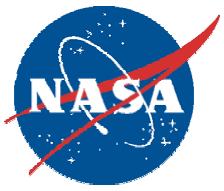

National Aeronautics and
Space Administration

Office of Earth Science

Report of Findings
Environmental Public Health Tracking Network
(EPHTN)
June 30–July 1, 2003

Prepared by
Public Health Applications Team
John C. Stennis Space Center, MS

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EXECUTIVE SUMMARY

On June 30-July 1, 2003 representatives from the Centers for Disease Control and Prevention (CDC), National Center for Environmental Health (NCEH) and NASA's Earth Science Enterprise, Public Health Applications Program convened to discuss technical requirements, capabilities and areas of opportunity for collaboration on the Environmental Public Health Tracking Network (EPHTN).

The EPHTN is a disease surveillance (decision support) system designed to coordinate tracking of chronic diseases and potentially associated environmental factors. The EPHTN is a newly funded, high priority undertaking that is in the early conceptual design state. The CDC NCEH is charged with the responsibility of leading the design of this tracking network and issuing guidelines for its implementation and management.

The purpose of the meeting was twofold: to understand the conceptual design of this tracking network, and its information and technology requirements; and to present an overview of NASA's Earth science, data and technology that may be useful to the development, implementation and operation of the EPHTN. The goal of the meeting was to determine if NASA capabilities could meet CDC needs for the EPHTN and, if so, define and assess those opportunities for future collaboration and NASA investment.

NASA concluded that the Agency's science, data, technology capabilities hold great potential to enhance the systematic collection of important environmental parameters for input into the Nationwide tracking network in the longer-term (7-10 years). In the shorter-term (1-5 years) it will be important to evaluate, verify and validate, the utility of specific NASA data and technology on a smaller scale for example, by environmental media (air, water, soil, etc), and in partnership with CDC selected recipients of EPHTN funding. Results from these short term investments will provide important feedback to the overall design, implementation and management of the EPHTN. NASA opportunities to enhance the EPHTN are expected to increase over time, as the development of this network matures. With this realization in mind, the following six recommendations are offered for consideration:

1. Form technical work groups, with key CDC, EPA, and EPHTN-grant recipients, to better define and understand priorities and requirements around specific environmental media. One outcome of these work groups would be the matching of requirements to specific sensors and sensor products. It is anticipated that the validation of remotely sensed data sets would be the subject of workgroup discussion and action.

2. Baseline NASA atmospheric measurement capabilities to meet specific exposure information requirements for chronic disease. Efforts should focus on CDC defined high priority diseases with known atmospheric (e.g., air pollutant) correlations. Efforts should be highly focused and explicitly tied to the overall design and/or implementation of the EPHTN. Any resulting applied research should be conducted in conjunction with CDC sponsored EPHTN partners. For a list of CDC EPHTN grant recipients and summary of activities see Appendix A.

3. Seek efficiencies in information exchange and leveraging of resources by exploiting cross-cutting interests with NASA's Air Quality National Application Program. The Public Health Applications Program should seek to conjoin and/or leverage investments undertaken by the Air Quality National Application Program in partnership with the Environmental Protection Agency (EPA). The EPA is a stakeholder agency for public health and a CDC NCEH partner

on the Environmental Public Health Tracking Network. Cross-cutting opportunities should be explicitly tied to the overall design and/or implementation of the EPHTN.

4. Re-vector heritage research efforts in asthma to align with CDC research priorities for asthma, especially CDC-defined priorities for understanding asthma etiology. This should include a clear connection to the EPHTN.

5. NASA should seek an active role in the evaluation of data technology and tracking methodology for the EPHTN to ensure potential NASA contributions on the technology front are brought to bear in the development and implementation of this network. NASA's expertise in data collection, data handling and automation, data display and archiving are likely to benefit these aspects of the EPHTN.

6. NASA should develop a strategy team to assess existing mechanisms for the communication of application data and information product requirements to appropriate NASA sensor/science teams. If no mechanisms currently exist, the strategy team should document the need, report gaps and propose new procedures to facilitate the connection between NASA's applications communities and NASA's sensor/science teams. The anticipated outcome of this connection will be the development, verification and validation of new applications of NASA satellite data and technology for the Environmental Public Health Tracking Network and other high priority decision support systems.

BACKGROUND

The need for a nationwide health tracking network was clearly articulated in a 2000 report by the Pew Environmental Health Commission titled "America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network"[1]. This report examined the Nation's (federal, state and local) public health capacity to respond to environmental threats and found the existing environmental health system lacked critical information and infrastructure and suffered from a lack of coordination between public health agencies and environmental agencies with the regulatory authority and enforcement responsibility for environmental health. This report recommended the establishment of a Nationwide Health Tracking Network and proposed an approach for accomplishing the task [2].

The 107th Congress, second session responded to the need to establish a Nationwide Health Tracking Network. Both the House and Senate sponsored bills in support of this effort[3]. In 2002, Congress appropriated $17.5 million to the CDC to begin developing a Nationwide Health Tracking Network and develop State and local health department capacity in environmental health. In 2003, Congress appropriated an additional $28 million for this effort.

The Centers for Disease Control and Prevention (CDC), National Center for Environmental Health (NCEH) is the lead agency responsible for the development and implementation of a Nationwide Health Tracking Network. The CDC NCEH formed the Environmental Public Health Tracking Program to coordinate development of the Environmental Public Health Tracking Network (EPHTN).

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[1] See http://pewenvirohealth.jhsph.edu/html/reports/pewtrackingtechnical.pdf

[2] Ibid.

[3] For complete text of bills H.R. 4061 and S. 2054 see:
http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=107_cong_bills&docid=f:h4061ih.txt.pdf
http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=107_cong_bills&docid=f:s2054is.txt.pdf

On October 29, 2002, three members from NASA's Public Health Applications Program met with representatives from the CDC NCEH. The purpose of this trip was to initiate a dialogue between NASA and the CDC to explain the history and purpose of NASA's Public Health Applications Program and to discuss utilization of NASA science and Earth observing technology for the Environmental Public Health Tracking Network. Dr. Robert Venezia, Dr. Robert Ryan and Timi Vann were the NASA representatives. The NASA presentation given at this meeting is provided in Appendix B.

The CDC NCEH expressed interest in NASA's capabilities in Earth science and technology. However, they were uncertain how to approach and develop a meaningful partnership that would lead to substantive improvements in the design and implementation of the EPHTN. As a result of this feedback, Dr. Robert Venezia and Timi Vann submitted a formal proposal for collaboration with the CDC NCEH on a National Environmental Public Health Tracking Network (Appendix C). This proposal was reviewed and accepted by the CDC NCEH. Soon after, the CDC NCEH began efforts to draft a Memorandum of Understanding to formalize the partnership.

In February, 2003 both agencies agreed a technical meeting was warranted. In late June and early July 2003, the CDC and NASA met on the campus of the University of Mississippi Medical Center. This meeting represented the culmination of a year long effort by both agencies to exchange information and discuss partnership collaborations around the development of the Environmental Public Health Tracking Network.

PROGRAM PARTICIPATION AND ORGANIZATION

Fifty six people participated in this workshop. Representatives from the CDC NCEH Environmental Public Health Tracking Program, the Agency for Toxic Substances and Disease Registry (ATSDR), and academic and State and local health department recipients of EPHTN funding attended this meeting to provide information on environmental health tracking and examples of work funded to support the development of the EPHTN. Scientists and engineers from four NASA centers, the NASA sponsored Socio-economic Data and Applications Center, and Headquarters attended this meeting to present NASA's capabilities, and the University of Mississippi Medical Center presented a clinical perspective. Dr. Stanley Morain, Director of the Earth Science Data Analysis Center and Dr. Phil Heard, Environmental Health Advisor for the Maryland Department of the Environment provided additional support and critical feedback. A list of attendees may be found in Appendix D.

The meeting was organized to first afford the CDC an opportunity to present an overview on the Environmental Public Health Tracking Program. The CDC invited the ATSDR and academic, State and local health department recipients of EPHTN funding to highlight environmental health tracking programs and projects. These presentations were diverse and highlighted the complexity of developing a Nationwide tracking network. Presentations included an overview of the Wisconsin Public Health Information Network Portal and information systems architecture for childhood cancer environmental tracking, a summary of the CDC's health and environmental data needs for asthma surveillance, EPHTN and ATSDR environmental data needs and gaps, and statistical methodologies in environmental health science.

NASA presented an overview of remote sensing, sensor technology and data products and management systems. The agenda included time to present NASA's population data and how the Agency was addressing issues of interoperability and data confidentiality. Additionally, NASA's research efforts to assess links between ecosystem health and childhood asthma, and human effects on local and regional environments were presented for discussion and feedback.

Dr. F.B. Carleton, Jr., Associate Chairman, Department of Emergency Medicine at the University of Mississippi Medical Center, presented a clinical provider perspective on data and information.

Each presentation was followed by questions and answers. Time was reserved at the end of each day for group discussion. The agenda may be found in Appendix E and copies of the presentations may be found in Appendix F.

FINDINGS AND RECOMMENDATIONS

Surveillance

Public health surveillance is defined as the ongoing, systematic collection, analysis and interpretation of health-related data for planning, implementation and evaluation of public health practice. Effective surveillance is closely integrated with the timely dissemination of these data to those responsible for prevention and control. Public health surveillance is used for detecting the magnitude and geographic extent of illness, the natural history (e.g., temporal trends) of disease, detection of epidemics, evaluation of control measures and monitoring changes in infectious disease. The systematic collection of data on these important elements stimulate generation of new hypotheses and help establish new environmental health research foci.

Surveillance for Environmental Public Health Tracking is more specifically defined as the ongoing collection, integration, analysis, and interpretation of data about 1) environmental hazards; 2) exposure to environmental hazards; and 3) the human health effects that are potentially related to the exposure of environmental hazards. Effective surveillance for the EPHTN includes the timely dissemination of information.

NASA learned a great deal about surveillance, the intended functionality and purpose of the EPHTN and about CDC interests. Discussions on data availability and gaps for specific registries and inventories were helpful. However, CDC and ATSDR priorities for environmental hazard and exposure data, and information on how these data would be integrated into the EPHTN were not clearly understood. NASA would benefit from additional discussions on how environmental hazard, exposure and specific disease-registry data will be coupled with and/or integrated into the EPHTN. As the EPHTN evolves, both agencies would benefit from a refinement of priority needs and subsequent matching to remote sensing capabilities.

NASA participants gained insight into the Environmental Protection Agency's (EPA) responsibilities for tracking specific hazard data. The EPA collects hazard data through a variety of programs and inventories including the Ambient Air Monitoring Program, National Emission Inventory and the Toxic Release Inventory. Presentations on EPA's contributions to National environmental data sets were particularly helpful since the EPA is a stakeholder agency for public health and a CDC NCEH partner on the Environmental Public Health Tracking Network.

Given this background information the following recommendations are offered:

Recommendation 1: Form technical work groups, with key CDC, EPA, and EPHTN-grant recipients, to better define and understand priorities and requirements around specific environmental media. One outcome of these work groups would be the matching of requirements to specific sensors and sensor products. It is anticipated that the validation of remotely sensed data sets would be the subject of workgroup discussion and action.

Significant discussion focused on ambient air quality, particulate matter, aerosols and pollutants. Specific requirements were not refined in the context of the EPHTN, but NASA recognizes that air pollution and respiratory health is a high priority for CDC-funded tracking.

Recommendation 2: Baseline NASA atmospheric measurement capabilities to meet specific exposure information requirements for chronic disease. Efforts should focus on CDC-defined high priority diseases with known atmospheric (e.g., air pollutant) correlations. Efforts should be highly focused and explicitly tied to the overall design and/or implementation of the EPHTN. Any resulting applied research should be conducted in conjunction with CDC sponsored EPHTN partners.

Recommendation 3: Seek efficiencies in information exchange and leveraging of resources by exploiting cross-cutting interests with NASA's Air Quality National Application Program. The Public Health Applications Program should seek to conjoin and/or leverage investments undertaken by the Air Quality National Application Program in partnership with the Environmental Protection Agency (EPA). The EPA is a stakeholder agency for public health and a CDC NCEH partner on the Environmental Public Health Tracking Network. Cross-cutting opportunities should be explicitly tied to the overall design and/or implementation of the EPHTN.

Asthma

NASA presented the Agency's on-going asthma research. The presentation included an overview of a Baltimore-based project, description of the project's objectives and methodology, and the preliminary results. The primary purpose of this presentation was to seek feedback from the CDC on the methodology, results, and practical benefits of the project from the public health research, practice, and policy perspectives.

In response, the CDC recognized NASA's great technical capacity for research, especially in analyzing multiple large databases on environmental and public health variables. However, they also noted that NASA does not have the mandate to do public health research on the causes of asthma and that this presents challenges. From the research and practice standpoints, NASA's etiologic work appears to have been conducted in isolation from the Federal agencies charged with understanding and responding to asthma. From the policy standpoint, NASA is working somewhat independently of the CDC, EPA, and NIH divisions concerned with asthma. The CDC presented NASA with a summary of health and environmental data needs for asthma and discussed the complexity associated with asthma etiology and surveillance. The CDC offered specific questions that could serve as a starting point for a more focused collaboration on asthma. Answers to these questions and more in depth discussion on the etiologic research and risk factor surveillance priorities for asthma hold promise for future collaboration.

The CDC is one of the primary health agencies with the mandate to conduct public health research on the causes of asthma but their technical capacity to collect, analyze, and model data to predict and respond to asthma is constrained by limited resources. NASA could help mitigate CDC resource constraints for asthma surveillance by targeting unique NASA capabilities on CDC-defined high priority needs for asthma.

Recommendation 4: Re-vector heritage research efforts in asthma to align with CDC research priorities for asthma, especially CDC-defined priorities for understanding asthma etiology. This should include a clear connection to the EPHTN.

Technology and Data Consideration

Computational Technologies and Information Systems

In 2001 and 2002, the NCEH sponsored four workgroup meetings designed to address critical themes associated with the development of the EPHTN. Workgroup 2 was designed to discuss data technology and tracking methodology with the purpose to "identify relevant national data standards; to establish system specifications; and to describe potential prototypes or models for automating, linking, and analyzing hazard, exposure, and health outcome data"[4]. This workgroup made the following recommendations:

1. The EPHTN should be developed in cooperation with CDC's National Electronic Disease Surveillance System (NEDSS), EPA's National Environmental Information Exchange Network, and other national data architectures.

2. The EPHTN should consist of a system of distributed data sources, all of which can receive or send data. Data providers should, to the extent possible, maintain their data at their location, in the data's original form, in the data provider's preferred database, and in the preferred format.

3. The EPHTN should adopt metadata standards that allow users to find and use data available in the network.

4. EPHTN architects should work with federal partners and private standard-setting organizations to share, create, or modify data processing, performance, and technology standards.

5. EPHTN architects should adopt a formal technology-neutral methodology for modeling, analysis, and design of the tracking network. This will provide both an architectural framework and technical guideline for the surveillance facts of the diseases, conditions, environmental hazards, and environmental exposures relevant to the tracking network. Formal models should be developed to encompass the business model, workflow models, partner models, process models, use case models, options analysis models, data-flow models, and data models.

6. The EPHTN should identify, integrate, and make available tools for data analysis, interpretation, and presentation. To the extent possible, data dissemination should use automation tools, such that "the data find the user" rather than forcing users to repeatedly search for information when new updates become available.

7. EPHTN architects should explore developing relationships with private providers (e.g., physicians, administrators of health care plans, pharmacy staff, emergency department staff, poison control center staff, laboratory personnel) to gain access to nontraditional surveillance and tracking data sources.

8. EPHTN architects should ensure data sharing agreements exist between relevant agencies at the state and federal levels. These interagency agreements, or memoranda of understanding,

[4] See http://www.cdc.gov/nceh/tracking/tracking_network_workgroups_report.htm#wg2

allow agencies that collect data under specific legal authority to release those data to the agencies who need them for program and policy development planning. Such agencies include state and local agencies, EPA, poison control centers, the National Institutes of Health (NIH), the U. S. Geologic Survey (USGS), the Department of Energy (DOE), the Department of Housing and Urban Development (HUD), and the National Aeronautics and Space Administration (NASA).

9. EPHTN architects should develop a comprehensive information security plan and include technical specifications describing the plan in the construction of the network.

Note: The complete Final Report from the Data Technology and Tracking Methodology workgroup may be found in Attachment B at http://www.cdc.gov/nceh/tracking/tracking_network_workgroups_report.htm#attachB

NASA's experiences and expertise in information technology and its application to data acquisition, data management, and data analyses could directly benefit the development of the EPHTN. NASA is a recognized leader in many of these areas, including metadata standards, distributed data systems, data system architectures and data and data system interoperability. NASA's knowledge should be shared with the CDC as the EPHTN continues to develop and evolve.

Recommendation 5: NASA should seek an active role in evaluation of data technology and tracking methodology for the EPHTN to ensure potential NASA contributions on the technology front are brought to bear in the development and implementation of this network. NASA's expertise in data collection, data handling and automation, data display and archiving are likely to benefit these aspects of the EPHTN.

Data Product Development

NASA is not the federal agency responsible for cartography and map production. However, NASA sensors collect environmental data that are often presented in image format to match standard mapping projections and scales. The results enhance standard map products produced by agencies like the CDC that could be used in surveillance networks like the EPHTN. One unique capability NASA brings to an applications partnership is the supply of calibrated and validated environmental data that can be merged by users into a wide array of map products to fit their needs. Additionally, there are many applications where global, regional, and local phenomena measured at coarser resolutions can be merged or fused with finer resolution data from other sources to derive information not readily interpretable from any single source. The challenge is to learn what sensors might reasonably provide information elements and to systems engineer the fusion of data from various remote sensing systems for use in environmental public health surveillance.

Each NASA sensor has a science team that develops the algorithms that define the products, validate the products, and makes them available through a Data Active Archive Center (DAAC). Data and information products required by CDC can be articulated, engineered, and tested for their utility. However, the science teams cannot anticipate what those products might be. It is imperative that a strategy be developed that links CDC defined information needs to related NASA sensor/science teams.

Recommendation 6: NASA should develop a strategy team to assess existing mechanisms for the communication of application data and information product requirements to appropriate NASA sensor/science teams. If no mechanisms currently exist, the strategy team should document the need, report gaps and propose new procedures to facilitate the connection between NASA's applications

communities and NASA's sensor/science teams. The anticipated outcome of this connection will be the development, verification and validation of new applications of NASA satellite data and technology for the Environmental Public Health Tracking Network and other high priority decision support systems.

SUMMARY

This meeting provided NASA with important feedback from the CDC regarding the development of the EPHTN. This Report of Findings offers six specific recommendations for NASA HQ consideration. The EPHTN represents a long-term NASA investment (7-10 years). However, there may be opportunities to evaluate NASA contributions to the EPHTN in the shorter, 1 to 2 year time frame. NASA, in partnership with the CDC NCEH Environmental Public Health Tracking Program, should seek to collaborate with state and other federal agencies to demonstrate the feasibility and utility of a local tracking network that integrates environmental and health data sources. The evaluation, verification, validation and benchmarking of a prototype tracking network that links information from hazard, exposure, and health effect surveillance and monitoring systems and explores the usefulness of this composite data for public health purposes would significantly contribute to the overall design of the larger EPHTN and would serve to assess the value of NASA's Earth science and technology contributions. Any short term collaboration should be designed to determine feasible methods for integrating multiple health and environmental data sources, valid analysis methodologies to produce information that could guide public health action, and the most effective ways to communicate this information to different audiences. As described, this type of short term collaboration holds tremendous possibilities for methodology development and for stimulating significant advancements in public health surveillance.

APPENDIX A

CDC-FUNDED ENVIRONMENTAL PUBLIC HEALTH TRACKING PROJECTS[5]

The 2002 competitive grants program for funding states offered two developmental program options described as **Part A** (Planning & Capacity Building) and **B** (Enhancement & Demonstration Project). **Part A** offered state and local health departments the opportunity to receive funding of $400,000-$600,000 per annum for 3 years to develop plans and components of a standards-based, coordinated, and integrated environmental public health tracking (surveillance) system. **Part B** offered state and local health departments funding of $600,000-$800,000 per annum for 3 years to develop or enhance exposure or health effect surveillance systems and conduct projects to assess the utility of linking and reporting health effect data with exposure or hazard data for guiding appropriate public health action or practice. These states also will work on the blueprint and components of a standards-based tracking system. *http://www.cdc.gov/nceh/tracking/trackingAAG.pdf*.

PART A RECIPIENTS

Connecticut: Department of Public Health

Program Description: The State of Connecticut, Department of Public Health (DPH), plans to develop a comprehensive plan that will lead to a coordinated and integrated environmental public health tracking network (EPHTN) that allows linkage and reporting of health effects data with human exposure data and environmental data. In order for DEP to achieve the goals of this project, a planning consortium will be assembled representing all facets of the community. The planning consortium will provide critical input to program staff to direct the planning process. A comprehensive inventory and assessment of existing surveillance systems will provide the planning consortium with the information base needed to develop methodologies to identify and prioritize tracking needs. DEP and DPH already have several surveillance systems and databases that will be explored for linkage opportunities as part of the program. The planning process for development of an EPHTN will involve a more complete inventory and summary of each database listed in the proposal, as well as other databases and information streams expected to be discovered once the planning effort begins.

Maine: Department of Human Services, Bureau of Health

Program Description: The Maine Bureau of Health (MBOH) proposes a three-year project to develop an environmental public health tracking and surveillance system. The requested funding will leverage existing efforts and resources from other entities within the state. The primary goals of this project are to:

1. Develop plans and components of a standards-based, coordinated, and integrated Environmental Public Health Tracking (Surveillance) System that allows linkage and reporting of health effects data with human exposure data and environmental hazard data.

2. Increase environmental public health capacity at the local and state levels.

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[5] For complete project description see http://www.cdc.gov/nceh/tracking/EPHTracking/tracking_project_summaries.pdf

Although the Maine Public Health Information System (MPHIS) may not be fully realized for several years, Maine will be able to develop model systems that link environmental health data and can be used by other states and localities for planning environmental public health actions on the basis of reliable, accessible data.

Maryland: Department of Health and Mental Hygiene

Program Description: The Maryland Department of Health and Mental Hygiene (DHMH) is working through an Interagency Coordinating Group (ICG) to launch, coordinate, and oversee progress for the Maryland environmental health tracking initiative. The DHMH proposes to use funds to:

1. Enhance the state's capacity for biomonitoring by purchasing essential laboratory equipment and hiring an additional laboratory scientist.

2. Inventory existing Maryland databases for environmental hazards, human, exposures, and health effects.

3. Assess each database for its utility and potential for integration and linkage within an environmental public health tracking system.

4. Engage and develop partnerships with stakeholders in the community, academia, and federal, state, and local government agencies in the planning and development of Maryland's environmental public health tracking system.

5. Develop a planning consortium.

6. Set initial priorities for the environmental health tracking system.

7. Participate in national meetings and conference calls for the development of standards and best practices in environmental public health tracking.

8. Assess statutory and regulatory authorities for, and barriers to, an environmental public health tracking system.

9. Upgrade databases that do not comply with national standards, such as the National Electronic Disease Surveillance System.

10. Train environmental, healthcare, and public health professionals.

11. Develop a staged plan for an environmental public health tracking system in Maryland to include direct electronic data reporting and linkages within, between, and among hazard, exposure, and health effect databases.

12. Examine environmental public health indicators in relation to the priorities set for Maryland.

13. Continually evaluate and improve the developing environmental public health tracking system.

Montana: Department of Public Health and Human Services

Program Description: Montana plans to establish the Montana Environmental Public Health Surveillance System (EPHSS) Program. First-year objectives and activities of this project are planning, capacity building, and assessment. In the initial phase, Montana intends to address priority issues that affect the state. One of the priorities identified is the incidence of asthma. Using the new EPHSS, Montana will work to reduce asthma by linking data among existing databases and surveillance systems as well as implementing new systems. Montana will improve the partnerships among agencies and constituency groups to establish a broad-based planning consortium. Montana will develop, where necessary, and enhance health effect, exposure, and hazard surveillance systems that can be integrated into a statewide and national environmental public health tracking network (EPHTN).

Nevada: Department of Human Resources

Program Description: Using lessons learned from the joint investigation between Nevada, CDC, and the Agency for Toxic Substances and Disease Registry (ATSDR) of the Churchill County, Nevada, childhood leukemia cluster, Nevada's project will build upon the strengths of a Coordinating Technical Leadership Team comprising dedicated staff from the divisions of Health and Environmental Protection, Department of Agriculture, Department of Information Technology, and the Nevada Indian Commission.

Nevada's Environmental Public Health Tracking System (EPHTS) project has four major goals:

1. Identify and increase the public health and environmental exposure prevention, surveillance, and reporting infrastructure capacities at the state, local, and tribal levels

2. Improve understanding of policy makers, community leaders, tribal leaders, and citizens about the relations between exposure to environmental hazards and health effects such as asthma, cancer, and lead and arsenic poisoning

3. Facilitate the integration of an environmental public health surveillance system with Nevada's National Electronic Disease Surveillance System (NEDSS), the federal Environmental Protection Agency's National Environmental Information Exchange Network, and a surveillance system being established under the Health Resources and Services Administration's hospital bioterrorism preparedness initiative

4. Create a state of "readiness" and partnership among stakeholders and their constituents so that these planning activities will lead to a funded implementation stage that we envisage as the logical next step to the EPHTS program.

New Hampshire: Department of Health and Human Services

Program Description: The State of New Hampshire (NH) proposes a collaborative effort between the NH Department of Health and Human Services' Office of Community and Public Health (OCPH) and the NH Department of Environmental Services (DES) to map, build, and use a new system of environmental public health tracking (EPHT). The EPHT system will be a standards-based process built upon staged improvement of data linkages that allow direct electronic data reporting across the following three areas: 1) human health effects (disease), 2) exposure, and 3) environmental hazard

data. The EPHT network will be based on a public health tracking logic model of progress and feedback that links health effects to disease prevention and health promotion activities.

New Mexico: Department of Health

Program Description: The State of New Mexico proposes to increase its environmental public health capacity by developing the components of a statewide environmental public health tracking system (EPHTS) that is (1) capable of linking health effects data with human exposure and environmental hazards data and (2) standards-based and capable of integration with data from other states and other national data sets. New Mexico's goals, objectives, and activities include:

1. Conducting an inventory of current and potential datasets, and evaluating existing data sets based on CDC guidelines for surveillance evaluation

2. Developing and maintaining partnerships with appropriate agencies and community groups

3. Building an infrastructure to support a statewide EPHTS by providing the resources to build capacity and address the needs identified above, as well as developing and implementing a plan to enhance, standardize, link and integrate existing surveillance systems

4. Developing a plan for using the enhanced linked environmental data to allow informed decision making on the national, state, and local levels by creating strategies for data dissemination, and addressing potential obstacles to such dissemination

Oregon: Department of Public Health and Human Services

Program Description: Oregon aims to increase environmental public health capacity at the state and local levels and increase awareness of environmental health issues; build a diverse and effective planning consortium to prioritize environmental health needs and concerns and collaboratively develop standard indicators to measure hazards, exposures, and health outcomes; identify data, monitoring, and tracking systems, and develop or enhance tracking systems for priority indicators; and create an implementation plan and test the system for electronically linking data.

EPHT program staff will assess the existing environmental public health capacity and needs of local health departments. Oregon also will review the training capacity for environmental public health at academic institutions (including the nearest Center of Excellence in Environmental Public Health Training), and professional organizations. It will create and distribute a comprehensive list of training resources, and develop a statewide environmental public health training improvement plan.

EPHT staff will collaborate with other participating states and the CDC on setting data standards for a national tracking network. EPHT will work with the nearest Center of Excellence to assess and incorporate relevant environmental public health indicators into the Oregon EPHT implementation plan.

The Environmental and Occupational Epidemiology Section will strengthen and formalize its collaboration with the Department of Environmental Quality. Representatives of these agencies and other partner organizations will form a technical team to develop appropriate architecture standards and data structures for EPHT to integrate data from various sources, while maintaining data security and confidentiality.

Pennsylvania: Department of Health

Program Description: Pennsylvania Department of Health (PADOH) will partner with the Pennsylvania Department of Environmental Protection (PADEP) to implement this program. This grant allows PADEP and PADOH to collaborate on environmental problems that emerge throughout the state and develop a coordinated and integrated environmental public health tracking (surveillance) network (EPHTN) that will include both environmental databases developed and maintained by PADEP as well as environmental health outcome databases developed and maintained by PADOH.

Commitments outlined by PADOH are

1. Establish a planning consortium of technical experts, community leaders, and other key stakeholders

2. Further examine state legislation and regulations to determine whether additional authority or resources are required to collect new data, integrate data, and share data

3. Develop and evaluate strategies for communicating information generated by an EPHTN and related program activities to diverse audiences

4. In collaboration with the Centers for Excellence in Environmental Health Tracking, examine the feasibility of environmental public health indicators and develop training tools and provide training to state and local staff on topics related to environmental health tracking

5. In collaboration with Environmental Public Health Tracking program partners and stakeholders, develop standardized data definitions; examine the availability and applicability of data standards and data exchange messages; and discuss project accomplishments, barriers, and lessons learned through a variety of communication media.

Utah: Department of Health

Program Description: The Utah Department of Health (UDOH) proposes to develop, in collaboration with the Utah Department of Environmental Quality (UDEQ) and CDC, plans for, and components of a statewide standards-based, coordinated, and integrated environmental public health tracking network (EPHTN) that allows linkage and reporting of health effects data with human exposure data and environmental hazard data. This EPHTN will be designed to inform consumers, communities, public health practitioners, researchers, and policy makers about chronic diseases and related environmental hazards and population exposures. This will provide UDOH and UDEQ with the capacity to better understand, respond to, and prevent chronic disease in Utah. Information generated by this program will enable UDOH and UDEQ to identify populations at high risk in Utah, examine health concerns at the local level, recognize related environmental factors, and establish prevention strategies statewide.

Houston, Texas: Department of Health and Human Services

Program Description: The Houston Department of Health and Human Services (HDHHS) proposes to develop a local environmental public health tracking system that builds on existing local data systems and integrates with the Texas Department of Health's chronic disease, injury, and birth defects surveillance systems; the Texas Natural Resource Conservation Commission's monitoring data; and the U.S. Environmental Protection Agency's tier two data to provide a local response,

surveillance, and research resource to mitigate the effects of environmental exposures on the health of Houstonians.

New York City, NY: Department of Health and Mental Hygiene

Program Description: The New York City Department of Health and Mental Hygiene (NYC DOHMH) plans to assess, evaluate and enhance current health effect, exposure, and hazard surveillance systems in New York City. Its program, Environmental Connections, will build on the existing environmental public health tracking systems of the DOHMH and its sister agencies.

The objectives of Environmental Connections are to

1. Formalize existing working relationships between DOHMH and DEP
2. Evaluate current data systems for air, food, water, pesticide use, and the indoor environment as they relate to existing health-related data systems in NYC
3. Establish an inventory of tracking systems
4. Convene a planning consortium of local data-using stakeholders
5. Assess needs for environmental public health in NYC
6. Offer technical training in surveillance and tracking to DOHMH and sister agency staff
7. Prioritize areas of focus for environmental public health in NYC
8. Assess the need for changes to current regulations and legislation to facilitate environmental health tracking
9. Develop the plans for and components of a local standards-based integrated environmental public health tracking system
10. Participate in the development of a national plan.

Washington, D.C.: District of Columbia Department of Health

Program Description: The District of Columbia Department of Health (DOH) will develop information systems within DOH, specifically systems containing environmental data on human exposures and hazards; those capturing data on health effects will be used to build an environmental public health tracking system. Project goals include (1) further documenting the relation between environmental exposure and health effects; (2) gaining greater ability to undertake health assessment, policy development and assurance; and 3) generating information that guides policy development and decision making on prevention and treatment activities, as well as resource allocation.

PART B RECIPIENTS

California: Department of Health Services

Program Description: The California Environmental Public Health Tracking Network (EPHTN) Program has six objectives:

1. Involve stakeholders by convening a planning consortium (comprising technical experts from the U.S. Environmental Protection Agency, California Department of Health Services, California Environmental Protection Agency, University of California, local public health and environmental officials, community-based and non-governmental organizations, and environmental advocacy groups) that will facilitate effective planning, implementation, and evaluation of the proposed program.

2. Identify and prioritize state and local needs for development of an EPHTN by assessing needs using survey questionnaires and phone interviews; assessing the feasibility of using Environmental Public Health Indicators and other indicators for surveillance; and identifying and prioritizing organizational, hardware, software, and informational needs.

3. Enhance EPHTN capacity by assessing needs of current state and local EPHTN capacity, resources, skills, and assets, collaborating with the Centers for Excellence in developing, implementing, and evaluating training programs.

4. Develop plans for a standards-based EPHTN, including testing protocols for data transfer and modeling; data refinement, augmentation, and linkage; security; dissemination and accessibility tools; and integration with other systems.

5. Develop an outreach and education strategy for communicating information generated by EPHTN by assessing needs of stakeholders to determine the most effective forms and content for receiving EPHTN information and their current capacity to educate the public; developing, field testing, and evaluating communication strategies.

6. Conduct a pilot project that will track asthma prevalence and adverse pregnancy outcomes and link these data to environmental hazard data on traffic exhaust exposure.

Illinois: Department of Health

Program Description: Illinois proposes to establish an enhanced environmental public health tracking network (EPHTN) system to address the information gap in documenting possible links between environmental hazards and chronic diseases and to relate and report health effects data with environmental data.

The goals are to assess needs, plan for staged development of a standards-based EPHTN, implement and evaluate a demonstration pilot project on data linkage and reporting, communicate and disseminate information, and collaborate with partners and stakeholders. To accomplish these goals, 24 specific and time-referenced objectives have been established. These include conducting inventory of existing surveillance and monitoring systems, describing the information infrastructure, reviewing and modifying statutes and regulations, identifying gaps in data collection and analyses, establishing partnership with stakeholders and key players, incorporating input from partners, collaborating with the Centers for Excellence, setting and incorporating standards, establishing

communication and dissemination format and routines, and evaluating the performance of the tracking system and using the result to guide its further development.

Massachusetts: Department of Public Health

Program Description: The Massachusetts Department of Public Health, Bureau of Environmental Health Assessment (MDPH/BEHA), has been funded to conduct three pilot demonstration projects under this cooperative agreement:

1. Pediatric asthma surveillance to be linked with a database on indoor air quality (IAQ) data in schools.

2. Developmental disability surveillance to be linked with polychlorinated biphenyl compound (PCB) environmental exposures and with biomarkers from a newborn screening database.

3. Systemic lupus erythematosus (SLE) surveillance to be linked with electronic environmental databases for specific pollutants of interest (e.g., petroleum distillates)

MDPH/BEHA has identified these three environmental public health tracking (surveillance) efforts as priorities in Massachusetts based on the following criteria: (1) they are already conducting some surveillance for each health outcome; (2) each health outcome involves different types of environmental exposure pathways; (3) tracking these health outcomes will address data gaps, as well as high levels of community concerns in the Commonwealth; (4) each pilot represents an opportunity to enhance existing infrastructure through uniquely different reporting/ascertainment methods; (5) each pilot is compatible with the program announcement requirements for electronic reporting; and (6) each health outcome is plausibly associated with environmental exposure opportunities to be linked.

1. In addition to the pilot projects, MDPH/BEHA will

2. Enhance electronic reporting capabilities for sharing data across tracking systems, within confidentiality and security restrictions.

3. Standardize reporting of target health outcomes and develop standard data systems for sharing information.

4. Increase the number of partnerships with medical community and academic institutions for health outcomes targeted for the pilot projects.

5. Verify validity and completeness of data sources for developmental disability outcomes of interest.

6. Conduct file searches to evaluate quality of readily available information from electronic Massachusetts Department of Environmental Protection-regulated facility and site databases for linking with SLE cases.

Missouri: Department of Health and Senior Services

Program Description: Missouri proposes to initiate electronic reporting of laboratory results for blood lead levels, document environmental assessments and abatement activities, and create linkages with

Department of Natural Resources lead smelter and mining site databases and with other surveillance databases.

The Missouri Department of Health and Senior Services (DHSS) Office of Information Systems (OIS) is developing the Missouri Health Strategic Architectures and Information Cooperative (MOHSAIC), which is DHSS' effort to create one integrated public health information system to document and address information of interest to public health in Missouri.

DHSS will use funds from this project to initiate electronic reporting and posting of laboratory results for blood lead levels, develop and implement electronic notification of system users of posted results for their clients, document environmental assessments, document lead abatement activities, and create electronic linkages to Department of Natural Resource's (DNR) lead smelters and lead mining sites databases. Part of the project involves capturing detailed data on the assessment of the environment and abatement activities. Once completed, this infrastructure will allow the linkage of other stand-alone surveillance databases with MOHSAIC. These include information about other heavy metals, private drinking-water well results, and other required environmental conditions, cancer and birth defects registries and asthma.

DHSS also proposes to collaborate on standardization needs with other Environmental Public Health Tracking Network partners, and to collaborate with the Centers for Excellence for Environmental in Public Health Tracking on epidemiology studies.

New York: State Department of Health

Program Description: New York State proposes to develop plans to evaluate the feasibility and usefulness of linking and reporting of health effects data with human exposure data and environmental hazard data. Required program activities include: developing partnerships with individuals and organizations who are important to the development and implementation of an environmental public health tracking network (EPHTN); establishing a planning consortium; examining current legislation and regulations regarding collection, integration, and sharing of data; and developing and providing training to state and local staff in a variety of areas related to environmental public health tracking.

The first programmatic goal is to enhance the state's capability to track children's environmental health, specifically to assess the relation between air pollution and pregnancy outcomes, asthma development, and childhood mortality. As part of this project, the grantee will link New York State Department of Health's Integrated Child Health Information System (ICHIS) with New York State Department of Environmental Conservation's air monitoring system. The project will be evaluated, and its results will be used to guide decisions about what other hazard or exposure databases should be linked to ICHIS or how this database can be used to assess other health endpoints potentially related to environmental contamination. These lessons will be extended to guide or modify a plan for establishing an EPHTN.

The second and third programmatic goals are to enhance the state's capability for tracking exposures to contaminants in drinking water and to enhance our capability to track neurologic conditions, autoimmune diseases, developmental disabilities, diabetes, and chronic diseases other than reproductive outcomes, cancer, and asthma. These two areas need additional development before the grantee can readily track and link these data.

New York State will prioritize state and local needs for tracking health effects, exposures, and hazards with the goal of incorporating them into an EPHTN. This will be done in conjunction with partners and a planning consortium. State and local legislation and regulations will be reviewed to determine whether additional authority is needed to integrate, share, or collect new data.

New York proposes to develop strategies for communicating information generated by the EPHTN network with the public, local, and federal governments, tribal governments, healthcare providers, non-governmental organizations, and other for-profit and nonprofit groups in a timely manner for use in public health practice or environmental protection programs. New York also will work with the Centers for Excellence in for EPHT to (1) develop training tools and deliver training in surveillance practices, environmental assessment, biomonitoring, evaluation, and risk communication to state and local staff and (2) evaluate environmental public health indicators.

Washington: State Department of Health

Program Description: Washington State proposes to develop a blueprint for environmental public health tracking, enhance existing exposure and health effects surveillance systems, and conduct projects aimed at demonstrating data linkage to show the value of electronic reporting and the utility of linked data for policy. Washington's primary project involves the enhancement of the Washington Electronic Disease Surveillance System's (WEDSS) electronic hospital reporting of birth defects, the development of population-based exposure data (including a states-focused Health and Nutrition Examinations Surveys biomonitoring program), the enhancement of environmental monitoring and data analyses of persistent toxins such as mercury and PCBs.

In addition, Washington plans to expand electronic hospital reporting to include pesticide illnesses (hospitalization and emergency department (ED) case data), and establish electronic reporting of pesticide-exposure cases by the poison control center to the Department of Health. Probabilistic record linkage methods will be used to connect individual exposure data to individual health outcome data. Finally, WEPHTN will bring together partners from the state education system and the local school districts to develop a prototype data system for school-based environmental monitoring and illness surveillance.

The project will expand the development of WEDSS infrastructure to better meet the needs of the WEPHTN. These efforts will focus on task automation, development of the integrated data repository, improvements to the alert system, and enhancement and expansion of electronic reporting. The specific improvements to electronic reporting will include:

1. Improvement of electronic laboratory reporting of lead exposure blood-test results

2. Enhancement of electronic hospital reporting, including cases of work-related asthma

3. Enhancement of electronic hospital reporting and electronic laboratory reporting, including cancer

4. Establishment of electronic reporting of pesticide illness cases by Labor and Industries Workers' Compensation databases to DOH Pesticide Incident Monitoring System

5. Development of electronic laboratory reporting of private laboratory pesticide exposure test results.

These efforts will be complemented by coordination with the Washington State Department of Ecology and the development of metadata for linkage with the Washington Environmental Information Exchange node.

Finally, Washington will

1. Develop training tools and train staff and partners
2. Evaluate the program
3. Develop communication and data dissemination strategies
4. Examine the feasibility of selected environmental public health indicators
5. Collaborate on epidemiologic studies
6. Participate in CDC-sponsored discussions and workgroups.

Wisconsin: Department of Health and Family Services Division of Public Health

Program Description: The Wisconsin Environmental Public Health Tracking Collaborative (WEPHTC) will streamline and centralize access to existing environmental, agricultural, and health data systems specific to Wisconsin creating a user-friendly Wisconsin Environmental Public Health Tracking System. The WEPHTC has the following goals

1. Establish a comprehensive, Web-based environmental public health tracking system that integrates environmental and health information
2. Build a tracking system based on national data standards and case definitions
3. Facilitate use of the tracking system to address community and individual concerns as well as priority research questions identified by the Centers for Excellence.

Two pilot projects will be initiated in Year 1 of the project: the childhood cancer follow-back, and a pilot for three environmental indicators (carbon monoxide poisoning, methyl mercury exposure, and pesticide poisonings). For the childhood cancer follow-back project, information from the state tumor registry will be linked with environmental data, including, at a minimum, drinking water quality, ambient air quality, residential and regional pesticide use, traffic density near the home, and radiation exposures such as radon, x-ray, and electro-magnetic fields. An automated reporting system that will facilitate reporting by coroners, healthcare providers, local public health agencies, poison centers, and clinical laboratories will be developed for carbon monoxide and pesticide poisoning surveillance efforts. Additionally, a laboratory-based surveillance system for methyl mercury that will focus on adult males aged $\geq$ 40 years will be developed. Hair samples from the males will be accompanied by a diet survey so that hair mercury levels can be compared with fish intake levels. These pilot projects will demonstrate the feasibility of linked environmental health data systems deployed on Wisconsin's Health Alert Network.

At the completion of Year 2 of the project, the WEPHTC will prepare an annual tracking report based on statistical analyses of the surveillance data, including categorizing cases by age, sex, rural or urban location, environmental exposure data, and other variables. County or regional incident rates will be

calculated. Standardized reports will be developed and implemented in SAS Internet, which will allow automated report generation and statistical display from the live surveillance database.

CENTERS OF EXCELLENCE

Johns Hopkins University: Bloomberg School of Public Health

Program Description: The proposed Center of Excellence in Environmental Health Tracking will build on the longstanding efforts of the Johns Hopkins School of Public Health (JHSPH) to strengthen the national environmental health infrastructure. The goals of the Center are to strengthen the environmental health workforce through training and education, provide technical assistance and research support for the development of the Environmental Public Health Tracking Network (EPHTN), and conduct research to investigate links between the environment and health effects. The Center will bring together faculty leadership from across Johns Hopkins institutions, allowing flexibility to meet partner and project needs and integrating the methods of medicine, epidemiology, biostatistics, environmental science, risk assessment and Communication, and health informatics. The efforts of the Center will be shaped by partnerships with participating state and local agencies, national health and environmental organizations, and CDC. A Center strategic plan will be developed with partners, including an assessment of needs and priorities for training, technical support, methods development, communication, and tracking research.

JHSPH will work to strengthen workforce capacity through flexible multi-disciplinary training and technical assistance. The Center will provide training though multiple venues, including seminars, short courses, and distance learning. Courses will be offered in methods and applications of public health surveillance and risk communication. The Center will support graduate fellows and develop a certificate program in health surveillance, including courses in epidemiology, risk assessment, biostatistics, exposure assessment and biomonitoring, environmental assessment, and evaluation. JHSPH will provide its partners with broad technical assistance, including the definition and selection of indicators, analysis of health and environmental data, development of statistical methods, and the characterization and communication of public health risks.

The Center will conduct research to support the EPHTN, examining selected indicators and developing approaches for statistical, temporal, and geographic analysis, and characterizing and communicating risks and public health implications. In addition, JHSPH will conduct an epidemiologic investigation of environmental exposures and a selected health effect, which will be developed in collaboration with partners to address public health priorities and interests. To evaluate Center activities and progress on building the EPHTN, JHSPH will develop baseline and final evaluations of the state of environmental public health tracking.

Tulane University: School of Public Health and Tropical Medicine

Program Description: The goals of the Tulane Center are to provide expertise and support to state and local health agencies to develop the national Environmental Public Health Tracking Network (EPHTN), and to investigate potential links between health effects and the environment. This proposal uses a practical approach to conduct the research needed to provide practitioners with the methods and skills to implement an EPHTN in their states, then to partner with states to research answer to community environmental concerns. The research focus is conceptualized to include three areas:

1. Research and development of the EPHTN including a technical framework for a distributed data network that provides access to data, characterization and standardization of data, and development of algorithms for linking data and analyzing trends

2. Research using hazard, exposure, and health outcome databases to describe links between environment and health, including hierarchal data analysis and ecologic and analytic epidemiological studies

3. Development and evaluation of communication strategies to disseminate information, and training modules to enhance skills of practitioners who implement the tracking system.

