NASA SCIENCE MISSION DIRECTORATE

Earth-Sun System Applied Sciences Program
Air Quality Program Element
FY2006-2010 Plan

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Expanding and accelerating the realization of economic and societal benefits from Earth-Sun System science, information, and technology

NASA Science Mission Directorate
Earth-Sun System Division
Applied Sciences Program

Applied Sciences for the Air Quality Program Element:

This document contains the Air Quality Program Element Plan for FY 2006-2010.
This plan derives from direction established in the NASA Strategic Plan, Earth Science Enterprise and Space Science Enterprise Strategies, Earth Science Applications Plan, and OMB/OSTP guidance on research and development. The plan aligns with and serves the commitments established in the NASA Integrated Budget and Performance Document.

The Program Manager and the Applied Sciences Program Leadership have reviewed the plan and agree that the plan appropriately reflects the goals, objectives, and activities for the Program Element to serve the Applied Sciences Program, Earth-Sun System Division, NASA, the Administration, and Society.

(Signature on file) _____ _____
Lawrence Friedl — Date
Program Manager, Air Quality
Applied Sciences Program
NASA Earth-Sun System Division

(Signature on file) _____ _____
Lawrence Friedl — Date
Lead, National Applications
Applied Sciences Program
NASA Earth-Sun System Division

(Signature on file) _____ _____
Ronald J. Birk — Date
Director, Applied Sciences Program
NASA Earth-Sun System Division

NASA Earth-Sun System Division: Applied Sciences Program

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NASA Science Mission Directorate – Applied Sciences Program

Air Quality Program Element Plan: FY 2006 - 2010

I. Purpose and Scope

This Applied Sciences National Applications Program Element Plan is applicable for Fiscal Years 2006 through 2010. The plan documents the purpose of the program and the implementation approach to meet the program objectives using the allocated resources. The plan describes the program element approach in extending NASA Earth-Sun system science research results to meet the decision support requirements of partner agencies and organizations. The Applied Sciences Program requires this plan to function as a program management tool, describing the program structure, functional mechanisms, performance measures, and general principles that will be followed in extending NASA research results for societal benefits.

Scope within NASA and Applied Sciences Program

Each National Applications Program Element is managed in accordance with, and is guided by, the NASA Strategic Plan and Earth Science Applications Plan. The program element benefits from NASA Earth-Sun system science research results and capabilities, including the fleet of NASA research satellites, the predictive capability of models in the Earth System Modeling Framework (ESMF), Project Columbia, the Joint Center for Satellite Data Assimilation (JCSDA), and the Earth-Sun System Gateway (ESG). The Applied Sciences Program seeks to develop with its partners scientifically credible integrated system solutions in which uncertainty characterization and risk mitigation has been performed using the capability of the national Earth-Sun laboratories and others in the community of practice.

The FY06 President's Budget for the NASA Applied Sciences Program specifies between $48 million and $55 million annually for FY06 – FY10. There are two elements to the Applied Sciences Program: National Applications and Crosscutting Solutions. Each National Applications Program Element benefits from the performance results of Crosscutting Solutions (see Crosscutting Solutions Program Element Plan). Each National Applications Program Element leverages and extends research results from the over $2 billion per year supporting Earth-Sun system science and development of innovative aerospace science and technology. Additional information about the NASA Applied Sciences Program can be found at http://science.hq.nasa.gov/earth-sun/applications.

The Air Quality Management Program Element extends Earth-Sun science results, products derived from science information, models, technology, and other capabilities into partners' decision support tools for air quality management issues. The Air Quality program addresses issues of concern and decisionmaking related to air quality planning, compliance, and forecasting. The program focuses on air quality decision tools serving the following classes of issues:

- Air quality planning, assessment, and emission control strategies;

- Air pollution and emissions sources, transport and deposition;
- Emissions inventories;
- Compliance and regulation;
- Air quality forecasting;
- International atmospheric policies and treaties;
- Economic management and trade; and,
- Public and environmental health

NASA partners with Federal agencies and regional-national organizations that have air quality management responsibilities and mandates to support air quality managers – primary partners are the US Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA). The program includes participation from international organizations on air quality activities usually through a US partner. Some of the Air Quality program activities relate to other program elements such as Public Health, Aviation, Agricultural Efficiency, Energy Management, and Homeland Security. Air Quality program activities provide results for NASA support to Administration, interagency, and international activities, including the White House Committee on Environment and Natural Resources (CENR), Interagency Working Group on Earth Observations (IWEGO), ad hoc Group on Earth Observations (GEO), Climate Change Science Program (CCSP) and Integrated Global Atmospheric Chemistry Observations (IGACO).

Examples of Earth science missions for the Air Quality program include: Aura, Terra, Aqua, EP-TOMS, CloudSat, CALIPSO, NPP, NPOESS, Glory, and OCO. Examples of Earth science models include: RAQMS, GOCART, MM5, Hysplit, GMAO, WRF-CHEM, and GEOS-CHEM. Project plans associated with the Air Quality program designate specific sensors and models, and they state specific activities with the partners to extend NASA Earth science results (e.g., measurements, environmental data records, geophysical parameters, assimilated data, visualizations, model predictions).

This plan covers objectives, projects, and activities for Fiscal Years 2005-2009. Priority air quality constituents are ozone, aerosols (PM2.5), other EPA criteria pollutants, and emissions indicators (e.g., NO2, HCHO). In Fiscal Year 2005 (FY05), the program's priority activities focus on completing the transfer of aerosol transport and data fusion techniques to NOAA and EPA for air quality forecasting; validating and benchmarking use of NASA Earth observations from (EP-TOMS, GOES) research spacecraft and data assimilation in Community Multi-scale Air Quality model (CMAQ) boundary conditions; assessing use of satellite observations for fire emissions inventory; incorporating specifications of the physical atmosphere in CMAQ; incorporating specifications of land-use activity modeling in DSTs; evaluating potential support to Weather Research and Forecast model (WRF) and developing activities with NOAA on support to the WRF model/decision tool; identifying international air quality issues to support; pursuing assessment via Observing System Simulation Experiment (OSSE) of CloudSat and CALIPSO observations for forecasting; and pursuing Aura data for contributions to EPA/NOAA forecasts and CMAQ (http://www.wrf-model.org).

In FY06-09, the program's priorities focus on developing prototypes and evolving products for air quality transport and forecasting applications (e.g., aerosols in CMAQ and ozone in forecasts); expanding sources of measurements and model products (e.g. CloudSat, CALIPSO, OCO, NPP, Glory) for air quality; validating and benchmarking Aura products to CMAQ; and, developing products for other air quality decision tools. The program plans to increase its use of competitive solicitations to identify projects.

II. Goals and Objectives

Goals

The goal of the Air Quality Management Program is to:

Enable partners' beneficial use of NASA's Earth-Sun science results, observations, models, and technologies to enhance decision support capabilities serving their air quality management and policy responsibilities.

Major tenets of the Air Quality program's goal include:

- Develop and nurture partnerships with appropriate air quality organizations
- Identify and assess partners' air quality management responsibilities, plans, and decision support tools and evaluate capacity of NASA's science results to support the partners' solutions
- Validate and verify application of NASA's science results with partners, including development of products and prototypes to address partners' requirements
- With partners, document value of NASA's science results relative to partners' benchmarks and support adoption to transition from research to operations
- Communicate results and partners' achievements to appropriate air quality communities and stakeholders

Objectives

All National Applications Program Elements are aligned to the NASA Strategic Plan and the agency's objectives as expressed in the NASA Integrated Budget and Performance Document (IBPD) and the Performance Assessment Rating Tool (PART).

The Air Quality Program serves the NASA Strategic Plan Objectives 1.2, 2.2, and 3.1, and the NASA FY05 Integrated Budget and Performance Document (IBPD) Performance Measures 5ESA2, 5ESA4, 5ESA6, 5ESA7, 5ESA8, and 5ESA9 (ifmp.nasa.gov/codeb/budget2004). Specifically, the Air Quality Program Element pursues the following short- and near-term objectives:

(Note: Objectives are cumulative totals for the program rather than specific to an individual year.)

<u>Short-term Objectives (FY05)</u>
QI-QII 2005

- Complete report on potential NASA science support (e.g., Terra, Aqua, Aura) to at least two major international atmospheric treaties or policies (e.g., stratospheric ozone, international transport of pollutants).

