

## **Behind the Portal: Use of GOS Map and Data Services Final Project Report**

October 26 2010

### **Agreement Number**

NSDI CAP G09AC00106

### **Project Title**

Leveraging GOS Map and Data Services for Search and Rescue Operations using NASA WorldWind Open Source 3D Visualization Platform

### **Organization**

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### **Collaborating Organizations**

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NASA Search and Rescue Mission Office  
NASA Goddard Space Flight Center, Greenbelt MD  
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## 1. Executive Summary

This project had two major goals (1) extending the NASA WorldWind Open Source 3D Visualization platform to support access to the GOS Catalog and Data Services, and (2) integrating the resulting extension into the NASA Goddard Search and Rescue (SAR) Mission Office's Decision Support Tools. A WorldWind extension was developed to support the following functionality:

- Discovery of relevant data available via the GOS portal directly through the WorldWind user interface (including weather, demographics, transportation, and other base data),
- Access, exploitation and visualization of discovered data in WorldWind's 3D environment,
- Leverage of GOS portal update feed functionality to retrieve updates on the latest relevant resource availability from GOS.

As expected in SAR situations, it is critical for both the local authorities and the regional centers to have access to accurate and up-to-date data to support the rescue operations. The GOS Portal can provide the gateway to discover and access such data (via open standards). The functionality developed in this project (discovery, access, visualization and update detection) enhances the existing WorldWind-based SAR applications enabling them to (1) leverage the immensely rich datasets of the NSDI, including data that they would not have otherwise been able to locate or use in time (2) combine data (recent and historical) on-demand at various levels (local, regional and national), and (3) get data directly from its custodians hence alleviating the data assembly overhead in SAR situations.

By providing this functionality via a mature open source platform, the WorldWind GOS Catalog extension can be easily customized to support other application domains seeking direct catalog and data access to the GOS Portal. As such, the WorldWind GOS Catalog extension provides not only premier 3D visualization of data but also premier data discovery and access through leveraging of the NSDI infrastructure and its technology standards.

The latest version of the WorldWind GOS Catalog module as integrated with the SAR application is available at <http://worldwind.arc.nasa.gov/java/apps/SARApp/SARApp6.jnlp>. The source code is available in the WorldWind Java drop code at <http://builds.worldwind.arc.nasa.gov> (in the package gov.nasa.worldwind.applications.gos).

## 2. Project Narrative

### 2.1 Project Background

For the past few years, the NASA WorldWind team has been working closely with the Goddard SAR Mission Office on development of specialized functionalities in WorldWind to support Search and Rescue operations in cooperation with various organizations including FAA, NOAA, the Air Force Rescue Coordination Center and the national Search and Rescue School. Recent work has focused on integration of radar tracks, historical weather information, and statistical analysis of relationship between aircraft crash position and last known location, and visualization of areas of high probability where missing aircraft is likely to be found.

The Goddard SAR Mission Office is the only NASA office to support the National Search and Rescue Plan and serves as the designated agency to perform Search and Rescue Research and Development (R&D) in an effort to meet search and rescue needs. The RD&D is targeted towards development and enhancement of technologies that will help save lives and property, and reduce SAR costs and risks to SAR personnel. Tested technologies are then deployed at the NOAA

Search and Rescue Satellite-Aided Tracking (SARSAT) Office and other SAR agencies and Organizations.

