히스토그램 및 필터링 처리

Application services and process

about satellite information

히스토그램과 필터링

픽셀 기반 처리

- 픽셀의 원래 값이나 위치에 기반한 픽셀 값 변경
- 다른 픽셀의 영향을 받지 않음

픽셀 기반 처리 기법

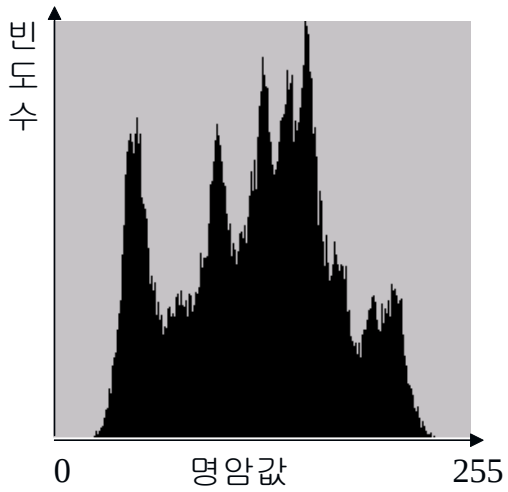
- 산술 연산, 히스토그램 평활화, 명암대비 스트레칭, 이진화

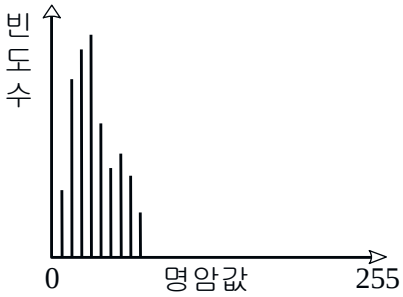
화소에 일정한 값을 더하거나 빼거나 나누거나 곱하는 연산으로
덧셈/뺄셈 -> 영상 밝기 조절
곱센 /나눗셈 -> 명암 대비 조절

히스토그램과 필터링

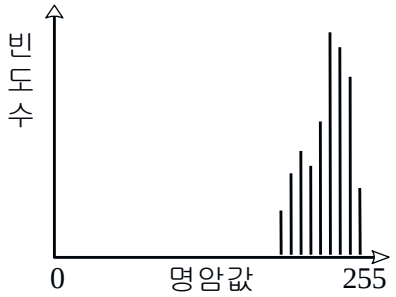
히스토그램

- 화사가 가진 명암 값에 대한 막대 그래프

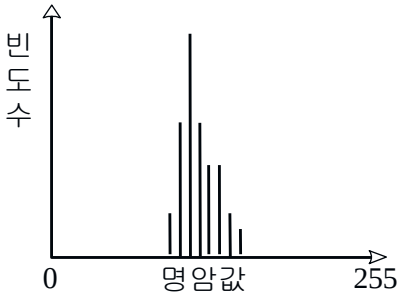




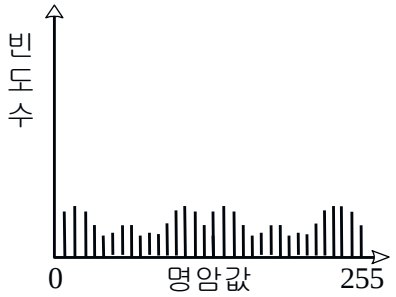
(a) 어두운 영상



(b) 밝은 영상



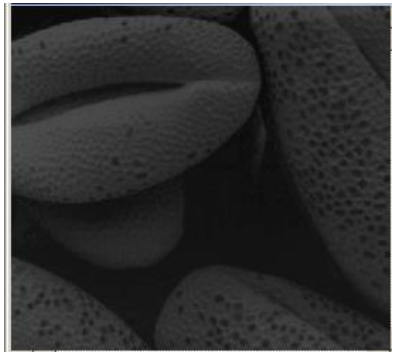
(c) 낮은 명암대비 영상

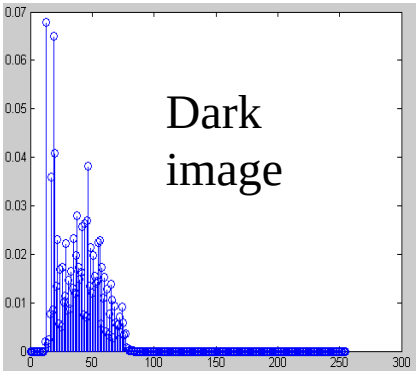


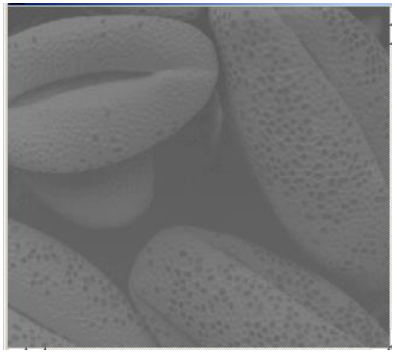
(d) 높은 명암대비 영상

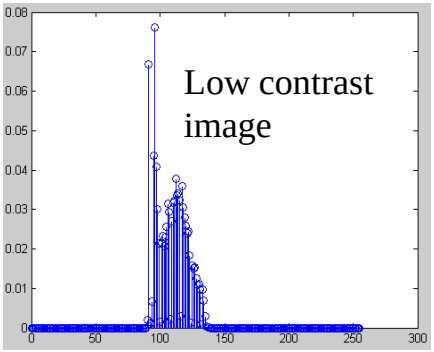
히스토그램과 필터링

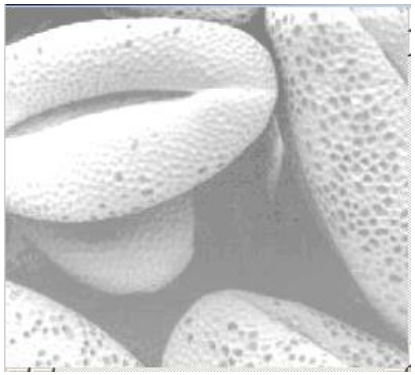
히스토그램

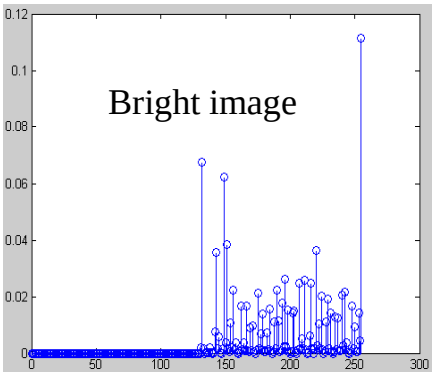


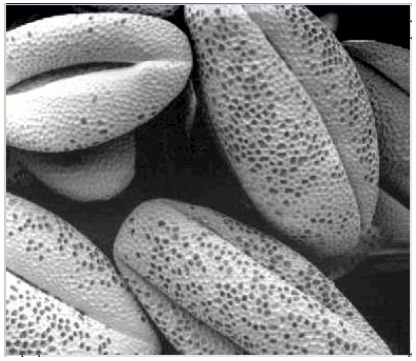


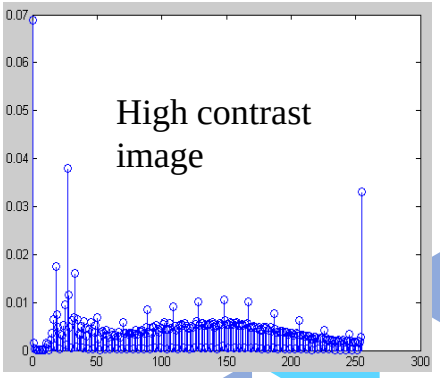






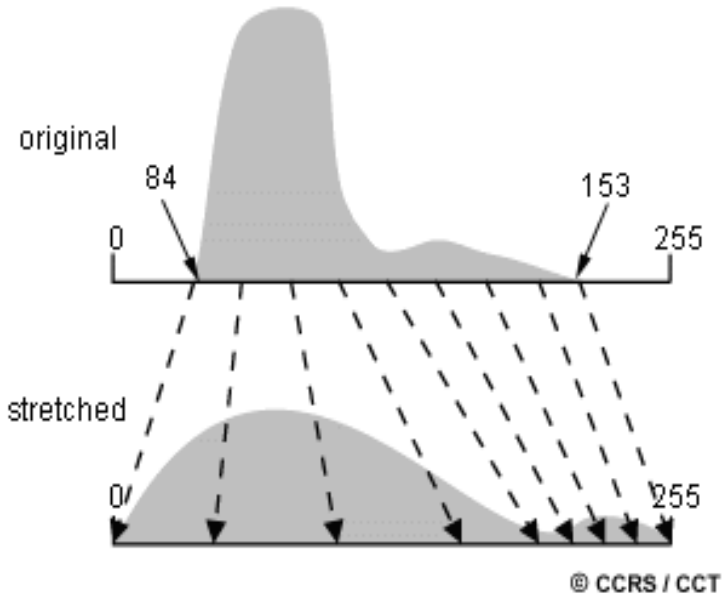


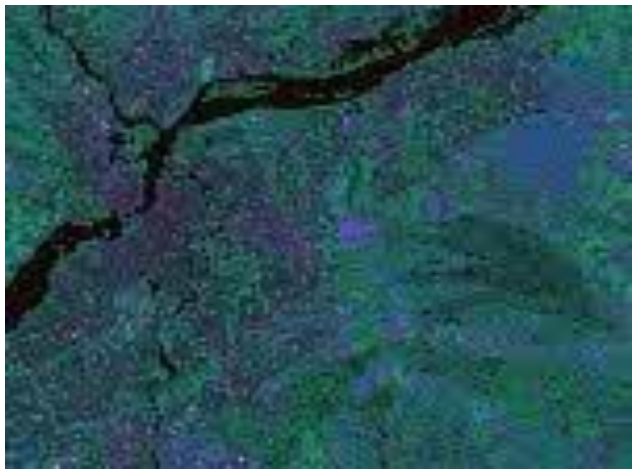


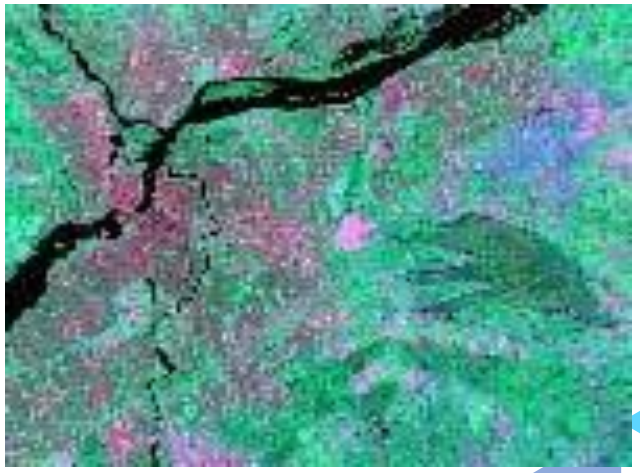


히스토그램과 필터링

히스토그램

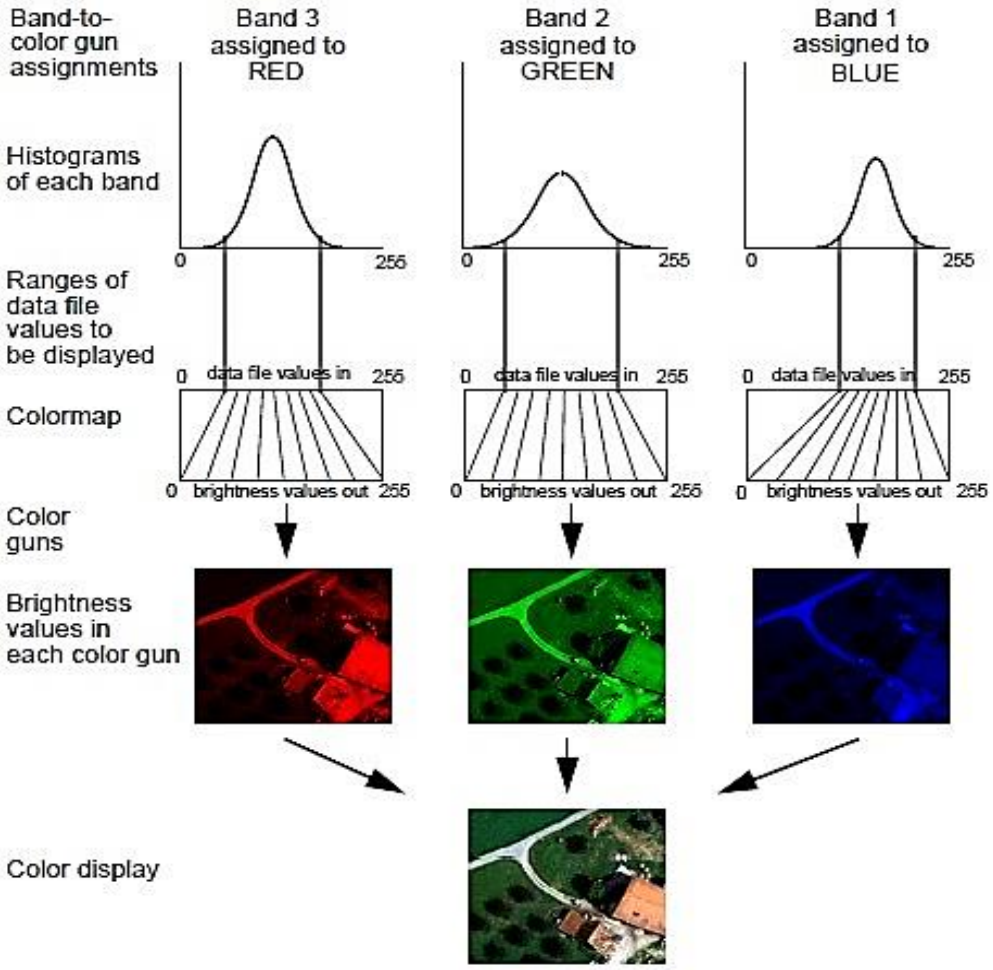






히스토그램과 필터링

히스토그램



히스토그램과 필터링

히스토그램 평활화

- **기존 영상의 명암 값 분포를 재분배하여 일정한 분포를 가진 히스토그램 생성**
- **처리 과정**

1. 입력양상의 히스토그램 생성
   - 명암 값 j의 빈도수 hist[j]를 계산

2. 각 명암 값 i에 대하여 0 부터 I 까지의 빈도수의 누적 값 계산

3. 단계 2에서 구한 누적 값을 정규화

4. 입력영상에서 픽셀 값 i를 정규화된 값 n[i]로 변환하여 결과 영상 생성

$$sum[i] = \sum_{j=0}^{i} hist[j] \qquad (2)$$

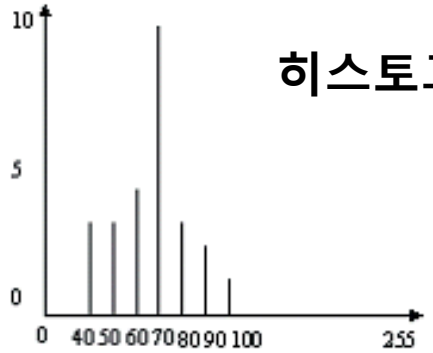
$$n[i] = sum[i] \times \frac{1}{N} \times 255 \qquad (4)$$

히스토그램과 필터링

히스토그램 평활화

40	40	50	60	70
40	50	60	70	70
50	60	70	70	80
60	70	70	80	90
70	70	80	90	100

원영상



히스토그램

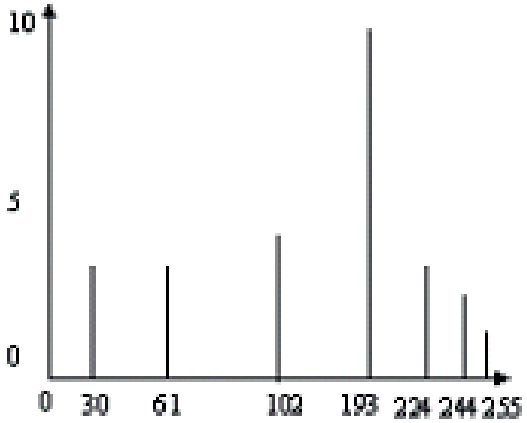
명암값	누적합 sum[i]	정규화 값 n[i]
40	3	30
50	6	61
60	10	102
70	19	193
80	22	224
90	24	244
100	25	255

정규화

$$10 \times \frac{1}{25} \times 255$$

30	30	61	102	193
30	61	102	193	193
61	102	193	193	224
102	193	193	224	244
193	193	224	244	255

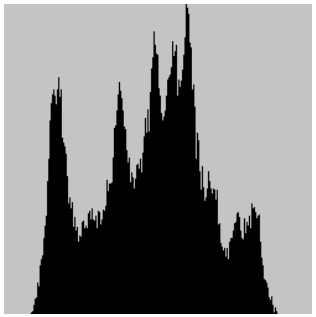
평활화된 영상

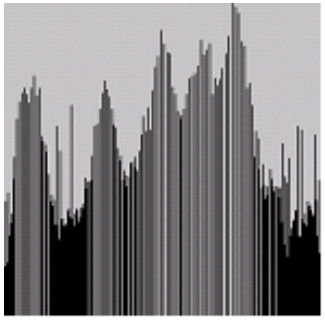
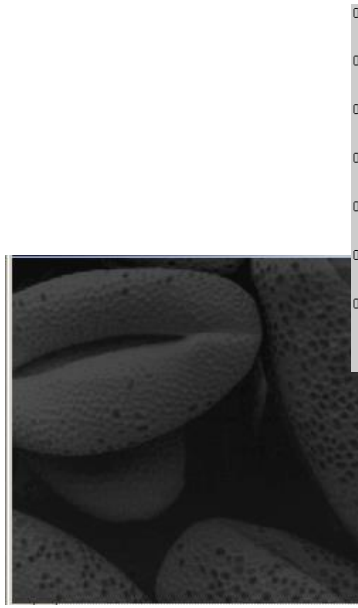
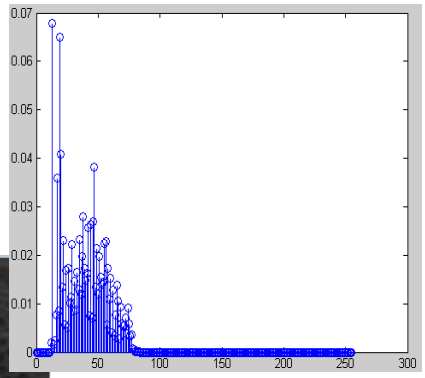
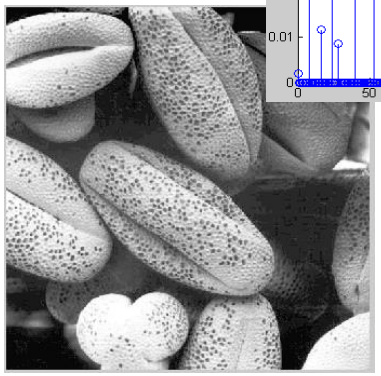
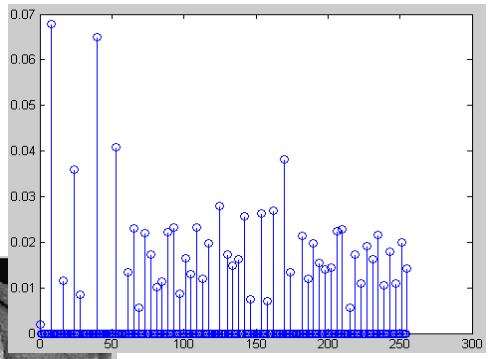


히스토그램

히스토그램과 필터링

히스토그램 평활화

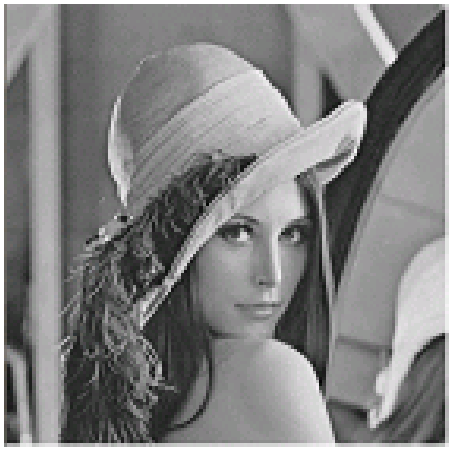
히스토그램과 필터링

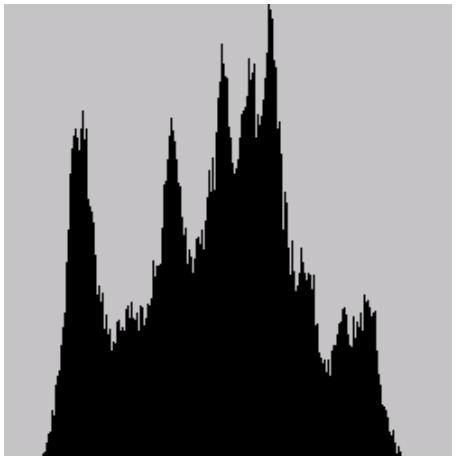
명암 대비 스트레칭

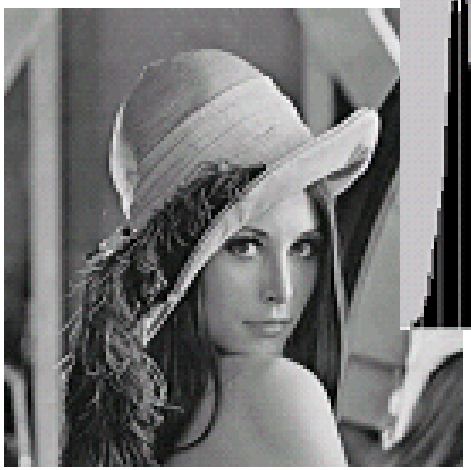
- 히스토그램이 모든 범위 화소 값을 포함하도록 영상 확장
- 중앙에 집중된 히스토그램을 갖는 영상에 적합

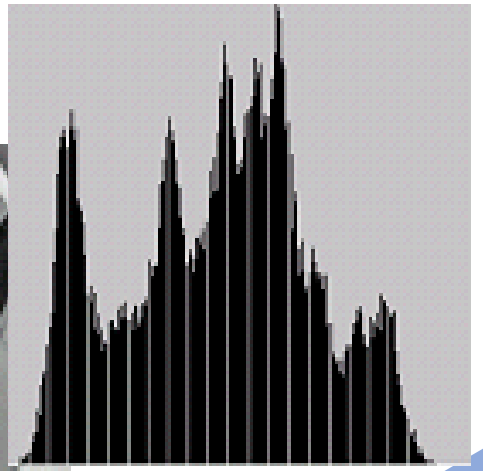
$$P'(x,y) = \frac{P(x,y) - \min}{\max - \min} \times 255$$

