

# **MINX Document 4**

## **MINX - Basic Features**



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Government sponsorship acknowledged.**

# Contents

- **Software overview**
- **Main menu**
  - **Show orbit location**
  - **Find overpasses**
  - **Show camera image**
  - **Compare data products**
  - **Animate cameras**

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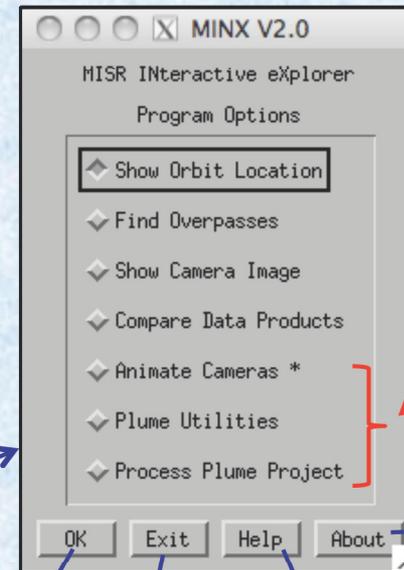
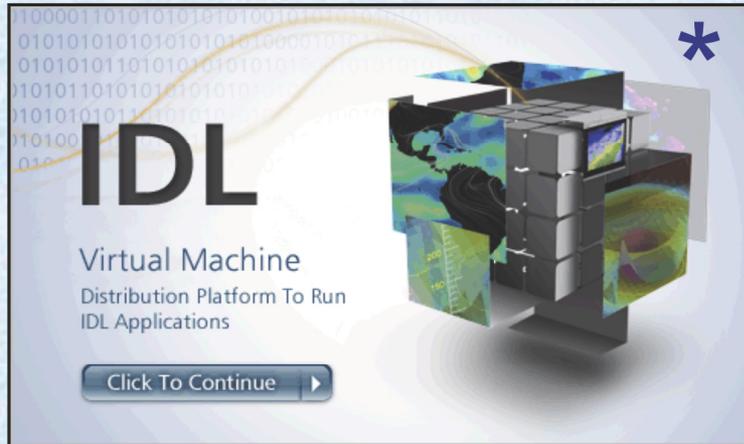
# MINX Software Overview

- Used to digitize > 12,000 smoke plumes for EPA/NASA project
- Interactive, **IDL visualization tool** with GUI interface
- Runs on **Mac OS X** and **MS Windows** (no Linux, no 64-bit version)
- Very memory and CPU intensive
- Downloadable from Open Channel Foundation website:  
<https://www.openchannelsoftware.com/projects/MINX>
- Distributed as IDL virtual machine (**VM**) application (from Exelis company)
- Won a NASA Space Act award in 2008
- Plume height project and software support:  
Stacey Boland, Eric Danielson, David Diner (MISR PI), Michael Garay, Jeff Hall, Earl Hansen (MISR project manager), Ralph Kahn, Cecelia Lawshe (Raytheon), Jason Matthews, Susan Paradise, Brian Rheingans, Charles Thompson, > 10 summer students

# Running MINX

(all MINX images captured on a Mac computer)

- On following slides, colored annotations mean:
  - **Blue** : user's action and the resulting behavior of MINX
  - **Red** : descriptions of dialog box and data window features
  - **\*** : starting point on slide



Plume height analysis

Display MINX copyright information

Proceed to selected option

Exit MINX

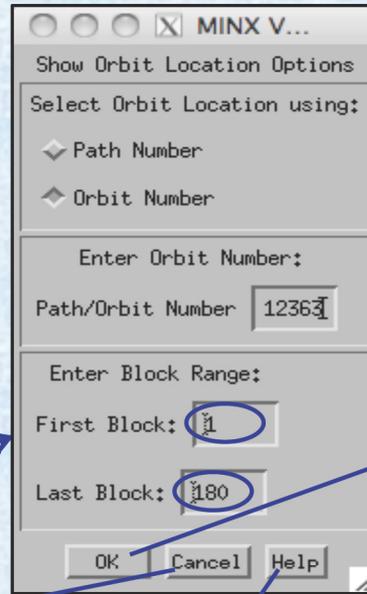
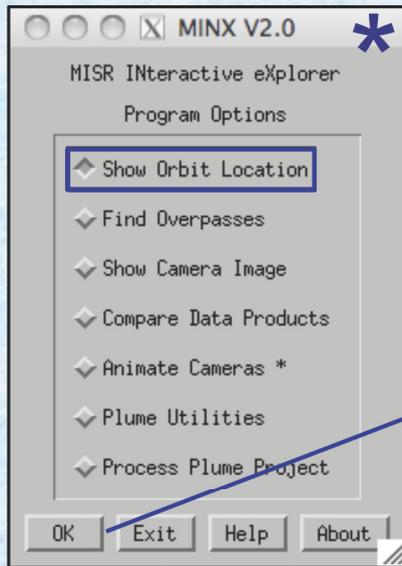
Display description of each item on main menu and indicates what version of IDL is running

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# Show Orbit Location - 1

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

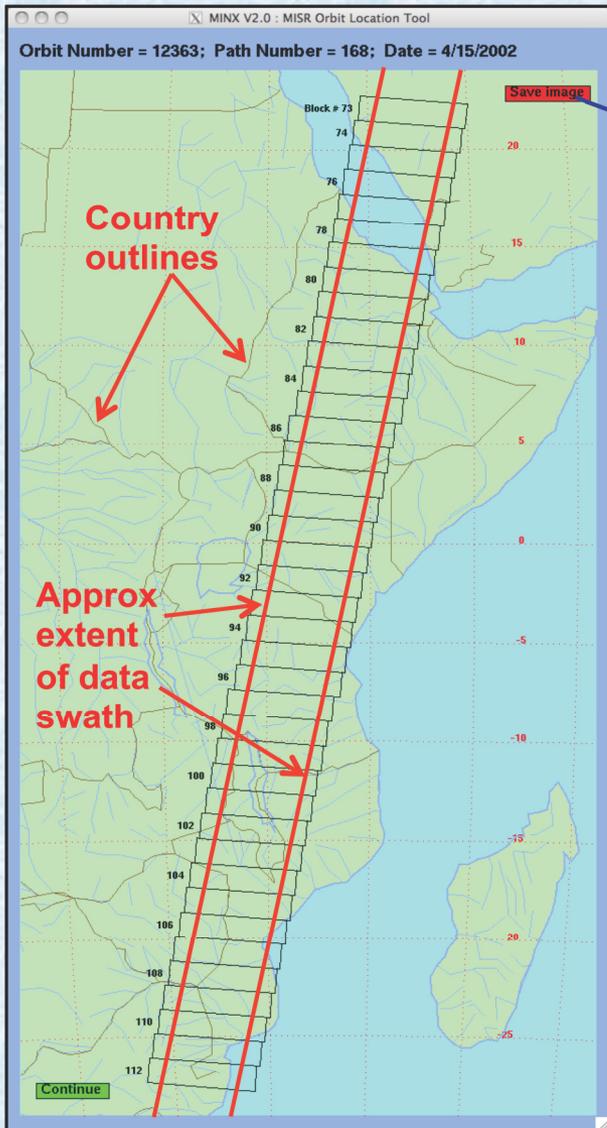


Display instructions



- A good way to find the Path Number and acquisition Date for any Orbit Number
- Clicking green “Continue” button OR right-clicking on map deletes the map and returns control to “Show Orbit Location Options” dialog

# Show Orbit Location - 2



Specify output TIFF filename

Directory: /Users/dlnelson/

Filter: \*.tif

Files: MINX\_024298\_An.tif, SolutionLines3D.tif, brf\_plot.tif, test\_orbit.tif

Directories: 055051, 056546, 057201, 058978, 061064

Selection: I

OK Filter

MINX V... \*

Show Orbit Location Options

Select Orbit Location using:

- Path Number
- Orbit Number

Enter Orbit Number:

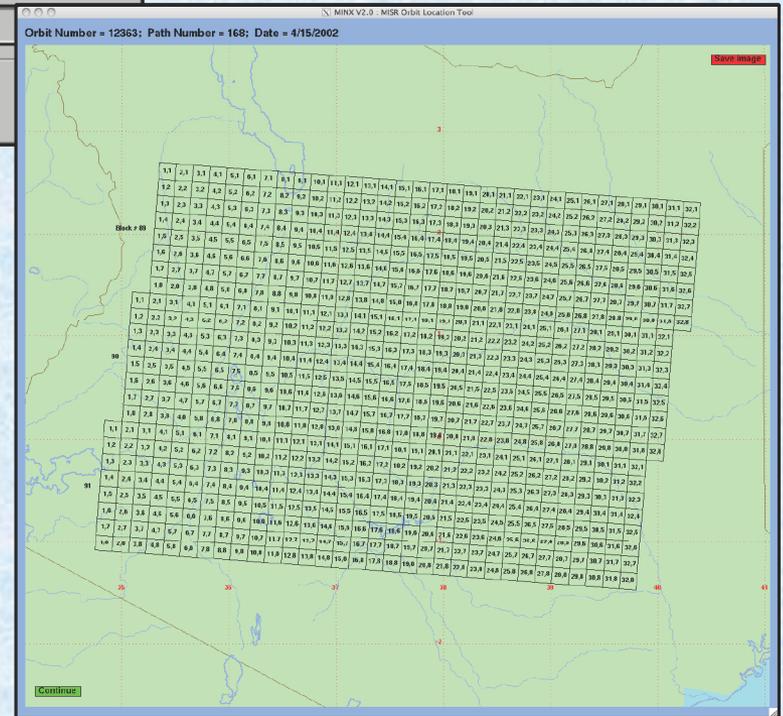
Path/Orbit Number: 12363

Enter Block Range:

