LizardTech

GeoExpress 10

User Manual

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Preface

The **GeoExpress User Manual** is written for geographic information system (GIS) professionals that want to compress and manipulate geospatial data with GeoExpress. This guide assumes that you have basic knowledge of GIS, including mosaics, coordinate reference systems, multispectral imagery, and LiDAR point clouds.

This guide describes how to install and operate the graphical version of GeoExpress. To install GeoExpress on Linux, you must install the command line version of GeoExpress. For installation instructions and other information about the command line version of GeoExpress, see the **GeoExpress Command Line User Manual**.

Contents

Chapter 1: Before You Begin

GeoExpress overview

GeoExpress is a software solution for compressing and manipulating geospatial data. GeoExpress supports a broad range of file formats, including the industry standard MrSID format and the ISO standard JPEG 2000 format.

Some of the tasks that you can perform with GeoExpress include:

- Compress raster and LiDAR data;
- Create seamless mosaics;
- Specify separate compression ratios for individual bands in a multispectral image;
- Reproject raster images to another coordinate reference system;
- Perform color balancing;
- Crop and demosaick raster images;
- Despeckle raster images;
- Edit image metadata.

You can save images that you create with GeoExpress to your computer or a LizardTech Express Server. Then, view the images in the geographic information system (GIS) software of your choice, including Esri®, Bentley®, Autodesk®, and more.

What's new

NOTE: To see a list of fixes and other information for the current version of GeoExpress, see the **GeoExpress Read Me.pdf** file included in the installation.

Version 10.0

New features

GeoExpress 10 has a greatly improved user interface that can help streamline your workflow. Among the improvements are:

- **Reworked Job Properties panel:** The new organization reinforces workflow from the top down, showing the same types of information about each job and allowing you to easily identify, review, and edit modifications made to each job.
- **Reduced number of dialogs**
- **Improved mosaic creation**
- **New crop options**
- **Simplified reprojection:** Improved CRS selection and editing, new CRS source, simplified WKT viewing and editing, and improved error checking
- **Jobs:** You can now pause or cancel jobs individually or en masse, and can manually re-order running jobs.

GeoExpress 10 also includes these new and enhanced capabilities:

- You can now crop and reproject LiDAR point clouds
- You can now create mosaics from multiple sources, including:
  - Create an MG2 mosaic from MrSID sources
  - Create a TIFF mosaic
  - Create a multiresolution MG2 mosaic
- Encoding NITF imagery no longer requires a separate license. Note that encoding NITF imagery will incur a charge against the data cartridge.
- The **Crop** window always displays an image preview. You can cancel the preview if it is taking too long to render, at which point you can enter crop coordinates manually.

Version 9.5.x

New feature highlights

- **Enhanced multi-core support:** GeoExpress no longer limits the number of concurrent jobs and threads to eight.
- **LiDAR Compression:** GeoExpress supports compressing LiDAR point clouds in plain-text or LAS or LAZ formats.
- **Multipolygon Shapefile Cropping:** Define the area that you want to crop with a shapefile that can contain multiple polygons.
- **Command line tools:** We improved the method used to create MrSID mosaics from the command line.
- **BPF support:** GeoExpress supports input and output of Binary Point Files often used in Geiger Mode LiDAR imagery.
- **NAD83 2011 support:** GeoExpress now supports EPSG Coordinate Reference Systems and Coordinate Transformations related to NOAA's National Adjustment of 2011.
- **PIX support:** GeoExpress supports PCIDSK (PIX) files as input files.
- **Improved transparency conversion:** GeoExpress uses the **nodata** value of the input image as the transparency for the alpha band when converting to MG4 format.
- **Color balancing improvements**
- **Simplified licensing**

Version 9.0 and 9.1

New feature highlights

- **Floating Point Support for MrSID Generation 4:** GeoExpress uses quantization to create 32-bit floating point images in the MrSID Generation 4 format.
- **Dynamic Range Metadata Generation:** Use GeoExpress to write dynamic range metadata for images.
- **Improved Metadata for Auxiliary Files**
- **Command Line Image Statistics**
- **Simple Job List:** Any images that you add to the GeoExpress graphical user interface appear in a single simplified job list.
- **Intelligent Encoding:** GeoExpress automatically performs a subset of image compression and manipulation operations without re-encoding images.
- **Image Rotation:** For images that include rotation metadata, GeoExpress creates rotated output images.
- **Custom Watermarks:** GeoExpress supports watermark images in BMP, PNG, and JPEG formats.
- **Mosaic Enhancements for the Command Line:** Create mosaics using multiple coordinate reference systems from the command line.
- **PNG Support**
- **NITF RPC Support:** GeoExpress can now interpret NITF files with RPC metadata.

System requirements

Before you install GeoExpress, verify that your system meets the minimum system requirements.

Hardware requirements

For optimal performance, verify that your system meets the following recommended hardware requirements:

- 2.5GHz quad core processor
- 4GB RAM
- 300MB of disk space for installation (additional space required for images)

However, it is still possible to run GeoExpress on systems with the following minimum hardware requirements:

- 1.5GHz processor
- 1GB RAM
- 300MB of disk space for installation, and additional space for images

Operating system requirements

IMPORTANT: GeoExpress 10 is a 64-bit application and requires a 64-bit operating system.

Windows

- Windows 10
- Windows 8
- Windows 7
- Windows Server 2016
- Windows Server 2012 R2 Update
- Windows Server 2012
- Windows Server 2008 R2 SP1

Linux

NOTE: On Linux, GeoExpress runs as a command line-only program.

- Red Hat Enterprise Linux 7.0
- Red Hat Enterprise Linux 6.1
- CentOS 7

Software requirements

On Windows, GeoExpress requires the following software to run:

- Microsoft .NET Framework 4.6.1
- Visual Studio C++ 2017 Redistributable
- SlimDX Runtime .NET 4.0 (used to display LiDAR point clouds in 3D)

If this software is not already on your computer, the GeoExpress installer will install it for you.

Getting GeoExpress

When you purchase GeoExpress, you can choose to download an installer for the Windows GeoExpress graphical and command line applications, an installer for the Linux command line application, or an ISO including all versions of GeoExpress as well as other applications, utilities, and sample images.

Download the software from the LizardTech website (https://www.lizardtech.com/support/geoexpress/installers).

Chapter 2: Installation and Licensing

Installing GeoExpress

Overview

To set up GeoExpress, complete the following steps:

- Run the GeoExpress installer to install the GeoExpress application.
- Enter a license code or connect to a License Server.
- If you have a copy of GeoExpress Standard Edition, install a data cartridge.

Installing

If you are upgrading from GeoExpress 9.5 or later, you can install GeoExpress 10 without any special preparation.

If you are running GeoExpress 9.1 or earlier, you must uninstall the older version before installing GeoExpress 10. See **Instructions for GeoExpress 9.1 and earlier** on the GeoExpress Installers (https://www.lizardtech.com/support/geoexpress/installers) page.

GeoExpress 10 requires a new serial number.

1. Log on to the computer where you want to install GeoExpress.
   You don't need to log on as an administrator but you do need to be able to perform admin overrides.
2. Navigate to the directory containing the GeoExpress installer and double-click `SETUP.EXE` to start the **GeoExpress Installation Wizard**.
3. The installation wizard prompts you to complete the following tasks:
   - Install the Microsoft .NET Framework, Visual Studio C++ Redistributable, and any other required libraries.
   - Accept the License Agreement.
   - Decide whether to share anonymous usage information.
     To change this option within the application, choose **Help > Anonymous Application Usage**.
   - Enter your serial number or choose to run GeoExpress in Trial mode.
     Serial numbers are specific to a version of GeoExpress, and determine the functionality available to you. For example, there are different serial numbers for GeoExpress Standard and GeoExpress Unlimited.
   - Select the directory where you want to install GeoExpress.
   - Follow the steps to complete the installation.

Installing data cartridges

The Standard edition of GeoExpress requires a data cartridge to create new compressed images. The data cartridge represents a specific purchased amount of data that you can use to create these images.

Data cartridges are generated by LizardTech and emailed to you as an attached file. You add data cartridges in the **License and Cartridge Management** dialog.

You can either install a data cartridge on your computer or you can use a data cartridge from an Express Cartridge Manager Server.

For more information on configuring the Express Cartridge Manager and how to calculate data usage, see Data cartridges on page 133.

Requesting a data cartridge

1. Visit https://www.lizardtech.com/sales/purchase/ to submit a data cartridge request.
2. Your sales representative will work with you to place your order.
3. LizardTech Customer Support will send your data cartridge file through email.

If LizardTech Sales or Customer Support needs additional information to process your order, they will contact you.

Installing a data cartridge

Method 1

1. Save the email attachment that you received from LizardTech Customer Support.
2. Double-click the saved data cartridge file.
   This installs the data cartridge.

Method 2

1. Save the data cartridge that you received in an email from LizardTech Customer Support to your computer.
2. Start GeoExpress.
3. Choose **Options > Licensing**.
4. In the **Cartridges** section, click **Import**.
5. Navigate to the directory where you saved the email attachment.
6. Select the email attachment and click **Open**.
   GeoExpress installs the data cartridge. The bottom of the dialog shows how much data remains on your cartridge.

Connecting to an Express Cartridge Manager Server

1. Start GeoExpress.
2. Choose **Options > Licensing**.
3. In the **Cartridges** section, enter the name or IP address of the computer hosting the Express Cartridge Manager Server, followed by the port number, then click **OK**.
   The default port number is `9002`.

Licensing GeoExpress

The first time that you run GeoExpress, you must enter a serial number (if you did not enter one during installation) and a license code, or connect to a license server. Otherwise, GeoExpress will run in Trial mode, which expires after 30 days.

License codes are specific to your computer system. You can request a permanent license code from LizardTech Customer Support. If you activate a temporary license code, you can switch to a permanent license code in the **License and Cartridge Management** dialog.

If you connect to a license server, you use a floating license that can be shared by multiple computers.

Requesting a license

1. Start GeoExpress.
2. Choose **Options > Licensing**.
   This opens the **License and Cartridge Management** dialog.
   If your temporary license code has expired, the **License and Cartridge Management** dialog opens when you start GeoExpress.
3. In the **Licensing** section, click **Copy** to copy the locking code.
4. Click **Send Activation Request**. This will open your default web browser at the LizardTech Product Activation (https://www.lizardtech.com/support/product-activation/) page.
5. Fill out the form and paste your locking code in the **Locking Code** field.
   LizardTech Customer Support will send you a license code within one business day.

NOTE: If you use GeoExpress with a license server, you do not need to submit your computer's locking code.

Entering a serial number and license code

1. Start GeoExpress.
2. Choose **Options > Licensing**.
3. In the **Serial Number** section, enter the serial number that you received from LizardTech Customer Support if you have not done so previously.
   The **Serial Number** section will show whether the serial number is valid.
4. In the **Licensing** section, enter the license that you received from LizardTech Customer Support.
   You can also import the license file that you received from LizardTech; click **Import** in the **Licensing** section and select the `.lic` file.
5. Click **OK**.
   The title bar of the main GeoExpress window displays the type of license in use.

Connecting to a license server

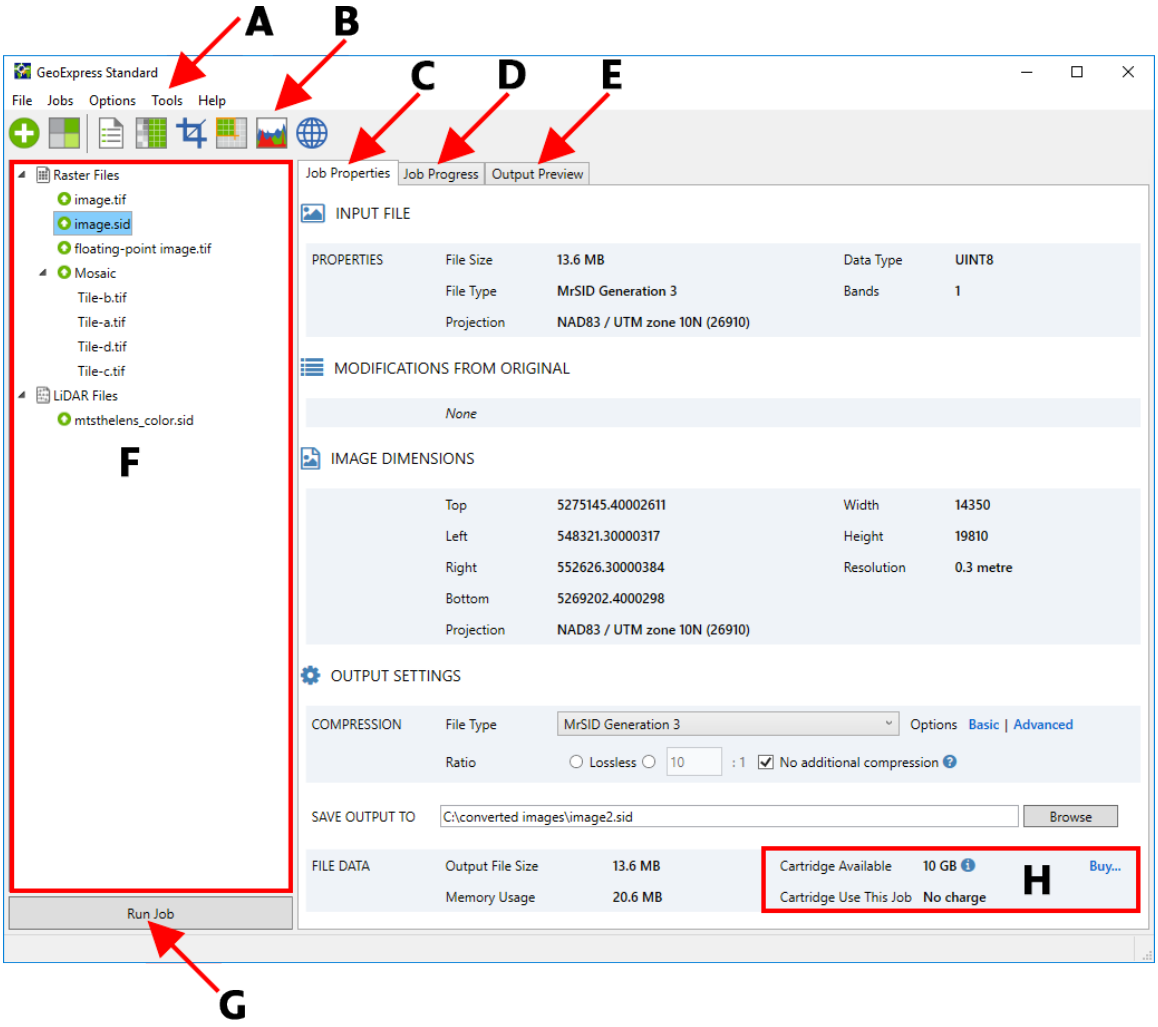
1. Run GeoExpress.
2. In the **Licensing** section, enter the name of the **License Server**.
3. Click **OK**.

For more information on floating licenses and the LizardTech License Server, see Floating licenses on page 134.

Chapter 3: Getting Around in GeoExpress

Main screen

You can use the GeoExpress graphical user interface to complete all compression and manipulation tasks. To start GeoExpress, double-click the desktop icon or on Windows 8 through 10, go to the **Apps** screen and click **GeoExpress 10** under **LizardTech**; on Windows 7, choose **Start > All Programs > LizardTech > GeoExpress > GeoExpress 10**.



A. **Menu bar:** Access most functions within GeoExpress. Learn more
B. **Toolbar:** Access common image manipulation functions. Learn more
C. **Job Properties tab:** details about selected job(s). Learn more
D. **Job Progress tab:** Details of running jobs. Learn more
E. **Output Preview tab:** Scalable preview of output for selected job. Learn more
F. **Job List:** Files to be process. Learn more
G. **Run Job button:** Start encoding selected jobs. Learn more
H. **Data cartridge details:** Shows how much data is available and the requirements for the selected job. Learn more

Menus and toolbar

GeoExpress menus

The menu bar is a central place where you can view most of the tasks that you can perform in GeoExpress and the options that you can set.

The following table describes some of the options unique to the menu bar:

OPTION	DESCRIPTION
File > Save project	Saves changes to the current project. If it has not been saved, you'll be prompted for a filename. A project consists of the current contents of the **Job List** and global settings.
Options > Preferences	Set or restore default preferences for output files, including output directory, compression ratio, and more. For raster images, you can set the default output directory and file format, set a default compression ration for each file format, and more. See General and Appearance preferences on page 106, MrSID preferences on page 111, and JPEG 2000 preferences on page 113. For LiDAR images, you can set the default compression ratio, specify the default number of points to display in the point cloud preview, and more. See LiDAR preferences on page 115.
Options > Licensing	Enter or import license information or a data cartridge license or connect to a License Server.

For a full description of all menu options, see File menu on page 145.

Toolbar

Access the GeoExpress toolbar to add images and mosaics to the **Job List** and to perform image manipulation tasks. The tools that you can access in the toolbar vary depending on the image that you select in the **Job List**.

The toolbar contains the following tools:

ICON	NAME	DESCRIPTION
	Add Image	Add one or more images to the **Job List**.
	Create New Mosaic	Adds a mosaic to the **Job List**. First you'll be prompted to select the files that make up the mosaic, then you can set the output file name, location, and format, change the projection and edit details of the mosaic.
	Edit Metadata	Edit the metadata of an image. For raster and LiDAR files, you can change the projection information stored in the metadata. For raster images, you can also include custom information in the image.
	Despeckle	Remove speckling from MrSID and JPEG 2000 raster images.
	Image Crop	Crop a raster image or LiDAR point cloud.
	Area of Interest	Specify part of a raster image as an "Area of Interest," and change the compression ratio of that area to preserve more detail or blur that part of the image.
	Color Balance	Change the brightness, contrast, and gamma values for a raster image, or for individual bands in the image.
	Reproject	Change the projection used by a raster image. You can select a standard coordinate reference system (CRS) or specify a custom well known text (WKT) string.

Job List

The **Job List** is the pane on the left side of the GeoExpress user interface that displays the raster and LiDAR files with which you want to work.

The **Job List** is where you add or remove images for compression and manipulation operations, work with project files, select images to view information about them, and run your jobs.

The **Job List** is divided into a section for raster files and a section for LiDAR files. GeoExpress treats each image, point cloud, and mosaic in the **Job List** as a discrete job. The name displayed in the **Job List** is a user-specified job name that has no effect on the resulting output file.

- **To add images and point clouds to the Job List,** click the **Add Image** button in the toolbar. You can also drag images into the job list from another application.
- **To create a mosaic,** click the **Create New Mosaic** button. The **Job List** displays the tiles that you add to a mosaic in an indented list.
- **To view information about a job,** select it in the list then click one of the **Job Properties**, **Job Progress**, or **Output Preview** tabs.
- **To edit a job's basic options,** double-click the job in the list.
- **To move a job in the list,** click it once then drag it up or down in the list.
- **To remove a job,** select it and press the **Delete** key.

Run Job button

Click the **Run Job** button immediately below the **Job List** to run one or more jobs. The jobs that you run depend on which jobs you have selected in the **Job List**. If no jobs are selected, then the **Run Job** button runs all jobs.

For more information on running jobs, see Run a job on page 28.

Shortcut menu

GeoExpress provides a shortcut menu when you right-click on a selected job in the **Job List**.

MENU ITEM	FUNCTION
Edit > Cut	Removes the selected elements from the list. You can then paste the elements at another location in the **Job List**.
Edit > Copy	Copies the selected elements. You can then use **Paste** to duplicate the items in the list.
Edit > Paste	Places copied or cut elements at the selected position in the **Job List**.
Edit > Select All	Selects all the items in the **Job List**.
Run	Run selected jobs.
Cancel	Stop one or more running jobs.
Resume	Resumes a selected job if it has been paused.
Pause	Pauses a selected job if it was running.
Remove	Remove selected jobs from the **Job List**.
Job Options	Set format, compression, dimensions, resolution, and tiling options for the selected job.
Advanced Options	Set advanced input, output, and other options for the selected job.
Metadata Options	View and edit image metadata.
Edit mosaic	Add, remove, crop, change order, and set a coordinate reference system for tiles. This option is only available if the selection is a mosaic job.
NITF Image Segments	Displays the image segments in the selected file and allows you to select the segments that you want to include in the output file.
Export Job Settings	Export a text file containing information about the selected job and the version of GeoExpress. Use this to remember job settings or when contacting LizardTech support.

Job Properties panel

The **Job Properties** panel displays information about the selected jobs, in four sections: **Input File**, **Modifications from Original**, **Image Dimensions**, and **Output Settings**.

NOTES

- If you have multiple files selected, any non-identical properties will be listed as Multiple.
- If you have selected a single tile in a mosaic, the properties displayed are for the entire mosaic. For example, the file size displayed will be the total disk space consumed by all tiles in the mosaic.

Input File

This section shows properties of the selected file:

- File size on disk in appropriate units (MB, GB, KB)
  If you select a single mosaic tile or the entire mosaic, the file size shown is always the total size of all the mosaic tiles on disk
- File type (TIFF, MrSID, etc.)
- Projection (if any)

Raster files will also include:

- Data type (FLOAT32, UINT16, etc.)
- Number of bands

Modifications from Original

This section will list any manipulations you have made on the selected job, in the order they will be performed. These include **AOI** (Area of Interest), **Color Balance**, **Crop**, **Despeckle**, **Metadata**, **Mosaicked**, and **Reprojection**.

Each listed manipulation is a link that you can click to review or edit the changes before you run the job.

Image Dimensions

This section shows the dimensions and projection for the output image. These may differ from the input image, especially if you have cropped or reprojected the image.

For raster jobs, the dimensions displayed are:

- **Top, Left, Right, Bottom:** the coordinates of the four edges of the image, in the CRS of the output projection
- **Projection:** The CRS of the output job. Unless you have reprojected the image, this will be the same as the source image.
- **Width, Height:** Size of the output file, in pixels
- **Resolution:** Scale of the image per pixel, in the units of the projection. If the projection is None (i.e., there is no CRS for the image), the resolution of 1 corresponds to 1 pixel (in the output) per pixel (of the input).
- **Tile Extents:** If you have selected a single tile in a mosaic, the **Tile Extents** link will be displayed; click it to view the top, left, bottom, right, and resolution of the selected tile.

For LiDAR jobs, the dimensions shown are:

- **X min, X max:** The lowest and highest coordinates of the point cloud on the X axis (East/West)
- **Y min, Y max:** The lowest and highest coordinates on the Y axis (North/South)
- **Z min, Z max:** The lowest and highest coordinates on the Z axis (elevation)
- **Projection:** The CRS of the output job.
- **Points:** The number of data points in the output point cloud. (This is typically an estimate if the job includes cropping or reprojection.)

Output Settings

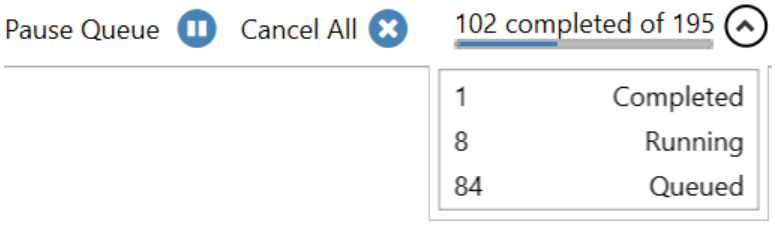
In this section, you can specify the type of file to be generated when the job is run, set basic compression options, and select a destination and filename for the output.

- **File Type:** Choose the desired output type from the pop-up menu.
  If you have selected multiple jobs that have different default outputs, this will be blank; you can set the same output for all selected jobs.
- **Ratio:** Identifies the level of compression applied to the output job.
  For some types of images you won't be able to change this (for example, floating-point images always use Quantization compression).
  Otherwise, you can choose between using lossless compression, or setting a target compression ratio.
- **Basic Options:** Click the **Basic** link to open the **Basic Options** dialog, which allows you to change location, format, compression, dimensions, resolution, and tiling options.
- **Advanced Options:** This link is only present for raster jobs. Click the **Advanced** link to open the **Advanced Job Options** dialog, where you can change many more job options.
- **Save Output to:** This field indicates the destination for the selected job. If you have selected one job, this field shows the destination path and filename.
  If you have selected multiple jobs with the same destination folder, this field will show the path to that folder; otherwise, it displays the word "Browse."
  Click the **Browse** button to choose a destination for the selected jobs.
- **File Data:** This shows the approximate size of the output file, the amount of system memory needed to run the job (for MG2, MG3, or MG4 raster images), the amount of data remaining on your data cartridge (for GeoExpress Standard users), and the approximate amount of data the job will consume from your cartridge.
  Click the **Buy** link to replenish your cartridge when it is low.
  For more information on how the memory usage is calculated, see Calculating memory usage on page 130.

Job Progress panel

In the **Job Progress** panel, you can monitor the progress of running jobs.

Use the controls at the top of the **Job Progress** panel to pause, resume, or cancel all jobs in the queue. Click the exposure arrow next to the progress bar at the right of the queue controls to show the status of jobs in the queue.

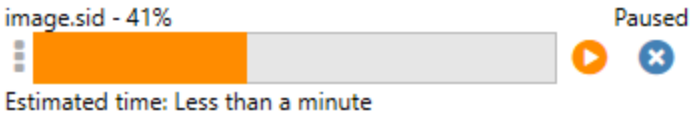


You can also review and control individual jobs in the queue.

Job control

Running jobs appear in a list, showing the job name and progress.

When a job is running, the progress bar is blue. Click the **Pause** button at the right end of a job progress bar to pause that job; click the **Cancel** button to cancel the job.

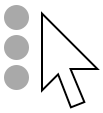


When a job is paused, the progress bar is orange. Click the **Resume** button at the end of the progress bar to resume the job.

NOTE: It may take considerable time for a job to pause, especially if it is a large mosaic.

When a job finishes, the progress bar shows green, then the job is removed from the **Job Progress** list.

GeoExpress processes each job in a separate thread. The number of threads that can run simultaneously depends on the number of processor cores available on your system. If you run more jobs than can be processed simultaneously, some jobs will be listed as “Queued.” You can cancel a queued job even before GeoExpress starts to encode it.



You can drag jobs up or down in the **Job Progress** list to change the order in which they are processed. Click and drag the dotted “handle” at the left end of the progress bar.

You can also right-click a job in the queue and choose **Run job next** from the shortcut menu to move the job to the top of the queue.

If a job cannot be completed, it will be displayed in the list as a failed job. You can click the **Start** button at the right end of the failed job’s progress bar to have GeoExpress try again.

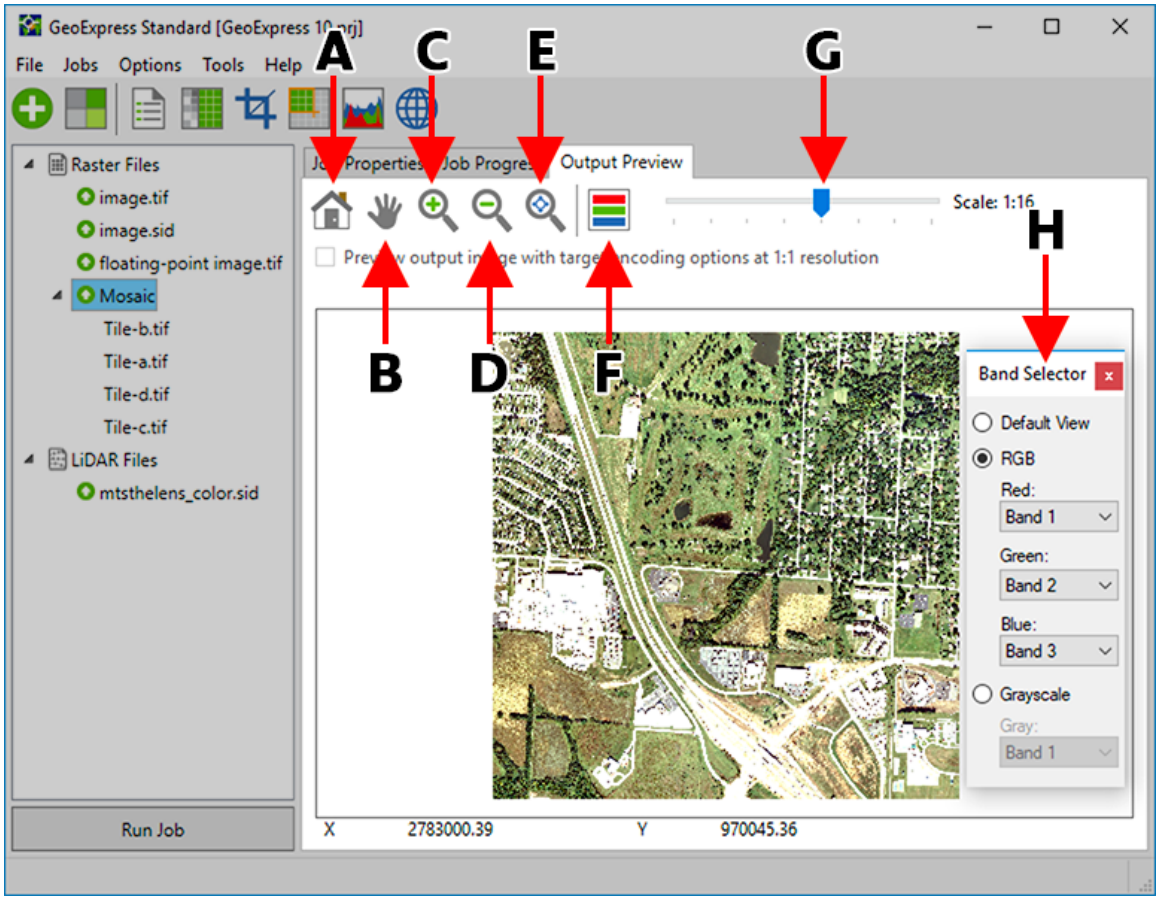
To see the log for a failed job, click it in the **Job List**. The relevant portion of the job log is displayed at the bottom of the **Job Progress** panel; there will usually be enough information to determine why the job failed.

Before you can make corrections to the job, you must cancel it; click the **Cancel** button at the right end of the progress bar, then return to the **Job Properties** panel to make changes to the job.

For more information about log files, see Viewing and using log information on page 116.

Output Preview panel

You can preview raster images and LiDAR point clouds. For raster images, you can preview images to see the expected output of a compression or manipulation operation. To cancel the rendering of a preview image, click on the **Job Properties** or **Job Progress** tab.



A. **Home:** Center and scale the preview to fit the window
B. **Pan:** Click and drag the image within the window
C. **Zoom In:** Click within the image to zoom in on a point
D. **Zoom Out:** Click within the image to zoom out from a point
E. **Smooth Zoom:** Use the mouse wheel (or equivalent) to zoom the image
F. **Band Selector:** Show or hide the **Band Selector** window
G. **Scale:** Drag the slider to scale the preview up or down
H. **Band Selector window:** Determine which bands are shown in the preview

X and Y coordinates for the position of the cursor are given below the image pane.

For more information on how to preview an image or mosaic, see Preview job output on page 27 and Previewing a mosaic on page 102.

Previewing raster images

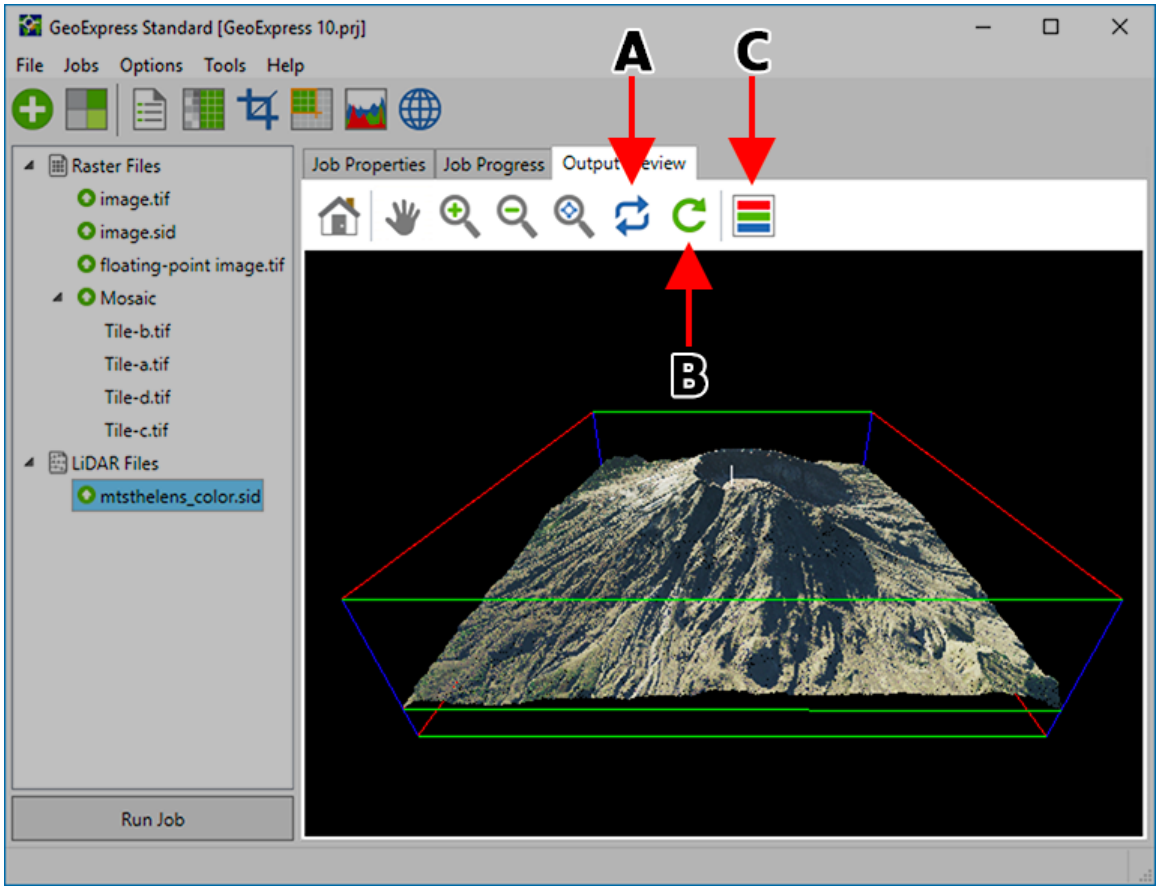
The **Output Preview** panel includes a toolbar to help navigate the preview image.

For raster images, you can move the **Scale** slider to change the scale of the preview image. Setting the scale to 1:1 enables the option to **Preview output image with target encoding options at 1:1**. When you select this option, GeoExpress runs the image compression or manipulation operations on the visible portion of the image.

For multispectral imagery, click the **Band Selector** button to manually select the bands that you want to preview. You can select **Default View**, **RGB**, or **Grayscale**. The **Default View** uses the first three bands of the multispectral image as the RGB bands. To manually select the RGB bands that you want to use, choose **RGB**. Use **Grayscale** to view a single band of the source image as a grayscale image.

NOTE: The **Band Selector** only affects the image preview. To change the RGB bands used in the encoding process, click **Advanced** in the **Job Properties** panel, then select the RGB bands that you want to use in the **Bands** tab of the **Advanced Job Options** window.

Previewing LiDAR point clouds



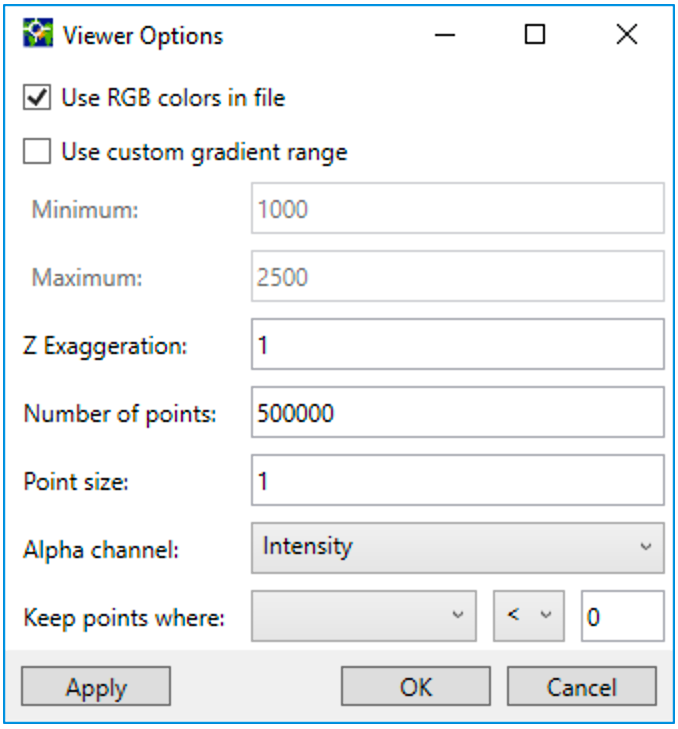
A. **Orbit focal point:** Click and drag within the image to rotate around the point clicked.
B. **Refresh points:** Clears the preview and re-renders your current view
C. **Viewer options:** Open the **Viewer Options** window

LiDAR point clouds are displayed in 3D. Click the **Orbit focal point** button to rotate the image. Click the **Refresh points** button to clear the preview pane and render the points in the current view again. To render your points quickly, GeoExpress draws a representative sample of your points rather than drawing every single point. If you pan or zoom in, you may want to refresh points to draw more points in the area that you are viewing. To increase or decrease the default number of points that GeoExpress draws, see Viewing on page 116.