- Min : 최저 화소 값
- Max : 최고 화소 값





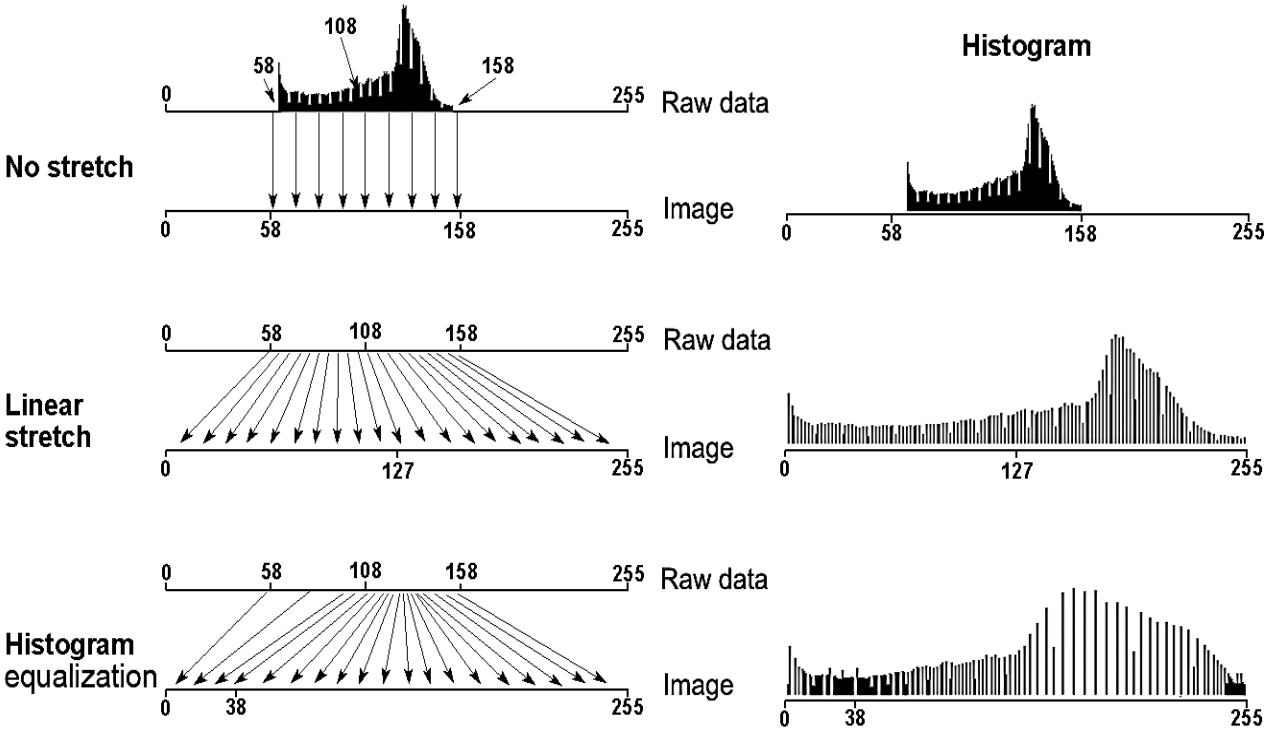




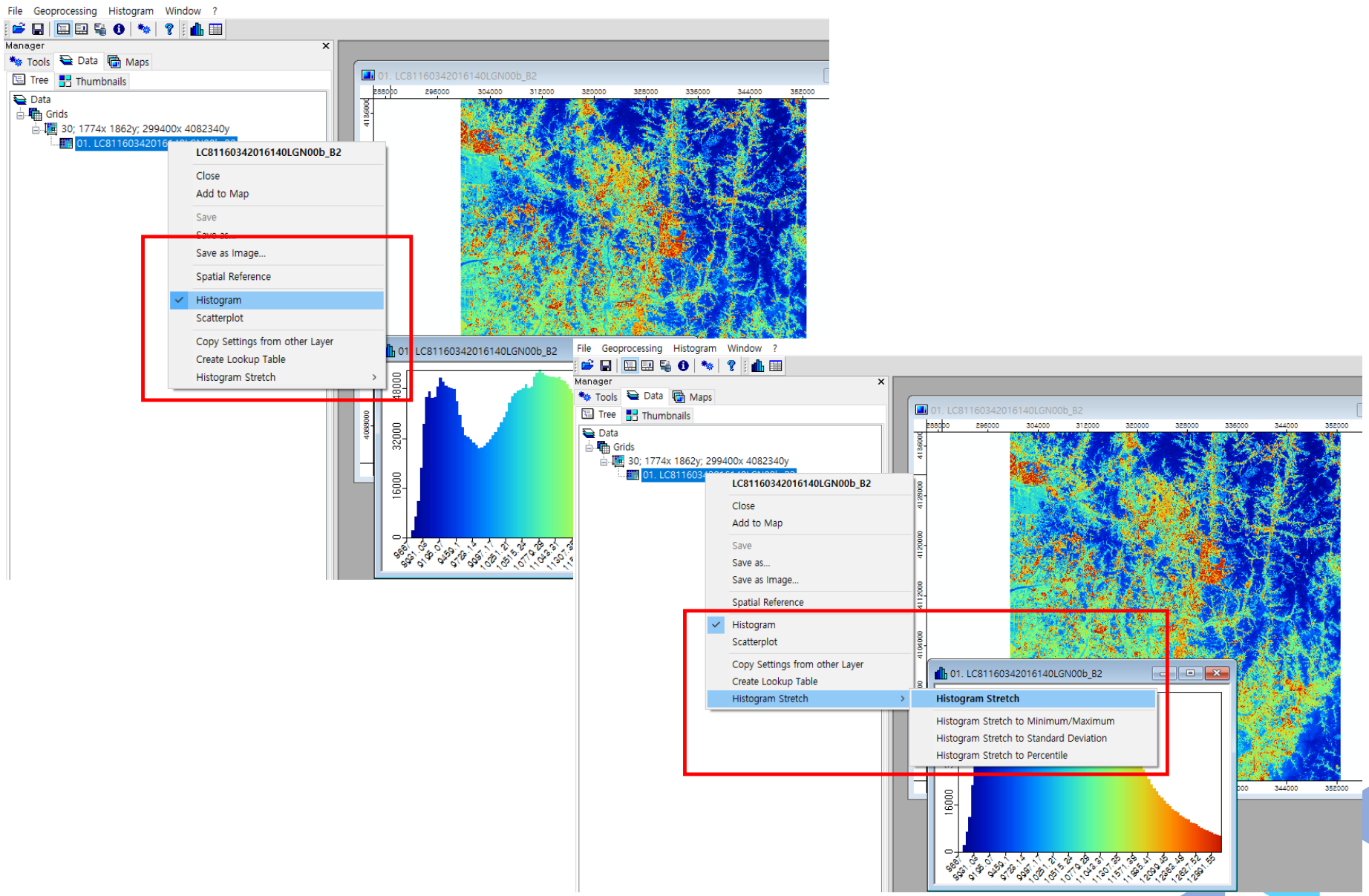
히스토그램과 필터링

차이점 (스트레칭 VS 평활화)

- 스트레칭은 히스토그램 평활화와 비교할 때 단순히 **영상 내 픽셀 밝기의 최소, 최대 값의 비율**을 이용해 **고정된 비율로** 영상을 낮은 밝기와 높은 밝기로 당겨 줌
- 그러므로 히스토그램이 펼쳐진 효과는 평활화 처리에서 훨씬 큼

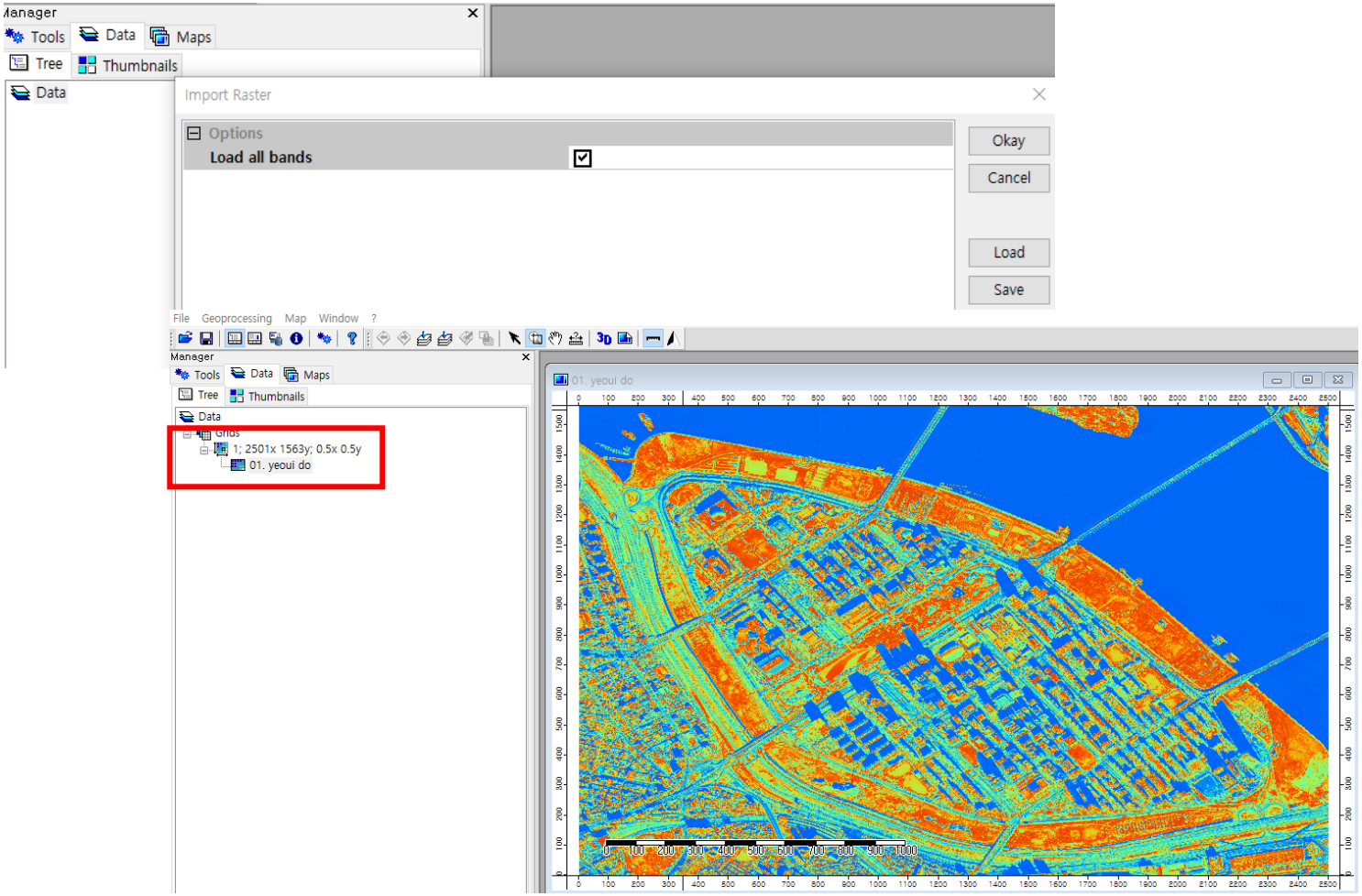


히스토그램 스트레칭 실습



히스토그램 분석 실습

❖ 여의도 지역 영상 불러오기



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히스토그램 분석 실습

❖ 색상 변경

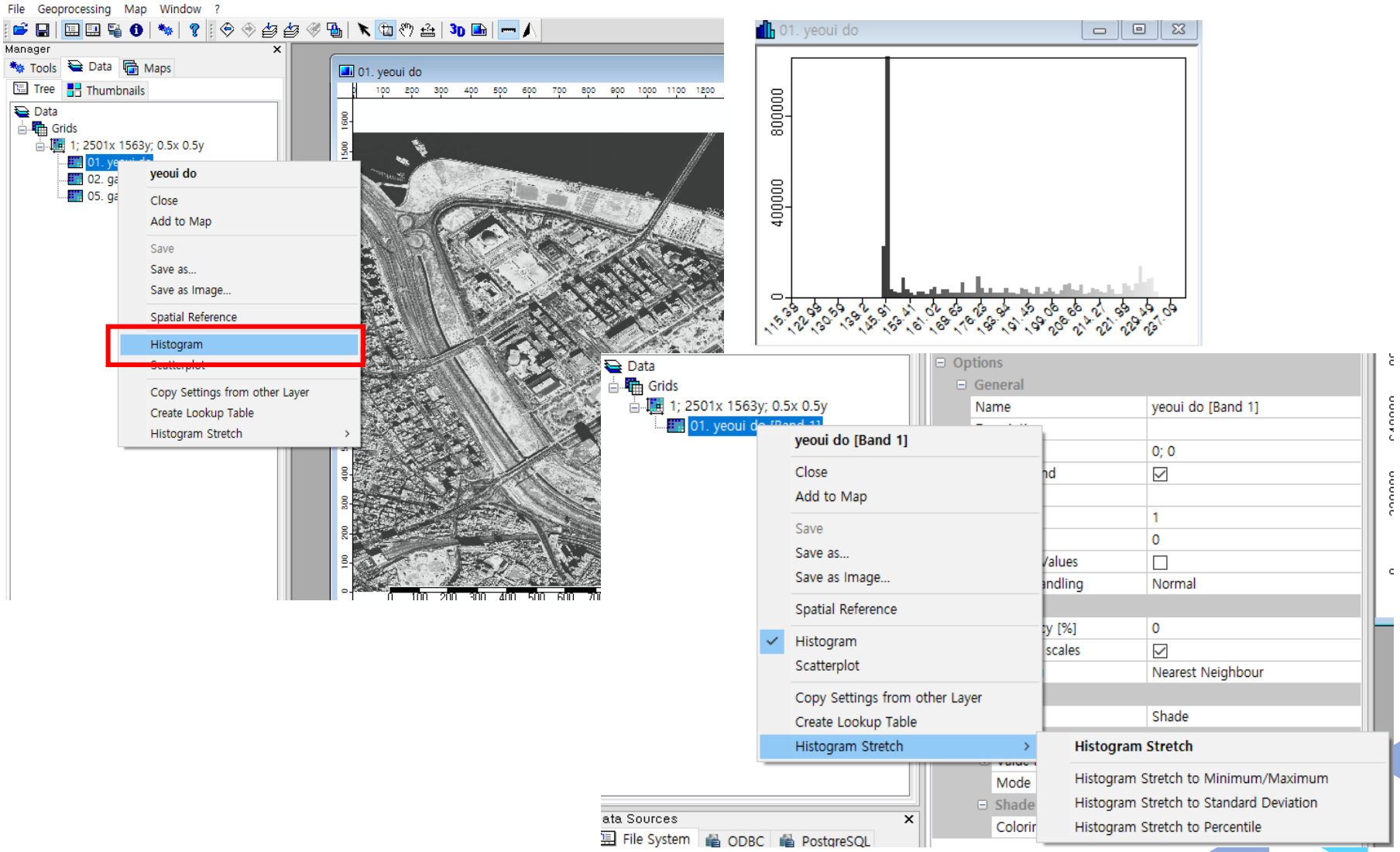
Properties: 01, yeoui do

History | Legend | Attributes | Settings | Description

Options	
General	
Name	yeoui do
Description	
No Data	0; 0
Show Legend	☑
Unit	
Z-Scale	1
Z-Offset	0
Show Cell Values	☐
Memory Handling	Normal
Display	
Transparency [%]	0
Show at all scales	☑
Resampling	Nearest Neighbour
Colors	
Type	**Shade**
Scaling	
Value Range	115.377198; 242.164221
Mode	Linear
Shade	
Coloring	**dark - bright**

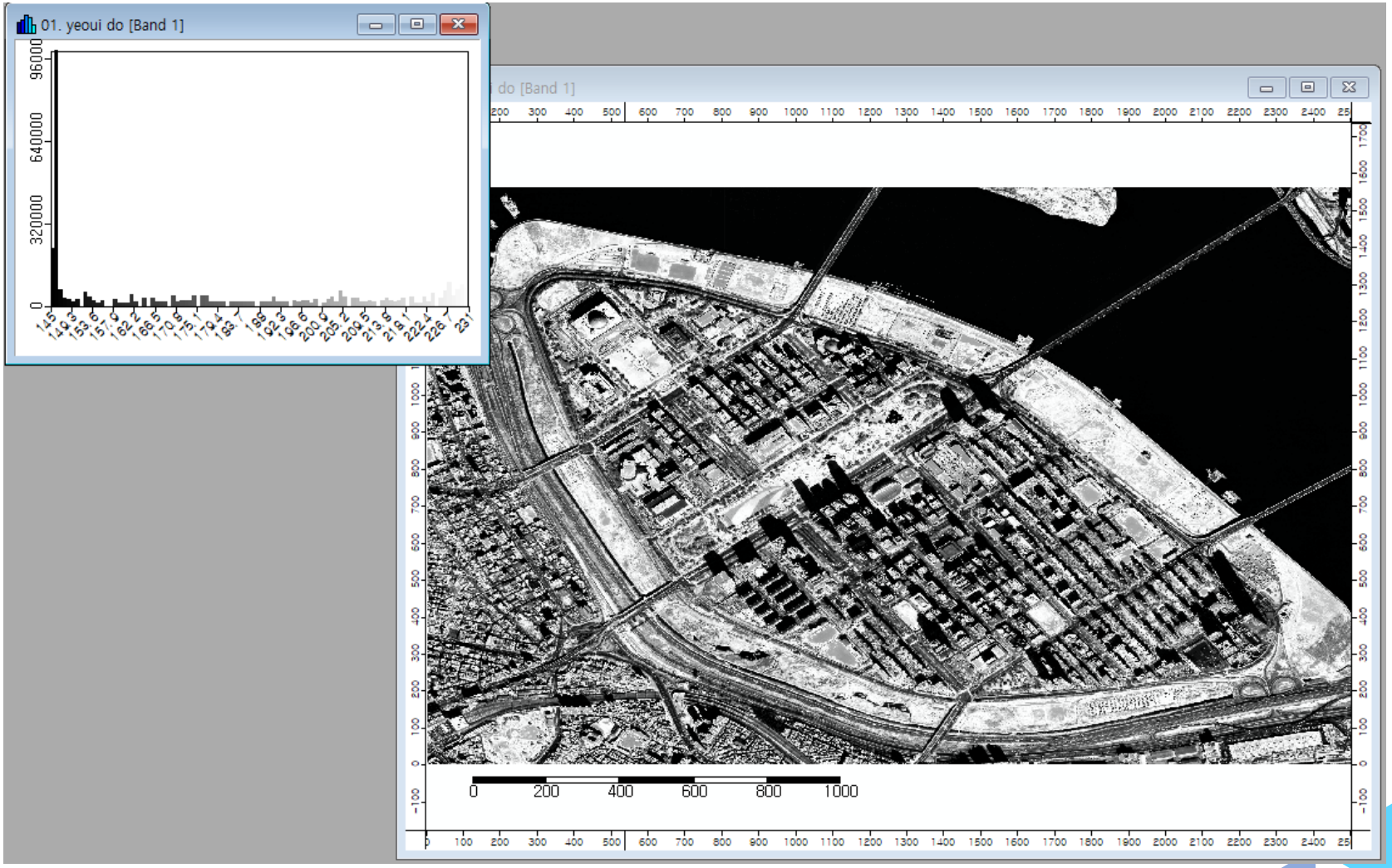
히스토그램 분석 실습

❖ 히스토그램 출력



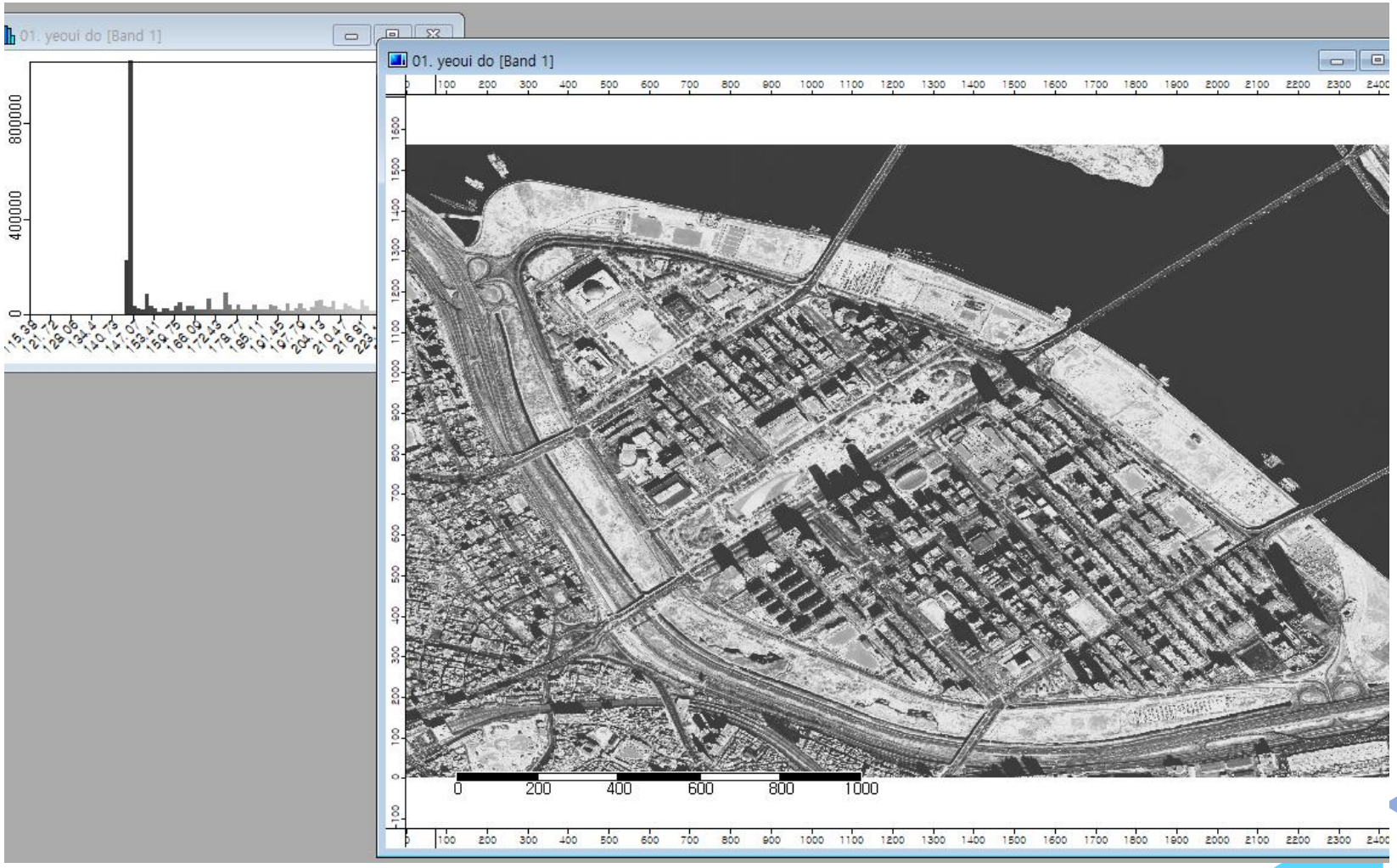
히스토그램 분석 실습

❖ 히스토그램 스트레칭(percentile)



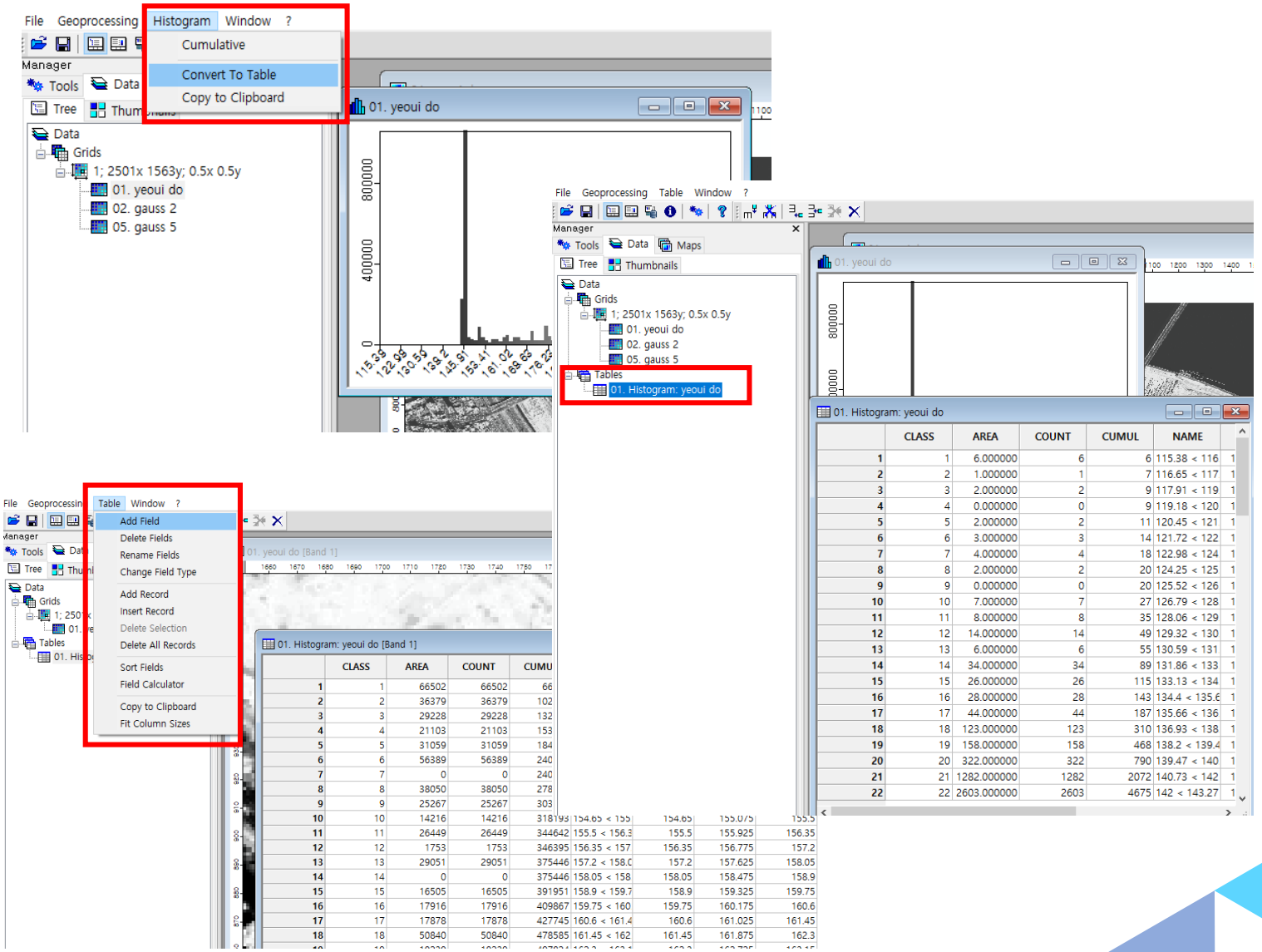
히스토그램 분석 실습

❖ 히스토그램 스트레칭(standard deviation)