- Complete report of NASA science capabilities related to NSF WRF, including analysis of potential Earth science product support and candidate measurements and models, such as the Land Use Data Analysis System

QIII - QIV 2005
5ESA2, 5ESA6, 5ESA7

- Complete transition of MODIS Aerosol Optical Depth (AOD) technique to NOAA & EPA for air quality forecasting.
- Complete validation & benchmark reports on the transition, improved techniques, and benefits.

Validate and complete benchmark report on NASA science support to boundary conditions for CMAQ (e.g., EP-TOMS Ozone residuals, assimilations, and boundary conditions (BC) from RAQMS).

QIII - QIV 2005 (cont.)
5ESA2, 5ESA6, 5ESA7

- Establish agreements with at least one federal partners and at least one non-federal partner or international organization (e.g., Regional Planning Organizations).
- Complete evaluation report of NASA science capabilities related to specifications of physical atmosphere and land-use associated properties for use in EPA CMAQ.
- Establish joint development plan with EPA, NOAA on NASA science support (e.g., Terra, Aqua, Aura, CloudSat, RAQMS, GOCART) to air quality tools (e.g., AIRNow AQI, CMAQ, WRF-CHEM), including emissions inventories.
- Evaluate potential of CALIPSO, CloudSat products to serve AIRNow and CMAQ; utilize Observation System Simulation Experiments (OSSE), as appropriate.

<u>Near-term Objectives (FY06-FY09)</u>
QI-II 2006

- Verify and validate NASA science enhancements in at least three separate air quality topics, decision support tools, and policy/management activities.
- Evaluate potential of NPP products to serve AIRNow and CMAQ and other tools; utilize Observation System Simulation Experiments, as appropriate.
- Publish at least two articles on NASA science input to air quality decision tools.

QIII-IV 2006

- Verify, validate, and complete benchmark report on performance of NASA science products from at least 4 sensors (e.g., Aura, CALIPSO, CloudSat) and models into at least 3 separate air quality decision support tools (e.g., AQI, CMAQ, WRF).
- Evaluate potential of OCO products to serve AIRNow and CMAQ and other tools; utilize
- Observation System Simulation Experiments (OSSE), as appropriate.
- Reports from REASoN (Falke) and EOS (Hutchinson) projects; publications as appropriate.

QI-II 2007

- Evaluate application of Glory products to serve AIRNow, CMAQ, and/or other priority air quality

decision support tools; utilize Observation System Simulation Experiments, as appropriate.

QIII-IV 2007

- Update joint development plans with EPA, NOAA, and other priority partners.
- Publish at least three articles on air quality applications of Earth science, including at least one in a peer-reviewed journal.

2008

- Evaluate application of Aquarius products to serve AIRNow, CMAQ, and/or other priority air quality decision support tools (use OSSEs as appropriate)
- Verify, validate, and complete benchmark reports on performance of NASA science products from at least 6 sensors on NASA research spacecraft (e.g., OCO, CALIPSO, Glory, NPP) and models into at least 4 separate air quality issues or decision support tools.

2009

- Evaluate application of HYDROS and other products to serve priority air quality decision support tools (use OSSEs as appropriate)
- Publish at least four articles on air quality applications of NASA science, including at least two in peer-reviewed journals.
- Verify, validate, and complete benchmark reports on performance of NASA science products from at least 7 sensors and models into at least 4 separate air quality issues or decision support tools.

III. Program Management and Partners

A. Program Management

Air Quality Program Manager:
Lawrence Friedl,
NASA-Headquarters

- Program development, strategy, plans and budgets
- Program representation and advocacy; report results and issues to NASA senior management and beyond
- Manage program to meet IBPD objectives and serve program assessments (e.g., PART)
- Communication of Earth-Sun system priorities and directives to Air Quality program team and network
- Implementation of interagency agreements and partnerships
- Represent program and Applied Sciences Program through interagency/international committees and working groups
- Monitoring Air Quality program measures and performance evaluation

Air Quality Deputy Program Manager:
Doreen Neil,
NASA-Langley

- Management of Air Quality program tasks at Langley Research Center Coordination and communication between NASA Centers on Air Quality program activities
- Leadership and communication to Air Quality program team and network
- Leadership on project plans, development, performance, and partnership relationships
- Communication of project measures, performance, status, and issues to Program Manager
- Management for grants and cooperative agreements funded through Langley

B. Air Quality Network & Partners

Earth-Sun System Division and NASA Centers:

Atmospheric Composition Theme ..... Phil DeCola, NASA HQ
Climate Change and Variability Theme..... Don Anderson, NASA HQ
Weather Theme..... Tsengdar Lee, NASA HQ
Tropospheric Chemistry and Aerosols..... Hal Maring, NASA HQ
Modeling ..... Don Anderson/Tsengdar Lee, NASA HQ
Technology .....Mike Tanner, NASA HQ
Business and Budget ..... Joan Haas, NASA HQ
Ames Research Center (ARC) ..... Steve Hipskind
Goddard Space Flight Center (GSFC) ..... Anne Thompson
Jet Propulsion Laboratory (JPL) ..... Tony Freeman
Marshall Space Flight Center (MSFC) ..... Dale Quattrochi/Dick McNider
Langley Research Center (LaRC) ..... Doreen Neil
Stennis Space Center (SSC) ..... Troy Frisbie

Federal Partners:

US EPA..... Jim Szykman (EPA at NASA-LaRC)
Terry Keating (EPA-OAR)
- Office of Air and Radiation (OAR)
- Office of Air Quality Planning and Standards (OAR-OAQPS)
- Office of Environmental Information (OEI)
- Office of Research and Development (ORD)

NOAA .....Jim Maegher, Pai-Yei Whung
Shoba Kondragunda, Steve Fine
- Air Resources Lab (ARL)
- Aeronomy Lab (AL)
- National Weather Service (NWS)
- National Environmental Satellite, Data and Information Service (NESDIS)
- National Center for Environmental Prediction (NCEP)

Federal Aviation Administration(FAA)..... Julie Draper
Agriculture Department (USDA) .....Ray Knighton, Al Ribeau
- US Forest Service (USFS)

Regional Planning Organizations:

CENRAP: Central Regional Air Planning Association
MANE-VU: Mid-Atlantic/Northeast Visibility Union
Midwest RPO: Midwest Regional Planning Organization
VISTA: Visibility Improvement State and Tribal Association of the Southeast
WRAP: Western Regional Air Partnership

International, National and Regional Organizations:

NARSTO (formerly North American Research Strategy for Tropospheric Ozone)
IGOS: Integrated Global Observing Strategy (IGACO – Atmospheric Composition Theme)
ECOS: Environmental Council of the States
Washington University at St. Louis – NASA Cooperative Agreement
University of Texas-Austin – NASA Cooperative Agreement
A&WMA: Air & Waste Management Association

Distributed Active Archive Centers (DAAC) and Earth Science Modeling Centers:

Langley Atmospheric Sciences DAAC (LaRC DAAC - LaRC)
GSFC Earth Science DAAC (GES DAAC - GSFC)
Land Processes DAAC (LP DAAC - USGS)
National Space Science and Technology Center (MSFC)
CIMSS: Cooperative Institute of Meteorological Satellite Studies
NCAR: National Center for Atmospheric Research
AeroCenter: GSFC Center for Aerosol Research
GISS: Goddard Institute for Space Studies

IV. Decision Support Tools and Management Issues

Priority Decision Support Tools

AIRNow and Air Quality Index

EPA provides a data clearinghouse, central forecast facility, and archive for regionally and locally generated daily air quality forecasts under its AIRNow Program, which developed the AQI as a health-based index for reporting air quality. AIRNow gathers data from numerous sources, including a nation-wide network of in situ monitors. EPA has regularly reported AQI for ozone, and initiated a PM AQI in October 2003. EPA has an AQI for five major air pollutants: groundlevel ozone, PM, carbon monoxide, sulfur dioxide, and nitrogen dioxide. EPA, state and local agencies, and the media report current and forecast AQI and air quality conditions. NASA works with EPA and NOAA to evaluate, validate and verify, and benchmark this assimilation of MODIS AOD, MODIS Cloud Optical Thickness (COT), wind speeds, air trajectory models, and data fusion techniques to assist the products they provide to air quality forecasters and the public (www.epa.gov/airnow).

