New Technique to Make Quick-Look Image of Landsat Satellite Data Using Popular Software

Heru Riyanto

Remote Sensing Department, Exploration Division, Research and Development Centre for Oil and Gas Technology "Lemigas", Jakarta, Indonesia

Email address:
herur@lemigas.esdm.go.id, heru_riyanto_2000@yahoo.com

Abstracts: Image processing technique for certain purpose that applied in satellite data mainly divided into: pre-processing, image enhancement and mozaicking. These processes, of course, utilizing all bands of satellite imagery data. To predict the output of imagery before actual process is done, we sometimes need a preliminary result and it need a 'tricky' procedure. For example, to predict best band combination for geological interpretation, we can choose band combination of 457 or 347. We can directly do this activity by previously load the data of band 3, band 4, band 5 and band 7, and then combine band as we need. In this study, in other hand, we just only load one band, and we can create each combination we need effectively and fast, using popular image processing program, PhotoShop 5. The result is sufficient for quick look requirement.

Keyword: Landsat TM 7+, Quick-Look, Compressed File, pixel-to-pixel operation

1. Introduction

Satellite data is widely useful in variety aspect of life. For example, we use satellite data to determine several morphological appearances such as landuse, land cover, bedding, fault, formation boundary of an area to trace the presence of natural resources, especially in remote area. Several satellites has been launched both in special purpose or in general purpose, which can be distributed base on the need.

For satellite with small number of band, such as Ikonos (4, 3 multispectral + 1 Panchromatic), radar (1 band), it simple to be printed, processed or interpreted. But for satellite that has many bands (more than 3 band), such as Landsat TM 7+ (8 bands) and Aster (14 bands), there are many problem to choose three band which assign to RGB monitor.

In line with increasing of number of satellite band, the more combinations that occurred that require more storage devices and also take experience to determine the right combination to achieve results as needed.

If we want to make a quick-look picture from Landsat Satellite imagery, we has many choices to do this. As we know, Landsat TM 7+ has 8 channel (6 channel in visible band, i.e. band 1, 2, 3, 4, 5, and 7; and thermal band, namely band 6 and pan-chromatic band or band 8). The choice to make RGB file as many as combination 3 bands of 8 bands. By definition, the number of combination is 8 x 8 x 8 or 512 (Since each band has possibility to be assigned into red, green and blue of gun-ray CRT monitor, and brightness degree of LED-lamp in LED monitor). We do not need to print all combinations for our special purpose. We sometime only print one or two represented image. These kind of images sometime called as quick look image.

Data processing is define as:

1. an operation performed on a given set of data to extract the required information in an appropriate form, such as diagram, report, or table;
2. manipulating of input data with an application program to obtain desired output as an audio/ video, graphic, numeric, or text data file.

(http://www.bussinessdictionaly.com/definition/data-processing.html)

This study tries to solve this problem by combining most important information of each band into single band. By this manner, we no need to save all bands into storage (hard-disk), makes it easy to choose a combination that fits over the needs and the processing results can be used for further purposes. The number of single data to be compressed is only 8 files per 1 compressed file.

Compressed File is a compilation of information acquired from 8 bands (original bands) and compressed them into

single file. This file is done using special algorithm which will accomodate as much as possible any informations in its original files. Also, compressed file is effective to create Quick Look file or may it can be used to make interpretation.

To recover 'original' file, there are many image processing program, but some of them require special skills to run it, such as TerraMar, ER-Mapper, ERDAS, ILWIS. For printing purpose (for documentation or manual interpretation purpose), popular programs also can be simulated to handle it, such as PhotoShop ver 5.0 or MatLab software. In PhotoShop software needs 'LUT' (Look-Up Table) file for process it, especially in color coding, while MatLab software needs subroutine 'Color Map'

Here, author chooses a popular programs / software are commonly used, in which easy to use (*user friendly*). The author choice is PhotoShop software ver. 5.0 that have ability to process automatically through a series of commands which saved in a file with the extension ATN.

