

About New Version

- V2.7.0 is the latest version of the software. (As of 20200117)
- In this version, minor bugs are fixed.
- Add menu to create image frame kml file.
- Full test was conducted as shown in test table.

Test results table

Data	Test Mode and evaluation					
Image data	from original image to Tile	FBD dual composite	Multi temporal composite	Inter ferometry	Dinfero	HH-HV composite
FBD Lev 1.5 CEOS	Success	Success	Success	NA	NA	NA
FBS Lev 1.5 CEOS	Success	NA	Test skipped	NA	NA	NA
FBS Lev 1.1 CEOS	Success	NA	equal to infero	Success	Test skipped (*1)	NA
FBD Lev 1.1 CEOS	Success	Success	equal to infero	Success	Test skipped (*1)	Success
*1: Already working correctly.						

1. Introduction (1/4)

- ALOS2 image viewer is a comprehensive SAR image handling and display software tool.
- The program a GUI based program which runs on Windows 7 / 10.
- The program can handle ALOS2 Palsar images of Level 1.1 complex data and Level 1.5 amplitude data.
- The program can display images and create various composite images like HH-HV composite, multi -temporal composite and support interferometry / differential interferometry operations.
- Also, the program can conduct orthographical rectification and kml file export of the results.
- Image pixel value statistics can export for a set polygon areas with sigma 0 values.

Introduction(2/4)

Applications of PALSAR data

- There is a great potential of SAR image applications which cover ;
 - a) Cloud free target area view and show surface roughness affected by electromagnetic states of the surface materials.
 - b) Multi temporal composite to identify changes happen in between the observation dates.
 - c) Multi polarization composite to classify land surface conditions.
 - d) Precise surface height change monitoring from SAR differential interferometry.
 - e) Cloud free Dem extraction from interferometry.

Introduction (3/4)

Image classification parameter of PALSAR data

- Since SAR pixel value is a measure of radar reflectance at the Earth's surface, the nature is quite different from optical sensor pixel values.
- Due to the nature, most of the optical image classification techniques are not applicable to the SAR image.
- Basic possible classification using SAR image is done by ;
 - 1) Absolute radar reflectance value evaluation,
 - 2) Mutual relation among Polarization component values,
 - 3) phase information utilization, and
 - 4) pattern (texture) of pixel values among neighboring pixels.

In the current version, image classification using above characteristics is not implemented.

Introduction (4/4)

What is explained in this document

This document is a manual of “ALOS2Viewr” software. The program can process ALOS2 PLSAR image to display, create various composite, interferometry and measure pixel value statistics. Background purpose of the document is to realize following items.

- Familiarize with AOS2 Palsar2 image handling.
- Learn basic manipulation of SAR data to establish link to existing GIS system.
- Observe difference of SAR images from optical sensor images.
- Practice on amplitude SAR image handling using sample data.
- Practice on SLC image handling to create interferogram and differential interferogram.
- Export interferogram set data as ortho-rectified kml/png data to display on Google Earth.

2. Functions of ALOS2Viewer (1/3)

- This program provides following functions as;
 - 1) Display single Level 1.5 Palsar2 CEOS format image and scroll full scene in a PC with small display area and displays various parameter of image data.
 - 2) Create color composite images from Level 1.5 or Level 1.1 Palsar2 images.
 - 3) Conduct orthographic rectification by importing several kind dem existing on web site.
 - 4) Export orthographically-rectified image as KML file which can be seen on Google Erath.
 - 5) Conduct SAR interferometry from a pair of Level 1.1 Palsar2 images.

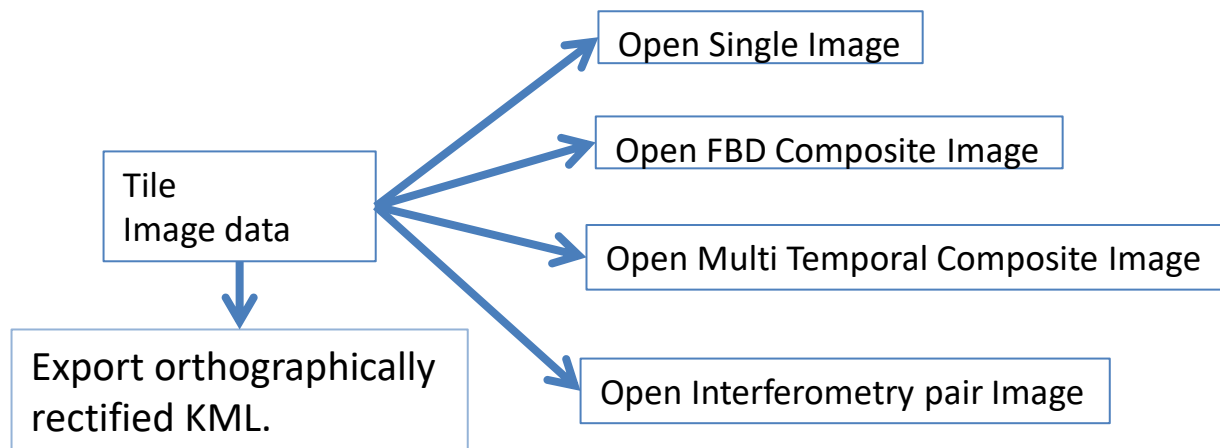
Functions of ALOS2Viewer (2/3)

Basic Viewer Process flow



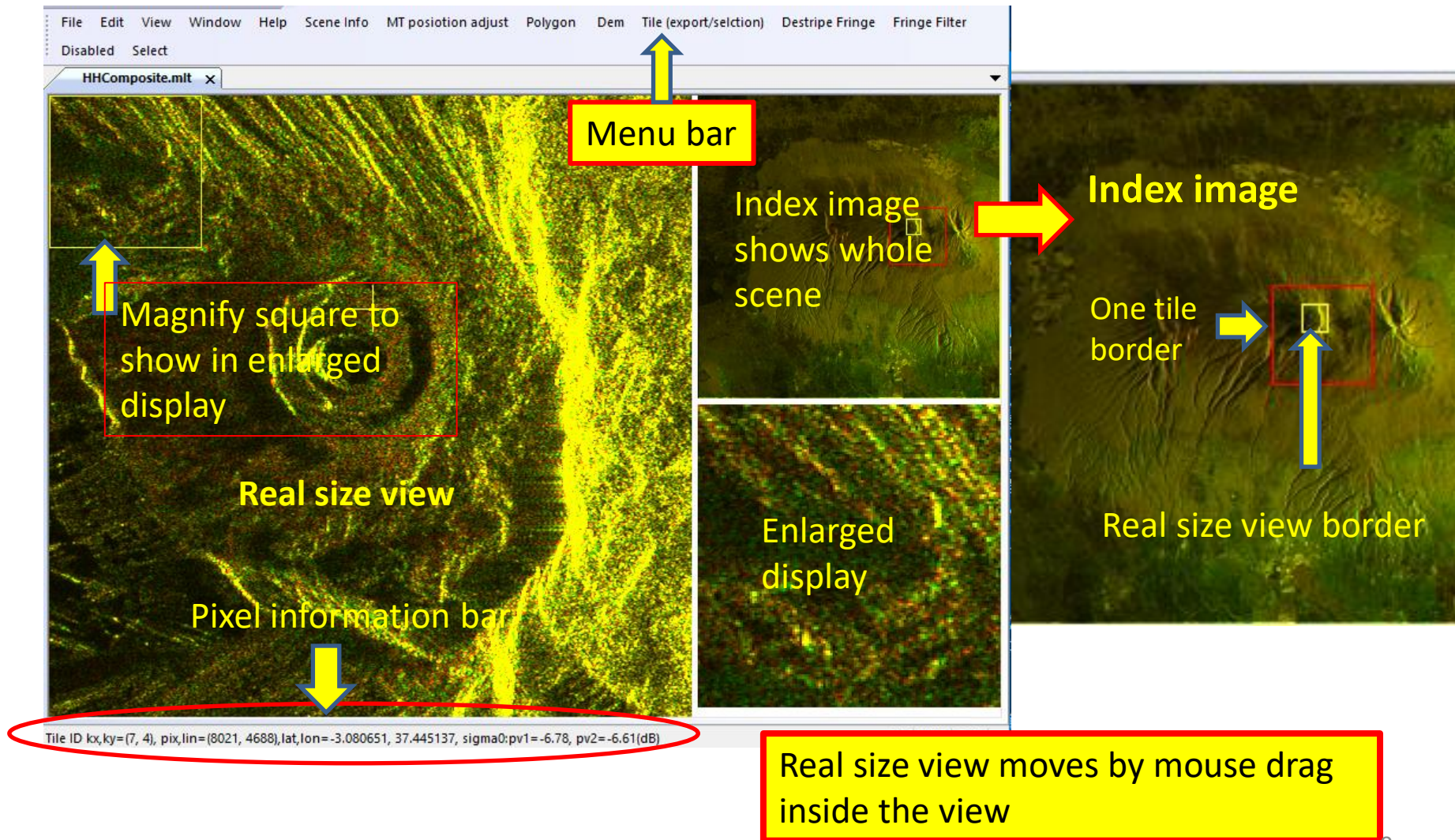
Open original image and save as tile image.
For L1.1 data size reduction to 3/8 of original file size is supported.

Every time when you obtain new PALSAR 2 data, you must convert original data into tile image file.
Then you can proceed to next step(s).

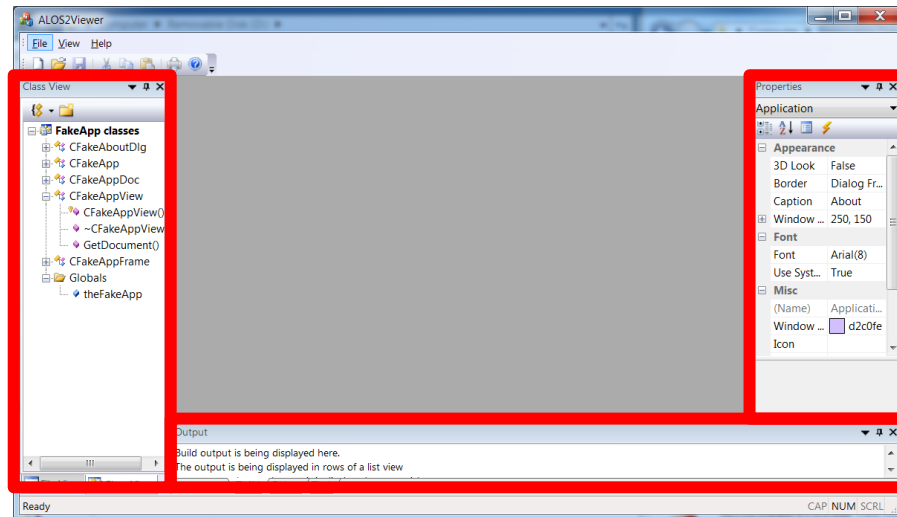


Functions of ALOS2Viewer (3/3)

Display window structure



Additional note



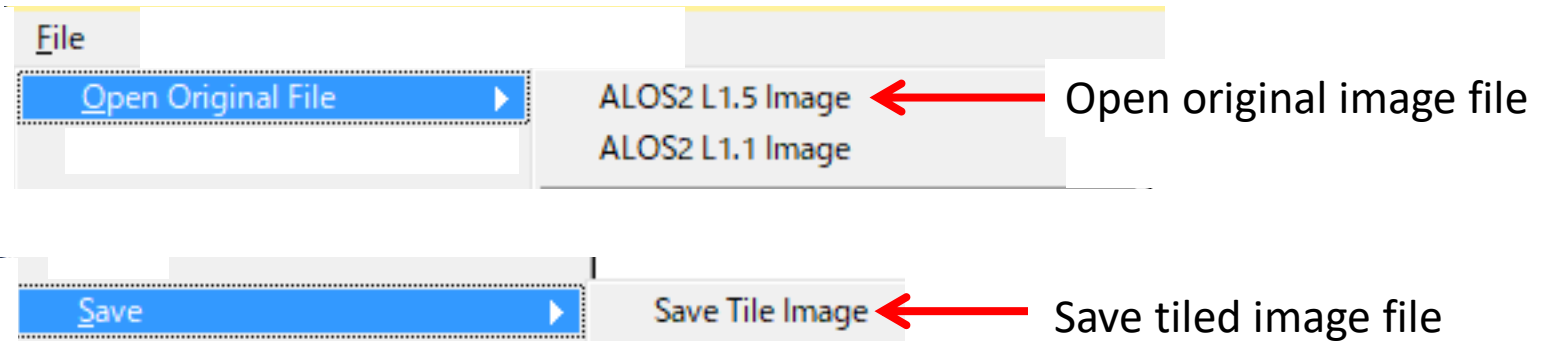
If initial opening of ALOS2Viewer shows sub window inside, close those sub-windows. From the next start of the program, this sub-windows will never appear again.

3. Program Menu(1/10)

- There are many menu items to work on this viewer.
- For better use of the program, you must recognize basic functions of the menu items.
- Refer the function of the menu shown in the following pages.

Program Menu(2/10)

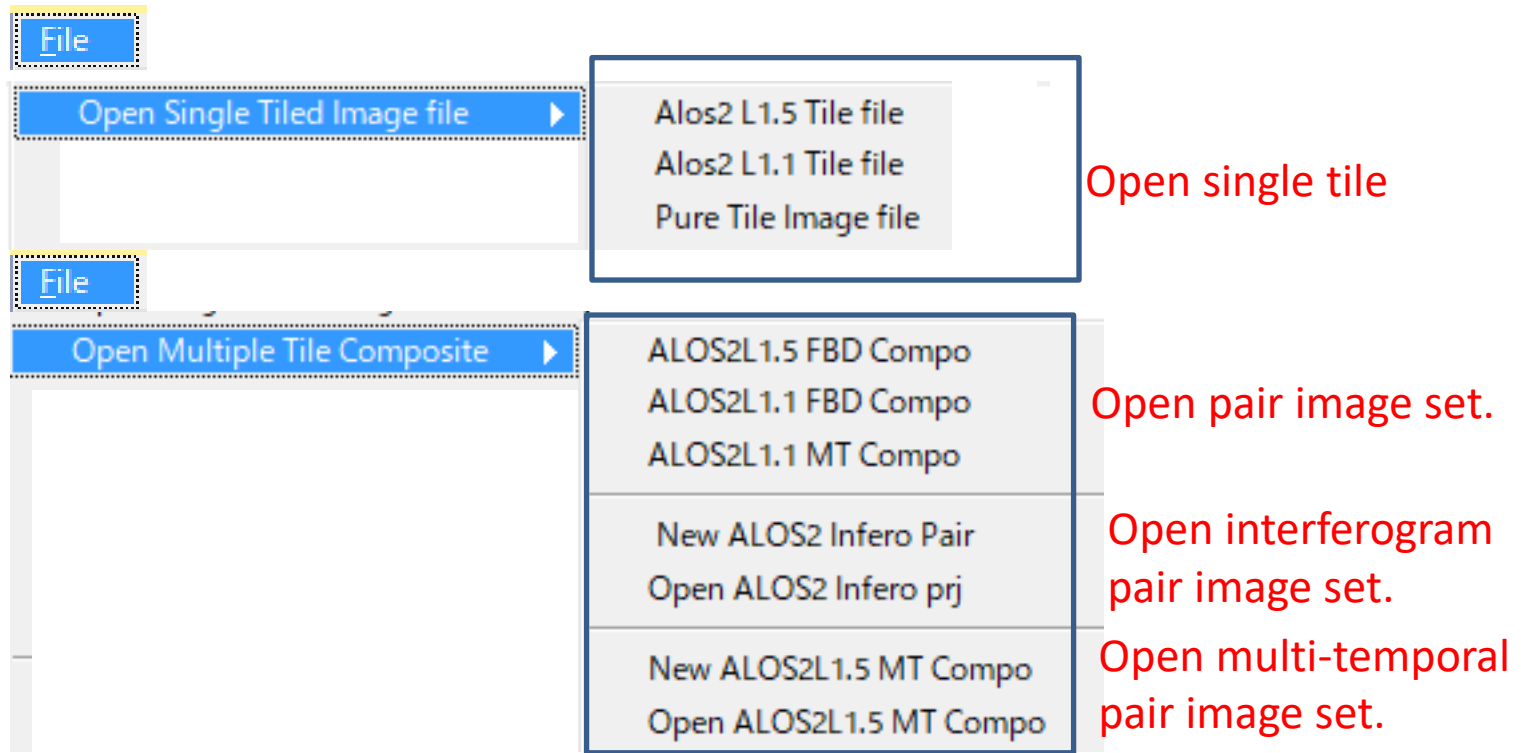
File Menu- Original image Open/ Save



1. Initial process is to open Original image from “Open Original Single File”. For ALOS2 data there are two basic type of files (L1.5 & L1.1).
2. The process open image and leader file to extract parameters and convert raster image to tile with data compression (for L1.1).
3. After image Open, don’t forget to select “Save Tile Image” to keep reduced size tile image and associated parameter files.
4. All parameters of original ALOS data is kept in the set of tiled image.
5. After successful save of tiled images), original image is not necessary afterward.