NOTE: To preview a LiDAR point cloud stored as a text file, ensure that you select the option to **Read the whole file** when the **Text Parsing** dialog appears.

LiDAR Viewer options

Click **Viewer options** to adjust several options that can affect the LiDAR preview. These settings only affect the preview, and not the output file.



- **Use RGB colors in file:** Check this box to display the image preview with RGB color. If the LiDAR file does not include color information, this option will be disabled.
  If **Use RGB colors** is turned off or unavailable, the preview will default to using a gradient ranging from blue for the lowest elevation to red for the highest, based on data points in the file.
- **Use custom gradient range:** Check this box and enter the minimum and maximum elevations to use for the gradient range. All points below the minimum value will be blue, and all points above the maximum will be red.
  Elevation units are defined by the vertical projection; the elevation range in NAVD 88-based projections is expressed in meters.
  Use this option if the default gradient does not display properly. (This can occur if one or more points in the point cloud has an incorrect Z value.)
  You need to uncheck **Use RGB colors** for this option to take effect.
- **Z Exaggeration:** Change this value to exaggerate or de-emphasize the effect of differences in elevation. 1 is the true scale; enter a larger value to stretch the height, or a value between 0 and 1 to flatten the preview's elevation.
- **Number of points:** This is the number of points that GeoExpress will use to preview the image. Lower values will speed up the preview but provide less detail; increase the point count to get better detail (at the expense of rendering speed).
- **Point size:** This is the number of screen pixels used to display a single point in the point cloud. You may want to increase this if you dramatically reduce the **Number of points** used in the preview; using more pixels per point will smooth out a preview that has a low point count.
- **Alpha channel:** Specify the property of the point cloud that will be represented in the Alpha channel of the preview image. (The Alpha channel is rendered as transparency.)

- **Keep points where:** Use this feature to identify a threshold for what points in the point cloud to display. Choose a property from the first pop-up menu (such as **Intensity**), a relationship from the second (such as **!** for NOT), and enter a relevant value in the text field.For example, specify **Z > 1000** to restrict the preview to points whose elevation is over 1000.
- Click **Apply** to apply changes to the preview image and keep the **Viewer Options** window open.
- Click **OK** to apply your changes and close the **Viewer Options** window.
- Click **Cancel** to revert the preview and close the **Viewer Options** window.

Chapter 4: Working with GeoExpress

Typical workflow overview

This is a typical process for most compression and manipulation operations in GeoExpress.

1. Add images, LiDAR point clouds, or mosaics to the **Job List**. Learn more
   The images, point clouds, and mosaics that you want to compress or manipulate in GeoExpress are called jobs.
2. Select the jobs that you want to manipulate or compress.
3. Select an output format. Learn more
4. Select an output destination.
5. Specify compression for the job. Learn more
6. Optionally, for images and mosaics, perform image manipulation operations. For example, you might despeckle or reproject an image. Learn more
7. Optionally, specify additional job options. For example, for raster images, you might change the resolution or create image tiles. Learn more
8. Optionally, preview the image or point cloud before running the job. Learn more
9. Optionally, for raster images, create a test image. Learn more
10. Run the job. Learn more

Adding and removing jobs

Adding a job

Before you can compress or manipulate images and point clouds, you must add them to the **Job List**.

A job can consist of a single image to be manipulated, or a group of images to be merged together as a mosaic.

To add a single image job, you can:

- Drag one or more image files from Windows Explorer into the **Job List**;
- Click **Add Image** on the toolbar and select image files to add as jobs;
- Choose **File > Add image(s)** and select image files;
- Choose **File > Recent files** then select an image file that you worked with recently.

NOTE: If you add a LiDAR text file to the **Job List** you must set text parsing options so that GeoExpress can match the columns in the text file to standard fields. For more information, see LiDAR text parsing options on page 67.

To add a mosaic job, click **Create New Mosaic** on the toolbar or choose **File > New Mosaic**.

NOTE: If you drag multiple image files into the **Job List**, GeoExpress will offer to create a new mosaic from them.

To learn more about mosaics, see Creating a mosaic on page 98.

Working with jobs

Jobs are grouped in the **Job List** by kind: **Raster Files** and **LiDAR Files**. To expand or collapse a group of jobs, click the triangle next to the group icon.

A mosaic job is shown as a sub-group within each group. To see the individual image tiles in a mosaic, click the triangle to the left of the mosaic name.

Select a job in the **Job List** to view information about the job, set job options, or run the job.

To select all the jobs in the **Job List**, right-click anywhere in the **Job List** and choose **Edit > Select All**, or press **Ctrl+A**.

Removing a job

To remove a job from the **Job List**, right-click on the job name and choose **Remove**, or select the job and press the **Delete** key.

When you remove a mosaic job from the **Job List**, you also remove all the tiles associated with the mosaic.

NOTE: You do not need to remove an image or mosaic from the **Job List** to keep it from being encoded. Only the files that you select in the **Job List** are encoded when you click **Run Job**.

Specify the job output

Selecting an output format

When you compress an image or point cloud, the default output format is MrSID Generation 4. You can change the output format in the **Job Properties** tab.

1. Select one or more jobs in the **Job List**.
2. Click the **Job Properties** tab to view job properties.
   If you have selected more than one job, the **Job Properties** panel will show properties common to all the selected images.
3. In the **Output Settings** section of the panel, select the output format for the selected jobs from the **File Type** pop-up menu.

NOTE: Some output formats may not be available depending on certain properties of your input image, such as the data type and number of bands.

Selecting an output destination

By default, the output destination is the same directory where the input image is stored, and the output filename is the same as the input filename.

To change the destination, click **Browse** under **Output Settings**, or type a path in the **Save Output To** field.

If you have only one image selected in the **Job List**, you can also specify a new name for the output file.

For more information about the output destination, see Destination options on page 65 and Selecting an Express Server on page 66.

Specify compression

The images and point clouds that you create with GeoExpress are compressed by default.

You can set compression options for each job in the **Job Properties** panel.

For raster images, you can specify a compression ratio or a target file size, use lossless compression, set per-band compression ratios, or use quantization.

For LiDAR point clouds, you can specify a compression ratio or use lossless compression.

NOTES

- Lossless compression will compress the data as much as possible without changing the image or point cloud. All other compression methods are "lossy" and could result in slight visual artifacts, but usually give a much higher compression ratio.
- Specifying a compression ratio for LiDAR jobs results in points being removed from the point cloud. The number of points removed will be logged and displayed in the **Job Progress** panel.

- To use lossless compression for any type of job, select **Lossless** under **Output Settings**.
- To specify how much you want the output file to be reduced in size, enter a compression ratio. For example, if you have a 100 megabyte uncompressed image and you specify a compression ratio of 20:1, the file size of the output image will be 5 megabytes.
- GeoExpress automatically uses the quantization compression when you compress a floating point image. Learn more.
- You can set other compression options in the **Basic Options** window. Learn more

For more information on setting default compression preferences, see Preferences on page 106.

Perform image manipulations

For raster images and mosaics, you can use the tools in the **Toolbar** to perform the following image manipulation operations:

- Edit metadata for an image. Learn more
- Despeckle an image. Learn more
- Crop an image. Learn more
- Select an Area of Interest. Learn more
- Set color balancing for an image. Learn more
- Reproject an image. Learn more
- Edit the coordinate reference system of LiDAR point clouds. Learn more

Set job options

To set basic job options, click **Basic** under **Output Settings** in the **Job Properties** panel, or choose **Options > Job options**.

The options available depend on whether the job is for a raster file or a LiDAR file and the output format that you select.

For raster images, you can:

- Change the output destination or publish to an Express Server;
- Change the output format and compression options;
- Set dimensions and resolution of the output file;
- Set tiling options for the output file.

You can also access the **Advanced Job Options** window, where you can set a color space, edit transparency values.

For LiDAR point clouds, you can use job options to remove LAS variable length record (VLR) metadata, set column mapping options for text files, and more.

See also:

- Raster job options on page 65
- Advanced job options on page 69
- LiDAR job options on page 67

Preview job output

You can preview a job to see the expected output of a compression or manipulation operation.

When you preview an image, you do not use data from the data cartridge.

1. Select the job in the **Job List**.
2. Click the **Output Preview** tab.
3. Optionally, for raster images, move the slider above the preview image to change the scale of the image or click the **Band Selector** button to manually select the bands that you want to view.

For more information on the **Output Preview** tab and the **Band Selector**, see Output Preview panel on page 19.

Create a test image

A test image is an output image with a visible watermark.

Use a test image to preview the results of an image manipulation or compression operation without using data from the data cartridge.

You can create test images from raster images and mosaics, but not LiDAR point clouds.

1. Select one or more jobs in the **Job List**.
2. Click **Advanced** in the **Job Properties** panel, or choose **Options > Advanced options**. This opens the **Advanced Job Options** dialog.
3. Click the **Job Progress** panel.
4. Select **Encode As Test Image** and click **OK**.
5. Click **Run Job**.

Here is an example of a test image:

Run a job

When you run a job, GeoExpress performs the compression and manipulation operations that you selected.

To run one or more jobs, select jobs and click the **Run Job** button.

NOTE: The **Run Job** button will change depending on what you have selected.

- With one job selected, the button is labeled **Run Job**.
- With multiple jobs selected, the button is labeled **Run # Selected Jobs**, where # is the number of jobs.
- With no jobs selected, the button reads **Run All Jobs**; click it to process all the jobs in the **Job List**.

Job Progress

When you run a job, GeoExpress displays the **Job Progress** panel where you can monitor the progress of the operation. In the **Job Progress** panel you can:

- Pause, resume, or cancel any running job, or all jobs;
- Rearrange jobs in the queue to determine the order jobs will be run;
- Review the log for current jobs.

If you click away from the **Job Progress** tab, GeoExpress continues running the jobs in the background.

For details about monitoring jobs, see Job Progress panel on page 17.

TIP: GeoExpress adds information about each job that you run to the GeoExpress log file. For more information on logs, see Viewing and using log information on page 116.

Other options

Export job settings

Export job settings when you want to save information about a particular job. The job settings are saved to a text file and include the following information:

- GeoExpress version number.
- Job properties from the **Job Properties** panel.
- Job encode settings.

To export job settings, right-click on the name of a job in the **Job List** and choose **Export Job Settings** from the shortcut menu.

Project files

A GeoExpress project file is an XML file that saves each job in the **Job List** and all options that you have applied to each job.

The project file includes the file path of each image, mosaic tile, and LiDAR point cloud in the **Job List**. If you move any files to another directory, you can edit the project file in a text editor.

- **To open an existing project,** choose **File > Open project**.

  NOTE: GeoExpress 10 can only open project files saved from GeoExpress 9.5.3 and newer.

- **To create a new project,** choose **File > New project**.
  When you create a new project, you clear the **Job List**. If there are items in the **Job List** that have not been saved, GeoExpress prompts you to save the jobs in a project file.
- **To save a project,** choose **File > Save project**.
  Saving an edited project overwrites the original.

Chapter 5: Features in Depth

Compression

Compression basics

Compress your images and point clouds to decrease the size of the files. GeoExpress compresses your images and point clouds by default.

When you compress raster images with GeoExpress, you can specify a compression ratio, specify a target file size, use lossless compression, or use quantization for floating point images. If you decide to specify a compression ratio for a raster image, you can specify a separate compression ratio for each band in an image. When you compress LiDAR point clouds with GeoExpress, you can specify a compression ratio or use lossless compression.

If you specify a compression ratio or a target file size, GeoExpress uses lossy compression. When you use lossy compression, you compress an image to a much smaller file size by discarding some image data or removing points from a point cloud.

When you compress a floating point image, GeoExpress uses a lossy compression method called quantization to compress the image.

When you use lossless compression, you compress an image as much as possible without discarding any image data.

Specifying a compression ratio

Set a compression ratio for an image to specify how much smaller you want the output image to be compared to the input image. For example, if you have a 100 megabyte image and you specify a compression ratio of 20:1, the file size of the output image is 5 megabytes.

NOTE: For previously-compressed data, the compression ratio is relative to the number of pixels in the rendered image, **not** the size of the input file. Specifying a 10:1 compression ratio for a file that was already compressed 20:1 will likely yield a much larger file.

1. Select an image in the **Job List**, then click the **Job Properties** tab.
2. Enter the compression ratio that you want to use into the **Ratio** field.

As a rule of thumb, you can compress raster images to a ratio of 20:1 without introducing noticeable compression artifacts. Compression artifacts include blurring and speckling. By default, the compression ratio for RGB images is 20:1 and the compression ratio for grayscale images is 10:1.

For multispectral images and LiDAR point clouds, GeoExpress uses lossless compression by default.

NOTE: Specifying a compression ratio for LiDAR jobs results in points being removed from the point cloud. The number of points removed will be logged and displayed in the **Job Progress** panel.

Using lossless compression

Use lossless compression when you need the compressed file to be identical to the original file. GeoExpress will compress the image or point cloud as much as possible without discarding any data.

You can use lossless compression to create MrSID Generation 4, MrSID Generation 3, JPEG 2000, LAS, LAZ, and BPF images.

Lossless compression typically yields a 2:1 compression ratio which results in a 50% reduction in the output file size.

1. Select an image or point cloud in the **Job List**, then click the **Job Properties** tab.
2. Select the **Lossless** compression option.

> **NOTE:** If you compress an image that has already been compressed, you can select **Lossless** to ensure that GeoExpress does not discard any additional data.

Specifying per-band compression ratios

You can set individual compression ratios for each band in a multispectral image or mosaic. Use per-band compression when you want to compress certain bands in an image more than others. For example, if you want to preserve the visual quality of a multispectral image, you can compress the RGB bands of the image less than the other bands.

> **NOTE:** You can only set per-band compression ratios for MrSID Generation 4 output images.

1. Select an image in the **Job List**, then click the **Job Properties** tab.
2. Make sure the **File Type** is **MrSID Generation 4**.
3. Open the Basic Options dialog.
4. In the **Compression** area of the **Basic Options** dialog, select the **Per-Band** option.
5. Click **Select Bands**.
6. Select one or more bands from the list and enter a compression ratio (or select **Lossless**).
7. Click **Apply to Selected** to set the compression ratio for the selected bands, then click **OK**.

Specifying a target file size

Specify a target file size for a raster image to create an output image whose file size equals the target file size. You can specify a target file size for MrSID Generation 3 and Generation 4 images.

1. Select an image in the **Job List**.
2. Open the Basic Options dialog.
3. Select the **Target File Size** option.
4. Enter the target file size in the text field.
   Choose the units (e.g., KB, MB, GB) from the drop-down menu next to the file size field.

The RGB color transform

For multispectral images, GeoExpress enables the **RGB Color Transform** option by default. With this option enabled, GeoExpress will optimize the compression of the first three bands of the image rather than compressing each band individually.

If the first three bands of the image are not the RGB bands, change the order of the bands before you apply the RGB color transform.

If you select the **Lossless** option, GeoExpress does not optimize the compression ratio of the RGB bands.

By default, GeoExpress matches the color space of the output image to the color space of the input image. When you change the compression method of an image to per-band compression, GeoExpress does not apply the RGB color transform by default.

Using quantization for floating point images

GeoExpress uses quantization to compress a floating point image. You can create 32-bit floating point images in the MrSID Generation 4 format.

Quantization is a lossy compression method that reduces the number of pixel values in the image. Quantization is necessary for floating point images for two reasons:

- Performing arithmetic on floating point values results in rounding discrepancies.
- Compressing floating point values results in unnecessarily large images. This is because some of the digits in each pixel value contain data that is not significant and cannot be compressed.

As a result, GeoExpress uses a lossy compression method for floating point images, but guarantees the accuracy of the image data to an optimized precision value.

To compress a floating point image with the quantization compression method:

1. Select a floating-point image in the **Job List**.
   A floating-point image has the data type **FLOAT32**, displayed in the **Input File** section of the **Job Properties** panel.
2. Open the Basic Options dialog.
3. In the **Format and Compression** section, set **Format** to **MrSID Generation 4**.
   GeoExpress automatically sets the **Compression** option to **Quantization**.
4. Click **Set Quantization** to configure precision and other quantization options.

For more information, see Quantization options on page 79.

Metadata

Viewing metadata

For raster images you can view existing metadata.

1. Select a job in the **Job List**.
2. Click the **Edit Metadata** button in the toolbar.
   The **Metadata Manager** appears.
3. Click the **Viewer** tab.
   The image metadata appears.
4. If an image has geographic markup language (GML) embedded in the metadata, select the **GML** option to view the GML.
5. Click **OK**.

Editing metadata

Use the **Edit Metadata** tool to edit the metadata of images and LiDAR point clouds.

For raster images, you can edit user, image, and NITF metadata. For LiDAR point clouds, you can only edit coordinate reference system metadata.

Raster metadata

NOTE: The types of metadata that you can edit depend on the output format that you select for an image.

1. Select one or more jobs in the **Job List**.
2. Click the **Edit Metadata** button in the toolbar.
   The **Metadata Manager** appears.
3. To edit user metadata, click the **User** tab of the **Metadata Manager**.
   - To add a new tag, click **Add User Tag**, then enter a name and value for the tag.
   - To edit the value of an existing tag, select it from the drop-down and enter another value.

   NOTE: Tag names cannot contain spaces, and tag values cannot be empty. Existing tags can be deleted but cannot be renamed.
4. To edit image metadata, click the **Image** tab of the **Metadata Manager**.
   - To specify the image's coordinate reference system, click **Select a Coordinate Reference System** or enter a custom well known text (WKT) string in the **WKT** text field. Learn more
   - Edit the image origin, image resolution, and dynamic range.

   NOTE: Selecting a coordinate reference system in the **Metadata Manager** does not reproject the image.
5. To edit NITF metadata, click the **NITF Options** tab of the **Metadata Manager**.
   - Edit the file header and file security fields in the **File Header** subtab. Learn more
   - Edit the image subheader, image comments, and image security fields in the **Image Subheader** subtab.
6. Click **OK**.

NOTE: Some existing JPEG 2000 images are encoded in such a way that certain decoders may fail to display them if you edit their metadata. To accommodate these images, GeoExpress handles several JPEG 2000 parameters in a special way. If you are editing the metadata of existing images and wish to change parameters for tile length markers, packet length markers, or tile parts, you must change them on the JPEG 2000 tab of the **Preferences** dialog. (For more information see JPEG 2000 preferences on page 113 and Advanced JPEG 2000 options on page 88.)

LiDAR metadata

For LiDAR point clouds, you can edit the coordinate reference system (CRS) stored in the file metadata.

1. Select one or more jobs in the **Job List**.
2. Click the **Edit Metadata** button in the toolbar.
   This opens the **Set Projection** dialog.
3. Use the **Projection Source** pop-up menu to choose a list of standard projections.
4. Choose a projection, then click **Set Projection**. Learn more

Image metadata

LizardTech image metadata is information about the pixel values that tells viewing software how to interpret or treat each pixel. There are many image metadata tags, and a small subset of these are available for editing.

Editing the image tags does not affect the pixel values themselves. For example, changing WKT metadata does not reproject an image from one CRS to another. However, changing metadata may affect how an image is **displayed** in a viewer.

Coordinate reference system and WKT

You can assign a WKT to the image that identifies its coordinate reference system. This is useful when you know the CRS of an image but that data isn't captured anywhere in the file. It's also useful if the WKT is incorrect and you need to correct it.

IMPORTANT: Setting the WKT in the metadata of an image does NOT reproject the image. It only identifies where the image already is. To reproject an image to a new CRS, use the reprojection tools. Additionally, carelessly changing the WKT of an image may make the image inaccurate or unusable in any GIS applications that rely on this information.

Image Origin

These X and Y fields can be used to set the *x*, *y* location of the image.

Image Resolution

These X and Y fields can be used to set the *x* and *y* resolutions of the image.

Dynamic Range

To improve the appearance of MrSID images in other GIS programs, you can use GeoExpress to write dynamic range metadata for images.

NOTE: If you select MrSID Generation 4 as the image output format, dynamic range values are calculated automatically for all images except for 8-bit images. If you want to enter the dynamic range values manually for those images, change the method for generating the dynamic range to **None** in the **Format-Specific** tab of the **Advanced Job Options** dialog. For more information on calculating the dynamic range, see Dynamic Range Metadata Generation on page 83.

The dynamic range metadata is particularly useful for images that only use a small portion of their datatype bandwidth.

For example, 11-bit images are often stored as 16-bit images, where the upper five bits are left empty. The only bits that are meaningful are the first eleven. The full dynamic range of pixel values in an unsigned 16-bit image runs from 0 to 65535. The first eleven bits fall between 0 and 2047, which is only 3% of the full range! When you look at the histogram of this image (for information on histograms see The Color Balance tool on page 58), all of the values will be gathered into the far left side, causing the image to appear black when it's scaled to display on a computer monitor. For an 11-bit image, the minimum value would be 0 and the maximum value would be 2047 ($2^{11} - 1$).

An alternate way to think of dynamic range is "window and level." The window is the width of data that's important and the level is where the midpoint of the window lies within the entire range. For our 11-bit image, the window, or width, is 2048 (2^{11}), and the level, or midpoint, is 1023.5 (($2^{11} - 1$) / 2). The window and level are displayed next to the **Min** and **Max** fields to aid you in setting the dynamic range.

To set the dynamic range of the image, type the minimum pixel value in the **Min** field and the maximum pixel value in the **Max** field.

IMPORTANT: Setting the dynamic range does not change the pixel data of the image. It only gives clues as to how the image should be displayed. Some applications may honor this value and some may ignore it, depending on how the pixels need to be represented for a given workflow. Additionally, setting the dynamic range is not the same as color balancing. Color balancing changes the actual pixel values, which changes the nature of the image. (For more information see Performing color balancing for a mosaic on page 101.)

Viewable image metadata

In addition to the image metadata that you can edit, GeoExpress embeds encoded MrSID and JPEG 2000 images with a header to preserve metadata from source images. This header is able to carry information on image location, projection, date produced, and RGB color lookup tables (CLUT) for indexed color images. Each tag is accompanied by a short description of the method used to write out the data, either ASCII, signed or unsigned 8-bit, signed or unsigned 16- or 32-bit integers, or single or double-precision floating point.

Certain input image types such as NITF, GeoTIFF, ERDAS IMAGINE and USGS DOQ may have additional metadata tags. Such tags are carried over from the source image as-is to the output file in addition to the standard LizardTech metadata tags. If the image being encoded is a mosaic, GeoExpress preserves the metadata values from the first image in the mosaic. If no information is available for a specific tag, the tag is left out of the header. Some tags apply to any MrSID or JPEG 2000 image, with or without georeferencing information; other tags apply specifically to georeferenced images.

NOTE: When encoding GeoTIFF imagery, all the native GeoTIFF metadata tags are prepended with the string `GEOTIFF_CHAR::`.

In addition there are special tags that contain statistical information about the pixel intensities in an encoded image. These tags contain the minimum, maximum, mean, and standard deviation of the pixel values in the image. For a grayscale image, single values are output. For an RGB image, values are output in an array where the first value represents the red band, the second band represents the green band, and the third band represents the blue band.

The `mrsidgeoinfo` command line tool can display metadata tags. It is included in the GeoExpress installation.

General tags

The tags written into MrSID and JPEG 2000 metadata are listed in the following table. If an image or mosaic is cropped while being encoded, the values apply to the cropped output image unless noted otherwise. There is no predetermined order for the tags.

TAG	DESCRIPTION	NOTES
IMAGE::BITS_PER_SAMPLE	Number of bits per sample (unit16)	
IMAGE::COLOR_SCHEME	Color space of the image (unit32)	Possible values: 0 for RGB, 2 for CMYK, 3 for grayscale, or 10 for multispectral
IMAGE::DATA_TYPE	Datatype of samples in image (unit32)	Possible values: 0 for unsigned 8-bit int, 1 for 32-bit float, or 2 for unsigned 16-bit int
IMAGE::DEFAULT_DATA_VALUE	Sample values for background pixel	Stored as an array of values, one for each band, in order. The values are stored in the datatype of the samples. **Note:** With older images containing unit8 data, the tag IMAGE::NO_DATA_VALUE may be used
IMAGE::DYNAMIC_RANGE_ WINDOW	Custom contrast setting (double)	Represents the size of the range of the data
IMAGE::DYNAMIC_RANGE_ LEVEL	Custom brightness setting (double)	represents the midpoint of the range of the data
IMAGE::EOM	End of metadata	
IMAGE::HEIGHT	Height of the image in pixels (unit32)	
IMAGE::INPUT_FILE_SIZE	Size of the input image or mosaic, in bytes (double)	
IMAGE::INPUT_FORMAT	Name of the input image type (string)	
IMAGE::INPUT_LUT	Color lookup table	Stored as an array of 758 values (3 × 256), one value for each band (R, G, B) for each of the 256 entries in the table.
IMAGE::INPUT_NAME	Filename of the input image (string)	
IMAGE::NO_DATA_VALUE	Sample values for background pixel	Used only for older MrSID images; see IMAGE::DEFAULT_DATA_VALUE.
IMAGE::SOM	Start of metadata	
IMAGE::TRANSPARENT_DATA_ VALUE	sample values for the nodata pixel	Stored as an array of values, one for each band, in order. Values are stored in the datatype of the samples.
IMAGE::WIDTH	Width of the image, in pixels (unit32)	
IMAGE::X_RESOLUTION	Georeferencing pixel resolution in the *x*-direction (double)	

TAG	DESCRIPTION	NOTES
IMAGE::XY_ORIGIN	Georeferencing location (*x*, *y*) for the center of the top left pixel.	Stored as an array of two doubles.
IMAGE::Y_RESOLUTION	Georeferencing pixel resolution in the *y*-direction (double)	

Area of Interest (AOI) tags

The tags in the table below apply only to images encoded with an Area of Interest.

TAG	DESCRIPTION	NOTES
IMAGE::AOI::N::REGION::VECTOROVERLAY	Name of the vector overlay file, if any (string)	
IMAGE::AOI::N::REGION::VECTOROVERLAY_LAYER	Layer number from the vector overlay file, if one is used (integer)	
IMAGE::AOI::N::REGION::X	Upper left *x* position of the region (integer)	
IMAGE::AOI::N::REGION::Y	Upper left *y* position of the region (integer)	
IMAGE::AOI::N::METHOD	The Area of Interest method used (string)	Possible values: `shift inner`, `shift outer`, or `weight`.
IMAGE::AOI::N::WEIGHT	Weight value used (double)	
IMAGE::AOI::N::MAGNIFICATION	Magnification at which the AOI was applied (double)	
IMAGE::AOI::N::NAME	Optional name of the AOI region (string)	
IMAGE::AOI::N::COMMENT	Optional comment for the AOI region (string)	
IMAGE::AOI::N::URL	Optional URL referring to the AOI region (string)	

MG2-spaceific tags

The tags in the table below apply to MG2 images only:

TAG	DESCRIPTION	NOTES
IMAGE::COMPRESSION_BLOCK_SIZE	Block size used in MrSID encoding (unit32)	
IMAGE::COMPRESSION_GAMMA	G-weight value used in MrSID encoding (float)	
IMAGE::COMPRESSION_VERSION	Version of the encoder used (array of 3 sint32 values)	
IMAGE::COMPRESSION_WEIGHT	Weight value used in MrSID encoding (float)	
IMAGE::CREATION_DATE	Date and time of image encoding (string)	
IMAGE::COMPRESSION_NLEV	Number of zoom (resolution) levels in the image (unit32)	
IMAGE::STATISTICS:MAXIMUM	Maximum sample values for each band in the input image (array of values)	The number and datatype of the values correspond to the number of bands and sample type of the image.
IMAGE::STATISTICS:MINIMUM	Minimum sample values for each band in the input image (array of values)	The number and datatype of the values correspond to the number of bands and sample type of the image.
IMAGE::STATISTICS:MEAN	Average value of all samples for each band (array of doubles)	
IMAGE::STATISTICS:STANDARD_DEVIATION	Standard deviation of all samples for each band	
IMAGE::TARGET_COMPRESSION_RATIO	compression ratio used for encoding (float)	For MrSID Generation 2 (MG2), this value only approximates the actual compression ratio achieved.

MG4-specific tags

The tags in the table below apply to MG4 images only:

TAG	DESCRIPTION	NOTES
IMAGE::QUANTIZATION_SCALE	Precision values used for quantization	For floating point images, GeoExpress uses the quantization compression method. For more information on the precision value, see Quantization precision on page 80.

Other metadata tags

When using GeoTIFF input images, the GeoTIFF metadata tags are copied directly into the MrSID or JPEG 2000 file. When using ERDAS IMAGINE and USGS DOQ metadata, certain other custom metadata tags are inserted as well.

NITF metadata

You can edit the following metadata for images with the NITF output format:

- File header
- File security fields
- Image subheader
- Image security fields
- Image comments

For more information on NITF metadata, see the NITF 2.1 specification at http://www.gwg.nga.mil/ntb/baseline/docs/2500c/2500C.pdf.

Viewable NITF Metadata

In addition to the NITF metadata that you can edit, GeoExpress embeds metadata from NITF input files to preserve the source metadata. When reading a NITF file, GeoExpress stores many NITF fields as metadata, for example as tag/value pairs in MrSID imagery.

NOTE: The following discussion assumes familiarity with the NITF specification.

In general, the tag name is of the form
`NITF::xxnnn::field`
where `xx` is a two letter code representing the NITF segment (IM for image, FH for file header) and `nnn` is the NITF segment number. TRE fields contain the prefix `TRE_`. Specifically, GeoExpress stores input fields in metadata tags as described in the following tables.

File Header Fields

GeoExpress stores file header fields in the following tags:

NITF FIELD	GEOEXPRESS TAG
FHDR	NITF::FH000::FHDR
FVER	NITF::FH000::FVER
STYPE	NITF::FH000::STYPE
OSTAID	NITF::FH000::OSTAID
FDT	NITF::FH000::FDT
FTITLE	NITF::FH000::FTITLE
ONAME	NITF::FH000::ONAME
OPHONE	NITF::FH000::OPHONE
NUMI	NITF::FH000::NUMI
NUMS	NITF::FH000::NUMS
NUML	NITF::FH000::NUML
NUMT	NITF::FH000::NUMT
NUMDES	NITF::FH000::NUMDES
NUMRES	NITF::FH000::NUMRES

Using GeoExpress, you can set the values for OSTAID, FDT, FTITLE, ONAME, and OPHONE when encoding NITF images.

Security-Related Fields

GeoExpress stores security-related fields from the file header (unless they are blanks) in the following tags:

NITF FIELD	GEOEXPRESS TAG
SCLAS	NITF::FH000::SCLAS
SCLSY	NITF::FH000::SCLSY
SCODE	NITF::FH000::SCODE
SCTLH	NITF::FH000::SCTLH
SREL	NITF::FH000::SREL
SDCTP	NITF::FH000::SDCTP
SDCDT	NITF::FH000::SDCDT
SDCXM	NITF::FH000::SDCXM
SDG	NITF::FH000::SDG
SDGDT	NITF::FH000::SDGDT
SCLTX	NITF::FH000::SCLTX
SCATP	NITF::FH000::SCATP
SCAUT	NITF::FH000::SCAUT
SCRSN	NITF::FH000::SCRSN
SSRDT	NITF::FH000::SSRDT
SCTLN	NITF::FH000::SCTLN

GeoExpress allows you to specify values for any of these fields.

Image Segment Fields

GeoExpress stores image segment fields in the following tags:

NITF FIELD	GEOEXPRESS TAG
IID1	NITF::IM001::IID1
IDATIM	NITF::IM001::IDATIM
TGTID	NITF::IM001::TGTID
IID2	NITF::IM001::IID2
ISORCE	NITF::IM001::ISORCE
ICORDS	NITF::IM001::ICORDS
IGEOLO	NITF::IM001::IGEOLO
NICOM	NITF::IM001::NICOM
ICOM1	NITF::IM001::ICOM1
ICOM2	NITF::IM001::ICOM2
ICOM3	NITF::IM001::ICOM3
ICOM4	NITF::IM001::ICOM4
ICOM5	NITF::IM001::ICOM5
ICOM6	NITF::IM001::ICOM6
ICOM7	NITF::IM001::ICOM7
ICOM8	NITF::IM001::ICOM8
ICOM9	NITF::IM001::ICOM9

With GeoExpress, you can enter custom data for these image segment fields: `IID1`, `IDATIM`, `TGTID`, `IID2`, `ISORCE`, `NICOM`, `ICOM1 through ICOM9`.

Additional Notes

In addition, GeoExpress does the following:

- Handles the security fields in the Image Segment as they are handled in the file header;
- Stores all detected TREs in metadata as binary data. For example, USE00A data would be stored as an array of bytes using the tag `NITF::IM001::TRE_USE00A`;
- Explicitly recognizes the following TREs when reading in a NITF file:
  `J2KLRA`, `USE00A`, `STDIDC`, `PIAIMC`, and `RPC00A/B`.
  For these TREs, additional metadata entries are created corresponding to each of their constituent fields. For example, PIAIMC data is represented as follows:

```
NITF::IM001::TRE_PIAIMC_CLOUDCVR
NITF::IM001::TRE_PIAIMC_SRP
NITF::IM001::TRE_PIAIMC_SENSMODE
NITF::IM001::TRE_PIAIMC_SENSNAME
…
```

User metadata

LizardTech user metadata is merely descriptive and has nothing to do with the image pixel data. There are 12 default user metadata tags. They can be thought of as addenda or footnotes and include such data as geographic location, company name, and scan info. You can include data for any or all or none of the tags, and you can add your own custom user metadata tags for other information you would like to include. All of LizardTech's user metadata tags can be edited.

Metadata templates

To assist in editing the user metadata of multiple images, the **Metadata Manager** allows metadata templates to be saved and applied to one or more images. A metadata template contains all of the tags and values that you wish to apply to a given image or images.

Metadata templates are created, edited, saved, retrieved and applied in the **Metadata Template Editor**.

Accessing the Metadata Template Editor

1. Select one or more jobs in the **Job List**.
2. Choose **Tools > Metadata**.
   This opens the **Metadata Manager** dialog.
3. Click **Metadata Templates** to open the **Metadata Template Editor**.

Select or deselect a value or set of values to enable or disable a given tag.

The image tags are the same as those in the **Metadata Manager** except that you can choose to save any or all of these in the template.

Creating a tag in the Template Editor

1. Click in the **Name** field of the row that starts with an asterisk (*).
2. Type a name for the tag.
3. Click the **Value** field and enter a value.

Tag names cannot contain spaces and tag values cannot be empty.

Deleting a tag in the Template Editor

1. Select the entire tag by clicking the gray cell at the far left of the row.
2. Press the **Delete** key.

Saving a template

1. Click the **Save Template** button.
2. Enter a name for the template and click **OK**.

Loading a template

1. Click the **Load Template** button.
2. Choose a template from the drop-down list and click **OK**.

Deleting a template

1. Choose the template in the **Load Metadata Template** or **Save Metadata Template** dialog.
2. Right-click the template name and choose **Delete this template**.

Applying a template

1. Create a template or load a template in the **Metadata Template Editor**.
2. Click **Apply Template**.

Despeckling

If you need to make images with higher compression ratios, use the **Despeckle** tool to minimize compression artifacts.

A side effect of lossy encoding schemes is that subtle compression artifacts are introduced which alter the pixel values of the source image. While these changes are usually invisible to the human eye, they can damage the integrity of any collar regions in the image, which makes it difficult to seamlessly mosaic images together. The best way to avoid this "speckling" in the collar areas is to compress to MrSID Generation 4 (MG4), or to losslessly encode source images to MrSID Generation 3 or JPEG 2000.

IMPORTANT: Despeckling is a computationally expensive operation that increases the time it takes to encode an image. Also, despeckled JPEG 2000 files employ an alpha band to mask the transparent region; most, but not all, applications can view JPEG 2000 files with alpha bands.

Despeckling is only supported for MG3, MG4, and JPEG 2000 output. If you select JPEG 2000 as the format of your despeckled output, that output will be a GMLJP2 file and thus a JPEG 2000 Part II file, even if your input was a JPEG 2000 Part I file. Source images with alpha bands cannot be despeckled when outputting to JPEG 2000. Also, the area of valid image data must be contained within a single polygon (for example, an image of a series of islands cannot be despeckled).

By default, images are not despeckled upon encoding. Further, despeckling is not recommended for images without a collar. To despeckle images by default for the MrSID or JPEG 2000 formats, set the despeckling option in the preferences. For more information on preferences, see Preferences on page 106.

NOTE: Some existing JPEG 2000 images are encoded in such a way that certain decoders may fail to display them when despeckled with GeoExpress' default settings. To accommodate these images, GeoExpress handles several JPEG 2000 parameters in a special way. If you are despeckling images using the **Despeckling** dialog and wish to change parameters for tile length markers, packet length markers, or tile parts, you must change them on the **JPEG 2000** tab of the **Preferences** dialog. (For more information see JPEG 2000 preferences on page 113 and Advanced JPEG 2000 options on page 88.)

Despeckling an image

When you select a single job for despeckling, the image is displayed in the preview area of the dialog. If you select multiple jobs, the preview pane and navigation buttons are not displayed. You can despeckle images with the MrSID Generation 4, MrSID Generation 3, or JPEG 2000 output format.