2. Materials and Methods

2.1. Materials

The study uses data Landsat Imagery of Jakarta City, a capital of the Republic Of Indonesia. This area is chosen based on availability data and to show the affectivities of data compression,. The Metropolitan Jakarta City locates in Path 121 / Row 64 of Landsat TM7+ satellite imagery. This data itself is acquired 27 July 2000, which has complete band,

including thermal band and pan-chromatic bands. The whole dimension of this scene is actually (after process geo-corrected) 7,901 pixel row and 6,991 pixel column. This scene has coordinate boundary $106^o10'20.5"$ E to $108^o18'28.8"$ E and $4^o50'30.8"$ S to $6^o44'18.6"$ S. Band 6 (thermal band) is resampled (resize twice that original size), in order to matching its size other band, because the size per pixel (60 meter) is twice than the other (30 meter), while band 8 (pan-chromatic) is sub-sampled (resize to half-size than original size), i.e from 15 meter to 30 meter. We only crop area 500 pixel widths and 400 pixel height.

2.2. Methods

After data is loaded in the computer, the next steps is applying contrast enhancement, in order the monitor able to produce optimal appearance of each band. The histogram equalization technique, a non-linear stretch, is applied. In this method, the DN values are redistributed on the basis of their frequency. More different gray tones are assigned to the frequently occurring DN values of the histogram. Minimum DN of each band is assigned to 0 (black), the middle DN is assigned to 128 and the maximum DN is assigned to 255 (white) in the monitor. The Gamma shows how spreading the grayscale of original color.

Table 1 shows characteristics of sensor Landsat TM 7+, resolution of each band, minimum and maximum of band before and after histogram equalization is applied.

Table 1. *Landsat TM &+ Satellite, sensor, and optimal DN range of each band Path 121 / R64.*

Band	Bandwidth (/um)	Resolution (m)	Input			Output			Gamma
			Min	Mid	Max	Min	Mid	Max	
1	0.45 – 0.52	30	56	82	117	0	128	255	1.13
2	0.52 – 0.60	30	38	58	104	0	128	255	1.61
3	0.63 – 0.69	30	28	47	109	0	128	255	1.91
4	0.76 – 0.90	30	18	109	172	0	128	255	0.77
5	1.55 – 1.75	30	13	76	142	0	128	255	1.08
6	10.4 – 12.5	60	109	136	154	0	128	255	0.84
7	2.08 – 2.35	30	115	159	188	0	128	255	0.72
8	0.50 – 0.90	15	10	36	98	0	128	255	1.52

After histogram equalization technique is applied, then all the 8 files, named as Band1.psd to Band8.psd, are ready to be processed. If we using the ordinary process that applied, we can choose directly the band that we want to assigns it in red, green and blue channel.

Figure 1 show the flowchart of ordinary process. The raw data, i.e single channel data (left picture) need to be enhance its color, pick three of eight bands, combine it into RGB color image (right picture) and ready to be printed or interpreted.
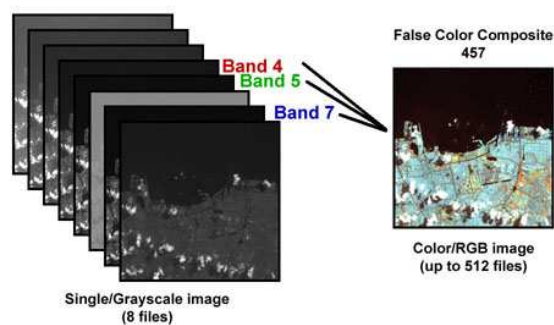

Fig. 1. *Flowchart of ordinary process in image processing.*

This activity, of course, has some restriction, such as we must has all data (or save all eight data in data storage), and need some experience to determine how combination that meet to our need.