First Block: 73

Last Block: 112

OK Cancel Help



- Specifying a block range zooms the image
- The MISR swath occupies about 75% of each block
- Requesting 3 or fewer blocks shows enlarged swath with 17.6 km regions indicated

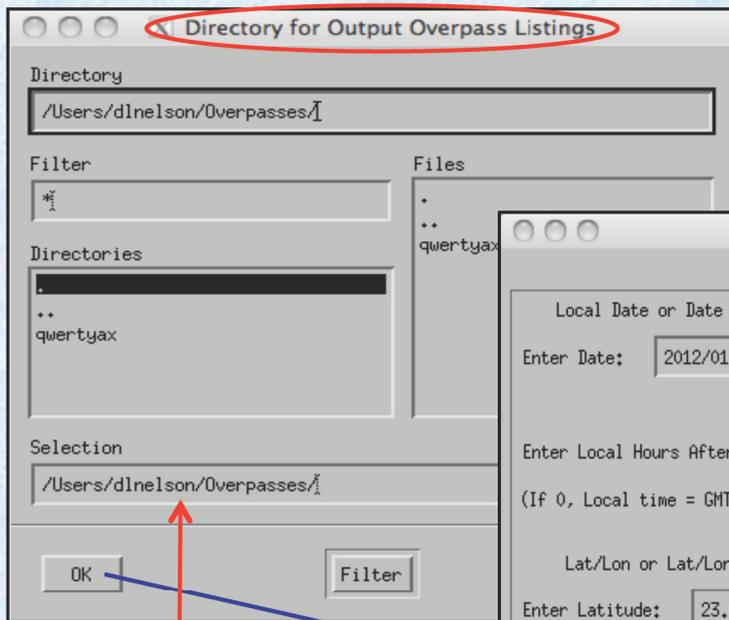
# Contents

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  - **Show orbit location**
  - **Find overpasses**
  - **Show camera image**
  - **Compare data products**
  - **Animate cameras**

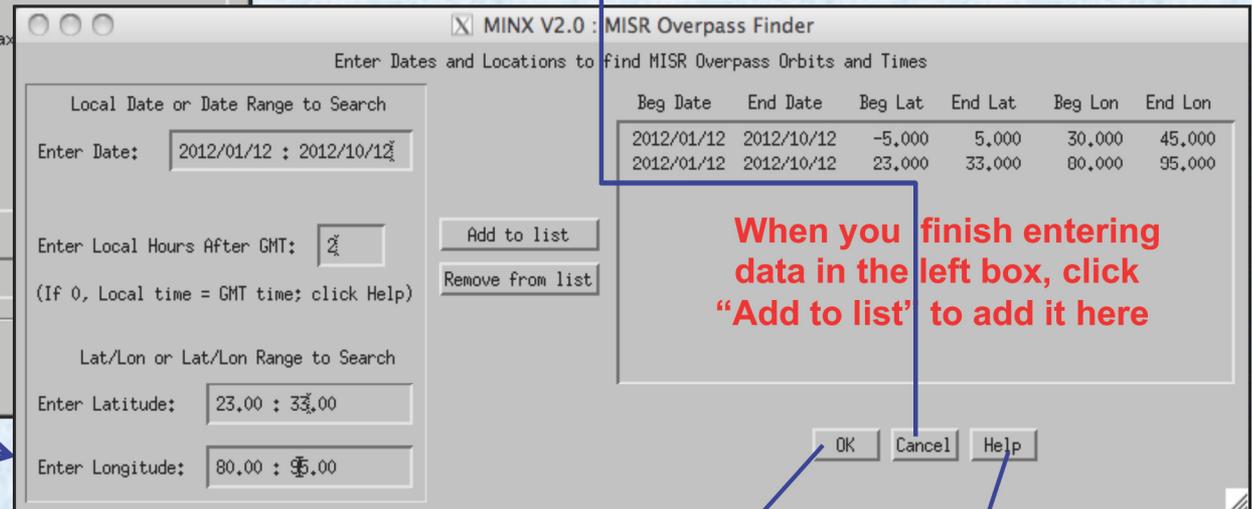
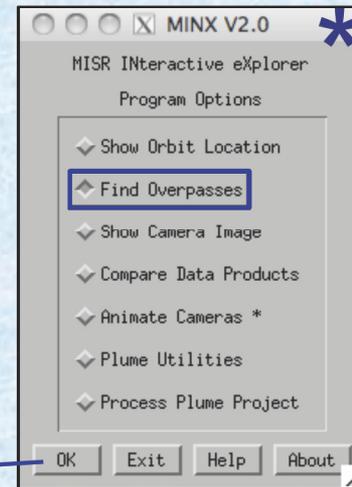
# Find Overpasses - 1

**Objective:** To produce a detailed 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 pass over a particular fire or dust event?” or “What MISR orbits imaged Nepal in February, 2012?”

- Instructions accessed via the “Help” buttons are extensive and useful
- Avoid using very large geographic or time ranges if you intend to create an image for each overpass



You must enter a directory name in “Selection” box



Proceed to next step

Display instructions



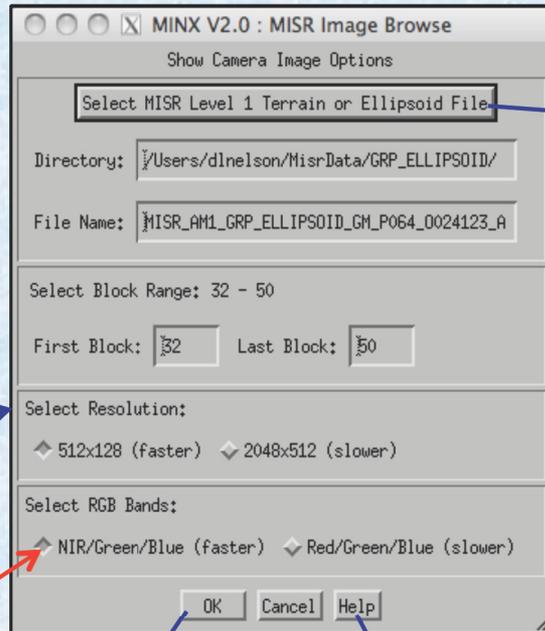
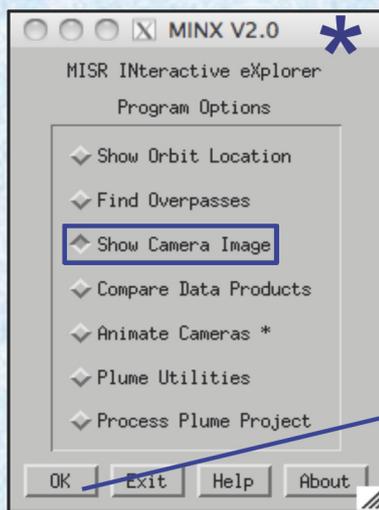
# Contents

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- **Main menu**
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  - **Find overpasses**
  - **Show camera image**
  - **Compare data products**
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# Show Camera Image - 1

**Objective:** To display a static, color image of all or part of a swath for a single MISR camera. Useful for rapidly browsing orbit imagery at higher resolution than the Browse Tool, but requires L1 data be available.