1. Add a source image or mosaic to the **Job List**.
2. Click the **Despeckle** button on the toolbar.
   This opens the **Despeckle Options** dialog.
3. Select **Despeckle Output**.
4. Optionally, enter threshold and point spacing values by typing them in the edit fields or using the slider controls (see below for information about these values). **Note:** The sliders only move within the recommended range (1-127 for threshold and 6-12 for point spacing), but you may enter any integer greater than zero in the fields.
5. To preview the effects of the threshold at different settings select the **View Threshold** option and then move the **Threshold** slider. Black areas are pixels whose values fall below the threshold and will be used to determine the despeckling collar of the image.
6. Click **OK**.

Despeckling threshold

All pixel values below the despeckling threshold will be used in the despeckling process. For example, with a threshold value of 10, GeoExpress treats any border pixels with a value less than 10 as no-data pixels.

By default, the threshold value is 8.

Point spacing

In order to despeckle an image, GeoExpress must determine the mask or "outline" of the valid image data. This outline is created as a polygon of connected points, similar to a "connect the dots" drawing. Image data that fall outside the outline are treated as invalid and subject to despeckling.

Whether image pixels are incorporated into the mask or abandoned as "islands" of data is largely a function of the point spacing value, which determines the distance between the points that make up the outline. The less distance there is between points in the outline, the more points it takes to create the entire outline.

Therefore, decreasing the point spacing value raises the number of points, which is generally desirable and is particularly useful when the outline is complex, such as that of a coastline. However, higher numbers of points may slow performance or cause the job to fail. Conversely, increasing the point spacing value reduces the total number of points, which makes for better performance. When the outline is simple, such as a rectangle, the point spacing value can safely be increased.

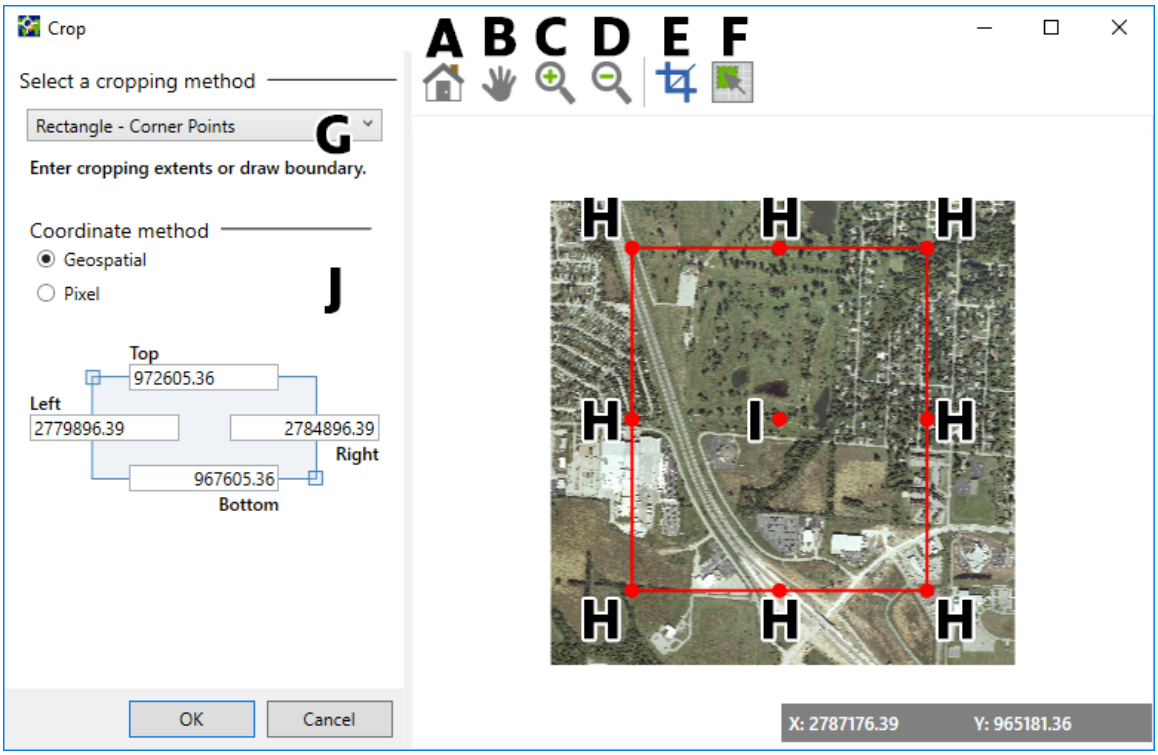
For any given dataset, some trial and adjustment may be required to arrive at the best balance between a more accurate mask (lower point spacing value) and better encode performance (higher point spacing value).

Generally, even values between 6 and 12 work best. By default, the point spacing value is 6.

Cropping an image

Use the **Image Crop** tool to crop a region from any image in the **Job List**.

You can crop a raster image, a LiDAR point cloud, or a mosaic.



NOTE: When you open the **Crop** window, the image will start to preview automatically. If the preview is taking too long, you can cancel the preview and proceed to enter cropping coordinates manually. To restart the preview, close and re-open the **Crop** window.

A. **Home:** Center and scale the preview to fit the window
B. **Pan:** Click and drag the image within the window
C. **Zoom In:** Click within the image to zoom in on a point
D. **Zoom Out:** Click within the image to zoom out from a point
E. **Crop:** Drag a new crop region on the preview image
F. **Select features:** Click polygons to include in the output image when cropping using a vector file
G. **Crop method:** Choose a cropping method from the pop-up menu
H. **Resize handles:** Drag an edge handle in or out to size the crop area
I. **Move handle:** Drag the center area to reposition the crop area
J. **Crop edit:** Depending on the cropping method, you can edit specifics about the crop in this space

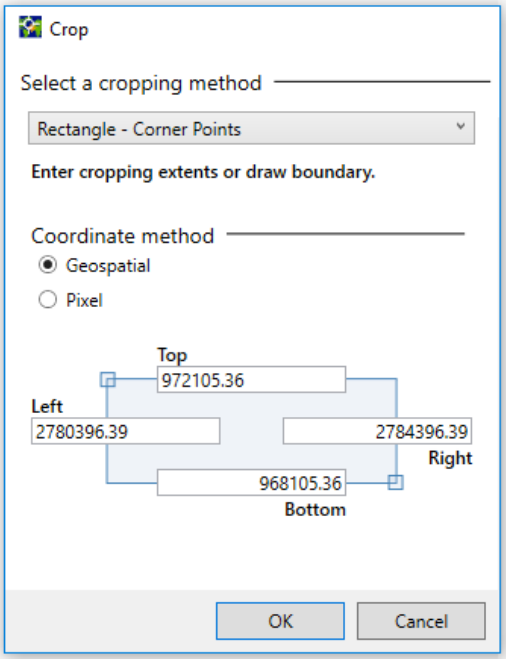
Cropping method

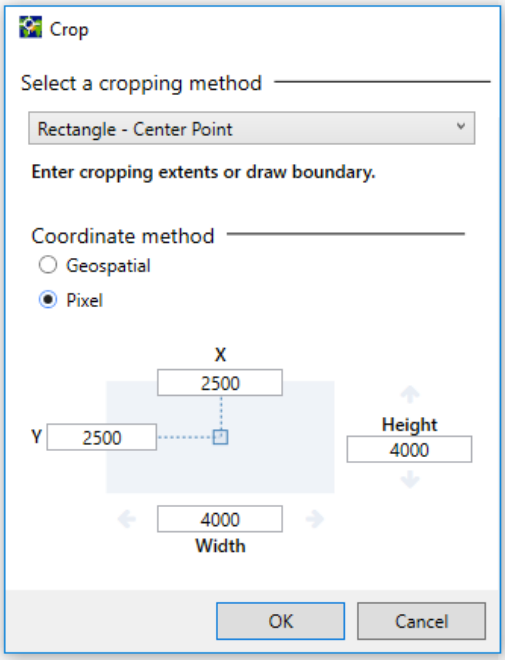
There are three ways to crop an image:

- Rectangle - Corner Points
- Rectangle - Center Point
- Vector file (only available for raster images)

Rectangular cropping

For cropping by rectangle, you can use the **Crop** tool to drag a rectangle on the preview image, then resize the crop, or you can enter precise coordinates for cropping.





For **Corner Point** cropping, you specify the coordinates of the top left and bottom right corners of the cropping rectangle.

For **Center Point** cropping, you specify the horizontal and vertical (X and Y) coordinates of the center of the cropping rectangle, and its height and width.

For raster images, you can enter geospatial or pixel coordinates. LiDAR images have no pixel data, so you can only crop using geospatial coordinates.

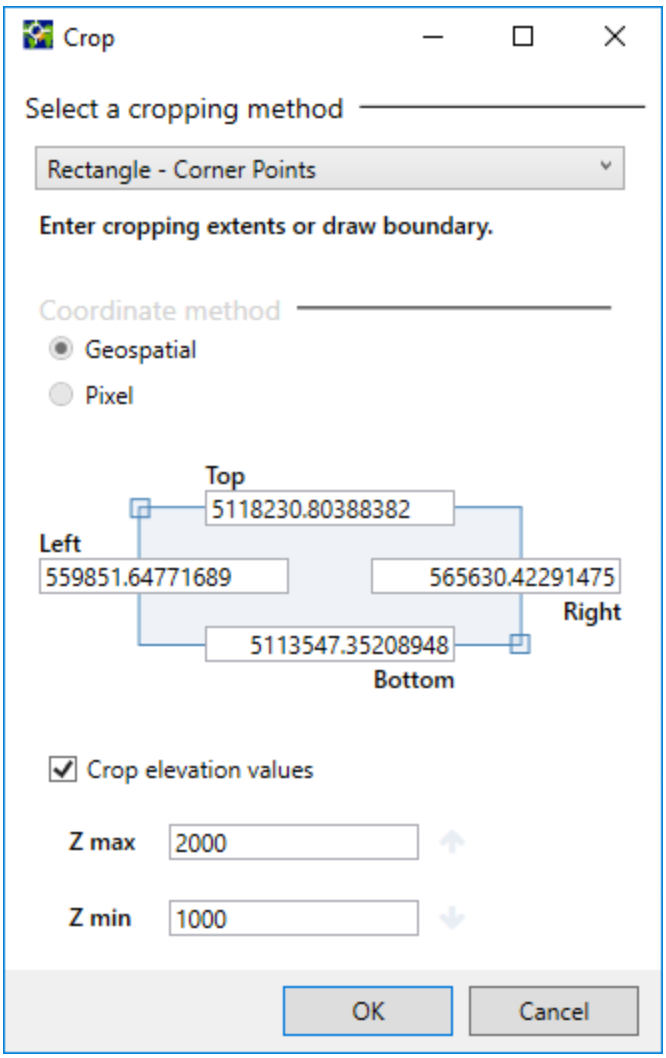
LiDAR cropping

When you crop a LiDAR point cloud, you also have the option to crop elevation values.

This can be useful if trying to remove unwanted imagery (birds, for example), or if you are trying to extract only points within a certain elevation range.

Check the box labeled **Crop elevation values**, then set the elevation range (**Z min** and **Z max**) for the output image.

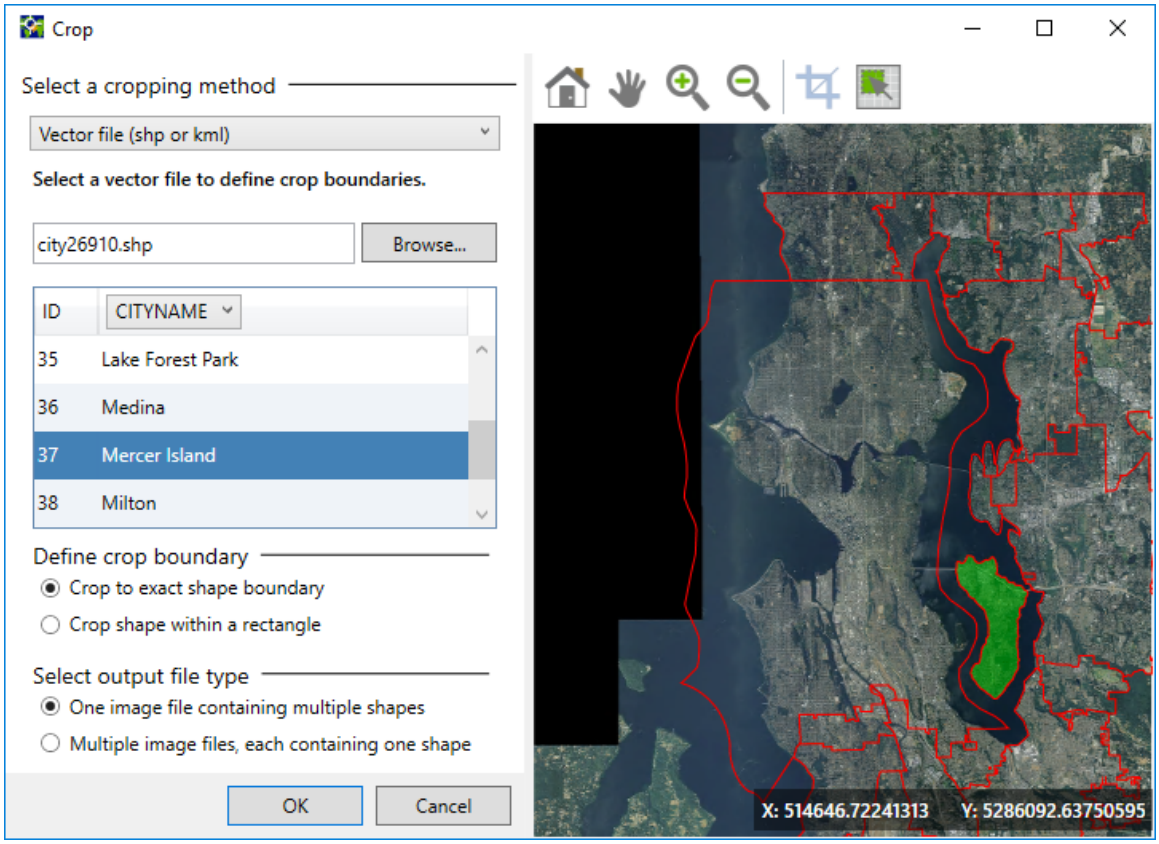
Although the range selection is not shown in the preview image in the **Crop** dialog, it will be reflected in the **Output Preview** panel.



Vector file cropping

For raster images where you also have access to a vector file describing one or more regions of the image, you can use this file for cropping to include only specific regions.

NOTE: Cropping by vector file is not supported when the output format is JPEG 2000 and the input image has multiple bands.



Click Browse to select a vector file (`.shp` or `.kml`) to load.

The list at the left of the **Crop** window shows shape regions within the vector file; the header of the second column includes a pop-up menu where you can select information from the vector file to display.

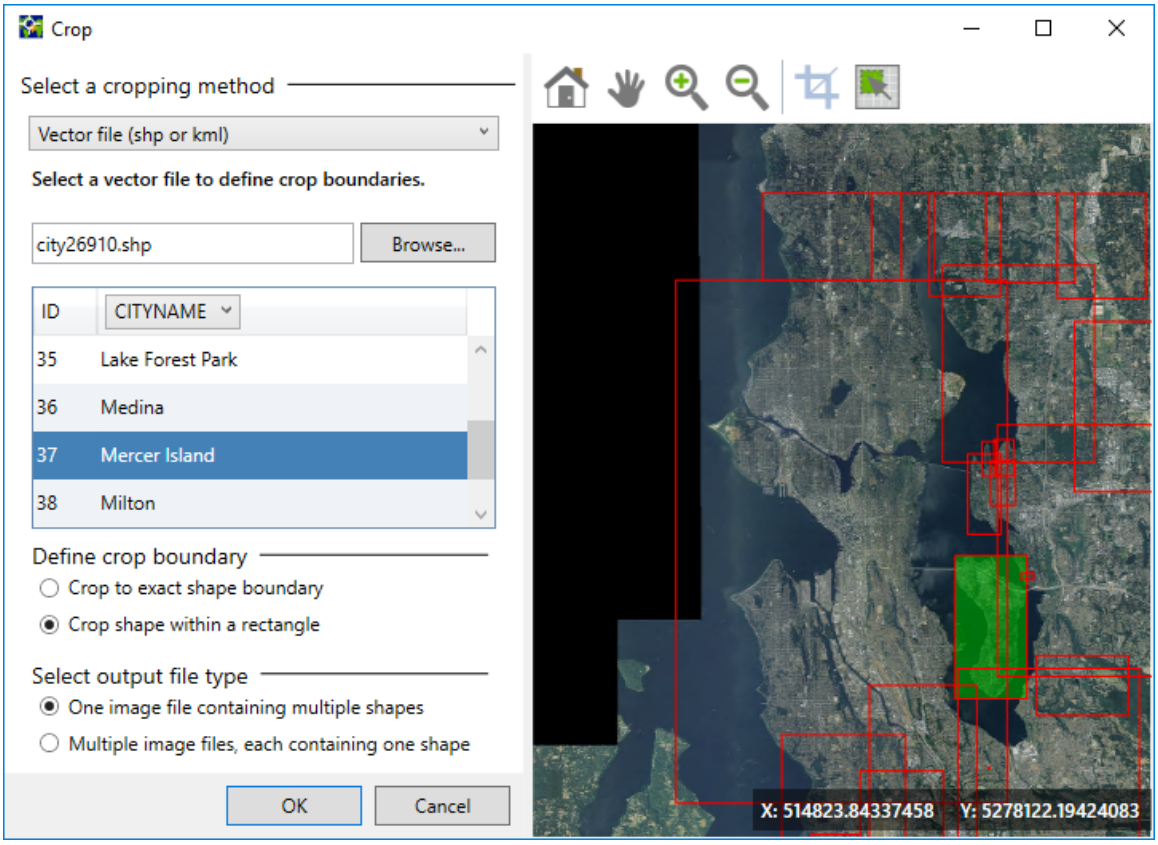
The preview shows the defined shapes outlined in red; selected regions are filled with green.

Select one or more regions in the list, or click the **Select feature**s tool and select multiple regions within the preview image.

(To select more than one region in the list or in the preview, hold down the **Ctrl** key while you select areas. You can also click and drag within the preview image to select all regions within an area.)

Crop output options

You can specify whether the cropped output file includes only data within the selected shape regions, or includes all data within the rectangle that encompasses all selected shape regions.



If you select multiple shape regions, you can also choose whether the output is comprised of one file with all selected regions, or multiple files, each containing the cropped content from one shape region.

If you choose the multiple image option, images are saved using the naming convention `<output file name>_<column label>_<polygon ID>`.

For example, if you select KingCounty as the output file name, and the shapefile polygons have a column for CityName, one of the output files would have the name `KingCounty_MercerIsland_37.sid`.

NOTE: If you crop existing MrSID and JPEG 2000 images but do not compress the images again, you do not use data from the data cartridge.

Area of Interest

What is an Area of Interest?

The Area of Interest (AOI) encoding feature enables image customization through the preservation or obscuring of detail. AOI enables you to define one or more areas within an image or mosaic and encode these areas at a higher or lower compression ratio than the remainder of the image. Using AOI thus creates a visual contrast between the area(s) of interest and the surrounding image, rendering either “sharper” (lower compression) areas or “blurred” (higher compression) areas. In the image below we’ve drawn a rectangle around an area that has been defined as an Area of Interest and compressed at a lower ratio than the rest of the image. Note that more detail is preserved within that area.

GeoExpress offers three methods of encoding an Area of Interest: the weight, shift and mask methods. GeoExpress enables you to encode an Area of Interest in MG3, MG4, or JPEG 2000 format. When the output format selected is JPEG 2000, any method can be used. MrSID encoding requires the weight or mask method.

For more information about using these methods, see MG3 and MG4 Area of Interest encoding on page 55 and JPEG 2000 Area of Interest encoding on page 55.

Although Area of Interest is a simple concept, there are many factors that come into play when generating both the preview and the final encoded image in an Area of Interest operation. Some of these factors are:

- the relative size of the selected area in relation to the entire image
- the difference between the two compression ratios applied (inside and outside the selected area)
- the presence or addition of a crop operation in conjunction with an Area of Interest encode
- the desired output format (MG3, MG4, or JPEG 2000)
- the complexity of the imagery being manipulated

Some of the effects that a user may experience as a result of these factors are:

- slight bleeding of the AOI resolution into the surrounding image
- “outside” area seems less compressed than expected given the specified compression ratios
- Area of Interest specified as lossless is not always numerically lossless for some encode scenarios (this variation is greater in JPEG 2000 encoding than in MrSID encoding).

Defining an Area of Interest

You may define an Area of Interest in GeoExpress by vector overlay or by drawing a single rectangle. GeoExpress allows you to define an Area of Interest in MG3, MG4, and JPEG 2000 encoding.

Vector overlay support enables you to include multiple Areas of Interest within a single image.

1. Select a job in the **Job List**
2. Click the **Area of Interest** button on the toolbar.
   This opens the **Area of Interest** dialog.
3. To view the image while setting Area of Interest parameters, click the **Show Image** button.

Drawing a single rectangular Area of Interest

A single rectangle can be used to express an Area of Interest either as the foreground or background (see Inner and Outer Areas on the facing page).

You can define a single rectangle either by entering values for offsets or by drawing a rectangle across the image with the **Draw Area** tool.

> **NOTE:** The **Draw Area** tool will only be available if you display the image preview.

To enter numerical values to define a single rectangular Area of Interest:

1. Access the **Area of Interest** dialog as described above.
2. Select the **User Defined Rectangle** option.
3. Enter values for the **Top**, **Right**, **Bottom**, and **Left** offsets.
4. Select other desired parameters and click **OK**.

To use the **Draw Area** tool to define a single rectangular Area of Interest:

1. Access the **Area of Interest** dialog as described above and click **Show Image**.
2. Select the **User Defined Rectangle** option.
3. Click the **Draw Area** icon above the image window.
4. Click and drag on the image to define a rectangle.
5. Adjust the shape and size of the rectangle by clicking and dragging the “handles” at the sides and corners; adjust its position using the middle handle. Offset or other positioning values are automatically filled in.
6. Select other desired parameters and click **OK**.

Using vector overlays to define Areas of Interest

GeoExpress supports vector overlays of Esri Shapefile (`*.shp`), MapInfo TAB (`*.tab`), and GML version 2 (`*.gml`) formats. Vector overlays must be in the same coordinate system as the input image file and must contain closed polygons in order to be valid. GeoExpress uses all valid shapes within the active layer as the combined Area of Interest; individual shapes within the active layer cannot be turned on or off.

> **NOTE:** The use of GML-formatted vector overlays can result in the creation of files with a `.gfs` extension in the directory on your computer where the GML files are stored. These are not used again and may be ignored or deleted.

Area of interest options set by the user apply to all shapes in the active layer.

Vector overlays are not editable within GeoExpress.

To use a vector overlay to define an Area of Interest:

1. Access the **Area of Interest** dialog as described above.
2. Select **Vector Overlay File**.
   A panel of vector overlay options appears in the middle of the dialog.
3. Enter a file path in the **Vector Overlay File** field or click **Browse**.
4. Select an active layer from the drop-down list if necessary. GeoExpress supports only a single layer of a given vector overlay. By default the first layer is selected.
5. Select any other desired parameters and click **OK**.

To remove a currently listed vector overlay, click **Remove Vector Overlay File**.

If you use a vector overlay to define an Area of Interest and select the **Show Image** option, the shapes will be drawn on top of the input image in the image window. Filling in the shapes may give you a better idea of the areas they define by displaying the shapes as solid polygons.

To fill in the Areas of Interest, select the **Fill Shapes** option below the image window.

To customize the outline color for the drawn shapes, click the **Outline Color** button. Set the line width for the drawn shapes on the **Appearance** tab of the **Preferences** dialog.

Changing the outline color and line width has no affect on the resulting encoded image, and is only used for previewing purposes.

Inner and Outer Areas

All regions inside specified Areas of Interest are called “foreground”. All surrounding regions are called “background”. The **Inner** and **Outer** options correspond respectively to foreground and background and enable you to choose which part of an image the AOI processing will affect.

In MrSID encoding, “inner” and “outer” are not specifically referred to except when using the mask method, as noted below. Either the foreground or background is given preference by the difference in weight between them as specified by the compression ratio of the foreground and that of the area(s) of interest.

In JP2 encoding using the weight and shift methods, selecting either the **Weight Inner** or the **Shift Inner** option preserves the quality of the foreground at the expense of the surrounding regions. Similarly, selecting **Weight Outer** or **Shift Outer** preserves the quality of the background at the expense of the foreground.

The mask method renders either the foreground (by selecting the **Mask Inner** option) or background (by selecting the **Mask Outer** option) as a solid color. Click **Mask Color** to select the mask color for either of these options.

Cropping with an Area of Interest

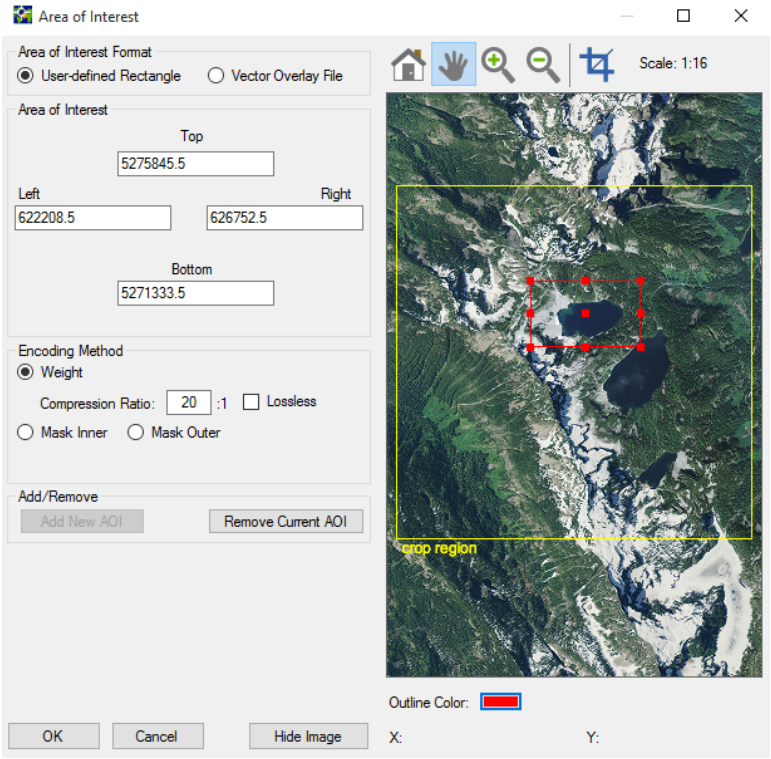
GeoExpress is designed to accommodate a workflow that demands a number of image customizations at a single encode. Accordingly, it is possible to crop an image and encode an Area of Interest at the same time. A useful workflow would be to first define a crop region in an image and then define an Area of Interest.

To specify your Area of Interest in relation to an existing crop region:

1. Select an image on which you have already defined a crop region (see Cropping an image on page 46).
2. Choose **Tools > Area of Interest**.
3. Click **Show Image**.
   The region you defined appears marked out in lines and labeled as the crop region.
4. Define your Area of Interest and encode.

You can specify an Area of Interest anywhere in the image, regardless of whether or not it is in the crop region. Areas of Interest defined outside a crop region will not appear in the results for the cropped version of the image, but this may be a desired effect since a project can be used for multiple operations.

In this illustration, an Area of Interest is being drawn within an existing crop region.



MG3 and MG4 Area of Interest encoding

GeoExpress offers two methods, the weight and mask methods, for encoding an Area of Interest with MG3 or MG4 as the output format.

TIP: Area of Interest encoding of MG3 and MG4 images can be done more quickly if the images were originally encoded as optimizable. For more information, see Optimizable on page 83.

NOTE: Area of Interest encoding in MG3 format automatically uses the 2-Pass optimizer, even if it has not been selected on the **Format-Specific** tab of the **Advanced Job Options** dialog. For more information, see 1-Pass or 2-Pass Optimizer on page 86.

The weight method

The weight method is the default for encoding Areas of Interest with GeoExpress. (This is not to be confused with the **Weight** parameter in the **Advanced Job Options**.) The parameters for using the weight method differ depending on the output format. MG3 and MG4 require the user to enter a compression ratio for the Area of Interest.

GeoExpress calculates the resultant image filesize as part of the encoding process, taking into account the user-defined compression ratios for inside and outside the Area of Interest. Selecting the **Weight** option enables you to specify an encode ratio for the Area of Interest or select **Lossless**. The outside area will be encoded at the compression ratio specified in the **Job Options** dialog. These ratios are used in a calculation of the overall image compression.

The calculated filesize appears on the **Job Properties** panel for the image once you close the **Area of Interest** dialog.

The mask method

The mask method renders either the foreground or the background as a solid color, completely removing the underlying image data.

The mask method only applies to encode jobs and is not available for optimizations.

To mask an area inside the AOI polygon (foreground), select **Mask Inner**.

To mask a region outside the AOI polygon, select **Mask Outer**.

Mask color

To specify or change the mask color, select either **Mask Inner** or **Mask Outer**, then click **Mask Color**. This opens the **AOI Mask Color** dialog.

By default the mask color is black. Black drives all pixel values to the minimum supported value (usually zero), while white drives all pixel values to the maximum supported value (e.g. 255 for an 8-bit image). You can also specify a custom 8-bit RGB color value.

To specify a custom 8-bit RGB color value, select the **Custom** option and fill in the red, green and blue values.

Reading the log file

The compression ratios for the inside and outside of the Area of Interest are reported in the GeoExpress log file after you run the Area of Interest job. For more information on log files, see Viewing and using log information on page 116.

JPEG 2000 Area of Interest encoding

GeoExpress offers three methods, the weight, shift and mask methods, for encoding an Area of Interest (AOI) with JPEG 2000 (JP2) as the output format. Also, the weight and shift methods can favor the “inner” or “outer” area (for more information see Inner and Outer Areas on page 53).

The weight method

In JPEG 2000 encoding the weight value controls the image quality of the foreground relative to the background or vice versa: larger values will result in a higher quality foreground and a lower quality background, and smaller values will result in less of a marked difference. (**Note:** a value of 1.0 will have essentially no AOI weighting effect.)

Using the weight method

1. Click the **Area of Interest** button on the toolbar (or select **Area of Interest** from the **Tools** menu) to open the **Area of Interest** dialog.
2. Define an Area of Interest by one of the following methods (for more information see Defining an Area of Interest on page 52):
   - using a vector overlay
   - drawing or entering values for a single rectangle
3. Select **Weight Inner** or **Weight Outer**.
   The **Value** field appears with the default value of 100.
4. Change the default value if desired.
5. If desired, choose a number of resolution levels to be included in the AOI process from the drop-down list. The default is all levels, but you may choose any number equal to or less than the number of resolution levels the image includes (see Zoom options on page 75). For example, if the image is being encoded to have five resolution levels, then you may choose five or less and the default would be all five levels.
6. Click **OK**.

When using the Weight method, the actual boundaries of the region are defined by the extents of the codeblocks within each resolution level. Because the spatial extent of the codeblocks varies by level, the actual encoded region may appear larger than the selected region, and a step-like fall-off in quality may be noticeable.

The shift method

The shift method is an alternative way to express the encoding of an Area of Interest when you select JP2 as the output format. Rather than affecting the amount of quality in a codeblock at encode time, the shift mode adjusts the “importance” of individual pixels by the specified shift amount. In other words, this function promotes the importance (or sharpness) of the data inside or outside the Area of Interest (see Inner and Outer Areas on page 53). The shift value to be specified is the number of bit positions to “promote” the foreground region over and above the background. For 8-bit samples, an appropriate scaling factor would be 12. Images to be encoded with large bit-depths and/or a large number of levels may, under certain conditions, require a higher value.

Using the shift method

1. Click the **Area of Interest** button on the toolbar (or select **Area of Interest** from the **Tools** menu) to open the **Area of Interest** dialog.
2. Define an Area of Interest by one of the following methods (for more information see Defining an Area of Interest on page 52):
   - using a vector overlay
   - drawing or entering values for a single rectangle
3. Select **Shift Inner** or **Shift Outer**.
   The **Value** field appears.
4. Enter a shift value.
5. If desired, choose a number of resolution levels to be included in the AOI process from the drop-down list. The default is all levels, but you may choose any number equal to or less than the number of resolution levels the image includes (see Zoom options on page 75). For example, if the image is being encoded to have five resolution levels, then you may choose five or less and the default would be all five levels.
6. Click **OK**.

The differences between the two methods are subtle and technical; we recommend that the weight method be used unless large quality differences are desired. While the shift method does not suffer the stepping effects of the weight method, it affords less granularity of control between foreground and background. The weight method is enabled by default.

Although with practice and experimentation the shift mode can be used to completely mask out a desired region, its purpose is "obscuring" areas of an image rather than masking them out. It is recommended that you use the Mask method if you wish to achieve a masking effect (for more information see The mask method on page 55).

The mask method

The mask method in JPEG 2000 is the same as in MrSID Area of Interest encoding. See The mask method on page 55.

Number of AOI levels

This parameter controls the number of resolutions levels subject to the Area of Interest encoder process in the shift and weight methods; this can be used to alleviate the "stepping" effect mentioned above. When "Number of AOI Levels" is set to less than the total number of levels in the image, the lower-resolution levels will not undergo AOI processing; in this way, only the N highest resolutions are affected, so the icon image (and potentially other lower-resolutions) will appear as if no AOI had been selected.

For information on viewing the results of encoded Areas of Interest, see Reading the log file on page 55.

Notes on AOI encoding and JPEG 2000

When using the Weight method for Area of Interest encoding with JPEG 2000, it is recommended that you use a smaller codeblock size, such as width = 32, height = 32. This parameter can be set on the **Format-Specific** tab of the **Advanced Job Options** dialog (see Advanced JPEG 2000 options on page 88).

The overall compression ratio chosen for the encode job can be as important to the appearance of the region as the actual weight or shift values chosen. The image quality at a given compression ratio may diverge dramatically from expected results when AOI encoding is enabled. Getting the desired effect in JPEG 2000 Area of Interest encoding may require a trial and revision process.

Area of Interest scenarios

Increased visual quality in Area of Interest

A city government has an area that will be under construction with a new housing development. The contractor needs access to high-quality imagery in the construction zone. The contractor will need the remainder of the imagery at a lower quality in order to overlay existing roads, etc. The city has an existing composite MrSID Generation 3 (MG3) mosaic of MrSID imagery created from 100 smaller MG3 images compressed at a ratio of 20:1. The city will import a vector overlay that outlines the area of construction and would like to specify a lossless compression ratio in this area (i.e. no additional loss after original 20:1 compression) and an additional 20:1 compression for the remainder of the image in order to reduce the file size of the deliverable and still meet the contractor's needs.

Decreased visual quality in Area of Interest

The United States Department of Defense (DoD), as a measure against terrorism, requires that imagery over the nation's Capitol building and White House in Washington, DC, not be delivered in high resolution. In the past data providers have downsampled those areas of the images and mosaicked them back together, which can be time consuming. A data provider would like to load the mosaic of original TIFF files into GeoExpress, select a region, apply a 100:1 compression ratio over the selected region and 20:1 compression for the remainder of the mosaic.

Areas of Interest defined for faster viewing

A Paris city employee working in the field with low bandwidth wants to view an extremely large image of Paris online through a viewing application. She is only interested in the portion of the image that shows the Eiffel Tower. If that portion of the image has been defined as an Area of Interest, it can be given display priority so that area appears sooner, becoming crisp and clear before the rest of the image.

Color balancing

The Color Balance tool

Use GeoExpress to perform color balancing operations for raster images when you select MG3, MG4, or JPEG 2000 as the output format. You can color balance 8-bit and 16-bit unsigned grayscale and RGB images. You can also color balance mosaics and multiple images at a time. There are three types of corrections that you can apply: uniform corrections, non-uniform corrections, and automatic corrections.

For information about color balancing and mosaics, see Performing color balancing for a mosaic on page 101.

For information about color balancing many images at a time, see Batch color balancing on page 60.

Uniform corrections

Uniform corrections affect the brightness and contrast of all pixels in the same way, so light spots will still be light and dark spots will still be dark regardless of the corrections that you apply.

In the **Uniform Corrections** tab, select the bands for which you want to perform corrections and use the sliders to adjust gamma, brightness, and contrast values.

You can apply uniform corrections to single images and mosaics.

Non-uniform corrections

You can only apply non-uniform corrections to mosaics.

Non-uniform corrections adjust the color values of specific portions of each mosaic tile.

When you combine multiple images with similar imperfections, the flaws become very noticeable.

To correct these patterns across a mosaic, use non-uniform corrections.

There are three types of non-uniform corrections:

- **Vignette correction**. Corrects color inconsistencies caused by a camera lens. Use vignette correction when your images display a lower light intensity around their edges. The correction automatically normalizes the highlights and dark spots across tiles to create a mosaic that appears more unified. Vignette correction affects all the tiles in the mosaic.
- **Tilt correction**. Corrects bidirectional reflectance. Bidirectional reflectance describes the effect of the angle of the sun on an image. Use tilt correction when the images in a mosaic were all taken under similar lighting conditions. For example, your images may be darker on one side than the other. When you apply tilt correction to all the tiles in a mosaic, GeoExpress matches the color levels of each tile in the mosaic. Tilt correction affects all the selected tiles in a mosaic.
- **Seam line correction**. Corrects discrepancies in the edges of tiles in a mosaic. Use seam line correction to smooth the transitions between tiles. Depending on the geometry of a given mosaic, sometimes seam lines cannot be generated. In that case, the **Apply Seam Lines** option is unavailable. Seam line correction affects all the tiles in a mosaic.