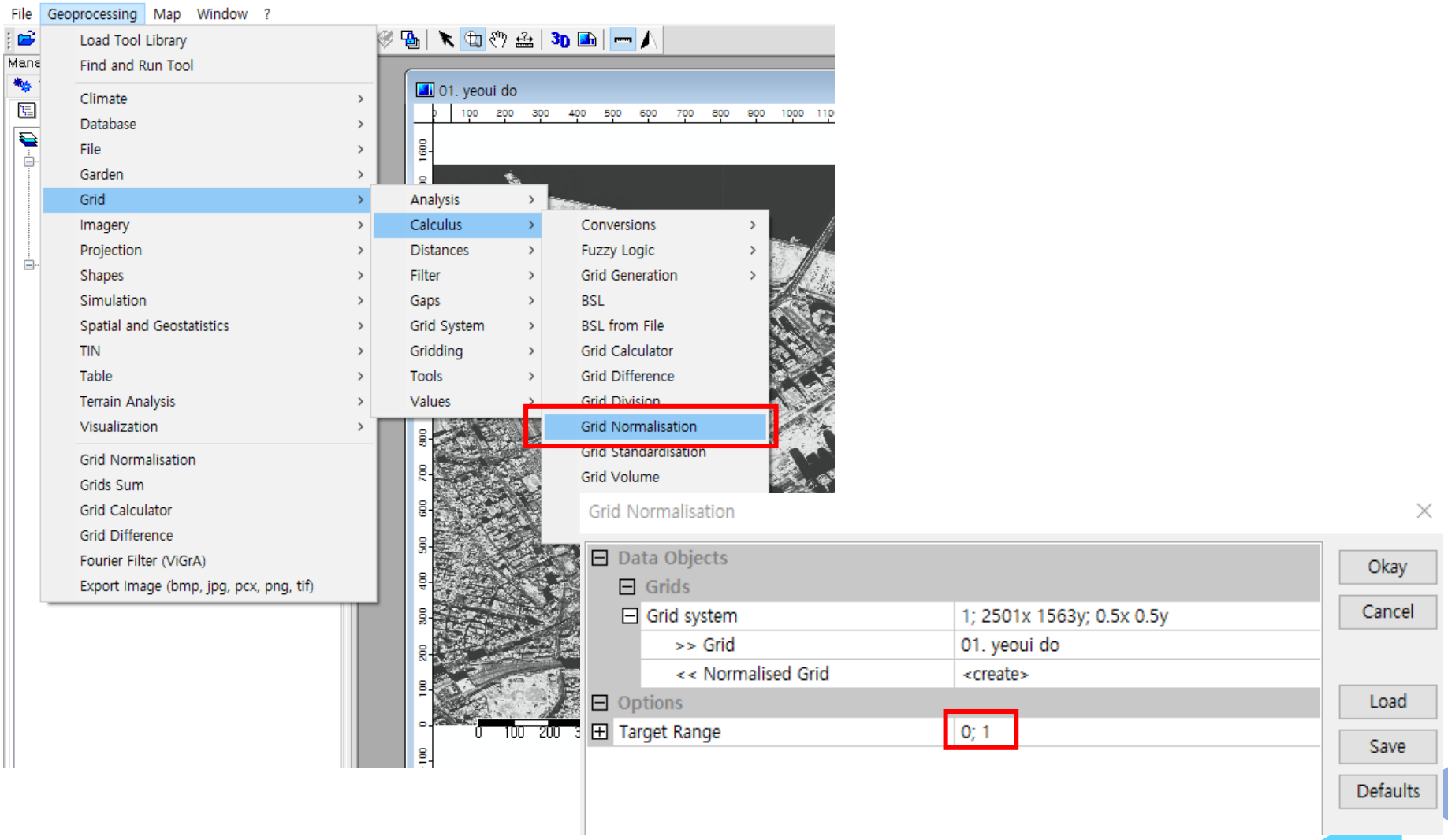
히스토그램 분석 실습

❖ 테이블 연산



히스토그램 분석 실습

❖ Grid Normalizing



히스토그램 분석 실습

❖ **Grid Normalizing**

7.4 Normalizing a grid

Sometimes, you might need the values of a grid to be expressed using a different scale, usually from 0 to 1. This is quite common when you deal with several grids and you want to use a model in which each parameter should be scaled according to a particular scale such as the aforementioned 0–1 one. Again, you can normalize a grid simply using the grid calculator, applying this formula:

$$x'_{i,j} = \frac{x_{i,j} - \min}{\max} \tag{7.4}$$

where min and max are, respectively, the minimum and maximum values found in the grid.

However, SAGA has a single module that simplifies this task, and it will be described next.

Select the *Normalize grid* menu item. The parameters window you will see is very simple. Select an input and an output grid, and then choose from one of the two available methods.

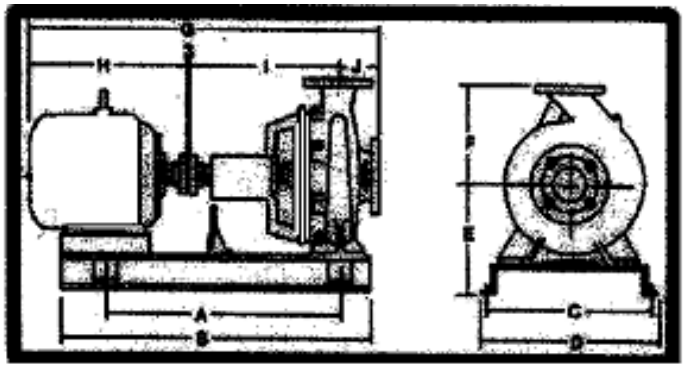
- $(0.0 < x < 1.0)$: If you select this option, SAGA will use equation 7.4 to normalize the grid
- **Standard Deviation**: If this method is selected, the standard deviation of the resulting normalized grid will equal 1.

영상 처리

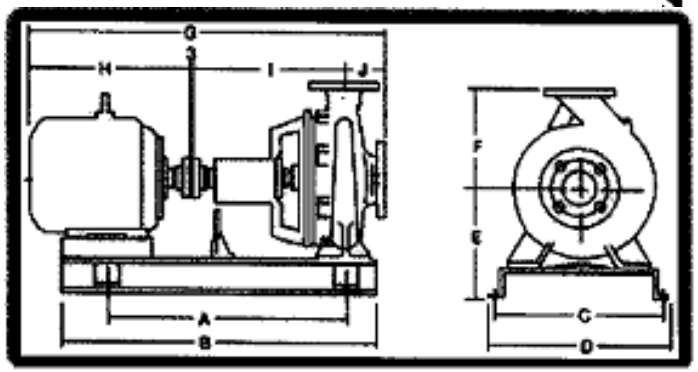
이진화

- 2가지 값을 갖는 영상으로 변환

$$P'(x,y) = \begin{cases} 255 & P(x,y) \geq T \\ 0 & P(x,y) < T \end{cases}$$



스캔된 영상



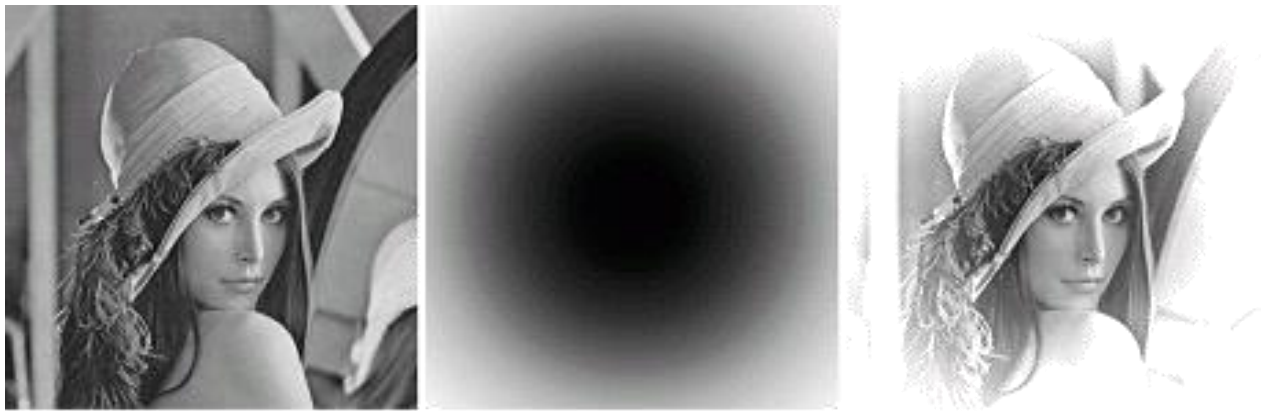
잡음이 제거된 영상

영상 산술 처리

덧셈 연산

- 두개의 이전 영상에 덧셈 연산을 수행하여 새로운 영상을 생성할 때 사용
- 일반적으로 다음과 같은 혼합 함수 사용

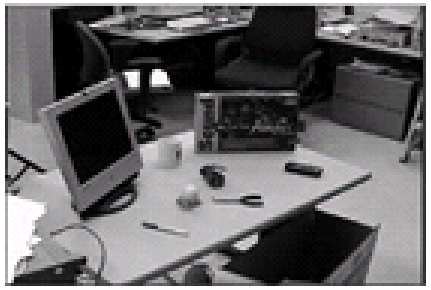
$$O(x,y) = \alpha \times I_1(x,y) + \beta \times I_2(x,y)$$



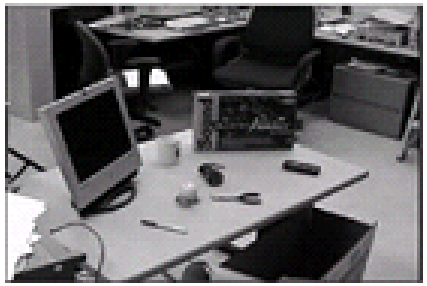
영상 산술 처리

뺄셈 연산

- 두개의 이전 영상에 뺄샘 연산을 수행하여 차이를 보고 싶을 때 사용
- 보안 시스템이나 영상 분석 시스템에서 이용

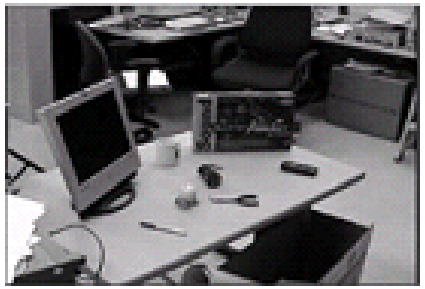


영상 1

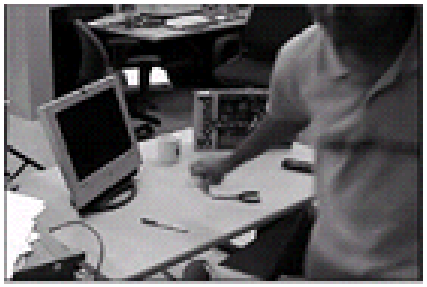


영상 2

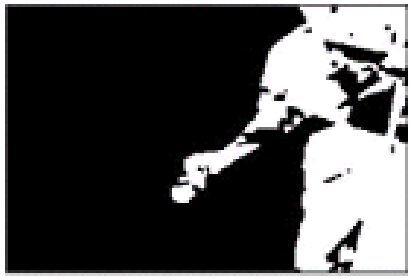
영상 1 – 영상 2



영상 3



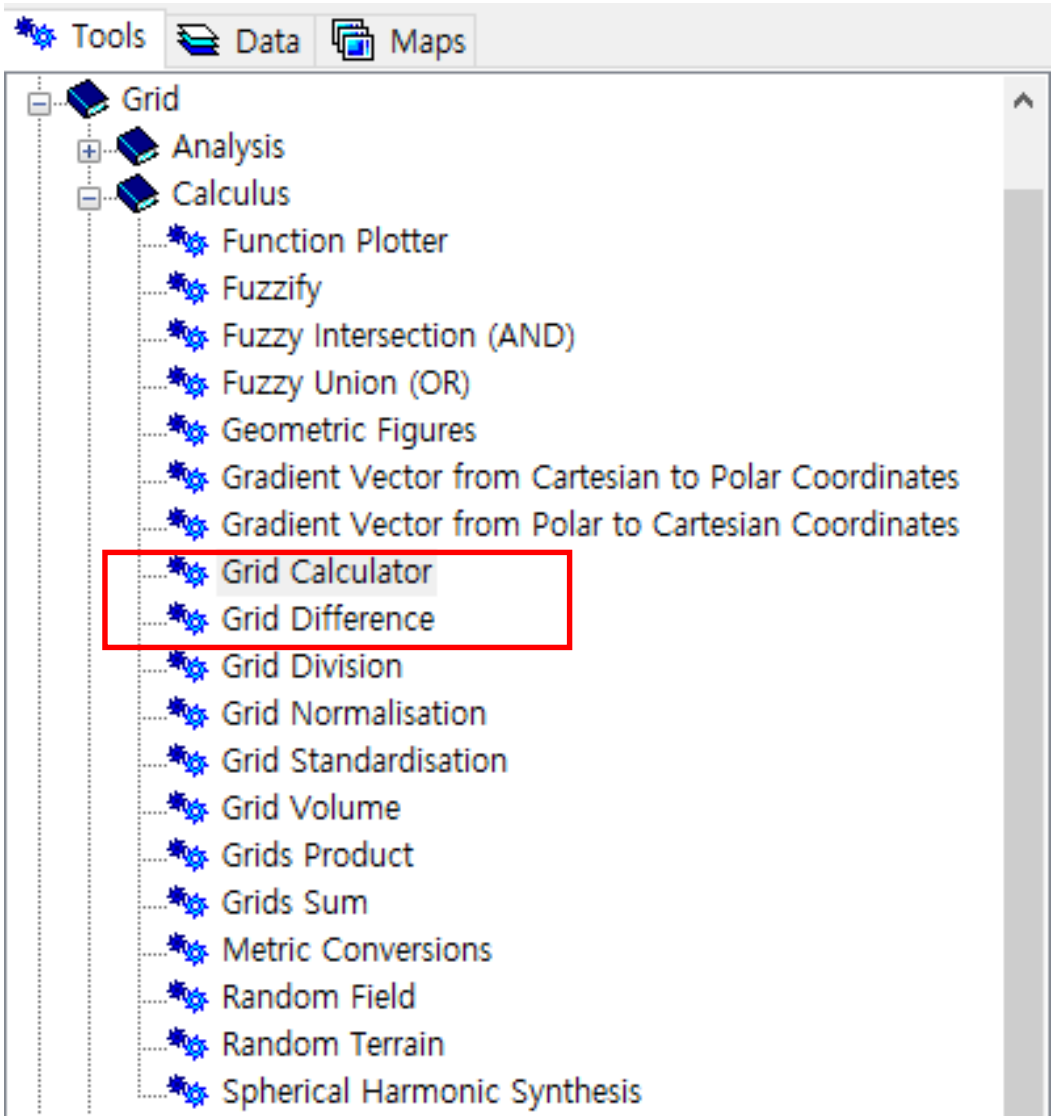
영상 4



영상 3 – 영상 4

침입자 감지

영상 산술 처리 방법


Tools
Data
Maps
Grid
Analysis
Calculus
Function Plotter
Fuzzify
Fuzzy Intersection (AND)
Fuzzy Union (OR)
Geometric Figures
Gradient Vector from Cartesian to Polar Coordinates
Gradient Vector from Polar to Cartesian Coordinates
Grid Calculator
Grid Difference
Grid Division
Grid Normalisation
Grid Standardisation
Grid Volume
Grids Product
Grids Sum
Metric Conversions
Random Field
Random Terrain
Spherical Harmonic Synthesis

필터링 처리

영역 기반 처리

- 입력 화소와 그 주위 화소를 이용하여 출력 화소 값을 결정
- 회선(convolution) 기법을 널리 이용
- 영역 기반 처리 예
  > 흐리게 하기, 선명하게 하기, 경계선 검출, 잡음 제거

I_1	I_2	I_3
I_4	I_5	I_6
I_7	I_8	I_9

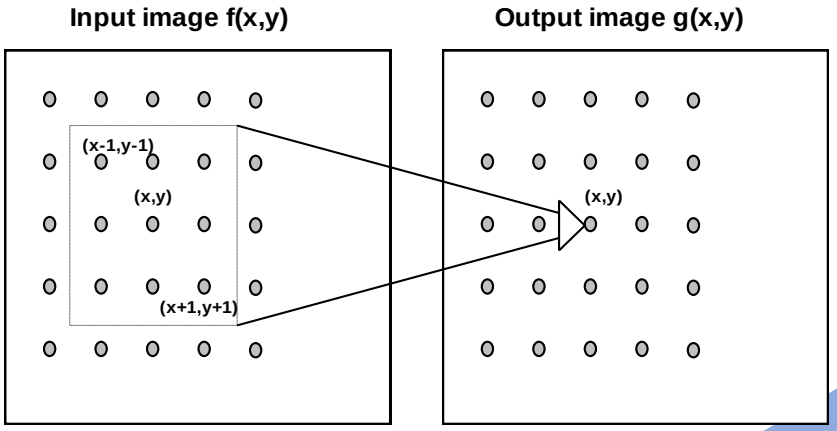
입력 영상

M_1	M_2	M_3
M_4	M_5	M_6
M_7	M_8	M_9

회선마스크

출력 픽셀 값 =

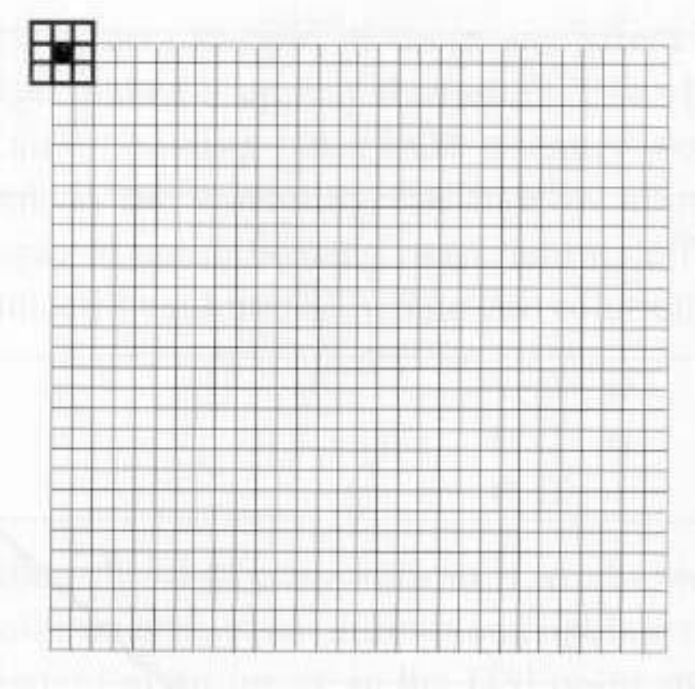
$$I_1 \times M_1 + I_2 \times M_2 + I_3 \times M_3 + I_4 \times M_4 +$$
$$I_5 \times M_5 + I_6 \times M_6 + I_7 \times M_7 + I_8 \times M_8 + I_9 \times M_9$$



필터링 처리

회선 수행 방법

- 좌측 상단 픽셀부터 한 픽셀 씩 차례로 수행
  > 먼저 우측 방향으로 진행
  > 한 줄이 끝나면 아래 줄로 이동



필터링 처리

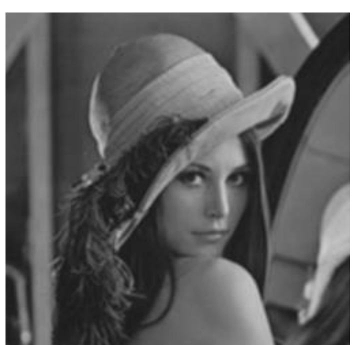
영상 흐리게(블러링)

- 입력 픽셀 값을 주위 픽셀 값 들과의 평균 값으로 변환하는 다음과 같은 회선 마스크사용

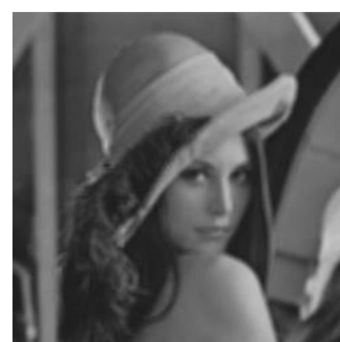
평균 마스크

$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$

$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$
$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$
$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$
$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$
$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$	$\frac{1}{25}$



3x3 마스크 적용



5x5 마스크적용

필터링 처리

영상 선명화(샤프닝)

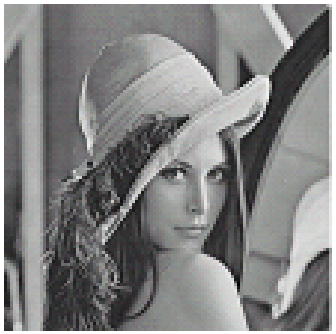
- 입력 픽셀 값을 주위 픽셀 값 들과의 평균 값으로 변환하는 다음과 같은 회선 마스크사용

0	−1	0
−1	5	−1
0	−1	0

마스크 1

−1	−1	−1
−1	9	−1
−1	−1	−1

마스크 2



입력 영상

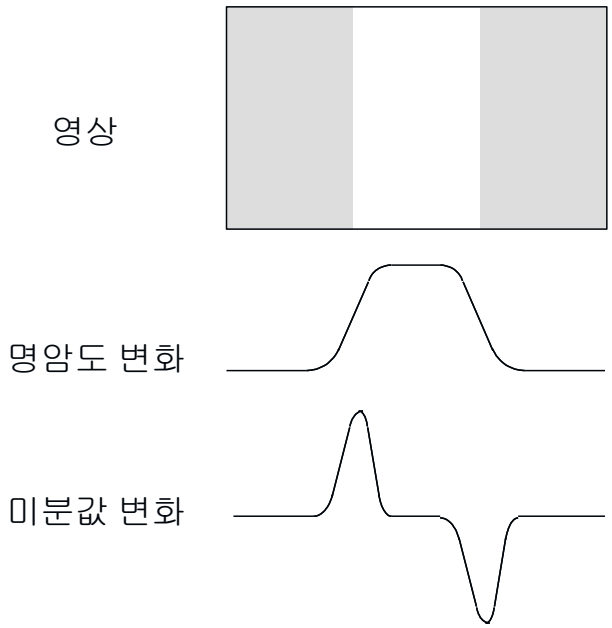
마스크 1 적용

마스크 2 적용

필터링 처리

경계선 검출

- 경계선: 입력 영상에 대한 많은 정보 포함
- 물체를 식별하고 물체의 위치, 모양, 크기 등을 인지하는 데 큰 역할
- 영상의 밝기가 낮은 값에서 높은 값으로 또는 높은 값에서 낮은 값으로 변하는 지점에 존재



필터링 처리

경계선 검출 회선 마스크

- 미분 연산을 회선 마스크로 표현 가능
  > 수평 경계선과 수직 경계선을 개별적으로 검출

	수평 경계선	수직 경계선
Prewitt	$\begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$	$\begin{bmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{bmatrix}$
Roberts	$\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} 0 & 0 & -1 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$
Sobel	$\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$	$\begin{bmatrix} 1 & 0 & -1 \\ 2 & 0 & -2 \\ 1 & 0 & -1 \end{bmatrix}$

필터링 처리

경계선 검출

Sobel

Prewitt

Roberts

필터링 처리

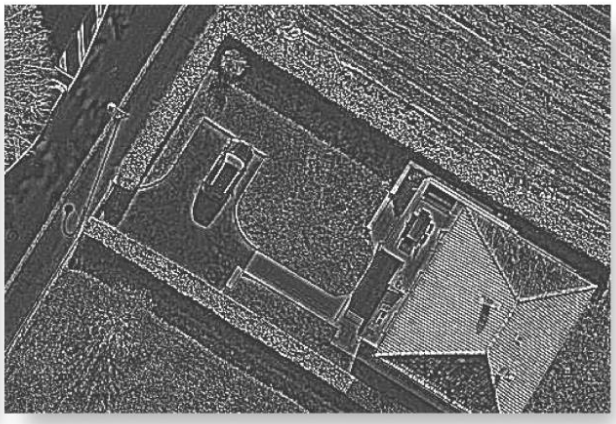
위성 영상 필터링 적용 예

Spatial Filtering of Raster Data

a. Original contrast stretched.

b. Low-frequency filter applied to the red band.

c. Median filter.

