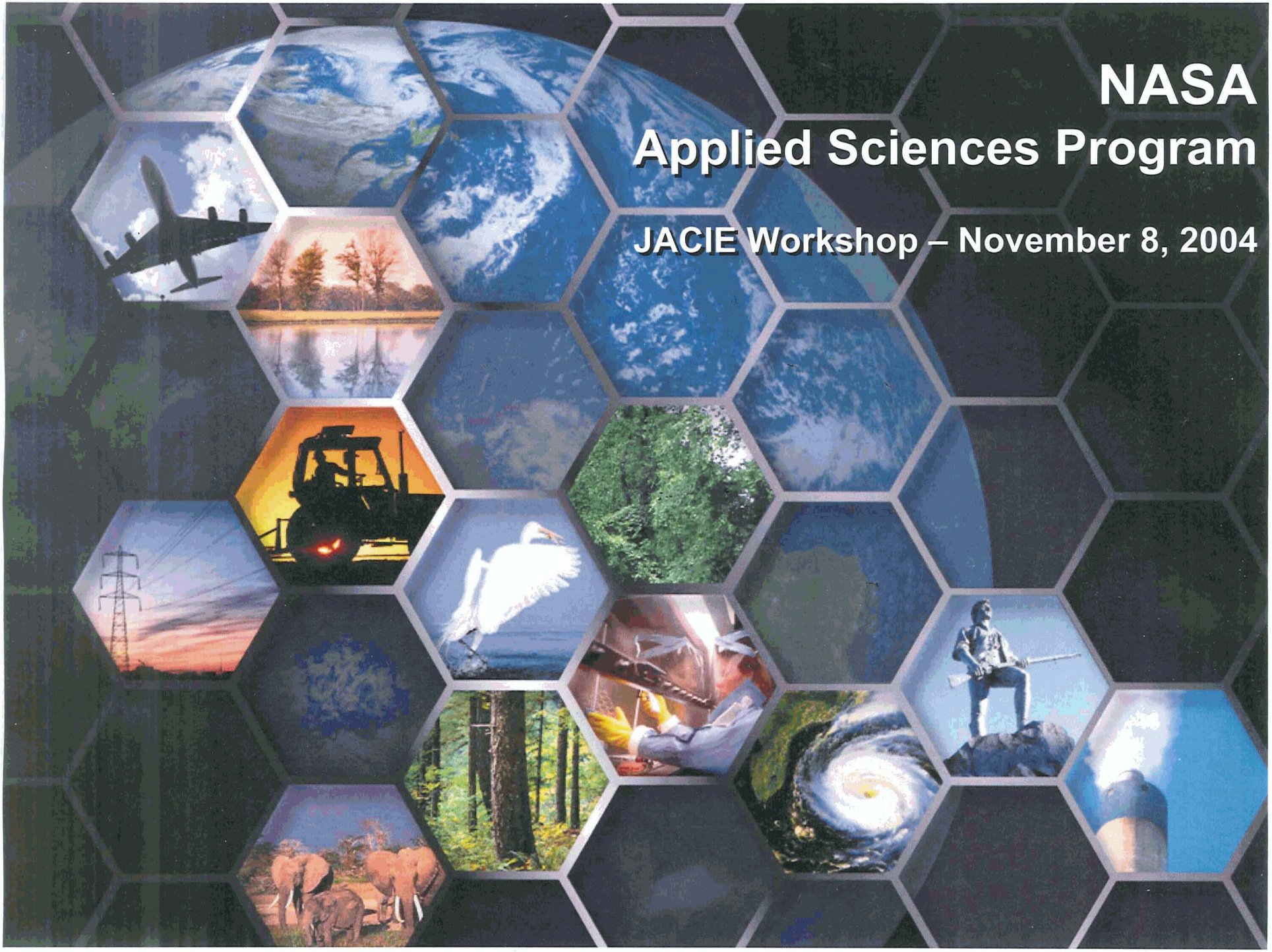


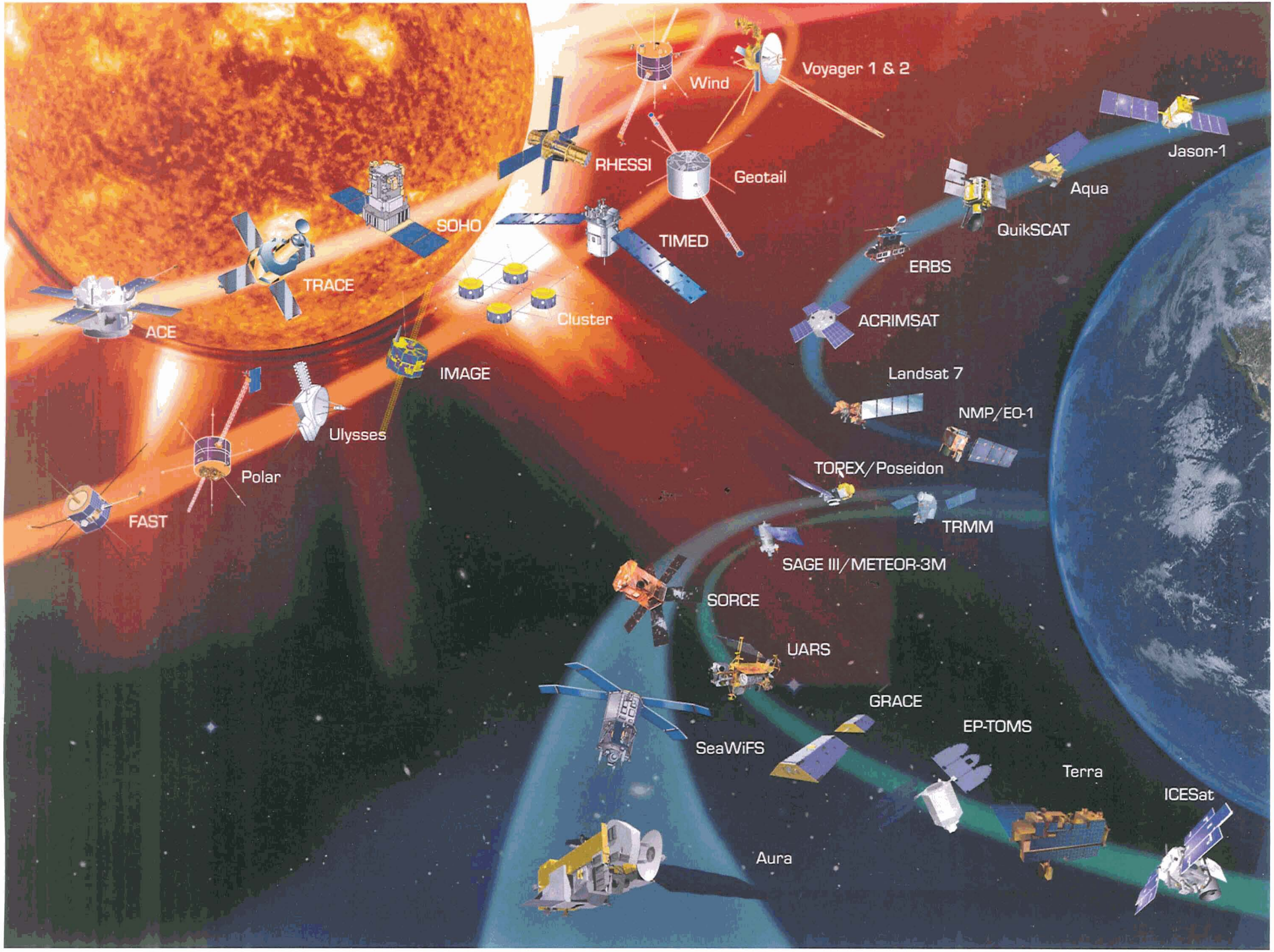
NASA
Applied Sciences Program

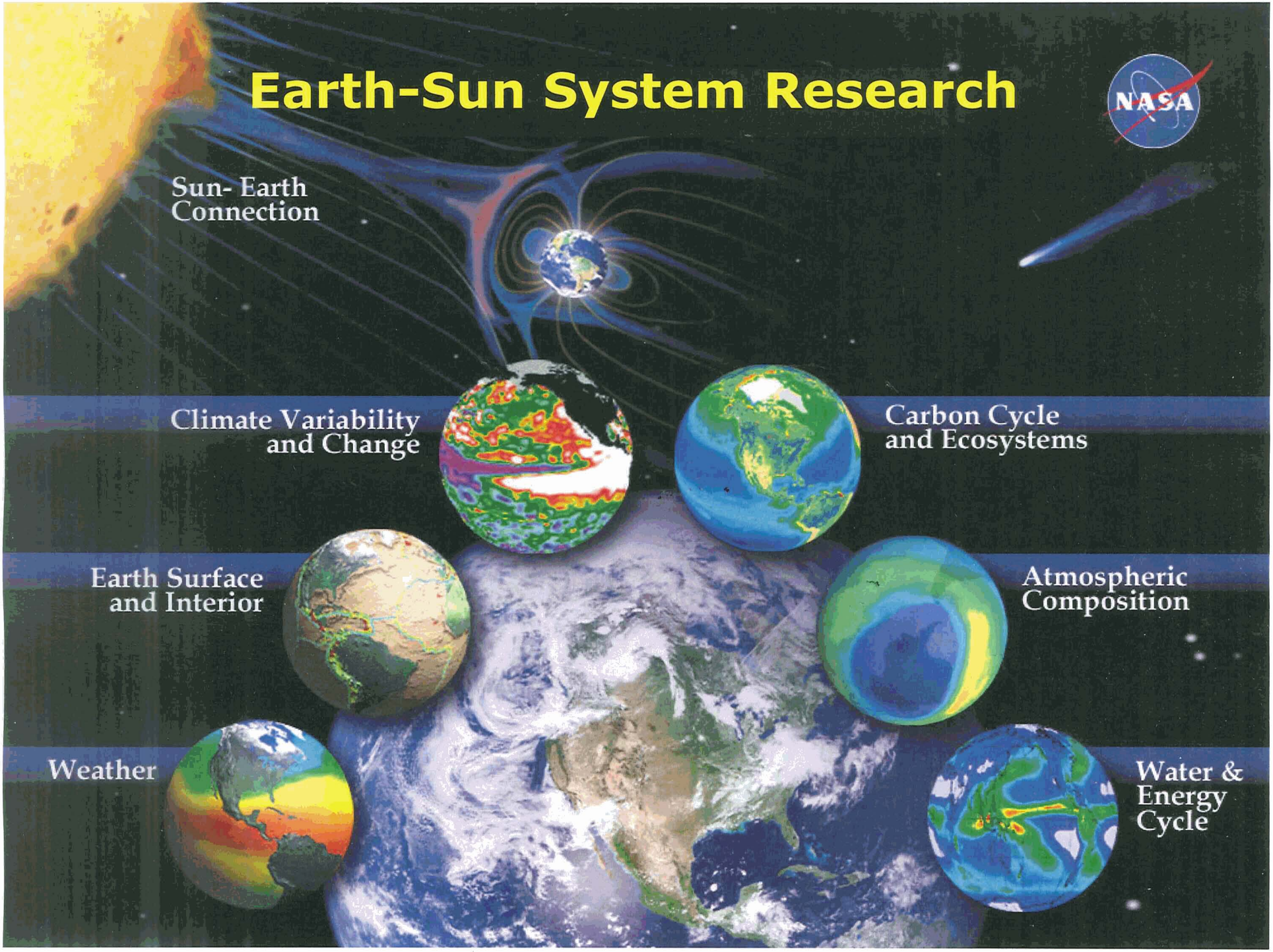
JACIE Workshop – November 8, 2004


The NASA Vision
To improve life here,
To extend life to there,
To find life beyond.
The NASA Mission
To understand and protect our home planet,
To explore the universe and search for life,
To inspire the next generation of explorers
... as only NASA can.

What's New: NASA Transformation

- NASA Transformation: Merge Office of Earth Science with Office of Space Science
- Science Mission Directorate Formed
  - Three Mission Areas: Earth-Sun System, Solar System, Universe
- Sun-Earth System Division
  - Research Program
  - Missions Program
  - Applied Sciences Program
    - National Applications Program Element
      - 12 National Applications
    - Crosscutting Solutions Program Element
      - Integrated Benchmarked Systems Function
      - Solutions Networks Function
      - Human Capital Development Function
      - Geoscience Standards and Interoperability Function


Wind
Voyager 1 & 2
RHESSI
Geotail
Jason-1
Aqua
SOHO
TIMED
QuikSCAT
TRACE
ERBS
Cluster
ACE
ACRIMSAT
IMAGE
Landsat 7
NMP/EO-1
Ulysses
TOREX/Poseidon
Polar
TRMM
FAST
SAGE III/METEOR-3M
SORCE
UARS
GRACE
SeaWiFS
EP-TOMS
Terra
ICESat
Aura