Program Menu(3/8)

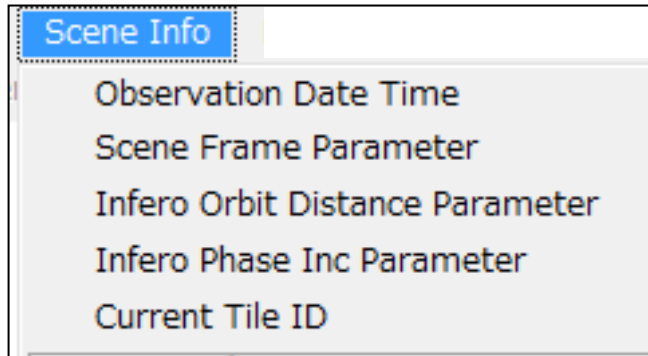
File Menu-Open Tile Images



After creating several original image files,
you can open tiled ALOS2 Images in various image combinations.

Program Menu(4/10)

Scene Info



This menu is to show:

- image observation date –time,
- scene frame parameter,
- Interferometry orbit distance parameter,
- interferometry phase parameter,
- and display tile location parameter.

Select menu for these items, then items appear in a dialog.

Program Menu(5/10)

Multi-temporal/Interferometry Relative image positioning

MT position adjust

Create New Tie-point Table
Save Conjugate Point Table
Load Existing Conjugatepoint data

Calc Tie point adjust parameter
Display Current Tie-Point Table

Adjust Tie-Point displacement
Reset Tie-Point displacement
Display Coherence Histogram

Single Point Matching
Reset Conjugate Point table

Display Mt/Infero Composite
Color Data mode (2 color/3 color=checked)

These menu items cover to get exact pixel position matching between different date observation data.

Initial positioning is done using parameter in the **leader file** associated with each image.

These menu items support small value adjustment to get better position matching between pair images.

These menu items support poor quality leader file or no leader file case.

This manu item change composite color mode.

Program Menu(7/10)

Dem Handling Menu



Dem (digital elevation model) is used to convert SAR image to orthographically rectified image and differential interferometry process. Currently, three Dem sources is available as free of charge data. In this program, use of ASTER GTM V2 is recommended because of its global coverage and good quality through long time improvement. From page 65 of this document, a process to down load necessary dem files are explained.

Program Menu(8/10)

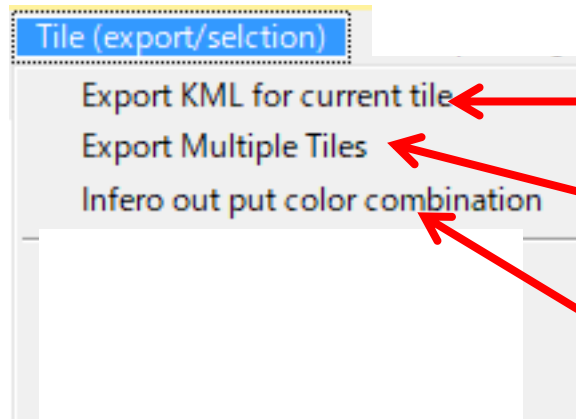
Polygon Handling Menu



This menu group supports polygon handling. Actual process is explained in chap. 6 (p30) of this manual.

Program Menu(9/10)

KML Export Menu



This menu export kml file and associated png file of currently displayed tile.

This menu export rectangle matrix area tiles

This menu defines color mode of Interferogram, dinfero, and coherece map to export kml in current tile case.
For multiple tile case, color mode is set interactively by the area set dialog.

New Addition to export "Scene frame kml" is supported.
After opening a original image,
select Menu: Scene info->Create Image frame kml.
You will find akml file in the opened image place.

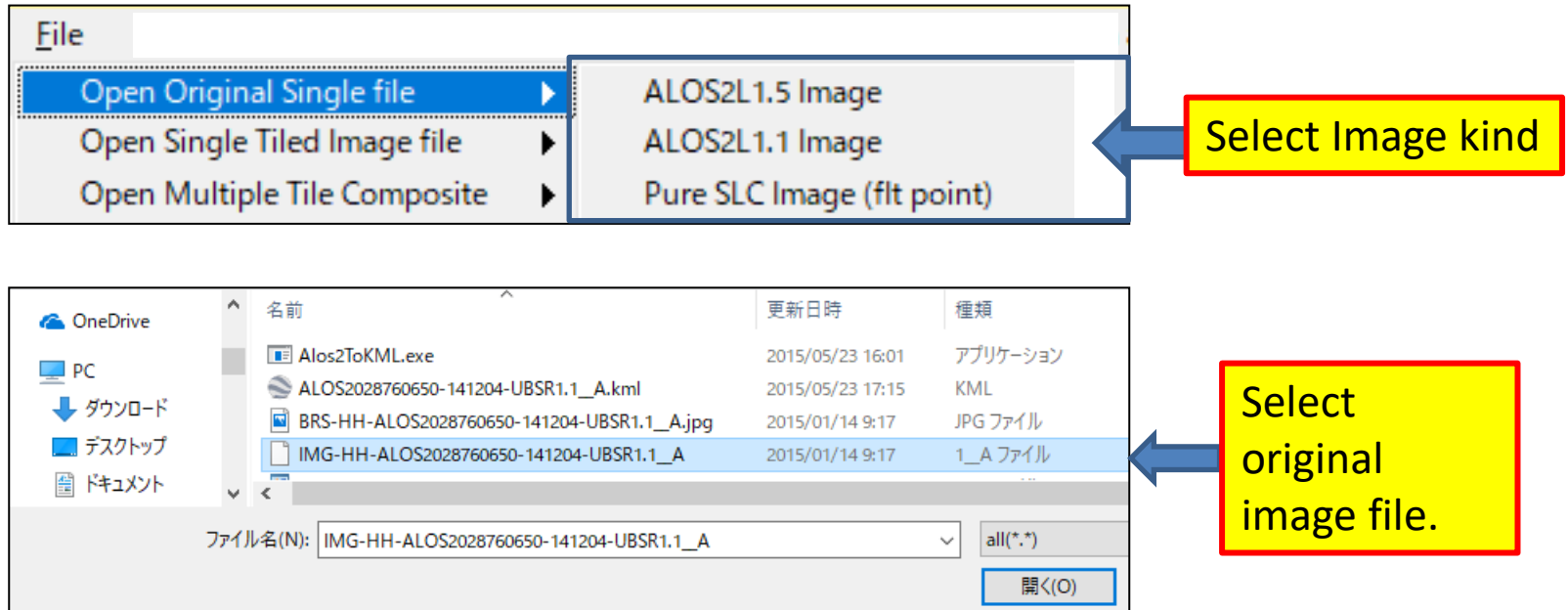
Program Menu(10/10)

Destripe Fringe Menu



This menu group supports inteferogram quality enhancement. Actual process is explained in Practice 9 (p47~, p59 is to show menu item of "Calc Fringe inc pattern").

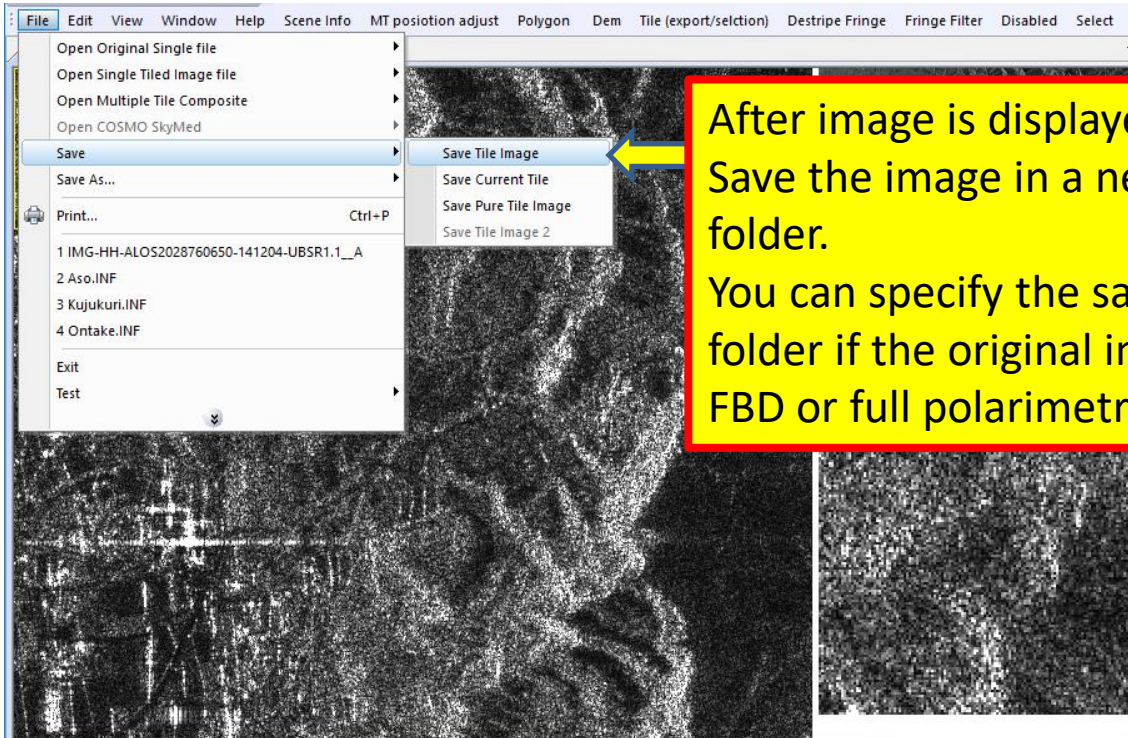
4. Initial Image Handling(1/2)



To start program, the first process is to convert original raster file into tiled image structure. The purpose to make tile file is to enhance random access speed in the image position displace.

In the program, all functions are work only for tile structure image.

Initial Image Handling(2/2)



After image is displayed.
Save the image in a new tile
folder.
You can specify the same
folder if the original image is
FBD or full polarimetry.

Save original image into tile mode image.

Unit tile in the created file consist of 1024 by 1024 pixels.

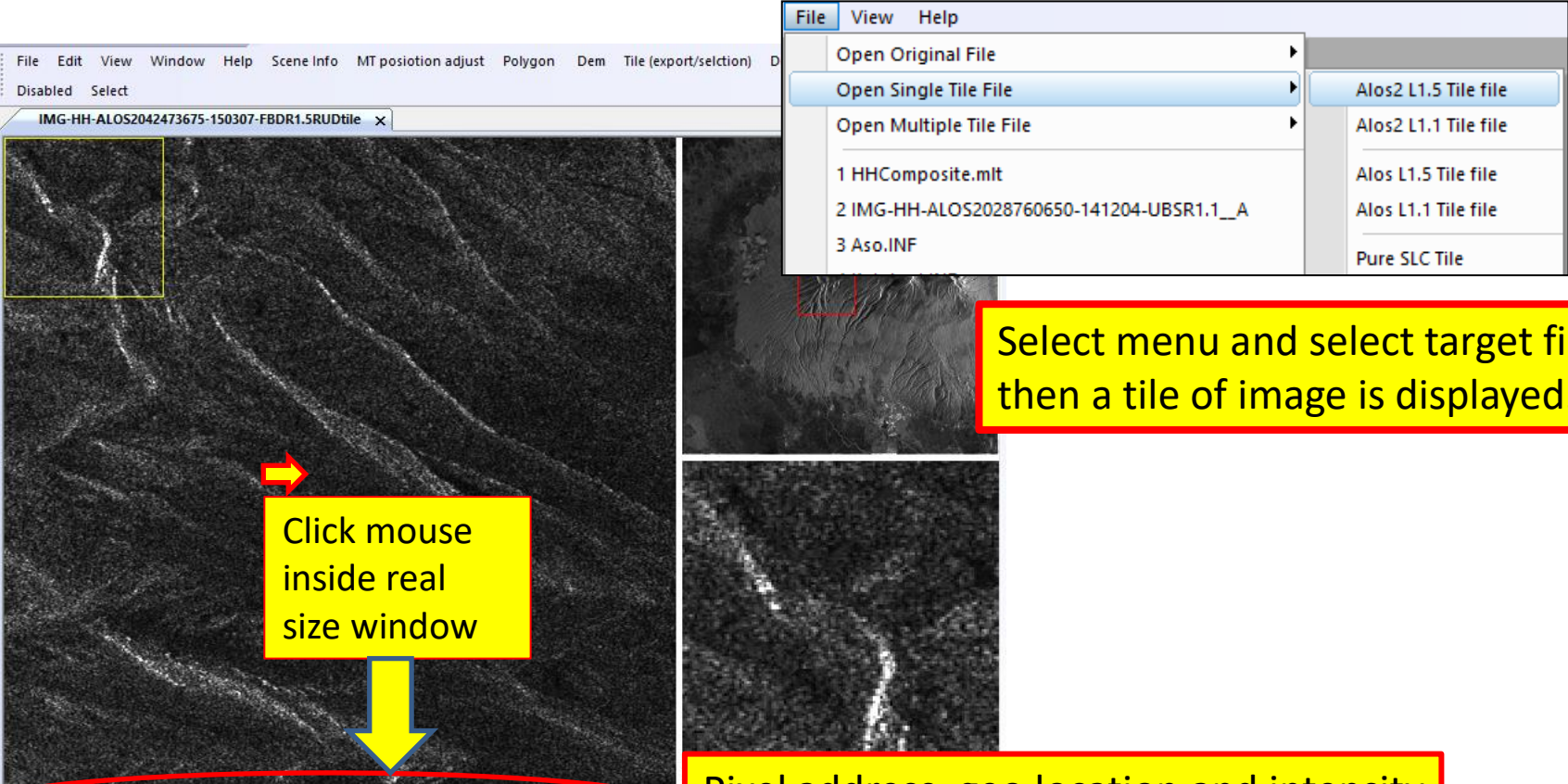
Tile pixel format follows original format but for SLC (Lev 1.1 in ALOS2) applies a compression mode, which reduce file size to **3/8th** of original image file size.

In the following process original file is not accessed any more.

Key and Mouse Control

- Mouse click: image address, sigma0 display (bottom task bar)
- Mouse drag: Left mouse button + move : real image move (drag image)
- “r” key: move to adjacent scene
- “control” key + mouse click in index image: Scene jump
- “t” key hold and mouse click: draw poly vertex
- “y” key: register polygon.
- “L” key: image brightness increase.
- “k” key: image brightness decrease.

5. Tile Image Handling-1. Open Single Tile file



The screenshot shows a software window titled "IMG-HH-ALOS2042473675-150307-FBDR1.5RUDtile". The main area displays a large, dark, textured satellite image. A red arrow points to a small inset window in the top-left corner of the main image. A yellow box with a red border contains the text "Click mouse inside real size window" with a yellow arrow pointing down to the main image. A menu is open, showing options: "Open Original File", "Open Single Tile File", and "Open Multiple Tile File". The "Open Single Tile File" option is selected, and a sub-menu is visible with options: "Alos2 L1.5 Tile file", "Alos2 L1.1 Tile file", "Alos L1.5 Tile file", "Alos L1.1 Tile file", and "Pure SLC Tile". The "Alos2 L1.5 Tile file" option is selected. Below the main image, a task bar displays the following information: "Tile ID kx,ky=(4, 4), pix,lin=(4355, 4331),lat,lon=-3.018168, 37.247597, sigma0:pv1=-14.65, pv2=-9.00(dB)".

