MINX Document 4
Basic Features

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Raytheon Company and Columbus Technologies and Services, Inc.

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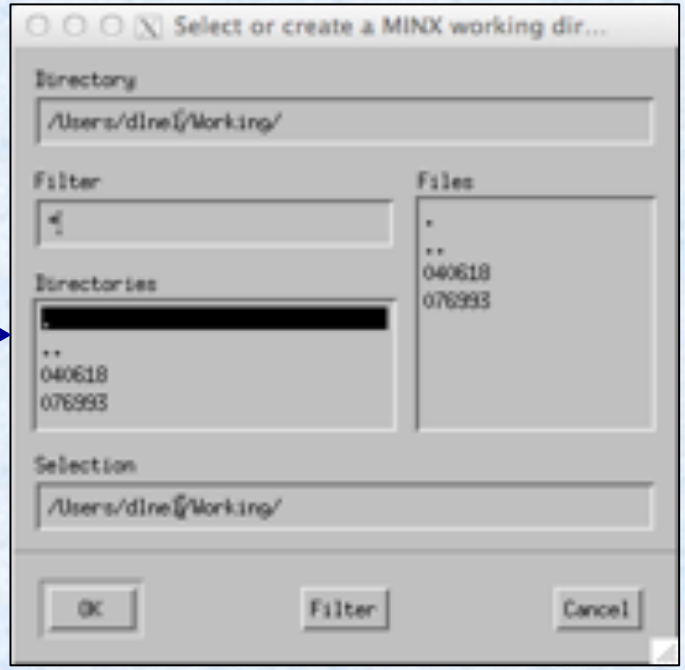
Introduction

MINX Overview

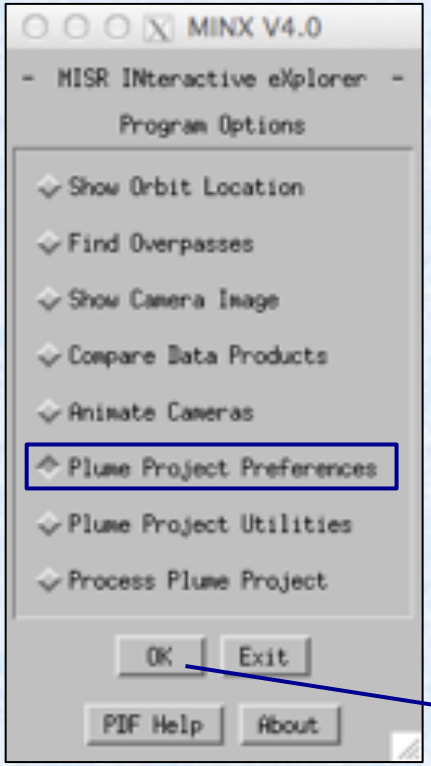
- **Interactive, IDL visualization tool with GUI interface**
- **Runs on Mac OS X, MS Windows and Linux**
- **Very memory, CPU and graphics intensive**
- **Downloadable from Github website:**
  https://www.github.com/NASA/MINX
- **MINX V4.1 is distributed as an IDL virtual machine (VM) application and includes the IDL VM as part of the distribution. You no longer need to download IDL or the IDL VM from the Exelis website.**
- **Used to digitize and retrieve heights for ~ 30,000 smoke plumes for the NASA/EPA Plume Height Project since 2007**
- **Among the Plume Height project and MINX software support contributors are:**
  Stacey Boland, Mian Chin, Eric Danielson, David Diner (MISR PI), Michael Garay, Jeff Hall, Earl Hansen (MISR project manager), Ralph Kahn, Ernest Koeberlein (Raytheon), Tom Kucsera, Cecelia Lawshe, Jennifer Logan (Plume Height Project PI), Jason Matthews, Susan Paradise, Brian Rheingans, Charles Thompson, Michael Tosca, Sebastian Val, Maria Val Martin and many summer students
- **NOTE – Most of the contents of this file are also available as internal documentation in MINX. Look for the "PDF Help" buttons.**

MINX Startup - 1

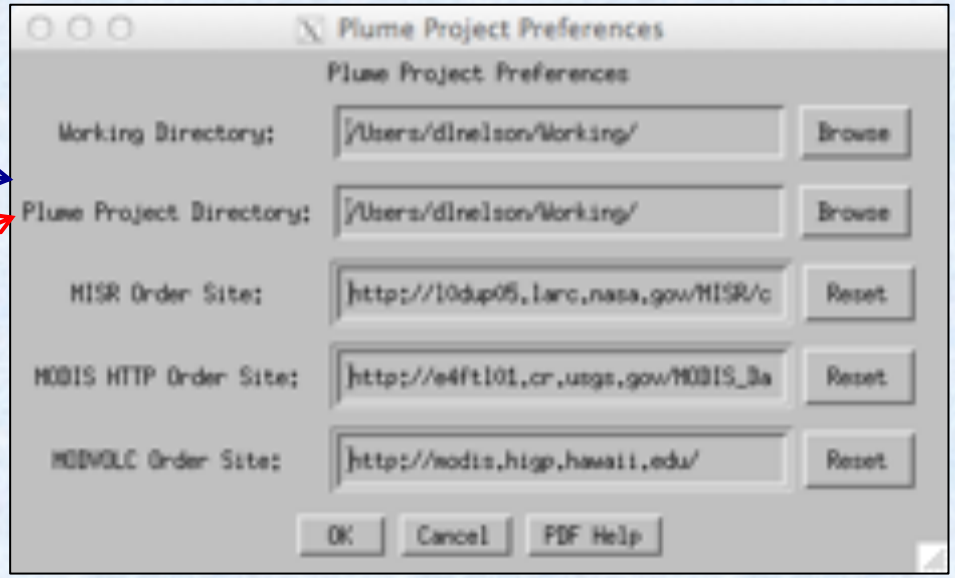
- Whenever you start MINX, the first image you see is the IDL Virtual Machine logo. Simply click anywhere inside the logo to proceed.
- The first time you start MINX, or whenever you have deleted a file in your home directory named MINX_preferences.sav, the next dialog box presented will prompt you to select or create a Working directory for the session.
- The default working directory is /<your home directory>/Working.
- On successive startups, you will not see the Working directory dialog, because the Working directory, along with many other parameters, will have been saved in a newly created MINX_preferences.sav file.
- The Working directory is where many MINX tools will write output. Exceptions are when MINX specifically asks you to enter an output directory.



MINX Startup - 2



- You can change the Working directory at any time from the Plume Project Preferences option on the MINX Program Options menu.
- Click the Browse button next to Working Directory to bring up the same dialog box that was presented on initial startup.
- All other items in this Preferences dialog refer exclusively to the last two Plume Project items on the MINX Program Options menu.
- The Plume Project Directory plays a special role. It points to a directory that must contain a file name PlumeProjOrbitList.txt
- The PlumeProjOrbitList file in turn has entries that point to input and output directories, so you can maintain multiple projects.



This directory is important for plume projects and only serves to point to a directory that contains a PlumeProjOrbitList.txt file.

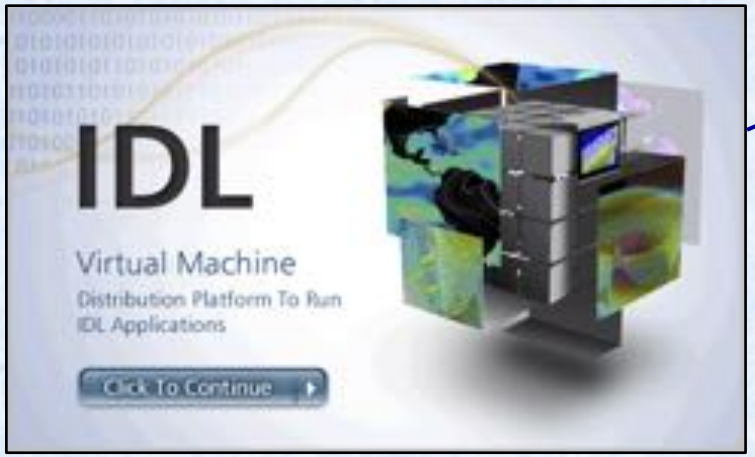
If these important website URLs ever change, you can update them here.

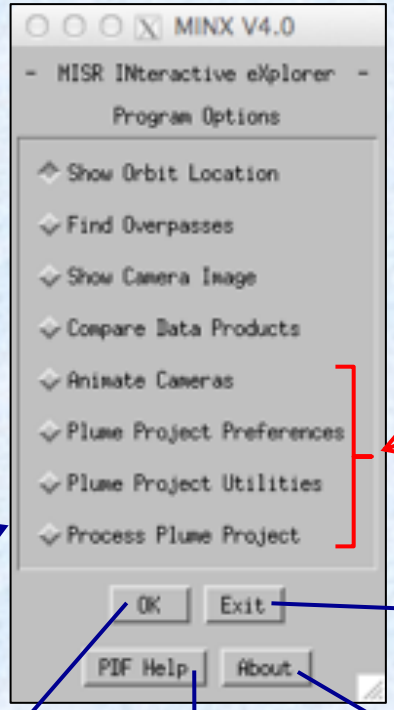
Running MINX

This is the normal MINX startup sequence after the initial startup

On the following slides, colored annotations mean:

- **Brown** : general descriptions and comments
- **Blue** : user's actions and the resulting response of MINX
- **Red** : descriptions of specific dialog box and data window features





Plume height analysis tools

Exit MINX

Proceed to selected option

Display PDF file summarizing items on main menu

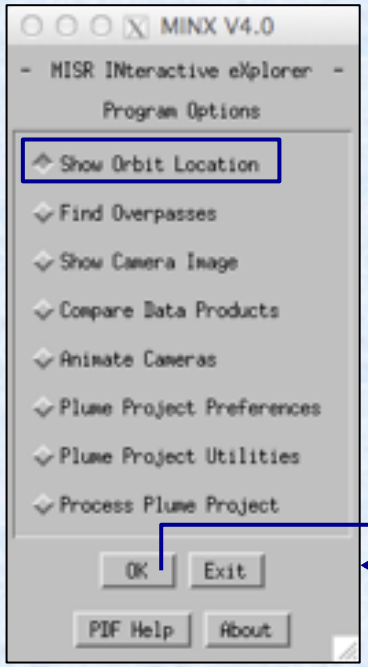
Display system information and MINX copyright information

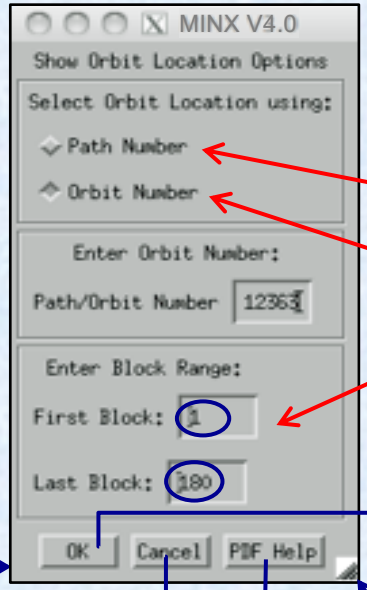
NOTE - all MINX images shown in this document were captured on a Mac computer

Show Orbit Location

Show Orbit Location - 1

Objective: To illustrate in map view where MISR paths, orbits and blocks are without external inputs.





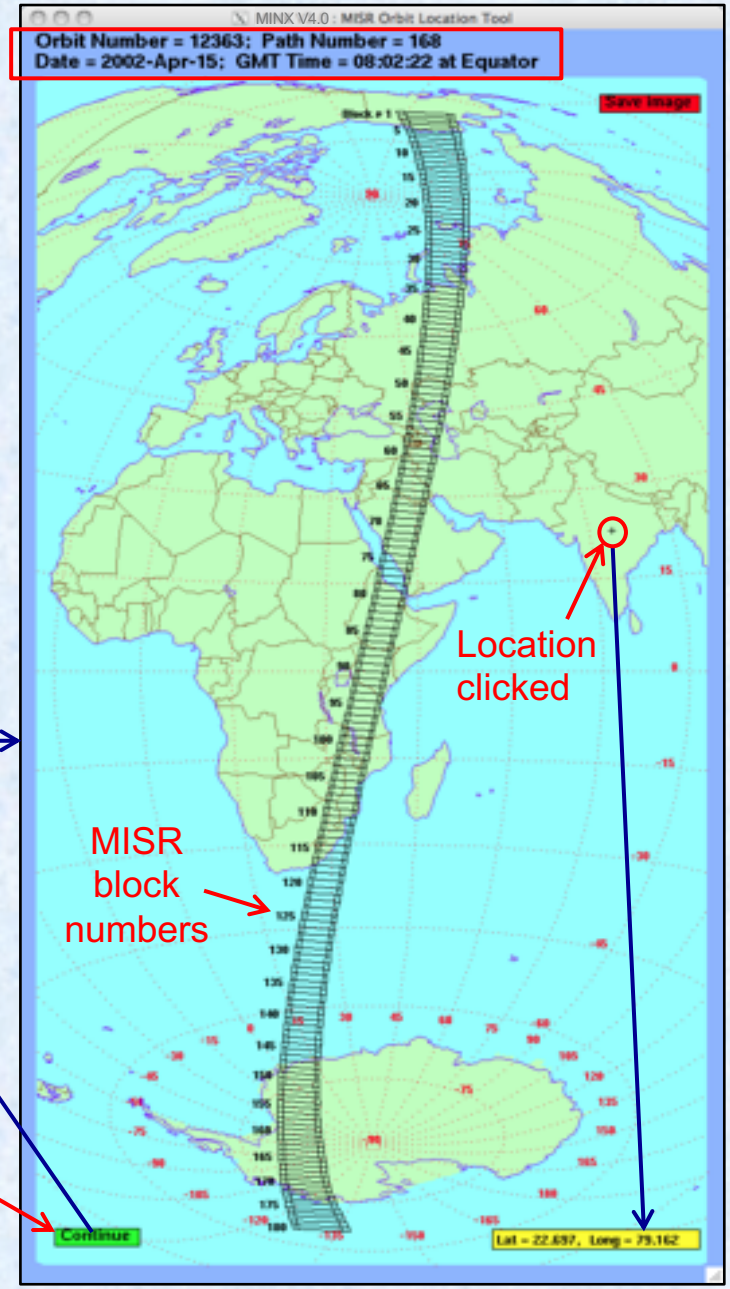
Valid data ranges

[1 – 233]

[1 – 99999]

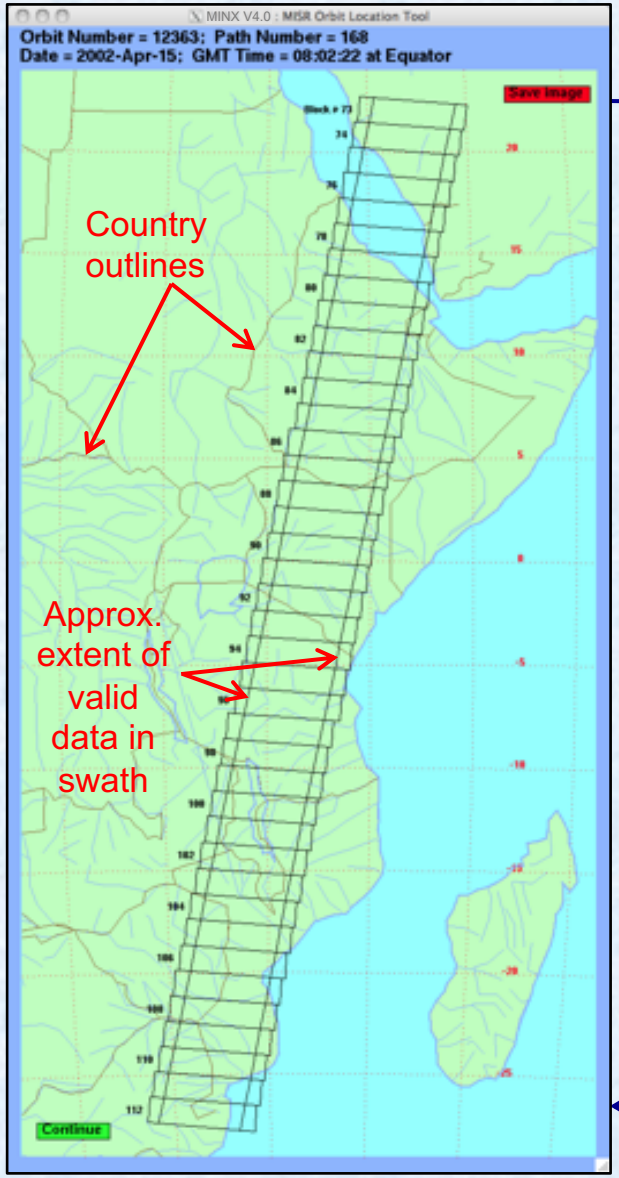
[1 – 180]

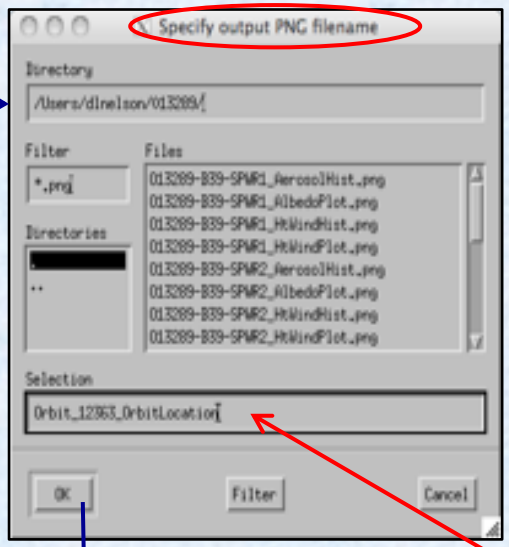
Display these instructions

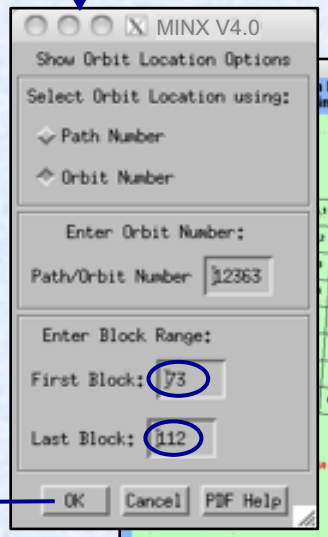


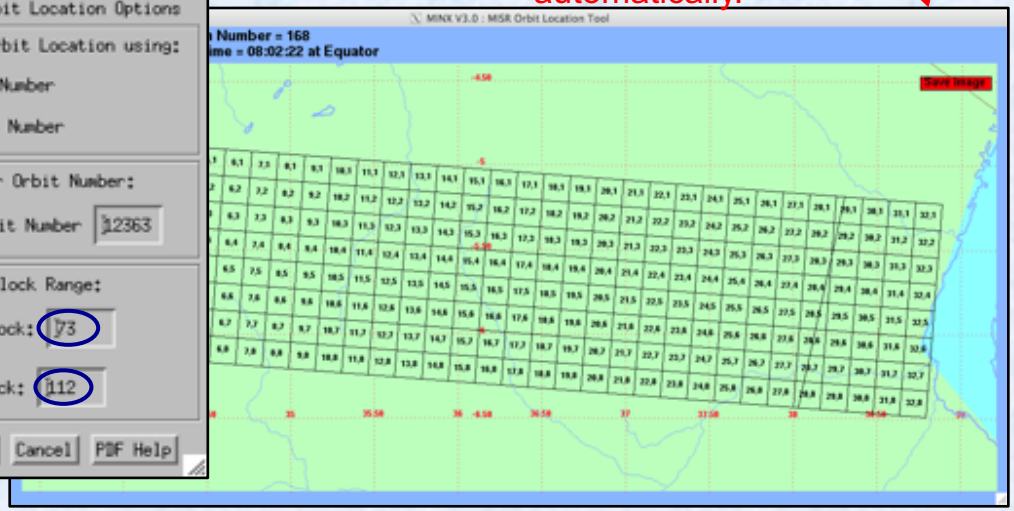
- **This is a good way to find the Path number and acquisition Date and Time for any Orbit Number.**
- **Clicking the green "Continue" button OR right-clicking on the map deletes the map and returns control to "Show Orbit Location Options" dialog.**
- **Clicking in the map window displays geographic coordinates in the yellow box at the bottom.**

Show Orbit Location - 2









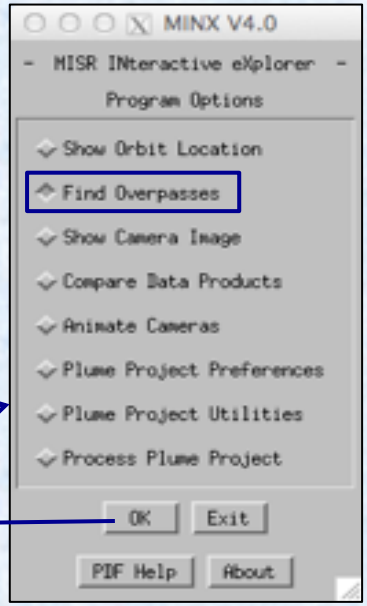
- The image is zoomed to contain the requested block range.
- The MISR swath occupies about 75% of each block.
- Clicking the red box allows you to save the image as a PNG file.
- Requesting only 1 block shows a wider map with 17.6 km aerosol retrieval regions drawn and numbered.

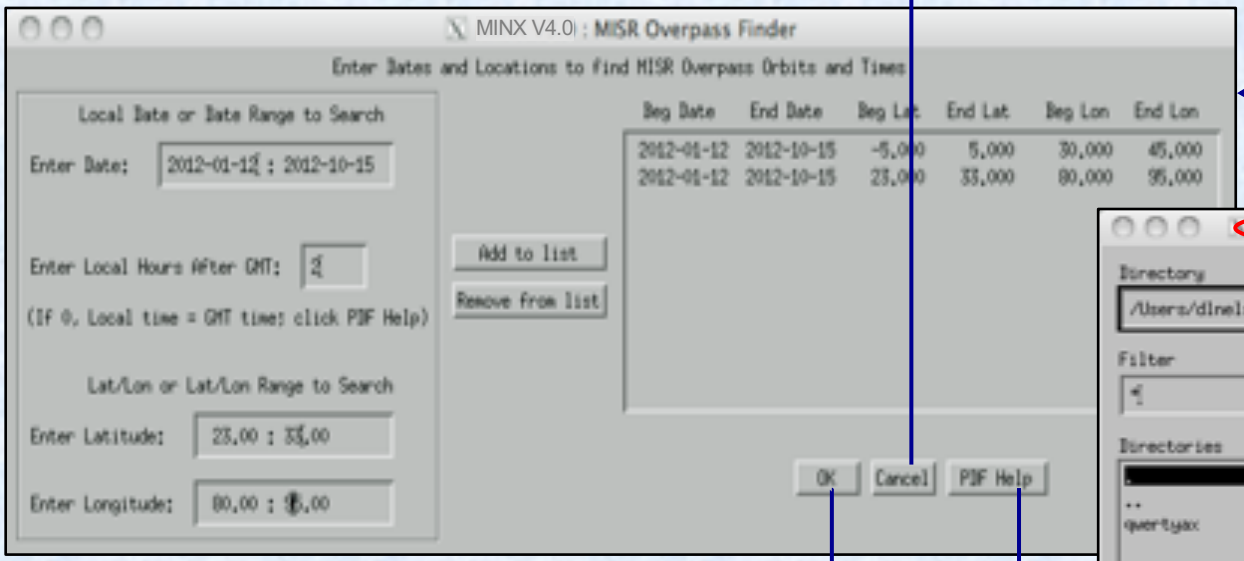
A "png" extension is added to name automatically.

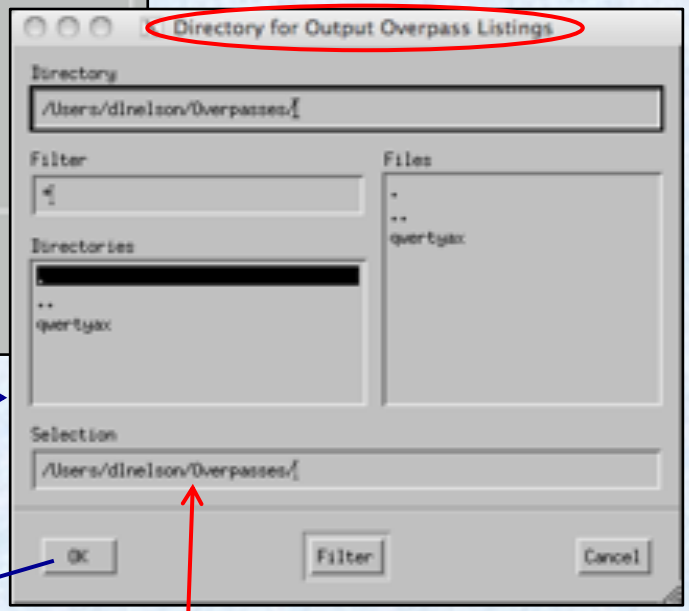
Find Overpasses

Find Overpasses - 1

Objective: To produce a list of MISR orbits that pass over a specified point or region on a specified date or range of dates. Useful in answering: "Did MISR see a particular fire or dust event?" or "What MISR orbits imaged Japan in Feb, 2012?"







