

# ENVI Tutorial: Working with NITF Data

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Working with NITF Data .....	2
Files Used in this Tutorial .....	2
Exercise 1: Metadata, TREs, DESes, Chipping, and Saving .....	3
Viewing Metadata .....	3
Viewing a Text Segment .....	4
Tagged Record Extensions .....	4
Data Extension Segments .....	4
Chipping the Image and Saving to NITF Format .....	7
Exercise 2: RPC Map Information .....	10
Background on Sensor Models .....	10
Viewing Map Information .....	11
Exercise 3: Viewing Composite Images and Editing PIA TREs .....	12
Saving to NITF Format .....	12

## Working with NITF Data

This tutorial introduces common tasks when working with National Imagery Transmission Format (NITF) files. The first exercise shows you how to open a NITF 2.1 multiple image segment file; how to view metadata, Tagged Record Extensions (TREs), and Data Extension Segments (DESEs); how to chip (subset) the file; and how to save the chip to NITF format. The second exercise demonstrates the use of rapid positioning coordinate (RPC) map information in georeferencing a NITF file. The third exercise explains how to work with composite images and how to edit Profile for Imagery Access (PIA) TREs.

### Files Used in this Tutorial

ENVI Resource DVD: Data\nitf

File	Description
digitalglobe_ncdrd_chip.ntf	NITF 2.1 Quickbird image of St. Petersburg, Russia
target_example.ntf	NITF 2.1 composite image

The QuickBird file `digitalglobe_ncdrd_chip.ntf` is courtesy of DigitalGlobe and may not be reproduced without explicit permission from DigitalGlobe. The file `target_example.ntf` was provided by the Joint Interoperability Test Command (JITC) for test purposes.

## Exercise 1: Metadata, TREs, DESes, Chipping, and Saving

In this exercise, you will open a NITF 2.1 file; view metadata, TREs, and DESes; chip (subset) the file; and save multiple image segments to NITF format.

1. From the ENVI main menu bar, select **File > Open Image File**. The Enter Data Filenames dialog appears.
2. Navigate to Data\nitf, select the file digitalglobe\_ncdrd\_chip.ntf, and click **Open**. The file appears in the Available Bands List as two image segments. Image segment #1 is a QuickBird image of St. Petersburg, Russia, and image segment #2 is an NCDRD cloud image.
3. In the Available Bands List, right-click on the filename digitalglobe\_ncdrd\_chip.ntf, and select **Load True Color**. An RGB version of image segment #1 is loaded into a new display group.



### Viewing Metadata

1. In the Available Bands List, right-click on the filename digitalglobe\_ncdrd\_chip.ntf and select **View NITF Metadata**. The NITF Metadata Viewer dialog appears. The metadata for this file is organized into separate entries for the file header, image segments, a text segment, and Data Extension Segments (DESes). The metadata fields are described in more detail in the following specification document: <http://www.ismc.nga.mil/ntb/baseline/docs/2500a/index.html>
2. In the NITF Metadata Viewer, click the + symbol next to **NITF file header** to see metadata describing the file properties.
3. Click the + symbol next to **Image segment #1** and **Image segment #2** to see metadata describing the image characteristics. Image segments contain raster image data, intended for display or analysis. Under image segment #2, notice that the Image Representation field contains the value “NODISPLY.” This means the image segment will not be chipped if you save it to NITF format.

## Viewing a Text Segment

This file contains a text segment, which consists of textual information not intended for graphical display. Most of the time, text segments are provided to supplement the graphic content in the dataset.

1. In the NITF metadata viewer, click the + symbol next to **Text segment #1**.
2. Click on the line that says **Text: <Click to view>**. A Text dialog appears with the information contained within the text segment subheader. In this case, the text segment contains the end-user license agreement from DigitalGlobe.
3. Close the Text dialog.

## Tagged Record Extensions

When you click the + symbols to expand the file header, image segments, and DESes in the NITF Metadata Viewer, you will notice various colored icons that say “TRE.” These are tagged record extensions, which contain information about the segment they are in. The file header can contain one or more TREs that apply to the entire data set, and each segment (image, text, annotation) can also have one or more TREs associated with it. TREs can specify attributes such as processing history, information about specific targets in an image, collection information, and other types of metadata.

A white TRE icon contains metadata for a TRE that you cannot edit when saving the file. A green icon contains metadata that you can edit when saving the file.