Community Multi-scale Air Quality Model

EPA, with assistance from NOAA and the modeling community, developed the Community Multiscale Air Quality model (CMAQ/Models-3), to improve the environmental management community's ability to evaluate the impact of management practices for multiple pollutants and multiple scales and to improve the scientist's ability to understand and simulate chemical and physical interactions in the atmosphere. CMAQ is a comprehensive air quality modeling system, and CMAQ simulates processes to describe the generation, fate, and transport of atmospheric pollutants and urban, regional, and national air quality over several time scales. EPA, States and Regional Planning Offices (RPO) use CMAQ to simulate effects of pollution control options, assess multi-pollutant impacts, track and predict changes in emissions mitigation strategies, develop implementation plans, and make regulatory decisions. NASA works with EPA on use of EPTOMS, Aura, and observations from other research spacecraft as well as Global-to-Regional models (GOCART, RAQMS) to develop regional boundary conditions to initialize CMAQ, especially for ozone, particulate matter, physical parameters, and landscape characteristics. CMAQ is also the basis for work on air quality forecasting activities (www.epa.gov/asmdnerl/models3).

NOAA Forecasting

NOAA, in cooperation with EPA, began providing operational, daily air quality forecasting in September 2004. Initial guidance focuses on 1-2 day ozone forecasts for the Northeastern U.S. NOAA plans to expand the coverage incrementally to cover the entire nation by 2008. In addition, NOAA plans to include PM forecasts within five years, and, within the decade, NOAA plans to add additional pollutants and extend forecast intervals to two days or beyond. The initial operational modeling system, to be run at NOAA's NCEP, will consist of NOAA's Eta meteorological model linked with EPA's CMAQ model. The coupled Eta-CMAQ system will initially produce forecasts with a grid resolution of 12 km. Major issues related to air quality forecasting include emissions sources, transport/dispersion, and weather. Key NOAA activities to improve ozone forecasting include reducing land-use error, temperature interpolation

Emissions Inventories

Emissions inventories cut across several aspects of the Air Quality program. EPA prepares a national database of air emissions information (a.k.a., emissions inventory) with input from numerous State and local air quality monitoring/reporting agencies. These data are used for air dispersion modeling, regional strategy development, regulation setting, air toxics risk assessment, and tracking trends in emissions over time. The EPA emissions inventory contains CO, NOx, SO2, PM, VOCs, and NH3. The inventory defines the pollutant sources as point, area, or mobile. The NASA Air Quality program works with partners on appropriate priorities and activities related to emissions inventories, such as emissions from wildfires or measurable natural and anthropogenic (HCHO, NO2) sources or proxies (www.epa.gov/ttn/chief/net/index.html).

Weather Research and Forecasting - Chemistry (WRF-Chem)

WRF is a next-generation meteorological model being developed collaboratively among several agencies (NOAA/NCEP, NOAA/FSL, NCAR). WRF-Chem is a version of WRF that simulates trace gases and aerosols simultaneously with meteorological fields in the WRF framework. WRFChem model will have the option to simulate the coupling between dynamics, radiation and chemistry. Uses include forecasting chemical-weather, testing air pollution abatement strategies, planning and forecasting for field campaigns, analyzing measurements from field campaigns the assimilation of satellite and in-situ chemical measurements (www.wrf-model.org).

Potential Air Quality Management Issues: FY06-FY10

The Air Quality Management program element authorizes activities that contribute to the overall success of the program through studies, working group participation, program reviews, and similar enabling endeavors.

Cross-Application Activities

The program consists of functional elements that contribute to all of the National Applications activities. The intention is to have the performance of these functions leverage accomplishments, and therefore the apparent resource investment, to the greatest extent possible into the National Applications partnerships. These functions are: Geoscience Standards and Interoperability, Human Capital Development, Integrated Benchmark Systems, and Solutions Networks. Examples of leveraged activities are:

- The Earth-Sun System Gateway is a "portal of portals" providing an access point through an Internet interface to all web-enabled NASA research results.
- A Solutions Networks capability to discover candidate configurations of NASA research results with the potential to improve partner's decision support systems.
- A Rapid Prototyping Capability to support NASA and partners in reducing uncertainty and testing the validity of NASA research results in decision support tools.
- Systems integration capability, knowledge tools and skilled human capital to help conduct studies on the systematic transitioning of the results of research to operational uses and the capability of operational systems to support scientific research.
- A student-based, human capital development program for building capability in entry level participants in the community of practice while developing solutions for state and local applications.

V. Application Activities

A. Projects

All National Applications Program Elements authorize peer-reviewed projects to support each element's goal and objectives. To secure funding and authorization to undertake activities supporting NASA and the Applied Sciences Program, project teams are responsible for developing project plans and managing the activities. The project plans specify the Earth-Sun observations, models, and other research results to extend to decision support tools as well as the activities to produce appropriate deliverables. The plans integrate contributions from appropriate the partners, NASA Centers and other contributors from the community of practice. Projects are expected to extend the benefits of NASA research results to the maximum extent possible, including the use observations from sensors on: Aura, Terra, Aqua, TRMM, NPP, NPOESS, Hydros, Topex, Jason, OCO and Aquarius.

B. Solicitations

The Applied Sciences Program utilizes full and open competitions to fund proposals from the community to contribute the Agency's objectives. This implementation strategy will continue to be critical part of extending the benefits of NASA Earth-Sun system research results and contributing to the improvement of future operational systems. The Program has participated in providing opportunities to the community in recent solicitations, including REASoN, Decisions 2004, and Decisions under ROSES. The proposals related to this National Applications Program Element that have been funded under these solicitations are described in Section V.D. Program Element Projects.

C. Congressionally Directed Activities

As of the publication of this document, an assignment of FY06 congressionally mandated activities was not completed by the Agency.

The procurement rules and management practices of the Agency require that congressionally mandated activities follow the same principles of planning and accountability as all other funded projects. Only activities that are aligned with NASA's mission, are technically credible, and are appropriately budgeted will be approved to receive funding from the Program. The project teams of congressionally mandated activities are responsible for developing project plans and managing the activities.

D. Program Element Projects

Included below are the brief descriptions of the funded projects managed under this National Applications Program Element. Complete and detailed descriptions are documented in the Project Plans for each activity.

Project: Air Quality Planning (Chemical, and Aerosol) — Directed Project

Spacecraft measurements, and assimilation products for beneficial, routine use in air quality planning tools, specifically CMAQ. FY05 - Chemical: Continue work on examining ozone boundary conditions for CMAQ - proof of concept with historical ozone data based on TOMS-EP and GOES approaches. Prototype/validate activities with EPA on time-varying boundary conditions. Goal: Benchmark activities for transition in FY06+. Evaluate AIRS CO ground/observational spacecraft comparisons (based on Research and Analysis Program-funded Algorithm Theoretical Basis Document ATBD) and begin assimilation into CMAQ. Aerosols: Initiate evaluation/approaches for aerosols (observational spacecraft measurements, assimilations, boundary conditions). FY06-beyond: Transition successful efforts and techniques on time-varying boundary conditions to EPA and CMAQ. Evolve BC support through Aura, other measurements, and assimilations.

Budget ($K)

Procurement

FY06	375
FY07	375
FY08	300
FY09	0
FY10	0

Project Manager	*Centers*	*Timeframe*	*Partners*
Doreen Neil	LaRC, GSFC, MSFC, JPL	FY04 - FY08	NOAA, EPA

Earth Science Products: EP-TOMS, GOES, Aura (OMI-HRDLS-TES), GOCART, RAQMS, GMAO, GMI, MODIS

Other Apps.

Deliverables

Description	*End Date*	*IBPD Metric #*
Evaluation Report	N/A	
Design & Implement	9/30/2005	
Verification and Validation Report	9/30/2005	6ASP02.A
Benchmark Report	9/30/2005	
Results conference(s)	9/30/2006	
Project Plan	10/1/2005	

Notes: Note: This project draws on significant coordination between LaRC, GSFC, and MSFC on chemical, physical, land measurements and assimilations. The project plan specifies groups within each center for support and coordination. The program expects to solicit proposals for some to all of the activities through competitive solicitations.

Project: Air Quality Planning (Physical, Land-Air Connections) — Directed Project

The goal of this project is to evaluate/validate the role of Earth-Sun science physical parameters and land-characteristics products that can serve as input to CMAQ. The project focuses on physical meteorology, land characteristics, land-atmosphere exchange, and ammonia emissions and on developing and validating Earth science products for routine use in air quality decisions. Possible benchmark in future. Physical/Land: Complete evaluation report on incorporation of specification of physical atmosphere and land-use & associated properties into CMAQ. Assess improvements to CMAQ based on physical atmosphere and land-use properties. Pursue joint plans with EPA if improvements are worthwhile. Land Atmosphere/Ammonia: Integrate model products with EPA CMAQ (FY04-06: ~85K); benchmark report. FY05 150 Project Manager Centers

Budget ($K)

Procurement

FY06	200
FY07	200
FY08	170
FY09	0
FY10	0

Project Manager	*Centers*	*Timeframe*	*Partners*
Christa Peters-Lidard,	(GSFC), MSFC, LaRC	FY04 - FY06	EPA

Earth Science Products: Land Surface Model, Ammonia Model

Other Apps.: Ag. Effic.