- **No external inputs are required.**
- **Avoid using large geographic or time ranges if you intend to create an image for each overpass unless you want hundreds of PNG files.**

Display these instructions

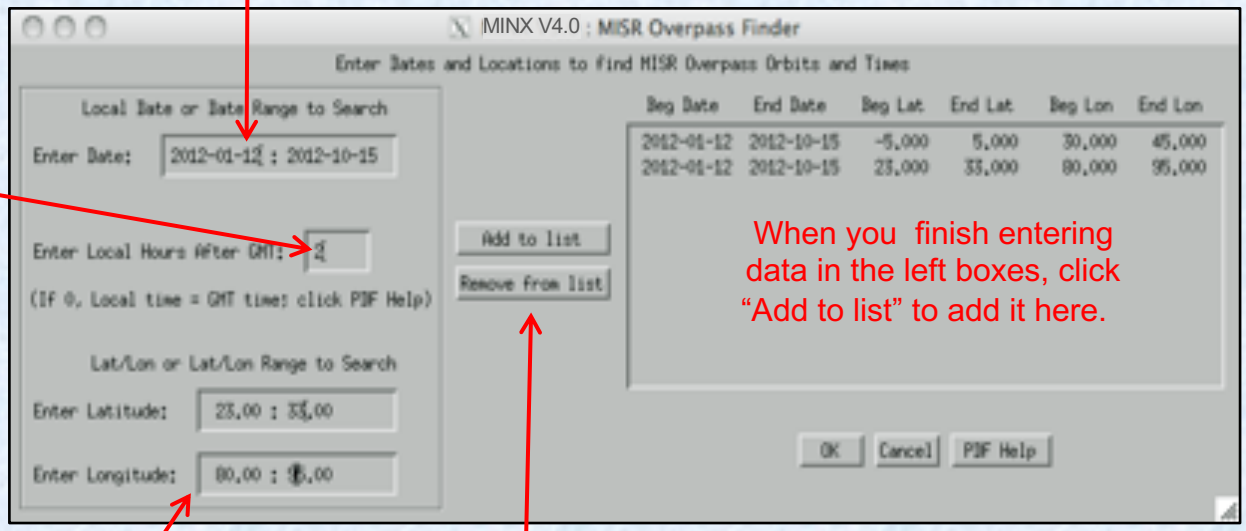
Process request

You <u>must</u> enter a directory name in this "Selection" box.

Find Overpasses - 2

Enter either a single date or a date range here. The format must be either "YYYY-MM-DD" for a single date or, for a date range, "YYYY-MM-DD : YYYY-MM-DD". The search will begin at midnight local time at the beginning of the first date and will continue through midnight local time at the end of the second date.

Enter the number of hours between GMT and local time at the location(s) you enter. This number should be negative for time zones west of Greenwich and positive for time zones east. The number of hours you enter will be applied to the search process for ALL the entries in the list you construct. You may also want to adjust for Daylight Saving Time. You may ignore this entry if your Date Range is broader than required. Note: GMT or Greenwich Mean Time is nearly identical to UTC or Coordinated Universal Time.

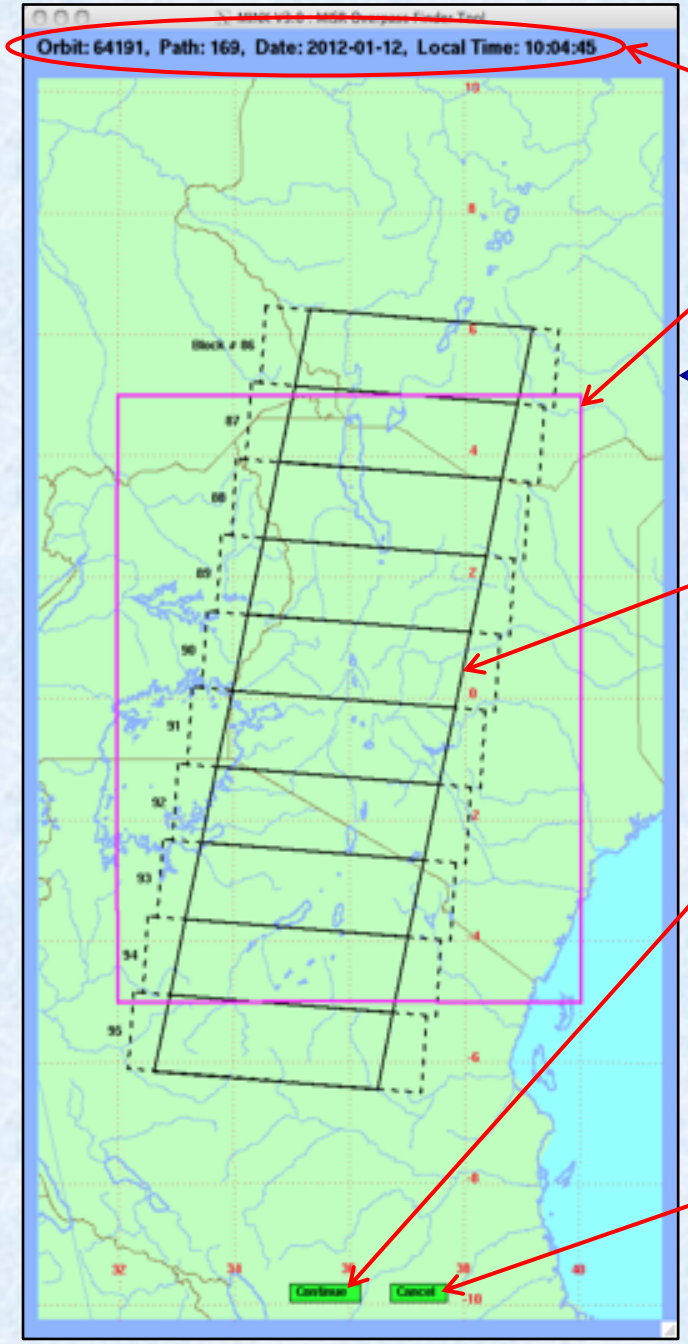


When you finish entering data in the left boxes, click "Add to list" to add it here.

Once you have completed the date and location entry, click "Add to list" to copy the information to the list box on the right. Then you can enter more date and location values, each time adding them to the list. If you are not satisfied with an entry in the list, click on the entry to highlight it, and then click "Remove from list" to remove it.

Enter a latitude or latitude range and a longitude or longitude range in decimal degrees. For single points use format "sDD.DDD"; for a region the format is: "sDD.DDD : sDD.DDD". The "s" stands in for "+" or "-". The absolute value of latitudes must not exceed 84 deg, and the absolute value of longitudes must not exceed 180 deg. Decimal points are optional.

Find Overpasses - 3



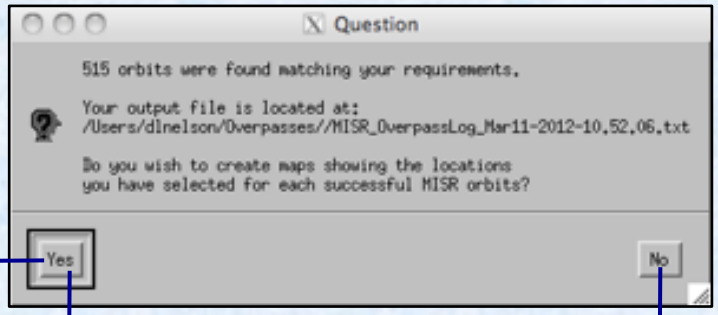
Overpass details for this orbit.

Region specified for finding MISR overpasses.

Orbits are returned only if the specified overpass region intersects the solid black lines of the orbits' swaths.

Click here to show the next overpass image. Text data and images are saved to file.

Click here to stop showing images. Text data will still be written to file, but not images.




```
Search number     : 1
Input date range : 2012-01-12 to 2012-10-15
Input lat range  :    -5.000  to     5.000
Input lon range  :    30.000 to    45.000

List of Orbits satisfying search criteria :
64191,64220,64235,64249,64264,64278,64293,64322,64351,64366,64380,
64395,64409,64424,64453,64468,64482,64497,64511,64526,64555,64584,
etc.
67948,67963,67977,67992,68036,68021,68050,68079,68094,68108,68123,
68137,68152,68181,68196,68210,68225
```

Orbit	Path	Blk	GMT Date	GMT Time	Local Date	Local Time
64191	169	86	2012-01-12	08:04:45	2012-01-12	10:04:45
		95	2012-01-12	08:07:53	2012-01-12	10:07:53
64220	167	86	2012-01-14	07:52:23	2012-01-14	09:52:23
		95	2012-01-14	07:55:31	2012-01-14	09:55:31
64235	174	86	2012-01-15	08:35:39	2012-01-15	10:35:39
		91	2012-01-15	08:37:23	2012-01-15	10:37:23
64249	165	86	2012-01-16	07:40:02	2012-01-16	09:40:02
		95	2012-01-16	07:43:10	2012-01-16	09:43:10
64264	172	86	2012-01-17	08:23:17	2012-01-17	10:23:17
		94	2012-01-17	08:26:04	2012-01-17	10:26:04
64278	163	87	2012-01-18	07:28:01	2012-01-18	09:28:01
		95	2012-01-18	07:30:48	2012-01-18	09:30:48
64293	170	86	2012-01-19	08:10:56	2012-01-19	10:10:56
		95	2012-01-19	08:14:04	2012-01-19	10:14:04
64322	168	86	2012-01-21	07:58:34	2012-01-21	09:58:34
		95	2012-01-21	08:01:42	2012-01-21	10:01:42

etc.

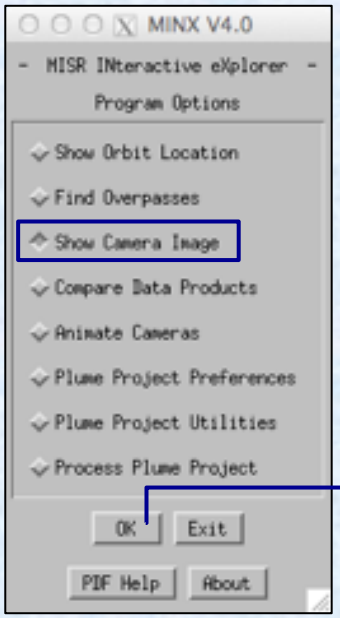
Report file shows a comma-separated list of orbits at the top for convenience in ordering MISR products. Block and time details are in the table below. GMT and local times are shown for the first and last blocks intersected.

Show Camera Image

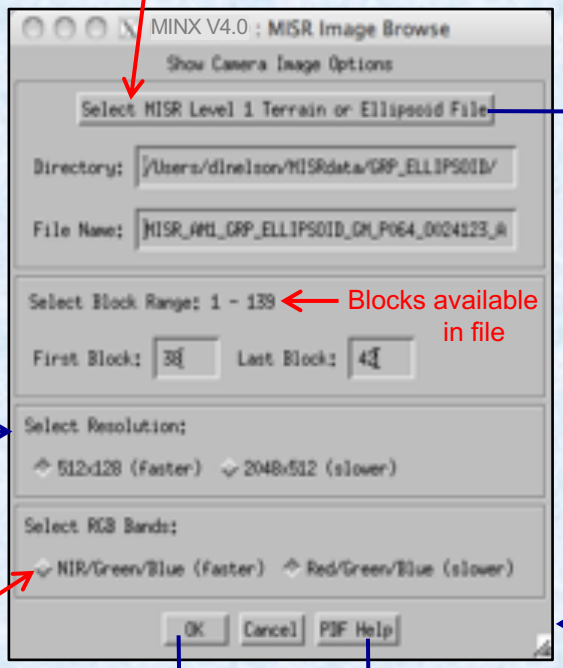
Show Camera Image - 1

Objective: To display a static, color image of all or part of a swath for a <u>single</u> MISR camera. Useful for rapidly browsing orbit imagery at higher resolution than the online Browse Tool, but requires MISR level 1 radiance data.

- **512x128 resolution (1100 m pixels) may allow displaying an entire orbit for any camera; blocks are not "assembled" to correct for between-block offsets.**
- **2048x512 resolution (275 m pixels) may allow displaying as many as 10 to 40 + blocks before you run out of memory. Blocks are "assembled" into continuous images.**

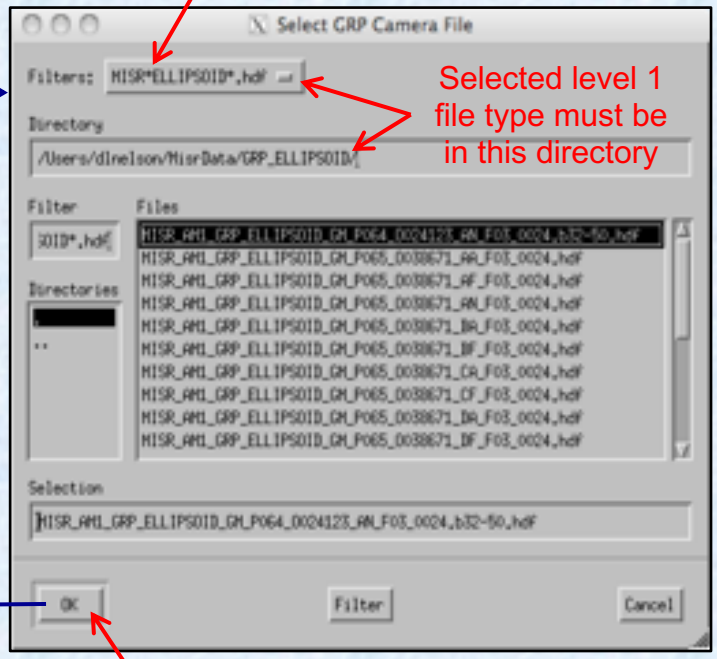


Click this button first.



Blocks available in file

Select Ellipsoid-referenced or Terrain-referenced level 1 file



Selected level 1 file type must be in this directory

Clicking "NIR/Green/Blue" substitutes the NIR band for Red which is smaller and faster for cameras other than An

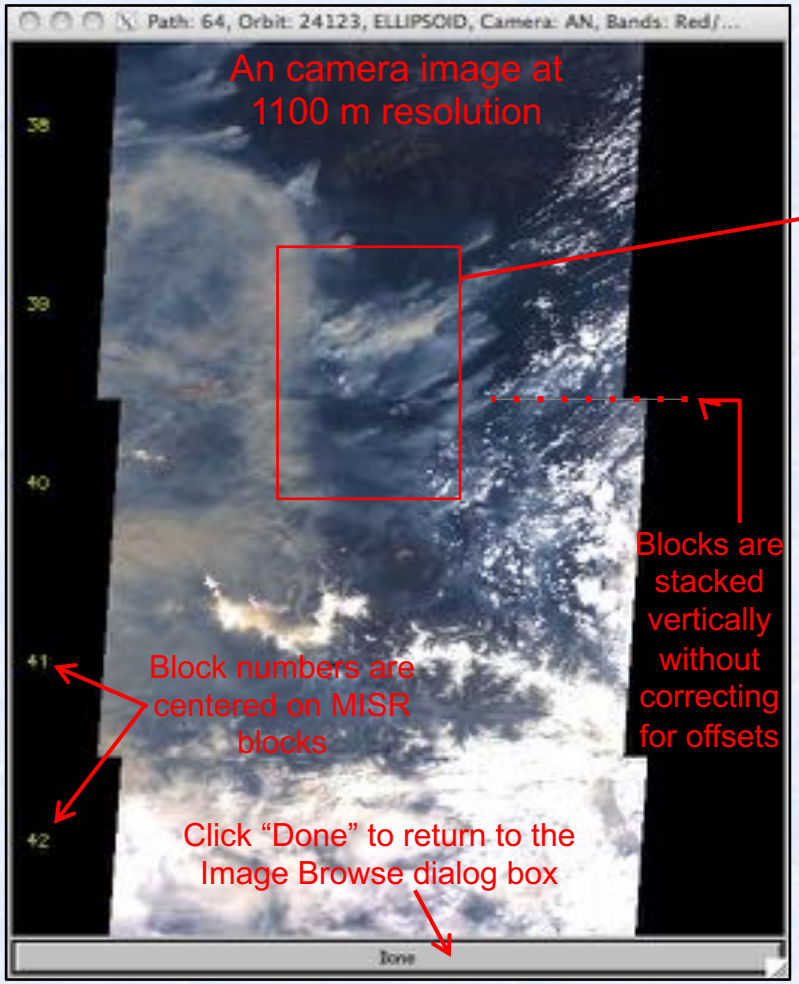
It also shows vegetation very clearly as red.

Display image

Display these instructions

Clicking "OK" populates the "MISR Image Browse" dialog box with file name and block range information.

Show Camera Image - 2



- **<u>In An product file,</u> all bands are stored at 275 m resolution.**
- **<u>In image above</u>, RGB is displayed at 1100 m.**
- **MISR blocks are not "assembled" (offsets are not applied).**

- **<u>In Af product file,</u> Red band is stored at 275 m resolution, Green and Blue at 1100 m.**
- **<u>In image above</u>, RGB is displayed at 275 m.**
- **MISR blocks are "assembled" smoothly.**

Compare Data Products

Compare Data Products - 1

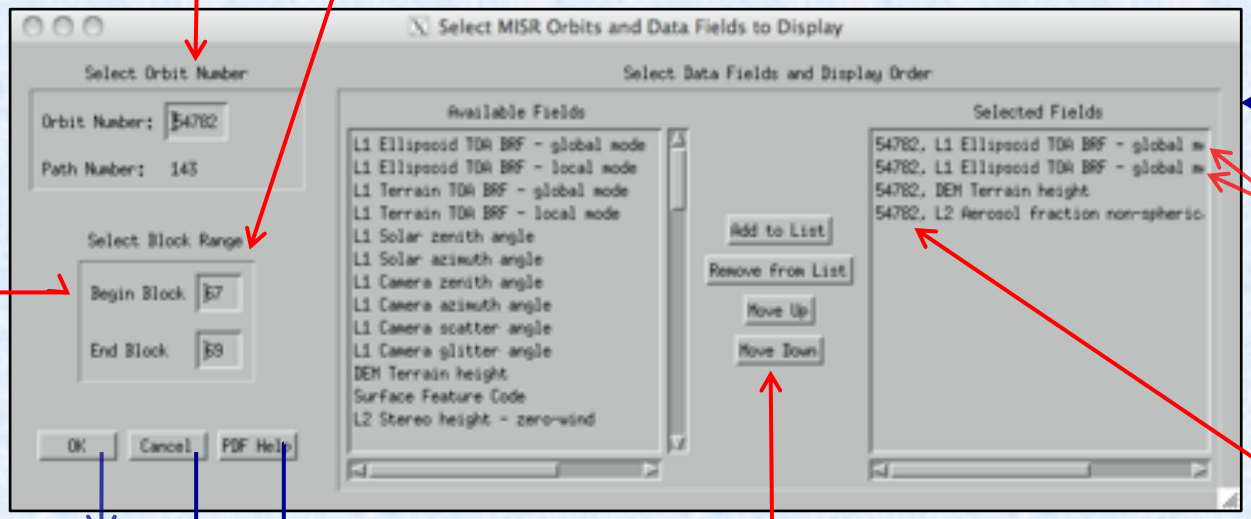
Objective: To display several user-selected, MISR data products side-by-side in separate panes of a larger window, all at the same 1100 m/pixel resolution. Also to query all these data products for their values with a single mouse click. Useful for studying the spatial variation of MISR data and relating data types to each other.

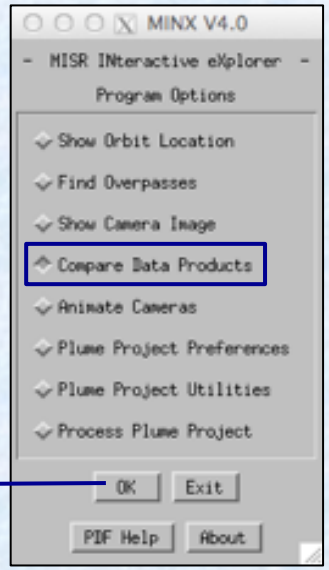
MISR data fields that can be selected for display in the "Available Fields" list include:

- **Global and local mode radiance data (level 1 GRP_TERRAIN or GRP_ELLIPSOID products)**
- **Radiometric cloud and glitter masks (level 1 RCCM product)**
- **Sun and camera angles (level 1 GP_GMP geometric parameters product)**
- **DEM terrain heights and surface feature codes (AGP ancillary geographic product)**
- **Cloud heights, winds and cloud masks (level 2 TC_STEREO and TC_CLOUD stereoscopic products)**
- **Aerosol optical depths, single scatter albedos, angstrom exponents and mixture sizes and shapes (level 2 AS_AEROSOL product) – a new aerosol product is expected to become available in 2015**
- **Surface BRF, DHR, NDVI and RPV parameters (level 2 AS_LAND aerosol surface product)**
- **Local, restrictive and expansive top-of-atmosphere albedos, both spectral and broadband (level 2 TC_ALBEDO albedo product)**
- **Cloud, smoke and dust masks (level 2 TC_CLASSIFIERS product)**

Compare Data Products - 2

First enter an orbit number to display - its path number is automatically updated. Then select beginning and ending MISR block numbers to display for all data fields. 4 to 9 blocks may fit on your screen; others will be accessible by vertical scrolling. Dialog controls at the bottom of each pane scroll with the data, so it's best to limit the number of blocks you display.





2 different cameras can be displayed by entering the same field twice – the cameras will be selected in the next step.

The orbit number is added to the field name so different orbits can be displayed and compared. You must select orbits from the same path.

Continue processing

Return to Main Menu

Display these instructions

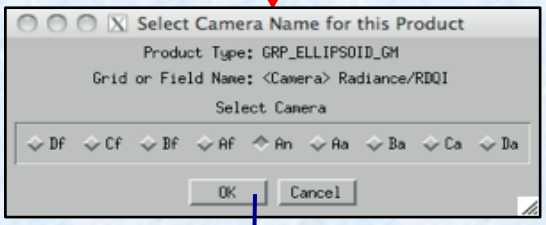
Select a data field to display from "Available Fields", then click "Add to List" to copy the name to "Selected Fields". Add more fields as needed. You can select several fields at once. 3 to 5 fields may fit on your screen – others you have loaded will be accessible by horizontal scrolling. Remove a field by highlighting it in "Selected Fields" and clicking "Remove from List". Or rearrange the order in which data fields will be displayed by highlighting a field and clicking the "Move Up" and "Move Down" buttons.

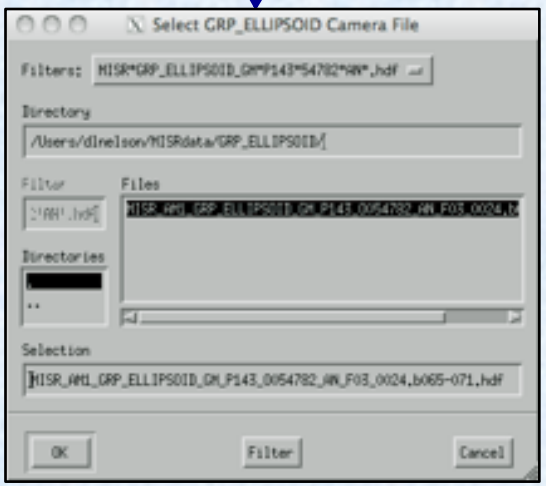
After the first field has been added to the "Selected Fields" list, editing of block numbers is disabled. To re-enable block numbers, you must first remove all entries in the "Selected Fields" list.

Compare Data Products - 3

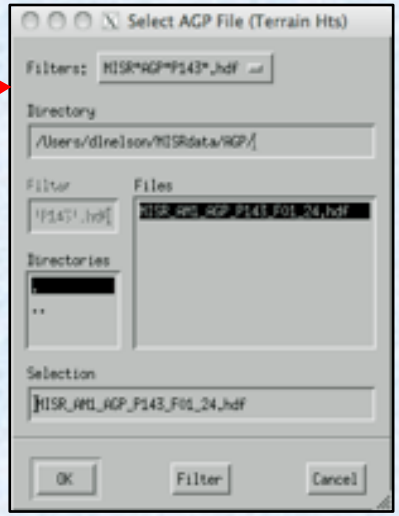
Next a series of dialog boxes is presented in two passes over the selected products. In the first pass, select the MISR product files to load. File names are requested in the order they appeared in the “Selected Fields” list.

For level 1 product files that are divided into 9 camera files per orbit, a camera-name dialog is shown before the camera-file dialog. MINX will show only those file names in the camera-file dialog that match the camera name you entered in the camera-name dialog. Read the dialog title and text carefully to ensure you’re selecting parameters for the correct product. In the example on the previous slide, the second product type is also GRP_ELLIPSOID. The same pair of camera-name and camera-file dialogs will be repeated, allowing a different camera to be selected.