Each TRE supported by the NITF/NSIF Module references an XML definition file that is installed with your ENVI software if you purchased the NITF/NSIF Module. For a full list of supported TREs and links to their specifications, see Appendix A of the *NITF/NSIF User’s Guide* (available through ENVI Help or as a PDF included with your NITF/NSIF Module installation).

The following figure shows the TREs for Image Segment #1.



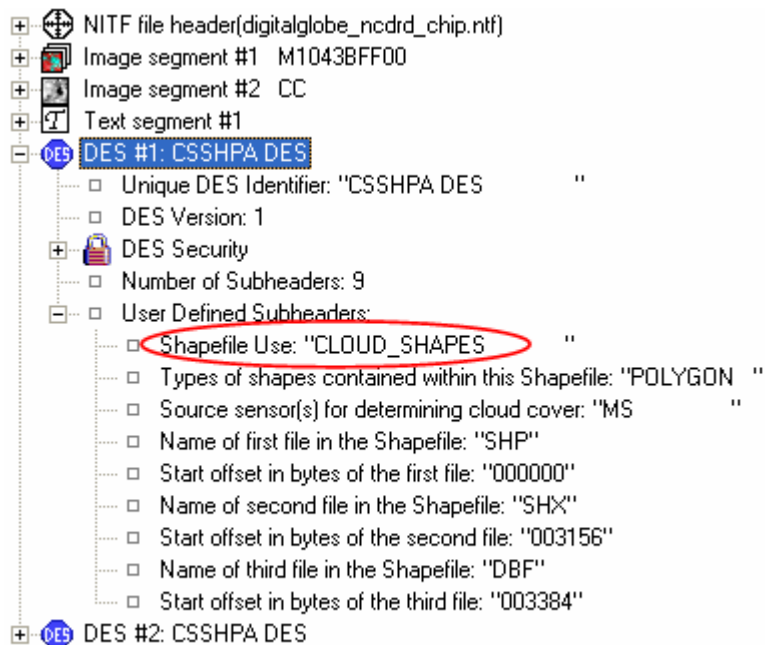
When working with NITF data outside of this tutorial, your data may contain some TREs that do not have an associated XML file. These TREs are displayed with a “Definition Unknown” label next to their name. Their contents may be viewable if the TREs do not contain binary data. ENVI will save these TREs.

## Data Extension Segments

In the NITF Metadata Viewer, you will also see two blue icons that say “DES.” These are data extension segments, which are similar to TREs because they contain information that cannot be stored in other NITF segments.

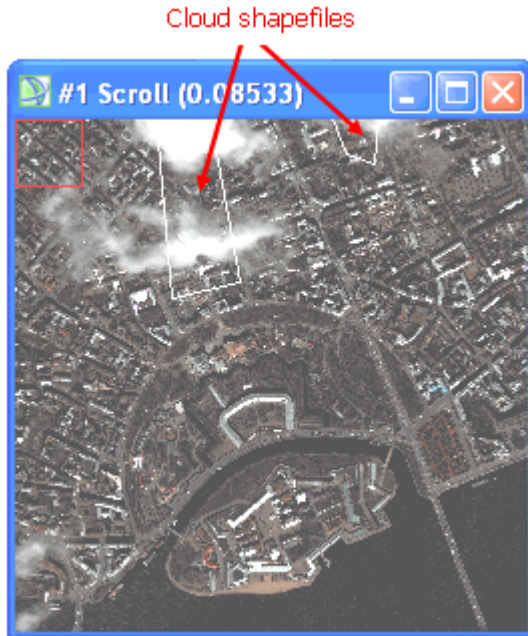
The file you are working with is a NITF 2.1 Commercial Dataset Requirements Document (NCDRD) file that contains two shapefile DESes indicated by the word “CSSHPA.”

1. Click on the + symbol next to **DES #1: CSSHPA DES** to view its metadata. Then click the + symbol next to **User Defined Subheaders**. You will see that this is a CLOUD\_SHAPES DES, which is a polygon shapefile containing cloud locations.