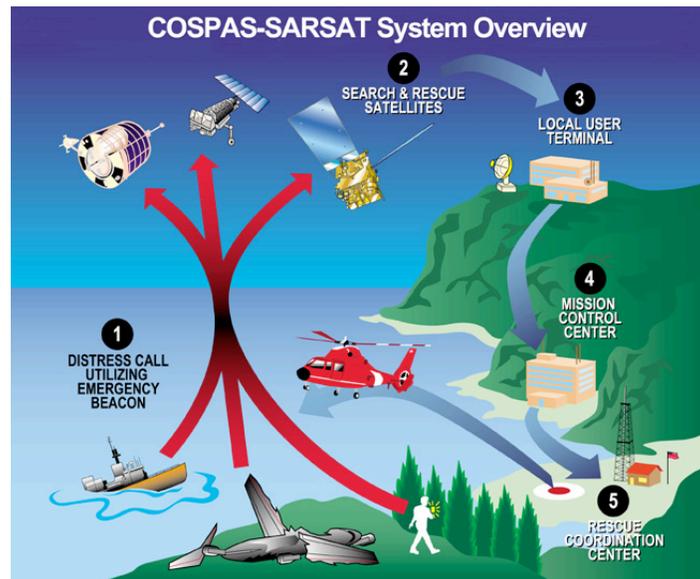


Figure 1. SARSAT System Overview. <http://www.sarsat.noaa.gov>

As seen in Figure 1, the SARSAT system is designed to identify the location of mariners, aviators and recreational enthusiasts in distress almost anywhere in the world at anytime and in almost any circumstance. Once the location is identified, an alert is forwarded to the appropriate local search and rescue authorities to inform them of the distress event.

The Goddard SAR Mission Office has selected NASA WorldWind because it is an open source geospatial information platform that is continually advanced by NASA, its partners and the open source community. It allows users to easily visualize and explore distributed geospatial information in a visually rich and extensible 3D environment. The proposed work will enhance the WorldWind-based SAR application to leverage GOS' immensely rich and diverse assets as well as standards-based discovery and metadata protocols to provide a platform for discovery, integration and visualization of local, regional and national data as needed in SAR missions. Three characteristics make WorldWind the ideal platform for such work:

- WorldWind provides a unifying information browser to enable a whole class of 3D geospatial applications. WorldWind is not so much a single program but a coherent suite of modular components to be used selectively or in concert with any number of programs.
- WorldWind is a modular component technology. It can be embedded as part of any application. It makes possible the inclusion of virtual globe technology in support of any application.
- WorldWind is NASA Open Source Agreement software. With the code being fully accessible, anyone can advance the technology, embed it in their applications, or extend it with additional functionalities, and they can do so in a commercial or other proprietary manner. WorldWind technology can be modified by others and redeployed to service any other problem domain needing this kind of technology.

## 2. 2 Technical Approach

The technical approach consisted of 3 phases based on the concept of building a generic WorldWind GOS Catalog extension that can then be used as the basis for integration into the SAR decision-support application (as well as other applications). The 3 phases of the project were:

1. **Design and development** of a generic and easy-to-use WorldWind GOS Catalog module that can query the GOS Portal catalog based on various user criteria, display the search results and visualize some of the underlying data in 3D. This included the following four areas, which were performed iteratively.
  - a. Designing and developing the generic search and retrieval user interface. This included
    - i. Simple search option supporting keyword search and geographic extent,
    - ii. Advanced search option supporting searches based on GOS data category, GOS content type, etc.
  - b. Selecting one of the GOS APIs (REST or CSW) to implement in the project
    - i. The project team experimented with both interfaces for the GOS Catalog, and elected to support the CSW interface in the final deliverable of the project because of its higher potential for reuse, and its reliance on an international geospatial standard (OGC CSW).
  - c. Handling metadata and search results in a way that mirrors the geodata.gov display and enables ease of access to the entire FGDC CSDGM metadata record as needed. Furthermore, in the case of web services:
    - i. Connecting to the FGDC Service Status checker (providing the user with meaningful information on the status of the service),
    - ii. Displaying the footprints of the results on the WorldWind globe,
    - iii. Enabling complete listing of layers/features/coverages (via GetCapabilities) available through a web service via a simple click of a button,
    - iv. Supporting 3D visualization of the data layers in WorldWind when available via OGC WMS,
  - d. Incorporating a feed update functionality that displays a feed of the most recent changes in the GOS catalog.
2. **Integration** of the GOS Catalog module into the SAR decision-support application
  - a. Several meetings were held with the SAR team to identify the most useful and user-friendly ways to integrate the new discovery functionality into the SAR application,
  - b. Special care was taken to implement and test the new functionality without disrupting the current (operational) use of the application.
3. **Documentation** of the integration process such that other applications can customize the code for their own uses
  - a. The documentation is attached to this report.