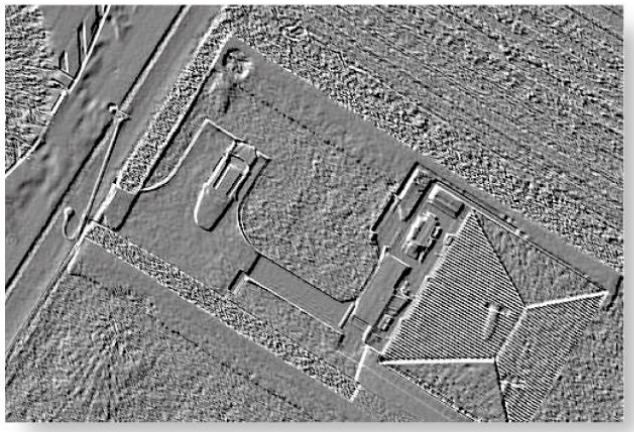


d. High-frequency sharp edge filter applied to the red band.

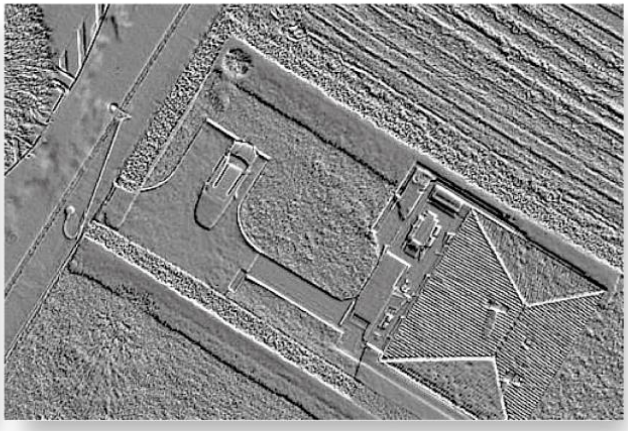
필터링 처리

위성 영상 필터링 적용 예

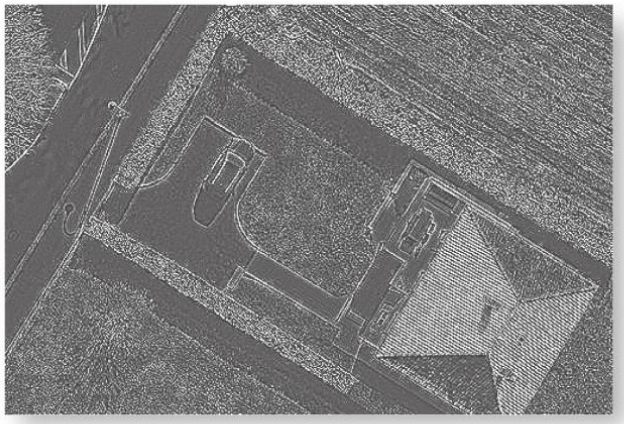
Spatial Filtering of Raster Data



a. Emboss Northwest filter.



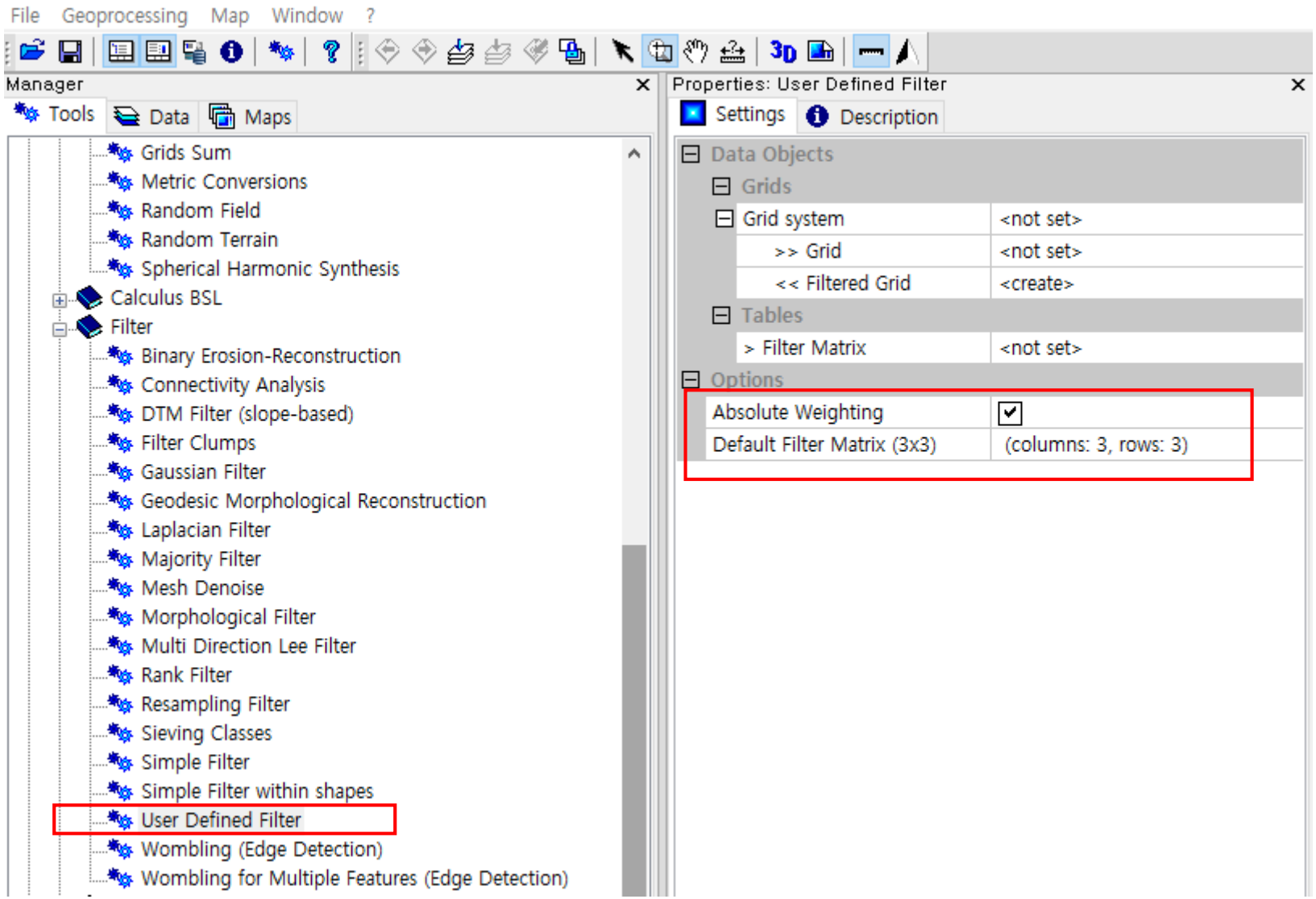
b. Compass Northeast filter.



c. Laplacian 4 filter.

d. Laplacian 5 filter.

필터링 처리 방법


File Geoprocessing Map Window ?
Manager
Tools Data Maps
Grids Sum
Metric Conversions
Random Field
Random Terrain
Spherical Harmonic Synthesis
Calculus BSL
Filter
Binary Erosion-Reconstruction
Connectivity Analysis
DTM Filter (slope-based)
Filter Clumps
Gaussian Filter
Geodesic Morphological Reconstruction
Laplacian Filter
Majority Filter
Mesh Denoise
Morphological Filter
Multi Direction Lee Filter
Rank Filter
Resampling Filter
Sieving Classes
Simple Filter
Simple Filter within shapes
User Defined Filter
Wombling (Edge Detection)
Wombling for Multiple Features (Edge Detection)
Properties: User Defined Filter
Settings Description
Data Objects
Grids
Grid system <not set>
>> Grid <not set>
<< Filtered Grid <create>
Tables
> Filter Matrix <not set>
Options
Absolute Weighting
Default Filter Matrix (3x3) (columns: 3, rows: 3)

심플 필터 실습

The way the simple filter is performed can be adjusted by modifying the values in the *Search Mode*, *Filter* and *Radius* Grid. First, you should select the type of filter you want to pass to your input grid. These are the available filters:

- **Smooth**: Smoothing a filter will soften the difference between a cell and its surrounding cells. The 2D representation of the grid will get blurred. The 3D view will show a smoother relief. The new value is calculated using the following formula:

$$z' = \overline{z} \tag{7.1}$$

  Where $\overline{z}$ is the average value in the analysis window.

- **Sharp**: This filter has the opposite effect to the smoothing one, accentuating the differences between cells. Its formula is as follows:

$$z' = 2 * z - \overline{z} \tag{7.2}$$

- **Edge**: Use this to detect edges and areas of high variation in a grid. The resulting is not a grid similar to the input one, but rather different, so you will not be able to use it just like the original one. The formula for this module is:

$$z' = z - \overline{z} \tag{7.3}$$

심플 필터 실습

Since the new values assigned to each cell are calculated from the original values of the cell and the values of its surrounding ones, the number of cells to consider around the central one has to be defined. To do that, you have two parameters, namely *Search Mode* and *Radius*.

Using the *Search Mode* you can select a round or square group of cells to be considered around the central one. The size of this group, expressed as the number of cells to consider to each size of the central cell, can be set using the *Radius* field. The higher the value you introduce, the more accentuated the effect of the filter will be.

After all the parameters have been set, press the *OK* button. You will see how SAGA works, and its progress will be shown in the progress bar on the lower–right part of the main window. Once it has finished filtering the grid, you will have a new one in the grid project window.

You have just used your first module and performed your first processing operation on a grid. As you can see, using this module was not really hard, just a couple of parameters to set and not much more. Notice how, after you use a module, a new menu item appears in the *Modules* menu. The last four modules that have been used have its own menu item here, so they can be more easily used next time.

The usage of the other filter modules is quite similar, so instead of explaining how to use them (which would be redundant) I will describe the effect that each filter has on the input grid, and when you should use each one of them.

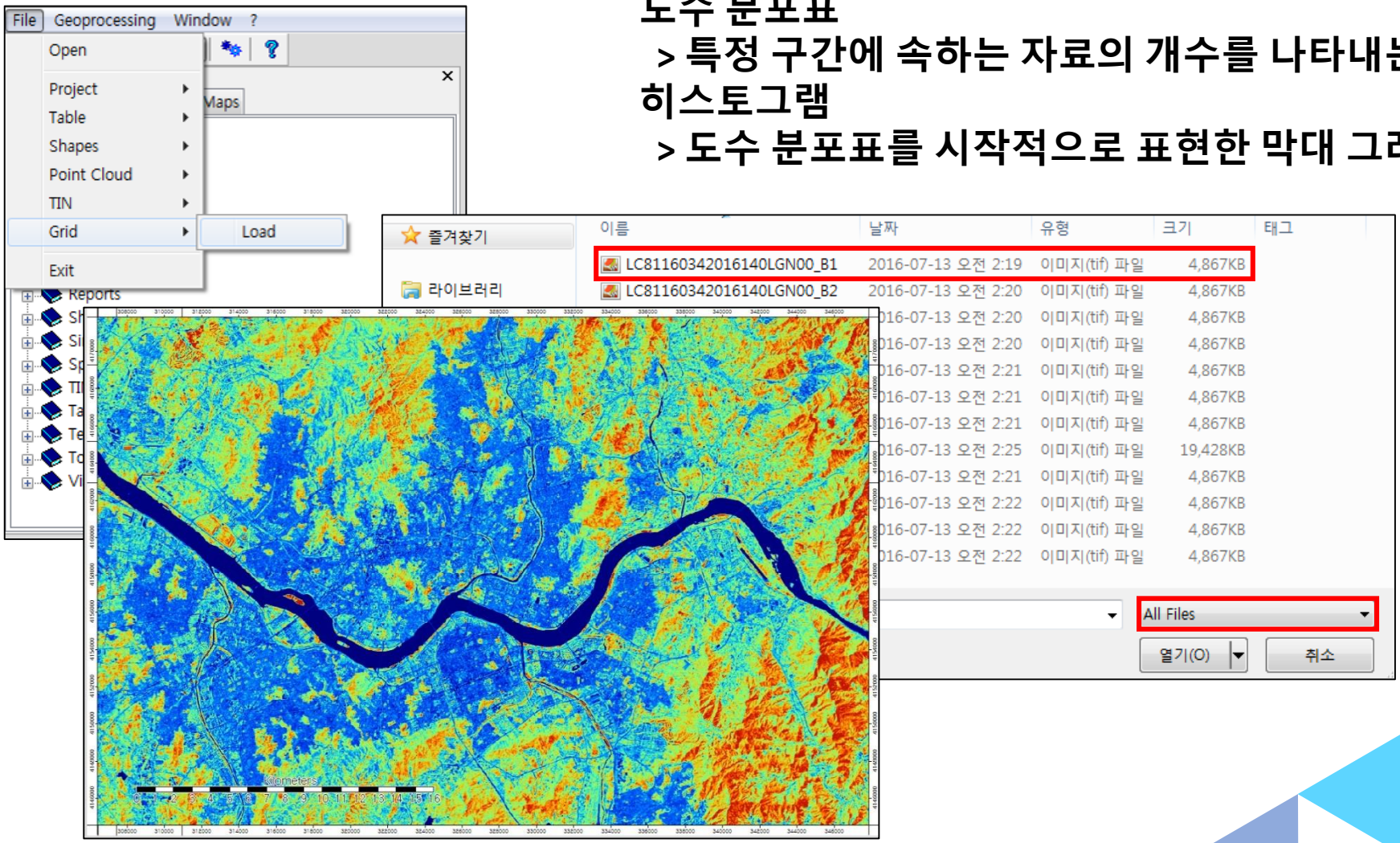
The second filter menu item you can found is the *Gauss Filter for Grid*. A Gaussian filter is an smoothing filter, but its mathematical background its a bit more complex than the simple filter. Also, its smoothing effect is "stronger" then the one you can get with the simple filter.

To adjust the smoothing intensity, use the *Standard Deviation* parameter. You will find as well the usual *Radius* and *Search Mode* fields. The greater the *Standard deviation* value, the greater *Radius* you should introduce.

영상 흐림 실습

❖ 데이터 불러오기(File -> Grid -> Load)

❖ 1번 밴드 선택 후 데이터 확인

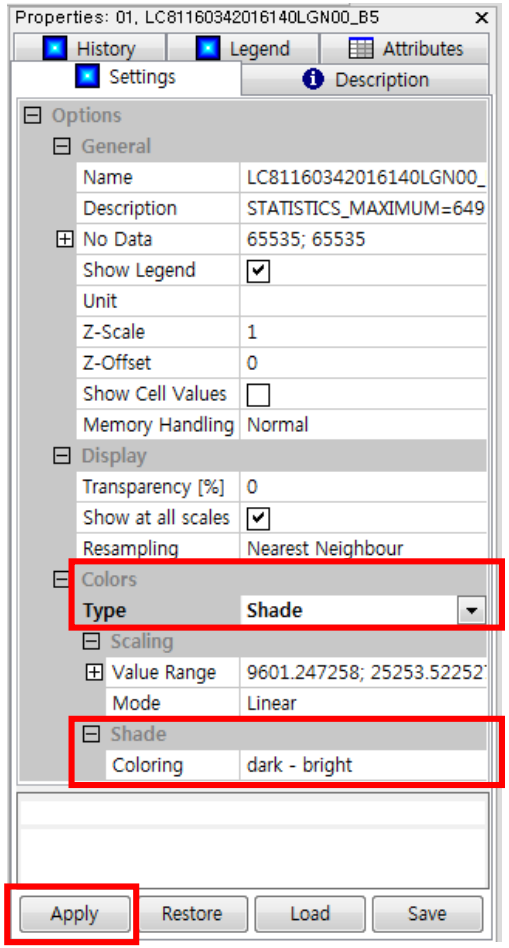


도수 분포표
> 특정 구간에 속하는 자료의 개수를 나타내는 표

히스토그램
> 도수 분포표를 시작적으로 표현한 막대 그래프

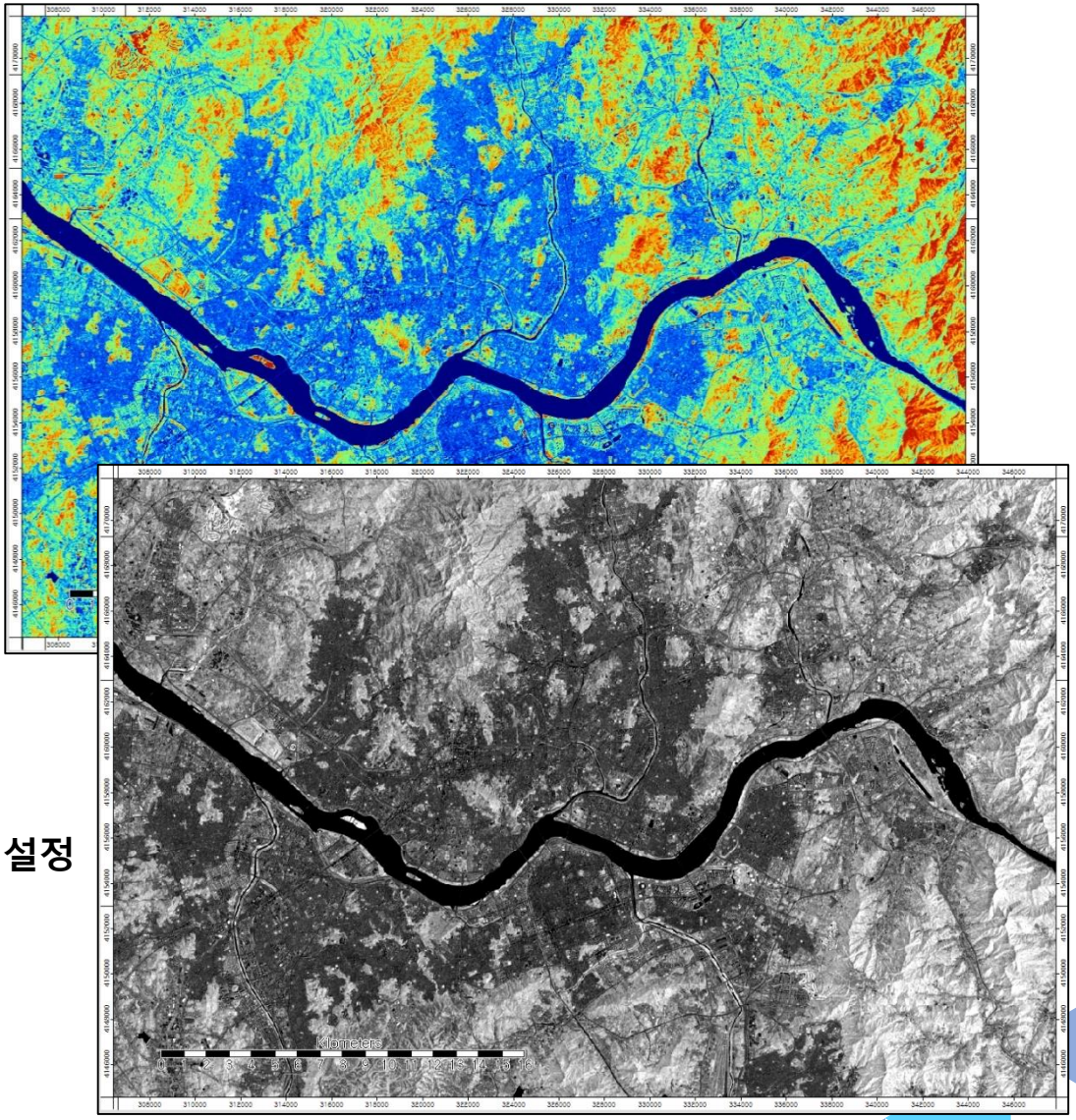
영상 흐림 실습

❖ 영상의 색 변경 (Settings -> Color)



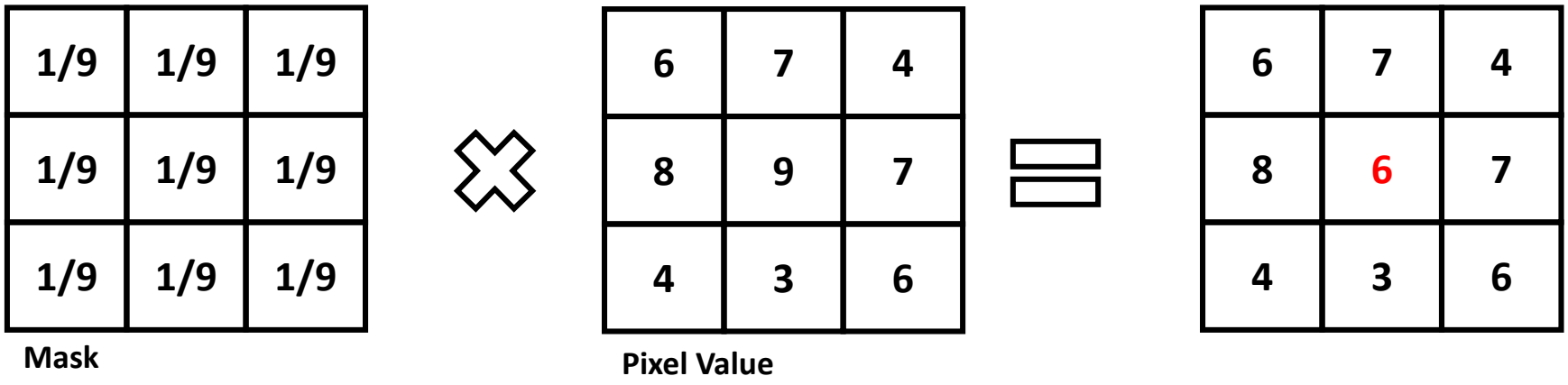
Shade 설정

dark-bright 설정



영상 흐림 실습

❖ 필터 계산 법

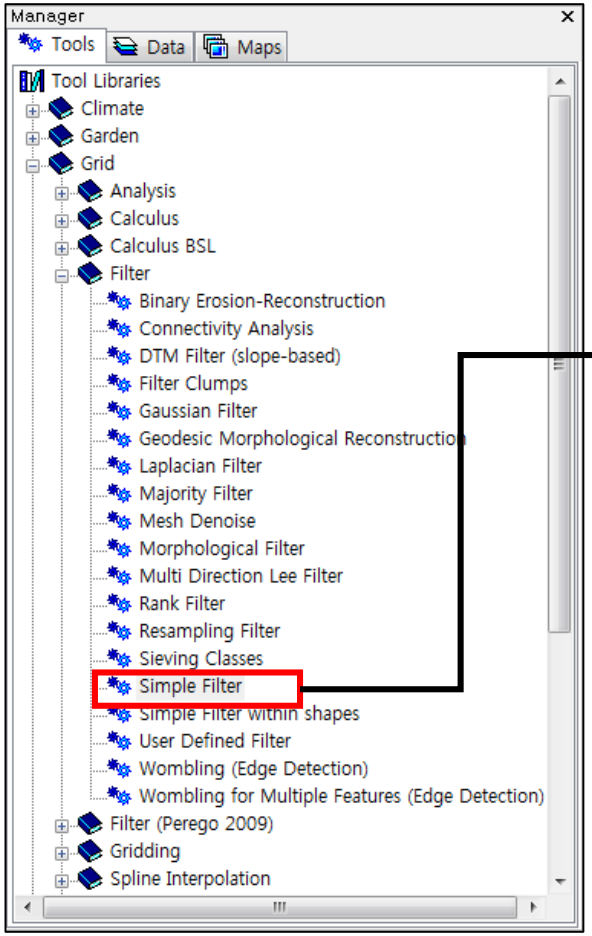


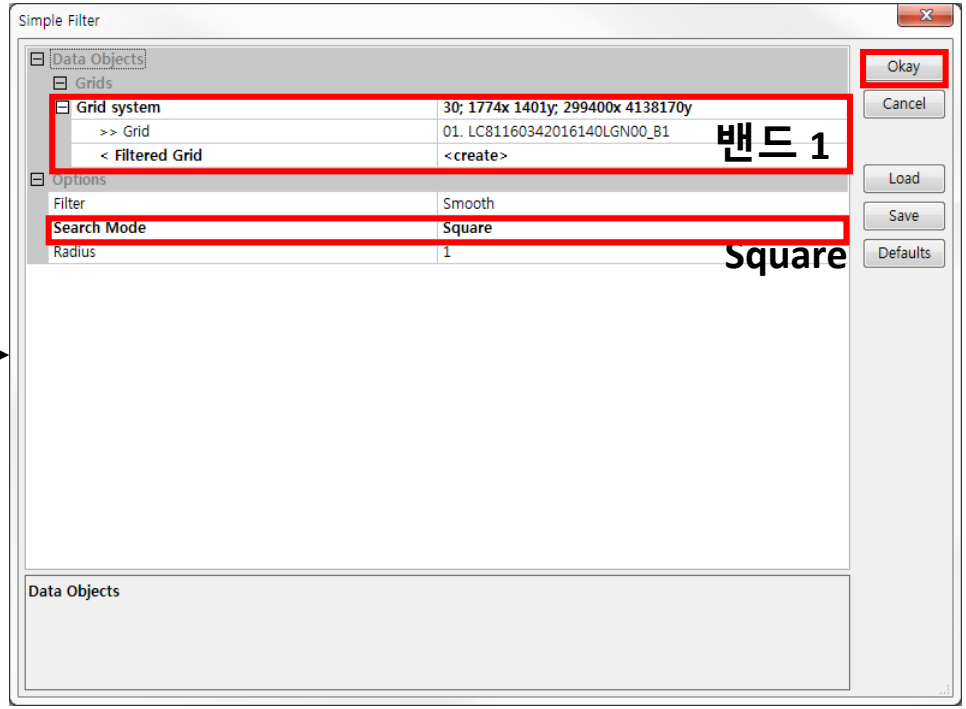
(6x1 + 7x1+ 4x1 + 8x1 + 9x1 + 7x1 + 4x1 + 3x1 + 6x1) / 9 = 6

