ENVIRONMENTAL GEOGRAPHIC INFORMATION SYSTEMS (EGIS) at STENNIS SPACE CENTER (SSC)

Hugh Carr, Doc Smoot, Joy Parikh
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OBJECTIVE

- Background of SSC Environmental GIS (EGIS)
- Principal Center Activities
- SSC’s GIS Applications
  - Environmental Emergency Response Tool
  - CERCLA
  - Facilities Master Planning
  - Natural Resource Management and Site Assessment
INTRODUCTION

• As a Federal agency, NASA is subject to the environmental provisions of:
  – National Environmental Policy Act (NEPA)
  – Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund)
  – National Historic Preservation Act
  – Endangered Species Act (ESA)
  – Resource Conservation and Recovery Act (RCRA)
INTRODUCTION

• These regulations often require reports, maps, models, and quantitative measurements of:

  • Chemical Use
  • Wastewater discharge
  • Air Emissions
  • Environmental Assets
  • Natural Resources
  • Cultural Resources

Consequently, there is a demand for tools that consolidate ecological, cultural, and geological information into one central resource to facilitate environmental management and informed decision making.
GIS is a system of computer software, hardware data, and personnel capable of displaying, analyzing, and modeling geographically referenced information. This tool allows for the storage and analyses of vast amounts and various kinds of geospatial data.
BEGINNING of SSC EGIS

- NASA Environmental Office
  - Assess and monitor impacts of onsite activities
    - Environmental Justice
    - Propulsion testing

- Building the database
  - Incorporated data collected for the Advanced Solid Rocket Motor Program (ASRM)
    - Primarily included data of the Center
  - Procured data from government information sources
EXTENT OF EGIS

- Four counties in Mississippi and four parishes in Louisiana
- Over 400 data layers including vector and raster data from various public and private sources
- Over 100GB of data
## ORGANIZATION OF DATA LAYERS

### Hydrology
- Represents the classification and use of surface and subsurface water
- **Subsurface**
  - Wells
- **Surface**
  - Hydrologic Units/Subunits
  - Water Bodies
  - Rivers/Streams

### Infrastructure
- Represents cultural features that support the basic activities of "modern" life.
- **Transportation**
  - Roads
  - Railroads
- **Utilities**
  - Natural Gas Pipelines

### Cadastral/Geodetic
- Represents the locational information required to define the geographic position of a place or feature
- **Public Land Survey System (PLSS)**
  - Sections
  - Subdivisions
  - Townships
  - Parcel Boundaries
- **Referencing System**
  - 1:24,000 Quadrangle Grid
  - 1:100,000 Quadrangle Grid

### Physical Geography
- Represents the conditions reflecting the natural environment
- **Land Characterization**
  - Land Use
  - National Wetlands Inventory (NWI)
  - Q3 Flood
  - Vertebrate Species Locations
  - Threatened & Endangered Species Habitats
- **Physiography**
  - Soils
  - Surface Geology
  - Contours
  - Elevation

### Geo-Political
- Represents the various boundaries used or defined by federal, state and local units of government
- **Administrative**
  - State Boundaries
  - County Boundaries
  - Census Places
  - Stennis Space Center Boundaries
  - Public School District
  - County Zoning Boundaries
- **Political**
  - Senate Districts
  - House of Representatives District
  - Voting Precincts
  - Zip Code Boundaries
## ORGANIZATION OF DATA LAYERS

<table>
<thead>
<tr>
<th>Socio-Economic</th>
<th>Represents the aspects of human society covering past and current conditions</th>
</tr>
</thead>
</table>
| **Census Data** | Block Groups  
Census Tracks  
Census Demographics |
| **Cultural** | Hospitals  
Schools  
Public Colleges and Universities  
Buildings/Parking Lots  
Archaeological Sites |
| **Environmental** | Hydrogen Tanks  
Acoustic Levels |
| **Remote Sensing Data** | Landsat Thematic Mapper (30 Meter)  
Spot (20 Meter)  
Radarsat (12 Meter)  
ATLAS (2.5 Meter)  
Star3i (2.5 Meter; 10 Meter)  
AVIRIS (2 Meter)  
Positive Systems (1 and 3 Meter)  
IKONOS (1 and 4 Meter) |