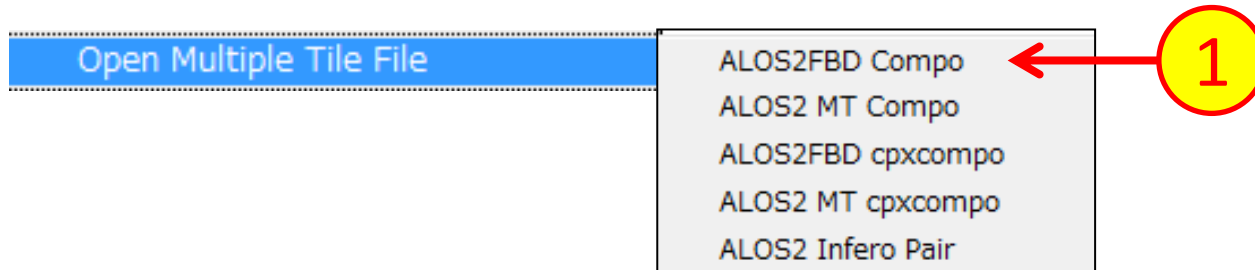
Select menu and select target file, then a tile of image is displayed.

Click mouse inside real size window

Pixel address, geo location and intensity value are displayed in the task bar.

Tile Image handling-2.(1/2)

Create FBD color composite



2

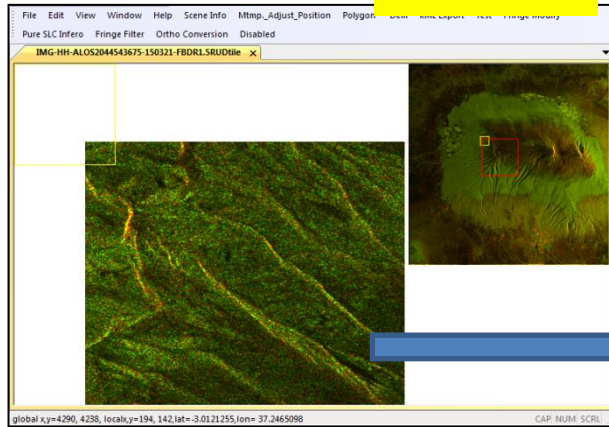
Select HH polarization Tile File

HV Tile file is searched in the same folder of HH polarization tile file then create composite and display automatically.

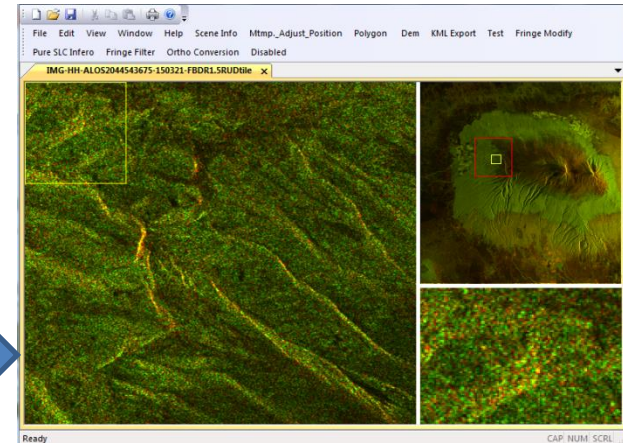
Image handling-2.(2/2)

FBD display and basic image view manipulation

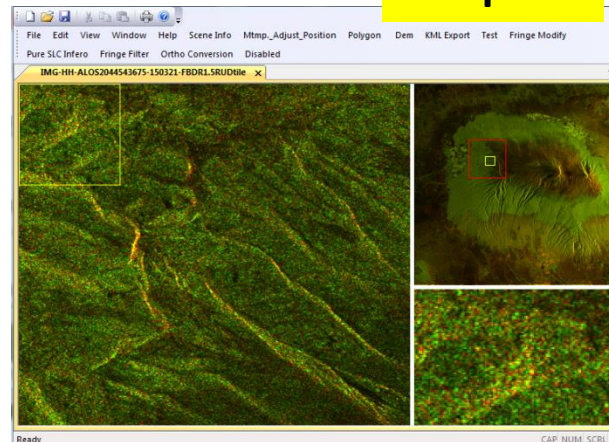
Scroll tile



Drag mouse in the tile and press “r” key, then tile is extended to open area(s).



Jump tile



Hold “ctrl” key and click mouse inside index image.

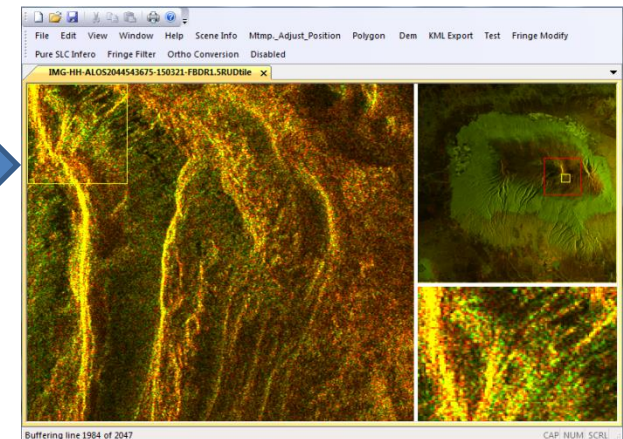
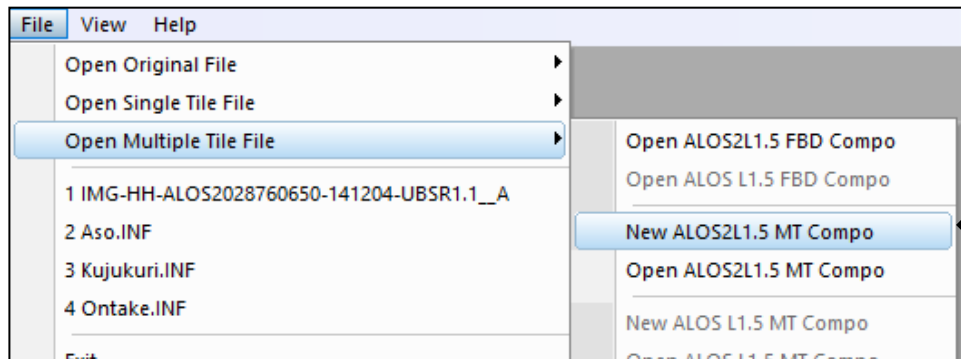
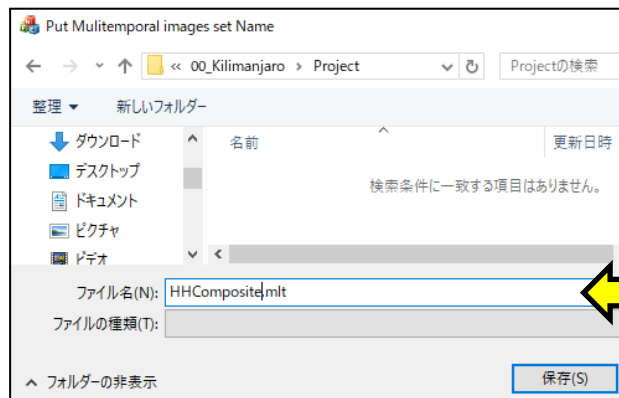


Image Handling-3. (1/5)

Create Multi-temporal composite



1 Select menu
"New...MT Compo"

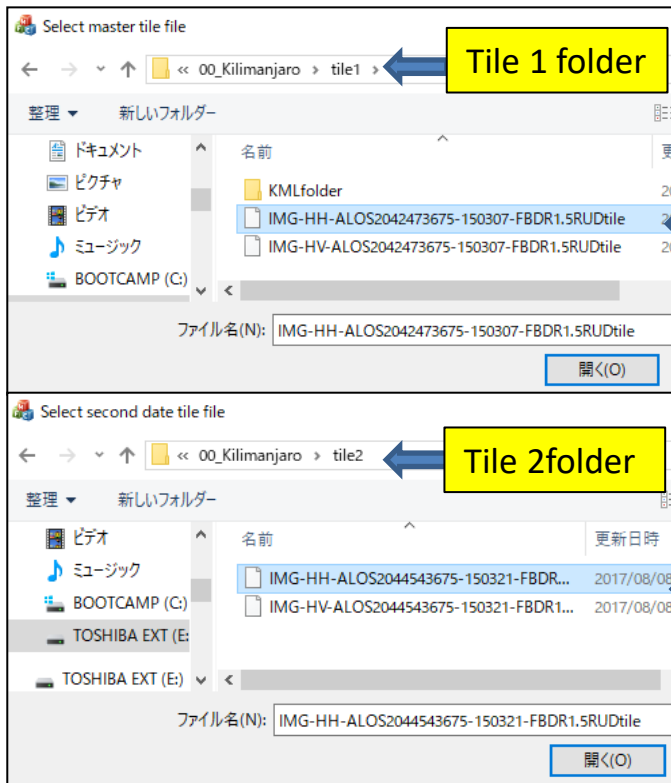


2 Create a project file
in a project folder.

This process handles Lev.1.5 image files.

Image Handling-3. (2/5)

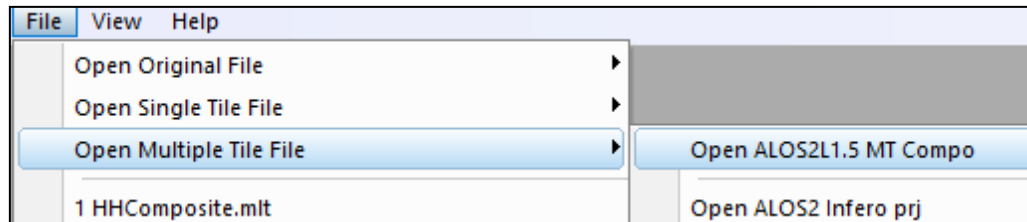
Create Multi-temporal composite



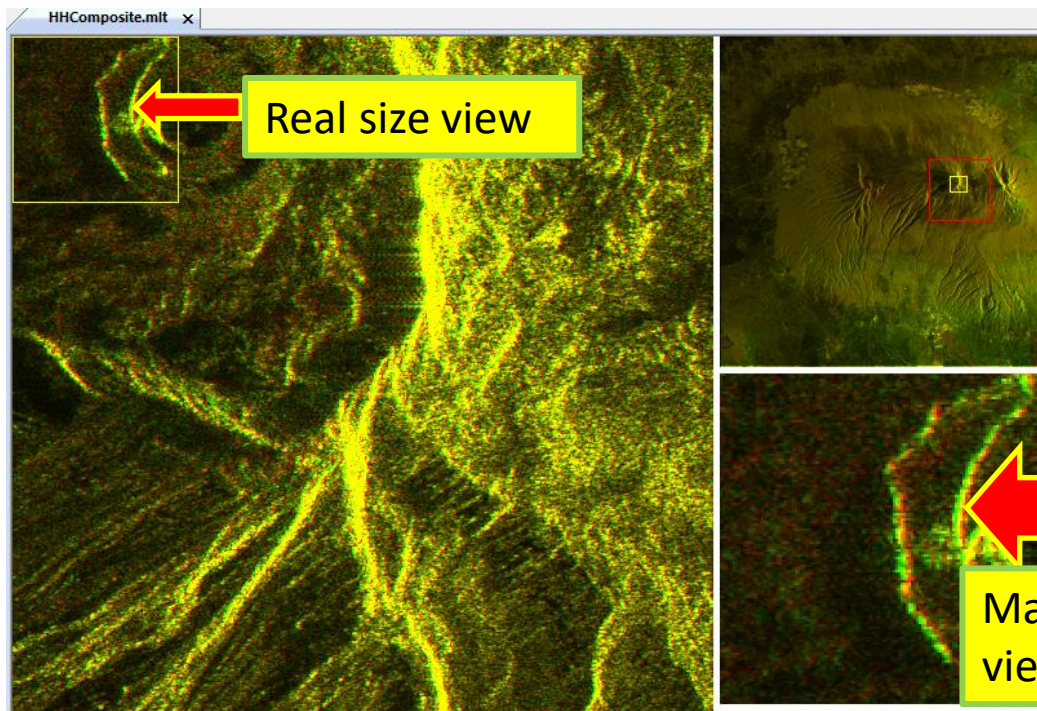
Select 2 or 3 images which cover the same area but different observation dates.

Image Handling-3. (4/5)

Create Multi-temporal composite



Open project by selecting created project file.



Real size view

In this case, image blur is recognize at a bright edge in the image.
This blur can be corrected by adjusting relative image position. (see next page).

Magnified view

Image Handling-3. (5/5)

Create Multi-temporal composite

File Edit View Window Help Scene Info MT position adjust Polygon Dem

Disabled Select

HHComposite.mlt x

Calc Tie point adjust parameter

Adjust Tie-Point displacement

1 Click mouse at a blur pixel by holding "c" key.

2 Select menu

3

Tie Point displacement set

Horizontal -1.7470862

Vertical 0.6255668

OK

CANCEL

Blur image

Blur corrected

After a while, a dialog to show correction value appears. Then click OK. The blur is corrected. You can modify the value in the dialog here or from menu "Adjust Tie-Point displacement".

6. Other image manipulation (1/5)

Polygon draw

- You can draw polygon in both real size window and magnified window.
- Number of possible polygon at one tile is up to 60 and number of vertex must be less than 512.
- Polygon is always linked with tile and independent from other tile-linked polygon.

Draw polygon: Hold “t” key and click mouse inside real size window or mag window.

To close a polygon draw: Press “y” key, then polygon will close.

Selection of polygon draw area: first polygon decide draw window. You can draw polygon moving in both windows at a time, but when you press “y” key. Points outside current draw window will be erased.

Polygon ID: Polygon ID can be displayed by menu selection in polygon menu.

Other image manipulation (2/5)

Polygon save/Import

- Save :Polygon save is also by a menu selection in the Polygon menu. Polygon file name is current tile id. The file is in the image tile folder and in the sub-folder named “PolygonFolder” or “GeoPolyFolder”.
- Save mode: Polygon is saved as vertex point array or latitude/longitude position array (geopoly). The former has attribute of “.ply” and the latter has the attribute of “.gpy”.
- Import polygon can also be done by menu selections in Polygon menu. At the selection the program suggests you to select current tile linked polygon file. If the file does not exist, the polygon is not created yet.
- Geopoly can be exchanged with other image through geo-tag.

Other image manipulation (3/5)

Pix value statistics

- Sigma0 value average and variance can be counted by menu selection in Polygon menu.
- If you select “polygon statistics, a message box shows the results. Also, a csv file will be generated to store the values. Unit of the values are dB value of sigma0. You can use the value in various way like absolute reflection index comparison, classification referencing and so on.

Stat report on polygon

Poly ID	npix	1st vertex (x	y)	in tile vtx(x y)		CH1 mean sigma0(dB)	CH1 std high sigma0(dB)	CH2 mean	CH2 std high
0	8174	7345	4830	1201	734	-14.435	-10.729	-12.595	-8.868
1	5897	7379	4767	1235	671	-14.447	-10.773	-12.653	-8.95
2	4879	7175	5110	1031	1014	-14.349	-10.667	-12.779	-9.028
3	4385	7004	4957	860	861	-14.428	-10.765	-14.792	-11.102
4	6617	6944	5166	800	1070	-14.382	-10.684	-14.59	-10.852

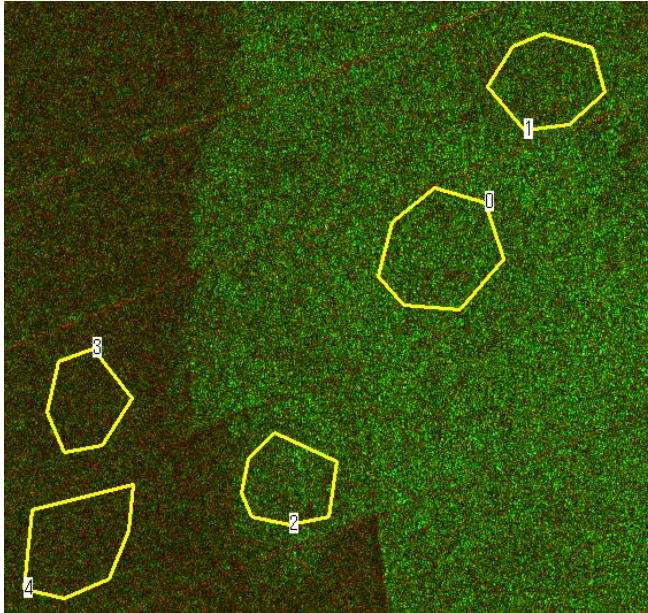
Other image manipulation (4/5)

Applications of Pixel Value Statistics

- SAR image pixel values are precisely calibrated, which is a big advantage over optical remote sensing system.
- Using the values, we can detect the changes happen in forests, agriculture fields and urban areas.
- Some times even a soil moisture value can be detected using the values.
- In the forest area, deforestation by logging and forest fire is a severe issues in the global warming trend.
- The program has the function to evaluate reflectance statistics in the areas defined by drawn polygons.