Tulane proposes to:

1. Develop an Internet interface for databases on water quality, asthma, and blood lead that can be refined for use with other data sources

2. Describe existing hazard, exposure, and health effect data systems and determine their utility for public health tracking

3. Develop statistical methods for geographic information systems and trend analysis using existing and innovative data sources

4. Design a mercury exposure monitoring strategy

5. Assess factors necessary to link data from ambient air monitoring, passive dosimetry for volatile organic compounds, biomarkers of metal and pesticide exposure, and multiple disease rates in a study of populations living near petrochemical refineries

6. Develop and evaluate strategies to communicate information from the previous study to the affected community

7. Conduct an epidemiologic study on the relationship between chronic lead exposure and adverse cognitive and neurobehavioral effects

8. Design and evaluate training modules in environmental assessment and risk communication

University of California, Berkeley: School of Public Health

Program Description: The School of Public Health at the University of California Berkeley (UCB) is establishing a Center of Excellence in Environmental Public Health Tracking in collaboration with the UCLA School of Public Health. The Center focuses on five key components:

1. An environmental epidemiologic component relevant to environmental health tracking will be conducted using California data to study associations between criteria air pollutants and asthma exacerbation

2. Information from two ongoing UCB projects, the Fresno Asthmatic Children's Environment Study on relations between air pollution and asthma exacerbation in children in Fresno, California, and a CDC-funded pilot project to track asthma among students in Oakland public schools, will be used to assist health departments in the design of environmental health

tracking systems for asthma (designated the top priority health outcome for tracking in the states surveyed by the Pew Environmental Health Commission)

3. Methods will be developed to link environmental concentrations and body burdens of environmental contaminants. Building on substantial existing modeling efforts, this work will emphasize approaches that can be applied in a variety of settings and produce results that can inform public health and environmental policy and practice

4. Methods will be developed for environmental health tracking using California and national data sets. This component will incorporate targeted technical review, peer review, community consultations, and data analysis. It will rely on a framework that includes four steps: identify key measurements or indicators, identify data sources available to estimate these elements, develop and implement approaches to analyzing data, and report results. This framework examines five areas: releases or sources of agents, ambient or media-based concentrations of agents, human exposures or body burdens, disease outcomes likely to be associated with exposures, and interventions. The topics of particular interest are air pollution and contaminants in food and drinking water and their associated health effects, but the approach can be applied to any topic area

5. Communication and training materials will be developed in Years 2 and 3 for health departments, policy makers, community organizations, and other stakeholders

APPENDIX B

OCTOBER 29, 2002 PRESENTATION

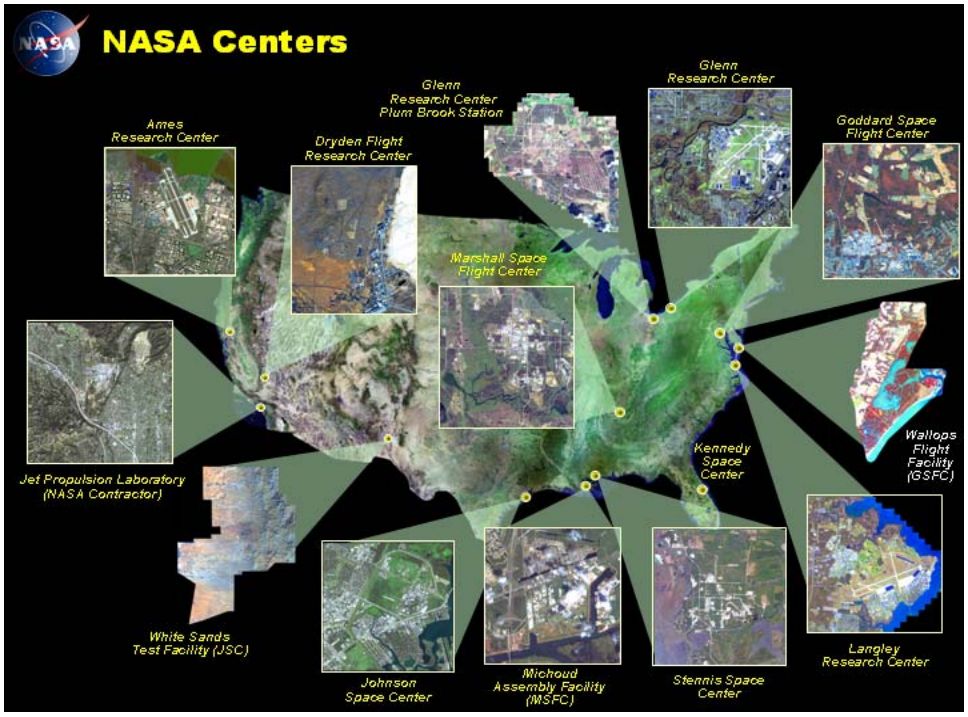
NASA Mission

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.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

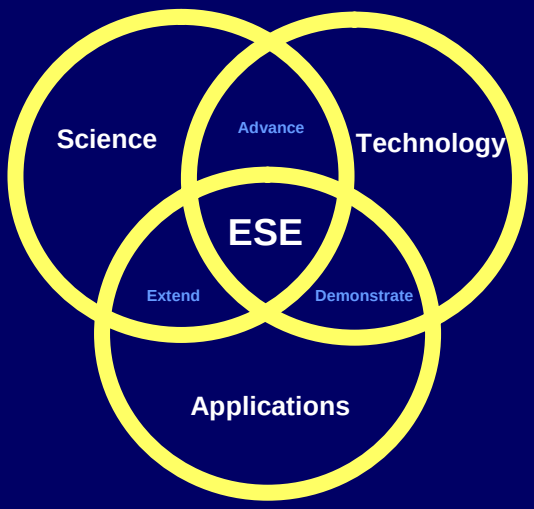
- **EARTH SCIENCE ENTERPRISE**
- **SPACE SCIENCE ENTERPRISE**
- **BIOLOGICAL AND PHYSICAL RESEARCH**
- **HUMAN EXPLORATION AND DEVELOPMENT OF SPACE**
- **AEROSPACE TECHNOLOGY**

NASA Centers



NASA Earth Science Enterprise

Develop a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of climate, weather, and natural hazards for present and future generations



Earth Science Enterprise: Science

Science Goal
Observe, understand, and model the Earth system to learn how it is changing, and the consequences for life on Earth

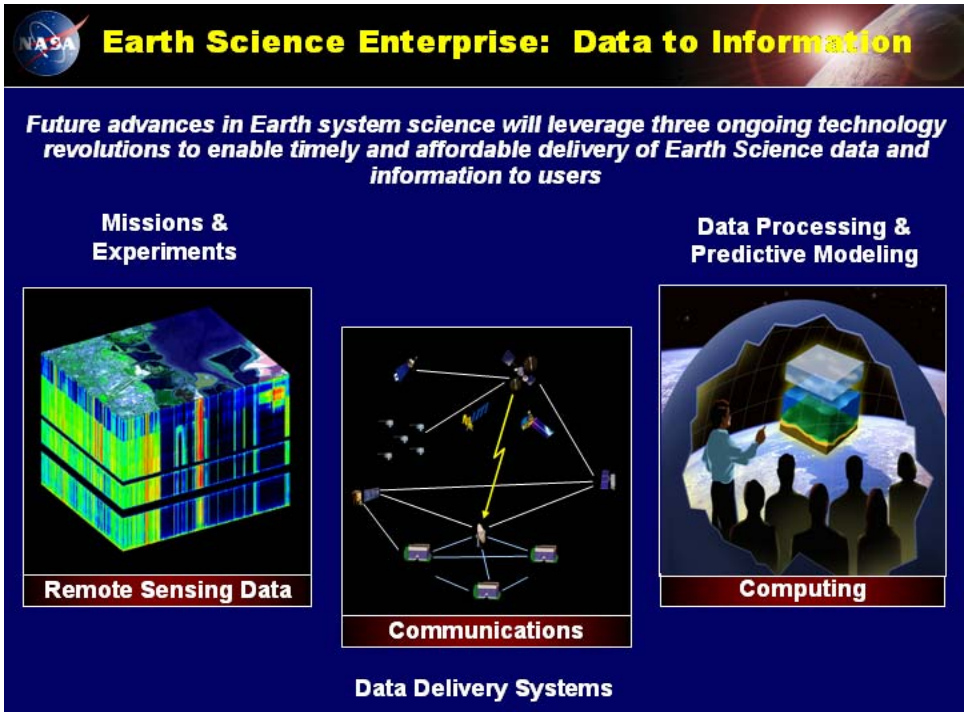
Variability: **How is the global Earth system changing?**

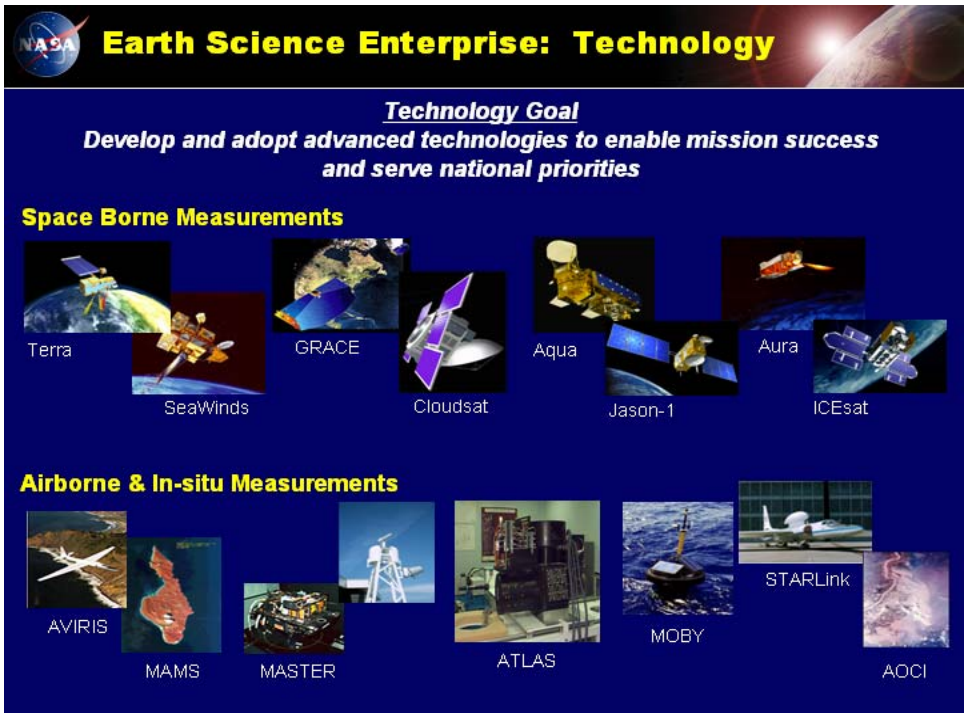
Forcing: **What are the primary causes of change in the Earth system?**

Response: **How does the Earth system respond to natural and human-induced changes?**

Consequences: **What are the consequences of changes in the Earth system for human civilization?**

Prediction: **How well can we predict future changes to the Earth system?**


Earth Science Enterprise: Data to Information
Future advances in Earth system science will leverage three ongoing technology revolutions to enable timely and affordable delivery of Earth Science data and information to users
Missions & Experiments
Data Processing & Predictive Modeling
Remote Sensing Data
Communications
Computing
Data Delivery Systems

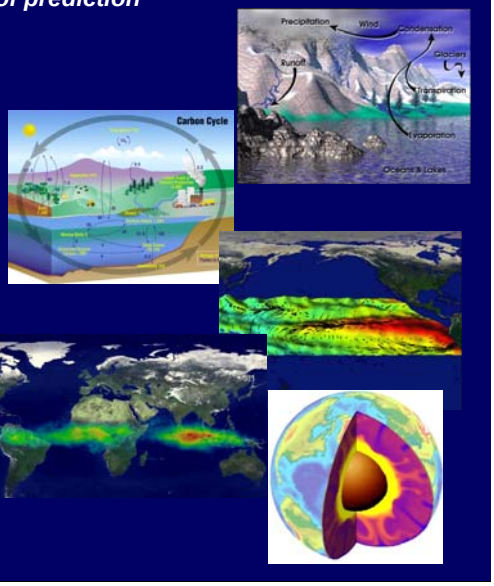

Earth Science Enterprise: Technology
Technology Goal
Develop and adopt advanced technologies to enable mission success and serve national priorities
Space Borne Measurements
Terra
SeaWinds
GRACE
Cloudsat
Aqua
Jason-1
Aura
ICEsat
Airborne & In-situ Measurements
AVIRIS
MAMS
MASTER
ATLAS
MOBY
STARLink
AOCI

Earth Science Enterprise Modeling

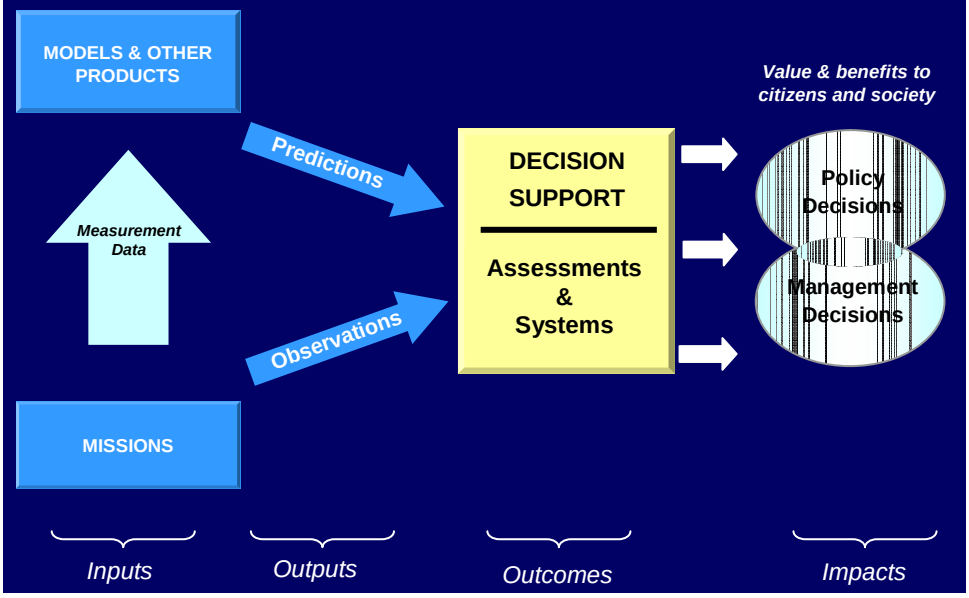
Models integrate information from a suite of observations to answer questions of prediction

NASA Research Areas & Models

- **Water & Energy Cycle**
- **Carbon Cycle**
- **Weather & Climate**
- **Chemistry-Climate Connection**
- **Solid Earth & Natural Hazards**



Missions to Models to Decision Support



Decision Support Systems

A Decision Support System is a computer-based system designed to help people and organizations retrieve, summarize, display, analyze and model data and that results in information for improved decision making

National Application Program Examples:

Water Management	Aviation Safety	Public Health
		?
Agriculture Water Resources & Decision Support AWARDS	Aviation Weather Information AWIN	Environmental Public Health Tracking Network EPHTN

Earth Science Enterprise: Applications

Applications Goal

Expand and accelerate the realization of economic and societal benefits from Earth science, information and technology

12 National Applications


Carbon Management


Public Health


Energy Forecasting


Aviation Safety


Water Management


Homeland Security


Coastal Management


Disaster Preparedness

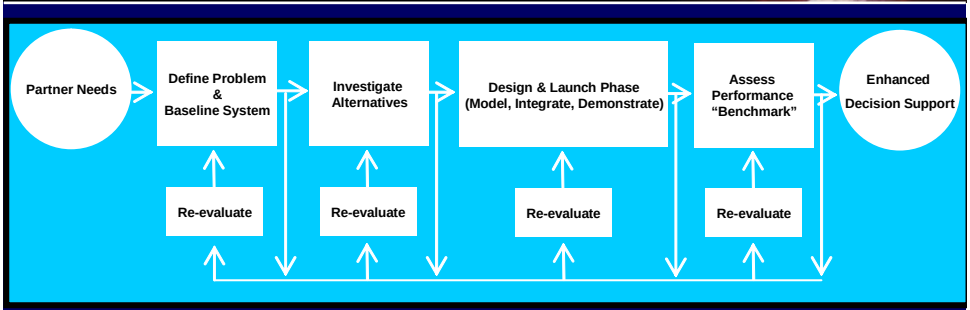

Agricultural Competitiveness


Invasive Species


Community Growth


Air Quality

Applications Approach

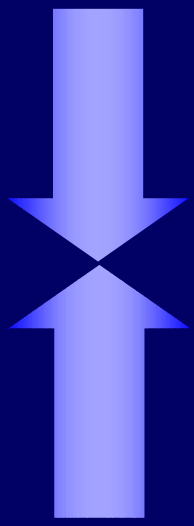


Adapted from Bahill & Gissing (1998)

Systems Engineering Approach

A systems engineering approach leads to scalable, systemic, and sustainable solutions and processes that contribute to the success of the mission, goals and objectives of each National Application.

Application Project Selection Criteria



Socioeconomic Value

Application (User) Feasibility

Mandated Program

Partnership Opportunity

Appropriate for NASA

Science & Technology Readiness

Program Balance

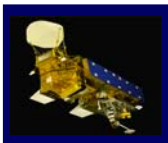
Cost / Budget Context

Application Selection Criteria: Public Health

Appropriate for NASA?

- ✓ **Do vectors, reservoirs, hosts, or disease agents exhibit spatial, spectral or temporal patterns?**
- ✓ **Are vectors, reservoirs, hosts, and disease agents linked to environmental factors?**
- ✓ **Are the patterns and associated environmental factors observable via remote sensing science and technology?**

Infectious Disease & Environmental Health

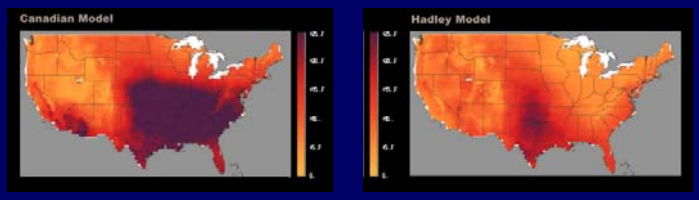
	Disease, Health, & Environmental Parameters	Government, Commercial & Int'l RS Systems
Infectious Disease Encephalitis Filariasis Lyme Disease Malaria Rift Valley Fever * * * **Environmental Health** Asthma / Respiratory Skin Cancer Extreme weather Harmful Algal Blooms Natural & Human Disasters * *	Ocean circulation Temperature Vector habitats Vegetation type and density Human settlements Atmospheric constituents Land surface, soil moisture Hydrology, Flooding UV Radiation Contaminant Transport * * *	 Aqua  QuickBird  SPOT 5 * * *

Why NASA – Why Public Health?

Humanity's influence on the global climate will grow in the 21st century. Increasingly, there will be significant climate-related changes that will affect each one of us [US Global Change Research Program]

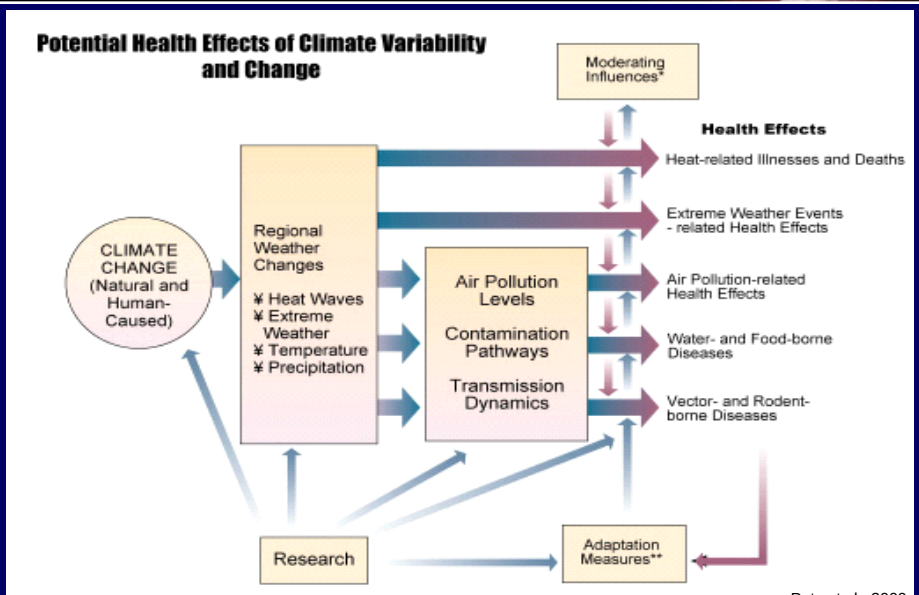
- **U.S. Global Change Research Program (USGCRP) Act of 1990 Public Law 101-606. NASA is a USGCRP Participating Agency**
- **The National Assessment climate models indicate the North American climate will be characterized by increased temperatures, an altered hydrologic cycle, and increased variability**

July Heat Index Change – 21st Century



Map by B. Felzer, UCAR, based on data from Canadian and Hadley modeling centers
http://www.usgcrp.gov/usgcrp/Library/nationalassessment/healthimages.htm

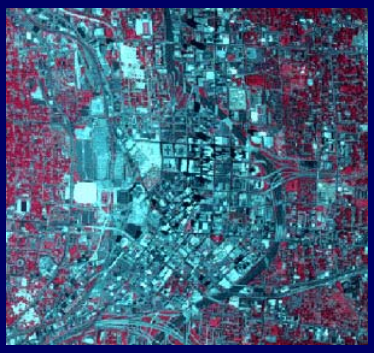
Why NASA – Why Public Health?

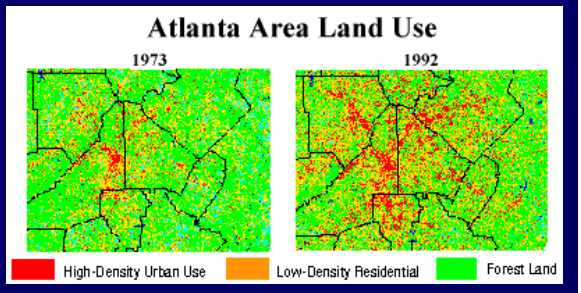


Patz et al., 2000
http://www.usgcrp.gov/usgcrp/Library/nationalassessment/healthimages.htm

NASA Heritage Efforts in Public Health

Science Success: **Urban Heat Island Effect—use of NASA satellite and airborne instrumentation to model land use impact on heating of cities and ozone generation**



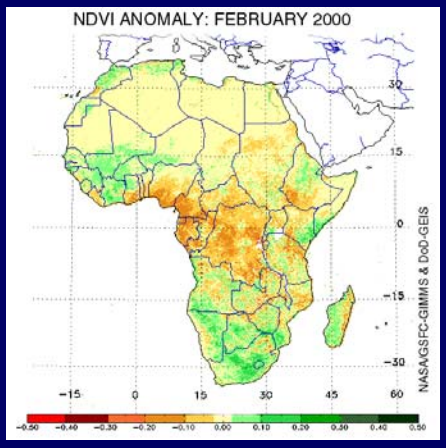


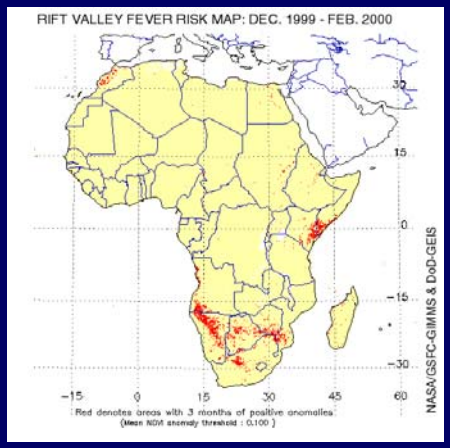
NASA MSFC Global Hydrology and Climate Center, Quattrochi, et al.

Applications Lesson: **decision-support system to apply model outputs?**

NASA Heritage Efforts in Public Health

Science Success: **Rift Valley Fever--predicting regional outbreaks of RVF using satellite data on rainfall, El Nino Southern Oscillation and vegetation**

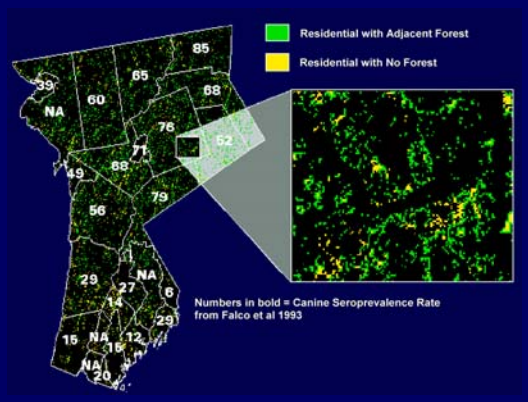




Applications Lesson: **scale, no response**

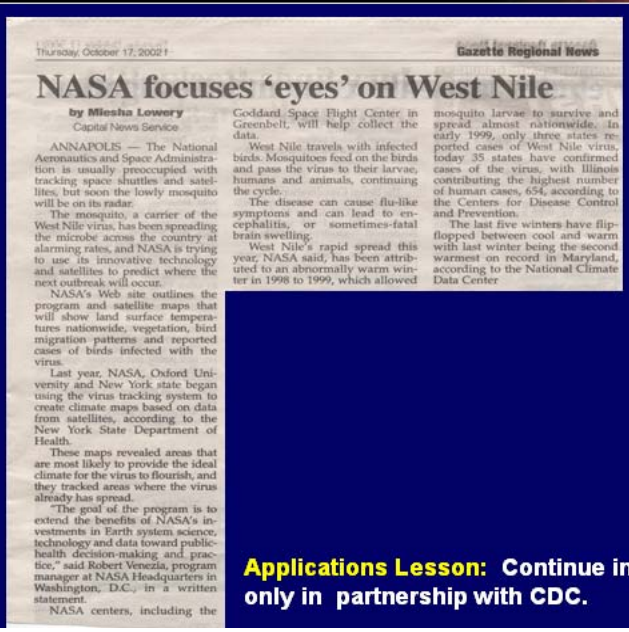
NASA Heritage Efforts in Public Health

Science Success: **Lyme Disease--identifying vector-friendly environmental conditions using satellite data on rainfall, vegetation, proximity to human settlements**



Applications Lesson: **cost/benefit - vaccine better use of resources?**

NASA Current Efforts in Public Health



Thursday, October 17, 2002 f

Gazette Regional News

NASA focuses 'eyes' on West Nile

by Miesha Lowery
Capital News Service

ANNAPOLIS — The National Aeronautics and Space Administration is usually preoccupied with tracking space shuttles and satellites, but soon the lowly mosquito will be on its radar.

The mosquito, a carrier of the West Nile virus, has been spreading the microbe across the country at alarming rates, and NASA is trying to use its innovative technology and satellites to predict where the next outbreak will occur.

NASA's Web site outlines the program and satellite maps that will show land surface temperatures nationwide, vegetation, bird migration patterns and reported cases of birds infected with the virus.

Last year, NASA, Oxford University and New York state began using the virus tracking system to create climate maps based on data from satellites, according to the New York State Department of Health.

These maps revealed areas that are most likely to provide the ideal climate for the virus to flourish, and they tracked areas where the virus already has spread.

"The goal of the program is to extend the benefits of NASA's investments in Earth system science, technology and data toward public-health decision-making and practice," said Robert Venezia, program manager at NASA Headquarters in Washington, D.C., in a written statement.

NASA centers, including the Goddard Space Flight Center in Greenbelt, will help collect the data.

West Nile travels with infected birds. Mosquitoes feed on the birds and pass the virus to their larvae, humans and animals, continuing the cycle.

The disease can cause flu-like symptoms and can lead to encephalitis, or sometimes-fatal brain swelling.

West Nile's rapid spread this year, NASA said, has been attributed to an abnormally warm winter in 1998 to 1999, which allowed mosquito larvae to survive and spread almost nationwide. In early 1999, only three states reported cases of West Nile virus, today 35 states have confirmed cases of the virus, with Illinois contributing the highest number of human cases, 654, according to the Centers for Disease Control and Prevention.

The last five winters have flip-flopped between cool and warm with last winter being the second warmest on record in Maryland, according to the National Climate Data Center.

Applications Lesson: **Continue investment only in partnership with CDC.**

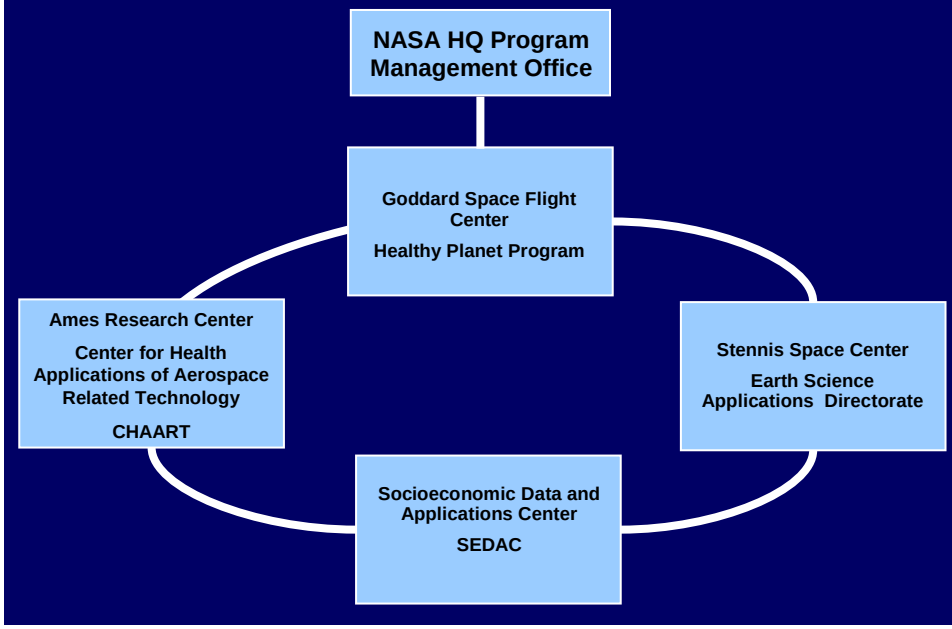
Discussion with NCEH

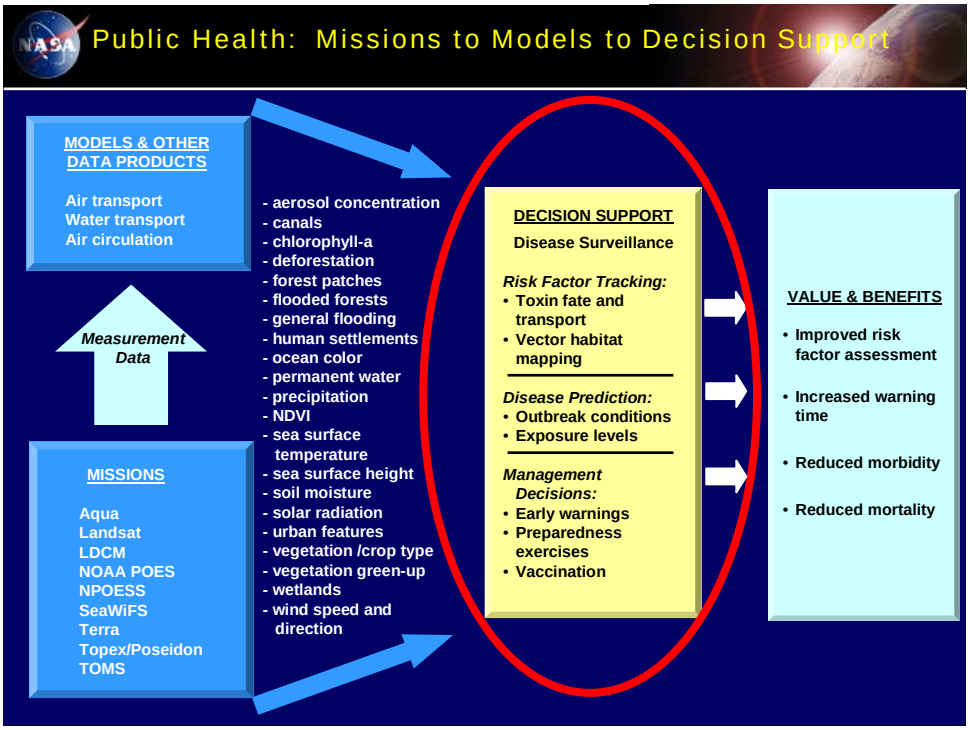
We know that Earth system science (remotely sensed data) is a useful tool for research of environment-disease relationships, however….

3 critical questions:

- ✓ **Can it be used for "….the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in pubic health action….,i.e. surveillance?"**
- ✓ **Is this application likely to produce a meaningful enhancement to public health surveillance systems?**
- ✓ **Can we (NASA and CDC) demonstrate this?**

Public Health Applications Program Elements





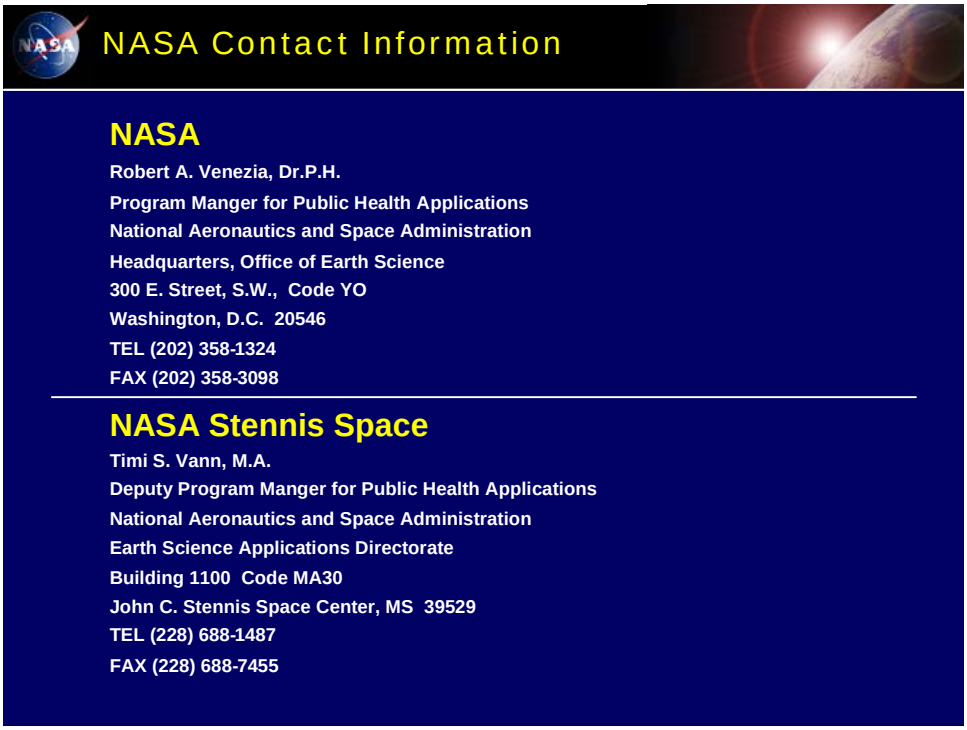
Proposed Action Steps

Joint planning with NASA and CDC….

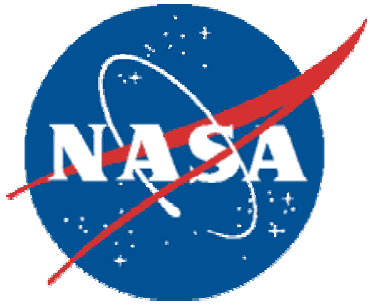
✓ **CDC & partners invited to attend workshop(s) at NASA's Stennis Space Center to continue dialogue ~ Spring 2003**

- **Meeting of epidemiologists & Earth scientists and engineers**
- **Technical discussion of surveillance systems and Earth science inputs**
- **Proposed demonstration linkage with Environmental Health Tracking Network, West Nile Virus, Bio-Defense Initiatives**

✓ **CDC & EHTN partners invited to NASA Ames Research Center for training in the use of Earth science / remote sensing for public health**


NASA Contact Information
NASA
Robert A. Venezia, Dr.P.H.
Program Manger for Public Health Applications
National Aeronautics and Space Administration
Headquarters, Office of Earth Science
300 E. Street, S.W., Code YO
Washington, D.C. 20546
TEL (202) 358-1324
FAX (202) 358-3098
NASA Stennis Space
Timi S. Vann, M.A.
Deputy Program Manger for Public Health Applications
National Aeronautics and Space Administration
Earth Science Applications Directorate
Building 1100 Code MA30
John C. Stennis Space Center, MS 39529
TEL (228) 688-1487
FAX (228) 688-7455

APPENDIX C



NASA Earth Science Enterprise
Applications Division
Public Health Applications Program

Proposal for Collaboration with the Centers for Disease Control and Prevention National Center for Environmental Health on a National Environmental Public Health Tracking Network

Robert A. Venezia, Dr.P.H.
Program Manager for Public Health Applications
NASA Headquarters
Timi S. Vann
Deputy Program Manager for Public Health Applications
NASA Stennis Space Center
February 2003

Contents

I. Introduction

In October 2002, NASA's Public Health Applications Program management visited the CDC National Center for Environmental Health in Atlanta to share information on NASA's interests in environmental health and its previous work in public health-related research. The goal for this outreach meeting was to propose an inter-agency collaboration in the application of Earth system science, technology, and data to public health surveillance. NASA has followed closely the development of CDC, ATSDR, and EPA efforts to design a national environmental public health tracking network and believes that NASA assets could contribute meaningfully to its creation. This document is a proposal to the Centers for Disease Control and Prevention, National Center for Environmental Health to initiate a partnership with the NASA Public Health Applications Program to enable that contribution.

II. Background

A. NASA Earth Science Enterprise

Five strategic enterprises function as primary business areas for implementing NASA's mission to "understand and protect our home planet; explore the universe and search for life; and inspire the next generation of explorers…as only NASA can." NASA's mission to understand and protect our home planet is implemented by the Earth Science Enterprise. NASA's Earth Science Enterprise is headquartered in Washington, DC with research and development functions distributed among field centers, collaborative laboratories, and partner academic institutions. The annual budget of the Earth Science Enterprise is approximately $1.5 billion.

The primary technology for enabling NASA's Earth system science is *remote sensing* which is the science of observing objects and phenomena with devices that are not in direct contact with the objects or phenomena of interest. NASA is recognized as a leader in remote sensing of the Earth using satellite and airborne platforms and electro-optical, radar, laser and other advanced imaging technologies. NASA's unique technical capability to pursue science through space-based observation allows researchers to observe the Earth on a global scale – as a complex interrelated system of land surface, solid Earth, biosphere, atmosphere and oceans. NASA's investment in this long-term and integrated research program is designed to better understand the dynamic relationships between each aspect of the Earth's system to enable humans to better predict and perhaps better respond to significant global climate change.

NASA's Earth science research is enabled by a technology program that plans, develops and launches advanced Earth observing satellite and airborne systems. Innovations in ground-based measurement systems, supercomputing data processing and display are also an integral part of the science and technology programs. The research findings and technology developments are extended beyond the science community through an applications program designed to integrate these assets into information systems that support policy analysis and decision-making.

B. Applications Division

NASA's Earth Science Enterprise Applications Division implements its applications program through Federal agency collaboration and other national-level partnerships. Partnerships enable the Applications Division to analyze the needs of professional communities that have data and information requirements which may be met by NASA's unique Earth science

assets. NASA bears the high risks associated with the adoption of new technology and data by funding partnerships to systematically define requirements, evaluate capabilities and, if feasible, integrate solutions derived from NASA investments. NASA's primary interest is to see that its technology, data and information products become supplemental tools, used as part of a partner's overall toolkit, in applications that serve National priorities. These tools may take the form of national assessments or products used in computer-based information processing systems.

The Applications Division seeks to partner with the federal agencies and national organizations that have primary responsibility for the following focal areas:

- Air Quality
- Agricultural Competitiveness
- Aviation Safety
- Carbon Management
- Coastal Management
- Community Growth
- Disaster Preparedness
- Energy Forecasting
- Homeland Security
- Invasive Species
- Public Health
- Water Management

For each focal area, NASA seeks agencies and organizations that:

1. are recognized leaders and subject matter experts
2. have the mandate and responsibility for establishing, coordinating and implementing a national agenda that defines priorities
3. have the capability to develop and/or maintain complex information infrastructure and networks, including the capability to integrate advanced technologies and complex data to support decision-making.
4. have an organizational structure and/or mechanisms capable of extending research results and applications to state and local users

NASA's applications program seeks collaborations where the partner defines the priority problems and the solutions are disseminated, to the greatest extent possible, through the organizational and structural networks of the partner. If NASA cannot establish a collaborative partnership with the lead agencies and organizations associated with one of the application focus areas, then NASA shifts resources away from that area and targets those resources to the remaining areas that do hold and maintain partnership opportunity. NASA will not invest without a commitment to collaborative partnership.

C. Public Health Applications Program

Over the past two decades, NASA researchers have successfully used remotely-sensed Earth observations to study relationships between certain diseases and environmental factors. NASA's ability to measure and monitor changes in factors such as, temperature, rain, wind, soil moisture, solar radiation, land cover, vegetation, and extreme weather event patterns have proven useful for increasing scientific understanding of infectious disease and environmental health.

With the creation of the Public Health Applications Program, NASA began focusing its public health-related research and development activities toward operational uses by the public health practice community. The advent, growth and integration of Geographic Information Systems (GIS) into public health practice provided an increased opportunity for NASA to contribute data and information products in ways that were not previously possible. Although NASA does not build, own or operate these information systems, they are

convenient systems for displaying and analyzing a great variety of spatial data collected by NASA's remote sensing instruments. Appendix A includes a sample bibliography of the public health uses of GIS and remote sensing.

NASA's Public Health Applications Program is a Headquarters-coordinated group of agency Programs with capabilities, expertise and strong interests in addressing national public health objectives. NASA's Ames Research Center in Moffett Field, California; Goddard Space Flight Center in Greenbelt, Maryland; Stennis Space Center in Hancock County, Mississippi, and; the NASA-sponsored Socioeconomic Data and Applications Center at Columbia University in Nyack, New York, all have coordinated efforts under the Public Health Applications Program. These five Program elements contribute the following unique capabilities:

NASA Headquarters

Program Office

The Program Office develops strategy, establishes partnerships, allocates resources and provides direction to and oversight of all NASA Public Health Applications Program elements.

NASA Ames Research Center

Center for Health-Related Applications of Aerospace Technologies (CHAART)

CHAART works with the U.S. and international public health community to 1) bridge new technologies through training, education, outreach, and capacity building, 2) identify gaps in technology through collaboration in peer-reviewed research, and 3) use new technologies to improve disease models. CHAART develops tools and analysis techniques for disease surveillance and modeling, and provides consultation on multi-source data fusion and database development, visualization and information extraction, and active linking of *in situ* data with satellite data archives.

NASA Goddard Space Flight Center

Healthy Planet Program

Healthy Planet is specifically designed to apply remote sensing data and technologies to understanding the links between human health and the environment, weather and climate. This diverse group of Earth system scientists and experts in data visualization, advanced computation, and data systems communication, has access to NASA's entire archive of over a petabyte (10^{15} bytes) of data on the Earth's environment.

NASA Stennis Space Center

Public Health Program Team

The Program Team develops and manages an interdisciplinary approach to applications, called *systems engineering*, that enables the formulation, production and implementation of product or system improvements that meet the information or technical needs of any given partner. Integrated Product Teams (IPTs) are formed that include NASA and members of the partner organization. NASA funds the IPTs to: 1) characterize the partner-driven requirements; 2) research a range of possible solution sets; 3) integrate selected solutions, and; 4) document (i.e., "benchmark") baseline improvements. The outcome of this

systematic process results in well-documented and measurable partner-driven engineering solutions. This NASA supported activity provides partners with supporting technical documentation that validates the design processes, verifies measurable baseline improvements, and demonstrates government efficiencies by leveraging resources across agencies and disciplines.

Columbia University International Earth Science Information Network

Socioeconomic Data and Applications Center (SEDAC)

SEDAC's mission is to develop and operate applications that support the integration of socioeconomic and Earth science data. It serves as an "Information Gateway" between the Earth and social sciences. SEDAC Projects help users synthesize and apply Earth science and socioeconomic data and information in their research, educational activities, analyses and decision making.

III. Proposal for NASA - CDC Partnership

A. Collaboration on a National Environmental Public Health Tracking Network

In order to apply NASA technology to public health surveillance issues, a dialogue must take place between Earth system scientists and engineers and the architects of the surveillance systems. The goal of this dialogue is to match NASA capabilities with epidemiologic requirements. Dialogue has occurred in the past through research projects hypothesizing the correlation of specific remotely sensed parameters with disease risk factors. However, most of these efforts were limited to the study of infectious disease and did not include environmental health risks. Moreover, they did not address such correlations from a more practical epidemiologic perspective to identify the requirements for, and impediments to, using remotely sensed data to enhance surveillance.

To begin the process, NASA proposes a linkage of its Public Health Applications Program with the CDC initiative to create a national environmental public health tracking network. As a first step, NASA proposes development of a Memorandum of Agreement between the two agencies with guidance to shape the working relationship with NCEH, state health departments, and academic public health architects. With this agreement in place, a dialogue should occur between the public health practice and Earth system science communities to match environmental exposure assessment needs with NASA capabilities. The requirements-matching work will build on the results of the four NCEH-sponsored workgroups whose goal was to develop practical recommendations for implementing the network. A longer term goal is to provide results on a regular and sustained basis in a format compatible with public health databases and in a manner useful to practicing epidemiologists.

B. Short-Term Initiative (Years 1 & 2)

The partners should hold requirements definition meetings. The goals of these meetings are:

Goal 1. To identify and characterize high priority risk factors to be measured and tracked by the network, including the temporal, spatial, and spectral characteristics of specific factors needed to obtain useful measurements.

Goal 2. To evaluate the range of possible NASA technology sources capable of meeting these measurement and tracking needs.

Note: This effort is not limited to the direct application of remote sensing instrumentation to risk factor observation. It includes the

possibility of developing or improving statistical algorithms and disease models using Earth system data and advanced computational capabilities, and the application of advanced communication technology for data linkage and high speed information transfer.

These meetings will bring together diverse groups of NASA Earth system scientists and engineers with EPHTN personnel, particularly from Part B - Data Linkage Demonstration Projects and the Centers for Excellence. The proposed schedule for the first meeting is late Spring 2003. As soon as possible, a joint planning committee should meet to identify participants.

C. Long-Term Initiative (Years 2 to 5)

The results from Goals 1 and 2 will provide information necessary to determine EPHTN data requirements. The following longer range goals are focused on building capacity and infrastructure to sustain data input from Earth observation resources. These goals reflect the purpose of the EPHTN Part A - Planning and Capacity Building initiatives.

Goal 3. To define and document information technology and workforce development requirements including 1) data formats and supporting information technology infrastructure needed to manage Earth observation data flow, 2) size and complexity of the data network, and 3) training requirements for network managers and data recipients to understand and use Earth system data.

Goal 4. To evaluate the range of possible NASA technology sources that meet network architecture needs for Earth system data.

Goal 5. To develop, prototype and test data integration solutions.

Goal 6. Verify and validate improvements in a "real world" (i.e., public health practice) setting.

In summary, the challenge of the long-term initiative is to integrate large volumes of data with computationally demanding scientific models. The goal is to produce and package products that public health practitioners can accommodate in their decision making processes.

IV. Anticipated Benefits to Partnership

From October 2001 to March 2002, CDC, ATSDR, EPA and partners convened a series of workgroups to develop practical recommendations for implementing a national environmental public health tracking network. NASA's contribution to this implementation effort is particularly relevant to the final recommendations of two of those workgroups, specifically *Workgroup 2: Data Technology and Tracking Methodology*, and *Workgroup 3: Tracking System Inventory and Needs Assessment*. These recommendations addressed a number of areas of significant NASA investment, including the development of data distribution networks, metadata standards, and information system modeling, analysis and design. One recommendation even mentions NASA specifically as an agency data source. Finally, NASA has technology that may be directly relevant to measuring environmental phenomena related to several of the already identified priority environmental factors.

Data Distribution and Storage

NASA maintains one of the largest known data distribution and archival systems in the world to manage its flow and exchange of Earth observation data. This network currently holds several petabytes of environmental data and is expected to expand to the exabyte (10^{18} bytes)

range with the launch of near future satellite observation systems. The experience and expertise in developing and maintaining such a vast amount of data and ensuring access to a complex network of users--including many other Federal, state and local agencies academia--would be valuable to the effort to create an environmental public health tracking network.

Modeling

The purpose of NASA's data distribution and archival system is to support the development of virtual Earth models that depict the dynamic forcings and consequences of global change. As a result, NASA also has a wealth of expertise to share in integrating large volumes of data with computationally-demanding scientific models. The GSFC Healthy Planet and Columbia University SEDAC programs have considerable capabilities in this area.

Metadata

NASA is both a creator and distributor of geospatial data and related products. In particular, the NASA-sponsored Columbia University SEDAC program participates in two major clearinghouse and cataloging initiatives: the Federal Geographic Data Committee Clearinghouse, and the NASA Global Change Master Directory. SEDAC creates metadata records using multiple formats to ensure interoperability with each of these catalog systems. SEDAC also developed a "Guide to FGDC Complaint Metadata " and offers training in its development and use.

Data Sharing

NASA is a primary partner in one of the U.S. Office of Management and Budget's E-government initiatives called Geospatial One-Stop. This effort builds on previous and ongoing investments already made to develop the National Spatial Data Infrastructure as well as advances in geospatial information technologies to encourage greater collaboration and coordination in their use across all levels of government. Geospatial One-Stop will make it easier to access existing geospatial information across the nation, facilitate sharing of information and planning for future investments in geospatial data, and expand collaborative partnerships to help leverage investments and reduce duplication of data.

Current NASA Initiatives

NASA's Earth Science Enterprise is currently reviewing proposals for a multimillion dollar initiative to create a *Research, Education and Applications Solutions Network* (REASoN). The REASoN is envisioned to be NASA's next generation distributed network of data and information providers for Earth Science Enterprise science, applications and education programs. Public health-related applications are a high priority for funding under the REASoN solicitation. Additionally, the REASoN solicitation complements other NASA investments and programs, such as the Advanced Information Systems Technology (AIST) Program. Efficiencies in research and applications can be made by formally linking future REASoN providers with CDC and others to facilitate the exchange of information and leverage investments to meet mutual goals. For more information on REASoN see: http://research.hq.nasa.gov/code_y/closed.cfm

V. Conclusion

In summary, NASA brings to this proposed partnership its entire portfolio of aerospace science and technology assets, its own funding to support the necessary programmatic resource commitment, a dedication to meeting partner requirements for reality-based

solutions, and the highest possible level of Agency support for the effort. This proposal is timely in that the national environmental public health tracking network is in its design phase. NASA and CDC have an opportunity to explore new information and technologies for public health surveillance without reconstructing or retrofitting a finished system. Initiating the collaboration requires little more than a brief series of meetings of technical and scientific personnel from both communities, and it is our hope that CDC officials will agree to this proposed partnership. The NASA Public Health Applications Program management and technical support team look forward to working with the CDC on this, and other issues of critical national concern.

APPENDIX D

PARTICIPANT LIST

CDC/ATSDR PARTICIPANTS				
NAME	**TITLE**	**PROGRAM**	**AGENCY**	**PHONE**
Lorraine Backer, PhD	Epidemiologist	Health Studies	NCEH/EHHE	404-498-1342
Stephanie Bock Foster, MPH, MA	Epidemiologist		ATSDR/HS	404-498-0568
Vickie Boothe, BSEE	Environmental Engineer	Env. Public Health Tracking	NCEH/EHHE	404-498-1082
Timothy Broadbent	Public Health Analyst		CDC/OD	404-639-7820
Randolph Daley, DVM, MPH	Epidemiologist	Env. Public Health Tracking	NCEH/EHHE	404-498-1347
Owen Devine, PhD	Statistician	Birth Defects	CDC/NCBDDD	
Roger Gibson, MPH		Office of Surveillance	MO Department of Health and Senior Services	573-751-9071
Ginger Gist, PhD, DAAS	Environmental Health Scientist	Exposure and Disease Registry	ATSDR/HS	404-498-0103
Lawrence Hanrahan, PhD, MS		Environmental Health Tracking	Wisc.Div. of Public Health	608-266-1253
Daniel Holcomb, BA	Environmental Health Scientist	Exposure and Disease Registry	ATSDR/HS	404-498-0595
Sara Kuffron, MS		Environmental Health Tracking	Mass. Dept. of Public Health	617-624-5757

Andrea Lipman, MS	Program Analyst	Env. Health Laboratory	NCEH/EHL	770-488-4594
Kristen Chossek Malecki, MPH		Environmental Health Tracking	Johns Hopkins University	410-955-1604
Fran Mather, PhD		School of Public Health &Tropical Medicine	Tulane University	504-587-7329
Pamela Meyer, PhD	Health Scientist	Childhood Lead	NCEH/EEHS	770-488-3633
Joshua Mott, PhD	Epidemiologist	Asthma	NCEH/EHHE	404-498-1017
Amanda Niskar, DrPH, RN, MPH	Epidemiologist	Env. Public Health Tracking	NCEH/EHHE	404-498-1371
Judy Qualters, PhD	Epidemiologist	Env. Public Health Tracking	NCEH/EHHE	404-498-1815
Joe Rogers, BS	Supr Computer Specialist	Chronic Disease	CDC/DCPC	770-488-4701
Edward Seto, PhD		School of Public Health	University of California, Berkeley	510-643-4422
Leslie Todorov, MPH	Epidemiologist	Env. Public Health Tracking	NCEH/EHHE	404-498-1819
Stacy Young, MS, MPH	Epidemiologist	Health Studies	NMSG CONTRACTOR	770-234-6531
UMMC PARTICIPANTS				
NAME	**TITLE**	**PROGRAM**	**AGENCY**	**PHONE**
F.B. Carlton, Jr., MD	Professor and Associate Chairman	Department of Emergency Medicine	University of Mississippi Medical Center	601-984-5570
Stan Chapman, MD	Associate Vice Chancellor for Research Integrity	Director Division of Infectious Diseases	University of Mississippi Medical Center	601-984-5560

David J. Dzielack, PhD	Associate Vice Chancellor for Research Integrity		University of Mississippi Medical Center	601-815-5000
Fazlay S. Faruque, PhD	Direcotr of GIS	Office of Research	University of Mississippi Medical Center	601-984-4993
Richard Finley, MD	Associate Professor of Medicine	Infectious Diseases	University of Mississippi Medical Center	601-984-5560
Grace "Lorine" Oberhausen	Senior Secretary	Office of Research	University of Mississippi Medical Center	601-815-5000
Worth Willimas	Senior Analyst/Programmer	Office of Research	University of Mississippi Medical Center	601-815-1949
NASA PARTICIPANTS				
NAME	**TITLE**	**PROGRAM**	**AGENCY**	**PHONE**
Louisa R. Beck	Remote Sensing Scientist	Center for Health Applications of Aerospace Related Technologies	NASA Ames Research Center	650-604-5896
Slawomir Blonski, PhD	Research Engineering Associate Manager, Lockheed Martin Space Operations	Remote Sensing Directorate	NASA Stennis Space Center	228-688-1944
Robert S. Chen, PhD	Manager	Socioeconomic Data Archive Center	NASA Goddard Space Flight Center	517-797-2611
Phil Heard, M.D., MPH	Environmental Health Advisor	Maryland Department of the Environment	Maryland Department of the Environment	410-537-3601
Dan Kimes, PhD	Research Scientist		NASA Goddard Space Flight Center	301-614-6600

Elissa Levine, PhD	Research Scientist		NASA Goddard Space Flight Center	301-614-6654
Nancy G. Maynard, PhD	Associate Director Environment and Health	Healthy Planet Program	NASA Goddard Space Flight Center	301-614-6572
Kenneth McDonald	Data Systems Branch	Data Systems Branch	NASA Goddard Space Flight Center	301-286-5331
Terry McPherson, CAPT (Ret.)	Chief Applications Research Division	Applications Research Division	NASA Stennis Space Center	228-688-2137
Stanley Morain, PhD	Director	Earth Data Analysis Center	University of New Mexico	505-277-3622
Nathan Pollack	Scientist	Earth Sciences Data and Information Services Center Distributed Active Archive Center and Products and Services Cooperative	NASA Goddard Space Flight Center	301-614-5612
David L. Powe, EdD	Director	Earth Science Applications Directorate	NASA Stennis Space Center	228-688-1487
Dale Quattrochi, PhD		Earth Science and Applications Division	NASA Marshall Space Flight Center	256-961-7887
Kristen Russell	Systems Engineer, Lockheed Martin Space Operations	Remote Sensing Directorate	NASA Stennis Space Center	228-688-3948
Cindy Schmidt	NASA Adjunct Investigator	California State University, Monterey Bay	NASA Ames Research Center	650-604-0021

Peter Smith, PhD	Data Support Lead	Earth Sciences Data and Information Services Center Distributed Active Archive Center and Products and Services Cooperative	NASA Goddard Space Flight Center	301-614-5325
Lauren Underwood, PhD	Scientist, Lockheed Martin Space Operations	Remote Sensing Directorate	NASA Stennis Space Center	228-688-2096
Timi S. Vann	Deputy Program Manager for Public Health Applications	Applications Research Division	NASA Stennis Space Center	228-688-1487
Robert A. Venezia, Dr.P.H.	Program Manager for Public Health Applications	Office of Earth Science	NASA Headquarters	202-358-1324
Vicki Zanoni	Program Manager, Verification and Validation	Systems Engineering Division	NASA Stennis Space Center	228-688-2305

APPENDIX E

FINAL AGENDA

Meeting Purpose: The purpose of the working meeting is to exchange information about agency programs and explore how NASA Earth science data, technology, and other capabilities may meet environmental public health data and exposure assessment needs for the National Environmental Public Health Tracking Network and for the Agency for Toxic Substances and Disease Registry.