### Data Providers & Collaborators

- NASA Center Archive  
- US Census Bureau  
- US Geological Survey  
- FEMA  
- Soil Conservation Service  
- US Corps of Engineers  
- US Fish and Wildlife Service  
- Tax Assessor’s Office  
- Planning Commission  
- Coastal Environments, Inc.  
- Department of Marine Resources  
- Gulf Regional Planning Commission  
- Dept of Environmental Quality  
- Universities and Colleges
Parcel Number: 079-0-32-002.00
Owner: Boelte, Gerald A.
Legal Description: Section south of Texas Flat Rd.
Total Acreage: 1601
NOISE POLLUTION MODELING

Monitor effects of operations onsite
Assess potential offsite impacts from propulsion testing on site
SSC LANDUSE CHANGE
LANDCOVER ASSESSMENT

Characterize landcover to predict impacts of current activities and future programs.
In May 2000, Stennis Space Center was designated as the Principal center for support of NASA’s Environmental GIS activities.

SSC has led a NASA-wide effort to develop and deliver a baseline EGIS for each of NASA’s 14 field centers and component facilities. These databases were designed to support NASA’s Environmental Management Program.
EGIS DELIVERED TO FIELD CENTERS

- Glenn Research Center
- Goddard Space Flight Center
- Wallops Flight Facility
- Langley Research Center
- Marshall Space Flight Center
- Stennis Space Center
- Michoud Assembly Facility
- Kennedy Space Center
- Johnson Space Center
- White Sands Test Facility
- Dryden Flight Research Center
- Jet Propulsion Laboratory
- Ames Research Center
- Glenn Plum Brook Station
PRINCIPAL CENTER ACTIVITIES

• Five-year MOA; currently in 4th year

• Collaborate with NASA field centers to develop requirements

• Designed, delivered, installed baseline EGIS database, IKONOS imagery, and metadata to each Center

• Customized, delivered, installed agency-wide emergency response application to four centers
FY04 PRINCIPAL CENTER ACTIVITIES

- Web-based Agency-wide EGIS Portal connecting NASA HQ to select Field Centers
- Building upon the original EGIS databases
- Initially includes SSC, MSFC, KSC, GRC, GRC-PBS
- Password protected, query, display, analysis capabilities, electronic data exchange
- Future efforts: integration of other NASA Field Centers and development of NASA-Wide Web applications
• Emergency Response/Disaster Preparedness
  - Emergency Environmental Response Tool (EERT)

• Facilities Management and Master Planning
  - Conversion of CADD data to GIS format
  - Development of a web-based application

• Groundwater Monitoring and Chemical Remediation
  - CERCLA

• Resource Management and Site Assessment
An Environmental Response application was developed at SSC to support NASA’s emergency response and preparedness requirements. This application provides the ability to effectively plan, manage, and coordinate environmental emergency incidents and facilitate data sharing among onsite personnel to provide near real-time management capabilities.

The Environmental Office in conjunction with the Fire Department, Security Office, and Facilities Management Office can use EERT to develop a comprehensive emergency management plan in the event of a major chemical release.
EnvironmenTal EmergenCy reSPonse TooL (eERT)

- Interfaces with ALOHA (Areal Locations of Hazardous Atmosphere) model and chemical inventory to plot plume dispersion

- Incorporates real-time weather information to display wind speed and direction; provides notification of major changes

- Establishes and geographically plots security perimeters

- Updates and monitors the status of impacted buildings and traffic control points
INCIDENT SIMULATION

1. Select Location
2. Set Buffer Size
3. Set Event Type
Inputs

Chemical Type

Atmospheric Information

Specific Conditions
**** BUILDING STATUS REPORT ****

Report Date: 7/26/2003 Report Time: 1:15:01 PM

Building Number: 1100
Building Status: Notified
Point of Contact: Jerry Snow
POC Phone Number: 689-5881
POC Agency: USN/RIDCC

Building Number: 1100
Building Status: Notified
Point of Contact: Claudia Schornick
POC Phone Number: 689-1704
POC Agency: NOAA/NDBC

Building Number: 1100
Building Status: Notified
Point of Contact: Tina Reid
POC Phone Number: 689-2451
POC Agency: NOAA/NDBC

Building Number: 1100
Building Status: Notified
Point of Contact: Bob Capps
POC Phone Number: 689-7451
POC Agency: NOAA/NDBC