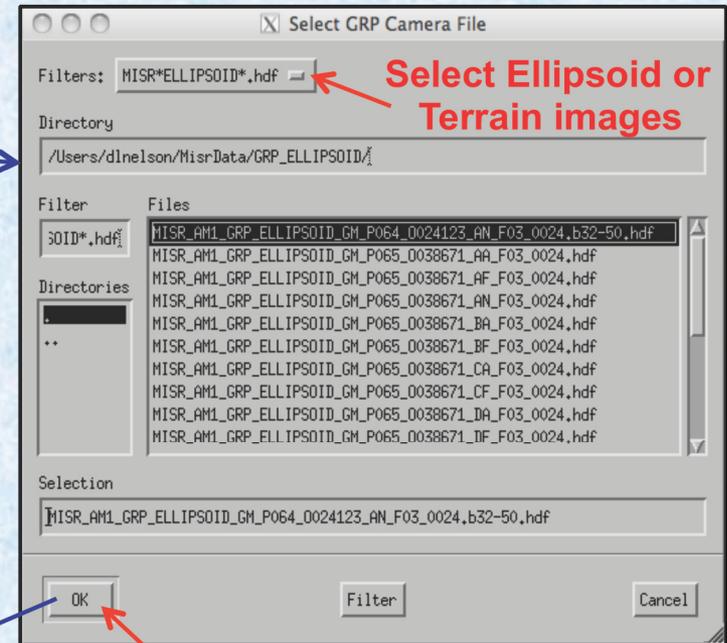
- 512x128 resolution (1100 m pixels) should allow displaying entire orbit for any camera - blocks are not assembled
- 2048x512 resolution (275 m pixels) may allow displaying as many as 30 blocks - blocks are assembled for continuous swath



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

**Proceed to next step**

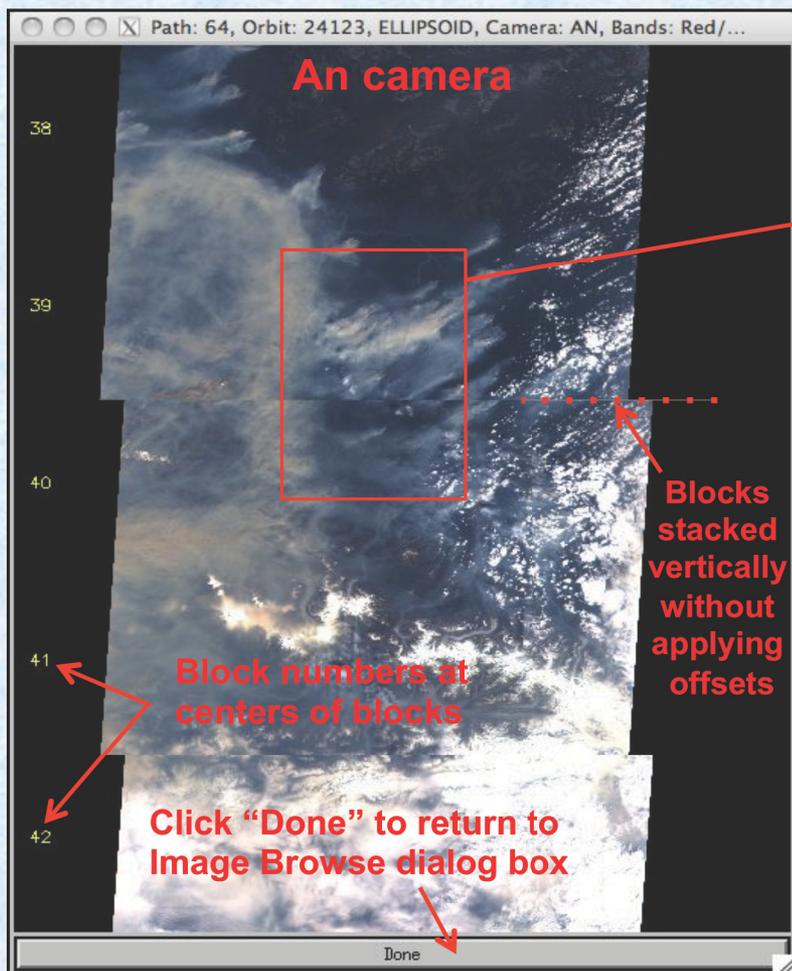
**Display instructions**



**Select Ellipsoid or Terrain images**

**Clicking "OK" removes the "Camera File" dialog and populates the "Image Browse" dialog with the camera file selection info**

# Show Camera Image - 2



- In An product file: RGB bands at **275 m**
- In image: RGB displayed at **1100 m**
- MISR blocks not assembled (offsets not applied)



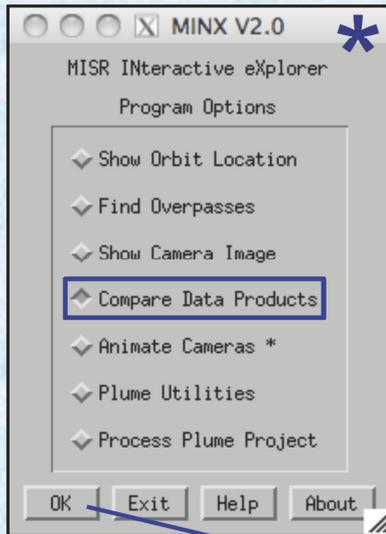
- In Af product file: Red band stored at **275 m**, Green and Blue at **1100 m**
- In image: RGB displayed at **275 m**
- MISR blocks assembled smoothly

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  - **Show camera image**
  - **Compare data products**
  - **Animate cameras**

# Compare Data Products - 1

**Objective:** To display side-by-side images of “any” combination of MISR data fields at the same 1100 m pixel scale and to synch the cursor in all images to retrieve corresponding pixel values. Useful for visually correlating variations between data fields, e.g. radiance, aerosol optical depth and cloud height.



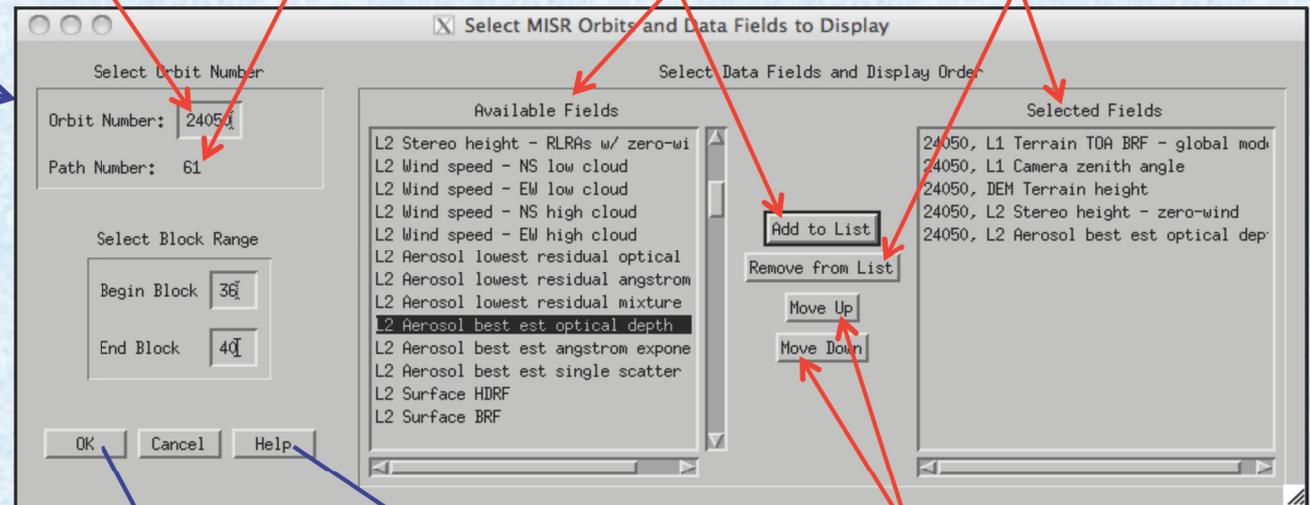
You must know your orbit number in advance

Path number is calculated immediately

Highlight a MISR data field in “Available Fields” scrollable list, then click “Add to List” to copy it to “Selected Fields” list

Highlight a data field in “Selected Fields” list, then click “Remove from List” to remove it

- Selecting many blocks will initiate scrolling in vertical direction - especially inconvenient
- Selecting many data fields will initiate horizontal scrolling
- If you change orbits, first delete all items in “Selected Fields” list



