MINX Document 5
Measuring Aerosol Height and Motion with MINX

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Contents

- Parallax, disparity and image matching
- Height/wind retrieval algorithm
- MINX height retrieval comparisons
- Digitizing procedure
- Evaluating results
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Parallax

Parallax is a difference in the apparent position of an object viewed along different lines of sight. Nearby objects have larger parallax than more distant objects, so parallax can be used to determine distance.

MISR geometry when all cameras view a stationary cloud

Spacecraft motion

Da and Cf camera parallax relative to An camera
Disparity is closely related to parallax. It is the measure of total offset in the apparent position of an object viewed along different lines of sight due to actual movement of the object in addition to height parallax. In MINX, the direction of cloud (or plume) motion is input by user.
Disparity - 2

If entire disparity is attributed to height parallax (zero-wind height), then:
- For cloud and spacecraft motion in same direction, height estimate is too low
- For cloud and spacecraft motion in opposite directions, height estimate is too high
Objective: To find a feature in the image from a non-nadir camera that corresponds to a feature in the image from the An camera and to measure its disparity.

- In MINX, the An camera always acts as the reference image
- Six other cameras provide comparison images
- Image matching finds disparities between the target pixel location in reference image and the corresponding pixel location in the comparison image
- Disparity has SOM across-track and along-track components
- It can be applied to features on the earth’s surface or above the surface
- MINX uses the correlation coefficient (CC) for assessing the quality of a match
- Image-matching will fail if the images lack texture or distinctive features
Correlation Coefficient: 
\[ r_{xy} = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{(n-1)s_x s_y} \]

Where:
- \( r_{xy} \) = correlation coefficient
- \( x_i \) = BRF values at pixels in reference patch
- \( \bar{x} \) = mean value of the BRFs in reference patch
- \( y_i \) = BRF values at pixels in comparison patch
- \( \bar{y} \) = mean value of the BRFs in comparison patch
- \( n \) = number of pixels in reference patch
- \( s_x \) = standard dev. of BRF values in reference patch
- \( s_y \) = standard dev. of BRF values in comparison patch

- Correlation finds match to nearest pixel
- To increase precision, fit a bi-cubic surface to the correlation matrix around the solution pixel and interpolate to derive a finer grid
- Find the fine grid point with the largest CC - this gives fractional (sub-pixel) disparities
① Center the reference patch over the upper-left most pixel in the comparison image’s search region

② Calculate correlation coefficient using BRFs for the overlapping pixels and place results into its corresponding location in correlation matrix

③ Slide the reference patch to next pixel in search region and compute CC again –repeat for all pixels in the search region

④ The pixel in the comparison image with highest CC is the match
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MINX Top Level Algorithm

User indicates digitizing is complete for plume

For each sample point in plume

Step 1 - Preprocess data

Step 2 - Measure disparities

Step 3 – Model best winds and heights for each camera

Step 4 – Find best winds and heights combining all cameras

Done?  

no

yes

Display results
Step 1 - Preprocess Data

1. Get wind direction from nearest point on splined wind direction line
2. Get terrain elevation from MISR AGP product
3. For each camera paired with An:
   - Get camera azimuth and zenith angles from MISR GP_GMP product
   - Compute SOM across-track and along-track zenith angles

 Decision: Done?
   - Yes: To Step 2
   - No: Continue with steps 1-3
Get Wind Direction

- The height/wind retrieval problem has 3 unknowns: height, wind-speed across-track and wind-speed along-track.
- User inputs a (wind) direction of motion during digitizing.
- If either the across-track or the along-track wind speed is known, the other component can be computed using the wind direction.
- Thus the retrieval problem simplifies to 2 unknowns.

Digitized plume showing “wind direction” line in yellow.

Wind-speed across modeled by MINX.

Wind-speed along-track is easily computed from wind-speed across-track plus wind direction.
Compute Across and Along-Track Zenith Angles

**Objective:** To convert camera azimuth angle and camera zenith angle into 2 orthogonal components of zenith angle in the SOM across-track and along-track directions. This allows us to compute the 2 components of disparity independently.