Other image manipulation (5/5)

Draw polygon and get statistics table.



Drawing polygons in a tile and select menu
“ “
,

A statistics value is reported in a csv file.
The polygons group can be stored in a file
with the tile id of current scene.

Tile can be saved either in a polygon pix
address or lat,lon values. The latter can
export to other scenes using geo parameter.

HH Stat report on polygon

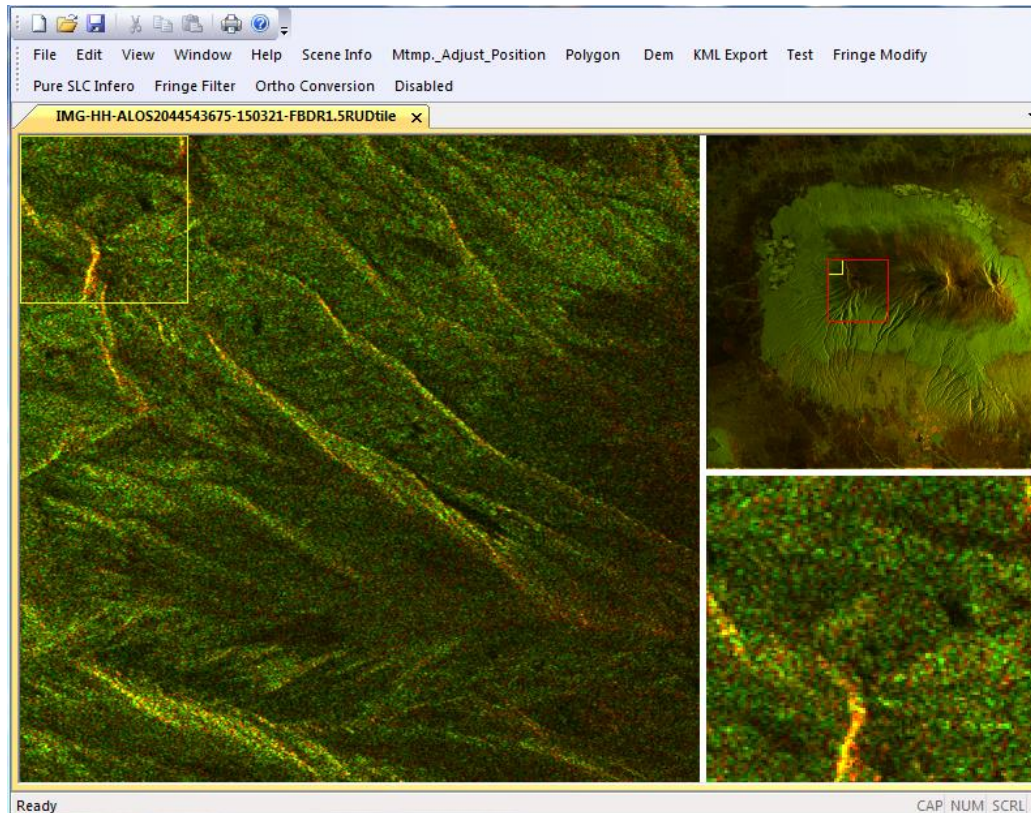
Poly ID	npix	1st vertex (x	y)	in tile vtx(x	y)	CH1 mean sigma0(dB)	CH1 std high sigma0(dB)	CH2 mean	CH2 std high
0	8174	7345	4830	1201	734	-9.97	-6.285	-5.296	-1.494
1	5897	7379	4767	1235	671	-9.897	-6.265	-6.254	-2.484
2	4879	7175	5110	1031	1014	-9.768	-6.13	-6.414	-2.551
3	4385	7004	4957	860	861	-10.071	-6.386	-10.313	-6.68
4	6617	6944	5166	800	1070	-9.941	-6.282	-10.088	-6.395

6. Interferometry Support

- All functions to create PLASAR2 interferometry is supported by this program.
- Currently phase unwrap is not supported.
- Created interferogram, coherence and differential interferogram and dual dates amplitude color composite is exported as orthographically rectified kml/png images, which can be displayed on Google Earth.

7. Data handling Practice 1(1/6)

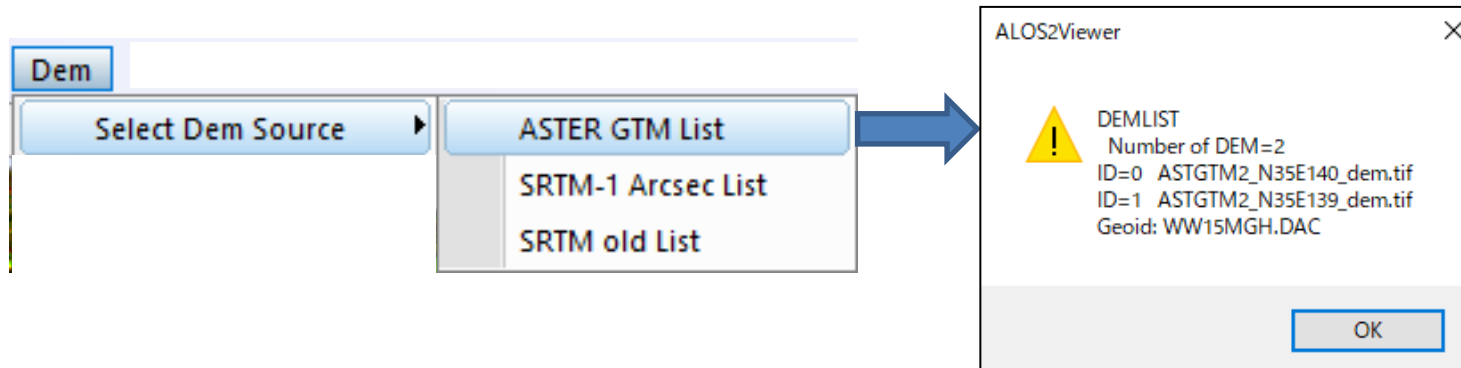
FBD Composite->KML out



Menu : File->Open Multi File Composite->Alos2L1.5FBD Compo and Select one Tile Image of an FBD pair;

Practice 1(2/6)

Dem import(part 1 of 3)



From Dem menu, select dem source kind. ASTER GDEM is usually recommended but other source is OK if the data available.

When use select dem kind, a list of dem which covers target area is shown in the dialog.

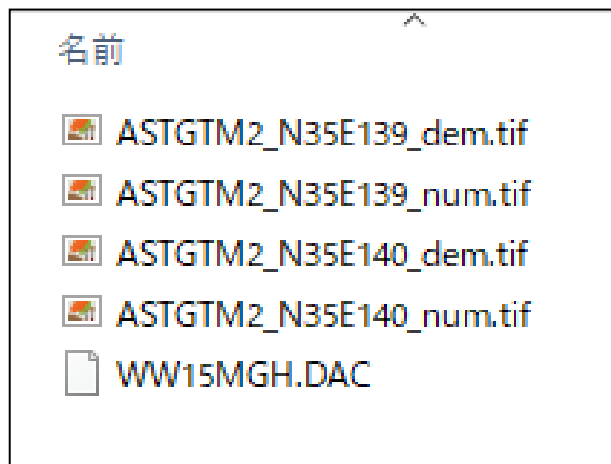
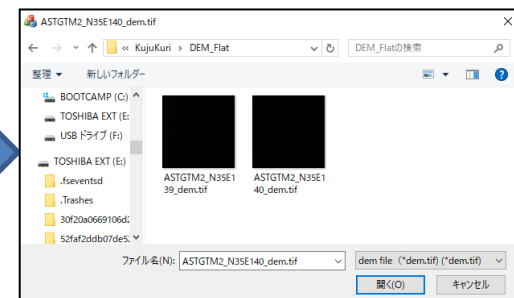
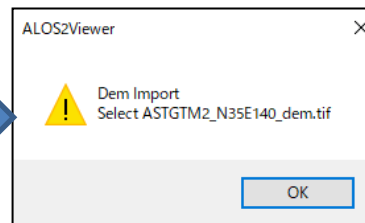
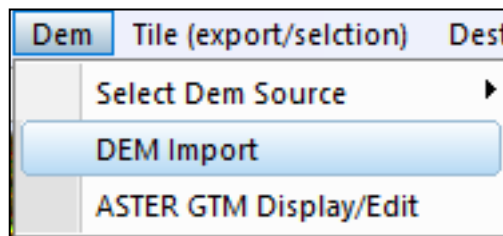
For the ALOS/ALOS2 images, number of DEM is up to 4 but if the scene is inside dem unit rectangle only one is enough. In the above example 2 dem unit is required.

You must also prepare geoid file (WW15MGH.DAC).

Prepare listed dem file and the Geoid file.

Practice 1(3/6)

Dem import(part 2 of 3)

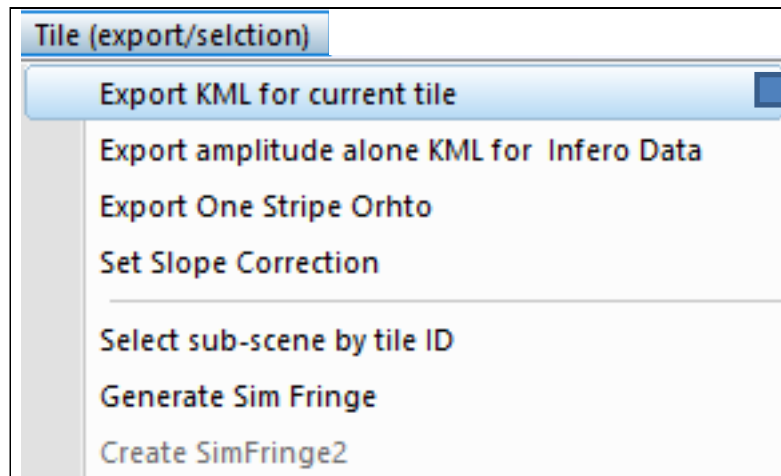


Select one of the dem file(s) and geoid file by following the program suggestion. Necessary dem files are imported automatically assuming the necessary dem files are in the same folder.

All the necessary dems (**_dem.tif) are in the same folder.

Practice 1(4/6)

Dem import(part 3 of 3)

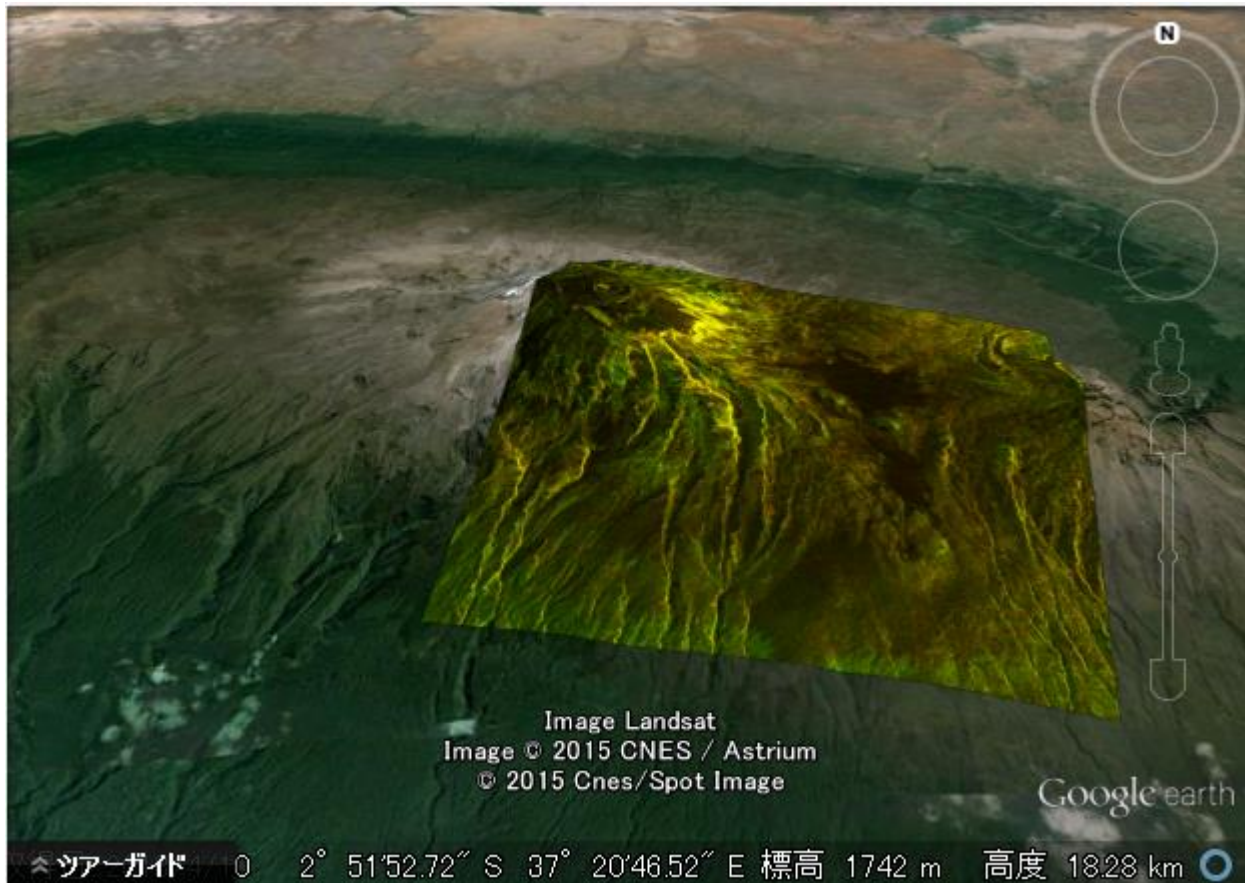


Select menu and kml files are created in the "kml" folder inside master tile folder.

For other tiles, display the tile and select this menu. Then the results stored in the same folder. File id is the tile index number.

Practice 1(5/6)

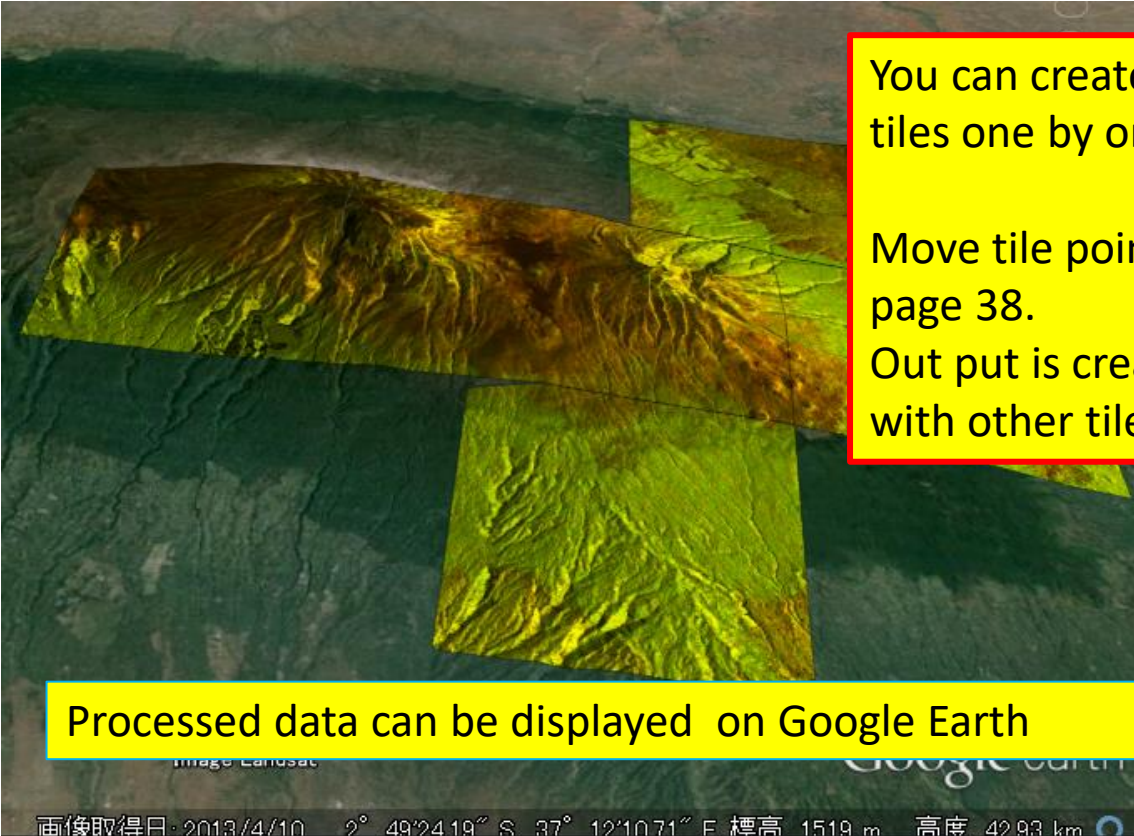
KML display



- A tile is ortho rectified as a png image.
- Ortho rectification is conducted by connecting two tiles at one process which makes no blank for a tile except the main frame border area.
- By switch on and off, you can check how SAR shows ground object .