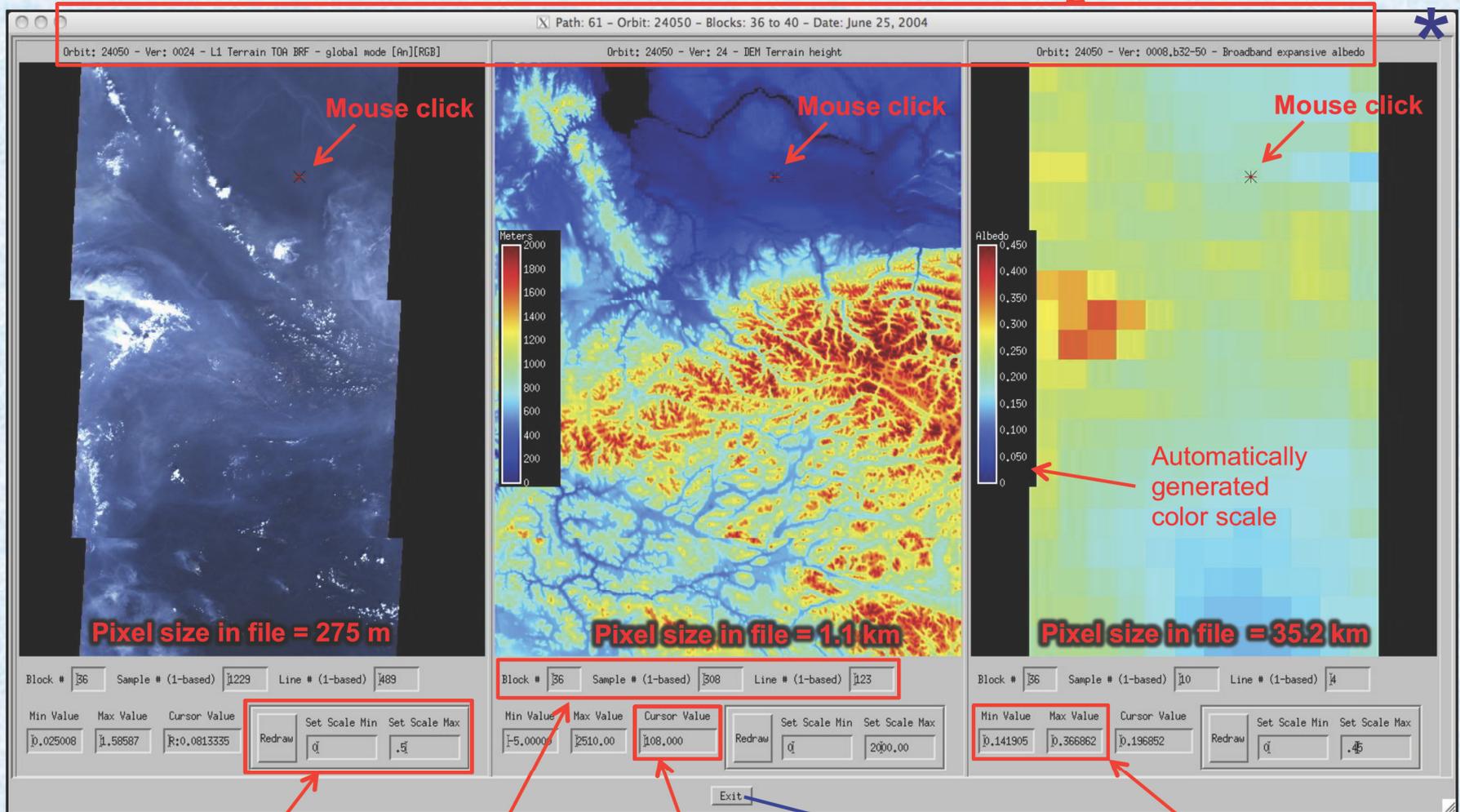
Proceed to next step: dialog boxes asking for camera, band, filename, ...

Display instructions

Highlighted field in “Selected Fields” list can be rearranged with the “Move Up” and “Move Down” buttons

# Compare Data Products - 2

Description of orbit and data fields including camera and band



Enter min and max values for color scaling, then click "Redraw"

"Mouse click" coords in pixel size correct for data field

Field's data value at "Mouse click" location

Return to "Select Data Fields" dialog

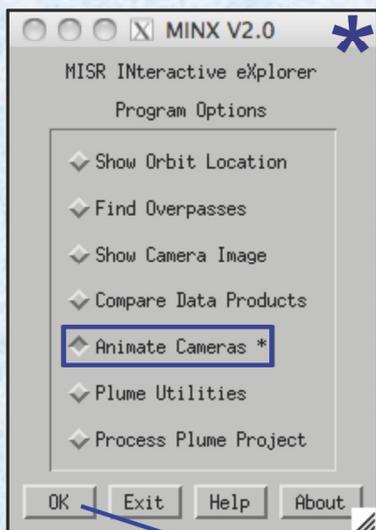
Min and max of values for all displayed data

# Contents

- **Software overview**
- **Main menu**
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  - **Find overpasses**
  - **Show camera image**
  - **Compare data products**
  - **Animate cameras**

# Animate Cameras - Select Data

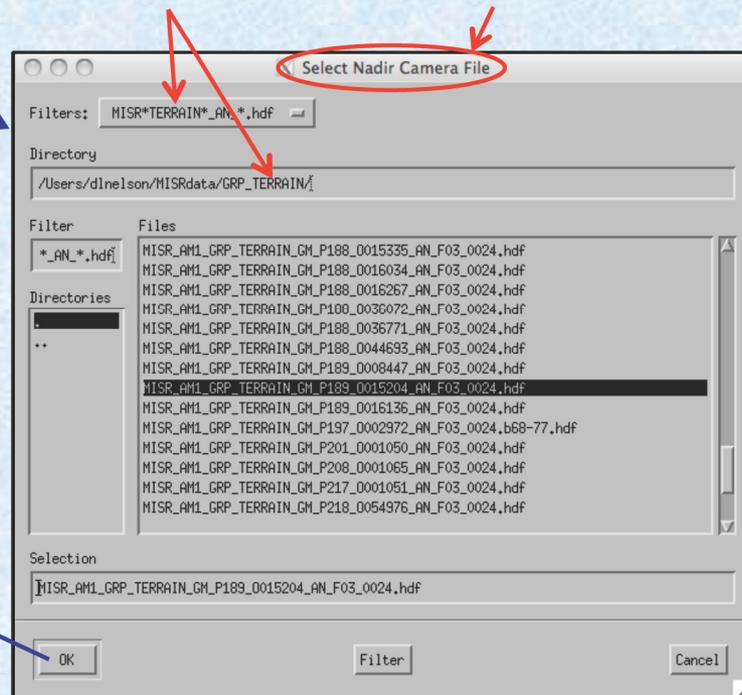
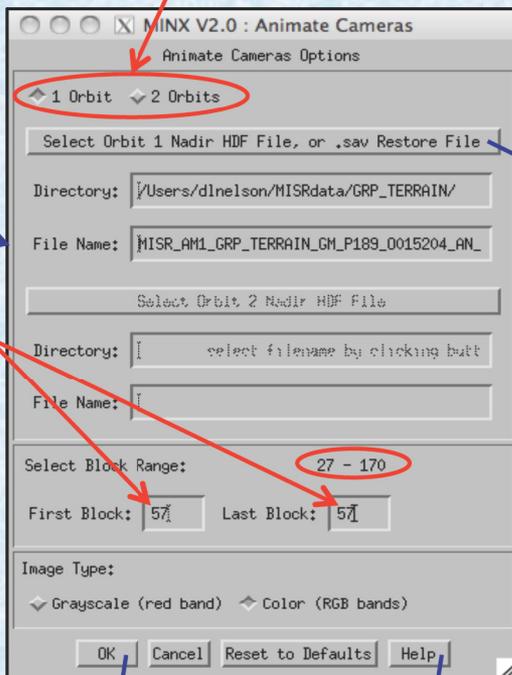
**Objective:** To display selected blocks of MISR radiance imagery at 275 m resolution in all channels; to view 9 cameras as an animation; and to perform analyses on data including determining aerosol heights.



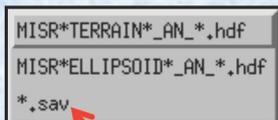
2 orbits from the same path can be loaded at once and compared

L1B2 data type selected in "Filters:" must match the file types found in directory pointed to by "Directory" edit box

Only An camera needs to be selected - other 8 cameras are found automatically if in same directory



Depending on your computer's resources, you may be able to load from 3 to 10 or more blocks of MISR data



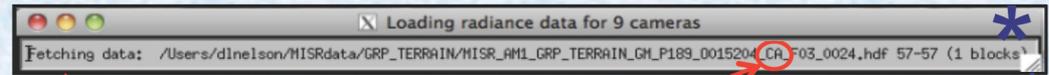
The "Filters" dropdown list provides one way to load a previously saved MINX session

Proceed to next step

Display instructions

# Animate Cameras – Load Data

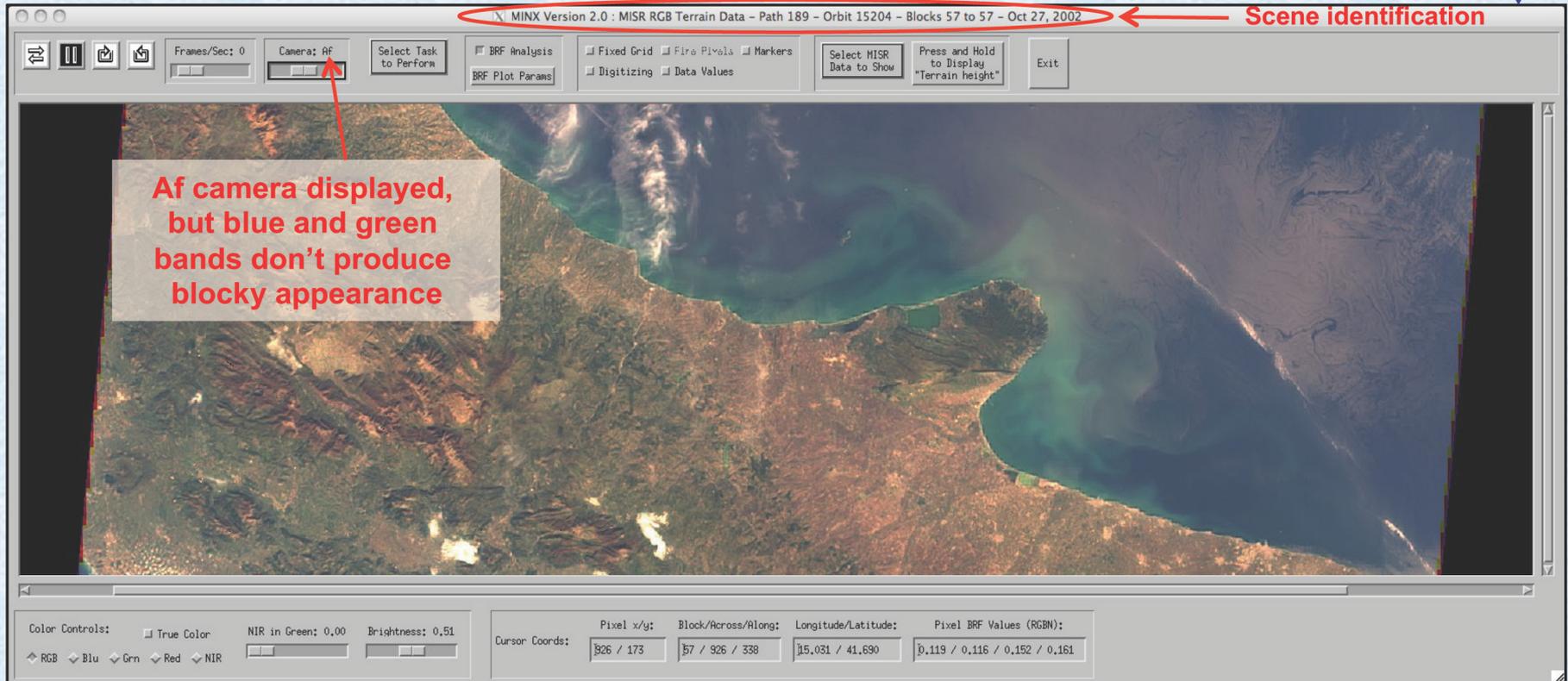
- MISR radiance data are converted to TOA BRFs before data are displayed
- MISR's 9 camera images occupy the same virtual screen space and rapidly alternate in an animation sequence