- 필터 마스크(3 x 3)와 픽셀 값을 곱한 후 더함
- 더한 값을 9로 나누어 중앙 픽셀에 적용함
- 필터는 기존 영상의 잡음제거 및 분석을 위해 사용

영상 흐림 실습

❖ **Simple Filter(Tools 탭 -> Grid -> Filter -> Simple Filter)**

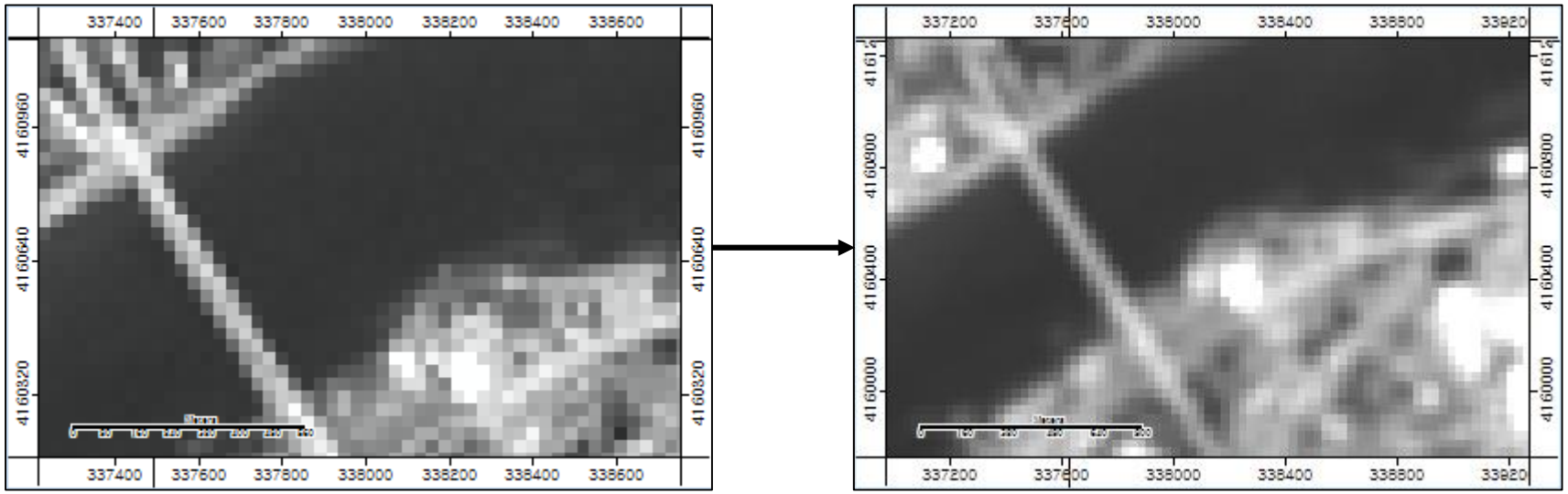




또는 Apply, Execute

영상 흐림 실습

❖ 필터 적용 전과 후 이미지 확인

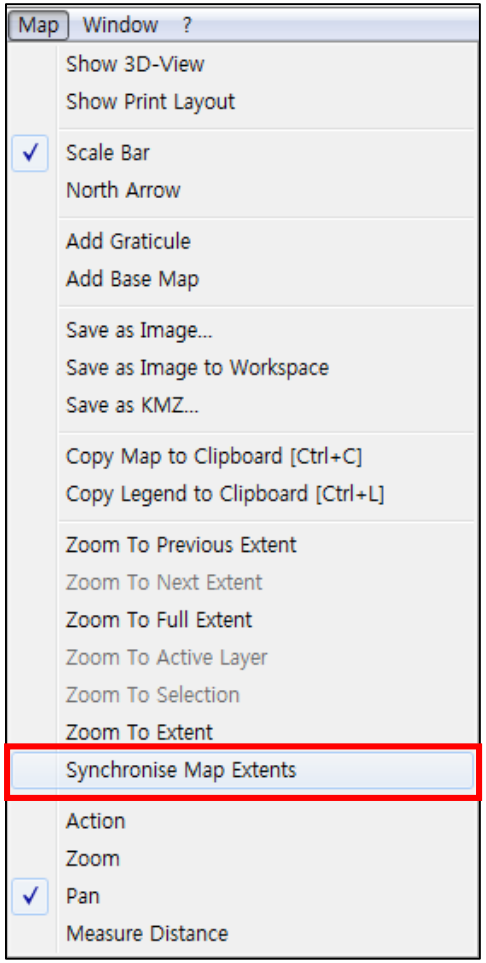


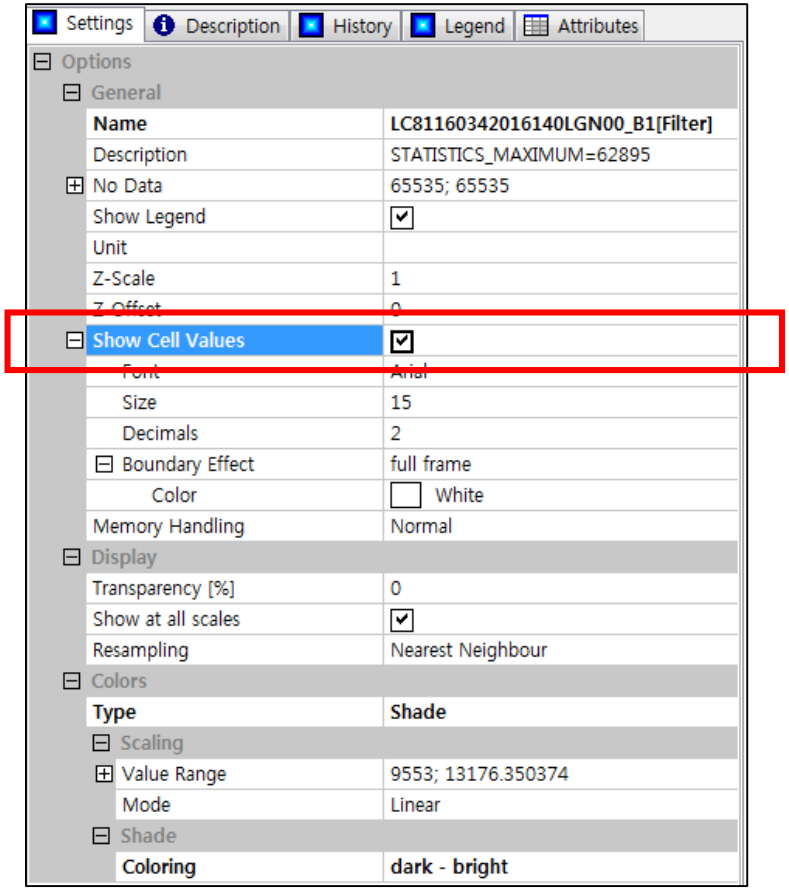
필터 적용 전

필터 적용 후

영상 흐림 실습

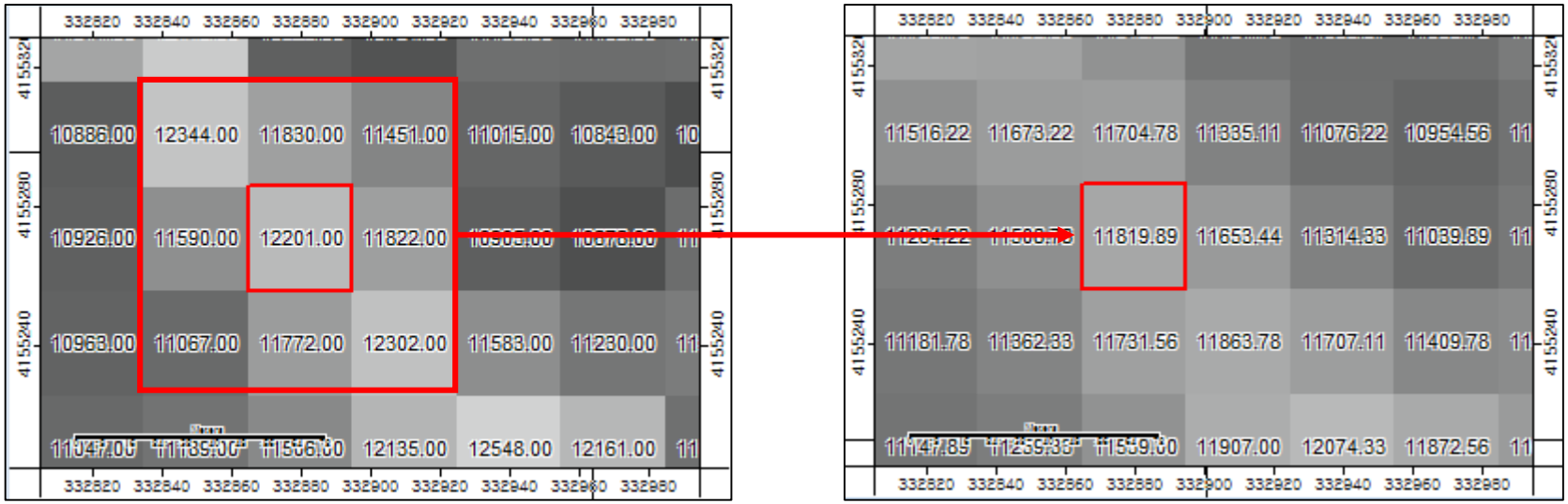
- ❖ 맵 동기화 (Map -> Synchronise Map Extents)
- ❖ 각 셀 값 확인 (Settings -> Show Cell Values) ※2개 영상 모두 체크





영상 흐림 실습

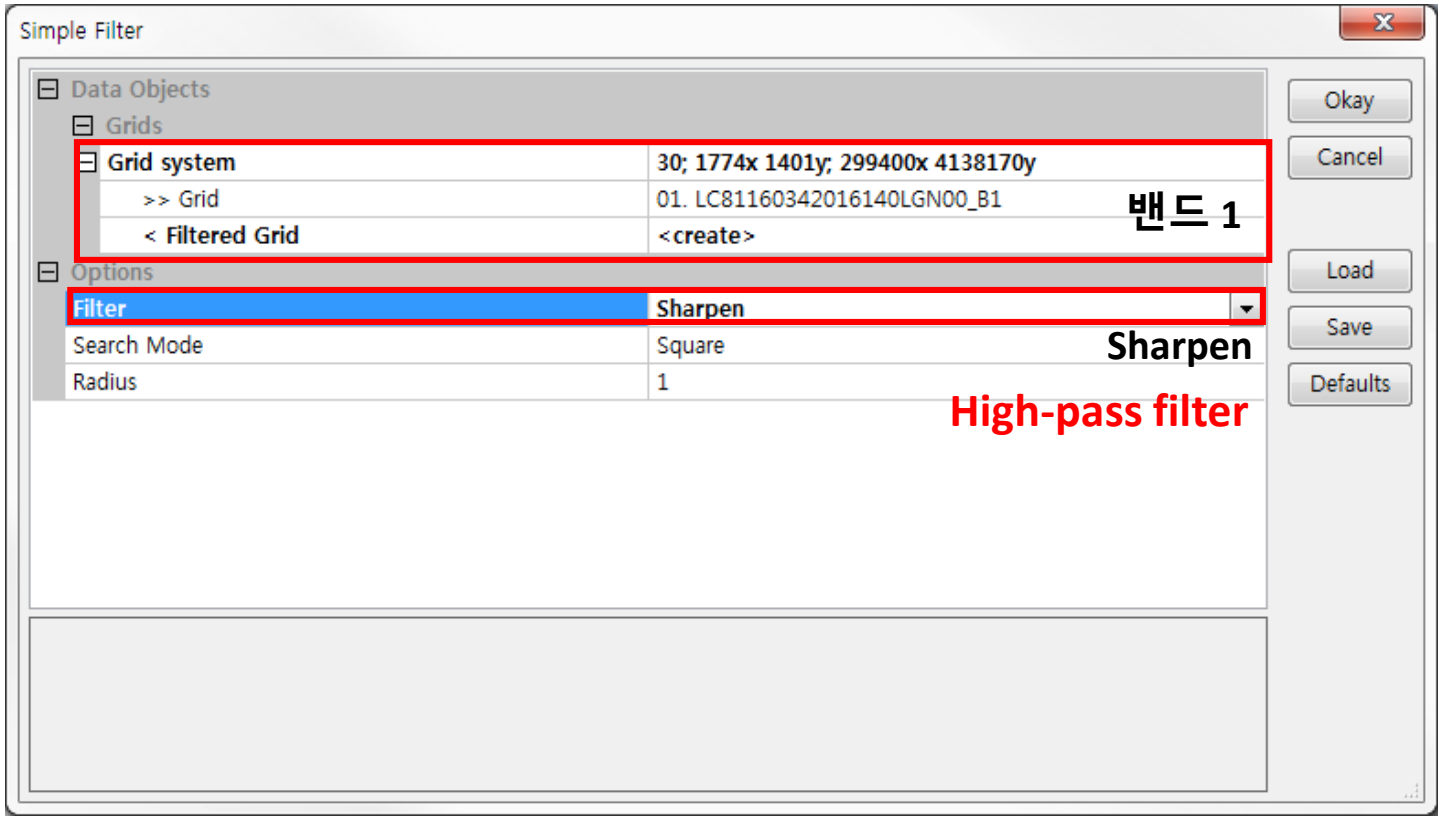
❖ 영상 확대하여 필터 적용 값 확인



(12344x1 + 11830x1 + 11451x1 + 11590x1 + 12201x1 + 11822x1 + 11067x1 + 11772x1 + 12302x1) / 9 = **11819.89**

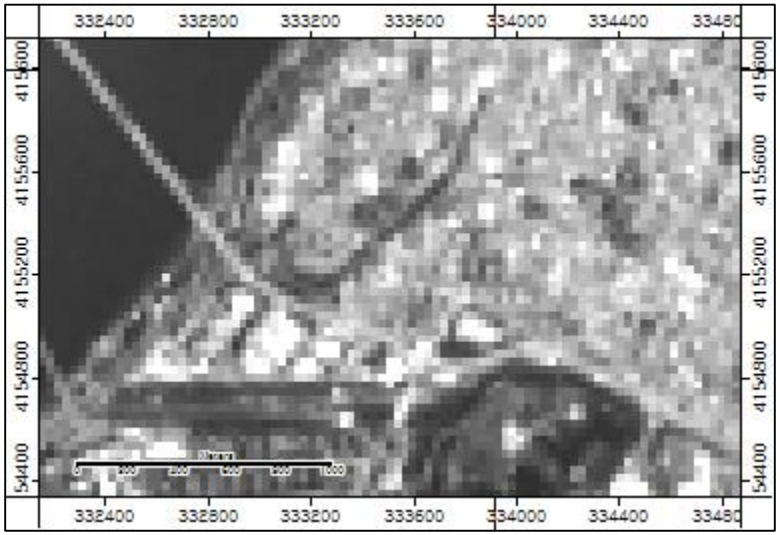
영상 선명화 실습

❖ Simple Filter(Tools 탭 -> Grid -> Filter -> Simple Filter)

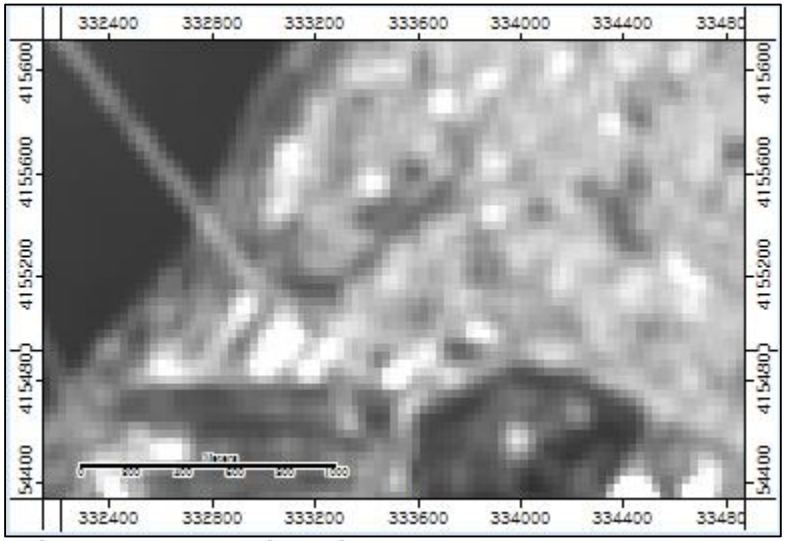


영상 선명화 실습

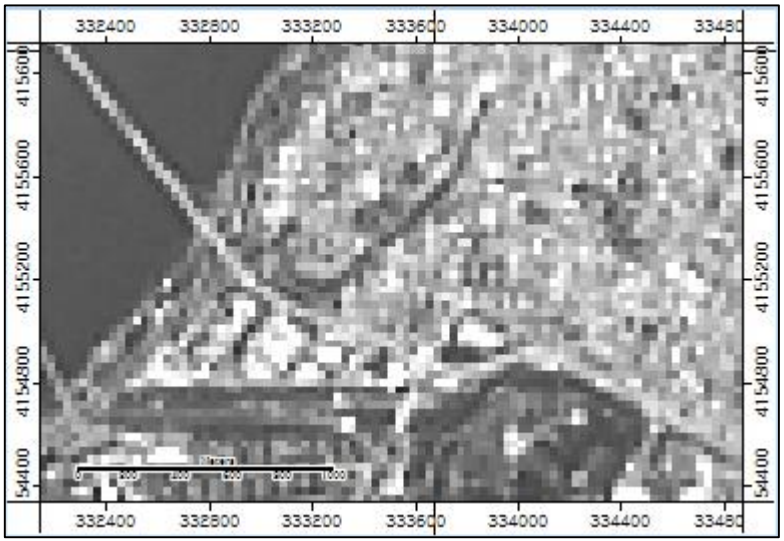
❖ 필터 영상 확인



필터 적용 안함



필터(Smooth) 적용 후

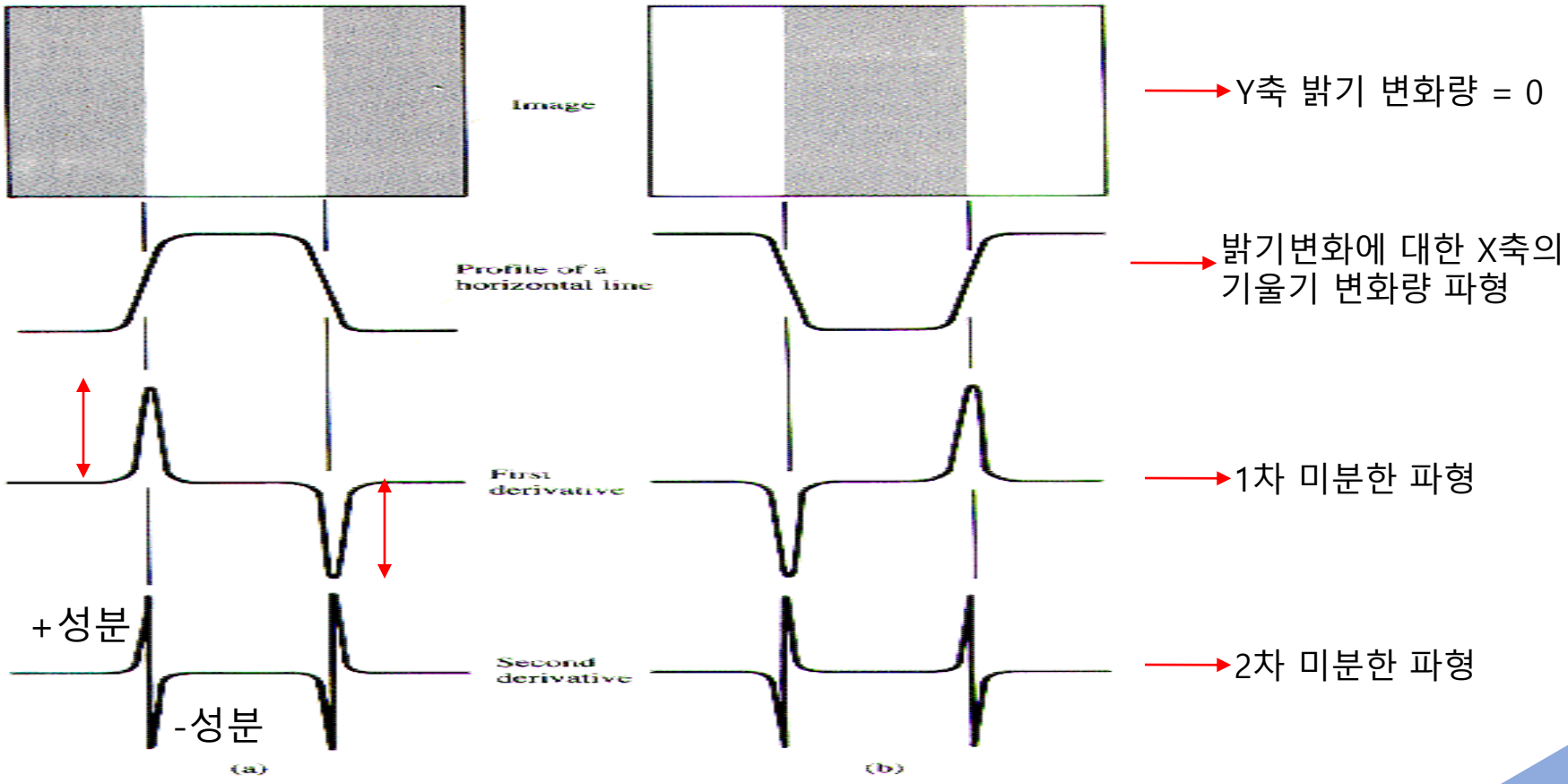


필터(Sharpen) 적용 후

Simple filter가 제공하는
다른 설정을 수행

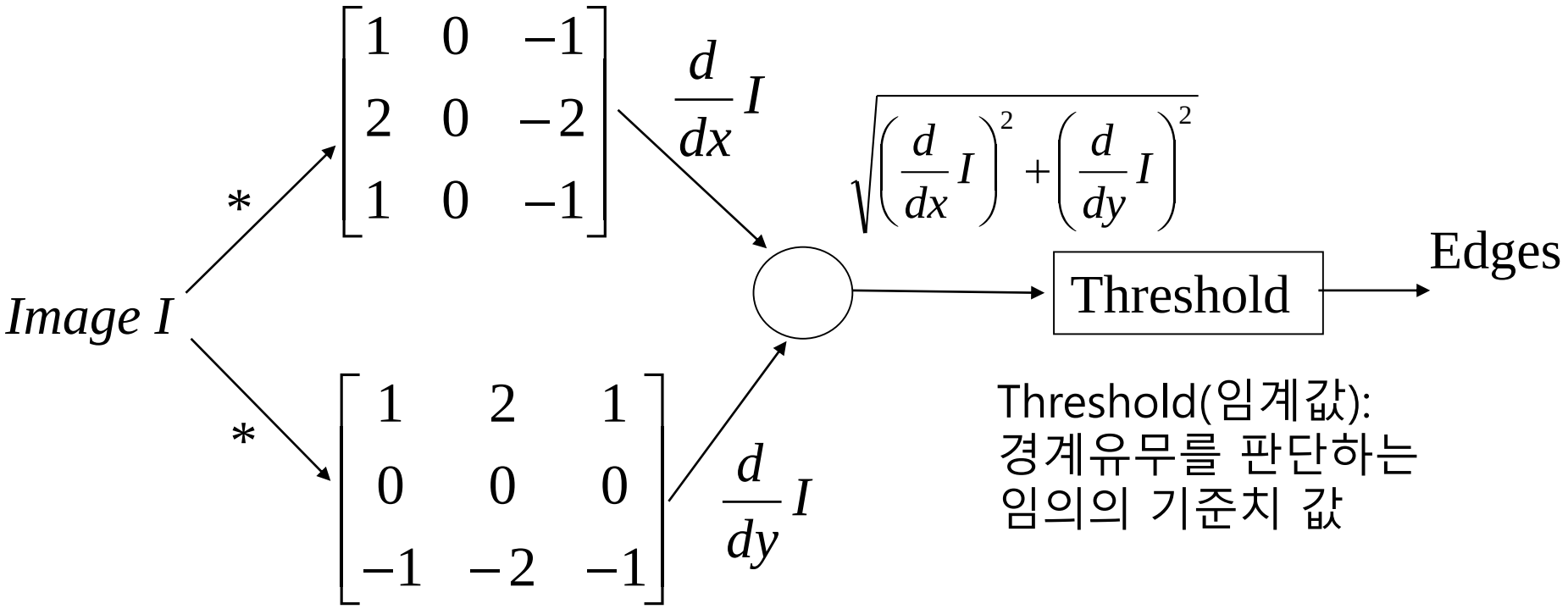
윤곽선 검출(Edge Detection)