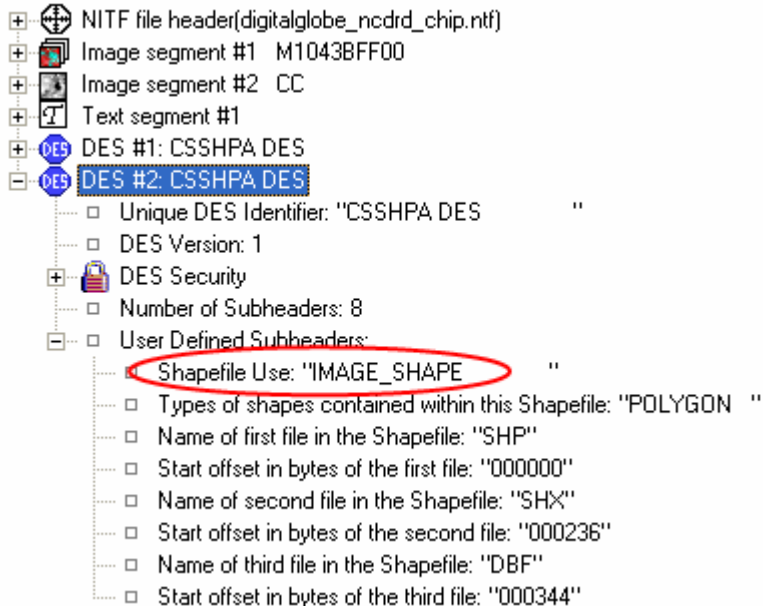


**Figure 3: Example CLOUD\_SHAPES DES**

2. In the NITF Metadata Viewer, click **Load DES Shapefiles**. This button is only available when you open NCDRD files with at least one CSSHPA DES. ENVI extracts the corresponding shapefile element, converts it to ENVI vector format (EVF), and loads it into the Available Vectors List.
3. In the Available Vectors List, select the layer named **digitalglobe\_ncdrd\_chip\_CLOUD\_SHAPES**, and click **Load Selected**. The Load Vectors dialog appears.
4. Select **Display #1**, and click **OK**. Polygon vectors overlay the image segment in the display group, roughly outlining the boundaries of clouds. The Vector Parameters dialog also appears.



5. Use the Vector Parameters dialog to change the color of the vector layer to another color.
6. In the NITF Metadata Viewer, click on the + symbol next to **DES #2: CSSHPA DES** to view its metadata. Then click the + symbol next to **User Defined Subheaders**. You will see that this is an IMAGE\_SHAPE DES, which is a single-polygon shapefile defining the original image extent.



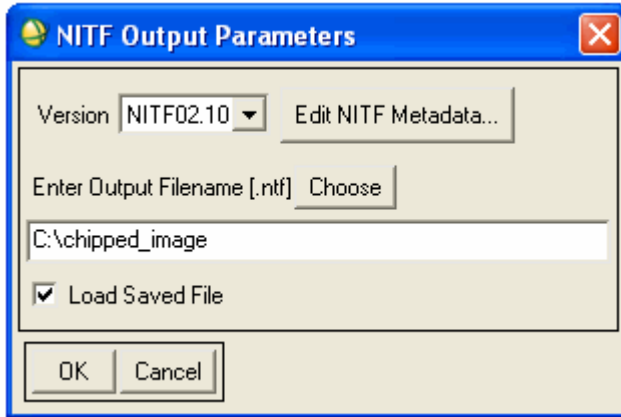
7. When you are finished, close the Available Vectors List, Vector Parameters, and NITF Metadata Viewer dialogs. The vector shapefiles disappear from the display group. (If you want to view them again in the future, you can select **Vector > Available Vectors List** from the ENVI main menu bar, then load the desired vectors to the display group.)

## Chipping the Image and Saving to NITF Format

In these steps, you will attempt to chip (subset) both image segments and output them to NITF format.