NOTE: Tilt correction is computationally intensive. If there are many tiles in the mosaic, both the preview and the mosaic job may take more time to process.

Automatic corrections

Automatic corrections adjust the color values of multiple images or mosaic tiles to match another image.

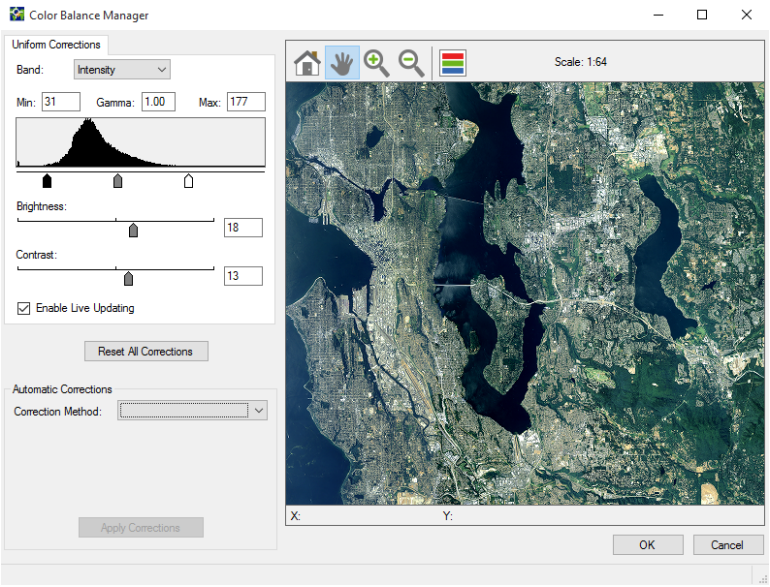
You can apply automatic corrections to single images and mosaics. If the corrections are going to be applied to multiple images, all the images must have the same number of output bands and the same data type. If you select **Duplicate job parameters**, this also applies to the image whose color corrections you want to match.

The following list describes the automatic correction methods that you can use:

- **Match tiles to each other**. Mosaics only. Sets the intensity of each tile in a mosaic to match the average of all tiles.
- **Match to a selected tile**. Mosaics only. Sets the intensity of the tiles that you select to match the color levels of a source tile that you specify. To specify a source tile, select a tile in the tile list and click **Set Selected Tile As Source Tile** in the **Automatic Corrections** panel. Then, select the tiles in the tile list to which you want to apply the corrections and click **Apply Corrections**.
- **Duplicate job parameters**. Matches the color balancing corrections applied to another image in the **Job List**. If you have not applied color balancing corrections to another job yet, GeoExpress displays a blank pane. Use this option to quickly apply color balancing corrections to many images at a time.
- **Match to histogram**. Matches the histogram values of another image that you select. GeoExpress calculates histogram values for the image that you select, including brightness, contrast, gamma, and more, then GeoExpress attempts to apply those values to the current image.

Color balancing an image

1. Select a single job from the **Job List**.
2. Click the **Color Balance** button on the toolbar.
   This opens the **Color Balance Manager**.



3. From the **Band** drop-down list select a band or **Intensity**.
   For grayscale images, only one band is available. Select an individual band to modify it individually or select intensity to modify all bands.
4. Make changes to histogram values by entering new values into the **Min**, **Max** and **Gamma** fields, or click and drag the slider controls below the histogram.
5. Click **OK**.

Batch color balancing

To perform color balancing for many images at a time, you must first set the color balancing corrections that you want to apply to a single image. Then, you can apply those corrections to all the remaining images.

1. Add all the images that you want to color balance to the **Job List**.
2. Select one of the images from the **Job List**.
3. Click the **Color Balance** button on the toolbar.
   The **Color Balance Manager** appears.
4. From the **Band** drop-down list select a band or **Intensity**.
   For grayscale images, only one band is available. Select an individual band to modify that band, or select **Intensity** to modify all bands.
5. Make changes to histogram values by entering new values into the **Min**, **Max** and **Gamma** fields, or click and drag the slider controls below the histogram.
6. Click **OK**.
7. Select the remaining images that you want to color balance from the **Job List**.
   Hold the **Shift** key to select a range of images.
8. In the **Automatic Corrections** panel, select **Duplicate job parameters** from the drop-down.
   The first image to which you applied color balancing corrections appears in a list below the drop-down.

   > **NOTE:** The list only displays images to which you have applied color balancing corrections, and which have the same number of bands and the same data type as the images that you selected in the **Job List**. Additionally, the list does not display mosaics to which you have applied corrections, only single images.

9. Click the first image to which you applied color balancing corrections.
10. Click **Apply Corrections**.
11. Click **OK**.
12. Click a blank section in the **Job List** to ensure that no jobs are selected.
13. Click **Run All Jobs**.

Histogram values

GeoExpress displays the histogram for an image on the left side of the **Color Balance Manager**. The histogram control enables you to adjust the minimum, maximum, and gamma values for each band in the image.

The black slider represents the minimum pixel value, the white slider represents the maximum pixel value, and the gray slider represents the gamma value. The range of values for the minimum and maximum controls is based on the data type of the image. For example, for 8-bit images, the range of values is 0 through 255. The maximum value cannot be less than or equal to the minimum value.

The gamma slider is restricted to a fractional position in between the minimum and maximum sliders. The range of gamma values is 0.102-9.99. The default value of 1.0.

The histogram controls adjust dynamically as the brightness and contrast values are changed.

To revert back to an image's original state, removing all color corrections, click **Reset All Corrections**.

Brightness and contrast

Below the histogram control are two slider controls for modifying the brightness and contrast of the active band of the image. They accept integer values from -100 to 100.

The histogram controls adjust dynamically as the brightness and contrast are changed.

Live updating

The **Enable Live Updating** option controls how the preview image is updated. If **Enable Live Updating** is enabled, the image will update in real time as you manipulate the slider controls. If the update performance starts

to slow down, as it may for very large mosaics, you can disable the live updating feature so that the image only updates after a dragging operation is complete (i.e. when the mouse button is released).

Mapping RGB bands

The **Band Selector** button allows you to rearrange the red, green, and blue bands for viewing in the **Color Balance Manager**. You can select one band to represent the grayscale band.

1. In the **Color Balance Manager**, click **Band Selector**.
   This opens the **Band Selector** dialog.
2. Select **RGB** to select RGB bands or select **Grayscale** to select a grayscale band.
3. Click **OK**.

NOTE: Selecting bands in the **Band Selector** dialog has no effect on the order of output bands.

Reprojection

What is reprojection?

Reprojection is changing the projection of an image from one coordinate reference system (CRS, sometimes also called spatial reference systems or SRS) to another.

A coordinate reference system defines the location of a point on a planar or spherical surface. An example familiar to many people is a graph with *x* and *y* axes. A geographic coordinate system is a three-dimensional reference system that locates points on the Earth's surface based on projections. Projections are the method used to display a spherical surface onto a flat surface. In this manner, Cartesian coordinate systems can be overlaid.

Coordinate reference systems are prearranged projections used in specific countries either in modern times or in historical maps. However, many states and counties within a country may employ a different coordinate reference system. These reference systems differ in order to maintain the highest accuracy in a smaller defined region. Because they are only approximations of the shape of the Earth–which is irregularly shaped–the larger an area a given coordinate system covers, the less accurate it will be.

An agency working on a broad area of coverage, such as statewide, will typically work in the UTM (Universal Transverse Mercator) system, since it can be used over larger geographic areas. Organizations whose Area of Interest covers a smaller geography, such as county or city level management, will typically work in a State Plane coordinate system. This presents problems when trying to employ data from different sources for use in a single project.

The reprojection tools in GeoExpress enable you to take images that are georeferenced in one or more coordinate reference systems, and reproject these images to a different coordinate reference system either individually or as a mosaic. CRSs are identified by regions of use, subregions and system names as defined by the European Petroleum Survey Group (EPSG). You can also use well-known text strings (WKTs).

You can repurpose and combine diverse data sets by using the GeoExpress reprojection tools when you create a new image or by reprojecting your existing images. With support for over 2,500 WKT (well-known text) coordinate systems such as State Plane Coordinate Systems and UTM–as well as hundreds of specific regional projections–GeoExpress enables geospatial professionals to share imagery across boundaries previously imposed by disparate coordinate reference systems.

As an example, say you have a shapefile using a coordinate reference system of Latitude/Longitude, WGS84, while the raw imagery you purchased from an image data provider is created in UTM, NAD83, Zone 18N. Using the reprojection feature in GeoExpress, you are able to reproject the raw imagery to the Lat-Long coordinate reference system while converting it to MG3, MG4 or JP2 format within your normal encoding workflow.

NOTE: Reprojection necessarily involves encoding since pixel data cannot be altered in compressed wavelet space.

Reprojecting an image

To reproject an image, you must set a coordinate reference system (CRS) for the source image and for the output image. You can reproject images to the MrSID Generation 4 (MG4), MrSID Generation 3 (MG3), JPEG 2000, and NITF 2.1 output formats.

1. Click the **Reproject** button on the toolbar.
   This opens the **Reprojection Manager** dialog.
2. If the Source File has a known CRS, then that CRS is displayed.
   If you need to set or change the CRS, select one using the **Projection** pop-up menu.
   Initially, the menu lists recently-used projections. Use the search field at the top of the listing to narrow down a long list.
   If you need to use a different projection:
   a. Click **Full Search** to open the **Set Projection** window.
   b. Use the **Projection Source** pop-up menu to choose a list of standard projections.
   c. Choose a projection, then click **Set Projection**. Learn more
3. To set the projection for the Output File, choose one from the **Projection** pop-up menu.
4. Click **Advanced** to set additional reprojection options.
5. Click **OK**.

NOTE: When you reproject an image, you affect the image's pixel data. As a result, you should always reproject an image before you perform other image manipulation operations, especially cropping or defining an Area of Interest.

IMPORTANT: Since a coordinate reference system works in two dimensions (X and Y), GeoExpress does not alter the vertical (Z) coordinates of LiDAR point clouds during reprojection. This generally won't be a problem, since the vertical location of a point should not change during reprojection.

Selecting a coordinate reference system

You can set a coordinate reference system for an image or mosaic by reprojecting the image or by editing its metadata.

You can select an existing projection or create or import a custom Well Known Text (WKT).

To select a projection:

1. Select a subset of available projections from the **Projection Source** pop-up menu.
2. To filter the list of available projections, type one or more substrings from the projection name into the search field, separated by spaces. For instance, type `pola na` to quickly display the "WGS 84 / EPSG Canada Polar Stereographic (5937)" projection.
3. Click **Set Projection**.

To import a WKT:

1. Choose **Custom** from the **Projection Source** pop-up menu.
2. Click **Import**, choose the `.wkt` or `.prj` file, then click **Open**.
3. GeoExpress will display the imported file and report if it is not valid.
   If the WKT is not valid, you can edit it, delete it, or cancel the **Set Projection** operation.
4. To change the name of the WKT as displayed within GeoExpress, click once in its name in the list on the left and type a new name.
5. Click **Set Projection** to accept and select the imported WKT.
   To save the imported WKT without setting it, click **Save**, then click **Cancel** in the **Set Projection** dialog.

To create a custom WKT:

1. Choose **Custom** from the **Projection Source** pop-up menu.
2. Click **New**.
3. Enter the text for the WKT. GeoExpress will validate the text as you type and display its validity.
   If you do not want to keep the WKT you have created, you can delete it or cancel the **Set Projection** operation.
4. To change the name of the WKT as displayed within GeoExpress, click once in its name in the list on the left and type a new name.
5. Click **Set Projection** to accept and select the new WKT.
   To save the custom WKT without setting it, click **Save**, then click **Cancel** in the **Set Projection** dialog.

NOTE: For information on how to create a WKT, see the Open Geospatial Consortium (OGC) spec # 01-009 at http://www.geoapi.org/3.0/javadoc/org/opengis/referencing/doc-files/WKT.html. For a listing of common WKT strings, see http://www.spatialreference.org/.

To delete a custom or imported WKT:

1. Open the Set Projection dialog.
2. Select **Custom** from the **Projection Source** pop-up menu.
3. Select a WKT in the list on the left.
4. Click **Delete**. In the confirmation dialog, click **Yes**.
5. Click **Cancel** in the **Set Projection** dialog, then click **Cancel** in the **Metadata Manager** or **Reprojection Manager** window.
   This way, you do not inadvertently change the projection for the selected job.

Advanced reprojection options

Resolution

To specify the output resolution of the reprojected image, select **Set output resolution** and enter the *x* and *y* values in the edit fields. If this option is disabled, GeoExpress calculates the output resolution when it performs the reprojection.

WARNING

- This parameter has been made configurable in the event that experienced users require adjustments. However, adjusting the output resolution can have far-reaching effects and it is recommended that you allow GeoExpress to calculate it for you.
- If you set the resolution manually and notice that the image is offset, select **Align pixels with output resolution**. This option aligns the output image to an integer multiple of the output resolution.

Error fraction

The error fraction is a value from 0.0 to 1.0 that indicates the level of accuracy of the reprojection. A value of 0.0 is the highest level of accuracy—essentially a "lossless" reprojection. An error fraction of 0.125 means that each reprojected pixel could be off by an eighth of a pixel, while a value of 0.25 indicates a quarter-pixel inaccuracy.

Block value

Block values tell the encoder to reproject the pixels in blocks of dimensions the user may specify.

NOTE: These blocks are different from both the MG2 and the MG3/MG4 encoding blocks.

Using block values improves disk access and memory usage and can improve performance. Smaller block values use less memory but may be slower. Block values do not affect the output image.

By default the block value is 2048.

Resample Method

The **Resample Method** drop-down list shows the available resampling methods for the reprojection operation. Nearest Neighbor is the fastest method, while Bicubic gives more accurate results. Bilinear is a compromise—faster than Bicubic and more accurate than Nearest Neighbor.

Use Temp Files

If you enable the **Use Temp Files** option, the encoder caches the reprojection processing blocks to disk in the form of a temp file instead of keeping them in RAM.

This option is enabled by default.

Image reprojection scenarios

NOTE: The process of rendering previews for very large images or mosaics can be time consuming, especially when reprojecting mosaicked images in different resolutions and coordinate systems. Previewing does not decrement the data cartridge.

Single image reprojection workflows

Reprojection of single TIFF images

A user has a set of 500 images in TIFF format with TIFF world files and wants to put each single image into a new coordinate system and encode to MrSID at the same time. The user adds the images into the Job list. GeoExpress knows where they are located (due to the world files) but knows nothing about the coordinate reference system (CRS). The user assigns a coordinate system to the source images to be used as a source

CRS. The user can select multiple files and apply the CRS once to all of the source data. Then the user selects the destination CRS that will apply to all images in the current selection. The user specifies other compression parameters independent of the reprojection option, then encodes the images normally.

Reprojection of single MG2 images

Same as "Reprojection of Single TIFF Images" above, except that the user has MrSID Generation 2 images with sdw files.

Reprojection of MrSID images with embedded GeoTIFF

Same as "Reprojection of Single TIFF Images" above, except that the user has MrSID files with embedded GeoTIFF tags. GeoExpress automatically reads those GeoTIFF tags to determine the source coordinate system.

Reprojection of GeoTIFF images

Same as "Reprojection of Single TIFF Images" above, except that the user has GeoTIFF files. GeoExpress automatically reads the CRS and assigns it as a source CRS.

Mosaic Reprojection Workflows

Mosaicking single images with the same CRS and reprojection to new CRS

The user is a provider who has many GeoTIFF images in the same CRS (UTM). The user wants to mosaic these together and reproject them to the State Plane system. In this instance GeoExpress reads the CRS from the images and mosaic prior to reprojection to ensure a seamless mosaic.

Reprojection of UTM, State Plane and Lat-Long together in a single mosaic

A city government has received images in UTM from the NAIP program, has existing imagery in state plane coordinate system and has purchased satellite imagery in lat-long. The imagery from NAIP is a one-foot-pixel, the city's imagery is a half-foot pixel and the satellite imagery is a five-meter pixel. The NAIP imagery is in MrSID format, the city's data is in GeoTIFF and the satellite imagery is in TIFF with TIFF world files. This user can create a single MrSID mosaic in State Plane coordinates from all three sources of imagery in one single encode operation.

Raster job options

The following list describes some of the options that you can set for raster images and mosaics:

- Select an output destination.
- Select an output format and compression method.
- Select custom dimensions and resolution.
- Select tiling options.

NOTE: For raster images, you can also click **Advanced** on the **Job Properties** panel to set additional options. For example, you can use the advanced options to select a color space, edit transparency values, and more. For more information on advanced job options, see Advanced job options on page 69.

Destination options

Use the **Destination** tab to save output files to a file on your computer or to an Express Server. You can only save MrSID and JPEG 2000 images to Express Server.

To select an output destination:

1. Select one or more jobs in the **Job List**.
2. Click **Job Properties**.
3. Enter a file path in the output destination field, or click **Options: Basic** and select **Publish to Express Server**.

Selecting an output file

By default, the output directory is the same as the input directory.

To change the default output directory, see Preferences on page 106.

Selecting an Express Server

GeoExpress 10 supports Express Server version 6.0 and later. You can save images in the following output formats to an Express Server:

- MrSID Generation 4
- MrSID Generation 3
- MrSID Generation 2
- JPEG 2000 (Part I)
- JPEG 2000 (GMLJP2)

If you select **Publish to Express Server** on the **Job Options** dialog, you must still specify a file path on the **Destination** tab. GeoExpress uses the directory that you specify as a temporary directory where it saves the output file before publishing to Express Server.

When you select **Express Server** as the output destination, the **Express Server Browser** opens.

1. In the **Express Server Browser**, enter the URL of the Express Server where you want to save files. You can also click the drop-down box to view the list of Express Servers to which you have recently connected.
2. Click **Connect**.

   NOTE: The server is queried for a list of catalogs on the server. Catalogs that have a spatial index appear with the world map icon and the EPSG code of the spatial index. If there are no catalogs on the Express Server, contact the server administrator.

3. If the Express Server requires authentication, it will prompt you to enter your user name and password. Enter them, then click **OK**.
4. Select the catalog to which you want to save your files.

   NOTE: The output images that you create must use the same spatial reference system as the target catalog.

5. Optionally, select **Replace existing files** to overwrite files in the catalog that have the same name. If files with the same name exist and this option is not selected, the upload fails and reports that the file exists.
6. Click **OK**.

Format and compression options

Use the **Format and Compression** tab to select an output format and compression method.

For more information about output formats, see Supported output file formats on page 123. For more information about compression, see Features in Depth on page 30.

Dimensions and resolution options

Use the **Dimensions and Resolution** tab to change the dimensions of an image or select a custom resolution.

You can select from the following dimensions:

- **Full resolution.** Use the native resolution of the input image. This option is the default.
- **Print.** Scale the image so that the resolution matches that of a typical printer.
- **Medium.** Scale the image to either 2048 pixels wide or 2048 pixels high depending on the orientation.
- **Web.** Scale the image to either 512 pixels wide or 512 pixels high depending on the orientation.
- **Custom.** Enter a custom width and height, or enter a custom resolution.

Tiling options

Use the **Tiling** tab to break the output image into multiple tiles.

The following list describes the tiling options that you can select:

- **No tiling.** Create a single output image. This option is the default.
- **Number of tiles.** Break an image into a number of columns and rows that you specify. For example, if you select four columns and three rows, the job creates 12 images.
- **Tile by units.** Break an image into tiles based on the geospatial units of the image. For example, if the image is in a UTM projection, the unit is meters and you can create tiles 1000 meters wide by 1000 meters high.
- **Tile by pixel area.** Break an image into tiles such that each tile has the width and height that you specify. For example, you may want to create square tiles that are 2048 by 2048 pixels.

LiDAR job options

Some of the options that you can set for LiDAR images and mosaics include:

- Enter a custom block size.
- Omit LAS variable length record (VLR) metadata.
- Column mapping options for text files.

LiDAR compression options

Use the **Compression** tab to change the block size and remove variable length record (VLR) metadata from LAS files.

The block size is the number of points that GeoExpress processes and stores at one time. Enter a large block size to increase compression speed. Enter a small block size to decrease memory usage. Valid values are from 2048 to 16384. The default value is 4096.

If you select the **Omit Custom LAS VLR metadata** option, GeoExpress removes VLR metadata from LAS files. VLR metadata can include vendor-specific data, user-specified data, and more.

LiDAR text parsing options

Use the **Text Parsing** tab of the **Job Options** dialog to map text file columns to standard or custom fields and to load the whole text file. GeoExpress prompts you to set these options automatically when you add a LiDAR text file. At a minimum, you must map the X, Y, and Z columns of a file.

Header Lines

LAS files often contain header lines with the names of the columns and additional information. Enter the number of header lines are in the file so that GeoExpress does not attempt to read those lines as valid values.

Column Mapping

Use the drop-down boxes for each column to map values to standard fields like X, Y, Z, Intensity, and more.

Custom Fields

Create, edit, and delete custom fields that you want to map to columns. For example, you may want to create fields for a custom GPS time format or for sensor information.

Precision Factors

When a job is run, each number in the data columns is represented by an offset and the default precision factor of 0.001. The Precision factor fields enable you to change the factor by which the data in any or all three axis columns will be represented to account for the number of significant decimal places in those columns.

Reading the Whole File

If you select this option, GeoExpress reads the whole text file to determine image properties like the extents. You must select this option if you want to preview the LiDAR point cloud.

Column Mapping Prompt

Select the **Prompt me to map columns every time** option to display these text parsing options every time that a text file is added.

Advanced job options

Advanced job options overview

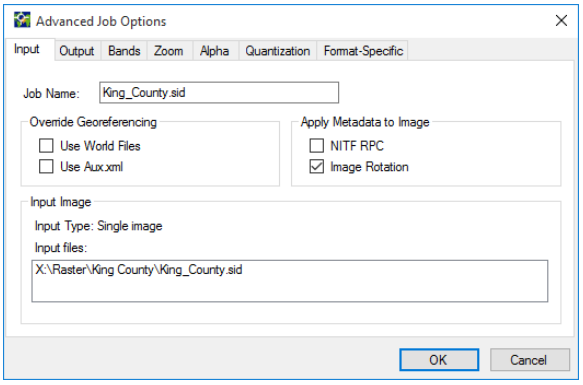
For raster images, you can click **Advanced** on the **Job Properties** tab to select additional job options.

The following table describes some of the tasks that you can perform in each tab of the **Advanced Job Options** dialog.

TAB	TASKS
Input	• Change the name of the selected job • Use world files and aux.xml files to override the georeferencing information in the selected image • Apply image rotation from the image metadata • Apply NITF RPC from the metadata
Output	• Create a test output image • Convert images to 8-bit • Set a custom watermark for the selected image • Create a shapefile representing the tiles used in a raster mosaic • Crop a DOQ image with corner cross points • Flatten a composite mosaic • Enable multiresolution mosaics • Enable mosaics with multiple coordinate reference systems • Enable multiple image segments for NITF images
Bands	• Select a color space for the image • Select and map bands for the image
Zoom	• Set the number of zoom levels in the output image • Specify a target thumbnail size • Resample the image
Alpha	• Specify transparency values for MrSID Generation 4 (MG4) files • Create or regenerate an alpha band
Transparency	• Specify transparency values for JPEG 2000, MrSID Generation 2 (MG2), and MrSID Generation 3 (MG3) files
Quanitization	• Enter quantization options for floating point images Quantization is the compression method for floating point images.
Security	• Set password protection for MG2 and MG3 images
Format-Specific	• Configure image encoding performance by changing the block size or strip height • Configure the display of an image by changing the weight values and sharpness • Generate dynamic range metadata • Select and edit JPEG 2000 profiles

NOTE: The options available in the **Advanced Job Options** dialog depend on the output format that you select.

Input options



Enter a new **Job Name** to change the name displayed in the **Job List**.

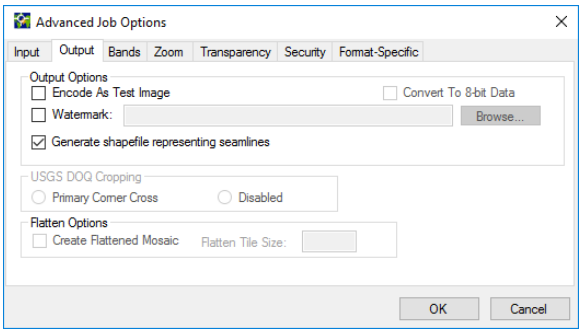
Use the **Override Georeferencing** section to override a file's native georeferencing information with information from another file. The other file can be a world file or an `aux.xml` file included in the same directory as the image. When georeferencing information for an image or mosaic tile is given in the form of a world file or `aux.xml` file, GeoExpress can use that information to override the file's native georeferencing. For more information on world files, see World files on page 118.

Use the **Apply Metadata to Image** section to change the output image based on information in the image metadata. There are two types of metadata that you can apply: NITF RPC metadata and image rotation metadata. NITF RPC metadata maps pixel data to location data for orthorectification. Image rotation metadata describes how to rotate the output image.

The **Input Image** section identifies whether the input image is a single image, a mosaic, or a color composite image, and lists the input file or files. Note that the job name can be different from the input file name and the output file name. Also the job name is different from the project name that is displayed in the blue bar at the top of the screen in the work area.

Output options

Set options for the output image in the **Job Progress** panel. The options that you see depend on the job type and the output format.



Test image

You can create a test image from a single raster image or raster mosaic. This allows you to test an operation without using data from the data cartridge.

Test images are output images that have a visible watermark.

NOTE: You cannot create test images from LiDAR point clouds.

8-bit data

Convert unsigned 16-bit data to unsigned 8-bit data during encoding.

Watermark

You can add custom watermarks to your images. GeoExpress supports black and white watermark images in BMP, PNG, and JPEG formats.

Click the **Browse** button to select the image that you want to use as a watermark. The following figure shows an example of a watermarked image:

NOTE: In versions of GeoExpress before v9.5.3, watermark images were limited to 128 × 128 pixels in size. Watermarks must be no wider and no taller than the output image.

Seamlines shapefile

You can choose to generate a shapefile that shows the tiles that make up a raster mosaic output.

If you create a raster mosaic, select this option to include a shapefile in the output. When viewed with the appropriate program (such as GeoViewer), the shapefile will overlay the output image to indicate where each tile in the image is located.

USGS DOQ Cropping

If the job contains DOQ images, the **USGS DOQ Cropping** panel will be available. Cropping is either by corner cross or disabled.

Flatten

To flatten a composite mosaic, select the **Create Flattened Mosaic** option. When you flatten a mosaic that contains overlapping tiles, you discard the data from tiles that are not visible. For more information on composite mosaics, see Mosaic output formats on page 98.

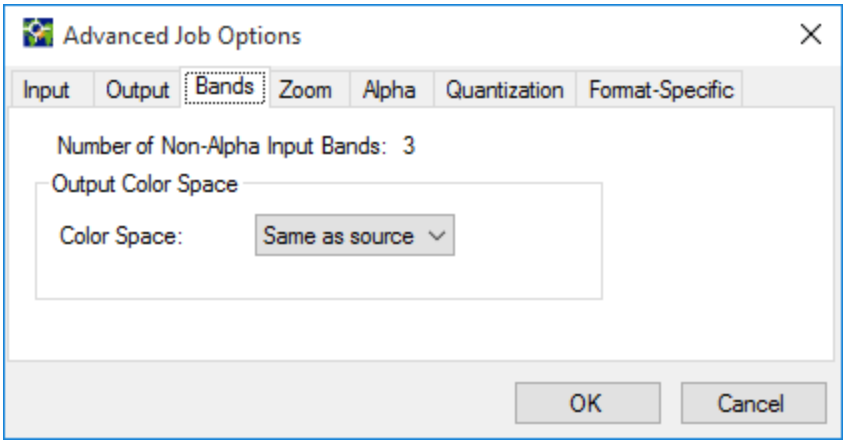
When you flatten a mosaic, the **Flatten Tile Size** field is available. GeoExpress divides mosaics that are to be flattened into tiles for encoding. Acceptable values are integers between 1024 and 4096, and powers of two (1024, 2048 and 4096) are recommended though not required. The default tile size is 2048.

NOTE: You may encounter irregularities in the progress meter when flattening mosaics.

Band options

Use the **Bands** tab to select a color space for the output image and to select and map bands.

NOTE: For MG3 and MG4 files, the output color space is only supported for encoding single images and flat image mosaics.



Output color space

The options available in this group depend on which color space you choose from the drop-down menu. For grayscale or RGB output, another drop-down menu enables you to select a single band or three bands, respectively. For multispectral output, the **Select Bands** button appears enabling you to access a dialog where you can select bands from your input image and order them for your output image. The default color space is **Same as source**. For more information on selecting bands, see Selecting and mapping bands on the facing page.

The MrSID Generation 4 (MG4) format supports multispectral color spaces, but to output a multispectral image to MG2 or MG3 format, you need to select an output color space of grayscale, RGB, or CMYK, and map bands to the selected space.

For multispectral images, select **Apply RGB Color Transform to First Three Bands** if the first three bands in your output list are Red, Green, and Blue in that order. (This option is enabled by default.)

If the first three bands are not Red, Green, and Blue, click the **Select Bands** button to re-order the bands. For more information on the RGB color transform, see The RGB color transform on page 31.

Supported color spaces

The following table shows supported output MrSID color spaces for various input and output formats:

COLOR SPACE OF SOURCE IMAGE	SUPPORTED MRSID OUTPUT	SUPPORTED JPEG 2000 OUTPUT
Grayscale	Grayscale	Grayscale
RGB	RGB, Grayscale	RGB, Grayscale
CMYK	CMYK, Grayscale	–
Multispectral	RGB, Grayscale, CMYK, Multispectral	RGB, Grayscale, Multispectral

For multibanded output to MG4 and JPEG 2000, additional options on the **Color Space** drop-down are available, most notably that a multispectral input image can use **Same as source** for the output color space.

NOTE: GeoExpress does not support the CMYK color space for JPEG 2000 images, either as input or output. For source images that are CMYK, the only supported output color space for JPEG 2000 encoding is grayscale. The preview input image color space controls remain the same.

With multispectral image support, it becomes necessary to provide color space control over the input and output images so that they can be viewed by human eyes. The **Output Color Space** control shows a list of supported output color spaces for the currently selected output format. The supported output color spaces for MrSID Generation 3 (MG3) are grayscale, RGB, and CMYK. If the input image is already in one of the supported color spaces, **Same as source** will also be an available option. By selecting an output color space other than **Same as source**, a group of band selectors will become visible, allowing the user to choose which input bands map to the output color space. If you chose **RGB** as your output color space, three controls would appear for choosing the red, green, and blue component bands of the output image. Then you could choose which bands of the source image were most interesting or important to you, for example bands 1, 3, and 5.

If you want to encode a six-banded image to MrSID format, you should select MG4 as your output format.

Selecting and mapping bands

For raster multispectral images, you can select and map image bands from a source image to a MrSID or JPEG 2000 output image. Not all workflows are available for all output formats.

The following table shows which workflows each format supports.

WORKFLOW	SUPPORTED BY OUTPUT FORMAT			
	MG2	MG3	MG4	JPEG 2000
Choose one band from an RGB or multispectral source to represent the single output (grayscale) band	✓	✓	✓	✓
Map any 3 bands from an RGB or multispectral source to the Red, Green, and Blue output bands	✓	✓	✓	✓
Choose to carry over all source bands to your output image in their original order			✓	✓
Map an arbitrary subset of bands (more than 3) from a multispectral image to your output image, in any order			✓	

By default, GeoExpress retains all source bands in order.

The following procedures assume you have loaded one or more images into the **Job List**.

Selecting a grayscale band

You can select a single band for MrSID or JPEG 2000 output.

1. Select a MrSID or JPEG 2000 format from the **Output Format** drop-down menu.
2. Click **Advanced** in the **Job Properties** panel.
3. Click the **Bands** tab.
4. Choose **Grayscale** from the **Color Space** drop-down menu.
   A drop-down menu appears listing all the available bands in the source image.
5. Choose any single band from the drop-down menu.
6. Set other options on this tab, then click **OK**.

Selecting bands for RGB output

You can select and map bands for RGB output in MG3, MG4, or JPEG 2000 format.

1. Select a MrSID or JPEG 2000 format from the **Output Format** drop-down menu.
2. Click **Advanced** in the **Job Properties** panel.
3. Click the **Bands** tab.
4. From the **Color Space** drop-down menu choose **RGB**. Several drop-down menus appear listing all the available bands in the source image.
5. Choose any three bands from the drop-down menus.
6. Click **OK**.

Retaining all source bands in order

You can carry over all source bands to MG4 or JPEG 2000 output formats in their original order.

1. Select MrSID Generation 4 or JPEG 2000 from the **Output Format** drop-down menu.
2. Click **Advanced** in the **Job Properties** panel.
3. Click the **Bands** tab.
4. From the **Color Space** drop-down menu choose **Same as source**.
5. Set other options on this tab, then click **OK**.

Selecting and mapping bands for multispectral output

You can select and map more than three bands for MG4 output.

1. Select **MrSID Generation 4** from the **Output Format** drop-down menu.
2. Click **Advanced** in the **Job Properties** panel.
3. Click the **Bands** tab.
4. From the **Color Space** drop-down menu choose **Multispectral**, then click **Select Bands**.
   This opens the **Select Bands** dialog. By default, all bands are carried over from the input list to the output list.

   NOTE: The Alpha band is encoded losslessly and is not displayed in the list of bands. For more information on Alpha bands in MrSID images, see Alpha band options on page 76. For more information about Alpha bands in JPEG 2000 imagery, see Encoding with alpha bands in JPEG 2000 on page 94.
5. If the image contains red, green, and blue (RGB) bands, re-order the bands with the up and down arrows so that these bands are at the top of the bands list, then select the option to **Apply RGB Color Transform to First Three Bands**.

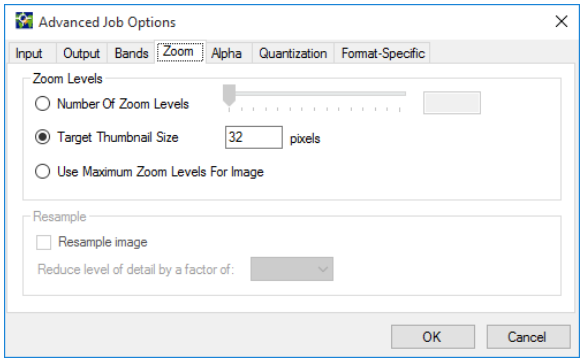
   IMPORTANT: When you set the first three bands of the image as the RGB bands and apply the RGB Color Transform, GeoExpress optimizes the image compression ratio of each one of the RGB bands to create a smaller image without sacrificing visual quality.

   For more information on the RGB color transform, see The RGB color transform on page 31.
   This option is enabled by default for multispectral images.
6. Optionally, select the bands that you want to remove from the output image and click the left arrow to remove them.
7. Click **OK**.

NOTE: For information on setting per-band compression ratios, see Specifying per-band compression ratios on page 31.

Zoom options

Use the **Zoom** tab to select the number of zoom levels that you want in the output image or to specify a target thumbnail size. For an MG3 or MG4 file you can also resample the image.



The number of zoom levels in an encoded image can be specified directly or it can be dependent on the image size in relation to a specified target thumbnail size. The larger the image, the greater the number of zoom levels it can contain.

By default, GeoExpress does not specify the number of zoom levels but uses a thumbnail size of 32 pixels instead. You may specify a higher value here, resulting in fewer zoom levels, or a lower value, resulting in more. You can also specify a number of zoom levels or instruct the program to use the maximum number of zoom levels the image can contain.

To specify the number of zoom levels, select **Number of Zoom Levels** and drag the slider or enter the number of levels in the **Zoom Level** field.

Picture the encoded image as a pyramid, with each zoom level being sliced from the pyramid. The base of the pyramid is level 0, the maximum resolution. Level 1 is half the size of level 0 with a preview image that has one quarter the resolution of level 0. Level 2 is half the size of level 1, and so on to the final level, whose smallest dimension is 2 pixels.

Zoom level can be set to any value greater than zero for MG3 and MG4 and from 3 through 9 levels for MG2.

> **NOTE:** The full resolution (or **base**) image is called the zeroth level (0th level) and is not counted as one of the zoom levels. For example, setting the zoom level at 3 will result in three additional resolutions besides the base level. Setting the number of zoom levels to 0 will yield an output image with the maximum number of zoom levels (the same as moving the **Zoom Levels** slider all the way to the right, or selecting the **Use Maximum Zoom Levels** option.

To specify the target thumbnail size, select **Target Thumbnail Size** and enter a dimension in pixels.

To allow GeoExpress to automatically calculate and use the maximum number of zoom levels possible for an image, select **Use Maximum Zoom Levels for Image**.