① 1차 미분 값에서 그래프 기울기의 크기로 영상에서 윤곽선의 존재여부 확인
② 2차 미분 값에서 그래프 기울기의 부호로 윤곽선 픽셀의 밝고 어두운 부분의 위치 확인



미분연산자에 의한 윤곽선 파형

윤곽선 검출(Edge Detection)



Threshold(임계값):
경계유무를 판단하는
임의의 기준치 값

윤곽선 검출(Edge Detection)

Sobel 필터를 이용한 영상 정보 경계선 추출 (Edge Extraction)

	수평 경계선	수직 경계선
Prewitt	$\begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$	$\begin{bmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{bmatrix}$
Roberts	$\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	$\begin{bmatrix} 0 & 0 & -1 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$
Sobel	$\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$	$\begin{bmatrix} 1 & 0 & -1 \\ 2 & 0 & -2 \\ 1 & 0 & -1 \end{bmatrix}$

$$E(x,y)=\sqrt{E_r^2(x,y)+E_c^2(x,y)}$$

$E_r(x,y)$: 수평 경계선 검출용 회선 마스크 적용 결과 값

$E_c(x,y)$: 수직 경계선 검출용 회선 마스크 적용 결과 값

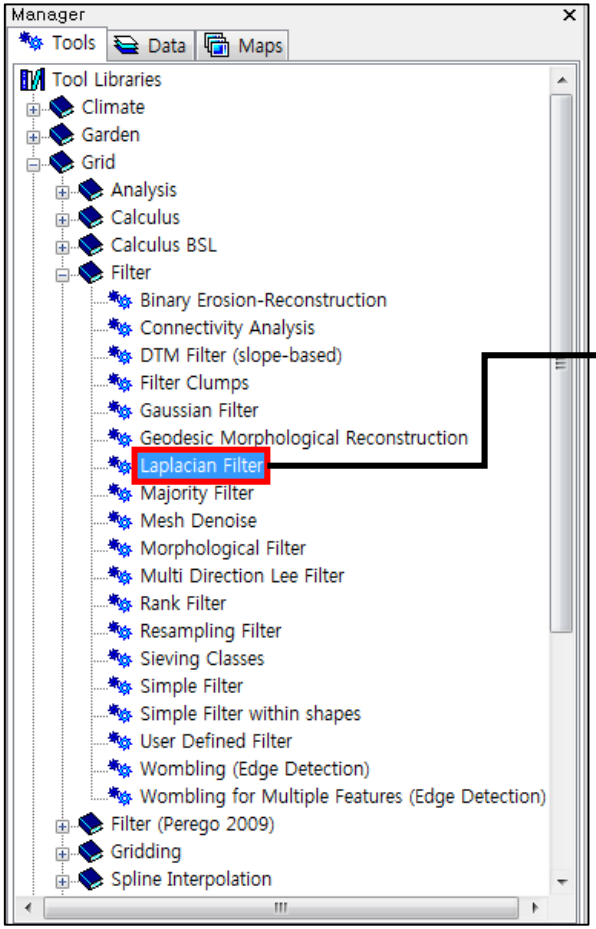
라플라시안(Laplacian) 마스크

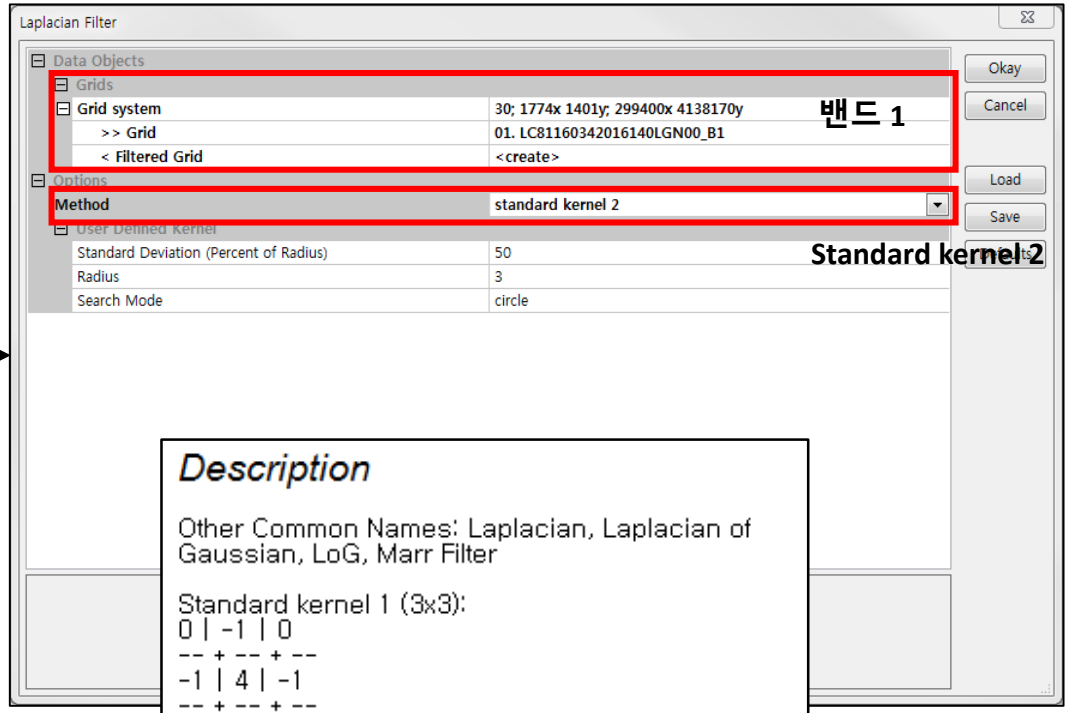
- 2차 미분 연산자, 날카로운 윤곽선 검출
- 연산속도가 빠르고, 모든 방향 윤곽선 검출

−1	−1	−1
−1	8	−1
−1	−1	−1

엣지 추출 실습 (라플라시안)

❖ **Laplacian Filter(Tools -> Grid -> Filter -> Laplacian Filter)**





Description

Other Common Names: Laplacian, Laplacian of Gaussian, LoG, Marr Filter

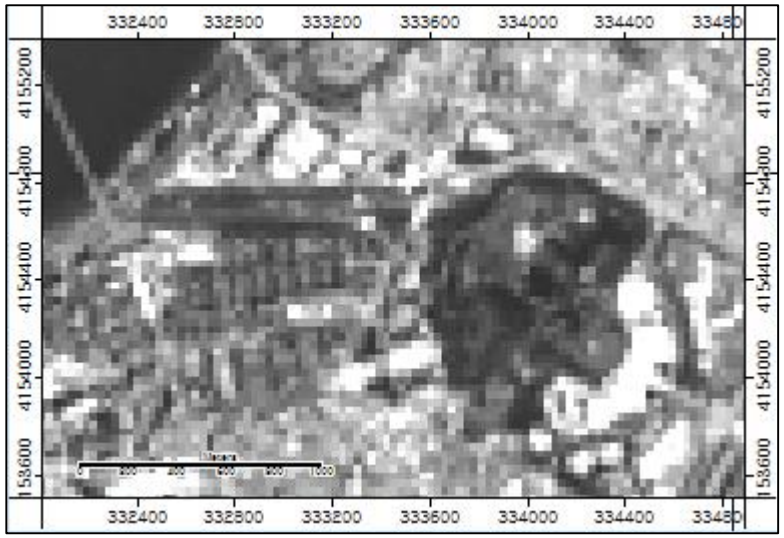
Standard kernel 1 (3x3):
0 | -1 | 0
-- + -- + --
-1 | 4 | -1
-- + -- + --
0 | -1 | 0

Standard kernel 2 (3x3):
-1 | -1 | -1
-- + -- + --
-1 | 8 | -1
-- + -- + --
-1 | -1 | -1

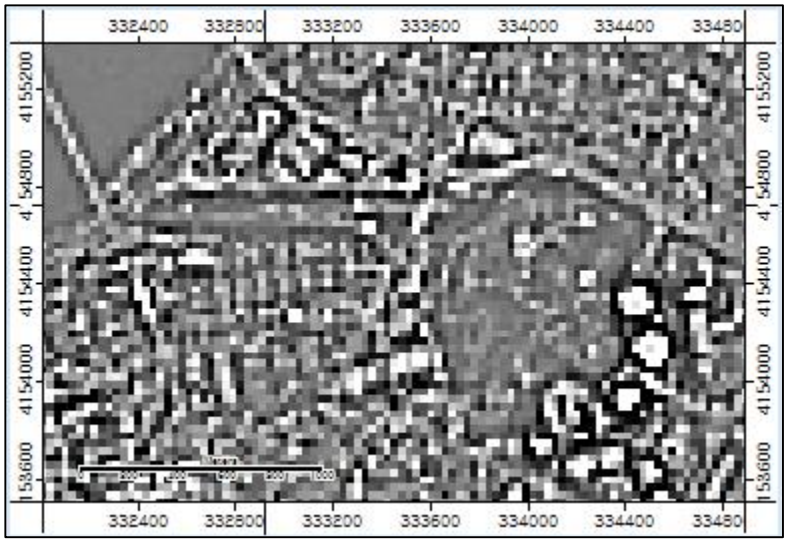
Standard kernel 3 (3x3):
-1 | -2 | -1
-- + -- + --
-2 | 12 | -2
-- + -- + --
-1 | -2 | -1

엣지 추출 실습 (라플라시안)

❖ 필터 적용 전과 후 영상 확인



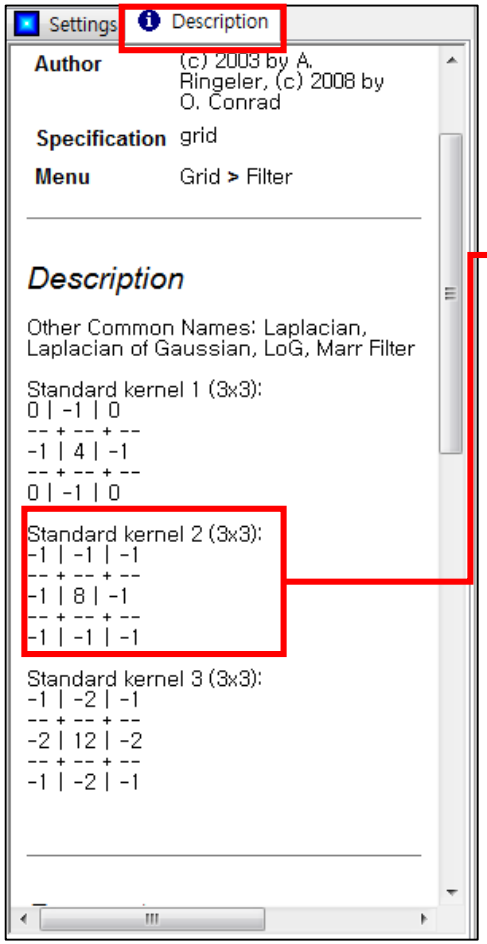
필터 적용 전

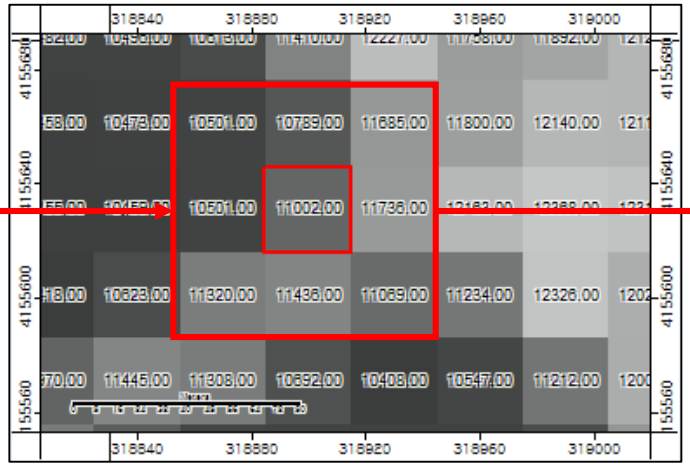


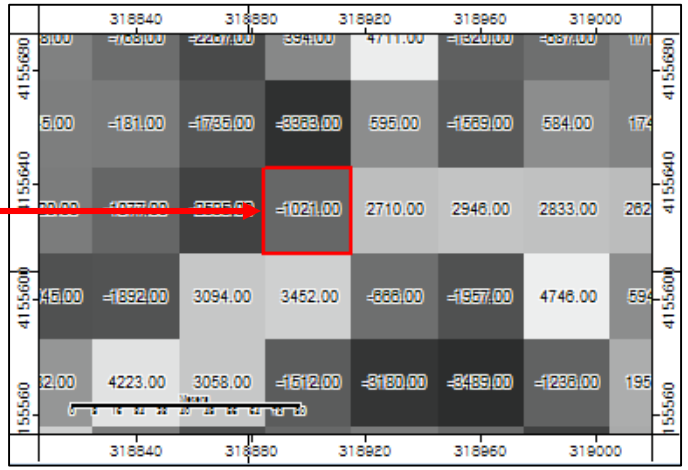
필터 적용 후

엣지 추출 실습 (라플라시안)

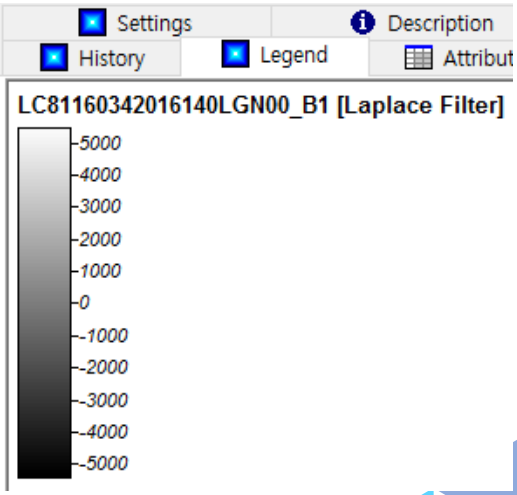
❖ Tools 탭 Laplacian Filter 선택 후 Description 탭에서 적용된 필터 마스크 값 확인 가능





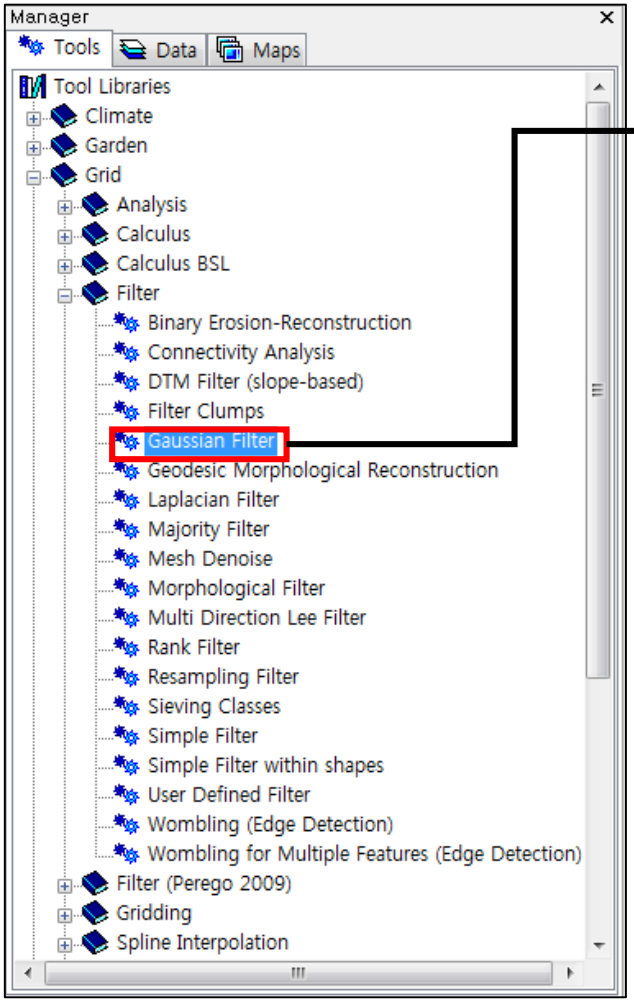


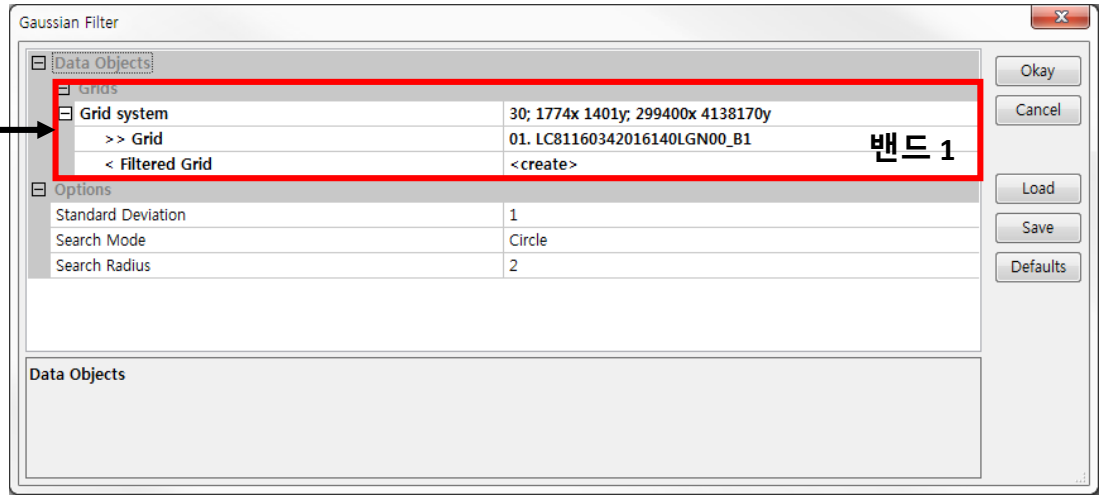
(10501x-1 + 10789x-1 + 11685x-1 + 10501x-1 + 11002x8 + 11736x-1 + 11320x-1 + 11436x-1 + 11069x-1) = -1021.00



영상 흐림 실습 (가우시안)

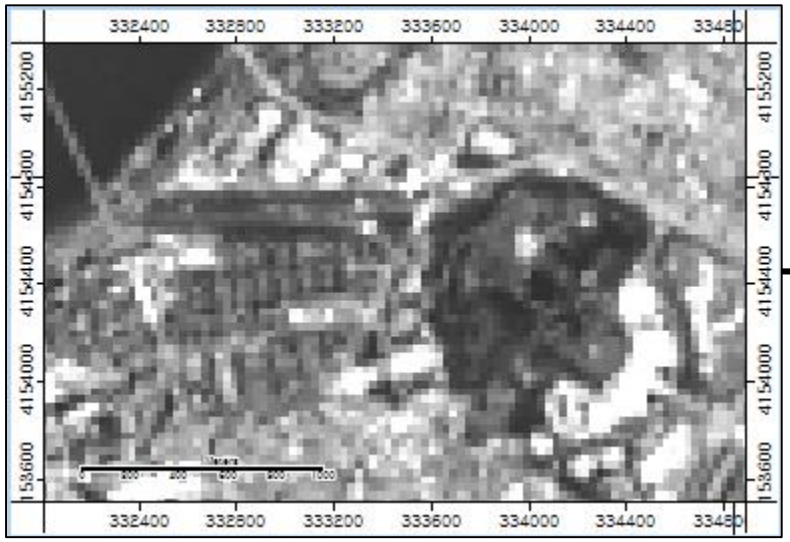
❖ Gaussian Filter(Tools -> Grid -> Filter -> Gaussian Filter)



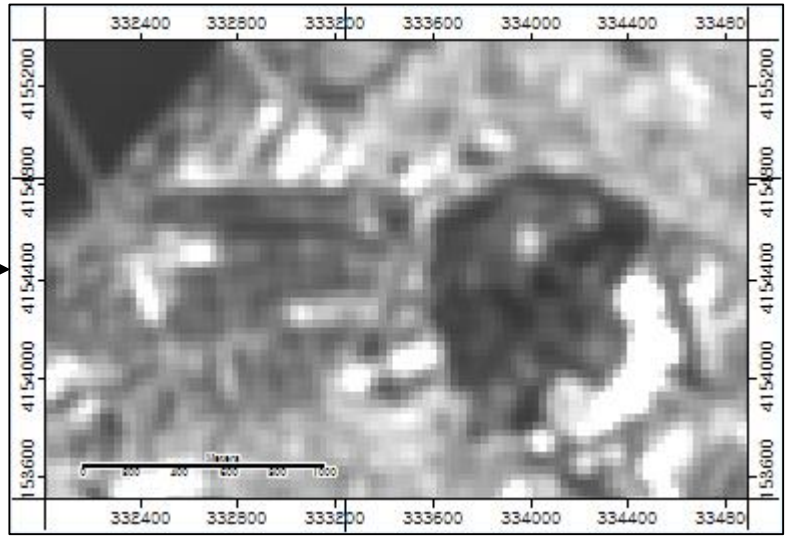


영상 흐림 실습 (가우시안)

