Behind the Portal: Use of GOS Map and Data Services Interim Project Report

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Agreement Number

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Project Title

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

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Executive Summary

This projects aims at (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. The WorldWind extension is being designed 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 GeoRSS to receive 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 so support the rescue operations. The GOS Portal can provide the gateway to discover and access such data (via open standards). The proposed functionality (discovery, access, visualization and update detection) will enhance 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 an 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. The proposed work will deliver a more mature open source technology (WorldWind) that 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.

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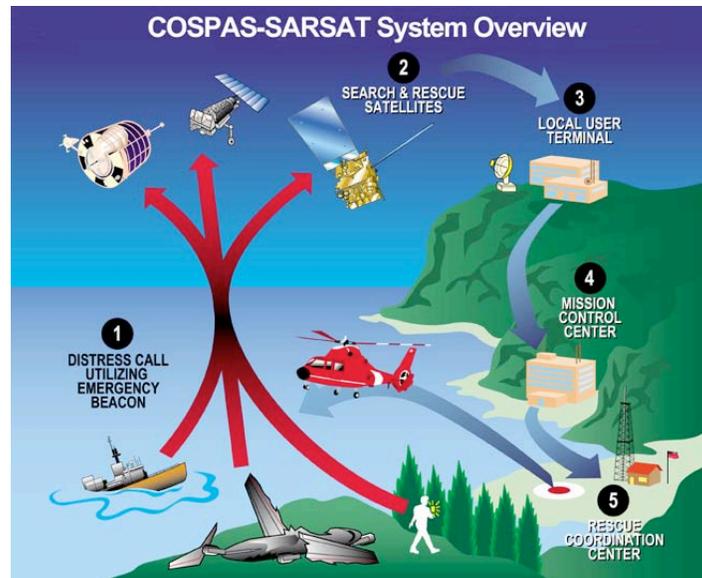
Figure 1. SARSAT System Overview. http://www.sarsat.noaa.gov

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.

Technical Approach and Milestones

The proposed work involves building a generic WorldWind GOS Catalog extension that can be used as the basis for integration into the SAR decision-support application (as well as other applications). The project consists of the following steps:

1. **Aug 2009 – Jan 2010** Designing and developing 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 includes the following three areas, which were performed iteratively until both the user interface and the underlying search standard were finalized.

    a. Designing and developing the generic search and retrieval user interface. This includes

        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. Displaying returned 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, and supporting visualization of time-series data in 3D.

    c. Experimenting with the REST and CSW interfaces of the GOS Catalog and selecting one for use in the final version of the project

        i. Experimenting with the GOS REST API and its different types of responses (GeoRSS, KML and html),

        ii. Experimenting with the GOS CSW API supporting OGC CSW 2.0.2,

        iii. Selecting an API to use for the final version of the project based on development complexity, potential for reuse of the code, applicability to the SAR application, and type of standards employed (REST vs. CSW).

2. **Jan 2010 – Feb 2010** Identifying a set of use cases where the integration of the GOS Catalog module can enhance the SAR decision-support application (without disrupting the current use of the application)

    c. Brainstorming with the SAR team on the most valuable ways to integrate the new discovery functionality into the SAR application (from both the user interface and the functionality perspectives)

3. **March 2010 – May 2010** Integrating the GOS Catalog module into the SAR decision-support application

    c. Investigating the possibility of checking for updates to data of interest in SAR application

      d. Enhancing the generic application, as needed, based on any new requirements that could be useful for other applications as well

4. **June 2010 – July 2010** Documenting the integration process such that other applications can customize the code for their own uses.

Project Status and Findings to-date

As of the writing of this report, the design and development of a generic (java-based) GOS Catalog extension has been completed based on the CSW interface and is available for download and testing at http://worldwind.arc.nasa.gov/java/apps/gosapp/gosapp.jnlp. After a period of experimentation with the REST interface, the CSW interface was selected for the final version in order to remain aligned with OGC standards (based on WorldWind's commitment to OGC standards). Furthermore, the CSW interface is likely to be more interoperable (at least at the protocol level), enabling the WorldWind code to easily support querying of other CSW-based catalogs (such as the GEOSS Common Infrastructure Registries and other GEOSS community catalogs).

Various lessons have been learned to-date about the GOS 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). The WorldWind extension could also leverage the capability (potentially to be incorporated into GOS) 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).