2.3. A New Concept in Processing Data
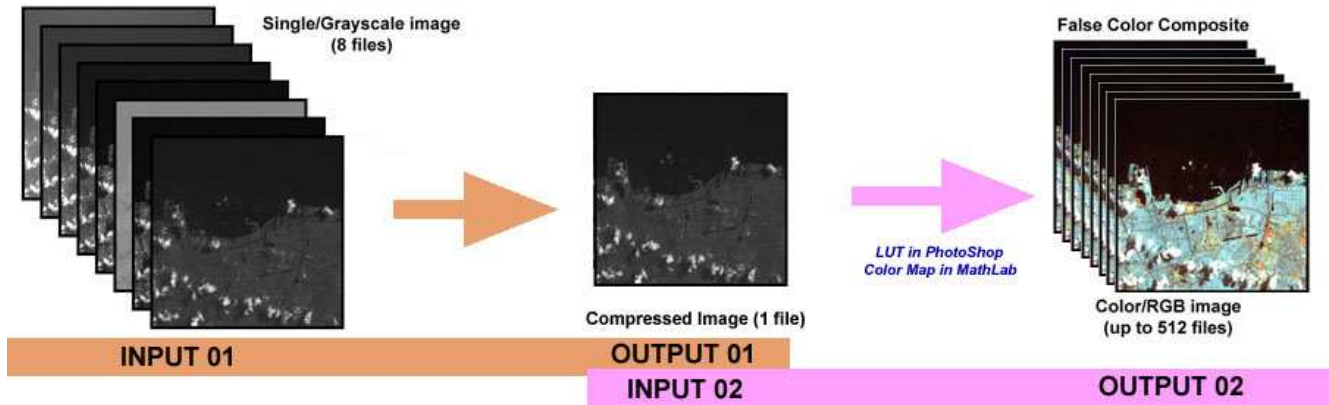
In this study, we want to introduce a new concept in

processing satellite data (in this case for Landsat TM 7+ data satellite) if we only need to see a quick-look of image that produce when we choose a certain combination.. As shown in Figure 2, we try to make a 'bridge' before the raw data is processing later. The 'bridge' is combining all 8 bands into single band. As a result, the flowchart in figure 2 can be separated into two main processes as shown in Fig 3 and 4.
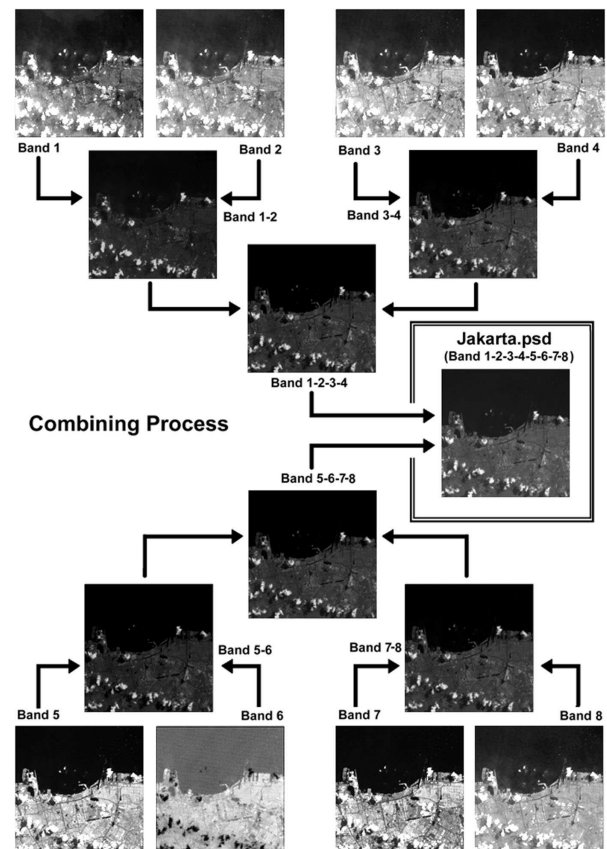

Fig. 2. *The flowchart of new concept in Image processing.*

Process in Figure 3, as described above, need special treatment and need complicated procedure and unique algorithmms. In this advanced process, we try to accommodate all information in each band effectively, investigate most dominant information of each band and its relation from one band to another, and finally blend and store it into single band.

Compressed File is created by pixel-to-pixel operation of all bands (2 bands in every single process). The important thing that all bands need a preliminary process, namely color enhancement, in order to increase information acquisition of each bands.

Compressed File is done in stage by stage process, where 2 files/bands are analyzed and processed into single file which has maximum information of these 2 bands. Operation is done using mathematical and statistical methods so the correlation value of 2 bands is minimum (preferable correlation value between two bands is 0).