**** TRAFFIC CONTROL POINT REPORT ****


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<tr>
<th>TCP_ID</th>
<th>STATUS</th>
<th>NAME</th>
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<tr>
<td>1</td>
<td>Entry Control Point</td>
<td>Road C</td>
</tr>
<tr>
<td>2</td>
<td>Pending</td>
<td>Elkh Blvd</td>
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<tr>
<td>3</td>
<td>Entry Control Point</td>
<td>Elkh Blvd</td>
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<tr>
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<td>Established</td>
<td>1165 Frontage Access and Parking</td>
</tr>
<tr>
<td>5</td>
<td>Pending</td>
<td>NASA Access and Parking</td>
</tr>
<tr>
<td>6</td>
<td>Pending</td>
<td>NASA Access and Parking</td>
</tr>
<tr>
<td>7</td>
<td>Established</td>
<td>Road C</td>
</tr>
<tr>
<td>8</td>
<td>Established</td>
<td>1100 Frontage Access and Parking</td>
</tr>
<tr>
<td>9</td>
<td>Established</td>
<td>Elkh Blvd</td>
</tr>
<tr>
<td>10</td>
<td>Pending</td>
<td>Elkh Blvd</td>
</tr>
<tr>
<td>11</td>
<td>Established</td>
<td>1100 Access and Parking North</td>
</tr>
</tbody>
</table>
FINAL PRODUCT

Established Traffic Control Points
Evacuated Building
Emergency Vehicle Entry Control Point
Cordoned Building
Hazard Plume
Notified Building
Pending Traffic Control Points
EERT INTEGRATION AT NASA

Developed a uniform application that allows NASA Centers to work together more efficiently, thus improving overall coordination and collaboration.
SSC ENVIRONMENTAL GIS APPLICATIONS

- Emergency Response/Disaster Preparedness
  - Emergency Environmental Response Tool (EERT)

- Facilities Management and Master Planning
  - Conversion of CADD data to GIS format
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- Groundwater Monitoring and Chemical remediation
  - CERCLA

- Resource Management and Site Assessment
CAD/GIS INTEGRATION in ArcGIS
FACILITIES MASTER PLAN (FMP) WEB PORTAL

• Pilot project to design, develop, and implement a web-based SSC FMP GIS application

• Aligns with NASA’s Master Planning NPG 8820.2A

• Integrates narratives, databases, maps, and spatial query tools

• Provides true planning tool

• Linked to CADD database

• Initiated web-based – available site-wide
LAND USE
ENVIRONMENTAL
FMP FLOORPLAN DATA RETRIEVAL

Calculates how many rooms are occupied by a specific department/program.

Generates room statistics including occupant name, phone, email, number of square feet occupied, manager.
FUTURE SECURITY GIS CAPABILITIES

E-911 Computer Aided Dispatch

Security Patrol Car #3:
Sgt. John Doe
Lat: -89.57
Lon: 30.39
1400 hrs
12-04-04

Live CCTV Cameras

Emergency Floorplan Analysis Tool

Camera Controls

Pan Left  Pan Right  Zoom In  Zoom Out  Tilt Up  Tilt Down
• Emergency Response/Disaster Preparedness
  -Emergency Environmental Response Tool (EERT)

• Facilities Management and Master Planning
  -Conversion of CADD data to GIS format
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• Groundwater Monitoring and Chemical Remediation
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• Resource Management and Site Assessment
As part of the historic operations at SSC, various contaminants have been disposed and released.

SSC began a site identification and investigation process in 1990, and have designated 9 sites as clean-up areas.

The Relational Laboratory Information Management System (RLIMS) is the repository for current and future chemical data.
CERCLA PROJECT FLOW

CERCLA FY 2004 Process Flow

- GISKEY
- RLIMS
- SDE

Develop a common relational database for both GISKEY and RLIMS

- Display/Queries
- Relevant Links
- 2D-Modeling Plotting Time Series Change D.
- 3D-Modeling Plotting Time Series Change D
- Reporting

Completed Tasks

Tasks In Progress
Area A
Air Force Disposal Site Pesticide Operations Area
When: 1970s - 1990s
Where: Western boundary of SSC near Buildings 2501 and 2502
What: Contaminated debris and pesticide operation waste
Contaminants: Organic compounds, dioxin, pesticides/herbicides, and metals
CERCLA GIS WEB PORTAL

• Immediate access to SSC’s clean up sites via Internet

• Facilitates reporting, compliance, site-assessment

• Dynamic 2-D maps, quarterly reports, analytical spreadsheets, site photos, EPA substance registry list, etc.