1. From the ENVI main menu bar, select **File > Save File As > NITF**. The Select NITF Output File dialog appears. The left side of the dialog lists both image segments associated with the file.
2. Select the image segment named `digitalglobe_ncdrd_chip.ntf M1043BFF00`. Information about the file is displayed, along with Spatial Subset and Spectral Subset buttons and an All Image Segments check box.
3. Click to enable the **All Image Segments** check box to select both image segments for saving. Special rules apply when saving any NITF image with multiple image segments:
  - You can save one or all of the image segments to an output NITF file. If you have three or more image segments, you cannot use **Ctrl-click** to select multiple image segments. If you hold down the **Shift** key and select another segment, the last segment you selected is highlighted (not all segments).
  - You cannot create a NITF file with multiple image segments if the input file does not contain multiple image segments.
  - The Spectral Subset button is not available if all segments are selected.
  - If you select all image segments and uncheck All Image Segments, the previously selected image segment is selected.
  - You can edit multiple image segment metadata the same was as single-image output.
  - You cannot save image segments containing masks to an output NITF file.
  - You cannot change the NITF file version or compression parameters when saving multiple image segments.
4. Click **Spatial Subset**. The Select Spatial Subset dialog appears.
5. Click **Image**. The Subset by Image dialog appears.
6. Leave the **Samples** and **Lines** values at **400**, and move the red box to any location within the image. Click **OK**.
7. Click **OK** on the Select Spatial Subset dialog and the Select NITF Output File dialog. The NITF Output Parameters dialog appears.

8. Select an output filename and click **OK**. After processing is complete, the output file (and its associated image segments) are added to the Available Bands List.



## Examining the Output

1. In the Available Bands List, right-click on **Image Segment #2** of your chipped image and select **Load Band to New Display**. Note that image segment #2 (the NCDRD cloud image) was not chipped upon output because the Image Representation metadata value was “NODISPLY” (in the original image).
2. Close **Display #2** (containing Image Segment #2).
3. In the Available Bands List, right-click on the new filename and click **Load True Color to <new>**. In the next step, you will use ENVI’s Dynamic Overlay feature to compare the original (unchipped) image in Display #1 to the chipped image in Display #2.
4. From any display group menu bar, select **Tools > Link > Link Displays**. The Link Displays dialog appears.
5. Ensure that the **Display #1** and **Display #2** toggle buttons are both set to **Yes**. Also ensure the **Dynamic Overlay** toggle button is set to **On**. Click **OK**.
6. Click in one of the Image windows to toggle between the original (unchipped) image and the chipped image. Notice the color differences between the two images. ENVI automatically assigned a default 2% linear stretch to the unchipped image, but not to the chipped image that you saved.

## Viewing the Output Metadata

1. In the Available Bands List, right-click on the new filename, and select **View NITF Metadata**. The NITF Metadata Viewer dialog appears.
2. Browse through the metadata and notice that ENVI retained the input metadata, TREs, and DESes. An exception is that some fields in the image and file header metadata were updated to indicate processing changes to the file upon chipping. Also notice that ENVI added an ICHIPB TRE to Image Segment #1, which indicates the image was chipped.

If you click the + symbol to expand the NITF file header metadata, you will see the Originating Station ID, Originator’s Name, and Originator’s Phone fields were changed to the defaults set in the NITF configuration file.

On Windows, the NITF configuration file is located in `C:\Program Files\ITT\IDLxx\products\envi\menu\nitf.cfg`.

On Unix, the file is located in `/usr/local/itt/idlxx/products/envi/menu/nitf.cfg`.

To learn more about changing the default values for these (and other) fields in the NITF configuration file, see “The NITF Configuration File” in ENVI Help.

3. Click **Load DES Shapefiles**.
4. In the Available Vectors List, select the **CLOUD\_SHAPES** layer corresponding to the output file you created. Click **Load Selected**. The Load Vectors dialog appears.
5. Select **New Vector Window**, and click **OK**. Note the full extent of the DES shapefile. It was not chipped upon output.
6. When you are finished, close all dialogs and display groups except for the Available Bands List and NITF Metadata Viewer. You will use the same data file for the next exercise.

## Exercise 2: RPC Map Information

In this exercise, you will learn how the NITF/NSIF Module uses RPC map information to georeference a file. You will open the file `digitalglobe_ncdrd_chip.ntf` (which contains RPC map information) and view the map information used for georeferencing.

The NITF/NSIF Module uses a variety of different map information for georeferencing:

- Replacement sensor model (RSM) TREs
- Rapid positioning capability (RPC) TREs
- DIGEST GeoSDE TREs (MAPLOB, PRJPSB, and GEOPSB TREs)
- IGEOLO image header field

If a NITF file contains RPC or RSM map information, the NITF/NSIF Module in ENVI uses that information to georeference the file. If a file does not contain RPCs or RSMs, ENVI looks for the items in the above list (in that order) to georeference the file. This exercise focuses on the use of RPCs only.