At first stage, the number of bands is reduce into 4 bands (from 8 original bands), namely Band12, Band34, Band56 and Band78 (Band12 is combination of Band 1 and Band 2).

The next stage (second stage), all 4 'intermediate' files are separated into 2 groups, namely Group1 (Band12 and Band34) and Group2 (Band56 and Band78).

As previous stage, Band12 and Band34 are analyzed and processed into single file (Band1234), while Band56 and Band78 are processed into Band5678 file.

The last stage, Band1234 and Band5678 are anayzed and processed again, and finally Band12345678 or in this case Jakarta.psd. file will be produced.

Jakarta.psd file (origin format for Photohop) file is single layer and single channel/band or Grayscale file, which it size is exactly same as a single band of raw data.

Fig. 3. *The flowchart of combining eight raw file into single file.*

The next process to see how far this combination file is work properly, is recover original data. Figure 4 shows the flowchart of this process.

Although the process to combine need complicated

process, in other hand, process to recover data is relative easy. We use the popular package program of image processing, namely PhotoShop ver 5.0 or later to do it. Using action subroutine, prepared by PhotoShop, we can assign combination as much as we desire. We have developed a subroutine Combination.atn to make process as easy as 123 and it work in almost computer specification. By this manner,

we only need 2 files, 1 file data (Jakarta.psd) and 1 file for subroutine (Combination.atn). Using this 2 files, we can make all combination of RGB color file (512 files) as easy as and as fast as 123. Please contact heru_riyanto_2000@yahoo.com or herur@lemigas.esdm.go.id for these files.
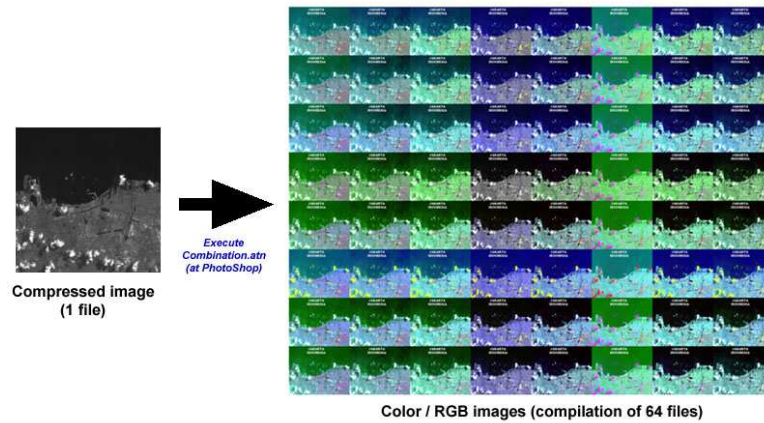

Fig. 4. *The flowchart of recovery data from compressed file.*

In the last development, the subroutine (Combination.atn) has ability to create 64 RGB-color file simultly in short time (less than 4 minute for input size 400 x 500 pixels) in only 5 clicks of keyboard and/or mouse (after Combination.atn is loaded)

3. How to Process it

First of all, you must make a working directory in your main harddisk computer. The working directory is C:\Process. After this directory present, copy two files to this directory (Jakarta.psd and Combination.atn)..

To execute the action file (combination.atn), at first we must load PhotoShop ver. 5.0 or later. The next step is load Combination.atn subroutine after clear all actions subroutine. Once this subroutine is loaded, you can operate in in only 5 click.

After process finish, we will get 11 new files. File 01.psd corresponds to first file in which file combination.psd is formed, in this case, file 01.psd is file band 1 in original file. File 02.psd corresponds to band 2, file 03.psd to band 3, file 04.psd to band 4, file 05.psd to band 5, file 06.psd to band 6 (thermal band), file 07.psd to band 7, and file 08.psd to band

8 pan-chromatic band of Landsat TM7+ satellite imagery.

Another file will be created in this process is Horz.psd Vert.psd and RGB.psd. File Horz.psd is sequence of band arrange in horizontal direction, Vert.psd is band sequence in vertical direction, and RGB.psd is 64 RGB-color image that arrange in 8 rows and 8 columns. Open this RGB.psd to see the final result of action file execution.

Here the shortcut to make the action work.