Deliverables

Description	*End Date*	*IBPD Metric #*
Evaluation Report	6/30/2005	
Design & Implement	6/30/2005	
Verification and Validation Report	6/30/2005	6ASP02.A
Benchmark Report	9/30/2005	
Contact Network		
Project Plan	10/1/2005	

Notes: Note: This project draws on significant coordination between GSFC, MSFC, and LaRC. The project plan specifies groups within each center for support and coordination. The program expects to solicit proposals for some to all of the activities through competitive solicitations.

Project: Air Quality Forecasting — Directed Project

The goal is to develop, validate and benchmark NASA science products, especially observational spacecraft products and data fusion and models, for beneficial, routine use in EPA AIRNow-AQI and EPA-NOAA air quality forecasts. FY05 Aerosols: Complete transition of techniques to NOAA/EPA through CIMSS, including activities to get NOAA approval. Update validation/benchmark report based on system improvements and forecasts. Complete flags for snow mask and reflectivity in desert SW for operational support. Ozone: Comparisons with ground data (TOMS); evaluation of Aura / OMI & comparisons with ground. Pursue activities with EPA AIRNow AQI; set plan with NOAA WRF. Other: Evaluate potential for Earth science results to support EPA advisory on NOx, SOx, HCHO (based on AIRNow plans/direction) FY06-9 Aerosols: Use solicitations to support enhancements, such as vertical insights and/or urban-specific products.

Budget ($K)

Procurement

FY06	180
FY07	180
FY08	200
FY09	200
FY10	0

Project Manager	*Centers*	*Timeframe*	*Partners*
Doreen Neil	(LaRC), GSFC	FY04 - FY08	EPA, NOAA

Earth Science Products: Terra - MODIS, Aqua - MODIS, CloudSat, CALIPSO

Other Apps.: Public Health

Deliverables

Description	*End Date*	*IBPD Metric #*
Evaluation Report		
Design & Implement		
Verification and Validation Report		
Benchmark Report		
Results Conference	9/30/2006	
Project Plan	10/1/2005	

Notes: Note: This project requires very strong links between GSFC and LaRC to develop aerosol products, prototypes, and support transfer to EPA as well as strong coordination on technical and programmatic issues, including aerosol measurements, visualizations, and partner coordination. The project plan identifies groups within each Center for support and coordination. The program expects to solicit proposals for some to all of the activities through competitive solicitations.

Project: Project Emissions — Directed Project

The goal of this project is to evaluate, validate and benchmark role of NASA science products, observational spacecraft measurements, and assimilation products to support emissions inventories, factors, etc. that serve air quality planning, assessments, forecasting, etc. The project is a combination of activities: activities with the RPO WRAP to support regional haze, activities with BlueSkyRAINS, and on-going efforts to support emissions inventories more timely. FY05: Project with RPO WRAP to examine Earth science products to support modeling for 2002 regional haze responsibilities. Evaluate/validate/benchmark role of Earth science products to capture fires and emissions - compare observed to reported fire databases. Prototype technique to extend to emission inventory. Activities to support the interagency BlueSkyRAINS test in Summer 2005, including evaluation of Earth science products to support BlueSkyRAINS.

Budget ($K)

Procurement

FY06	180
FY07	180
FY08	200
FY09	200
FY10	0

Project Manager	*Centers*	*Timeframe*	*Partners*
Amber Soja	LaRC (lead), GSFC	FY04 - FY06	RPO-WRAP, EPA, USDA

Earth Science Products: Terra-MODIS, MOPITT; Aqua-MODIS; CALIPSO

Other Apps.: Disast. Mgnt, Ag. Effic.

Deliverables

Description	*End Date*	*IBPD Metric #*
Evaluation Report	6/30/2005	
Design & Implement	6/30/2005	
Verification and Validation Report	6/30/2005	
Benchmark Report	9/30/2005	
Results Conference	9/30/2006	
Project Plan	10/1/2005	

Notes: Note: This project draws on significant coordination between LaRC and GSFC. The project plan specifies groups within each center for support and coordination. The program expects to solicit proposals for some to all of the activities through competitive solicitations.

Project: REASoN: Particulate Air Quality Management				Solicitation	
This activity partners with EPA, RPOs, and state organizations to develop a Federated PM network and associated tools to produce NASA science aerosol products to the Air Quality community, especially Web-tools to support decision making through data access, visualization, and analysis.				*Budget ($K)* *Procurement*	
				FY06	312
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	320
Doreen Neil	LaRC	FY04 - FY)8	EPA, RPOs, States	FY08	334
				FY09	0
				FY10	0
Earth Science Products	Terra- MODIS, Aqua- MODIS			*Other Apps.*	
Deliverables	*Description*	*End Date*	*IBPD Metric #*	Public Health, Ag Effic.	
	Evaluation Report	6/30/2005			
	Design & Implement	6/30/2005			
	Verification and Validation Report	6/30/2005			
	Benchmark Report	9/30/2005			
	Semi-annual Reports				
	Results conference	9/30/2006			
	Project Plan	10/1/2005			
Notes:					

Project: Emissions Inventories (Supplement to RSP Solicitation)				Solicitation	
The purpose of this activity is to examine the ability of satellite-based measurements and models to develop emission inventories for use by air quality models and managers. This activity is a cost-share between Research and Analysis and Applied Sciences (combined $150K per year for 3 years)				*Budget ($K)* *Procurement*	
				FY06	50
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	0
Jim Gleason	(GSFC)	FY04 - FY06	EPA	FY08	0
				FY09	0
				FY10	0
Earth Science Products	EP-TOMS, OMI, HRDLS, GEOS-CHEM, MM5, RAQMS			*Other Apps.*	
Deliverables	*Description* / *End Date* / *IBPD Metric #* Evaluation Report Design & Implement Verification and Validation Report Benchmark Report Project plan — 10/1/2005 Semi-annual report Results conference			Ag. Effic.	
Notes:					

Project: EOS Follow-on: EOS Products for Air Quality Management					Solicitation
The purpose of this activity is to evaluate the use of EOS products for monitoring and modeling air quality in Texas, including transport & generation. Project focuses on aerosol and cloud data products for air quality management. Project began in FY04 ($295K)				*Budget ($K)* *Procurement*	
				FY06	279
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	0
Lawrence Friedl	HQ	FY04 - FY06	Texas CEQ	FY08	0
				FY09	0
				FY10	0
Earth Science Products	MODIS, MISR, AMSR-E, HSB			*Other Apps.*	
Deliverables	*Description* / *End Date* / *IBPD Metric #* Evaluation Report Design & Implement Verification and Validation Report Benchmark Report Project Plan — 10/1/2005				
Notes:					

Project: Decision Support Tools, Working Groups, Committees				Project Management	
Identify & evaluate AQ management issues and decision support tools for future support (eg EPA Visibility and reigional haze) Support interagency, national, regional, and international working groups (eg CCTP, IGOS, IGACO, NARSTO) Evaluation Reports				*Budget ($K)* *Procurement*	
				FY06	100
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	100
Doreen Neil	LaRC (lead), GSFC, SSC, ARC, MSFC, JPL	Annual -	EPA	FY08	100
				FY09	100
				FY10	
Earth Science Products	EP-TOMS, OMI, HRDLS, GEOS-CHEM, MM5, RAQMS, GOCART			*Other Apps.*	
Deliverables	*Description*	*End Date*	*IBPD Metric #*		
	Evaluation Report				
	Design & Implement				
	Verification and Validation Report				
	Benchmark Report				
	Meeting Reports				
	Analyses and/or Recommendation				
	Annotated bibliographies				
	Refs in Project Evaluation Reports				
	Project Plan	10/1/2005			
Notes:					

