

**International
Computing in the Atmospheric
Sciences 2013 (iCAS2013)
Annecy, France
September 8-12, 2013**

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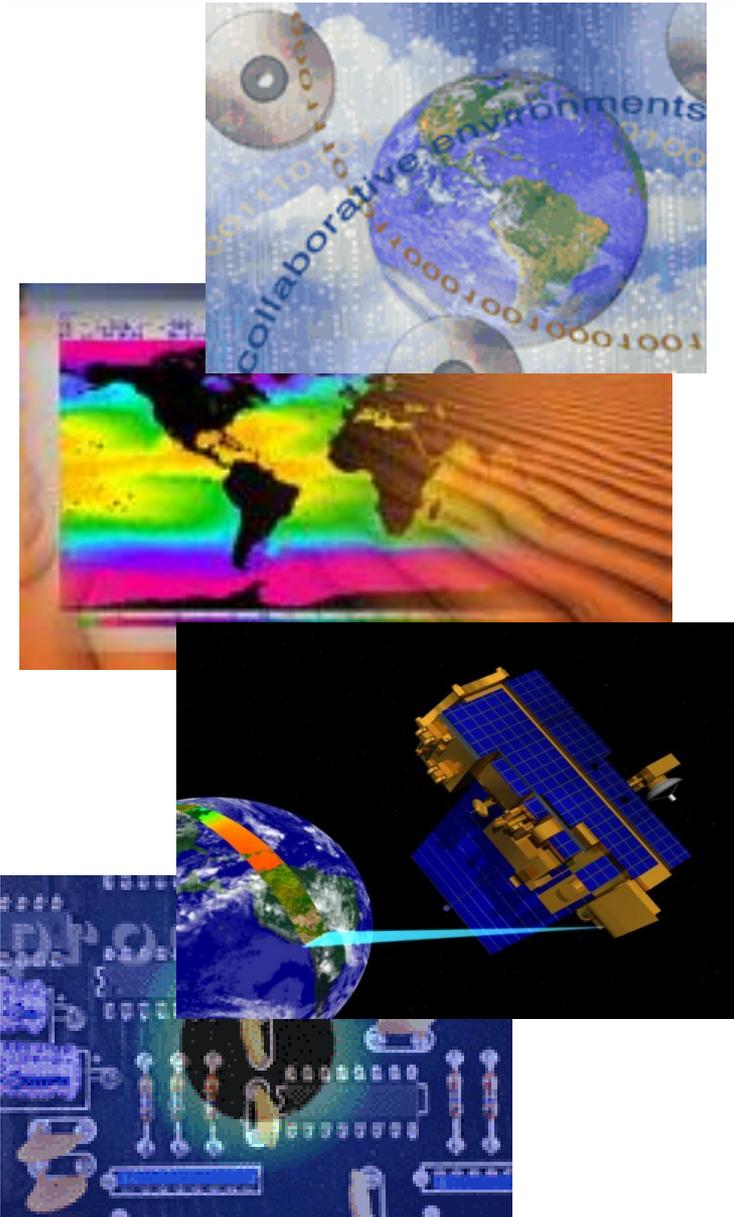
<http://www.itsc.uah.edu>



NSSTC Core Facility

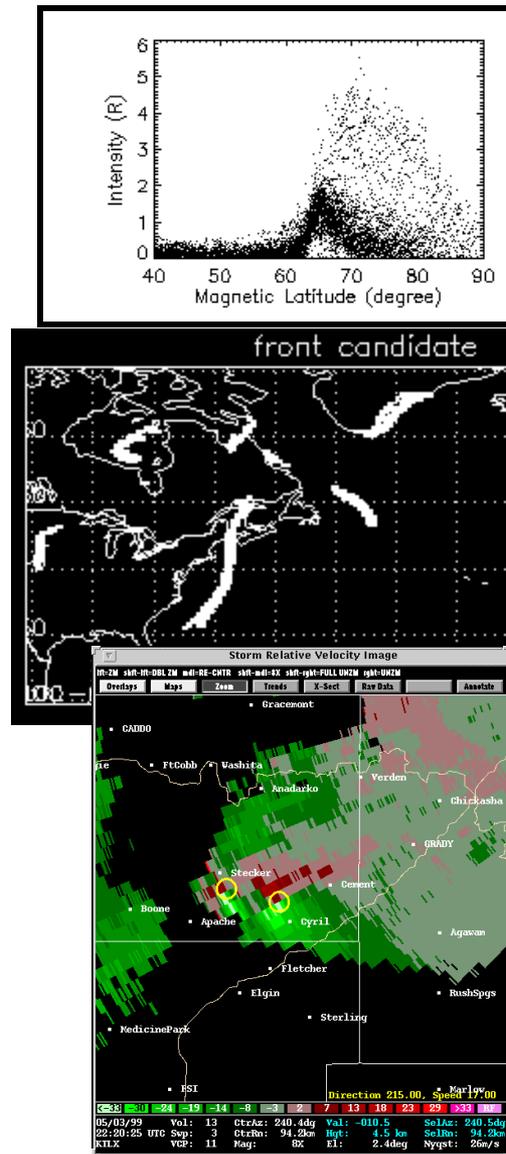
Primary Research Focus Areas

- Data Mining and Knowledge Discovery
- Visual Analytics
- Geoinformatics
- Modeling and Simulation
- Systems Interoperability
- Knowledge Engineering and Semantic Web
- Information Management and Technologies for Big Data
- Asynchronous Collaboration Technologies / Web 2.0
- Decision Support Frameworks
- Cybersecurity/Information Assurance
- Real-time Processing
- Event-driven / On-demand Processing
- Geospatial Technologies
- Sensor Networking Analysis



Data Mining: Algorithm Development and Mining (ADaM) Toolkit

- UAHuntsville has been at the forefront of mining sensor data for over 15 years
- ADaM – UAHuntsville developed toolkit with 100+ algorithms, used worldwide
- Automated discovery of patterns, signatures, anomalies
- Derived knowledge for decision making and response
- Allows learning and training for adaptation
- Most cited article in *Elsevier Computers and Geosciences*, 2005-2010

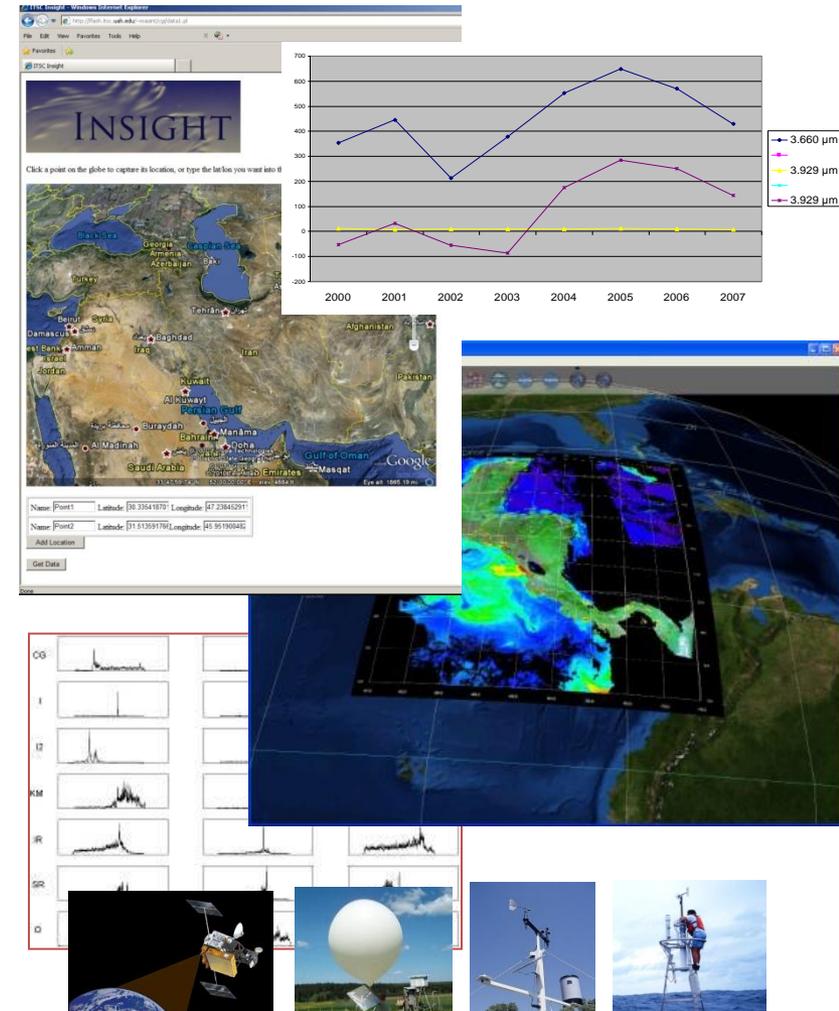



The screenshot shows the ADaM website in a Mozilla Firefox browser window. The browser title is 'ADaM - Mozilla Firefox' and the address bar shows 'http://datamining.itsc.uah.edu:3945/adam/doci'. The website header includes 'THE UNIVERSITY OF ALABAMA IN HUNTSVILLE INFORMATION TECHNOLOGY AND SYSTEMS CENTER' and 'ADaM Algorithm Development and Mining system'. The main content area is divided into several sections: 'Home News Publications To Do Bug Tracker', 'Get Involved Mailing Lists', 'Download License Binaries', 'ADaM Help Documentation FAQ Links', and 'Contact Us'. There are also links for 'ADaM Documentation', 'Data Mining Overview', and 'ADaM 4.0.2 Overview'. A 'Pattern Recognition' section lists 'Classification Techniques' (Bayes Classifier, Naive Bayes Classifier, Bayes Network Classifier, CBEA Classifier, Decision Tree Classifier, SEA classifier, Very Fast Decision Tree Classifier, Back Propagation Neural Network, k-Nearest Neighbor Classifier, Multiple Prototype Minimum Distance Classifier, Recursively Splitting Neural Network) and 'Clustering Techniques' (DBSCAN, Hierarchical Clustering, Isodata, k-Means, k-Medoids, Maximin). An 'Image Processing' section lists 'Basic Image Operations' (Arithmetic Operations(+/-/*), Collaging, Cropping, Image Difference, Image Normalization, Image Moments, Equalization, Inverse, Quantization, Relative Level Quantization, Resampling, Rotation, Scaling, Statistics, Thresholding, Vector Plot) and 'Segmentation/Edge and Shape Detection' (Boundary Detection, Polygon Circumscription, Making Region, Marking Region). A 'Filtering' section lists 'Dilation'. The footer of the browser window shows 'Transferring data from datamining.itsc.uah.edu...'

How do you get the right information to the right people at the right time?

