**Protected Area Archive Release 1**
**November 2004**

Please monitor http://asterweb.jpl.nasa.gov for updates and additional information.

The Protected Area Archive is a collection of satellite images of areas of conservation interest, packaged with a simple-to-use toolset to find and view them. This readme file explains how to install PAA, gives a brief overview of how to use it, describes the Protected Area Archive project, provides some background information on images and how they are created, and summarizes the ASTER and Landsat sensors.

Comments are welcomed and encouraged. Please send to:

Gary Geller
MS 171-264
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, California 91109 USA
+1 818-354-0133
Gary.N.Geller@jpl.nasa.gov

## 0. GETTING STARTED

### 0.1 Installation

This application is designed to run on Windows systems, and has been tested on Windows XP, Windows 2000, and Windows 98. It should also run on Windows NT and Windows 95 systems though none were available for testing. A 300 Mhz Pentium or faster system is recommended, though it will run on slower systems (just…slower).

To install, insert the CD into the CD drive and the installation should start automatically. Follow the instructions. If it does not start automatically, manually run the setup.exe file to begin the installation. If you are installing from an electronic version, expand the file and then run the setup.exe file.

The PAA application utilizes the Microsoft .NET Framework 1.1, and so the .NET Framework must be installed on your machine. If it is not already installed you will be prompted for permission to do so, and installation will continue. Its not possible to run PAA without the .NET Framework.

The program can be completely uninstalled using Start/Settings/ControlPanel/AddRemovePrograms.

In general, each CD has two components: the PAA "application", and the data that comprise the Collection. The steps described above copy the binary and support files from the CD into the appropriate directories, make some minor entries in the system registry, and make sure any needed libraries are present. The data, which consists mostly of images and shapefiles, is not copied during the installation of the application. Instead, immediately after the installation completes you will probably want to "Import" the Collection from the CD, as follows:

1. Start PAA (click on the Desktop Icon or use the Start Menu).
2. Go to File→Import Collection.
3. Select the CD.
4. Select the one folder on it (you should recognize the Collection name).
5. Click OK.

This will copy the Collection from the CD onto your PC. If you don't do this you can still open the Collection but you will need to have the CD inserted into the CD reader of your computer, and then select the Collection using File/OpenCollection/Browse. In fact, after the application is started you can open any collection you can "see", such as on the CD drive, on any other device, or anywhere on the network. This allows sharing of large collections among a network of users (though this capability has not yet been extensively tested).

0.2 Quickstart Guide

This section provides a brief overview of how to use the basic functions of PAA.

1. Double-click the desktop icon called PAA.exe. This will start the program.
2. Select a Collection using File/Open Collection. A "Collection" is just a group of images tied together by a particular theme, such as all the PAs in a country, or complete coverage of a watershed. The Collections that reside on the "local" machine (the one you are on) are listed and you can select one. However, if there are also Collections elsewhere that are of interest, such as on a CD or out on the network somewhere, you can browse around and select one of them. Only one Collection can be open at a time.
3. A map of the world will open and the scenes in the Collection will be indicated by small, solid red squares.
4. Zoom in to the general region of interest by using the two zoom buttons, or selecting the "zoom box" button and then click-dragging a rectangle over your area of interest. Pan by clicking on the pan button and then pulling the image using the mouse with the left button depressed.
5. Find an area of interest and observe the outlines of the ASTER and Landsat scenes. You can use the Sensor menu to select which sensor layers are displayed. There may be as many as four, corresponding to ASTER and the three epochs of Landsat data.
6. Double-click within the scene outline of interest. An image of that scene will be displayed. If more than one scene exists at that location you can right-click to get a scene list, then select from there.
7. The "I" button on the image toolbar can be used to display the scene acquisition date and other information.
8. A preliminary area and distance measurement function is available by pressing the button with a polygon or a line on it. You can then use mouse clicks to define a temporary polygon on an image (such as a burned area). Double clicking terminates the polygon and displays the area in square kilometers.
9. You can annotate the image, or adjust contrast, gamma, etc, using the image editor buttons, which starts an image editor program called Photofiltre. One of those brings up a simple snapshot of the current image window, while the other brings up the original jpg image.

## 1. PROTECTED AREA ARCHIVE

1.1 Basic Concept

The purpose of the Protected Area Archive is to make NASA data covering areas of conservation interest easily available, and to provide simple and intuitive tools to utilize

it. The intended audience is largely conservation managers, and it assumes no knowledge of remote sensing or image processing. It is hoped that this will help address what may be the two biggest obstacles to using satellite images that many managers face: 1) finding and obtaining appropriate data and 2) viewing and analyzing the data. The Concept Overview below provides more information on the overall activity.

### 1.2 Variants and Themes

The Protected Area Archive is available with a variety of different data collections covering different geographic areas or conceptual themes. In the future it is expected that users will be able to create their own collections using a web-based tool, then have the result mailed to them or made available for download.