1. Create a closely spaced pair of points P1 = [lat1, long] and P2 = [lat2, long] on the same geographic meridian in the region of interest, and project each to SOM coordinates.
2. Find distances \((dx_{\text{north}}, dy_{\text{north}})\) along the SOM\(_{\text{north}}\) and SOM\(_{\text{east}}\) axes between the points.
3. Compute the angle, \(A\), clockwise from local north to SOM\(_{\text{north}}\): \(A = \text{ATAN}(dx_{\text{north}}, dy_{\text{north}})\)
4. Compute the angle, \(C\), clockwise from SOM\(_{\text{north}}\) to the azimuth direction of the camera (\(AZM_{\text{cam}}\)) to give the SOM-relative azimuth angle of the camera (\(AZM_{\text{som}}\)): \(C = B - A\)
5. Decompose the camera zenith angle (\(ZEN_{\text{cam}}\)) into across-track and along-track components to derive the SOM zenith angles (\(ZEN_{\text{som}}\)):
   - \(ZEN_{\text{SOM[across]}} = ZEN_{\text{CAM}} \times \sin(AZM_{\text{SOM}})\)
   - \(ZEN_{\text{SOM[along]}} = ZEN_{\text{CAM}} \times \cos(AZM_{\text{SOM}})\)
Step 2 – Measure Disparities

- From Step 1
- For each camera paired with An
- Done?
  - yes → To Step 3a
  - no
    - Pass 1 - Perform image-matching to nearest 1100 m pixel over a large area
    - Pass 2 - Perform image-matching to nearest 275 m pixel over a small area centered on Pass 1 solution
    - Pass 3 – Interpolate Pass 2 solution to nearest 1/3 pixel
Step 3a – Forward Model Winds and Heights for Each Matched Camera

From Step 2

For each height in model height range

For each wind-speed in model wind-speed range

Compute orthogonal component of model wind speed using wind direction

Compute across and along contributions to disparity due to model wind speeds – use known elapsed time between camera views

Compute across and along contributions to disparity due to model height parallax

To Step 3b
Compute Across and Along Contributions to Disparity due to Parallax

Earth geometry used in modeling along-track component of disparities due to height parallax

Forward modeling equation to compute disparity ($D_y$) for one camera in along-track direction:

$$D_y = \left( ASIN\left( \frac{H + R_{earth}}{R_{earth}} \ast SIN(Z'_y) \right) - Z'_y \right) \ast C_{earth}$$

The same equation is used to compute disparities in the across-track direction.

Where:

- $D_y =$ disparity in SOM y direction
- $H =$ height of aerosol pixel above ellipsoid
- $R_{earth} =$ radius of earth = 6371 km
- $C_{earth} =$ circumference of earth = 40,030 km
- $Z'_y =$ zenith angle component in SOM along direction ($Z'_y$ closely approximates camera zenith angle $Z_y$)
Step 3b – Find Best Height and Winds for Each Matched Camera

From Step 3a

For each height in model height range

For each wind-speed in model wind-speed range

Difference computed disparities and measured disparities and store in 3D array

Find height and wind values where disparity difference is minimum – solution for camera

To Step 4
3D Data Cube of Disparity Differences

- Each node in the data array is indexed by model parameters X (wind-speed across), Y (wind-speed along) and H (height)
- Each node contains a disparity difference: \( D_{\text{total}} = D_{\text{measured}} - D_{\text{modeled}} \)
- Best height/wind solutions exist wherever \( D_{\text{total}} = 0 \); this is true for all points on a sloping line parallel to the wind-speed along axis
- The intersection of this line with a plane containing the user-supplied wind direction is the solution

If wind direction is known, modeling needs to be done only in the plane containing the wind direction - 3 unknowns reduce to 2 and a camera pair rather than a camera triplet is able to provide a unique solution

3D data array for solution of winds and height for one camera at one data point
Step 4 – Find Best Height and Winds Combining all Successful Cameras

From Step 3b

Find median values of the heights and of the winds from all cameras with successful retrievals

Keep all camera solutions whose heights and winds differ from the medians by less than some threshold values

Done – on to next point

If at least 3 camera solutions remain, consider the retrieval successful, so find the mean of the remaining heights and the mean of the remaining winds and report them
## MISR vs. MINX Stereo Height Algorithms