Project: Project Study: Air Quality and Atmospheric Treaties				Project Management	
Examine international atmospheric policies and treaties and the potential role NASA science results may play in the policy making and decision support. This project identifies the policies/treaties, their schedules, and major issues and decisions facing the organizations. The information and analysis should identify possible policy-directed applications of NASA science on international fronts and partnerships.				*Budget ($K)* *Procurement*	
				FY06	
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	
Lawrence Friedl	GSFC (lead), LaRC	FY04 - FY05	EPA	FY08	
				FY09	
				FY10	
Earth Science Products	Report to identify appropriate Earth science observations, models			*Other Apps.*	
Deliverables	*Description*	*End Date*	*IBPD Metric #*		
	Evaluation Report	complete			
	Design & Implement				
	Verification and Validation Report				
	Benchmark Report				
	Annotated bibliography				
	Project Plan	10/1/2005			
	Schedule and recommendations				
Notes:					

Project: Three-Dimension Air Quality System (3D-AQS)				Solicitation	
				Budget ($K) *Procurement*	
				FY06	
Project Manager	*Centers*	*Timeframe*	*Partners*	FY07	
Raymond Hoff	GSFC, LaRC	-		FY08	
				FY09	
				FY10	
Earth Science Products				*Other Apps.*	
Deliverables	*Description* / *End Date* / *IBPD Metric #* Evaluation Report Design & Implement Verification and Validation Report Benchmark Report			Public Health, Agricultural Efficiency	
Notes:					

E. Additional Activities & Linkages

NASA and Science Mission Directorate Priorities

The Air Quality Management Program leverages, utilizes, and contributes to priority activities of NASA and the Federal Government, including:

• Federal Enterprise Architecture (FEA) is a business and performance-based framework to support cross-agency collaboration, transformation, and government-wide improvement.
• The Global Information Grid (GIG) is the first stage of a U.S. military global, highbandwidth, internet protocol-based communications network (a.k.a., ëinternet in space').
• The Joint Center for Satellite Data Assimilation (JCSDA) is a multi-agency collaboration to accelerate and improve the quantitative use of research and operational observational spacecraft data in weather and climate prediction models. NOAA (NESDIS, NWS, OAR), NASA, Navy, Air Force, and NSF (through UCAR) collaborate in JCSDA.
• Metis is a visual modeling software tool for planning, developing, and analyzing agencies' enterprise architectures. The Applied Sciences Program is using Metis to identify possible linkages between observations, models, and decision support tools to support the IWGEO and NASA/NOAA R2O activities.
• Observing System Simulation Experiments (OSSEs) use simulated observations to assess the impacts of future observational spacecraft instruments on weather and climate prediction, and OSSEs provide opportunities to test new designs and methodologies for data-gathering and assimilation.
• Project Columbia is a NASA-wide project to develop a new, fast supercomputer (using an integrated cluster of interconnected processor systems) to support the Agency's mission and science goals, including enhanced predictions of weather, climate, and natural hazards.

E. IBS Request

• A Rapid Prototyping Center is a proposed center at Stennis to support NASA and partners in testing and verification of Earth science results in decision support tools.
• Transition from Research to Operations Network (R2O) is a network that focuses on systematically transitioning the results of research to operational uses.

Program Response to IBS Request

To be supplied by program management.

E. Crosscutting Request

DEVELOP is a student-based program for rapidly prototyping solutions for state and local applications and helping students develop capabilities related to applied Earth-Sun science.

Earth-Sun System Gateway is a "portal of portals" providing an access point through an Internet interface to all web-enabled NASA research results

Program Response to Crosscutting Request

To be supplied by program management.

VI. Budget: FY06-010

The following table lists the Air Quality Program budget (procurement) for FY2006:

Project	FY06 Procurement Allocation ($K)
Air Quality Planning (Chemical, and Aerosol)	$ 375
Air Quality Planning (Physical, Land-Air Connections)	$ 200
Air Quality Forecasting	$ 180
Project Emissions	$ 180
REASoN: Particulate Air Quality Management	$ 312
Emissions Inventories (Supplement to RSP Solicitation)	$ 50
EOS Follow-on: EOS Products for Air Quality Management	$ 279
Decision Support Tools, Working Groups, Committees	$ 100
Project Study: Air Quality and Atmospheric Treaties	$ NULL
Three-Dimension Air Quality System (3D-AQS)	$ NULL
Total =	$ **1676**

Appendix C lists program-wide budget allocations for FY2006-10.

VII. Program Management and Performance Measures

The Air Quality Management team uses performance measures to track progress, identify issues, evaluate projects, make adjustments, and establish results of the program element. The program's goal and objectives (Section II) state what the program intends to achieve. These measures help the team monitor progress within and across specific activities to ensure the program meets its goal and objectives.1 The management team analyzes these measures retrospectively in order to made adjustments proscriptively to the program approach and objectives.

The measures are in two categories: Program Management measures are internally focused to assess the activities within the program. Performance measures are externally focused to assess if the program activities are serving their intended purpose. In general, the Air Quality program element uses these measures to evaluate the performance of activities conducted and sponsored by the program, especially the projects. In addition, the Applied Sciences Program uses this information in preparing IBPD directions and PART responses.

Program Management Measures (Internally-focused):

Inputs:
1) Potential issues and DSTs identified for Air Quality - number, type, range
2) Eligible partners to collaborate with - number, type, range
3) Potential results/products identified to serve Air Quality - number, type, range;

Outputs:
1) Assessments or evaluations of DSTs - number, range
2) Assessments of Earth science results/products to serve DSTs - number, range
3) Agreements with partners - presence
4) Reports (evaluation, validation, benchmark) - number, type

Quality and Efficiency:
1) Earth science results/products - number used per DST, ratio of utilized to potential
2) Agreements - ratio of agreements to committed partners
3) Reports - partner satisfaction, timeliness, time to develop
4) Reports - ratio of validations to potential products, ratio of benchmarks to validations

Performance & Results Measures (Externally-focused):

Outcomes:
1) Earth science products adopted in DSTs - number, type, range; use in DST over time
2) Earth science products in use - ratio of products used by partners to reports produced
3) Partner & DST performance - change in partner DST performance, number and type of public recognition of use and value of Earth science data in DST

Impacts:
1) Partner value - change in partner metrics (improvements in value of partner decisions)

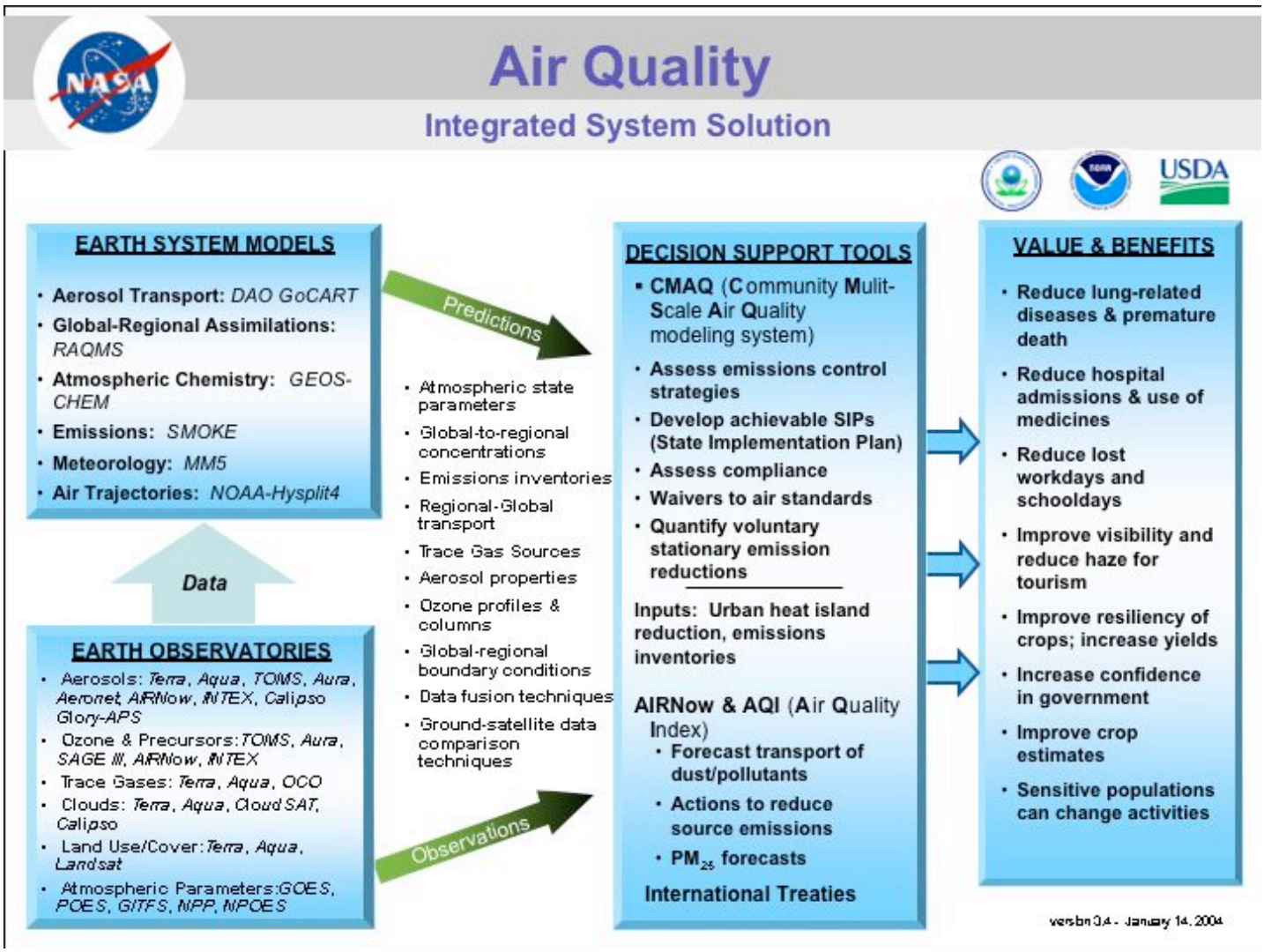
In addition to the stated measures, the Air Quality program periodically requests an assessment of its plans, goals,