Practice 1(6/6)

Ortho-Graphic SAR as FBD Composite



You can create orthographically rectified tiles one by one by repeating ;

Move tile point and repeat process of page 38.

Out put is created in the same KML folder with other tiles.

Processed data can be displayed on Google Earth

面像取得日: 2013/4/10 2° 49'24.19" S 37° 12'10.71" E 標高 1519 m 高度 42.83 km

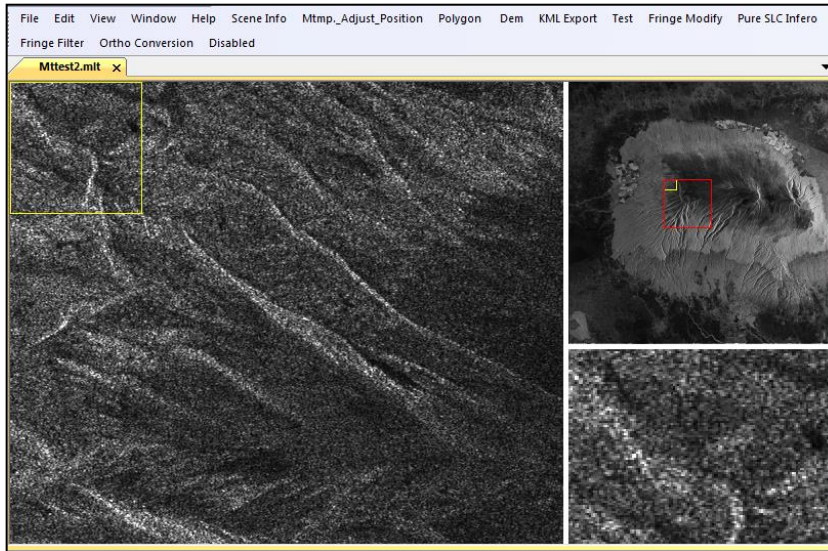
8. Practice 2(1/5)

Multi-temporal composite->KML out

- Prepare two different observation date SAR to observe a same area. Put data set in an arbitral process folder.
- Menu: Open Multiple Tile File->New ALOS2L1.5 Mt Compo
- Create a “MtProcess” folder in the above process folder. Create a project file by putting arbitral project name in the file open dialog.
- Select image tile one by one. First image becomes master and second image becomes slave.

Practice 2(2/5)

Initial image display



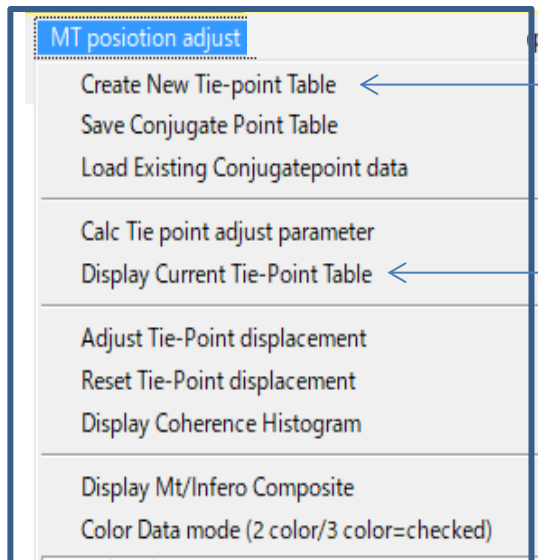
Although you have *selected two image tiles*, *initial display is a gray scale (not color)*.

At this point master and slave image are displayed as separate images because image relative address is not match each other. To create a color composite of multi temporal images, you must first adjust relative position of images. You can switch master and slave by clicking “v” key.

The process to create position adjust table is explained in the next pages.

Practice 2(3/5)

Initial displace adjust



Click this menu item, then relative displacement of the pair image at 4 corners are calculated from internal table are created.

Check the table value from this menu item.

Initial image pair is not exactly overlaid each others.

Initial process is to adjust relative displace using internal pixel address to latitude / longitude value table.

To achieve pair image link process, necessary preparation is only the process shown above.

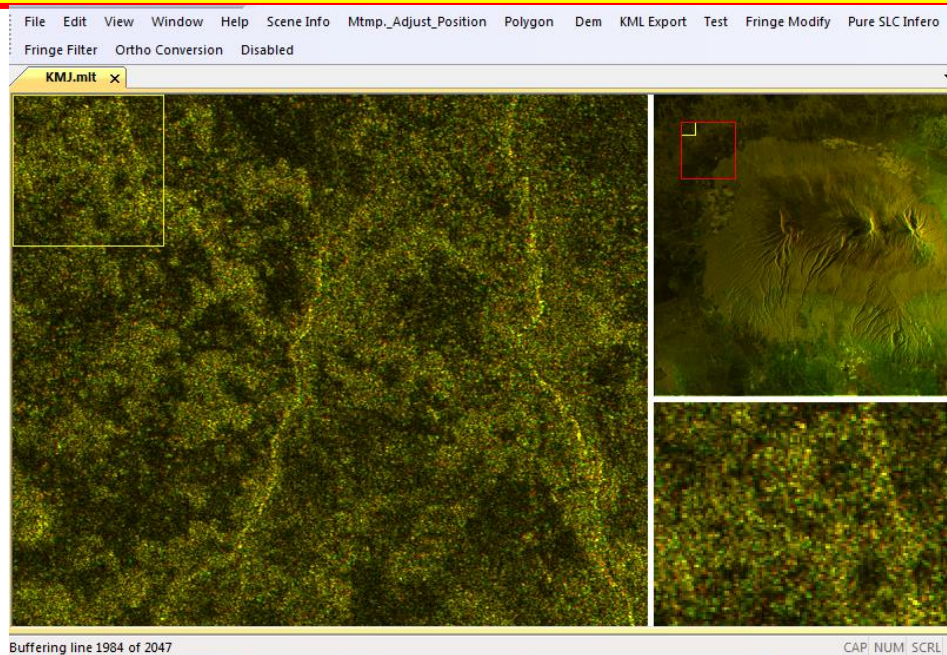
Close opened image, then select menu "Open ALOS2 MT composite" project menu and select created project file.

Practice 2(4/5)

Display Color composite

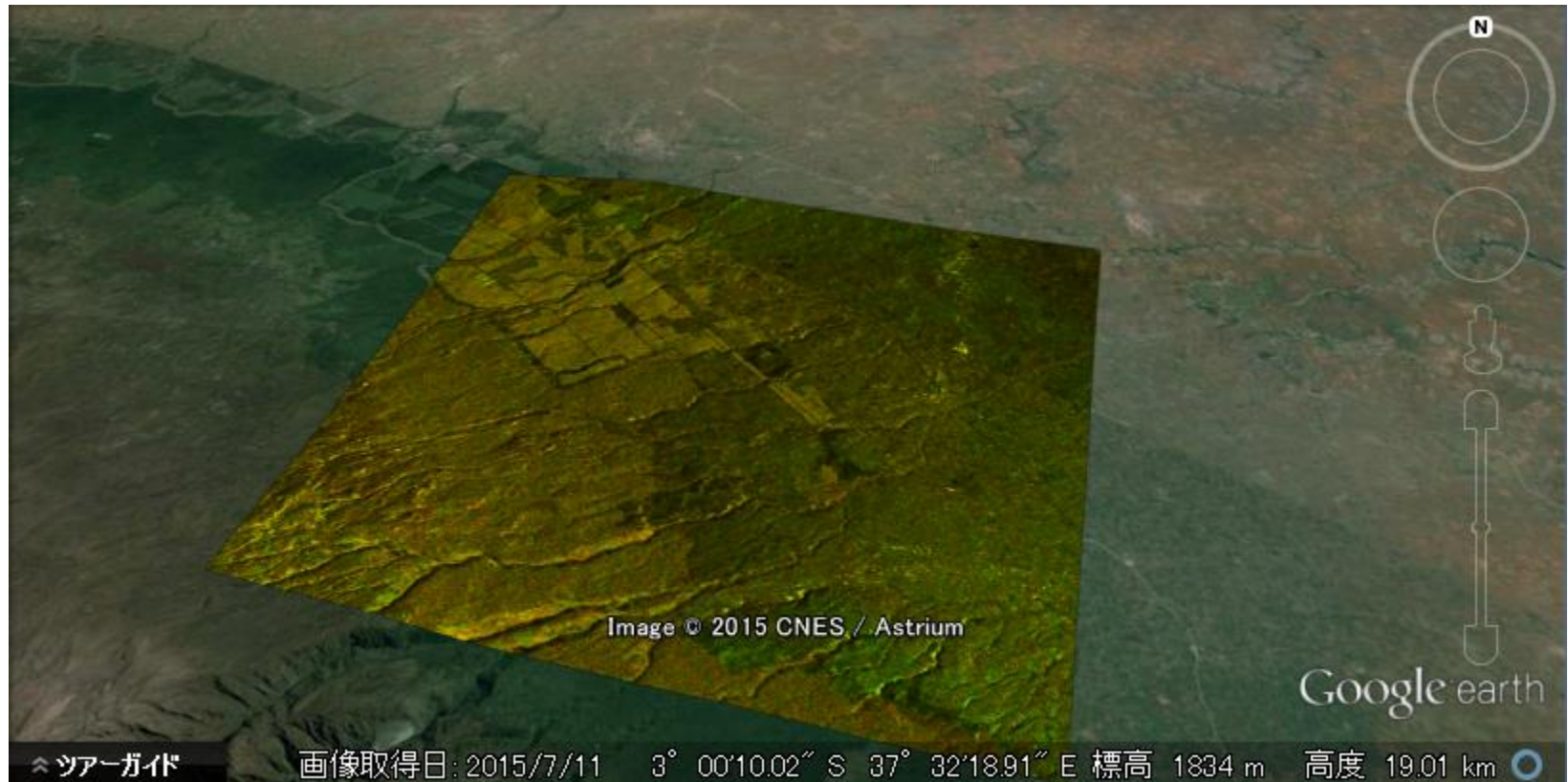
If some color blur in overlaid image, adjust relative pixaddress by following the process in page 28 of this document.

Ortho out process is exactly the same as shown in section 7 (page 36-38).



Practice 2(5/5)

KML display of MT orthographic image



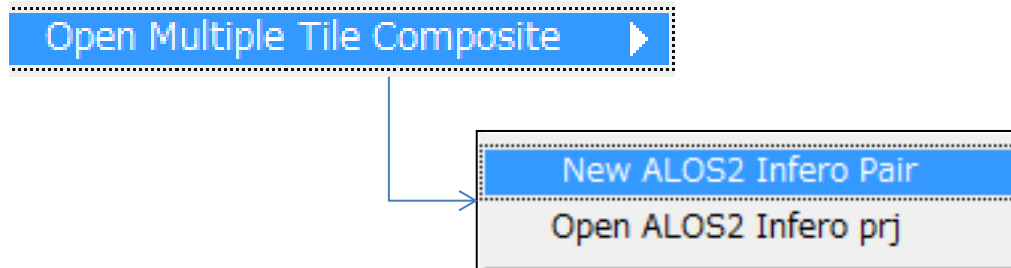
9. Practice 3(1/19)

Interferometry process



Practice 3(2/19)

Initial Interferometry process



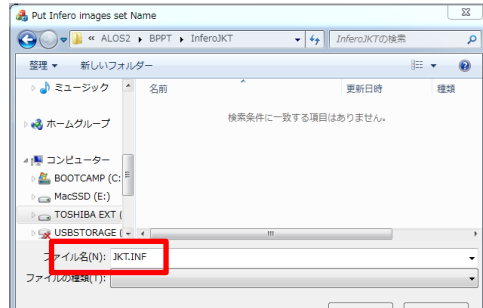
Interferometry and multi-temporal composite of L1.1 data is the same process.
Start from "New ALOS2 Infero Pair".

Create New project in a project folder which you have created or selected.

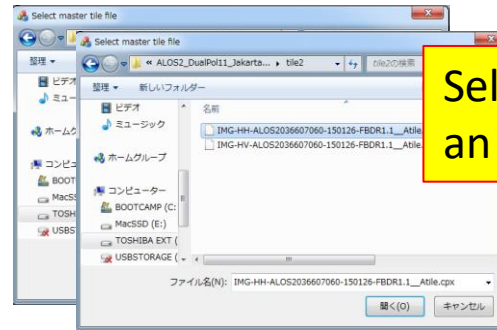
Select two L1.1 tile images which make a inteferometry pair.
Then initial process starts and two images are separately prepared and first image will be displayed at initial stage.

Practice 3(3/19)

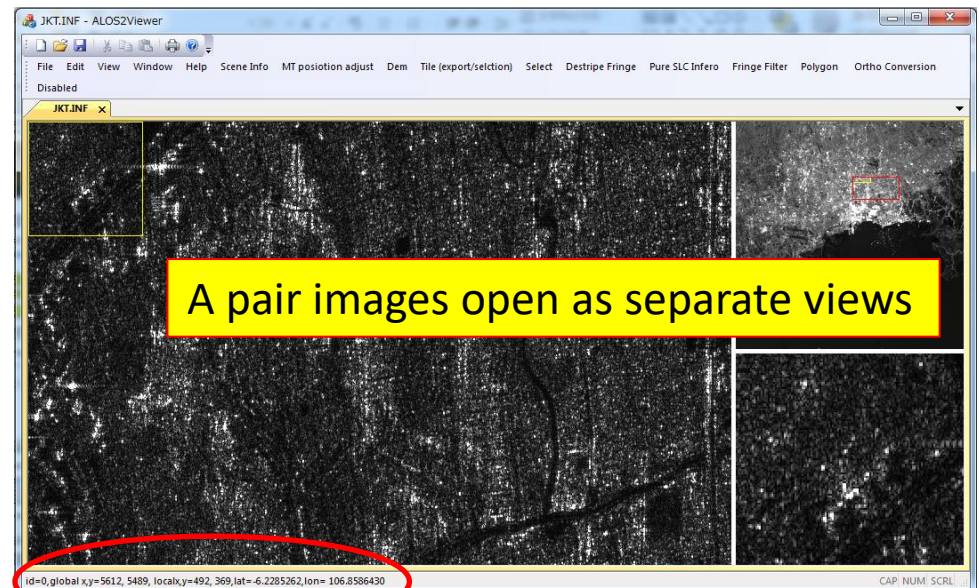
Project start ->Initial display



Create an infero project in a newly created project folder.



Select two image tiles of an infero pair



A pair images open as separate views

Displat tile id=0, global address=5612,5489,local point x,y=492,369



Press "v" key to switch image "0" and image "1" and vice versa.

Displat tile id=1, global address=5612,5489,local point x,y=492,369

Practice 3(4/19)

Initial setup and preparation process

The screenshot shows the ALOS2Viewer interface. The main window displays a grayscale aerial image of a forested area. A yellow arrow points from the 'Close Image View' text to the 'Kujukuri.INF' window title bar. The 'MT position adjust' menu is open, with 'Create New Tie-point Table' circled in red. A yellow arrow points from this menu item to a dialog box titled 'ALOS2Viewer'. The dialog box contains a warning icon and the following text:

! K=0, MPx, MPy=0, 0, displace x,y=37.85, -4.68
K=1, MPx, MPy=23339, 0, displace x,y=38.79, -4.20
K=2, MPx, MPy=0, 32520, displace x,y=37.93, -5.10
K=3, MPx, MPy=23339, 32520, displace x,y=38.80, -4.62
PhincH=0.000000, PhincV=0.000000
Precision slave pixel adjust(x=0.000, y=0.000)

An 'OK' button is at the bottom right of the dialog box. A yellow arrow points from the 'Click OK' text to this button. A yellow box at the top right contains the text: 'Soon a dialog appears to show tie point table. Click OK and close current view.'