<table>
<thead>
<tr>
<th>Feature</th>
<th>MISR Standard Stereo Product</th>
<th>MINX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 imagery</td>
<td>Ellipsoid-projected</td>
<td>Terrain-projected</td>
</tr>
<tr>
<td>Matcher cost func</td>
<td>Mean of normalized differences</td>
<td>Pearson’s correlation coefficient</td>
</tr>
<tr>
<td>Order of solution</td>
<td>Winds retrieved first, heights later</td>
<td>Winds and heights retrieved simultaneously</td>
</tr>
<tr>
<td>Cameras used</td>
<td>An / Bx / Dx triplets for wind Af / An / Aa triplets for height</td>
<td>Cf, Bf, Af, Aa, Ba, Ca, each paired with An for height and wind</td>
</tr>
<tr>
<td>Wind retrieval dependency</td>
<td>Depends on earth curvature viewed by D cameras and applicable to any feature above the terrain</td>
<td>Depends on knowledge of wind direction and generally applicable only to plumes or where wind direction is known</td>
</tr>
<tr>
<td>Wind resolution</td>
<td>Wind retrievals averaged over 70.4 km and applied to heights at 1.1 km</td>
<td>Heights and winds retrieved simultaneously at 1.1 km resolution</td>
</tr>
<tr>
<td>Number of unknowns</td>
<td>3: wind speed across-track, wind speed along-track and height</td>
<td>2: one wind speed plus height; the other wind speed is derived from user-supplied wind direction</td>
</tr>
<tr>
<td>Methodology</td>
<td>Finds unique inverse solution using 1 set of camera triplets (2 sets for wind)</td>
<td>Uses forward modeling that averages results of up to 8 camera pairs</td>
</tr>
</tbody>
</table>
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MINX Height Retrieval Comparison - 1

- MINX and MISR zero-wind and wind-corrected heights are similar
- MISR heights and winds are “quantized” due to matching at whole pixel level
- MISR winds are constant over large distances due to 70.4 km resolution retrieval
- Across-track winds are more similar than along-track winds
- A new version of the MISR stereo product produces significantly improved results
MINX Height Retrieval Comparison - 2

MINX plume heights for 8 Ring of Fire volcanic eruptions compared with heights from other sources

Except for temperature-retrieved heights, MINX retrievals are remarkably close to those from other sources

VOLCANO EVENTS, BY SYMBOL
- Augustine - January 30, 2006
- Okmok - July 13, 2008
- Okmok - July 22, 2008
- Okmok - July 29, 2008
- Cleveland - July 22, 2008
- Redoubt - April 5, 2009
- Sarychev - June 14, 2009
- Sarychev - June 16, 2009

DATASETS COMPARED, BY COLOR
- Puff model height vs. MISR retrieved height
- Observation flight height vs. MISR height
- Temperature retrieved height vs. MISR height

Courtesy of Angela Ekstrand, Alaska Volcano Observatory
Redoubt Eruption – Alaska – April 5, 2009

AVHRR retrieves heights near the water surface when the ash plume is thin

Images and analysis courtesy of Angela Ekstrand et al, AGU 2010
Collocation of micropulse lidar and MISR data at Anmyon on the coast of South Korea

by Ben Dunst, UCLA and Mike Garay, JPL

Wind direction for MINX retrieval derived from meteorological data
Dust over Atlantic Ocean off West Africa seen by Calipso lidar and MISR by Olga Kalashnikova and Mark Chodas, JPL
Dust over Bodele Depression, Chad seen by Calipso lidar and MISR

by Mike Garay, JPL
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Digitizing Procedure Overview

① Load Level 1 radiance images (session 2)
② Adjust image color and brightness (session 2)
③ Assess and correct camera co-registration errors
④ Load MODIS fire pixels if appropriate (session 4)
⑤ Study feature geometry and scene context to determine:
  • Outline of feature to digitize
  • Wind direction to digitize
  • Retrieval parameters (session 4)
⑥ Digitize feature
  • Digitize outline and wind direction
  • Select AGP and GP_GMP product files to load when prompted (required)
  • Select other MISR product files when prompted (optional)
⑦ Evaluate digitizing results
  • Study height/wind plots and color overlays
  • Delete digitized feature if not satisfactory
  • Redigitize with new parameters
  • more in session 4
Objective: To improve stereo height retrieval accuracy by reducing errors in camera-to-camera geometric registration before image matching is performed.