MONDAY, JUNE 30 INTRODUCTION TO ATSDR & CDC AGENCY PROGRAMS

8:30 - 9:00	Opening Remarks – Dr. Robert Venezia (NASA HQ)/Dr. Judy Qualters (NCEH) Purpose, Goals, Objectives Schedule, Orientation, Logistics
9:00 - 9:30	Environmental Public Health Tracking Program Overview – Dr. Randolph Daley
9:30 - 10:00	Agency for Toxic Substances and Disease Registry – Dr. Ginger Gist
10:00 - 10:15	**BREAK**
10:15 - 11:00	NASA "Big Picture" overview (Louisa Beck)
11:00 - 11:30	Wisconsin EPHTN - Childhood Cancer Project – Dr. Lawrence Hanranan
11:30 - 12:30	**LUNCH**
12:30 - 1:00	Asthma Surveillance and Data Needs – Dr. Joshua Mott
1:00 - 1:30	Birth Defects Surveillance, Research, and Prevention – Dr. Owen Devine
1:30 - 2:00	ATSDR Environmental Data Needs – Dr. Ginger Gist
2:00 - 2:15	**BREAK**
2:15 - 2:45	Some Statistical Methods for Linking Health/Exposure/Hazards – Dr. Fran Mather
2:45- 3:30	Availability and Gaps in EPHTN Environmental Data – Vickie Boothe
3:30 - 4:30	Facilitated Discussion on Common Themes

ADJOURN

TUESDAY, JULY 1 NASA CAPABILITIES

8:00 - 8:15 Recap of Monday – expectations for Tuesday session (*Venezia*)

8:15 - 9:00 Sensor Technology Overview (*Vann*)

9:00 - 9:45 Data products & Data Management Systems (*Pollack/Smith/McDonald*)

9:45 - 10:00 **BREAK**

10:00 - 10:45 Population Data, data interoperability &confidentiality (*Chen*)

10:45 - 11:15 Clinical perspective on data and information (*Dr. Carleton, Department of Emergency Medicine, UMMC*)

11:15 - 12:00 Asthma & Air Quality Related Capabilities (*Levine, Kimes, & Maynard*)

12:00 - 1:00 **LUNCH**

1:00 - 1:45 Human Effects on Local and Regional Environment with Emphasis on Urbanization (*Quattrochi*)

1:45 - 3:30 Identifying Critical Themes – Facilitated Group Discussion

3:30 - 3:45 **BREAK**

3:45 - 4:30 Next Steps & Wrap UP

ADJOURN

APPENDIX F

ATSDR/CDC NCEH/NASA PRESENTATIONS

01 Randolph Daley–CDC, NCEH
"A Nationwide Environmental Public Health Tracking Network:
Protecting CommunitiesThrough Integrated Environmental Public Health Surveillance"

02 Ginger Gist–ATSDR
"Agency for Toxic Substances and Disease Registry"

03 Joshua Mott–CDC, NCEH
"Asthma Surveillance: A Brief Summary of Health and Environmental Data Needs"

04 Cindy Schmidt & Louisa Beck–NASA, Ames
"NASA Science, Technologies, and Human Health"

05 Lawrence Hanrahan–Bureau of Environmental Health
"Wisconsin Environmental Public Health Tracking Network: Childhood Cancer"

06 Owen Devine–CDC
"Birth Defects Surveillance, Research and Prevention"

07 Ginger Gist–ATSDR

08 Fran Mather & L.E. White–Tulane University
"Statistical Methods for Linking Health/Exposure/Hazards"

09 Vickie Boothe–CDC, NCEH
"Environmental Hazard Data for the National Environmental Public Health Tracking Network Availability and Gaps"

10 Timi Vann–NASA SSC
"Sensor Technology Overview"

11 Peter Smith, Nathan Pollack, Ken McDonald, Steve Kempler & Bill Teng–NASA GSFC
"Utilizing Earth Science Remote Sensing Data and Services to Support Environmental Health Decision: An Introduction to the GSFC's Earth Science (GES) Data and Information Center (DISC)/Distributed Active Archive Center (DAAC) Remote Sensing Data and Services"

12 Bob Chen, Deborah Balk, & Francesca Pozzi–SEDAC
" Population, Interoperability, and Confidentiality"

13 Rick Carlton–Dept of Emergency Medicine, UMMC
"Clinical Perspective on Data and Information"

14 Dan Kimes & Elissa Levine–NASA, Goddard
"Assessing Links Between Ecosystem Health and Childhood Asthma

Randolph Daley
"A Nationwide Environmental Public Health Tracking Network: Protecting Communities Through Integrated Environmental Public Health Surveillance"

A Nationwide Environmental Public Health Tracking Network

Protecting communities through integrated environmental public health surveillance

W. Randolph Daley DVM MPH Dipl. ACVPM
Environmental Health Tracking Branch
Division of Environmental Hazards and Health Effects
National Center for Environmental Health

Environmental Public Health Tracking *Call for Action*

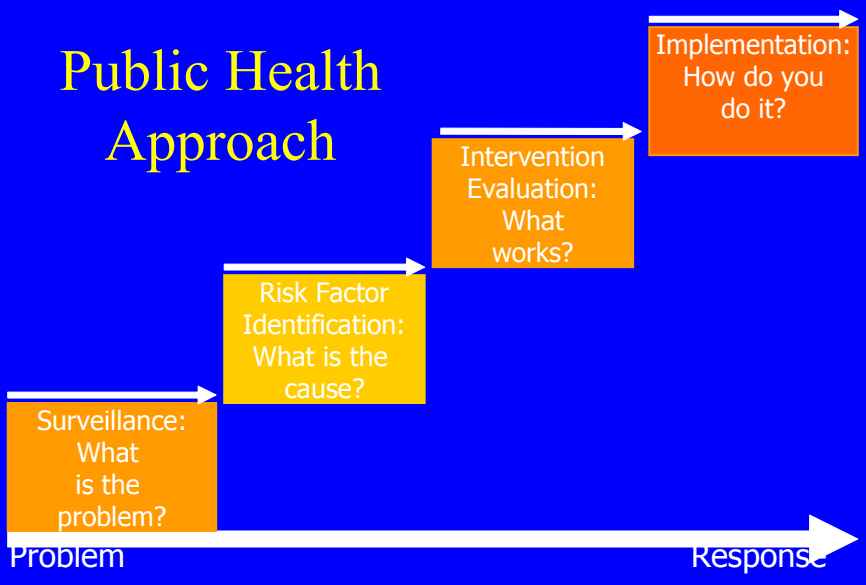
- **Pew Environmental Health Commission recommends a "Nationwide Health Tracking Network for diseases and exposures"**
- **CDC and ATSDR develop a "Proposed Plan for an Environmental Public Health Tracking Network"**
- **$17.5 million appropriated to CDC in FY02**
- **Legislation**
  - **State – California, Montana**
  - **National – Nationwide Health Tracking Bill introduced**

Public Health Surveillance

Ongoing, systematic collection, analysis, and interpretation of health-related data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those responsible for prevention and control.

CDC

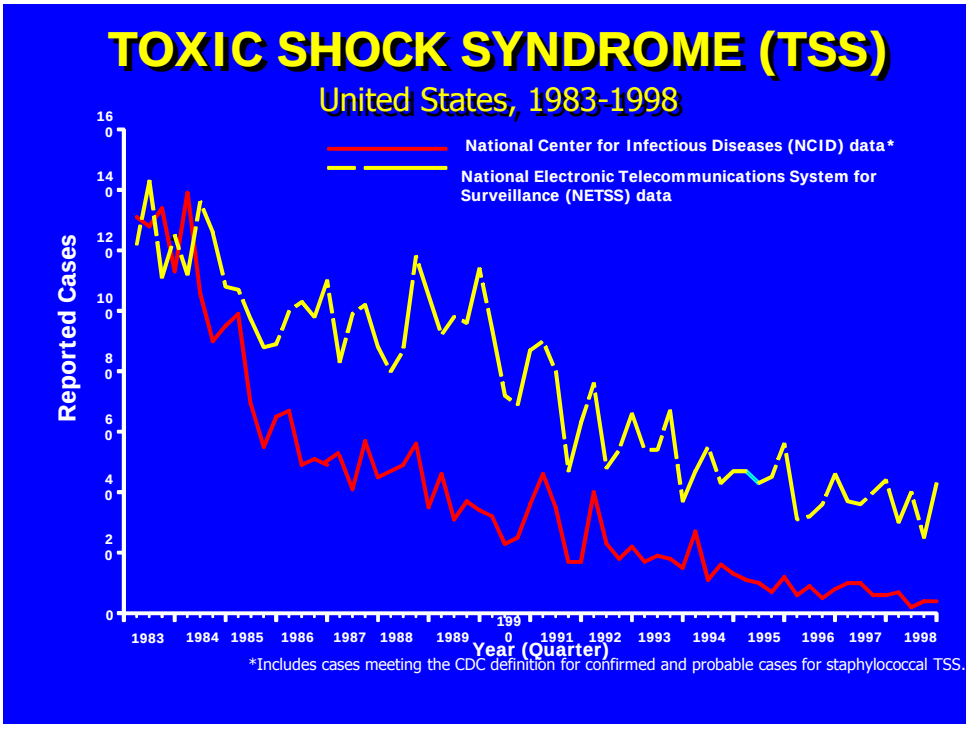
Public Health Approach

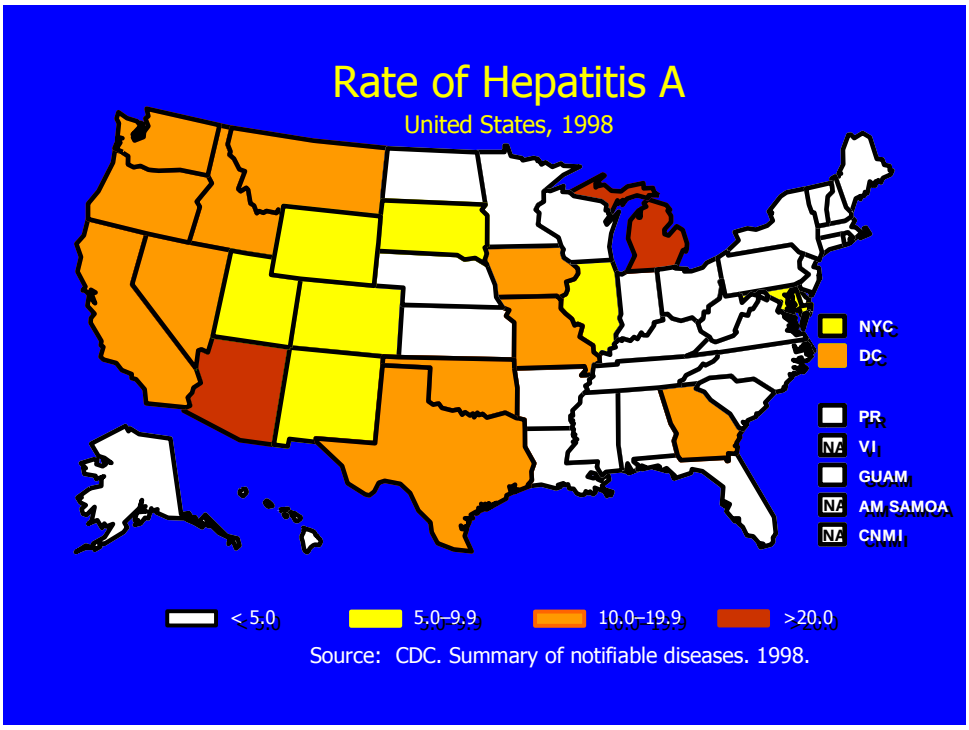


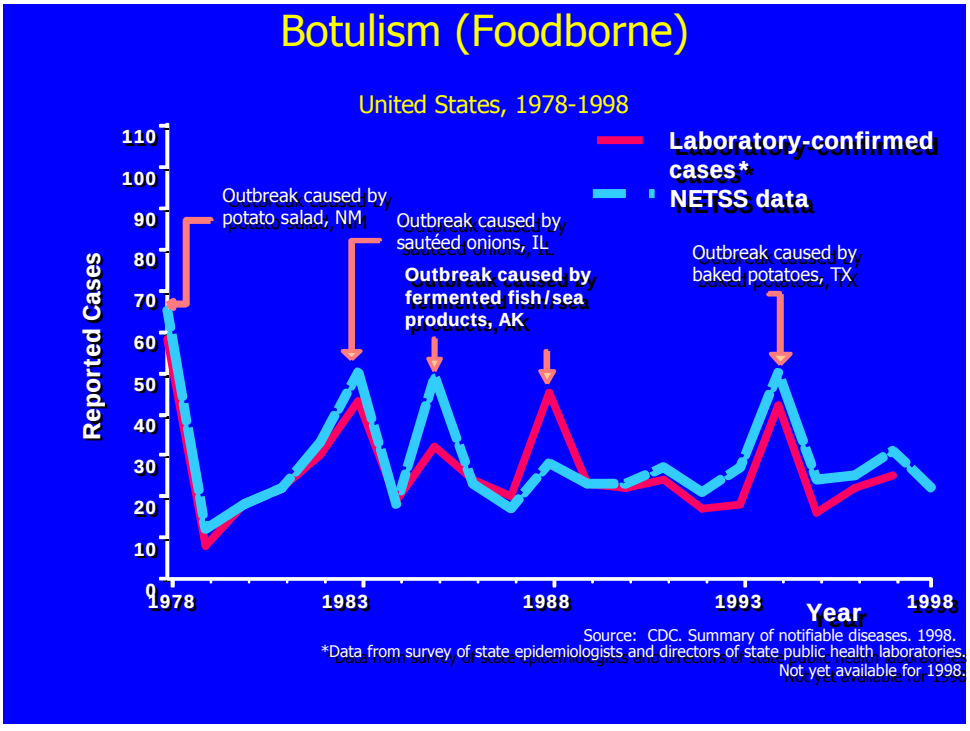
CDC

Uses of Public Health Surveillance

- Estimate magnitude of the problem
- Determine geographic distribution of illness
- Portray the natural history of a disease
- Detect epidemics/define a problem
- Generate hypotheses, stimulate research
- Evaluate control measures
- Monitor changes in infectious agents
- Detect changes in health practices
- Facilitate planning




Rate of Hepatitis A
United States, 1998
NYC
DC
PR
NA VI
GUAM
NA AM SAMOA
NA CNMI
< 5.0
5.0–9.9
10.0–19.9
>20.0
Source: CDC. Summary of notifiable diseases. 1998.


Botulism (Foodborne)
United States, 1978-1998
Laboratory-confirmed cases*
NETSS data
Outbreak caused by potato salad, NM
Outbreak caused by sautéed onions, IL
Outbreak caused by fermented fish/sea products, AK
Outbreak caused by baked potatoes, TX
Reported Cases
110
100
90
80
70
60
50
40
30
20
10
0
1978
1983
1988
1993
1998
Year
Source: CDC. Summary of notifiable diseases. 1998.
*Data from survey of state epidemiologists and directors of state public health laboratories.
Not yet available for 1998.

Types of Surveillance Systems

- ACTIVE
  - Health Department initiated
- PASSIVE
  - Provider initiated
- LIMITED
  - Temporary (limited by time)
  - Sentinel (limited by place)

Data Collection Methods

- Disease Notification – reportable diseases
- Registries – cancer registries
- Vital Statistics – mortality
- Administrative Systems – hospital records
- Surveys – NHANES, BRFSS

Childhood Blood Lead Surveillance

- Laboratory blood-lead test results among children.
  - All Results
  - Elevated Results
- Medical treatment
- Environmental sources of lead exposure

National Program of Cancer Registries (NPCR)

Data

- Incidence
- Type
- Site
- Stage
- Treatment
- Outcome

Goals

- Patterns and trends
- Program planning and intervention
- Resource allocation
- Advance research

National Health and Nutrition Examination Survey (NHANES)

- Home Interview – health status, diseases, diet
- Health Examination – blood pressure , body fat, vision, hearing, blood profile, serology
- Biomonitoring – lead, mercury, cadmium

CDC's Vision for Public Health Surveillance

- A network that acts as an electronic nervous system capable of monitoring and maintaining the public's health. Like the human nervous system, it will detect problems, analyze accumulated data, create useful information, communicate alerts as needed, and direct appropriate response.

- The Environmental Public Health Tracking Network is one component of this overall vision.

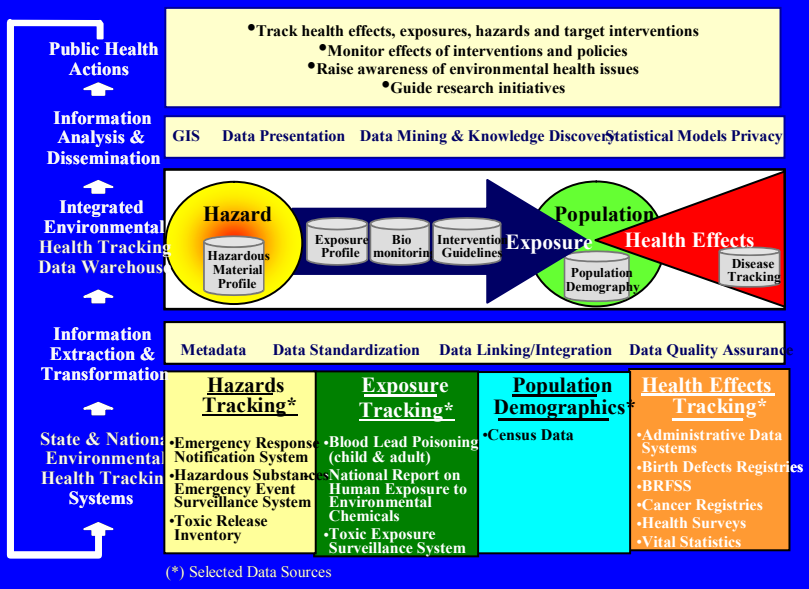
Environmental Public Health Tracking

The ongoing collection, integration, analysis, and interpretation of data about:

- Environmental hazards
- Exposure to environmental hazards
- Human health effects potentially related to exposure to environmental hazards

It includes dissemination of information.

Environmental Public Health Tracking: Complexity



Hazard ⇒ Exposure ⇒ Health Effect

Hazard Tracking

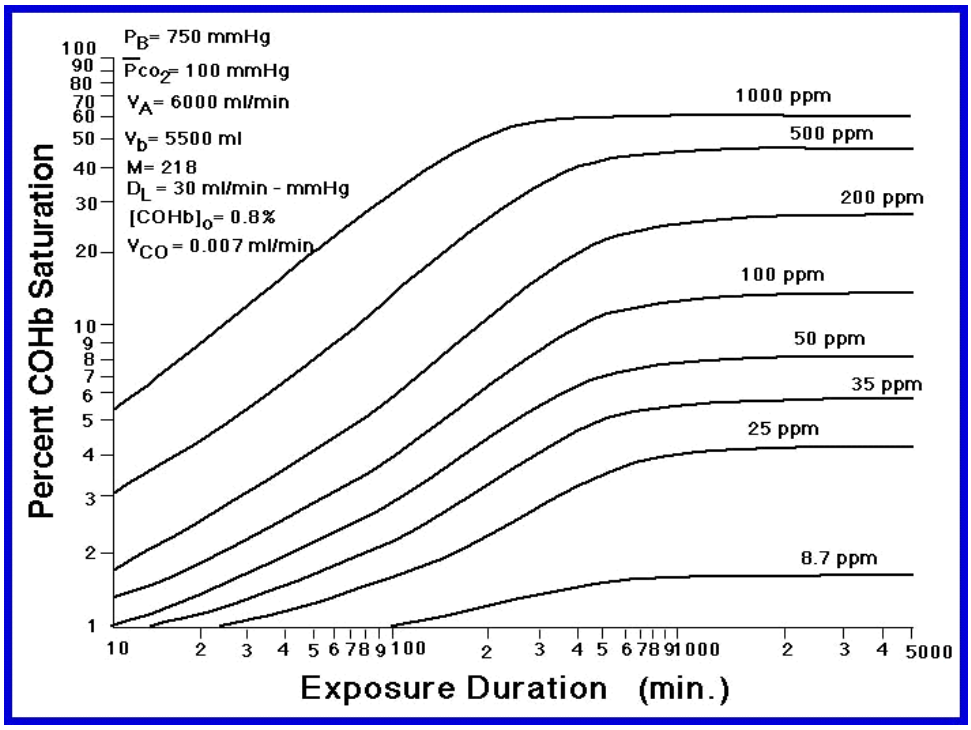
Environmental Indicators

- Criteria air pollutants
- Indoor tobacco smoke
- Water contaminants
- Pesticide use
- Fish contaminants
- Chemical spills
- Residence in floodplain

Data Sources

- *State air and water quality monitoring programs*
- *Toxic Release Inventory*
- *National Weather Service*
- *Seafood safety programs*
- *Hazardous Substances Emergency Event Surveillance System*

Hazard ⇒ Exposure ⇒ Health Effect


P_B= 750 mmHg
$\overline{P}co_2$= 100 mmHg
V_A= 6000 ml/min
V_b= 5500 ml
M= 218
D_L = 30 ml/min - mmHg
$[COHb]_o$= 0.8%
V_{CO} = 0.007 ml/min
1000 ppm
500 ppm
200 ppm
100 ppm
50 ppm
35 ppm
25 ppm
8.7 ppm
Percent COHb Saturation
Exposure Duration (min.)

Exposure Tracking

Environmental Indicators

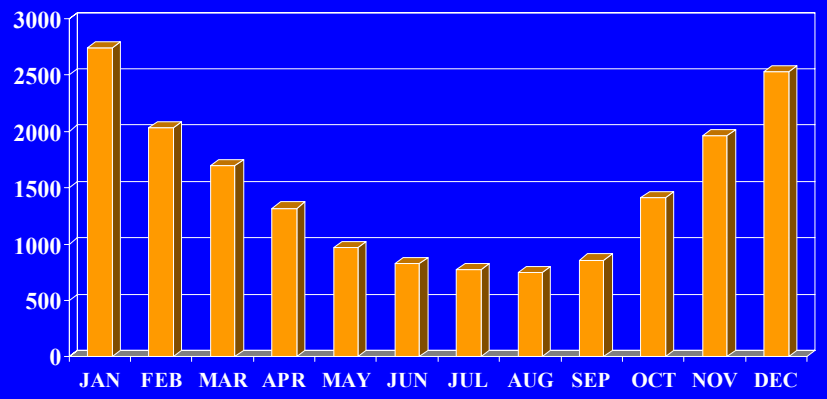
- Childhood blood lead levels
- Heavy metals
- Persistent chemicals
- Pesticides

Data Sources

- *Childhood Lead Poisoning Prevention Program*
- *NHANES – Chemical Exposure Report*
- *Toxic Exposure Surveillance System*

Hazard ⇒ Exposure ⇒ Health Effect

Monthly CO Mortality – 1979-1998



CDC

Health Effect Tracking

Environmental Indicators

- Heat/Cold mortality
- Melanoma
- Carbon monoxide poisoning
- Asthma

Chronic Disease Indicators

Data Sources

- *Vital Statistics*
- *Hospital Discharge*
- *Cancer Registries*
- *Birth Defects Network*
- *National Surveys*
- *Medical Records*
- *School Health*

Hazard ⇒ Exposure ⇒ Health Effect

↑ ↑ ↑

Interventions

Environmental Public Health Tracking Network

Protecting communities through integrated environmental public health surveillance

State and National Data Collection Systems

- Environmental Hazards Tracking
- Environmental Exposure Tracking
- Health Outcomes Tracking

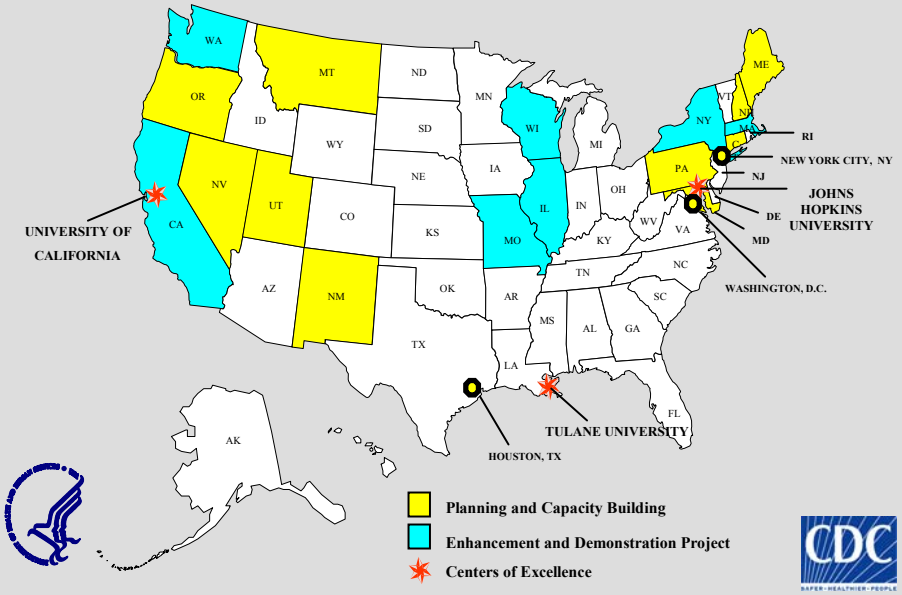
Integrated Environmental Health Tracking, Analysis, Evaluation And Dissemination

Public Health Actions

- Track health, disease, and risks to target interventions
- Detect new health events and unusual occurrences associated with environmental exposures
- Monitor effects of interventions and policies
- Raise awareness of environmental health issues
- Guide research initiatives

CDC

The National Environmental Public Health Tracking Program - 2002

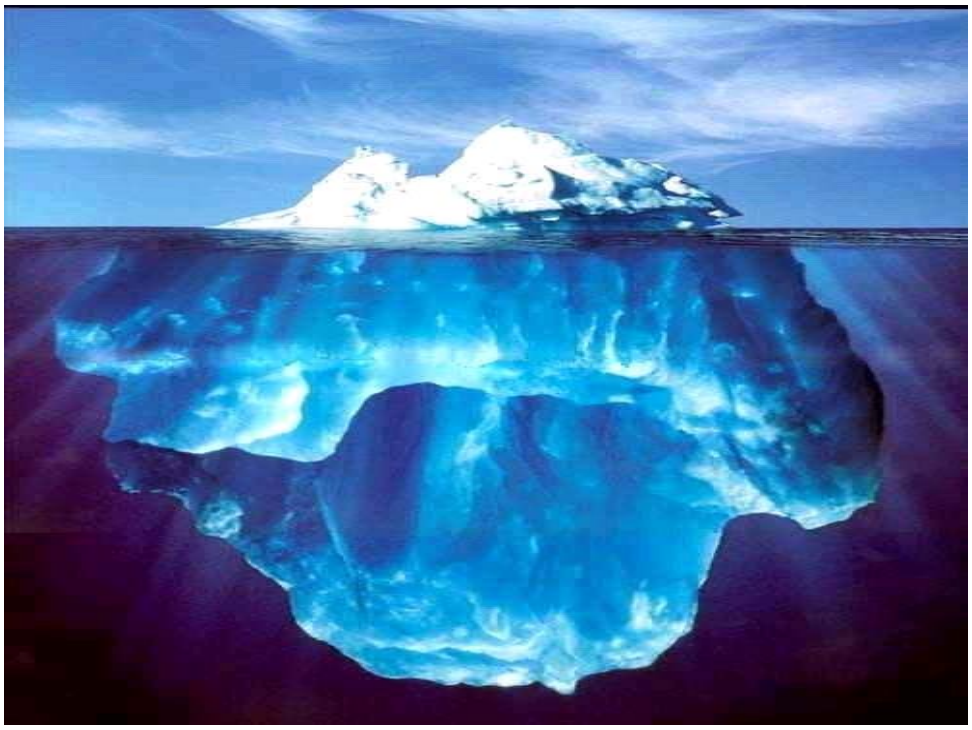


Environmental Health Tracking

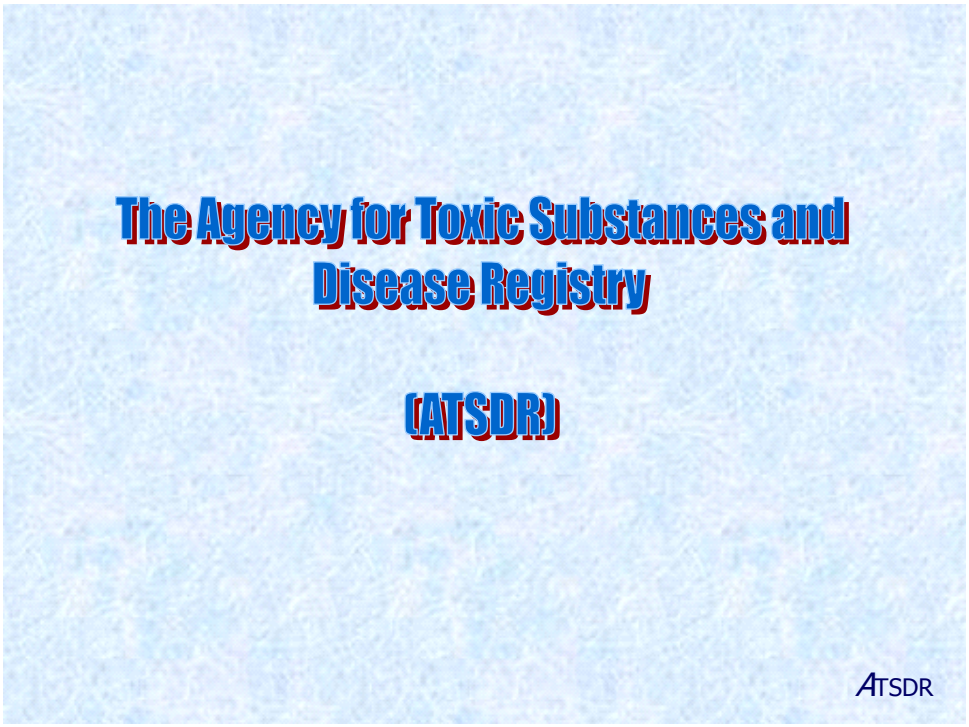
- Website: www.cdc.gov/nceh/tracking

- Judy Qualters, Acting Branch Chief
  Environmental Health Tracking Branch
  Environmental Hazards and Health Effects
  National Center for Environmental Health
  (404) 498-1300
  jqualters@cdc.gov

CDC



Ginger Gist
"Agency for Toxic Substances and Disease Registry"



How ATSDR Program Activities Work

ATSDR organizes its work into four major areas:

- Establishing environmental health hazard;
- Measuring human contact;
- Determining physiological effects from exposure to hazardous substances; and
- Creating public health interventions.

ATSDR

Site-specific Activities

Public Health Advisories

Public Health Assessments

Petitioned Public Health Assessment

Public Health Consultations

ATSDR

Public Health Advisories

ATSDR issues a public health advisory when its scientists determine that a substance released into the environment poses a significant risk to human health.

Public health advisories also include recommended measures to reduce human exposure and eliminate, or substantially mitigate, significant risk to human health.

ATSDR

Public Health Assessments

An in-depth ATSDR evaluation of available data and information on the release of a hazardous substance into the environment.

These assessments are used to assess any pertinent current or future impact on public health.

ATSDR

Petitioned Public Health Assessment

A petitioned public health assessment is a health assessment conducted at the request of a member of the public.

ATSDR

Public Health Consultations

The public health consultation is a more limited response to a specific request for information pertaining to a hazardous substance or facility.

ATSDR

Site-specific Activities (continued)

Health Investigations

Health Studies

Epidemiologic Studies

Surveillance

National Exposure Registry

ATSDR

Health Investigations

ATSDR systematically collects, analyzes, and interprets health data while monitoring specific health events.

Health investigations may include epidemiologic, surveillance, or other studies of toxic substances and their effects.

ATSDR

Health Studies

Biological Indicators of Exposure Studies - Consist of biological testing (usually of blood or urine) of people who live near a potentially hazardous site.

Cluster Investigation Studies - Conducted to determine if a rate of a reported illness (such as cancer) in a community is higher than expected, and if so, to investigate possible environmental causes.

Disease and Symptom Prevalence Studies - Determine the rates of health problems (diseases and symptoms) among people who live near a potentially hazardous site to determine if any illness requires further investigation for environmental causes.

ATSDR

Epidemiologic Studies

Epidemiologic studies conducted by ATSDR are investigations which test or generate scientific hypotheses to ascertain and evaluate any causal relationship between exposure to a hazardous substance and an outcome.

ATSDR

Surveillance

Surveillance activities address the ongoing systematic collection, analysis, and interpretation of health data during the process of describing and monitoring a health event.

ATSDR

The National Exposure Registry

The National Exposure Registry is made up of substance-specific registries.

The primary purpose of the exposure registry program is to create a large database of similarly exposed persons.

This database is used to facilitate epidemiologic research in determining adverse health effects of people exposed to a low level of chemicals over a long period of time.

ATSDR

The National Exposure Registry

Trichloroethylene (TCE) Registry

Dioxin* Registry

Benzene Registry

Trichloroethane (TCA) Registry

Radioactive Substances Registry**

Chromium (VI) Registry**

*2,3,7,8-Tetrachlorodibenzo-*p*-dioxin
**Approved but not implemented

ATSDR

Substance-specific Activities

Toxicological Profiles

Priority Listing of Hazardous Substances

ATSDR Decision Guide for Identifying Substance-specific Data Needs Related to Toxicological Profiles

ATSDR

Toxicological Profiles

ATSDR Toxicological Profiles are documents which comprehensively characterize environmental, toxicological, and health effects information for specific hazardous substances.

Public Health Statements - Describes in lay terms the specific effects of exposure to the particular substance to ensure that information provided in the toxicological profile has the broadest public use.

ATSDR

Priority Listing of Hazardous Substances

The Listing Activity uses the criteria of:

- chemical toxicity;
- frequency of occurrence, and;
- potential for human exposure.

In 1997 a total of 775 candidate substances were evaluated to create the current list of 275 substances.

ATSDR

Decision Guide for Identifying Substance-specific Data Needs Related to Toxicological Profiles

Used to determine priority data needs for specific substances.

Data needs may be filled through:

- the Toxic Substance Control Act and the Federal Insecticide, Fungicide and Rodenticide Act;
- voluntary testing by the private sector; or
- research facilitated by ATSDR with the use of Superfund monies.

ATSDR

Other ATSDR Activities

HAZDAT Database - A computer-based information system which includes environmental and health data contained in Agency products such as public health assessments, public health consultations, toxicological profiles, and EPA site characterization documents.

Emergency Response - ATSDR provides health related support to states, local agencies, and health care providers in public health emergencies that involve exposure to hazardous substances.

ATSDR

Other ATSDR Activities (continued)

Special Initiatives -

- Great Lakes Human Health Effects Research Program
- Child Health Initiative
- Mississippi Delta Project
- Minority Health Program

Hazardous Substances and Public Health - A forum for health care professionals to exchange information about environmental health.

ATSDR

ATSDR
Office of the Assistant Administrator
1600 Clifton Road, Mailstop E-28
Atlanta, GA 30333

Phone: 1-888-42ATSDR
(1-888-422-8737)

http://atsdr1.atsdr.cdc.gov:8080/

ATSDR

The National Exposure Registry (NER)

Division of Health Studies (DHS)
Exposure and Disease Registry Branch (EDRB)

ATSDR

What is the National Exposure Registry (NER)?

The NER is a listing of people who have been exposed to hazardous substances in the environment.

Purpose: To aid in assessing long-term health consequences to the general population from exposure(s) to Superfund-related hazardous substances.

ATSDR

What are the goals and objectives of the National Exposure Registry?

- To facilitate epidemiological and health studies
- To facilitate state and federal health surveillance programs by enabling the identification and tracking of participants in registry and by maintaining information on the registrants
- To provide information that can be used to assess the burden of the effects of an exposure or health outcome on a population

ATSDR

Procedures for Establishing a Registry

- Selection of Primary Contaminant(s)
- Site Selection
- Population Selection
- Data Collection
- Data Storage
- Follow-up Activities
- Other Activities or Studies
- Termination of Registry

ATSDR

What are the criteria for chemical selection?

- The chemical appears on the National Priorities List (NPL) of Hazardous Substances
- A toxicological profile has been written for the substance
- Chemical has not been selected previously for a registry
- Chemical is present at more than 100 sites in HazDat
- Chemical ranks highest based on specific criteria (i.e., extent of contamination, toxicity, potential for human exposure, data gaps, and registry potential for filling the data gaps)

ATSDR

What are the primary criteria for site selection?

- Documented contamination of media
- Levels of contamination
- Complete exposure pathway
- Length or duration of exposure
- Size of the potentially exposed population

ATSDR

How do you determine if a person has been exposed to a hazardous substance?

- A contaminated source must exist AND
- A route of exposure must exist AND
- Documented exposure to the contaminant has occurred

ATSDR

Currently Active NER Registries

- Trichloroethylene (TCE)
- Trichloroethane (TCA)
- Benzene
- Dioxin (TCDD)

ATSDR

Data Collection

- Baseline Interview: Face-to-face interview using CAPI (Computer-Assisted Personal Interview) system.
- Address update: Name, address and telephone number confirmation (by mail), 6 months after baseline interview.
- Follow-up Interview: Telephone interview using CATI (Computer-Assisted Telephone Interview) System. Conducted one year after baseline and triennially thereafter.

ATSDR

Trichloroethylene (TCE) Registry

- Established 1989
- 14 sites in 5 states (MI, IN, IL, PA, AZ)
- 4,986 registrants (alive and deceased)

ATSDR

Dioxin* Subregistry Registry

- Established 1989
- 5 sites in 2 states (MO and AR)
- 3,131 Registrants (alive and deceased)

*2,3,7,8-Tetrachlorodibenzo-*p*-dioxin—TCDD

ATSDR

Benzene Registry

- Established 1991
- 1 site (TX)
- 1,143 Registrants (alive and deceased)

ATSDR

1,1,1-Trichloroethane (TCA) Registry

- Established 1992
- 1 site (NY)
- 3,665 registrants (alive and deceased)

ATSDR

Sources of Exposure

- Exposure to contaminated well or municipal water (TCE, TCA, and benzene)
- Exposure to contaminated soil (dioxin)

ATSDR

When is a Registry Terminated?

- The hazardous substance of interest is no longer used or manufactured or no longer found at dump sites, and all registrants are deceased; an exception may be made when the contaminant is thought to have the potential for causing multigenerational effects,
- Technological advances enable the measurement of a previously immeasurable hazardous substance, such as dioxin in tissue or body fluids. After applying this new technology to persons in the Registry who were originally enrolled on the basis of less precise estimates of exposure, ATSDR finds that no one has had a significant exposure to the hazardous substance, or
- A hazardous substance is determined through further study to cause no adverse health outcomes

ATSDR

Participation Rates for the National Exposure Registry

Time Frame	Participation (including deceased)%	% Lost to Follow Up	% Lost to Refusal	% Other
Baseline	93.0	0.9	1.0	5.1
Follow-up 1	89.0	4.0	4.0	3.0
Follow-up 2	87.0	3.0	7.0	3.0
Follow-up 3	90.0	3.0	5.0	2.0

ATSDR

Current National Exposure Registry Studies

- Impact of TCE Exposure on Oral Motor, Speech, and Hearing in Children
- Cancer Morbidity Rates for the NER (TCE and TCA Registries)
- Adverse Late Pregnancy Outcomes in a Population Exposed to TCE in Drinking Water
- The Impact on Women Exposed to TCE
- Hanford Birth Cohort Study
- Tremolite Asbestos Registry

ATSDR

National Exposure Registry's Website

http://www.atsdr.cdc.gov/NER

ATSDR

Asthma Surveillance: A Brief Summary of Health and Environmental Data Needs

Joshua Mott, Air Pollution and Respiratory Health Branch, NCEH, CDC

Need for Asthma Surveillance

- Asthma is a frequent cause of emergency department (ED) visits and hospitalizations, and a very costly disease
- Surveillance is needed at the national, state, and local level.
  - Comparison of local disease estimates to each other and to the nation is important to our understanding of the problem and potentially effective solutions.
- Even limited data can be useful in targeting and evaluating efforts to improve secondary prevention

Asthma Surveillance: Health Data Needs

Conceptual Framework for Asthma Surveillance: (Boss et. al, 2001)

Four Basic Questions:

- How much asthma is there?
- How severe is asthma?
- How successful are we in managing asthma?
- What are the costs of asthma?

How much asthma is there?

Why do you want to know it?

- Provide an indication of the burden of disease
- Identify causal and precipitating factors

What data are needed to learn it?

- Prevalence of asthma: age, sex, race; lifetime and/or current
- Prevalence of asthma in schools
- Incidence of asthma

How severe is asthma?

Why do you want to know it?

- Possible to decrease asthma severity
- Outcome evaluation
- Indication of burden of asthma on health care system

What data are needed to learn it?

- Number of asthma deaths by age, sex and race
- Frequency/duration of asthma hospitalization
- Frequency of unscheduled visits (including ED)

How successful are we in managing asthma?

Why do you want to know it?

- Necessary to define program needs
- Intermediate indicators of program success

What data are needed to learn it?

- Prevalence of specific medication use
- Measures of signs and symptoms, frequency and severity

What is the cost of asthma?

Why do you want to know it?

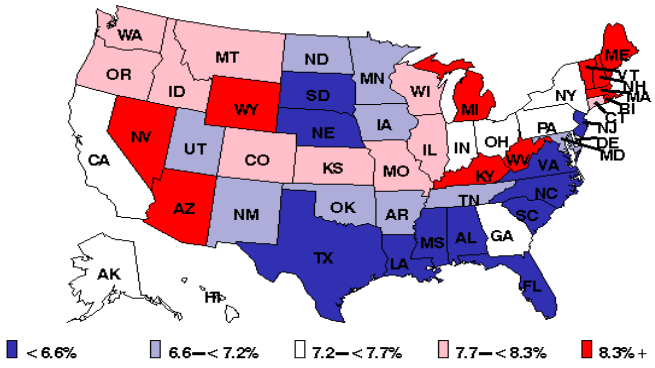
- Provides concrete economic figures for policymakers

What data are needed to learn it?

- Medicaid/Medicare or other administrative data
- Indirect: School/Work Absenteeism
- Hospitalization costs

State Examples: How much asthma is there?

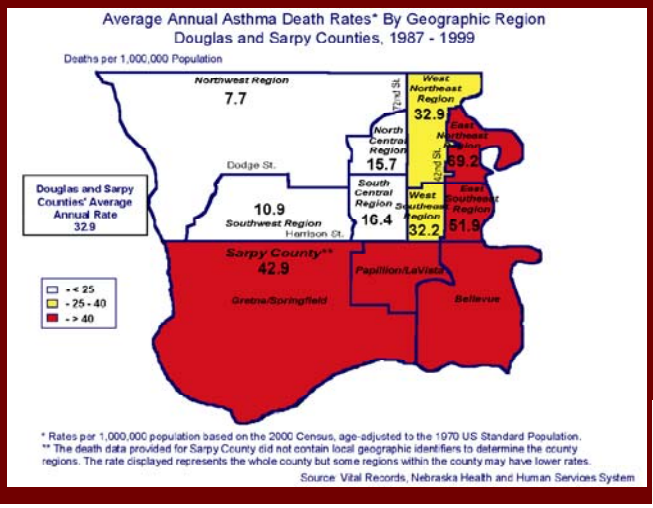
Map C1
Adult Self–Reported current Asthma
Prevalence Rate (percent) by State: BRFSS 2001



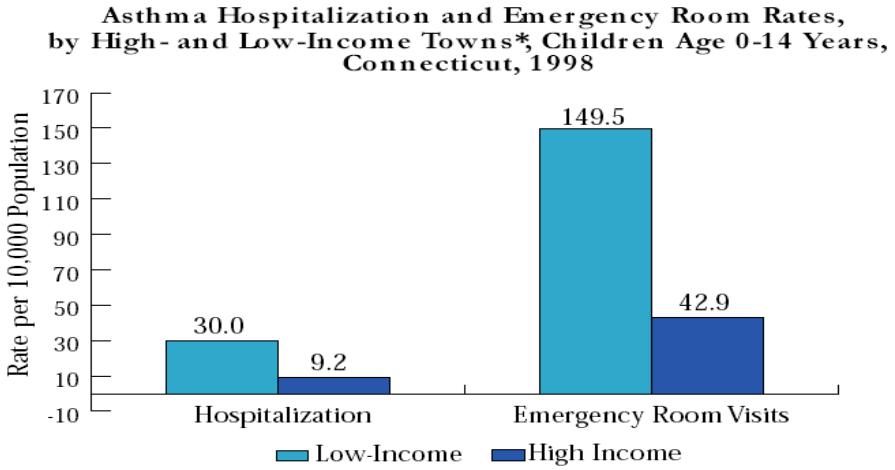
Footnote: Ranges based on quintiles of the overall prevalence estimates from year 2001 data

Air Pollution and Respiratory Health Branch, National Center for Environmental Health
Centers for Disease Control and Prevention

State Examples: How severe / well managed is asthma?



State Examples: How severe / managed is asthma?



Summary: Core Elements of a Surveillance System

- Prevalence data using core asthma questions on BRFSS
- Hospitalization data from discharge data bases
- Mortality data available via CDC Wonder and in each state
- Explore by age, sex, race, over time and geography

Examples of Data Sources for a More Comprehensive System

- BRFSS Child Asthma Prevalence module
- Youth Risk Behavior Survey
- Asthma-specific surveys in schools
- BRFSS Optional Adult Asthma module
- Emergency department data
- Medicaid program
- National Asthma Survey

Surveillance is Complicated

- Asthma is episodic in nature and its clinical expression can vary greatly.
- No confirmed case definition for surveillance purposes.
- Severity and control of the disease are intertwined.

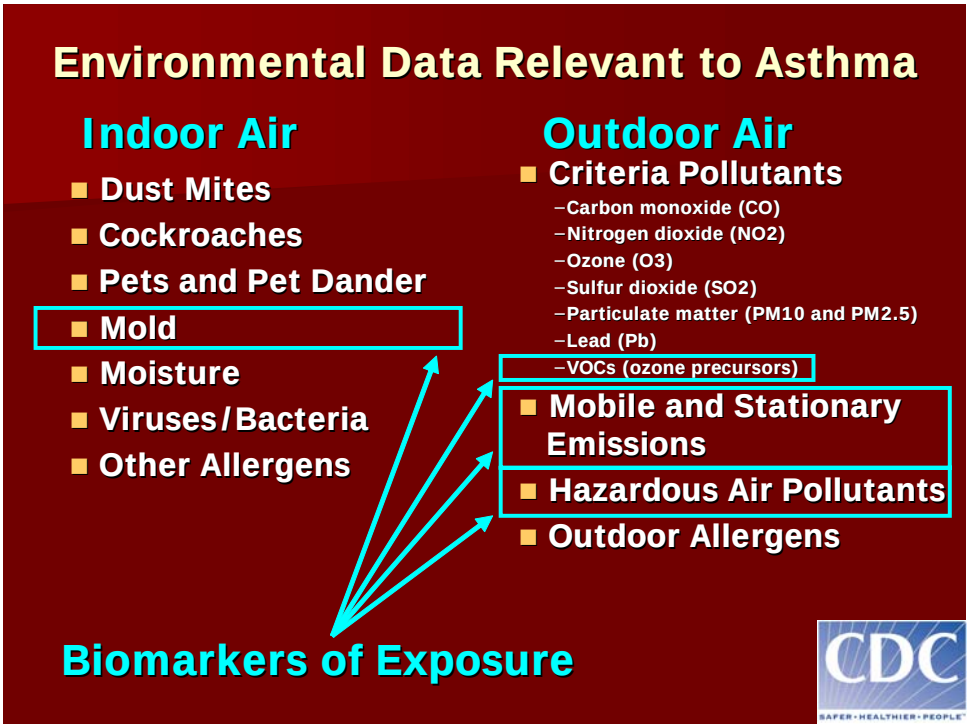
Surveillance Fact Sheets (State-Level Asthma Surveillance Data)

- CDC Wonder Underlying Cause of Death Data
- Multiple Cause of Death Data
- State Hospital Discharge Data
- State Emergency Department Data

Surveillance Fact Sheets

- State Medicaid Claims Data
- Medicare Claims Data
- Behavioral Risk Factor Surveillance System, Core Asthma Questions
- Behavioral Risk Factor Surveillance System, Optional Asthma Modules

Asthma Surveillance: Environmental Data Needs



Desirable Characteristics of Environmental Data

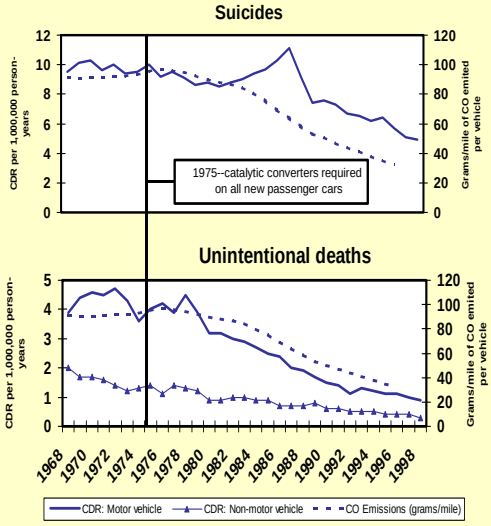
- Geographic/spatial comparability to health data
  - Challenge: Not to oversimplify. People are mobile, cross spatial boundaries, move from indoor-outdoor environments.
  - Biomarkers have value but are burdensome, expensive.
  - Other possibilities?
- Demographic comparability to health data
  - Most important for IAQ measures
- Temporal comparability
  - Different needs for different data (e.g. daily data for ED visits or hospitalizations, yearly data for prevalence; hourly data for symptom diaries)
- Timeliness

What Environmental Data Are Available / Have We Used?

EPA DATA

- Criteria Pollutants, Hazardous Air Pollutants, Mobile Emissions.
  - County-level resolution data for many states
  - Two-to-three year time lag
  - Annual, quarterly, daily, hourly depending on source
    - Air Quality System,
    - National Emissions Trends,
    - National Toxics Inventory Databases.

Annual crude death rates from carbon monoxide poisoning, and average annual estimated CO emissions per light duty motor vehicle (grams/ test mile), United States, 1968-1998.



CO Emissions Control Timeline

1970: Congress enacts Clean Air Act. CO emissions standard at 34.0 grams/mile.

1975: Catalytic converter introduced on new passenger cars to meet new CO emissions standard of 15 grams/mile.

1978: 1975 and newer model year cars make up 34% of the U.S. passenger vehicle fleet.

1980: All new passenger cars required to meet new CO emissions standard of 7.0 g/mile. 1975 and newer model year cars make up 50% of US. passenger vehicle fleet.

1981: All new cars required to meet new CO emissions standard of 3.4 g/mile.

1990: 1975 and newer model year cars make up 91% of the U.S. passenger vehicle fleet.

1992: Standards setting emission limits for carbon monoxide at temperatures < 20 º F are established. Oxygenated gasoline is introduced in cities with high CO levels.

Source:EPA CO emissions inventory data, and Fact Sheet OMS-12.

Opportunities with NASA?

Thoughts entering this meeting…

- Is there geographic specificity beneath the county (e.g. zip code or census tract) level?
- Is data available in areas that current do not have monitoring?
- Are there measures of additional air pollutants?
- Are there measures of pollutants specifically in the breathing zone of humans?
- What is the timeliness of measurements relative to what is available?
- Can we model appropriate temporal relationships between measurements of pollutants and asthma indicators such as ED visits or hospitalizations?
- Can we find creative ways to better measure the dynamic exposure environment of individuals?