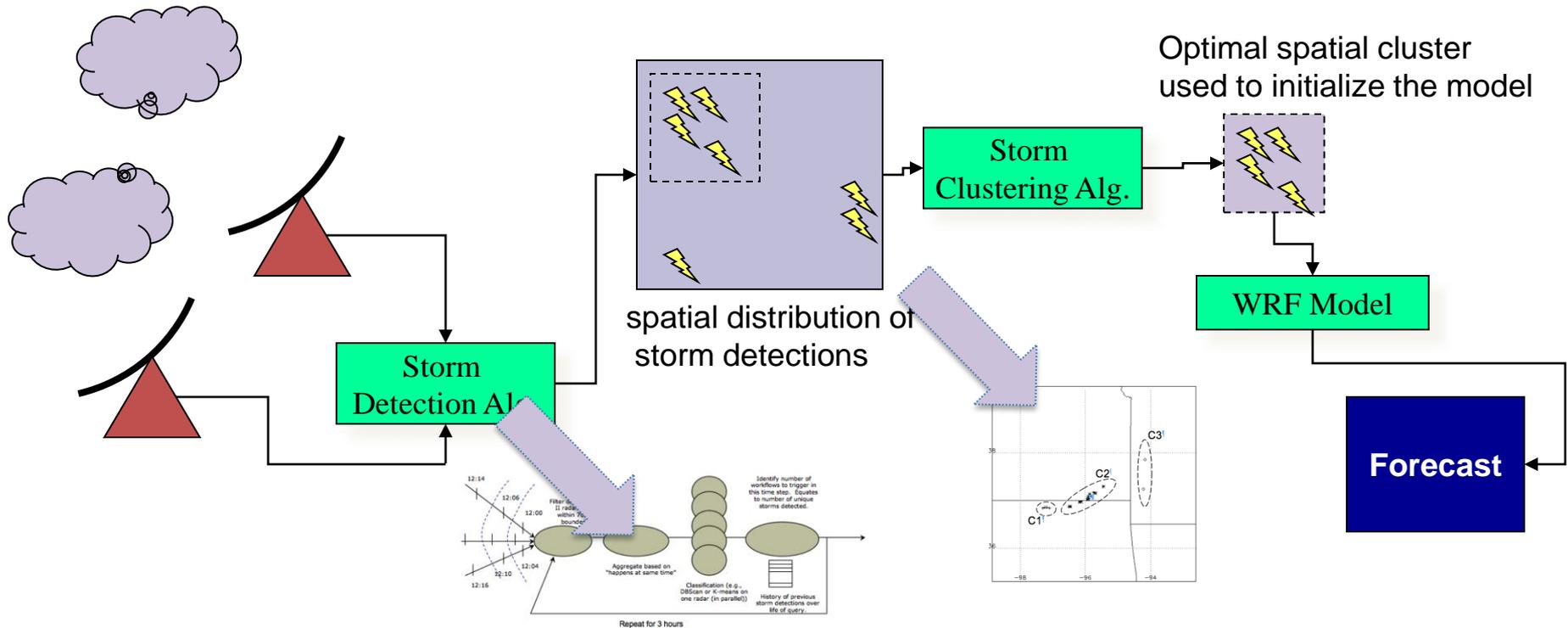
- *Sensor Data Integration/Fusion*
- *Signature Analysis*
- *Pattern Recognition*
- *Real-Time Data Analysis*

- **ADaM Algorithm Development and Mining toolkit**
- **Remote Sensing Analysis**
 - Thermal analysis of human activity
 - Evaluating environmental impacts on socioeconomic activities
 - Algorithm Development
 - Multi-source integration and fusion
- **NASA/USAID sponsored SERVIR Environmental Data Products for Central America and Africa**
 - Decision Support System for environmental analysis
- **JCTD EUCOM Efforts**
 - Providing data products for the Arctic region
- **NSF Linked Environments for Atmospheric Discovery**
 - Real-time mining and analysis
 - Adaptive processing



Sensor Data Integration is Critical for Meaningful Situational Awareness

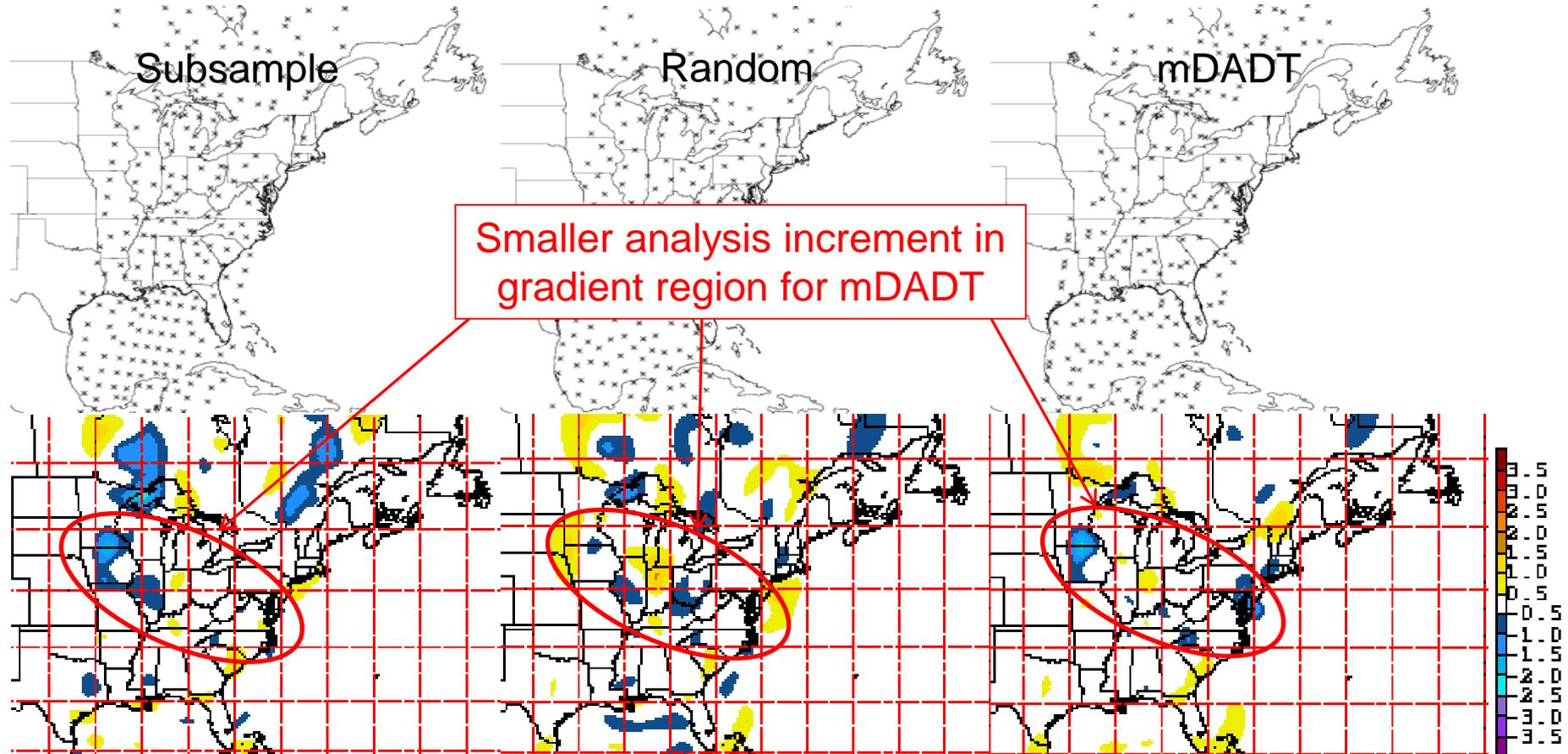
LEAD : Storm Detection and Clustering for Dynamic Model Forecast Initialization



- Mining algorithms work within the LEAD framework for a dynamic and adaptive response by running a workflow of services (model forecasts) triggered by weather events