Progress box appears at top left of screen as cameras load

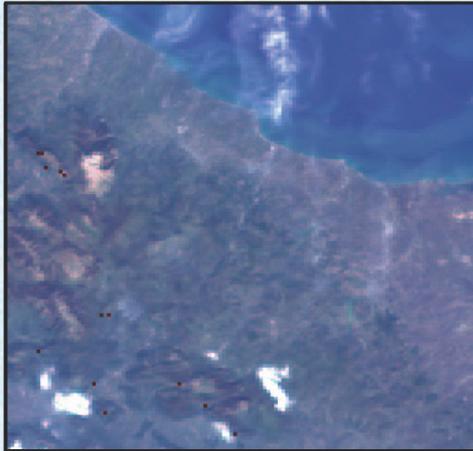
Camera name changes as each camera file is loaded in turn

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



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

# Animate Cameras – Enhance Resolution



RGB image from Af camera with **native resolution** in each band



RGB image from Af camera with **resolution enhanced**

- In enhanced green band pixels:
  - The mean pixel value remains unchanged at 48
  - Individual pixel values are in the same ratio to each other as are the pixels in the red band
- The more similar the ratios of red and green BRFs actually are at 275 m resolution, the more successful the enhancement

48	32
64	80

Af camera, **green** band :  
4 - 1100 x 1100 m. pixels

+

56	56	54	58				
58	60	64	64				
66	66	74	66				
64	68	72	78				

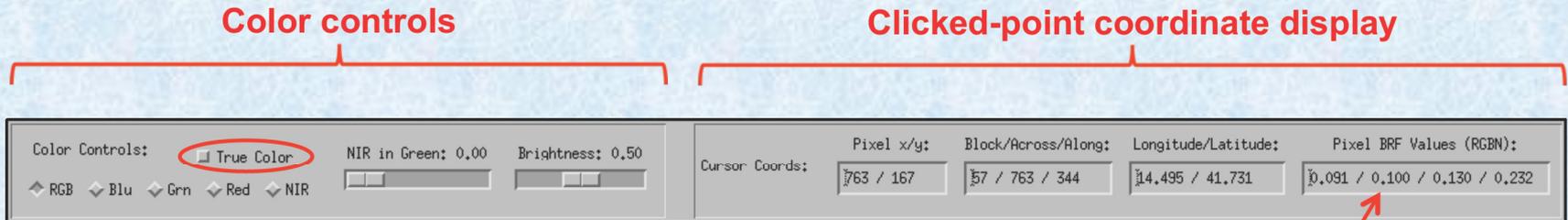
Af camera, **red** band :  
64 - 275 x 275 m. pixels

=

42	42	41	44				
45	45	47	47				
49	49	57	49				
47	51	53	60				

Af camera, **green** band :  
64 - 275 x 275 m. pixels

# Animate Cameras - Lower task bar

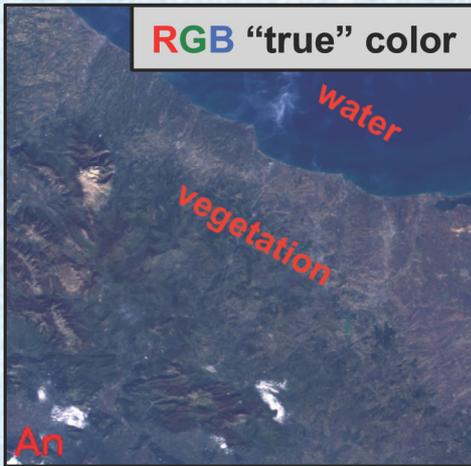


Besides the default RGB display, any band can be displayed alone in gray scale

BRF values are shown for 4 bands

- “True color” OFF maps data to a unique color scale for the 4 bands of each camera
- “True color” ON maps radiance (BRF) data to a single color scale for all 36 channels
- The “NIR in Green” slider allows NIR band data to be added to green so dense, dark forest scenes appear brighter
- When “True Color” is selected, sliders change to “Min BRF” and “Max BRF” for brightness control
- “Pixel x/y:” uses a single coordinate system for entire animation window based on 275 m pixels with origin [0,0] at the lower left corner of 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 upper left corner of each block

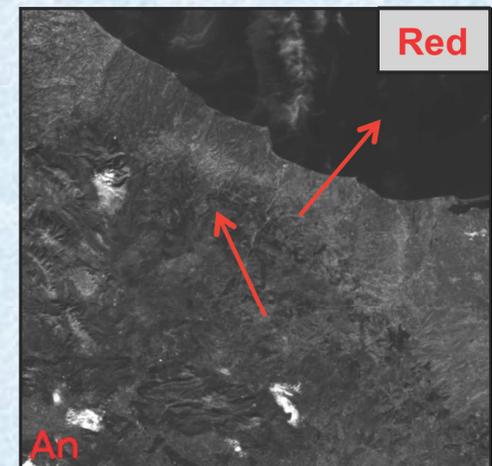
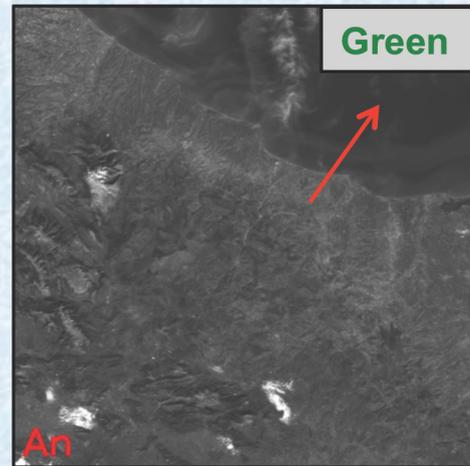
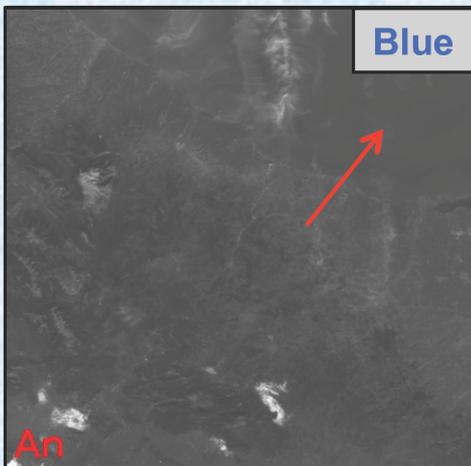
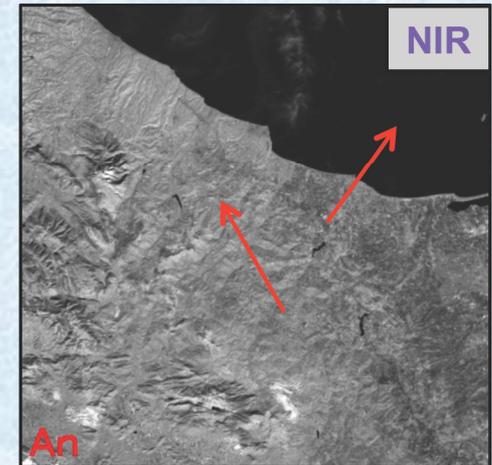
# Animate Cameras – Display Single Bands