CDC
SAFER·HEALTHIER·PEOPLE

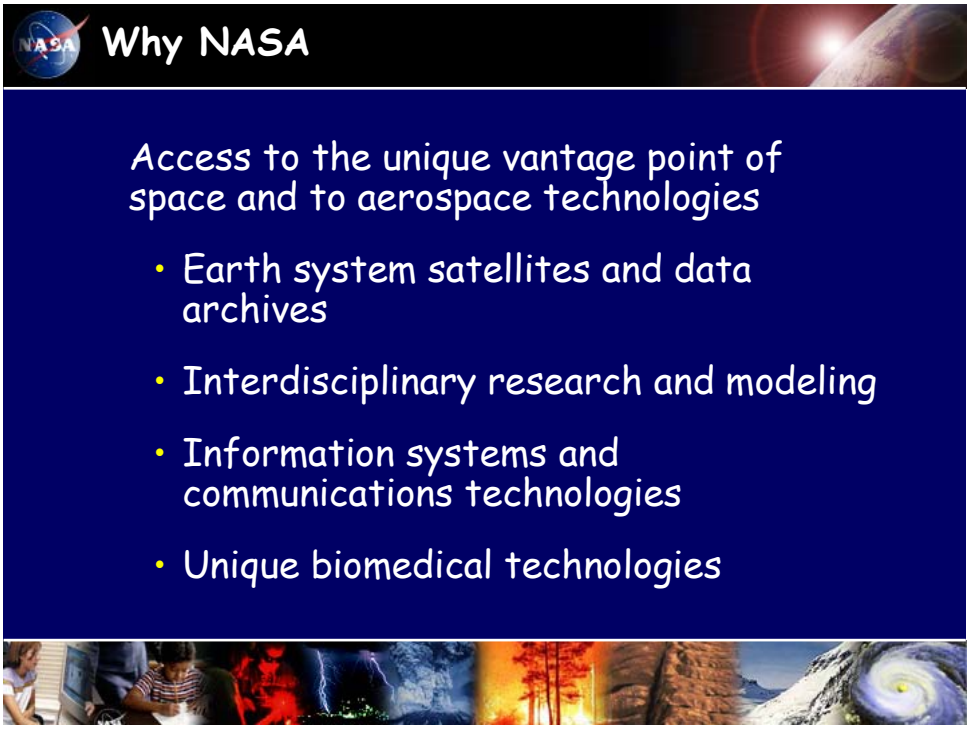
Specific Goals of Surveillance Fact Sheets

- Describe what asthma surveillance questions can be answered by different data sources
- Describe the history of each data source, its idiosyncrasies, and appropriate asthma case definitions
- Describe access to the data
- Provide standards for analysis to achieve uniform and comparable statistics across states

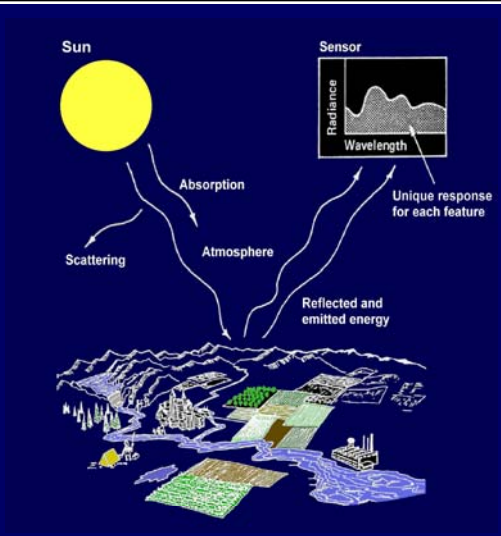
Specific Goals of Surveillance Fact Sheets

- Provide standard guidelines for sample size and data suppression
- Provide applicable HP2010 indicators
- Answer anticipated questions about the data source
- Provide contact information for persons at state and federal level with experience using these data

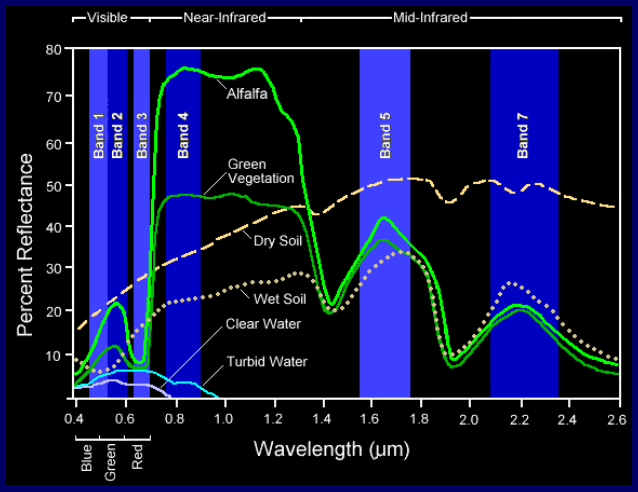

NASA Science, Technologies, and Human Health
Cindy L. Schmidt
Louisa R. Beck
Center for Health Applications of Aerospace Related Technologies
NASA Ames Research Center
Moffett Field, CA
Jackson, MS
30 June 2003


Why NASA
Access to the unique vantage point of space and to aerospace technologies
• Earth system satellites and data archives
• Interdisciplinary research and modeling
• Information systems and communications technologies
• Unique biomedical technologies

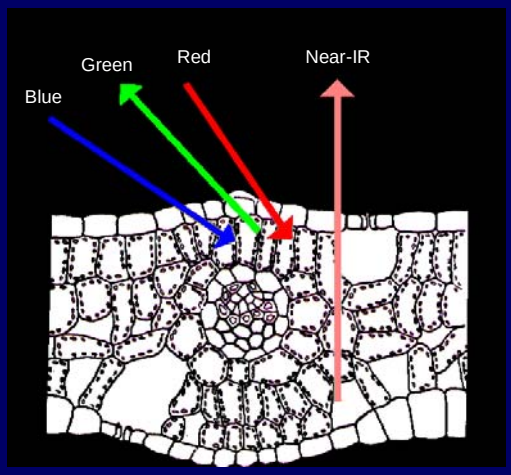
Atmosphere and Surface Interaction



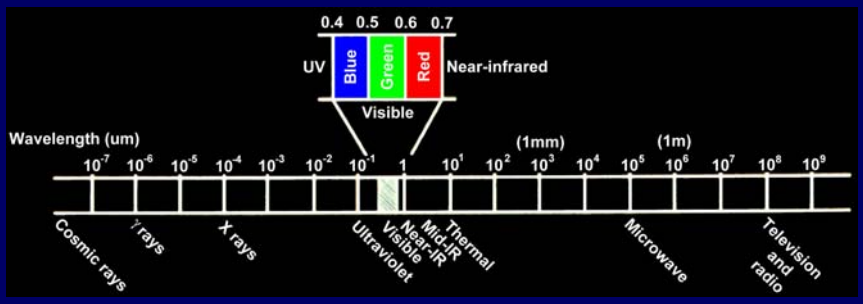
Spectral Reflectance Curves and TM Bands



Typical Relative Leaf Reflectance



Electromagnetic Spectrum



Selection Criteria:The Three Resolutions

- Spectral
- Spatial
- Temporal

Spectral Relationships

Visible	Vegetation discrimination, cultural features
Near-IR	Vegetation vigor; biomass; type
Mid-IR	Soil, vegetation moisture; soil types
Thermal IR	Vegetation stress; surface temperature
Radar	Sensing through clouds, day or night

Spectral Comparison

ETM+ Imagery of Yolo County, CA in May 2001

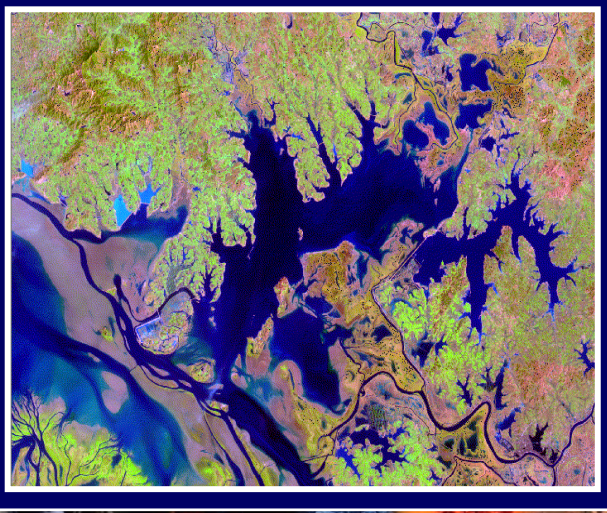
Pan

"True" Color

NIR

Mid-IR

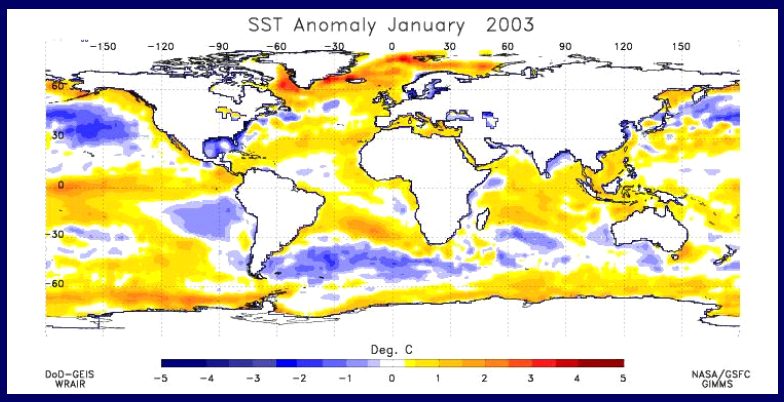
Schistosomiasis Study



Poyang Lake, China

Institute of Parasitic Diseases
Chinese Academy of Preventive Medicine, Shanghai, China

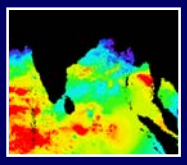
Sea Surface Temperatures and RVF
NOAA AVHRR



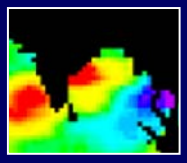
SSTs in the central Pacific are above normal, continuing a pattern observed since May 2002. The entire central-western Indian Ocean shows a large pool of above-normal SST, although below-normal SST have emerged along the East African coast.
Source:http://www.geis.ha.osd.mil/GEIS/SurveillanceActivities/RVFWeb/infopages/update.html

Cholera in the Bay of Bengal, Bangladesh
NASA / University of Maryland Biotechnology Institute

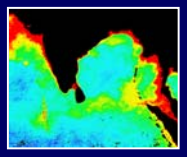
Sea Surface Temperature
NOAA AVHRR



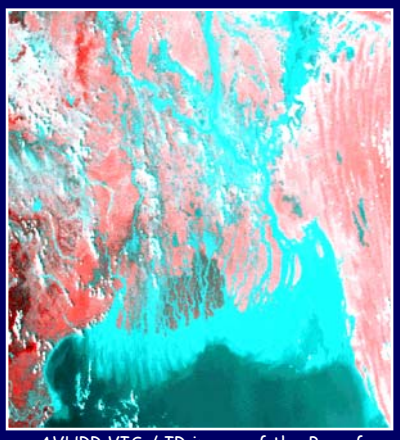
Sea Surface Height
Anomaly
TOPEX/Poseidon



Chlorophyll
Concentration
SeaWiFS

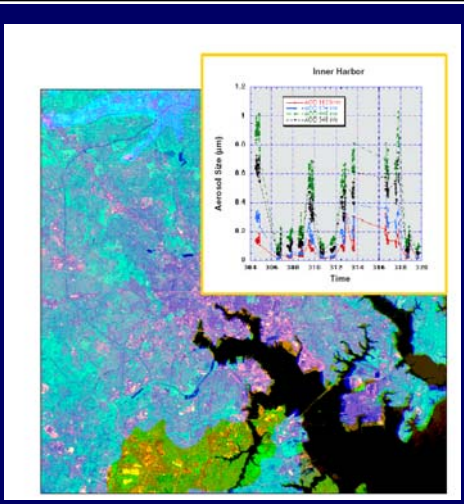


low high



AVHRR VIS / IR image of the Bay of Bengal showing sediment outflow from the Ganges River

Childhood Asthma



Investigating climate and environmental links to childhood asthma

Landsat Image and Aerosol Optical Depth Plot

Baltimore, Maryland

Source: http://healthyplanet.gsfc.nasa.gov/project2.html

Thermal Imagery

Urban Heat Island:
Investigating the relationships between heat, air pollutants, and cardio-vascular, stroke and respiratory diseases in the urban environment

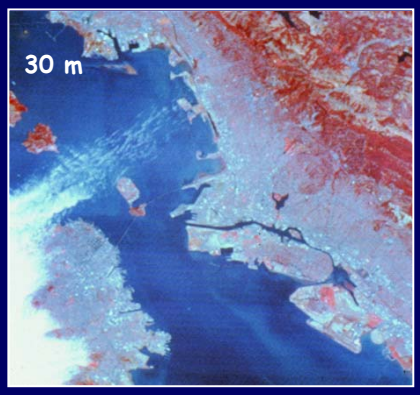
Baton Rouge, Louisiana

The yellow and red areas are hot, and generally correspond with roads and buildings; blue and green areas are cool and indicate water and vegetation

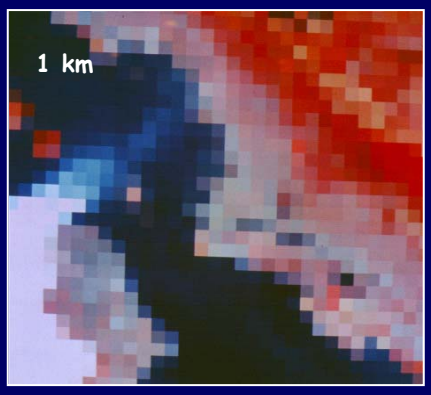
Source: http://www.ghcc.msfc.nasa.gov/urban/urban_remote_sensing.html

Spatial Resolution

San Francisco Bay



Landsat TM



Simulated NOAA AVHRR

Spatial Resolution

Ikonos 4-m Data
Atlanta, Georgia

Ikonos Spatial/Spectral Comparison

Panchromatic

Multispectral

Pixel Sizes

	Panchromatic	Multispectral
Commercial	1-3 m	4-15 m
ASTER		15-20 m
IRS	6 m	23 m
SPOT	10 m	20 m
Landsat ETM+	15 m	30 m
MODIS		250-1000 m
AVHRR		1100 m

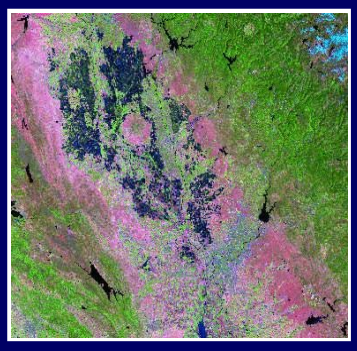
Temporal Resolution

- Seasonal
- Year-to-year

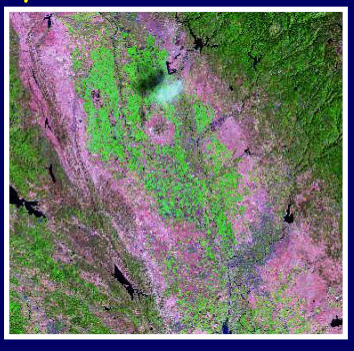
Seasonal Variation

Landsat TM Scenes

Sacramento Valley, California



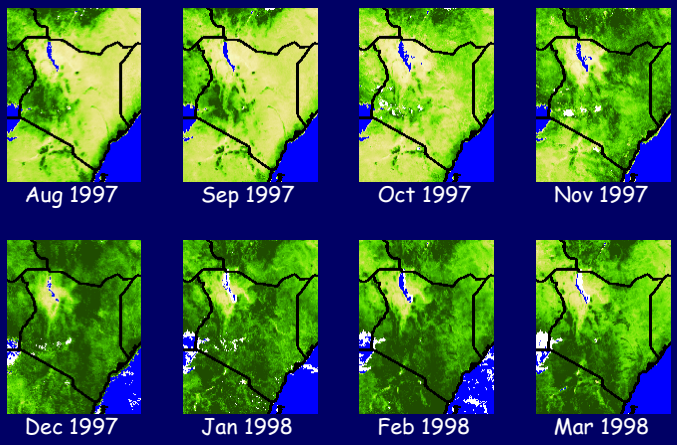
4 June 1996



6 September 1995

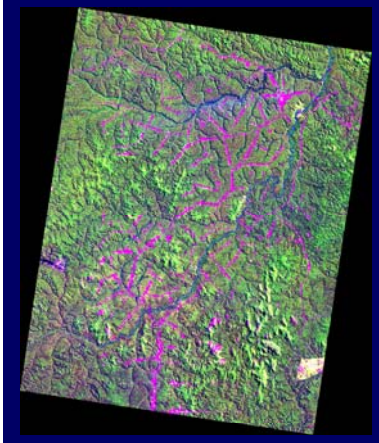
Seasonal Variation

Kenya AVHRR NDVI

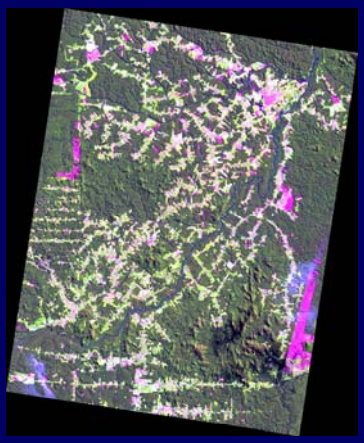


Source: Pathfinder Global 8-km AVHRR Archive

Year-to-Year Variation



Landsat TM
1985



Landsat TM
1995

Machadinho Settlement Project

Rondônia, Brazil

Dr. Marcia Castro, Princeton University

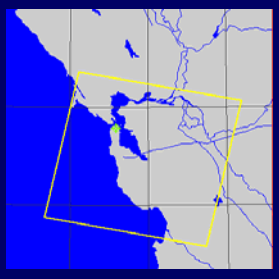
Repeat Coverage

AVHRR	0.5 day
MODIS	2 days
Commercial	2-11 days
SPOT	3 days
ASTER; ETM+	16 days
IRS LISS III	24 days

Scene Coverage

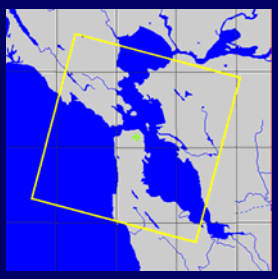
NOAA AVHRR

Least Expensive



Landsat TM, ETM+

Moderate Cost



SPOT HRV

Expensive

Environmental Parameters

Rainfall	Formation of breeding sites
Temperature	Survival of pathogens, vectors, hosts/reservoirs
Soil type	Survival of ticks, helminths, mosquitoes
Elevation/Topography	Vector distribution
Human activities	Creation of new habitats; contact risk
Water bodies	Mosquitoes, snails
Vegetation characteristics	Resting sites; food sources; vector habitat

All parameters can be sensed remotely and modeled spatially

Multispectral: Local Scale

High spatial resolution (<20 m) imagery, with limited geographic coverage; expensive

Parameter	Link	Disease
House type	Socio-economic status, hosts	Chagas', Leishmaniasis
Containers	Breeding sites	Dengue, Malaria, Filariasis
Ditches, ponds	v/r/h habitat	Malaria, RVF, Schisto
Roads	Human migration patterns	Malaria, Hantavirus
Vegetation	Bloodmeals, resting sites	Malaria, Trypanosomiasis

QuickBird-2; Ikonos

Local Scale Imagery

Schistosomiasis Study

Ikonos 4-m Data of Kenyan Village

Base Map

Color-coded symbology for GIS Layers, which are georeferenced to field data through the use of GPS

Multispectral: Regional Scale

20-1000 m spatial resolution, with frequent regional coverage; moderate cost

Parameter	Link	Disease
Settlements	Human population density	Leishmaniasis, Malaria
Vegetation type	v/r/h habitat, pollen	VBDs, Asthma
Ecotones	Human-vector contact risk	Lyme disease, YF, Chagas'
Soil type	Vector survival, mold	Tick-borne diseases (TBDs),Valley Fever
Soil/leaf moisture	Vector survival, fungi, mold	TBDs, Schisto, RVF, Allergies
Chlorophyll	Plankton	Cholera
Water quality	Pollution	Cryptosporidiosis

CBERS; Ikonos; IRS-1C, D LISS III; Landsat ETM+; QuickBird-2; SPOT-4, -5; Terra ASTER, MISR, MODIS

Multispectral: Global Scale

Greater than 1-km spatial resolution, with very frequent, regional-to-global coverage; moderate to low cost

Parameter	Link	Disease
Gen'l veg. pattern	Habitat opportunities	VBDs (e.g., Tryps)
Veg. green-up	Habitat opportunities	VBDs (Hanta, RVF, WNV)
Water properties	Sediments, pollution	Cholera, Diarrheal diseases
Surface temps	Wet soils, p/v/r/h survival	Schisto, TBDs, WNV
Ocean temps	Plankton blooms, climate	Cholera, RVF
Ocean color	Plankton mats	Cholera
Aerosols	Pollution	Allergies, Asthma

ENVISAT MERIS; Meteosat; NOAA AVHRR; OrbView-2 SeaWiFS; SPOT Vegetation; MODIS

Selected Missions

- Terra – global land data (MISR, MODIS, ASTER)
- Landsat-7 – multispectral, moderate resolution earth images (ETM+)
- EO-1 – land cover, land cover change (ALI, Hyperion)
- TRMM – Tropical Rainfall Mapping Mission
- NOAA-L, M – global atmospheric/surface data (AVHRR)
- SRTM – elevation mapping at 30-m resolution

ASTER
Advanced Spaceborne Thermal Emission and Reflection Radiometer

Detailed maps of land surface temperature, reflectance, and elevation to better understand the interactions between the biosphere, hydrosphere, lithosphere, and atmosphere; onboard Terra

The AST_08 product contains surface temperatures at 90-m resolution generated over the land from ASTER's five thermal-infrared channels. Compare with surface temperatures from MODIS (MOD_11) at 1-km, and NOAA AVHRR at 2-km resolution.

ATTRIBUTES:

- Instruments: VNIR, SWIR, TIR
- Spatial Resolution: VNIR - 15 m; SWIR - 30 m; TIR - 90 m
- Swath: 60 km at nadir, swath center is pointable; across track 106 km (SWIR, TIR) and 314 km (VNIR)
- Repeat Time: 4-16 days

ASTER Example

Source: http://asterweb.jpl.nasa.gov/gallery/default.htm

This ASTER image, acquired on 20 July 2000 shows a 60-km stretch of the Yangtze River in China, including the Xiling Gorge, the eastern of the three gorges. In the left part of the image is the construction site of the Three Gorges Dam, the world's largest. When the reservoir is filled in 2012, water will rise to a height of 175 m, and extend 600 km. Health experts are anticipating an upsurge of schistosomiasis as a result of the changing hydrology.

MODIS
Moderate Resolution Imaging Spectroradiometer

Simultaneous measurements in 36 spectral bands for observations of global dynamics and processes occurring on the land, in the oceans, and in the lower atmosphere; onboard Terra and Aqua.

The MOD_11 data product provides surface temperatures at 1-km resolution; MOD_13 provides daily NDVI at 250- and 500-m resolutions, as well as a Modified Vegetation Index (MVI).

ATTRIBUTES:

- Instrument: Imaging radiometer
- Bands: 36 from 0.4 to 14.5 μm
- Spatial Resolution: 250 m, 500 m, and 1 km
- Swath: 2330 km (across track) x 10 km (along track at nadir)
- Repeat Time: Global coverage in 1-2 days
- Aerosol Product: measures PM; 10km spatial resolution

MODIS Example

This image shows the Mississippi River running lengthwise through the center. The main river channel is surrounded by numerous branches and smaller channels, which once supported a vast wetland ecosystem that bordered the river along its length. Now most of that wetland has been converted to agricultural land.

In this false-color image, vegetation is bright green, water is black, and water with high volumes of sediment is bright blue.

Source: http://modis.gsfc.nasa.gov/gallery/index.php

Hyperion
Hyperspectral Imager

The Hyperion instrument provides a new class of Earth observation data for improved Earth surface characterization. The Hyperion capabilities provide resolution of surface properties into hundreds of spectral bands versus the ten multispectral bands flown on traditional Landsat imaging missions. Through these large number of spectral bands, complex land eco-systems can be imaged and more accurately quantified.

ATTRIBUTES:

- Instrument: Imaging multispectral radiometer
- Bands: 220 from 0.4 to 2.5 μm
- Spatial Resolution: 30 m
- Swath: 7.5 km
- Repeat Time: 16 days

Hyperion Example

Alaska

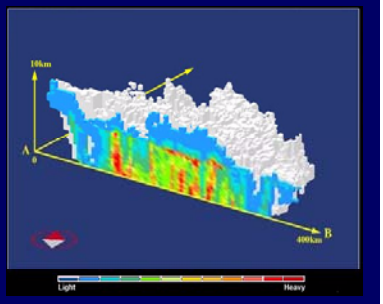
Image Date: 24 November '00
VE Record ID: 6932
Source: http://visibleearth.nasa.gov

PR
Precipitation Radar

3-D rainfall distribution over land and oceans; onboard TRMM

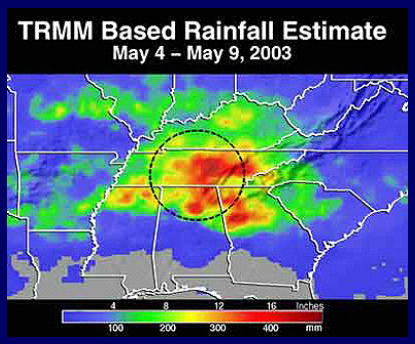
ATTRIBUTES:

- Instrument: L-band radar
- Channels: 13.796 and 13.802 GHz
- Horizontal Resolution (nadir): 4.3 km
- Vertical Resolution (nadir): 0.25 km
- Vertical Coverage: Surface to 15 km
- Swath: 220 km



PR Rainfall Cross Section

TRMM Example



TRMM is able to measure cumulative rainfall in selected areas over short time spans. The Spring of 2003 was very wet in the southeast, with a higher than normal number of tornadoes. In this map of rainfall, TRMM data indicated that up to 16" of rain fell in Tennessee and parts of adjacent Alabama and Georgia over a 6-day period in early May. (Source: http://rst.gsfc.nasa.gov)

SRTM
Shuttle Radar Topography Mission

The objective of the Shuttle RadarTopography Mission was to obtain elevation radar data on a near-global scale to generate the most complete high-resolution digital topographic database of Earth. During the mission, a specially modified radar system flew onboard Space Shuttle Endeavour for 11 days in February 2000. This radar system gathered data that will result in the most accurate and complete topographic map of Earth's surface that has ever been assembled.

ATTRIBUTES:

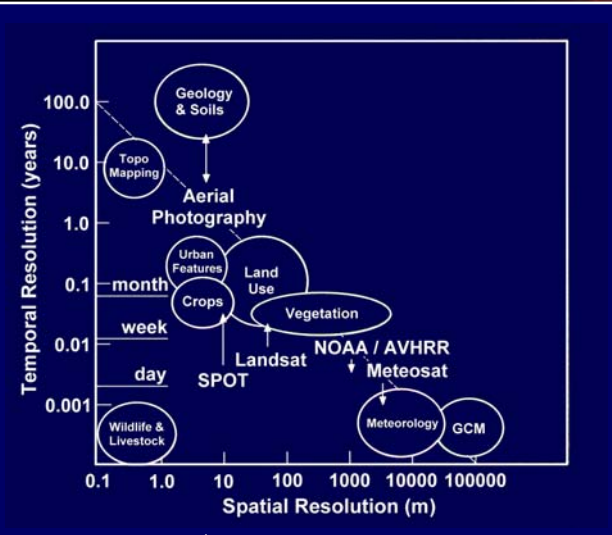
- Instrument: SIR-C/X-SAR multifrequency, multipolarization imaging radar system
- Wavelength: 5.6 cm
- Spatial Resolution: 30 m
- Swath: 225 km

CHAART Sensor Evaluation Interactive Search Engine

http://geo.arc.nasa.gov/health/

More information on *data products* in later presentation

Spatial vs. Temporal Resolution



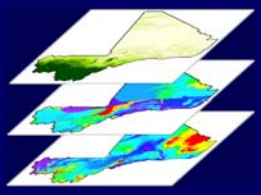
Source: S.I. Hay *et al.*, 1996

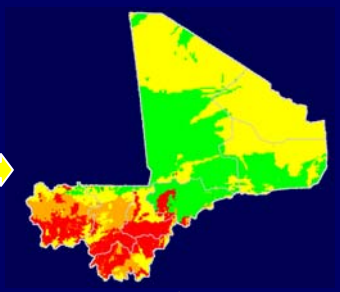
Resolution Issues

Resolution depends on the goal: Research, surveillance, or control?

	Spatial			Spectral			Temporal		
	Low	Med	High	Low	Med	High	Low	Med	High
Research			X		X	X			X
Surveillance	X			X				X	
Control		X			X		X		

Geospatial Disease Modeling





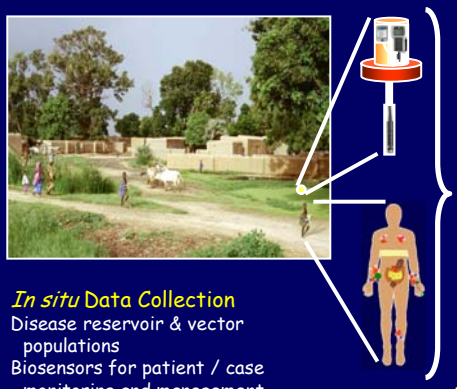
Geospatial Data
- Landcover
- NDVI
- Temperature
- Precipitation
- Epi, field data
- etc.

Data Integration
- Modeling
- Visualization
- Data fusion
- Data mining

Potential Risk

Handheld field computer for updating local conditions

New Tools



Satellite Communication

In situ Data Collection
Disease reservoir & vector populations
Biosensors for patient / case monitoring and management
Environmental parameters
- Meteorological
- Ecological (water quality, etc.)

Mobile Hand-held GIS
GPS for georeferencing
RS/GIS data viewing
Data analysis
Digital imaging
Telecommunication

Central Data Processing
Data fusion/Database development
Data mining
Visualization
Spatial/temporal modeling
Information extraction

Key Questions

- What are the abiotic / biotic factors that determine the spatial / temporal distribution of the disease?
- What are the available epi and field data?
- What is the ultimate goal? (research, surveillance, control? Determines scale, frequency)
- Training, capacity building needed? (Agency commitment?)

Wisconsin Environmental Public Health Tracking Network: Childhood Cancer

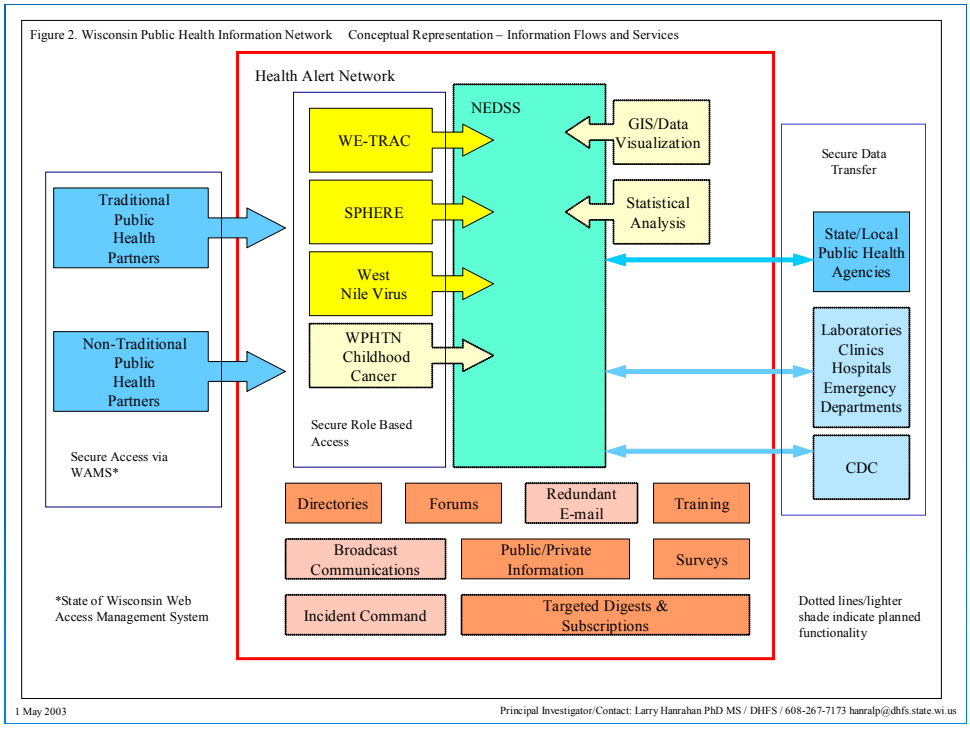
Lawrence P. Hanrahan PhD MS
Senior Epidemiologist & Chief
Epidemiology & Informatics Section
Bureau of Environmental Health
WI Division of Public Health
June 30, 2003
www.han.wisc.edu

Agenda

- Introduction - Wisconsin Public Health Information Network Portal (PHIN)
- Information Systems Architecture
- Program Area Module: Childhood Cancer Environmental Tracking – Information Processes & Data Feed Requirements
- Wisconsin Childhood Cancer Characteristics

CDC \ WI PHIN Functions

1. The Automated Exchange of Data Between Public Health Partners
2. The Use of Electronic Clinical Data for Event Detection
3. Manual Data Entry for Event Detection and Management
4. Specimen and Lab Result Information Management and Exchange
5. Management of Possible Case, Contacts and Threat Data
6. Analysis and Visualization
7. Directories of Public Health and Clinical Personnel
8. Public Health Information Dissemination and Alerting
9. IT Security and Critical Infrastructure Protection



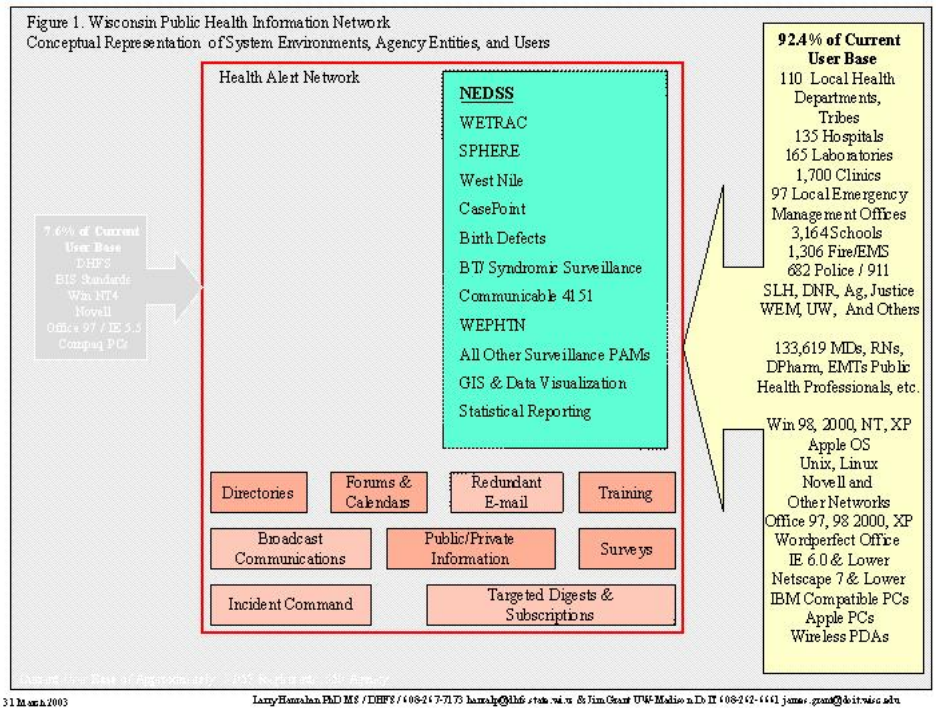
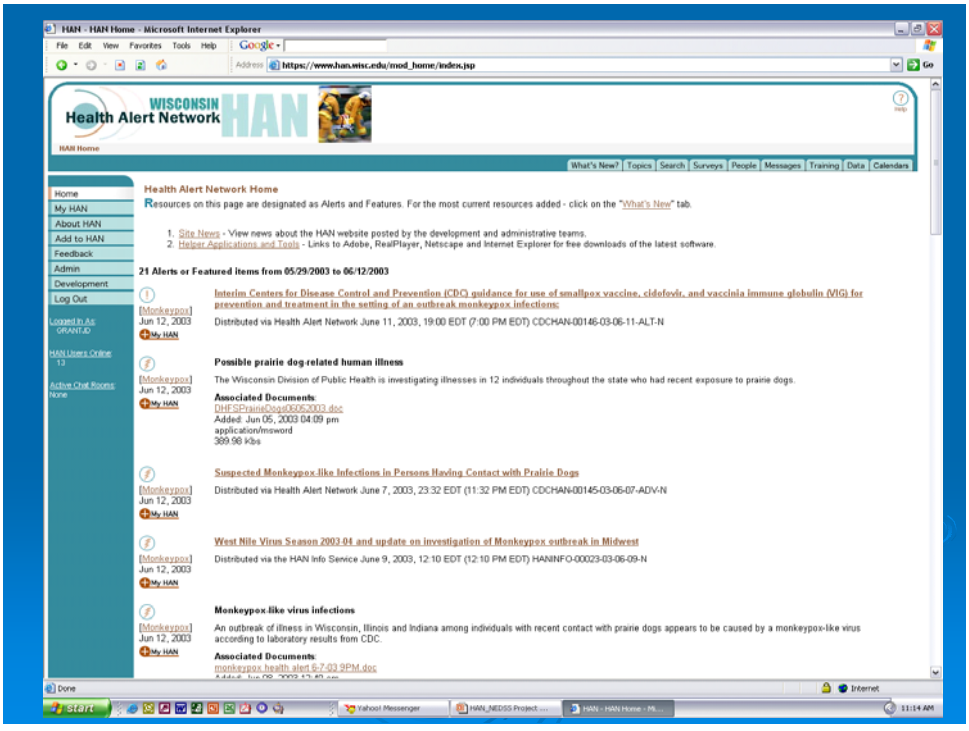


Figure 1. Wisconsin Public Health Information Network
Conceptual Representation of System Environments, Agency Entities, and Users
Health Alert Network
NEDSS
WETRAC
SPHERE
West Nile
CasePoint
Birth Defects
BT/ Syndromic Surveillance
Communicable 41.51
WEPHTN
All Other Surveillance PAMs
GIS & Data Visualization
Statistical Reporting
Directories
Forums & Calendars
Redundant E-mail
Training
Broadcast Communications
Public/Private Information
Surveys
Incident Command
Targeted Digests & Subscriptions
92.4% of Current User Base
110 Local Health Departments, Tribes
135 Hospitals
165 Laboratories
1,700 Clinics
97 Local Emergency Management Offices
3,164 Schools
1,306 Fire/EMS
682 Police / 911
SLH, DNR, Ag, Justice
WEM, UW, And Others
133,619 MDs, RNs, DPharm, EMTs Public Health Professionals, etc.
Win 98, 2000, NT, XP
Apple OS
Unix, Linux
Novell and Other Networks
Office 97, 98 2000, XP
Wordperfect Office
IE 6.0 & Lower
Netscape 7 & Lower
IBM Compatible PCs
Apple PCs
Wireless PDAs
31 March 2003


HAN - HAN Home - Microsoft Internet Explorer
WISCONSIN Health Alert Network HAN
Health Alert Network Home
Resources on this page are designated as Alerts and Features. For the most current resources added - click on the "What's New" tab.
21 Alerts or Featured items from 05/29/2003 to 06/12/2003
Possible prairie dog-related human illness
Monkeypox-like virus infections

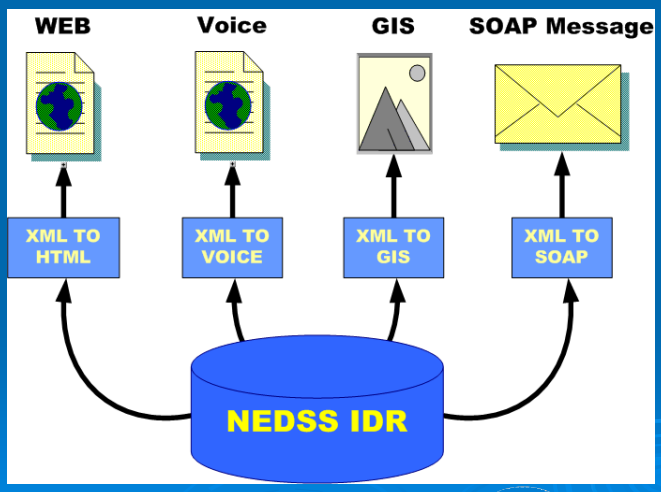
Applications Architecture

- PAM Builder Framework
- MVC Paradigm
- XML Data Model
- XSL Presentation
- JSP Controller

PAM Builder Framework

- Platform Agnostic Java
- Rapid and Low-Risk Development
- Conformance and MVC Adherence
- SQL Maintained in XML Document
- Connection Pooling and Caching
- Developers Love It

MVC Paradigm



Messaging

- Fail Safe Method for Transferring Data
- SOAP (Simple Object Access Protocol)
- Several Layers of Security
- In use at SLH and Milwaukee Laboratory
- Lightweight Message Producer
- Hospital Messaging / Tumor Registry

Security

Security Safeguards

Categories, described by HIPAA \ CDC Checklist:

- Physical
- Technical
- Administrative

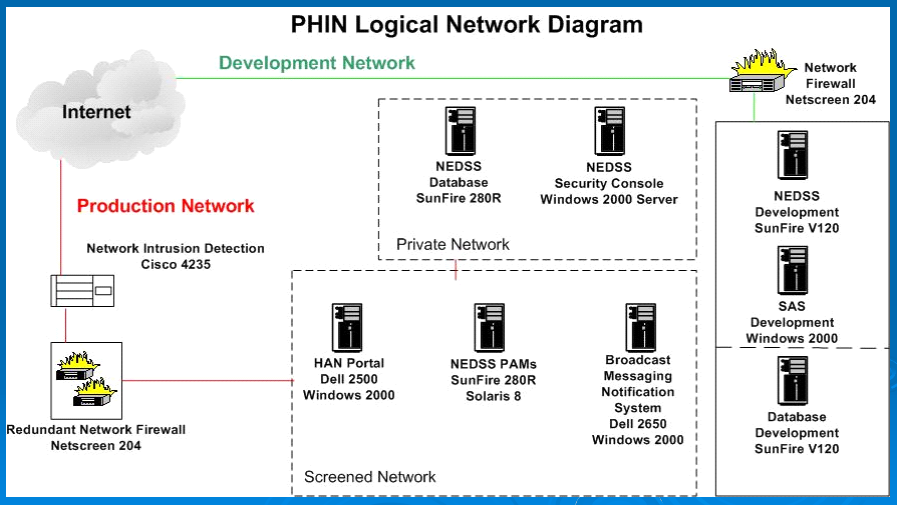
Directory

- Goals
  - Integrate with State Directory Efforts (WAMS)
  - Take advantage of existing infrastructure
  - Comply with CDC recommendations
  - Use industry-standard protocols (LDAP)
  - Public Health Staff White Pages
  - Role Based Access Control
  - Public Health Response

Infrastructure (Software)

- Solaris 8
- Apache 2 Web Server
- Tomcat 4 Application Server
- Apache SOAP Server
- WebLogic 7 J2EE Server
- Oracle 9i

Infrastructure (Hardware)



PAM Inventory

- AIDS Awareness (Production)
- WE-TRAC (Pilot)
- SPHERE (Production Rollout)
- West Nile (Production)
- SLED (Production)
- WBDR (Development)
- CasePoint (Analysis/Development)
- Environmental Tracking (Analysis / Development)

PAM Integration

- Integration with other systems
  - External
    - State lab, Marshfield Clinic, Hospitals
  - Internal
    - Resides on the PHIN Network
    - HAN
    - NEDSS Schema within the IDR

Childhood Cancer Tracking Information Track 1 Hypothesis Generation

- Cancer Case Messaged / Reported
- Record Populates Integrated Data Repository
- Environmental Data Merge
- Data Visualization / GIS
- Geographic / Ecologic / Exposure Risk

Childhood Cancer Tracking Information Track 2 Hypothesis Testing

- Cancer Case Messaged / Reported
- Record Populates IDR
- Case / Control Interview
- Exposure Histories
- Employment & Residential Histories
- Hazard Monitoring
- Biologic Monitoring

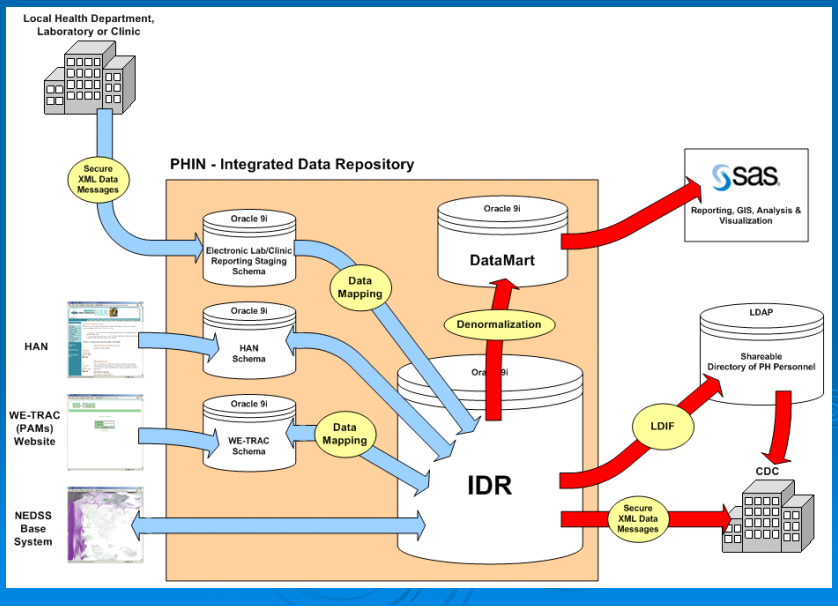
Integrated Data Inventory

- DWS: Drinking Water System
- GRIN: Groundwater Retrieval Information System
- SWAP: Source Water Assessment Plan "database"
- BRRTS: Bureau of Remediation and Redevelopment Tracking System
- GIS (formerly SWAP) RR Data Layer
- RR GIS Registry
- GEMS – Groundwater environmental monitoring system

Integrated Data Inventory

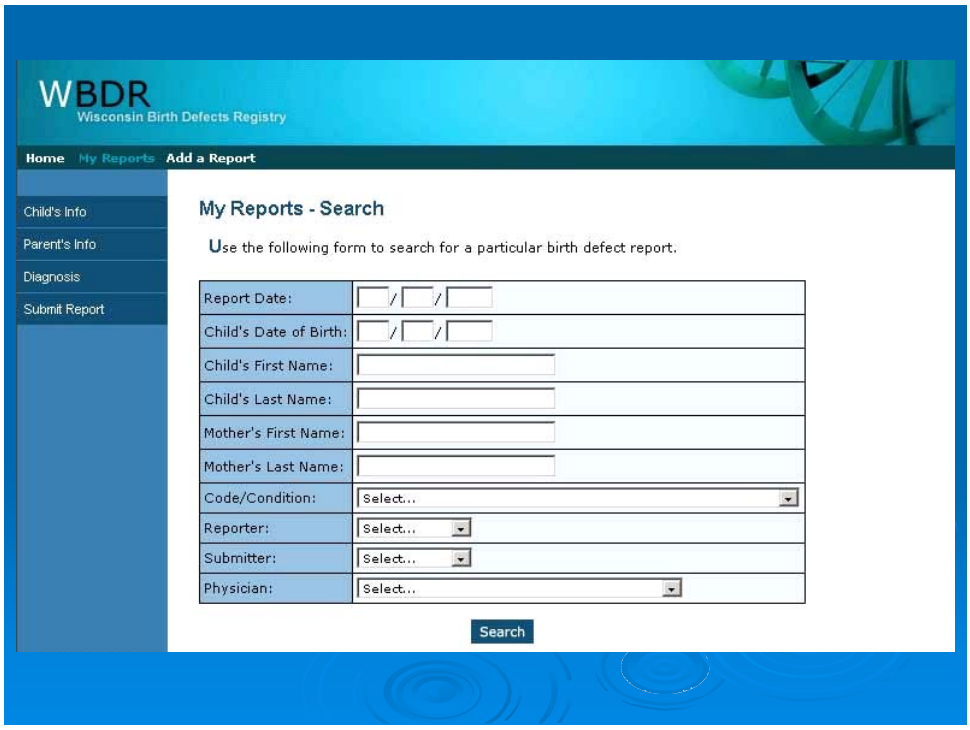
- SHWIMS: Solid & hazardous waste information management system.
- FIST: Field Investigation Site Tracking
- TRI:Toxics Release Inventory
- Air Emissions Inventory
- Great Lakes Air Toxic Emissions Inventory
- Periodic Emissions Inventory
- National Emissions Inventory (NEI)
- Census – Age / Race / Gender

Data Architecture



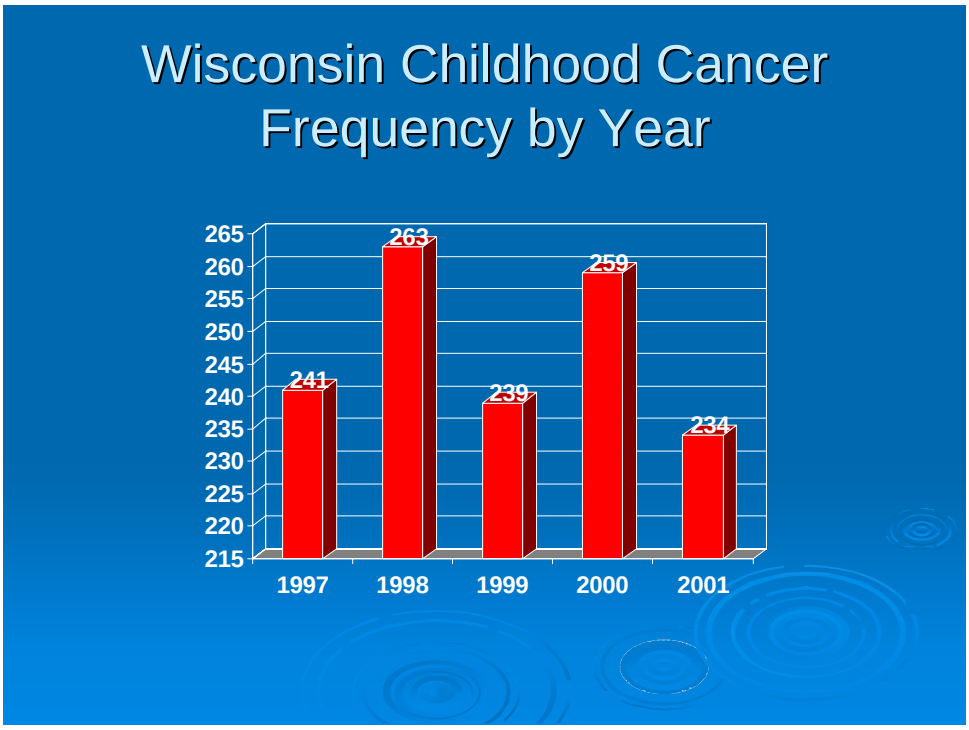
Data Visualization & Reporting Schema / SAS / ESRI

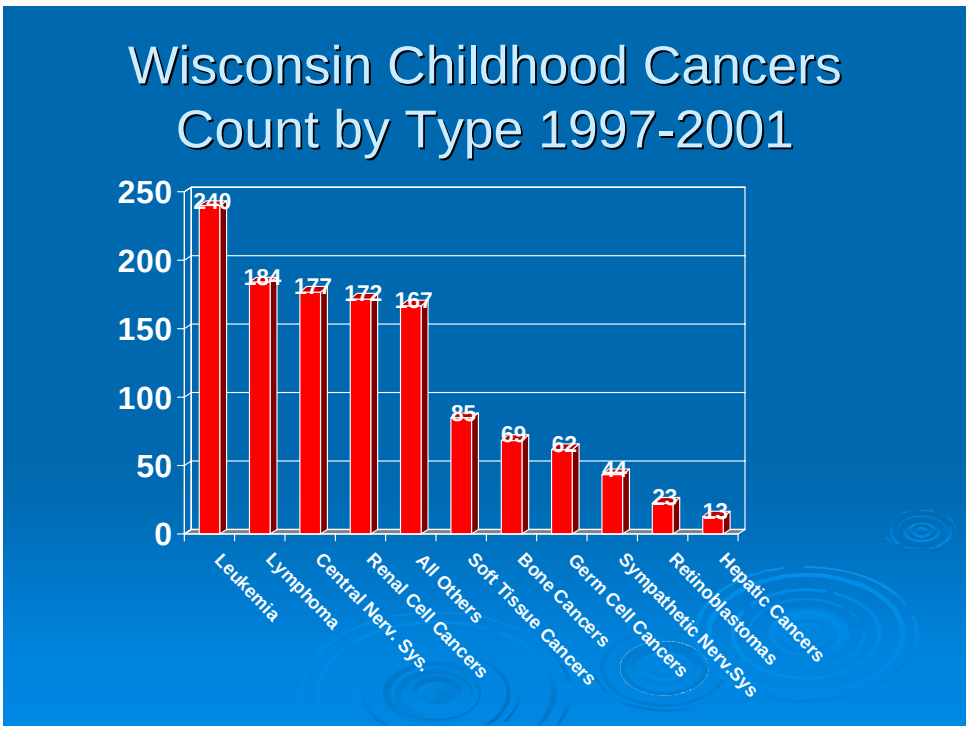
RBAC Level	Case Report / Alerts	Table	Statistic	GIS
Tracking Staff	Yes	Line Listing	Detailed	Detailed
Public Health	No	Fine	Fine	Fine
Public	No	Course	Course	Course



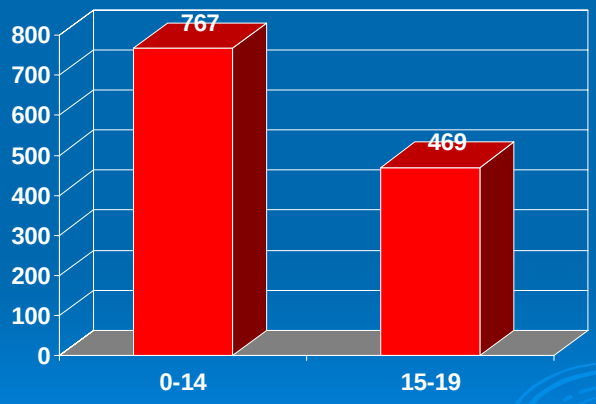
Wisconsin Tumor Registry

- Began in 1978
- Approximately 20,000 Reports Annually
- Incidence / Registry
- Linkage to Mortality
- Approximately 250 Childhood Cases Annually

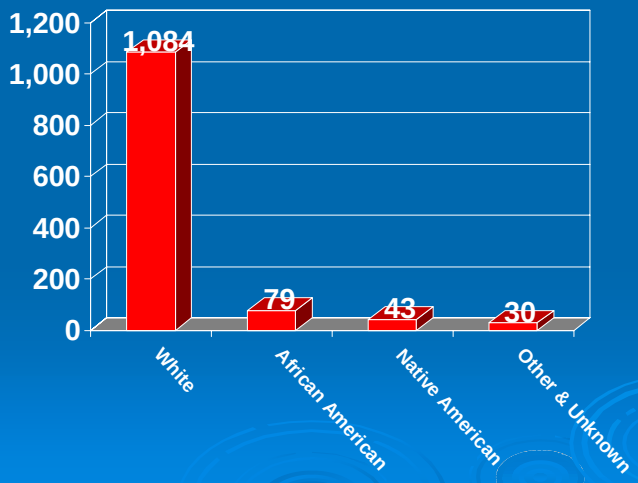

Wisconsin Childhood Cancer Frequency by Year
265
260
255
250
245
240
235
230
225
220
215
241
263
239
259
234
1997
1998
1999
2000
2001


Wisconsin Childhood Cancers Count by Type 1997-2001
250
200
150
100
50
0
240
184
177
172
167
85
69
62
44
23
13
Leukemia
Lymphoma
Central Nerv. Sys.
Renal Cell Cancers
All Others
Soft Tissue Cancers
Bone Cancers
Germ Cell Cancers
Sympathetic Nerv.Sys
Retinoblastomas
Hepatic Cancers

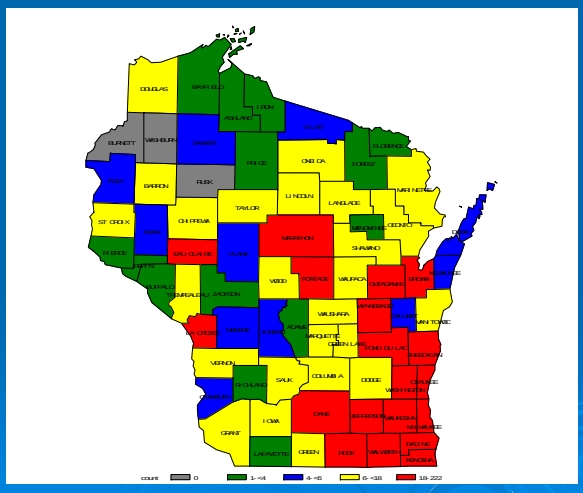
Wisconsin Childhood Cancer Frequency by Age Group



WI Childhood Cancers By Race



Childhood Cancer Counts 1997-2001



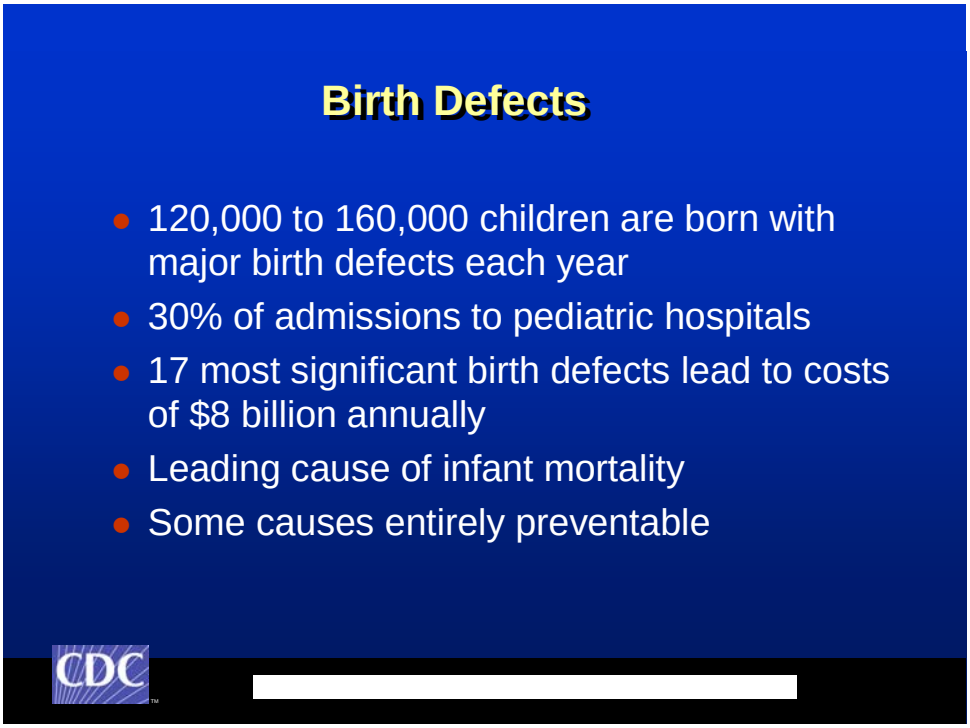
Wisconsin EPHTN Staff

- DHFS Staff
- Henry Anderson, Co-PI, Chief Medical Officer, Bureau of Environmental Health
- Tom Sieger, Co-PI, Director, Bureau of Environmental Health
- Lawrence Hanrahan, Co-PI, Supervisor, Epidemiology and Informatics
- Lynda Knobeloch, Co- PI, Supervisor, Research and Toxicology
- Laura Stephenson, Cancer Reporting System Coordinator
- DATCP Staff
- James Vanden Brook, Water Quality Section Chief
- Cody Cook, GIS specialist
- DNR Staff
- Timothy Mulholland, Organizational Ecologist
- SLH Staff
- George Bowman, Senior Analytical Chemist

Wisconsin Public Health Information Network Staff

- DHFS Staff
- Lawrence Hanrahan, PI, Supervisor, Epidemiology and Informatics
- UW-DoIT Staff
- Ken Ebbe, Supervisor
- Brian Busby, Supervisor
- Jim Grant, HAN Project Management
- Colleen Sims, NEDSS Project Management
- Steve McRoberts, NEDSS Applications Architect
- Steve Fosdal, Data Architect
- Mike Eubank, Applications Development
- Luke Fessler, Applications Development
- Nathan Maurer, Applications Development
- Guy Peyrot, Applications Development
- Robert Laurer, Applications Development
- Jeff Savoy, Security Officer
- Tom Jordan, LDAP Directory
- Dave Penpek, User Support
- Jake Simon, User Support
- Cathy O'Bryan, Training Support
- Kevin Thompson, Training Support
- Mary Waitrovich, Multimedia Support


Welcome to
The National Center on Birth Defects and Developmental Disabilities
Promoting the health of babies, children, and adults, and enhancing the potential for full, productive living
Owen J. Devine
June 30, 2003
CDC


Birth Defects
120,000 to 160,000 children are born with major birth defects each year
30% of admissions to pediatric hospitals
17 most significant birth defects lead to costs of $8 billion annually
Leading cause of infant mortality
Some causes entirely preventable
CDC

Developmental Disabilities

- Cause 12% of school age children to need special education
- Cost over $36 billion for special education
- Most causes unknown

National Center on Birth Defects and Developmental Disabilities

- Prevent birth defects and developmental disabilities that we know how to prevent;
- Pursue causes and risk factors of those we don't know how to prevent;
- Promote wellness of individuals living with a disability
- Partner with organizations with similar missions

Public Health and People with Developmental Disabilities: NCBDDD Mission…

Surveillance Systems

- prevalence rates and trends
- registry of cases
- monitor prevention programs

Epidemiologic Studies

- identify risk factors
- identify protective factors
- address public concerns

Prevention Programs

- prevention strategies
- public policy
- health education

CDC

National Center on Birth Defects and Developmental Disabilities

Surveillance and Research

CDC


Cooperative Agreements for Birth Defects Activities
Centers for Birth Defects Research and Prevention
Arkansas
California
CDC
Iowa
Massachusetts
New Jersey
New York
North Carolina
Texas
Utah
Arizona
Connecticut
Illinois
Louisiana
Puerto Rico
Rhode Island
Washington
Wisconsin
Alabama
Alaska
Colorado
DC
Hawaii
Indiana
Kentucky
Maine
Michigan
Missouri
Minnesota
Montana
New Hampshire
New Mexico
North Carolina
Oklahoma
South Carolina
Utah
Virginia
West Virginia
CDC
SAFER • HEALTHIER • PEOPLE™


NATIONAL BIRTH DEFECTS PREVENTION NETWORK
NBDPN
SURVEILLANCE · RESEARCH · PREVENTION
www.nbdpn.org/NBDPN
CDC

National Birth Defect Prevention Network

- Improve quality of surveillance data
- Promote scientific collaboration
- Provide technical assistance for data collection
- Facilitate the dissemination of information
- Compile and make available state surveillance data

National Birth Defects Prevention Network

- Annual report published in *Birth Defects Research*
- Surveillance Guidelines & Standards
- Collaborative research projects
  - Neural Tube Defect Ascertainment Project

Centers for Birth Defects Research and Prevention

- Support states in efforts to:
  - Enhance/develop birth defect surveillance systems
  - Use these data for prevention/intervention programs
- National Birth Defects Prevention Study

National Birth Defects Prevention Study

Purpose

- Test hypotheses regarding etiology
  - Suspected teratogens
  - Gene-environment interactions
  - Gene-gene interactions

National Birth Defects Prevention Study

Description

- Case-control study of major birth defects
- Clinical database entry/review
- Maternal interview
- Buccal cell (DNA) collection
- Over 10,000 interviews completed

ADDM Network
Autism and Developmental Disabilities Monitoring Network

- State groups funded by CDC to establish population-based surveillance programs for autism and related disabilities
- Goal is for each state to identify, as completely as possible, all ASD cases of selected ages in their study areas
- Current ADDM states: Arizona, Arkansas, Florida, New Jersey, South Carolina, Utah and West Virginia.

