INCREASING ACCESS AND USABILITY OF REMOTE SENSING DATA: THE NASA PROTECTED AREA ARCHIVE

Gary N. Geller, ASTER Conservation Liaison, Jet Propulsion Laboratory, California Institute of Technology, USA
+1 818-354-0133, Gary.N.Geller@jpl.nasa.gov

KEY WORDS: remote sensing, satellite, conservation, data access

ABSTRACT. Although remote sensing data are now widely available, much of it at low- or no-cost, many managers of protected conservation areas do not have the expertise or tools to view or analyze it. Thus access to it by the protected area management community is effectively blocked. The Protected Area Archive will increase access to remote sensing data by creating collections of satellite images of protected areas and packaging them with simple-to-use visualization and analytical tools. The user can easily locate the area and image of interest on a map, then display, roam, and zoom the image. A set of simple tools will be provided so the user can explore the data and employ it to assist in management and monitoring of their area. The "Phase 1" version requires only a Windows-based computer and basic computer skills, and may be of particular help to protected area managers in developing countries. Planned capabilities for Phase 1 include vector overlay display and creation, image annotation, distance and area measurement, and aids for visualizing and analyzing change. Because the target users generally have little experience with remote sensing, simplicity is an overarching principle. In Phase 2 additional capabilities will be added, such as a topographic layer and 3-D perspective roaming, plus a Web-based variant that utilizes multiband images. More generally, it is hoped that this approach of packaging themed collections of images with simple tools to use them will also be useful in other user communities for increasing access to satellite images.

INTRODUCTION

IUCN - the World Conservation Union, defines a protected area as: "an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means." The World Heritage Convention has given, to a selected group of these protected areas, the prestigious recognition of "World Heritage site," meaning it is a site of international importance.

Protected areas perform many functions. They are essential for conserving biodiversity, and for delivering vital ecosystem services, such as protecting watersheds and soils and shielding human communities from natural disasters. Many protected areas are important to local communities, especially indigenous peoples who depend for their survival on a sustainable supply of resources from them. They are places for people to get a sense of peace in a busy world - places that invigorate human spirits and challenge the senses.

Protected landscapes embody important cultural values; some of them reflect sustainable land use practices. They are important also for research and education, and contribute significantly to local and regional economies, most obviously from tourism. The importance of protected areas is formally recognized in the Convention on Biological Diversity (CBD). Article 8, for example, calls on contracting parties to develop systems of protected areas.

Protected areas face many challenges, such as external threats associated with pollution and climate change, irresponsible tourism, infrastructure development, and ever-increasing demands for land and water resources. These challenges are often compounded by lack of political support and inadequate financial and other resources.

While the importance of protected areas is internationally recognized and the associated overall threats are well-known, the management of protected areas, particularly in developing countries, is often complex. Typically, there are not enough resources to support needed monitoring, address threats, provide adequate maps, or assess and inventory the natural resources.

Satellite images have the potential to help PA managers do more with their limited resources, for example, by making it easy to see how and where things are changing. In fact, simply having access to an image can be of great help in many areas, which may have no maps available. A further benefit is a greatly improved ability to engage national decision-makers, since it is true that "an image is worth a thousand words". When decision makers see images it helps them understand and appreciate the problem and encourages action to alleviate threats to the site. However, many or most site managers and decision makers do not have the expertise to find the needed images and use them. The Protected Area Archive is designed so that virtually no training is required to use it. It will provide managers and other conservation practitioners with detailed images of their area and simple and intuitive tools to help explore and use them for improved park management and communications.

Much work on developing the Protected Area Archive has already been completed. The concept first surfaced in October 2002 and the developers have had an ongoing dialog with conservation practitioners since then so that the needs of the user community could be properly captured. A demonstration version of the system was first created for the World Parks Congress in September 2003. Since then improvements have been added and half a dozen geographical variants have been created (most of these can be downloaded from http://asterweb.jpl.nasa.gov/APAA/default.htm). Creating a new geographical variant is simple and requires only that a new collection of scenes be assembled.

WHY IT IS NEEDED

World-wide information on protected areas is currently quite poor, and in some developing countries the geographical information on protected areas is also poor. There is an urgent need to start creating national systems that will be the basis for conservation-

geographical-systems. By concentrating on protected areas and other areas of conservation interest, and by making the data accessible even to those without special training, the Protected Area Archive is a large step toward accomplishing that.