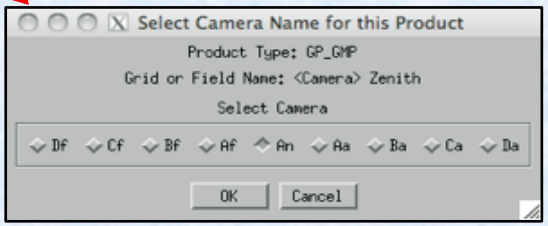




For most other product types, e.g. the AGP file containing DEM Terrain height on the preceding slide, only the file name is requested in pass 1.



In the second pass, select extra dimensions for each product. If a product has camera or band dimensions <u>inside the file</u>, dialogs will be shown where appropriate, in the same order as the products appeared in the “Selected Fields” list. Many products have no extra dimensions, and no dialog box will be shown for them. Dialog boxes for extra bands or cameras look like this:



Proceed to the next slide to see displayed results

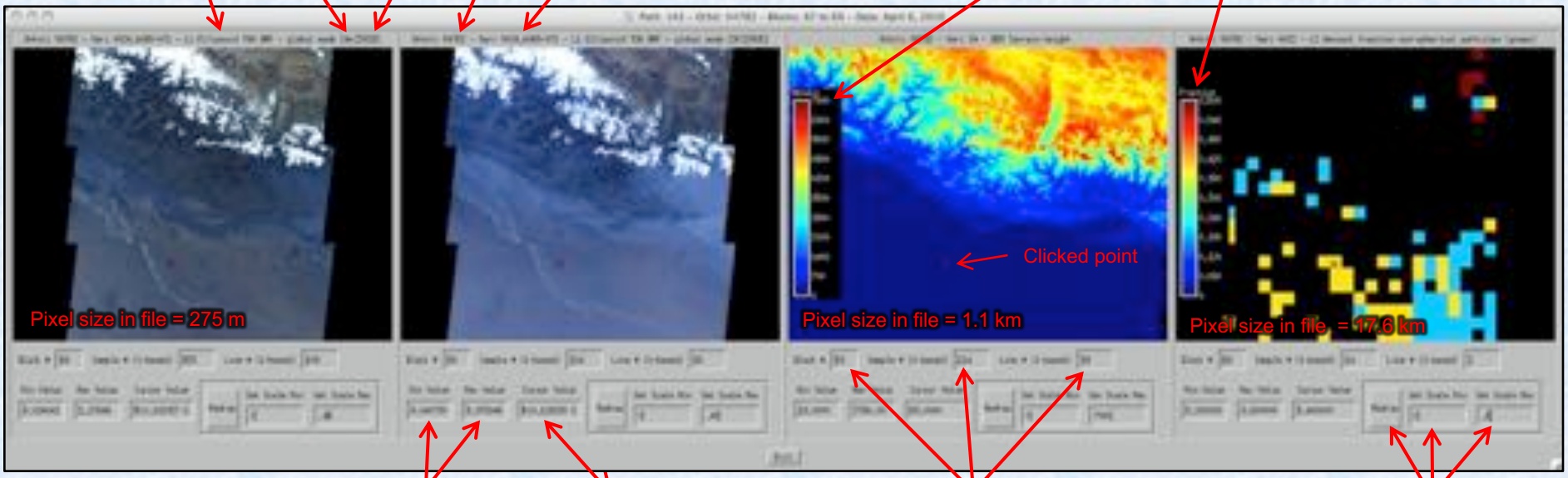
Compare Data Products - 4

Main "Compare Data Products" window and 4 product panes for 3 blocks of orbit 54782 over the Himalayas and Ganges Basin. Panes 1 and 2: radiance data for An and Df cameras respectively; pane 3: terrain heights; and pane 4: fraction of aerosol particles that are non-spherical.

Smoke is more evident at right center on pane 2 in the oblique Df image than in the vertical An image of pane 1. Dust streaming SE off the river channel near the clicked point is visible only in the Df image. The "Aerosol fraction non-spherical" product detects the dust: it shows more spherical particles in the smoky region and more non-spherical particles in the dusty region.

Data field Camera Band Orbit # Product version #

Color bars are automatically generated and are updated when you change scales.



All products are converted to 1100 m/pixel resolution for display purposes.

Minimum and maximum values in each pane are displayed.

Clicking in <u>any</u> pane displays a cursor symbol and a data value in <u>all</u> panes at the clicked point.

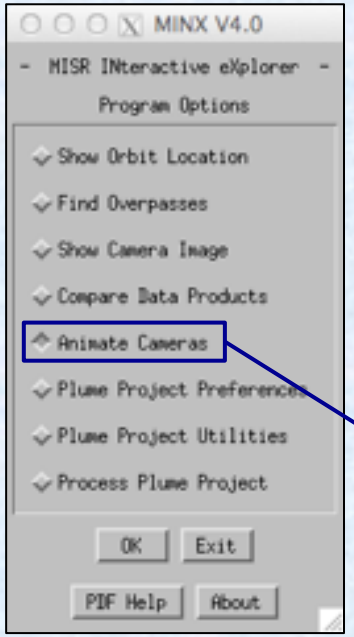
Clicking also shows the MISR block/sample/line coordinates appropriate to the native resolution of the pane's data.

The minimum and/or maximum of the color scale for each pane can be changed causing the pane to be redrawn.

Animate Cameras

Select MISR Orbit to Load

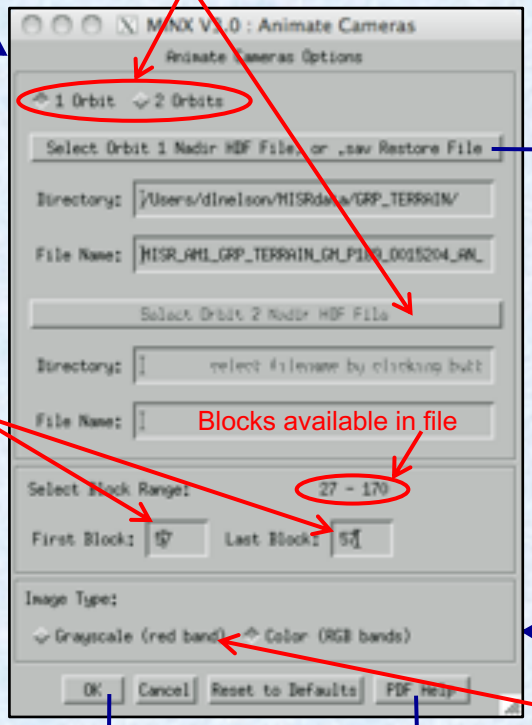
Objective: To display selected blocks of MISR radiance imagery at 275 m resolution in <u>all</u> channels; to view 9 cameras as an animation; and to perform analyses on data including determining aerosol heights and motion.

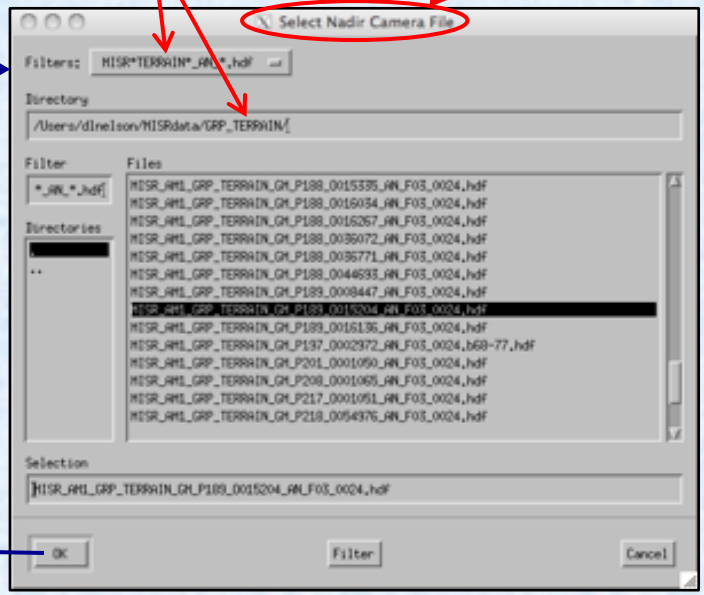


2 orbits from the same path can be loaded at once and compared. Then orbit 2 must also be selected below.

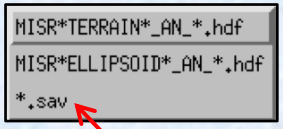
The L1B2 data type selected in "Filters:" must match the file type found in the directory you enter in "Directory" edit box.

Select only the An camera; the other 8 cameras are read automatically if in the same directory or in 9 separate directories named DF, CF, BF, AF, AN, AA, BA, CA, DA





Depending on your computer's resources, you may be able to load from 2 to 10 or more blocks of MISR data.



The "Filters" dropdown list provides one way to load a previously saved MINX session.

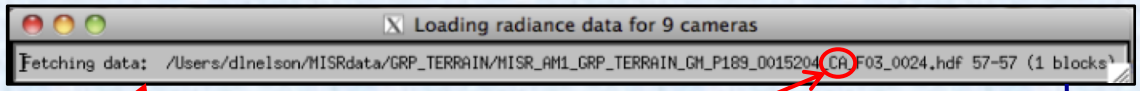
Automatically load camera imagery for selected orbit.

Display a Help file.

Loading only the high resolution red band reduces memory requirements significantly, but images are in grayscale.

Load Camera Images

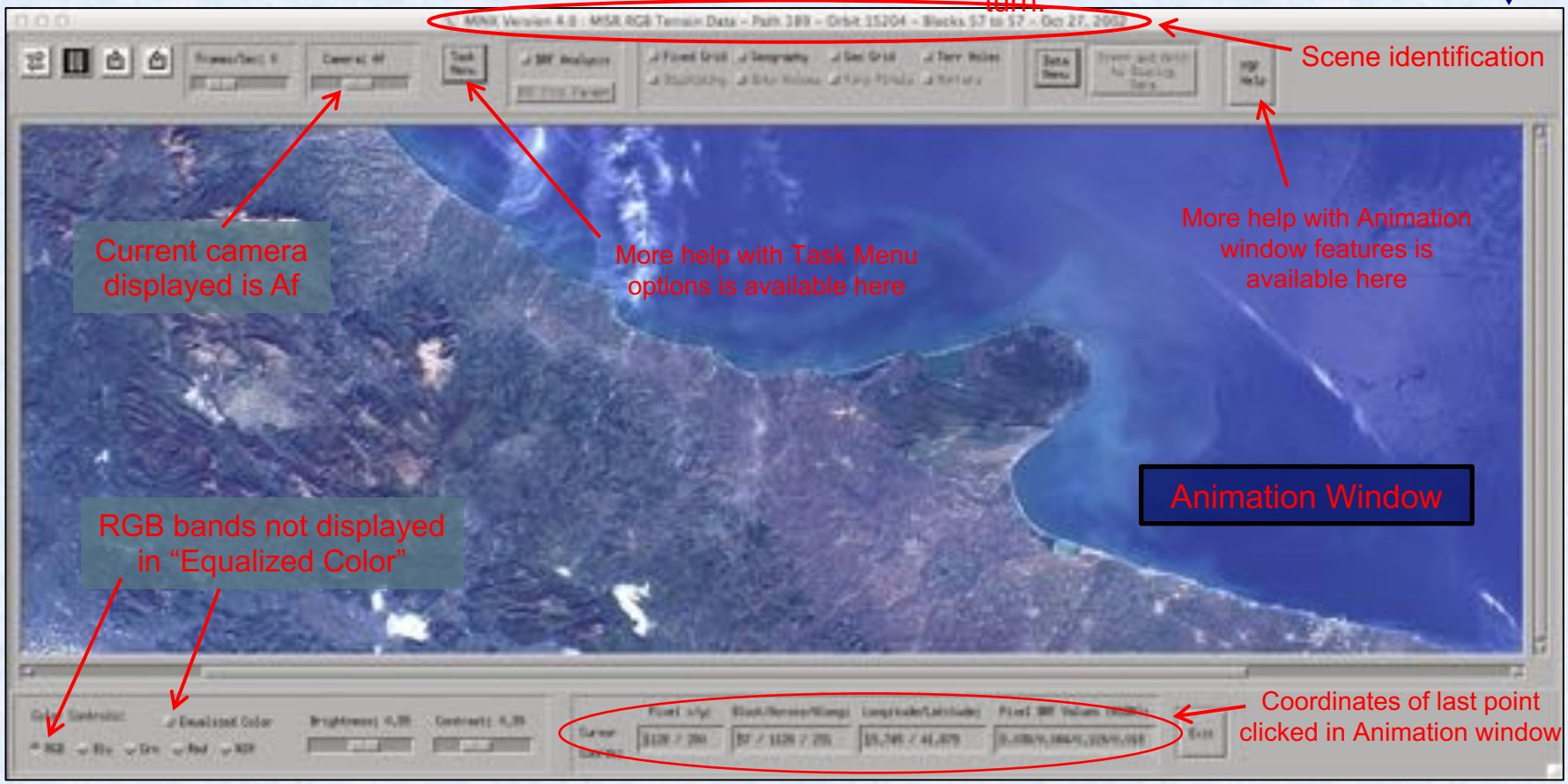
- MISR radiance data are converted to Top-Of-Atmosphere (TOA) BRFs before data are displayed.
- MISR's 9 camera images occupy the same virtual screen space and alternate in an animation sequence.



Progress box appears at top left of screen as cameras load.

Camera name changes as each camera file is loaded in turn.

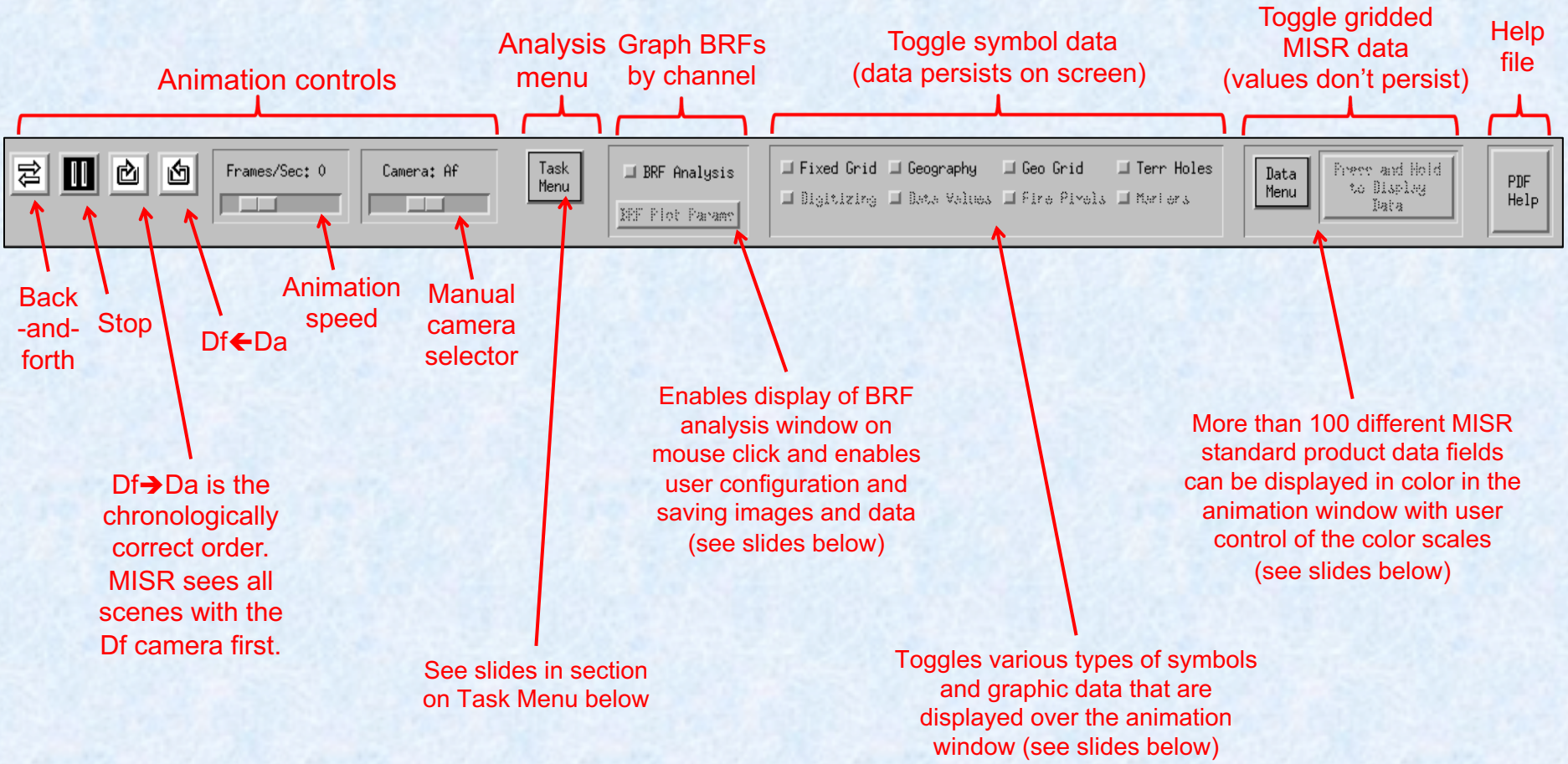
When data loading is done, the animation window appears and color scaling begins.



Peninsula with lagoon on Adriatic coast of Italy – Af camera showing sediment and sun glint in water on MISR block 57

Animation Window

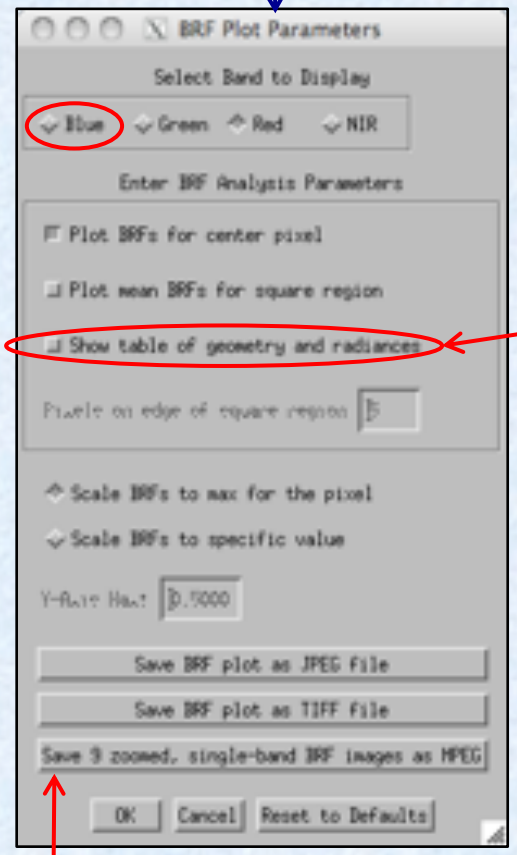
Upper Task Bar



BRF Analysis

(Bidirectional Reflectance Factor)

When BRF Analysis button is checked and user clicks in the animation window, this plot and zoomed image are shown.



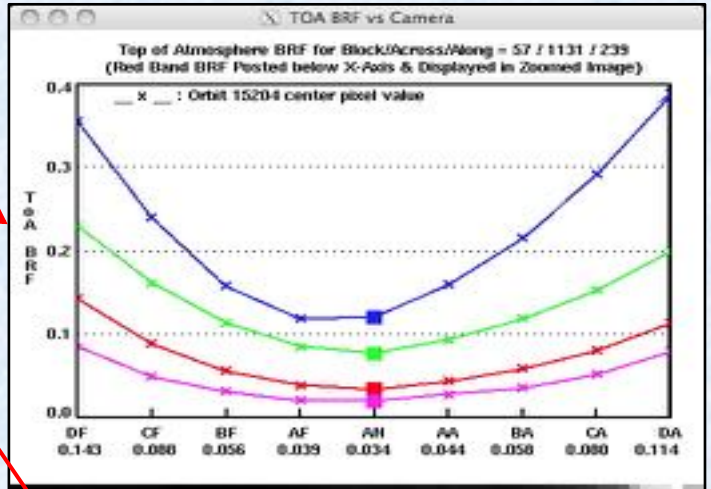
Zoomed image is scaled to data ranges in zoom window allowing subtle features, such as ship wakes at sea, to be seen.

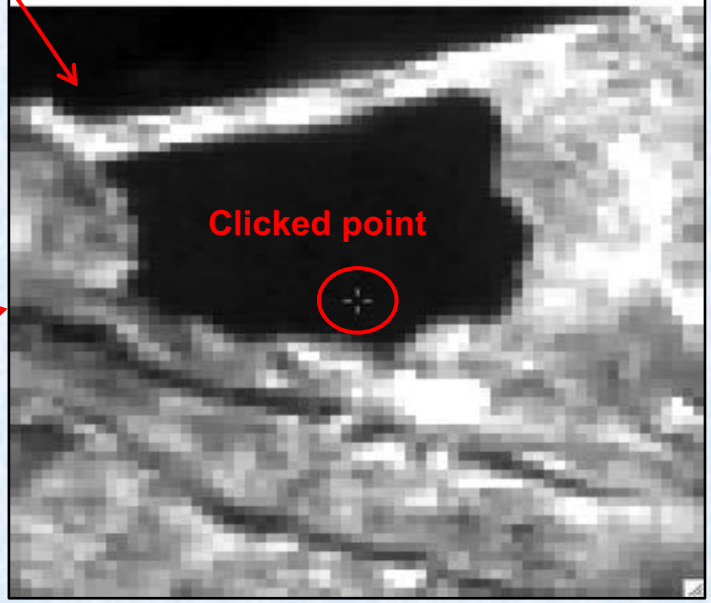
ASCII table of sun and camera angles and radiances, equivalent reflectances and BRFs for clicked point can be saved to file.

Image of graph and zoomed window can be saved to file. IDL license is required for MPG.

Scene showing 64x64 pixel square centered on point clicked by user

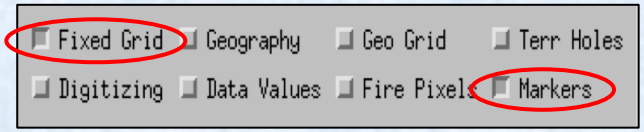
Top-of-Atmosphere BRF .vs. camera for clicked point (or mean for region)



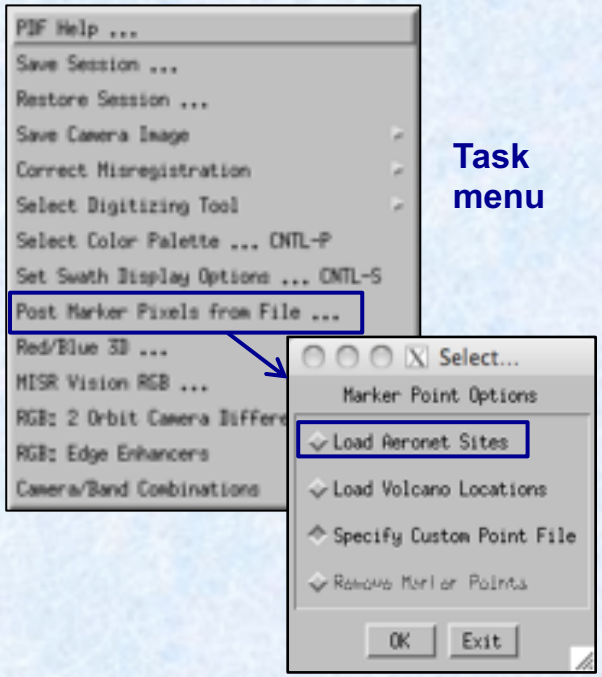


8x zoomed image of white square is displayed in band selected in dialog box

Toggle Symbol Data - 1



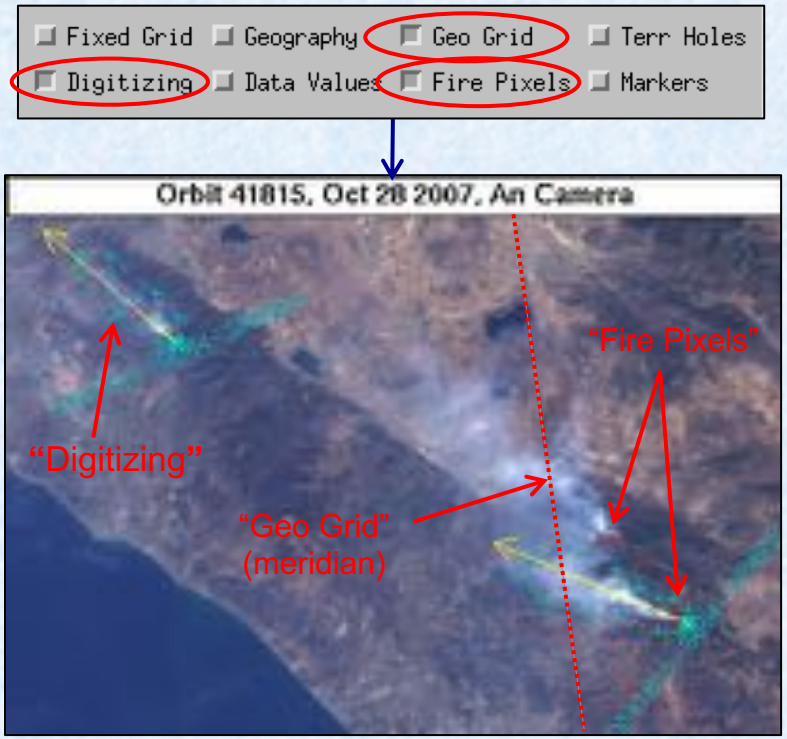
Fire scene SE of Los Angeles in 2007 showing yellow "Fixed Grid" '+' symbols and cyan "Markers" 'x' symbols that identify Aeronet sites.