CADDRE
Centers for Autism and Developmental Disabilities Research and Epidemiology

- Mandated by Children's Health Act of 2000
- Participants: California, Colorado, Maryland/Delaware, North Carolina and Pennsylvania
- Goals:
  - Monitor trends in autism spectrum disorders
  - Investigate causes of autism spectrum disorders; collaborative case-control study
  - Conduct individual center-specific projects
  - Provider and community outreach and education

Metropolitan Atlanta Congenital Defects Program (MACDP)

- Population-based surveillance system operating continuously since 1968
- Five counties in metro Atlanta
- Intensive case ascertainment of major birth defects
- Case registry for epidemiologic studies

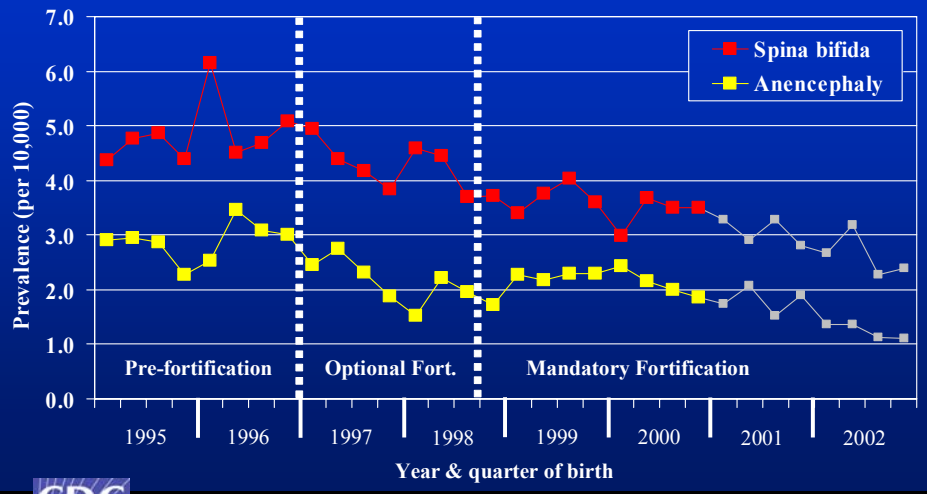
Metropolitan Atlanta Developmental Disabilities Surveillance Program (*MADDSP*)

- Population-based surveillance system initiated in 1981((*MADDS*); *MADDSP* since 1991
- Five counties in metro Atlanta
- Active surveillance based on record review
- Mental retardation, cerebral palsy, vision and hearing impairment; autism added for 1996 study year
- Children aged 3-10, 1991-1994 and 1996 for autism; 8 year olds in future
- Multiple sources (schools, clinics/medical sources)

National Center on Birth Defects and Developmental Disabilities

Prevention Activities

Prevalence of spinal bifida and anencephaly among all surveillance programs



CDC

Birth Defects Surveillance and Environmental Epidemiology

- ~45 state birth defects surveillance systems
  - 28 Cooperative Agreements awarded
  - 8 Centers for Birth Defects Research and Prevention
- Several surveillance systems have used data to evaluate environmental concerns and are interested in continuing related research
  - Reproductive effects of contaminated drinking water
  - Cardiac and craniofacial birth defects and ambient air pollution

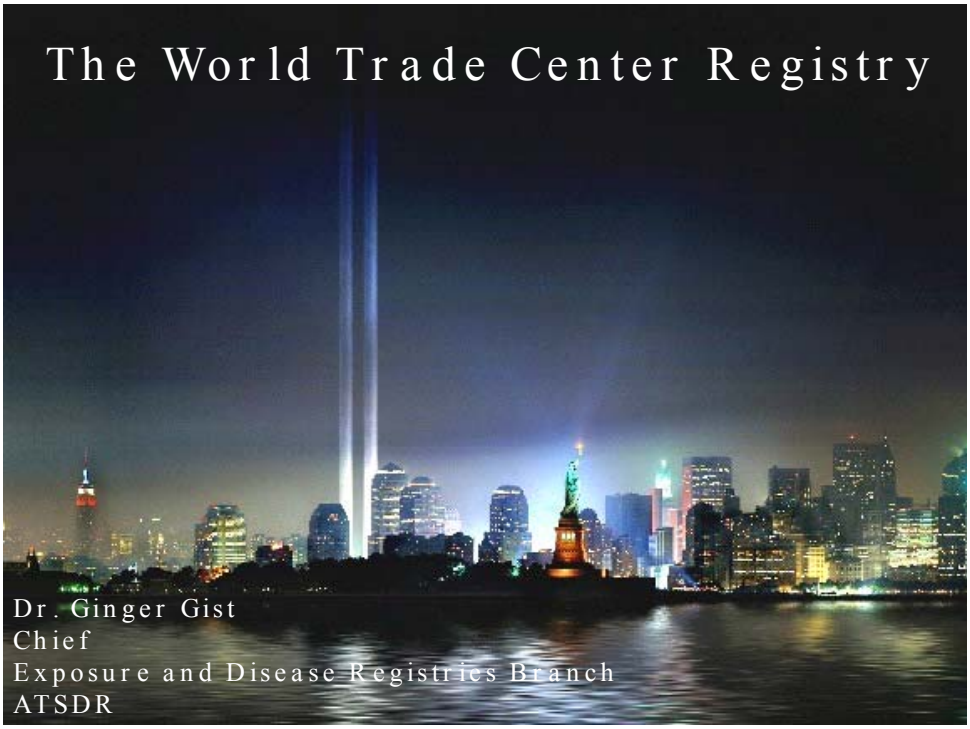
CDC

NCBDDD Website

www.cdc.gov/ncbddd/

Ginger Gist
"ATSDR Environmental Data Needs"

ATSDR Environmental Data Needs



The World Trade Center Registry

Registry of people who worked or lived in the vicinity of the World Trade Center (WTC) site September 11 through December, 2001.

Aim: to measure short and long term health and mental health effects of exposures from the attacks and ensuing smoke, dust, and airborne substances.

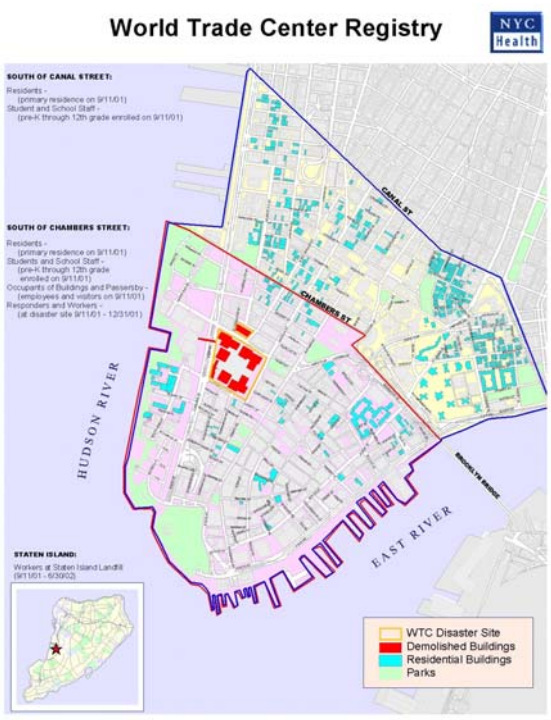
The World Trade Center Registry

September 11, 2001

Target populations

Enroll up to 200,000 persons including:

Geographical Boundaries and Eligibility Criteria



The World Trade Center Registry

- Occupants in non-residential buildings and passers-by south of Chambers Street on September 11, 2001

The World Trade Center Registry

- Persons with primary residence south of Canal on September 11, 2001

The World Trade Center Registry

- Students and staff in schools pre-K thru 12 south of Canal Street

The World Trade Center Registry

- Emergency, long-term responders, and clean up workers at WTC site and Staten Island Landfill

The World Trade Center Registry

Objectives

Identify patterns of illness and pinpoint their origins earlier than would be possible without a registry

Perform exposure analyses and disseminate prevention and public health policy information

Provide a centralized database of exposed persons for use in future epidemiological studies

The World Trade Center Registry

Rationale for selection of target populations

- Exposure to the actual event
- Exposure to the area immediately after the attack
- Ongoing exposures related to rescue, recovery and clean-up of the site (i.e., workers at the site) or living, working, or attending school
- Other affected individuals including residents, children enrolled in schools, persons employed in destroyed or damaged buildings, and workers handling WTC debris at the Staten Island landfill

The World Trade Center Registry

Target populations

Group	Estimated Size (Active tracing)	Expected Enrollment
Building occupants and passers-by south of Chambers St. on September 11, 2001	250,000 (?) (100,000)	100,000
Residents south of Canal St.	57,000 (28,000)	40,000
Site workers	25,000 (20,000)	20,000
Students and staff in schools	10,000 (?) (10,000)	5,000

Data Collection

Interviews

Telephone via CATI (90%), face-to-face via CAPI (10%)

Data elements:

Demographic information

Exposure information (i.e., location on 9/11, time at site on 9/11, etc.)

Health and mental health since 9/11

Ways to contact the registrant in the future

Use of the Data

- Evaluating the impact of September 11 on different exposure groups
- Matching of data against other databases such as cancer and death registries
- Data repository for future research

WTCR Web Site

- www.nyc.gov/health/wtcregistry

The Tremolite Asbestos Registry

Libby, Montana

TEST RESULTS

Based on asbestos medical testing by two or more doctors on people living in Libby.

Incidence of lung abnormalities

- Among former workers at the town's mine, run by W.R. Grace
  48%
  Test group: 159 of 328 people
- Among residents of the town 18 years or older
  18%
  Test group: 5,590 people
- Among the general population nationally
  0.2-2.3%

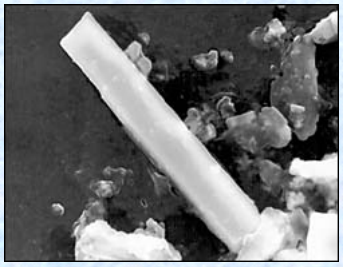
Source: Agency for Toxic Substances and Disease Registry

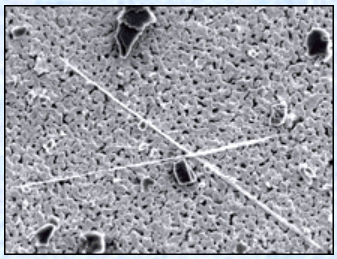
Vermiculite Mining

Uses of Vermiculite

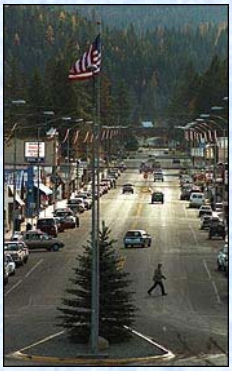
- Moisture reservoirs in potting soil
- Insulation

Tremolite Asbestos

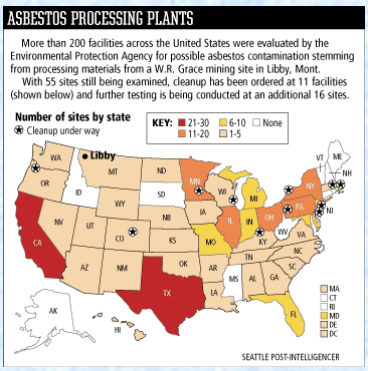




Current Status of the Libby, Montana Vermiculite Site



Other Potential Tremolite Asbestos Registry Sites



Statistical Methods for Linking Health/Exposure/Hazards

F.J. Mather, L.E. White
ATSDR/CDC/NASA Round Table
June 30-July 1, 2003

Tulane University
School of Public Health and Tropical Medicine

Outline

- Definitions
- Exposure Assessment
- Study Designs
- Ecological Studies, Problems, Bias
- Statistical Methods

Definitions

- Environmental Epidemiology
- Measurement of Disease
- Measurement of Exposure
  - Complex Mixtures vs. Single Agents
  - Time
  - External vs. Internal
    - Exposure vs. Dose
    - Hazard vs. Exposure

Exposure Assessment*

- Interviews, questionnaires, diaries
- External media (macro-environment)
- Concentrations in personal or micro-environment
- Individual doses
- Measurement of concentrations in human tissues
- Markers of physiologic effects (past exposure

*Hertz-Picciotto

Study designs

- Cohort
- Case-control
- Cross-sectional
- Community intervention
- Ecological studies

Ecologic Bias (1)

- Some confounding cannot be controlled in ecologic analyses
- Ecologic bias can arise when inferences are drawn about association on the individual level based on analyses conducted at the group level.

Ecologic Bias (2)

- Protection against bias is enhanced
  - smaller geographic units are used
  - analyses are stratified into subgroups of the population with more homogeneous disease risk.

Statistical Methods

- Mapping/Smoothing
- Clustering
- Hierarchical models
  - Empirical
  - Bayesian

Mapping/Smoothing

- Non parametric smoothing
- Kriging
- Robust thin plate spline
- Head banging
- Empirical Bayes
- Full Bayesian

Clustering

- Traditional
  - Pearson Chi-Square, Potthoff &Whittinghill
- Distance adjacency
  - Autocorrelation, Whittemore, Tango, K-functions
- Moving Window
  - Openshaw, Besag &Newell, Scan Stats, Cuzick & Edwards
- Risk Surface
  - Kernal Methods, General additive models, Geospatial, Disease mapping

Hierarchical Models (Empirical Bayes)

Level 1: $Y_i \sim \text{Poisson}(E_i\theta_i)$

Level 2: $\log(\theta_i) = \alpha + X_i^T\beta + U_i + V_i$

Where X_i are area level covariates with random effects

$U_i | U_j \sim N(u_i, \omega_u^2/m_i)$ spatial clustering $j <> i$

$V_i \sim N(0, \sigma_v^2)$ heterogeneity

Hierarchical Model (Bayesian Approach)

- Model is the same
- Prior distributions of α, β, ω_u^2, σ_v^2
- Can have hyper-priors where the parameters of the estimates have priors
- Compute the posterior distribution of parameters (Winbugs, Gibbs Sampler)

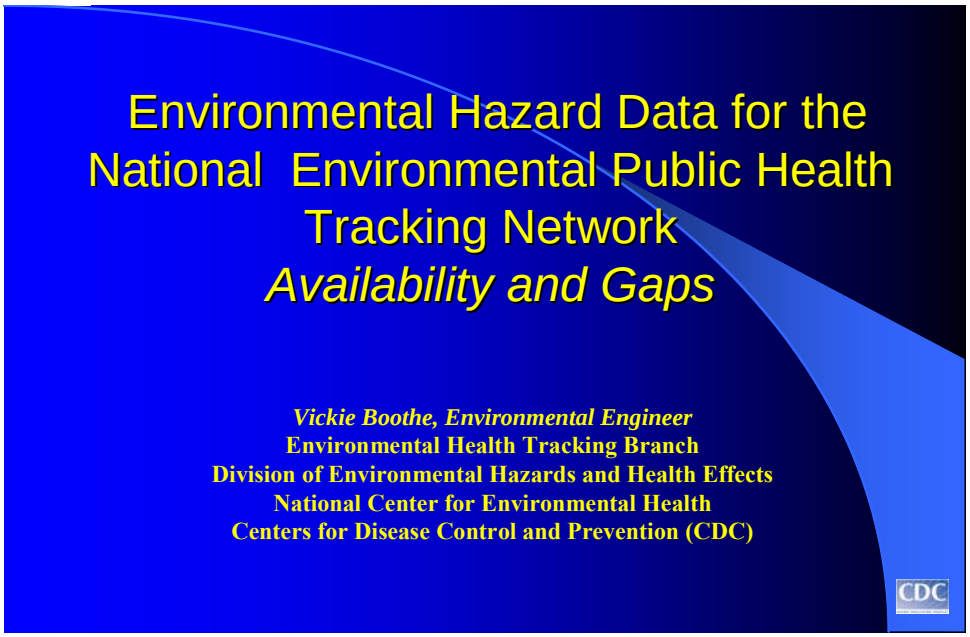
Bias in Enviro. Health studies

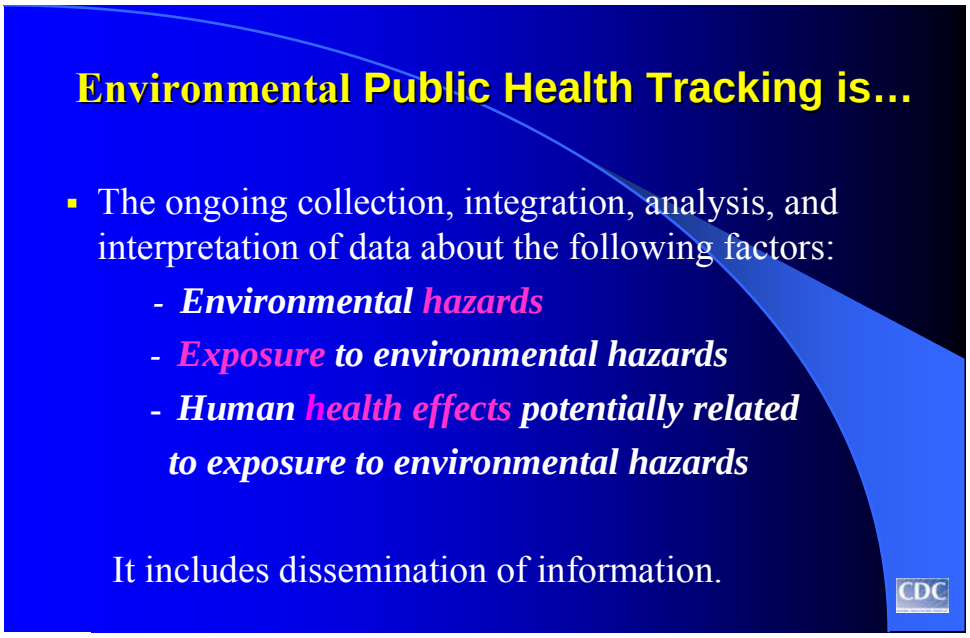
- Selection bias
- Ascertainment, numerator and denominator
- Disease induction and mis-specification of the exposure-disease model
- Exposure inaccuracy bias and errors in variables modeling
- Spatial dependency
- Significance tests
- Ecological bias
- Socio-economic confounding

References

- Elliott P, Wakefield J, Best N, Briggs D. Spatial Epidemiology Methods and Applications. Oxford University Press. 2001
- Rothman KJ, Greenland S. Modern Epidemiology. Chapters 28, 23,20,21

Vickie Boothe
"Environmental Hazard Data for the National Environmental Public Health Tracking Network Availability and Gaps"





Nationally Integrated Environmental & Health Data Can Be Used To:

- **Compare Trends**
  - *Hazards & Health Effects Over Time*
- **Identify Patterns**
  - *Distribution Hazards & Health Effects*

Note: NEPHTN data cannot be used to determine **cause.**

CDC

Desirable Characteristics for Hazard Data in the NEPHTN

- **Ongoing, Systematic Collection**
- **National in Scope**
- **Std Collection/Reporting Methods**
- **QA/QC Procedures**
- **Temporal & Location Variables**
- **Fine Resolution of Data**
- **Timely Availability**
- **Related to Human Exposure**

CDC

Appropriate Environmental Hazard Data for the NEPHTN Determined by:

- *Specific Question Asked*
- *Health Effect of Interest*
- *Type Exposure (Acute vs Chronic)*

CDC

Example questions that may be asked of the NEPHTN include…

- *Do asthma hospitalizations increase as concentrations of ozone or particulate matter rise? Is there a threshold concentration?*
- *Is there an identifiable pattern between the location of childhood leukemia cases and high levels of benzene, carbon tetrachloride and /or trichloroethylene (TCE) in the environment?*
- *Are Persistent Bioaccumulative Toxins (PBTs) such as mercury, PCBs, and dioxins in the environment impacting public health?*

CDC

Examples of National Data Available for Answers to Questions Include

- Air Pollution
  - Ambient Monitoring
  - Source/Facility Data
- Water Quality
  - Ambient Monitoring
  - Source/Facility Data
- **Drinking Water**
  - Compliance Status
  - Sources
- Hazardous Waste
  - Storage, Transport, Disposal
  - Superfund Site Data
- **Toxic Substances**
  - Pesticide Mfg , Use, Incidents
  - Facility Releases
- **Chemical References**
  - Physical/Chemical Properties
  - Standards & Health Effects

CDC

Initial Evaluation – Data Sets Closest to Meeting Desirable Characteristics

- Ambient Air Monitoring
  - ***Criteria Pollutants***
  - ***Urban Air Toxics***
- Emissions Inventories
  - ***Criteria Pollutants***
  - ***Air Toxics***

CDC

CRITERIA POLLUTANTS

AMBIENT MONITORING PROGRAM

CDC

Ambient Air Monitoring: Criteria Pollutants

The Clean Air Act requires EPA to set national ambient air quality standards which will protect public health with an ample margin of safety for the following 6 pollutants:

- Ozone
- Nitrogen Dioxide
- Particulate Matter
- Carbon Monoxide
- Sulfur Dioxide
- Lead

CDC

Air Pollution Monitoring Program

- ***The Air Pollution Monitoring program monitors all of the six criteria pollutants. The purpose is:***
  - To judge compliance with and/or progress made towards meeting ambient air quality standards.
  - To activate emergency control procedures that prevent or alleviate air pollution episodes.
  - To observe pollution trends throughout the region, including non-urban areas.
  - To provide a data base for research; development and evaluation of abatement strategies; and development and validation of diffusion models.

Three Types of Criteria Pollutant Monitoring Networks

- National Air Monitoring Networks (NAMs)
  - 1,080 stations
  - quarterly data submittal
  - comparisons & trends
- State & Local Air Monitoring Networks (SLAMs)
  - 3,150 stations, 5000 samplers
  - annual data submittal
  - violations/attainment status
- Photochemical Air Monitoring Networks (PAMs)
  - Serious, Severe, Extreme Areas
  - 56 VOCs, carbonyls (acetone, acetaldehyde, formaldehyde), total oxides of nitrogen (NOy)

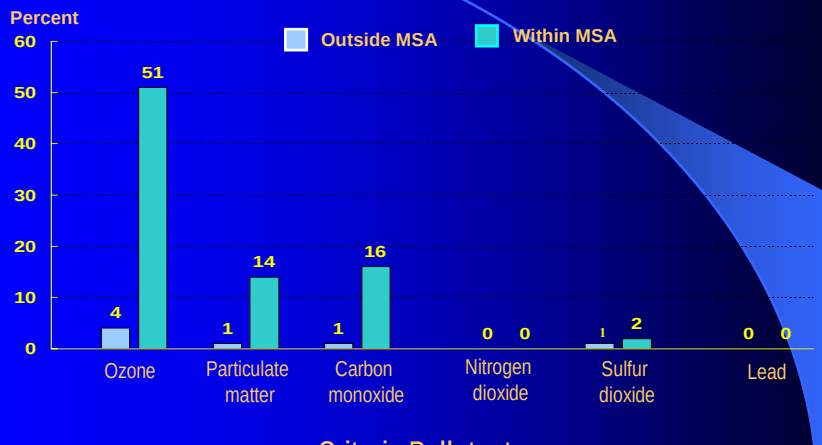
CDC

Criteria Pollutant Monitors - General Information

- Urban Areas > 200,000
  - *Minimum 2 Monitors*
- Sampling Frequency
  - *O3, CO, SOx, NOx – Hourly*
  - *PM10, PM2.5, Lead – 24hrs/6 days*
- Seasonal Data
  - *03 summer*
  - *PM winter*
- More Pollution – More Monitors

CDC

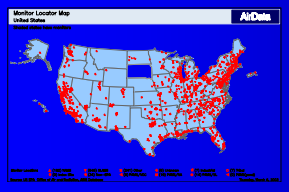
Persons Living in Non-Attainment Areas, 2001



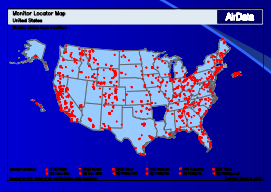
CDC

Criteria Pollutant Monitors

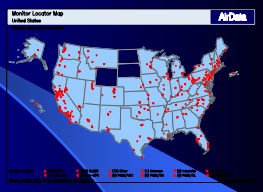
Ozone



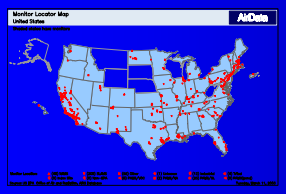
Particulate matter



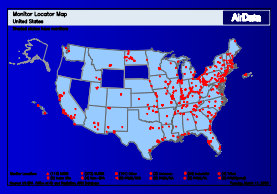
Carbon monoxide



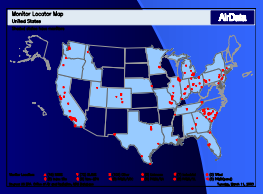
Nitrogen dioxide



Sulfur dioxide



Lead

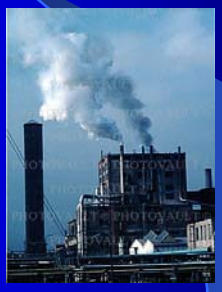


Examples of Available Air Monitoring Data Criteria Pollutants

- Data Variables
  - LONGITUDE/LATITUDE
  - INTAKE ELEVATION
  - MONITOR TYPE
  - SAMPLING FREQUENCY
  - SAMPLING INTEVAL
  - MEASUREMENT SCALE
  - MAX VALUE
  - COLLECTION METHOD
  - ANNUAL SUMMARY
- Monitor Objective Codes
  - UPWIND BACKGROUND
  - MAX PRECURSOR EMISSIONS I MPACT
  - MAX OZONE CONCENTRATION
  - EXTREME DOWNWIND
  - OTHER
  - POPULATION EXPOSURE
  - REGIONAL TRANSPORT
  - WELFARE RELATED

URBAN AIR TOXICS

MONITORING PROGRAM



Urban Air Toxics

(33 of 188 HAPs)

Acetaldehyde	Coke oven emissions	Manganese compounds
Acrolein	Dioxins	Mercury compounds
Acrylonitrile	1,2-dibromoethane	Methylene chloride
Arsenic compounds	1,3-dichloropropane	Nickel compounds
Benzene	Propylene dichloride	Polychlorinated biphenyls
Beryllium compounds	Ethylene dichloride	Polycyclic organic matter
1,3-butadiene	Ethylene oxide	Quinoline
Cadmium compounds	Formaldehyde	1,1,2,2-tetrachlorethane
Carbon tetrachloride	Hexachlorobenzene	Tetrachloroethylene
Chloroform	Hydrazine	Trichloroethylene
Chromium compounds	Lead compounds	Vinyl chloride

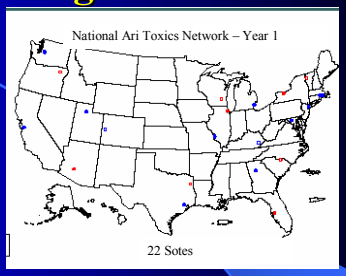
Source: U.S. EPA 1999

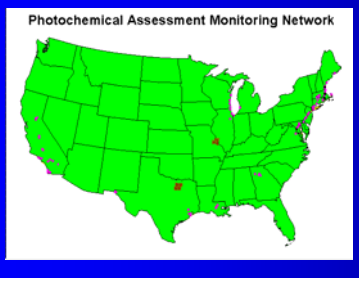
Urban Air Toxics – Monitoring Program

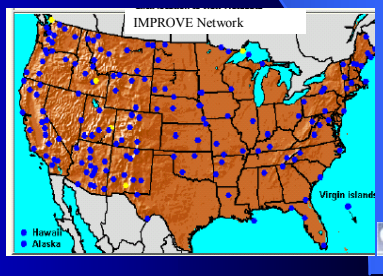
- Pilot Program – 300 sites/18 core compounds
  - 12 VOCs including benzene, methylene chloride, perchloroethylene, and vinyl chloride;
  - 9 metals including lead, arsenic, chromium and mercury;
  - 3 aldehydes,
  - 2 other HAPs - hexachlorobenzene and polycyclic organic matter.
- PAMs Network – 9 HAP compounds - - -
  Formaldehyde, Toluene, Benzene, Ethylbenzene, Xylenes, Hexane, Styrene, 2,2,4-Trimethylpentane Acetaldehyde
- Improve (Haze Network) – 10 metals
  - - antimony, arsenic, beryllium, cadmium, chromium, cobalt. lead. manganese nickel, selenium

CDC

Air Toxics Monitoring Sites





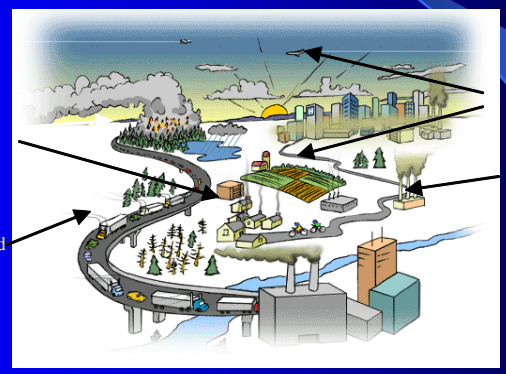


CDC

NATIONAL EMISSION INVENTORIES

What Is An Emission Inventory?

Inventory - current comprehensive listing by sources of air pollutant emissions in a geographic area during a specific time period



Inventories Contain Background Information

- Procedures used to collect data
- Data sources
- Copies of questionnaires and results
- Citations for all emission factors
- Methods used in calculations
- Documentation of assumptions
- QC/QA Description/Plan
- Sources not included
- List of references

CDC

NATIONAL EMISSION INVENTORY

Criteria Pollutants

CDC

NATIONAL EMISSIONS INVENTORY
Criteria Pollutants

- Ozone Precursors
  - ***Total VOCs & NOx***
- Particulate Matter
  - ***PM_{10} & $PM_{2.5}$***
- Sulfur Dioxide
- Carbon Monoxide
- Nitrogen Dioxide
- Lead

CDC

SOURCE TYPES IN THE NATIONAL EMISSIONS INVENTORY

- **Stationary Sources**
  - ***Point Sources*** *(power plants, manufacturing facilities))*
  - ***Area Sources*** *(gas stations, dry cleaners, agricultural burns)*
- **Mobile Sources**
  - ***On-road*** *(e.g., cars, trucks, buses)*
  - ***Off-road*** *(e.g., planes, trains, garden equipment)*
- **Biogenic Sources**
  - *Includes trees, plants, crops, etc.*

CDC

EMISSIONS INVENTORY DATA
CRITERIA POLLUTANTS

- Facility data - address & latitude/longitude.
- Emissions data - ***estimations of projected*** annual emissions by pollutant and source
- For seasonal programs such as ozone, emissions estimates for a "typical summer day"
- Emissions inventories updated by the states every three years

CDC

NATIONAL EMISSION INVENTORY
Hazardous Air Pollutants
(Air Toxics)

CDC

HAP EMISSION INVENTORY
Speciated Data

- Metals
  - Chromium – hexavalent and trivalent
  - Lead - organic and inorganic
  - Mercury - particulate, gaseous elemental, gaseous divalent
  - Nickel - nickel subsulfide and other nickel
- POM
  - 7- PAH
  - Other PAHs with cancer assessments
- Dioxins/Furans
  - TEQ and non-TEQ
- Xylenes, Cresols, Glycol Ethers
  - Xylenes - xylenes mixture of o, m,
  - Cresols - cresols/cresylic acids mixture
  - Glycol ethers - report as a group, only include glycol ethers, EGBE delisted from section 112 HAPs

CDC

SOURCE TYPES IN THE NATIONAL HAP EMISSIONS INVENTORY

- **Major Sources** - ***potential to emit 10 tons/year of one HAP or 25 tons/year total HAPs***
- **Area Sources** – ***any stationary source not defined as a major source***
- **Mobile Sources** – ***on-road vehicles, off-road vehicles, non-road diesel engines***

CDC

At What Level of Detail Are Inventories Compiled?

- **Point Source**
  - Plant
  - Unit
  - Process
  - Stack (release point)
- **Nonpoint Source**
  - State
  - County level
  - Tribe
  - Other (community assessments)

CDC

Where We Are Today

Data Availability & Gaps

- **Air Quality Monitoring**

  Desirable characteristics

  - Ongoing, systematic collection of monitored data
  - Fine resolution- frequent sampling
  - Std Collection/Reporting Methods
  - QA/QC Procedures
  - Temporal & Location Variables

  Gaps

  - Limited geographic coverage
  - Some not related to exposure

- **Emission Inventories**

  Desirable characteristics

  - Broad national geographic coverage
  - Includes all types of sources (Point, Area, Mobile, Biogenic)
  - Std Collection/Reporting Methods
  - QA/QC Procedures
  - Temporal & Location Variables

  Gaps

  - Estimates of Projected Emissions

CDC

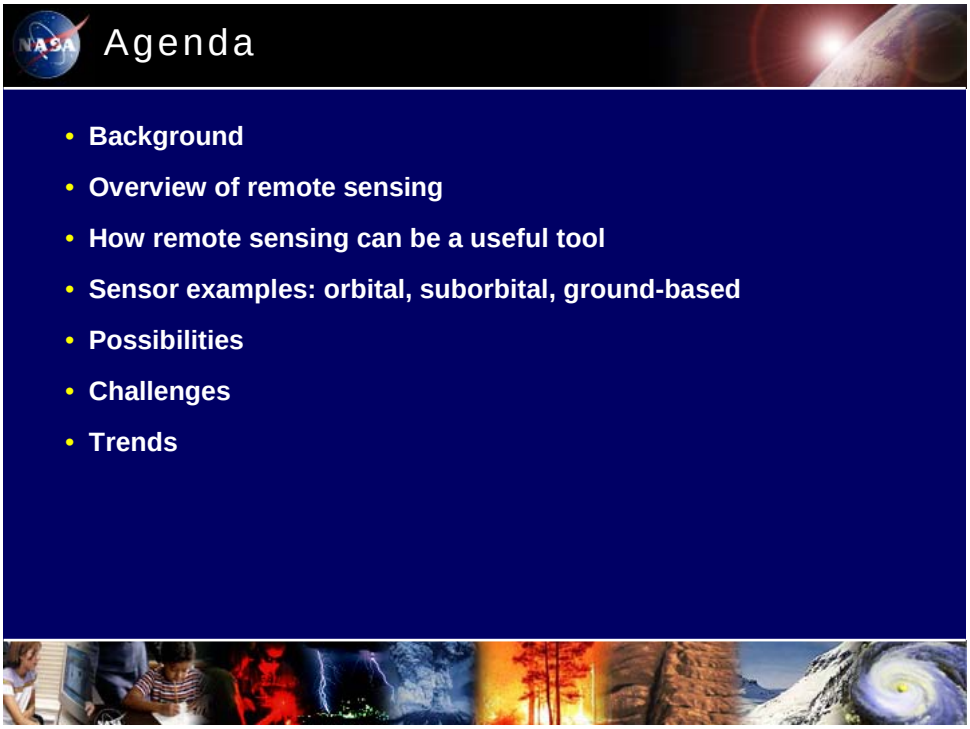
Where We Would Like To Get To

- Max & Avg Conc – Census Block
- Close to Real-Time Data

- Ozone
- PM
- Hg
- PCBs
- Dioxins
- Furans
- Metals
- Organophosphate Pesticides
- TCE
- Benzene
- Toluene
- Methylene Chloride
- Xylene
- Formaldehyde

CDC

Timi Vann
"Sensor Technology Overview"



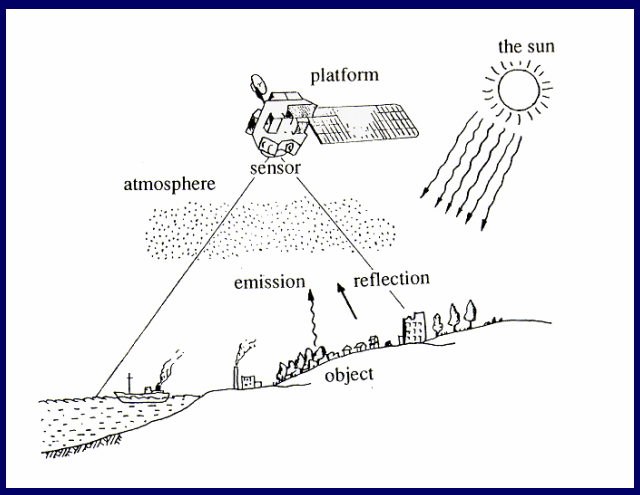
Background

- **NASA's Earth Science Enterprise is responsible for developing a scientific understanding of the Earth system to enable improved predictions of climate, weather, and natural hazards.**
- **NASA scientists use *remote sensing technology* as a tool to acquire detailed information about the Earth.**
- **Remote sensors collect measurement data on physical characteristics. These data can be used to characterize, understand, and predict environmental phenomena and to improve decision making.**

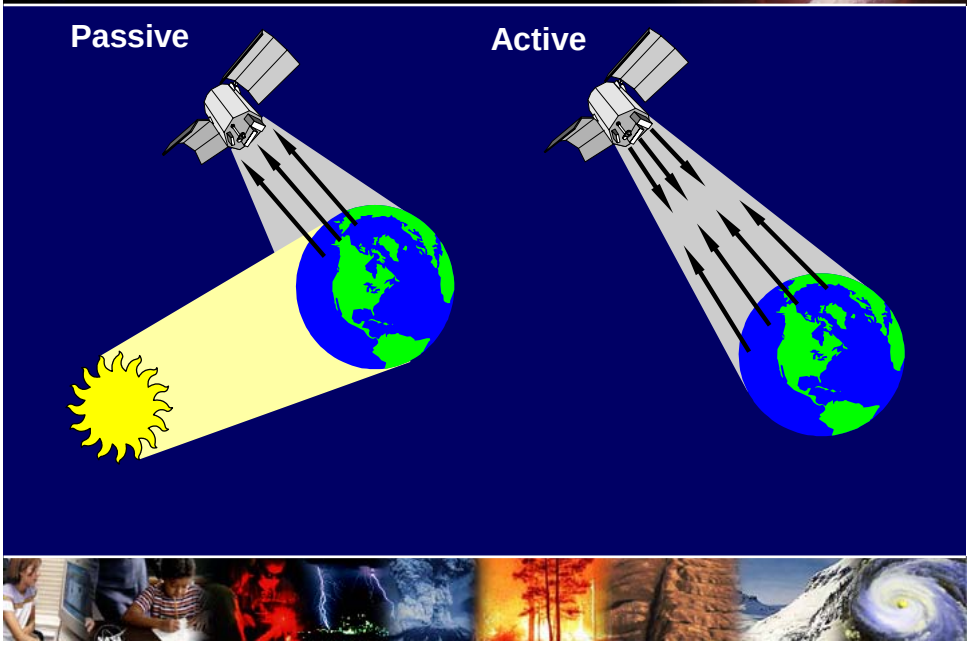
Overview of Remote Sensing

- **What is remote sensing?**
  - Measuring the physical characteristics of a targeted object or area without direct contact
- **How is this done?**
  - By detecting and measuring radiation, particles, and electromagnetic fields associated with an object
  - By recording measurements of electromagnetic energies
  - By analyzing the recorded data (imagery output) for spatio-temporal information

Elements of Satellite Remote Sensing



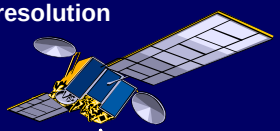
Active and Passive Sensors



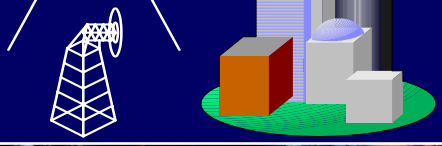
Data Sources

Suborbital
- 0.1–10 meter spatial resolution
- 1 hour – 1 year revisit

Orbital
- 1–1,000 meter spatial resolution
- 1–16 day revisit

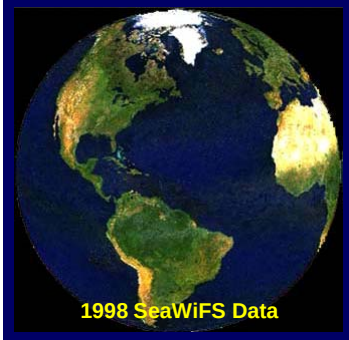


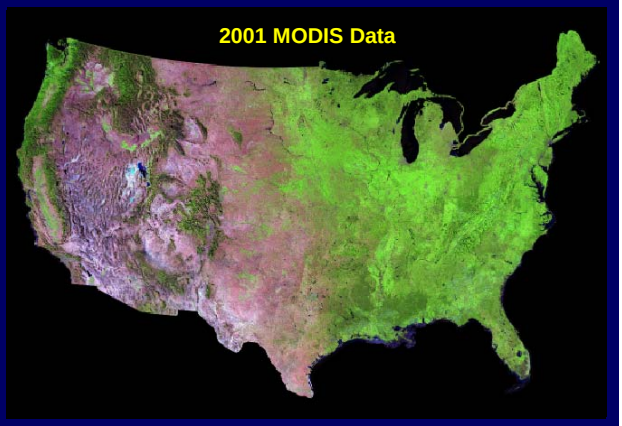
Ground Networks:
- Continuous data collection



How is Remote Sensing Useful?

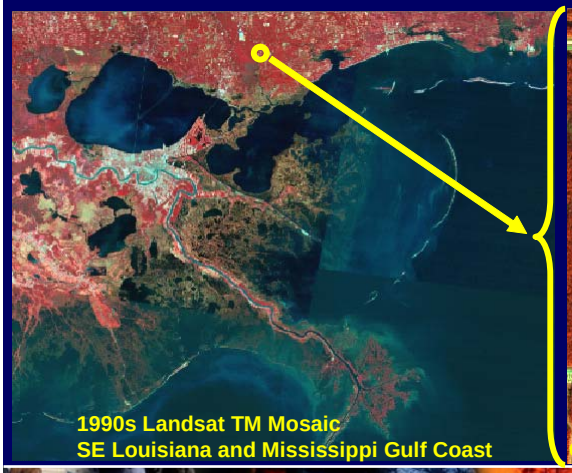
- Remote Sensing enables global and broad regional views of the Earth over decades of time.





How is Remote Sensing Useful?

- **Remote Sensing provides data to monitor environmental conditions across smaller regions and site-specific areas.**

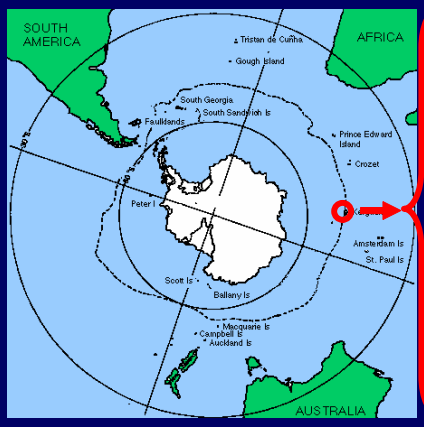


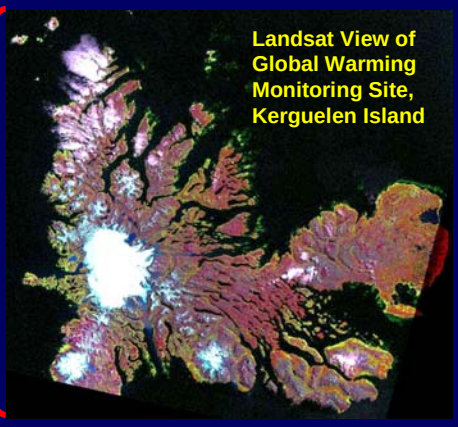
1990s Landsat TM Mosaic
SE Louisiana and Mississippi Gulf Coast

QuickBird Image of Stennis Space Ctr

How is Remote Sensing Useful?

- **Remote Sensing is a tool used to gather data and information about inaccessible, remote areas.**

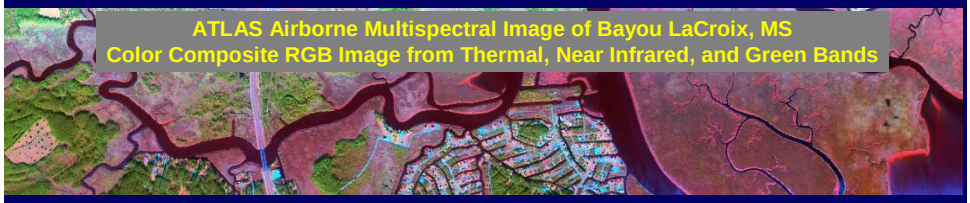


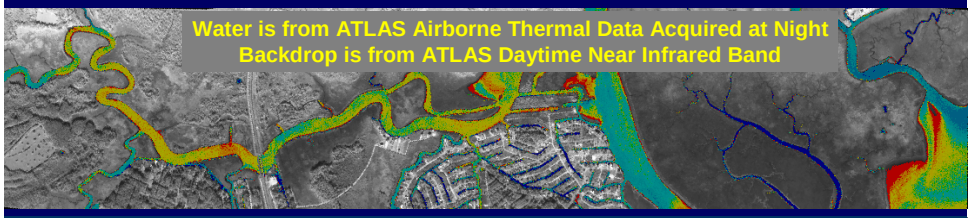


Landsat View of Global Warming Monitoring Site, Kerguelen Island

How is Remote Sensing Useful?