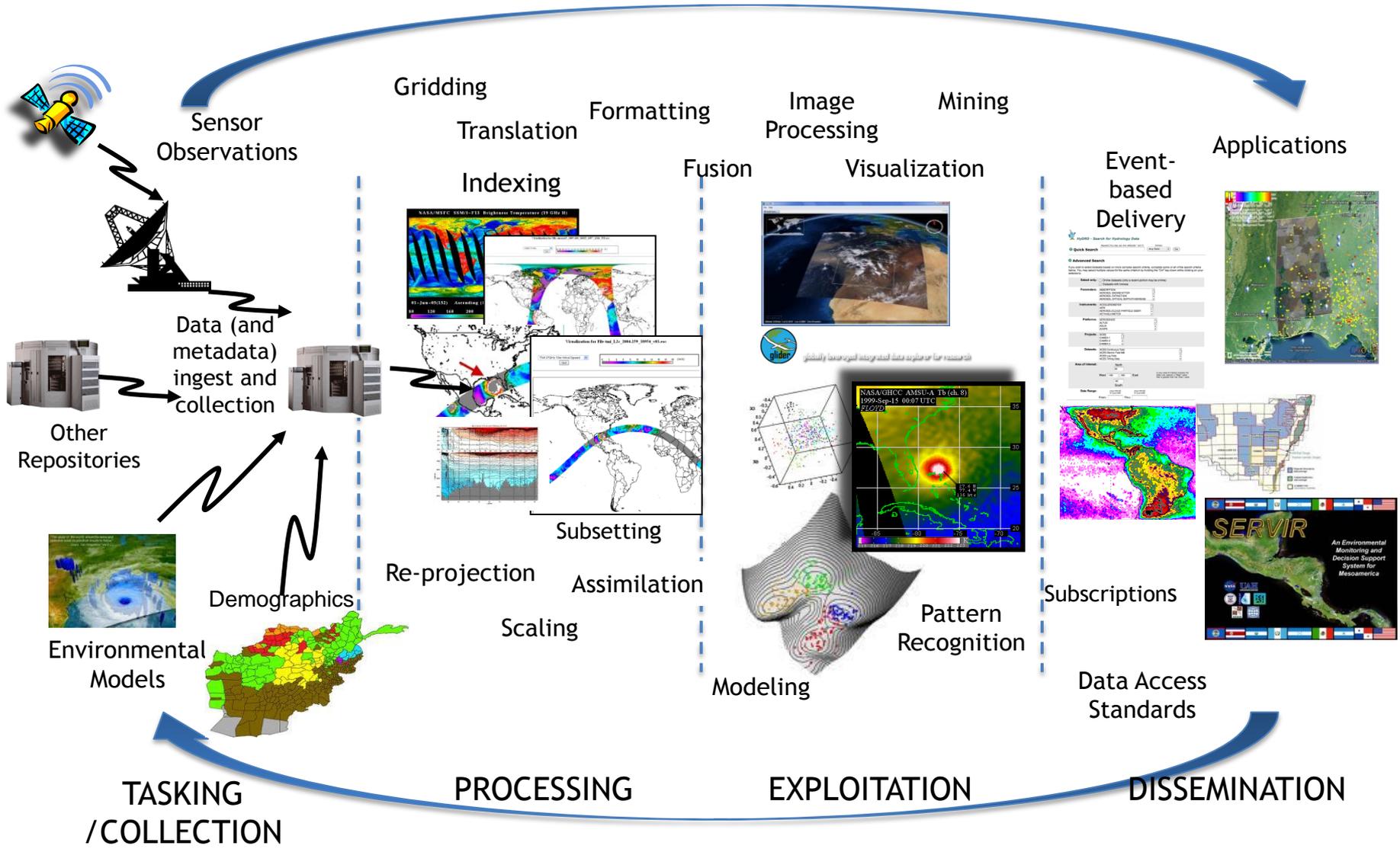
Intelligent Data Thinning Algorithm

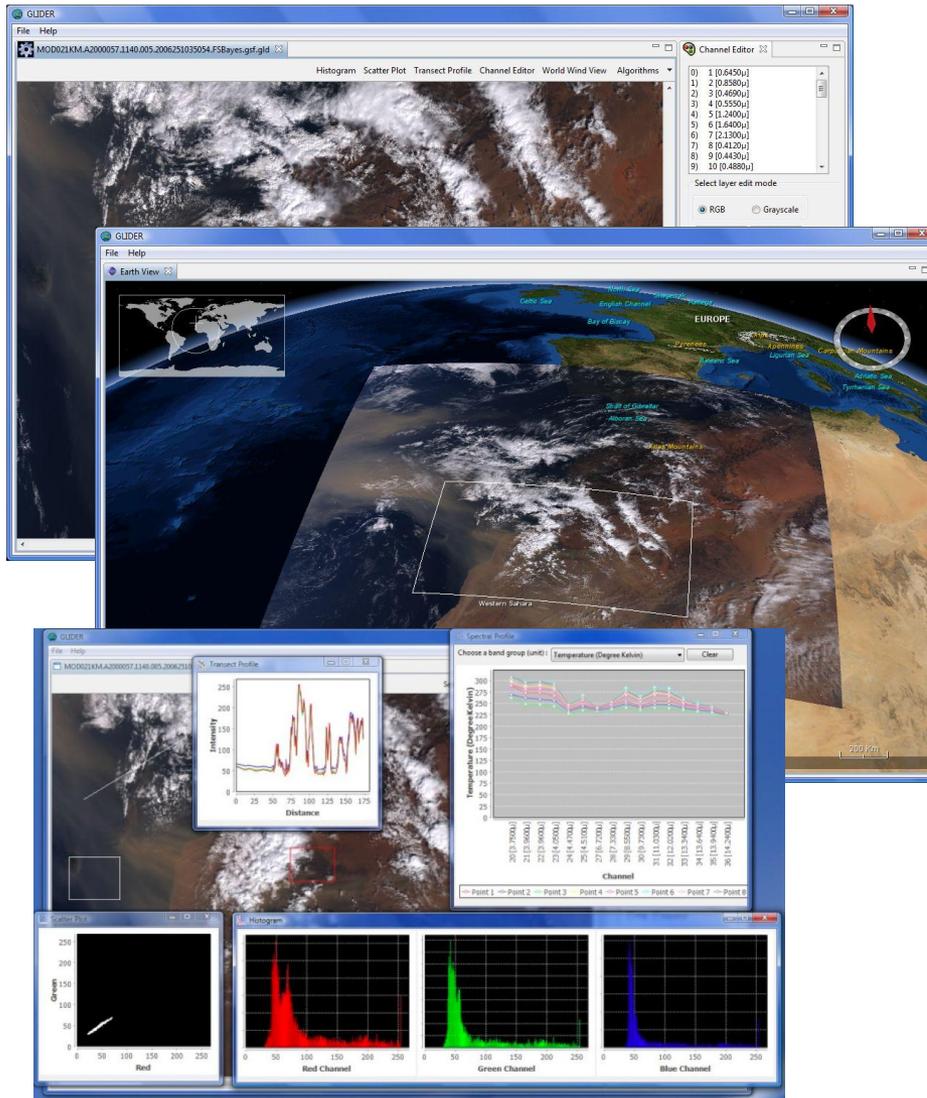
- Data Assimilation ingests observations into an analysis to provide the best possible representation of the atmospheric state to initialize a model forecast
- Ingesting high resolution observations is computationally very expensive



Lazarus, S. M., M. E. Splitt, R. Ramachandran, X. Li, S. Movva, and S. Graves:
Evaluation of Data Reduction Algorithms for Real-time assimilation and analysis.
Weather Analysis and Forecasting.

Conceptual Framework for Multi-source, Multi-function Analysis





Capabilities:

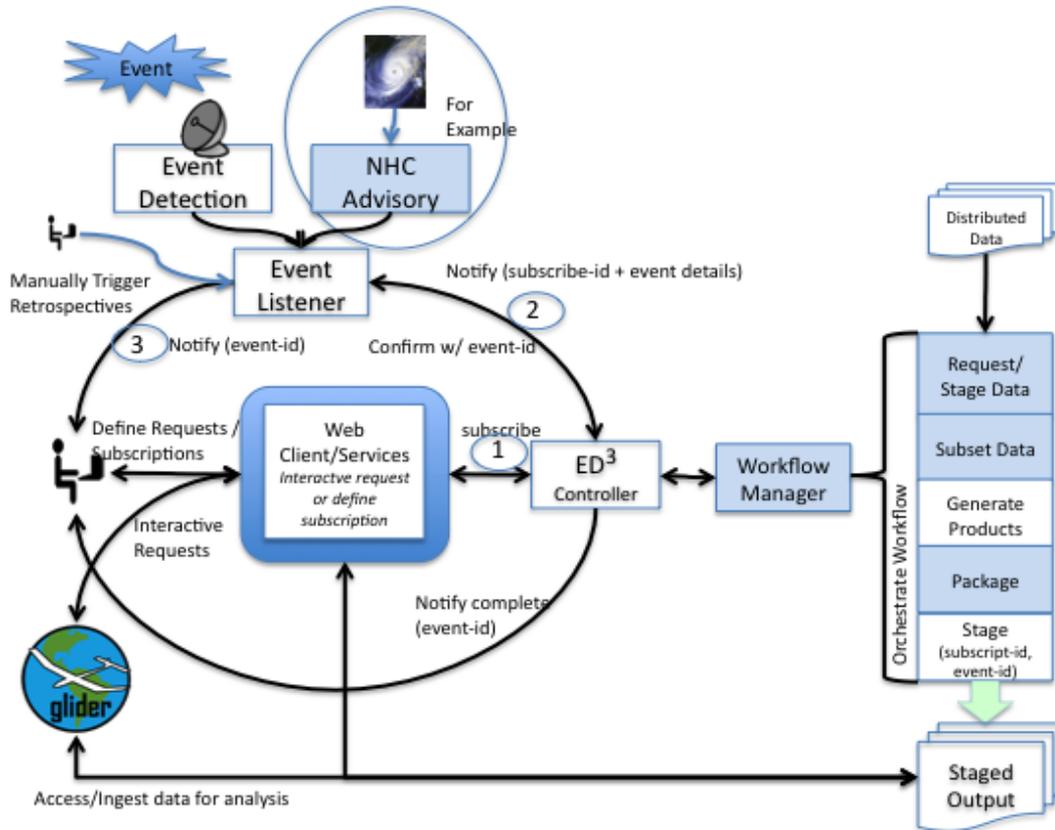
- **Visualize and analyze** satellite data in a native sensor view
- Apply **image processing algorithms** on the data
- Apply **pattern recognition/data mining algorithms** on the data
- **3D Globe Visualization** of satellite data, analysis/mining results, and additional layers
- Provides **multiple views** to manage, visualize, and analyze data

Integrates existing tools:

- ADaM: UAHuntsville's **Algorithm Development and Mining Toolkit**
- IVICS: UAHuntsville's **Interactive Visualizer and Image Classifier for Satellites**
- WorldWind: NASA's **3-D globe visualization** system

2010 winner NASA ESDSWG Software Reuse Award and also used by defense community

Event-Driven Data Delivery (ED³):



- **Automated and discrete access** to remote sensing data (NASA, NOAA, DOD, etc.)
- **Event-Driven Data Delivery** based on user inputs or subscriptions
- Enables **adaptive processing**
- Can be integrated with GLIDER and other tools for **mining, analysis, and visualization**
- Can be integrated with **analysis workflow management** tools

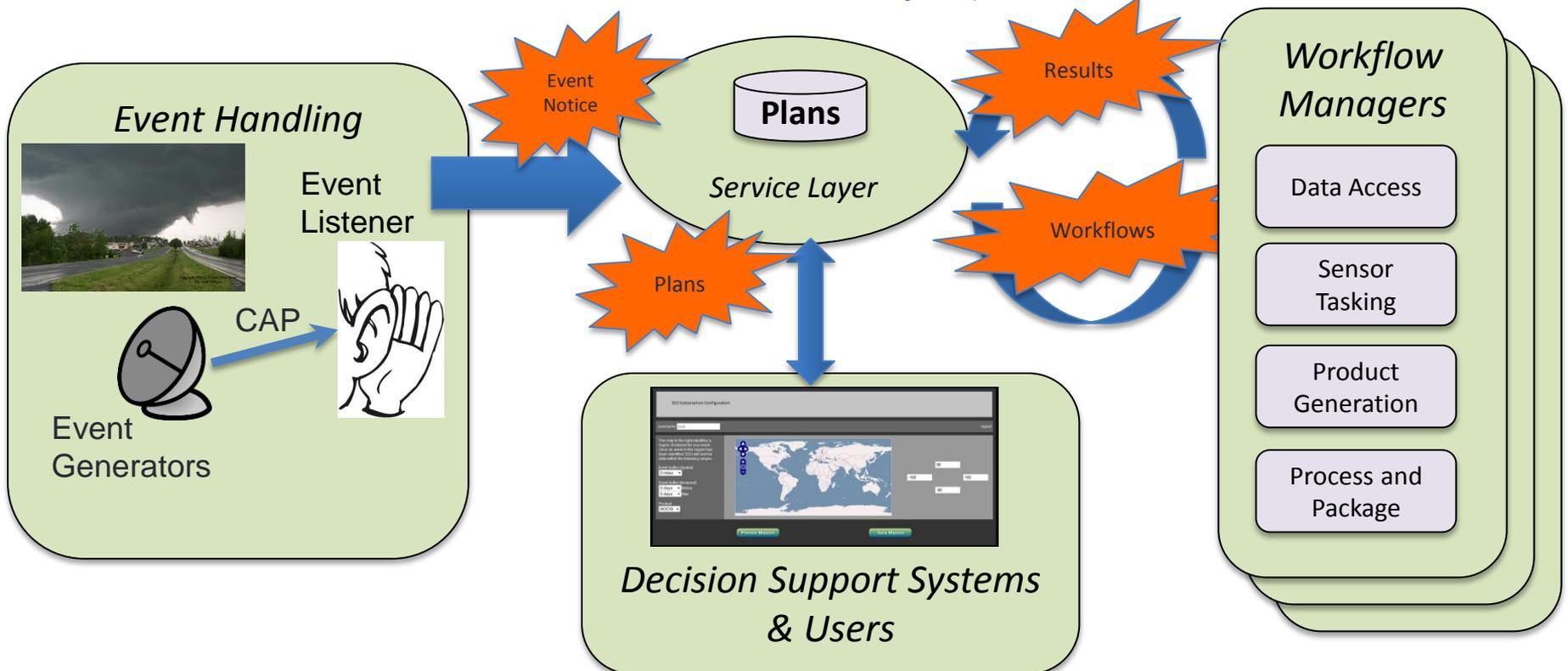
Disaster Response and Analysis Through Event-Driven Data Delivery (ED3) Technology

The ED3 Framework supports...