For a full discussion on how ENVI uses non-standard projections such as affine map transformations, RPCs, and RSMs, see “Non-Standard Projections” in ENVI Help.

## Background on Sensor Models

Sensor models are a type of map information used to define the physical relationship between image coordinates and ground coordinates. A sensor model is a mathematical model that replaces the rigorous (physical) sensor model associated with a specific sensor by representing the model’s ground-to-image relationship. It is used to map a 3D ground point to a 2D image point. Various commercial spaceborne image providers utilize replacement sensor models, particularly RPCs, which are one type. Two sensor models that ENVI uses are RPCs and RSMs. This tutorial only discusses the use of RPCs.

### RPCs

Rational polynomial coefficients (RPCs) are one type of sensor model. RPCs are not the same as a map projection; rather, they model the ground-to-image relationship as a third-order, rational, ground-to-image polynomial. You can use RPCs to perform orthorectification and DEM extraction in ENVI.

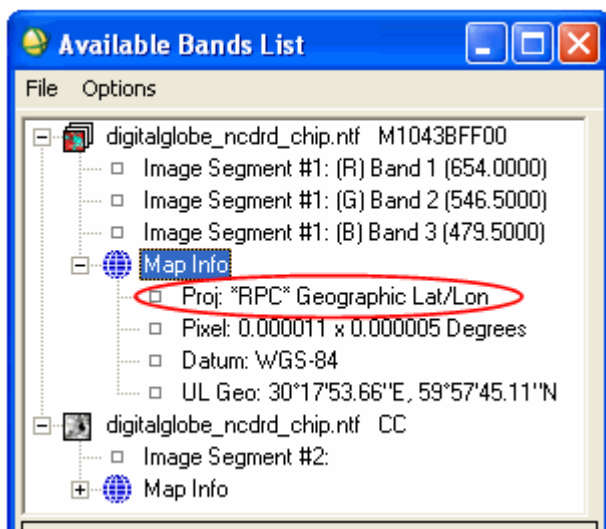
QuickBird data include pre-computed RPCs with the imagery. If your file has RPC information, you can automatically derive RPC-based geolocation information for individual pixels in an image. This method is not as geographically accurate as performing a full orthorectification, but it is less computationally and disk-space intensive.

If your image file has pre-computed RPC information, ENVI uses the mean elevation value used in the RPC transformation for the entire image. However, you can significantly increase the geolocation accuracy of the image if you associate the image with a DEM.

The NITF/NSIF Module reads RPC information from a NITF file and creates an RPC00A or RPC00B TRE. If either of these TREs exists in a NITF file, ENVI uses the RPC model to emulate a projection by default. The projection description includes the string `*RPC*` prior to the name of the coordinate system in which the image resides.

## Viewing Map Information

1. In the NITF Metadata Viewer dialog, click the + symbol next to **Image segment #1** (`digitalglobe_ncdrd_chip.ntf`) to expand its contents.
2. Scroll until you see the **RPC00B** TRE. Click the + symbol next to this TRE to expand its contents. All of the information here was derived from the RPC map information provided with the QuickBird image of St. Petersburg. ENVI had read this information into an RPC00B TRE and georeferenced the file using the coefficients shown here.
3. Click **Cancel** in the NITF Metadata Viewer dialog.
4. In the Available Bands List, you should see a **Map Information** icon under `digitalglobe_ncdrd_chip.ntf`. This indicates that the file is georeferenced. Click the + symbol to expand its contents. The Proj field shows that RPCs are used to emulate a Geographic Lat/Lon projection.



5. In the Available Bands List, right-click on `digitalglobe_ncdrd_chip.ntf`, and select **Load True Color**.
6. Double-click in the Image window to display the Cursor Location/Value tool.
7. Move around the image and note how ENVI displays geographic latitude and longitude coordinates. Also note that the Cursor Location/Value tool shows the Projection as **\*RPC\* Geographic Lat/Lon**.
8. When you are finished, select **File > Close All Files** from the ENVI main menu bar, then click **Yes** to close all files.

## Exercise 3: Viewing Composite Images and Editing PIA TREs

In this exercise, you will learn about composite images and how to edit Profile for Imagery Access (PIA) TREs when saving a NITF file.