- **Remote Sensors can collect multispectral image data, each band measuring specific spectral regions that are often beyond the range of human vision (e.g., ultraviolet, infrared, microwave).**

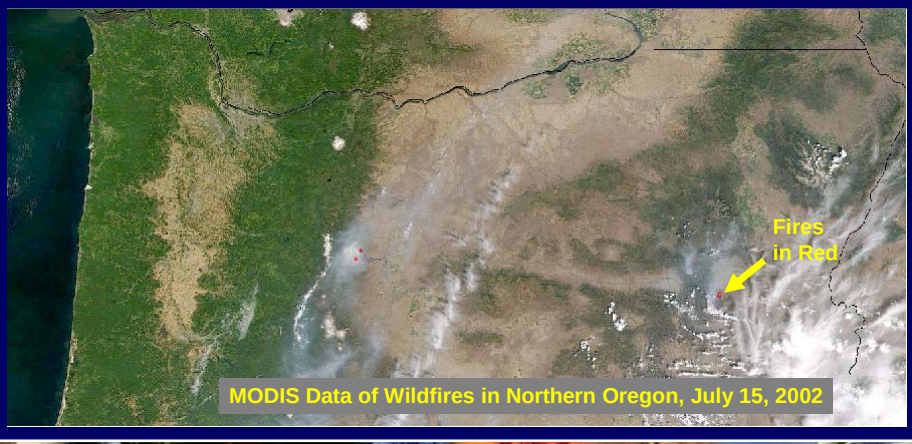


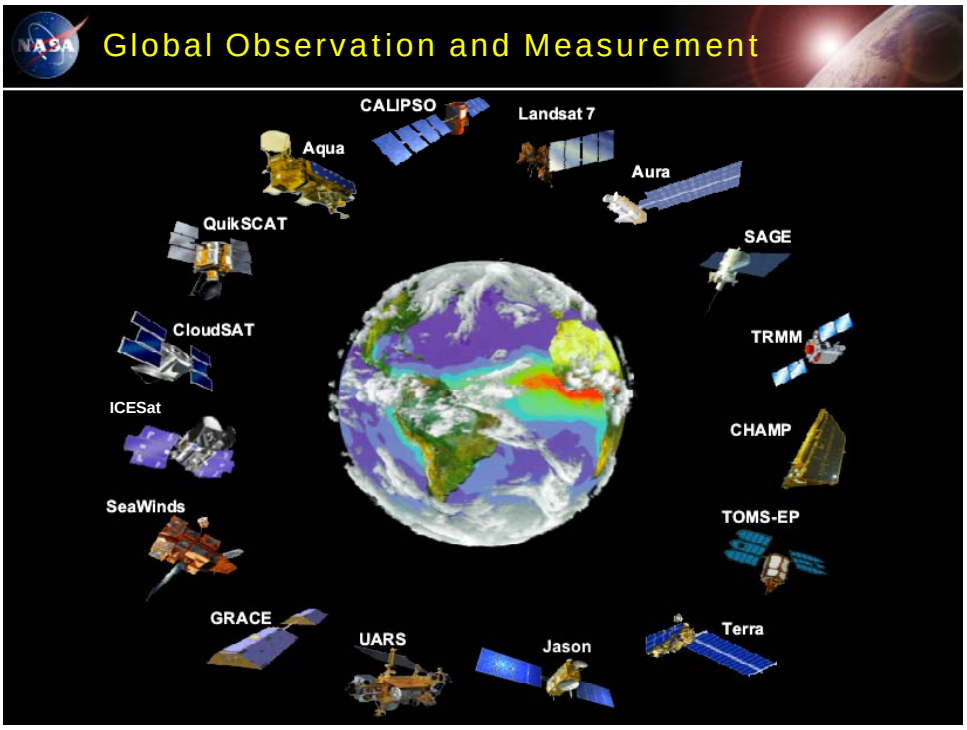


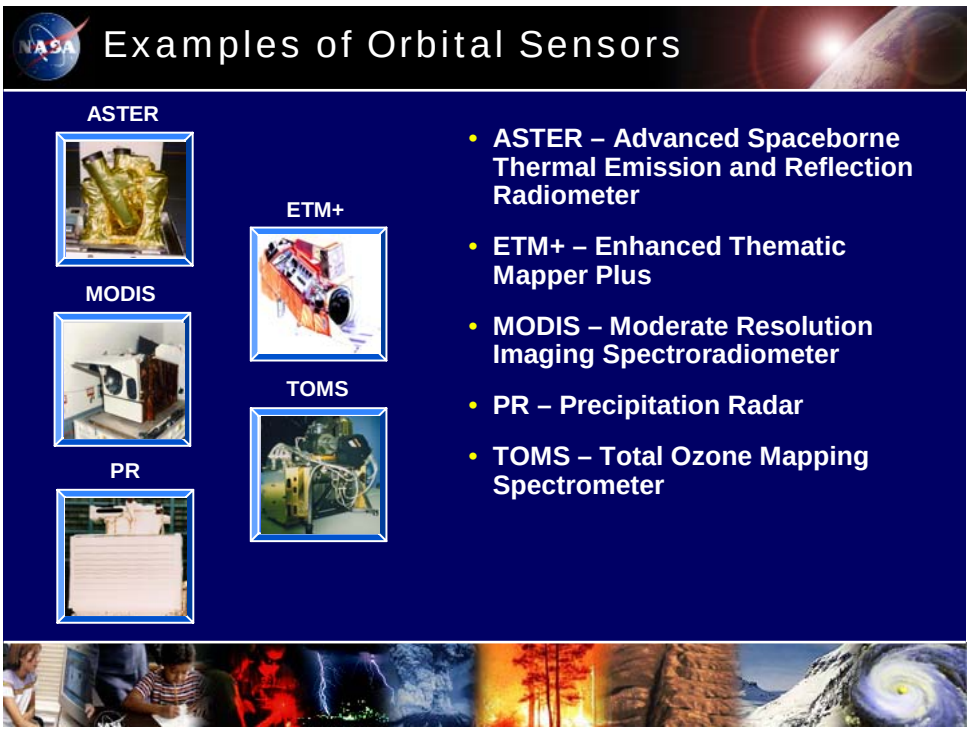
Coolest Hottest

How is Remote Sensing Useful?

- **Remote Sensing can provide multi-temporal information. Sensors can revisit the same area in terms of days; such capability is used to detect, monitor, and assess environmental change.**



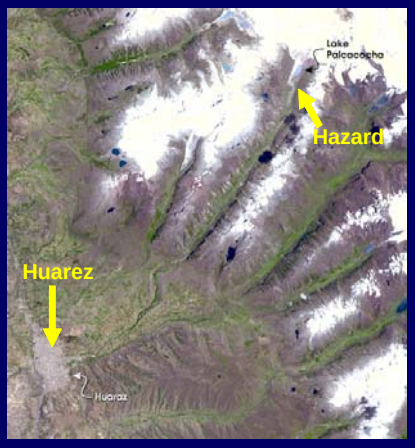

Global Observation and Measurement
CALIPSO
Landsat 7
Aqua
Aura
QuikSCAT
SAGE
CloudSAT
TRMM
ICESat
CHAMP
SeaWinds
TOMS-EP
GRACE
UARS
Jason
Terra


Examples of Orbital Sensors
ASTER
ETM+
MODIS
TOMS
PR
• ASTER – Advanced Spaceborne Thermal Emission and Reflection Radiometer
• ETM+ – Enhanced Thematic Mapper Plus
• MODIS – Moderate Resolution Imaging Spectroradiometer
• PR – Precipitation Radar
• TOMS – Total Ozone Mapping Spectrometer

ASTER

Advanced Spaceborne Thermal Emission and Reflection Radiometer

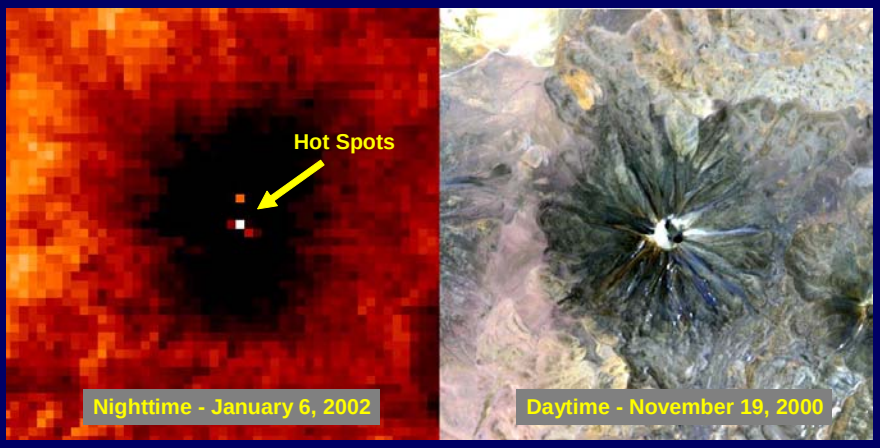
- ASTER is a multispectral sensor used to collect environmental and geological surface information
- Some ASTER applications
  - Urban Change & Ecosystem Dynamics
  - Hydrology
  - Volcanology
  - Geology
- One capability that makes ASTER unique
  - Capability to accommodate on-demand data acquisition requests



ASTER View of Glacial Hazard Near Huarez, Peru

Example of ASTER Data Product

ASTER Imagery Used in Monitoring Chiliques Volcano in Chile



MODIS

Moderate Resolution Imaging Spectroradiometer

- MODIS is a multispectral sensor
- Total of 44 standard products
  - Atmosphere products
    - Aerosol & cloud properties
  - Land products
    - Surface Reflectance
    - Leaf Area Index
    - Surface temperature
  - Ocean products
    - Sea surface temperature

MODIS View of Mt Etna Eruption

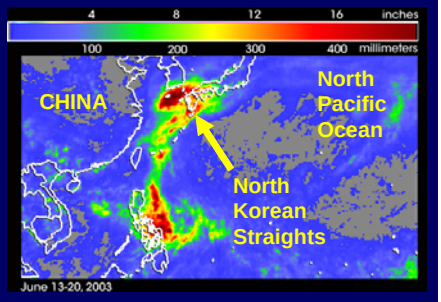
Example of MODIS Data Product

MODIS Rapid Response System Product
June 23, 2003, Image of Fires in Arizona

PR

Precipitation Radar

- PR is the first spaceborne rain radar in the world
- Major objectives of PR
  - Provide 3-D rainfall structure
  - Achieve quantitative rainfall measurements over land and ocean
  - Improve other rainfall measurements by adding rain structure information

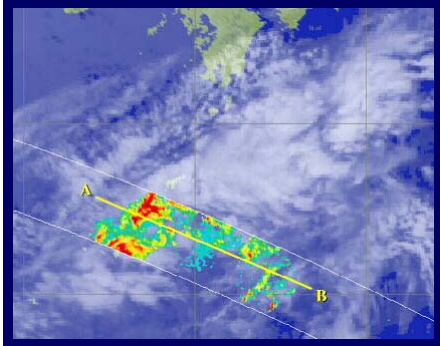


PR Rainfall Map of Typhoon Soudelor
June 13-20, 2003

EXAMPLE of PR/TRMM Data Product

PR/TRMM Products Characterizing Subtropical Rain Over Okinawa

Horizontal Cross Section of Rain at 23 km Height

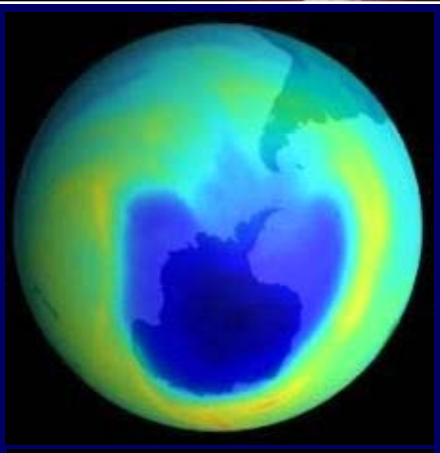


Corresponding 3D Rain Structure Data Collected 12/8/97 at 17:36-17:38 UTC

TOMS

Total Ozone Mapping Spectrometer

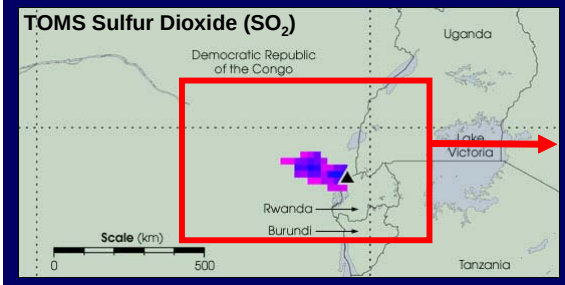
- TOMS is an atmospheric sensor
- Major objectives of TOMS
  - Continue global ozone dataset that began in 1978
  - Continue observation of ozone holes
  - Observe sulfur dioxide from volcanic eruptions
- TOMS image of Antarctica
  - Data acquired October 3, 1999
  - Ozone hole size is decreasing, compared to TOMS data from October 19, 1998

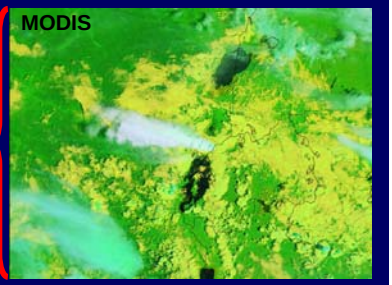


Example of TOMS Data Product

TOMS data can be used to monitor plumes of active volcanoes (SO_2 and Ash)

Eruption of Nyiragongo Volcano, Democratic Republic of the Congo
TOMS and MODIS imagery from January 7, 2002





Examples of Suborbital Sensors

ATLAS

MASTER

AVIRIS

- ATLAS – Airborne Terrestrial Applications Sensor
- MASTER – MODIS/ASTER Suborbital Simulator
- AVIRIS – Airborne Visible/Infrared Imaging Spectrometer

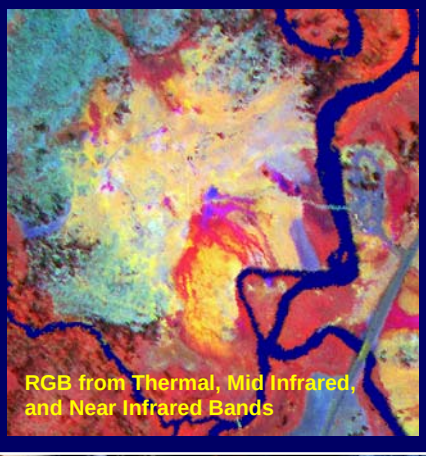
ATLAS

Airborne Terrestrial Applications Sensor

- ATLAS is a high-resolution multispectral sensor flown on a NASA Lear jet
- Advantages of ATLAS
  - Can schedule the data collection to meet specific needs
  - Spatial resolution of 2 to 30 meters depending on user requirements
  - Geolocational data is also recorded during image data acquisition
  - Very high spatial resolution aerial photography is acquired concurrently with ATLAS data acquisition

Example of ATLAS Data Product

ATLAS Imagery of Biscuit Basin Geothermal Area at Yellowstone National Park – Data Acquired August 1999



RGB from Thermal, Mid Infrared, and Near Infrared Bands

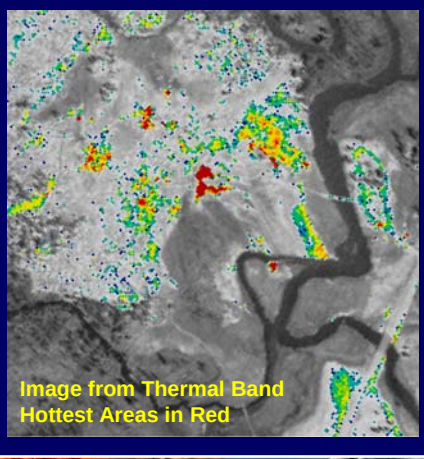
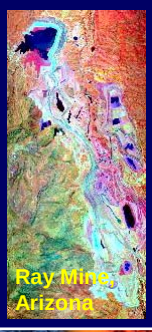


Image from Thermal Band Hottest Areas in Red

MODIS/ASTER – MASTER

- **MASTER is a suborbital multispectral sensor flown from ER-2 and DC-8 aircraft**
- **Major objective of MASTER**
  - **To support ASTER/MODIS instrument teams for the study of geologic and other Earth surface properties**

ER-2 Planes



Ray Mine, Arizona

DC-8 Plane

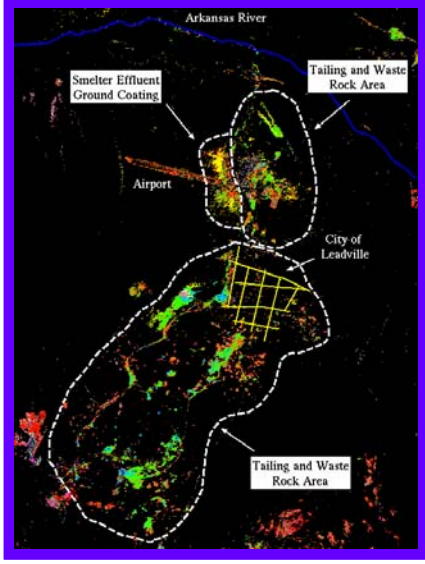
AVIRIS

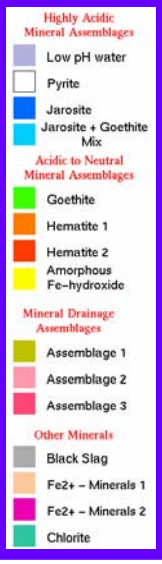
Airborne Visible/Infrared Imaging Spectrometer

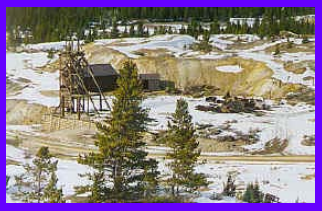
- AVIRIS sensor contains 224 different narrow wave bands
- Advantage of AVIRIS
  - A high-resolution hyperspectral sensor that enables scientists to precisely determine target's spectral signature
- Major objective of AVIRIS
  - Identify, measure, and monitor the Earth's surface features and atmosphere for understanding processes related to global climate change

AVIRIS Data For Mine Remediation

EPA use of USGS/USBR processed AVIRIS data of the California Gulch Superfund site "saved EPA $2 million and 2.5 years of work." Source: 1997 NASA Report to the President.







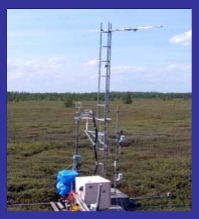
Mining Site near Leadville

Example of Mine Tailings

Examples of Ground Networks

AERONET

FLUXNET



NEXRAD

MPLNET

- AERONET (NASA) – Aerosol Robotic Network
- FLUXNET (NASA/DOE) – Micrometeorological Flux Network
- MPLNET (NASA) – Micro Pulse Lidar Network
- NEXRAD (NOAA) – Next Generation Weather Radar

AERONET

Aerosol Robotic Network

- Major objective of AERONET
  - Measuring solar and sky radiance, as well as atmospheric optical depth
  - Assessing aerosol optical properties and validating corresponding satellite data

FLUXNET

Flux Network

- A global network of research towers that measure exchanges of regional carbon dioxide (CO_2), water vapor, and energy between the terrestrial ecosystem and atmosphere
- Approximately 200 towers are in continuous operation worldwide
- At these tower sites, researchers also collect vegetation, soil, hydrologic, and meteorological data

NEXRAD

Next Generation Weather Radar

- Depending on local weather conditions, NEXRAD can be placed into one of three modes: clear air mode, precipitation mode, or severe weather mode
- The NEXRAD network provides significant improvements in tracking and characterizing severe weather

MPLNET

Micro Pulse Lidar Network

- **MPLNET is a worldwide network of micro-pulse lidar systems**
- **Major objective of MPLNET**
  - **Measure and analyze vertical distribution of clouds and aerosols**

Possibilities . . .

NASA sensor technology and NASA's understanding of remote sensing can be powerful new tools for improved disease surveillance and environmental public health tracking

Sensor and Data Challenges. . .

- Access
- Cost
- Interoperability/Integration
- Tasking
- Resolutions (spatial, spectral, temporal, and radiometric)
- Workforce development

Trends . . .

- The number and types of sensors will continue to increase and enhance current observational capabilities
- Over time and with increased commercialization of remote sensing systems:
  - Availability/access will increase
  - Number of end-users will increase
  - Costs will level and/or decrease
- Interoperability issues are currently being addressed
- Advanced educational opportunities to study remote sensing and remote sensing applications continue to grow

Acknowledgments & Contact Info

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- Kristen Russell
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- Lauren Underwood, Ph.D.
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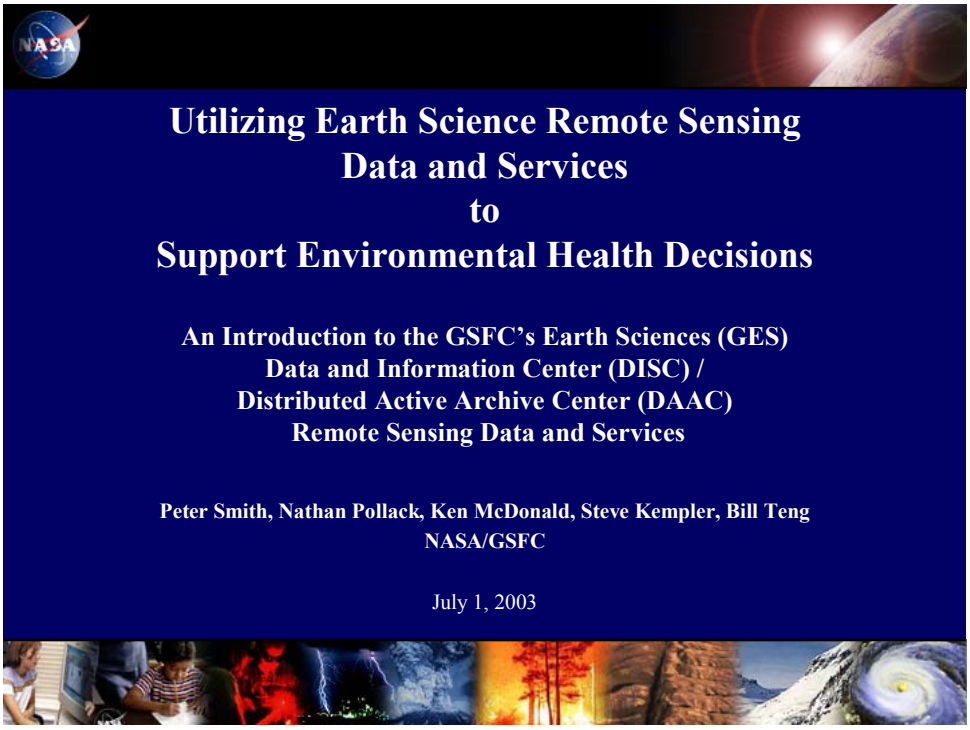
- Joe Spruce
  Scientist
- Slawomir Blonski, Ph.D.
  Research Engineering Associate Manager

For more information contact:

Timi S. Vann
Deputy Program Manager, Public Health Applications
National Aeronautics and Space Administration
Earth Science Applications Directorate
Building 1100 Code MA10
John C. Stennis Space Center, MS 39529
e-mail: timi.s.vann@nasa.gov

Peter Smith, Nathan Pollack, Ken McDonald, Steve Kempler & Bill Teng
"Utilizing Earth Science Remote Sensing Data and Services to Support Environmental Health Decision: An Introduction to the GSFC's Earth Science (GES) Data and Information Center (DISC)/Distributed Active Archive Center (DAAC) Remote Sensing Data and Services"



GES DAAC Data Access

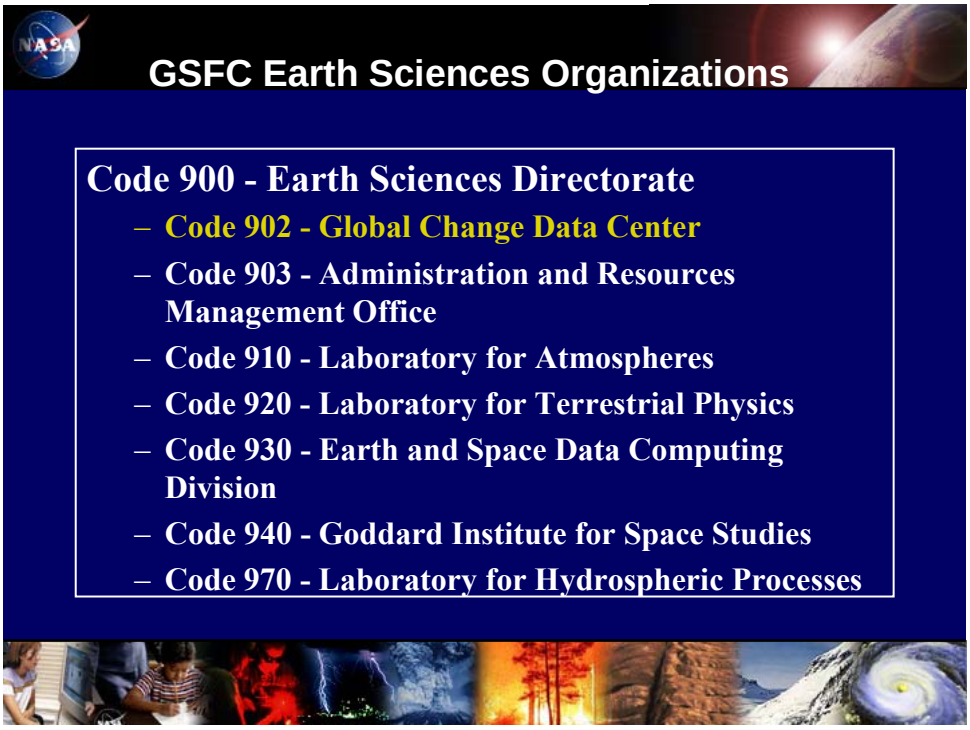
There are 3 ways to obtain data from the DAAC:

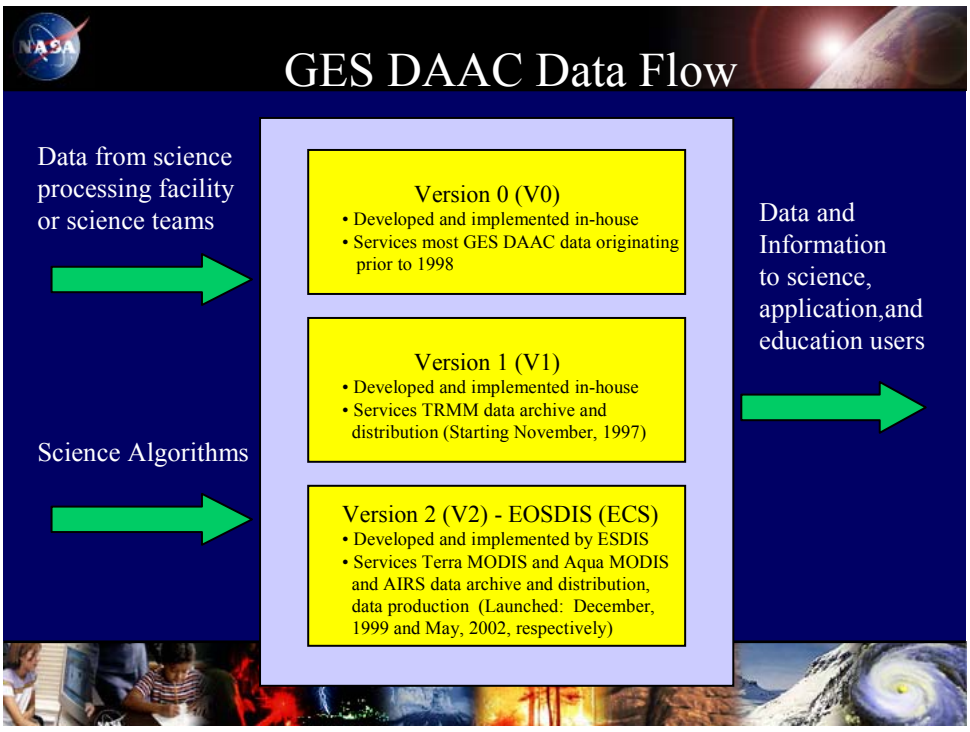
- WWW User Interface
  - Global EOSDIS Data Gateway (EDG), URL:
    http://redhook.gsfc.nasa.gov/~imswww/pub/imswelcome/
  - Local DAAC User Interface, URL:
    http://eosdata.gsfc.nasa.gov
  - Local DAAC User Interface for MODIS data:
    http://eosdata.gsfc.nasa.gov/MODIS/data_access.shtml
- Anonymous FTP at
  http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/FTP_SITE/ftp_site.html
- Subscriptions
  - Specified once and for all by user
  - User receives email for either push or pull operation

User Services Group:
301-614- 5473 (ECS) or 301-614-5224 (V0)
help@daac.gsfc.nasa.gov
GES DAAC Home Page: http://daac.gsfc.nasa.gov

GES DISC Mission

The GES DISCs mission is to maximize the investment benefit of the Earth Science Enterprise by providing data and services that enable people to fully realize the scientific, educational, and application potential of global climate data.

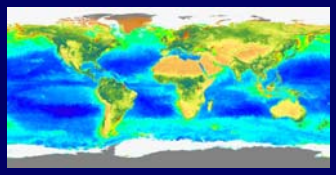

GSFC Earth Sciences Organizations
Code 900 - Earth Sciences Directorate
– Code 902 - Global Change Data Center
– Code 903 - Administration and Resources Management Office
– Code 910 - Laboratory for Atmospheres
– Code 920 - Laboratory for Terrestrial Physics
– Code 930 - Earth and Space Data Computing Division
– Code 940 - Goddard Institute for Space Studies
– Code 970 - Laboratory for Hydrospheric Processes


GES DAAC Data Flow
Data from science processing facility or science teams
Science Algorithms
Version 0 (V0)
• Developed and implemented in-house
• Services most GES DAAC data originating prior to 1998
Version 1 (V1)
• Developed and implemented in-house
• Services TRMM data archive and distribution (Starting November, 1997)
Version 2 (V2) - EOSDIS (ECS)
• Developed and implemented by ESDIS
• Services Terra MODIS and Aqua MODIS and AIRS data archive and distribution, data production (Launched: December, 1999 and May, 2002, respectively)
Data and Information to science, application,and education users

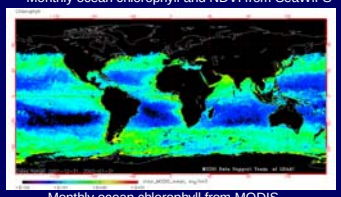
The GES DISC is NASAs Earth Science Data and Information Services Center for Specific Disciplines

- Atmospheric Chemistry
- Atmospheric Dynamics
- Hydrology
- Ocean Color
- Land Biosphere

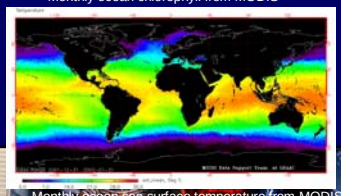
GES DAAC Science Disciplines



Monthly ocean chlorophyll and NDVI from SeaWiFS



Monthly ocean chlorophyll from MODIS



Monthly ocean sea surface temperature from MODIS

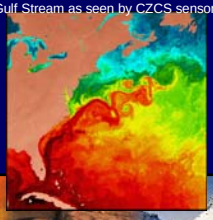
Global Biosphere

Ocean Color
- CZCS
- SeaWiFS
- MODIS
- NPP

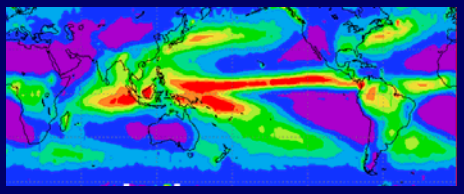
Land Biosphere
- AVHRR Pathfinder
- Triana

Blue - future mission
Red - current mission
Black - closed data set

Gulf Stream as seen by CZCS sensor

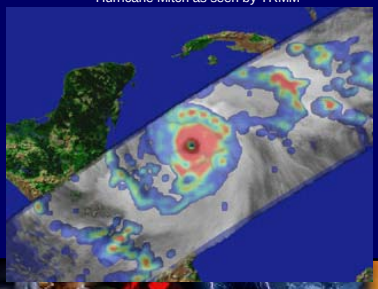


GES DAAC Science Disciplines



GPCP Annual Mean Precipitation 1988 -1998

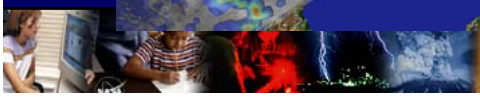
Hurricane Mitch as seen by TRMM



Hydrology

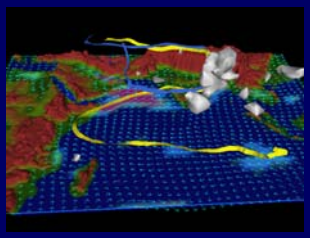
Rainfall Climatologies
Combined Satellite/Gauge Rainfall
TRMM
TRMM Field Experiments
GPM

Blue - future mission
Red - current mission
Black - closed data set



GES DAAC Science Disciplines

Atmospheric Dynamics

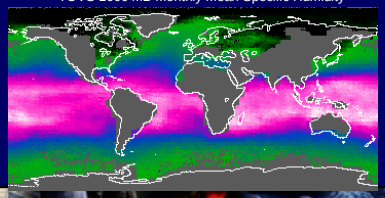


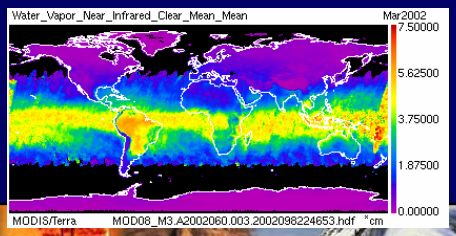
Air Parcel Trajectories computed using Data Assimilation

TOVS Pathfinder
Data Assimilation
MODIS
AIRS
NPP

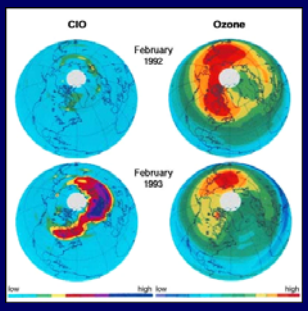
Blue - future mission
Red - current mission
Black - closed data set

TOVS 1000 MB Monthly Mean Specific Humidity



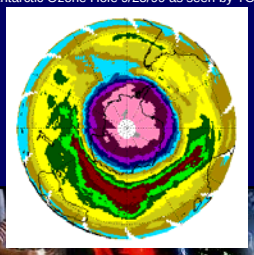


GES DAAC Science Disciplines



Relationship between stratospheric Chlorine Monoxide and Ozone

Antarctic Ozone Hole 9/25/99 as seen by TOMS



Atmospheric Chemistry

Heritage TOMS
Heritage SBUV
EP-TOMS
UARS
Triana
SORCE
HIRDLS (AURA)
MLS (AURA)
OMI (AURA)

Blue - future mission
Red - current mission
Black - closed data set

Datasets Containing Sample Parameters Applicable to Public Health

TOMS Total Ozone Mapping Spectrometer	- Total Ozone; S)2 Index; Reflectivity
TOVS TIROS Operational Vertical Sounder	- Temperature and Humidity Profiles; Ozone
UARS Upper Atmosphere Research Satellite	- Upper Air Trace Gas Profiles; Aerosol; UV Radiation
TRMM Tropical Rainfall Measuring Mission	- Rainfall Rate, Profile, and Type; Drop size Distribution
MODIS Moderate Resolution Imaging Spectro-radiometer	- Aerosol; Ozone; Temperature and Humidity Profiles; Water Vapor; Stability Indices
AIRS Atmospheric Infrared Sounder	- Temperature and Humidity Profiles

See “Climate Datasets at GES DAAC” handout for greater detail

MODIS Dataset

MODIS (Terra & Aqua)	03/00 - present	**Radiances (36 bands 0.4 -14 microns)**	250 m 500 m 1km
		Aerosol **Cloud Optical and Physical Parameters** **Water Vapor** **Ozone** **Temperature & Humidity Profiles** **Stability Indices** **Cloud Mask** **Brightness Temperatures**	1 km 5 km 10km 1 x 1 degree
		Ocean Color **Chlorophyll** **Phytoplankton** **Sea Sediments** **Vegetation Index** **Fluorescence** **Sea Surface Temperature**	1 km 4 km 36 km

Other Earth Sciences DAACs

- Alaska SAR Facility (ASF) - SAR, Sea Ice, Polar Processes, Geophysics
- Global Hydrology Resource Center (GHRC) - Hydrologic Cycle, Severe Weather Interactions, Lightning, Convection
- Langley Atmospheric Sciences Data Center (ASDC) - Radiation Budget, Clouds, Aerosols, Tropospheric Chemistry
- Land Processes (LP) DAAC - Land Process Data
- National Snow and Ice Data Center (NSIDC) - Snow and Ice, Cryosphere, Climate
- Oak Ridge National Laboratory (ORNL) - Biogeochemical Dynamics, Ecological Data for studying Environmental Processes
- Physical Oceanography (PO) DAAC - Oceanic Processes and Air-Sea Interactions
- Socio-economic Data and Applications Center (SEDAC) - Population, Sustainability, Geospatial Data, Multilateral Environmental Agreements

GES DAAC Data Services

GES DAAC services include:

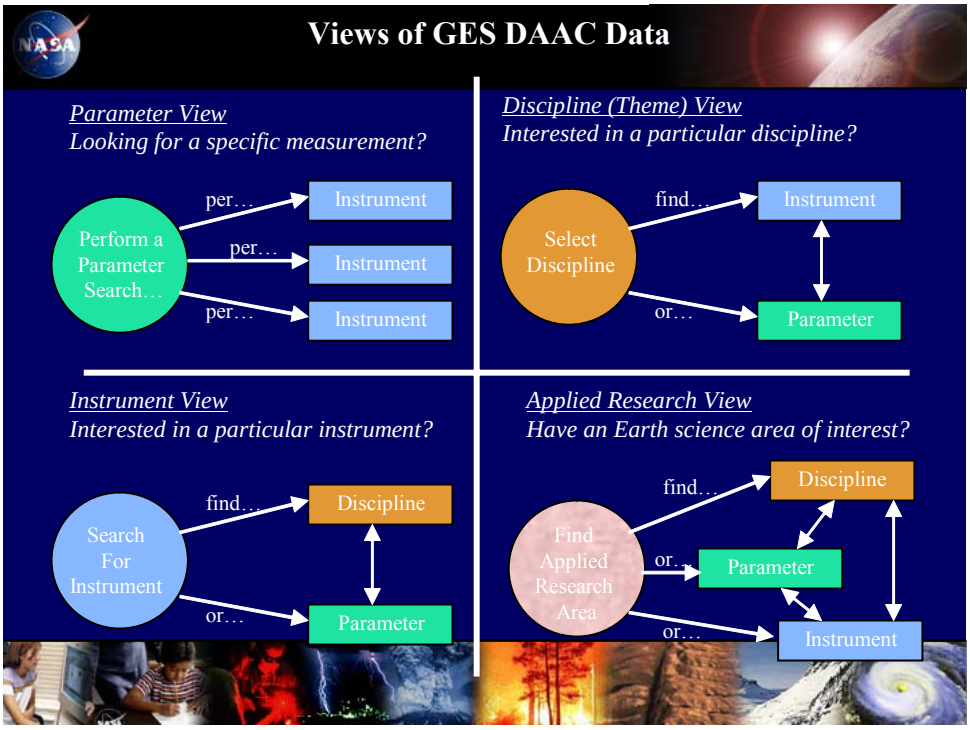
- Providing EOS and non-EOS ancillary data for science research, applied research, and applications users (e.g., education, policy makers, etc.)
- Distribution data products electronically or via media (e.g., 8mm tape, DLT and CD ROM)
- Online data search/browse/order (see slide after next)
- Full suite of documentation (detailed guide, summary guide, readme)
- User support via dedicated Data Support Teams (data access, HDF-EOS, documentation, data usage, etc)
- Subsetting, On-demand Subsetting, Subsampling, and Data Mining tools
- Data Visualization and Analysis Tools
- Making data available in GIS and binary formats
- Full suite of user services and outreach

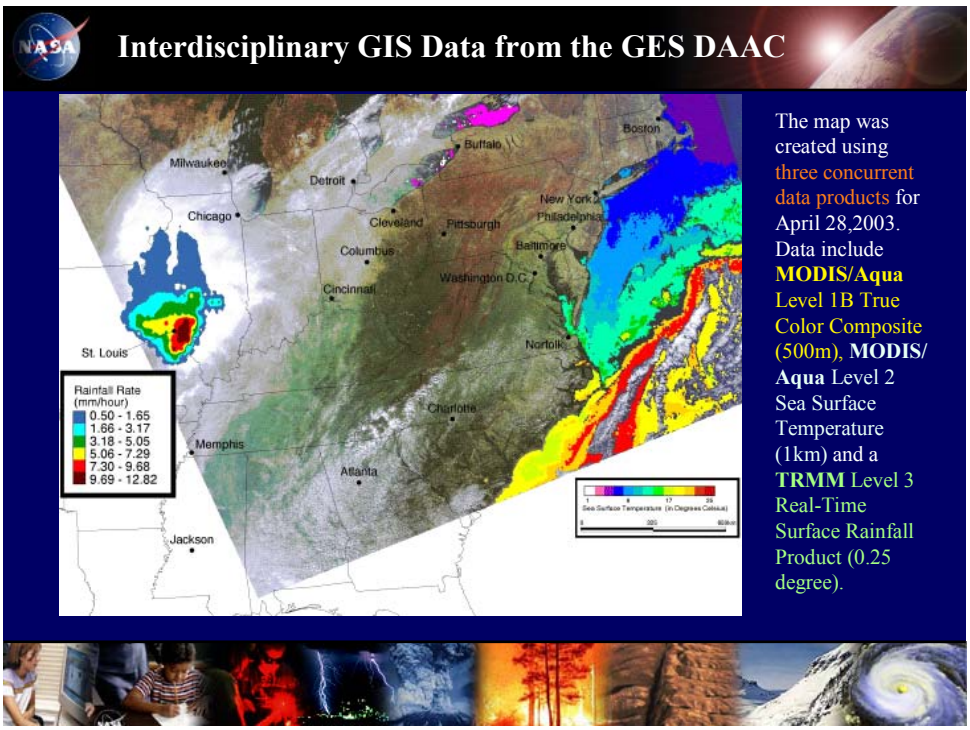
Consumption Chain

Data → **Information** → **Results** → **Decision Making** → **Societal Benefits**

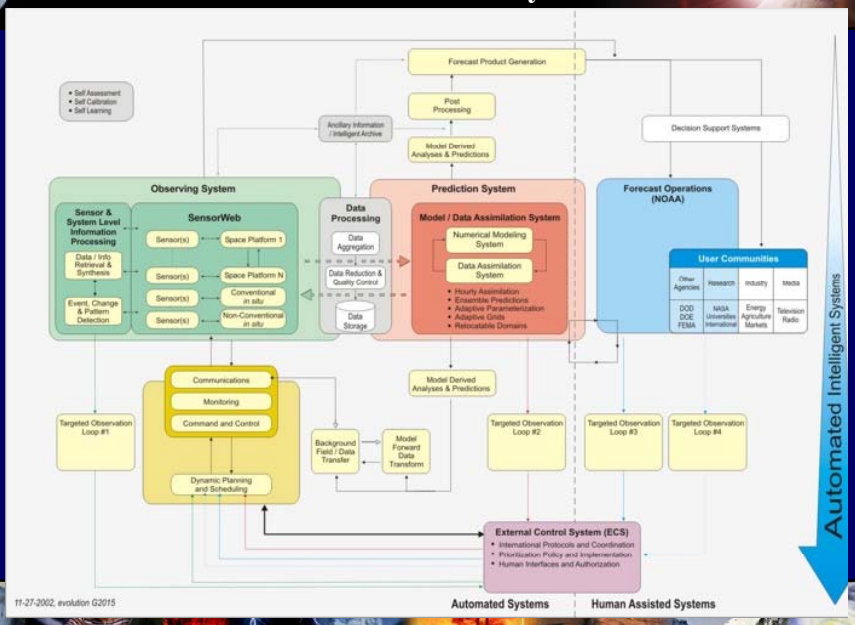
Increase information density

- **Read software**
- **Reformatting**
- **Subsets**
- **Regridding**
- **Time means**
- **Time series**
- **Basic statistics**
- **Online analysis**
- **Web GIS**
- **Real-time data**
- **Data mining**
- **Data collections**
- **Derived parameters**
- **Data Interoperability**


Views of GES DAAC Data
Parameter View
Looking for a specific measurement?
Perform a Parameter Search…
per…
per…
per…
Instrument
Instrument
Instrument
Discipline (Theme) View
Interested in a particular discipline?
Select Discipline
find…
or…
Instrument
Parameter
Instrument View
Interested in a particular instrument?
Search For Instrument
find…
or…
Discipline
Parameter
Applied Research View
Have an Earth science area of interest?
Find Applied Research Area
find…
or…
or…
Discipline
Parameter
Instrument

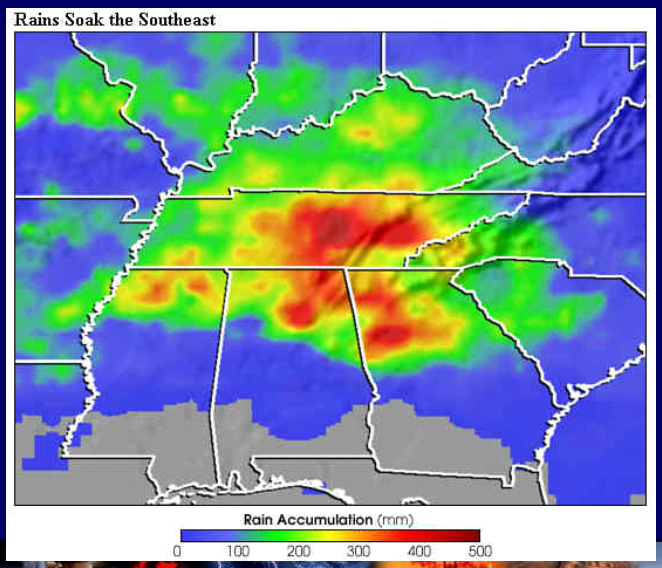

Interdisciplinary GIS Data from the GES DAAC
Milwaukee
Buffalo
Boston
Detroit
Chicago
Cleveland
Pittsburgh
New York
Philadelphia
Columbus
Baltimore
Washington D.C.
Cincinnati
St. Louis
Norfolk
Charlotte
Memphis
Atlanta
Jackson
Rainfall Rate (mm/hour)
0.50 - 1.65
1.66 - 3.17
3.18 - 5.05
5.06 - 7.29
7.30 - 9.68
9.69 - 12.82
The map was created using three concurrent data products for April 28,2003. Data include MODIS/Aqua Level 1B True Color Composite (500m), MODIS/ Aqua Level 2 Sea Surface Temperature (1km) and a TRMM Level 3 Real-Time Surface Rainfall Product (0.25 degree).

Sensor-Web Study



GES DAAC Data - Image Examples

TRMM Real-time Multi-satellite Precipitation (May 4-9, 2003)

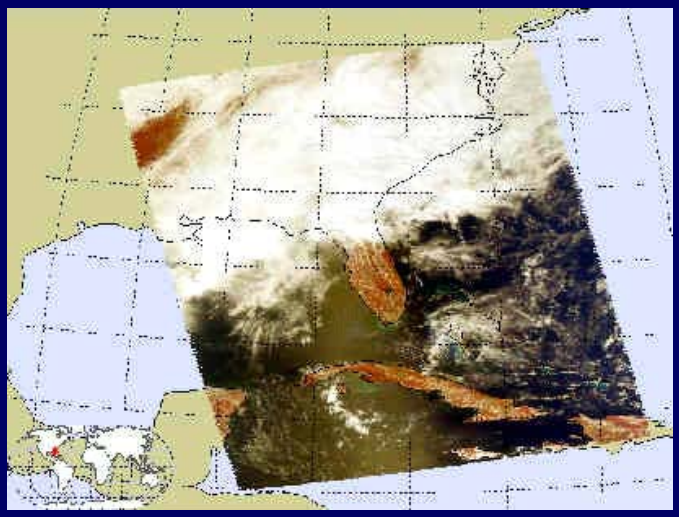


Resolution
0.25 deg

MODIS True Color Composite (May 3, 2003)

Resolution
250 m

AIRS Visible/Near Infrared, False-color Composite (April 8, 2003)



Resolution 2.3 km

DAAC Online Visualization and Analysis Systems (DOVAS)

- To provide a simple-to-use, web-accessible, user interface to GES DAAC data
- Current features: spatial and temporal subsetting; contour and time series plotting; ascii output

Interoperable Web Mapping Application at the GES DAAC – Web GIS

• To allow users to visualize GES DAAC and external data with a web browser
• Current features: spatial and temporal subsetting; panning and zooming, multiple images display; remote access to distributed data

Description

- The WebGIS tool is designed to allow users to visualize GES DAAC data with a web browser.

- Users can create custom maps using software implementing open interoperable interfaces developed by the Open GIS Consortium (OGC).