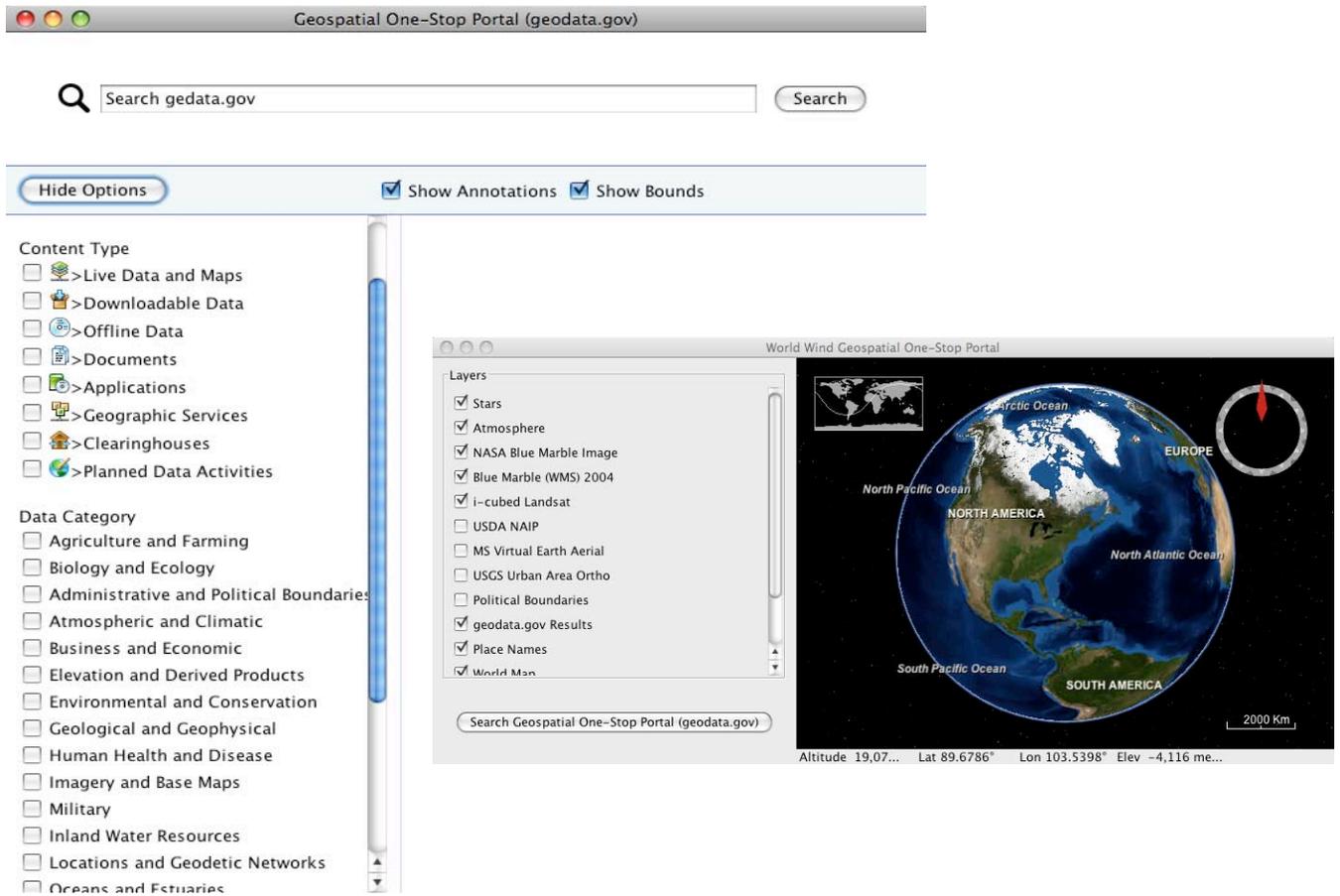The status of the project is documented below in a series of snapshots from the most recently released version of the extension (http://worldwind.arc.nasa.gov/java/apps/gosapp/gosapp.jnlp).