### 1.3 Contact Information

Gary Geller
MS 171-264
Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91109 USA
+1 818-354-0133
Gary.N.Geller@jpl.nasa.gov

### 1.4 Acknowledgements

Howard Tan and Duane Kiefer 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.

Development of the Protected Area Archive Release 1 is an activity of the US ASTER Science Team at Jet Propulsion Laboratory, California Institute of Technology, with support from NASA.

### 1.5 Copyright Information



### 1.6 Known Problems

1) When editing layer attributes, there may be some interesting results when multiple images are already open. Also, by changing the layer attributes it will effect all other images afterward. Lastly, when you remove a layer then hit cancel, the layer is still removed.

2) The horizontal scroll bar may be partially hidden by the status bar.

3) For users with non-standard system font sizes…the scene list (obtained by right-clicking an image on the World Map) may disappear when the user attempts to use the scroll bar. If you cannot see the complete list of scenes, the workaround is to single click on any item in the list, then use the keyboard arrows to scroll down to see the remaining entries.

## 2. PROTECTED AREA ARCHIVE PROJECT

### 2.1 Concept

The basic idea is to create collections of images of conservation areas such as Protected Areas (PAs) for use by site managers and other conservation practitioners. A set of simple visualization and analysis tools is provided so the user can explore the data and employ it to improve management of their area. Because the target users generally have little experience with Remote Sensing (RS; ie, satellite images), simplicity is an overarching principle.

### 2.2 Target audience

Initially, the audience is conservation managers with little or no experience in RS or use of satellite images. They may also have limited English language and computer skills, with poor Internet access.

### 2.3 Purpose

* Provide RS data and technology, otherwise unavailable, to conservation managers to enhance their management capabilities
* Provide tools to make these RS data accessible to non-experts
* Spark interest in RS by PA managers
* Use in various training events

## 2.4 Context

**Need**. RS is underutilized in the conservation community, perhaps particularly by conservation managers, and especially in developing countries. Providing a simple collection of RS data covering areas of conservation interest, accessible by clicking on a map, and manipulated with simple tools friendly to non-experts, will help make the benefits of RS available to conservation practitioners.

**Training**. This disk will be particularly useful for training because of its simplicity. By including all PAs in a geographic area (for example, for a country such as Thailand or Cambodia), each trainee can find the particular area where they work, sparking interest--this may be the first time for many of them to see and explore such an image. And they can then take the disk with them so they have it available in their office, providing an easy path to begin using RS data in their routine management activities.

**Broader Applications.** Such a disk also provides a starting point for further work in the area of developing simple, intuitive techniques and tools that can make RS more accessible. These techniques and tools would be of use to all user communities lacking easy access to RS, not just to those in the conservation community.

## 2.5 Capabilities

The philosophy is to start simple and grow as appropriate. Care must be taken to maintain simplicity as capabilities are added.

This release supports:

- ASTER data (2000 - present)
- Landsat data (from c. 1975, 1990, and 2000)
- Image find, roam, and zoom
- Image edit--adding text, arrows, etc, adjusting brightness, contrast, gamma…
- Display and management of PA boundaries and user-supplied overlay files (.shp)
- Distance and area measurement
- Remote image collections (open any collection available on the network)

Possible future capabilities:

- Support for MODIS
- Ability to update a collection with the most recent data
- Enhanced change analysis support
- Topographic layer, with draping capability and perspective roaming
- Support for multiband datasets
- Simple classification functions
- Custom CDs: user selects scenes and gets mailed a CD

## 3. ASTER INSTRUMENT AND DATA

Much of the data in the Protected Area Archive are from an instrument called ASTER. Most people, however, are not familiar with this instrument, and this section provides some basic information. To summarize very briefly: ASTER is quite similar to Landsat, but provides much more detailed images. Landsat, however, has a wider swath width, and a very large historical archive.

### 3.1 Overview

ASTER is a large, space-based, digital camera that started operating in early 2000. It acquires about 600 high-resolution images a day, each one covering an area of 60 x 60 km, with a pixel size of 15 m for bands 1-3. Depending on the version you have and the source of the images, the images on this disk may be "RGB 3-2-1 composite" jpgs, meaning that live vegetation appears red and most human-made areas are blue. For most collections, however, live vegetation is represented as green--obviously closer to real life, though for a variety of reasons this is not as easy as it sounds. Dead vegetation (such as grasslands during the dry season) tend to be purple. The jpg format was used to reduce the size of each image.

### 3.2 The Instrument

ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) is basically a large digital camera bolted to a satellite. The satellite, called Terra, is the size of a small bus, was launched in 1999, and has four other instruments. It circles Earth at a distance of 705 km, from pole to pole, about every 100 minutes, crossing the equator at about 10:30 am local time.