Earth-Sun System Research
NASA
Sun- Earth Connection
Climate Variability and Change
Carbon Cycle and Ecosystems
Earth Surface and Interior
Atmospheric Composition
Weather
Water & Energy Cycle

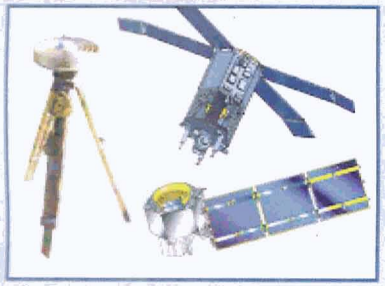
Turning Observations into Knowledge Products

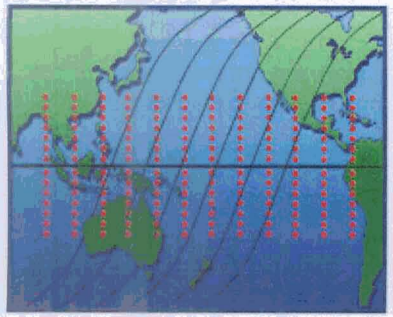
Downlink Speed

Petabytes 10^{15}

Multi-platform, multiparameter, high spatial and temporal resolution, remote & in-situ sensing

Advanced Sensors

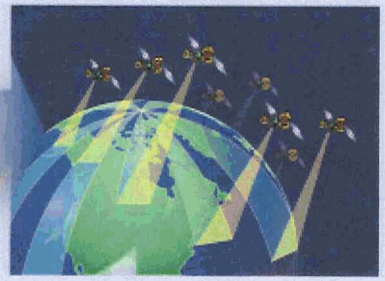


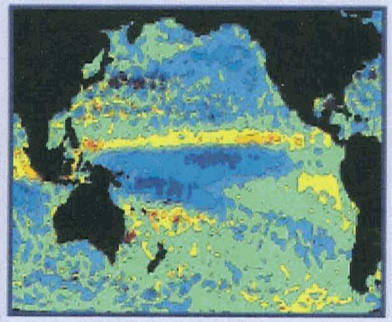


Terabytes 10^{12}

Calibration, Transformation To Characterized Geo-physical Parameters

Data Processing & Analysis

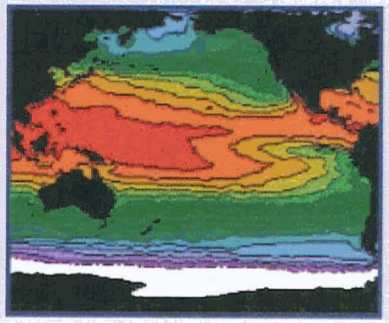




Gigabytes 10^{9}

Interaction Between Modeling/Forecasting and Observation Systems

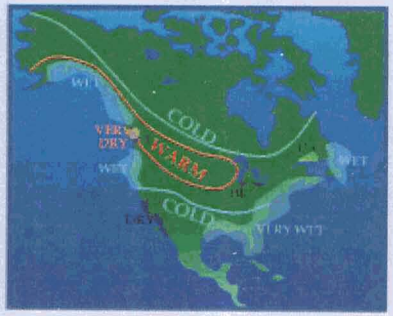
Information Synthesis



Megabytes 10^{6}

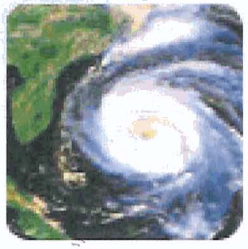
Interactive Dissemination and Predictions