Figure 1. Search screen with search parameters (left) and the WorldWind Globe (right).
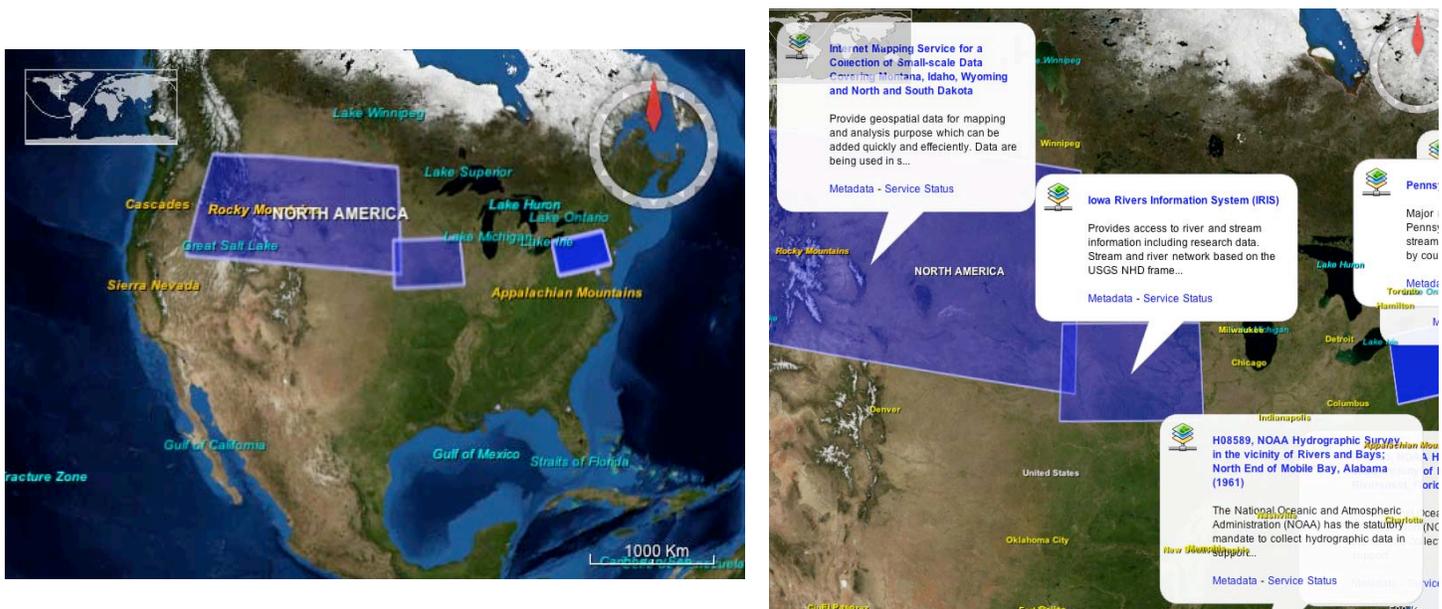