Close Image View

MT position adjust

Create New Tie-point Table

Save Conjugate Point Table

Load Existing Conjugatepoint data

Calc Tie point adjust parameter

Display Current Tie-Point Table

Adjust Tie-Point displacement

Reset Tie-Point displacement

Display Coherence Histogram

Display Mt/Infero Composite

Color Data mode (2 color/3 color=checked)

ここに入力

ALOS2Viewer

! K=0, MPx, MPy=0, 0, displace x,y=37.85, -4.68
K=1, MPx, MPy=23339, 0, displace x,y=38.79, -4.20
K=2, MPx, MPy=0, 32520, displace x,y=37.93, -5.10
K=3, MPx, MPy=23339, 32520, displace x,y=38.80, -4.62
PhincH=0.000000, PhincV=0.000000
Precision slave pixel adjust(x=0.000, y=0.000)

OK

Click OK

Soon a dialog appears to show tie point table. Click OK and close current view.

Next step is to select menu "Open Infero Project" for opening 2 date infero composite.

Practice 3(5/19)

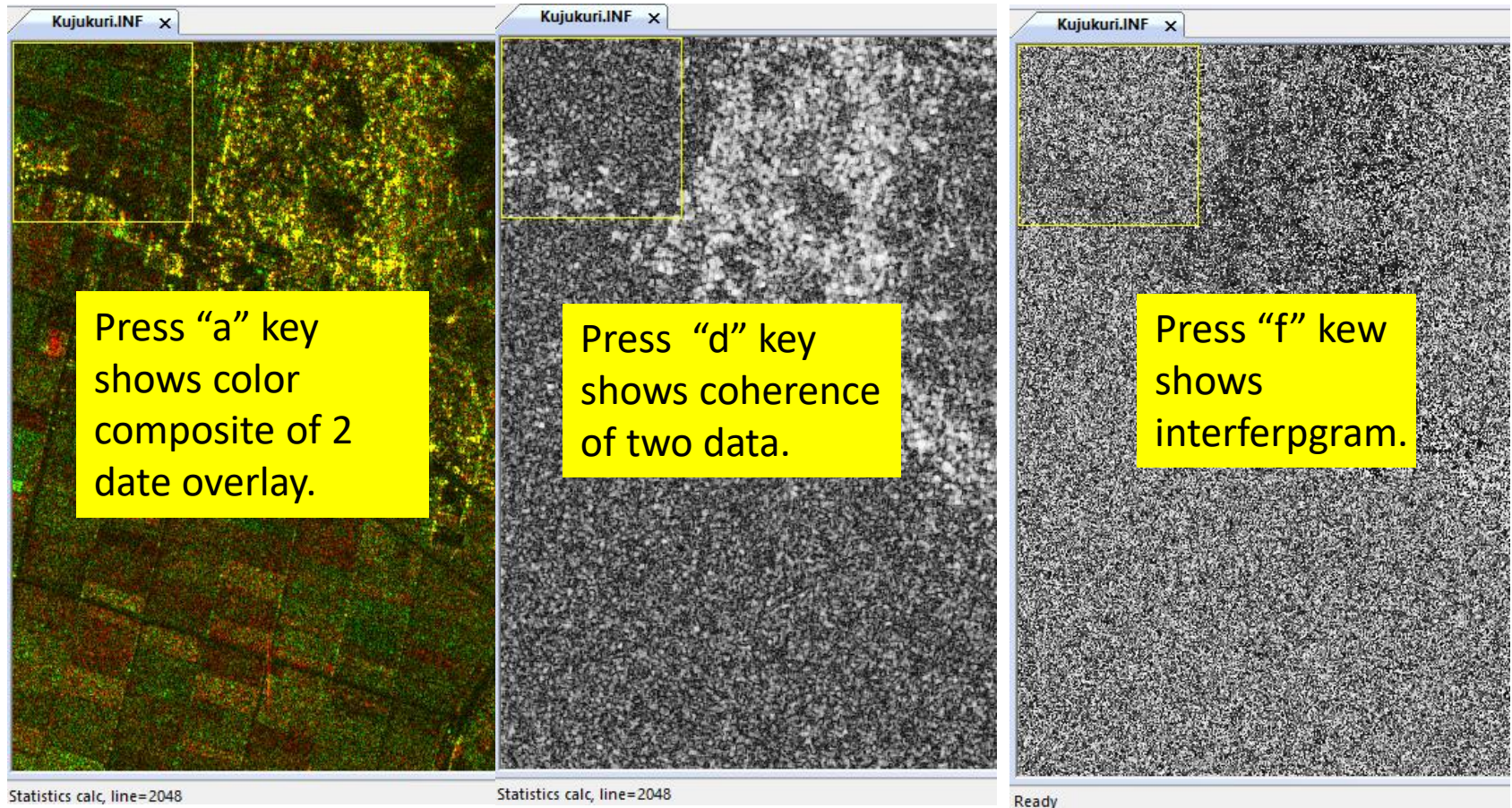
Open Project

Select menu “Open Infero Project” to open infero composite. The pair image is almost correctly overlayed.



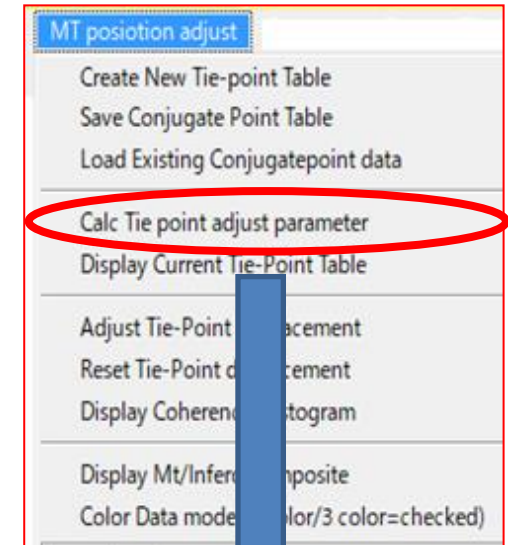
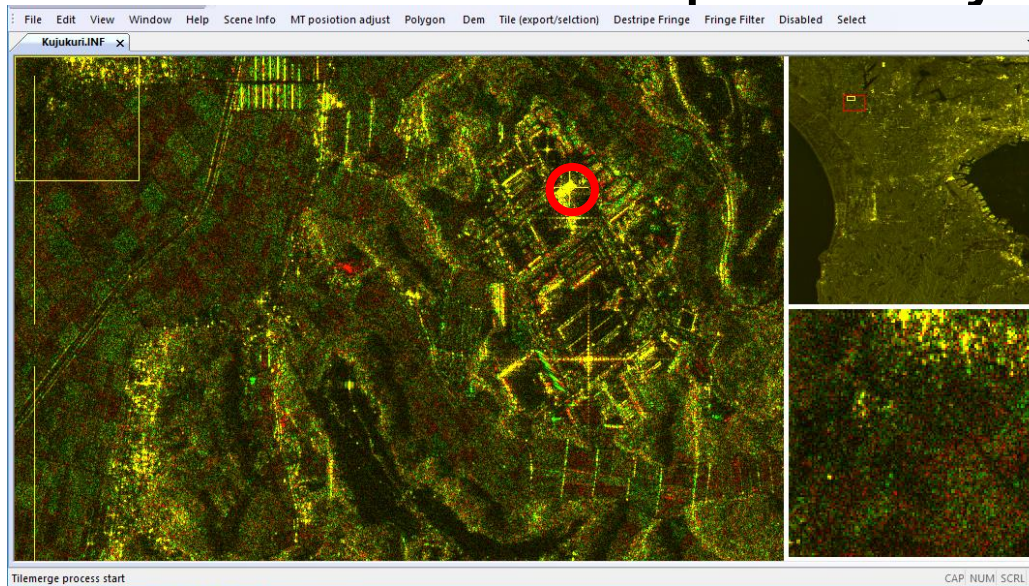
Practice 3(6/19)

Switch view



Practice 3(7/19)

Precision Tie point adjust (p1 of 4)

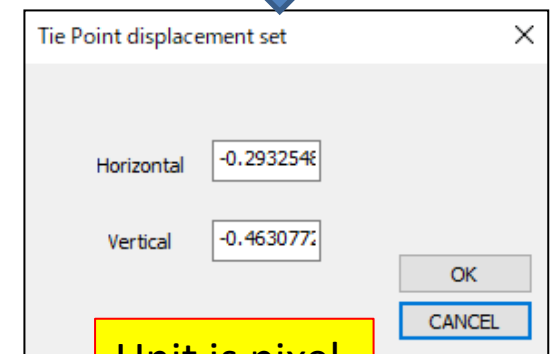


Hold “c” key and click mouse on a bright target in real size tile view.

Then select menu “Calc Tie point adjust parameter”.

After a short while, relative displace adjust value between master and slave images at the bright target is shown on the report dialog.

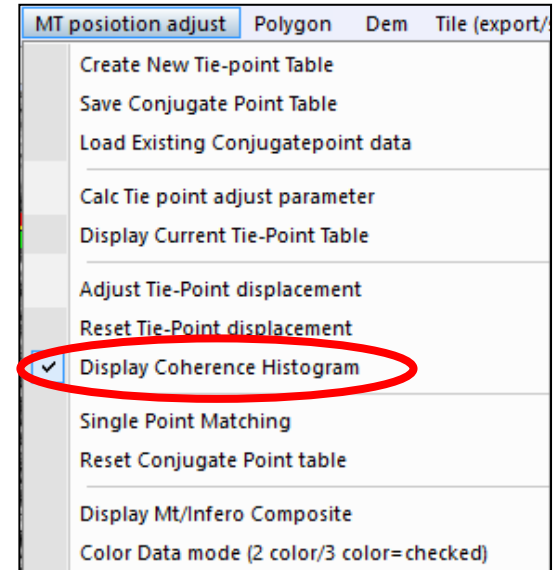
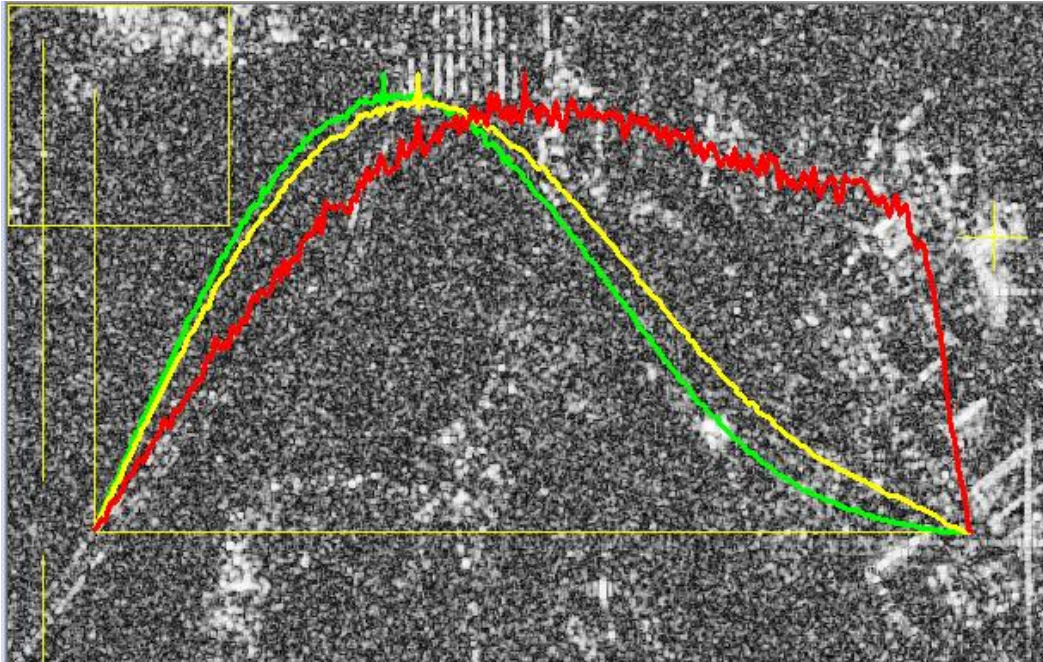
By click “OK”, the value is applied to the tile.



Unit is pixel.

Practice 3(8/19)

Precision Tie point adjust (p2of 4)



You can check the tie point matching quality by selecting menu “Display Coherence histogram” as shown above.

The 3 different color shows coherence histogram for bright pixels (red), medium brightness pixels (yellow), and dark pixels (green).

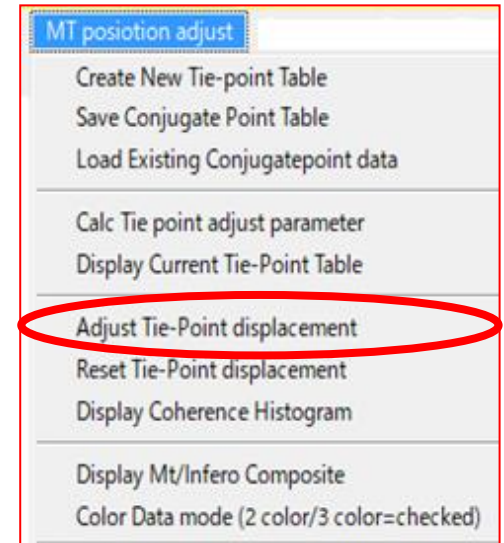
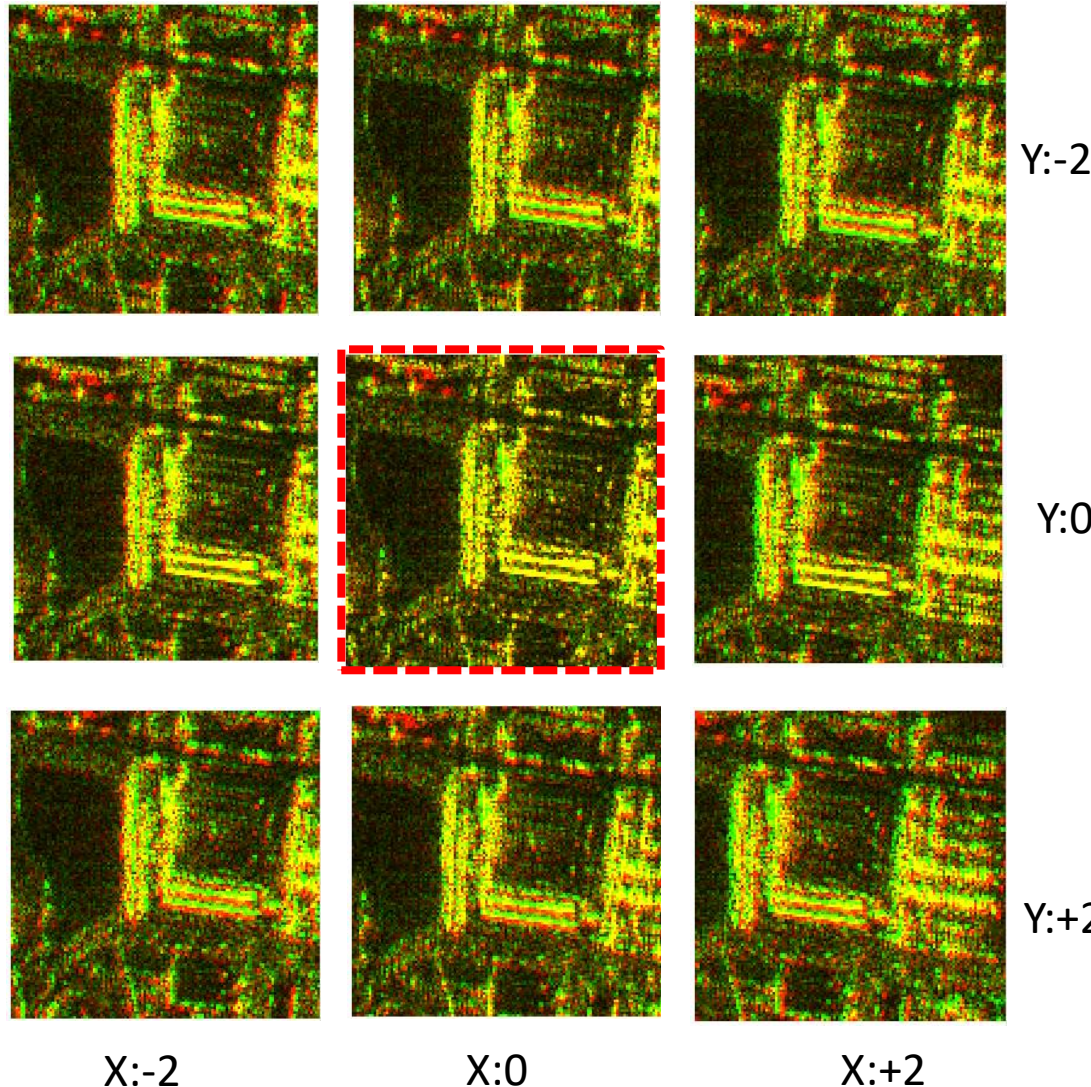
If the red curve histogram looks similar curve of yellow and green, tie point is not correct.