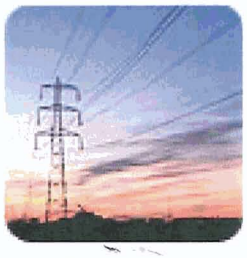
Access to Knowledge



Applications of National Priority


Homeland Security


Disaster Management


Energy Management


Aviation


Water Management


Public Health


Coastal Management

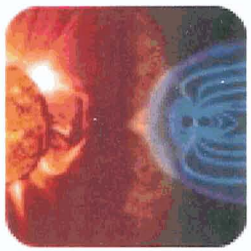

Carbon Management


Agricultural Efficiency


Invasive Species


Ecological Forecasting

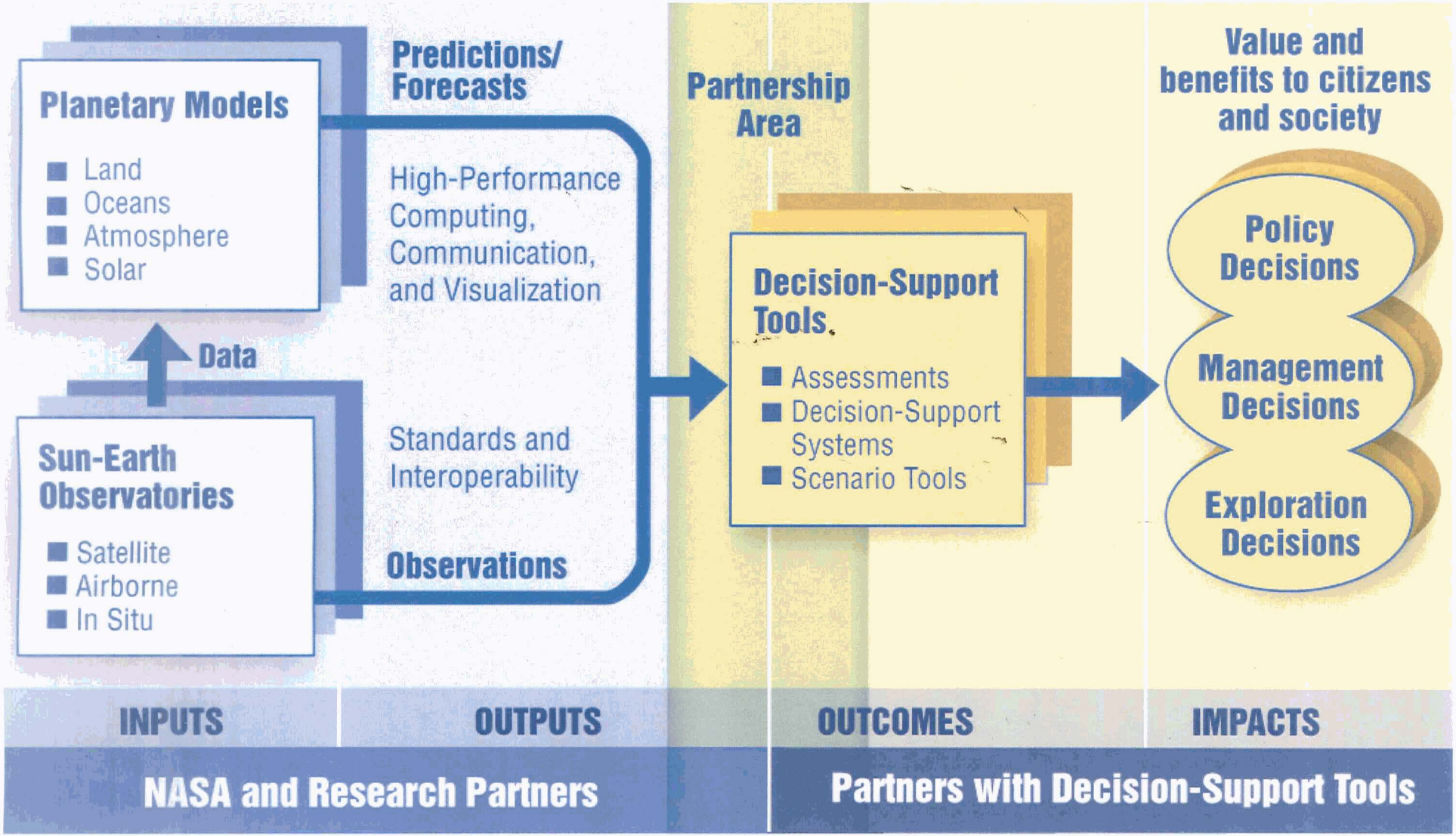

Air Quality


Space Weather

Applications, Partners and Decision Support

National Application	Partner Organizations	Decision Support Tools - Current Priority (supporting decision processes)
Agricultural Efficiency	USDA, NOAA	CADRE – Crop Assessment Data Retrieval & Evaluation (USDA)
Air Quality	EPA, NOAA, USDA	CMAQ – Community Multi-scale Air Quality Modeling System AIRNow & AQI – Air Quality Index
Aviation	DOT/FAA, NOAA	NAS_AWRP – National Air Space – Aviation Weather Research Program
Carbon Management	USDA, DOE, NOAA	CQUEST – Support to the Energy Act of 1992, Section 1605b
Coastal Management	NOAA, EPA, NRL	HAB – Harmful Algal Bloom Bulletin / Mapping System CREWS – Coral Reef Early Warning System
Disaster Management	DHS/FEMA, NOAA, USGS, USFS	HAZUS-MH – Hazards U.S. – Multi Hazards
Ecological Forecasting	USAID, NOAA, NPS, CCAD, USGS	SERVIR – Regional Visualization & Monitoring System
Energy Management	DOE, UNEP, NOAA, NRC	RETScreen – Energy Diversification Research Laboratory (CEDRL)
Homeland Security	DHS, USGS, NOAA, NIMA, DoD	IOF – Integrated Operations Facility
Invasive Species	USGS, USDA, NOAA	ISFS – Invasive Species Forecasting System
Public Health	NIH, CDC, DoD, EPA	PSS – Plague Surveillance System EPHTN – Environmental Public Health Tracking Network MMS – Malaria Monitoring & Surveillance RSVP – Rapid Syndrome Validation Project
Water Management	EPA, USDA, USGS, BoR	RiverWARE – Bureau of Reclamation Decision Support Tool AWARDS – Agricultural Water Resources & Decision Support Tool BASINS – Better Assessment Science Integrating Point & Non-point Source

Integrating Knowledge, Capacity and



National Priorities in a Global Context

Priority	National Activity	International Context
National Vision for Human and Robotic Exploration	Understanding the Earth as the Foundation for Planetary Exploration and Search for Life	*"Pursue opportunities for international participation to support U.S. space exploration goals"*
Global Earth Observation	NSTC CENR Interagency Working Group on Earth Observations (IWGEO, 15 Agencies)	Earth Observation Summit Group on Earth Observations (GEO) Global Earth Observation System of Systems (GEOSS) 10-Year Implementation Plan
Climate Change	Climate Change Science Program (CCSP, 13 Agencies) Climate Change Technology Program (CCTP, 12 Agencies)	Intergovernmental Panel on Climate Change (IPCC))
Weather	U.S. Weather Research Program (USWRP, 7 Agencies)	World Meteorological Organization (WMO)
Natural Hazards	NSTC CENR Subcommittee on Natural Disaster Reduction (SNDR, 14 Agencies)	International Strategy for Disaster Reduction
Sustainability	Roundtable on Science and Technology for Sustainability (National Academies)	World Summit on Sustainable Development (WSSD)
President's Management Agenda: E-Government	Geospatial One-Stop (GOS, 12 Agencies) and the Federal Geographic Data Committee (FGDC, 19 Agencies)	World Summit on the Information Society

Air Quality

Clean Air Standards and Air Quality Forecasts

State 2 (c. 2015): ESMF
- **Robust emissions control planning**
- **Routine warnings of pollution events**
- **Multiple-day air quality forecasts**

January 2004,
L. Friedl

Socioeconomic Impact

Simultaneous high-time & space resolved pollutants (O3, CO, NOx, SO2, HCHO, aerosols); local resolution in boundary layer. Nighttime chemistry & transport. Feedbacks betw. aerosols, O3, H20, climate. Chem-radiation coupling in GCMs. Quantify LRT in regional pollution.

Accurate pollution forecasts updated regularly within day. Reduced hospital visits from extreme events. Improved NAAQS planning - fewer non-attainment areas. Insight on mobile emission fluctuations. Advanced, targeted mitigation of impacts from severe episodes.

NPP-NPOESS - ozone trend & aerosols. Feedbacks between O3, H2O, and aerosols. Global trop. winds. Geographic evol. of trop. O3 & aerosols. Lightning NOx emission inventories. Trop. mixing & BL interaction. Urban-scale heat flux. High-res. soundings.

Clear Skies NOx/SO2 Trading Program. Longer lead-time on source & destination of ozone and aerosols. Alerts to re-route airplanes. Alerts to hospitals to expect specific symptoms. Ozone attainment areas. Potential EPA SIP credits for heat island reduction approaches & corresponding state/city policies.

CloudSat & CALIPSO - cloud profiles. Accurate energy & water in MM5. Vertical levels in lower troposphere. Models incorporate radiative forcings. Land-atmos. interactions. Chemistry-transport models. Stratospheric/trop. coupling. Chemistry-climate interactions.