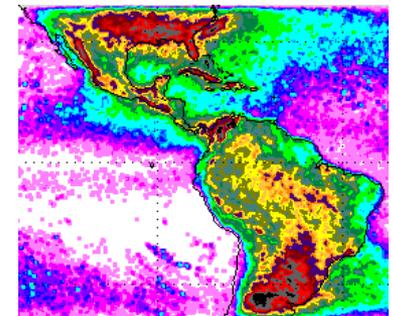
- generation and management of Preparedness Plans
- monitoring for events that match existing plans
- processing of event-driven workflows and
- rapid delivery of results to users and systems

ED3 Capabilities

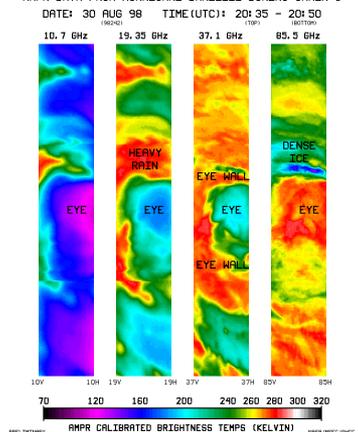
- **Event-Driven** Data Delivery based on user inputs
- **Automated access** to external data
- **adaptive processing**
- Integration with other tools for **mining, analysis, and visualization**



- **Partnership** between NASA and UAHuntsville to apply **advanced information technologies** to a variety of **science data projects**, thereby enabling research and scientific discovery
- **One of twelve full service NASA data centers** providing data ingest, routine and custom processing, archive, distribution, user support, and science data services
 - *Passive Microwave Data*
 - Fifteen-year inventory of satellite and aircraft based data
 - *Lightning Imaging Sensor Science Computing Facility*
 - National lightning data center for the TRMM Lightning Imaging Sensor and validation networks, satellite lightning observations back to 1973
 - *AMSR-E Science Investigator-led Processing System*
 - Generates swath, daily, and monthly products of precipitation, sea ice, water vapor, cloud water, sea surface temps, etc.
 - Near-real-time processing and distribution capability
 - *Field Campaigns:*
 - Web-based collaboration for science before, during, and after experiments. Data acquisition, integration, archive and distribution
 - CAMEX (1998, 2001), ACES (2002), TCSP (2005), NAMMA (2006), TC4 (2007), ARCTAS (2008), GRIP (2010), MC3E (2011), GCPEX (2012), IFloodS (2013)

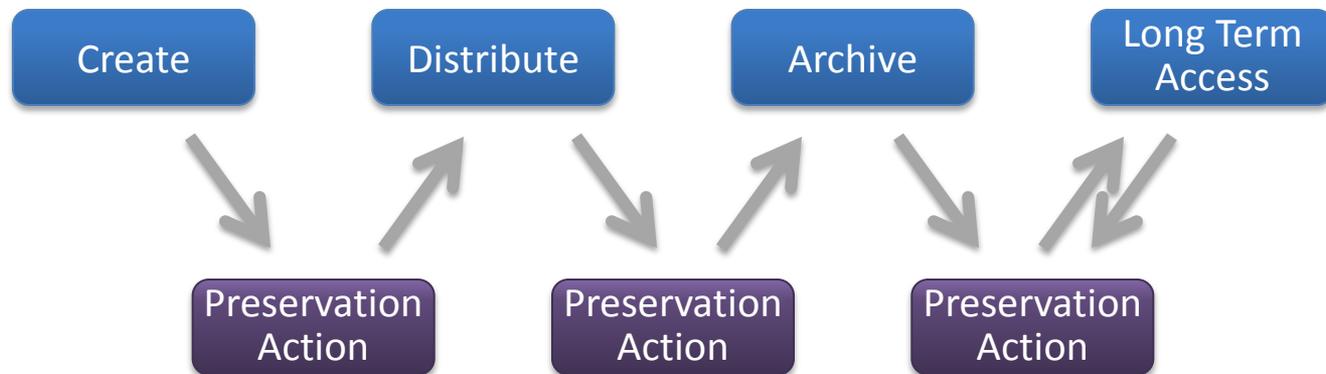


AMPR DATA FROM HURRICANE DANIELLE DURING CAMEX-3



Provenance Capture at Data Creation

- Archivists are traditionally responsible for curation (i.e., adding metadata and provenance) but not present at creation of scientific data. Moment of creation is where most knowledge about product is present.



- To be effective, provenance tools are required in earliest stages of data's life that help with preservation.

*Diagram from Berman et al.
"Sustainable
Economics for a Digital Planet"*

- ***Data lineage*** (data inputs, software and hardware) plus additional ***contextual knowledge*** about science algorithms, instrument variations, etc.
- ***Much information already available, but scattered across multiple locations***
 - Processing system configuration
 - Data collection and file level metadata
 - Processing history information
 - Quality assurance information
 - Software documentation (e.g., algorithm theoretical basis documents, release notes)
 - Data documentation (e.g., guide documents, README files)

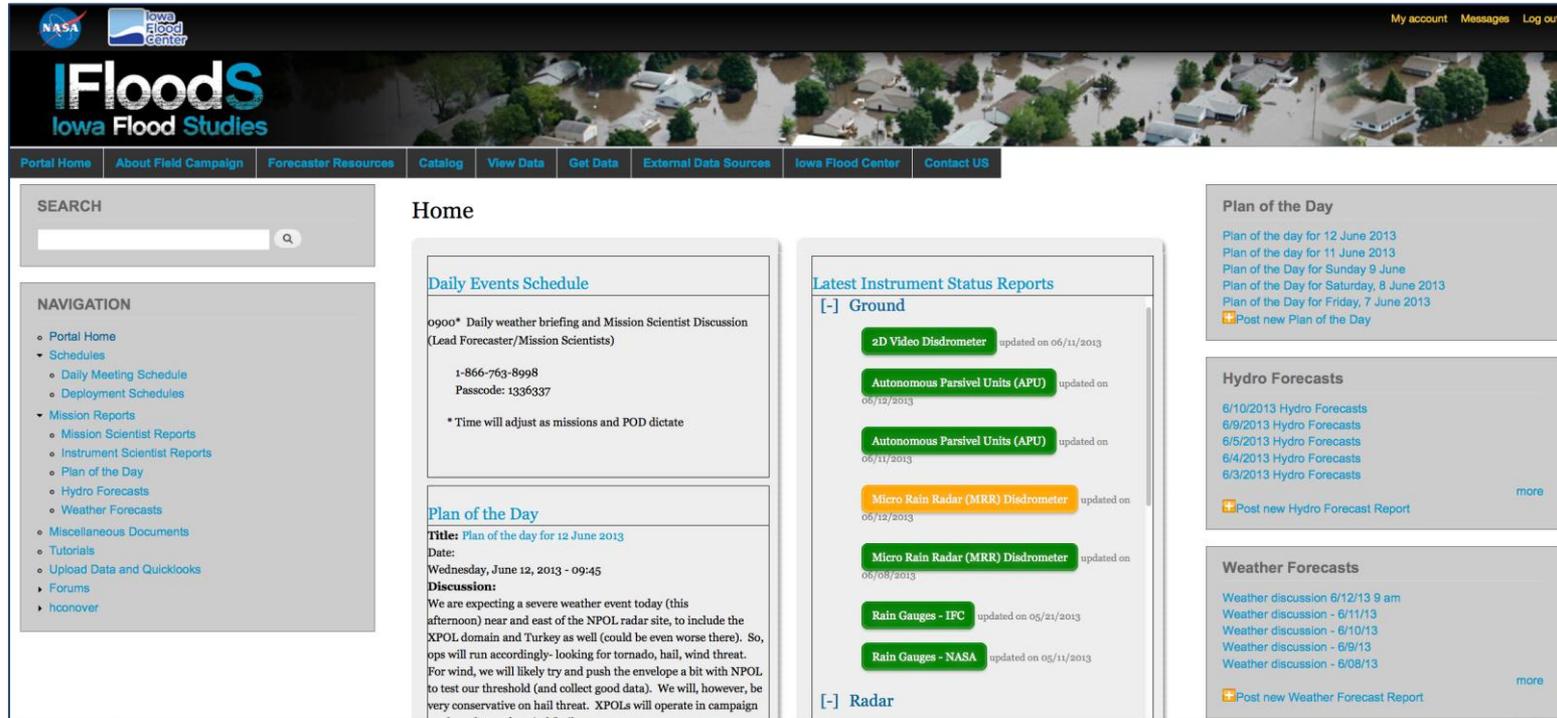


Data from Hurricane Science Campaigns

AMPR Products (8 datasets)
CAMEX-3 Products (20 datasets)
CAMEX-4 Products (41 datasets)
GRIP Products (22 datasets)
Geostationary Satellite Products (4 datasets)
Lightning Products (8 datasets)
NAMMA Products (22 datasets)
Passive Microwave Products (8 datasets)
Radar Products (11 datasets)
TC4 Products (2 datasets)
TCSP Products (12 datasets)

GPM Ground Validation Campaigns

- Light Precipitation Evaluation Experiment (**LPVEx**), Gulf of Finland in autumn 2010, to study **rainfall in high latitude environments**
- Midlatitude Continental Convective Clouds Experiment (**MC3E**), central Oklahoma spring and early summer 2011, to develop a **complete characterization of convective cloud systems, precipitation and the environment**
- GPM Cold-season Precipitation Experiment (**GCPEX**), Ontario, Canada winter of 2011-2012, collected microphysical properties, associated remote sensing observations, and coordinated model simulations of **precipitating snow**
- Iowa Flood Studies (**IFloodS**) hydrology-oriented experiment, Iowa, spring and early summer 2013, to study the relative roles of rainfall quantities and other factors in **flood genesis**