### 2. 3 Findings about GOS

Various lessons have been learned about the GOS Portal and its underlying resources, summarized as follows:

- The development team has found the GOS Catalog documentation easy to interpret and the GOS support team very accessible (in terms of responding to queries and introducing new features in a timely manner).
- The WorldWind extension leveraged GOS's consistent use of a record uuid (for instance, once retrieved, the uuid was used to retrieve the stylized FGDC metadata directly via a GOS servlet, hence avoiding having to re-invent the wheel for the WorldWind extension).
- The WorldWind extension successfully connected to the FGDC Service Status Checker, which improves the user experience and enhances the quality of the results by visually indicating whether services are available (and with one mouse click, get more information about their availability in the recent past). In the future, the WorldWind extension could potentially leverage the capability of querying the catalog based on availability criteria (hence providing better search results to the user).
- The WorldWind development team found the GOS REST interface quite easy to use (and to experiment with), especially given the different formats supported (most recently including JSON and ATOM).
- Although the CSW interface required a greater development effort to support the application, the team believes that the up-front effort will pay off in the long term in terms of being able to interoperate with/connect to other CSW catalogs with little changes to the code.
- The extension currently only supports display of WMS layers in the WorldWind Globe, but it is designed to easily inherit separately-developed WorldWind visualization functionality (such as support for KML, support for WFS/WCS visualization, etc).

### 2. 4 Feedback from SAR Community

The development team demoed the integration of the GOS portal into the SAR application to the SAR NASA Lab team and their partners on two occasions (March 30, 2010 and July 15, 2010). The feedback from the SAR team (with which this CAP project team very closely collaborated with on requirements for functionality and user interface) was extremely positive and supportive: “you have whet our appetite for all the data that we could find through this tool!” They further referred to the ability to discover data on-the-fly as “eye-opening” and the potential for saving lives by having access to the right information as needed “spectacular”.

The SAR NASA Lab team intends to present and demo the tool at an upcoming National Search and Rescue Committee (NSARC) meeting (<http://www.uscg.mil/hq/cg5/cg534/NSARC.asp>).

The CAP project team also gave two presentations at the annual AAG meeting in Washington DC (April 2010) which prompted the interest of the Civil Air Patrol and the USAF Rescue Coordination Center to work more closely with the NASA SAR Lab on using this tool as a basis for collaboration in the future.

In the process, the SAR team also came up with a list of enhancements/extensions to the tool that would further increase its usability in this domain. We were able to implement some of the enhancements suggested such as

- Supporting the ability to cancel searches,

- Providing the user with helpful feedback (such as when an error occurs as a result of a service being done, or if the search/update feed returns no results, etc),
- Cleaning up the user interface (in particular the part where search results appear along with their annotations on top of the globe, and allowing the user to turn them on and off, to make them transparent, etc).

Other suggested enhancements were out of scope for the project, but are documented in the next steps section of the report.

### 3. Next Steps

As the CAP project comes to a close, the project team hopes that the resources developed through this effort will continue to be used not only by the SAR community but also by other communities. More specifically, the team identified the following three critical next steps:

- Continue outreach of the project within the SAR community. This includes supporting the NASA SAR Lab in their presentations and demos at community events (such as the National Search and Rescue Committee (NSARC) meetings),
- Reach out to other communities, since the power of the WorldWind extension is in its flexibility to not only support a variety of domains and visualization needs, but also to support other catalogs and search criteria. There are many ways that this outreach can be performed.
  - o As a first step, information about the extension will be posted on the WorldWind forum in the hopes of generating interest in the WorldWind community.
  - o Support from FGDC on reaching out to other communities would be greatly appreciated.
- Identify resources to implement the enhancements suggested by the SAR partners, including but not limited to
  - o Providing the capability of refreshing WMS layers automatically (or at pre-set user-defined intervals). This could be particularly useful in the case of information that gets updated frequently such as weather maps,
  - o Providing the ability to bookmark search results, so the user application “remembers” the user’s searches and selected results. This is an excellent use case for using the OGC Context Document standard in this arena,
  - o Supporting services beyond the WMS to include the WFS and the WCS, as well as supporting KML files and the ability to overlay local data on top of data fetched from web services,
  - o Showing WMS layers as 3D surfaces when appropriate (e.g. Special Use Airspaces),
  - o Improving the display of the results footprints on the 3D globe (including making them less obtrusive and more interactive).

### 4. Feedback on CAP Program

The project team is appreciative of the funding and support provided by the CAP Program for this project. Such support is critical to open source projects like WorldWind, as it ensures that the

project continues to evolve in a direction that can best support the community's requirements. The project also provided a great opportunity to incorporate some key standards and web services into the WorldWind core code to make it better aligned with NSDI needs. The project team is also quite appreciative of the emphasis on supporting open standards in open source software that can be used and enhanced by the community long after the project is completed.