Resampling an image

Resample an image to reduce the number of zoom levels in an MG3 or MG4 image. You might resample an image for placement in an online catalog where you know it will only be displayed at a certain maximum size.

The resampling operation copies zoom levels from an existing image to make a new image. As a result, you can only resample images that meet the following criteria:

- The image must be in the MG3 or MG4 format.
- The output format for the image must be the same as the input format. For example, for an MG3 input image, you can only create a resampled MG3 output image.
- The image must have been created as an optimizable image. By default, MG3 and MG4 images are optimizable.
- The resampling operation cannot be combined with other image manipulation operations that require decoding the image data. For example, you cannot perform reprojection or color balancing operations in the same job as a resampling operation. Instead, resample the image, run the job, and then perform additional operations on the new image.

To resample an image, complete the following steps:

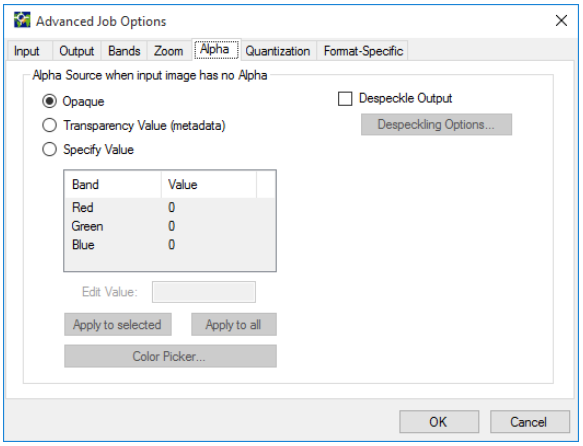
1. Click **Advanced** in the **Job Properties** panel.
2. Click the **Zoom** tab.
3. Select the **Resample image** option and select the factor by which you want to reduce the level of detail.

Resampling by a factor of two removes one zoom level and halves the image's width and height so that the result has a fourth of the area of the original. Resampling by a factor of four removes two zoom levels and quarters the image's width and height so that the result has one sixteenth of the area of the original. The number of resampling factors available in the drop-down menu is determined by the size of the original image.

Alpha band options

When you select MG4 as the image output format, you can use the **Alpha** tab to create or regenerate alpha bands. In MG4 images, the alpha band records which portions of your image do not contain image data.

For MG2, MG3, and JPEG 2000 files you can specify no-data values in the **Transparency** tab.



Alpha bands and MrSID

All images encoded to MrSID Generation 4 (MG4) have an alpha channel or alpha band. If one is present, GeoExpress uses the alpha band in the input image. If no alpha band is present in the input image, then GeoExpress creates one.

The alpha band is always encoded losslessly, even if the rest of the image undergoes lossy compression.

MG2 and MG3 do not support alpha channels, but the transparency information in the alpha band of your source image is still preserved when encoding to MG2 and MG3. The alpha band will first be applied to the source image and then discarded from the output file.

Examples

```
1:5@0,6:8@255
REMAINDER@0
1:255@0
1@127, REMAINDER@1
```

NOTE: For users of GeoExpress Standard Edition, the encoding of the alpha band does not additionally decrement your data cartridge. Your encode job will be metered the same with or without alpha bands.

Creating an Alpha band

All images encoded to MrSID Generation 4 have an alpha band.

1. Click **Advanced** in the **Job Properties** panel.
2. Click the **Alpha** tab.
3. Select the method that you want to use to create an alpha band.
   - **Opaque**. The Opaque method specifies that all pixels should be treated as valid image data.
   - **Transparency Value (metadata)**. Using this method, GeoExpress queries the image metadata for the transparency values and treats all pixels with matching band color values as transparent. This is the default.
   - **Specify Value**. You may specify transparency values for each band. GeoExpress treats as transparent all pixels whose band color values match the specified values. If you decide to specify a value for each band, you can use the color picker.

If your source image already has an alpha band, you can select **Regenerate Alpha Band** to discard the existing alpha band. By default, GeoExpress uses and preserves a source image's alpha band. This option might be used if your alpha band is corrupted or incorrect, in which case GeoExpress creates a new one.

Despeckling output

Speckling is an artifact of lossy compression that causes pixels which should be transparent to display in the output.

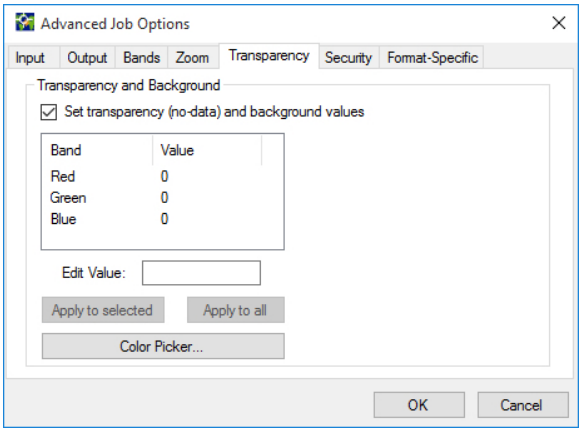
For example, you may specify 0,0,0 as the alpha band values for an RGB image so that all of the black pixels are made transparent. But in compression, the values of some pixels undergo slight changes in value. The difference is not be visible to the eye, but a pixel whose RGB values are 0,1,0 or 0,0,1, while it may still look black, no longer matches the specified transparency profile and so it will not be rendered transparent. Where this happens, speckling can appear in the collar regions of an image such as a DOQQ. In this case, select **Despeckle Output** to ensure that all of the pixels that should be transparent are treated correctly.

For more information and to manually set despeckling options, see Despeckling on page 44.

Transparency options

When you select MG2, MG3, or JPEG 2000 as the image output format, you can use the options on the **Transparency** tab to define the color of transparency and background areas. One color must serve for both the transparency and background values.

You can specify colors based on the color space (RGB/grayscale) and color depth (8-bit/16-bit) of the source image.



Transparency and background color

The transparency and background color setting must be within the range of pixel values that the image's data type supports (e.g. 0-255 for 8-bit images and 0-65,535 for 16-bit images). These values are derived from the native metadata for an input image.

To select an alternate transparency and background color do one of the following:

- Enter RGB values for each band using the **Edit Value** field. Values can be assigned to single or multiple bands.
- Select a color using the **Color Picker**.

The effects of the transparency options can be simulated in the **Job Output** panel.

NOTE: The MG4 format stores transparency in an alpha band whereas MG3, MG2, and JPEG 2000 images map transparency to a specific color. If your input image is in the MG4 format, and if the output format is MG3, MG2, or JPEG 2000, transparency is mapped to the transparency color that you specify.

Color Picker

You can select an 8-bit RGB color value from the color palette or **Color Picker** if the source image is an 8-bit RGB.

1. Click **Color Picker**. The **Color** dialog displays 48 color options, including black and white. You can add custom colors to the existing basic colors palette.
2. Select the proper color from the displayed palette.
3. Click **OK**.

GeoExpress uses the standard Windows color picker interface, which allows you to add custom colors. See your Microsoft Windows or Microsoft Office documentation for more information about picking colors.

Specifying a transparency value in indexed color images

All images in the MrSID format are in either grayscale or RGB mode. Color images are RGB; black-and-white images are grayscale. Any black-and-white image encoded by GeoExpress, if not already in grayscale mode, is converted to grayscale; any color image, if not already RGB (for instance, an indexed color image), is converted to RGB.

To specify a transparency pixel value, determine the RGB value of the transparency area in the source image. Most commonly, this will be black (0-0-0) or white (255-255-255). If desired, use a color-finder program to read the transparency RGB values. Once the RGB values for the transparency area have been determined, they must be entered manually.

The RGB color scale for an 8-bit image, with values of 0-255 for the colors red, green, and blue, is capable of accurately displaying 16,777,216 colors. An indexed color image selects colors from a scale containing 256 colors. Each color in an indexed color image is specified using a value from 0 to 255.

Due to the wide variety of indexed-color valuing systems available, a specific color in one indexed color image can be given one value, while the same color in another image is given a different value. For example, a color with a single RGB value may be given an indexed color value of 120 by one imaging application and 142 by another.

For this reason, any time the input or output transparency options are used with indexed color images, the indexed color values must be read in as RGB and entered manually.

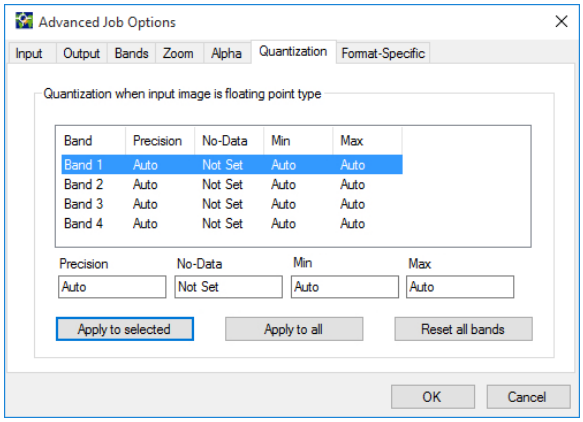
If desired, use a color-finder program to read the transparency RGB values.

Quantization options

When you select MG4 as the output format for a floating point image, you can use the options on the **Quantization** tab to define a quantization precision value and other quantization options.

NOTE: The No-Data value will be rounded to six decimal digits for display purposes, but calculations are performed using the full precision value.

For more information on quantization, see Using quantization for floating point images on page 32.



Quantization precision

When you compress a floating point image, GeoExpress automatically calculates the optimized precision value to use for quantization. You can also manually specify a precision value.

The pixel values of the compressed output image are accurate to within half of the precision value. For example, there is a pixel in your floating point image that has a value of 3000. If you specify a precision value of 0.5, then the same pixel after quantization will have a value between 2999.75 and 3000.25.

As a rule of thumb, you can calculate the optimized precision value used by GeoExpress with the following formula:

```
Precision = (Maximum value - Minimum value) / 216
```

Whether you manually specify a precision value or allow GeoExpress to automatically calculate a precision value, GeoExpress records the precision value used during quantization in the image metadata. The precision value for each image band is stored in the `IMAGE::QUANTIZATION_SCALE` metadata tag. The tag lists the precision value used for each band of the image, including the alpha band. The last value in the metadata tag is for the alpha band precision value.

TIP: Open the output image in GeoExpress to view the image metadata. For more information, see Metadata on page 32.

Setting a precision value

To set a precision value, enter a value in the Precision field of the **Quantization** tab. The precision value that you enter depends on the range of values in the input image.

You can specify one quantization precision value for all the bands in an image, or you can specify individual precision values for each band.

Quantization range

In addition to the quantization precision value, you can specify the range of values that you want GeoExpress to keep during quantization.

If the input image contains minimum or maximum values that are far removed from the rest of the pixel values, then you may want to manually specify minimum and maximum values. For example, if the input image contains a maximum value of 32,000, but does not contain any pixel values between 20,000 and 32,000, then you may want to specify a maximum value of 20,000. In this example, GeoExpress changes all pixel values greater than 20,000 to 20,000. If you manually constrain the quantization range, you can improve the appearance of images that have very little data near the minimum and maximum values.

To specify a range of values for quantization, enter minimum and maximum values on the **Quantization** tab. You can specify one minimum and one maximum value for all the bands in an image, or you can specify individual values for each band.

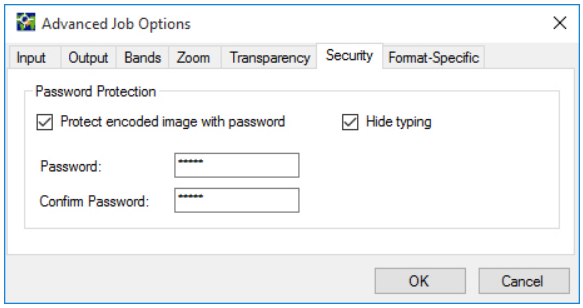
Quantization and No-Data

Many floating point images denote no-data values as an arbitrary minimum value. For example, an image may use -9999 as the no-data value even though there aren't any pixel values between -9999 and 0.

Such large gaps in pixel values create an artificially wide dynamic range that may cause output images to appear dark. For more information on dynamic range, see Dynamic Range Metadata Generation on page 83. To ensure that output images display correctly, ensure that the no-data value is specified in the metadata before you compress the image. If the no-data value is not in the metadata, you can manually specify the no-data value in the **No-Data** field of the **Quantization** tab.

Security options

GeoExpress enables you to lock your encoded MG2 and MG3 files with a password. MG4 does not support security options.



The **Security** tab provides the **Protect encoded image with a password** option. If you enable password protection, you can then choose whether or not to show the password with the **Hide typing** option.

Notes

There is no way to access a password-protected file if you forget the password.

The password is kept in the project file and stays with the project. Although a useful data protection feature, this is not a fully robust file security solution.

GeoExpress does not allow password-protected files to be used as input.

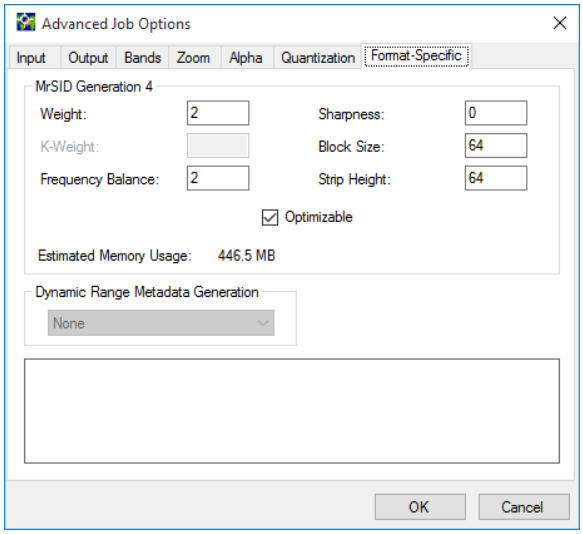
Only image data is encrypted; geocoordinates and other metadata are still accessible in password-protected files.

Format-specific options

Advanced MG4 options

You can use the options for the MG4 output format to configure the display of an image, configure performance, and generate dynamic range metadata.

The following figure displays the options that you can select for the MG4 output format:



NOTE: Since MrSID Generation 4 does not support CMYK content, the K-Weight option will not be enabled for MG4 output.

Weight

The **Weight** setting is treated the same for MG2, MG3, and MG4 outputs.

Weight affects the grayscale portion of a color image, which is the part of the image with no color information. A higher weight setting increases the emphasis on this grayscale aspect of a color image, while decreasing emphasis on color quality. A lower setting increases the consistency of color between the MrSID image and the original data.

Images with high color contrast will benefit from a lower weight setting. Images with greater detail benefit from a higher weight setting.

Acceptable values: 0.0–10.0

Default: 2

Frequency Balance

The **Frequency Balance** setting is the same for MG3 and MG4 output.

Determines the emphasis given to edges and flat areas in color and grayscale images. Images requiring precise edge definition will benefit from a lower setting. If precise edges are not as important as consistency in flat color areas, increase this setting. The practical range of values is 0.1 to 10 where 0.1 represents maximum edge definition with less emphasis on flat areas, and 10 represents minimum edge definition with smoother areas of relatively consistent color.

Acceptable values: 0.0–10.0

Default: 2

Sharpness

Sharpness is the same for MG3 and MG4 outputs.

Determines the sharpness of boundaries between different areas of an image. Images with large amounts of textured area (where color or intensity changes are occurring throughout a region, rather than just at a boundary) will benefit from a lower setting. Use a higher setting for images with little textured areas. The range of values is 0.0 to 1.0 where 0.0 represents minimum sharpness and 1.0 represents maximum sharpness.

Acceptable values: 0.0–1.0

Default: 0.0

Block Size

Block Size is the same for MG3 and MG4 outputs.

GeoExpress accesses image data in “blocks” of pixels.

IMPORTANT: Blocks in MG3 and MG4 encoding are different from blocks in MG2 encoding. The block size parameter in MG3 controls how large the bitplane-encoded regions are. Lowering this parameter may lower the memory usage of the encoder but may also decrease the lossless compression ratio. Raising this parameter may increase memory usage, but may improve the lossless compression ratio. This parameter has little effect on overall encode time. Typical values range from 32 to 64.

Acceptable values: 5–64

Default: 64

Strip Height

Strip Height is the same for MG3 and MG4 outputs.

Strip height affects performance and memory usage. The strip height parameter controls how many rows of the input image are processed at one time. Lowering this parameter may reduce memory usage, but may increase the encoding time. Raising this parameter may increase memory usage, but may also decrease encoding time. Unlike the block size, changing this parameter will not have any effect on the compression ratio of the output image.

Typical values range from 2 to 128. The encoder may perform more efficiently if the block size is a multiple of the strip height.

Acceptable values: even integers between 2 and source image height

Default: 64

Optimizable

The **Optimizable** option performs the same for MG3 and MG4 outputs.

Determines whether the output MrSID file contains optimization data. By default the **Optimizable** option is enabled.

The option for optimizing images is specific to MG3 and MG4 files. When you optimize an image, you make it possible to perform some image manipulation operations on the image without re-encoding or recompressing the image. Image manipulation operations that benefit from optimization include the following:

- Resampling
- Cropping
- Demosaicking
- Area of interest encoding

Creating an optimized image does not affect encoding time. However, saving optimization data for an image modestly increases the size of an image by approximately one to five percent. If image size is critical and you do not plan to perform further image manipulation operations, deselect the **Optimizable** option.

Dynamic Range Metadata Generation

To improve the appearance of MrSID images in other GIS programs, use GeoExpress to write dynamic range metadata for images.

You can generate dynamic range metadata for all images with the exception of eight bit images. For an image where the dynamic range is less than the full range of possible values for the image, you can use your GIS program to stretch the pixel values across the full range. For example, if you have a 16-bit image and the dynamic range is 11 bits, then you may want to use dynamic range stretching to improve the appearance of the image.

Dynamic Range Generation methods

To calculate the dynamic range of an image, select a dynamic range generation method.

RGB: Calculate the minimum and maximum dynamic range values for an image with red, green, and blue bands. Select the **RGB** method to minimize color shifting for RGB images. When you select the **rgb** method, GeoExpress calculates the combined dynamic range of the red, green, and blue bands.

Merged: Calculate the minimum and maximum dynamic range values for an image with multiple bands. Select the **Merged** method to preserve the proportions of pixel values across bands. For example, if you want to compare multiple bands in a multispectral image, you may want to select the **Merged** method. When you select the **merge** method, GeoExpress calculates the combined dynamic range of all bands.

Per-Band: Calculate the minimum and maximum dynamic range values for an image with one or more bands. Select the **Per-Band** method to calculate the dynamic range of each band individually. For example, if you have a multispectral image and you only want to view one band at a time, select the **Per-Band** method. When you select the **per-band** method, GeoExpress calculates the dynamic range of each band separately.

None: Do not calculate the dynamic range of the image.

> **NOTE:** To enter the minimum and maximum dynamic range values manually, select **None** as the dynamic range generation method and edit the image metadata. For more information on entering dynamic range metadata manually, see Image metadata on page 34.

Automatic and Strict dynamic range

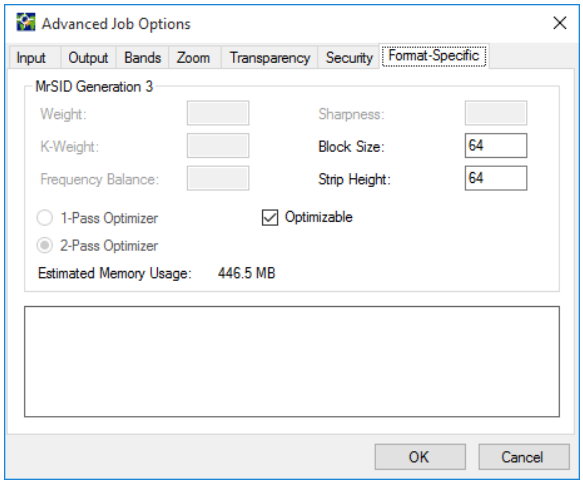
For 16-bit images with unsigned integer data, you can select either **Automatic Range** or **Strict Range**. 16-bit images with signed integer data and all 32-bit images use the **Strict Range** option. The following list describes the two ranges that you can select:

- **Automatic Range**: Set the maximum value to the estimated bit-depth and set the minimum value to zero. The estimated bit-depth is the next whole number of bits that contains the calculated maximum value in the image. For example, if the maximum value in the image is 3950, GeoExpress estimates that the image was taken with a 12-bit camera and sets the maximum value to 4095. Because GeoExpress sets a wider dynamic range for the image, you can minimize color shifting when you display the image.
- **Strict Range**: Set the maximum and minimum values to the exact dynamic range values calculated by GeoExpress.

Advanced MG3 options

You can use the options for the MG3 output format to configure the display of an image, configure performance, and set optimization options.

The following figure displays the options that you can select for the MG3 output format:



Weight

For details, see Weight on page 82.

K-Weight

Determines the emphasis for the K band of a CMYK color image. CMYK imagery with high color contrast will benefit from a lower setting. A CMYK image with a high density of detail will benefit from a higher setting. The practical range of values is 0.0 to 10 where 0.0 represents minimum intensity (and maximum color consistency between the MrSID image and the original CMYK data) and 10 represents maximum intensity.

Acceptable values: 0.0-10.0

Default: 0.25

Frequency Balance

For details, see Frequency Balance on page 82.

Sharpness

For details, see Sharpness on page 82.

Block Size

For details, see Block Size on page 82.

Strip Height

For details, see Strip Height on page 83.

1-Pass or 2-Pass Optimizer

This option is only available for MrSID Generation 3 (MG3) images. The 1-pass and 2-pass optimizer parameters affect encoding performance and memory usage. Although not as fast as the 1-pass optimizer, the 2-pass optimizer requires much less memory because it splits the encoding operation into two passes. This is required for very large files.

Note that the **Estimated Memory Usage** value is only displayed when the 2-pass optimizer is used.

By default the 2-Pass Optimizer is used for Area of Interest encoding even if this option has not been selected.

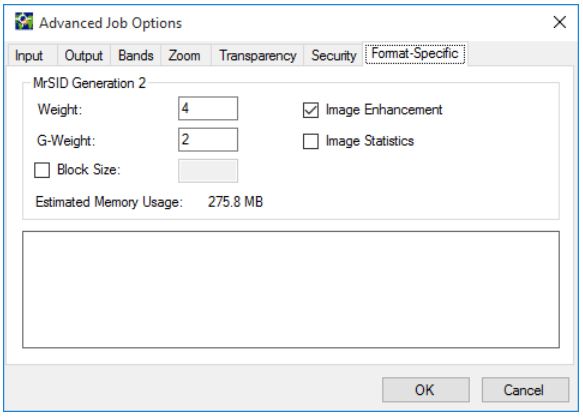
> **NOTE:** Encoding with the 1-Pass Optimizer is faster but requires that the entire image be loaded into memory. If the computer does not have enough memory, the job does not succeed.

Optimizable

For details, see Optimizable on page 83.

Advanced MG2 options

You can use the options for the MG2 output format to configure the display of an image, configure performance, and generate image statistics.



Weight

The settings for Weight and G-weight affect the color quality and line definition of encoded MrSID files. These two settings can be adjusted independently of one another. The Weight setting does not affect grayscale images whereas the G-weight setting affects both color and grayscale images.

For details, see Weight on page 82.

G-Weight

The G-weight parameter increases or decreases the definition of edges in an MG2 image. A lower setting for G-weight creates more defined edges with less emphasis on flat areas. A higher setting creates softer edges while smoothing the image in flatter areas with relatively consistent color.

In applications requiring precise edge definition, decrease the setting for G-Weight. If precise edges are not as important as consistency in flat color areas, increase the setting for G-Weight.

Acceptable values: 0.0–10.0

Default: 2

Block Size for MG2

MrSID accesses image data in “blocks” of pixels. Blocks in MG2 encoding are different from blocks in MG3 and MG4 encoding.

Different block sizes affect system resources. While a smaller block size in MG2 encoding uses less RAM, the opening and closing of multiple image blocks may impact a system in other ways, sometimes resulting in an encoding failure. If sufficient RAM is available, a larger block size is recommended for encoding projects approaching or exceeding a gigabyte in size.

By default, GeoExpress automatically selects a block size for MG2 encoding based on a calculated memory usage curve that is dependent on the input image. The default block size corresponds to the lowest point in the memory curve.

Block size may be set manually by selecting the **Block Size** option and entering a value in the field. When compressing imagery in excess of a gigabyte in size, use a block size of 1024. For imagery equal to or greater than three gigabytes, a block size of 2048 is recommended.

Changing the block size setting will not affect the rate of compression or the quality of the output image.

Minimum value: 32.

Image Enhancement

The **Image Enhancement** option improves the appearance of some images by adding information to the images. This means that pixels of different colors are added to the areas of flat color to make the artifacts less visible to the eye. The appearance of the resulting images may appear softer. This option is particularly useful for images that have large areas of similar color or continuous tone, such as a large blue sky, or a single background color where artifacts may become perceptible.

By default, image enhancement is enabled. LizardTech recommends that you experiment with a variety of images to determine which images benefit from this option.

Image Statistics

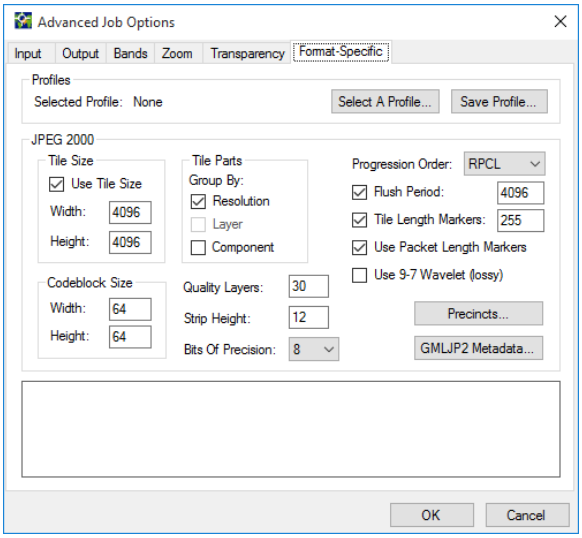
The **Image Statistics** option collects basic numeric statistics about the image's samples. Data collected includes the minimum, maximum, mean, and standard deviation of the samples for each band. The metadata tags that are added to the output file are:

```
IMAGE::STATISTICS:MAX
IMAGE::STATISTICS:MEAN
IMAGE::STATISTICS:MIN
IMAGE::STATISTICS:STANDARD_DEVIATION
```

By default, image statistics is disabled.

Advanced JPEG 2000 options

For JPEG 2000 images, you can select JPEG 2000 profiles and other options.



IMPORTANT: The information included below is provided with the assumption that the user is familiar with the JPEG 2000 standard. Parameter choices accommodated by the JPEG 2000 specification are of such a broad and varied range that it is possible for users to select settings that prove counterproductive to their goals. In particular, some optimal settings can result in degraded decode performance. Considerable trial and error may be required to achieve desired results when diverging from defaults and recommended settings.

NOTE: A JPEG 2000 image consists of one or more tiles, which are regions of the image that are compressed independently. The order of the resulting "packets" is governed by two settings: **Tile Parts** and **Progression Order**. These settings are especially useful to those who need to target specific JP2 workflows.

Profiles

This panel enables you to invoke a list of supported profiles comprised of preset encoding options for particular workflows, and to save your own custom profiles. For more information see Using JPEG 2000 profiles on page 91.

Tile Size

If enabled, the tile size must be no larger than the dimensions of the source image. Smaller tiles reduce the amount of memory required to encode the image, however the use of tiles may introduce edge artifacts.

Default: 4096 × 4096.

Tile Parts

Tiles may be written to the JPEG 2000 file sequentially or interleaved. When tiles are interleaved, Tile Parts defines the group of packets that are written together. Tile parts can be grouped by **Resolution**, **Layer**, or **Component**, depending on which **Progression Order** you use. If you don't specify a grouping option, the file will be written sequentially.

If an image consists of many tiles, then grouping first by **Resolution** allows a decoder to display a course resolution of each tile first, and then finer resolutions as more of the file is received.

Some **Progression Order** options preclude grouping by one or more of the **Tile Parts** options. For example, the factory default progression order of RPCL sets the **Tile Parts** option to **Resolution**, while making the **Layout** option unavailable and the **Component** option available.

Progression Order

Progression Order lets you specify the order in which packets will appear in a given file. This facilitates certain workflows. **Progression Order** may have a significant impact on the time and memory usage required to encode and/or decode the image.

Default: RPCL

Flush Period

When codestream flushing is enabled, less memory may be required to encode the image. The flush period should be on the order of the strip height being used. Using the flush period should not significantly affect output image quality.

Default: 4096

Tile Length Markers

Determines whether or not Tile Length Markers (TLMs) are to be put into the JPEG 2000 codestream. Use of TLMs may provide better decode performance.

Default: 255

Use Packet Length Markers

Enables or disables the use of packet length markers. Use of packet length markers may improve decoding performance.

Default: Enabled

Use 9-7 Wavelet

Specifies that the floating point 9-7 wavelet be used for encoding, instead of the default integer 5-3 wavelet. The 9-7 wavelet will not encode an image losslessly, however, it may result in a better looking image at higher compression ratios. This option is disabled by default and is only available when the **Encode Losslessly** option is not selected. By default, the NPJE and EPJE profiles use the 9-7 wavelet.

Codeblock Size

JPEG 2000 codeblock size is subject to the following restrictions:

- width and height must be powers of two
- width and height must be greater than 4
- width × height must be less than 4096
- width and height must be less than width and height of tile size
- width and height must be less than width and height of the image if tile size is not specified

The default codeblock value is 64 × 64.

Quality Layers

This value indicates the number of quality layers with which to encode the image. Among other things, quality layers enable better “streaming” (progressive transmission and display) in some applications.

Default: 30

Strip Height (JP2)

Affects memory usage. Increasing this value may improve runtime performance, but at a cost of requiring more physical memory. This value should be decreased when encoding very large images. Changing the strip height does not affect the quality of the output image.

Default: 12

Bits of Precision

Enables you to choose how many significant bits are to be used from the samples of the source imagery. For example, an image may consist of 16-bit data values, but only eleven of those bits may be meaningful.

Default: Enabled

Default JP2 settings

The table below lists GeoExpress's default JP2 settings.

To change these settings, see Preferences on page 106.

OPTION	SETTING
Use Tile Size	Enabled
Tile Size	Width: 4096 Height: 4096
Tile Parts	Group by resolution (R)
Code Block Size	Width: 64 Height: 64
Use Precincts	Enabled
Precinct Size	Width: 256 Height: 256
Strip Height	12
Quality Layers	30
Flush Period	Enabled; value: 4096
Tile Length Markers	Enabled; count: 255
Use Packet Length Markers	Enabled
Use 9-7 Wavelet (lossy)	Disabled
Progression Order	RPCL
Use GMLJP2 Metadata	Enabled

Precincts

Using precincts may improve the performance of decode operations for certain image encodings such as those in which tiles are not used. The **Precinct Editor** enables the user to enter precinct sizes for all of the zoom levels of the image.

Default: GeoExpress uses precincts in which width and height values are both 256.

To access the **Precincts Editor**:

1. Select **JPEG 2000** as the output format.
2. Click **Precincts** on the **Format-Specific** tab of the **Advanced Job Options** dialog.
   This opens the **Precincts Editor** dialog.

To disable use of precincts, deselect the **Use Precincts** option.

To edit a precinct value:

1. Open the **Precinct Editor** as described above.
2. Select a precinct number in the precinct list and click **Edit Precinct**. A new editing dialog appears.
3. Change width and height values and click **OK**.

Precinct sizes must be powers of two, except for the last one in the list, which has the lowest resolution.

GMLJP2 Metadata

Click the **GMLJP2 Metadata** button to write GML metadata to the JPEG 2000 image or to specify a GML data file.

When you enable the GMLJP2 option, GML metadata is added to the output file according to the GMLJP2 Application Schema version 3.1.1., which can be found at http://schemas.opengis.net/gml/.

If you would rather use an external file that contains all the coverage and other GML data, you may specify that file by deselecting the **Write GMLJP2 metadata box** option.

By default this option is enabled.

Evaluation order of metadata

If an external world file is present, its information trumps any metadata. Absent a world file, metadata are evaluated in the following order of priority:

1. GMLJP2
2. GEOJP2/GEOTIFF
3. MrSID metadata
4. World file metadata

NOTE: If a world file is present, then no coordinate reference system is associated with the output file (a NULL WKT is applied).

Using JPEG 2000 profiles

GeoExpress includes a selection of industry accepted profiles—groups of preset JPEG 2000 encoding options for particular workflows—and an interface for managing them. The **Profile Manager** enables you to select and edit profiles and create and save new ones.

Accessing the Profile Manager

1. Make sure you select JPEG 2000 as the output file format.
2. Click **Advanced** on the **Job Properties** panel.
3. Click the **Format-Specific** tab.
4. Click the **Select A Profile** button in the **Profiles** panel.
   The **Profile Manager** appears.

Selecting a profile

In the **Profile Manager**, select a profile from the drop-down menu and click **OK**. The selected profile is listed on the **Format-Specifc** tab and the options are set to match the profile.

Preloaded profiles

GeoExpress provides profiles composed of preset encoding options for particular workflows. These are EPJE, NPJE, Large Image, Large Image without TLMs, and Default. In the current implementation of GeoExpress, the EPJE profile is identical to the NPJE profile except for progression order. The profile named Default is not the same as the default GeoExpress encode settings.

When you select a profile from the drop-down list, it may display a user-defined description in the **Description** field to help identify it. Click **OK** to apply the selected profile.

You can also choose to load a custom profile stored anywhere on your network.

NOTE: Selecting **(None)** from the profile list sets the JPEG 2000 options to the defaults set in the GeoExpress preferences.

EPJE

Stands for **Exploitation Preferred JPEG 2000 Encoding**. The EPJE profile sets the values to the encoding parameters preferred by the National Geospatial-Information Agency (NGA) for image exploitation.

NPJE

Stands for **NGA Preferred JPEG 2000 Encoding**. The NPJE profile sets the values to the encoding parameters preferred by the National Geospatial-Intelligence Agency (NGA) for archiving.

Large Image

This profile is optimized for encoding very large images.

Large Image w/o TLMs

This profile disables tile length markers for better rendering in viewers that don't support them.

Default

This profile represents LizardTech's general purpose JP2 encode settings, determined at the SDK level. These are NOT the same as the GeoExpress factory default encode settings, which are recommended for large images. See Default JP2 settings on page 90.

NOTE: The NPJE and EPJE standardization process is not yet complete. These profiles use settings that are compliant with the NPJE and EPJE standards as the NGA currently defines them; however, if the specifications for the standards change, files encoded using the current NPJE and EPJE profiles may not be compliant with the finalized standards. As the standards evolve, LizardTech will make available updated profiles (XML files) to reflect any changes to the standards. Contact your LizardTech sales representative to learn more.

Modifying a profile

After you select and apply a profile, the profile name appears in the **Selected Profile** field on the **Advanced** tab. If any encode settings are modified after applying a profile, the **Selected Profile** field indicates that the current settings differ from the original profile settings, unless no profile was selected. For example, if you apply the EPJE profile and change one or more options, the profile is now listed as EPJE (modified).

Saving custom profiles

You can save the current encode settings as a custom profile.

1. On the **Format-Specific** tab of the **Advanced Job Options** dialog, click **Save Profile**.
2. Enter an output file name and a name for the profile if desired.
3. Optionally, add a description.
4. Click **OK**.

You can only save a profile if all of the encode parameters are discrete and unambiguous values. The default location for user profiles on Windows is `C:\Documents and Settings\<user name>\My Documents\LizardTech\GeoExpress\<version>\profiles`. Any profiles in this directory will automatically be available in the profile selector's drop-down list. To save a profile, you must enter a unique profile name.

Loading custom profiles

1. Access the **Profile Manager** as described above.
2. Click **Load Custom Profile** and browse for the desired custom profile, then click **Open**.
3. Optionally, add a description and click **OK**.

Notes on profiles

A profile is a collection of settings, not a singular entity. After a profile is applied to a job, only the particular settings—not the profile—are saved in the job. The profile itself is stored on disk. If a profile is edited or deleted after it is applied to a job, those changes are not retroactively applied toward any existing encode jobs.

Not all of the settings in the dialog are preserved in a profile—only the ones that affect how the output file is encoded. Most notably, thumbnail size and strip height are not included in the profile system. Profiles are used to store information about what JPEG 2000 options were used in choosing the organization of the file format (algorithmic codec settings), not encoder implementation choices. Changing the strip height or thumbnail size does not affect the layout of the file, since they are really encoding performance parameters.

JPEG 2000 images

JPEG 2000 overview

GeoExpress enables your applications to use JPEG 2000 compression on geospatial images with the same level of efficiency, metadata, and large-image support already available with MrSID. JPEG 2000 image compression offers many of the advantages implemented in the MrSID format, plus the added benefits of being an international standard (ISO/IEC 15444).

All of the basic options and some of the advanced options that are available for MrSID encoding are also available for the JPEG 2000 format. Certain advanced operations such as creating and updating composites and optimizing images are not available for JPEG 2000 encoding.

JPEG 2000 output selections

GeoExpress supports encoding JPEG 2000 files in two different modes, **GMLJP2** and **Part I**. By default GeoExpress uses GMLJP2, which is the best option for most workflows. For applications that do not support GMLJP2, the Part I mode generates files that do not use any Part II extensions. GMLJP2 metadata is not available in this mode. Other encoding features, such as the use of NPJE profiles and other metadata forms, are still available. Use the Part I mode only when you are sure that the image user's workflow entails applications that cannot read GMLJP2 files.