The screenshot shows the FloodS Iowa Flood Studies portal. The header includes the NASA and Iowa Flood Center logos, the title 'FloodS Iowa Flood Studies', and user links for 'My account', 'Messages', and 'Log out'. A navigation menu contains: Portal Home, About Field Campaign, Forecaster Resources, Catalog, View Data, Get Data, External Data Sources, Iowa Flood Center, and Contact US. The main content area is titled 'Home' and features several sections:

- SEARCH:** A search bar with a magnifying glass icon.
- NAVIGATION:** A list of links including Portal Home, Schedules (Daily Meeting Schedule, Deployment Schedules), Mission Reports (Mission Scientist Reports, Instrument Scientist Reports, Plan of the Day, Hydro Forecasts, Weather Forecasts), Miscellaneous Documents, Tutorials, Upload Data and Quicklooks, Forums, and hconover.
- Daily Events Schedule:** A section for '0900* Daily weather briefing and Mission Scientist Discussion (Lead Forecaster/Mission Scientists)' with contact information (1-866-763-8998, Passcode: 1336337) and a note: '* Time will adjust as missions and POD dictate'.
- Plan of the Day:** A section for 'Plan of the day for 12 June 2013' with the date 'Wednesday, June 12, 2013 - 09:45' and a discussion about a severe weather event near the NPOL radar site.
- Latest Instrument Status Reports:** A section with a '[-] Ground' expandable menu containing:
 - 2D Video Disdrometer (updated on 06/11/2013)
 - Autonomous Parsivel Units (APU) (updated on 06/12/2013)
 - Autonomous Parsivel Units (APU) (updated on 06/11/2013)
 - Micro Rain Radar (MRR) Disdrometer (updated on 06/12/2013)
 - Micro Rain Radar (MRR) Disdrometer (updated on 06/08/2013)
 - Rain Gauges - IFC (updated on 05/21/2013)
 - Rain Gauges - NASA (updated on 05/11/2013)
- [-] Radar:** A section for radar-related reports.
- Plan of the Day:** A section with links for 'Plan of the day for 12 June 2013', 'Plan of the day for 11 June 2013', 'Plan of the Day for Sunday 9 June', 'Plan of the Day for Saturday, 8 June 2013', and 'Plan of the Day for Friday, 7 June 2013', plus a '+Post new Plan of the Day' button.
- Hydro Forecasts:** A section with links for '6/10/2013 Hydro Forecasts', '6/9/2013 Hydro Forecasts', '6/5/2013 Hydro Forecasts', and '6/3/2013 Hydro Forecasts', plus a '+Post new Hydro Forecast Report' button and a 'more' link.
- Weather Forecasts:** A section with links for 'Weather discussion 6/12/13 9 am', 'Weather discussion - 6/11/13', 'Weather discussion - 6/10/13', 'Weather discussion - 6/9/13', and 'Weather discussion - 6/08/13', plus a '+Post new Weather Forecast Report' button and a 'more' link.

- Collaboration and Planning Tools
 - Current instrument status, weather forecasts, plan of the day
 - Corporate knowledge (meeting minutes, presentations, etc.)
 - Space to upload and share flight plans, mission reports and other documents

IOOS/NCEP Modeling Testbed (NOAA)

The image shows two overlapping screenshots of a web application. The top screenshot displays a 'SUPER-REGIONAL MODELING TESTBED' interface with a sidebar menu and a main content area containing text and a map. The bottom screenshot shows a 'Dataset Inventory Dashboard' with a table listing various datasets and their attributes.

GRIP Genesis and Rapid Intensification Processes (NASA)

The image shows a screenshot of the NASA GRIP website. It features a header with the NASA logo and 'NATIONAL AERONAUTICS AND SPACE ADMINISTRATION'. The main content area includes a 'Mission Calendar' section with a table listing dates and activities, and a 'GRIP News' section with a small image of a satellite.

GRIP Field Campaign (NASA)

GRIP Field Campaign (NASA)

The image shows a screenshot of the NASA GRIP website, specifically the calendar section for August 2010. The calendar is a grid with days of the week and dates. It includes a 'Please read note at bottom' section and a 'GRIP News' section with a small image of a satellite.

Northern Gulf Coastal Hazards Collaboratory (NSF)

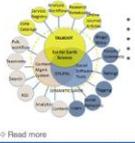
The image shows two overlapping screenshots of the Northern Gulf Coastal Hazards Collaboratory website. The top screenshot displays a map of the Gulf Coast region with various data points and a sidebar menu. The bottom screenshot shows a 'Project Participants' section with a map of the Gulf Coast region and a list of participants.

Northern Gulf Coastal Hazards Collaboratory (NSF)

TALKOOT

The image shows a screenshot of the TALKOOT website. It features a header with the TALKOOT logo and 'UA HUNTSVILLE'. The main content area includes a 'USER LOGIN' section with a form for username and password, and a 'PROJECTS' section with a list of projects and their descriptions.

Talkoot Collaborative Framework





SERVIR

An Environmental Monitoring and Decision Support System for Central America, Kenya and Nepal

Earth Observatories



Central American Commission for Environment and Development



- Emergency Responders
- Environmental Managers
- Political Leaders
- Researchers, Educators

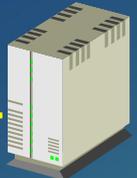
Environmental Monitoring & Decision Support Products



Electronic Transfer

SERVIR Node @ NSSTC

(NASA/MSFC and U. Alabama in Huntsville)



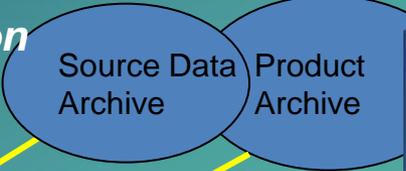
- Product Generation System**
- Ingest Data
 - Subset Data Over C. Amer. System
 - Mine Data for Events
 - Generate Products



- Web Server**
servir.nsstc.nasa.gov
- Distribute Products
 - Archive Products



Visualization System



Rapid Response ftp, e-mail, etc.

SERVIR Node in Panama

University of Arkansas
(World Bank Funding)

- Geographic Info Systems
- Decision Support Systems
- Environmental Data from Central American countries

Goals

- Rapid Response
- Corridor Preservation
- Species Preservation
- Sustained Development
- Better Living Conditions
- Policy Changes

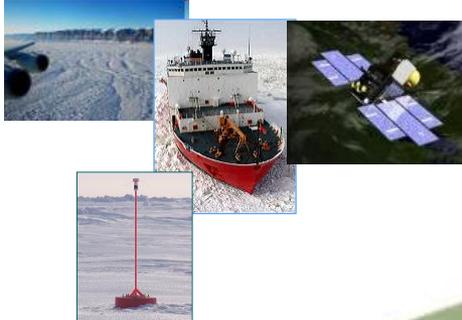
Data & Algorithms

SERVIR Partners

Links with other efforts: PEOPLE-ACE JCTD

An open source, web-based, multi-national environmental monitoring, research, and decisions support system to enable development of advanced value-added products

International observing systems
& product developers



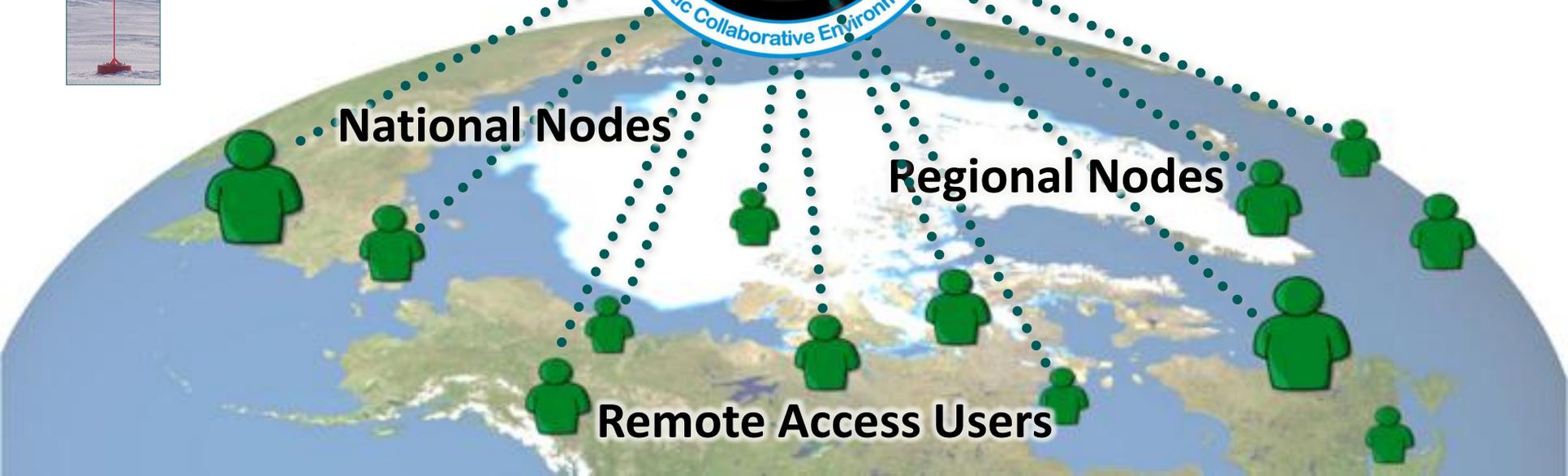
Data portals and science
programs



National Nodes

Regional Nodes

Remote Access Users



- Arctic Collaborative Environment (ACE) – Office of Secretary of Defense (OSD) Joint Capability Technology Demonstration (JCTD)
 - COCOM Sponsor: USEUCOM and NORAD-USNORTHCOM
 - Oversight Executive: Elmer Roman, OSD
 - Operational Manager: Steve Spehn, USEUCOM
- Field Campaign Mission Management
- Coastal Hazards Collaboratory

NSF EarthCube: Data Discovery, Mining and Access Community Activity

Vision

To transform the conduct of geosciences research by supporting the development of community-guided cyberinfrastructure to integrate data and information for knowledge management.

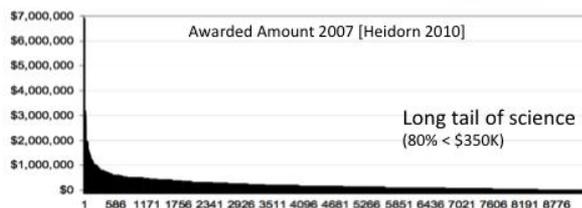
- **Purpose of EarthCube:** To understand more deeply the planet and its interactions will require the geoscience to take an increasingly holistic approach, exploring knowledge coming from all scientific and engineering disciplines.
- **CALL TO ACTION:** “Over the next decade, the geosciences community commits to developing a framework to understand and predict responses of the Earth as a system – from the space-atmosphere boundary to the core, including the influences of humans and ecosystems.”