1. Press F12 in your keyboard. It needs 1 click.
2. Open Jakarta.psd file (Choose Jakarta.psd then press Open button). Let it work for a while. It need 2 clicks of mouse!
3. Open the red channel you want to assign. For example if you want to arrange band 4 in red channel, then choose 04.psd which corresponds to band 4 (Choose 04.psd then press Open button). Let it work for a while. It also need 2 clicks of your mouse!
4. Let it done, until the screen is blank.

After 4 step above is done, the result is displayed if you open RGB file from the working area. The result depends to your choice in step 3 above. In this example, the result will show in Table 2 below:

Table 2. *The last result after pressing F12 and choosing band 04 (combination.atn operation).Red channel is band 4.*

		Green channel							
		Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7	Band 8
	Band 1	411	421	431	441	451	461	471	481
	Band 2	412	422	432	442	452	462	472	482
	Band 3	413	423	433	443	453	463	473	483
Blue	Band 4	414	424	434	444	454	464	474	484
channel	Band 5	415	425	435	445	455	465	475	485
	Band 6	416	426	436	446	456	466	476	486
	Band 7	417	427	437	447	457	467	477	487
	Band 8	418	428	438	448	458	468	478	488

453 is RGB color image when you assign band 4 in red channel, band53 in green channel and band 3 in blue channel.

If you want to crop the specific combination, 435 for example, you can do it easily using PhotoShop (Use Image > Crop, after you make a boundary using Rectangular Marquee Tool. If you want to process another combination, i.e arranging certain band in red channel, just do 4 steps above.

4. Result and Discussion

4.1. Data Size

By definition, size of single band is multiplication of row number and column number then add by size of header (data contains information of image in front of data, before main data is written) and tailer (additional information) in the end of data, if present. In the RAW format, which has headre and tailer size is 0, the size per band is exactly 200.000 bytes.

In this example, each band row number = 500, column = 400, header = 4,800, tailer = 0; then then size of single band is:

Size per band = 500 x 400 + 4,800 + 0 = 204,800 Byte = 200.0 kByte

From Table 3 we can see that total single band of original file is 1,600 kByte or 1.56 Mbyte. This size of compressed file is only 200 kByte, or one per eight of total original data. From this single band of compressed data can be created up to 512 RGB image (color image), which each color file has size as much as 610,304 Byte or 569.0 kByte. It means that total RGB image that can be created has size 312,475,684 byte or 305,152 kByte. This size is 1,525.76 times of the size of compressed data (by definition 512 * 3 = 1,536 times). It is amazing enough that from single data grayscale data, we

can 'explode' it up to 512 RGB color images.

Table 3. *Band size of original, compressed and RGB image, that generated by compressed file.*

Band	Type	Size (Byte)	Size (kByte)
1	PSD/RAW	204,800	200
2	PSD/RAW	204,800	200
3	PSD/RAW	204,800	200
4	PSD/RAW	204,800	200
5	PSD/RAW	204,800	200
6	PSD/RAW	204,800	200
7	PSD/RAW	204,800	200
8	PSD/RAW	204,800	200
Total 8 band	PSD/RAW	1,638,400	1,600
Jakarta (Compressed)	PSD/RAW	204,800	200
RGB	PSD/RAW	610,304	596
512 of RGB (possible RGB)	PSD/RAW	312,475,648	305,152