The project team enjoyed the close collaboration with the other awardees, as facilitated by the CAP program management team. Such collaboration was very beneficial for sharing knowledge and resources, and for leveraging the complementary nature and synergy of the projects.

The project team agrees with the other awardees on the need for increased support for outreach and partnering activities. It would be appreciated if FGDC could further support those activities during and after the projects, in terms of organizing dedicated events focusing on the awardees projects (as was done at the AAG conference), and of identifying opportunities for the awardees to connect to potential beneficiaries of the technologies developed.

## 5. Screen Shots

Below are some screen shots of the latest version of the WorldWind extension (<http://worldwind.arc.nasa.gov/java/apps/gosapp/gosapp.jnlp>), from the perspective of a user using the extension to discover and visualize resources. Developers are directed to the developer documentation, attached to this report. Developers are also encouraged to use the WorldWind forum if they have any questions or need any additional information on the extension.

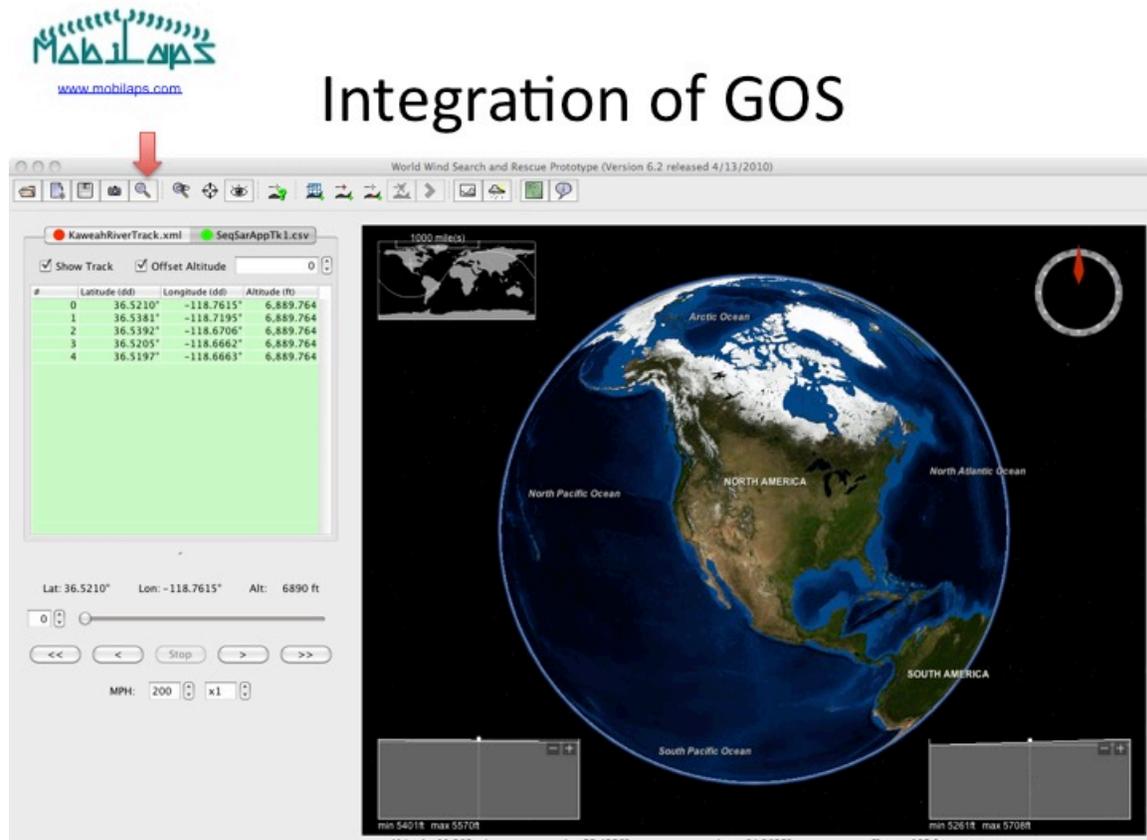


Figure 1. The GOS Portal Search as integrated into the SAR Application



## Searching GOS

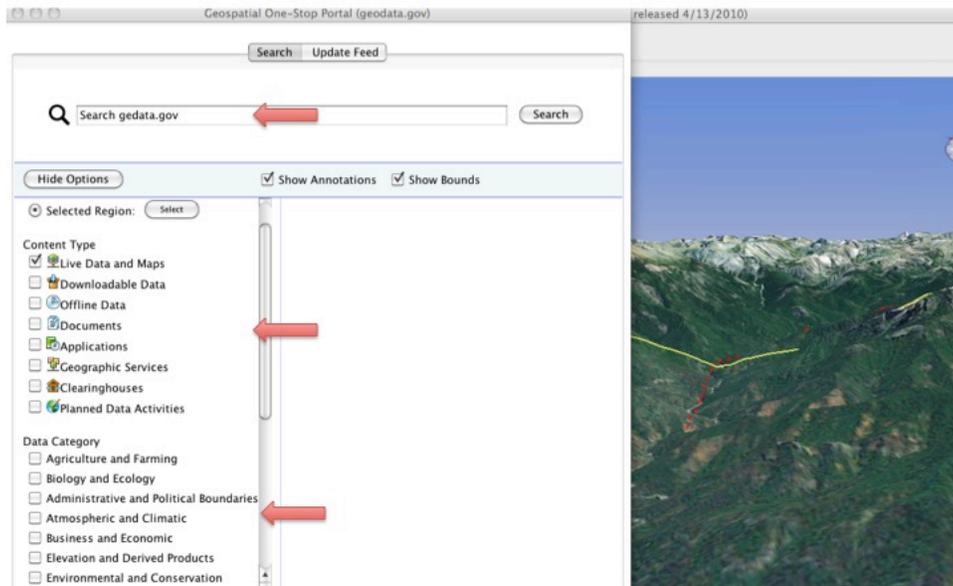


Figure 2. Search screen with search parameters (left) and the WorldWind Globe (right).



## Query Results

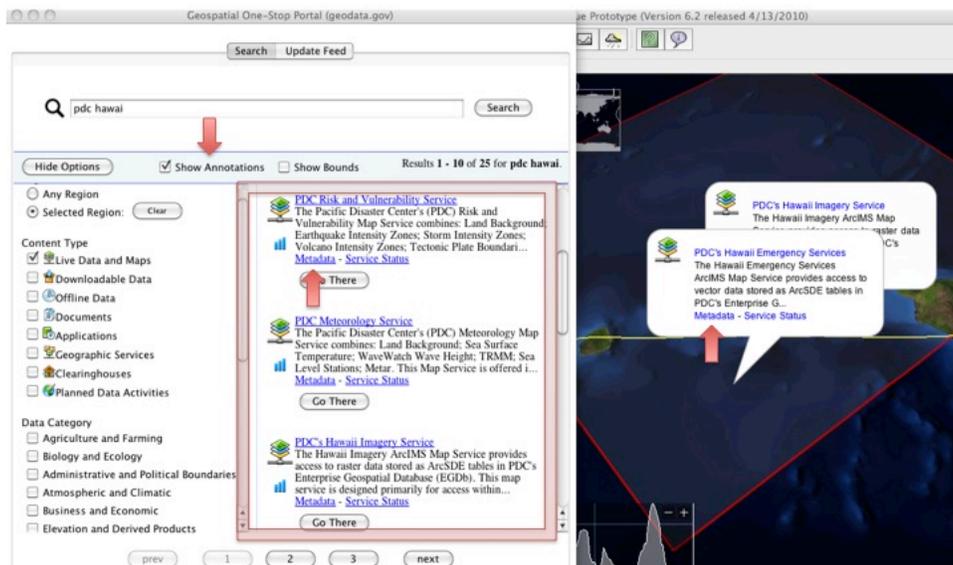


Figure 3. Query Results (with Annotations on the Globe).



Figure 4. Bounding boxes (left) and associated annotations (right) of search results.