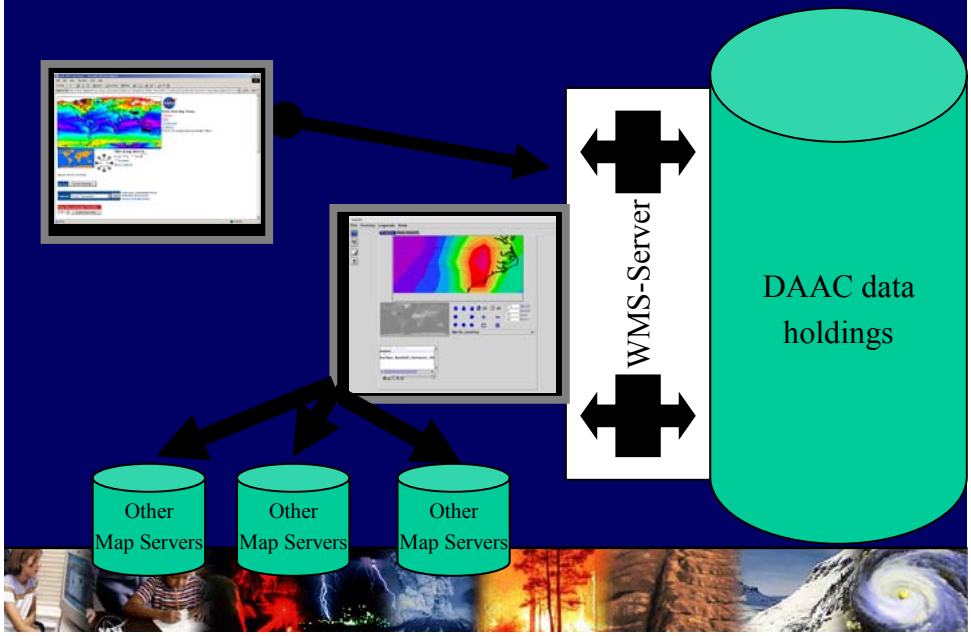
To see the current release:

http://daac.gsfc.nasa.gov/WEBGIS/

Technology

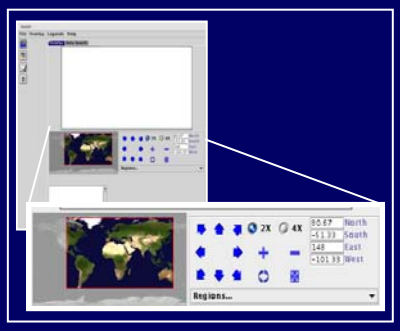
- Open GIS Consortium (OGC) standards for Web Mapping Server (WMS)
  - Allows GES DAAC to leverage ongoing interoperability work
- Java applet to allow users to interact with internal and external map servers
  - Including other GES DAAC efforts that can provide relevant services

Diagram of WebGIS

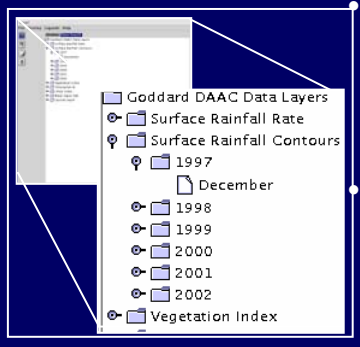


Web GIS - User Interface

- Interactive map to select a desired geographic subset
- Ability to click & drag or type in specific coordinates
- Also pre-defined subsets available

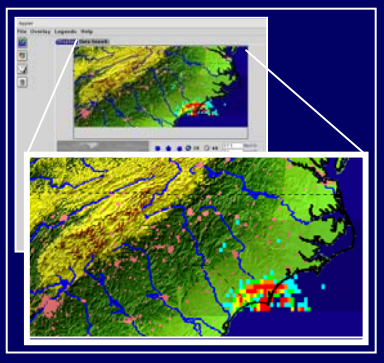


Web GIS - User Interface



- Search available:
  - Environmental parameters
  - Time
- Unified search for data various platforms/sensors

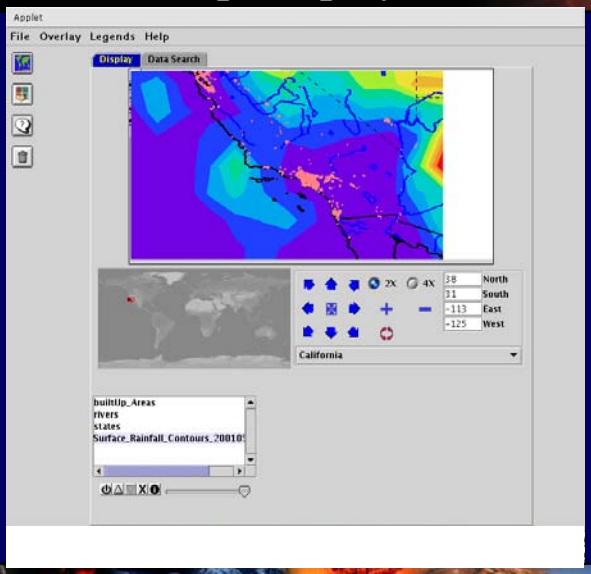
Map Display



- Display multiple superimposed images
- User can specify the order to draw layers
- Adjust the transparency level of individual layers

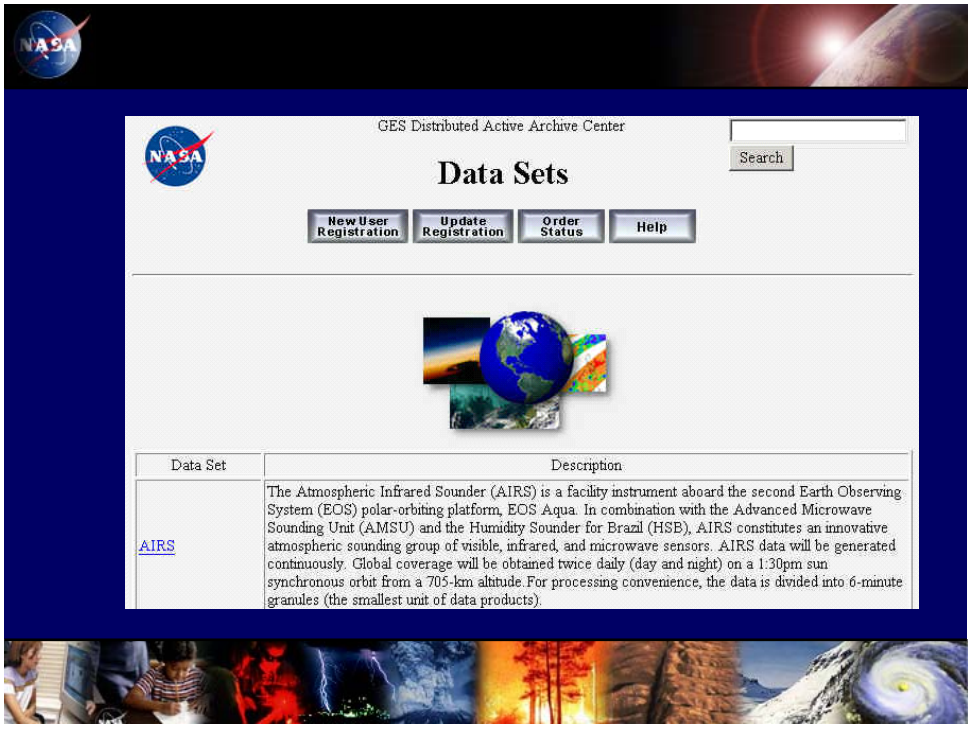
Map Display

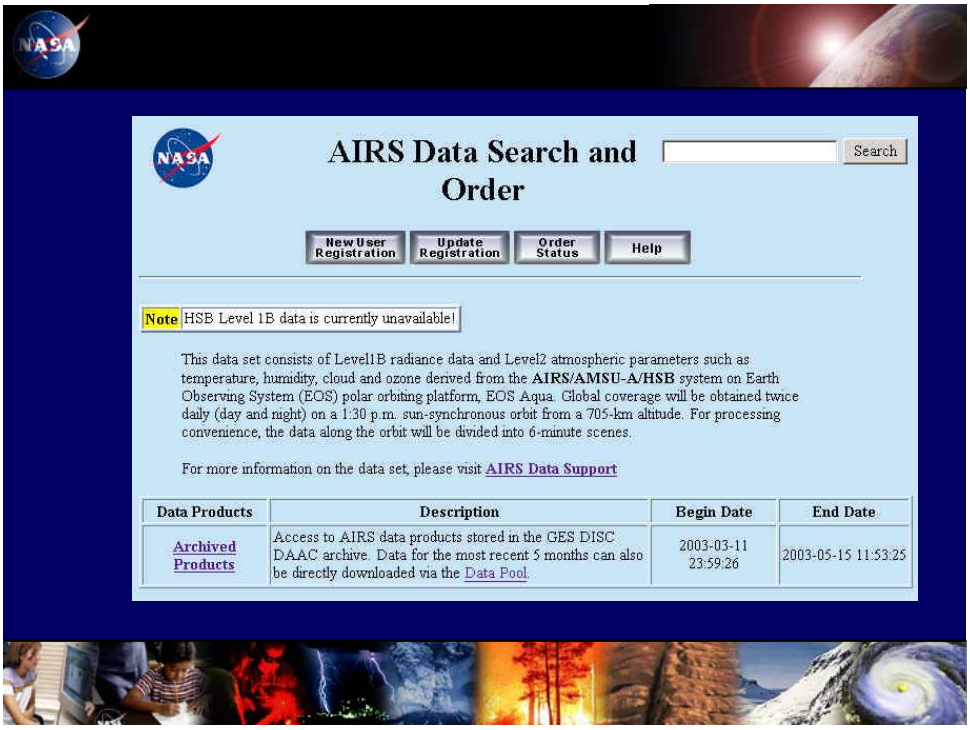
Map Display

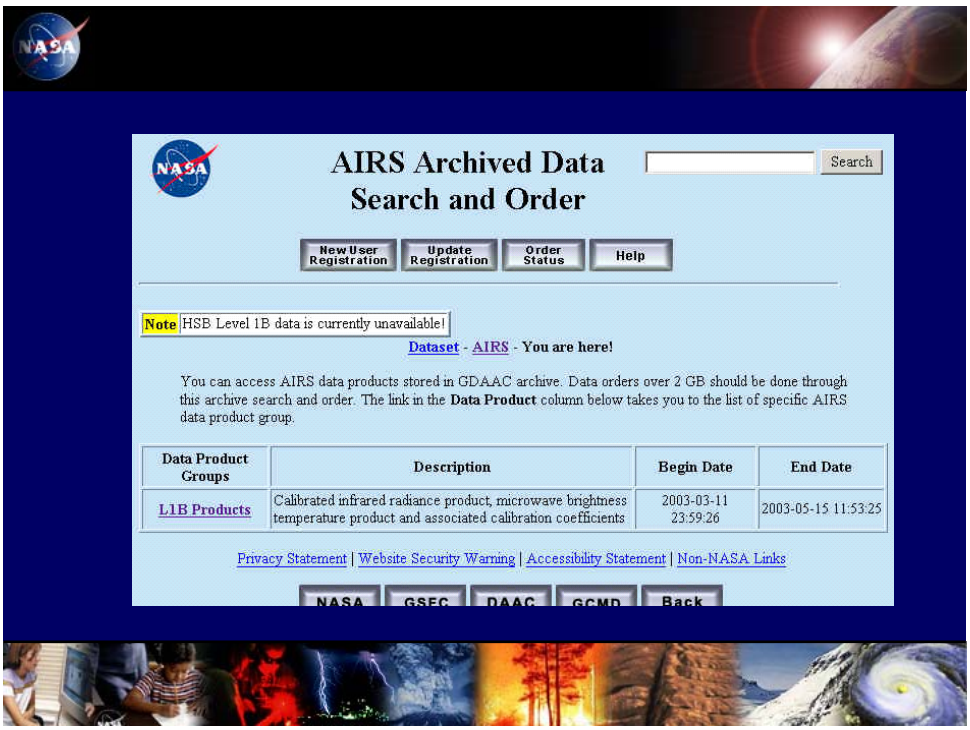


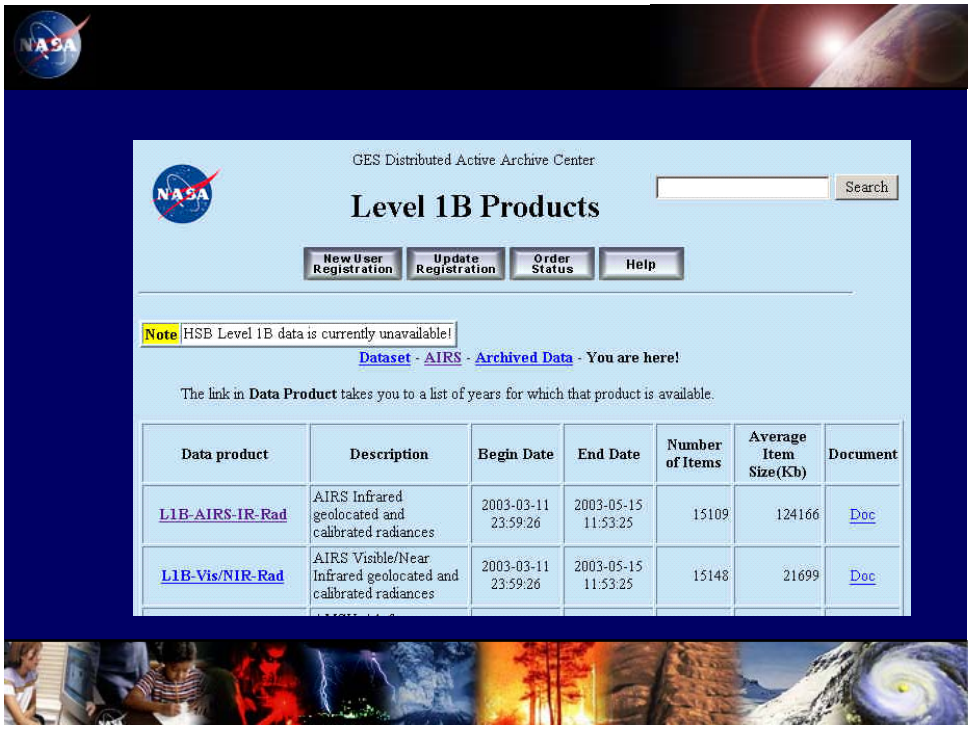
Extras

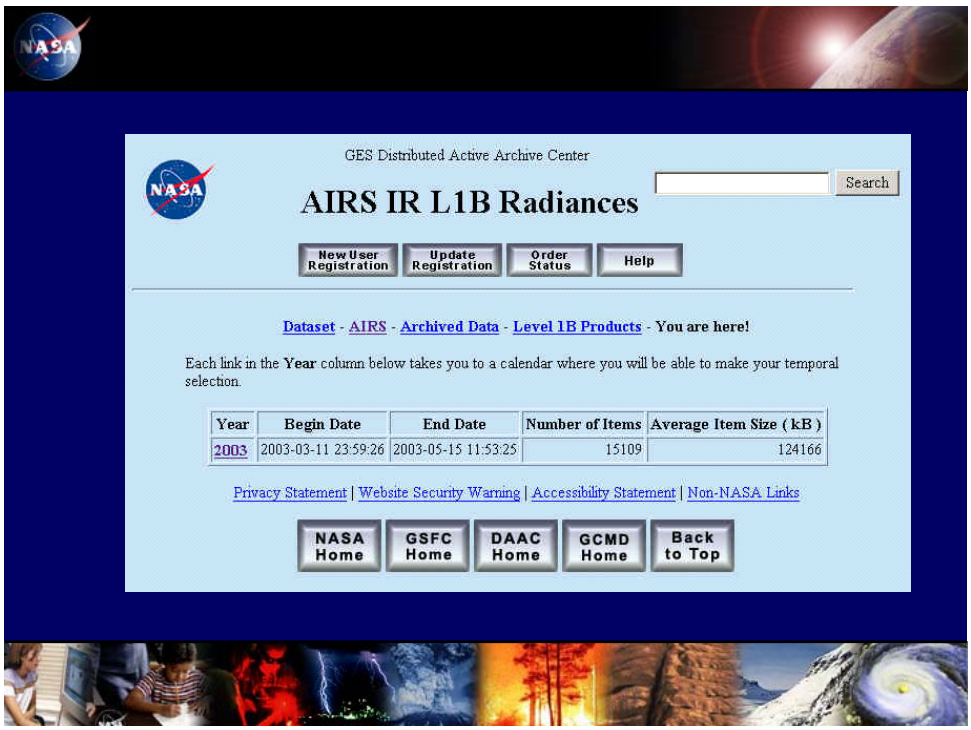
GES DAAC Data Search and Order

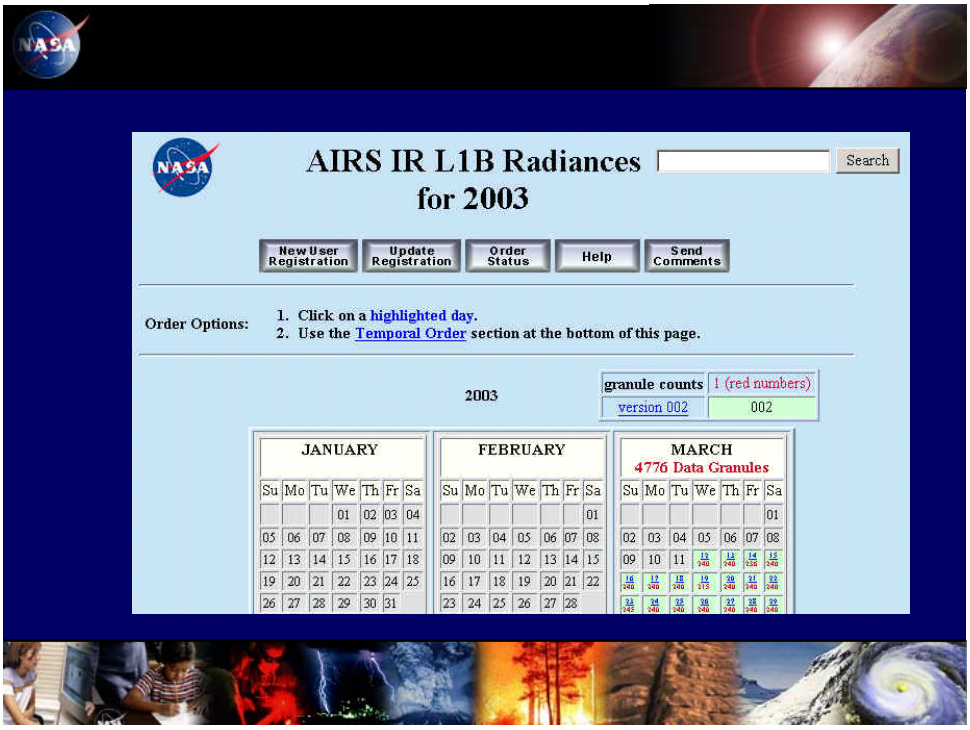


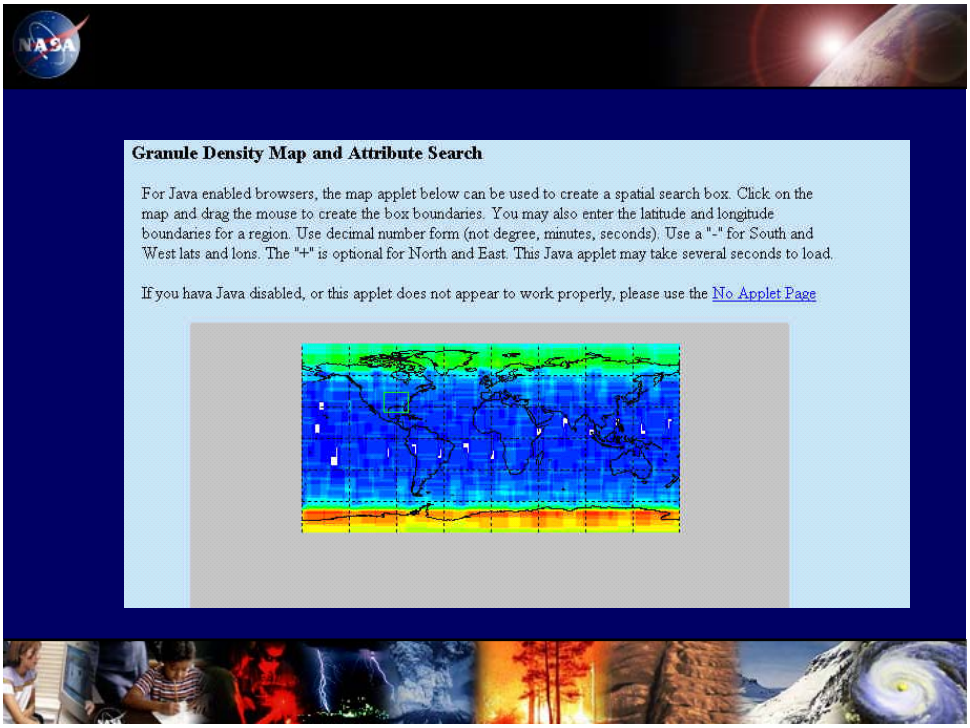

AIRS Data Search and Order
Search
New User Registration
Update Registration
Order Status
Help
Note HSB Level 1B data is currently unavailable!
This data set consists of Level1B radiance data and Level2 atmospheric parameters such as temperature, humidity, cloud and ozone derived from the AIRS/AMSU-A/HSB system on Earth Observing System (EOS) polar orbiting platform, EOS Aqua. Global coverage will be obtained twice daily (day and night) on a 1:30 p.m. sun-synchronous orbit from a 705-km altitude. For processing convenience, the data along the orbit will be divided into 6-minute scenes.
For more information on the data set, please visit AIRS Data Support
Data Products
Description
Begin Date
End Date
Archived Products
Access to AIRS data products stored in the GES DISC DAAC archive. Data for the most recent 5 months can also be directly downloaded via the Data Pool.
2003-03-11 23:59:26
2003-05-15 11:53:25

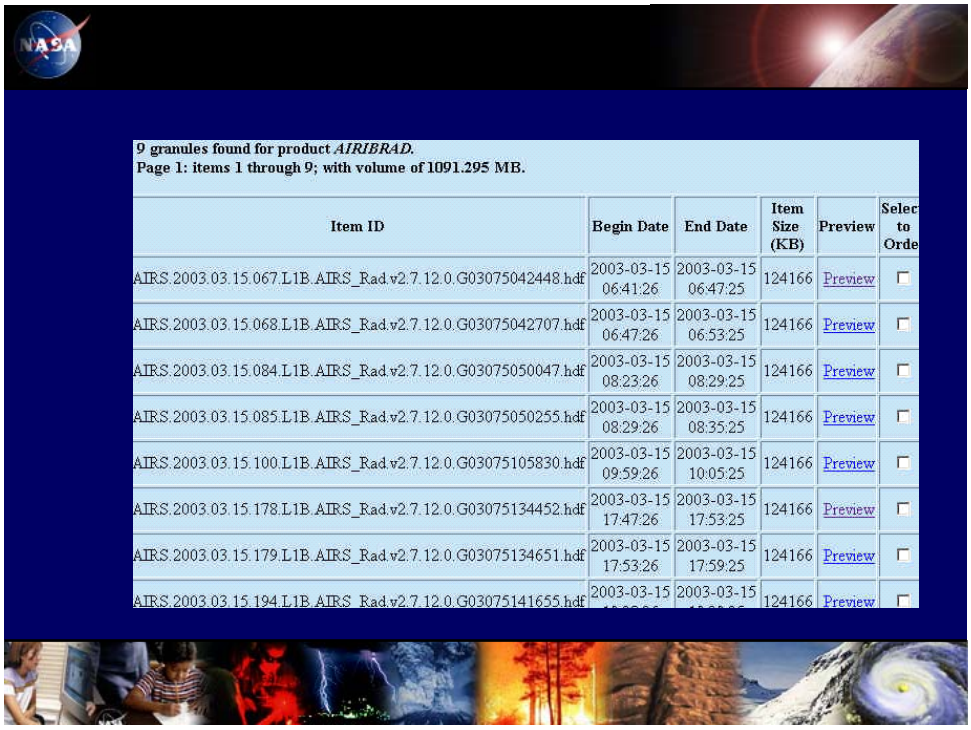

AIRS Archived Data Search and Order
Search
New User Registration
Update Registration
Order Status
Help
Note HSB Level 1B data is currently unavailable!
Dataset - AIRS - You are here!
You can access AIRS data products stored in GDAAC archive. Data orders over 2 GB should be done through this archive search and order. The link in the Data Product column below takes you to the list of specific AIRS data product group.
Data Product Groups
Description
Begin Date
End Date
L1B Products
Calibrated infrared radiance product, microwave brightness temperature product and associated calibration coefficients
2003-03-11 23:59:26
2003-05-15 11:53:25
Privacy Statement | Website Security Warning | Accessibility Statement | Non-NASA Links
NASA
GSFC
DAAC
GCMD
Back


GES Distributed Active Archive Center
Level 1B Products
Search
New User Registration
Update Registration
Order Status
Help
Note HSB Level 1B data is currently unavailable!
Dataset - AIRS - Archived Data - You are here!
The link in Data Product takes you to a list of years for which that product is available.
Data product
Description
Begin Date
End Date
Number of Items
Average Item Size(Kb)
Document
L1B-AIRS-IR-Rad
AIRS Infrared geolocated and calibrated radiances
2003-03-11 23:59:26
2003-05-15 11:53:25
15109
124166
Doc
L1B-Vis/NIR-Rad
AIRS Visible/Near Infrared geolocated and calibrated radiances
2003-03-11 23:59:26
2003-05-15 11:53:25
15148
21699
Doc


GES Distributed Active Archive Center
AIRS IR L1B Radiances
Search
New User Registration
Update Registration
Order Status
Help
Dataset - AIRS - Archived Data - Level 1B Products - You are here!
Each link in the Year column below takes you to a calendar where you will be able to make your temporal selection.
Year
Begin Date
End Date
Number of Items
Average Item Size (kB)
2003
2003-03-11 23:59:26
2003-05-15 11:53:25
15109
124166
Privacy Statement | Website Security Warning | Accessibility Statement | Non-NASA Links
NASA Home
GSFC Home
DAAC Home
GCMD Home
Back to Top


AIRS IR L1B Radiances for 2003
Search
New User Registration
Update Registration
Order Status
Help
Send Comments
Order Options:
1. Click on a highlighted day.
2. Use the Temporal Order section at the bottom of this page.
2003
granule counts
1 (red numbers)
version 002
002
JANUARY
FEBRUARY
MARCH
4776 Data Granules
Su Mo Tu We Th Fr Sa


Granule Density Map and Attribute Search
For Java enabled browsers, the map applet below can be used to create a spatial search box. Click on the map and drag the mouse to create the box boundaries. You may also enter the latitude and longitude boundaries for a region. Use decimal number form (not degree, minutes, seconds). Use a "-" for South and West lats and lons. The "+" is optional for North and East. This Java applet may take several seconds to load.
If you hava Java disabled, or this applet does not appear to work properly, please use the No Applet Page



9 granules found for product *AIRIBRAD*.
Page 1: items 1 through 9; with volume of 1091.295 MB.

Item ID	Begin Date	End Date	Item Size (KB)	Preview	Select to Order
AIRS.2003.03.15.067.L1B.AIRS_Rad.v2.7.12.0.G03075042448.hdf	2003-03-15 06:41:26	2003-03-15 06:47:25	124166	Preview	☐
AIRS.2003.03.15.068.L1B.AIRS_Rad.v2.7.12.0.G03075042707.hdf	2003-03-15 06:47:26	2003-03-15 06:53:25	124166	Preview	☐
AIRS.2003.03.15.084.L1B.AIRS_Rad.v2.7.12.0.G03075050047.hdf	2003-03-15 08:23:26	2003-03-15 08:29:25	124166	Preview	☐
AIRS.2003.03.15.085.L1B.AIRS_Rad.v2.7.12.0.G03075050255.hdf	2003-03-15 08:29:26	2003-03-15 08:35:25	124166	Preview	☐
AIRS.2003.03.15.100.L1B.AIRS_Rad.v2.7.12.0.G03075105830.hdf	2003-03-15 09:59:26	2003-03-15 10:05:25	124166	Preview	☐
AIRS.2003.03.15.178.L1B.AIRS_Rad.v2.7.12.0.G03075134452.hdf	2003-03-15 17:47:26	2003-03-15 17:53:25	124166	Preview	☐
AIRS.2003.03.15.179.L1B.AIRS_Rad.v2.7.12.0.G03075134651.hdf	2003-03-15 17:53:26	2003-03-15 17:59:25	124166	Preview	☐
AIRS.2003.03.15.194.L1B.AIRS_Rad.v2.7.12.0.G03075141655.hdf	2003-03-15	2003-03-15	124166	Preview	☐

Project Background

- WebGIS tool developed to assist GIS users to access GES DAAC data
- Evolved from our work in creating automated production of GIS data sets, and implementation of internet map server software
- Initial release March 2002, incremental releases planned as functionality increases

Technology

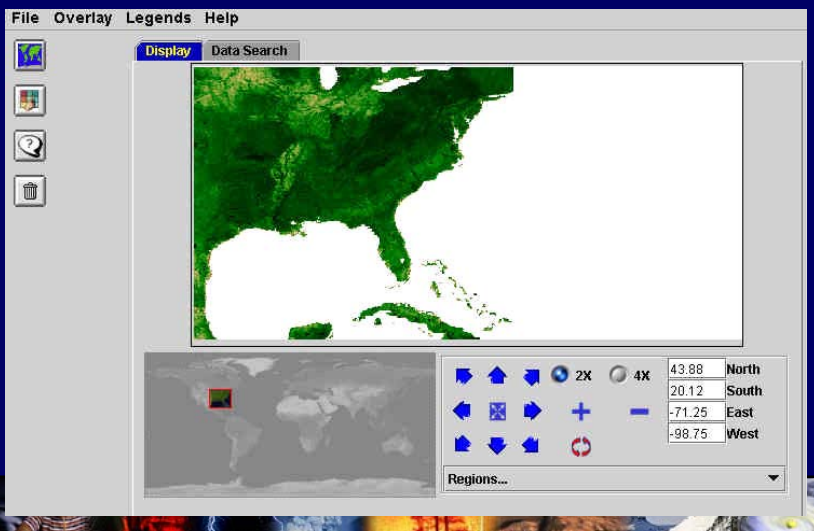
- Client Side
  - Java Applet embedded in HTML page
- Server Side
  - Perl cgi script
  - XML configuration files
  - Java image rendering/XML parsing software
- At regular intervals:
  - Serialize contents of XML files to Java objects

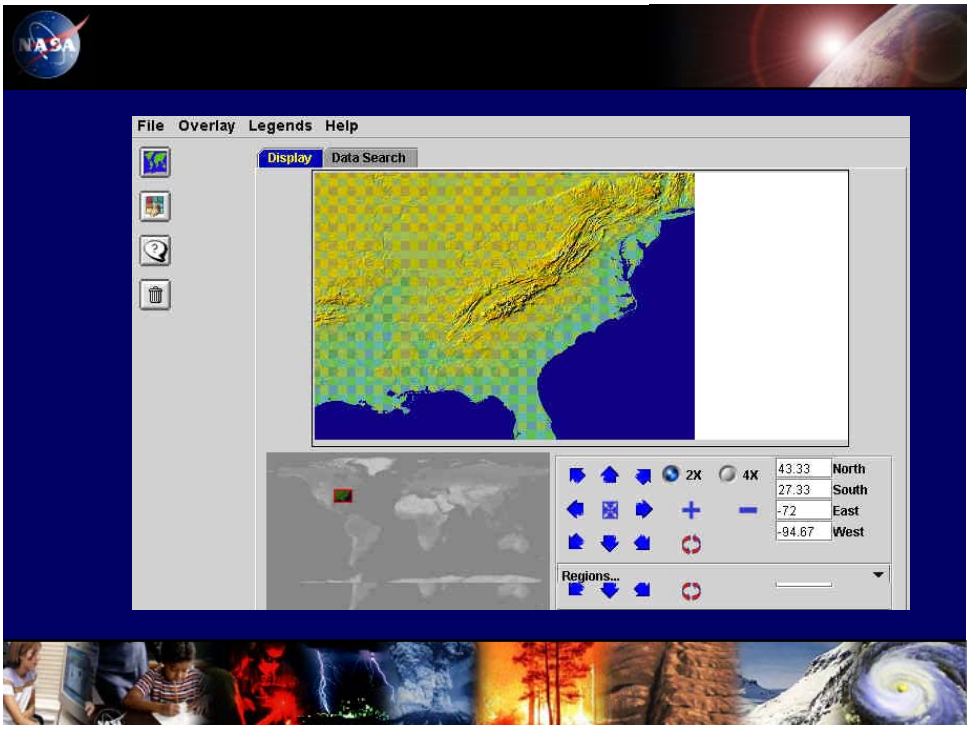
Map Server

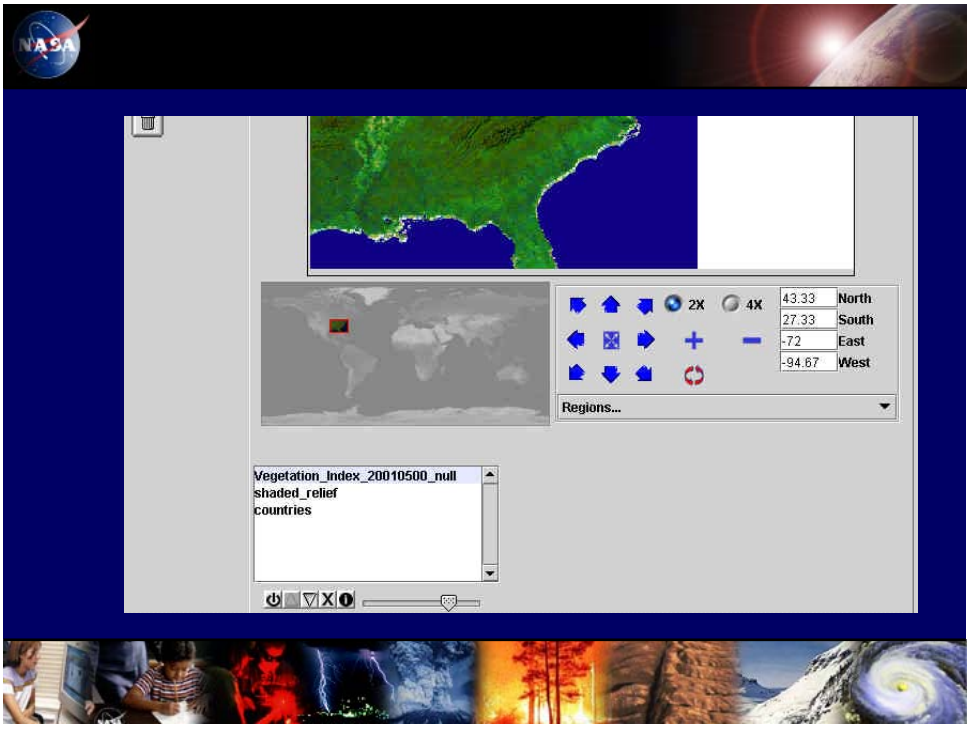
- Handles incoming map request
- Forwards those request to local rendering software or to an external map server
- Resulting image is routed back through the map server to the applet

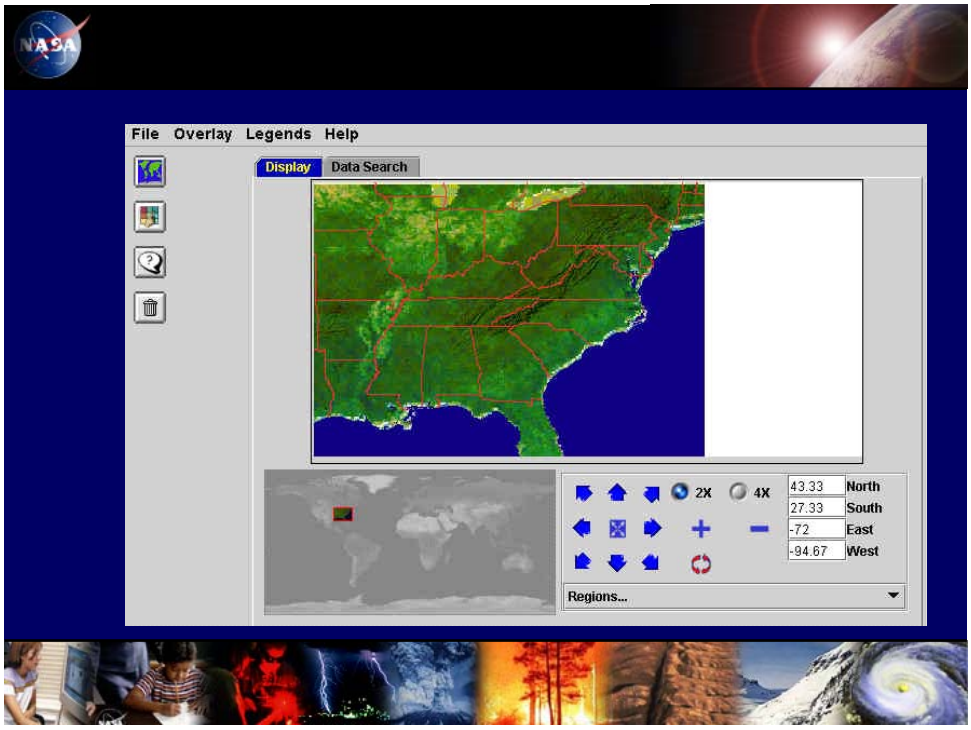
Another example of Web GIS follows

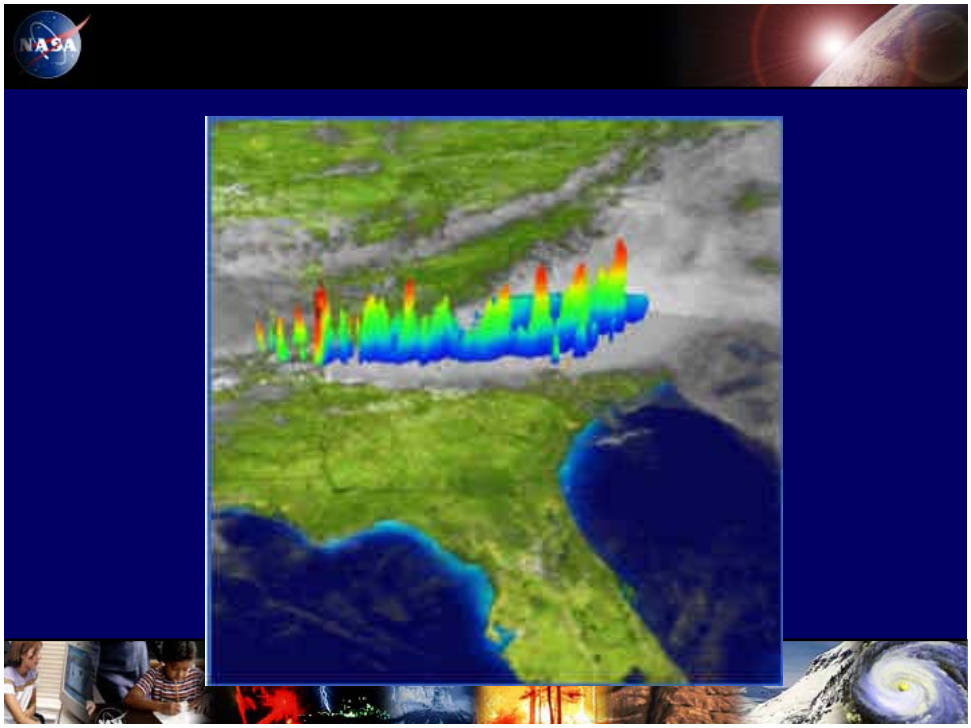
User Interface




File Overlay Legends Help
Display
Data Search
2X
4X
43.33
North
27.33
South
-72
East
-94.67
West
Regions...

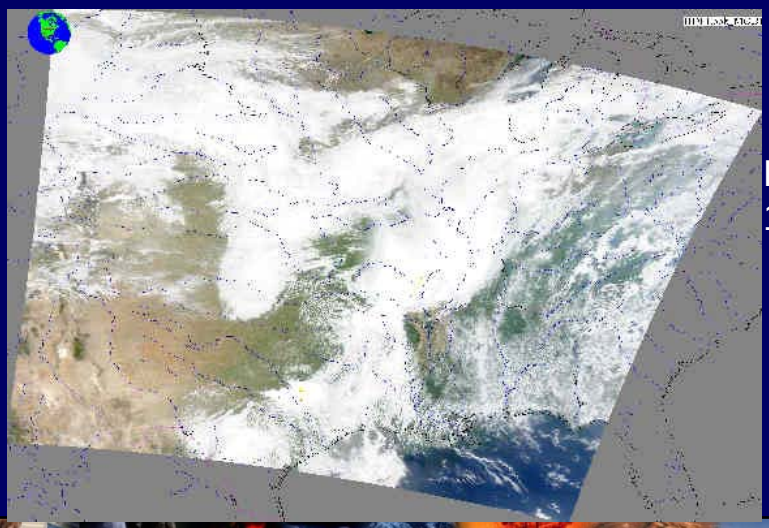

2X
4X
43.33
North
27.33
South
-72
East
-94.67
West
Regions...
Vegetation_Index_20010500_null
shaded_relief
countries


File Overlay Legends Help
Display
Data Search
2X
4X
43.33
North
27.33
South
-72
East
-94.67
West
Regions...



MODIS True Color Composite

(May 1, 2003)



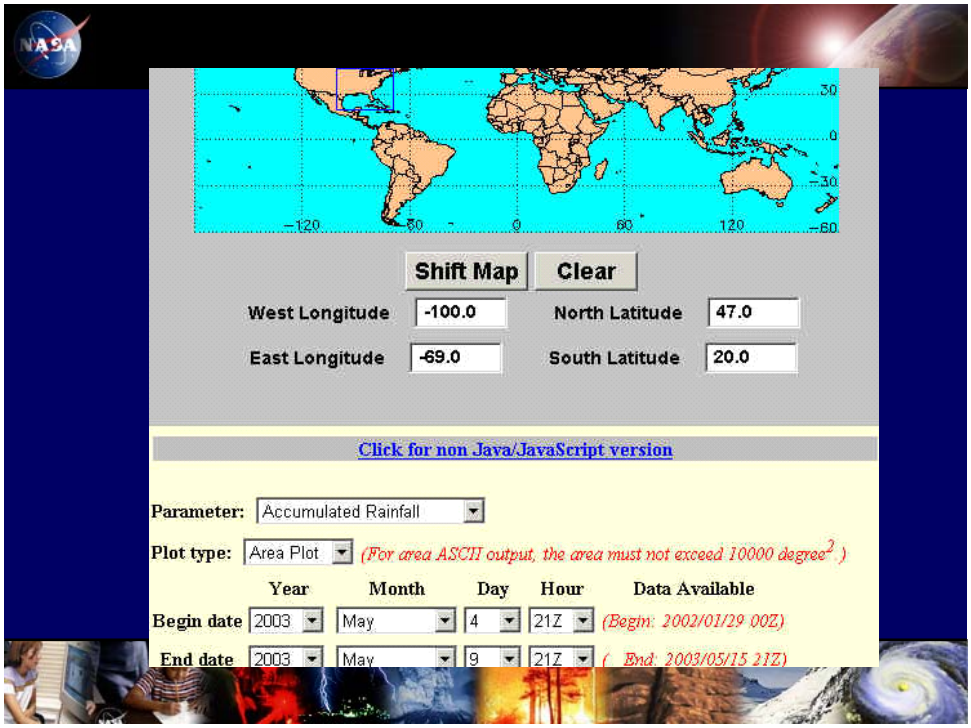
Resolution
1 km

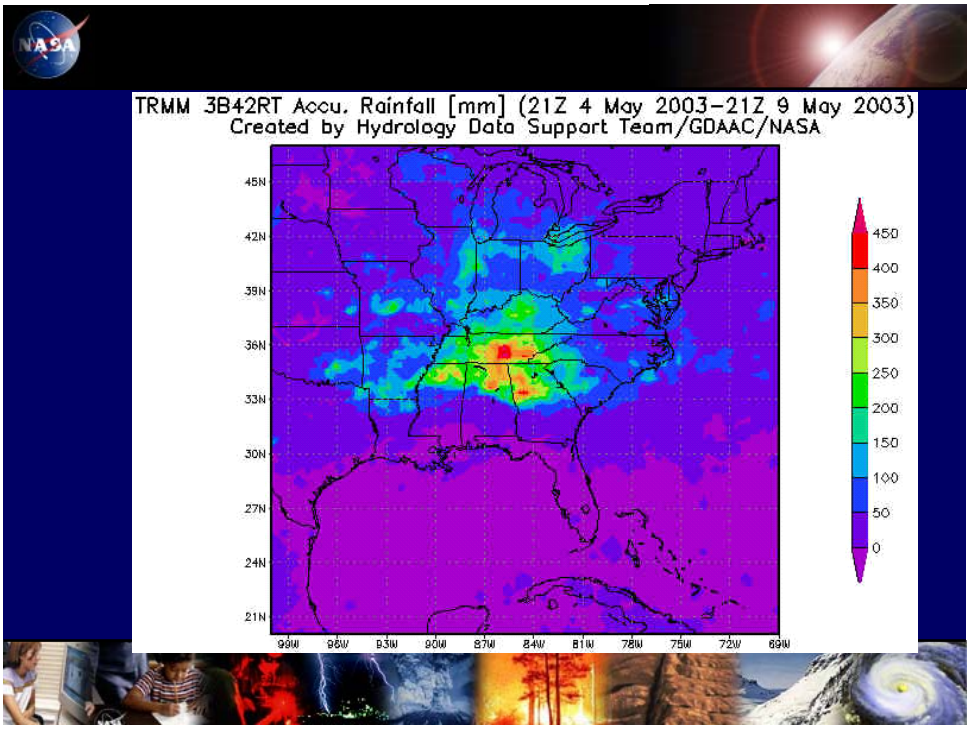
MODIS True Color Composite

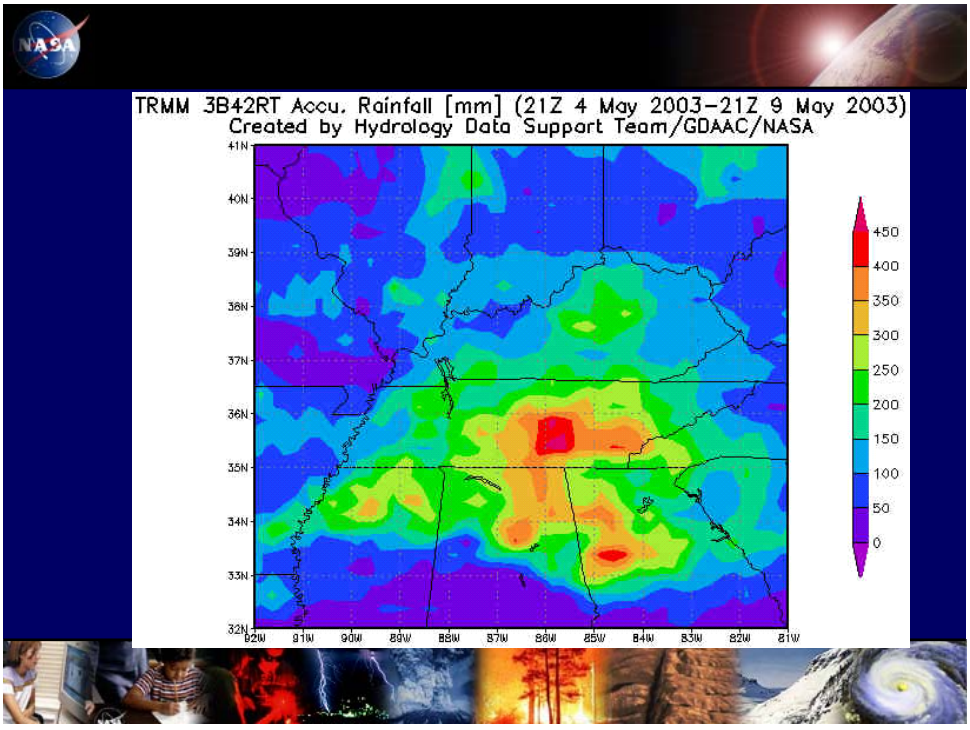
(May 1, 2003)

Resolution
250 m

DAAC Online Visualization and Analysis Systems (DOVAS)




TRMM 3B42RT Accu. Rainfall [mm] (21Z 4 May 2003–21Z 9 May 2003)
Created by Hydrology Data Support Team/GDAAC/NASA
45N
42N
39N
36N
33N
30N
27N
24N
21N
99W
96W
93W
90W
87W
84W
81W
78W
75W
72W
69W
450
400
350
300
250
200
150
100
50
0


TRMM 3B42RT Accu. Rainfall [mm] (21Z 4 May 2003–21Z 9 May 2003)
Created by Hydrology Data Support Team/GDAAC/NASA
41N
40N
39N
38N
37N
36N
35N
34N
33N
32N
92W
91W
90W
89W
88W
87W
86W
85W
84W
83W
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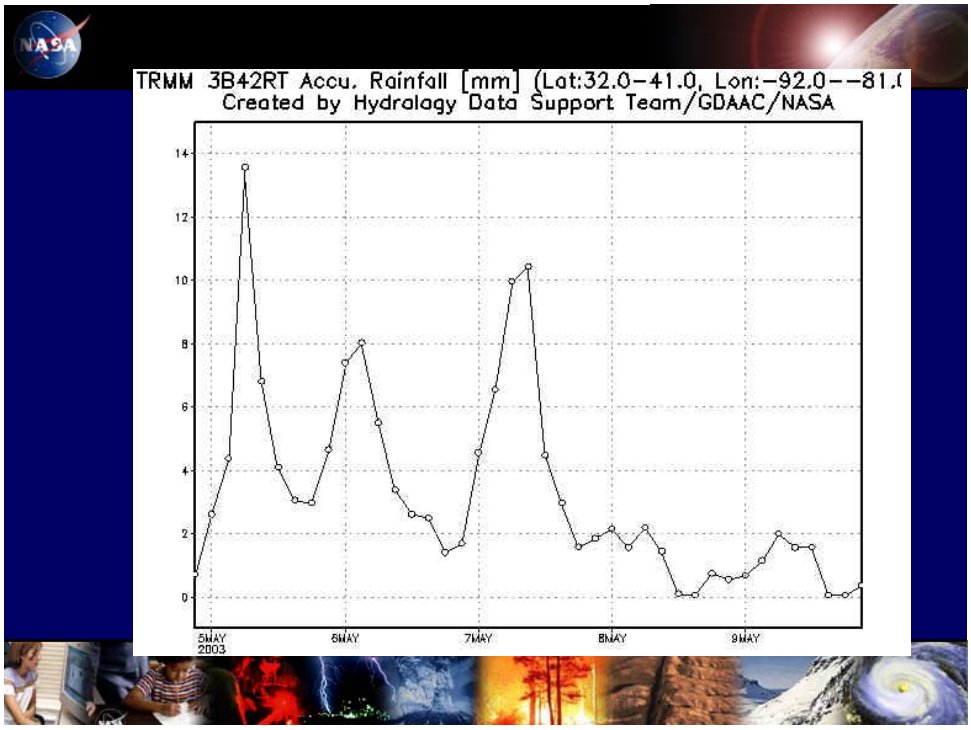
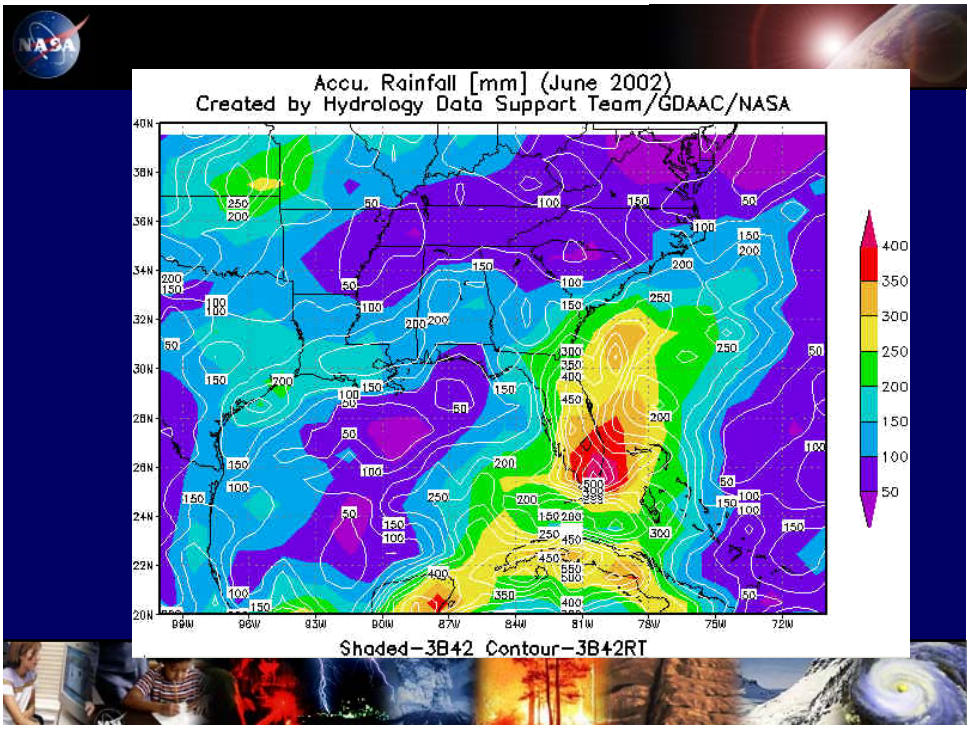
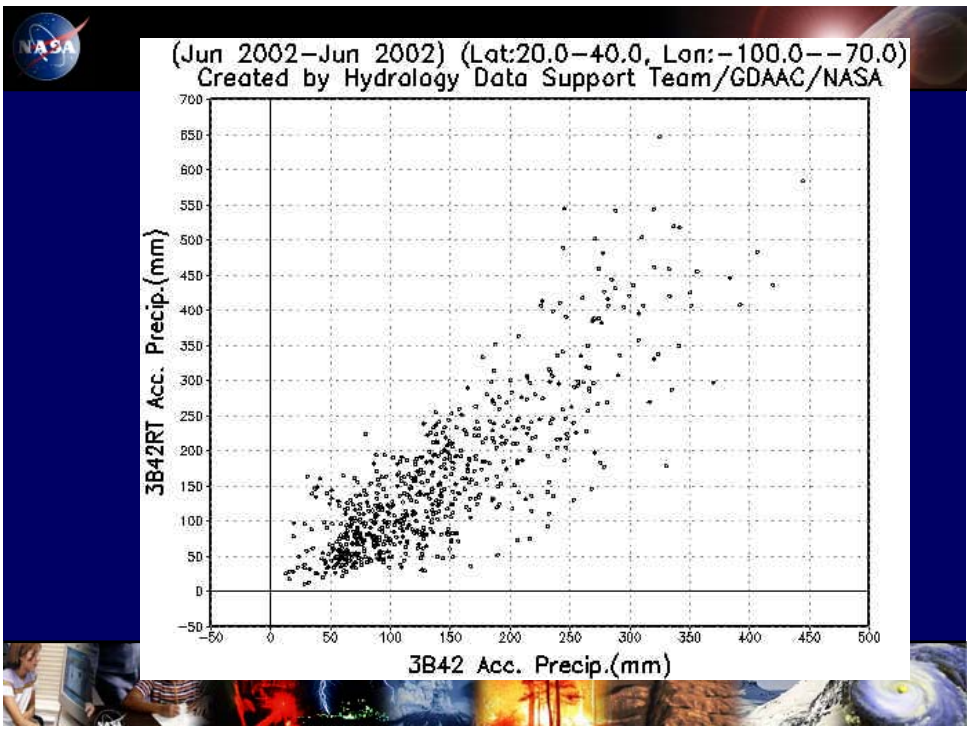
450
400
350
300
250
200
150
100
50
0



TRMM 3B42RT 3-Hourly Precip. Product
Average Precip. for lat=[32.0,41.0], lon=[-92,-81]
Undefined/Missing Value: -99999.0

Time(year:month:day:hour)	Precipitation(mm)
2003:05:04:21	0.7184
2003:05:05:00	2.6128
2003:05:05:03	4.3878
2003:05:05:06	13.5673
2003:05:05:09	6.8108
2003:05:05:12	4.1034
2003:05:05:15	3.0680
2003:05:05:18	2.9719
2003:05:05:21	4.6632
2003:05:06:00	7.3952
2003:05:06:03	8.0441
2003:05:06:06	5.5097
2003:05:06:09	3.3886
2003:05:06:12	2.6126
2003:05:06:15	2.4960
2003:05:06:18	1.4108
2003:05:06:21	1.7023
2003:05:07:00	4.5610
2003:05:07:03	6.5637
2003:05:07:06	9.9677
2003:05:07:09	10.4394
2003:05:07:12	4.4757
2003:05:07:15	2.9735
2003:05:07:18	1.5929
2003:05:07:21	1.8636


Accu. Rainfall [mm] (June 2002)
Created by Hydrology Data Support Team/GDAAC/NASA
Shaded-3B42 Contour-3B42RT


(Jun 2002-Jun 2002) (Lat:20.0-40.0, Lon:-100.0--70.0)
Created by Hydrology Data Support Team/GDAAC/NASA
3B42RT Acc. Precip.(mm)
3B42 Acc. Precip.(mm)


What We Heard,
So Far

Bob Chen, Deborah Balk, & Francesca Pozzi

"Population, Interoperability, and Confidentiality"

Population, Interoperability, & Confidentiality

- Georeferenced Population Data
- Interoperability in Accessing Spatial Data
- Protecting Confidentiality of Human Subjects

Dr. Robert S. Chen

- Manager, Socioeconomic Data and Applications Center (SEDAC); Deputy Director, Center for International Earth Science Information Network (CIESIN), Columbia University; Chair, NASA DAAC Alliance

Dr. Deborah Balk

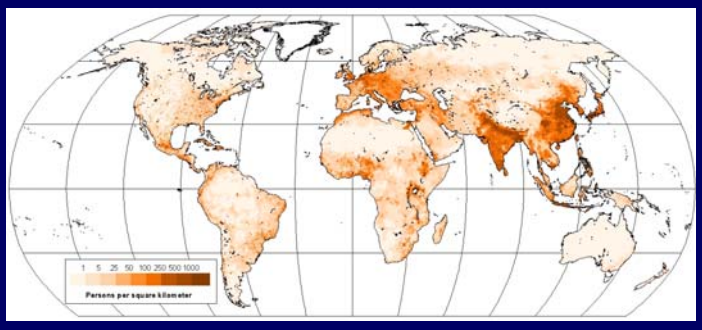
- SEDAC Project Scientist; Associate Research Scientist, CIESIN

Ms. Francesca Pozzi

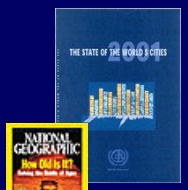
- CIESIN Staff Associate

World Data Center for Human Interactions in the Environment

Georeferenced Population Data

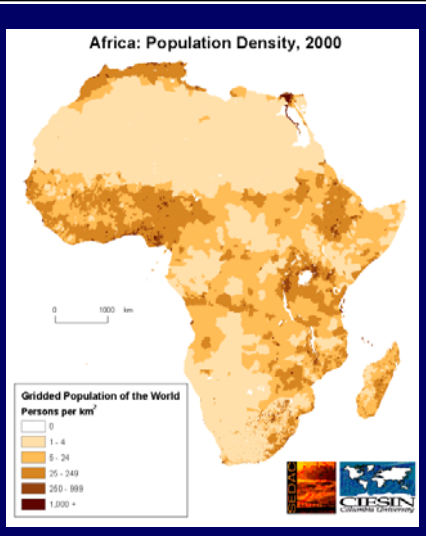


GPW V.2



- Gridded Population of the World (GPW) is based on the best available administrative boundary and census data, gridded on a 2.5 minute latitude/longitude grid. Version 2 provides estimates for 1990 and 1995.
- GPW provides a way of connecting environmental data of various types with people, especially with respect to their exposure and vulnerability.