- 1 pixel registration error can lead to a height error of $\sim 550$ m for Af/Aa cams and $\sim 150$ m for Cf/Ca
- Mean co-registration error of MISR data $< 1$ pixel
- Some orbits misregistered by more than 2 pixels
- Co-registration errors are evaluated on a regular grid of control points using image-matching with An as reference camera

To assess 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) – Bf image is displaced left relative to An by 3 pixels
4. Do not compare features in clouds or plumes (C) which are expected to “misregister”

Bf camera is mis-registered by -3 across-track pixels relative to An
Camera Registration Correction - 2

- **MINX** uses terrain-projected imagery so corrections to geometric registration errors can be partially corrected.
- Registration corrections are applied by warping image BRFs between a grid of control points using disparities derived from image-matching.
- Corrections are conservative - rapid variations in disparities are ignored.
- **To correct misregistration:**
  1. If only one camera requires correction, select that camera in the image window, then select “Correct Misregistration” from the MINX Analysis menu, finally select “Warp Current Camera to Match An”.
  2. If more than one camera requires correction, select the An camera in the image window, then select “Correct Misregistration” from the MINX Analysis menu, finally select “Warp Orbit 1 Cameras to Match An for Plumes” – A, B, C cameras will be processed.
- Another source of co-registration error is MISR’s digital elevation model (DEM) – these errors vary more rapidly and cannot be corrected.
Study 3D Geometry and Scene Context - 1

Objective: To isolate the aerosol feature from its surroundings and to understand its dynamics so a reasonable boundary and wind direction can be assigned.

• Observations (see next slide):
  • On Da and Ca cameras, a vertical column of ash marks the origin of plume (at the volcanic vent)
  • Ash from the volcano is wind-blown toward the upper right in image
  • Animating cameras gives the “illusion” of plume motion from bottom to top – effect of parallax
  • The plume intersects an upper-left to lower-right trending string of cloud
  • The plume is higher than the clouds since its parallax is greater
  • The plume is bifurcated with “ribs” on either side of central “spine”

Terrain-projected BRFs

Augustine Volcanic Eruption, January 30, 2006
77 km
Study 3D Geometry and Scene Context - 2
Objective: To define a plume boundary for the height retrieval code within which heights and winds will be retrieved and to provide a wind direction necessary for correcting the heights.

- MINX stores all regions (plumes and clouds) digitized for an orbit in a linked list
- Each region node contains pointers to linked lists of:
  - Points defining the boundary of the polygon
  - Points defining the wind direction line, if any
  - Points on a regular grid in the interior of polygon where heights will be retrieved
Digitize Plumes - 2

Selection determines the name of plume and the color of digitized polygon

If you have an IDL license, a 9-camera MPG or MP4 animation is saved – otherwise 9 JPEG images are saved

An image containing data from MISR standard Aerosol product is saved

Top-of-atmosphere albedos are computed and saved

You will be asked for a MISR standard Stereo product file, and those heights and winds will be added to profile plots

Profile plots will be drawn with higher resolution and fewer annotations and camera names are not written on images

No wind-corrected heights below this distance above terrain will be retrieved

No wind-corrected heights above this distance above sea level will be retrieved

No wind speeds above this value will be retrieved

Grid spacing between points in the plume polygon where retrievals are attempted

Retrieve heights and winds either along a digitized line or inside a digitized polygon – along line requires using “wind direction”

Compute only zero-wind heights (cloud) or compute zero-wind heights plus winds and wind-corrected heights (plume) – no wind direction requires “Retrieve inside polygon”

Digitized wind directions as well as 180 degree opposite wind directions are used – e.g. across eye of hurricane

Select MISR band(s) to use in the image matching step – if plume extends over land and water, “Match w/ Blue and Red” helps

Select the size of the image matcher to use – larger is slower and smooths results but increases the number of retrievals

Select the “quality” of the retrieval – higher provides greater confidence in results but reduces the number of retrievals – based on the number of camera pairs returning similar results and threshold on similarity

Select which cameras to match against the An camera – D cameras slow retrievals and are often not useful – for A cameras only, “Lowest retrieval precision” is needed

If cursor hovers over buttons, context-sensitive help is shown
Digitize Plumes – 3a

1. Using the mouse, left-click a point you choose to be the origin or source of the plume
2. Left-click additional points to define the boundary of the plume – a dashed line segment will connect each successive pair of points
3. Digitize the last point to coincide with the origin point – this automatically closes the polygon and assigns a unique name to the plume
4. If you selected “Use no wind direction” in the “Digitizing Options” dialog, then go to ⑤
   If you chose “Provide wind direction”, then:
   a) Left-click one or more additional points to define a wind vector – a dashed line connects the points
   b) Right-click anywhere in window when done
5. Select the AGP and GP_GMP product files to load when the dialog boxes prompt for them
6. The wind direction line will change to solid yellow and describe a splined curve – this signals that image matching and height retrieval are beginning
7. When calculations finish, results are displayed on the screen and are written to file