The two modes are included as options in the **Output Format** drop-down list. For convenience when creating mosaics, this drop-down list also appears on the **Create New Mosaic** dialog.

JPEG 2000 encoding utilizes the same data cartridge deduction mechanism that MrSID encoding does (see Frequently Asked Questions on page 139 and Data cartridges on page 133). Operations involving only MrSID and/or JPEG 2000 input files do not decrement the cartridge.

GML and GMLJP2

GeoExpress allows Geography Markup Language (GML) metadata to be added to JPEG 2000 (JP2) imagery to comply with the Open Geospatial Consortium (OGC) GMLJP2 standard.

What are GML and GMLJP2?

GML (Geography Markup Language) is an open, XML-based specification for representing geographic information including geographic features, coverages, observations, topology, geometry, coordinate reference systems, units of measure, time and other values. Because it is an XML grammar, it is both extensible and adaptable to any application within the broad geospatial field.

As a wavelet-based image compression format, JPEG 2000 (JP2) is capable of handling images into the gigabyte range and beyond. But until recently, JP2 was not particularly suited to the needs of the geospatial community because it didn't have a designated geospatial metadata standard. However, because the JPEG 2000 format allows for the inclusion of XML data, GML has emerged as the ideal partner for JPEG 2000 imagery, bridging the gap between JP2 and GIS.

GMLJP2 is the specification that standardizes that partnership and opens the door for greater interoperability between your imagery and the thousands of current and future geospatial applications that might use it. Containing its own geographic metadata, your JP2 imagery becomes “spatially aware” and is thus of increased value in geospatial applications. Prior to the adoption of GMLJP2, the lack of a geospatial metadata standard meant that applications and viewers may or may not have been able to read geospatial metadata in a JPEG 2000 file.

What kind of standard is GMLJP2?

The GMLJP2 specification was officially adopted in February 2006 by the Open Geospatial Consortium (OGC) as an open standard for representing geographic information in JPEG 2000 imagery. LizardTech supports open standards and is committed to the success of the GMLJP2 specification.

Jointly proposed and developed by LizardTech, Galdos Systems and a consortium of forward-looking aerospace and technology companies, GMLJP2 represents the most advanced means of including geographic metadata within compressed geospatial imagery and making that information useful in downstream applications now and in the future.

GMLJP2 in GeoExpress

GeoExpress already offers the most complete and easy-to-use implementation of the open JPEG 2000 standard. Now, your JP2 imagery encoded with GMLJP2 metadata is secure for the future because, like JPEG 2000, the GMLJP2 specification is an open, non-proprietary standard.

NOTE: Some applications that support JPEG 2000 do not support all of the features that are required to implement the GMLJP2 standard. For more information, see JPEG 2000 output selections on the previous page.

The GML option is available among the metadata control settings of the advanced JPEG 2000 options (see GMLJP2 Metadata on page 91).

Links

Learn more about the GML and GMLJP2 specifications at http://www.opengeospatial.org/specs/?page=specs.

The GMLJP2 Application Schema version 3.1.1. can be found at http://schemas.opengis.net/gml/.

JPEG 2000 and color spaces

JPEG 2000 images can be created with an essentially unlimited number of bands, so multispectral output can be created from multispectral input without having to go through an output color space. For JPEG 2000 encoding, the color compositor allows multibanded images to be created from files representing individual bands.

For more information see Creating multiband JPEG 2000 files on the facing page.

Encoding with alpha bands in JPEG 2000

JPEG 2000 supports the use of an alpha band or channel for masking out portions of an image. GeoExpress supports creating alpha bands in JPEG 2000 files where the TIFF or JPEG 2000 source image has an alpha band.

When an image that has an alpha band is encoded to the JPEG 2000 format, GeoExpress encodes the alpha band losslessly to preserve its integrity.

NOTE: For users of GeoExpress Standard Edition, the encoding of the alpha band does not additionally decrement your data cartridge. Your encode job will be metered the same with or without alpha bands.

Creating multiband JPEG 2000 files

GeoExpress allows the creation of multiband JPEG 2000 files from a collection of single-band grayscale image files. The input files must all have the same dimensions, resolution, bit depth, and geographic positioning. Empty bands are allowed, and treated as zero data.

1. Select **Add color composite image to encode** from the **File** menu.
   This opens the **Add Color Composite Image** dialog.
2. Select a color space for the image from the drop-down menu, either **RGB** or **Multispectral**. RGB populates the list box with editable red, green, and blue bands. Multispectral populates the list box with bands that range from 1 to n. You can change the number of bands in a multispectral image by clicking **Edit number of bands** and typing in a new value.
3. To add an image file to a band, select the desired band and then click **Edit file name**. This opens the **Edit File Name** dialog.
4. Type in a file name or click **Browse** to bring up a file browser. If you want to remove a file from a given band, simply clear the text from the file name field. A color composite image must have at least one band specified.

For information on NITF image segments in color composite images, see Using a NITF image segment as a component band in a color composite image on page 97.

NITF images

This chapter offers information about how to create National Imagery Transmission Format (NITF) images with GeoExpress.

The acronym NITFS sometimes seen refers to the NITF standard, which was created by the Department of Defense as a means of formatting digital imagery and imagery-related products and exchanging them among members of the intelligence community, the Department of Defense (DOD), and other government departments and agencies. NITF was created partly because government agencies needed a single common image representation that supported certain metadata features and workflows. While it is called an image format, NITF is perhaps more precisely described as a file format that wraps image files and metadata about those files.

The NITF format requires information to be entered in numerous metadata fields on several forms. For NITF JPEG 2000 encoding, you can edit the metadata fields—as well as the LizardTech metadata tags—in the **Metadata Manager**.

For details about how GeoExpress saves NITF metadata, see NITF metadata on page 40.

NOTE: When you use a NITF file as an input image, sometimes the band order of the image does not match the band order in the metadata. If this is the case, GeoExpress changes the order of bands in output images to match the metadata band order.

NITF compliance in GeoExpress

GeoExpress supports the following NITF standards:

- Version 2.1 of the NITF file format (MIL-STD-2500C, May 2006, plus change outlined in RFC NTB-038) for writing
- Versions 2.1 and 2.0 of the NITF file format for reading
- Version 01.10 of the BIIF Profile for JPEG 2000 (BPJ2K01.10, April 2009) including the J2KLRA TRE
- Version 2.1 of the Commercial Dataset Requirements Document (NCDRD STDI-0006, February 2010)
- Version 1.0 of the Implementation Practices of NITF (STDI-0005 IPON v1.0, August 2007)
- Version 00.20 of the JPEG 2000 Test Plan (BPJ2K01.00 Test Plan Draft Version 00.20, March 2010)

NOTE: These NITF standards may change and future releases will track the evolution of these standards to ensure interoperability.

NITF output options

You may select NITF 2.1 as an output format from the **Output Format** drop-down list, which appears in two places:

- The **Job Properties** tab for a selected job, and
- The **Create New Mosaic** dialog.

Two different types of NITF encoding are available: raw (uncompressed) and JPEG 2000.

Raw NITF

Because raw files are uncompressed, when you select NITF 2.1 (Raw) as the output format encode ratio, target file size and other options are not available, and there is no **Format-Specific** tab in the **Advanced Job Options** dialog. Metadata editing is not supported for raw NITF encoding.

JPEG 2000 NITF

When you select NITF 2.1 (JPEG 2000) as the output format, the source imagery is encoded to JPEG 2000 and all of the JPEG 2000 encoding options become available. The options common to MrSID formats are displayed on the **Job Properties** panel. These and all of the options specific to JPEG 2000 are available on the **Format-Specific** tab of the **Advanced Job Options** dialog. For more information about these options, see Advanced JPEG 2000 options on page 88.

Setting NITF as the default output format

You may specify NITF 2.1 as your default output format by selecting it from a drop-down list on the **General** tab of the **Preferences** dialog. For more information, see Preferences on page 106.

Multisegment NITF images

Using multisegment NITF files as input

To be valid, the image segments comprising an incoming NITF file must be mosaickable. They must have compatible resolutions, color spaces, and datatypes, and must all fall on the same coordinate space.

To view the image segments in a multisegment NITF image, right-click on the job in the **Job List** and select **NITF Image Segments**. You can remove segments from the output image by deselecting each image segment.

If no segments are selected, the input image is considered invalid.

When the image is encoded, the selected segments are mosaicked into a single flat image.

NITF mosaic tiles behave the same way as other image tiles in the encoding process; the selected segments of each tile are mosaicked together first, and then the tiles are mosaicked together for the final output.

Using a NITF image segment as a component band in a color composite image

To use a multisegment NITF file as a component band in a color composite image:

1. Choose **File > Add color composite image to encode**.
   This opens the **Add Color Composite Image** dialog.
2. Select **RGB** or **Multispectral** from the **Color Space** drop-down list at upper right.
3. Select a band and click **Edit File Name**.
4. Enter a file name or click **Browse** to locate the file, then click **OK**.
   If the file you selected is a multiple image segment NITF file, the **Image Segment Selector** dialog opens.
5. Select which 1-banded image segment of the selected NITF file you wish to use as the "active segment" for the selected band, then click **OK**.

Changing the active segment in a color composite Image

To change the active segment:

1. Choose **File > Add color composite image to encode**.
2. Click **Select Image Segment**.
3. Select a different 1-banded image segment from the drop-down list and click **OK**.

Creating multisegment NITF files

To create a NITF file with multiple image segments, the individual segments must be mosaickable. This is because they must be placed on a common grid. All of the mosaicking rules for other kinds of images apply to multisegment NITF images. For more information on mosaics, Mosaics below.

To create a multisegment NITF file:

1. Click the **Create New Mosaic** button on the toolbar.
   This opens the **Create New Mosaic** dialog.
2. Select **NITF** as the output format.
3. Select **Create multiple image segments**.

NOTE: Multisegment NITF encoding supports up to 999 image segments. If you attempt to encode more than 999 tiles as a multisegment NITF file, an error message informs you that you have exceeded the maximum number of image segments and asks whether or not you would like to flatten the input tiles first. Clicking **Yes** will result in a single image segment NITF file. This is equivalent to deselecting the **Create multiple image segments** option. Clicking **No** cancels the addition of that tile.

Mosaics

Mosaics overview

A mosaic is a group of images or point clouds that you want to view together. Each of the images or point clouds that make up a mosaic is called a tile.

You can manage the tiles in a mosaic to add tiles, remove tiles, or change the order of tiles. For raster images, you can also crop tiles.

For raster mosaics, you can perform the same manipulation operations that you perform for single images. For example, you can crop or despeckle a raster mosaic.

Creating a mosaic

NOTES
The process for creating a mosaic has changed from previous versions of GeoExpress.

- In GeoExpress 10, you select files to include in the mosaic, then specify the mosaic properties.
- Options for multiple projections and resolutions are automatically set based on the selected files.
- The format of the mosaic—raster or LiDAR—is determined automatically.
- By default, mosaics are sorted so that the highest-reolution image is at the top.

Use the **Create New Mosaic** button in the toolbar to create a mosaic. The mosaic options that you can select depend on the mosaic format that you select.

1. Click **Create New Mosaic** or choose **File > New Mosaic**.
2. Select files to add to the mosaic and click **Open**.
   You can select multiple files in the dialog, but you can also add more files later.
3. In the **Create Mosaic** dialog, you can fine-tune the mosaic settings. You can change these at any time.
   In the **Input File Summary** section, click **Edit** to add more tiles, rearrange tiles, or crop or change the projection of any tile. Learn more
   In the **Output File Settings**:
   - Click **Browse** to change the name and location of the output file.
   - Use the **Format** pop-up menu to change the output file format.
   - Use the **Projection** pop-up menu to change the projection of the output file.
     Initially, the menu lists recently-used projections. Use the search field at the top of the listing to narrow down a long list.
     If you need to use a different projection:
     a. Click **Full Search** to open the **Set Projection** window.
     b. Use the **Projection Source** pop-up menu to choose a list of standard projections.
     c. Choose a projection, then click **Set Projection**. Learn more
4. Click **OK** to create the mosaic.

In the **Job Properties** panel, you can:

- Click **Mosaicked** under **Modifications from Original** to edit the mosaic. Learn more
- Under **Output Settings**, you can change the output file type, location, and compression.
- Click **Options: Basic** under **Output Settings** to edit **Basic Job Options**. See: Raster job options on page 65 or LiDAR job options on page 67
- Click **Options: Advanced** under **Output Settings** to edit **Advanced Job Options**. Learn more

NOTE: Because images with different compression types and color lookup tables can be combined when multiple images are joined together, color lookup table information may not be reported for image mosaics.

Mosaic output formats

GeoExpress can create raster mosaics in MrSID Generation 2, 3, and 4 formats, and JPEG 2000, TIFF, and NITF formats. GeoExpress can create LiDAR mosaics in the MrSID Generation 4, LAZ, LAS, and BPF formats.

If you create a mosaic from existing MrSID images or JPEG 2000 images, GeoExpress does not deduct data from the data cartridge. For more information on output formats, see Supported output file formats on page 123.

MrSID raster mosaics

Use the MrSID file format to create flat mosaics and composite mosaics. A flat mosaic is a single image that you create from multiple input images. A composite mosaic is a group of images that display as a single image.

Flat mosaics

When you create a flat mosaic, GeoExpress creates a single image from the input tiles. Because a flat mosaic is a single image, it displays more quickly than a composite mosaic. You can perform any image manipulation operation on a flat mosaic that you can perform on a single image.

Composite mosaics

When you create a composite mosaic, GeoExpress creates a MrSID file that contains multiple input tiles. You can only create composite mosaics out of input tiles in the MrSID format. To create a composite mosaic out of images in other formats, first convert the input images to the MrSID format, then create a mosaic out of the MrSID files.

Because a composite mosaic is a container for existing files, you can create a composite mosaic without running an encoding operation. Use composite mosaics when you want to create mosaics quickly, for example, when you want to create mosaics from large input tiles.

A composite mosaic in the MrSID Generation 4 (MG4) format can only contain MG4 input tiles. A composite mosaic in the MrSID Generation 3 (MG3) format can contain MG3 and MG2 input tiles.

An MG4 composite mosaic contains an overview image for viewing at low resolutions. As a result, MG4 composite mosaics display more quickly than MG3 composite mosaics. However, MG4 composite mosaics may take slightly longer to create.

Multiresolution mosaics

A multiresolution mosaic is a raster mosaic made up of input images with different resolutions. When you create a multiresolution mosaic in any format, the resulting mosaic is a single image; in other words, it is a flat mosaic. The exception to this is the MrSID Generation 4 (MG4) format. You can create an MG4 composite mosaic out of multiresolution images if all of the input tiles are also in the MG4 format.

Mosaics with multiple projection systems

GeoExpress can create raster mosaics out of images with multiple projection systems. However, because images with different projection systems display discrepancies in their positioning, GeoExpress reprojects all of the images to the same coordinate reference system (CRS). By default, GeoExpress reprojects images to the WGS 84 projection system. To use a different projection system, see Reprojecting an image on page 62.

If one or more of the tiles in the mosaic does not have a valid CRS, or if you are using world files, you can manually assign a CRS to each tile by editing the mosaic. Learn more

JPEG 2000 raster mosaics

When you create mosaics in the JPEG 2000 format, GeoExpress runs an encoding operation that creates a single image from the input tiles. JPEG 2000 mosaics are equivalent to flat MrSID mosaics.

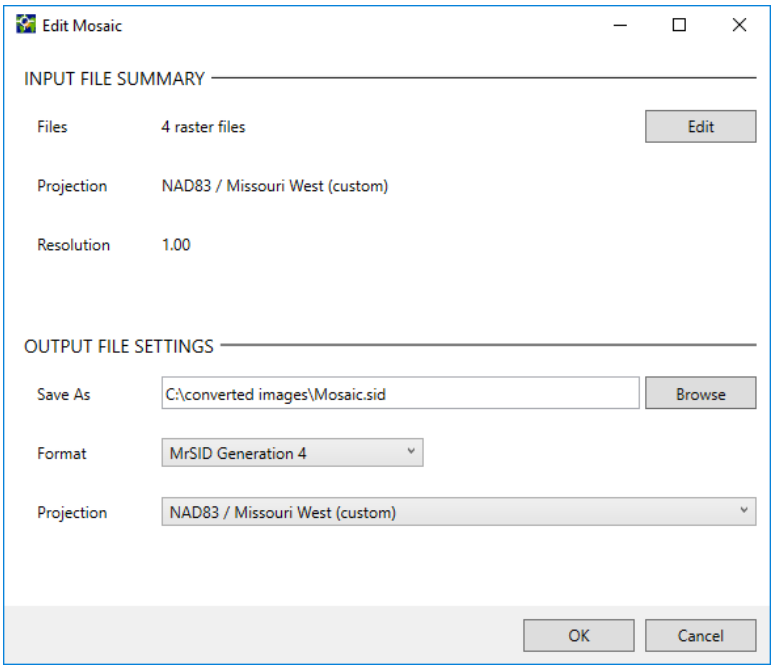
NITF raster mosaics

Use the NITF file format to create mosaics with single or multiple image segments. An image segment is an image in a NITF file. When you create a mosaic in the NITF file format, you can combine the input tiles into a single image or you can add each image to the NITF file separately. If you add images to the NITF file separately, the mosaic is called a multiple image segment mosaic. If you combine the input images into a single image, the mosaic is called a single image segment mosaic. A mosaic made up of a single image segment is equivalent to a flat MrSID mosaic. A mosaic with multiple image segments is similar to a composite mosaic in that it preserves the information from each input tile. However, multiple image segment mosaics require an encoding operation unlike composite mosaics, therefore they take longer to create.

Editing a mosaic

While you can perform basic operations on mosaics in the **Job List** and the **Job Properties** pane, the **Edit Mosaic** dialog allows you to:

- Add tiles.
- Remove tiles.
- Rearrange tiles.
  If tiles in a mosaic overlap, the mosaic displays whichever tile you place higher in the tile list.
- Crop the tiles in a raster mosaic.
- Assign a coordinate reference system (CRS) to individual tiles of a raster mosaic.
  All tiles must either have no CRS or some CRS assigned (even if they differ); you can't mix tiles with a CRS and tiles without a CRS.
- Change the output file destination, format, and projection.

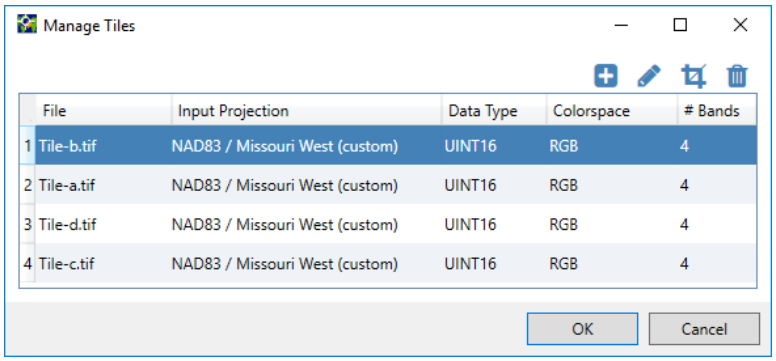


To edit a mosaic, select the mosaic in the job list and choose **Options > Edit mosaic**.

You can also right-click the mosaic and choose **Edit Mosaic** from the shortcut menu, or click **Mosaicked** in the **Modifications from Original** section of the **Job Properties** panel.

- To modify the tiles in the mosaic, click **Edit** under Input File Summary.
- To change the destination location, click **Browse** under Output File Settings.
- To change the output format, choose a format from the **Format** pop-up menu.
- To change the Coordinate Reference System of the output file, choose a projection from the **Projection** pop-up menu.
  Initially, the menu lists recently-used projections. Use the search field at the top of the listing to narrow down a long list.
  If you need to use a different projection:
  a. Click **Full Search** to open the **Set Projection** window.
  b. Use the **Projection Source** pop-up menu to choose a list of standard projections.
  c. Choose a projection, then click **Set Projection**. Learn more

Modifying tiles



- To add a new tile to the mosaic, click .
- To remove a tile, select the tile and click .
- To change a tile's projection, select the tile and click . Learn more
  You can set the projection for multiple tiles at the same time.
- To crop a tile, select the tile and click . Learn more
  You can only crop tiles in a raster mosaic, not a LiDAR mosaic.
- To reorder the tiles, use the shortcut menu. Right-click a tile in the list, then choose one of the move options:
  - **Move up**
  - **Move down**
  - **Send to top**
  - **Send to bottom**

  You can select multiple tiles and move them as a group.
- To resort tiles by the default sort, right-click a tile in the list and choose **Sort by resolution and time**.
  The highest resolution tiles will be at the top of the list. Of those tiles with the same resolution, the newest tile will be higher in the list.

Performing color balancing for a mosaic

Most raster image manipulation operations that you can perform are the same for mosaics and for single images.

However, when you perform color balancing for a raster mosaic you can also perform additional color corrections to match the appearance of tiles to each other. You can perform color balancing for mosaics with the following output formats:

- MrSID Generation 4
- MrSID Generation 3
- JPEG 2000
- NITF

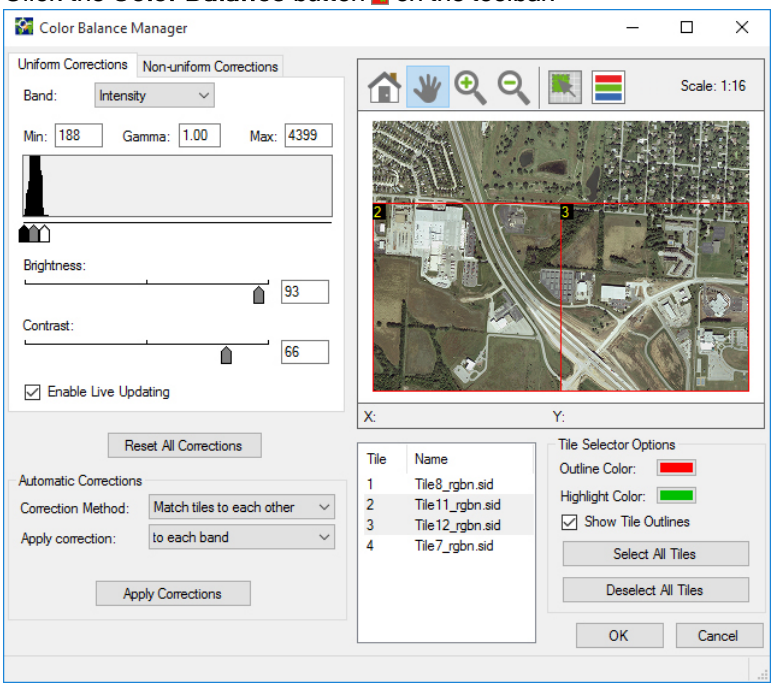
For the MrSID output formats, you can only perform color balancing for flat mosaics.

Applying corrections

When you perform color balancing for mosaics, you can perform uniform corrections, non-uniform corrections, and automatic corrections. You can apply corrections to the RGB bands or the Grayscale band, and you can apply multiple corrections to the same mosaic.

For more information on the types of corrections that you can apply, see Color balancing on page 58.

1. Select a mosaic in the **Job List**.
2. Click the **Color Balance** button on the toolbar.



3. Select the color balancing corrections that you want to perform and select the tiles to which you want to apply the corrections. Select tiles in the tile list or click the **Tile Select** button to select tiles in the preview image.
   - To perform uniform corrections, click the **Uniform Corrections** tab. Select one or more tiles that you want to correct. If you do not select a tile, the corrections that you perform are applied to all the tiles.
   - To perform non-uniform corrections, click the **Non-Uniform Corrections** tab and select one or more options.
   - To perform automatic corrections, select a **Correction Method** in the **Automatic Corrections** panel. You can choose to apply the correction to each band (the default) or to the intensity pseudo-band. Click **Apply Corrections**when you have specified your desired settings.

   NOTE: In versions of GeoExpress prior to v9.5.3, automatic corrections were applied to the Intensity pseudo-band. By applying the corrections to each color band, the colors of the resulting image are more uniform. This functionality is now the default behavior, but if you need to utilize corrections similar to earlier versions of GeoExpress, choose **intensity band** from the **Apply correction** menu.

4. Click **OK**.

NOTE: Uniform corrections will be more effective among image tiles composed of similar ground cover types than, for example, an array of tiles showing dense urban development and vegetation or bodies of water, and may require additional manual manipulation to make the tiles match their neighbors. Automatic corrections work on a tile by tile basis, so any boundaries, seams, or lens effects that occur inside of a tile will still be visible regardless of uniform corrections.

Previewing a mosaic

Select a raster or LiDAR mosaic in the **Job List** and click the **Output Preview** tab to preview all the tiles in the mosaic, or select one or more tiles in the **Job List** that you want to preview.

For raster mosaics, when you select bands using the **Band Selector** button, your selections apply to all of the tiles in the mosaic, even if only one tile in the mosaic is selected.

When you crop a raster mosaic, the preview image only displays the cropped area of the image. If you select a tile in the **Job List** that is not included in the cropped area of the image, the preview image is blank.

For more information about previews, see Output Preview panel on page 19.

Updating a MrSID image

For raster mosaics, you can create a composite mosaic to update one part of an image with new imagery. This is useful when, for instance, a particular region of an aerial photo mosaic needs to be updated because of building development or other geographic changes but an entire new image set is not needed. By updating just the affected image tiles geospatial image users can keep pace with geographic changes without constantly acquiring new image data for every region.

To update an image, create a new raster mosaic and select the composite mosaic option.

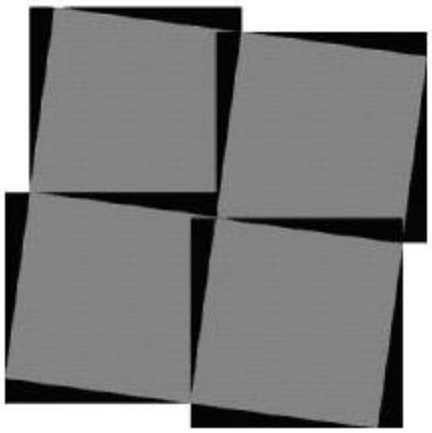
Mosaics with overlapping input

If two or more tiles in a raster mosaic overlap, the resulting mosaic displays whichever tile you place higher in the **Job List**.

If you create a mosaic out of overlapping tiles and the tiles are compressed images, despeckle the tiles to minimize compression artifacts between image tiles. For more information, see Despeckling on page 44.

If the transparency borders of individual tiles obscure image data in neighboring tiles, set transparency values for the mosaic. For example, when images are geographically rectified to align accurately with a fixed point such as magnetic North, the images appear tilted and contain borders of transparency along the edges. For more information on setting transparency values, see Alpha band options on page 76 for MG4 mosaics or Transparency options on page 78 for other output formats.

The following figure shows an example of a mosaic with overlapping transparency borders:



Mosaics with GeoTIFF images

If you create a mosaic that contains GeoTIFF images, you can select the georeferencing information that you want to use. A GeoTIFF image can store georeferencing information in a TIFF world file and in embedded metadata. If the GeoTIFF image has georeferencing information stored both in a world file and in its metadata, GeoExpress uses the embedded metadata by default. To use the georeferencing information in the world files, select the **Allow World Files to Override Native Georeferencing** preference. For more information on setting preferences, see Preferences on page 106.

If you encode a GeoTIFF image using georeferencing information from a TIFF world file, other spatial referencing information such as the coordinate reference system (CRS) found in the GeoTIFF metadata tags is saved in the MrSID metadata. In a mosaic composed of both TIFF and GeoTIFF images, GeoExpress saves metadata in the mosaic if the first input tile is a GeoTIFF image with metadata.

Creating a mosaic with a mosaic list file

Rather than use GeoExpress to select images or point clouds that you want to mosaic, you can create a text listing the images and point clouds that you want to mosaic. For raster mosaics, the text file must have a `.mos` extension. For LiDAR images, the file must have a `.list` extension.

To add a mosaic list file, complete the following steps:

1. Click the **Create New Mosaic** button on the toolbar.
2. Select a mosaic list file: `.mos` for raster mosaics, or `.list` for LiDAR mosaics.
   To filter only mosaic list files, type `*.list;*.mos` in the File Name field of the dialog.
3. Click **Open**.

This create the mosaic and opens the **Edit Mosaic** window. Learn more

Images with Georeferencing

For georeferenced images and point clouds, the text in the mosaic list file contains the file paths of the images that you want to mosaic. In the following example, a mosaic is created from four TIFF files: image_nw.tif, `image_ne.tif`, `image_sw.tif`, and `image_se.tif`.

Ensure that each image has an associated `*.tfw` file (the names of the corresponding files must match exactly, differing only in the `.tfw` file extension). This `*.tfw` file must be in the same directory as the file to which it refers. A sample file for this project is:

```
C:\maps\image_nw.tif
C:\maps\image_ne.tif
C:\maps\image_sw.tif
C:\maps\image_se.tif
```

When presented with a list of images, GeoExpress immediately looks for corresponding georeferencing information. The “Input File Size” and “Target File Size” reflect both the on-disk size of the source data and the estimated output file size of the full mosaic. When encoded, the images are combined in a seamless mosaic based on the information given in the georeferencing files.

NOTE: GeoExpress does not recognize mosaic list files with spaces in either the listed file names or in the listed paths. In addition, the first line in the file cannot be blank and the last line in the file must be followed by a carriage return.

Images without Georeferencing

When creating a raster mosaic using images with no georeferencing information, the text file must list the file names and the upper left corner pixel location for each image. Each image must be listed based on the following format:

```
image_name x-pixel_location y-pixel_location
```

Only a single space is required between each of the three items in the list. Each image listed must be on a separate text line.

Base the upper left corner pixel location of each image on the location of the image relative to an x=0, y=0 pixel location of the upper left corner of the entire set of images.

Consider an example where a single image is being created from four separate scanned Sun Raster images, each 640 by 480 pixels in size.

The file requires the following four lines:

```
image_nw.ras 0 0
image_ne.ras 640 0
image_sw.ras 0 480
image_se.ras 640 480
```

The first line in the file must not be left blank.

The sample auxiliary file above joins the specified images as follows:

Tips for encoding large mosaics

Tips for using less memory

- Reduce the **Strip height** to lower memory usage. (2 is the smallest).
- If that still uses too much memory, reduce the **Block size** to 32.

Tips for making it run faster

- Wherever possible, work with local files rather than files on a network share.
- Encoding mosaics is very I/O intensive; fast disks on a fast bus will greatly improve encoding performance, especially of large mosaics.
- File systems should use smaller block sizes. GeoExpress does lots of small reads of data so large file system blocks add lots of overhead to the small data reads.
- If reprojecting, set the **Strip height** to 2048 (the reprojection block size default) if the system has enough memory.

Preferences

Setting preferences

Every time that you create a job by adding an image or mosaic to GeoExpress, the job uses a set of default options.

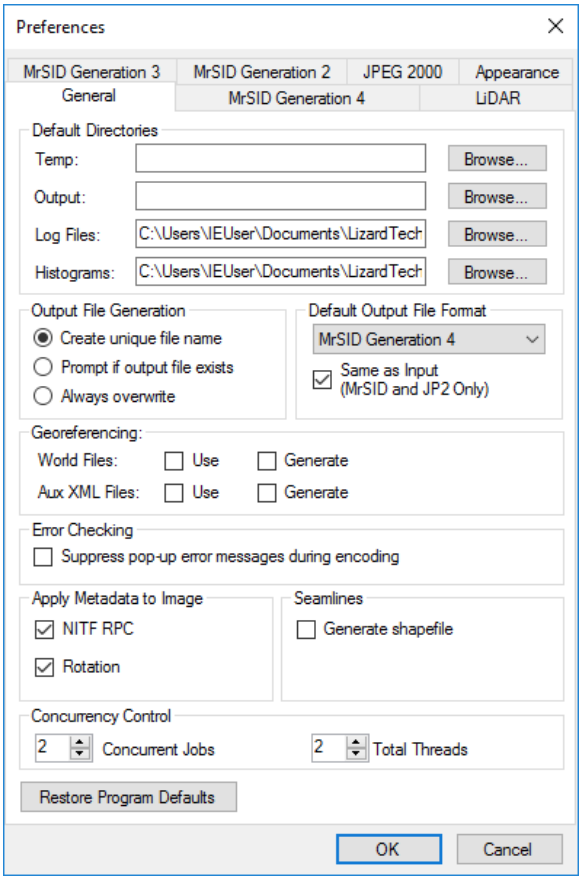
To change default job options:

1. Choose **Options > Preferences**.
2. Click a tab to set preferences for that category.
   Preferences pertaining to most job types are in the **General** and **Appearance** tabs.
   Preferences for raster jobs can be accessed through the **MrSID** and **JPEG 2000** tabs.
   Set preferences for LiDAR jobs in the **LiDAR** tab.
3. When you are finished, click **OK**.

NOTE: To restore the default preferences for GeoExpress, click **Restore Program Defaults**.

General and Appearance preferences

General preferences



Default directories

You can define default Temp, Output, Log File and Histogram directories by browsing or by entering a filepath.

Default Temp directory

When GeoExpress encodes a MrSID Generation 2 image, it creates a series of temporary files that are used in constructing the final MrSID image. Collectively, the temp files are roughly equivalent in size to the created MrSID

image. These files are deleted immediately upon completion of an encoding project.

Encoding requires enough disk space to accommodate both the output image and the temporary files. (For more information, System requirements on page 8.)

Normally GeoExpress will use the default Windows temp directory, typically `C:\Temp`, to store these temporary files. To use a different directory enter its path in the **Temp** field. If you are unsure of the entire path, click **Browse** to navigate to the preferred directory.

Default Output directory

GeoExpress will normally create an output image in the same directory as the source image (the source directory of the first image file in a mosaic).

To create new output images in a different directory, enter its path in the **Output** field.

Default Log directory

This option allows you to specify where GeoExpress will save log files.

Default Histograms directory

By default, histogram files are created in the same place as their source images, but if they cannot be created there (for example if the source images are in a read-only directory), then they are created in the directory specified in the **Histograms** field.

Output file generation

If you select the **Create unique file name** option when a new MrSID file is created in a directory where a file of the same name exists, the new file name is appended with an underscore and a number. For instance, if two files named `image.sid` are created in the same directory, GeoExpress names the second file `image - copy 1.sid`. Additional files created are appended with incremental numbers (such as `image - copy 2.sid`).

If you select the **Prompt if output file exists** option, you will receive a prompt when GeoExpress finds an existing file with the same name as the output file. A **Save As** dialog appears, prompting you to enter a new file name.

If you select the **Always overwrite** option, GeoExpress overwrites existing files.

> **WARNING:** Many USGS DOQ files have the same file name with a different extension. If you select **Always overwrite**, MrSID files created from multiple USGS DOQ files overwrite one another. LizardTech recommends that you not use the **Always overwrite** feature when working with USGS DOQ images.

Default output file format

A drop-down list enables you to select the default file format to use for output files. Regular options are MrSID Generation 4 (MG4), MrSID Generation 3 (MG3), MrSID Generation 2 (MG2) and JPEG 2000. Unless this default is changed manually, it is MrSID Generation 4.

You can override this behavior for MrSID and JPEG 2000 files; if you select **Same as input**, then the output file format will be the same as the input file format if the input file is MG2, MG3, MG4, or JPEG 2000. For input files of any other format, the default output format will be specified by the drop-down menu option.

Georeferencing

World files

Select the **Use** option (next to **World Files**) to have GeoExpress use the georeferencing information in a world file for an image or mosaic tile, rather than native georeferencing.

> **IMPORTANT:** This option will override any coordinate reference system (CRS) metadata—including well-known text strings (WKTs)—that may have been embedded in the file. You can manually edit the CRS in the image metadata with the **Edit Metadata** tool. For more information on selecting a CRS in the metadata, see Editing metadata on page 33.

Select **Generate** to automatically generate world files upon encoding.

For more information, see World files on page 118.

Aux XML files

Select the **Use** option next to **Aux XML Files** to have GeoExpress use georeferencing information in an Esri Aux file, rather than embedded CRS metadata. Selecting this option overrides the **Use World Files** option if it is also selected.

Select **Generate** to automatically generate Esri Aux files upon encoding. This enables you to make sure the georeferencing metadata in your MrSID and JPEG 2000 imagery will be readable in Esri applications.

Error Checking

When several jobs are being encoded as a batch, errors may occur that could interrupt the encoding project. These errors may be internal (for example, GeoExpress may encounter a corrupt or incompatible image or mosaic), or they may be external (for example, a Windows or network error). To force GeoExpress to ignore any such error messages and attempt to continue with the encoding project, select the **Suppress Pop-Up Error Windows During Encoding** option. The error messages will be written to the log file.

Apply Metadata to Image

If your images contain metadata for image rotation or rapid positioning capability (RPC), you can manipulate the output image so that it reflects the information in the metadata. You can select the following preferences for image metadata:

NITF RPC

NITF RPC metadata maps pixel data to location data for orthorectification. Select this option to apply the orthorectification described in the NITF RPC to the image.

> **NOTE:** To apply orthorectification, the NITF RPC metadata must use the WGS 84 datum.