• Flexible, cost-effective

• 30+ year archival
Area D
Recreational Disposal Area
When: 1960s - 1970s
Where: Southwestern portion of SSC near Building 2411
What: Used chemicals discharged into limestone pits for treatment
Contaminants: Organic compounds and pesticides
Status: Comment period closed and Decision Document signed. Soil removals completed. Depression at bottom of hillside was excavated, backfilled with clean fill, graded, and seeded. Installation of groundwater pump and treatment system began in Summer 2001.
LINK TO EPA

[Image of a computer screen showing a search for "Acetone" in the U.S. Environmental Protection Agency's Substance Registry System. The search results include information about Acetone.]
SSC ENVIRONMENTAL GIS APPLICATIONS

• Emergency Response/Disaster Preparedness
  -Emergency Environmental Response Tool (EERT)

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• Resource Management and Site Assessment
TIMBER MANAGEMENT

Timber Management Work Plan
Fee Area FY 2003

- Federal Land Ownership
- Bufferzone
- Management Plan:
  - Prescribed Burning
  - Timber Marking
  - Mitigation Harvest
  - Chop-Brown-Burn-Plant
  - Brown-Burn-Plant

Roads

Kilometers
0 0.3 0.6 0.9 1.2

Miles
0 0.15 0.3 0.6 0.9

Lines: 12 feet, 40 feet, 60 feet

Scale: 1 inch = 1,250 feet

Legend:

- Federal Land Ownership
- Bufferzone

Management Plan:

- Prescribed Burning
- Timber Marking
- Mitigation Harvest
- Chop-Brown-Burn-Plant
- Brown-Burn-Plant

Roads

Scale: 1 inch = 1,250 feet

Legend:

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Management Plan:

- Prescribed Burning
- Timber Marking
- Mitigation Harvest
- Chop-Brown-Burn-Plant
- Brown-Burn-Plant

Roads

Scale: 1 inch = 1,250 feet

Legend:
• Cogongrass has been designated as the seventh worst weed in the world, with over 1.2 billion acres infested worldwide

• Salvinia Minima
WETLAND MITIGATION SITES
WETLANDS INVENTORY

Data from wetlands mitigation sites are integrated into the EGIS to provide reports on species diversity, vegetative cover, wetland hydrology, and tree types.

<table>
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<tr>
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<th></th>
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<tr>
<td>Bald Cypress</td>
<td>542</td>
<td>466</td>
<td>448</td>
<td>442</td>
<td>448</td>
<td>502</td>
<td>510</td>
</tr>
<tr>
<td>Water Tupelo</td>
<td>70</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
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<tr>
<td>Pines</td>
<td>*</td>
<td>*</td>
<td>32</td>
<td>29</td>
<td>65</td>
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<td>57</td>
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<tr>
<td>Total Stem Count</td>
<td>612</td>
<td>469</td>
<td>482</td>
<td>471</td>
<td>513</td>
<td>510</td>
<td>576</td>
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</table>

Pitcher Plant Percent Coverage

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<tr>
<th>Year</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15%</td>
<td>12%</td>
<td>26%</td>
<td>30%</td>
<td>32%</td>
</tr>
</tbody>
</table>
FLOODPLAINS
DEER AUTO ACCIDENTS

Auto Accidents Involving Deer at Stennis Space Center

Month and Year of Accident

Total Number of Accidents

Month and Year of Accident

Monthly Distribution of Accidents

Year 2000 Accidents
Year 2001 Accidents

(does not include numbers for Oct, Nov or Dec 2001)
RECREATIONAL SITING
• Continue to develop uniform datasets and applications that allow offices throughout NASA to work together more efficiently, thus improving overall coordination and collaboration

Leverage other programs to provide value to NASA’s Environmental Management division and to the participating centers and major facilities

• Continue to design an SSC Enterprise-wide GIS for managing, maintaining, and sharing geographic data with applications in:
  - Homeland Security/Emergency Response
  - Resource Management
  - Facilities Master Planning
  - Environmental Site Assessment
GIS has become an integral part of environmental management. It integrates large volumes of spatial data from a variety of sources and provides planners, policy makers, and scientists, with the means to visualize and analyze environmental data to make better decisions. NASA has taken an active role in the utilization of this technology and is committed to community safety and protection of the environment.