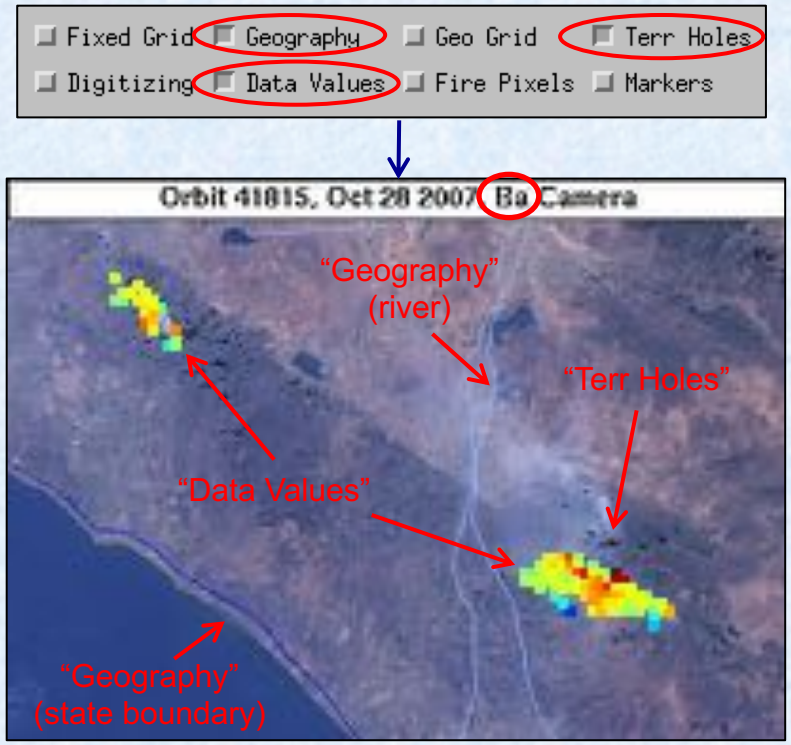


Task menu

- **Symbols remain on screen until toggled off – they persist.**
- **Yellow "Fixed grid" points are stationary and uniformly spaced and are useful for judging relative motion during animation.**
- **"Markers" selected from the Task menu are read from files and include 3 options: 1195 Aeronet sites, 1543 volcanos or a user-defined list of points.**

Toggle Symbol Data - 2

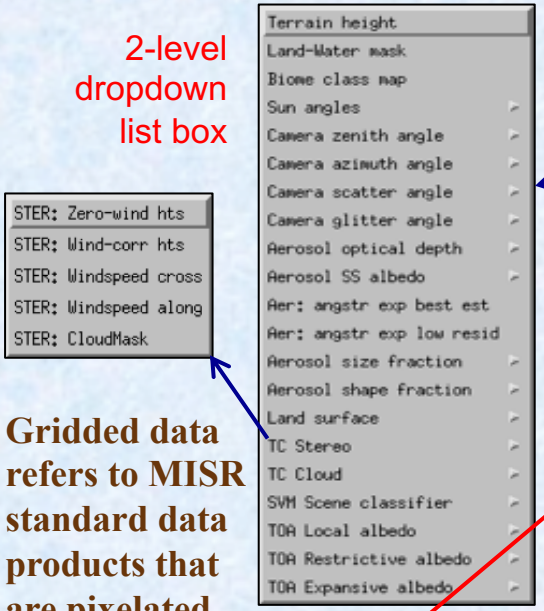


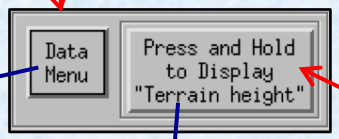


- **"Geography" includes IDL's database of country and state boundaries, coastlines, rivers, lakes etc.**
- **"Geo Grid" is a latitude-longitude grid that can be overlain on the image for location and NS reference .**
- **"Terrain Holes" refers to black, no-data areas seen only on oblique-looking cameras where the projection of level 1 Ellipsoid data to create Terrain data has hidden the surface behind steep terrain features like mountains.**
- **"Digitizing" symbols created by the user include outline of polygon, direction arrow and plume name.**
- **"Data Values" are posted after retrieval of heights inside the polygon digitized by user. Other data types and display options can be selected in the "Select Data Overlay Options…" dialog box in the Task Menu.**
- **"Fire Pixels" are generated from MODIS data using the "Plume Utilities" option on the MINX Main Menu.**
- **"Markers" (volcanos, Aeronet sites or custom markers) are loaded from the Task Menu.**

Data menu - Toggle Gridded Data

2-level dropdown list box

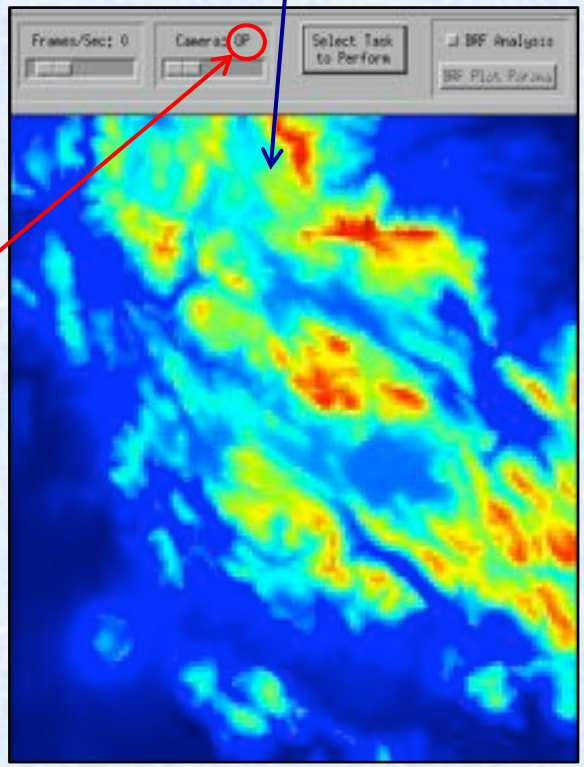




When a data product is selected from the Data Menu list, the user is asked to select the file containing the chosen MISR gridded data if not already loaded.

Toggle button for displaying data. Text changes to reflect the data type selected in the dropdown list.

- Gridded data refers to MISR standard data products that are pixelated to cover most of the area of the animation window.
- Gridded data are shown in an "extra", zeroth camera window called OP (for OPerations) located on the far left end of the "Camera:" slider control.
- By rapidly pressing and releasing the "Press and Hold" button, a visual correlation between gridded data and MISR level 1 BRF data can be made.

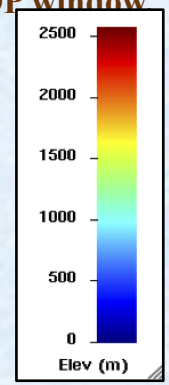


Portion of animation window showing color-coded terrain heights displayed while "Press and Hold…" button is depressed

Color bar parameters can be modified from a dialog box as described in slides below in the section on the Task Menu

When "Press and Hold" is pressed:

- Data are copied into the OP window.
- The view switches to the OP window
- A color bar is displayed either on the image or in a separate window and is updated if not already present and current.



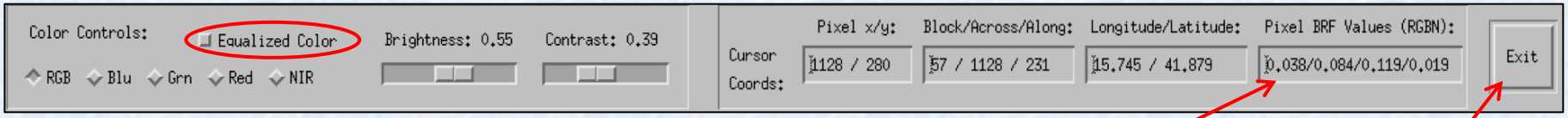
When "Press and Hold" is released:

- The view switches back to the original window.
- Data remain in the OP window and are manually accessible with the "Camera:" slider .
- The color bar window remains until another operation is selected or it may be hidden behind another window.

Lower Task Bar

Color controls

Coordinate display is updated whenever user clicks in the Animation window.



Besides the default RGB display, any band can be displayed alone in gray scale.

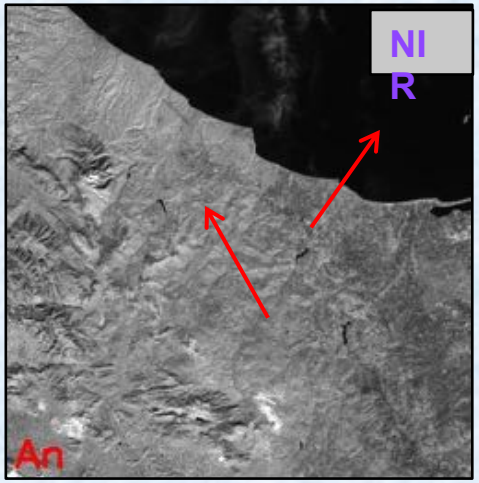
BRF values are shown for MISR's 4 bands: red, green, blue, NIR.

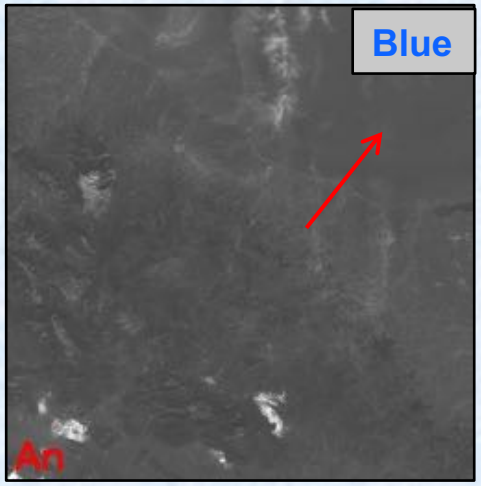
Clicking here returns user to the Animate cameras dialog to select another orbit.

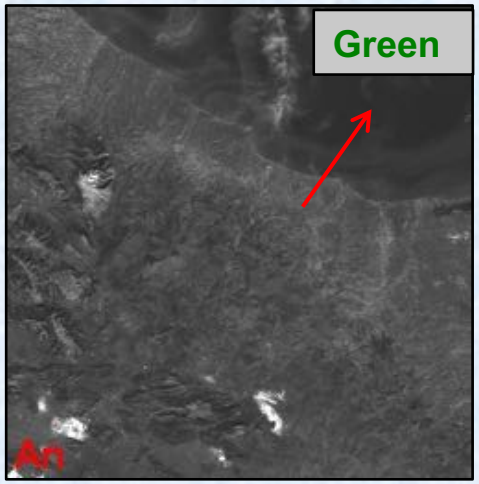
- **"Equalized color" = OFF (default) maps radiance (BRF) data to a color scale for each of MISR's 36 channels based on that channel's range of values. This enables better feature discrimination.**
- **"Equalized color" = ON maps BRF data to a single color scale for all 36 channels. This allows the display of "truer" relative brightness between cameras. The difference between ON and OFF may vary widely between orbits, depending on their color content.**
- **"Brightness" and "Contrast" sliders provide a means to control the display's color quality.**
- **"Pixel x/y:" uses a single coordinate system for the entire animation window based on 275 m pixels with origin [0,0] at the <u>lower left</u> corner of the window. Use these coordinates to specify an image rectangle when saving images to file.**
- **"Block/Across/Along:" uses a separate coordinate system for each MISR block based on 275 m pixels with origin [0,0] at the <u>upper left</u> corner of each block. Coordinates at left and right image edges can range outside the normal values of 0 to 2047.**

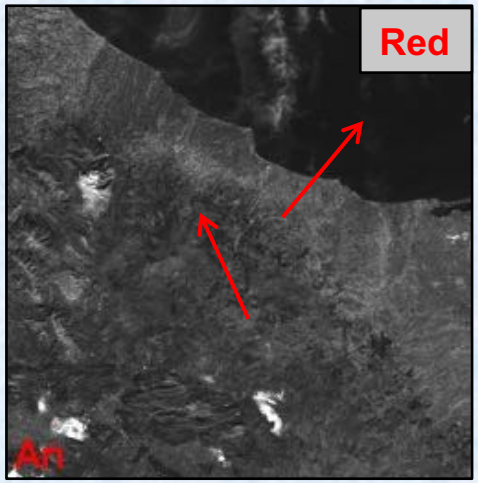
Display Single Bands

- Water absorbs NIR and Red light and reflects Blue and green.
- Vegetation absorbs Red light and reflects NIR and Green.
- Blue light is most strongly scattered by many aerosols.
- White features (clouds, snow, …) scatter all wavelengths equally.







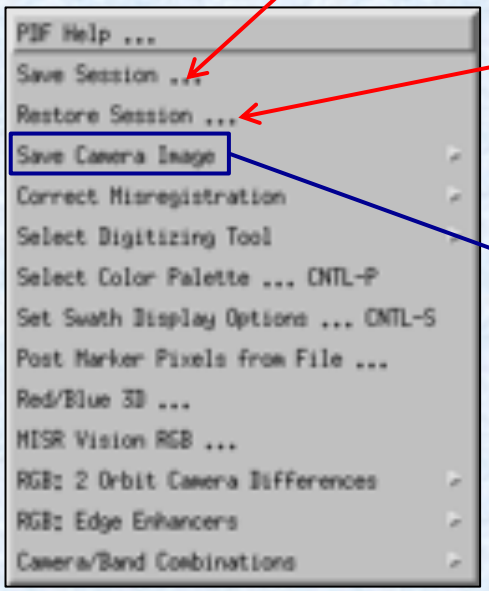


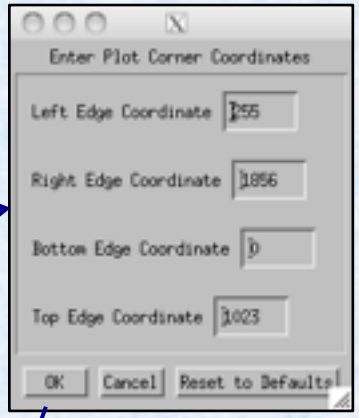
Task Menu

Save/Restore Session & Save Image to File

Option prompts for a file name into which a complete MINX animation session (images, digitizing, markers, settings etc.) is saved. Saved session files must have an extension of .sav. Saving and restoring a session can be slow.

Option prompts for a file from which a complete MINX animation session is restored. The current session is removed and replaced. Restoring a session can also be accomplished in the "Select Nadir Camera File" dialog during initial orbit loading by selecting ".sav" in the "Filters" dropdown list.





- **Specify the edge pixel coordinates of a region in the animation window that you want to capture and save in a graphics file.**

Select 1 of 9 image formats into which the selected region of the image window is to be saved (saving to MP4 requires an IDL license).

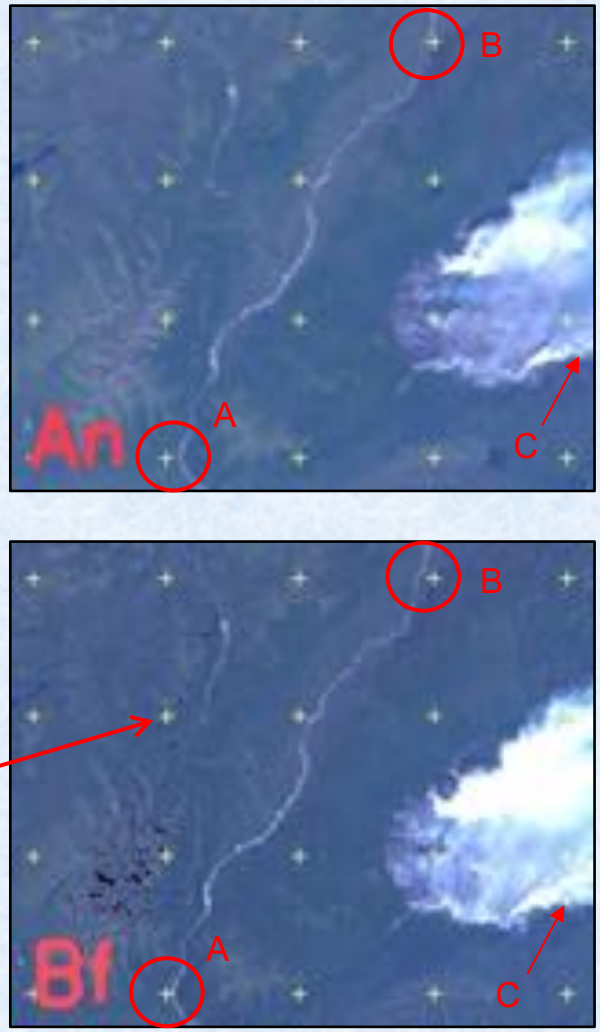
Dashed outline of region to save is drawn on the image. User is given a chance to change the region before being asked for a file name into which the image will be saved.

- **To find edge coordinates, click in the animation window, read values from the "Pixel x/y:" box at the bottom of the animation window, and test until desired values are found.**
- **All PNG images have transparent edges.**
- **Google Earth images are projected into a geographic coordinate system and overlay precisely on Google Earth maps.**
- **GeoTiff images are projected into the UTM map coordinate system.**

Camera Registration Correction - 1

The purpose of correcting camera registration is to improve stereo height retrieval accuracy by reducing errors in camera-to-camera geometric registration before image matching is performed.

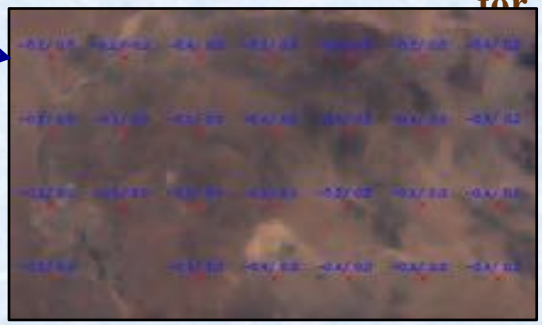
- A 1 pixel registration error can lead to a height error of ~ 550 m for Af/Aa cams and ~ 150 m for Cf/Ca.
- Mean co-registration error of MISR data < 1 pixel.
- However, one or more cameras on some orbits are misregistered by more than 2 pixels.
- Co-registration errors are evaluated on a regular grid of control points over the entire image using image-matching with An as the reference camera.
- To <u>assess</u> misregistration:
  - ① Turn on MINX "Fixed Grid" (yellow + symbols).
  - ② Animate cameras.
  - ③ Study distinctive terrain features near yellow grid points (circles A and B). In this example, the Bf image is displaced left relative to An by ~3 pixels.
  - ④ Do not compare features in clouds or plumes (C) which are <u>expected</u> to be offset by parallax or wind.

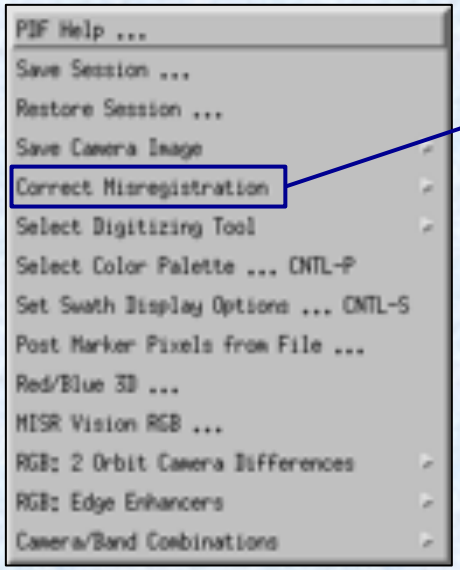


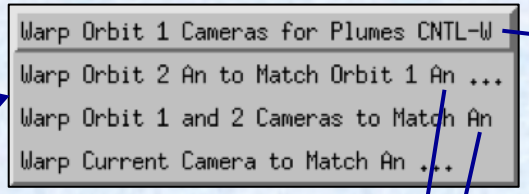
Bf camera is mis-registered by -3 across-track pixels relative to An

Camera Registration Correction - 2

- It is generally wise to perform a registration correction on every orbit for which you intend to perform a height retrieval. On some orbits a second pass of correction will improve results further.
- Correcting misregistration involves an automatic assessment of the position of terrain features on off-nadir cameras relative to the An camera. The assessment is performed on a grid of points over the entire image. The off-nadir camera image is then warped to match the An camera. Warping corrections at grid points are then shown as fractional 275 m pixels for across/along directions over the camera image.
- You will be asked to select a MISR AGP file (Ancillary Geographic containing DEM terrain heights) before correction begins.
- Warping corrections are conservative and do not correct for rapid variations caused by DEM inaccuracies.

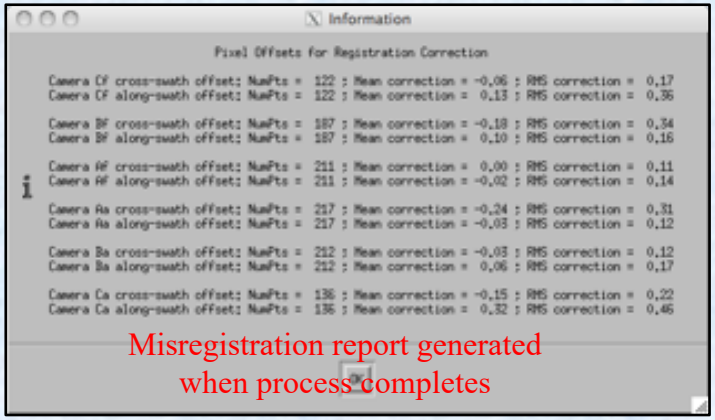






Use this for routine misregistration correction during plume height analysis.
Note – this option has a keyboard shortcut.

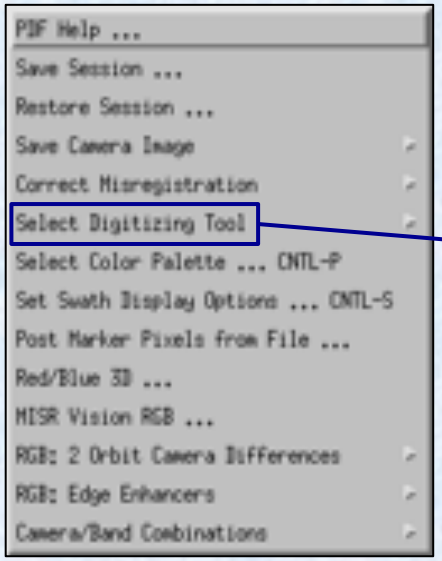
If you loaded 2 orbits and wish to correct the 2nd orbit to match the 1st, first correct the orbit 2 An camera relative to the orbit 1 An camera, then correct the non-nadir cameras to match their respective An cameras.



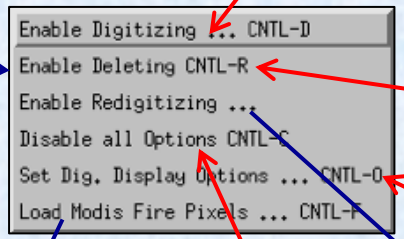
Misregistration report generated when process completes

Digitizing Tools

- **The "Select Digitizing Tool" option contains most of the features required for digitizing aerosol plumes and determining their height and motion.**



"Enable Digitizing", opens a dialog box containing numerous options and is the subject of an entire PDF Help file accessed from that dialog box. It also puts MINX into a state where mouse clicks are interpreted as digitizing commands until a different state is selected. **Note keyboard shortcut.** See slides in section on Digitizing Options for details.

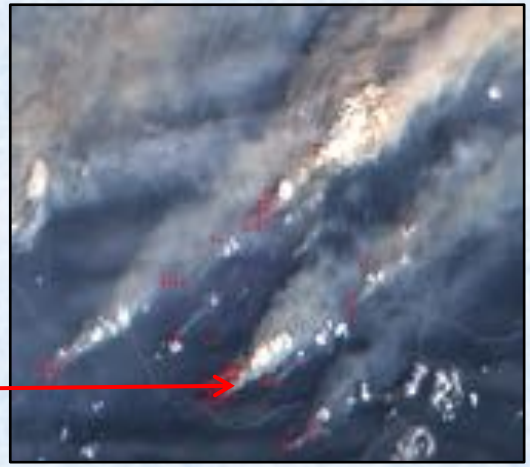


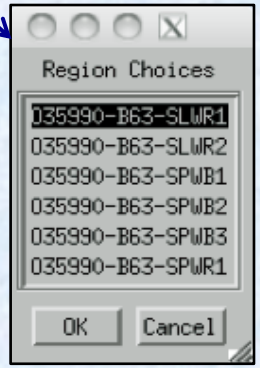
The "Delete Objects" option puts MINX in a state where clicking the mouse on a digitized feature identifies it for deletion. Then, if you agree to continue with deletion, the digitized feature is removed from the screen, from MINX memory and from files on disk. **Note keyboard shortcut**.

