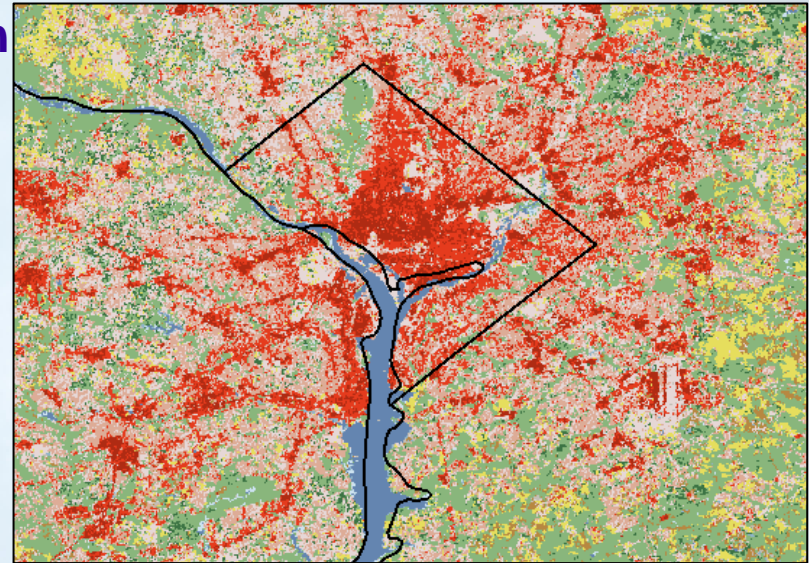
# Land Cover Database



- Purpose:
  - Used to determine agent surface absorption and secondary evaporation rates, plus surface layer turbulence profiles.
- Details:
  - 1km horizontal grid spacing.
  - 25 land use categories by season, which define:
    - Surface roughness
    - Surface albedo
    - Bowen ratio
    - Canopy Height
    - Canopy Flow Index
  - Based on 1993-1994 GOES AVHRR datasets.

# Land Cover Issues and Recommendations

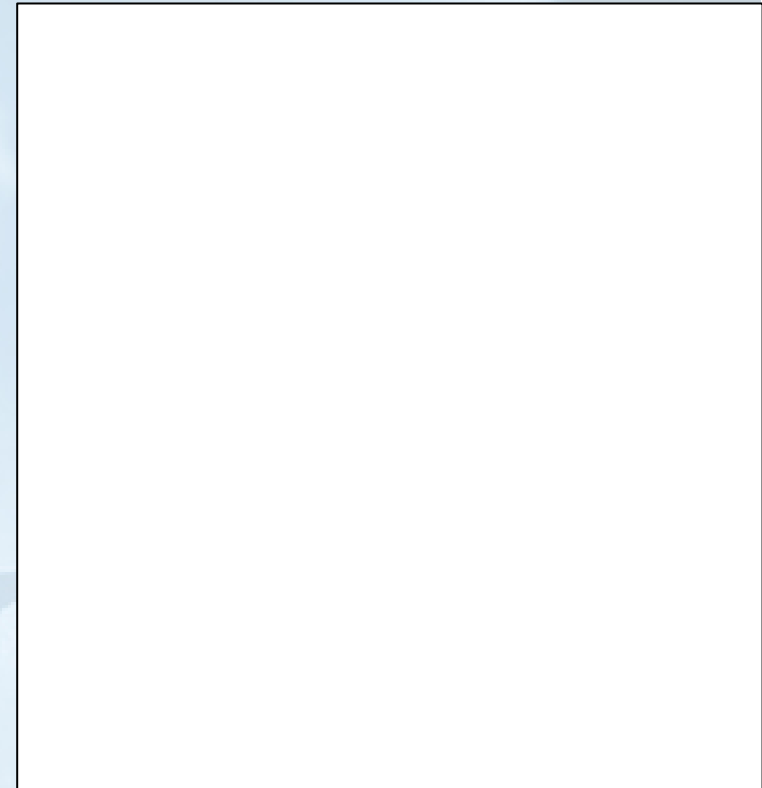
- **Outdated and does not reflect the rapid urbanization of the last 10 years**
- **Provides one generic urban classification and does not discern the differences among different urban types (e.g., downtown, suburban residential areas, and commercial/industrial areas).**
- **Recommended replacement:**
  - 2004-2005 MODIS database for natural surfaces merged with the 2002 30-m LANDSAT based USGS database for urban areas, which provides three separate classifications for urban land use.