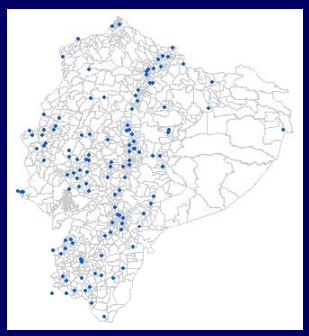
GPW Version 3 in Development



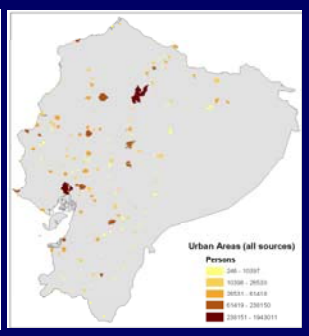
- GPW Version 3, currently under development, will provide population density estimates for 1990 and 2000
- The preliminary version for Africa includes more than an order of magnitude increase in the number of subnational administrative units used in gridding
- GPW Version 3 will serve as a core dataset in the Millennium Ecosystem Assessment and in the UN Millennium Development Project.

Global Urban Extent Database

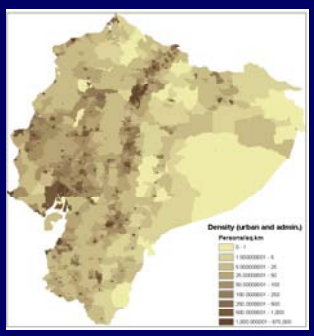
- A new database on urban location and extent combines available census and population data with stable night-time lights and other urban extent indicators



Points



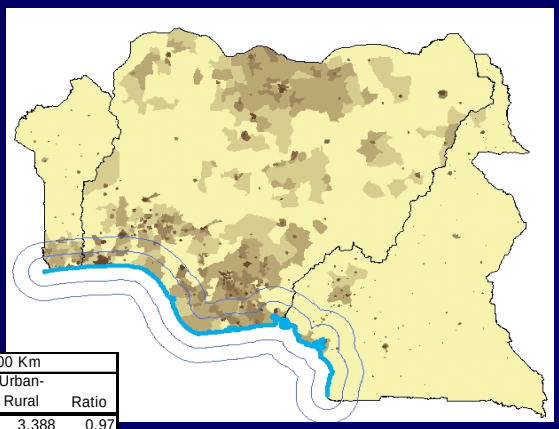
Polygons



Gridded surface
1 km

Application to Coastal Hazard Estimation

- **Urban-rural dataset for part of Western Africa shown with coastal buffers of 50 and 100 km**
- **Significant improvement over GPW version 2**



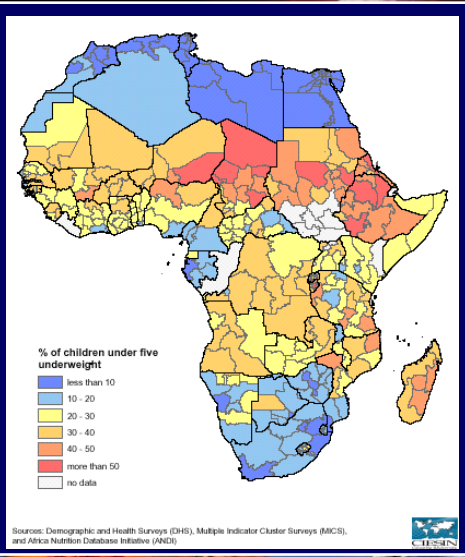
	50 Km			100 Km		
	GPW	Urban-Rural	Ratio	GPW	Urban-Rural	Ratio
Benin	2,694	2,355	0.87	3,487	3,388	0.97
Cameroon	2,300	2,356	1.02	2,885	2,943	1.02
Nigeria	14,194	24,592	1.73	23,971	34,176	1.43
Total	19,189	29,303	1.53	30,342	40,507	1.33

Population Density and Elevation

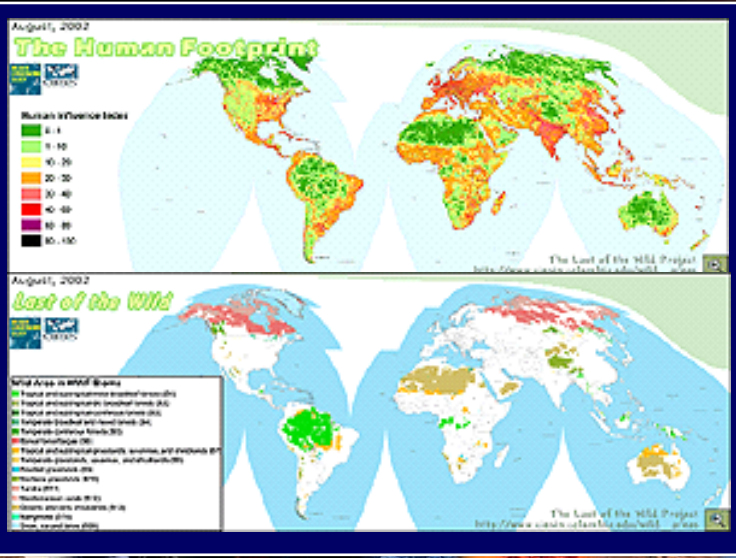
- **Urban-rural population density vs. elevation above sea level in Nigeria**

Poverty and Hunger

- Continuing controversy over measurement of poverty at global and national levels; subnational poverty mapping a major gap
- Wide range of applicable data sources, including remote sensing and other environmental/contextual datasets
- Major data gathering and integration effort including DHS, MICS, HDRO, national sources under auspices of UN Millennium Development Project.



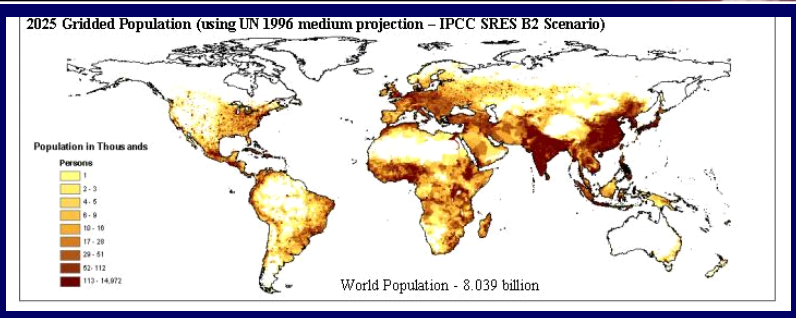
Last of the Wild and the Human Footprint

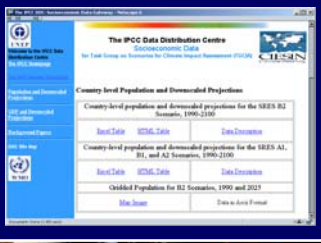


- Combination of several global spatial datasets to assess degree of human influence by ecological zone
- Recent publication in *Bioscience*

WILDLIFE CONSERVATION SOCIETY

IPCC Socioeconomic Data Distribution Centre

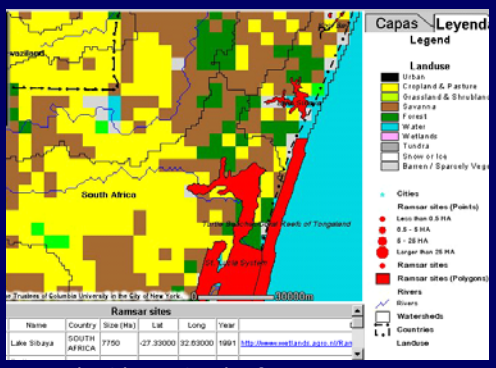




- **Downscaled country-level population projections consistent with scenarios from the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emission Scenarios (SRES)**
- **Gridded 1990 and 2025 population distribution consistent with "B2" scenario**

Ramsar Wetland Data Gateway

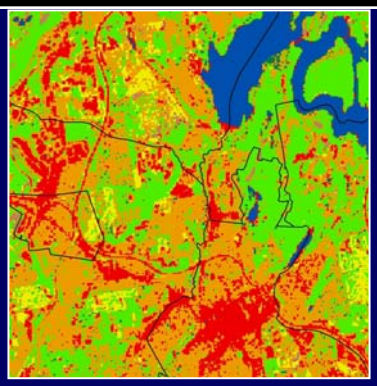
- **Online Internet mapping tool delivering official Ramsar Wetlands site data in combination with population, land cover, and other datasets**
- **Hot links to USGS Landsat 7 image browse tool**

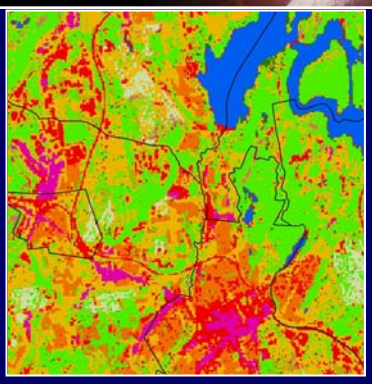


Lake Sibaya, South Africa

Corresponding Landsat 7 scene, May 2001, Path 167/Row 79

Land Cover: Westchester County NY





Maximum Likelihood Classification
- Water
- Evergreen Forests
- Deciduous Forests
- Grass and Undeveloped
- Low and Medium Intensity Resid.
- High Intensity Resid./CIT
- Soil/Exposed Rock
- No Data

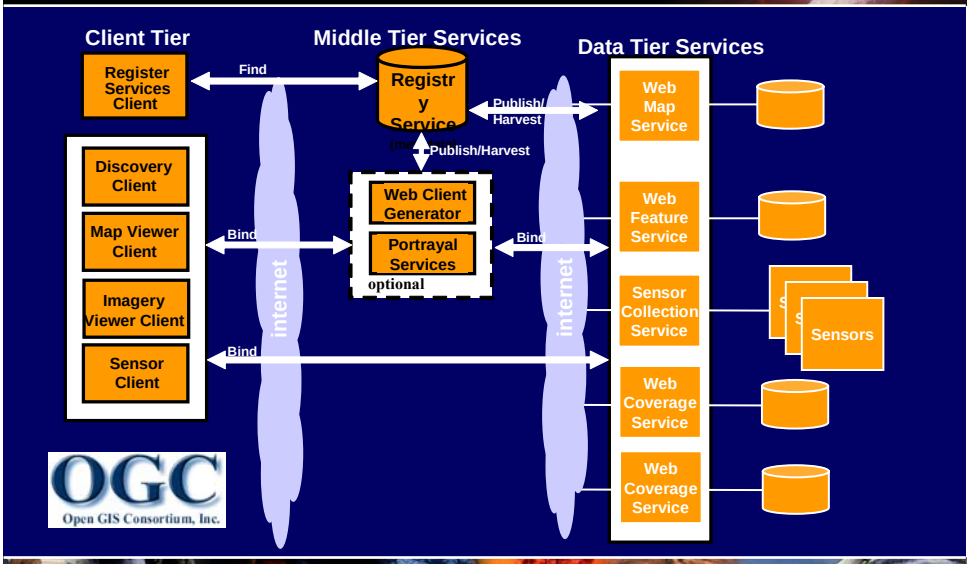
- Land cover classification map for Westchester County, New York, based on Landsat 7 ETM+ imagery for fall 1999 and winter 2000 at 30-m resolution.

Westchester Land Cover Classification
- Water
- Evergreen Forests
- Deciduous Forests
- Residential Grass
- Low Intensity Residential
- Medium Intensity Residential
- High Intensity Residential
- Commercial/Industrial
- Soil/Exposed Rock
- Undeveloped
- No Data

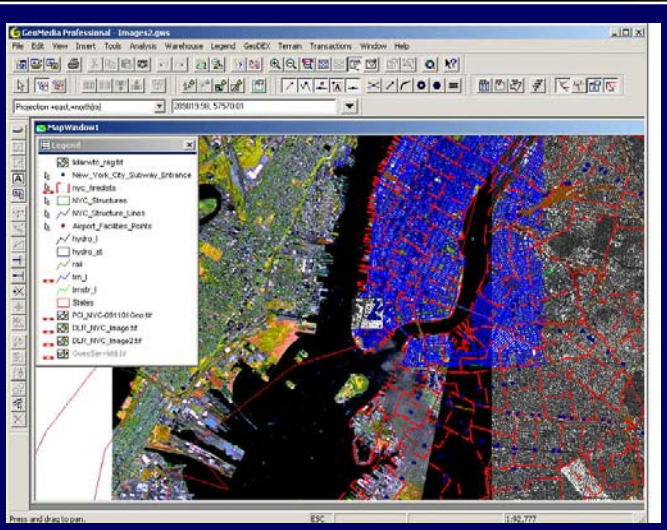
Interoperability in Accessing Spatial Data

- Issue: Manually downloading, accessing, and integrating spatial data can be costly and time consuming
- Question: How can users access distributed sources of spatial data seamlessly to support visualization, analysis, and decision making?
- Challenges:
  - Many different spatial data types, e.g., imagery, points, vectors, features, text, tables.
  - Wide range in data volume, bytes to petabytes
  - Different methods for spatial and temporal referencing, different geographic projections, different data formats and data structures, inconsistent interfaces and terminology, etc.

OGC Interoperability Framework



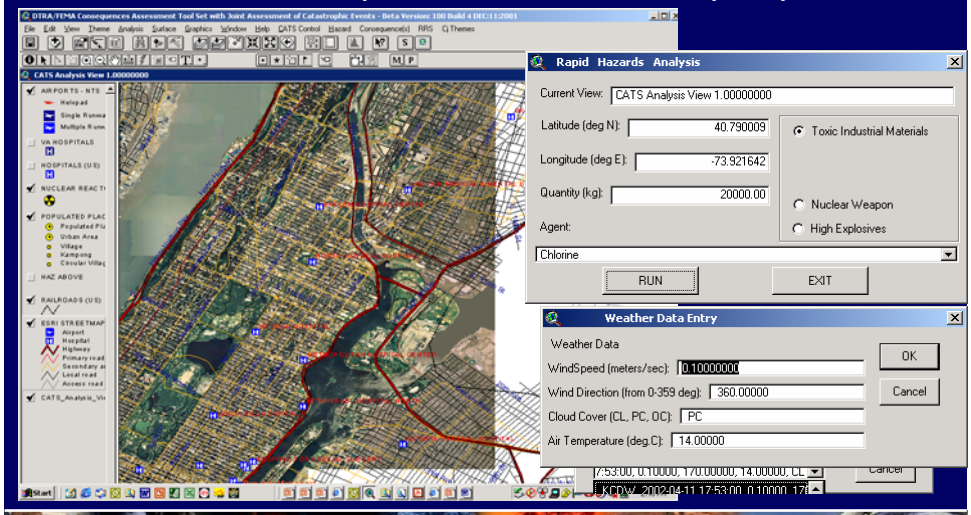
OGC New York City Testbed



- Intergraph client showing NYC imagery with overlaid features
- Fire districts (red lines) drawn from WFS-compliant SEDAC server
- SEDAC worked with Ionic Software and ESRI to host WMS-, WFS-, and WCS-compliant servers

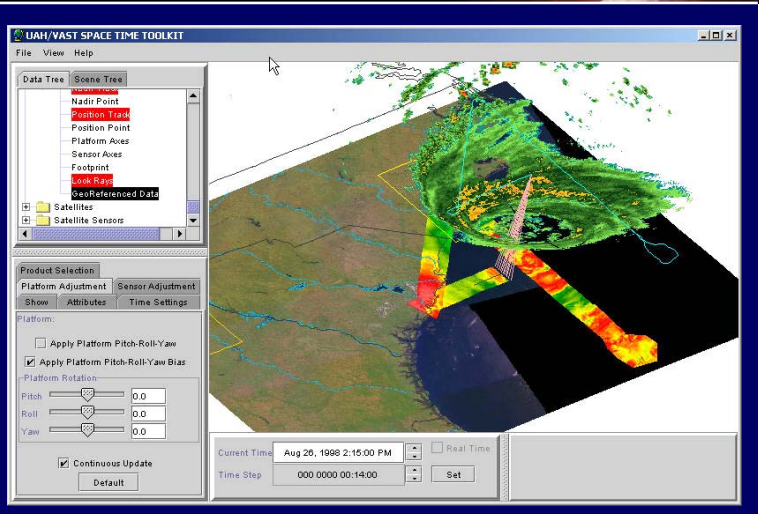
GIS-Based Decision Support Tool

- **DTRA FEMA Consequences Assessment Tool Set (CATS)**



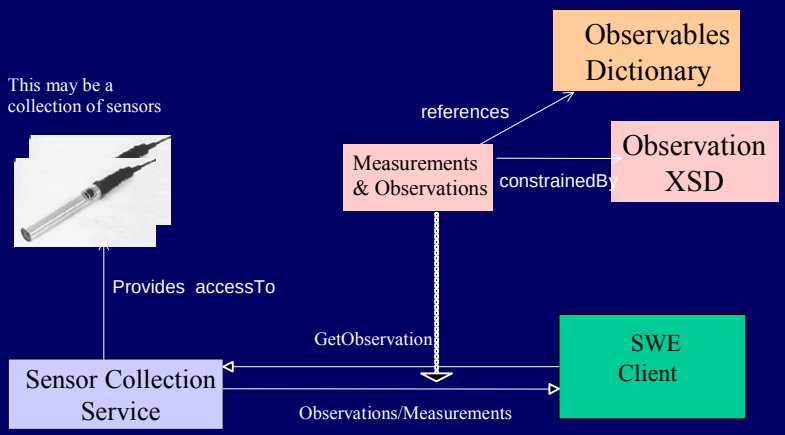
3-D Visualization of Data

- **UAH Space-Time Toolkit, M. Botts, University of Alabama Huntsville**
- **"Thick" client that supports animation, 3-D visualization of phenomena**



OGC Sensor Web Enablement

- **Sensor Web Enablement (SWE) is a set of OGC specifications to support direct linking of sensors to the Web**



NASA DAAC Interoperability Activities

WCS Viewer Architecture

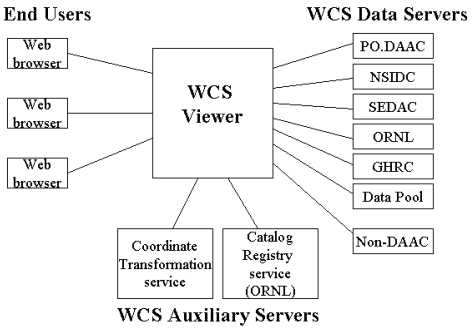


Figure 1. WCS Viewer connects WCS data servers with end users.

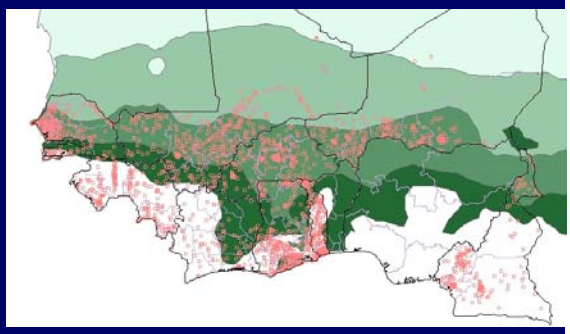
- **NASA DAACs are implementing various OGC-compliant services that will provide real-time or near-real time access to satellite data.**
- **The DAACs have proposed to enhance an open source client that will permit flexible access to distributed data sources.**
- **Raytheon, as part of the Synergy project, will be prototyping a Web Coverage Server to access near-real time data from the DAAC Data Pools**

Protecting Confidentiality of Human Subjects

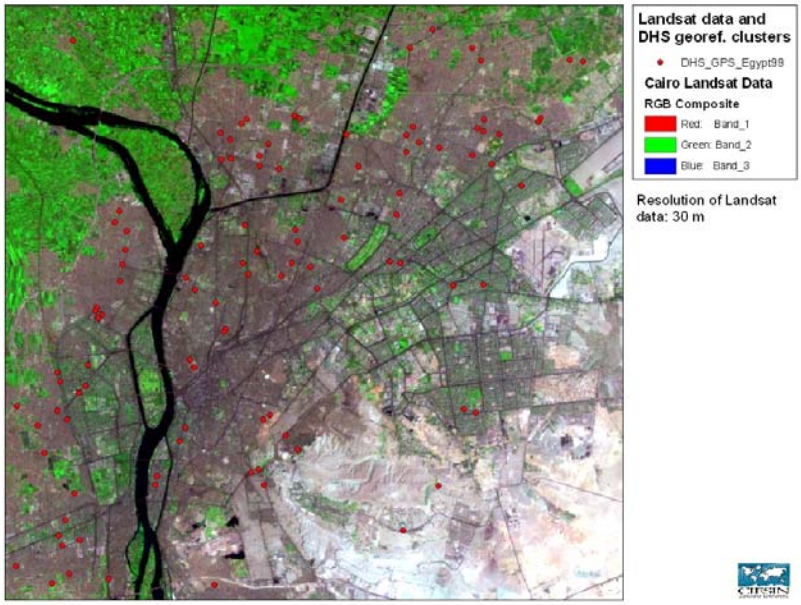
- **Issue: Linking georeferenced data with other types of data on individuals or households could compromise the confidentiality of the human subjects data.**
- **Question: To what extent is this an issue in surveillance and monitoring activities?**
- **Challenges:**
  - **Providing accurate, verifiable data to those who "need to know," e.g., to support analysis, decision making, and response planning**
  - **Shielding subjects from disclosure of data that could lead to violation of their confidentiality**

DHS Data Example

- **100 Demographic and Health Surveys in roughly 75 countries (1984-present)**
- **45 with Global Positioning System (GPS) data in 30 countries (late-90s to present), mostly in Africa**
- **GPS points taken at population center of cluster (or enumeration area)**
  - **Roughly 30 households per cluster**
  - **Ranges from a single building in an urban area to 250 km² area in sparsely populated areas**
- **Survey content includes highly sensitive subjects:**
  - **Births**
  - **Deaths**
  - **Contraceptive use**
  - **Household assets**
  - **HIV knowledge, preventative measures and blood samples**
- **Data are publicly and freely available with request**



DHS clusters in Cairo: Landsat 7



Medium vs. High Resolution Imagery

DHS clusters in Cairo: QuickBird

QuickBird Data and DHS georef. clusters

DHS_GPS_Egypt99

Cairo QuickBird data

RGB Composite

Red: Band_1

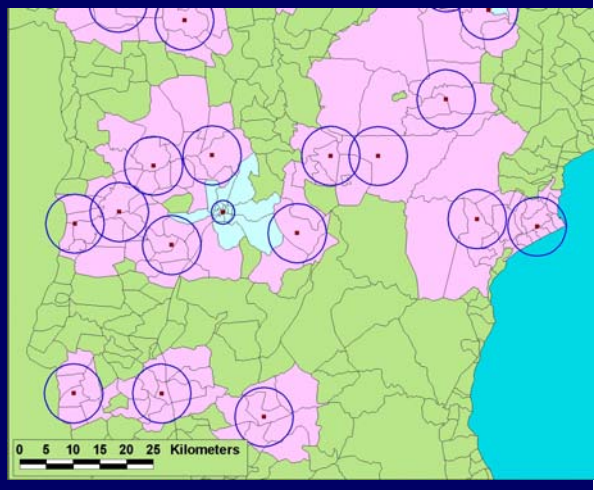
Green: Band_2

Blue: Band_3

Resolution of Quickbird data: 4 m

Confidentiality Approaches

- **Example approaches:**
  - **Add "spatial noise"**
  - **Aggregate results, do not release microdata**
  - **Randomize microdata**
  - **…**
- **What impact on science and decision making?**



Closing Comments

- SEDAC is one of 8 operational Distributed Active Archive Centers (DAACs) in the NASA Earth Observing Data and Information System
- SEDAC is specifically interested in integration of remote sensing and socioeconomic data to support science and decision making
- The DAACs are excited about potential opportunities to support operational applications of remote sensing and are willing to work directly with partners and users


Clinical Perspective on data and information
F. B. Carlton, Jr. MD
Professor and Associate Chairman
Department of Emergency Medicine
University of Mississippi Medical Center
The University of Mississippi Medical Center


THE PAST IS PROLOGUE.
Eastern Europe
Air pollution
Water pollution
Soil contamination
Chernobyl
Bhopal
Exxon Valdez
Persian Gulf War
Gulf War Syndrome
Global warming
Erin Brockovich
The University of Mississippi Medical Center

A PROBLEM!

- Lawsuit with hundreds of plaintiffs against large company alleging:
  - environmental contamination
    - Soil
    - Water
    - Air
  - Health effects

The University of Mississippi Medical Center

ALLEGED HEALTH EFFECTS

- Headaches
- Respiratory infections
- Dermatologic problems
- Dental problems
- Cancer
- Coronary artery disease
- Hypertension
- GI problems

The University of Mississippi Medical Center

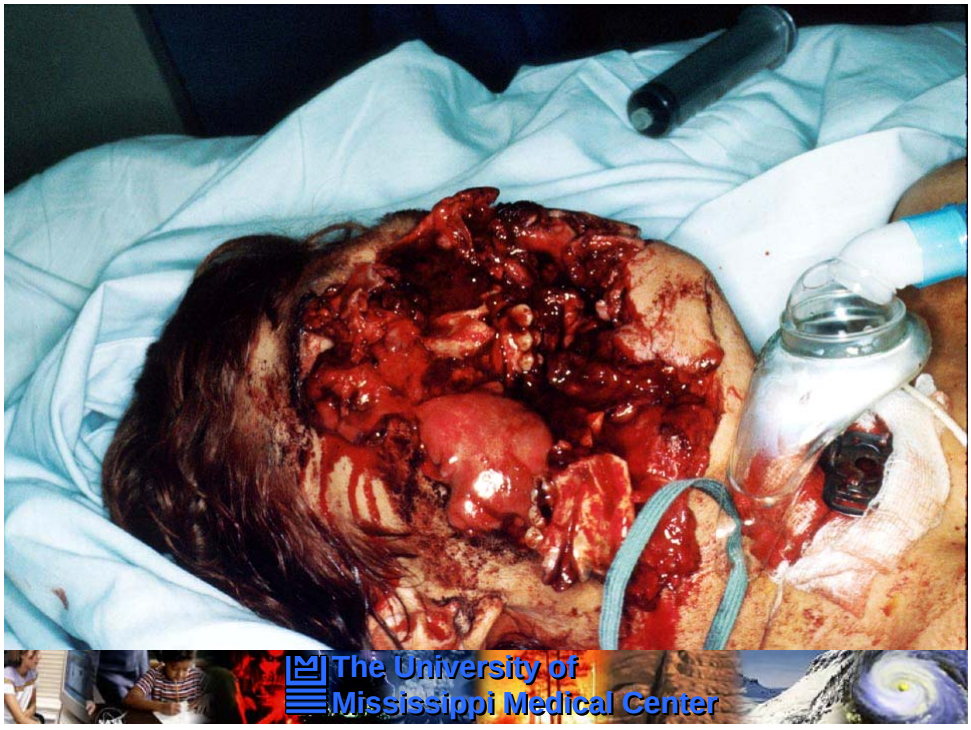
AGENTS

- Solvents
- Miscellaneous compounds (without significant toxicity)

CLINICAL THOUGHT PROCESS

- Specialists
  - Specific diagnosis:
    - "They say I'm having a heart attack."
- Generalists
  - Complaint driven:
    - What brings you to the hospital today?


The University of
Mississippi Medical Center


The University of
Mississippi Medical Center

COMPLAINTS

- Monitored
  - Asthma
  - Cancer
  - Birth Defects
  - West Nile
- Unknown
  - Headaches
  - Febrile illnesses
  - Diabetes
  - Dermatologic problems
  - Coronary artery disease
  - ?

DATA COLLECTION DIFFICULTIES

- Disjointed data bases
  - Physicians' offices
  - Hospitals
  - Etc.
- Accuracy of data bases
  - Case definitions
  - Stringency of application of diagnostic criteria

REPORTABLE EVENTS

- Vital statistics
- STD's
- GSW's
- Etc.

NOTIFICATION

- Timeliness
- Succinct
- Relevant specialties

A PARABLE

- Someone rescued from the river.
- Occurs again.
- Scenario repeats with increasing frequently
- Rescuers eventually are too busy with their daily tasks of rescuing to assess what is occurring up river and institute preventative measures.

ACCESSING MEDICAL DATA

- Integration from multiple providers
- Data quality
- GIS
- Data analysis
  - By diagnosis
  - By complaint
  - Interpretation


PREVENTION AND TREATMENT
• Interdisciplinary approach is essential
– Relevant clinical specialties
– Related health scientists
– Specialties from other fields
The University of
Mississippi Medical Center

Assessing Links Between Ecosystem Health and Childhood Asthma

Dan Kimes and Elissa Levine
Biospheric Sciences Branch, NASA/GSFC
Greenbelt, MD

In collaboration with
C. Blaisdell[1], S.Weiss[1], M.B. Bollinger[1], S. Amr[1], B. Holben[2], R. Nelson[2] , S. Timmins [2], A. Ullah [2], and others

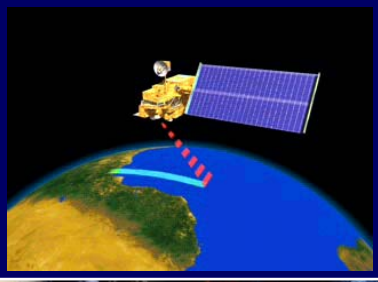
[1] University of Maryland, School of Medicine
[2] NASA/GSFC, Biospheric Sciences Branch

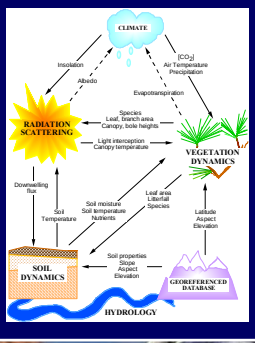
With funding from NASA's Healthy Planet: Earth Science and Public Health Program, Health Care Financing Administration, and NASA/GSFC's Director's Discretionary Fund

July 1, 2003

NASA's Earth Science Enterprise Contribution:

- **Measuring** from space and on the ground
- **Modeling** to understand complex interconnections within the Earth's systems
- **Provide** advanced technologies **and new analytical frameworks**
- **Present information in a global context**





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Baltimore Prototype

- Asthma prevalence in Baltimore has been increasing over the past 16 years
- Asthma is the #1 cause for pediatric hospitalization at the University of Maryland School of Medicine, accounting for 20% of all admissions in Baltimore
- Baltimore generally has poor air quality and environmental conditions which may be linked with asthma

Pilot Project Accomplishments

- Design and development of a series of tools and capabilities for integrating, visualizing, accessing, and analyzing environmental, remotely sensed, and clinical health data
  - Preliminary planning done in collaboration with partners from the medical and public health communities whose mandate is to make decisions about management of pediatric asthma related to:
    - Appropriate medical regimen
    - When to take action to avoid exposure
    - Where to target intervention and education programs
    - Policy for long term changes

Preliminary Results

- **Journal articles (5 to date) and presentations at scientific conferences reporting on:**
  - Geographic and temporal distribution of pediatric asthma
  - Detection of epidemics
  - Identity of sensitive populations
  - Preliminary analysis of effects of environmental factors on asthma incidence
  - Other information

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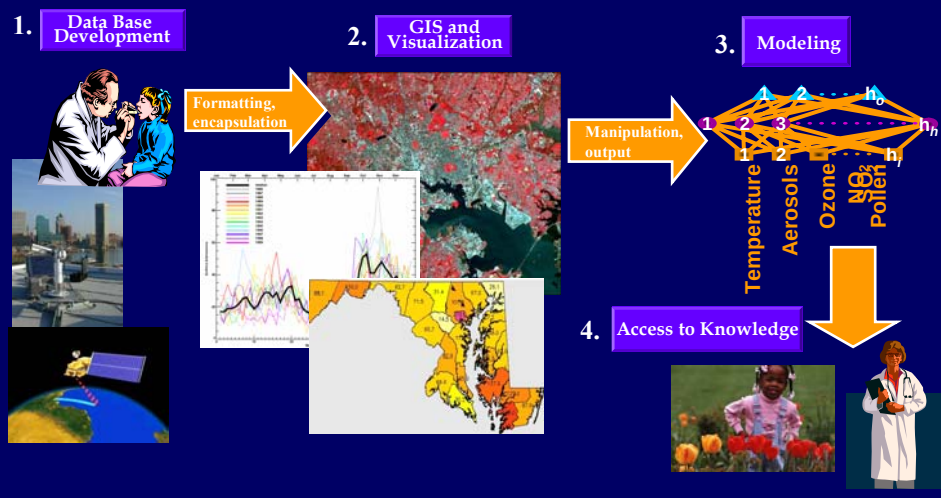
Design of Tools and Capabilities



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Data Base Components

Clinical data: HSCRC (hospitalizations and emergency room admissions with daily time step, zip code spatial level, age, gender, race), Medicaid, others

Socio-Economic: US census data, school data

Weather: precipitation, wind speed and direction, temperature, humidity, etc.

Air Quality: O_3, NO_2, CO, SO_2, air toxins, precursors to ozone, etc.

Water Quality: pharmaceuticals, pesticides, and other compounds

Environmental: pollen, molds, brownfields, soil properties, topography, ecoregions, agricultural activity, etc.

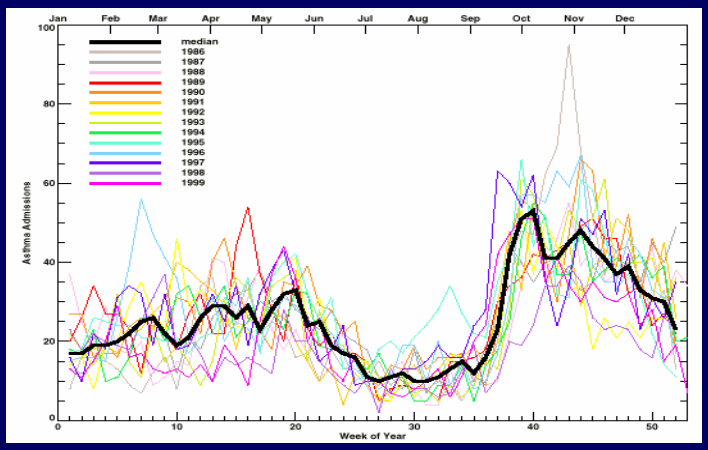
Remote Sensing: Landsat, AVHRR, Ikonos, SPOT, Aeronet, MODIS, ASTER, etc.

Landmark features: roads, cities, traffic, major industrial areas, etc.

Example of Interface for Data Tools

Temporal Data Application

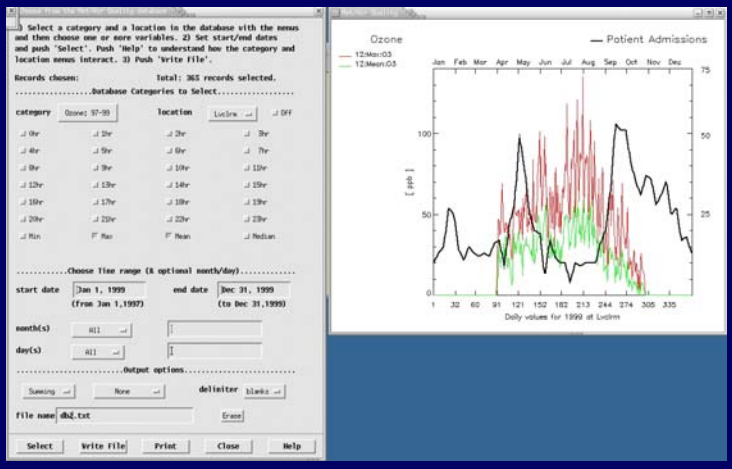
Pediatric Asthma Hospital Admissions,1986-1999, Baltimore, MD



Blaisdell et al, .J. of Asthma, 2002; Kimes et al., Environmental Research, 2003

Temporal Data Application

Daily Ozone and Pediatric Hospital Admissions, 1999



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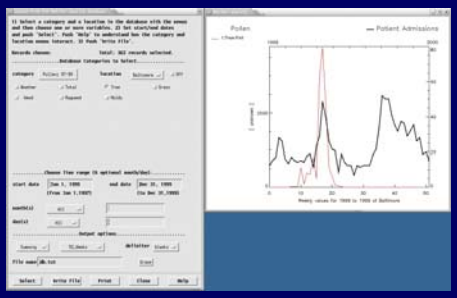
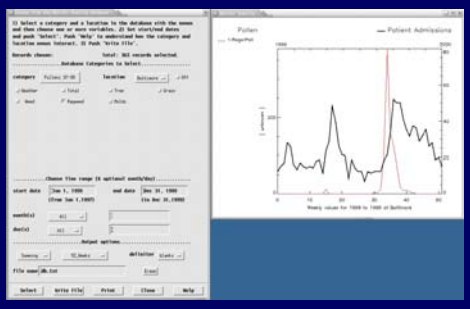
Temporal Data Application

Tree and Ragweed Pollen, and Pediatric Hospital Admission, 1999





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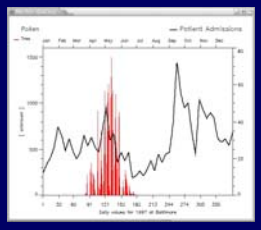
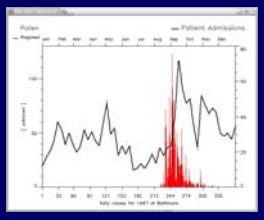
Temporal Data Application

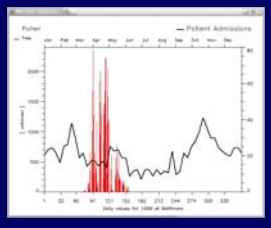
Tree and Ragweed Pollen, and Pediatric Hospital Admissions

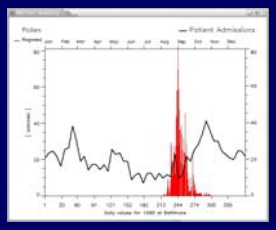
1997





1998





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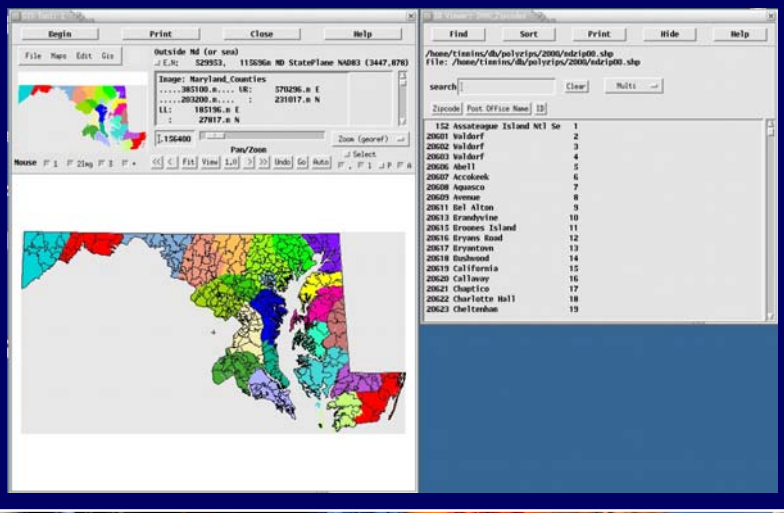
Example of Spatial Tools

Zip Codes for Maryland Counties



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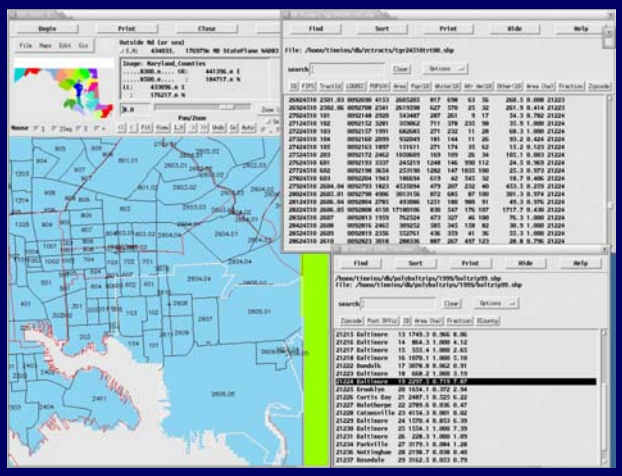
Example of Spatial Tools

Census Tracts within Zip Codes, Baltimore, MD



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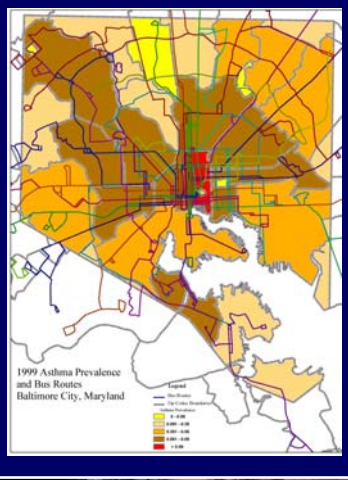
Spatial Tool Application

Bus Routes and Pediatric Asthma Hospital Admissions



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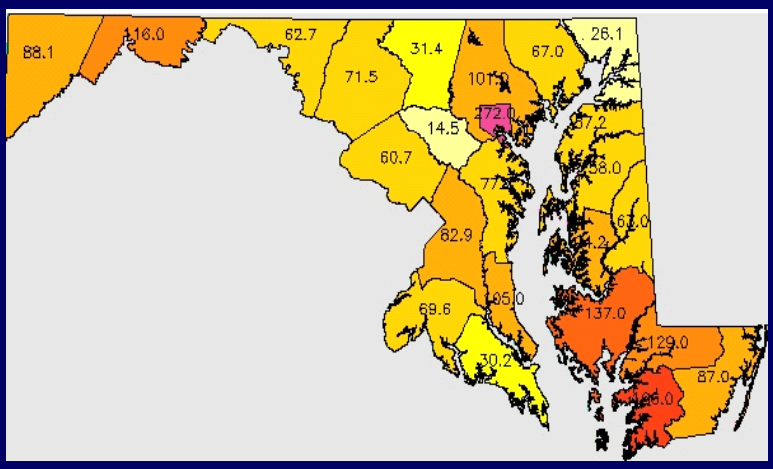
Spatial Tool Application

Pediatric Asthma ED Admissions/10,000, 1999, MD Counties



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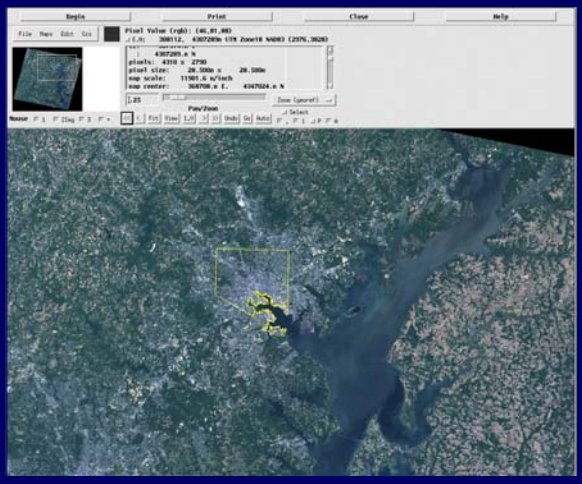
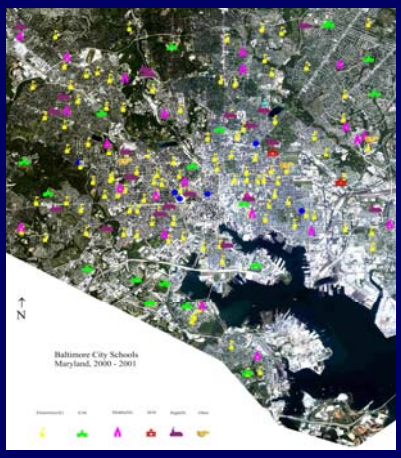
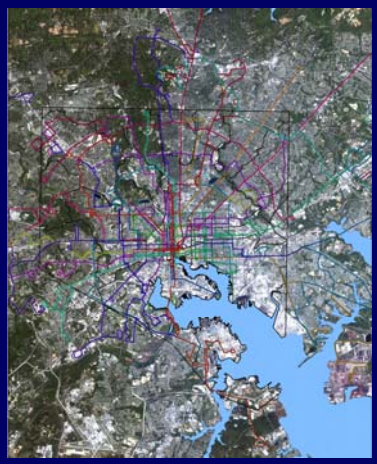
Remote Sensing Products:



- Extent of Urbanization
- Timing of Greenness
- Land Cover change
- Land Use change
- Pollution mapping
- Agricultural Activity
- Distance to Roads and industry
- Thermal Properties
- Others…

IKONOS, May 2000, Baltimore, MD

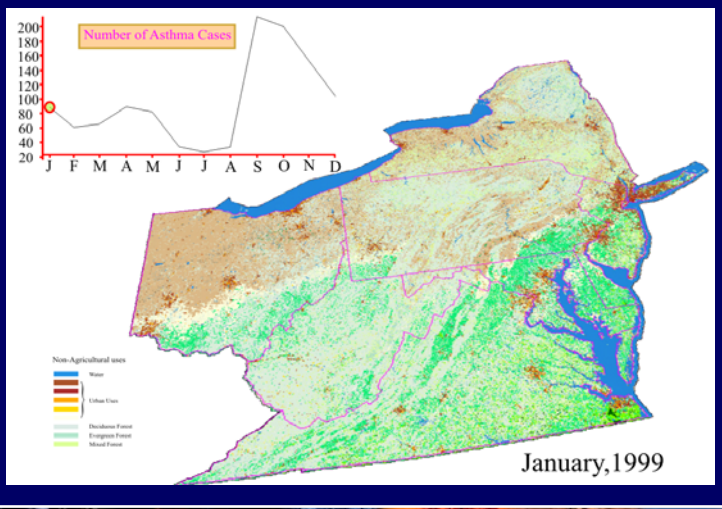




(Amr et al., Annals of Asthma and Allergy, 2002)

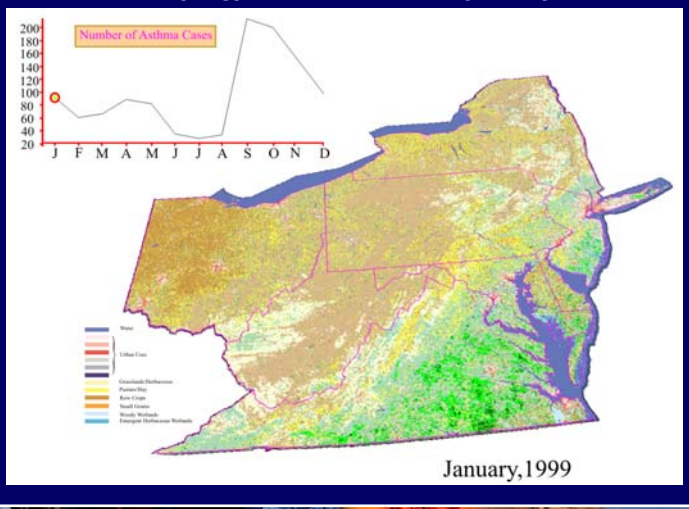
NDVI Change for Agricultural Areas

SPOT (Veg) Data, 1999, 10 day composite



NDVI Change for Forested Areas

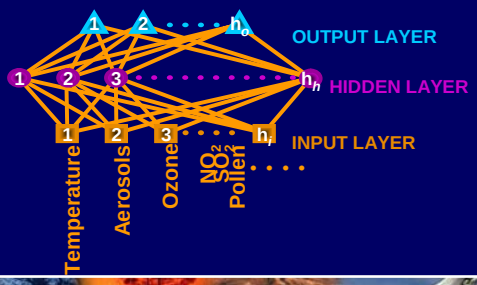
SPOT (Veg) Data, 1999, 10 day composite



Modeling Strategy

Linear and non-linear modeling techniques are being used to:

- **Identify the most important variables**
- **Produce the "best" possible model**
- **Provide an adaptable system that handles diverse data**



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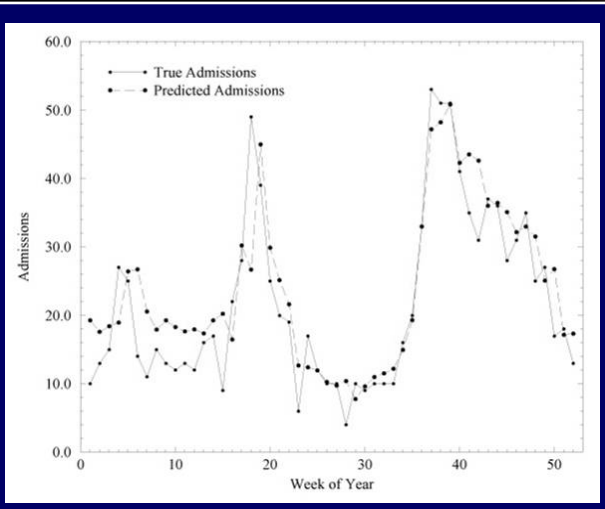
Prediction of Future Admissions



R^2=.85

Blaisdell et al. J. of Asthma, 2002; Kimes et al., Int. J. Neural Network Appl, 2003

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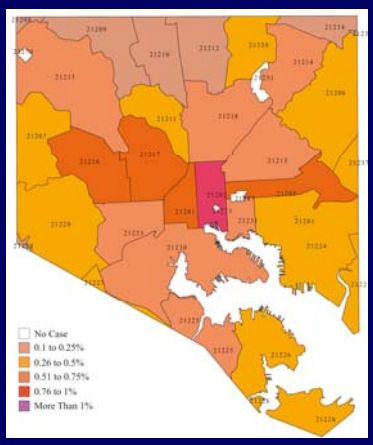
Factors Related to Spatial Distribution of Hospital Admissions

% Pediatric Hospitalization Rates by Zip Code, Baltimore, MD, 1999



Kimes et al., Health and Place, 2004

R^2=.95

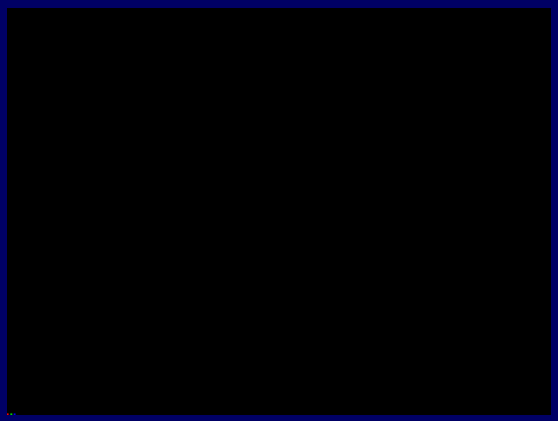
From Landsat:

- Highest proportion of built areas
- Lowest vegetation cover
- Highest thermal IR radiant temperatures

From Census:

- Highest proportion of families headed by single parent
- Highest levels of poverty

Baltimore Student Sun Photometer Network



Summary

A set of data analysis tools and capabilities are being built which can be used to assist:

- **Decision support about asthma at local, regional, and national scales**
- **Integration and analysis of clinical, remotely sensed, and environmental data for tracking other health issues as well as for homeland security**

Summary (continued)

- **Clear temporal trends of pediatric asthma hospitalizations have been identified which are being used to guide the search for triggers responsible for asthma using various classes of data**
- **Accurate predictions of pediatric asthma can be made using remotely sensed, socioeconomic, and historical clinical data**