"Set Dig. Display Options" enables you to change the type of data displayed inside digitized polygons, the color bar scale and other parameters. **Note keyboard shortcut.** See a following slide for details.

"Disable Digitizing" cancels either the "Enable Digitizing" or "Delete Objects" states. **Note keyboard shortcut.**

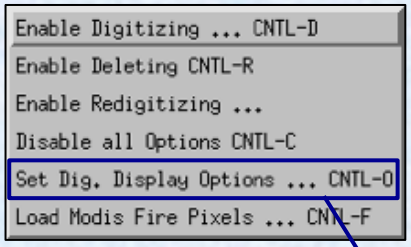
- **The "Load MODIS Fire Pixels" option prompts you for the fire pixel file to load.** ***Note keyboard shortcut.***
- **MODIS thermal anomalies or fire pixels can be generated in a MINX format file using "Plume Utilities" options on the MINX Main Menu.**
- **Fire pixels are displayed as red dots over MISR imagery and carry with them the per-pixel fire radiative power (FRP).**





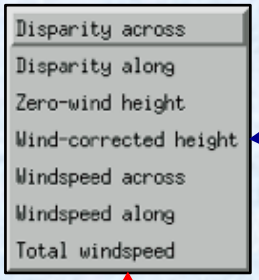
- **If you exit MINX after digitizing plumes but later want to redigitize one or more of them, use the "Redigitize Objects" option and choose the plume name from the list that's presented. This prevents MINX from over-writing the incorrect file on disk.**
- **Plume names contain a reference to the MISR orbit and block and a plume number incrementing from 1 to N within each block.**

Data Overlay Options

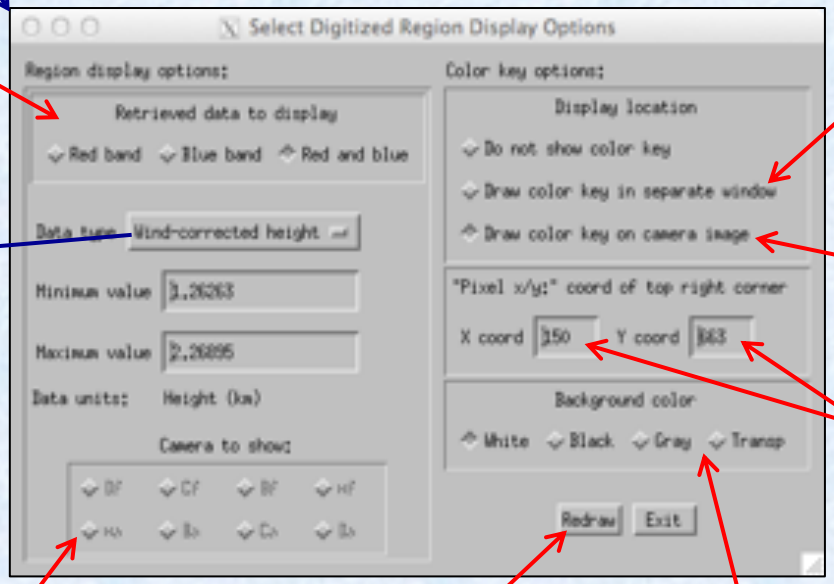


- **This option allows you to select the type of colored pixel data to show inside digitized polygons (e.g. plumes) on the animation window, to scale the colors and to display a color key. *Note the keyboard shortcut.***
- **If several digitized plumes are present in the animation window, all are rescaled using the same minimum and maximum scale values you specify.**
- **When a new plume polygon or line is digitized, MINX automatically sets the "Data Type" to "Zero-wind height" or "Wind-corrected height" as appropriate and rescales the colors so they are also appropriate for that plume. This is so the automatically captured and saved screen images of the current plume are presentable.**

If both red and blue bands were used to retrieve heights, you can choose which to display in the animation window.



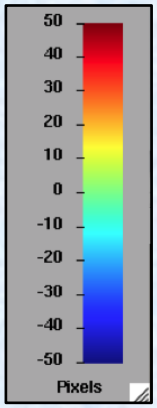
The type of data chosen in this listbox determines what appears inside digitized polygons as well as the units shown at the bottom of the color key.



For routine use, draw the color key in a separate window for convenience.

If you're saving an image for presentation, you can overlay the color key on the image so it will be captured. This button enables entering data in the X/Y coordinate boxes below it.

Use Pixel x/y: coordinates at the bottom of the animation window to set the location for the upper right corner of color key if drawn on the image.



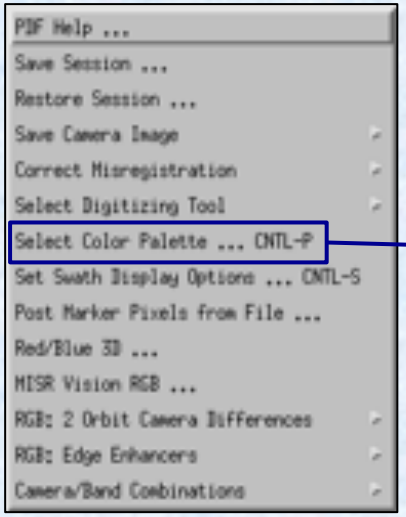
After changing any parameter, click "Redraw" to redraw window.

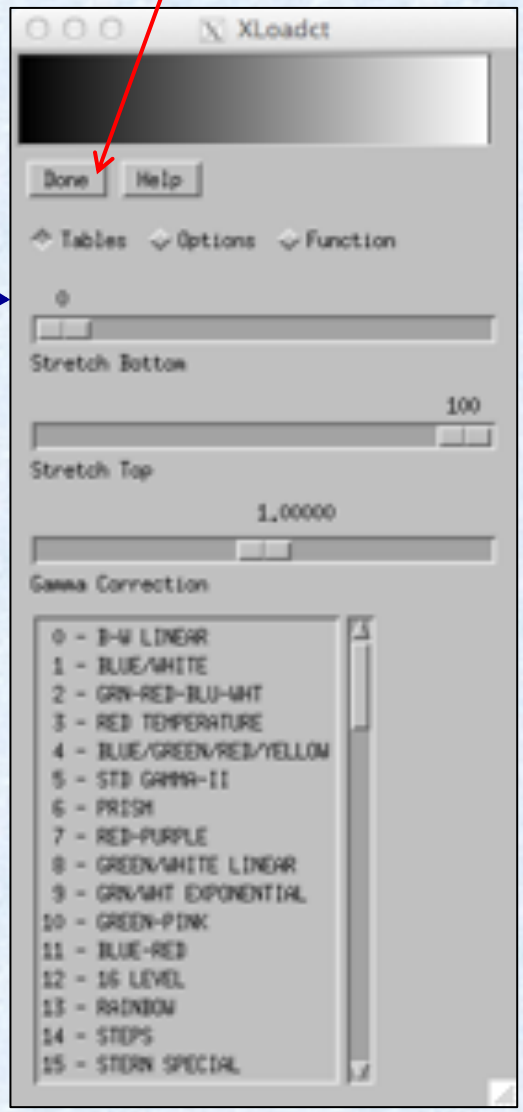
The background color can be chosen for the color key. Gray is shown in the example at right.

Choosing "Disparity across" or "Disparity along" enables these camera buttons. Disparity is the offset in pixels between a feature in the chosen camera and the An camera.

Select Color Palette

When finished, click the "Done" button and redraw your image.

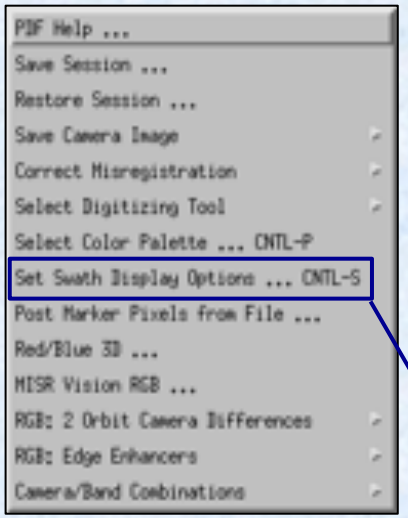




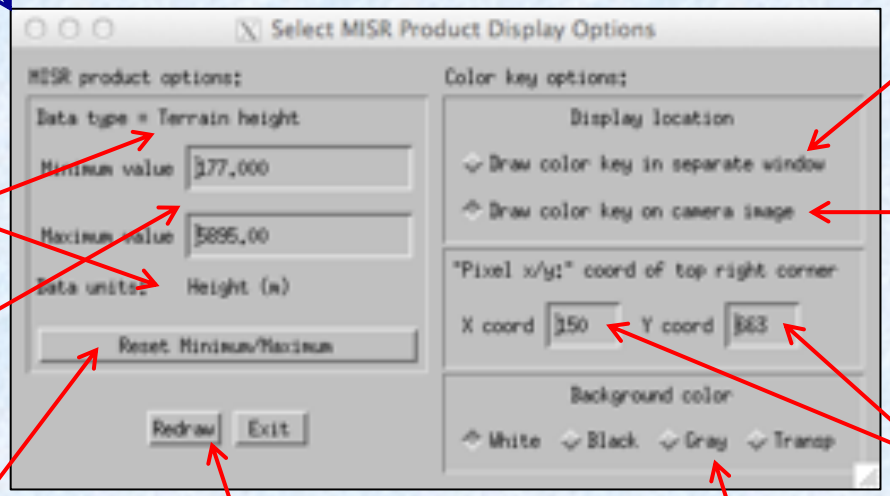
- **"Select Color Palette" lets you select and/or modify a color palette from the IDL standard set that will be used to draw all polygon color fill for digitized plume regions as well as for all MISR product swath images selected from the "Data Menu" on the animation window.** ***Note the keyboard shortcut.***
- **Colors that define the MISR camera BRF images are not affected – their pixels are colored by directly scaling their RGB data channels and mapping them into your display's RGB channels.**
- **A palette that highlights relevant features and that displays continuous color and intensity variation is often best to use. Good choices for this purpose, where darker colors are at the low end, are palettes numbered 0, 1, 3, 7, 8, 9, 19 and 21. For palettes where brighter colors are at the low end, you can use numbers 20, 22 and 49-65.**

- **Simply selecting one of the standard palettes is adequate for most purposes.**
- **You can use the other controls to modify a palette if you have special requirements.**

Swath Display Options



- **This option allows you to select parameters that modify the display of MISR standard product data fields in the animation window, e.g. rescaling the colors, displaying a color key, etc.** ***Note the keyboard shortcut.***
- **The dialog parameters pertain to the currently selected MISR data type that was selected from the "Data Menu" button.**
- **When a new MISR data type is selected, the dialog will disappear, so you'll need to load it again for the new data, either from the Task Menu of by using the keyboard shortcut.**



The current data type and its units are displayed.

You can reset the minimum and maximum values for the current data type in these edit boxes. They will take effect when you depress the redraw button.

Click reset to restore the actual minimum and maximum values of the data in the edit boxes.

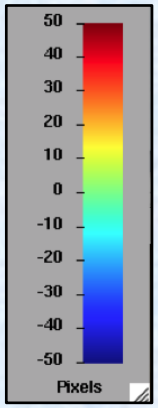
The "Redraw" button should be pressed to update the display state for any changes that were made, as well as to duplicate the functionality of the "Press and Hold" button on the animation window.

The background color can be chosen for the color bar. Gray is shown in the example at right.

For routine use, draw the color key in a separate window for convenience.

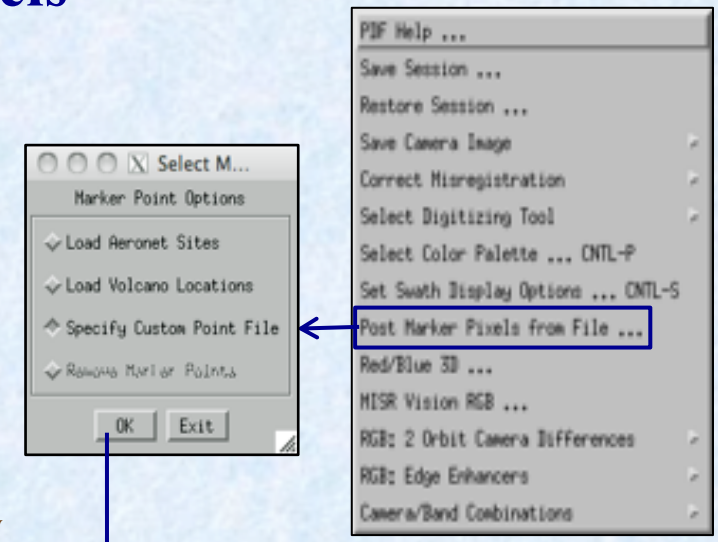
If you're saving an image for presentation, you can overlay the color key on the image so it will be captured. This button enables entering data in the X/Y coordinate boxes below it.

Use Pixel x/y: coordinates at the bottom of the animation window to set the location for the upper right corner of color key if it's drawn on the image.



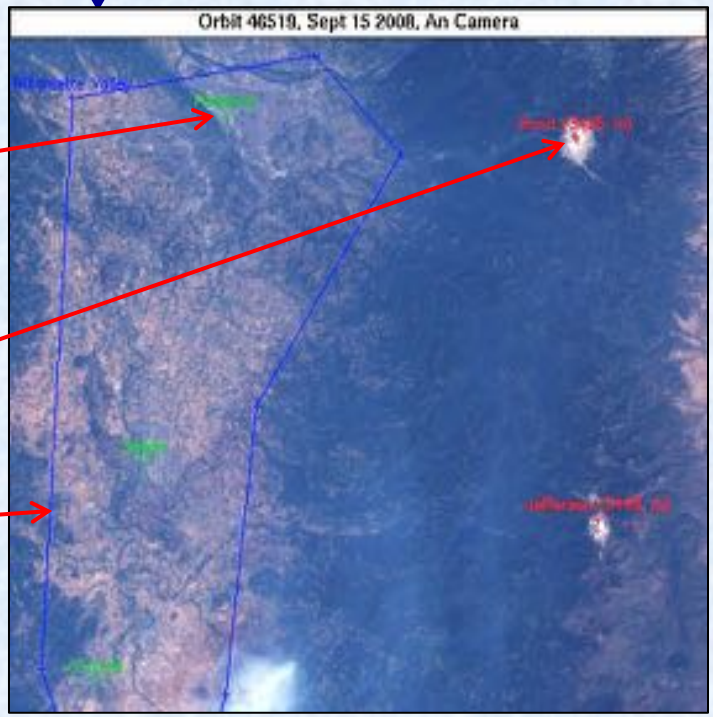
Post Marker Pixels

- Marker points form symbols and lines that can be drawn over an image at precise geographic locations. They can be assigned symbol types, colors and names.
- Two classes of marker points are hard-wired into MINX: volcanos are displayed in green with a "+" symbol, the volcano name and its summit elevation; Aeronet sun photometer sites are shown in cyan with an "x" symbol, the site name and its elevation.
- A third class of marker point is user-defined and can be displayed as lines as well as points. These markers are read from a user-created text file whose format is described below, and for which you are prompted.
- Any one of these types of markers can be displayed at a time. To display another type, you must first remove any existing marker points using the "Remove Marker Points" option.



File that created markers on image of NW Oregon, USA

```
Example of custom marker file.
9
1 + green Portland
   -122.677    45.522
1 X green Salem
   -123.033    44.938
1 + green Corvalis
   -123.254    44.563
1 + green Eugene
   -123.085    44.050
1 + green Bend
   -121.310    44.052
1 + red Hood (3425 m)
   -121.70     45.37
1 + red Jefferson (3199 m)
   -121.80     44.69
1 + red South Sister (3157 m)
   -121.77     44.11
8 + blue Willamette Valley
  -123.1       45.6
  -123.4       44.6
  -123.2       44.0
  -122.9       44.5
  -122.7       45.0
  -122.2       45.4
  -122.4       45.6
  -123.1       45.6
```



File Format

1) Line 1 – an arbitrary, descriptive text string.
2) Line 2 – the number of points and/or lines in the file to follow.
3) Line 3 – four items describing this marker in this order: number of points; symbol name; color name; and marker name (spaces OK).
4) Line 4 to N – decimal longitude and latitude, one point in item's list per line.
5) Repeat 3) and 4) as required by line 2.

Valid Names

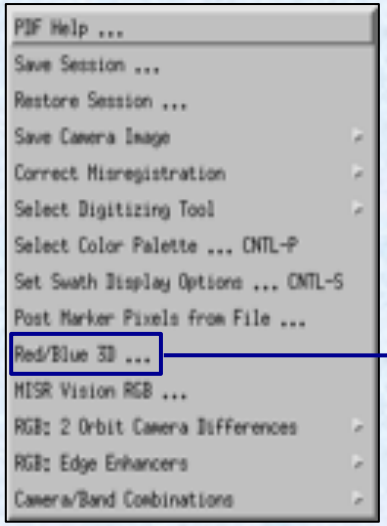
Symbols: +, ×, *, square, triangle, diamond

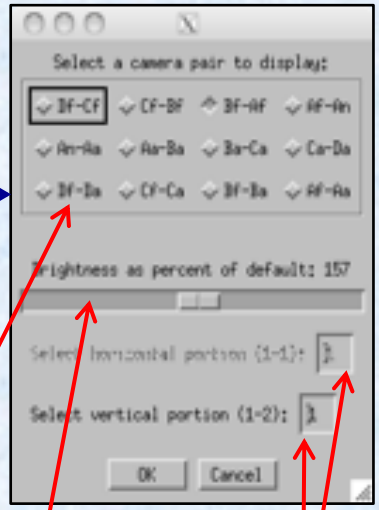
Colors: red, green, magenta, blue, yellow, aqua, white, pink, lt_blue, lt_green, gray, blue2, purple, brown, black

Red/Blue 3D Images

- MISR images can be displayed in the OP window and viewed in 3D with special red/blue glasses.
- Images are rotated 90 degrees counterclockwise so they can be viewed on the screen.

- To view <u>terrain relief</u> in 3D, you must load MISR GRP_ELLIPSOID products.
- To view clouds, plumes and other above-terrain features in 3D without any 3D terrain relief, use MISR GRP_TERRAIN products.

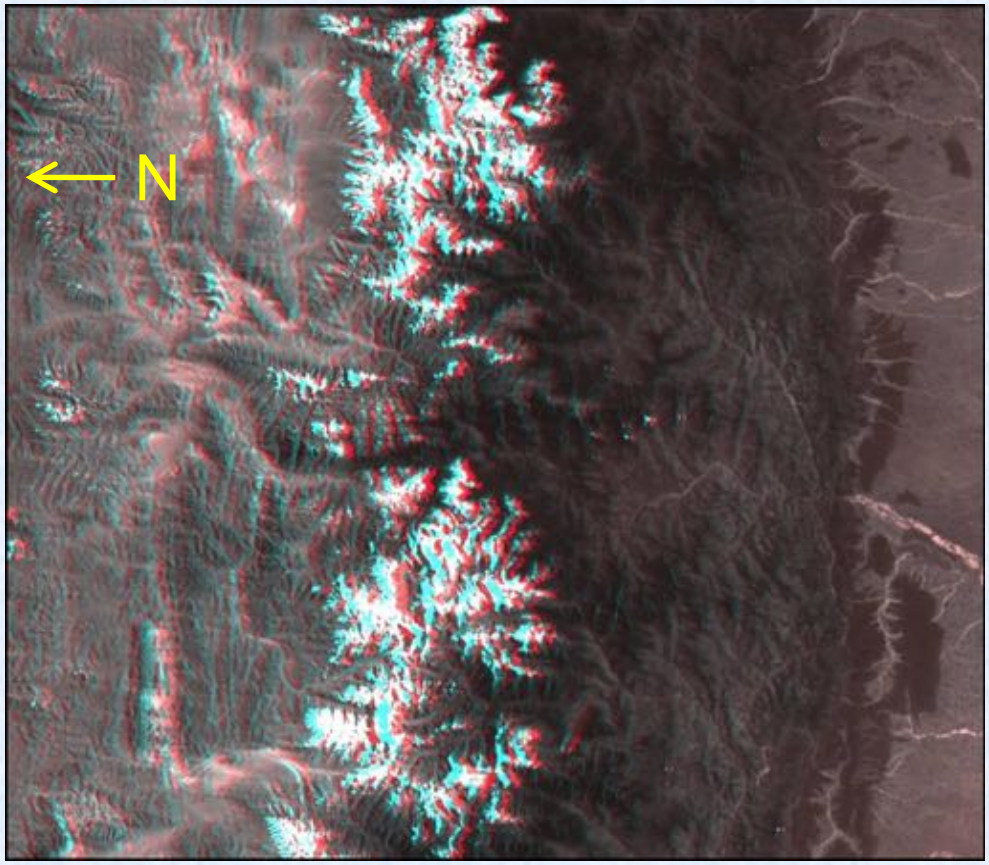




Experiment to find the camera pair to display that works best for you.

Adjust image brightness with this slider.

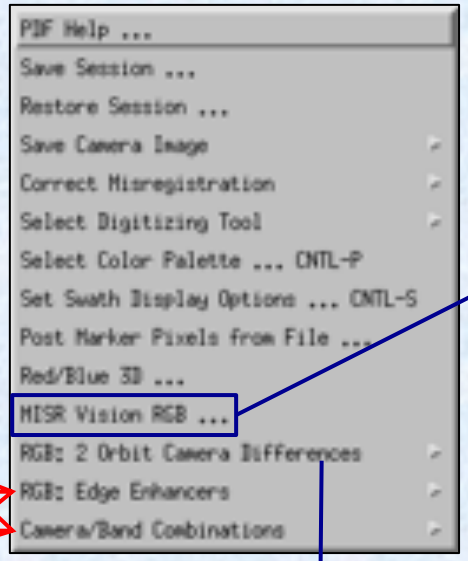
Because the image must be rotated 90 degrees, it may not fit in the OP window. If there are fewer than 4 blocks loaded, it will be too wide for the available vertical window size. If there are more than 4 blocks loaded, it will be too long for the available horizontal window size. Use these edit boxes to specify which portion of the image to display. Or better, load 4 blocks.

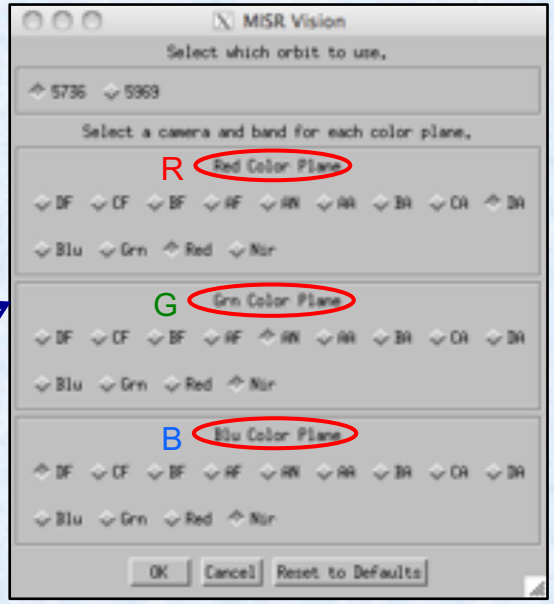


Nepalese Himalayas and Tibetan Plateau (reduced ~ 1.5X)

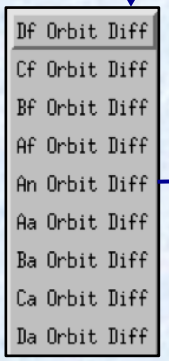
MISR Vision & 2 Orbit Camera Differences

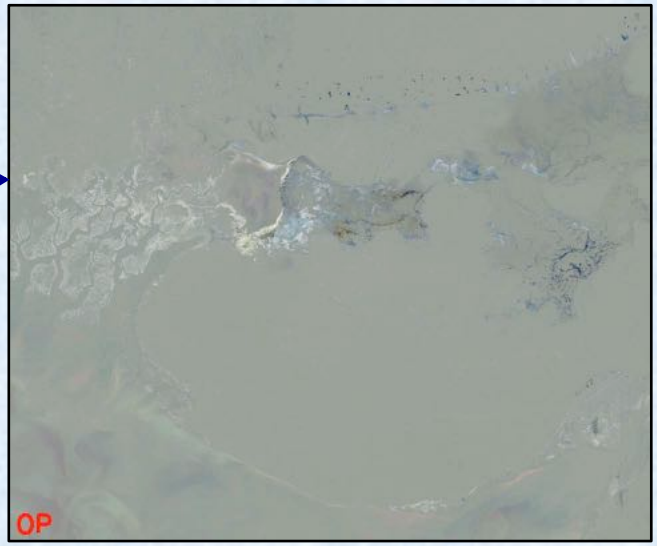
These create new images in the OP window. Experiment freely.





- This option differences the images for 2 orbits from the <u>same path</u> using the selected cameras and displays the results in the OP window.