In addition to increasing the information available for protected areas, satellite images and remote sensing techniques can directly aid in the conservation of nature in a variety of ways, including:

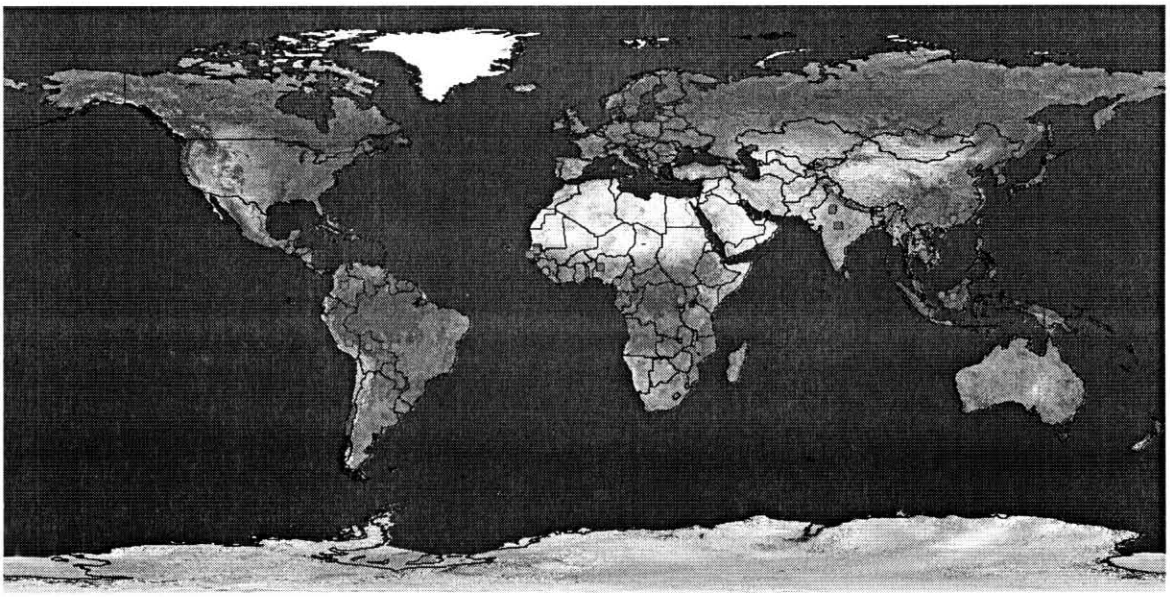
- Detection and management of threats such as
    - Agricultural encroachment
    - Illegal logging
    - Fire
    - Adjacent development and "islandization"
    - Air and water pollution
- Finding new areas deserving protected status
- Managing networks of PAs (such as finding corridors)
- Predicting future threats and change
- Locating new PAs
- Monitoring and managing existing PAs
- Monitoring, predicting, and managing change