Color Controls:  True Color

◇ RGB ◇ Blu ◇ Grn ◇ Red ◇ NIR

- 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



# Animate Cameras - Upper task bar

**Animation controls**

- Back-and-forth
- Stop
- Df→Da
- Df←Da
- Manual camera control

**Analysis menu**

- Select Task to Perform

**Graph BRF by channel**

- BRF Analysis
- BRF Plot Params

**Toggle symbol data (values persist)**

- Fixed Grid
- Fire Pixels
- Markers
- Digitizing
- Data Values

**Toggle gridded data (values don't persist)**

- Select MISR Data to Show
- Press and Hold to Display "Terrain height"

**Exit**

- Exit

**Callouts:**

- ④: Save this Camera as TIFF, Save this Camera as JPEG, Save this Camera as GIF, Save this Camera as PNG, Save Camera images in 9 TIFF files, Save Camera images in 9 JPEG files, Save 9 Camera images in 1 MPEG file
- ①: Enables BRF Plot Params button and displays analysis window on mouse click
- ②: BRF Plot Parameters window (Select Band to Display: Blue, Green, Red, NIR; Plot BRFs for center pixel, Plot mean BRFs for square region, Show table of geometry and radiances; Scale BRFs to max for the pixel, Scale BRFs to specific value; Save BRF plot as Color PostScript file, Save BRF plot as B/W PostScript file, Save BRF plot as JPEG file, Save BRF plot as TIFF file, Save 9 zoomed, red-band BRF images as MPEG)
- ③: Terrain height window (Aerosol optical depth, Aerosol SS albedo, Aerosol ang exp, SVM smoke mask, SVM dust mask, SVM cloud mask, SVM land mask, Sun zenith ang, Sun azimuth ang, Camera zenith angle, Camera azimuth angle, Camera scatter angle, Camera glitter angle)
- Camera zenith angle: Zen: Df camera, Zen: Cf camera, Zen: Bf camera, Zen: Af camera, Zen: An camera, Zen: Aa camera, Zen: Ba camera, Zen: Ca camera, Zen: Da camera

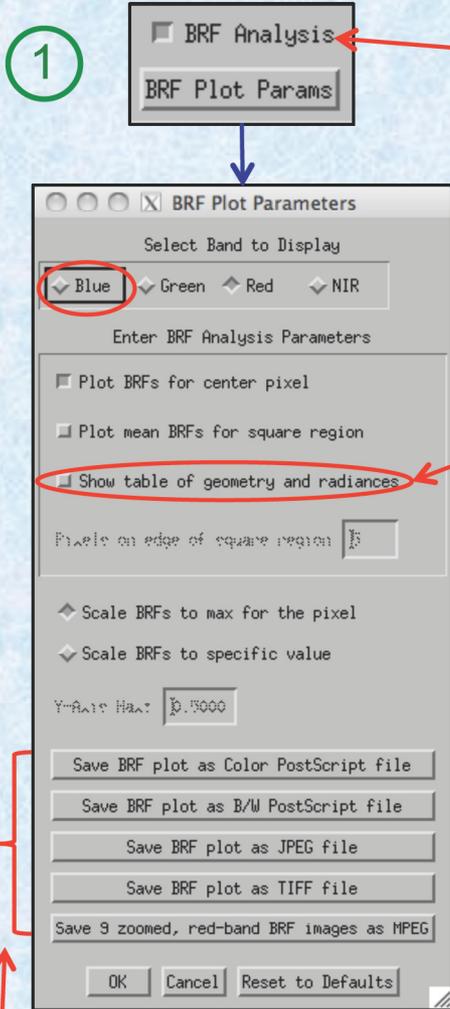
**Other windows:**

- Select Digitized Region Display Options: Region display options (Data type: Disparity along, Minimum value: -90,0000, Maximum value: 90,0000, Data units: Pixels, Camera to show: Df, Cf, Bf, Af, Aa, Ba, Ca, Da), Color key options (Display location: Do not show color key, Draw color key in separate window, Draw color key on camera image), "Pixel x/y:" coord of top right corner (X coordinate: 400, Y coordinate: 300), Background color (White, Black, Gray, Transp)

# Animate Cameras

## BRF Analysis

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



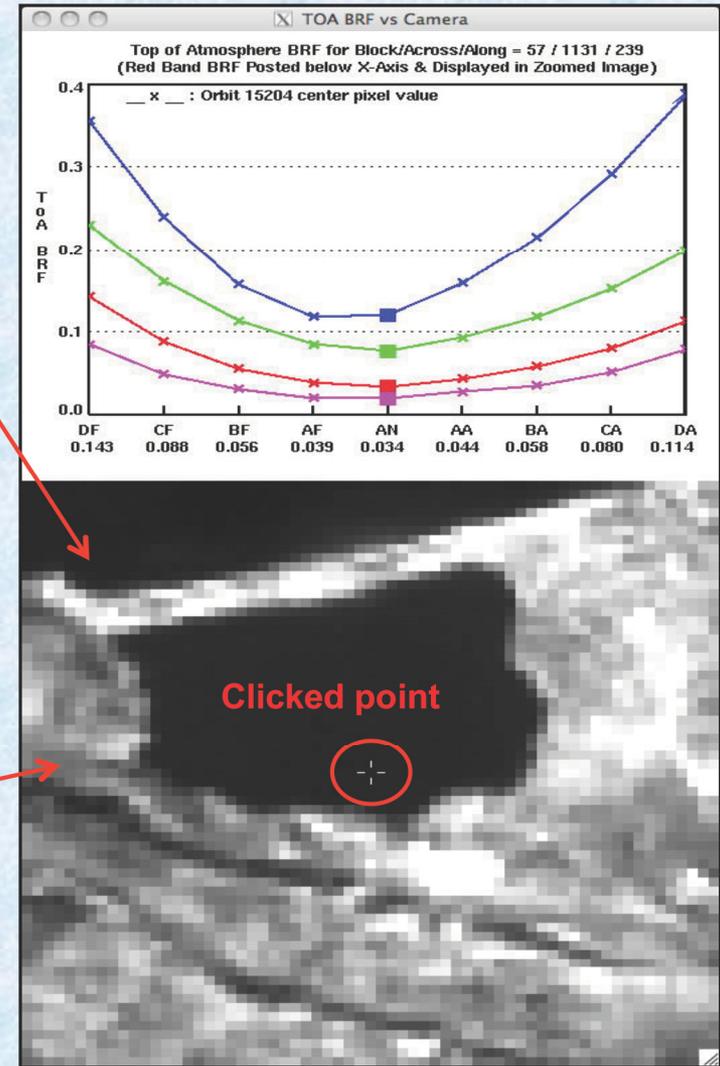
When BRF Analysis button is checked and user clicks in animation window, graph and zoomed image are updated

Zoomed image is scaled to data ranges in zoom window allowing subtle features to be seen

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



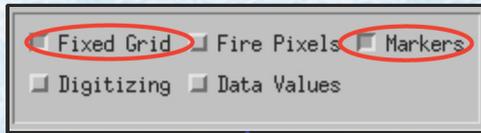
Scene showing 64x64 pixel square centered on point clicked by user



8x zoomed image of white square in selected band

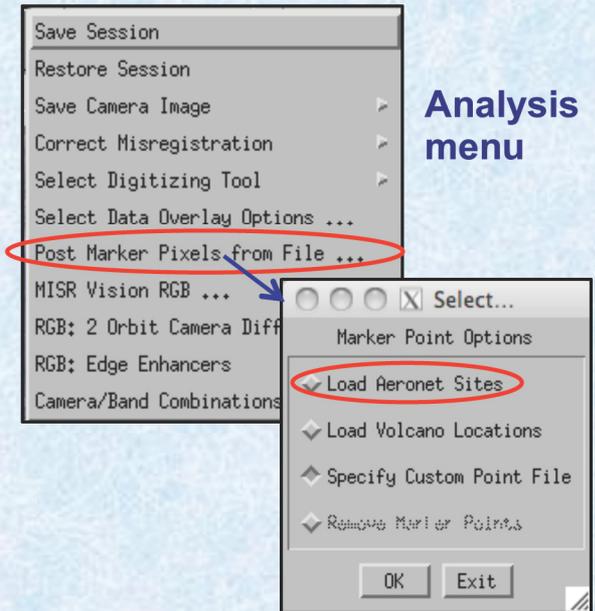
Image of graph and zoomed window can be saved to file

# Animate Cameras – Toggle Symbol Data - 1



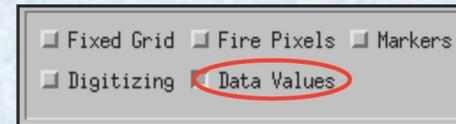
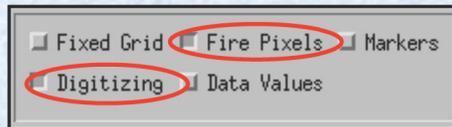
2

Portion of animation window showing “Fixed Grid” and “Markers” symbols for fire scene SE of Los Angeles in 2007