ASTER itself takes about 600 pictures ("scenes") a day, each covering an area of 60 x 60 km. Like most satellite sensors, ASTER is much more complex than a hand-held digital camera. First, and most importantly, a separate image is created for each color (or more precisely, each wavelength range, or "band"). Because ASTER has a total of 14 bands, it actually acquires 14 different images for each scene. This is useful because different materials can look very different in different bands--by acquiring images in each of the 14 bands a lot can be learned about the materials being imaged. When an image is "processed", each band can be treated separately, leading to some very powerful (and sometimes very complicated) analysis techniques. To keep things simple, and to save space, the images on this disk are "composite" images derived from bands 1, 2, and 3. A website is planned that will provide the full multi-band images along with some simple tools to help analyze them.

Another difference between ASTER and a typical digital camera is that ASTER has three lenses--(called telescopes because of their size and power)--rather than one. In fact, ASTER is really three separate instruments, each one specializing in a different part of the spectrum. This is because photons in one part of the spectrum behave very differently than in another, so different technologies are used for each part.

One of the most important characteristics of ASTER is its high resolution--a pixel size of 15 m for bands 1-3 (compared to Landsat's 15 to 30 m resolution). High resolution is useful for park managers because it provides more detail and, consequently, greater ability to detect changes and to observe the status of the park.

The ASTER instrument and its operation is a joint project between the US and Japan. Japan designed and built the instrument, the Level 1 processing system, and the operations system, and performs the day-to-day mission planning and the Level 1 data processing. The US designed, built, and operates the Terra spacecraft and the associated ground system.

### 3.3 The Images

All digital images, whether from personal digital cameras or from those in space, are composed of pixels (picture elements). Each ASTER image on this disk has about 16 million pixels (4200 x 4200), and is a "composite" color image derived from bands 1, 2, and 3, which are sensitive to green, red, and near-infrared, respectively. Each pixel in these images corresponds to about a 15 x 15 m patch on the ground. The jpg format was chosen to decrease the size of the images so a sufficient number of them could be placed on a single CD; in most cases, however, the loss in data quality due to compression is minimal.

In some versions of PAA or in some images, live vegetation appears red--the brighter and redder the more healthy the vegetation. Man-made materials like concrete and buildings tend to be a light blue or gray. Bare soil can vary in color and brightness depending on what materials it is made of. Water is very dark.

In such a case people wonder why the scenes are not displayed in their natural colors, and there are several reasons for this. The first is due to historical reasons. Much early remote sensing work used infrared-sensitive film because healthy vegetation strongly reflects those wavelengths (a plant cannot use them for photosynthesis). The human eye can not see infrared, yet some visible color has to be used to represent it if the images are going to be useful. For infrared-sensitive film, that color was red, and so red has been used to represent the infrared ever since, even for digital images that use no film, such as ASTER.

The second reason is that this is the way the "color assignments" have been made. The color red is assigned to band 3 (sensitive to part of the infrared spectrum), green is assigned to band 2 (sensitive to red) and blue is assigned to band 1 (sensitive to green). So, a piece of ground that reflects highly in band 3 will appear bright red in the processed image, one that reflects highly in band 2 will appear bright green, and one that reflects highly in band 1 will appear bright blue. Of course, most things are actually a combination of these, though often one band predominates.

In most versions of PAA and in most images, however, vegetation appears green. However, this requires some special processing because ASTER does not have a "blue" band (this was omitted because blue light tends to be scattered a lot by the atmosphere and so is rather "noisy"). Without blue a "natural color" image is not possible, so the existing bands were combined in a way that leads to a fairly--but not completely--natural looking image.

3.4 The Full ASTER Data Archive

All ASTER scenes (currently numbering roughly one million) are archived at a data center in South Dakota, USA (as well as at the equivalent data center in Tokyo). Access to the data in the US archive is by one or both of the following tools (the first provides both search and order capability, the second only search--but a much friendlier search--and an easy path to ordering):

** EOS Data Gateway (EDG): http://edcimswww.cr.usgs.gov/pub/imswelcome/

** Global Visualization Viewer: http://glovis.usgs.gov/

3.5 For More Information

For more information on ASTER, the various ASTER data products, how to submit data acquisition requests, the work of the ASTER Science Team, and much more, please visit the US ASTER website:

http://asterweb.jpl.nasa.gov/

3.6 Brief Specifications

Launched: December 1999
Expected lifetime: 6+ years
Number of bands: 14
Number of telescopes: 3 (VNIR, SWIR, TIR)
Pixel size:
- 15 m (VNIR)
- 30 m (SWIR)
- 90 m (TIR)

Stereo: yes
Repeat frequency: 1-16 days

## 4.0 LANDSAT INSTRUMENT AND DATA

Landsat data from up to three epochs are included on most PAA disks. These data are part of the "Geocover" global orthorectified dataset, fully explained in the reference below, which is available at http://glcf.umiacs.umd.edu/pdf/PERSMarch_04_313-322.pdf

Tucker, CJ, DM Grant, and JD Dykstra. 2004. NASA's Global Orthorectified Landsat Data Set. Photogramm Eng Rem Sen Vol. 70, No. 3, March 2004, pp. 313–322

Additionial information on the Landsat instruments and data can be found at websites such as

http://landsat.gsfc.nasa.gov/
http://landsat7.usgs.gov/index.php