• While you are in “Digitize” mode, you can continue digitizing plumes
• Once each AGP, GP_GMP or other MISR product is loaded, there are no more load data prompts
Digitize Plumes – 3b

1. Using the mouse, left-click a point you choose to be the origin or source of the plume
2. Left-click additional points to define the boundary of the plume – a dashed line segment will connect each successive pair of points
3. Digitize the last point to coincide with the origin point – this automatically closes the polygon and assigns a unique name to the plume
4. If you selected “Use no wind direction” in the “Digitizing Options” dialog, then go to 5.
   If you chose “Provide wind direction”, then:
   a) Left-click one or more additional points to define a wind vector – a dashed line connects the points
   b) Right-click anywhere in window when done
5. Select the AGP and GP_GMP product files to load when the dialog boxes prompt for them
6. The wind direction line will change to solid yellow and describe a splined curve – this signals that image matching and height retrieval are beginning
7. When calculations finish, results are displayed on the screen and are written to file

- While you are in “Digitize” mode, you can continue digitizing plumes
- Once each AGP, GP_GMP or other MISR product is loaded, there are no more load data prompts
Digitize Plumes – 3c

1. Using the mouse, left-click a point you choose to be the origin or source of the plume.
2. Left-click additional points to define the boundary of the plume – a dashed line segment will connect each successive pair of points.
3. Digitize the last point to coincide with the origin point – this automatically closes the polygon and assigns a unique name to the plume.
4. If you selected “Use no wind direction” in the “Digitizing Options” dialog, then go to 5.
   If you chose “Provide wind direction”, then:
   a) Left-click one or more additional points to define a wind vector – a dashed line connects the points.
   b) Right-click anywhere in window when done.
5. Select the AGP and GP_GMP product files to load when the dialog boxes prompt for them.
6. The wind direction line will change to solid yellow and describe a splined curve – this signals that image matching and height retrieval are beginning.
7. When calculations finish, results are displayed on the screen and are written to file.

• While you are in “Digitize” mode, you can continue digitizing plumes.
• Once each AGP, GP_GMP or other MISR product is loaded, there are no more load data prompts.
Digitize Plumes – 3d

1. Using the mouse, left-click a point you choose to be the origin or source of the plume
2. Left-click additional points to define the boundary of the plume – a dashed line segment will connect each successive pair of points
3. Digitize the last point to coincide with the origin point – this automatically closes the polygon and assigns a unique name to the plume
4. If you selected “Use no wind direction” in the “Digitizing Options” dialog, then go to 5.
   If you chose “Provide wind direction”, then:
   a) Left-click one or more additional points to define a wind vector – a dashed line connects the points
   b) Right-click anywhere in window when done
5. Select the AGP and GP_GMP product files to load when the dialog boxes prompt for them
6. The wind direction line will change to solid yellow and describe a splined curve – this signals that image matching and height retrieval are beginning
7. When calculations finish, results are displayed on the screen and are written to file
Digitize Plumes – 3e

1. Using the mouse, left-click a point you choose to be the origin or source of the plume
2. Left-click additional points to define the boundary of the plume – a dashed line segment will connect each successive pair of points
3. Digitize the last point to coincide with the origin point – this automatically closes the polygon and assigns a unique name to the plume
4. If you selected “Use no wind direction” in the “Digitizing Options” dialog, then go to 5
   If you chose “Provide wind direction”, then:
   a) Left-click one or more additional points to define a wind vector – a dashed line connects the points
   b) Right-click anywhere in window when done
5. Select the AGP and GP_GMP product files to load when the dialog boxes prompt for them
6. The wind direction line will change to solid yellow and describe a splined curve – this signals that image matching and height retrieval are beginning
7. When calculations finish, results are displayed on the screen and are written to file

- While you are in “Digitize” mode, you can continue digitizing plumes
- Once each AGP, GP_GMP or other MISR product is loaded, there are no more load data prompts
Digitize Plumes – 3f

1. Using the mouse, left-click a point you choose to be the origin or source of the plume.
2. Left-click additional points to define the boundary of the plume – a dashed line segment will connect each successive pair of points.
3. Digitize the last point to coincide with the origin point – this automatically closes the polygon and assigns a unique name to the plume.
4. If you selected “Use no wind direction” in the “Digitizing Options” dialog, then go to 5.
   If you chose “Provide wind direction”, then:
   a) Left-click one or more additional points to define a wind vector – a dashed line connects the points.
   b) Right-click anywhere in window when done.
5. Select the AGP and GP_GMP product files to load when the dialog boxes prompt for them.
6. The wind direction line will change to solid yellow and describe a splined curve – this signals that image matching and height retrieval are beginning.
7. When calculations finish, results are displayed on the screen and are written to file.