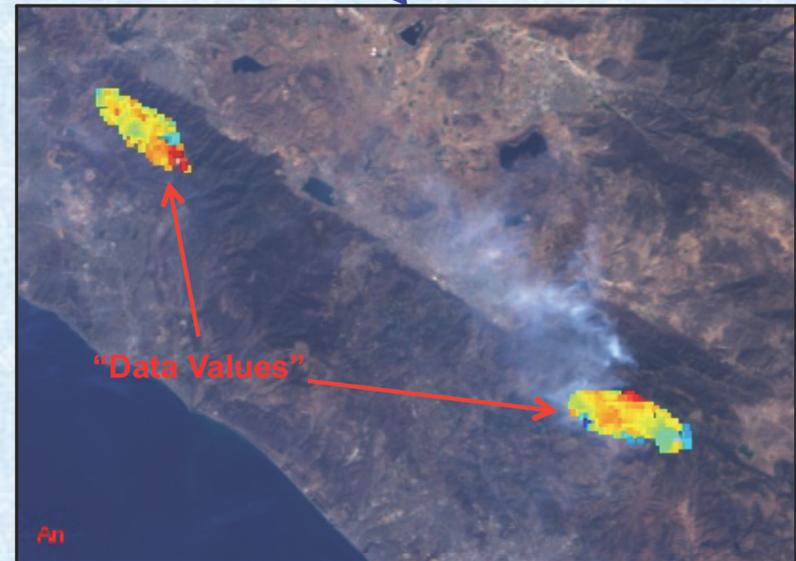


- Symbols remain on screen until toggled off – they persist
- “Fixed grid” points are computed on the fly & are useful for judging relative motion during animation
- “Markers” are read from files and include 3 options: 794 Aeronet sites or 1543 volcanos or a user-defined list of points

# Animate Cameras – Toggle Symbol Data - 2



“Fire Pixels” and “Digitizing” symbols for Los Angeles fires



“Data Values” symbols for Los Angeles fires

- Prepare MODIS “Fire Pixels” for display from “Plume Utilities” option on Main Program dialog
- “Digitizing” symbols created by user include outline of polygon, direction arrow and plume name
- “Data Values” are posted after retrieval of heights inside polygon digitized by user
- Different “Data Values” and other options can be selected in a dialog box activated by clicking the “Select Data Overlay Options...” choice on the Analysis menu

# Animate Cameras – Toggle Gridded Data

Dropdown list box

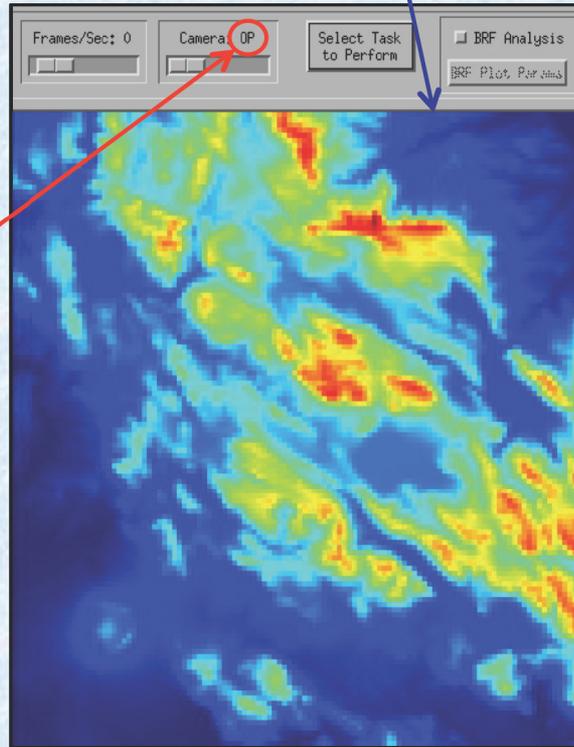
- Terrain height
- Aerosol optical depth >
- Aerosol SS albedo >
- Aerosol ang exp
- SVM smoke mask
- SVM dust mask
- SVM cloud mask
- SVM land mask
- Sun zenith ang
- Sun azimuth ang
- Camera zenith angle >
- Camera azimuth angle >
- Camera scatter angle >
- Camera glitter angle >

- Gridded data refers to data types that are pixelated and cover much of the area of the animation window
- Gridded data are shown in an “extra”, zero<sup>th</sup> 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 BRF data can be made

Select MISR Data to Show    Press and Hold to Display "Terrain height"

③

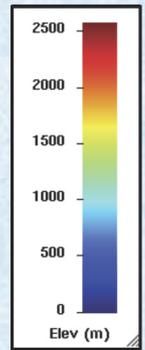
Toggle button for displaying data - text changes to reflect the data type selected in dropdown list



Portion of animation window displayed while “Press and Hold...” button is pressed

## When “Press and Hold” is pressed:

- The user is asked to select the file containing chosen MISR gridded data if it’s not already loaded
- Data are copied into the OP window
- The view switches to the OP window
- A color bar is displayed in a separate window or updated if not already present and current

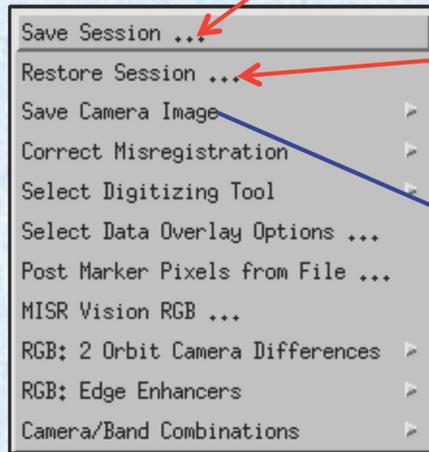


## When “Press and Hold” is released:

- The view switches back to the original window
- Data remain in the OP window and are manually accessible
- The color bar window remains until another operation is selected

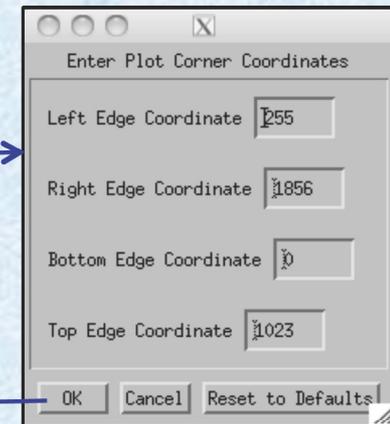
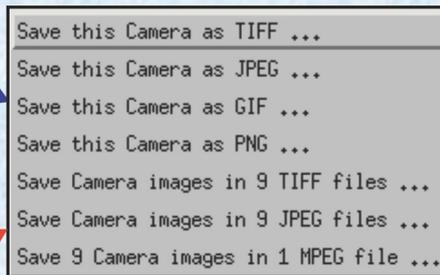
# Animate Cameras – Analysis Menu - 1 4

Prompts for a file name into which a complete MINX animation session (images, digitizing, markers, etc.) is saved - Saved session files must have an extension of .sav



Prompts for a file from which a complete MINX animation session is restored – current session is replaced

Restoring a session can also be accomplished in “Select Nadir Camera File” dialog during initial orbit load by selecting “.sav” in the “Filters” dropdown list



Select 1 of 7 image formats into which selected region of the image window is to be saved (MPEG requires IDL license)

Dashed outline of region is drawn on image - user is given an opportunity to change region before being asked for file name to which image will be saved

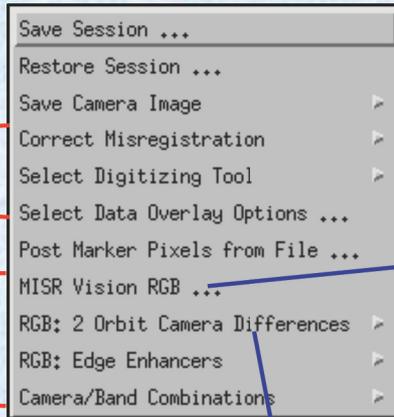


- Specify coordinates of the edges of region in animation window to be saved to file
- Find coordinates by clicking in window and reading values from the “Pixel x/y:” cursor coord box at bottom of animation window

# Animate Cameras – Analysis Menu - 2

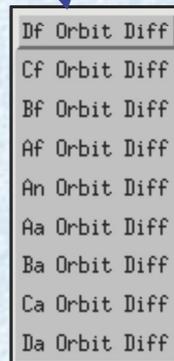
Defer until discussion on digitizing

These create new images in OP window



• Creates new camera image in the OP window whose RGB values are any combination of the data in MISR's 36 channels