1. From the ENVI main menu bar, select **File > Open Image File**. The Enter Data Filenames dialog appears.
2. Navigate to `Data\nitf`, select the file `target_example.nitf`, and click **Open**. This is a composite image consisting of two image segments and various annotation segments. The first entry that appears in the Available Bands List is the RGB composite image. The next two entries are the image segments that make up the composite image.
3. Click **Load RGB**. The composite image is loaded to a new display group.
4. In the Available Bands List, right-click on **Image Segment #1** and select **Load Band to New Display**. The first image segment appears in a new display group.
5. Double-click inside the Image Window in **Display #1** (composite image). The Cursor Location/Value dialog displays. Move your cursor around the composite image, then around the corresponding image segment (for the same location). Note that the composite image does not display geographic information, but the image segment does. The composite image is simply a graphical depiction of the individual image and annotation segments, but it does not provide map information.

### Saving to NITF Format

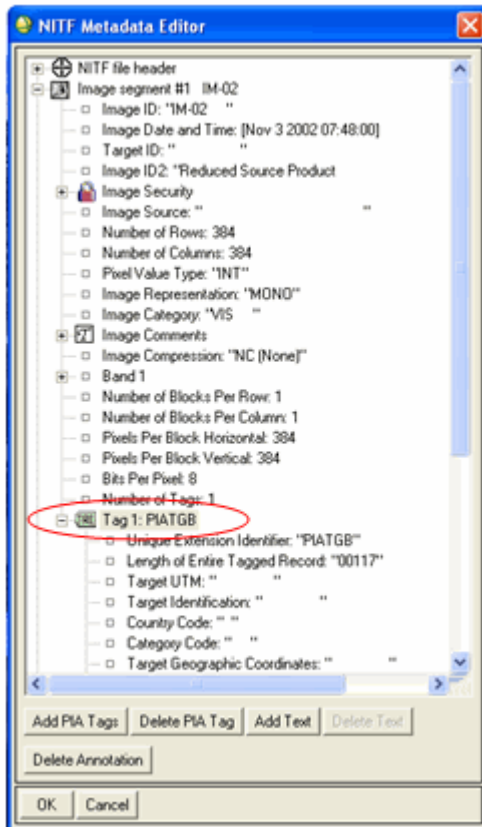
1. From the ENVI main menu bar, select **File > Save File As > NITF**. The Select NITF Output File dialog appears.
2. Select the **COMPOSITE** image for output. Notice that all of the image segments are selected for output when you select the composite image. The All Image Segments check box is also automatically checked.
3. Click **OK**. The NITF Output Parameters dialog appears.
4. Click **Edit NITF Metadata**. The NITF Metadata Editor dialog appears.

### Adding PIA TREs

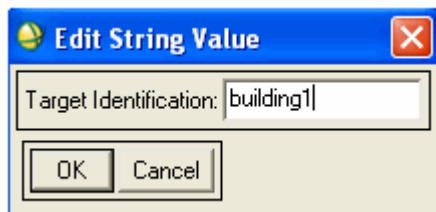
The NITF Metadata Editor lets you add or delete Profile for Imagery Access and Profile for Imagery Archive (PIA) TREs, which hold information required by the Standards Profile for Imagery Access (SPIA). A variety of government agencies require these TREs in NITF image products. In this step, you will simulate adding a Profile for Imagery Access Target Descriptive (PIATGB) TRE to mark a target of interest in the data.

1. In the NITF Metadata Editor, select **Image segment #1** and click **Add PIA Tags**. The Add PIA Tags dialog appears.
2. Change the value for **PIATGB (PIA Target Tag)** to **1**.

- Click **OK**. The metadata under Image segment #1 expands in the NITF Metadata Editor. A new green TRE symbol appears at the bottom of the metadata.
- Click the + symbol to expand the new TRE.



- Double-click on any of the empty fields such as **Target UTM**. A text entry dialog appears.
- Enter your own text and click **OK**. A text entry dialog for the next PIATGB TRE metadata field appears.



- Continue adding your own values for the PIATGB TRE metadata in this manner.
- Click **OK** in the NITF Metadata Editor. ENVI validates your entry and issues an error message if you entered incorrect data.
- In the NITF Output Parameters dialog, enter an output filename, and click **OK**.
- When the output file appears in the Available Bands List, right-click on its filename and select **View NITF Metadata**.
- Examine the metadata in the output file. You should see the new PIATGB TRE metadata.