Figure 2. Bounding boxes (left) and associated annotations (right) of search results.
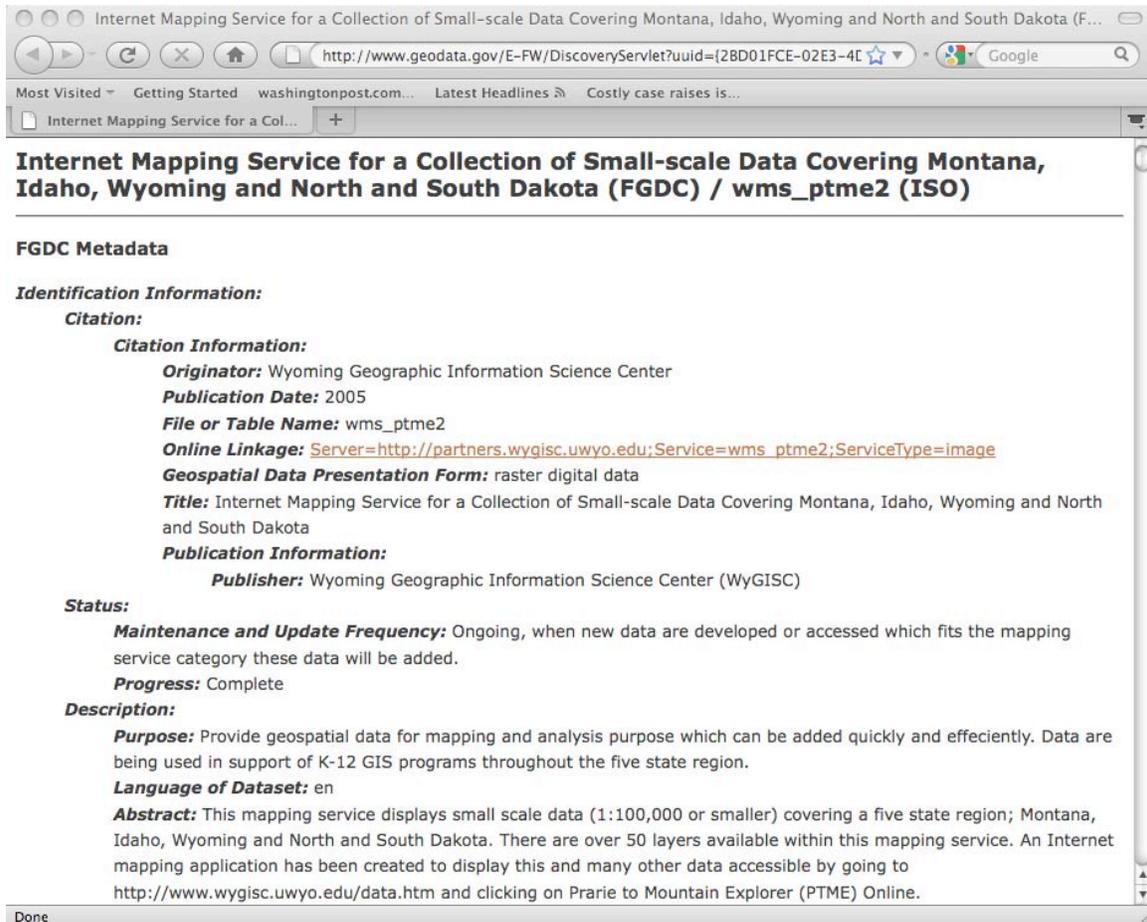
Figure 3. Metadata about a record displayed by launching web browser (directly using the geodata.gov DiscoveryServlet)
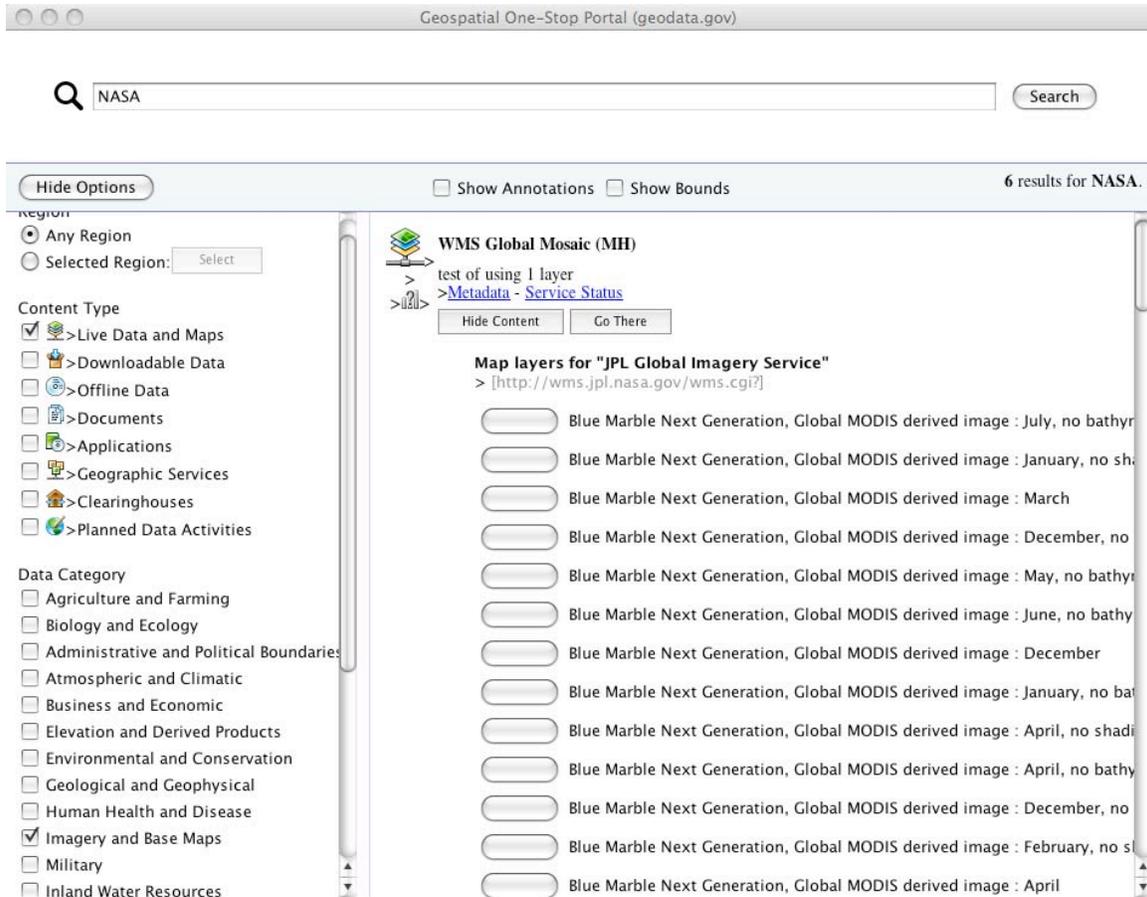
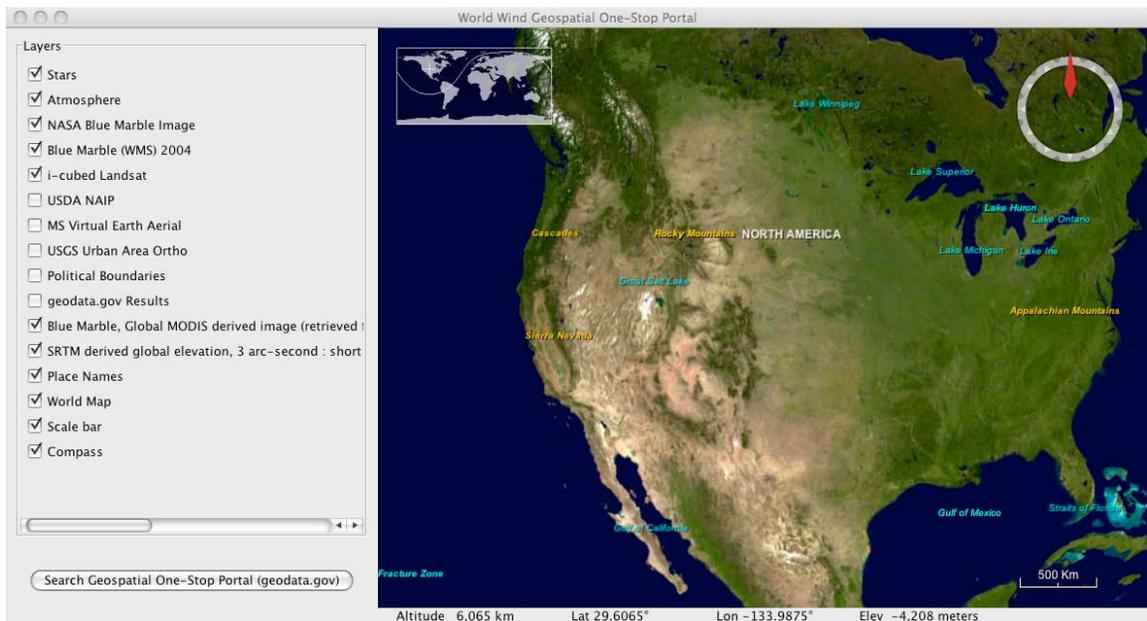**Figure 4. Showing map layers of WMS service (as well as links to metadata and service cheker).**

Figure 5. Displaying selected WMS layers in WorldWind Globe (note the layer names on the left showing which layers have been discovered via GOS)

Next Steps

The next steps for the project consist of

- Identifying the main uses cases for integrating the GOS Catalog into the SAR decision-support application (discovery of data in distress situations, notification of data update in areas of interest, etc),

- Integrating the GOS Catalog into the SAR decision-support application and demoing it to the SAR community for feedback and future improvement,

- Showcasing the WorldWind extension (generic and SAR-specific) at various conference events including but not restricted to AAG (Washington DC, April 2010), ESRI Federal User Conference (Washington DC, February 2010), ASPRS conference (San Diego, April 2010), IGARSS (Hawaii, July 2010)