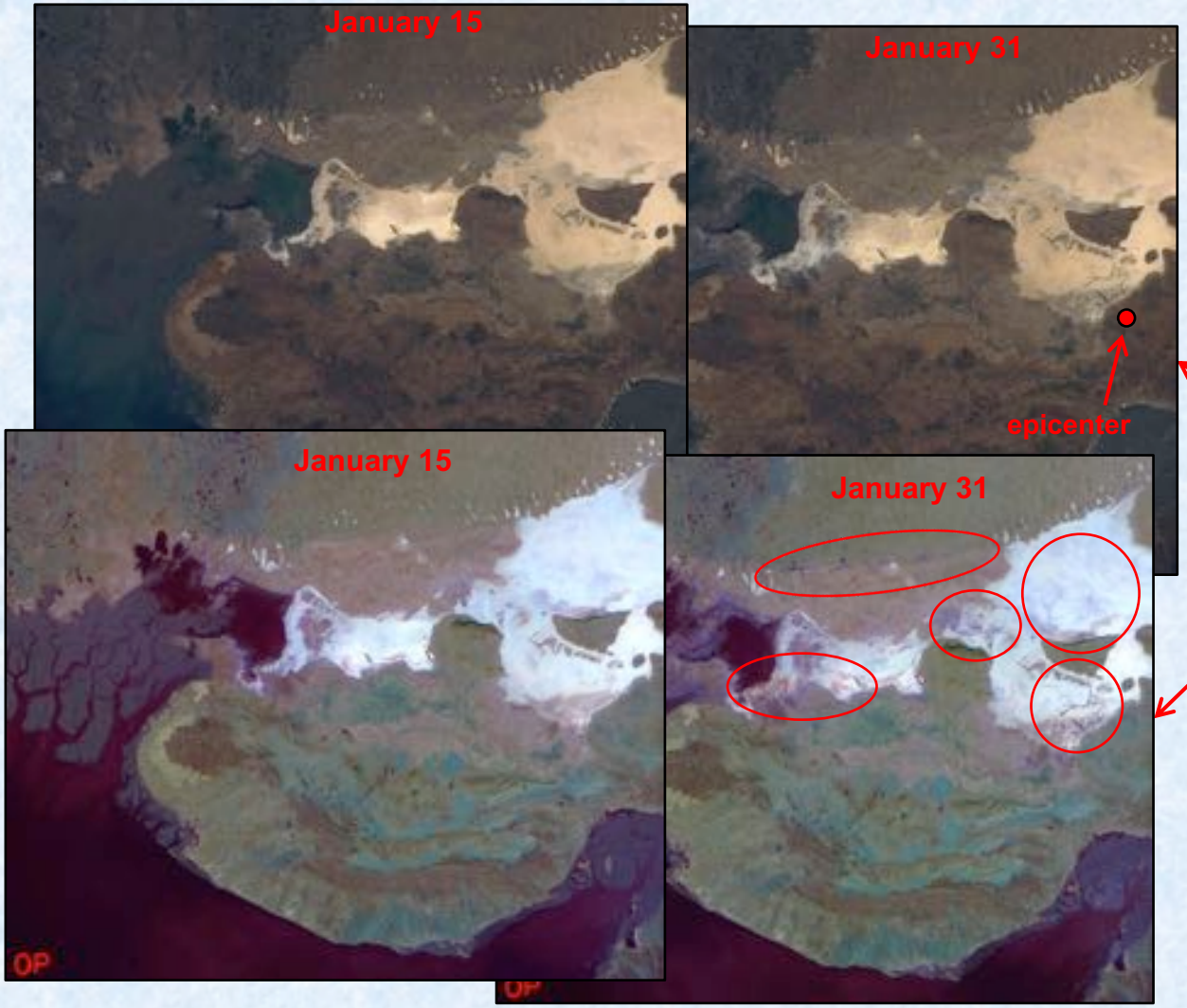


- It is most useful to difference orbits in order to inspect changes in land surface.

- MISR Vision creates a new camera image in the OP window whose RGB components represent the selected MISR channels.
- This permits MINX to perform <u>multi-angle</u> compositing as well as <u>multi-spectral</u> compositing.
- The capability highlights features that are sensitive to view angle, such as rough ice vs. smooth ice or shallow surface water present before and after an earthquake (see next slide).

This is the result of subtracting the Jan. 15 An camera image from the Jan. 31 An image for the same 2 Bhuj, India orbits shown in the next slide. It illustrates a 2nd method for highlighting the areas where water was expelled by the Bhuj earthquake.

MISR Vision and Bhuj Earthquake Effects



Based on B. Pinty et al, EOS, February, 2003

- Before and after images of the area where, on January 26, 2001, a magnitude 7.7 earthquake struck in Gujarat Province of northwestern India.
- 20,000 people were killed and extensive damage was incurred.
- Upper images: Standard MISR RGB image (An camera) before (Jan 15) and after (Jan 31) the earthquake.
- Lower images: Shows same data but in false color with Df NIR in red color plane, An NIR in green plane and Da red in blue plane.
- Pink/purple areas show new areas of water and dendritic drainages where liquefaction forced water to the surface.

Digitizing Options

Digitizing Options Dialog Box - 1

Your selection of aerosol type contributes a code letter to the name of the plume and the plume files, and it determines the color of the digitized polygon boundary. This is used primarily for sorting when data are being loaded onto the Plume Project website. There are no other effects.

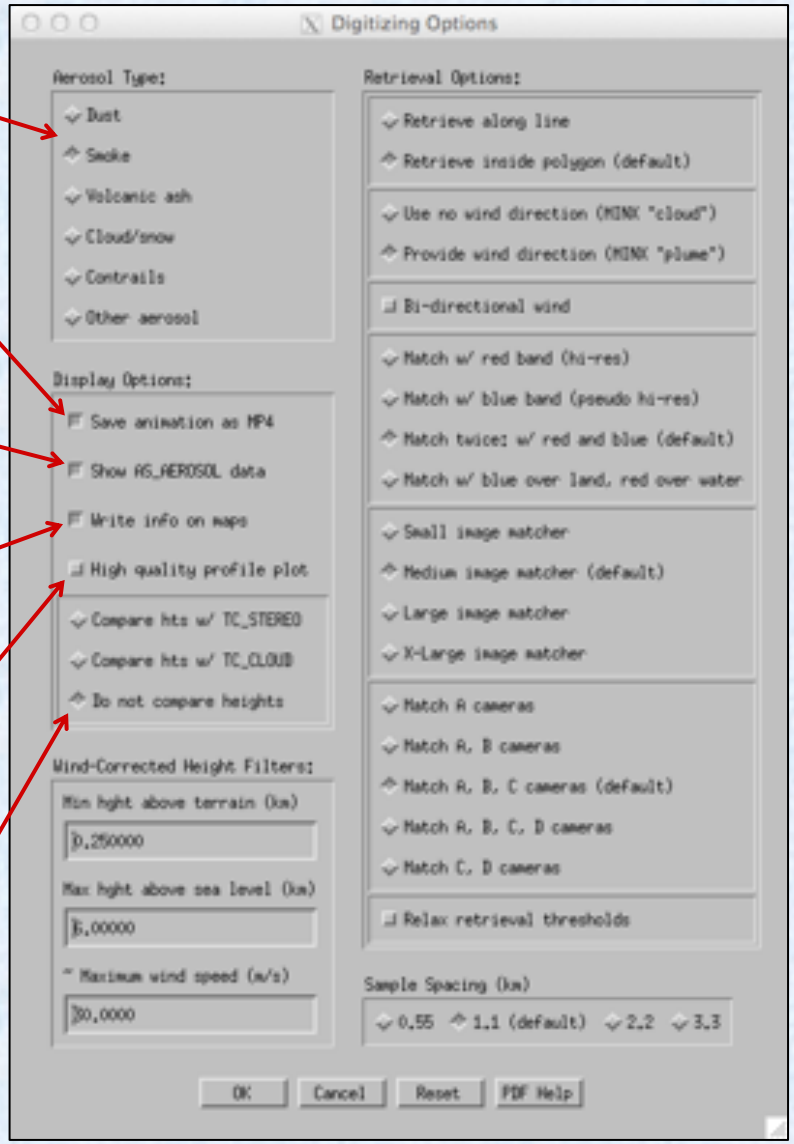
If this is checked and you have an MP4 license from Exelis, a 9-camera MP4 animation is saved. If it is not checked or you have no MP4 license, 9 JPEG images are saved. If you have an IDL license, you can request MP4 licenses from Exelis at no charge.

If you have a MISR AS_AEROSOL standard product file for the current orbit, then by checking this button you are notifying MINX to load the file and read it. Whenever you digitize a new region, aerosol data for the points in that region are automatically collected and summarized in a set of histograms which are saved to a file for each plume. *This must be included in datasets destined for the Plume Height Project website.*

If this is checked, identifying information is added to a title bar at the top of map images automatically saved to file when you digitize a plume. *This must be included in datasets destined for the Plume Height Project website.*

Images, profile plots and histograms are always automatically saved for each region digitized. When this button is checked, each height/wind profile will be drawn larger and with fewer annotations than normal to make it more presentable for publication. Also, any map images that are saved, either automatically or manually from the "Save Camera Image" option on the "Task Menu", have the 2-character camera name removed from the lower left corner.

MISR has two standard products that contain global stereoscopic cloud height and wind retrievals: TC_Stereo and TC_Cloud. If one of these options is selected, you will be prompted to select the appropriate product file after each retrieval is finished. MINX will read the file and add corresponding standard product heights and winds to the MINX results on the height and wind profiles and histograms.



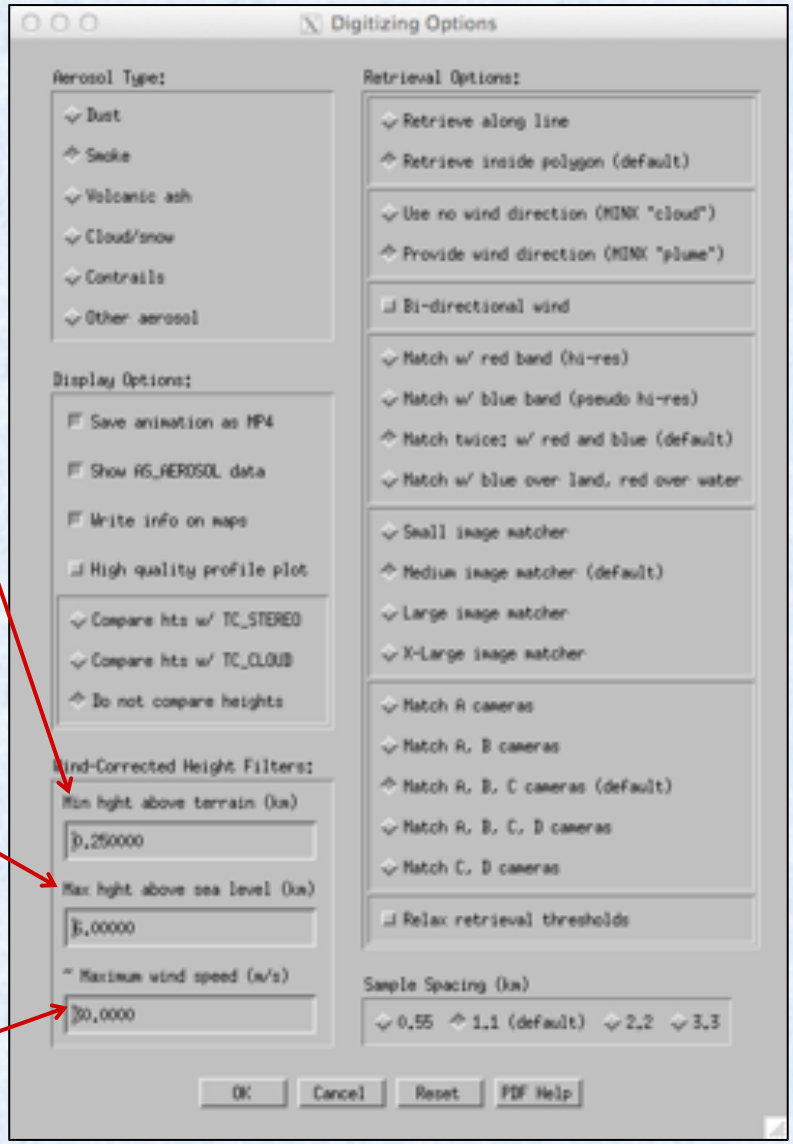
If the cursor hovers over a button, context-sensitive help is shown.

Digitizing Options Dialog Box - 2

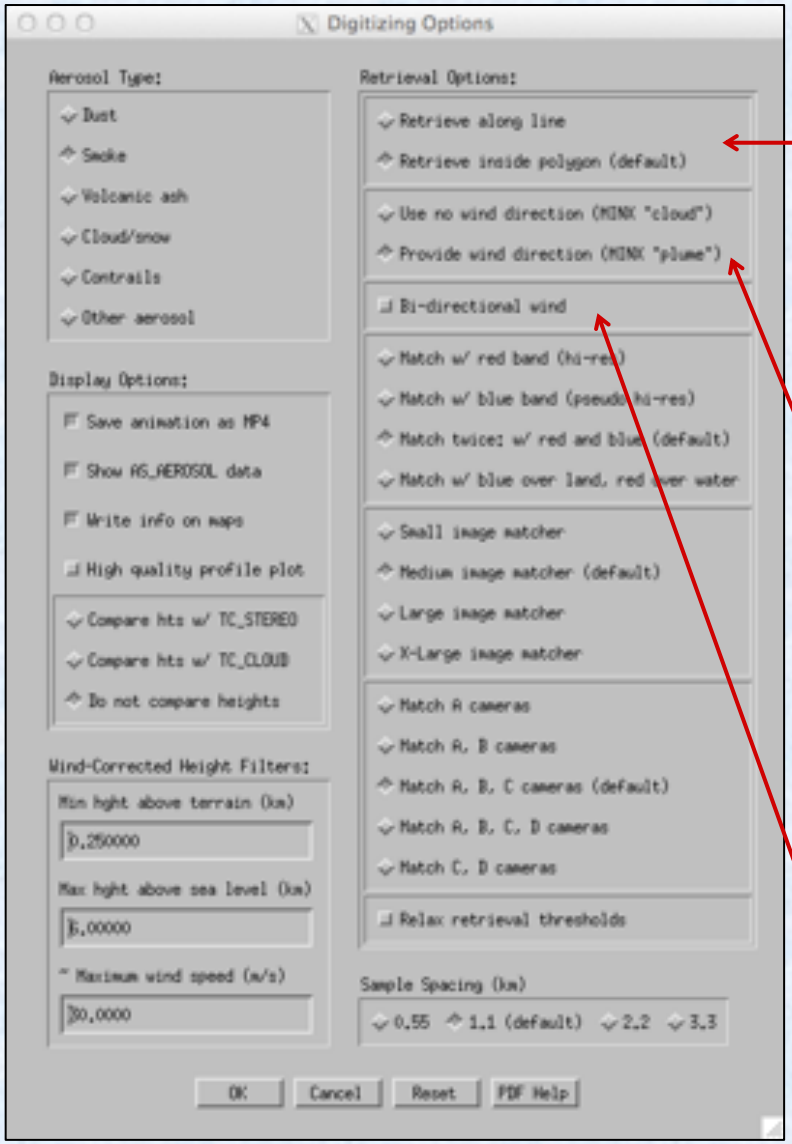
This filter establishes the lower-limit of retrieved wind-corrected heights relative to ground level.
The retrieval algorithm cannot distinguish between aerosols above the terrain and the terrain itself. So if the cameras aren't adequately co-registered, or if the terrain model (DEM) is not accurate enough where you are digitizing, MINX may retrieve heights from the terrain tens or hundreds of meters above ground level. Set the value of this parameter to suppress these invalid terrain retrievals from wind-corrected height records. The default value is generally good, but especially for aerosols that may be close to the ground, and when camera co-registration is very good, the value may need to be set to as low as 0.1 km above the terrain. This value does not affect zero-wind heights.

This filter establishes the upper-limit of retrieved wind-corrected heights relative to sea level.
It is not uncommon for aerosol plumes to be partially exposed beneath patchy clouds. It is tedious to digitize around clouds to exclude them and thus avoid contaminating valid aerosol heights and winds with cloud heights and winds. This parameter makes it easier to exclude unwanted heights by suppressing those that are higher than the indicated height above sea level. In order to determine what value to assign, it is necessary to digitize a feature several times. In the first pass, assign a large enough value to determine, from the height profile, whether there is a clean separation between the heights of clouds and aerosol. If there is, perform a second pass and set the filter to a value between the plume heights and cloud heights.

This filter establishes the upper-limit of retrieved absolute wind-speed in either the across-track or along-track direction.
This filter and the upper-limit height filter above affect the computation time for height/wind retrievals. Use the smallest reasonable values in these fields to minimize run time. The value assigned to this parameter can also be used to exclude height/wind retrievals for fast-moving aerosols.



Digitizing Options Dialog Box - 3



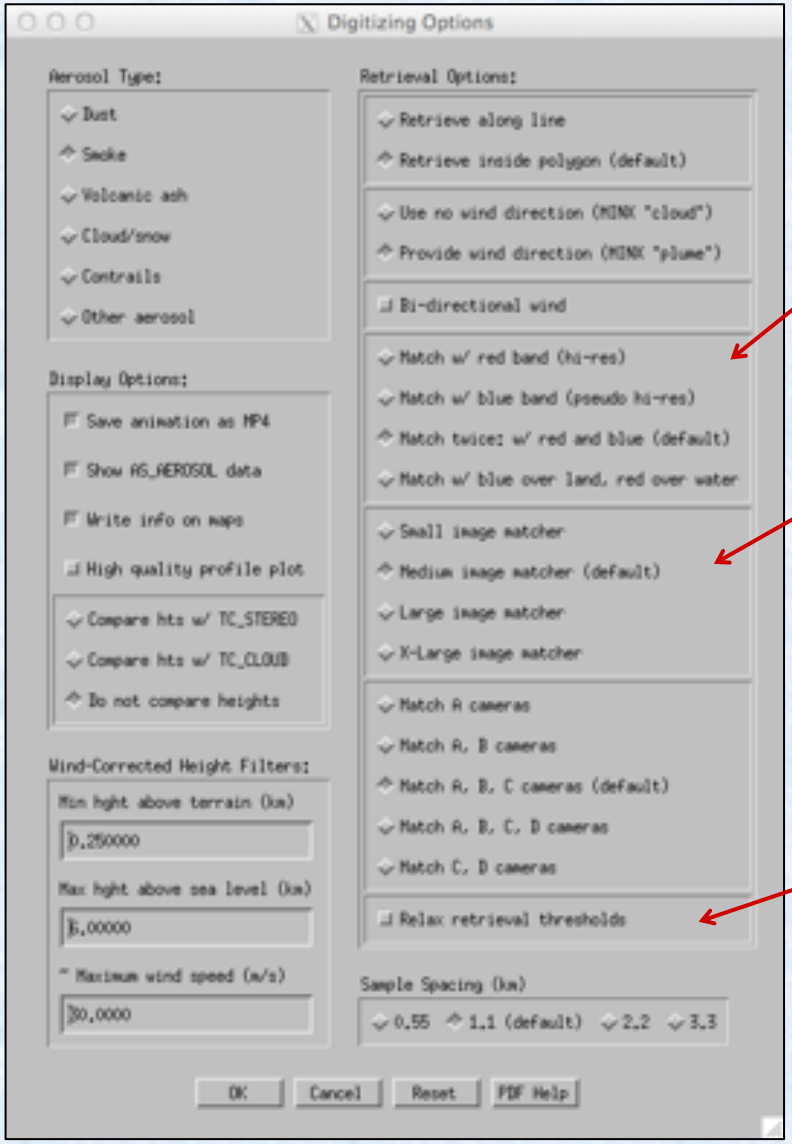
You can retrieve heights and winds either along a digitized line or inside a digitized polygon.
If you choose "Retrieve along line", then the digitized line serves both as the wind direction line and as the line along which height/wind retrievals will be made. The digitized line will be splined and resampled at a uniform interval set by the "Sample Spacing" parameter. This is useful for generating a single-valued height profile and for reducing computation time when testing a scene. "Retrieve along line" is available only when "Provide wind direction" is chosen. If you choose "Retrieve inside polygon", you must digitize a closed polygon. Height retrievals will be performed on a regular grid of points inside the polygon where grid interval is set by the "Sample Spacing" parameter. You can provide a wind direction or not, depending on the checked item in the next box. See additional description in slide below.

"Use no wind direction" computes only zero-wind heights which assumes the entire disparity or offset between camera images is due to parallax (wind is discounted). This may be your only height determination option if you lack wind direction information, though there may be a significant error in the results. You will need to digitize a closed polygon surrounding the aerosol or cloud of interest, but no wind vector is needed. This defines the MINX "cloud" type.
"Provide wind direction" computes both zero-wind heights plus winds and wind-corrected heights. This is the appropriate option whenever you have knowledge of wind direction from any source that you can use to establish a wind vector. You must digitize a closed polygon as well as a direction line. This defines the MINX "plume" type.

Checking the "Bi-directional wind" box instructs MINX to use the wind direction you provide plus its 180 degree opposite in determining heights. This can be useful in a left-to-right transect across the eye of a hurricane, for example, where wind directions reverse.

If the cursor hovers over a button, context-sensitive help is shown.

Digitizing Options Dialog Box - 4



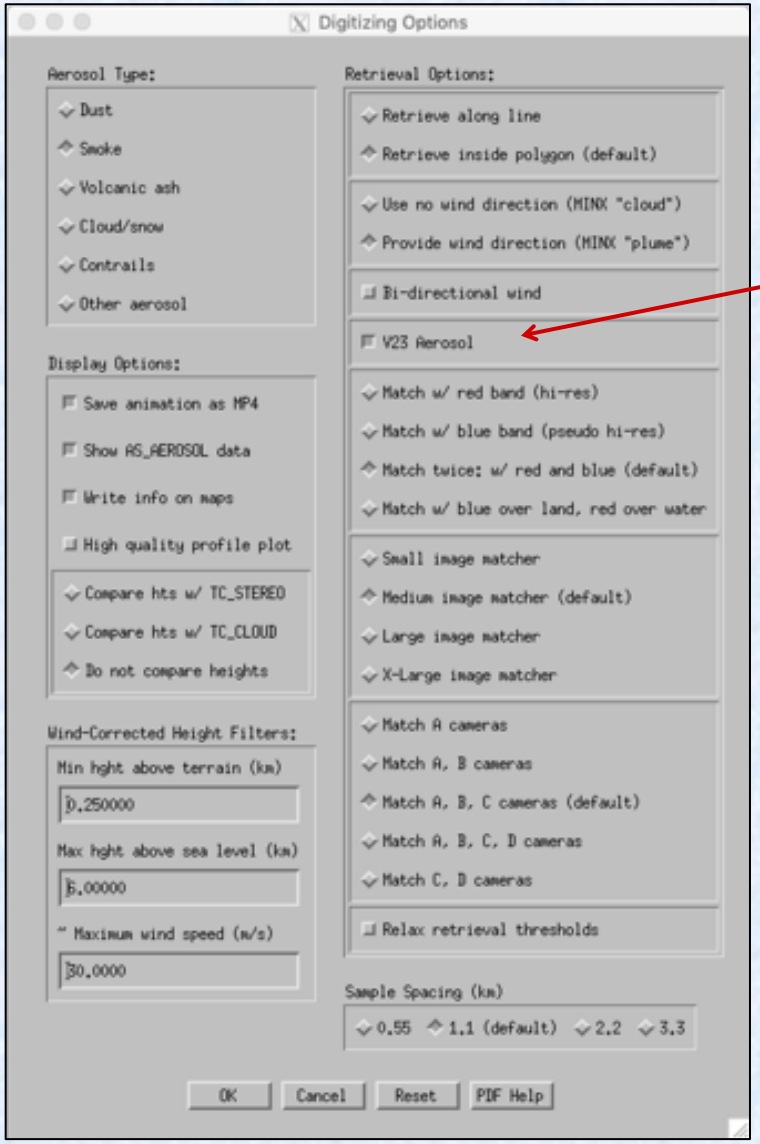
Select which MISR band(s) to use in the image matching step of the height retrieval.
MINX can retrieve heights with either/both the red and blue bands. The red band has the highest native resolution and should be used if it provides acceptable results, especially over water and for retrieving heights of clouds or other optically dense aerosols. If an aerosol is not optically dense and/or lies over a bright surface, then the blue band will often produce more and better results. If a plume extends across a coastline to lie over both land and water, "Match w/ Blue and Red" may produce superior results. *Retrievals destined for MISR's Plume Project website must use the "Match Twice: w/ red and blue" option throughout.*

Select the size of the image matcher.
This affects the quality of the retrieval and the speed of the operation. The default matcher is appropriate for most purposes. Large matchers run more slowly, generate smoother retrieval results and may increase the number of successful retrievals. The small matcher may provide improved results over thin aerosols with fine detail in the underlying terrain. Matchers vary in size from 7 pixels to 15 pixels square for "Small", "Medium" and "Large" matchers. The "X-Large" matcher is extremely slow and smooths out much of the spatially-variable detail in retrieved heights. See additional description in slide below.