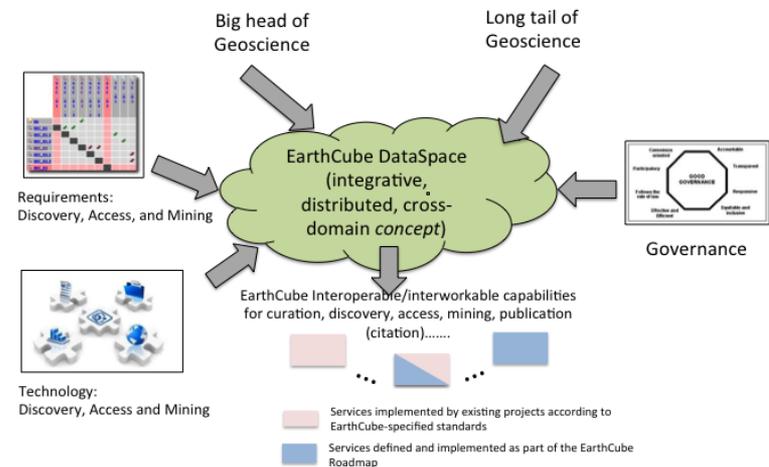
Data Lifecycle

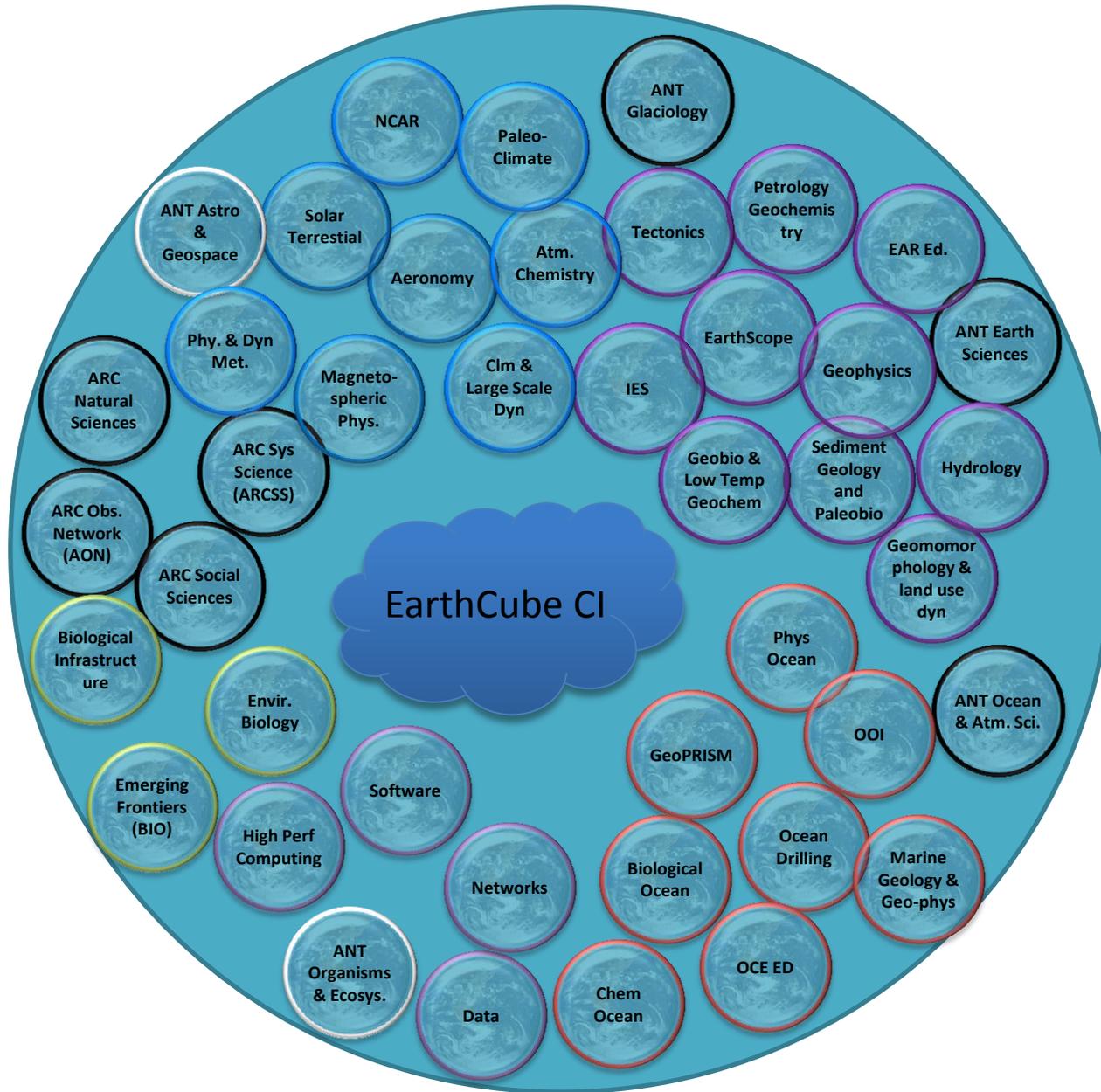


Ad hoc processes



EarthCube DataSpace





Integrating Real-time Data into the EarthCube Framework

THE UNIVERSITY OF
ALABAMA IN HUNTSVILLE

June 17-18, 2013

Boulder, CO



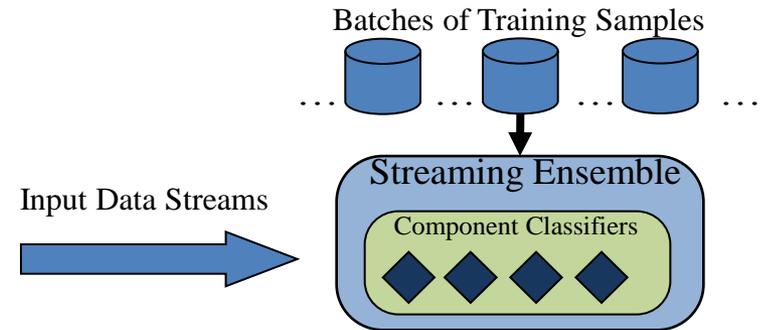
Chandrasekar (CSU), Mike Daniels (NCAR), Sara Graves (UAH)
Branko Kerkez (Michigan), Frank Vernon (USCD)

Signature Identification/Characterization using UAH's Coverage Based Ensemble Algorithm(CBEA)

A new ensemble classification method for streaming data developed by UAH

Motivation: Constraints on Streaming Data

- Cannot make multiple passes through all training data
- May only save a small subset of the available samples
- Must make best use of available samples
- Must not forget information provided by old samples
- Can only keep a small number of classifiers
- Must adapt to changing conditions or concepts



CBEA – Training Approach

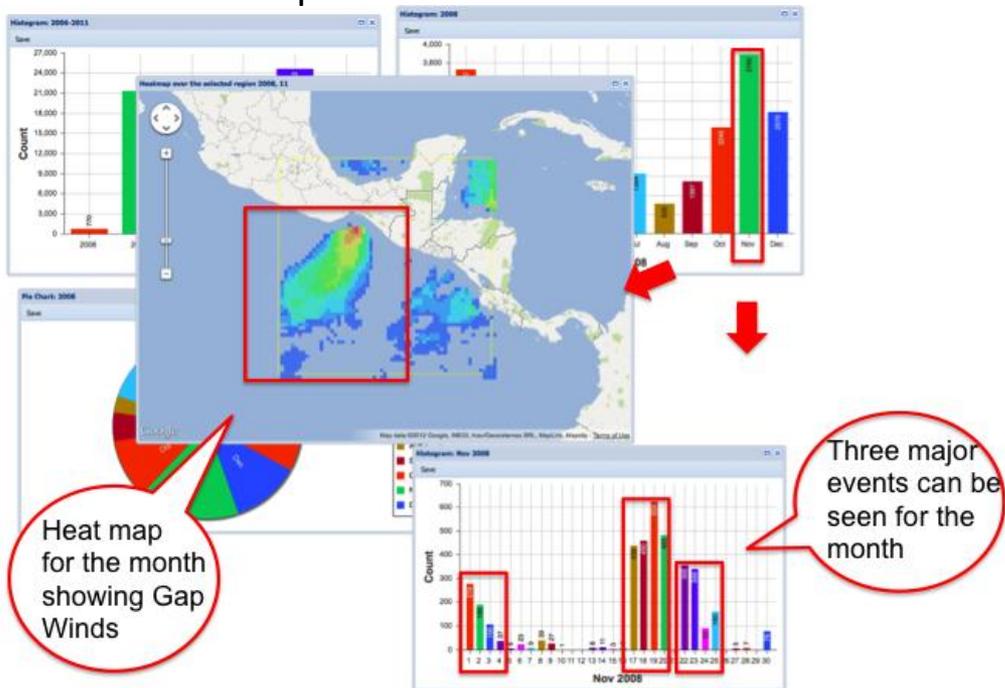
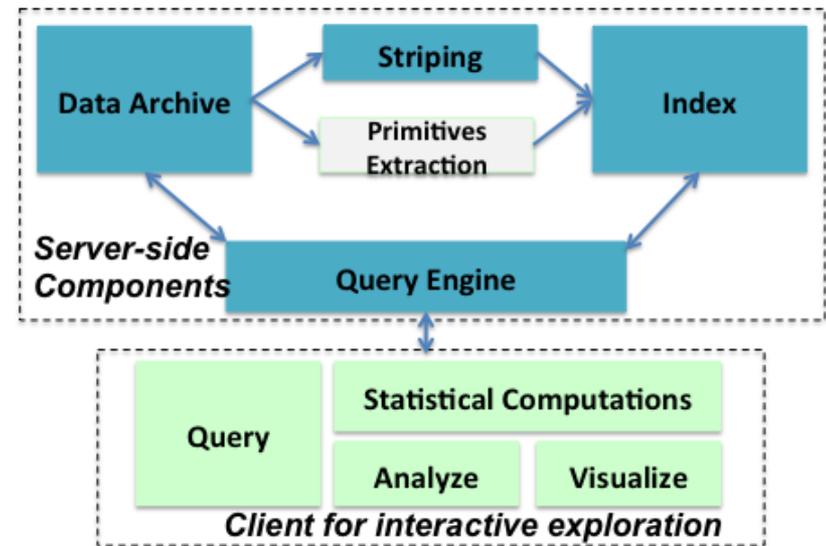
Characteristics of CBEA

- General purpose ensemble classification method capable of **incremental learning** from **streaming data** and performing classifications in **real time** to provide adaptability
- Handles multiple types of data at **different resolutions** of spatial, temporal and other types of information
- Handles **uneven sampling** of the classes of interest and the pattern space
 - e.g., if there are not enough truth samples for a particular class or if we are trying to detect a rare event such as nuclear detonations
- Adapts to **features that change over time**
 - e.g., if the enemy tries to mask or change the weapon signature such as modifying missile propulsion system

CBEA outperforms Streaming Ensemble Algorithms (SEA) on classification problems with uneven sampling of the pattern space.