In recent years, the SSC EGIS has emerged as a support tool for natural resource management, groundwater monitoring, emergency response, land cover assessment, facilities management, environmental assessment, wildlife tracking, and noise pollution modeling.

**Benefits**

GIS has become an integral part of environmental management. It integrates large volumes of spatial data from a variety of sources and provides planners, policy makers, and scientists, with the means to visualize and analyze environmental data to make better decisions. NASA has taken an active role in the utilization of this technology and is committed to community safety and protection of the environment.

**NASA’s Unique Capacity and Contributions**

NASA has become a recognized leader in geospatial applications and environmental management in the scientific community. The Environmental Management Division enables environmentally sound mission success through four key areas: Prevention, Conservation, Compliance and Restoration.

NASA SSC Environmental Office is collaborating with other NASA field centers to promote GIS and improve the way we monitor and manage our environment and natural resources.
Facility management and safety officers are responsible for ensuring the physical security of the facilities, staff, and equipment as well as for responding to environmental emergencies, such as accidental releases of hazardous materials. All phases of emergency management (planning, mitigation, preparedness, and response) depend on data reliability and system interoperability from a variety of sources to determine the scope of the event.

The EERT integrates and utilizes existing NASA environmental and facility information, including GIS vector layers, hazardous materials (HAZMAT) data, point-of-contact information, and satellite imagery. Furthermore, it incorporates real-time weather information and can model chemical release plumes from government validated and approved models, such as the Aerial Locations of Hazardous Atmosphere (ALOHA) model. The EERT allows emergency response teams to monitor traffic control points, to identify entry control point(s) into and out of a cordoned area, and to monitor evacuated buildings within the cordoned area.

The EERT is a key geospatial component of NASA’s Environmental Management System that uses both GIS and remote sensing technologies to support NASA’s response and preparedness requirements. The primary advantages of using the new system include the ability to identify unique aspects of the event site, to identify specific locations of hazardous materials, to specify safety zones and their appropriate sizes, and to track the extent of dangerous plumes. This flexibility permits more efficient and effective use of resources, such as the placement of blockades, emergency response teams, and special equipment.
Integrating GIS and Facility Master Planning

Using GIS for Facilities Management

The SSC Facilities Master Plan provides a graphic, statistical, and narrative description of land, buildings, topography, climate, resources, and operations in and around Stennis Space Center. It contains information for planning SSC’s growth and expansion, and for anticipating the impact such development may have on the environment and the surrounding communities.

Decision Support Solutions

Information regarding the physical components, equipment, and infrastructure of industrial facilities are largely developed and managed with Computer Aided Design (AutoCAD) programs for applications in municipal infrastructure, utility management, gas and electric maintenance, and organizational planning. Successfully integrating these drawings and other facility management data with existing GIS and remote sensing data layers will help provide decision makers and site planners access to all relevant information pertaining to the environmental conditions, current, and planned facilities at SSC. It is the hope of NASA’s Environmental Officers to create a web-enabled GIS database from unique and existing data sources such that the sum of its contents is greater than the sum of its parts. An important advantage of integrating databases is that the data is accessible for users within and outside the centralized computing site.
As NASA’s Lead Center for Rocket Propulsion Testing, Stennis Space Center is responsible for developing and testing large liquid propellant rocket systems. Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), mandates that the federal facilities remediate areas where hazardous waste has been generated, stored, treated, or disposed in the past. To date, nine clean-up sites have been identified at SSC, and environmental management personnel have taken a proactive approach to restore each area. To aid in this effort, a web enabled CERCLA GIS database is being developed to help inventory, monitor, manage, and restore chemically contaminated areas. Specifically, this GIS is used to measure the scope and extent of contamination, detect concentration patterns, and model the migration of contaminants.

An important aspect for environmental characterization is providing a graphic visualization of site conditions including spills, emissions, or contamination plumes. The ability to automate the production of this information is valuable for creating compliance reports for regulatory agencies, generating management reports for internal use, evaluating the progress of a remediation program, providing information in response to unforeseen emergencies, and providing outreach material to the public.