Forecasts of beginning & length of annual "pollution season." Improvements from achievable SIPs - reduced haze, improved visibility in parks, cleaner water, healthier forest ecosystems, reduced lost work/school days. Support US treaty on long-range transport of organic pollutants.

AURA - SO2, NOx, NH3 and aerosol products & IMPROVE network. INTEX-West. NH3 emissions factors; air dispersion models (NOx, CO, PM); MM5 & assimilation of surface moisture, heat capacity, insulation. Nested model developments. RAQMS & DAS for daily 3-D ozone.

Support for goals of Clear Skies initiative. Science-based attribution of source emissions. States quantify voluntary stationary emission reductions within 18 months. Heat island effects in local weather and air quality forecasts. Longer-term AQI forecasts. UV-B notice.

AURA - AURA - AURA. Trop. residuals (O3, NO2, SO2, HCHO); NRT NOx & VOC emission inventories (top-down/bottom-up) for CMAQ & ozone precursors; O3 assimilations in CMAQ; 3-D global trop. chemistry in GEOS-CHEM; aerosol pattern rendering.

Support 2004 NOx SIP call. State justify & EPA corroborates claims for foreign-born pollution waivers. Annual EPA analysis of worst 20 pollution events for trends. Extend PM/O3 forecasting to rural areas - warnings to farmers. Targeted mitigation approaches. Ozone loops in EPA's AQI.

INTEX continental inflow-outflow; ICESat - vertical distribution of dust & clouds; ASTER urban heat flux; Global-to-regional RAQMS - prototype BCs in CMAQ; DAS nested GCM to 0.5° grid. Pollution trajectories & BL deposition of LRT of aerosols. PM network.

States assess emissions control options, development options &emissions strategies to build attainable SIPs. Achievable SIPs improve air quality, public health & economic development opportunities. Urban health alerts for temperature-induced pollution events. EPA guidebook on heat island reduction approaches. States claim waivers for foreign-born pollutants.

MODIS AOD, MOPITT CO, TOMS ozone residuals - correlate to EPA ground measures. Large scale transport of aerosols. GOCART assimilations for B.C.s in models. NRT MODIS-TEOM data fusion.

Policy-Forecasts-Health-Economics. Aerosol transport loops in EPA Air Quality Index (AQI) for regional forecasts. Improved siting for surface monitoring network locations. Support EPA-developed tools for state/locals on regional haze. Evaluate exceptional events for effects on NAAQS violations. EPA PM transport rule making.

State 1 (c.2003)
CMAQ & AIRNow-AQI

TOMS | Aqua/Terra | AERONET | ICESat | Aura | INTEX | CloudSat | CALIPSO | Glory | OCO | NPP/NPOESS | GTCM*

2003 2005 2007 2009 2011 2013 2015

* Unfunded

Improved capabilities to air quality managers to assess, plan & implement sound-science, emissions control strategies, policy, & air quality forecasts.

Air Quality

Integrated System Solution

EARTH SYSTEM MODELS

- **Aerosol Transport:** *GOCART*
- **Global-Regional Assimiliations:** *RAQMS*
- **Atmopsheric Chemistry:** *GEOS-CHEM*
- **Emissions:** *SMOKE*
- **Meteorology:** *MM5, ETA*
- **Air Trajectories:** *NOAA-Hysplit4*

Predictions

- **Atmospheric state parameters**
- **Global-to-regional concentrations**
- **Emissions inventories**
- **Regional-Global transport**
- **Trace Gas Sources**
- **Aerosol properties**
- **Ozone profiles & columns**
- **Global-regional boundary conditions**
- **Data fusion techniques**
- **Ground-satellite data comparison techniques**

Data

EARTH OBSERVATIONS

- **Aerosols:** *Terra, Aqua, TOMS, Aura, Aeronet, AIRNow, INTEX, CALIPSO, Glory-APS*
- **Ozone & Precursors:** *TOMS, Aura, SAGE III, AIRNow, INTEX*
- **Trace Gases:** *Terra, Aqua, OCO*
- **Clouds:** *Terra, Aqua, CloudSAT, CALIPSO*
- **Land Use/Cover:** *Terra, Aqua, Landsat*
- **Atmospheric Parameters:** *GOES, POES, GIFTS, NPP, NPOES*

Observations

DECISION SUPPORT TOOLS

CMAQ (**C**ommunity **M**ulit-scale **A**ir **Q**uality modeling system)

- **Assess emissions control strategies**
- **Develop achievable SIPs (State Implementation Plan)**
- **Assess compliance**
- **Waivers to air standards**
- **Quantify voluntary stationary emission reductions**

AIRNow & AQI (**A**ir **Q**uality Index)

- **Forecast transport of dust/pollutants**
- **Actions to reduce source emissions**
- **$PM_{2.5}$ forecasts**

International Treaties

VALUE & BENEFITS

- **Reduce lung-related diseases & premature death**
- **Reduce hospital admissions & use of medicines**
- **Reduce lost workdays and schooldays**
- **Improve visibility and reduce haze for tourism**
- **Improve resiliency of crops; increase yields**
- **Increase confidence in government**
- **Improve crop estimates**
- **Sensitive populations can change activities**

Air Quality

TOMS-EP

Aqua

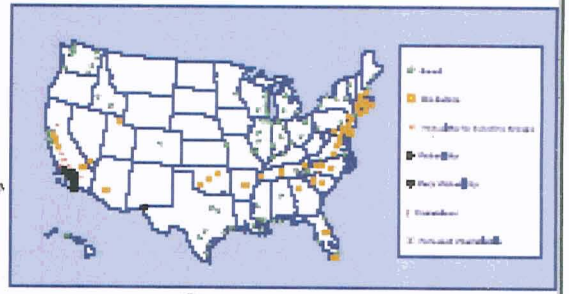
Tasking

Data Processing & Mission Control

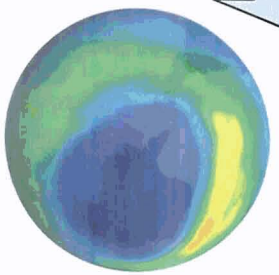
AIRNOW
www.epa.gov

The U.S. EPA has developed the AIRNow website to provide the public with easy access to national air quality information. This website offers daily Air Quality Index forecasts as well as real-time conditions for over 300 cities across the U.S.