priorities, and activities through external review. The Air Quality team uses these measures along with comparisons to programmatic benchmarks to support assessments of the Applied Sciences Program (e.g. internal NASA reviews and OMB PART). In specific, the Air Quality program uses comparisons to similar activities in the following programs (i.e., program benchmarks) to evaluate its progress and achievements: - Environmental and Societal Impacts Group at NCAR - NCAR Research to Applications Group - Global Monitoring for Environment and Security (GMES) in Europe The Air Quality program will report on its progress through various programmatic media (e.g., NASA websites, AIWG website, and Earth-Sun System Gateway) and will publish articles in journals and trade media.

VIII. Appendicies

A. Integrated System Solutions Diagram

Appendix A illustrates a candidate configuration for the extension of NASA science measurements, model products, and data fusion techniques to support Air Quality partners, their decision support tools, and benefits of Earth science to society. Results from NASA Earth-Sun system science are typically observations, data sets, climate data records, algorithms, and models utilizing the observations. Observations for Air Quality Management include measures of aerosols, ozone, trace gases, cloud properties, meteorology, and land-cover/use. Models use these and other measurements to generate predictions of atmospheric and air quality conditions (e.g., aerosol transport, emissions sources, ozone levels) and to assimilate data from global-to-regional scales. The Air Quality program works with partners on methods for their decision support tools - AIRNow, CMAQ, WRF - to ingest NASA science observations and predictions and, in turn, improve the capabilities of their tools to serve their decision processes and, ultimately, the public.



B. Roadmap

The figure illustrates the evolving, progressive nature of links between the increasing capabilities of NASA-supported research, measurement systems, and technology and their extension to partners' management and policy responsibilities. The yellow bars on the left state the expected research and developments from Earth-Sun system science and technology; the blue bars to the right reflect the contributions of the research in terms of improved management capabilities. Each level shows a steady improvement in the measurements and research along with enhanced management capabilities and public value. This Air Quality application roadmap builds on the roadmaps of the six Applied Sciences Science Focus Areas, particularly the Atmospheric Composition Theme, Weather Theme, and Climate Variability and Change Theme.

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
Simultaneous high-time & space resolved pollutants (O3, CO, NOx, SO2, HCHO, aerosols); local resolution in boundary layer. Nighttime chemistry & transport. Feedbacks betw. aerosols, O3, H2O, climate. Chem-radiation coupling in GCMs. Quantify LRT in regional pollution.
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.
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.
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.
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.
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.
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.
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.
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.
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.
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.
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.
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.
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.
Improved capabilities to air quality managers to assess, plan & implement sound-science, emissions control strategies, policy, & air quality forecasts.
Socioeconomic Impact
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

C. Applied Sciences Program Budgets FY2006-10

The following figures represent the FY06 budgets for the respective Program Elements; they do not represent the entire Applied Sciences Program budget. There is an additional $8.95million in Congressionally-directed activities and $5million for the Mississippi Research Consortium that these figures do not incorporate.

Program Element	FY06 Procurement Allocation
National Applications	
Agricultural Efficiency	$ 1,955,803
Air Quality	$ 3,116,464
Aviation	$ 3,048,878
Carbon Management	$ 1,544,831
Coastal Management	$ 1,416,233
Disaster Management	$ 2,743,760
Ecological Forecasting	$ 3,240,170
Energy Management	$ 1,875,253
Homeland Security	$ 1,987,054
Invasive Species	$ 2,241,940
Public Health	$ 3,356,124
Water Management	$ 1,714,341
Crosscutting Solutions	
DEVELOP	$ 1,498,000
Geospatial Interoperability	$ 2,400,000
Solutions Networks	$ 2,822,000
Integrated Benchmarking System	$ 4,500,000

The following figures show the five-year run-out for the entire Applied Sciences Program. The figures are based on the FY07 President's budget submitted to Congress. The lower line shows the target budget including agency corporate and institutional adjustments.

	2006	2007	2008	2009	2010
Present Budget Summited to Congress	53,254,855	51,049,000	50,287,000	48,588,000	48,662,000
Target After Adjustments	47,321,663	39,101,000	33,922,000	34,801,000	34,803,000

D. Related NASA and Partner Solicitations and Grants

Appendix D lists NASA Earth-Sun system science research projects, Earth science fellowships, GLOBE activities, and Earth science New Investigators related to Air Quality activities.

Fellowships

Earth-Sun Division Education

Institution	*PI*	*Title/Subject*	*Timeframe*
CIT	Andrew Mollner	Laboratory Studies of Tropospheric Ozone Chemistry: Isoprenes	2005-2007

Fellowships

Earth-Sun Division Education

Institution	*PI*	*Title/Subject*	*Timeframe*
Texan A&M	Fan Jiwen	Investigation of Urban Aerosols and Their Impact on Cloud Microphysics	2005-2007

Fellowships

Earth-Sun Division Education

Institution	*PI*	*Title/Subject*	*Timeframe*
Colorado University Boulder	Alison Aiken	Aerosol Morphology and Improve Quantitative Analysis of Tropospheric Aerosols in Aircraft Studies	2005-2007

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
CSU	Katherine Corbin	Using Satellite Observations of CO to Improve Estimates of CO2 Sources and Sinks	2005-2007

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
UCLA	Troy Robert	Dehydration in the Tropical Tropopause Layer: Integration of Humidity and Temperature Data from AIRS/AMS	2005-2007

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
University of Alabama Huntsville	Jun Want	The Effect of Central American Smoke Aerosols on Air Quality and Climate over the Southeastern United States	2005-2007

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
Colorado University Boulder	John Huffman	Development and Application of a Size and Chemical Composition-Resolved Aerosol Flux Measurement	2004-2006

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
CSU	Kristen Koehler	Laboratory Investigations of the Links Between Mineral Dust and Cloud Formation	2004-2006

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
UC-Irvine	John Newberg	Ozone Chemistry with Sea-Salt Particles at the Air- Particle Interface: A Surface Analysis Approach	2004-2006

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
CU-Boulder	Cynthia Shaw	Derivation of Ozone Photochemical Loss by Combining Satellite Data and a 3-Dimensional Chemical Transport Model	2004-2006

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
Boston College	Jay Slowick	Effect of Morphology and Composition on Hygroscopicity of Soot Aerosols	2004-2006

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
Harvard	Colette Heald	Global Sources of CO - Integrated Observing	2003-2005

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
University of Maryland	Heather Kilcoyne	Aerosol Retrieval Algorithms and Retrieval Method Over Land	2003-2005

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
CU-Boulder	Karl Feierabend	Spectrocpy and Phtoreactivity of Hydrated Complexes and Relevance to Atmospheric Chemistry	2003-2005

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
University of Maryland	Honquing Liu	Novel Approach to Global Aerosols	2003-2005

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
UCSD	Karen Shell	Conceptual Modeling of the Climatic Role of Airborne Mineral Dust	2003-2005

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
Northwestern	Andrea Voges	Heterogeneous Atmospheric Chemistry Studied Using Nonlinear Optical Techniques	2003-2005

Fellowships

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
University of Maryland	Stefania Korontzi	The Spatial and Temporal Distribution of Biomass Burning in Southern Africa	2003-2005