❖ 필터 적용 전과 후 영상 확인



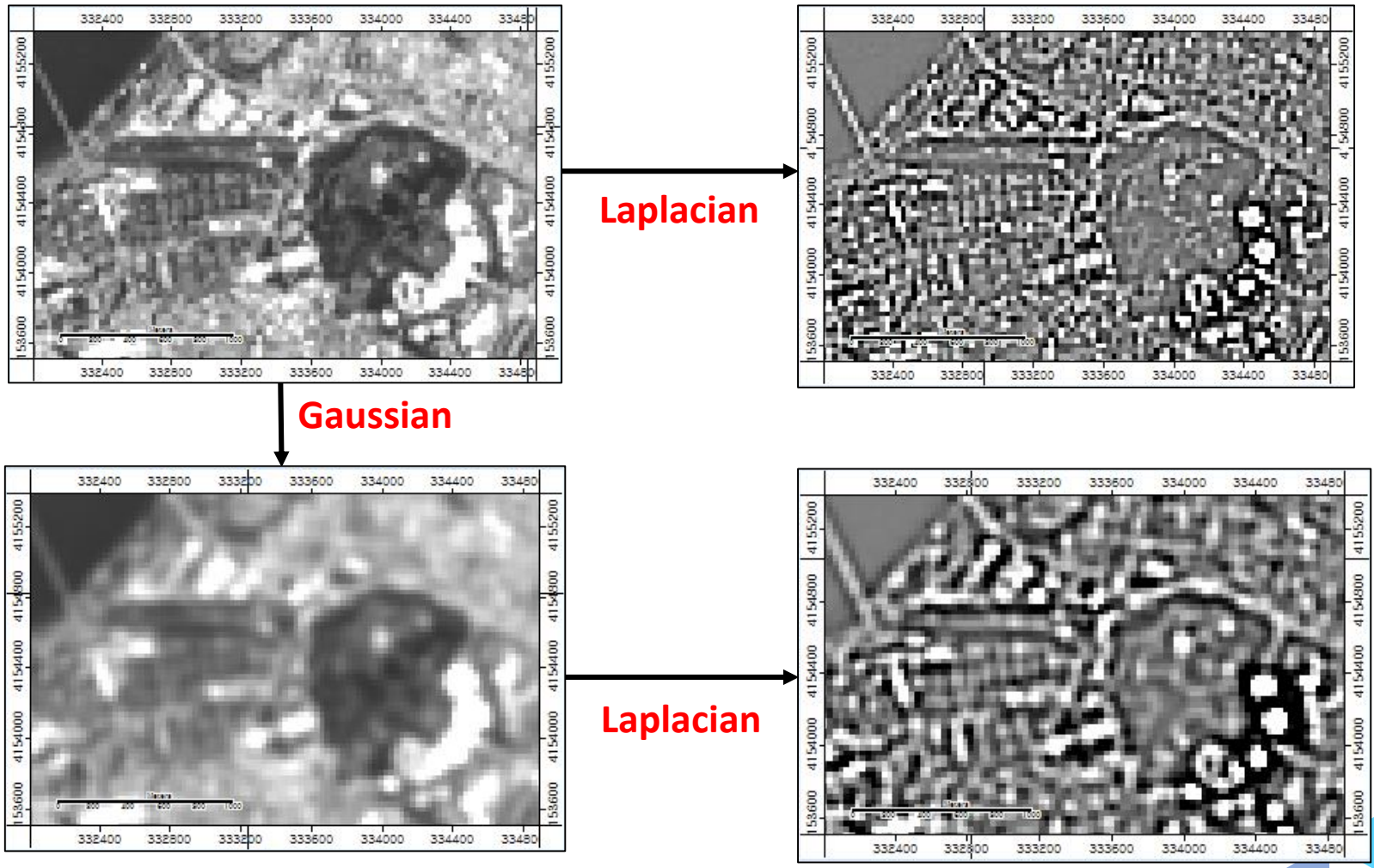
필터 적용 전



필터 적용 후

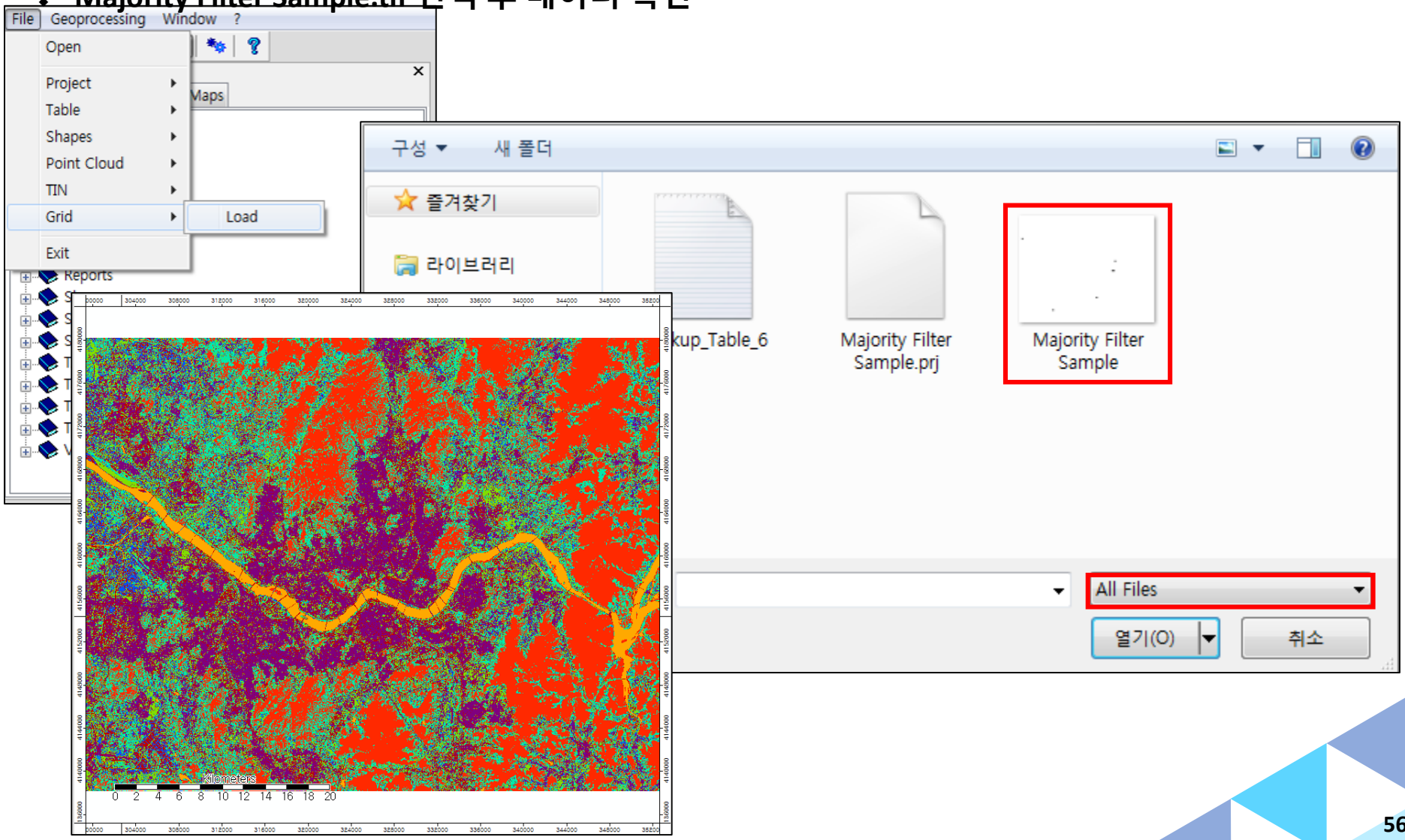
윤곽선 검출 (혼합)

- ❖ Gaussian Filter와 Laplacian Filter를 혼합 사용하여 좀 더 정확한 윤곽선 검출에 사용
- ❖ 원본 영상에 Gaussian Filter 적용 후 Laplacian Filter 순으로 적용) LoG filter



잡음 제거 실습

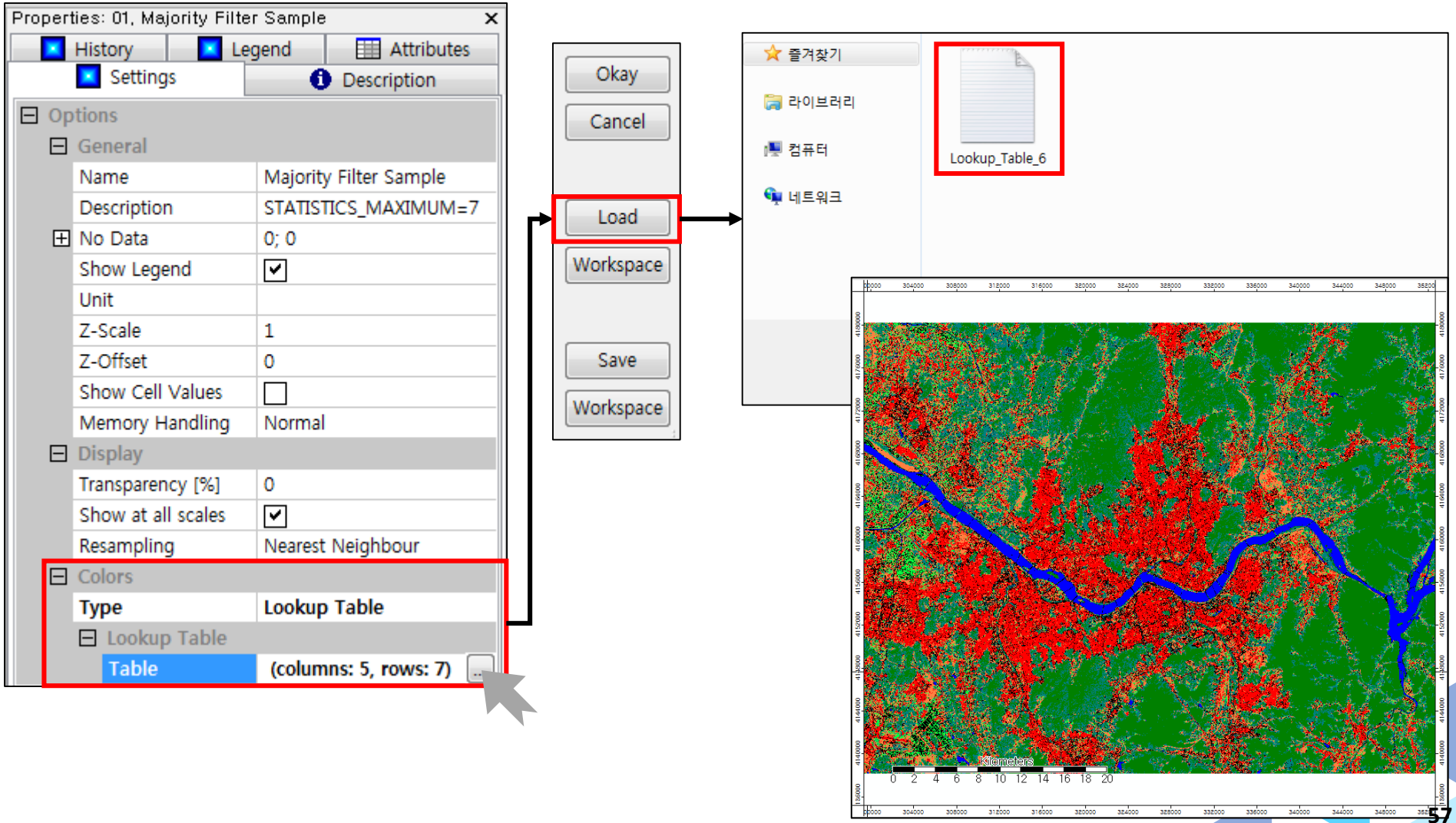
- ❖ 데이터 불러오기(File -> Grid -> Load)
- ❖ Majority Filter Sample.tif 선택 후 데이터 확인



잡음 제거 실습

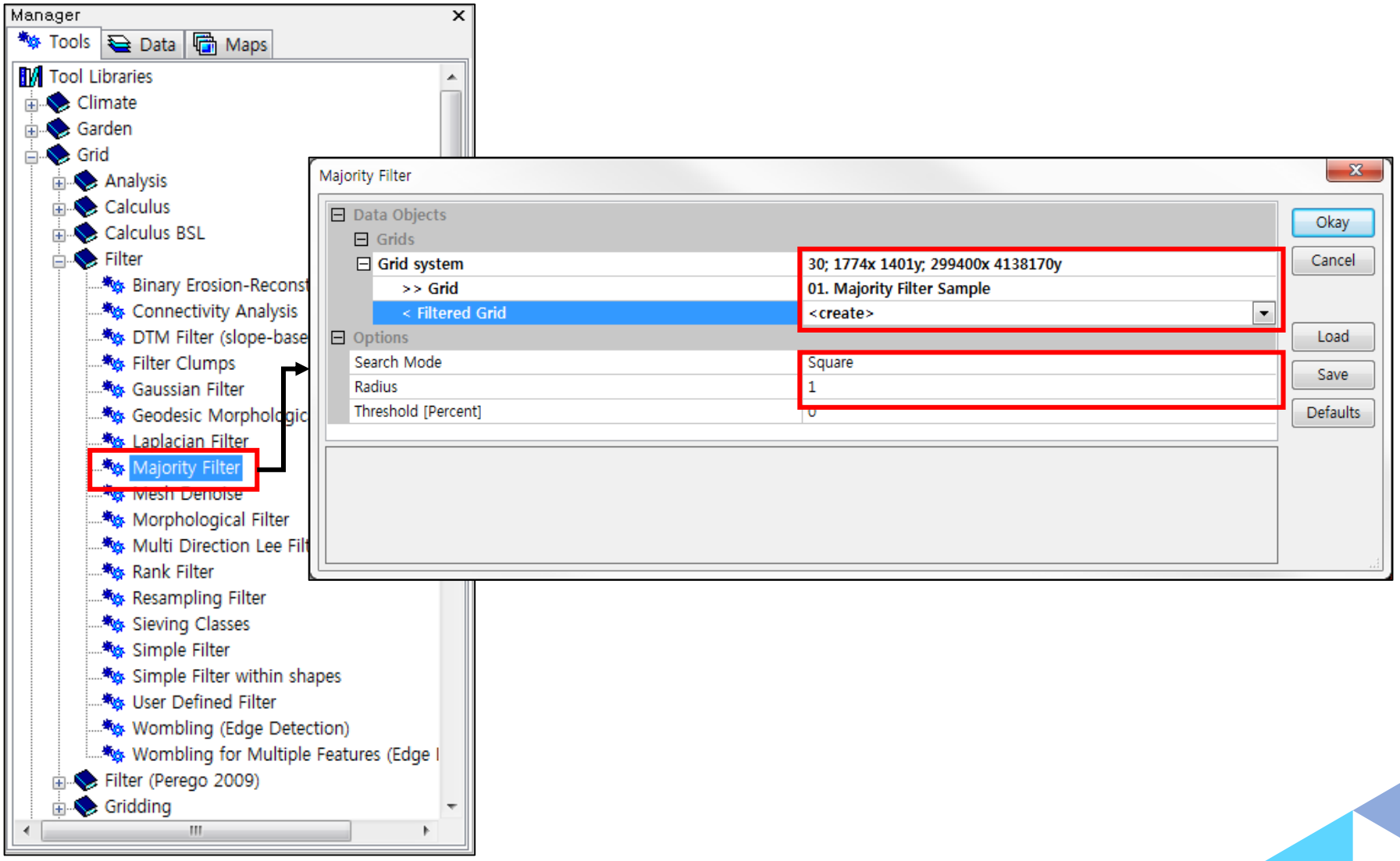
❖ Settings 탭 Colors Type을 Lookup Table로 변경

❖ Lookup Table 속성에서 Lookup_Table_6.txt 불러온 후 적용



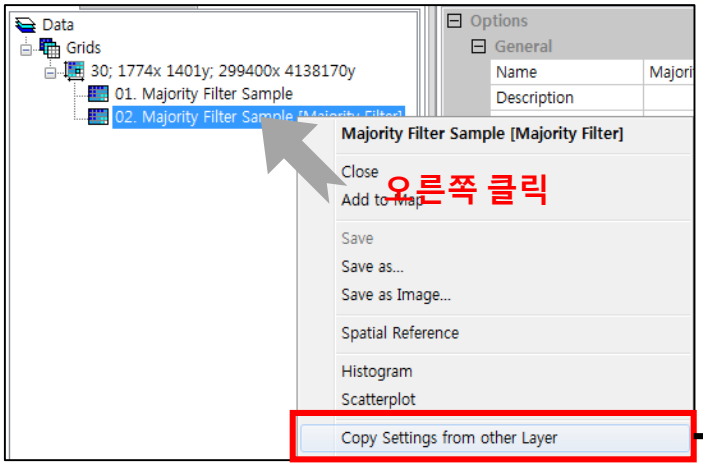
잡음 제거 실습

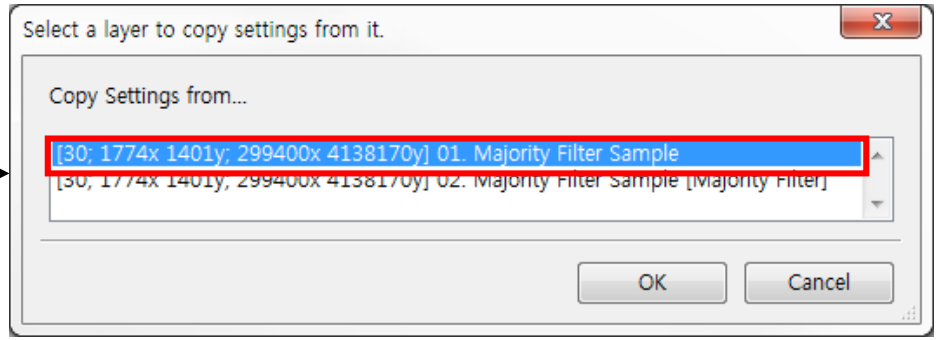
❖ **Majority Filter (Tools -> Filter -> Majority Filter)**

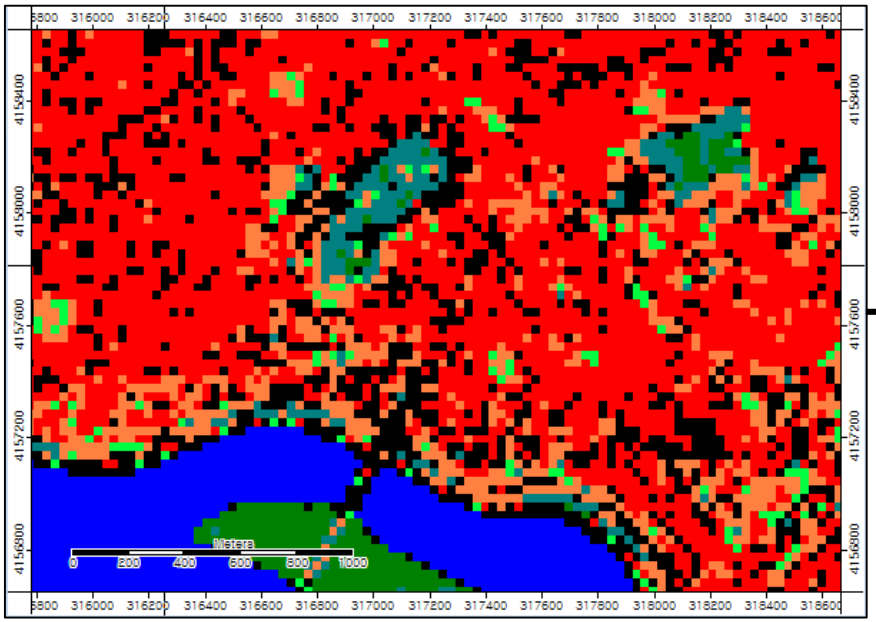


잡음 제거 실습

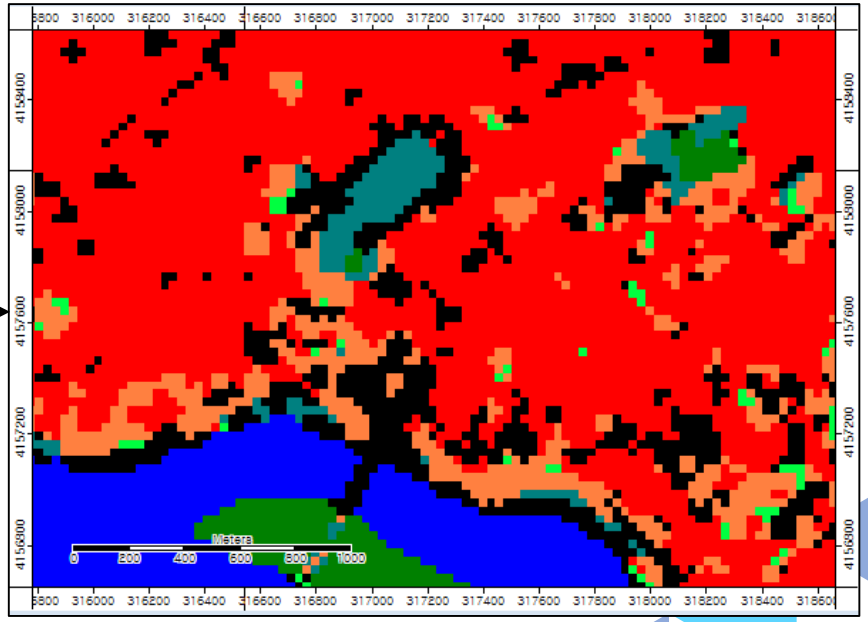
❖ Majority Filter 적용 (Copy Settings from other Layer -> Majority Filter Sample)







필터 적용 전



필터 적용 후

영상 융합

정의

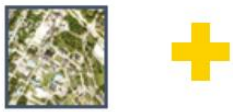
- 특정 알고리즘의 사용을 통해 두 개 혹은 그 이상의 서로 다른 영상을 조합하여 새로운 영상을 만들어내는 것
- 원격탐사 분야에서는 고해상도 위성영상을 활용하여 상대적으로 낮은 공간해상도를 가지고 있는 다중 분광 영상의 공간해상도를 강제적으로 증가시키는 기법 의미
- Pansharpening이라고 불림

활용

- Geoeye-1, Worldview-2와 같은 국외 고해상도 위성영상과 국내 KOMPSAT 2/3/3A 1m 내외 공간해상도를 가지는 전정색 영상과 함께 2-4m 공간해상도 가지는 다중 분광 영상을 제공
- 위성 센서로부터 고해상도 전정색 영상과 동일한 공간해상도를 가지는 다중 분광 영상을 취득하는 것은 물리적으로 불가능, 그러므로 융합 기법 필요

영상 융합

	아리랑위성 2호	아리랑위성 3호	아리랑위성 3A호
다중분광 영상의 공간해상도	4m	2.8m	2.2m
전정색 영상의 공간해상도	1m	0.7m	0.55m
융합영상의 공간해상도	1m	0.7m	0.55m