Rotation

Image rotation metadata describes the direction that an image should point. For example, an image might contain metadata that rotates an image so that it points north. Select this option to create rotated images with empty space in the corners. The empty space is compressed so that it does not add to the size of the image. This is the default setting so that your images are displayed with the correct orientation even in viewers that do not support metadata for image rotation.

The following figure shows a rotated image:

The black areas represent the parts of the image that do not contain data values. In MrSID Generation 4 images, the no-data values are stored in the alpha band. For more information on alpha bands, see Alpha bands and MrSID on page 76.

Seamlines

For raster mosaics, you can choose to generate a shapefile representing the tiles that make up the image. When viewed in an appropriate application (such as GeoViewer), you can overlay the shapefile on the output image to identify the original tile positions.

Select this option to have the default for raster mosaics include a seamlines shapefile in the output.

Concurrency Control

If you run GeoExpress on a system with multiple processor cores, GeoExpress creates multiple threads to process jobs more quickly. You can set the following preferences for concurrency:

- **Concurrent jobs**. The maximum number of jobs that GeoExpress can run at the same time. Each job uses one or more threads. If the number of concurrent jobs exceeds the number of total threads, GeoExpress does not run the full number of concurrent jobs.
- **Total threads**. The number of threads that GeoExpress uses. GeoExpress always uses the total number of threads available regardless of the number of jobs.

The maximum number of concurrent jobs and total threads that you can set equals the number of processor cores in your system. For example, if your system has six cores, you can run a maximum of six concurrent jobs and six threads. By default, the number of concurrent jobs and total threads equals the maximum.

If you reduce the number of total threads, GeoExpress uses fewer cores. Reduce the number of total threads when you want to perform other processor-intensive tasks on the system that runs GeoExpress.

NOTE: Prior to GeoExpress 9.5.5, the maximum number of threads and concurrent jobs that could be run was 8. In version 9.5.5 and later, these are only limited by the number of processor cores on your system.

Concurrency Example

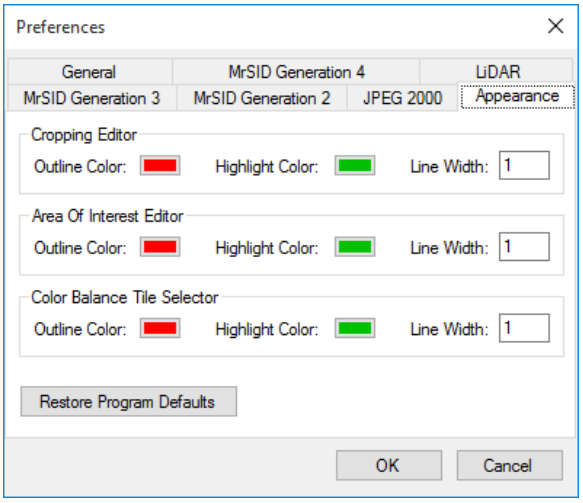
You have 12 jobs that you want to run on a system with six cores. The following list describes how GeoExpress runs the jobs for various preference combinations:

- If you set the number of concurrent jobs to six and the number of threads to six, GeoExpress runs six jobs at a time and allocates one thread to each job. Use this combination for optimal performance.
- If you set the number of concurrent jobs to three and the number of threads to six, GeoExpress runs three jobs at a time and allocates two threads to each job.
- If you set the number of concurrent jobs to six and the number of threads to three, GeoExpress runs three jobs at a time and allocates one thread to each job. Because GeoExpress uses one thread for each job, GeoExpress cannot run the full number of concurrent jobs.

GeoExpress continues running as many concurrent jobs as possible until it finishes all 12 jobs.

Appearance preferences

The **Appearance** tab of the **Preferences** dialog allows you to change the color and width of lines and highlights that are applied in the **Image Crop**, **Area of Interest**, and **Color Balance Tile Selector** dialogs. Colored rectangles display the color currently selected.



To change a color, click on the appropriate color swatch. Use the Windows color picker to choose a new color, then click **OK**.

To change a line width, enter the desired value in the appropriate **Line Width** field.

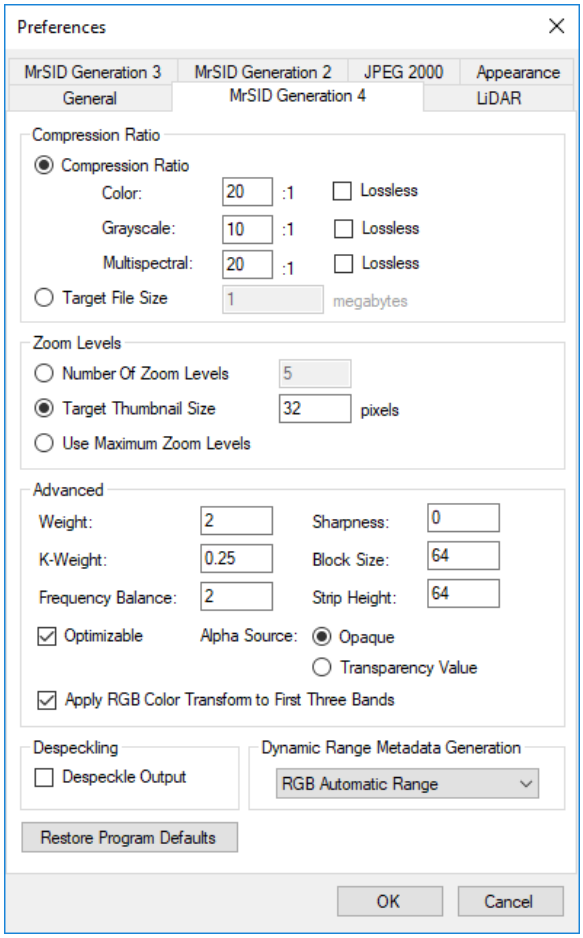
MrSID preferences

This page describes the preference options for MrSID Generation 4 (MG4), MrSID Generation 3 (MG3) and MrSID Generation 2 (MG2).

You can set the following preferences for MG2, MG3, and MG4 files:

- Compression ratio preferences. For more information on compression ratios, see Features in Depth on page 30.
- Zoom levels preferences. For more information on zoom levels, see Zoom options on page 75.
- Advanced preferences. For more information on advanced options such as weight and block size, see Format-specific options on page 81, Advanced MG3 options on page 85, and Advanced MG2 options on page 86.

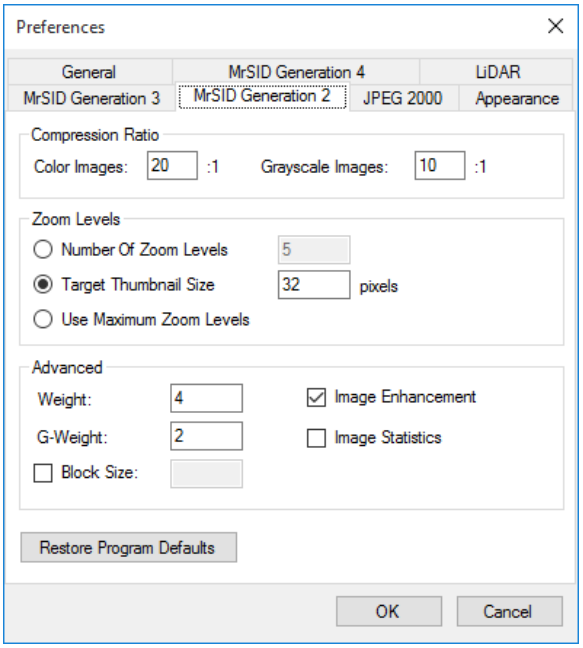
The MrSID Generation 3 (MG3) and MrSID Generation 4 (MG4) preferences mirror the settings found in the MG3 and MG4 format-specific options on the **Advanced Job Options** dialog, with the exception that a default compression ratio can be specified for both color and grayscale images. When you add a new MG3 or MG4 encode job, the compression settings are initially set to the values declared on this tab. The effects of these options can be simulated on the **Job Output** panel.



The preference options for MG3 and MG4 are the same with the following exceptions:

- **Compression Ratio** preferences for MG4 include a setting for **Multispectral**.
- For MG4, the **Compression Ratio** can be set to default to **Lossless** for **RGB**, **Grayscale**, and **Multispectral**.
- Advanced MG4 preference options include the **Apply RGB Color Transform to First Three Bands** setting that allows you to specify that multispectral files whose first three bands are R, G, and B (in that order) should have this transform run on them. (This option is enabled by default.)
- Advanced MG4 preference options include two Alpha Source options, one to specify that all pixels are opaque and one to specify that the transparency or **nodata** value should be automatically detected from the image metadata. Using the **Transparency Value** is enabled by default.
- Advanced MG4 preference options include Dynamic Range Metadata Generation options. For more information on generating dynamic range metadata, see Dynamic Range Metadata Generation on page 83.
- Advanced MG3 preference options include selecting either the 1-pass or 2-pass optimizer.

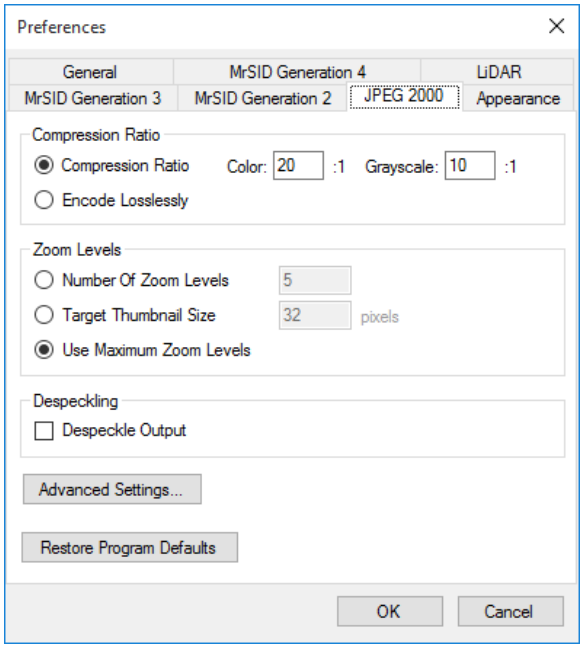
The MrSID Generation 2 preferences mirror the settings found in the MG2 format-specific options on the **Advanced Job Options** dialog, with the exception that a default encode ratio can be specified for both color and grayscale images. When you add a new MrSID Generation 2 encode job, the encode settings will initially be set to the values declared in this tab.



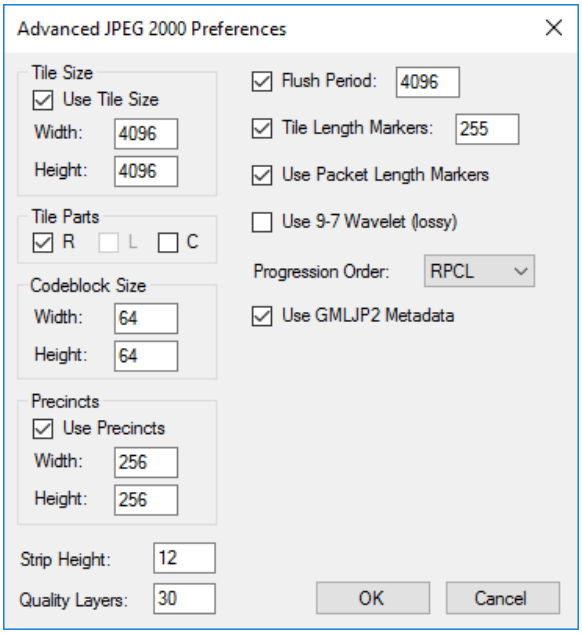
JPEG 2000 preferences

If you want to use JPEG 2000 as your default file output, select either **JPEG 2000 (GMLJP2)** or **JPEG 2000 (Part I)** from the **Default Output File Format** drop-down list on the **General** tab of the **Preferences** dialog.

The JPEG 2000 tab of the **Preferences** dialog has a number of basic JPEG 2000 options, as shown below. These are the same options as those available for MrSID encoding. For more information on compression, see Features in Depth on page 30. For more information on zoom levels, see Zoom options on page 75.



Click the **Advanced Settings** button for further options.



The parameters set on the tab and dialog shown above determine the default options that appear in the **Advanced Job Options** dialog, which includes all of these. Changes made on the **Advanced Job Options** dialog only affect the current job. To change the default settings, the parameters must be changed here.

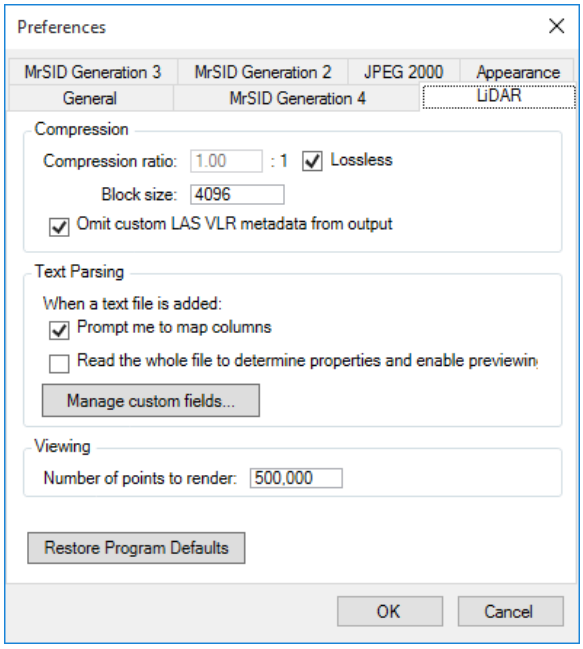
For details about the advanced options see Advanced JPEG 2000 options on page 88.

LiDAR preferences

Set default preferences for LiDAR data in the **LiDAR** tab of the **Preferences** dialog.

The **LiDAR** tab is divided into three panes:

- Compression
- Text Parsing
- Viewing



Compression

Set general compression preferences for LiDAR data.

Compression ratio

How much you want to compress the data. Depending on the compression ratio, the resulting file may have fewer points than the original point cloud. You can also select **Lossless** to create a compressed point cloud identical to the input point cloud.

Block size

The number of points to process and store at one time. Enter a large block size to increase the compression speed. Enter a small block size to decrease memory usage. Valid values are from 2048 through 16384. The default value is 4096.

Omit custom VLR metadata

Omit custom variable length record (VLR) metadata from LAS files. VLR metadata can include vendor-specific data, user-specified data, and more.

Text Parsing

Set options for LiDAR point clouds stored as text files.

Map columns

If you select this option, GeoExpress displays a dialog that you can use to select columns from the input text file and map their values to standard fields like X, Y, Z, intensity, and more.

Read the whole file

Select this option to have GeoExpress read all of the data in the input text file to determine properties like the point cloud extents and to enable previewing the file.

Manage Custom Fields

Click **Manage custom fields** to see the default fields available for LiDAR point clouds and to create custom fields. For example, you may want to create a custom field for a non-standard time format, for sensor information, and more.

Viewing

Set preferences for previewing LiDAR files.

Number of Points to Render

Enter the number of points to display when you preview the point cloud. Enter a large value to display more detail. Enter a low value to display point clouds faster. The minimum value is 50,000 and the default value is 500,000.

> **NOTE:** While previewing a LiDAR file, you can change many settings temporarily; see Output Preview panel on page 19.

Viewing and using log information

You can access log information for GeoExpress encoding and publishing operations in the log folder or directly from the GeoExpress graphical user interface (GUI).

Accessing text files in the log folder

By default, text files containing log records are located in `My Documents\LizardTech\GeoExpress\<version>\logs` (where <version> is the version number of GeoExpress). You can change the location of the log files in the **Preferences** dialog.

The log folder contains separate logs for completed encoding and completed publishing jobs.

Encoding jobs are recorded in the `GeoExpress_log.txt` and `session_log.txt` files. `GeoExpress_log.txt` is a persistent log that is appended with each encoding operation the user runs, whereas `session_log.txt` is a temporary log that lists only the images that were encoded in the current job. It is overwritten upon each new encoding operation.

Publishing jobs are recorded in the `GeoExpressPublish_log.txt` and `publish_session_log.txt` files. As with their encoding counterparts, `GeoExpressPublish_log.txt` is a persistent record of publishing operations that grows over time, while `publish_session_log.txt` records only the last completed publishing job.

Accessing and using session records in the GUI

Viewing encoding results

A description of recently completed encoding projects can be viewed on the **Job Progress** panel for a selected job.

1. Click the **Job Progress** tab.
   The session log is displayed at the bottom of the panel.
2. Use the scroll bar to locate information about a specific image.

> **TIP:** If you select a job in the **Job List** while you view the **Job Progress** tab, the session log only shows information about the selected job.

Exporting the session log

Click the **Export Log** button to save the session log for a selected job. You can export the session log to a `.csv` or `.txt` file.

Viewing results for a publishing operation

Upon completion of a publishing operation, the text window of the **Publish Images** dialog reports the results of the publishing operation. This is the same information logged in the `GeoExpressPublish_log.txt` and `publish_session_log.txt` files.

Copying text from log entry

You may wish to copy information from the log entry and paste it elsewhere. Use the standard Windows copy (**Ctrl+C**) and paste (**Ctrl+V**) shortcuts on any text in the **Session Log** text box of the **Job Progress** tab.

Chapter 6: Additional Operations

Publishing to Express Server

You can use GeoExpress to publish images directly to Express Server. Express Server supports MG4, MG3, MG2, and JPEG 2000 images. Publishing is a one-time operation that does not use project files and does not alter or delete the source images.

To publish existing images:

1. Choose **Tools > Publish images**.
2. Add images to the **Source Images** list: click **Add Images To Publish**, or drag files into the **Publish Images** window.
3. When you finish adding images, click **Publish to Express Server**.
   This opens the **Express Server** browser. For more information, see Selecting an Express Server on page 66.
4. Click **OK** to begin the publishing process.
   The **Publish Image** dialog changes to display two progress bars. The bottom bar monitors the publishing progress of an individual image and the top bar monitors the aggregate progress of all the images in a job.

To cancel the operation, click either **Cancel All** or **Cancel Current Image**.

Viewing Results

The results of a publishing operation are displayed in the **Publishing** dialog.

You can also view the results by opening the log files stored at `<User directory>\Documents\LizardTech\GeoExpress\<version>\logs`.

There are two log files related to publishing:

- `GeoExpressPublish_log.txt` is a running log of all publishing operations.
- `publish_session_log.txt` is a temporary log that only lists the images published in the most recent publishing operation.

For more information see Viewing and using log information on page 116.

World files

A “world file” is a simple text file containing auxilliary georeferencing information for an image. It can be used to georeference an image that has no georeferencing information within it, or to override existing georeferencing information.

By convention, the filename for a world file is the same as the image it pertains to, with a different extension. The three-letter extension is made up of the first and last characters of the image filename extension, followed by a **w**. For example, the world file for a TIFF image named `bainbridge.tif` would be `bainbridge.tfw`; the world file for a MrSID image named `madison.sid` would be named `madison.sdw`.

Generating world files

Select **World Files: Generate** on the **General** tab of the **Preferences** dialog to automatically generate world files upon encoding.

Format

The world file format is six lines, each line containing a double precision value (represented in text). No additional lines may be present. Leading and trailing white space are allowed.

The meanings of the six values are:

1. dimension of a pixel in map units in *x* direction
2. first rotation term
3. second rotation term
4. dimension of a pixel in map units in *y* direction
5. *x*-coordinate of the center of the upper-left pixel
6. *y*-coordinate of the center of the upper-left pixel

The *y*-dimension is, by convention, a negative value.

GeoExpress ignores the rotation term in most cases.

Example

This is an example of a world file:

```
  0.20000000
  0.00000000
  0.00000000
 -0.20000000
780.10000000
219.90000000
```

This world file indicates the image resolution is (0.2, -0.2) and the upper-left is at (780.1, 219.9). The rotation terms are zero, meaning no rotation is required.

Using world files

Once you have added imagery to the **Job List**, you should check its extents on the **Job Properties** tab to make sure it has the proper positioning. If it does not, check for the presence of world files in the source directory. If there are world files, you can instruct GeoExpress to use them.

To specify that world files should be used:

1. Select an image in the **Job List** and click the **Advanced** button on the **Job Properties** tab.
   This opens the **Advanced Job Options** dialog.
2. Select the **Input** tab.
3. Select **Use World Files**.
4. Click **OK**.

IMPORTANT: Use of world files removes the CRS or other georeferencing information from the image.

TIP: If no world file exists or if using world files does not result in correct positioning, you can change the image extents by editing the image metadata. For more information see Raster metadata on page 33.

Generating Esri AUX files

AUX files are used in older Esri products in the ArcGIS suite to specify coordinate reference system information. They have the extension `.aux`. You may want to generate Esri AUX files if your imagery will be used in Esri ArcGIS 9.1 or earlier.

To generate Esri AUX files:

1. Choose **Options > Preferences**.
2. Select **Generate** next to **Aux XML Files** in the **Georeferencing** group of options.
3. Click **OK**.

AUX files will now be generated upon encode and output to the same folder as the output images.

To stop generating Esri AUX files, deselect the **Generate** option.

By default Esri AUX files are not generated.

Appendix A: File Formats

Supported input file formats

This table describes the file formats of the images that you can add to the **Job List**.

FILE FORMAT	FILE EXTENSION	SUPPORTED DATA TYPES	SUPPORTS MULTISPECTRAL?	NOTES
BIPF	`.bpf`		N/A	Binary Point File, commonly used for Geiger Mode LiDAR images.
CADRG	The most common extension is `.toc`	8-bit unsigned	No	
DTED	`.dt0`, `.dt1`, `.dt2`	16-bit signed, 32-bit floating point	No (limited to one band)	
ECW	`.ecw`	8-bit unsigned	Yes	Earth Resoure Mapping's Enhanced Compression Wavelet format.
ERDAS IMAGINE	`.img`	8-bit and 16-bit signed and unsigned, 32-bit floating point	Yes	GeoExpress supports color lookup tables (CLUTs) with 8-bit per sample RGB color values.
ERDAS LAN	`.lan`	8-bit unsigned	Yes	In 4-band LAN images, bands 2, 3, and 4 are interpreted as Red, Green, and Blue, respectively.
JPEG	`.jpg`, `.jpeg`	8-bit unsigned	No, limited to 3 bands	Requires a world file for georeferencing.
JPEG 2000	`.jp2`, `.jpc`	8-bit and 16-bit signed and unsigned	Yes	Multiple bands supported or all color spaces.
LAS	`.las`		N/A	This is a binary, uncompressed LiDAR point cloud format. GeoExpress supports LAS versions 1.0-1.3, with experimental support for LAS 1.4.
LAZ	`.laz`		N/A	This is a binary, compressed LiDAR point cloud format.
MrSID Generation 2 (MG2)	`.sid`	8-bit and 16-bit unsigned, 32-bit floating point	No	4 bands are supported for CMYK input only.
MrSID Gen 3 (MG3)	`.sid`	8-bit and 16-bit unsigned	No	4 bands are supported for CMYK input only.

FILE FORMAT	FILE EXTENSION	SUPPORTED DATA TYPES	SUPPORTS MULTISPECTRAL?	NOTES
MrSID Gen 4 (MG4) LiDAR	`.sid`		N/A	This is a binary, uncompressed LiDAR point cloud format.
MrSID Gen 4 (MG4) Raster	`.sid`	8-bit and 16-bit signed and unsigned, 32-bit floating point	Yes, up to 255 bands	Multiple bands supported for all color spaces.
NITF 2.0, 2.1.	`.ntf`	8- and 16-bit signed and unsigned	Yes	Only supports uncompressed, JPEG compressed, and JP2 compressed data.
PCIDSK	`.pix`	8-bit and 16-bit signed and unsigned, 32-bit floating point	Yes	Does not support mixed data type, RPC segments, GCP segments, or Color Lookup Tables.
PNG	`.png`	8-bit and 16-bit unsigned	No	Requires a world file for georeferencing.
Raw (uncompressed) BBB files (BIL, BIP, and BSQ)	`.bil`, `.bip`, `.bsq`	8-bit and 16-bit signed and unsigned, 32-bit floating point	Yes	
Sun Raster	`.ras`, `.rast`	8-bit unsigned	No	
Text	The most common extension is `.txt`.		N/A	Also known as ASCII files. These are plain-text files with delimiters for point clouds.
TIFF/GeoTIFF	`.tif`, `.tiff`, `.tfw`	8-bit and 16-bit signed and unsigned, 32-bit floating point	Yes	For more information on supported TIFF compression formats, see Supported TIFF compression types on page 126.
USGS DOQ	`.nes`, `.ses`, `.nws`, `.sws`, `.doq`	8-bit unsigned	No	Both the old and new USGS DOQ formats are supported and can be combined in mosaics.
Windows BMP	`.bmp`	8-bit unsigned	No	Requires a world file for georeferencing. Only supported on Windows.

Supported output file formats

Many of the options available to you in GeoExpress vary depending on the output format that you select. Additionally, the options available depend on whether the file is a raster file or a LiDAR point cloud file.

GeoExpress supports the following output formats:

- MrSID Generation 4 (MG4), MrSID Generation 3 (MG3), MrSID Generation 2 (MG2)
- JPEG 2000 (Part I), JPEG 2000 (GMLJP2)
- NITF 2.1 (Raw), NITF 2.1 (JPEG 2000)
- GeoTIFF
- LAS
- LAZ
- BPF

MrSID

The MrSID format is a proprietary format developed by LizardTech that supports lossy and lossless compression. There are several generations of the MrSID file format. Additionally, for the latest generation, MrSID Generation 4 (MG4), there is a version that supports raster and a version that supports LiDAR.

The raster version of MG4 supports multispectral data, per-band compression, custom metadata, and advanced image manipulation features. The format is widely supported across GIS software packages. The LiDAR version of MG4 stores compressed point clouds in an accessible format meant to address some of the problems with storing and accessing large LiDAR point clouds.

For both raster and LiDAR data, if you're not sure which file format to select, you may want to select MrSID Generation 4.

JPEG 2000

The JPEG 2000 format is an open standard that provides superior compression compared to the original JPEG format.The JPEG 2000 (Part I) format uses the original JPEG 2000 specification which is more widely supported. The JPEG 2000 (GMLJP2) format includes support for geographic markup language (GML). Use the JPEG 2000 (GMLJP2) format when you need to create JPEG 2000 files that contain coordinate reference systems (CRS), topology, and other geographic features.

For a comparison of MrSID and JPEG 2000 files, see Comparison of compressed output formats on page 125.

NITF

The NITF format is a container that can include an image, image metadata, and other graphics. GeoExpress supports creating NITF files that contain raw or JPEG 2000 images.The NITF format is the standard for various departments of the United States government. Use the NITF format when your organization requires NITF metadata.

GeoTIFF

The GeoTIFF format embeds georeferencing metadata into TIFF images. In GeoExpress, you can only create GeoTIFF files from MrSID input files, and you can only create uncompressed GeoTIFF files. Use the GeoTIFF format when you might need to view your image in an image viewer that does not support GIS. Any image viewer that can read TIFF files will display GeoTIFF images. If the viewer does not support the georeferencing metadata, the metadata is ignored. GeoTIFF is generally an uncompressed file format.

LAS

The LAS format is one of the most commonly used LiDAR file formats, and can be read in virtually any application that support LiDAR point clouds. LAS is a public, uncompressed file format maintained by the American Society

for Photogrammetry and Remote Sensing (ASPRS). GeoExpress can write LAS 1.0 through 1.4 files.

When you create a LAS file from another LAS file, GeoExpress uses the same version of LAS. For example, if the input file is a LAS 1.1 file, GeoExpress creates another LAS 1.1 file. If you write a LAS file from MrSID or from another format, the version of LAS that GeoExpress uses depends on the contents of the file. If the file contains features unique to a specific version of LAS, GeoExpress uses that particular version.

LAZ

The LAZ format is a compressed format for LiDAR point clouds. LAZ is an open-source file format developed by Martin Isenberg at RapidLasso.

GeoExpress does not support LAZ output from a LAS 1.4 file that includes records 6-10.

BPF

Binary Point File (BPF) serves as a lightweight, quick, binary file format for the storage of unorganized point cloud data. It is commonly used in Geiger Mode LiDAR imagery.

Lossy and lossless compression

You may compress your images “losslessly” (using **lossless compression**) or “lossily” (using **lossy compression**). Lossless compression preserves all data. Lossy compression discards some data in order to achieve smaller file sizes. For the purposes of real workflows, however, it is useful to think of GeoExpress as offering three categories of image quality: lossless, visually lossless, and lossy.

Lossless

Lossless compression retains all source image data. No data is discarded. This level of compression typically yields a 2:1 compression ratio, for a 50% reduction in the space required to store the image. Lossless compression should be used when it is critical that all bits of the original image be preserved. This is the case for archival storage, as well as for uncommon workflows where no possible loss of precision is ever acceptable. You may also wish to use lossless compression when you are generating a “master” image from which other derivative images will be made, as through the MrSID optimization process. From a lossless MrSID or JPEG 2000 file, the original TIFF or other raw file can be reassembled identically, bit-for-bit.

NOTE: When you use the lossless option to recompress an image that has already been compressed lossily, it means that no further loss of data will occur. It is helpful to remember that in lossless compression all image data from the source image is retained.

Visually lossless

This is actually a form of lossy compression, and the name is not intended to mislead. Visually lossless represents the limit of data that can be discarded before the human eye can detect any degradation in image quality. This level of compression is typically 20:1 for RGB and 10:1 for grayscale imagery. This is the most common level of compression quality used, as it preserves the appearance of the imagery for most workflows, including use of your imagery as a background layer and for many forms of visual analysis and exploitation.

Lossy

Beyond 20:1, image degradation and artifacts can appear, although often not too significantly until ratios of 40:1 or 50:1. Such lossy quality may be acceptable when the imagery is used only as a background layer for appearance or when the image quality is less important than the storage size or speed, such as for informal visual inspections.

Comparison of compressed output formats

For raster images, GeoExpress can create compressed images in the MrSID and JPEG 2000 formats. Because the NITF format can contain JPEG 2000 files, you can also create compressed NITF files. For LiDAR data, GeoExpress can create compressed files in the MrSID and LAZ formats. For LiDAR data, LAZ files can only be created using lossless compression. MrSID files are lossless by default, but you can also specify a compression ratio to create lossy files.

TIP: Select an image in the job list to view the file format, output file size, and more in the **Job Properties** panel.

Compressed Raster Formats

The following table compares some of the features supported by the raster output formats:

FEATURE	OUTPUT FORMAT			
	MG2	MG3	MG4	JPEG 2000
Lossy output with a maximum of 3 bands, cropping, no advanced encoding, output file smaller than 2GB	✓	✓	✓	✓
Advanced encoding (such as reprojection, color balancing, despeckling, and Area of Interest encoding)		✓	✓	✓
Output file size larger than 2GB		✓	✓	✓
Lossless output		✓	✓	✓
Mosaic that uses MrSID files as input		✓	✓	✓
Multispectral output			✓	✓
Arbitrary band mapping			✓	
Per-band compression			✓	

Compressed LiDAR Formats

The following table compares some of the features supported by the LiDAR output formats:

FEATURE	OUTPUT FORMAT			
	LAZ	LAS	BPF	MG4
Lossless compression	✓	✓	✓	✓
Using a specified compression ratio				✓
Creating mosaics				✓

For more information on output formats, see Supported output file formats on page 123.

Supported TIFF compression types

The **Job Properties** panel provides information about the input images used in a project. Information about any TIFF compression technique used in the input images is also provided, even if the technique is not supported by GeoExpress.

The following table lists TIFF compression types displayed by GeoExpress and whether the compression type is supported by GeoExpress.

COMPRESSION	SUPPORT
CCITT Group 3 fax	No
CCITT Group 4 fax	No 1
LZW (Limpel-Ziv-Welsh)	Yes
Old JPEG	No
Standard JPEG (including 12-bit)	Yes
NeXT run-length encoding	No
CCITT run-length encoding	Yes 2
Pixar image format	No
Desktop color separation	No
Standard JBIG	No
Pack-bits encoding	Yes
ThunderScan	No
Deflate method (PNG)	No

1 GeoExpress is able to process single-page Group 4 TIFF files, but encoding this format is not recommended.

2 There are many different types of run-length encoding. Some methods are supported; others are not. GeoExpress works best with uncompressed images.

Sample MrSID metadata

Following is the header metadata from a sample MrSID image.

```
Record 0:
Tag: GEOTIFF_CHAR::GTModelTypeGeoKey
Type: ASCII[1]
Data:
[0]: ModelTypeProjected
Record 1:
Tag: GEOTIFF_CHAR::GTRasterTypeGeoKey
Type: ASCII[1]
Data:
[0]: RasterPixelIsArea
Record 2:
Tag: GEOTIFF_CHAR::GeogEllipsoidGeoKey
Type: ASCII[1]
Data:
[0]: Ellipse_GRS_1980
Record 3:
Tag: GEOTIFF_CHAR::GeogGeodeticDatumGeoKey
Type: ASCII[1]
Data:
[0]: Datum_North_American_Datum_1983
Record 4:
Tag: GEOTIFF_CHAR::ProjLinearUnitsGeoKey
Type: ASCII[1]
Data:
[0]: Linear_Meter
Record 5:
Tag: GEOTIFF_CHAR::ProjectedCSTypeGeoKey
Type: ASCII[1]
Data:
[0]: PCS_NAD83_UTM_zone_10N
Record 6:
Tag: GEOTIFF_NUM::1024::GTModelTypeGeoKey
Type: UINT16[1]
Data:
[0]: 1
Record 7:
Tag: GEOTIFF_NUM::1025::GTRasterTypeGeoKey
Type: UINT16[1]
Data:
[0]: 1
Record 8:
Tag: GEOTIFF_NUM::2050::GeogGeodeticDatumGeoKey
Type: UINT16[1]
Data:
[0]: 6269
Record 9:
Tag: GEOTIFF_NUM::2056::GeogEllipsoidGeoKey
Type: UINT16[1]
Data:
[0]: 7019
Record 10:
Tag: GEOTIFF_NUM::3072::ProjectedCSTypeGeoKey
Type: UINT16[1]
Data:
[0]: 26910
Record 11:
Tag: GEOTIFF_NUM::3073::PCSCitationGeoKey
Type: ASCII[1]
Data:
[0]: Universal Transverse Mercator; North American 1983; GRS80; Zone Number 10N
Record 12:
Tag: GEOTIFF_NUM::3076::ProjLinearUnitsGeoKey
Type: UINT16[1]
Data:
[0]: 9001
Record 13:
Tag: GEOTIFF_NUM::3080::ProjNatOriginLongGeoKey
Type: FLOAT64[1]
Data:
[0]: -123.000000
Record 14:
Tag: GEOTIFF_NUM::3081::ProjNatOriginLatGeoKey
Type: FLOAT64[1]
```

```
Data:
[0]: 0.000000
Record 15:
Tag: GEOTIFF_NUM::3082::ProjFalseEastingGeoKey
Type: FLOAT64[1]
Data:
[0]: 500000.000000
Record 16:
Tag: GEOTIFF_NUM::3083::ProjFalseNorthingGeoKey
Type: FLOAT64[1]
Data:
[0]: 0.000000
Record 17:
Tag: GEOTIFF_NUM::3092::ProjScaleAtNatOriginGeoKey
Type: FLOAT64[1]
Data:
[0]: 0.999600
Record 18:
Tag: IMAGE::INPUT_FILE_SIZE
Type: FLOAT64[1]
Data:
[0]: 75121662.000000
Record 19:
Tag: IMAGE::INPUT_FORMAT
Type: ASCII[1]
Data:
[0]: GeoTIFF
Record 20:
Tag: IMAGE::INPUT_NAME
Type: ASCII[1]
Data:
[0]: H:\Seattle\10tet279287.tif
Record 21:
Tag: IMAGE::WIDTH
Type: UINT32[1]
Data:
[0]: 5000
Record 22:
Tag: IMAGE::HEIGHT
Type: UINT32[1]
Data:
[0]: 5000
Record 23:
Tag: IMAGE::COLOR_SCHEME
Type: UINT32[1]
Data:
[0]: 0
Record 24:
Tag: IMAGE::DATA_TYPE
Type: UINT32[1]
Data:
[0]: 0
Record 25:
Tag: IMAGE::NO_DATA_VALUE
Type: UINT8[3]
Data:
[0]: 0
[1]: 0
[2]: 0
Record 26:
Tag: IMAGE::TRANSPARENT_DATA_VALUE
Type: UINT8[3]
Data:
[0]: 0
[1]: 0
[2]: 0
Record 27:
Tag: IMAGE::XY_ORIGIN
Type: FLOAT64[2]
Data:
[0]: 527900.150000
[1]: 5230199.850000
Record 28:
Tag: IMAGE::X_RESOLUTION
Type: FLOAT64[1]
Data:
[0]: 0.300000
Record 29:
```

```
Tag: IMAGE::Y_RESOLUTION
Type: FLOAT64[1]
Data:
[0]: 0.300000
Record 30:
Tag: IMAGE::WKT
Type: ASCII[1]
Data:
[0]: PROJCS["NAD83 / UTM zone 10N",GEOGCS["NAD83",DATUM["North_American_Datum_1983",
        SPHEROID["GRS 1980",6378137,298.2572221010002,AUTHORITY["EPSG","7019"]],
        AUTHORITY["EPSG","6269"]],PRIMEM["Greenwich",0],UNIT["degree
        (supplier to define representation)",0.01745329251994328]
        ,AUTHORITY["EPSG","4269"]],PROJECTION["Transverse_Mercator"],
        PARAMETER["latitude_of_origin",0],PARAMETER["central_meridian",-123],
        PARAMETER["scale_factor",0.9996],PARAMETER["false_easting",
        500000],PARAMETER["false_northing",0],UNIT["metre",1,
        AUTHORITY["EPSG","9001"]],AUTHORITY["EPSG","26910"]]
```

Appendix B: File Sizes and Memory Usage

Calculating memory usage

The amount of memory that GeoExpress uses to perform operations depends on the following factors:

- The image manipulation operations that you perform.
- The operating system.
- The image input format.
- The number of bands in the output image.
- The number of threads and concurrent jobs.
- The strip height and block size.