# Climatology Database

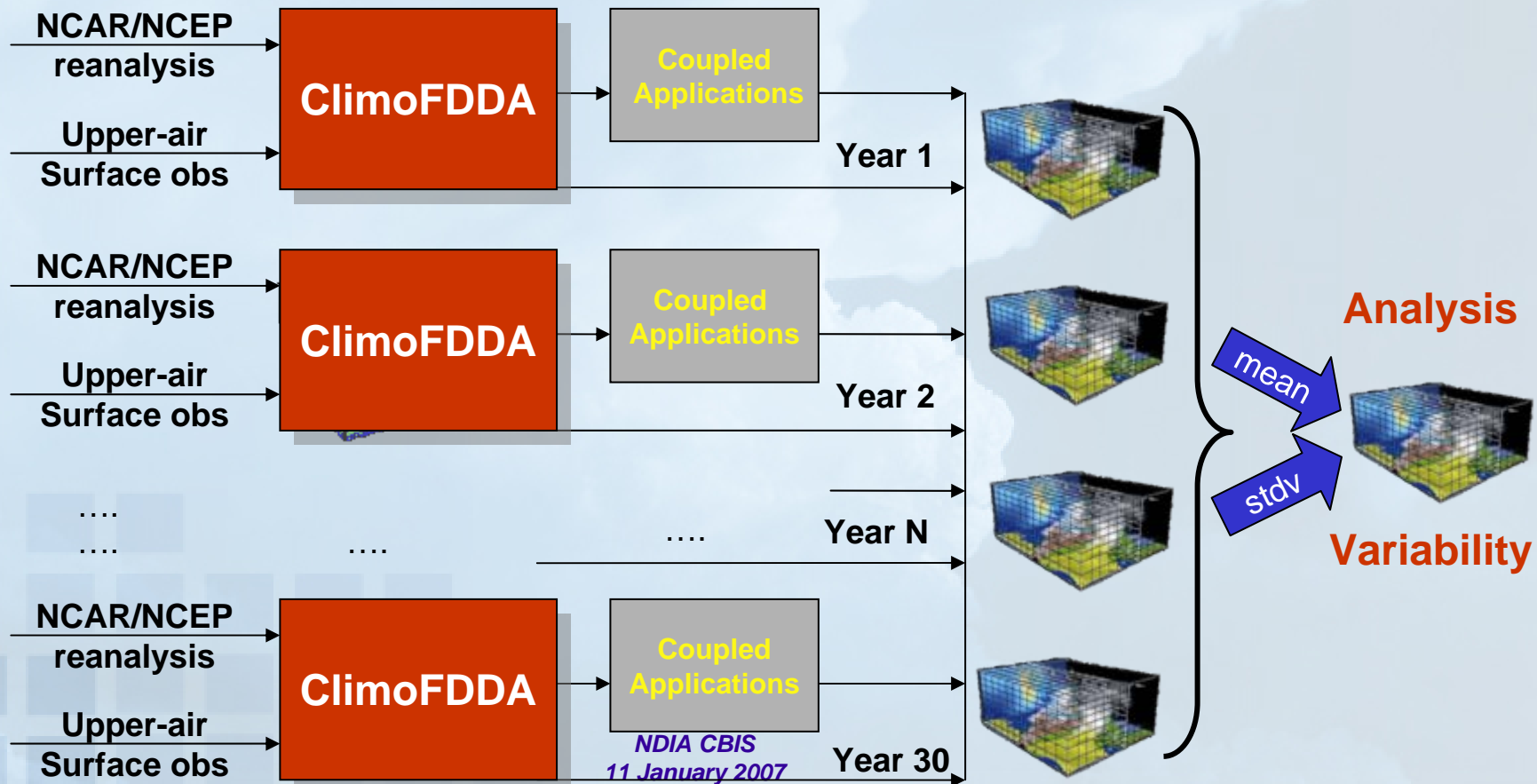


- **Purpose:**
  - Used to derive uncertainty associated with T&D calculations (e.g. Hazard areas).
- **Details:**
  - 2.0 Deg horizontal grid spacing
  - 28 vertical levels
  - Twelve 24 hour periods (6hour temporal resolution) containing:
    - Monthly means and stdevs of u and v wind components, plus u-v correlations
    - Monthly means of T, P, RH
    - Binned frequencies of occurrence of precipitation, wind speed, cloud cover.
  - Developed by AFCCC and based on 1996 NCEP/NCAR Global Reanalysis.



# Recommended Climatology Replacement

- Updated database based on latest 50year NCAR/NCEP Global Reanalysis.
- Generate higher resolution databases, using NCAR Global Climatology Analysis Toolset (GCAT)



# Project Objective #2 Status and Plans



- Database development scheduled to begin ~ March 2007.
- Anticipate first set of enhanced products to be delivered to JEM by early 2008.

# Summary



- Supporting development and integration of DTRA NexGen MDS capabilities into JEM system.
  - First version of MDS API delivered and successfully integrated into JEM.
  - Development of next version of API underway in concert with ongoing MDS enhancements.
- Enhancing and upgrading JEM environmental databases
  - Focusing on enhancement of land cover and climatological databases
  - Development to begin March 2007.
  - First set of enhancements to be delivered early 2008.



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# Contact Information

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