Internet Mapping Service for a Collection of Small-scale Data Covering Montana, Idaho, Wyoming and North and South Dakota (FGDC) / wms\_ptme2 (ISO)

FGDC Metadata

**Identification Information:**

**Citation:**

**Citation Information:**

**Originator:** Wyoming Geographic Information Science Center

**Publication Date:** 2005

**File or Table Name:** wms\_ptme2

**Online Linkage:** [Server=http://partners.wygisc.uwyo.edu;Service=wms\\_ptme2;ServiceType=image](http://partners.wygisc.uwyo.edu;Service=wms_ptme2;ServiceType=image)

**Geospatial Data Presentation Form:** raster digital data

**Title:** Internet Mapping Service for a Collection of Small-scale Data Covering Montana, Idaho, Wyoming and North and South Dakota

**Publication Information:**

**Publisher:** Wyoming Geographic Information Science Center (WyGISC)

**Status:**

**Maintenance and Update Frequency:** Ongoing, when new data are developed or accessed which fits the mapping service category these data will be added.

**Progress:** Complete

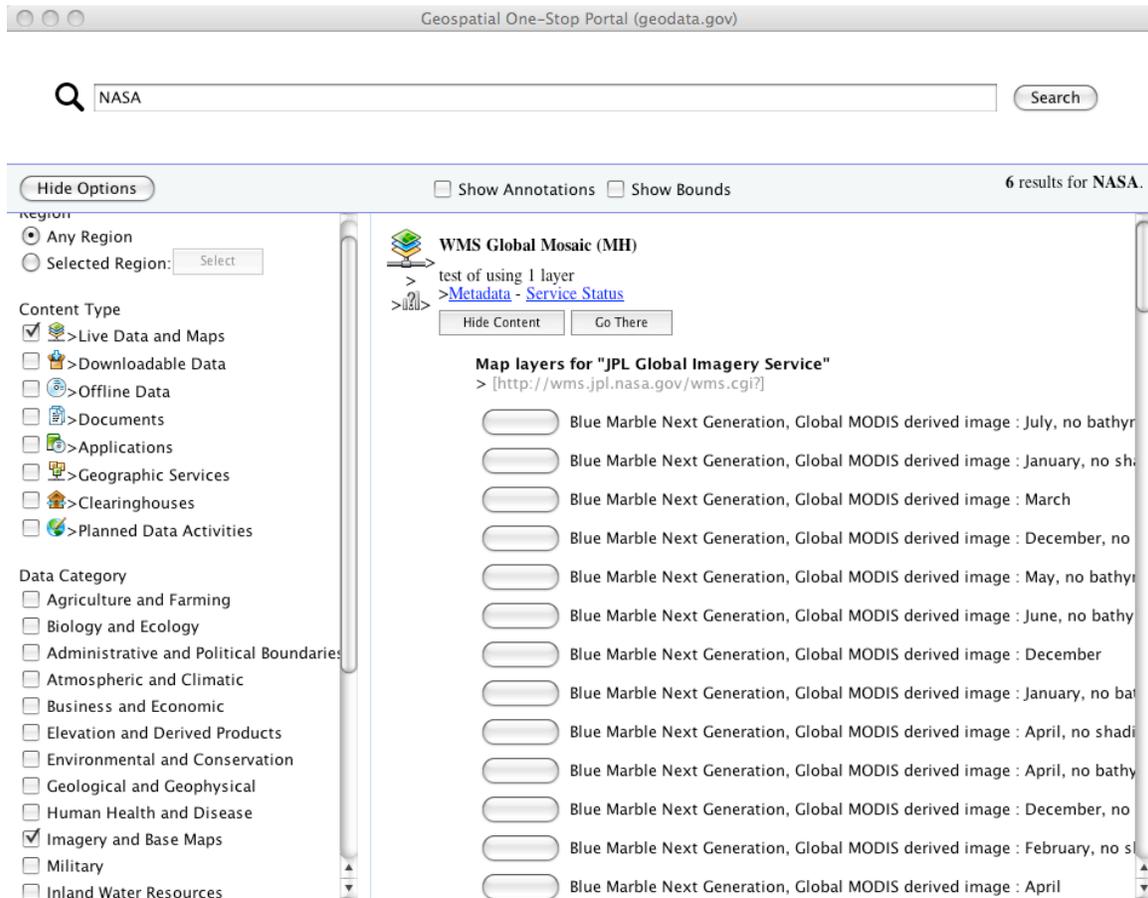
**Description:**

**Purpose:** Provide geospatial data for mapping and analysis purpose which can be added quickly and efficiently. Data are being used in support of K-12 GIS programs throughout the five state region.