Ozone and PM2.5 Forecasts

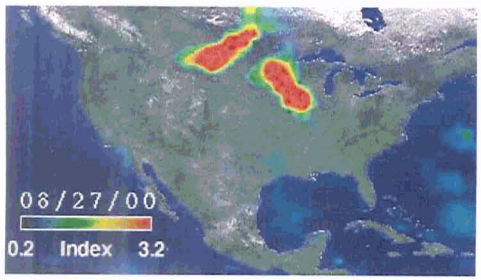


Processing



Ozone

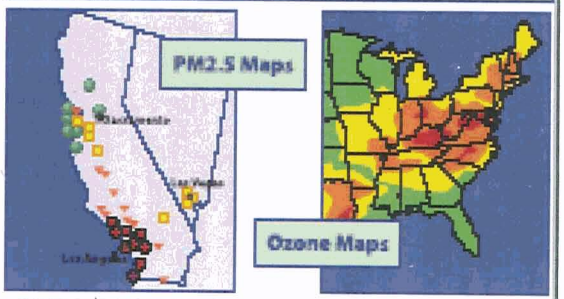
Exploitation



EOSDIS Science Data Systems: DAACs

Public Access

Current Air Quality Conditions



Applied Sciences and JACIE

- NASA Research is Undertaken Utilizing Best Possible Data Sources AND Not Competing with Private Industry
- JACIE is integral to the Applied Sciences goal of incorporating commercial data sources into scientific research
  - Used by Earth System Science Research as an high resolution augmentation to NASA remote sensing assets
  - Used by Space Science to help characterize "Mars Analog" Features on Earth for Future Exploration
- Applied Sciences Annual Performance Goals Include:
  - Crosscutting Solutions: Work within the Joint Agency Committee on Imagery Evaluation and the Commercial Remote Sensing Policy Working Group through partnerships with NIMA, USGS, NOAA, and USDA to verify/validate at least two commercial remote sensing sources/products for Earth science research, specifically with respect to land use/land cover observations for carbon cycle and water cycle research.

Applied Sciences Solicitation:
Decision Support through Earth Science Results

A--NASA COOPERATIVE AGREEMENT NOTICE (CAN) APPLIED SCIENCES PROGRAM-2004
General Information

Document Type: Presolicitation Notice Solicitation Number:NN-H-04-Z-YO-010-CPosted Date:Sep 03, 2004Original Response Date:Dec 17, 2004Current Response Date:Dec 17, 2004Original Archive Date:Sep 03, 2005Current Archive Date:Sep 03, 2005Classification Code:A -- Research & Development

Description

The National Aeronautics and Space Administration (NASA) is announcing opportunities to participate in the Applied Sciences Program of the Science Mission Directorate. The Program requests innovative solutions to evaluate, verify and validate, and benchmark solutions that **integrate NASA Earth and Space science results into decision-support tools of partnering organizations**. Proposals are invited in two main areas: 1) Integrated Systems Solutions to integrate NASA Earth and Space science results into applications of national priority, demonstrate prototypes, and benchmark performance, and 2) Solutions Networks to improve the collective ability of Earth science organizations to interact and harness the results of NASA Earth and Space science research. Participation in the CAN is open to all categories of domestic and foreign organizations, including educational institutions, industry, non-profit institutions, NASA research centers, and other government agencies and laboratories. This solicitation will be available electronically on the release date via the Internet at the Science Mission Directorate ? Destination Earth Home Page: http://www.earth.nasa.gov/ under ?Research Opportunity.? Paper copies of the announcement will be available to those who do not have Internet access by calling (202) 358-3552 and leaving a voice-mail message. The following dates apply to this announcement: CAN Release Date: September 17, 2004 Step 1 (Pre-Proposals) Due: October 22, 2004 Step 2 (Final) Proposals Due: December 17, 2004 POC: Lawrence Friedl Program Manager, Science Applications Applied Sciences Program NASA Headquarters Washington, DC 20546 Phone: (202) 358-1599 Fax: (202) 358-3098 E-mail: Lawrence.A.Friedl@nasa.gov "This is a broad agency announcement as specified in FAR 6.102 (d) (2). Notwithstanding the posting of this opportunity at FedBizOpps.gov, Grants.gov, or at both sites, NASA reserves the right to determine the appropriate award instrument for each proposal selected pursuant to this announcement.

Back Up Slides

- Questions or Comments, Contact:
- Martin Frederick/Deputy Director, Applied Sciences Program
  - Email: Martin.Frederick-1@nasa.gov
  - Program Website: www.earth.nasa.gov/eseapps/
  - Phone: 202-358-0913

Disaster Management

HAZUS-MH - Risk Assessment and Loss Estimation

January 12, 2004,
S. Ambrose

Primary Partners:

State 2- Improved
Hurricane prediction
Flood prediction
Severe Storm prediction
Wildfire prevention and prediction
Earthquake prediction

Socioeconomic Impact

Transfer of advanced event-modeling capabilities using next-generation hardware, software, and communications

Outcomes: Improvement of FEMA capabilities across all hazards and phases

Impacts: Reduce losses across all disasters

Land use/Land cover, changes in earth's surface topography and Improved geodetic imaging, ocean measurements to track hurricanes

Outcomes: Improvement of FEMA planning, and response capabilities to weather and natural hazards

Impacts: Reduce losses across all weather-driven Disasters and earth movement

Improved measurements of soil moisture, global precipitation, water vapor, and wind

Outcomes: Improvement in wildfire prediction, HAZUS-MH High Winds Module Final Version

Impacts: Reduce losses related to hurricane, fire, and high wind disasters.

Understanding of Earth's gravity field And terrestrial reference frame changes in geomagnetic field and understanding of sea level change and climate

Outcomes: Improvement of the HAZUS-MH earthquake assessments And flood inundation for coastal areas

Impacts: Reduce losses related to hurricanes and earthquakes.

Production of assimilated data sets, reanalysis of long period observations

Outcomes: Improvement in climate data and information for risk assessments

Impacts: Reduce losses related to flood and wind disasters. Better community planning

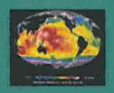
State 1- Earthquake Damage assessment


QuikSCAT


Terra


Aqua


TRMM


OcnTopo


Hydros


* OSWinds


Aquarius


NPOESS

* Pre-formulation

2004 2005 2006 2008 2010 2020

An operational decision support system for quantification and verification of solutions for natural hazard predictions.