By selecting the same menu, the curves diminish.

When tie point match is correct, coherence image shows bright pattern as shown above image back ground.

Practice 3(9/19)

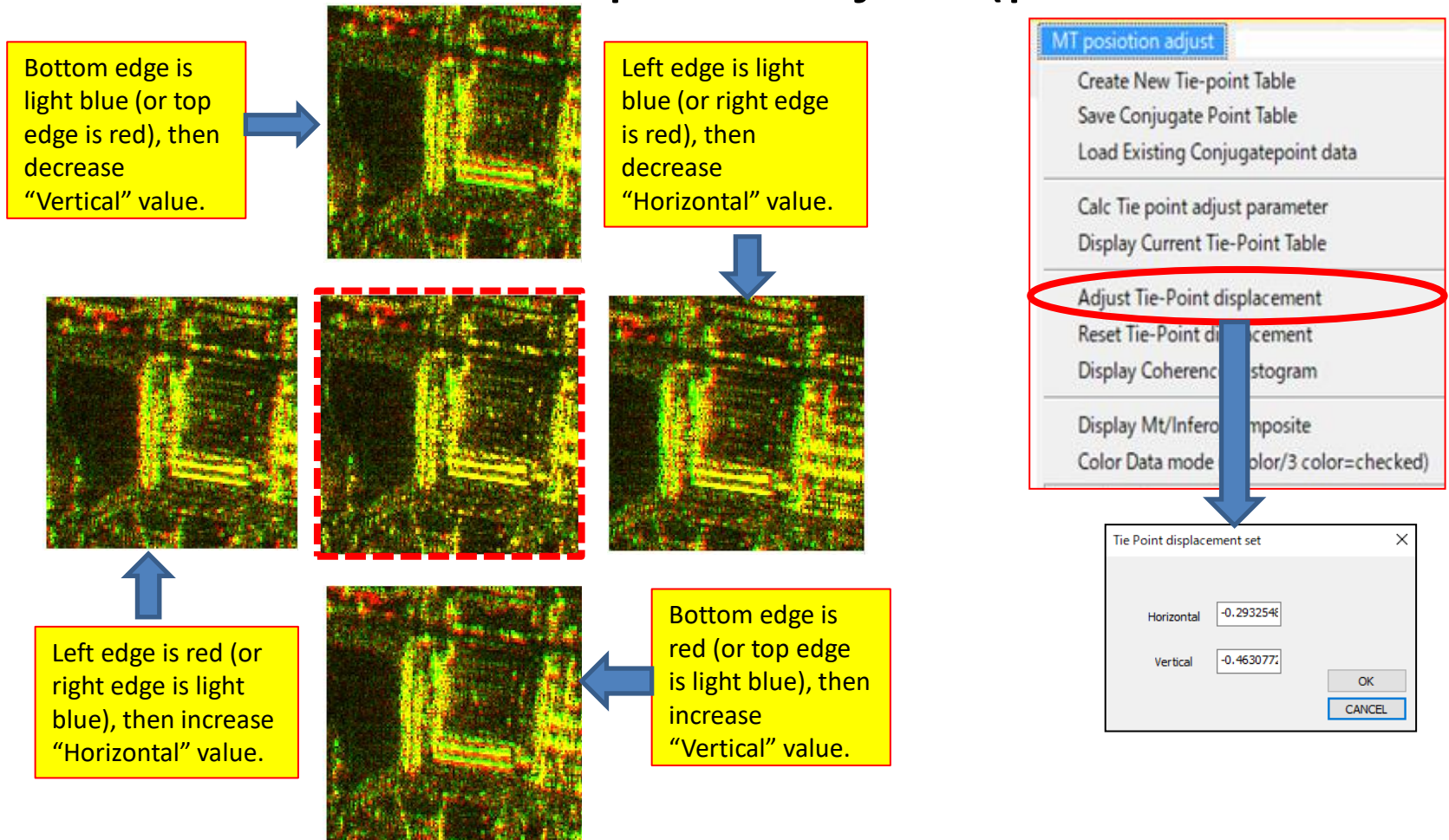
Precision Tie point adjust (p3of 4)



The 9 patch shows pixel displace value effect. The number means modify value of pixels in X and Y directions from the best match center value.

Practice 3(10/19)

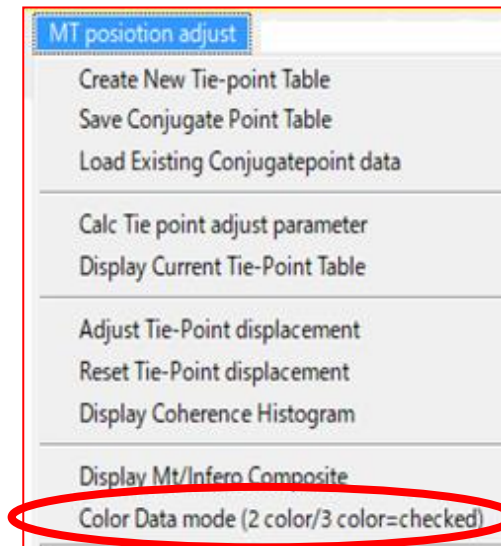
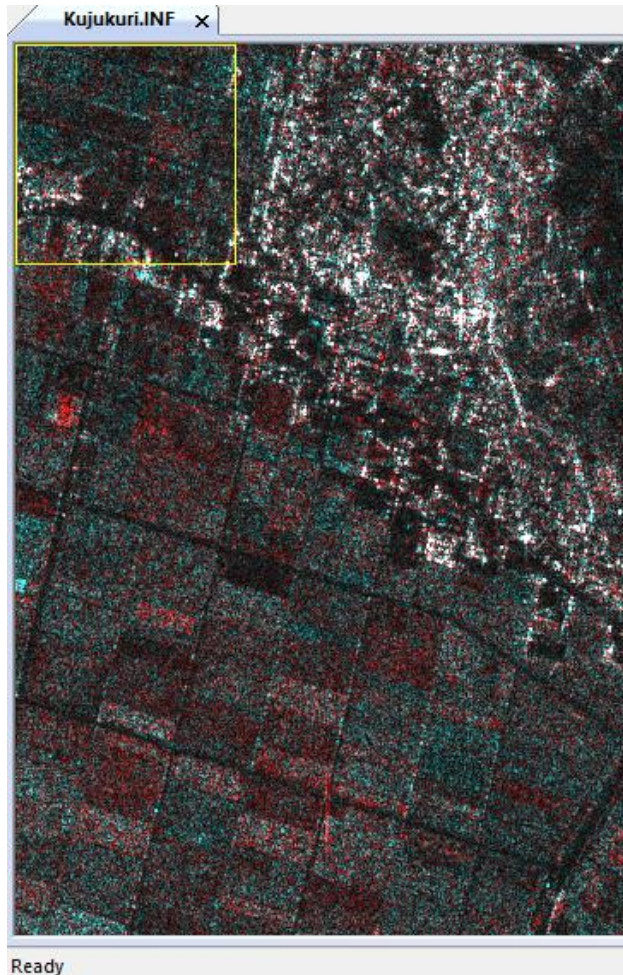
Precision Tie point adjust (p4of 4)



If coherence histogram shows poor coherence, watch the bright target and evaluate the bright edge and apply modification as shown in the caption box.

Practice 3(11/19)

Alternative display of view

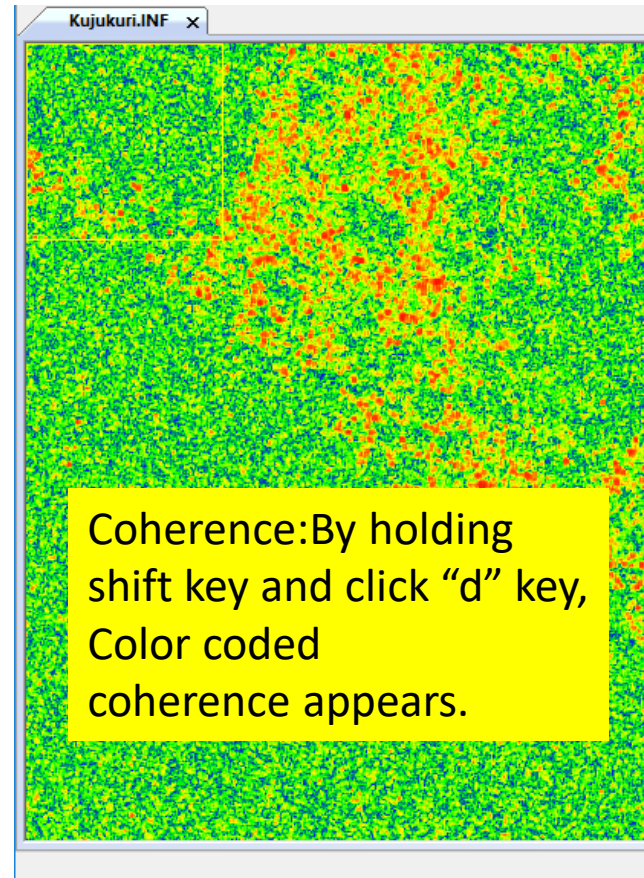
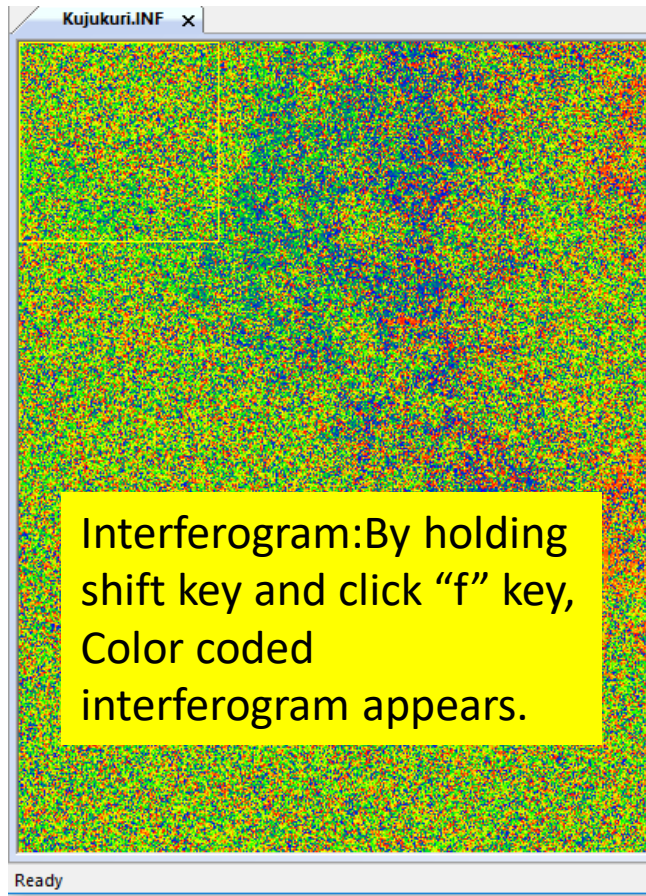


By select Color data mode, 2 color and 3 color mode is switched. Switch effect appears when tile is refreshed.

2 color is (R=master, G=slave, B=blank),
3 color is (R=master, G=B=slave).

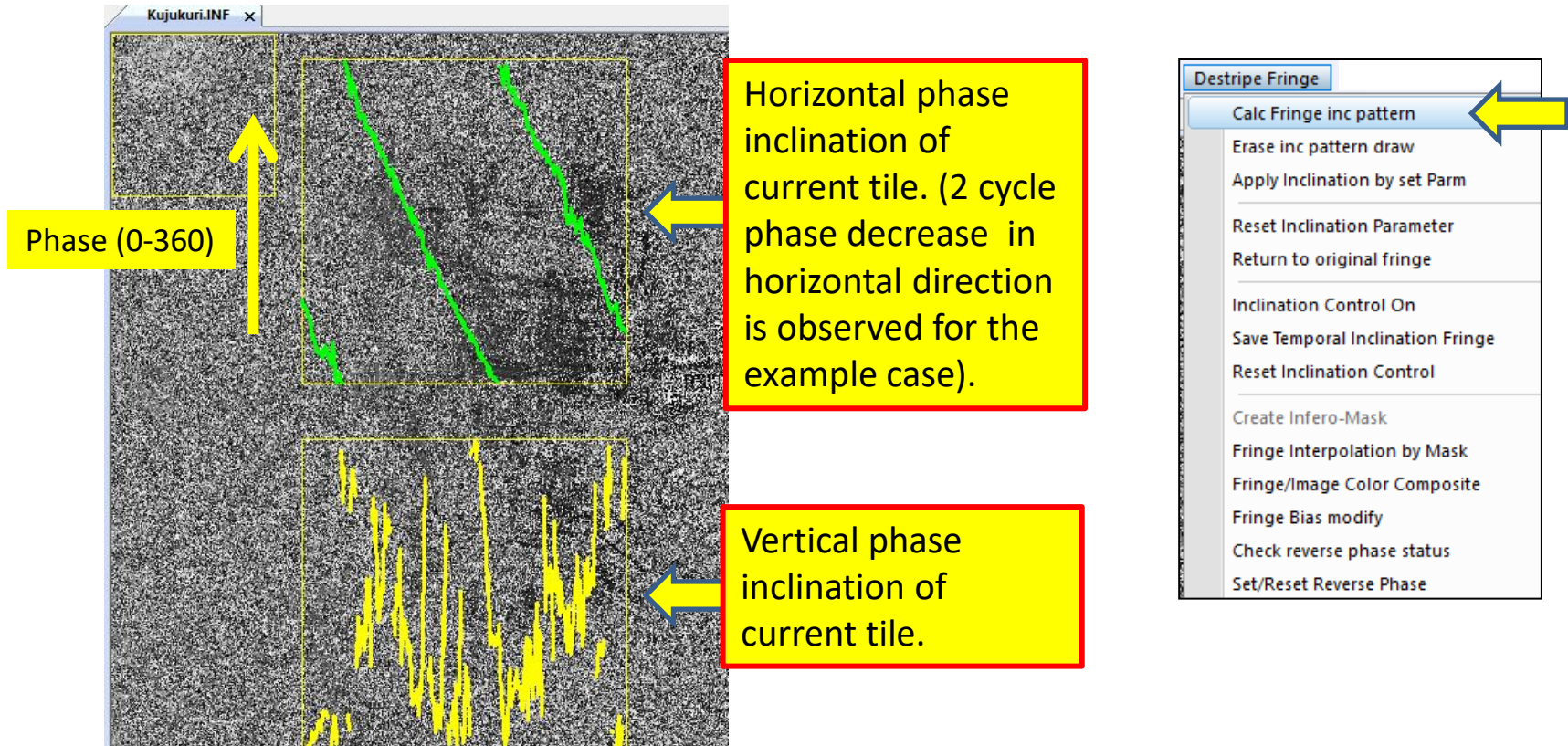
Practice 3(12/19)

Alternative display of interferogram and coherence



Practice 3(13/19)

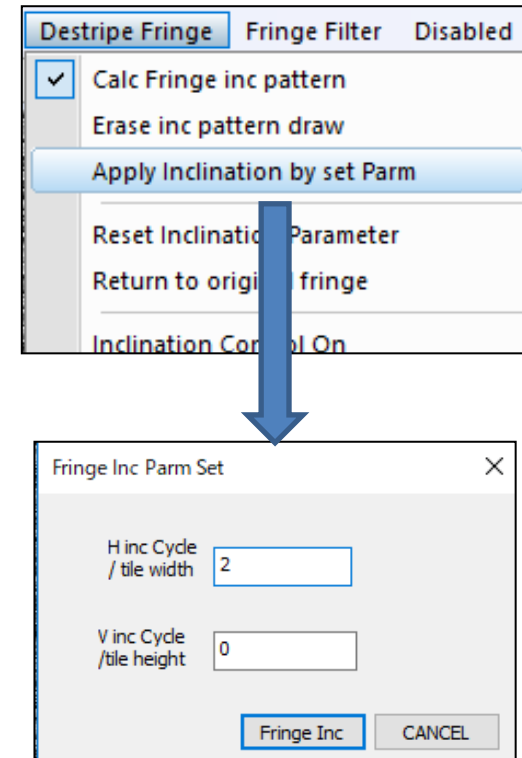
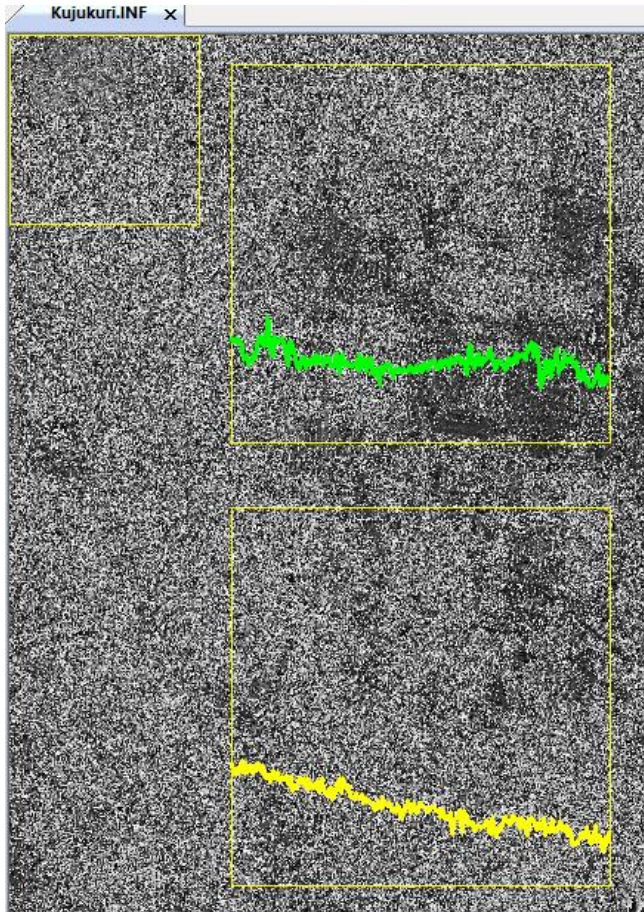
Evaluate stripe cycle



By selecting menu “Calc fringe inc pattern” , phase slope for horizontal direction (upper) and vertical (lower) are displayed. In this sample case, horizontally 2 cycle phase decrease along horizontal direction observed but no clear phase trend for vertical direction observed.