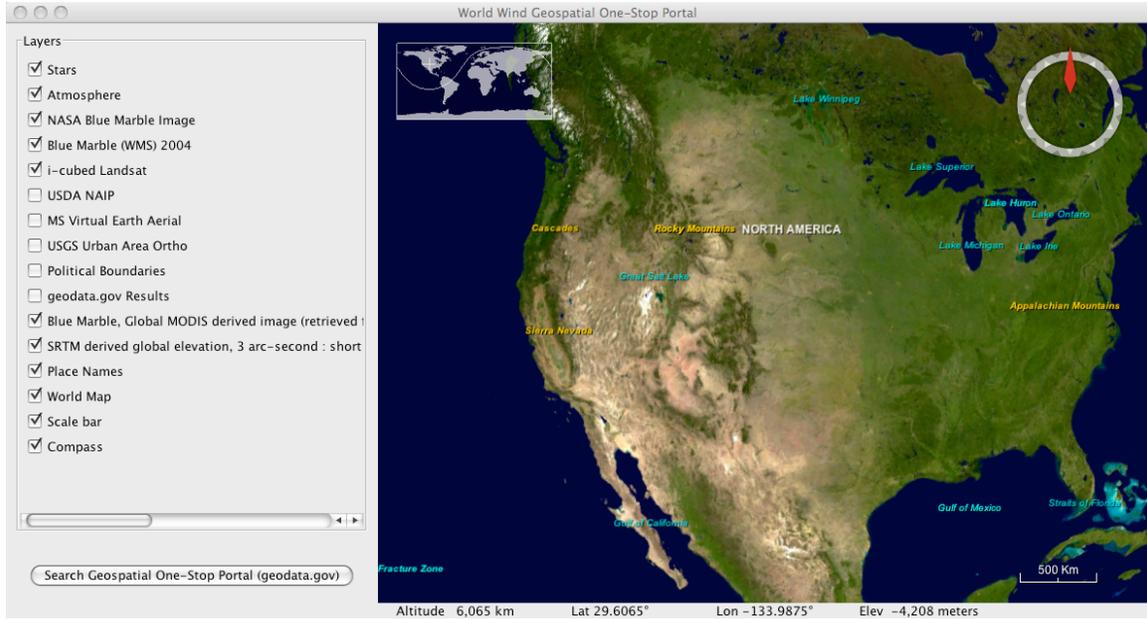
**Language of Dataset:** en

**Abstract:** This mapping service displays small scale data (1:100,000 or smaller) covering a five state region; Montana, Idaho, Wyoming and North and South Dakota. There are over 50 layers available within this mapping service. An Internet mapping application has been created to display this and many other data accessible by going to <http://www.wygisc.uwyo.edu/data.htm> and clicking on Prairie to Mountain Explorer (PTME) Online.

**Figure 5. Metadata about a record displayed by launching web browser (directly using the geodata.gov DiscoveryServlet).**



**Figure 6. Showing map layers of WMS service (and links to metadata & service checker).**

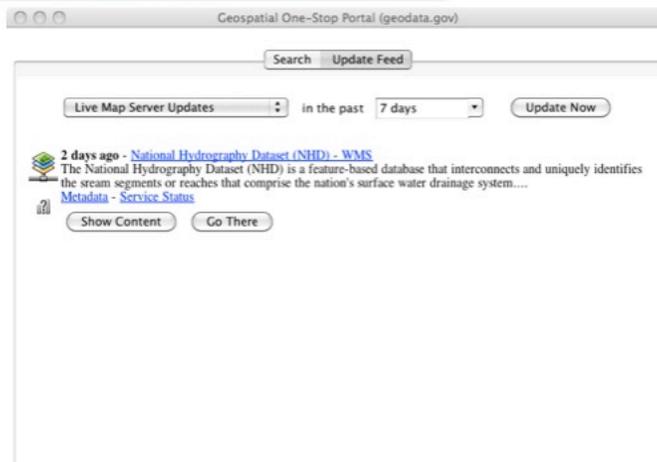


**Figure 7. Displaying selected WMS layers in WorldWind Globe (note the layer names on the left showing which layers have been discovered via GOS).**



## Update Feeds

- All updates
- Live Map Server updates
- Most recent search updates



**Figure 8. Update Feed Interface, providing the ability to search for updates to data using different criteria.**