4.2. Image Appearance

Figure 5 shows comparison of original file combination and compressed file combination using band 4, 5 and 7 as red, green and blue channel. Even minor difference is still detected, but as a whole, the color of RGB from compressed data is similar to RGB from original data. In this figure, we still able to trace main features, like a road, cloud cover, river, building (dense and rare) and other features. It means that file that generated by compressed file is still comprehensive to make quick look image, especially for documentation purpose.
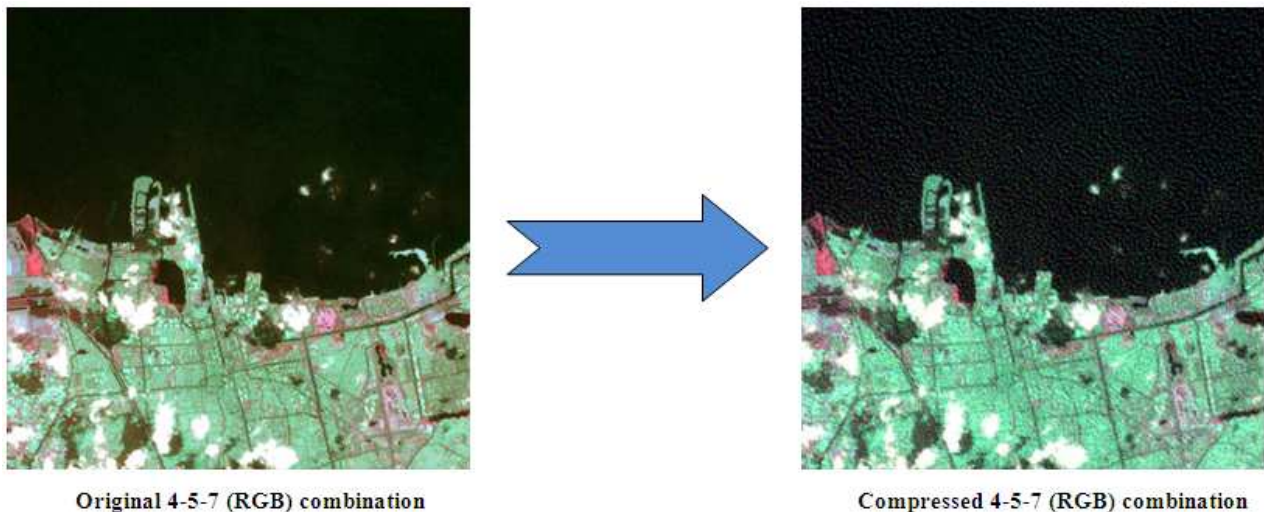

Original 4-5-7 (RGB) combination   Compressed 4-5-7 (RGB) combination

Fig. 5. *Comparison of original file combination and compressed file combination.*

5. Conclusion

By combining and compressing several data/file into one or single data/file, we can conclude as follow:

1. The compressed data contain information of original data in some degree.
2. Easy to handle, because need small number of data (i.e two data only) compare with original data (8 files)
3. Easy to make combination of all possible color

combinations, 3 of 8, i.e. 512 files.
Beside this purpose, the compressed data has a challenge

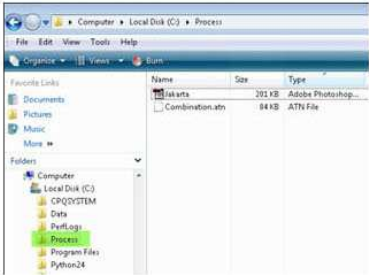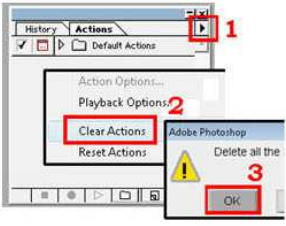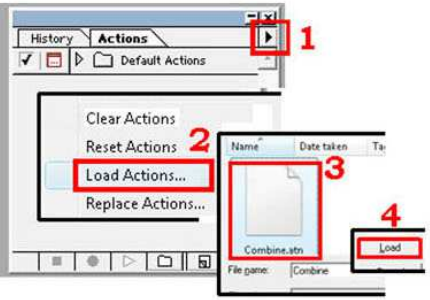to be utilized for another purpose (study in progress).

ACTION	RESULT
1. Pre-processing, make a working folder (C:/Process), and copy two files: Jakarta.psd and Combination.atn	
2. Open PhotoShop ver 5.0 (or later) program	
3. Open 'Action' window (Windo > Show Actions)	
4. Clear default Actions (Click small triangle, and choose Clear Action, then OK)	
5. Open and load action file (Click small triangle, choose Load Action.. > Combintaion.atn > OK)	
6. Close action windows (Click small cross in upper right window)	
7. Press F12 in your keyboard **8. Open Jakarta.psd (Jakarta.psd > Open)** **9. Open 04.psd (04.psd > Open)** **10. Open RGB.psd (File > Open.. > RGB.psd > Open)**	*Wait for a momonet!* *Wait for a momonet, until screen is blank* *Finally, you open 64 RGB image file* *(band 4 in red channel, see step 9)*