- While you are in “Digitize” mode, you can continue digitizing plumes.
- Once each AGP, GP_GMP or other MISR product is loaded, there are no more load data prompts.
Digitize Plumes – 3g

1. Using the mouse, left-click a point you choose to be the origin or source of the plume
2. Left-click additional points to define the boundary of the plume – a dashed line segment will connect each successive pair of points
3. Digitize the last point to coincide with the origin point – this automatically closes the polygon and assigns a unique name to the plume
4. If you selected “Use no wind direction” in the “Digitizing Options” dialog, then go to 5.
   If you chose “Provide wind direction”, then:
   a) Left-click one or more additional points to define a wind vector – a dashed line connects the points
   b) Right-click anywhere in window when done
5. Select the AGP and GP_GMP product files to load when the dialog boxes prompt for them
6. The wind direction line will change to solid yellow and describe a splined curve – this signals that image matching and height retrieval are beginning
7. When calculations finish, results are displayed on the screen and are written to file

- While you are in “Digitize” mode, you can continue digitizing plumes
- Once each AGP, GP_GMP or other MISR product is loaded, there are no more load data prompts
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Evaluate Results - 1

Objective: To determine whether the heights and winds for the digitized feature are reasonable and acceptable or whether it should be redigitized or discarded.

- For each aerosol feature digitized, MINX produces 3 map-view images (see below), 2 profiles, 2 histograms and 1 text file containing raw data point information.
- All 8 files are automatically saved in a sub-directory in user’s home directory named “0<orbit number>” e.g. “/Users/dlnelson/032555/”
- The MPEG camera animation file is created only if you have an IDL license – otherwise MINX will create 9 JPEG images
- Several images are also displayed on-screen for post-digitizing evaluation.

9-camera animation

Digitized plume polygon and wind direction arrow

Color-coded retrieved heights
Evaluate Results - 2

Some of apparent scatter in heights is due to multiple data points at same distance from origin.

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

Total wind speed is: \( \sqrt{\text{wind}_{\text{across}}^2 + \text{wind}_{\text{along}}^2} \)

Wind speed along-track is positive toward the top of MISR orbits; wind speed across-track is positive toward the right.

Height and wind histograms

- The Height Profile is the most important graphic for evaluating the success and validity of the retrieval.
- If “Use no wind direction” was selected in “Digitizing Options” dialog, then only the Height Profile and the Zero-Wind Heights histogram will be populated.
Evaluate Results - 3

Header records in raw data file

Aerosol parameter histograms (retrieved from MISR standard aerosol product)

Data-point table in raw data file (file is truncated across and down)

New naming convention in MINX V2.0

New in MINX V2.0

V2.0 also records the points defining the polygon and the wind direction (not shown)
Evaluate Results - 4

Disparity types are available for each camera matched – choosing one enables camera selection buttons.

Retrieved data types available after digitizing a region.

Create independent color scale window for routine analysis.

Overlay on animation window at these “Pixel x/y” coordinates for saving presentation quality image to disk.

These values map to the first and last colors in the color scale.

Camera selection is allowed only for a Disparity data type.

Selected Data type is displayed in each digitized polygon with colors set by Minimum and Maximum values – color key is also shown if selected.
Evaluate Results – Delete Plume

• To delete a region (plume, cloud or line):
  ① Select “Delete Objects” from “Select Digitizing Tool” submenu
  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 is 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

O49787-B68-SPNB3 - typical region name in MINX V2.0

O49787 - MISR orbit number
B68 - MISR block number where first point was digitized
SPNB - region identifier assigned by MINX based on user’s selections in Digitizing Options dialog box (see table below)
3 - unique region identifier incremented for each new region in a block

Key to Region Identifier Letters

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D = Dust</td>
<td>L = Line</td>
<td>N = No wind provided (“cloud”)</td>
<td>R = Red</td>
</tr>
<tr>
<td>S = Smoke</td>
<td>P = Polygon</td>
<td>W = Wind provided (“plume”)</td>
<td>G = Green</td>
</tr>
<tr>
<td>V = Volcanic ash</td>
<td></td>
<td></td>
<td>B = Blue</td>
</tr>
<tr>
<td>W = Water</td>
<td></td>
<td></td>
<td>N = NIR</td>
</tr>
</tbody>
</table>
References