Choose to accept height retrievals with a lower level of confidence in their quality.
The default retrieval thresholds are appropriate for most purposes. If you relax these thresholds, you can often increase the number of retrievals significantly, but possibly at the expense of accuracy. The thresholding algorithm is based on several parameters including the number of camera pairs that return similar results, on the clustering of results within a certain distance (threshold) of each other and on the proximity of the direction of motion to the along-track direction. It is often very useful to select this option when the number of successful retrievals in an aerosol region is small or zero.

If the cursor hovers over a button, context-sensitive help is shown.

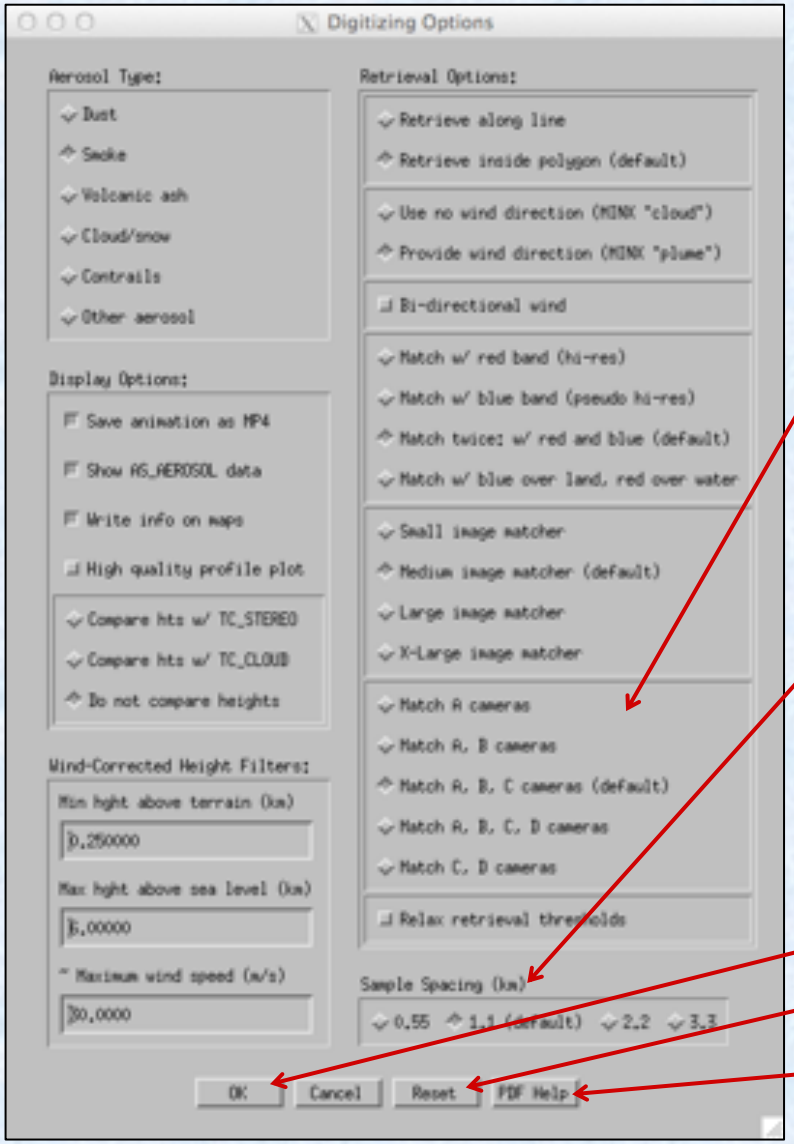
Digitizing Options Dialog Box - 5



V23 Aerosol
Checking the "V23 Aerosol" box instructs MINX to use the newer 4.4km V23 AS Aerosol files in NetCDF format instead of the older HDF4 based 17.6km products.

If the cursor hovers over a <u>button</u>, context-sensitive help is shown.

Digitizing Options Dialog Box - 6



Select which cameras to image-match against the An reference camera.
The default option uses the 6 cameras nearest nadir (Cf, Bf, Af, Aa, Ba and Ca) and is almost always the best choice. Adding the D cameras (Df and Da) slows retrievals and is useful only if an aerosol is relatively stratiform and otherwise produces poor retrievals. If you choose to use only the 2 A cameras or the 4 A and B cameras, you should also select "Relax retrieval thresholds", because fewer cameras are available to pass the threshold tests.

Select the spatial frequency for retrieval attempts.
This parameter determines the spacing between grid points in a plume polygon or between sample points on a splined direction line where height/wind retrievals are attempted. The permissible values are multiples of MISR's high-resolution pixel size (0.275 km). Closer spacing increases computation time by the square of the ratio (e.g., using 0.550 km spacing requires 16 times as long to run as using 2.2 km spacing). See additional description in slides below.

The amount of spatial detail you can extract from a scene is affected not only by the sample spacing, but also by the size of the image matcher. Smaller values of both increase the spatial detail. Smaller values of image matcher size increase noise, while smaller values of sample spacing generally increase the number of successful retrievals.

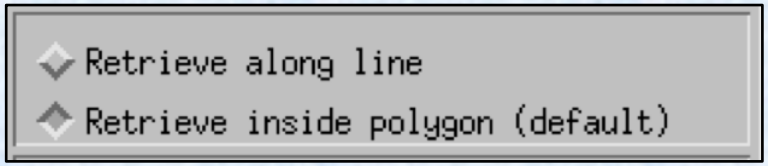
Clicking "OK" puts MINX into digitizing mode.

"Reset" returns all digitizing parameters to their default state.

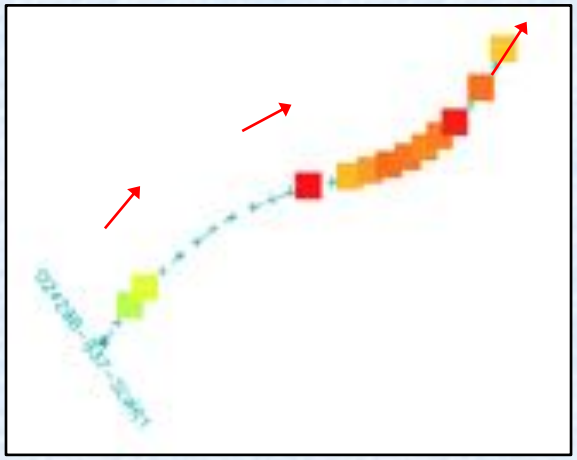
Shows a PDF help file for these digitizing options.

If the cursor hovers over a button, context-sensitive help is shown.

Line or Polygon - 1



- **Retrieve along line:**
  - Points digitized by user are connected by a splined curve that is resampled at uniform spacing according to the value in the "Sample spacing" option
  - The resampled line doubles as the wind direction line
  - This option disables "Use no wind direction (cloud)" option
  - Use this for a quick analysis or to display a plume or terrain height profile without clutter or if a plume has variable wind directions (e.g. if it fans out from the source)
- **Retrieve inside polygon:**
  - Sample points are created on a regular grid with spacing set by the "Sample spacing" option
  - If "Provide wind direction" is chosen, the direction used for wind correction at each sample point is the wind direction at the nearest point on the direction line
  - The wind-direction line does not need to be contained within the polygon – a line in any direction will result in retrieval attempts using that direction



Example of splined line defined by 4 digitized points and resampled to 3.3 km spacing

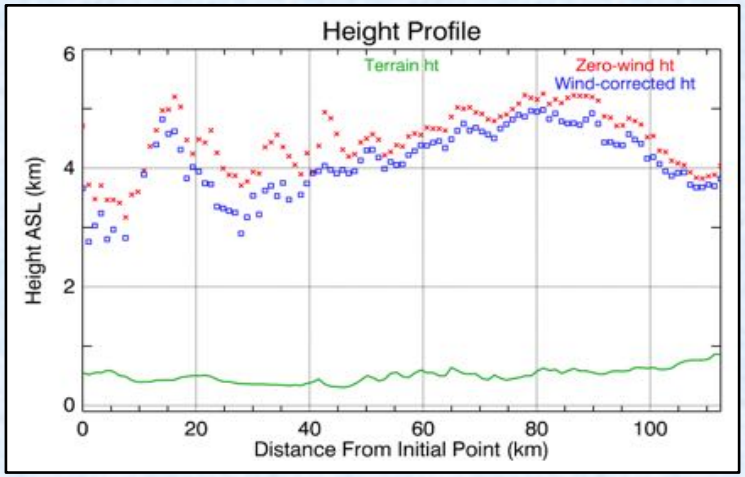
Dashes connect resampled points indicated by + symbols

Colored squares at points with successful height retrievals are sized to match sample spacing

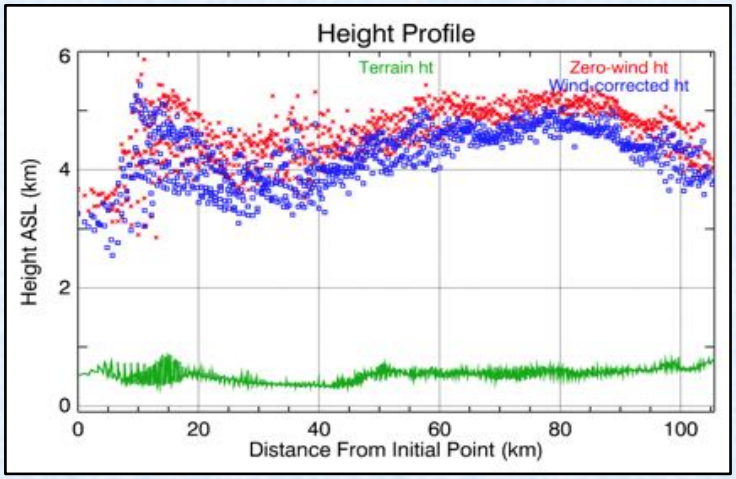
Arrows are wind direction vectors near selected points

Line or Polygon - 2

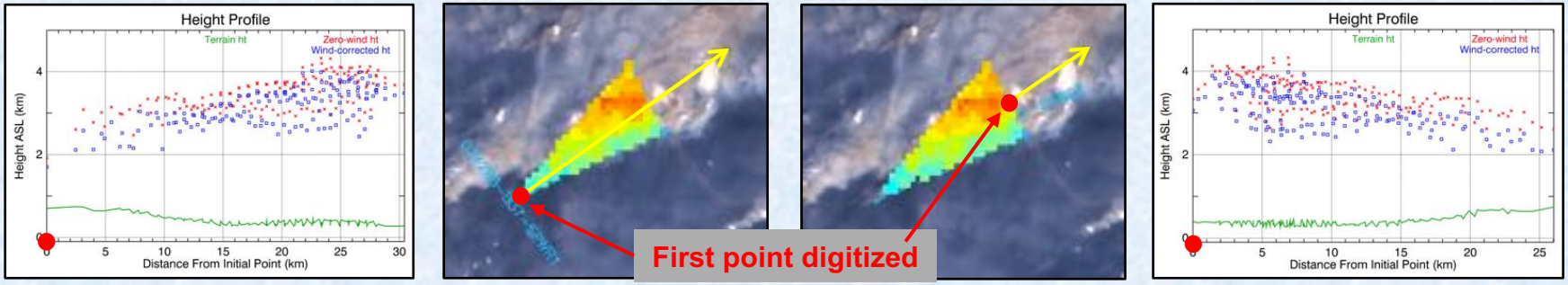
Height profiles for Alaskan plume on orbit 24298



Terrain and aerosol heights retrieved along a <u>line</u> are single-valued and show fine detail



Terrain and aerosol heights retrieved inside a broad <u>polygon</u> have a spread in height values



Plumes digitized starting from opposite ends but with the same wind vector
The same heights are retrieved, but height profiles are reversed

Effect of Image Matcher Size

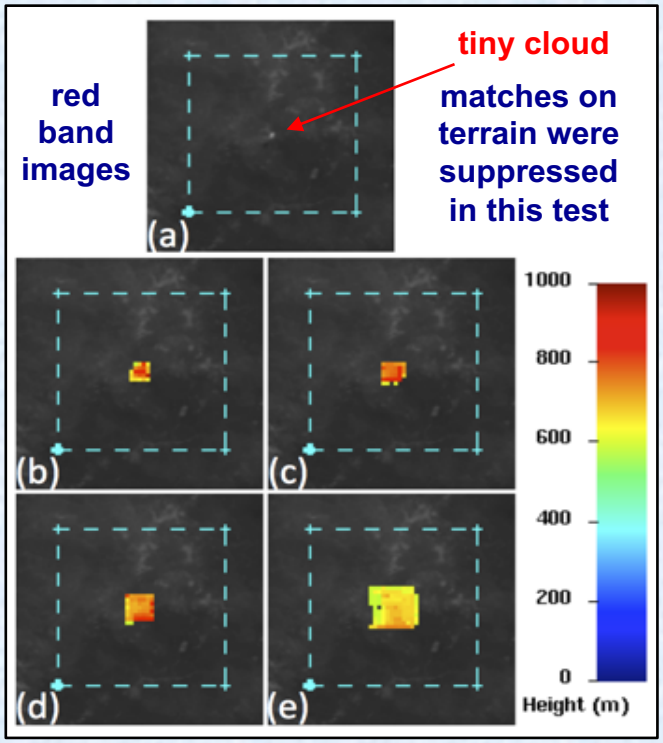
Image matching smears small Features:

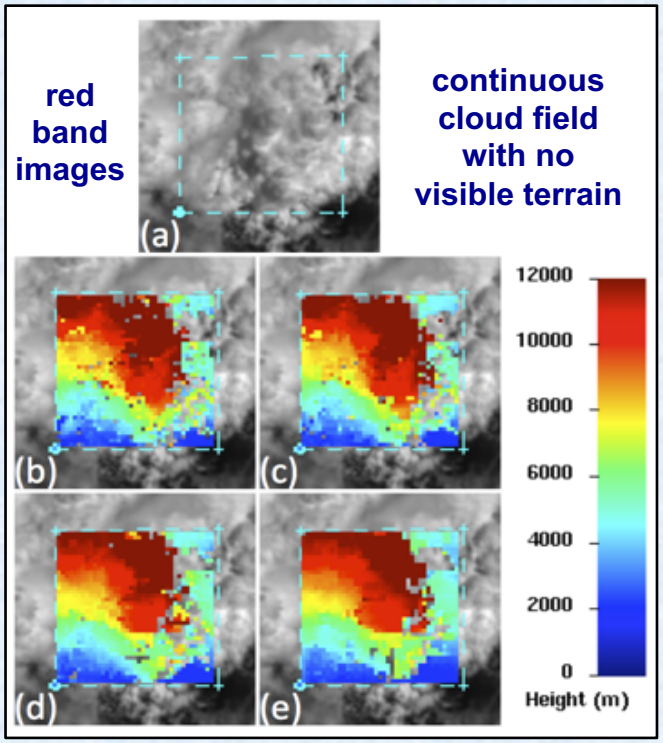
- "Point-source" cloud at image center
- Height of point feature is smeared over an area ≅ image matcher patch size

Image matching smooths Textures:

- Cloud overcast fills image
- Retrieved heights are smoothed more the larger the image matcher patch size

Zero-wind heights for two scenes were retrieved using 4 different image matcher sizes
Retrievals were done within the dashed cyan boxes using 550 meter sample spacing

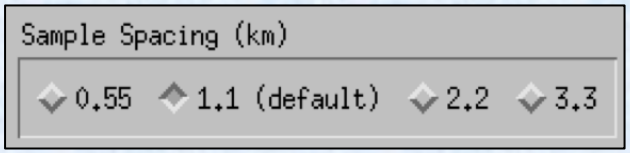




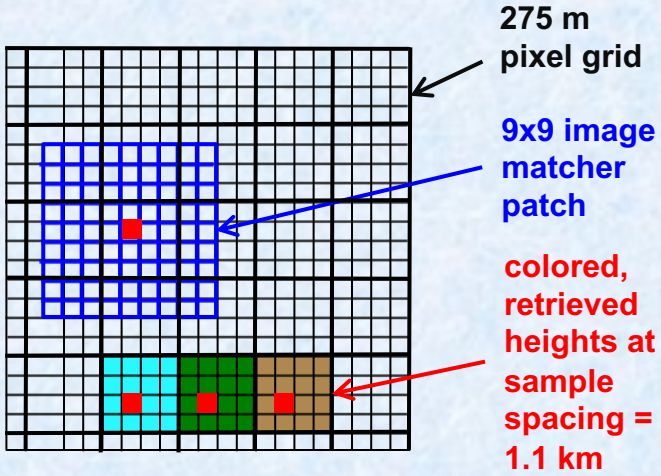
An camera image matcher sizes (N x 275 m pixels): (b) Small = 7, (c) Medium = 9 (d) Large = 13, Extra large = 23

Sample Spacing - 1

- Spacing of samples (where height/wind retrievals are performed) applies to both across and along dimensions within a digitized polygon or along the digitized line if the "Retrieve along line" option was chosen

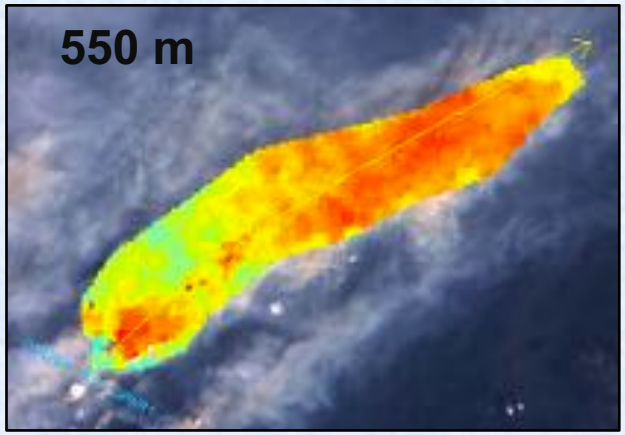


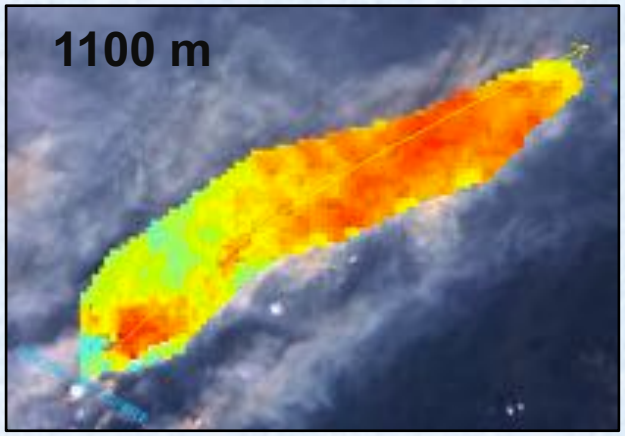
- For each doubling of sample spacing in the case of polygons, the number of points sampled decreases by 4 as does retrieval time
- Retrievals are based on 275 m pixels - MINX pixel spacing options are 2 pixels (0.55 km), 4 pixels (1.1 km), 8 pixels (2.2 km) and 12 pixels (3.3 km)
- Default spacing for retrievals with wind-correction (plumes) is 1.1 km – for retrievals without wind-correction (clouds), it is 2.2 km
- Retrieved values are displayed on the animation image as colored squares the size of sample spacing – don't confuse this with the size of the patches used in image matching
- Image matching patches are from 7 to ~13+ pixels on a side, so each height sample shares contributions to retrieved height with adjacent samples



Sample Spacing - 2

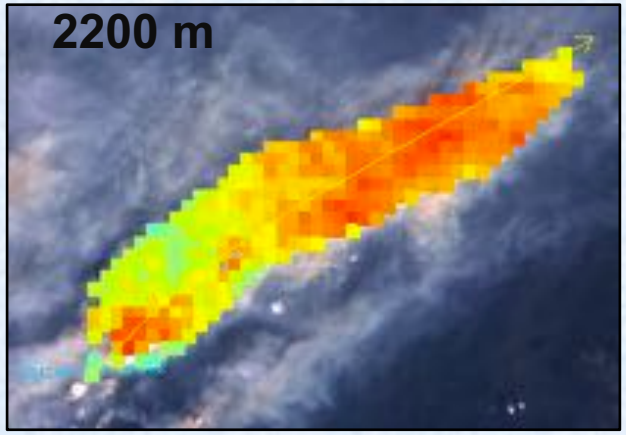
Examples of height retrievals using 4 different sample spacing options
Image matcher patch size is 9x9 pixels or almost 2.5 km in all cases

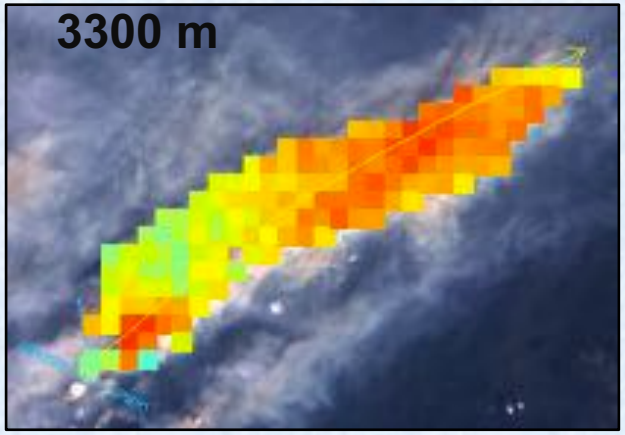




Alaska smoke plume – orbit 24298

115 km





Digitizing Procedure Overview

(refer to the "DigitizingInstructions.pdf" document for details)

1) **Load Level 1 radiance images:**
   a. **If no land is present in a scene, use GRP_ELLIPSOID (GRP_TERRAIN will be empty).**
   b. **In all other cases, use GRP_TERRAIN. Using GRP_ELLIPSOID images over land will produce invalid results, more so the greater the terrain elevation.**
2) **Load MODIS fire pixels if available.**
3) **Adjust image color properties if needed.**
4) **Assess and correct camera co-registration errors.**
5) **For each feature (plume or cloud or geometric region) in the scene:**
   a. **Carefully study feature geometry and context during camera animation to understand the scene and to determine:**
      - **Outline of feature to digitize.**
      - **Wind direction to digitize.**
      - **Retrieval parameters to use.**
   b. **Digitize feature:**
      - **Select retrieval parameters to use from "Digitizing Options" dialog box.**
      - **Digitize outline and wind direction.**
      - **Select AGP, biomes and GP_GMP product files to load when prompted (required only once in orbit).**
      - **Select other MISR product files when prompted (optional – provide only once in orbit).**
   c. **Evaluate digitizing results:**
      - **Study height/wind plots and map color overlays.**
      - **Delete digitized feature if not satisfactory.**
      - **Redigitize with new parameters if necessary.**

Digitizing Procedure - 1

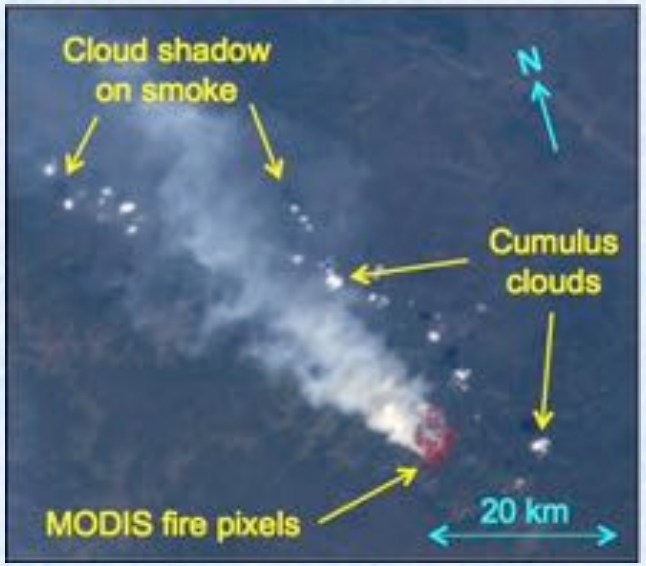


Figure 1

Figure 2

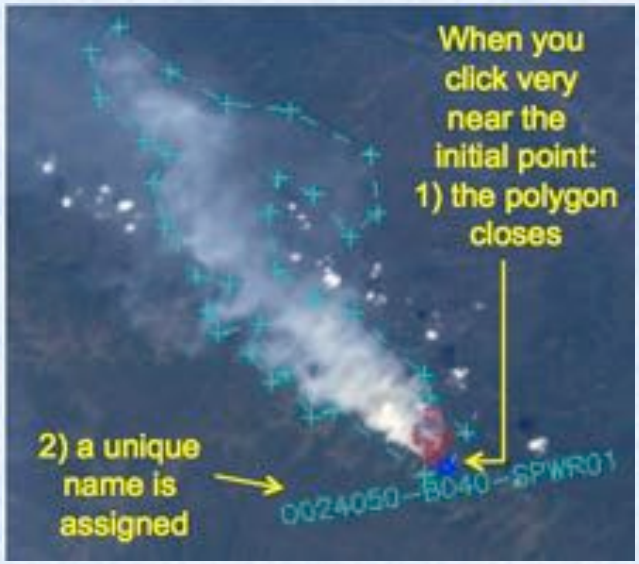
1) **Figure 1 shows a large smoke plume from a shrublands/forest fire in the Yukon Territory, Canada on 25 June 2004, imaged by MISR's nadir (An) camera. The smoke is being blown toward the NNW from a fire whose radiative power (FRP) is 1636 MWatt. There are small cumulus clouds drifting over the smoke.**

2) **To begin digitizing, click the <u>left</u> mouse button slightly *behind* (upwind of) the source of the plume (Figure 2). This point should be selected carefully, making sure you will be able to encircle the aerosol plume as well as all the MODIS fire pixels, if present, that you believe are associated with this plume. The total FRP for these fire pixels will be computed by MINX and reported in the output text file generated after the height retrieval process has finished. A large aqua dot will mark the location of the first point (aqua is the color that represents smoke - each aerosol type has its own color).**

Digitizing Procedure - 2

Figure 3

Figure 4



3) As you click the <u>left</u> mouse button on more points along the boundary of the plume, colored plus symbols (+) will appear with dashed lines connecting them to previous points (Figure 3). Define the plume boundary with only as many points as are needed to adequately capture the region of smoke for which you wish to retrieve heights. Notice that the cumulus clouds have been carefully avoided; very small bright features can seriously contaminate height retrievals.