Practice 3(14/19)

Phase inclination corrected



Since phase inc in horizontal direction is -2 cycle/tile, correction is to put +2 cycle as shown above dialog.
The result is shown on the left image.

Practice 3(15/19)

Ortho rectify and export kml

This process is exactly the same with L1.5 kml export. Refer page 36-38 of this document.

Difference from MT composite is that the process create not only amplitude image color composite, but also create color composite interfrogram, differantial interferogram and coherence.

Practice 3(16/19)

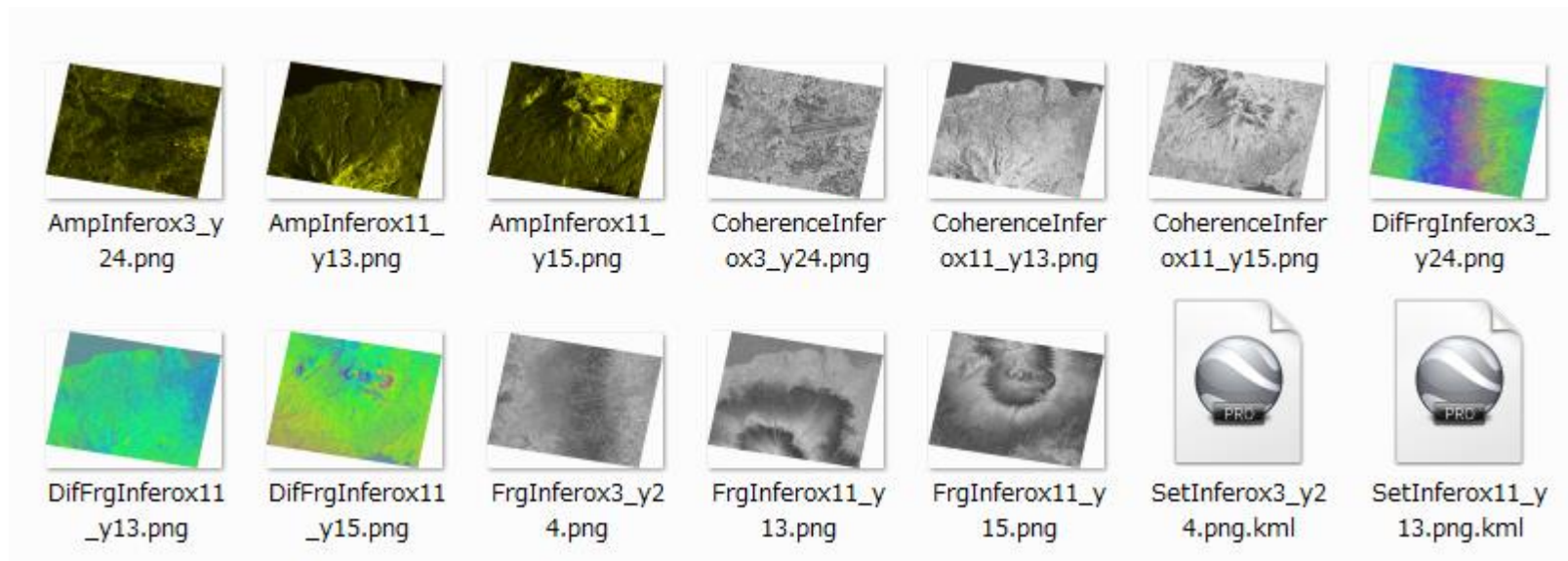
Differential fringe

- Differential interferometry is a good tool to detect precise land surface height change.
- Land subsidence in urban area, land deformation after an earth quake, volcano shape modification before eruption can be detected by the differential interferometry.
- This program has a function to export differential fringe in kml format.
- The process is implemented in kml export process. Automatic dif. Fringe generation will be done in the process.
- Out put is a group kml which consist of a dual temporal amplitude composite, fringe, dif-fringe as color coded and coherence.

Practice 3(17/19)

kml export of fringes

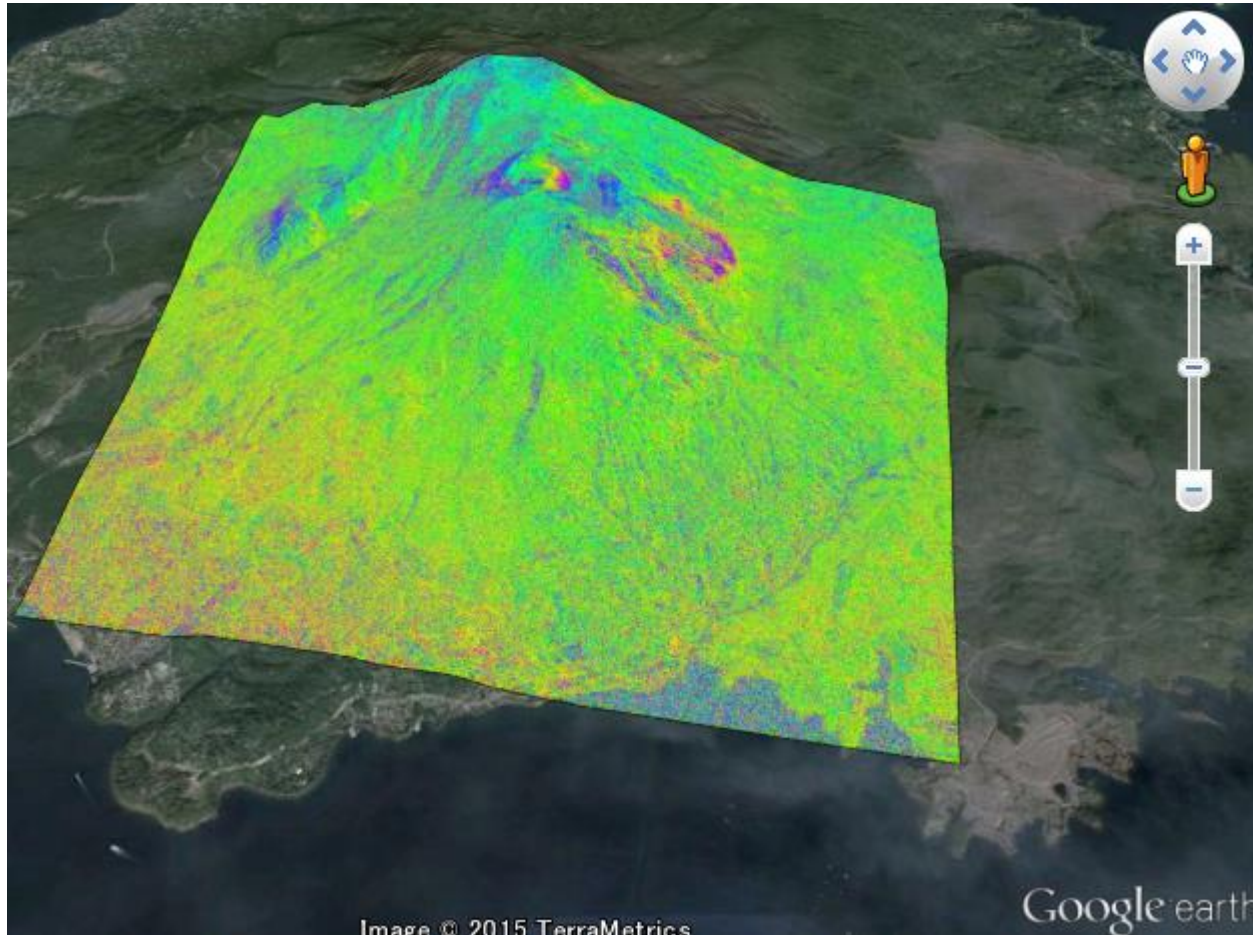
- Dem import, select menu that's it.
- Display image on Google Earth.



An example is shown above. Two kml files and associated png images are shown.

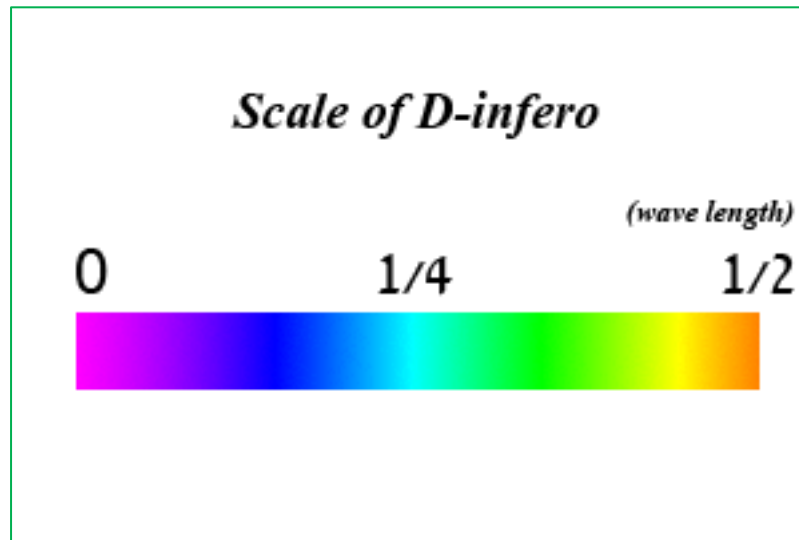
Practice 3(18/19)

Differential-interferogram on Google Earth



Practice 3(19/19)

Legend for Differential Infero



Legend is prepared as a Tiff file in the program folder.

DEM Download (ASTER GDEM)

ASTERGDEM data is available for download from some website
For example,

- NASA Reverb <https://reverb.echo.nasa.gov/reverb/>
- LP DAAC Global Data Explorer <https://gdex.cr.usgs.gov/gdex/>
- Earth Explorer <https://earthexplorer.usgs.gov/>

Any site requires register; ID & Password.

From the next pages, process to download the data from the LP DAAC Global Data Explorer is explained.

Then you can move to download page of ASTER GDEM. Follow the process in next pages.

LP DAAC Global Data Explorer






The screenshot displays the LP DAAC Global Data Explorer web application. The header features the USGS logo with the tagline "science for a changing world" and the NASA logo, followed by "LP DAAC". Navigation links include "EARTHDATA", "Data Discovery", "DAACs", "Community", and "Science Disciplines". A "USGS Home" link is also present. The main content area shows a world map with a "Log In" button highlighted by a red box. A red arrow points from this button to a larger "Log In" button in a pop-up menu. The right sidebar contains a "Map Layers" panel with options like "Background Image", "Data Coverage", "World Boundaries", and "Legend". The footer includes links for "Accessibility", "FOIA", "Privacy", and "Policies and Notices", along with contact information for the U.S. Department of the Interior and U.S. Geological Survey.

U.S. Department of the Interior | U.S. Geological Survey
URL: <https://gdex.cr.usgs.gov/gdex/>
Page Contact Information: LPDAAC@usgs.gov
Data Last Modified: 01/27/2017
<https://lpdaac.usgs.gov>

User Guide | GMU | CSISS | About GeoBrain | Contact

- Before download, log in the service
- If you don't have the account, need to register, but it's free

Zoom in and draw a polygon to cover the interesting area

1. Zoom in to the area by  or 
2. Draw a polygon to cover the interesting area by  or 
3. Click  & Show “Download” Window

Blue Polygon is an interesting area



Fill the Download Window Form

1. Select the options like as window on the right
 - Product: ASTER Global DEM V2
 - Format: GeoTIFF -1x1 Tiles
2. Research Area:
 - Choose the application of ASTERGDEM from the selection box
3. Click Submit button
4. Output window appears, click “Download” button
5. The dataset is downloaded in the Browser default folder

The screenshot shows a 'Download' window with the following elements:

- Output Settings** (highlighted with a blue box):
 - Product:** ASTER Global DEM V2 (dropdown menu)
 - Format:** Radio buttons for GeoTIFF, ArcASCII, GeoTIFF - 1x1 Tiles (selected), and JPEG.
 - Projection:** Lat/Lon (dropdown menu)
 - Compressed:** ☒ .zip
- Research Area:** Disasters (dropdown menu, highlighted with a green box)
- Agreement:** Text stating 'By selecting 'Submit', I agree to the following:' followed by two bullet points:
 - I agree to redistribute the ASTER GDEM *only* to individuals within my organization or project of intended use or in response to disasters in support of the GEO Disaster Theme.
 - When presenting or publishing ASTER GDEM data, I agree to include 'ASTER GDEM is a product of METI and NASA.'
- Disclaimer:** Text stating 'Because there are known inaccuracies and artifacts in the data set, please use the product with awareness of its limitations. The data are provided 'as is' and neither NASA nor METI/ERSDAC will be responsible for any damages resulting from use of the data.'
- Footnote:** Text stating 'Effects of the -32768 fill value surrounding Polygon and Defined Area selections can be mitigated by stretching the histogram within the valid GDEM data range.'
- Buttons:** 'Submit' (with a green checkmark icon, highlighted with a red box) and 'Cancel' (with a red X icon).

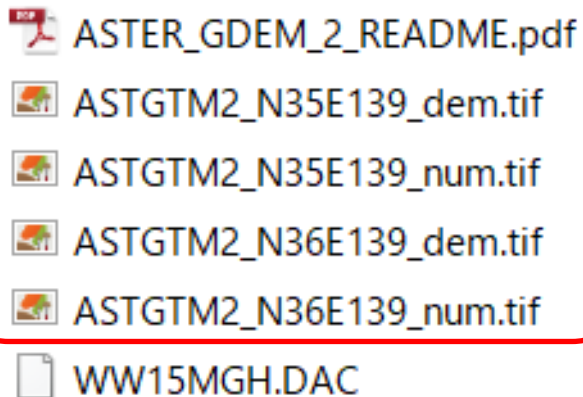
Set the DEM dataset

DEM dataset is downloaded by ZIP file format.

1. Unzipped it to **the same folder**
2. GEOID file ("WW15MGH.DAC") is required to put it in the same folder

To get the GEOID file, refer to the website below,

<http://earth-info.nga.mil/GandG/wgs84/gravitymod/egm96/binary/binarygeoid.html>



The sample area shown in blue polygon (page.67) has 5 files on the left.

And "WW15MGH.DAC" file should be set to the same folder.

Dem file names are ***_dem.tif

***_num.tif is also included, this is a quality assessment file, but not necessary to run ALOS-2 Viewer.

ASTER_GDEM_2_README.pdf is a readme file.