Polaris: Data Exploration Engine

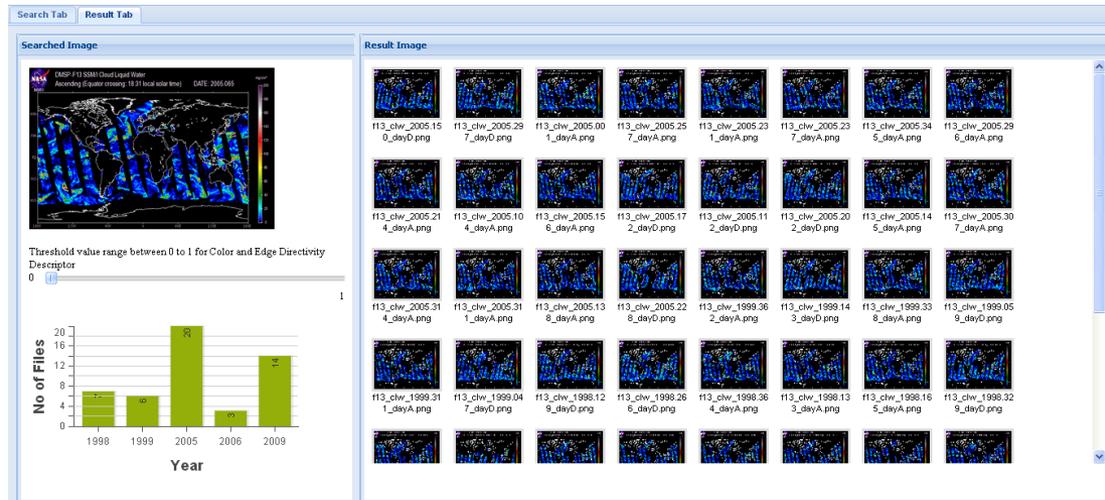
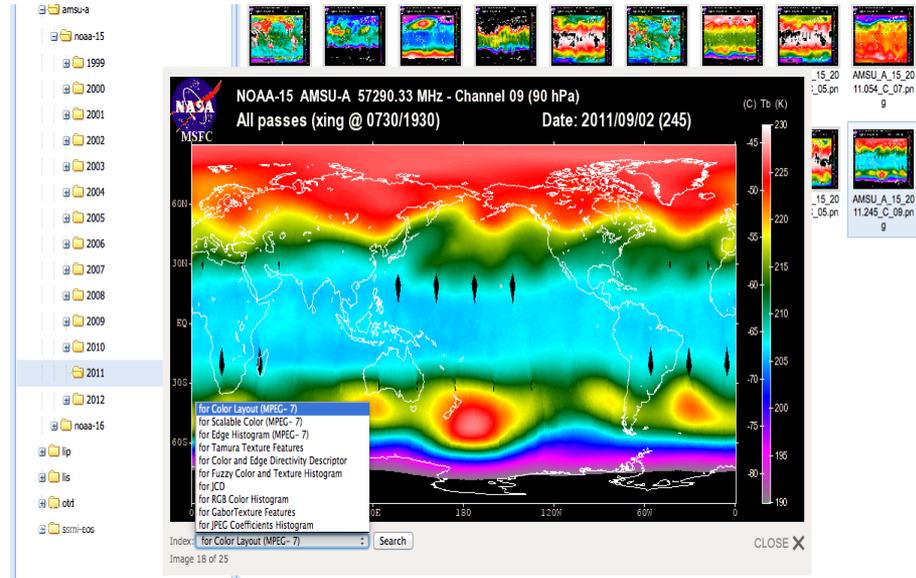
- All Special Sensor Microwave / Imager (/ Sounder; SSM/I and SSMIS) gridded data files of 1440x720 pixels staged on the cluster
- Data sets – Rain Rate, Surface Wind Speed, Atmospheric Water Vapor, Cloud Liquid Water
- Total volume is less than 1 Tb
- Cluster with 70 compute nodes consisting of two single core processors each used
- Data was preprocessed by striping it across the available compute nodes



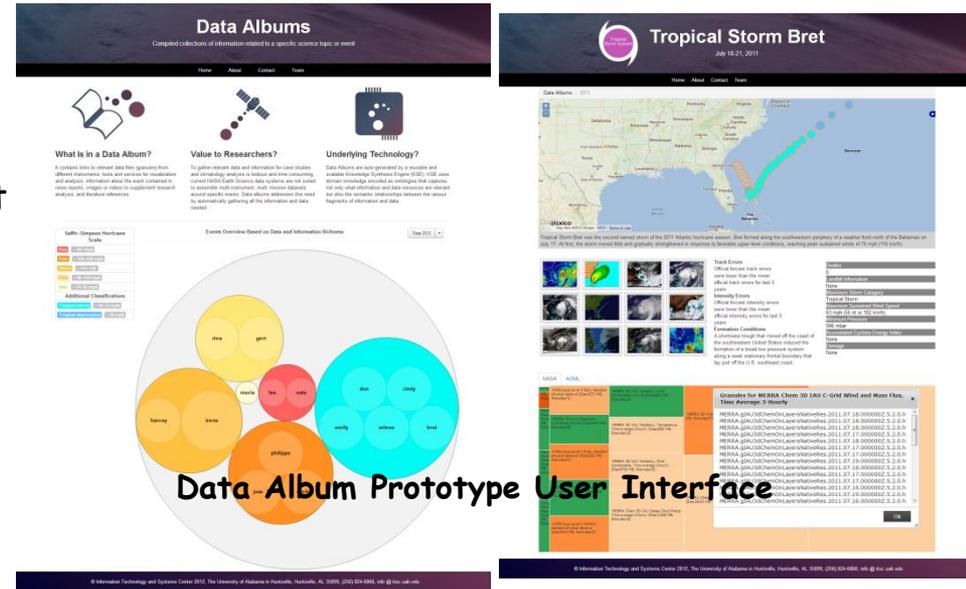
- Initial evaluations by researchers has clearly demonstrated the value of such a tool
- Polaris has been adopted by a joint project with NASA GSFC National Center for Climate Simulations
- Exploring opportunities to make the tool operational at NASA DAACs and NASA's Earth Exchange (NEX).

Content Based Image Retrieval Module

- Allows users to interactively query a large database of browse images based on image contents.
- Search service provides confidence scores for the matching images and filters the images based on the scores
- Basic analytics on the results are available via histogram on the count of number of matching results for years, months, and days.



- Build curated "Data Albums" - compiled collections of information related to a specific science topic or event, containing links to relevant data files (granules) from different instruments; tools and services for visualization and analysis; information about the event contained in news reports, images or to supplement research analysis; and literature references



The image shows two screenshots of the Data Albums website. The left screenshot displays the 'Data Albums' homepage with a navigation bar and three main sections: 'What is in a Data Album?', 'Value to Researchers?', and 'Underlying Technology?'. Below these sections is a 'Data Album Prototype User Interface' featuring a circular diagram with nodes for 'data', 'tools', 'analysis', 'visualization', 'news', and 'literature'. The right screenshot shows a 'Tropical Storm Bret' case study interface, including a map of the storm's path, a list of data granules, and a table of granules for the MERSA Chere 3D IAI C-SWd and Mast Phc. data source.

- Reuse current Noesis semantic aggregation technology to provide semi-automated creation and interactive curation of Data Albums for Earth science case studies.
- Enable scientific community participation and collaboration.
- *Implement Data Albums for two science focus areas*
- Catalog of Hurricane Case Studies for hurricane events
- Case study generator at NASA's SPoRT Center to help automate the selection of weather events

- *Noesis 2.0 initial implementation (aggregation based on data feeds)* 10 mon
- Catalog of hurricane case studies at GHRC 13mon
- Noesis 2.0 enhancements (user driven aggregation) 18mon
- Case study generator for SPoRT 20mon
- Enhancements as needed 24mon
- Final report 24mon

Motivation

- Case study analysis and climatology studies commonly used in Atmospheric Science research are instances where the focus is on a significant *event*
- Wide *variety* of data and information needed to support such studies is stored in *distributed* repositories in many of forms
- Design of current Earth Science data systems assumes researchers search data primarily by instrument or geophysical parameter
 - Requires prior knowledge on what to datasets to look for
 - Does not support new/interdisciplinary researchers

Bottom line: Gathering relevant data and information from distributed sources is *tedious* and *time consuming*

Challenges

- Need for tools to automate gathering of data and other *relevant* information from distributed resources for significant events of interest
- Tools should sift through large volumes of online content and gather only the *relevant resources* based on user's science needs (event of interest)
- Tools should *collate* the aggregated data information and present it in a *meaningful manner* for a wide range of users not just domain researchers

- Many hurricane researchers are familiar with limited, but specific datasets, but often are unaware of or unfamiliar with a large quantity of other resources.
- Finding airborne or satellite data relevant to a given storm often requires a time consuming search through web pages and data archives.
- Background information related to damages, deaths, and injuries requires extensive online searches for news reports and official storm summaries.

Storm Page

Data Albums
Completed collections of information related to a specific event topic or event

Data Album for Katia (2011)

Storm Statistics & Multimedia

Hurricane Katia was a long-lived and intense tropical cyclone that caused minor damage primarily throughout the Lesser Antilles and Europe during September 2011. It was the twelfth tropical cyclone and eleventh named storm, as well as the second hurricane and major hurricane of the unusually active 2011 Atlantic hurricane season. Originating as a tropical wave southwest of Cape Verde on August 29, Katia tracked generally west-northwest while gradually strengthening. The system intensified to a Category 1 hurricane on the Saffir-Simpson hurricane wind scale on August 31, and further to a Category 3a major hurricane by September 5. That afternoon, Katia attained its peak intensity as a Category 4, with sustained winds reaching 140 mph (220 km/h) and a minimum barometric pressure of 942 mbar (hPa; 27.82 inHg), while located several hundred miles north of the Lesser Antilles. The combined effects of higher wind shear from an approaching trough, interaction with a cold front, and increasingly cool sea surface temperatures thereafter gradually weakened the storm as it passed well west of Bermuda, and on September 10, Katia transitioned into an extratropical cyclone while persisting hurricane-force winds.