Disaster Management

Integrated System Solution

EARTH SYSTEM MODELS

- Earthquake: *MMI, Quakesim*
- Hurricane: *HURRSIM*
- Flood: *SLOSH, WAVEwatch, STWAVE, HURSURGE*
- Land: *GPS Network, SBEACH*
- Building Cost Models: *ATC-13*
- Building Structure Models: *EPEDAT*

Data

EARTH OBSERVATIONS

- **Land:** *Landsat, SRTM,* GPS, SCIGN, Terra, Aqua
- **Ocean:** *QuickSCAT, IceSAT, GOES, POES, SSMI, JASON, TOPEX/POSEIDON*
- **Atmosphere:** *TRMM, GOES, POES,* ***GPM, NPP, NPOESS***

****Future Mission***

Predictions

- Earthquake prediction
- Floods
- Hurricane & Typhoons

- Land Surface Topography
- Global Precipitation
- Ocean Surface Winds
- Surface Deformation
- Motions of the Earth's Interior

Observations

DECISION SUPPORT TOOLS

- HAZUS-MH (Hazards U.S. - Multi Hazard)
  - Disaster Recovery/ Mitigation
  - Land use decision
  - Potential economic loss
  - Estimation of direct damage, induced damage, direct losses, and indirect losses
  - Accurate risk prediction to communities
  - Loss estimates of buildings, essential facilities, transportation & utility lifelines, and population
  - Social impacts

VALUE & BENEFITS

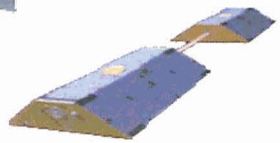
- Identify/ Prioritize high-risk communities
- Reduction in lives lost
- Reduction in damage cost
- Anticipate the scope of disaster-related damage
- Improve disaster response
- Community Planning

USGS science for a changing world

Disaster Management

QuikScat

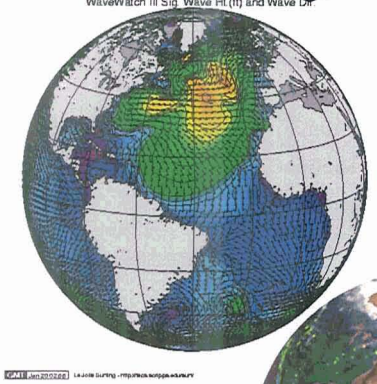
GRACE

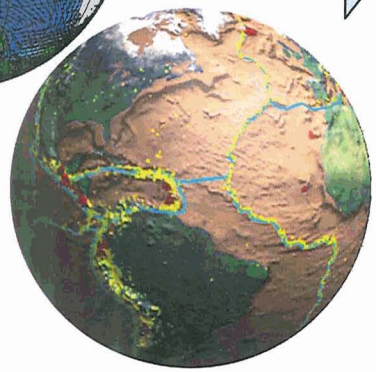


Tasking

Data Processing & Mission Control

Processing





Exploitation

Public Access

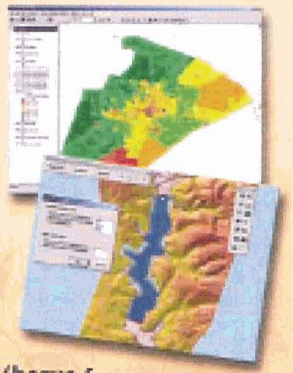
EOSDIS Science Data Systems: DAACs

Tools for Decision Makers

HAZUSMH can estimate losses from earthquakes, hurricane winds, and floods.

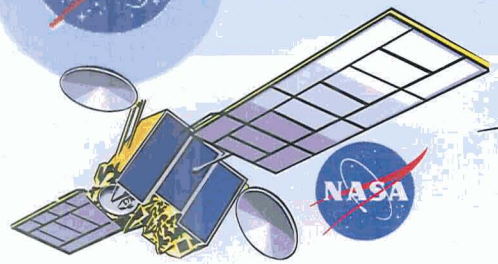
Use GIS technology to combine hazard layers with national databases and apply a standardized loss estimation and risk assessment methodology.

Nationwide database includes datasets on demographics, building stock, essential facilities, transportation, utilities, and high-potential-loss facilities.



Visit **www.fema.gov/hazus** for more information.

MODIS Rapid Response Project

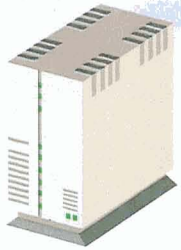


Terra & Aqua

Direct Broadcast Receiving Station

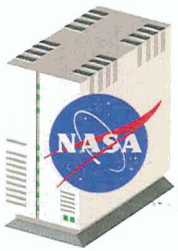
L1B Data

October 2001



USDA Forest Service Remote Sensing Application Center

Backup Feed L1B Data



Rapid Response System NASA/GSFC

Active Fire Locations

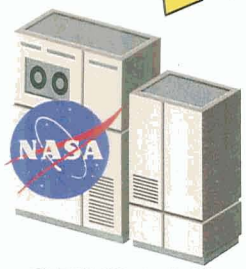
Cumulative Fire Maps
http://www.nifc.gov.firemaps.html