GLOBE

GLOBE Program

Institution	PI	Title/Subject	Timeframe
Drexel	Brooks, Mims	Atmosphere: Aerosols, Haze, Water Vapor	NULL

GLOBE

GLOBE Program

Institution	PI	Title/Subject	Timeframe
University of Toledo	Czajkowski, Benko	Atmosphere: Aerosols, Haze, Water Vapor	NULL

GLOBE

GLOBE Program

Institution	PI	Title/Subject	Timeframe
LaRC	Fishman, DeYoung, Olson, Canright, Ladd	Atmosphere: Ozone	NULL

GLOBE

GLOBE Program

Institution	PI	Title/Subject	Timeframe
CSU and JPL	Stephens, Pielke (Sr), Krumm, Vane, Whittmeyer	Atmosphere: Meteorological Measurements	NULL

New Investigators

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
Illinois	Larry Di Girolamo	The Spatial and Temporal Distribution of Biomass Burning in Southern Africa	2002-2004

New Investigators

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
Ames	Laura Irachi	Integration of Laboratory and Remote Sensing Data for Determination of the Origin of Organic Material in Lower Stratospheric Aerosol Particles	2002-2004

New Investigators

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
Princeton	Denise Mauzerall	Interannual Variability in Trans-Pacific Transport of Pollution	2002-2004

New Investigators

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
UCLA	Bjorn Stevens	NIP2002: Surface Divergence and Non-Precipitating Boundary Layer Clouds: Integrating Simple Models Using Satellite Data	2002-2004

New Investigators

Earth-Sun Division Education

Institution	PI	Title/Subject	Timeframe
BAERI-Ames	Jens Redman	Terra Retrievals of Aerosol Optical Depth; Feasibility of Determining the Direct Aerosol Radiative Forcing of Climate Using Future EOS Satellite Sensors	2002-2004

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	*PI*	*Title/Subject*	*Timeframe*
University of Wisconsin Madison	Ackerman	Refinement and Maintenance of the MODIS Cloud Mask Algorithm on Terra and Aqua	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	*PI*	*Title/Subject*	*Timeframe*
UMBC	Barnett	Production and Evaluation of the AIRS Trace Gas Research Products	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	*PI*	*Title/Subject*	*Timeframe*
CIMSS	Baum	Regional and Global Analyses of Multilayered Clouds, Ice- Phase Clouds and Mixed-Phase Clouds Using EOS Terra and Aqua Data	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	*PI*	*Title/Subject*	*Timeframe*
University of Illinois Urbana	Bond	Understanding the Atmospheric Transformation of Anthropogenic Aerosol: Inferences from Satellite Data and Global Aerosol Modeling	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
GSFC	Calahan	I3RC Workshops and 3D Community Tools Applied to Assessments and Improvements of Cloud Retrievals from Terra, Aqua, and THOR Offbeam Lidar	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
GSFC	Chin	A Global Model Analysis of Anthropogenic Aerosol Radiative Forcing Using Data from Terra and Aqua Satellites, Ground-Based Networks, and In-Situ Measurements	2004-2006

Other

EOS Continuation: Aqua-Tera-ACRIM

Institution	PI	Title/Subject	Timeframe
University of Alabama Huntsville	Christopher	A Multi-Sensor Approach for Estimating Global Aerosol Radiative Forcing from Terra and Aqua	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
Oregon State	Coakley	Effects of Partial Cloud Cover on the Retrieval of Cloud Properties and Radiative Fluxes	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
GSFC	Descloitres	The MODIS Rapid Response System: A Model for Generating Near Real-Time Applications Products	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
GSFC	Dubovik	Enhanced Remote Sensing of Atmospheric Aerosol by Multi-Sensor AERONET/MISR/MODIS Retrieval	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
NCAR	Emmons	Closing the Carbon Monoxide Budget: Variability in CO Emissions	NULL

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
LaRC	Ferrare	Aerosol Fine and Coarse Mode Profile Retrievals Using Airborne and Space-Based Lidar and MODIS Measurements	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
UCSC	Gautier-Downes	Properties and Diurnal Radiative Forcing of Mineral Aerosols Over Deserts Using Combined AIRS and MODIS and Ground-Based Observations	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
GSFC	Hsu	Retrieving Aerosol Properties over Bright-Reflecting Surfaces: An Extension of Current MOD04/MYD04 Products	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
University of Texas CSR	Hutchinson	Toward the Development of Advanced Data Products from EOS Terra and Aqua Direct Broadcasts for Air Quality Management in the State of Texas	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
Harvard	Jacob	Quantifying the Sources and Global Transport of Combustion Gases and Aerosols Using MOPITT, MODIS, MISR, and Related Satellite Observations	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	*PI*	*Title/Subject*	*Timeframe*
Stanford	Jacobson	Using Satellite Data and Models to Study the Effects of Global Climate on Regional Pollution and Vice-Versa	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	*PI*	*Title/Subject*	*Timeframe*
University of Maryland College Park	Justice	Refinement and Maintenance of the MODIS Fire Product Suite and MODIS Land Discipline Leader	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	*PI*	*Title/Subject*	*Timeframe*
University of Maryland College Park	Kalnay	Data Assimilation Using Advanced Infrared Sounder Data	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	*PI*	*Title/Subject*	*Timeframe*
Utah	Mace	Algorithm Refinement and Validation of Cloud and Radiation Products Derived from MODIS and CERES Radiances Using Ground-Based and Aircraft Data	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
PNNL	Marchand	Retrieval of Ice Cloud Crystal Habit and Cloud Phase Using MISR and MODIS Measurements	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
UMBC	McMillan	AIRS Trace Gas Retrieval Validation and Analysis and Fire Detection	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
University of Wisconsin Madison	Menzel	Maintaining and Refining the Calibration of Infrared Radiances and the Derivation of Cloud Properties with MODIS	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
GSFC	Platnik	Global Analysis of MODIS Level-3 Cloud Properties and Their Sensitivity to Aggregation Strategies	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
NCAR	Randel	EOS Integrated Investigations of Upper Tropospheric Water, Clouds and Temperature	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
JPL	Realmuto	Monitoring Volcanic Plumes and Clouds from Terra and Aqua	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
GSFC	Remer	Maintenance and Refinement of the Global MODIS Aerosol Products from Terra and Aqua (MOD04/MYD04)	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
MIT	Rosenkrantz	AIRS/AMSU/HSB Algorithm Refinement Through Improved Cloud Liquid Water Profile Estimates and Cloud Clearing Metrics	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
Boston University	Schaff	Algorithm Refinement for the MODIS Bi-Directional Reflectance/Albedo Product	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
MIT	Staelin	Retrievals and Global Studies of Precipitation Rate and Cloud-Base Pressure and Temperature	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
GSFC	Susskind	Upgrade and Maintenance of the AIRS Team Level 2 Algorithm	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
GSFC	Vermote	Fires as a Disturbance in the Earth-Atmosphere System, a Pilot Study Using MODIS Data and Experimental Algorithms	2004-2006

Other

EOS Continuation: Aqua-Terra-ACRIM

Institution	PI	Title/Subject	Timeframe
GSFC	Weaver	Spectral Signatures of Aerosols from Satellite Radiances	2004-2006

Research Projects

NPOESS Preparatory Project

Institution	PI	Title/Subject	Timeframe
GSFC	Lyapustin	Analysis and Validation of the Aerosol and Surface Reflectance EDRs Over Land for the VIIRS	2004-2006

Research Projects

IDS NRA

Institution	PI	Title/Subject	Timeframe
MIT	Prinn	Testing Trace-Gas Flux Models Using In Situ and Remotely Sensed Data	2003-2006

Research Projects

REASoN

Institution	PI	Title/Subject	Timeframe
LaRC	Delnore	Synergistic Data Support of Atmospheric Chemistry Field Campaigns	2003-2006

Research Projects

REASoN

Institution	PI	Title/Subject	Timeframe
GSFC	Holben	BAMGOMAS-Back Trajectories, Aeronet, Micropulse Lidar, GOCART, and MODIS for Aerosol Synergism	2003-2006

Research Projects

REASoN

Institution	PI	Title/Subject	Timeframe
GISS	Rossow	Variability of Global Cloud Property Distributions from Diurnal to Decadal Time Scales	2003-2006

Research Projects

NPOESS Preparatory Project

Institution	PI	Title/Subject	Timeframe
LaRC	Baum	Science Support for NPP Cloud Retrieval Effort	2004-2006