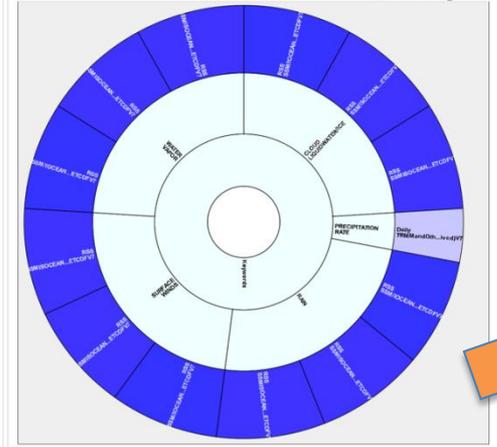
Storm Name	Year	Cyclogenesis Date	Cyclolysis Date	Highest Saffir-Simpson Category	Maximum Wind Speed	Minimum Central Pressure	ACE Index value	Damage	Track Errors	Intensity Errors	Genesis
Katia	2011	08/30	09/10	Cat 4	140 mph	942 mb	25.8225 x 10 ⁴	N/A	Official forecast track errors were lower than the mean official track errors for the previous 5-yr period.	Official intensity errors were lower than the mean official intensity errors for the previous 5-yr period.	Well



Collections based on Keywords or Instruments

32 of 32 keywords selected | 14 of 14 collections selected

Min Rank: 0
Max Rank: 0.178791
Current Threshold: 0.014



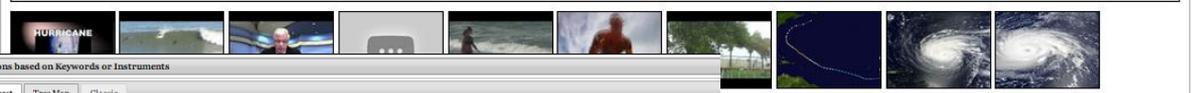
Granules

File Name	Rank	Relevance
AIRS_2011_08_29_052.L1B.AMSU_Rad.v5.0.0.0.G11241115158.pdf	0.178791	High
AIRS_2011_08_29_060.L1B.AMSU_Rad.v5.0.0.0.G11241115238.pdf	0.178791	High

Storm Statistics & Multimedia

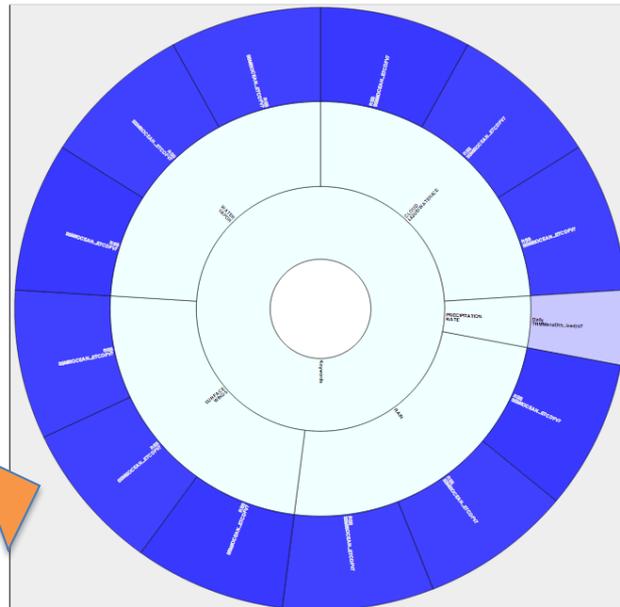
Hurricane Katia was a long-lived and intense tropical cyclone that caused minor damage primarily throughout the Lesser Antilles and Europe during September 2011. It was the twelfth tropical cyclone and eleventh named storm, as well as the second hurricane and major hurricane of the unusually active 2011 Atlantic hurricane season. Originating from a tropical wave southwest of Cape Verde on August 29, Katia tracked generally west-northwest while gradually strengthening. The system intensified to a Category 1 hurricane on the Saffir-Simpson hurricane wind scale on August 31, and further to a Category 3a major hurricane by September 5. That afternoon, Katia attained its peak intensity as a Category 4, with sustained winds reaching 140 mph (220 km/h) and a minimum barometric pressure of 942 mbar (hPa; 27.82 inHg), while located several hundred miles north of the Lesser Antilles. The combined effects of higher wind shear from an approaching trough, interaction with a cold front, and increasingly cool sea surface temperatures thereafter gradually weakened the storm as it passed well west of Bermuda, and on September 10, Katia transitioned into an extratropical cyclone while persisting hurricane-force winds.

Storm Name	Year	Cyclogenesis Date	Cyclolysis Date	Highest Saffir-Simpson Category	Maximum Wind Speed	Minimum Central Pressure	ACE Index value	Damage	Track Errors	Intensity Errors	Genesis
Katia	2011	08/30	09/10	Cat 4	132 mph	946 mb	25.8225 x 10 ⁴	N/A	Official forecast track errors were lower than the mean official track errors for the previous 5-yr period.	Official intensity errors were lower than the mean official intensity errors for the previous 5-yr period.	Well



Collections based on Keywords or Instruments

32 of 32 keywords selected | 14 of 14 collections selected



Min Rank: 0
Max Rank: 0.178791
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Granules

File Name	Rank	Relevance
AIRS_2011_08_29_052.L1B.AMSU_Rad.v5.0.0.0.G11241115158.pdf	0.178791	High
AIRS_2011_08_29_060.L1B.AMSU_Rad.v5.0.0.0.G11241115238.pdf	0.178791	High

- Different data collections relevant for this event
- User can customize relevancy threshold
- Color signifies relevancy
- Size is based on # of granules
- Links to data granules

Collaborative Workbench (CWB) to Accelerate Science Algorithm Development

This effort supports the vision of Earth Science research as a community enterprise and provide building blocks for the ESC.

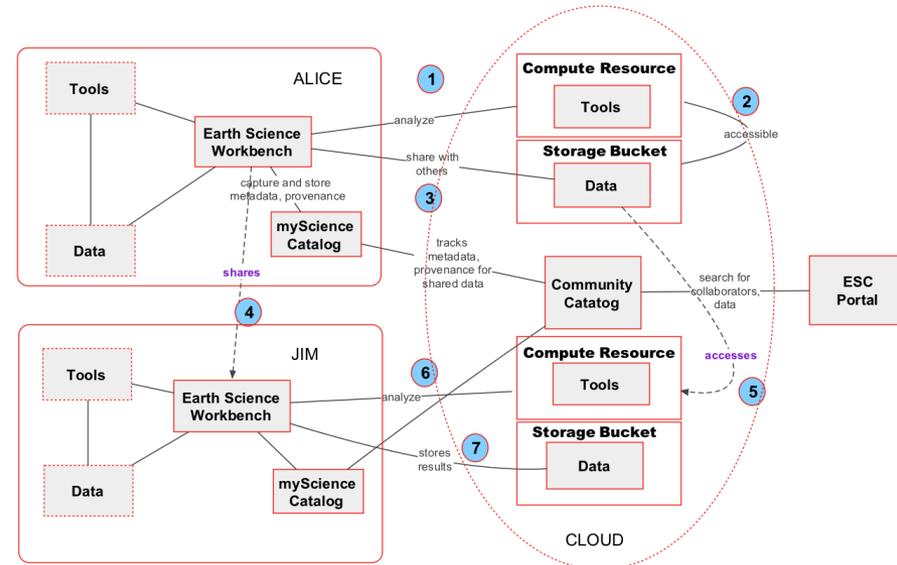
- Leverage the evolving technology landscape to design an architecture for scalable collaboration
 - Collaborations can scale from individuals sharing science resources, to sharing within groups such as science mission teams, to sharing with the entire science community.
- Design and build software components that fit the way researchers currently perform scientific analysis.
 - These new components should work as part of researchers' current analysis tools.

- Investigate different science collaboration modalities:

1. *Shared Resources, Local Computation*
2. *Shared Resources, Cloud Computation*
3. *Shared Virtual Machine*

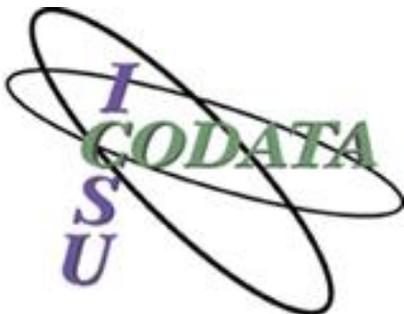
- Build core components required for an Earth Science Collaboratory:

- *Collaborative Workbench (CWB), Cloud-Service-Neutral Interfaces, myScience Catalog, Community Catalog*



- CWB core components implementation and integration: myScience Catalog, Apache Libcloud, Analysis Tools
- *Prototype 1 (Shared Resources, Local Computation) deployed and tested (10 months)*
- *Prototype 2 (Shared Resources, Cloud Computation) deployed and tested (16 months)*
- *Prototype 3 (Shared Virtual Image) deployed and tested (22 months)*
- Final architecture, documentation, publications (24 months)

- Next meeting 24th CODATA International Conference, November 2014 in New Delhi, India, ***“SciDataCon 2014”***
- International Council for Science (ICSU) Committee on Data for Science and Technology (CODATA)
- Data Science Journal
- Works closely with the World Data System – a globally interoperable distributed data system



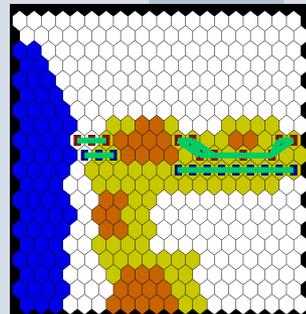
Data Mining

- Clustering
- Classification
- Anomaly Detection
- Association Rules
- Pattern Recognition
- Feature Selection
- Image Processing
- Text
- Texture
- Ontology driven



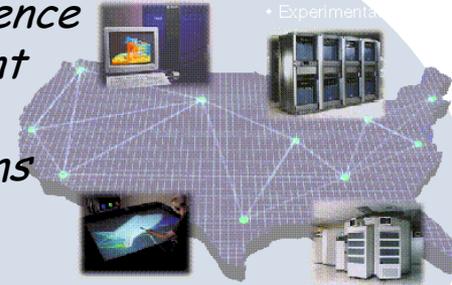
Advanced Computational Methods

- Artificial Intelligence for Wargaming
- Semantics
- Training Systems
- Path Determination
- Knowledge Networking
- Data Exploitation
- Adaptive Processing



Cybersecurity

- IA Center of Excellence
- Identity Management
- Metrics
- Trustworthy Systems
- Policy Development
- Risk Management
- Vulnerability Analysis
- Situational Awareness
- Privacy
- FISMA compliance



On-Demand Processing

- Real-time operations
- MultiSensor Fusion
- Signature Intelligence
- Unmanned Systems
- Sensor Networks



Strategic and Tactical Coordination

- Collaborative Environments
- Remote Mission Management
- Information Acquisition and Integration
- Urban Environments
- Emergency Response