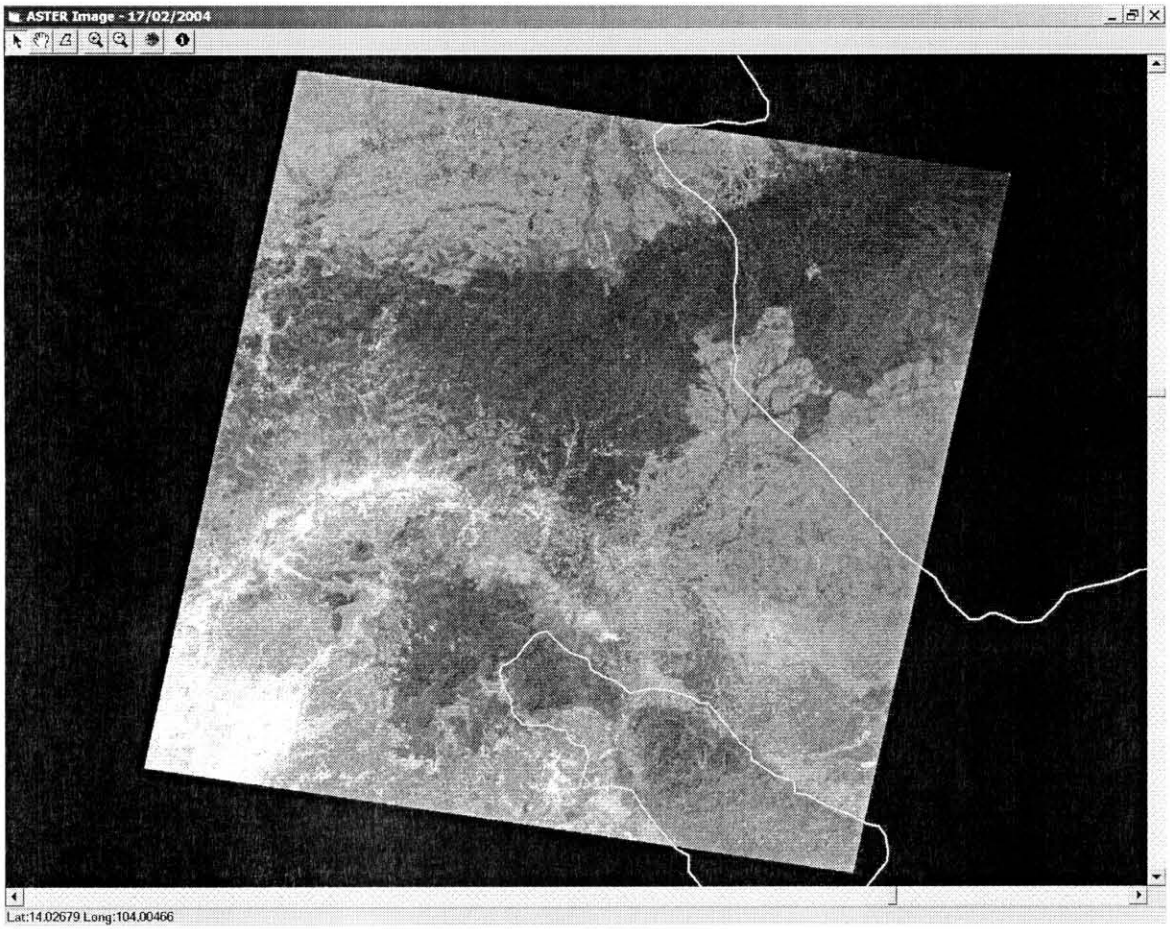
Despite these benefits, however, remote sensing is rarely utilized by PA site managers, especially in developing countries. The reason for this is primarily that the tools and techniques available to find and utilize RS data are designed for RS experts, and not appropriate for use by the typical PA manager who does not have the required knowledge. Providing collections of RS images specific to PAs, easily accessible by clicking on a map, and manipulated with simple tools friendly to non-experts, will help make the benefits of RS available to PA managers and other non-experts, often for the first time.

An additional area of need is for appropriate satellite images for training classes that focus on using remote sensing for conservation. Because of the value of remote sensing for conservation many such classes are offered each year. They would benefit if the images used in the class corresponded better to the specific PAs where the trainees work, and if simple and cost-free tools were available. Although it is designed to be of use even without training, the Protected Area Archive can help existing training classes by meeting both of these needs.

DELIVERED PRODUCTS

A CD or set of CDs will be created that contain satellite images of protected areas along with simple and intuitive tools for PA managers to use them. The geographic coverage, image characteristics, and tool capabilities are described below. Figure 1 shows the Scene Selector screen, Figure 2 and example of an image.




ASTER Image - 17/02/2004
Lat:14.02679 Long:104.00466

Geographic Coverage

Two groups of PAs will be included on this initial disk, corresponding to the needs of IUCN and UNESCO.

1. All the PAs in Thailand (as specified in the World Database on Protected Areas 2004), corresponding to xxxx regions. Disks for additional Southeast Asia countries may also be included if time permits.

2. Selected current and potential World Heritage Sites in Asia. These sites are listed in Appendix 1.

Satellite Image Characteristics

In general, each area will include a recent ASTER image plus at least one historic Landsat image from around 1980 or 1990 (a recent Landsat image from around 2000 may also be included). While cloud-free images are generally available for most sites this becomes difficult in chronically cloudy regions, which may have some gaps in coverage. The geographic alignment of the images with the PA boundaries will vary, and PAs may require multiple scenes; scenes will not be mosaicked. Each image will be in a compressed jpg format to allow for a large number of scenes on a single disk and to increase performance; corresponding loss in image quality is minor.