Of these factors, you can control the strip height and the block size that GeoExpress uses.

Memory usage is constant over the length of the encode operation.

Estimated memory usage display

The **Estimated Memory Usage** value is displayed on the **Job Properties** panel except when the output format is other than MrSID or the 1-pass optimizer is used. GeoExpress uses the 2-pass optimizer by default.

MG3 and MG4 memory usage

The following formula describes the approximate amount of memory used by GeoExpress to compress a single image to the MrSID Generation 4 (MG4) or MrSID Generation 3 (MG3) format:

```
Memory = ((8 + 4 × BlockSize + MIN(StripHeight, BlockSize)) × 4 +
   StripHeight) × NumBands × Width
```

The following list describes the variables used by the formula:

- `Memory` is the estimated memory usage in bytes.
- `You set BlockSize` on the **Format-Specific** tab of the **Advanced Job Options** dialog. For more information on block size, see Block Size on page 82.
- `MIN(StripHeight, BlockSize)` evaluates the values for the strip height and block size and equals whichever value is smaller.
- `You set StripHeight` on the **Format-Specific** tab of the **Advanced Job Options** dialog. For more information on strip height, see Strip Height on page 83.
- `NumBands` is the number of bands in the image to be encoded–typically 1 or 3. (This value is noted in the **Job Properties** panel.)
- `Width` is the width of the input image in pixels. (This value is noted in the **Job Properties** panel.)

MG2 memory usage

The following formula describes the approximate amount of memory used by GeoExpress to compress a single image to the MrSID Generation 2 (MG2) format:

```
Memory = ((8 + 4 × BlockSize + 64) × NumBands × Width × 4) +
   (0.005 × ExpectedOutputFileSize)
```

- `Memory` is the estimated memory usage in bytes.
- You set `BlockSize` on the **Format-Specific** tab of the **Advanced Job Options** dialog. For more information on block size, see Block Size for MG2 on page 86.
- `NumBands` is the number of bands in the image to be encoded–typically 1 or 3. (This value is noted in the **Job Properties** panel.)
- `Width` is the width of the input image in pixels. (This value is noted in the **Job Properties** panel.)
- `ExpectedOutputFileSize` is the target file size. (This value is noted in the **Job Properties** panel.)

How mosaic sizes are calculated

The size of a mosaic is calculated from the "nominal size" of the output mosaic, which is **not** the same as the file size.

For raster images, the nominal size is the product of the output image width, the image height, the number of bands, and the number of bytes per band. The nominal size assumes that all portions of the image include valid data, whether or not this is the case. (No-Data areas, areas outside a cropped image, and gaps between tiles are not considered part of the image, and areas of overlap are only counted once as part of the image.)

For LiDAR point clouds, the nominal size is a measure of the number of points in the point cloud and the number of fields for each point.

As a result, the size is not adjusted for the presence of transparency regions in the mosaic, such as when:

- a mosaic of non-contiguous images is created
- the output image for a contiguous mosaic does not conform to a rectangular shape

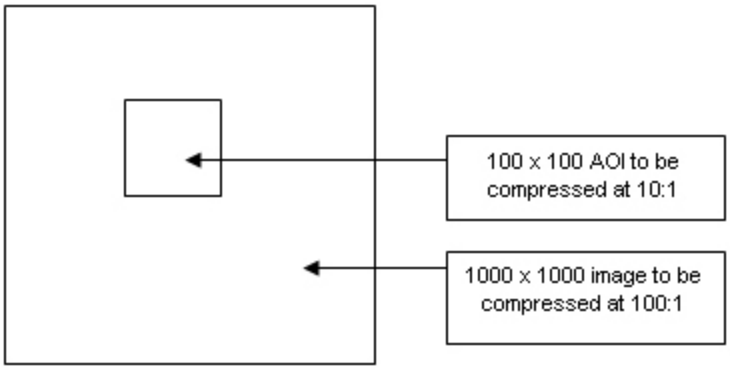
In these cases, the transparency regions in the output image are included in the mosaic size. Also in these cases, the estimated output file size may be considerably larger than the actual output file size.

NOTE: The cost charged to the data cartridge is not always equal to the mosaic size. It is calculated from the sum of the nominal sizes of the input tiles rather than from the nominal size of the resulting mosaic.

Calculating MrSID Area of Interest weight

GeoExpress calculates the resultant image filesize as part of the encoding process, taking into account the user-defined compression ratios for inside and outside the Area of Interest. Selecting the **Weight** option allows you to specify **Lossless** compression or to set a target **Compression Ratio** for the Area of Interest. (The outside area will be encoded at the compression ratio specified in the job options.)

As an example, consider a 1-band (grayscale), 8-bit input image measuring 1000 × 1000 pixels. The user specifies compression for this image at 100:1. An Area of Interest measuring 100 × 100 pixels is then defined within the image, and the compression ratio inside the Area of Interest is set at 10:1.



Based on these dimensions and specifications, GeoExpress makes the following calculations:

AOI compression ratio (CR_{AOI}) = 10
Base compression ratio for the image (CR_{other}) = 100
Area of the entire image ($Area_{total}$) is 1000 × 1000 pixels = 1,000,000 pixels
Area of the AOI ($Area_{AOI}$) is 100 × 100 pixels = 10,000 pixels
Area of the portion of the image surrounding the AOI ($Area_{other}$) is 1,000,000 pixels - 10,000 pixels = 990,000 pixels

GeoExpress then makes the following filesize calculations:

Filesize of the AOI (FS_{AOI}) = $Area_{AOI}$ / CR_{AOI} = 10,000 / 10 = 1000 bytes
Filesize of the "outside" (FS_{other}) = $Area_{other}$ / CR_{other} = 990,000 / 100 = 9900 bytes
Total filesize (FStotal) = FS_{AOI} + FS_{other} = 1000 + 9900 = 10,900 bytes

GeoExpress then calculates the overall compression ratio:

Compression ratio = $Area_{total}$ / FS_{total} = 1,000,000 / 10,900 = 91.73

In order to calculate the overall target filesize for the encode process the compression ratio for the overall image is set to 91.73. The target filesize thus becomes:

1,000,000 / 91.73 = 10,901 bytes

NOTE: This calculated filesize appears on the **Job Properties** panel for the image once you close the **Area of Interest** dialog. The actual output is reported in the **GeoExpress log file** on the **Job Progress** panel (see Viewing and using log information on page 116).

Appendix C: Data Cartridges and Floating Licenses

Data cartridges

If you have a copy of GeoExpress Standard Edition, you may need to install a data cartridge before being able to encode images.

To order a data cartridge, contact LizardTech at https://www.lizardtech.com/sales/purchase/.

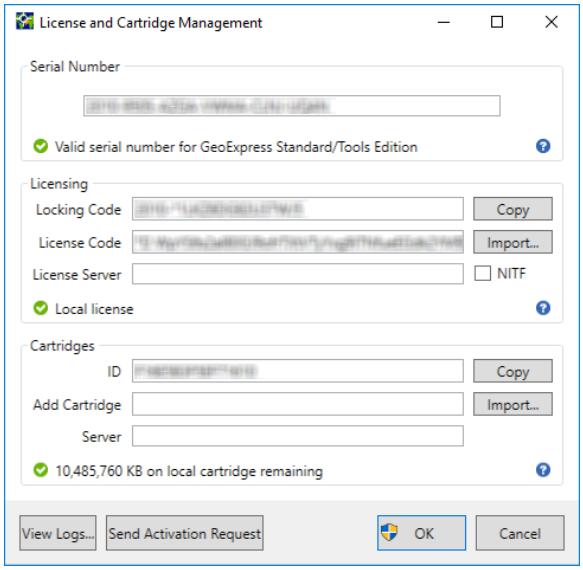
The information below tells you how to access cartridge information and add a cartridge.

For more information see Installing data cartridges on page 9.

Data cartridge information

The **License and Cartridge Management** dialog displays cartridge information and lets you add a cartridge or connect to an Express Cartridge Manager Server as shown below.

To access **License and Cartridge Management** choose **Options > Licensing**.



Cartridges

The **Cartridges** section shows the Cartridge ID or, if a Data Cartridge Server is being used to share a data cartridge, it shows the address of the Server. You can only use either a local cartridge or a cartridge server, not both.

The bottom of the panel shows how much data remains on your cartridge.

To add a local data cartridge that you have received from LizardTech, click **Import** in the Cartridges panel, select the `.ltc` file and click **Open**.

Calculating usage

The number of megabytes deducted for a job is approximately equal to the "nominal size" of the image or point cloud. For raster images, you can calculate the nominal size with the following equation:

```
width × height × number of bands × bytes per band
```

Note that the nominal size does not include areas of No-Data, so this equation yields a maximum nominal size.

For LiDAR point clouds, the nominal size is a measure of the number of points in the point cloud and the number of fields for each point.

For mosaics, the cost is calculated from the sum of the nominal sizes of the input tiles rather than from the nominal size of the resulting mosaic. This means that in cases where a mosaic of non-contiguous images is created you are not charged for the areas without tiles. (You are only charged once for areas where tiles overlap.)

NOTE: Because the charge is based on the nominal size of the image rather than the physical input file size, the encoding of compressed images such as JPEG deducts the cartridge by the same amount as the encoding of input images that are not compressed.

Floating licenses

Floating licenses enable a user on a networked computer to lease or "check out" a GeoExpress license for the period of time they are working. When the user exits the program, the license is returned to the License Server and available for another user.

On Windows, the LizardTech License Server runs as a service named `LizardTech License Server`.

Windows

Install the License Server

1. Download the LizardTech License Server from the LizardTech website.
2. Run `setup.exe`.
3. Follow the wizard steps to install the license server.
   When installation is complete, the License Server Utility will start. You can request a license immediately, or follow the steps below to add a license at anytime.

NOTE: For additional information on the setup and usage of LizardTech License Server, see the SentinelLM System Administrator's Online Guide installed with your License Server.

Request a License

1. Click **Start > LizardTech > Add Floating License**.
   This starts the License Server Utility.
2. Click **Request a License**.
   This will open your web browser to the LizardTech Product Activation page.
3. Enter the requested information and click **Submit**.
   - For LizardTech Product, select **GeoExpress**.
   - Select **New License**.
   - Paste your locking code.
   - Use the **Additional Information** field to give any additional information about your license usage. For example, if you have purchased 10 floating licenses but need to deploy them among multiple locations, let us know how you will distribute these ("2 licenses for our Portland office, 3 for Seattle, and 5 for London.") This way we can send you the license files you need for each location.

   Within about one business day you will receive an email from LizardTech Support that includes your license file. Save this file on the system where you installed the License Server.

Add a License

1. Click **Start > LizardTech > Add Floating License**.
2. Click **Import**.
3. Navigate to and select the downloaded license file (`*.lic`), then click **Open**.
   The License Server Utility will validate the license and display what type of license you imported.
4. Click **Add License** to add your new license to the license server.
5. Click **Done** to exit the License Server Utility.

Linux

Adding Floating Licenses under Linux

Once you have installed the License Server you must acquire a license code from LizardTech. A license code is required for each License Server you add to your network.

To add a license for a License Server on Linux:

1. Run the `echoid` file to display your locking code. On Linux this file is located by default in `/usr/local/LizardTech/LicenseServer/licenseserver/`.
2. Record the value returned by `echoid`, then visit https://www.lizardtech.com/support/product-activation/.
3. Enter the requested information and click **Submit**.
   - For LizardTech Product, select **GeoExpress**.
   - Select **New License**.
   - Paste your locking code.
   - Use the **Additional Information** field to give any additional information about your license usage. For example, if you have purchased 10 floating licenses but need to deploy them among multiple locations, let us know how you will distribute these ("2 licenses for our Portland office, 3 for Seattle, and 5 for London.") This way we can send you the license files you need for each location.

   You will receive a response from LizardTech within one business day.
4. When you receive your license code, run the `lslic` file in the same Tools directory:
   Open a command line interface and enter `lslic -A "license code"` (where `license code` is the code given to you by LizardTech; note that the quotes are required).

You can manually add the locking code to the file `/usr/local/LizardTech/LicenseServer/licenseserver/lservrc`.

To manually start the License Server, run the `./lserv` utility.

While using LizardTech License Server on a UNIX platform, you must be logged in as root to:

- Start the License Server
- Change distribution criteria (for redundant servers)
- Shut down the License Server
- Turn license server logging on and off
- Turn token borrowing on and off
- Add or delete license servers from the redundant license server pool

Only the user who started the license server can stop the license server. It is strongly recommended that only the root user administer the license server.

Select a license server

In most cases, you will not be aware of the floating license leasing process because it will occur invisibly and automatically. If you need to, you can choose to connect to a specific license server.

To specify a preferred License Server:

1. Choose **Options > Licensing**.
   This opens the **License and Cartridge Management** dialog.
2. Enter the IP address or network name of the license server.
3. Click **OK**.

Server Administration

Configuring floating and commuter licenses

As the license server administrator, you may control the percentage of available floating license seats that can be used as commuter licenses. That is, the number that can be checked out and used without a connection to the network.

To configure licenses, set your `LSERVOPTS` system environment variable with the following:

```
-com <percentage>
```

where `<percentage>` is an integer between 0 and 100. Do not include a percent sign. This percentage value determines the number of licenses that can be checked out as commuter licenses.

For example, specifying `-com 0` ensures that no floating licenses can be checked out as commuter licenses, while specifying `-com 100` ensures that all floating licenses may be checked out as commuter licenses.

NOTE: The percentage value rounds down so that, for example, specifying `-com 50` on a server that has 3 licenses allows only 1 license to be checked out as a commuter license.

WARNING: This environment variable affects all application licenses your license server is serving out, whether for GeoExpress or other applications. This means users of other software applications whose licenses you are administrating through your license server can be affected. For example, suppose you have 4 licenses for GeoExpress and you want to make 2 of them available for commuting. Suppose also that you have 1 license for Acme Supersoft. Specifying `-com 50` will make half of your GeoExpress licenses available as you planned but will have the additional side effect of restricting your Acme Supersoft license from being checked out (50% rounded down of one license is 0).

Utilities

Several utilities are available to help server administrators manage the LizardTech License Server on their network. By default these tools and their documentation are installed from the GeoExpress DVD when you install the License Server.

IMPORTANT: The License Server should be installed on the same subnet as any clients who wish to access it. If your License Server is not installed on your local subnet, you will be prompted to specify the name of the computer you wish to connect to for a floating license in the **GeoExpress Licensing** dialog.

Following are descriptions of other utilities included in GeoExpress that administrators are likely to need to access and use. For more information on these utilities and on others not listed below, see the SentinelLM System Administrator's Online Guide installed with your License Server.

UTILITY	PLATFORM	DESCRIPTION
echoid	All	Generates a locking code.
lserv	Linux	Starts the server (requires administrator rights).
lservnt	Windows NT	Starts or stops the server (see the SentinelLM System Administrator's Online Guide for parameters).
loadls	Windows NT	Loads the License Service into NT Services.
WinAdmin.exe	Windows	Displays a list of servers and licenses.
lsrvdown	All	Stops the server (requires administration rights).
lslic	All	Adds a license to your license file.
lsmon	All	Monitors license server transactions.
lswhere	All	Displays a list of license servers.

Using floating licenses

Using floating licenses on a network

In most cases, you will not be aware of the license check-out process because it will occur invisibly and automatically (see Select a license server on the previous page).

IMPORTANT: When using floating licenses a constant connection to the license server is required to perform encodes. If network connectivity is lost, encodes will fail.

Using commuter licenses

A commuter license is a floating license that has been disconnected from the network. If you are using a portable (laptop) computer, as for traveling purposes, you can check out a license from a license server on your network and then disconnect from the network. You can then use GeoExpress to encode images, no matter where you go, even out of the country.

NOTE: You must have purchased the Floating License option for GeoExpress in order to use commuter licenses. For more information, contact your LizardTech representative (https://www.lizardtech.com/sales#retail-sales).

To check out a commuter license, run the appropriate commuter utility as shown in the table below. These utilities ship with GeoExpress. Instructions for using them are given below.

IMPORTANT: You must check in a commuter license when you are through using it (see instructions for each utility below). If you leave a license checked out after you are finished using it, it remains unavailable for other users.

ON THIS PLATFORM	USE THIS UTILITY
Windows	LizardTech's Commuter Licensing utility or `ltcommute.exe`
Linux	`lcommute`

LizardTech's Commuter Licensing utility

Use the Commuter Licensing utility for Windows as an alternative to `lcommute` or `ltcommute`.

To check out a license using LizardTech's Commuter Licensing utility:

1. Choose **Start > Programs > LizardTech > GeoExpress > Commuter Licensing**.
   You can also run the executable `wcommute.exe`.
2. Click **Single Server** and specify a server name, then click **OK**.
   You can also click **Search Subnet** to display available licenses.
3. Select a license and click **Check Out**. The license is now marked with a red check.

To check in a license using the Commuter Licensing utility:

1. Choose **Start > Programs > LizardTech > GeoExpress > Commuter Licensing**, or type `wcommute.exe` at a command prompt.
2. Click **Single Server** and specify a server name, then click **OK**.
   You can also click **Search Subnet** to display available licenses.
3. Select the license (it will be marked with a red check when it is checked out) and click **Check In**. The license becomes unmarked and is now available for another user.

ltcommute (or ltcommute.exe)

On Windows, use the `ltcommute` utility.

To check out a license using `ltcommute` use the following command:

```
-co -s <server> -fn <feature name> -fv <feature version>
```

To check a license back in using `ltcommute` use the following command:

```
-ci -s <server> -fn <feature name> -fv <feature version>
```

lcommute (or lcommute.exe)

Use the `lcommute` utility for Linux platforms.

The `lcommute` utility can be used either with parameters or interactively. To operate interactively, specify no arguments at the command line (for more information see the System Administrator's Online Help, distributed on your GeoExpress DVD-ROM).

To check out a license using `lcommute` use the following command:

```
-c o -o n -s <server> -f <feature> -v <version> -d 0
```

IMPORTANT: Zero (0) must be used with the `-d` argument.

To check a license back in using `lcommute` use the following command:

```
-c i -0 n -s <server> -f <feature> -v <version>
```

Using Terminal Services

If you wish to use GeoExpress in a Terminal Services environment, you must use a floating license.

Frequently Asked Questions

Questions about Data Cartridges

For more information see Data cartridges on page 133, Licensing GeoExpress on page 10 and Installing data cartridges on page 9.

What are data cartridges?

Data cartridges are small, binary encrypted files that enable you to encode images with GeoExpress. Cartridges are a software-based replacement for the traditional physical dongle or hardware lock. They are generated by LizardTech, based upon your system ID, and then emailed to you as an attached file.

How does a data cartridge work?

Data cartridges are installed through the GeoExpress user interface. The user interface displays the amount of data in the installed cartridge and the amount of 'encoding' capacity remaining on the cartridge. The data cartridge is decremented based on the amount of input data calculated by multiplying the number of pixels to be encoded times the pixel depth.

What raster operations get charged against the cartridge?

For raster jobs, only the initial creation of MrSID and JPEG 2000 images charges the cartridge. Working with images that are already in the MrSID or JPEG 2000 format does not decrement the data cartridge. For instance, you can create a lossless MrSID or JPEG 2000 file, which decrements the cartridge, and then use that file to create visually lossless compressed MrSID or JPEG 2000 files that do not charge against the cartridge. Additionally, updating mosaics and creating mosaics of existing MrSID or JPEG 2000 files do not charge against the cartridge.

What LiDAR operations get charged against the cartridge?

For LiDAR jobs, the following operations charge the data cartridge:

- Creating a MrSID image from any other file format. However, creating a MrSID image from another MrSID image does not charge the data cartridge.
- Creating a LAZ image from a LAS image or a LiDAR text file. However, creating a LAZ image from another LAZ image does not charge the data cartridge.
- Creating a LAS image from a LiDAR text file.

If you have an input MrSID image, you can decode the image to LAS or LAZ without charging the data cartridge.

Can I share my data cartridge with other users in my organization?

Yes. GeoExpress has a server-based shared capacity cartridge. This is NOT a floating license (for floating license information see below) but rather a “big bucket” of capacity that can be accessed by multiple licensed users on the network.

Questions about Floating Licenses

For more information see Licensing GeoExpress on page 10 and Floating licenses on page 134.

How do I specify a License Server?

Enter the License Server IP address or network name in the **Licensing** section of the **License and Cartridge Management** window. To access this window, choose **Options > Licensing**.

Which license takes precedence when there are more than one available?

When you run GeoExpress after the temporary license has expired, the program first looks for a valid standalone (local) license on your computer. If there is none, it looks for a valid floating license by trying to connect to a license server on your local subnet. If it cannot find one you are prompted to either activate a permanent standalone license or specify a license server on your local subnet or a broader network.

Appendix D: Troubleshooting

Installation problems

Following are descriptions of several problems that could be encountered installing GeoExpress.

Invalid License Code Entered

The license code was entered incorrectly.Try re-entering it; choose **Options > Licensing** to open the **License and Cartridge Management** dialog.

The most reliable way to add the license is to import the license file. You should have received this file (with the extension `.lic`) in an email from LizardTech. In the **License and Cartridge Management** dialog, click **Import** next to the **License** field and select the `.lic` file.

If you still receive this error, you can edit the license file manually. The license code is stored in the `GeoExpress\bin` directory in a file called `lservrc`. Open this file with a text editor and compare the 51-character license code with the one you received from LizardTech. The code in the `lservrc` file can be corrected manually, if necessary. The number sign (#) character at the end of the license code indicates the end of the code. Although this character is not required for the license to be considered valid, it is useful for making sure that you have copied the string completely, and we recommend that you leave it in.

License Suddenly Not Recognized

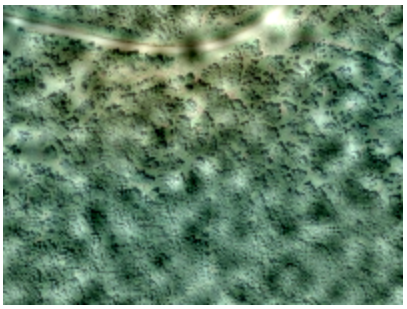
The permanent license that you received from LizardTech is keyed for a unique network card identification number. If the network connection becomes unavailable or your network hardware configuration has changed, the program may not accept the license code. Restore the network connection or the original network hardware configuration, or fill out the form at https://www.lizardtech.com/support/product-activation/ for a new permanent license.

License Timed Out Early

If you have a temporary version of GeoExpress and the clock in your operating system has been altered–for instance, if you have recently upgraded your system software–security features in the licensing software may not allow the program to run. Please contact technical support at https://www.lizardtech.com/support.

Encoding problems

If you set a low weight value for an image with low color contrast, you may notice the following pattern of light and dark spots across your image:



The following factors contribute to the creation of this pattern:

- Low weight value
- High compression ratio
- Low color contrast
- MrSID Generation 2 output format
- Image enhancement

To reduce the appearance of this pattern, complete the following steps:

1. Select the image in the **Job List**.
2. Click **Advanced** in the **Job Properties** panel.
3. Click the **Format-Specific** tab.
4. Increase the value in the **Weight** field. For example, you might change the value from 2 to 3.
5. Optionally, deselect the **Image Enhancement** option.
6. Click **OK**.
7. Click the **Run Selected Jobs** button to run the job.

Finding your version and build numbers

You may need to know your the version and build number of your GeoExpress software in order to communicate with LizardTech Support. To find these numbers, choose **Help > About GeoExpress**.

Technical Support

Most technical issues can be resolved using the various resources you have available. In addition to the product documentation and the “Read Me” file, LizardTech offers a knowledge base and product updates on the LizardTech website.

Knowledge Base

The LizardTech Knowledge Base contains articles about known technical and usage issues and is frequently updated.

https://www.lizardtech.com/support/geoexpress/knowledge-base

Product updates

Updated versions of LizardTech viewer tools are available for download at no cost.

https://www.lizardtech.com/support/geoexpress/installers

Support plans

Protect your investment in LizardTech software by participating in a LizardTech support plan. For more details, please contact your regional LizardTech office.

https://www.lizardtech.com/sales#retail-sales

Contacting Technical Support

To contact LizardTech Technical Support, visit http://www.lizardtech.com/support.

The support page includes links to the LizardTech Knowledge Base and the Product Activation page. A Contact Form is also provided for issues that require further assistance.

In an emergency, call 206-902-2845 between the hours of 8 AM and 5 PM Pacific Time.

Please have the following information available to assist in resolving your problem:

- The task you were working on when the problem occurred
- The command you typed prior to the problem, if applicable
- The exact error message, if applicable
- The type of file you are encoding and the file size
- Whether you have restarted the computer and attempted to reproduce the problem
- Which version of GeoExpress you are running (see Finding your version and build numbers on the previous page).
- Other LizardTech products you have installed
- The operating system
- The amount of hard drive space available
- The amount of memory installed in your system
- Any other information you feel is relevant

Appendix E: Company and Product Information

About LizardTech

Since 1992, LizardTech has delivered state-of-the-art software products for managing and distributing massive, high-resolution geospatial data such as aerial and satellite imagery and LiDAR data. LizardTech pioneered the MrSID® technology, a powerful wavelet-based image encoder, viewer, and file format. LizardTech has offices in Seattle, Portland, and Tokyo and is a division of Celartem, Inc. For more information, visit https://www.lizardtech.com.

Other LizardTech products

Thank you for using LizardTech® GeoExpress® software. Try the rest of our product line.

GeoViewer

Efficient Viewing and Exporting of MrSID and JPEG 2000 Layers

GeoViewer is LizardTech's free, standalone application for viewing geospatial imagery, vector overlays and LiDAR data. GeoViewer enables you to combine, view and export visual layers from varied sources, such as local repositories, Express Server catalogs, and WMS and JPIP servers. GeoViewer supports a wide range of input formats and exports to GeoTIFF, PNG and JPEG. It's the most efficient means of viewing MrSID and JPEG 2000 images.

For more information about GeoViewer, visit https://www.lizardtech.com/geoviewer-pro/overview.

Express Server

Image Delivery Software for Geospatial Workflows

LizardTech Express Server software is the best solution for distributing imagery in MrSID or JPEG 2000 format. With Express Server, users on any device access imagery faster, even over low-bandwidth connections. Express Server is faster, more stable and easier to use than any other solution for delivering high-resolution raster imagery.

For more information about Express Server, visit https://www.lizardtech.com/express-server/overview.

MrSID Decode SDK

Integration of MrSID Support into Third-Party Applications

The MrSID Decode SDK provides a framework for extracting raster or LiDAR data from MrSID files, including MrSID Generation 4 (MG4™). Used as the foundation for LizardTech's Express Suite® line of geospatial products—GeoExpress, Express Server and Spatial Express software—the MrSID Decode SDK is a robust toolkit suitable for complex application development needs.

MrSID Decode SDK is available for free download: https://www.lizardtech.com/developer/overview.

Appendix F: Summary of Menu Commands

File menu

The **File** menu includes commands for adding images and tiles to the **Job List** and for working with GeoExpress project (`.prj`) files. A project consists of the current contents of the **Job List** and global settings.

MENU ITEM	FUNCTION
Add image(s)	Add image files to the **Job List**. File types are determined by file extension; if you attempt to add a file with an unrecognized extension, you will be prompted to identify the file type. For a list of supported file types, see Supported input file formats on page 121.
Create new mosaic of images	Adds an empty mosaic to the **Job List**. You'll be prompted to identify the mosaic type (raster or LiDAR), output file and file type, and other details about the mosaic.
Add color composite image to encode	Add an image job consisting of separate files representing the Red, Green, and Blue bands of an image.
New project	Clears the **Job List**, ready to add images to a new project. (If the current project has not been saved or has been changed since last saved, you'll be prompted to save it.)
Open project	Opens a saved project file. **Note:** GeoExpress can not open project files saved by versions earlier than version 9.5.3.
Save project	Saves changes to the current project. If it has not been saved, you'll be prompted for a filename.
Save project as	Prompts to save the project with a new filename.
Print session log	Prints the log of all encoding jobs run since you launched GeoExpress. This is the same information displayed in the **Job Progress** panel.
Recent projects	Lists the last four project files that you accessed; select one to re-open it.
Recent files	Lists the last four non-project files; select one to add it to the current project.
Exit	Exit GeoExpress. You'll be prompted to save an unsaved or modified project or cancel any running jobs.

Jobs menu

The **Jobs** menu provides another means of executing jobs.

MENU ITEM	FUNCTION
Run selected jobs Optimize selected images Encode selected mosaics	Run the jobs that are selected in the **Job List**. The menu item may change depending on the nature of the job and the options selected for it.
Run all jobs	Runs all jobs in the **Job List**.

Options menu

The **Options** menu provides access to basic encode parameters, preferences and licensing.

MENU ITEM	FUNCTION
Job options	Set format, compression, dimensions, resolution, and tiling options for the selected job.
Advanced options	Set advanced input, output, and other options for the selected job.
Edit mosaic	Add, remove, crop, change order, and set a coordinate reference system for tiles. This option is only available if the selection consists of a mosaic job or files in a mosaic job.
NITF image segments	Displays the image segments in the selected file and allows you to select the segments that you want to include in the output file.
Preferences	Set or restore default preferences for output files, including output directory, compression ratio, and more.
Licensing	Enter or import license information or a data cartridge license, connect to a License Server, or utilize an NITF-enabled license if one is available.

Tools menu

The **Tools** menu offers options related to more complex encoding functions.

MENU ITEM	FUNCTION
Metadata	You can enter or modify **User** or **Image** metadata, including company name, copyright information, geographic location, and CRS, among others.
Despeckling	Enable despeckling for an image or tile, and set despeckling options.
Image crop	Specify cropping for the image, using either a simple rectangle or polygons defined in a shapefile.
Area of interest	Specify a region of the image to use increased or decreased visual quality compared to the rest of the image. This can be used to emphasize an important areas, or to “blur out” a sensitive region.
Color Balance	Apply brightness, contrast, and color corrections to mosaic tiles.
Reproject	Allows you to reproject images from one coordinate reference system (CRS) to another.
Publish images	Publish existing images directly to an Express Server.

Help menu

The **Help** menu provides information about GeoExpress and access to additional resources.

MENU ITEM	FUNCTION
Contents	Opens online help
Anonymous Application Usage	Provides a description of data that can be shared anonymously with LizardTech, with the option to enable or disable data collection.
LizardTech online tech support	Opens a browser window to LizardTech’s support website
Open log files folder	Opens the folder containing session and job log files.
About GeoExpress	Displays product and version information.

Glossary

A

alpha band

An image band that tracks the portions of an image that you do not want to display. Alpha bands are included in MrSID Generation 4 and are especially useful for aligning images seamlessly.

B

band

A band, or image band, is one set of samples corresponding to one spectral component of an image. For example, a typical image has three bands, a red band, a green band, and a blue band.

BBB

The name of a file format for raw images, short for BIL, BIP, and BSQ.

BIL

A band-interleaved by line image. This format stores all bands of pixel values for each consecutive lline or row of the image.

BIP

A band-interleaved by pixel image. This format stores all bands of pixel values for each consecutive pixel the image.

BSQ

A band sequential image. This format stores all pixel values for each band consecutively.

byte order

The order in which bytes are stored in computer memory. There are two types, little-endian and big-endian. Also known as “endianness”.

C

composite mosaic

A MrSID image that contains other MrSID images. Composite mosaics can be created quickly because they do not need to be compressed again, but they may load more slowly than flat mosaics.

compression

The process of transforming information so that it can be stored or conveyed in less space than the original information. See also lossless, lossy and visually lossless.

compression ratio

A ratio of an image’s nominal size and an image’s compressed size, where the nominal size is calculated from the length, width, number of bands, and number of bits in the image. For example, a raw image compressed from 10 GB to 1 GB has a compression ratio of 10:1.

D

dynamic range

The ratio between the largest and smallest values in an image. Image viewers use dynamic range values to improve the appearance of images. For an image where the dynamic range is less than the full range of possible values for the image, you may want to use your image viewer to stretch the pixel values across the full range.

E

endianness

See byte order.

F

flat mosaic

A MrSID image created from multiple input images. Flat mosaics do not preserve information about each input image and require compressing all the input images again. However, they load more quickly than composite mosaics.

frequency balance

A parameter used in MrSID to determine the emphasis given to edges and flat color areas when performing compression. See also weight and sharpness.

G

gamma

A parameter used in MrSID to determine the emphasis given to edges and flat color areas when performing compression. In MG3 and MG4 encoding, this parameter is called frequency balance. A lower value creates more defined edges, while a higher value creates softer edges.

GML

Geography Markup Language. An open, XML-based specification for representing geographic information including geographic features, coverages, observations, topology, geometry, coordinate reference systems, units of measure, time and other values. Because it is an XML grammar, it is both extensible and adaptable to any application within the broad geospatial field.

K

K-weight

A parameter used in MrSID to determine the emphasis given to the K (black) band of a CMYK image when performing compression.

L

level

See zoom level.

lossless

A compressed image that is identical to the input image across all pixel values. See also lossy and visually lossless.

lossy

A compressed image that approximates the pixel values of the input image. Lossy images are generally significantly smaller than lossless images. Depending on the compression ratio, a lossy image may display compression artifacts or it may appear to the human eye to be identical to the input image. See also lossless and visually lossless.

M

magnification

The scale at which an image is represented. Magnification is expressed as a positive floating point value. For example, 1.0 represents the full image, 0.5 represents a half-scale version, and 2.0 represents a double-scale version. The magnification value must be a power of two. See also scale and zoom level.

metadata

The information stored in an image that is not pixel value information. For example, typical metadata includes image properties like the width, height, and colorspace of the image. Alternatively, some images contain additional metadata such as the name of the image creator, the organization name, the creation date, and more.

MG2

MrSID Generation 2. A previous version of the MrSID image format. MG2 is limited to lossy encoding and does not support optimization nor some of the advanced features available in MG4. See also MrSID and MG4.

MG3

MrSID Generation 3. A previous version of the MrSID image format. MG3 supports lossless encoding, image optimization, composite images, and more. See also MrSID and MG4.

MG4

MrSID Generation 4. The current version of the MrSID image format. MG4 supports all the features of MG3 and adds support for alpha bands and multispectral images.

mosaic

An image created from multiple input images, also called image tiles, to form another larger image. There are two types of mosaics, flat mosaics and composite mosaics.

MrSID

Multiresolution Seamless Image Database - A wavelet-based image format designed for large, high-quality geospatial imagery. The current version of the MrSID file format is MrSID Generation 4. See also MG4.

N

nominal image size

The size of an image calculated from the width, height, number of bands, and number of bits in the image. The nominal size is iindependent of the file format or of the compression used on the image. You can use the nominal size of an image to compare the relative sizes of images in different formats and to calculate the compression ratio for an image. See compression ratio.

O

optimization

The process of creating an MG3 image from a source MG3 image without decoding the image and compressing it again. Common optimization operations include cropping and removal of resolution levels.

P

pixel

A pixel represents a value or set of values for a particular point in a raster image. For images with more than one band, a pixel includes the values of all the bands at the given pixel position.

R

resolution

A measure of the detail in an image. Typically, this is measured in ground units per pixel.

S

scale

The magnification at which an image is represented. Scale is represented as a signed integer, corresponding to the negative of the log of the magnification. That is, magnifications of 1.0, 0.5 and 2.0 are equivalent to scales of 0, 1 and -1 respectively. See also magnification and zoom level.

sharpness

A parameter used in MrSID to determine the sharpness of boundaries between different areas of an image when performing compression. See also frequency balance and weight.

strip height

The number of rows of an image to be processed in each step of an image read operation. Use of smaller strip heights may reduce memory requirements, but at a possible performance loss.

T

transparency color

Also called the no-data value. Pixels that match the transparency color are not displayed. The value can be specificied manually or in the metadata. See also alpha bands.

V

visually lossless

An image that appears to the human eye to be identical to the input image. However, a visually lossless image is actually a lossy image, and as such only approximates the pixel values of the input image.

W

wavelet

A mathematical representation of a pixel value that varies by frequency and duration. In wavelet space, the importance of a pixel depends on the values of its neighboring pixels. Wavelet-based image formats are able to present images at multiple zoom levels without creating image pyramids.

weight

A parameter used in MrSID to determine the emphasis given to the grayscale portion of a color image when performing compression. See also frequency balance and sharpness.

world file

A text file that contains geospatial positioning information to augment or replace the geospatial metadata in an image file.

Z

zoom level

The scale at which an image is represented. Levels are generally expressed with signed integer values. An image at scale 1 has half the width and height of the original. See also scale and magnification.

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