4) As you finish digitizing the plume and prepare to close the polygon, click the <u>left</u> mouse button as close as possible to the first point. If you are within a few pixels, the line will automatically close, and the polygon you have created will be assigned a unique name that will be posted near the first digitized point (Figure 4). This name consists of the orbit number, the block number that the first digitized point falls in and a sequential plume number within *that block*.

5) If you haven't closed the polygon for a plume and are not satisfied with your digitizing, you can cancel work in progress by clicking the <u>right</u> mouse button anywhere on the MINX image. This will erase the digitized points from the screen and internal storage, and you can start over.

Digitizing Procedure - 3

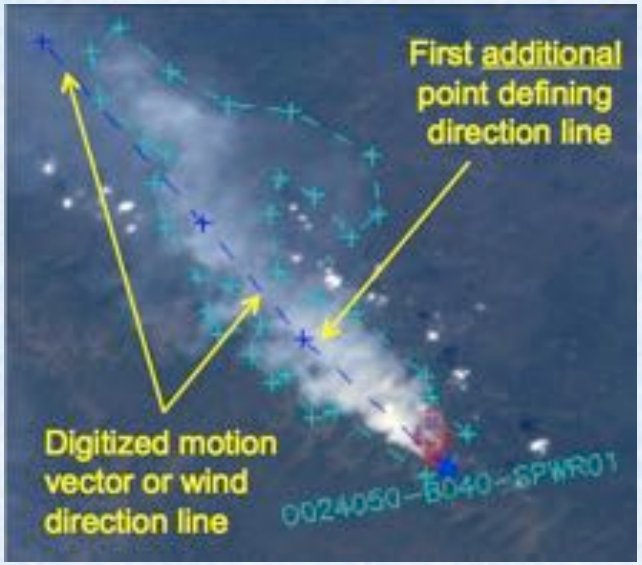


Figure 5

After you have left-clicked to close the polygon, you are ready to specify the direction in which the smoke particles of the plume are currently moving. The "first/last" point digitized is automatically assigned to become the first point in a direction line that you complete by continuing to digitize with the left mouse button (Figure 5). If the direction of motion is reasonably linear, you can define the direction with only one additional point, but you can digitize as many points as you wish. A direction line with more than two points will automatically be fit with a spline.

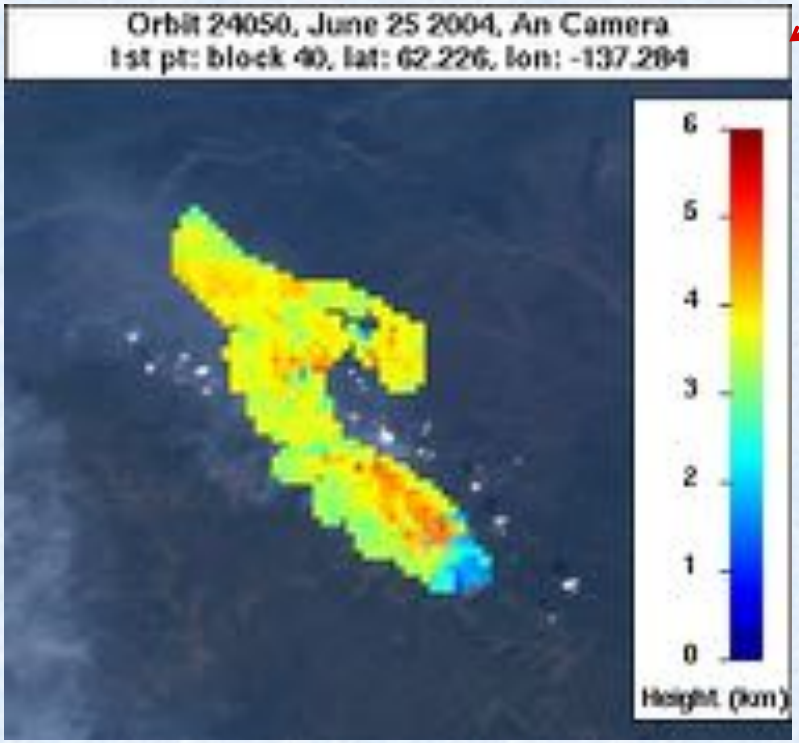
6) If you believe that the plume is affected by windshear, bend the direction line in the direction you think the winds were blowing *at the time the image was acquired*, not the direction the winds were blowing when the smoke was emitted. The direction line does not have to be confined to the plume polygon and should extend past the end of the plume so it can be clearly seen on the captured images.

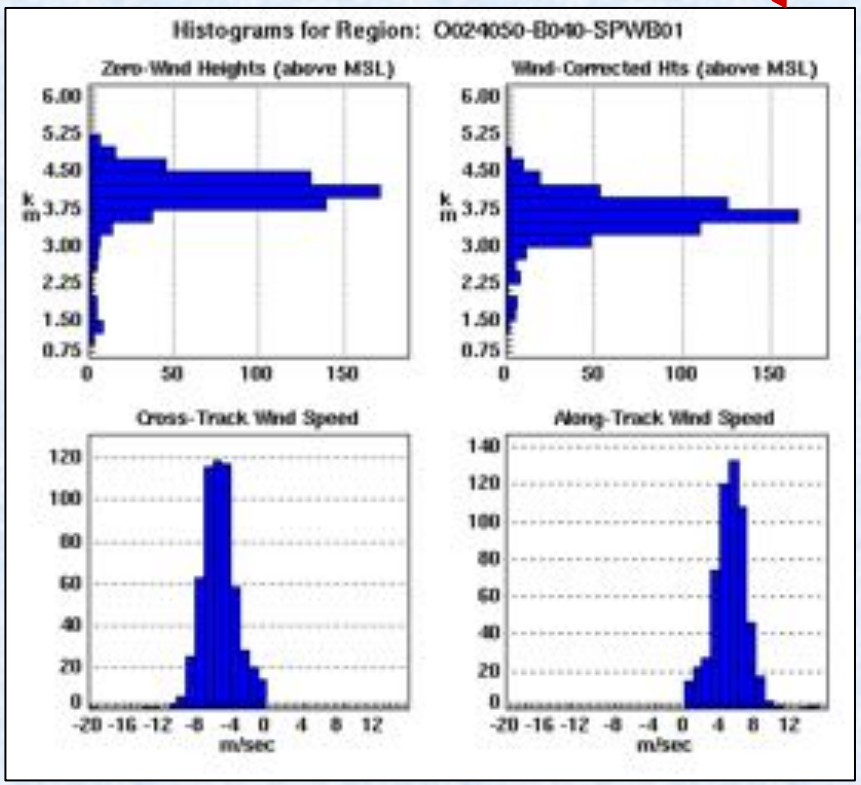
7) The plume direction of motion is computed and stored by MINX at many points on the direction line. When plume heights and winds are later computed at grid points in the interior of the polygon, the direction used in the height calculation for the grid point being evaluated is taken from the point on the direction line nearest to it. Therefore, rapid changes in wind direction within any sequence of three-points on the direction line should not be introduced – make the transition gradual over a few closely-spaced points if necessary.

Retrieval Results - Height / Wind Profile Plot

After the retrieval process has completed, MINX saves several images and a raw data file to disk. If you accessed the height retrieval tool from the MINX "Animate Cameras" option, you can find these files in your Working Directory. If you used the "Process Plume Project" option, the files will be in the directory pointed to by the third line in your PlumeProjOrbitList.txt file which in turn is in your current Project Directory. In either case, the files will be located in a subdirectory whose name is O<orbit>, where <orbit> is the orbit number of the currently loaded scene.

A color-coded image of plume heights is copied from the display on the animation window and embellished. A 4-paned histogram that summarizes retrieved height and wind information is also generated.





The color palette for coded heights and the color scale can be changed beginning in MINX 4.0.

Retrieval Results - Height / Wind Profile Plot

MINX estimates best values for maximum and median plume height above sea level.

Some aerosol height variation and most terrain height variation is because MINX displays multiple data points at the same distance from the origin of the profile.

Distance = 0 on profiles corresponds to the first point digitized, so profiles may appear reversed from map view.

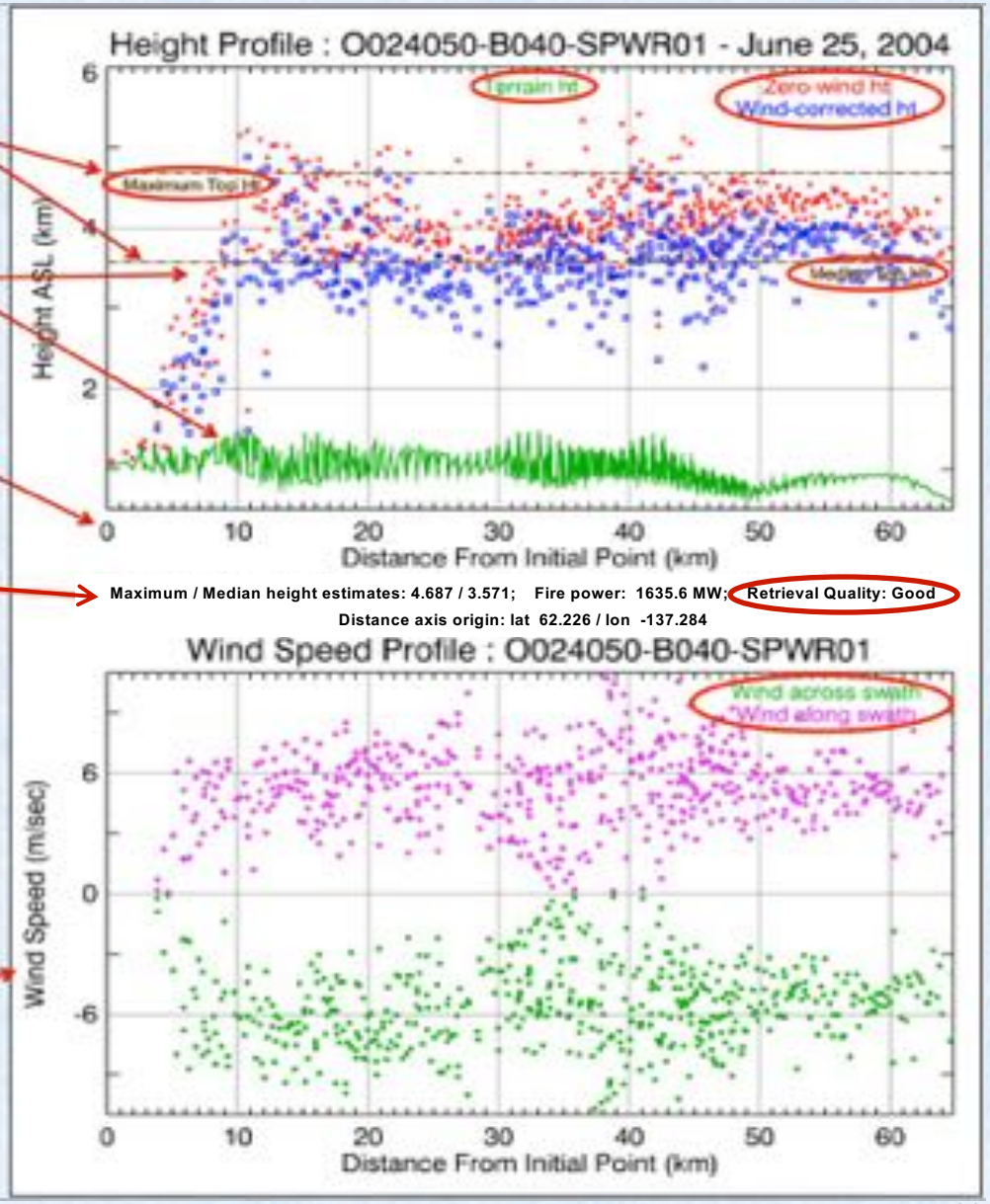
Several values relevant to reviewing plumes are printed between the profiles. Retrieval Quality is especially important.

If "Use no wind direction" was selected in the "Digitizing Options" dialog, then Wind-corrected height and both Wind Speeds will not be populated.

Total wind speed is :

$\sqrt{(wind_across^2 + wind_along^2)}$

Wind speed along-track is positive toward the top of the swath. Wind speed across-track is positive toward the right.



Retrieval Results - Raw Data File

```
Orbit number    : 24050
Path number     : 61
Block number    : 40
Date acquired   : 2004-06-25
UTC time        : 20:41:10
MINX version    : V4.0
User name       : dlnelson
Date digitized  : 2015-03-06

Region name                : 0024050-B040-SPWR01
Region aerosol type        : Smoke
Region geometry type       : Polygon
Region wind dir type       : Direction provided
Retrieved with band        : Both - Red
Retrieved with matcher     : Medium
Retrieved with cameras     : A B C
Retrieval precision        : Relaxed
Min ht > terrain (km)      :  0.250
Max ht > sealevel (km)     :  6.000
Sample spacing (km)        :  1.100
Registration corrected     : Yes
Image color equalized      : No

First point longitude      :  -137.332
First point latitude       :    62.255
Geographic region          :  NorthAmerica
Biome IGBP name, class     :  Open shrublands, 7
Red/blue band better?      :
Perimeter length (km)      :   135
Area (sq km)               :   518
Area per point (sq km)     :     1.210
Num. heights retrieved     :   381
Percent area covered       :    89
Fire elev. (m > MSL)       :  1059
Median ht (m > fire)       :  2508
Max ht (m > fire)          :  3807
Ht std. deviation (m)      :   547
Ht local variation (m)     :   122
|WndDir-AlongDir|(deg)     :    43
Total fire power (MW)      :  1636
Retrieval quality est.     :  Fair
Plume has pyro-cumulus     :  No
Comments by digitizer      :  None
```

Header section 1: general ID

Header section 2: height retrieval parameters

Header section 3: height retrieval summary

Red bars (—) indicate new or modified entries in the MINX V4.0 raw data file.

```
Level 1 radiance file   : MISR_AM1_GRP_TERRAIN_GM_P061_O024050_AN_F03_0024.hdf
Terrain elevation file  : MISR_AM1_AGP_P061_F01_24.hdf
Cam/Sun Geometry file   : MISR_AM1_GP_GMP_P061_O024050_F03_0013.hdf
SVM Classifiers file    : Not Loaded
Aerosol product file    : MISR_AM1_AS_AEROSOL_P061_O024050_F12_0022.hdf
IGBP biome grid file    : MODIS_MCD12C1_IGBP_BiomeGrid_2008.dat

POLYGON:   18 points in this table define the digitized bounding polygon if present.
```

Pt#	Long-itude	Lat-itude	Blk	Samp	Line
1	-137.283	62.228	40	939	423
2	-137.223	62.253	40	947	410
3	-137.391	62.412	40	899	357
4	-137.462	62.431	40	884	353
5	-137.542	62.482	40	864	337
6	-137.531	62.555	40	858	308
7	-137.542	62.647	40	846	273
8	-137.677	62.700	40	816	259
9	-137.798	62.692	40	795	268
10	-137.712	62.622	40	818	291
11	-137.759	62.600	40	812	302
12	-137.704	62.488	40	834	343
13	-137.601	62.421	40	860	364
14	-137.648	62.399	40	854	375
15	-137.525	62.319	40	885	400
16	-137.466	62.298	40	898	405
17	-137.315	62.219	40	934	428
18	-137.283	62.228	40	939	423

```
DIRECTION:   4 points in this table define the digitized direction line if present.
```

Pt#	Long-itude	Lat-itude	Blk	Samp	Line
1	-137.283	62.228	40	939	423
2	-137.614	62.464	40	853	348
3	-137.710	62.553	40	826	318
4	-137.885	62.790	40	769	234

Header section 4: data files loaded

Digitized polygon points table

Digitized direction line points table

Raw data Results table

RESULTS: 486 points in this table are samples where Windspeed heights or fire power were retrieved.

Pt#	Long-itude	Lat-itude	Blk	Samp	Line	Km to Pt 1	Dg Cw Rel N	Terr Elev	Feature Ht (m) Nomind	Feature Ht (m) W/Wnd	Feature Ht (m) Fltrd	Windspeed (m/s) Across	Windspeed (m/s) Along	Windspeed (m/s) Total	Optical Depth by Band Blue	Optical Depth by Band Green	Optical Depth by Band Red	Optical Depth by Band NIR	Single-Scattering Albedo Blue	Single-Scattering Albedo Green	Single-Scattering Albedo Red	Single-Scattering Albedo NIR	Tau Fraction by Particle Type Small	Tau Fraction by Particle Type Medium	Tau Fraction by Particle Type Large	Tau Fraction by Particle Type Spher	Ang Exp	Power MWatt
1	-137.283	62.228	40	939	423	0.0	325	1047	-9999	-9999	-9999	-99.9	-99.9	-99.9	-9.999	-9.999	-9.999	-9.999	-9.999	-9.999	-9.999	-9.999	-9.999	-9.999	-9.999	-9.999		-99
2	-137.782	62.682	40	799	271	56.0	342	858	4485	3991	3913	-5.7	7.7	9.6	0.353	0.361	0.368	0.366	0.956	0.986	0.997	0.998	0.122	0.363	0.516	0.400	-0.857	-99
3	-137.756	62.689	40	803	267	56.9	342	881	4588	3765	3811	-5.6	7.5	9.4	0.353	0.361	0.368	0.366	0.956	0.986	0.997	0.998	0.122	0.363	0.516	0.400	-0.857	-99
4	-137.761	62.680	40	803	271	56.1	342	845	4444	3730	3794	-6.0	8.0	10.0	0.353	0.361	0.368	0.366	0.956	0.986	0.997	0.998	0.122	0.363	0.516	0.400	-0.857	-99
5	-137.767	62.670	40	803	275	55.3	341	827	4476	3755	3804	-5.8	7.7	9.6	0.353	0.361	0.368	0.366	0.956	0.986	0.997	0.998	0.122	0.363	0.516	0.400	-0.857	-99
6	-137.729	62.696	40	807	263	57.0	342	916	4352	3864	3860	-6.1	5.5	6.9	0.353	0.361	0.368	0.366	0.956	0.986	0.997	0.998	0.122	0.363	0.516	0.400	-0.857	-99
7	-137.735	62.687	40	807	267	56.2	342	889	4453	3908	3889	-6.0	6.5	8.1	0.353	0.361	0.368	0.366	0.956	0.986	0.997	0.998	0.122	0.363	0.516	0.400	-0.857	-99
8	-137.741	62.677	40	807	271	55.4	342	845	4454	3909	3887	-5.8	6.7	8.3	0.353	0.361	0.368	0.366	0.956	0.986	0.997	0.998	0.122	0.363	0.516	0.400	-0.857	-99
9	-137.746	62.668	40	807	275	54.5	341	818	4382	3919	3875	-6.0	5.3	6.6	0.353	0.361	0.368	0.366	0.956	0.986	0.997	0.998	0.122	0.363	0.516	0.400	-0.857	-99
397	-137.292	62.250	40	935	415	2.5	325	977	1389	-9999	-9999	-99.9	-99.9	-99.9														
398	-137.297	62.240	40	935	419	1.6	325	1001	1407	-9999	-9999	-99.9	-99.9	-99.9														
399	-137.303	62.231	40	935	423	1.1	325	1078	1188	-9999	-9999	-99.9	-99.9	-99.9														
400	-137.254	62.275	40	939	403	5.5	325	992	2240	2070	1982	-2.6	1.0	3.2														
401	-137.260	62.266	40	939	407	4.4	325	1128	1675	-9999	-9999	-99.9	-99.9	-99.9														
402	-137.265	62.256	40	939	411	3.3	325	1195	1566	-9999	-9999	-99.9	-99.9	-99.9														
403	-137.271	62.247	40	939	415	2.2	325	1166	1419	1418	1518	-0.0	0.0	0.0														
404	-137.239	62.263	40	943	407	4.5	325	1199	1315	-9999	-9999	-99.9	-99.9	-99.9														
405	-137.245	62.254	40	943	411	3.5	325	1271	1299	-9999	-9999	-99.9	-99.9	-99.9														
486	-137.251	62.244	40	943	415	2.5	325	1273	1322	-9999	-9999	-99.9	-99.9	-99.9														

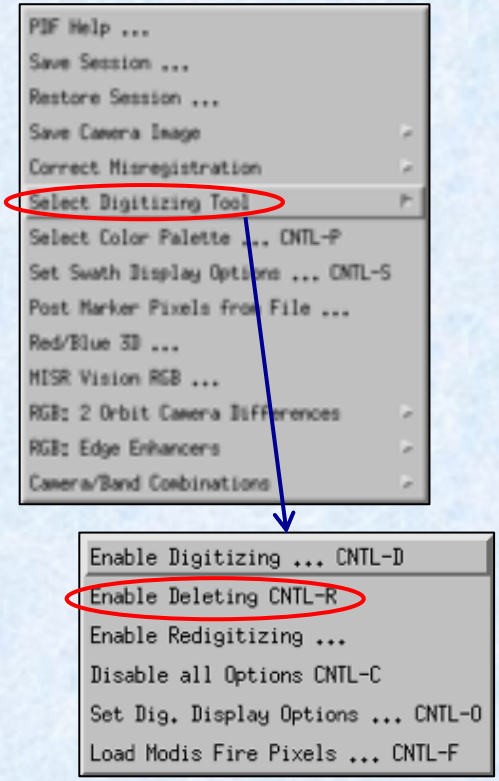
You can compute 'EW Windspeed' and 'NS Windspeed' at each point from the values of 'Windspeed Total' and 'Dg Cw Rel N' (wind direction clockwise from north) using these equations:

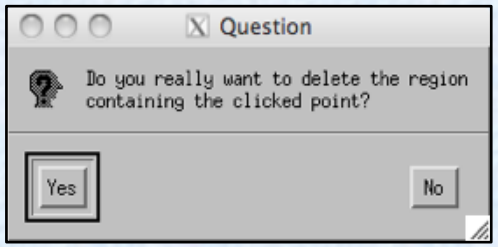
'EW Windspeed' = 'Windspeed Total' * cos(90-'Dg Cw Rel N') and

'NS Windspeed' = 'Windspeed Total' * sin(90-'Dg Cw Rel N').

Retrieval Results – Delete Plume

- To delete a region (plume, cloud or line):
  ① Select "Delete Objects" from "Select Digitizing Tool" submenu or use the keyboard accelerator, CNTL-R
  ② Left-click in or on any region
  ③ Click "Yes" in the dialog box to confirm the operation
  ④ You remain in "Delete" mode until you select a different menu option
- Deleting removes the image and text files from disk, from the animation window and from memory
- The deleted region name may be reused by the next region you digitize in the same block
- If several regions overlap and you click in their intersection, the earliest region digitized will be deleted
- MINX makes it possible to experiment: you may want to digitize, delete and redigitize a region numerous times to determine the best bounding polygon, wind direction and digitizing parameters





Digitized Region Naming Convention

O049787-B068-SPWB03 - typical region name in MINX V4.0

O049787 - MISR Orbit number

B068 - MISR Block number where initial point was digitized

SPNB - region identifiers assigned by MINX based on user's selections in Digitizing Options dialog box (see table below)

03 - unique region identifier incremented for each new region in each block

Key to Region Identifier Letters

Letter 1: region aerosol type	Letter 2: region geometry type	Letter 3: wind direction specified by user?	Letter 4: band used in height retrieval
D = Dust	L = Line	N = No wind provided ("cloud")	R = Red
S = Smoke	P = Polygon	W = Wind provided ("plume")	B = Blue
V = Volcanic ash			C = Red/Blue combination
W = Water			
J = Contrails			
O = other aerosol			

NOTE - In MINX V4.0 the plume naming convention changed so all orbit numbers have 6 digits, all block numbers have 3 digits and all region numbers have 2 digits.

A Selection of Papers & Presentations Referencing MINX Data

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MINX and MISR Documentation

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