Figure 6. *Step of combination.atn execution.*
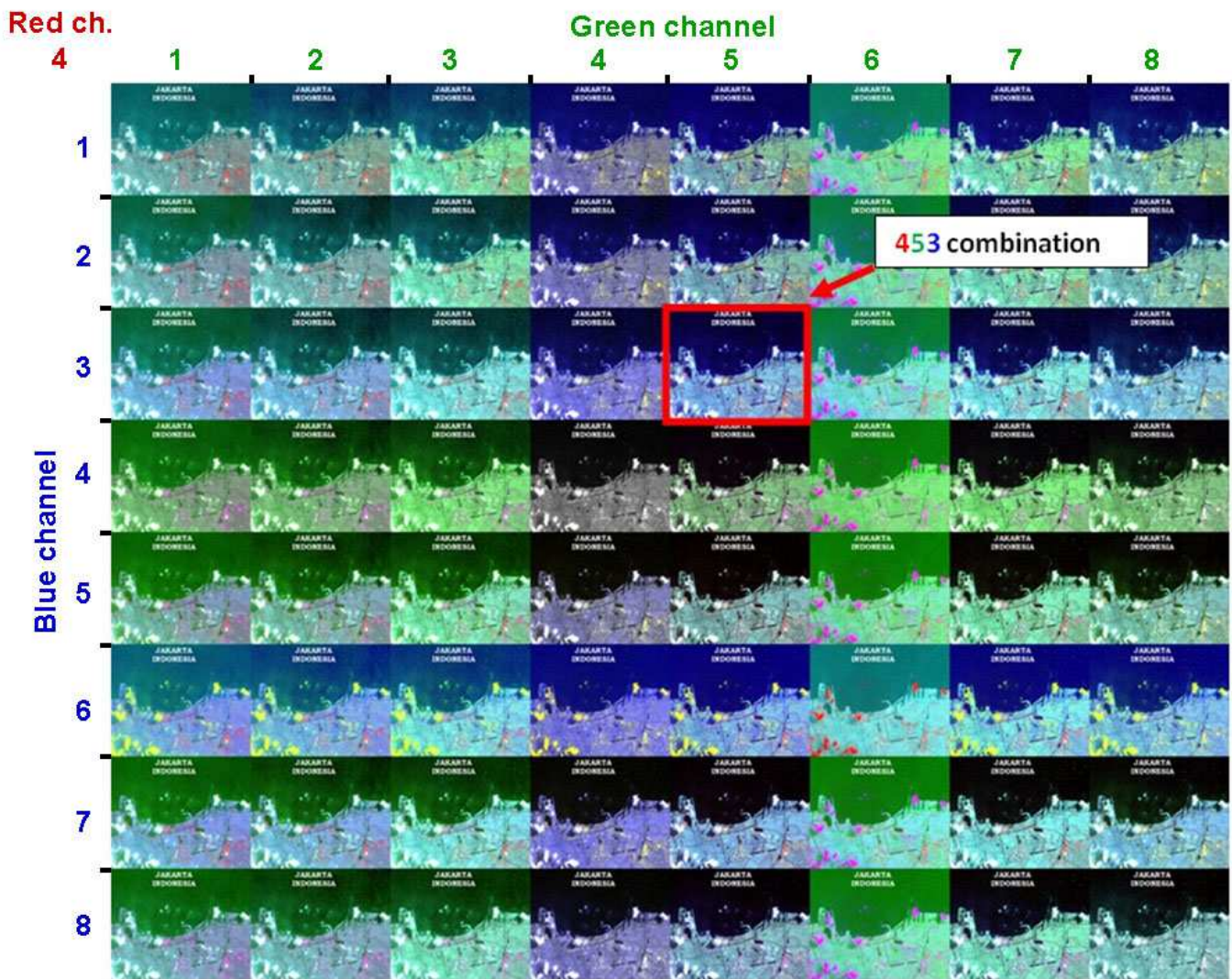
Figure 7. *Result of combination.atn execution.*

Figure 8. *453 band combination, enlarged.*

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