Research Projects

NPOESS Preparatory Project

Institution	PI	Title/Subject	Timeframe
University of Alabama Huntsville	Han	Measurement Accuracies of Two VIIRS Cloud EDRs: Cloud Optical Thickness and Effective Particle Size	2004-2006

Research Projects

NPOESS Preparatory Project

Institution	*PI*	*Title/Subject*	*Timeframe*
University of Maryland College Park	Justice	Assessing the NPOESS Preparatory Project (NPP) VIIRS Fire Product as a Climate Data Record	2004-2006

Research Projects

NPOESS Preparatory Project

Institution	*PI*	*Title/Subject*	*Timeframe*
USGS	Loveland	Strategy to Evaluate and Enhance the NPOESS Surface Type Environmental Data Record	2004-2006

Research Projects

NPOESS Preparatory Project

Institution	*PI*	*Title/Subject*	*Timeframe*
GSFC	McPeters	An Evaluation of OMPS Ozone Measurements for Producing NPP Climate Data Records	2004-2006

Research Projects

NPOESS Preparatory Project

Institution	*PI*	*Title/Subject*	*Timeframe*
Boston University	Schaff	Assessment of Aerosol, Albedo, and Surface Type Environmental Data Records (EDRs) from VIIRS	2004-2006

Research Projects

NPOESS Preparatory Project

Institution	PI	Title/Subject	Timeframe
UMBC	Torres	Assessment of NPOESS Aerosol Algorithm Enhancement Using VIIRS and OMPS Observations	2004-2006

E. Acronyms and Websites

ACRONYMS:

A&WMA	Air & Waste Management Association
AERONET	Aerosol Robotic Network
AIRS	Airborne Infrared Sounder
AIWG	Applications Implementation Working Group
AL	Aeronomy Lab
AMSU	Advanced Microwave Sounding Unit
AOD	Aerosol Optical Depth
APS	Aerosol Polarimetric Sensor
AQI	Air Quality Index
Aqua	Spacecraft with instruments to collect information on Earth's water cycle
Aquarius	Spacecraft with instruments to map global salt concentrations on ocean surface
ARC	Ames Research Center
ARL	Air Resources Lab
ATBD	Algorithm Theoretical Basis Document
Aura	Spacecraft with instruments to study Earth's ozone, air quality, climate
BAERI	Bay Area Environmental Research Institute
BAMGOMAS	Back trajectories, AERONET, MODIS, GOCART, MPLNET, Aerosol Synergism
BlueSkyRAINS	BlueSky Rapid Access Information System
CAEP	Civil Aviation Environmental Program
CALIPSO	Cloud-Aerosol LIDAR and Infrared Pathfinder Satellite Observations
CCSP	Climate Change Science Program
CCTP	Climate Change Technology Program
CDC	Centers for Disease Control and Prevention
CENR	Committee on Environment and Natural Resources
CENRAP	Central Regional Air Planning Association
CERES	Clouds and the Earth's Radiant Energy System
CIMSS	Cooperative Institute for Meteorological Satellite Studies
CIT	California Institute of Technology
CMAQ	Community Multi-scale Air Quality model
CO	Carbon Monoxide
CO2	Carbon Dioxide
COT	Cloud Optical Thickness
CSU	Colorado State University
CU-Boulder	Colorado University at Boulder
DAAC	Distributed Active Archive Center (Data Active Archive Center)
DEVELOP	No longer an acronym
DSS	Decision Support Systems
DST	Decision Support Tool
ECOS	Environmental Council of the States
EDR	Environmental Data Records
EOS	Earth Observing Systems

EOSDIS	Earth Observing System Data Information System
EP-TOMS	Earth Probe – Total Ozone Mapping Spectrometer
EPA	Environmental Protection Agency
EPHTN	Environmental Public Health Tracking Network
ESIP	Earth Science Information Partnership
FAA	Federal Aviation Administration
FEA	Federal Enterprise Architecture
FGDC	Federal Geographic Data Committee
FSL	Forecast Systems Laboratory
FY	Fiscal Year
GCM	Global Climate Model
GEO	ad hoc Group on Earth Observations
GEOS-CHEM	Goddard Earth Observing System-CHEMistry
GEOSS	Global Earth Observation System of Systems
GES DAAC	Goddard Earth Science Distributed Active Archive Center
GIG	Global Information Grid
GISS	Goddard Institute for Space Studies
GMAO	Global Modeling and Assimilation Office
GMES	Global Monitoring for Environment and Security
GOCART	Global Ozone Chemistry Aerosol Radiation Transport
GOES	Geostationary Operational Environmental Satellite
GOS	Geospatial One Stop
GSFC	Goddard Space Flight Center
HCHO	Formaldehyde
HRDLS	High-Resolution Dynamics Limb Sounder
HSB	Humidity Sounder for Brazil
HYDROS	Hydrosphere State Mission
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
IBPD	Integrated Budget and Performance Document
ICAO	International Civil Aviation Organization
IGACO	Integrated Global Atmospheric Chemistry Observations
IGOS	Integrated Global Observations Strategy
IWGEO	Interagency Working Group on Earth Observations
JACIE	Joint Agency Commercial Imagery Evaluation
JCSDA	Joint Center for Satellite Data Assimilation
JPL	Jet Propulsion Laboratory
LaRC	Langley Research Center
LIDAR	Light Detecting and Ranging
LP DAAC	Land Processes Distributed Active Archive Center
MANE-VU	Mid-Atlantic Northeast Visibility Union
MISR	Multiple Input Shift Register
MIT	Massachusetts Institute of Technology
MM5	Mesoscale Model
MODIS	Moderate Resolution Imaging Spectroradiometer
MOPITT	Measurements Of Pollution In The Troposphere

MSFC	Marshall Space Flight Center
N/A	Not Applicable
NARSTO	North American Research Strategy for Tropospheric Ozone
NAS	National Academy of Sciences
NASA HQ	NASA Headquarters
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NESDIS	National Environmental Satellite Data Information Service
NIP2002	New Investigator Program 2002
NH3	Ammonia
NO2	Nitrogen Dioxide
NOx	refers to the different Nitrogen Oxide atmospheric compounds
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
NSF	National Science Foundation
NWS	National Weather Service
OAQPS	Office of Air Quality Planning and Standards
OAR	Office of Oceanic and Atmospheric Research
OCO	Orbiting Carbon Observatory
OEI	Office of Environmental Information
OMB	Office of Management and Budget
OMI	Ozone Measuring Instrument
ORD	Office of Research and Development
OSSE	Observing System Simulation Experiment
PAM	Protected Area Management
PART	Program Assessment Rating Tool
PM	Particulate Matter
PM	Project Manager
POLDER	Polarization and Directionality of Earth's Reflectance
R2O	Research to Operations Network
RAQMS	Regional Air Quality Modeling system
REASoN	Research, Education, and Applications Solutions Network
RPO	Regional Planning Organization
SEA	State Enterprise Architecture
SO2	Sulfur Dioxide
SSC	Stennis Space Center
TBD	To Be Determined
Terra	Spacecraft with instruments measuring Earth’s climate
TES	Thermal Emission Spectrometer
THOR	Thickness from Offbeam Returns
TOMS	Total Ozone Mapping Spectrometer
UC – Irvine	University of California at Irvine
UCLA	University of California Los Angeles

UCSD	University of California San Diego
U Md – CP	University of Maryland at College Park
UMBC	University of Maryland Baltimore County
USDA	US Department of Agriculture
USFS	US forest Service
V&V	Verification & Validation
VIIRS	Visible/Infrared Imager/Radiometer Suite
VIRS	Visible Infrared Scanner
VISTA	Visibility Improvement State and Tribal Association of Southeast
VOC	Volatile Organic Compound
WRAP	Western Regional Air Partnership
WRF	Weather Research and Forecast
WRF-CHEM	Weather Research Forecast - Chemistry

WEBSITES:

AIWG: http://aiwg.gsfc.nasa.gov
Applied Sciences Program: http://science.hq.nasa.gov/earth-sun/applications
DEVELOP: http://develop.larc.nasa.gov
Earth-Sun System Gateway (ESG): http://esg.gsfc.nasa.gov/
Earth-Sun Science System Components: http://www.asd.ssc.nasa.gov/m2m
NASA FY2005 Budget: http://www.ifmp.nasa.gov/codeb/budget2005
Research and Analysis Program: http://science.hq.nasa.gov/earth-sun/science/
Science Mission Directorate: http://science.hq.nasa.gov
Science Strategies: http://science.hq/nasa.gov/strategy/