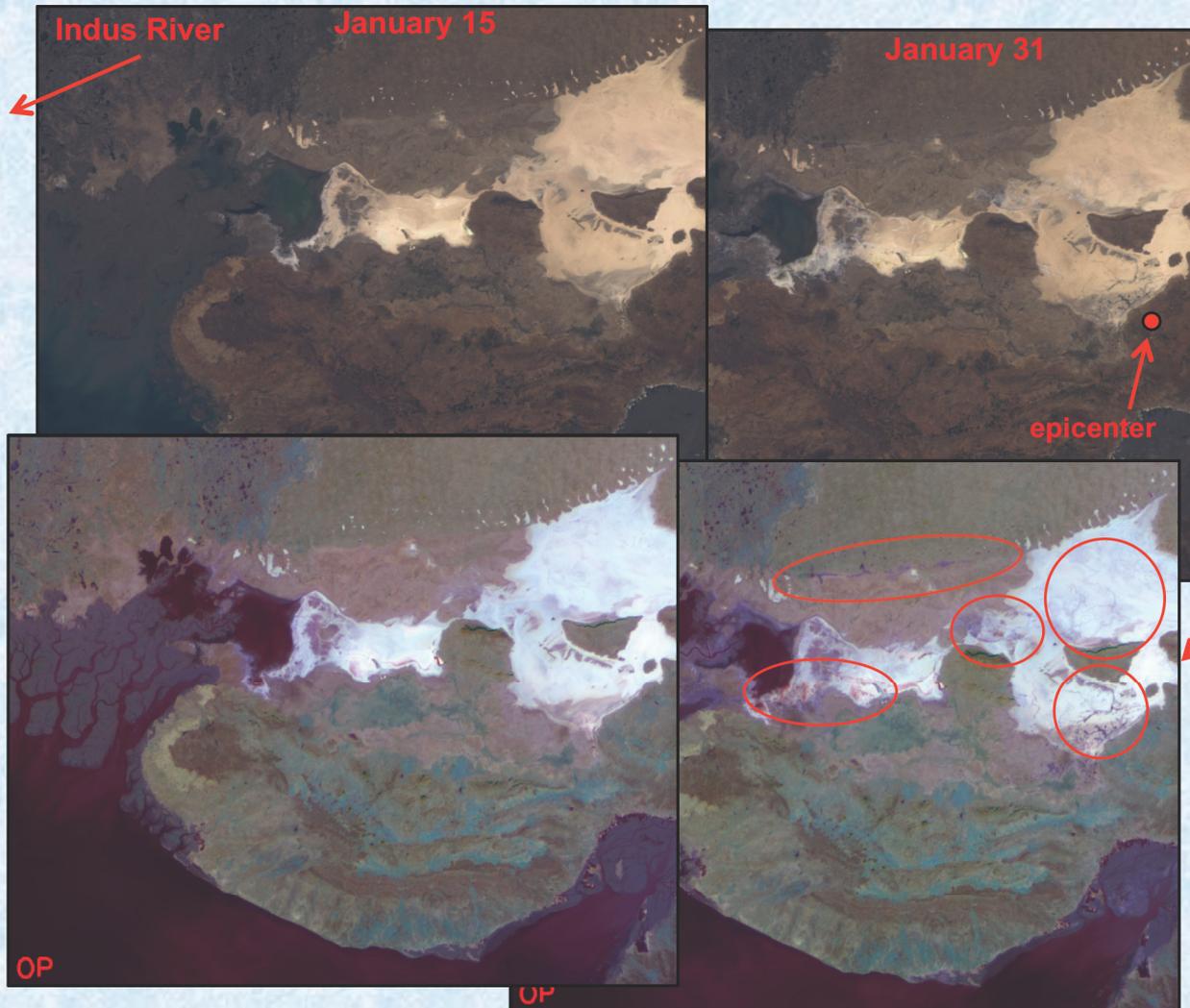
- Displays pixel-by-pixel difference in OP window between images for the selected camera from 2 orbits on the same path
- Both orbits must have been loaded into MINX



See next slide

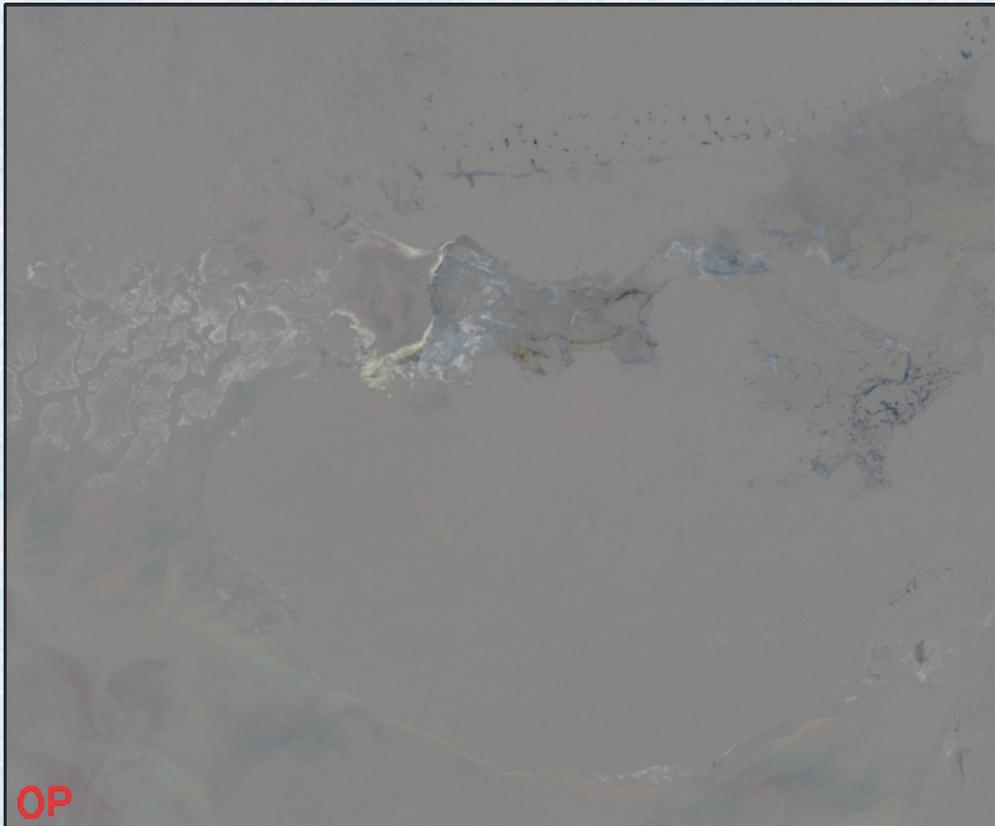
See slide following next

# Bhuj Earthquake Effects and MISR Vision

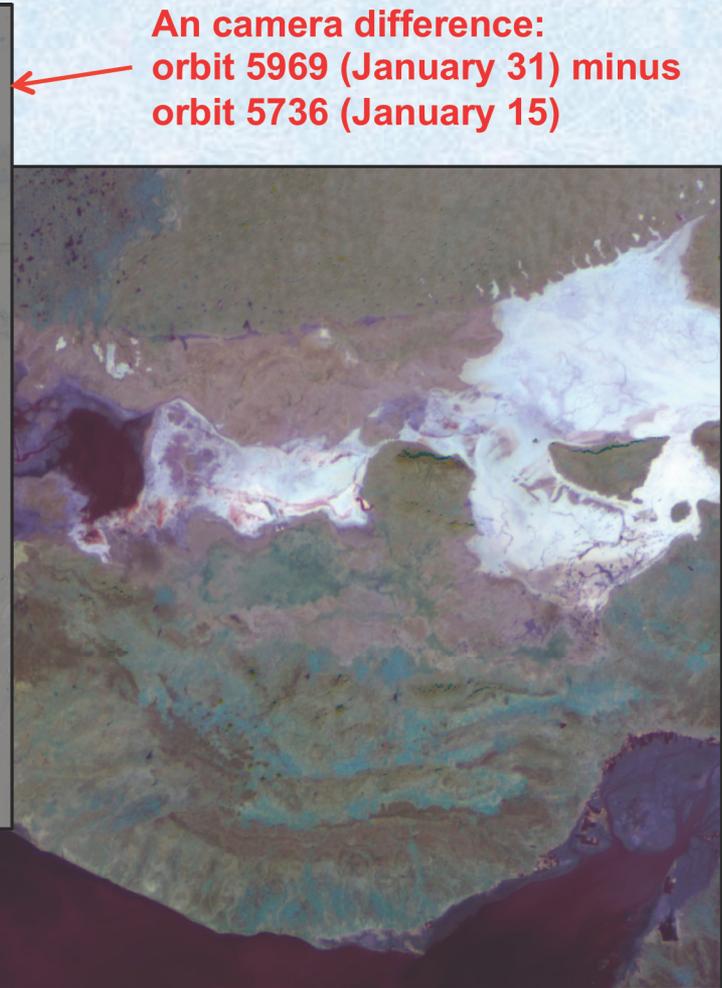


- Before and after of January 26, 2001, magnitude 7.7 earthquake in Gujarat Province of Western India
- 20,000 people killed and extensive damage
- **Upper images:** MISR RGB image (**An camera**) before (Jan 15) and after (Jan 31) earthquake
- **Lower images:** same data but **false color** with Df NIR in red 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

# Bhuj Earthquake Effects and Orbit Difference



False color image from orbit 5969 (January 31)



An camera difference:  
orbit 5969 (January 31) minus  
orbit 5736 (January 15)

# References

- **Pinty, B. et al. 2003. “Observing earthquake-related dewatering using MISR/Terra satellite data”, EOS, Transactions, American Geophysical Union, 84(5):37-48.**
- **MINX download website - <https://www.openchannelsoftware.com/projects/MINX>**