EDOS

MODIS L0 Data

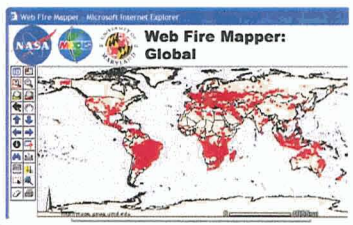
Burn Severity Maps
Handcrafted Imagery

Active Fire Locations
Selected Imagery

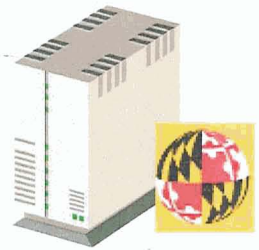


GES DAAC NASA/GSFC

NOAA



Active Fire and Corrected Reflectance
http://rapidfire.sci.gsfc.nasa.gov



University of Maryland Geography Dept

Web Fire Maps
http://rapidresponse.umd.edu

Invasive Species

USGS science for a changing world

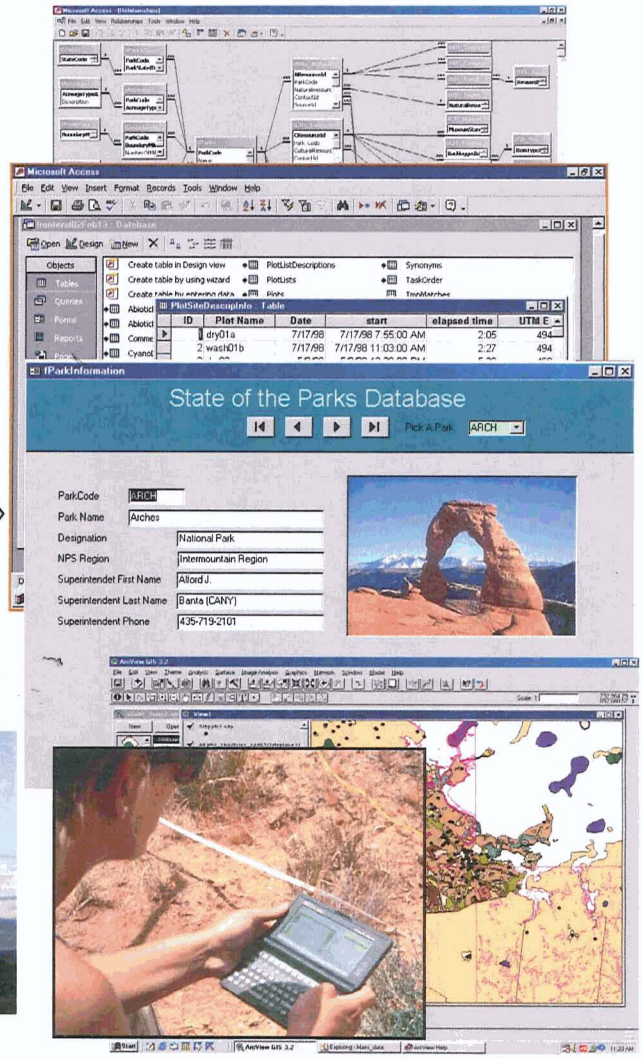
USDA

Aqua

Terra

Tasking

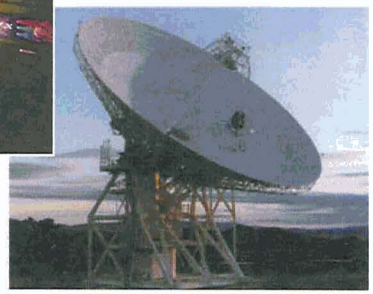
Data Processing & Mission Control

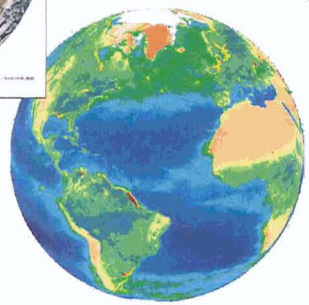


Public Access

Processing

Exploitation





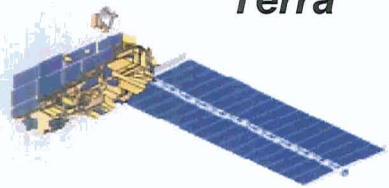
EOSDIS Science Data Systems: DAACs

Invasive Species Forecasting System

Agriculture Efficiency

Jason

Terra

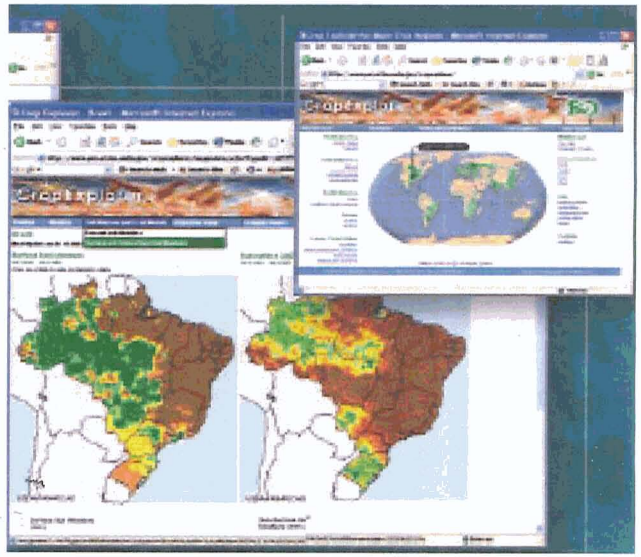


Tasking

Data Processing & Mission Control

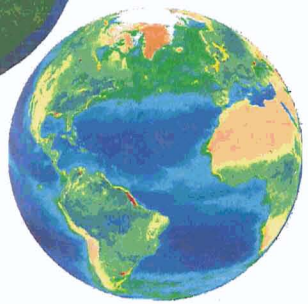
Processing

Public Access



CADRE

Exploitation



EOSDIS Science Data Systems: DAACs

SIAM-SERVIR

An Environmental Monitoring and Decision Support System for Central America

Earth Observatories

Electronic Transfer

SERVIR Node @ NSSTC

(NASA/MSFC and U. Alabama in Huntsville)

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

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

Visualization System

Source Data Archive

Product Archive

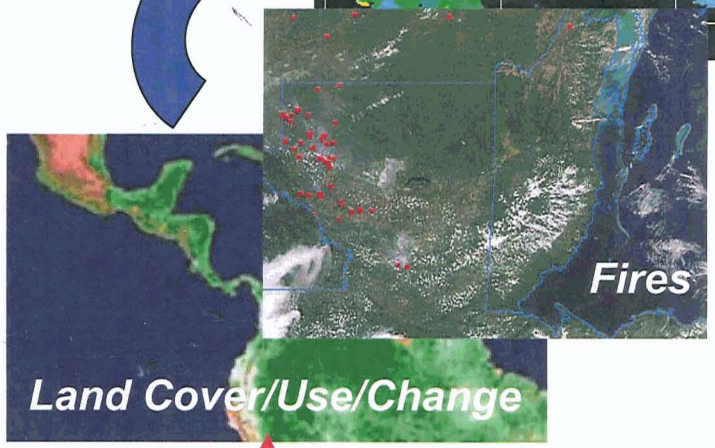
Data & Algorithms

SIAM-SERVIR Partners

Central American Commission for Environment and Development

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

Environmental Monitoring & Decision Support Products



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

NASA Science Supporting Citizens

- NASA performs human and robotic exploration in space
  - *About 40% of NASA's budget is dedicated to the study of the Earth and the Universe using the unique vantage point of space*
  - *Our fields of research include Climate Variability and Change, Astronomy, Weather, Heliophysics, Atmospheric Composition, Astrobiology, and more*
- One of the purposes of our scientific research is to increase knowledge of the Earth-Sun System to enable improved predictions of climate, weather, and natural hazards
- The *NASA Applied Sciences Program* goal is to extend the results of our scientific research and knowledge beyond the science community to contribute to our partners' applications of national priority.
- The Program primarily optimizes benefits for citizens by contributing to partnering on applications that are used by state, local, and tribal governments.