ASTER images will be based on the ASTER 1b "Calibrated Radiance at Sensor" product and will come from the ASTER archive maintained by the Land Processes DAAC; pixel size is 15 m. Landsat images will generally come from the Scientific Data Purchase program. This program provides nearly global coverage of orthorectified Landsat scenes from three epochs: 1980, 1990, and 2000. Pixel size is generally 80 m for the first epoch and 30 m for the second and third epochs.

Overview of Capabilities

This first phase release, for which funds are being sought, would contain the "core" capabilities--those cited by conservation practitioners as the most important at the recent IUCN World Parks Congress, at a "Remote Sensing, GIS, and Conservation" workshop held in Bangkok in October 2002, and with numerous discussions with conservation managers in Southeast Asia and elsewhere. Feedback has been solicited from users on various demonstration versions of the system, including selected African and Southeast Asian sites, a trace of the Mekong River, US National Parks, areas in Maharashtra State in India, and the world's Mediterranean-Type Ecosystems.

The Core Capabilities include:

- **Image finder.** Display overlays of image locations and protected areas so the user can easily find and display the images of interest.

- **Roam and zoom.** To find and see features of interest within an image
- **Change analysis support.** To help see what is changing and where
- **Themed overlays.** To select the type of protected areas displayed, as well as ancillary overlays such as country and PA boundaries, roads, cities, etc
- **Creation of new overlays.** To delineate boundaries, such as management or ecological units, fire events, etc
- **Image annotation.** Adding text, lines, polylines, polygons etc, so an image can be used to tell a story and effectively communicate an issue
- **Measurement of distance and area.** To determine the length of trails or roads, the size of management units, etc
- **Image adjustment.** Simple functions such as contrast, sharpen, etc, so that image features can be better visualized, and then saved

EXPECTED RESULTS AND FLOW TO FUTURE PLANS

This first phase release, for which funds are being sought, will include images of PAs in Thailand, selected UNESCO WHSs in Asia, and perhaps also PAs in other countries or conservation-relevant areas. This release will be of immediate use to managers whose areas of interest are included, and it will demonstrate the concept to managers and other conservation practitioners from all over.

Although the system is designed so that virtually no training is required for it to be useful, it will integrate well into existing training classes for PA managers, and is planned to be used at a training class at the congress. By including all PAs in a geographic area (for example, for Thailand, as proposed here), each trainee can find the particular PA where they work. After the class completes they can take the disk with them to their office, providing an easy means to begin using RS data in their routine management activities. The tools on the CD, developed in part from discussions with trainers, are a good match for the kinds of topics covered in training courses.

However, the greatest benefit of this first phase release is that it will provide a base for future, incremental expansion, driven by feedback from users. It will enable high-quality, experience-based feedback from users that is critical for further development. Incorporation into training classes will be a major source of such feedback, and we plan on working with trainers to help link the tool to such users.

Because the greatest benefit for the first phase is that it provides a path to further development, that path should be clearly illuminated. Thus, below are listed the primary areas for future expansion, and a more complete picture of the anticipated future of the Protected Area Archive is given in Appendix 2.

1) **Geographical coverage.** Expand to other countries, and to areas of conservation interest that may not be protected (potential PAs, areas surrounding PAs, wetlands, etc).

2) **World Heritage Sites.** UNESCO has expressed its commitment to expand such a system to include all 172 natural WHSs.

3) **Analytical tools.** Suggestions from users include simple classification functions, a topographic layer that can be combined with an image layer, 3D-perspective roaming, a Vegetation Index overlay, use of data products from other instruments (such as the MODIS Vegetation Change Function), and mosaicking support to combine images

4) **Distribution system.** This refers to the method used to package and distribute the data. For example, a library of CDs could be created based on country, biome, etc. Or, tools could be created to allow users to create their own CD that includes only those images of direct interest.

5) **Web version.** A web version would provide capabilities not available on CD, such as links to other information on the web (WCMC for background information on PAs, IUCN Species Information Service for species lists and distribution maps, etc).

ACKNOWLEDGEMENTS

Howard Tan of JPL did all the technical work, building the application and preparing the data.

This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement by the United States Government or the Jet Propulsion Laboratory, California Institute of Technology.