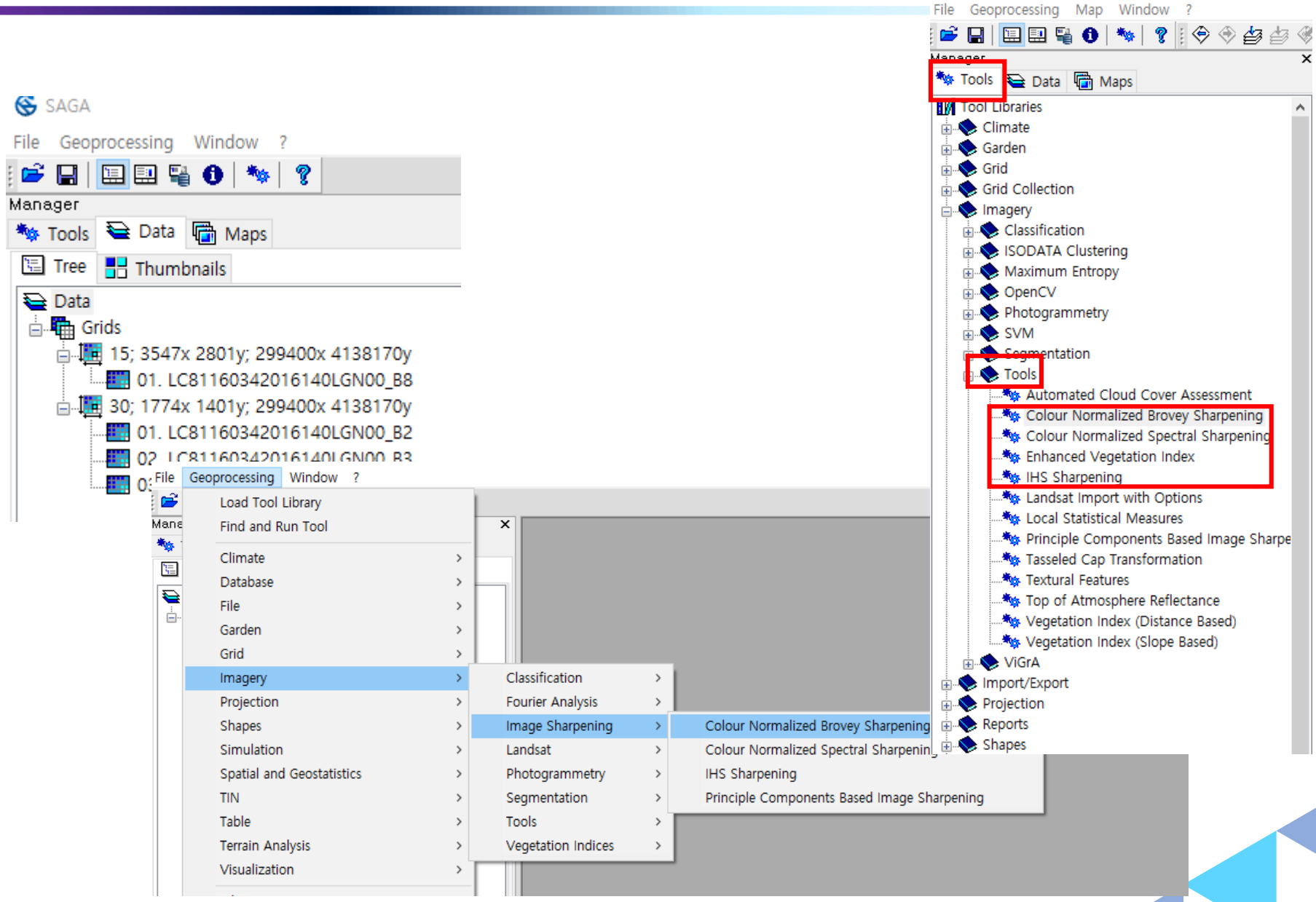


저해상도 다중분광 영상

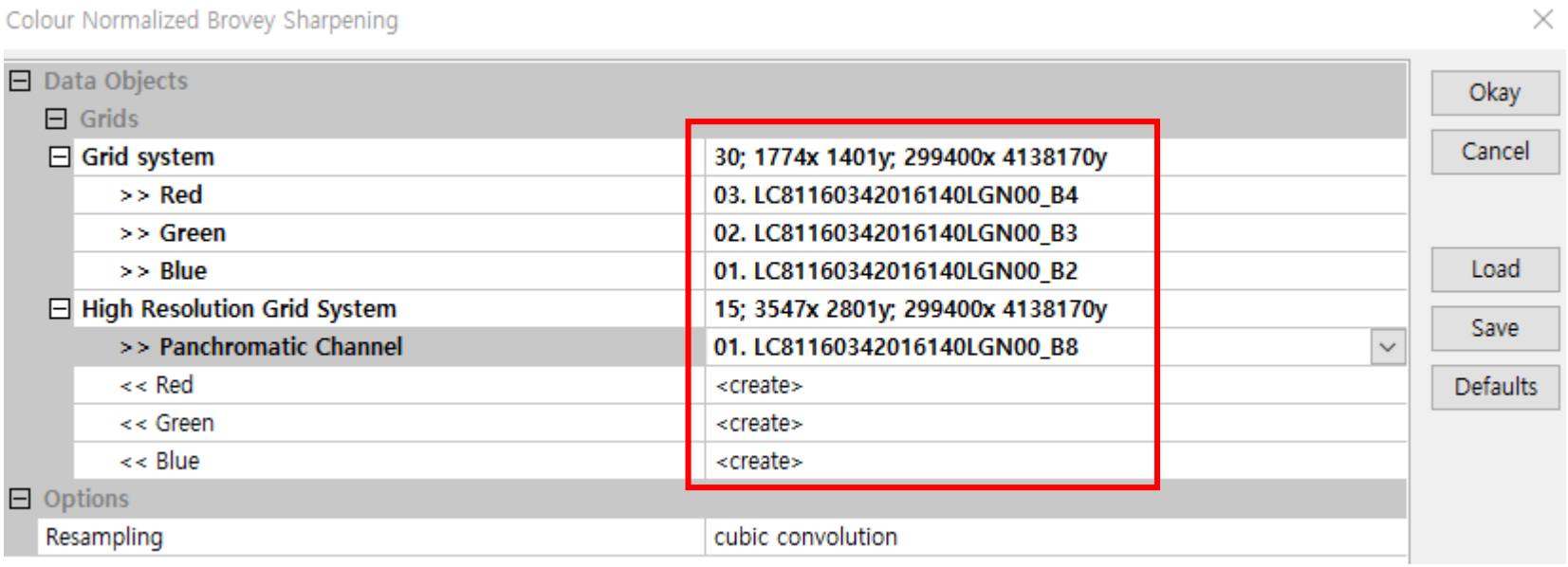
고해상도 전정색 영상

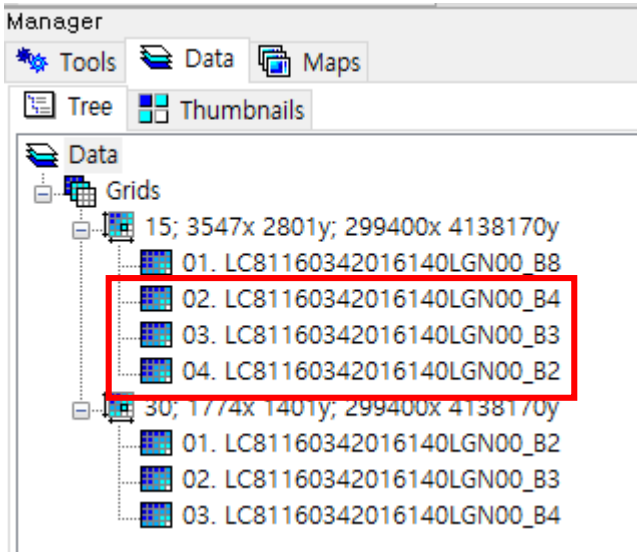
고해상도 다중분광 영상

영상 융합 실습(Pan Sharpening)

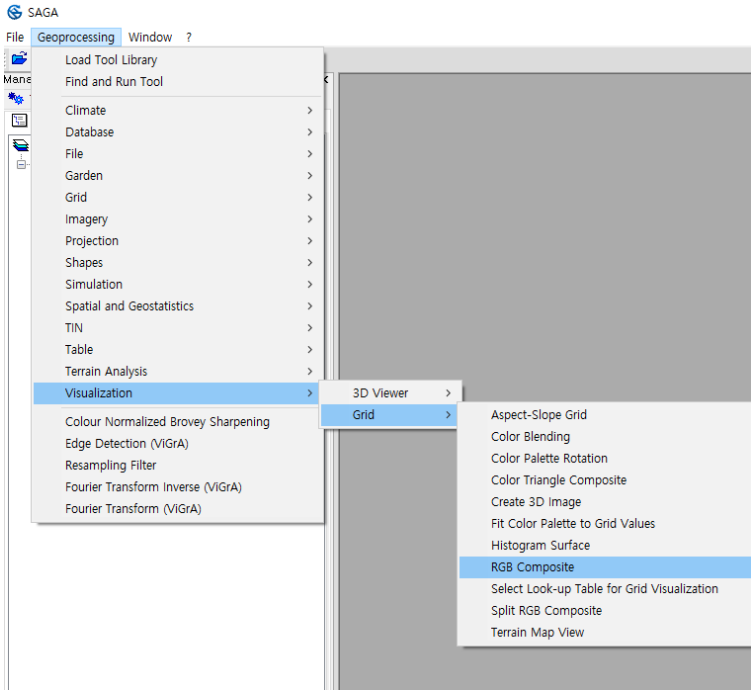


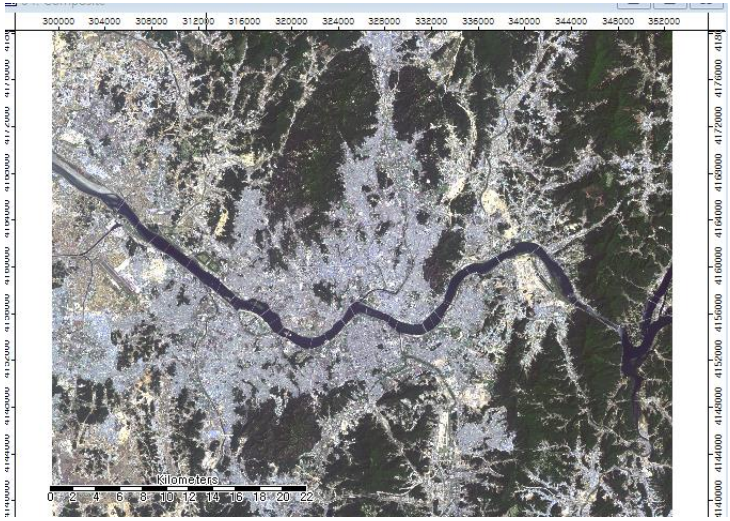
영상 융합 실습(Pan Sharpening)

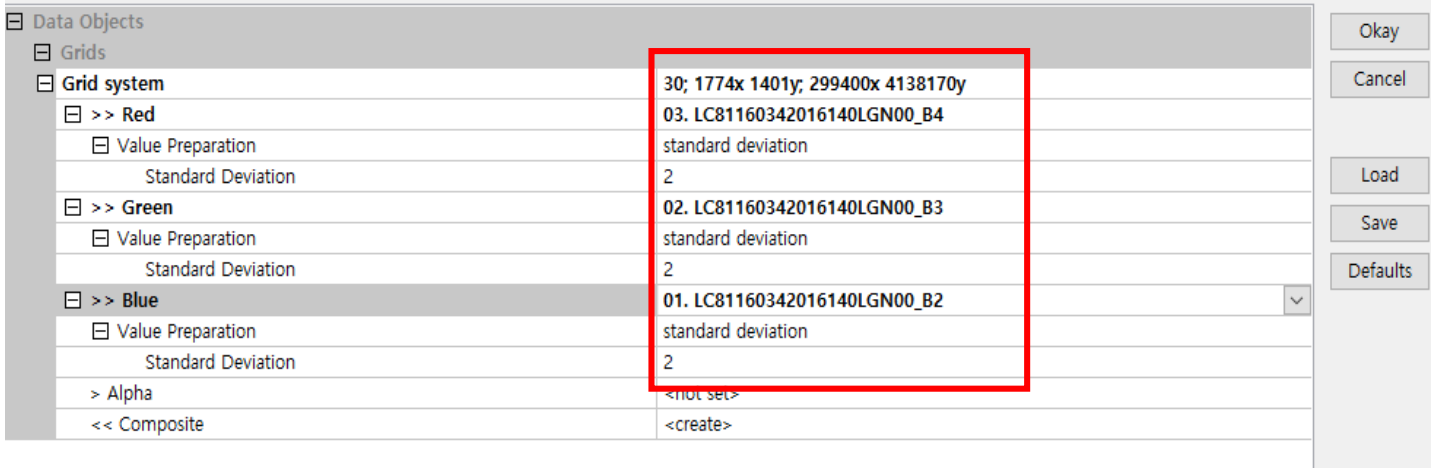




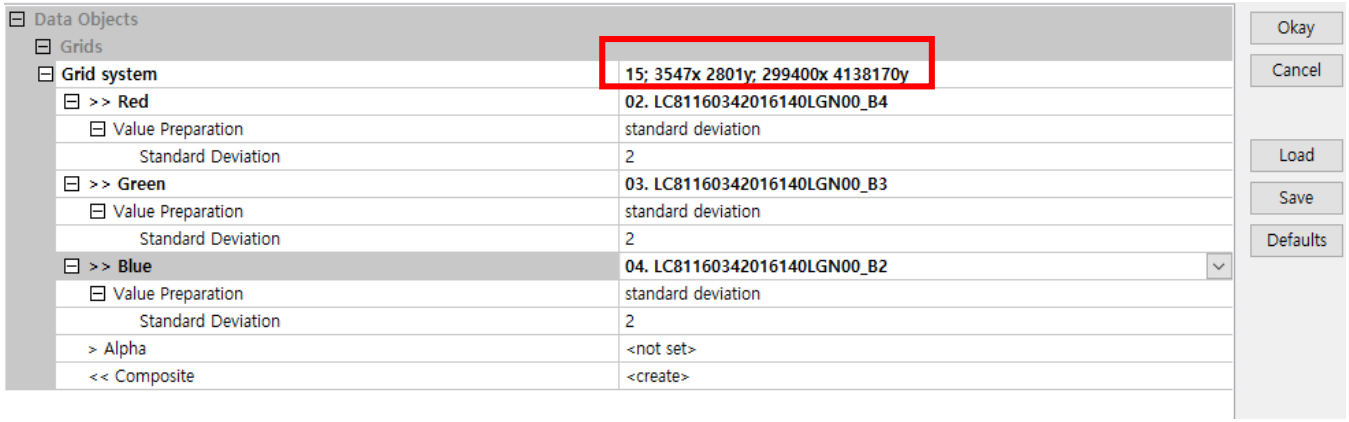
영상 융합 실습(Pan Sharpening)

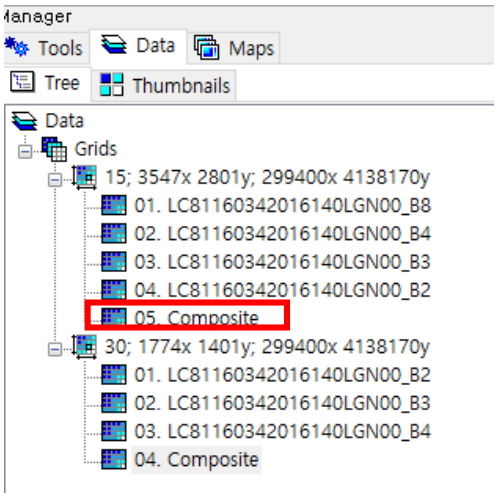


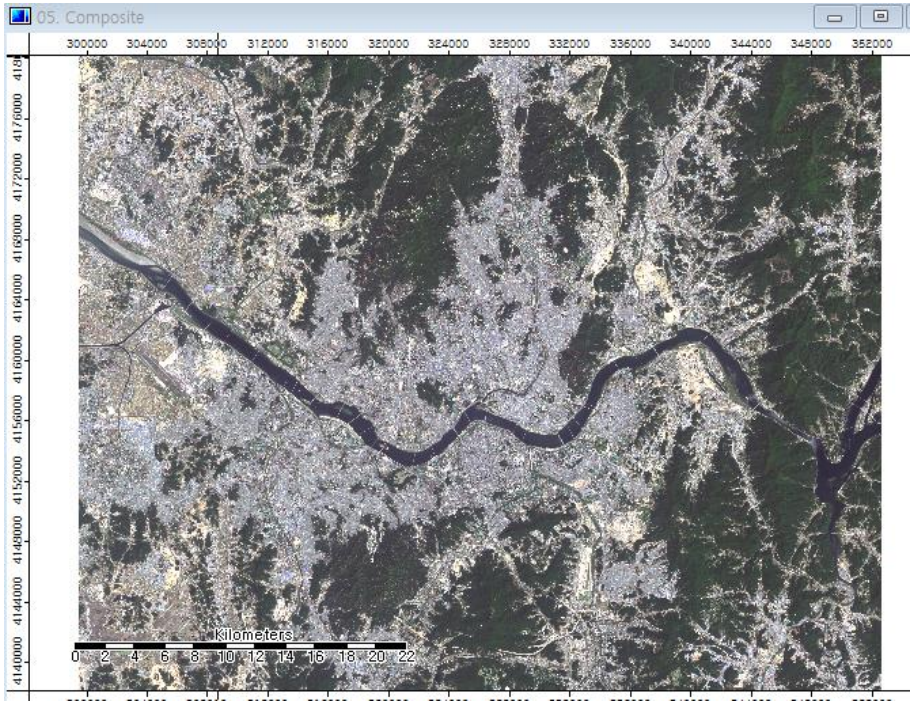




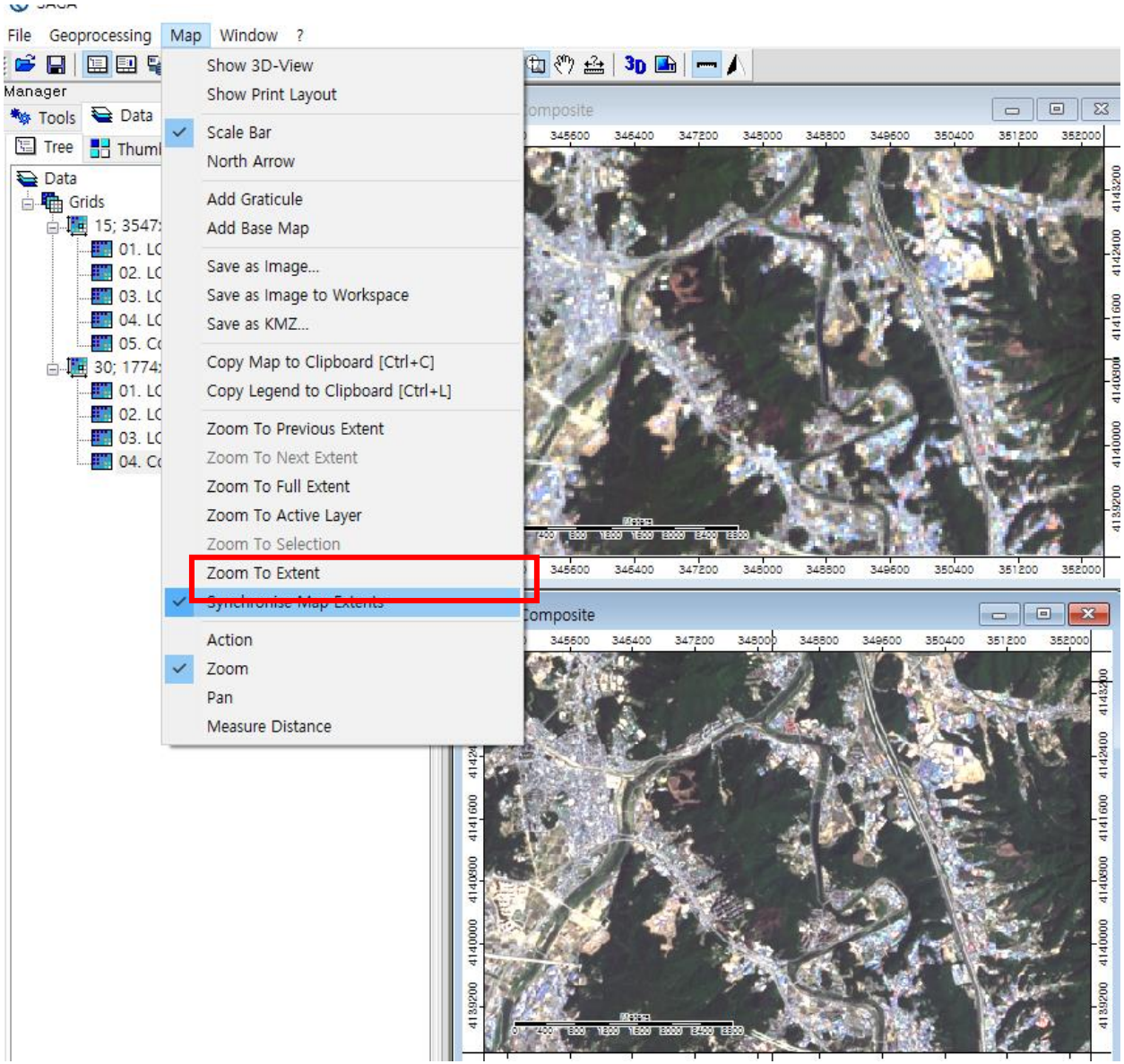
영상 융합 실습(Pan Sharpening)



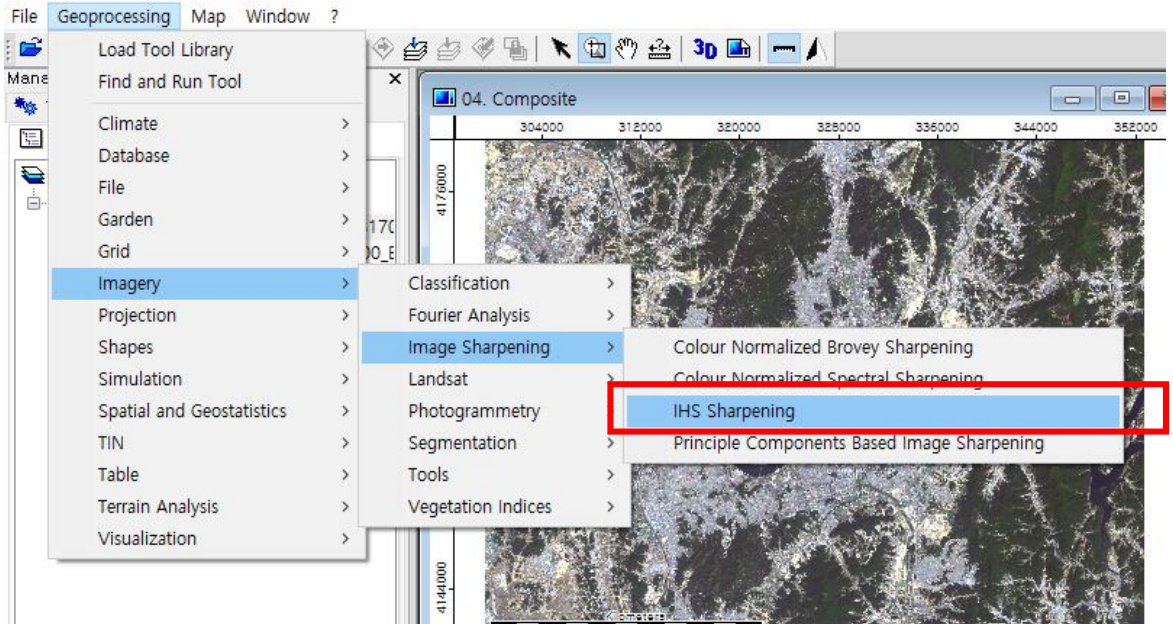


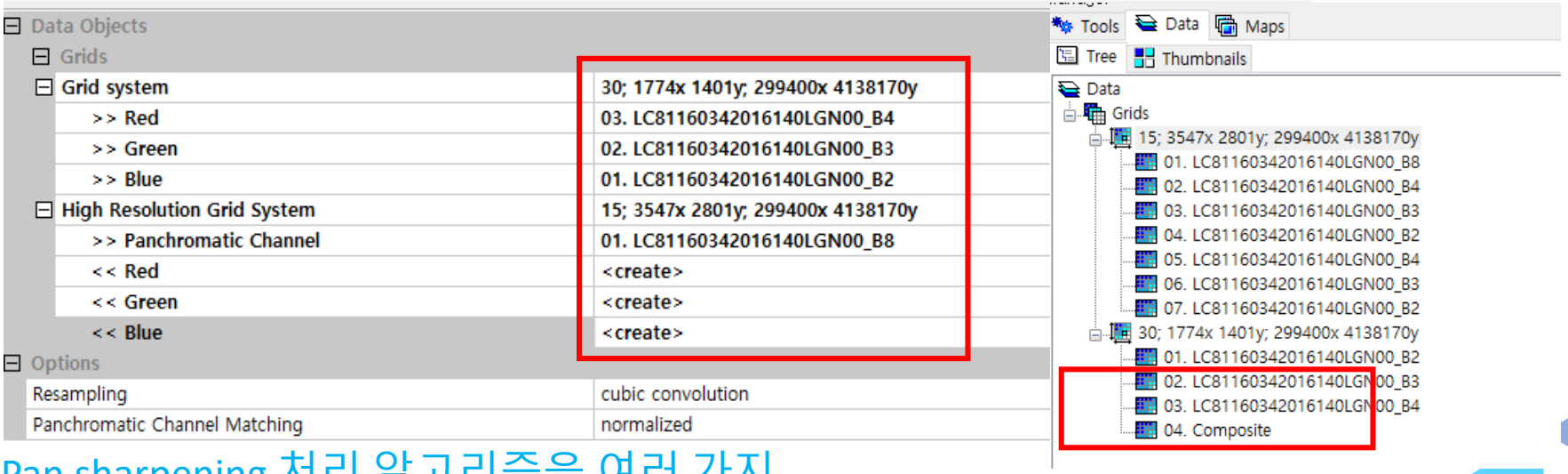


영상 융합 실습(Pan Sharpening)



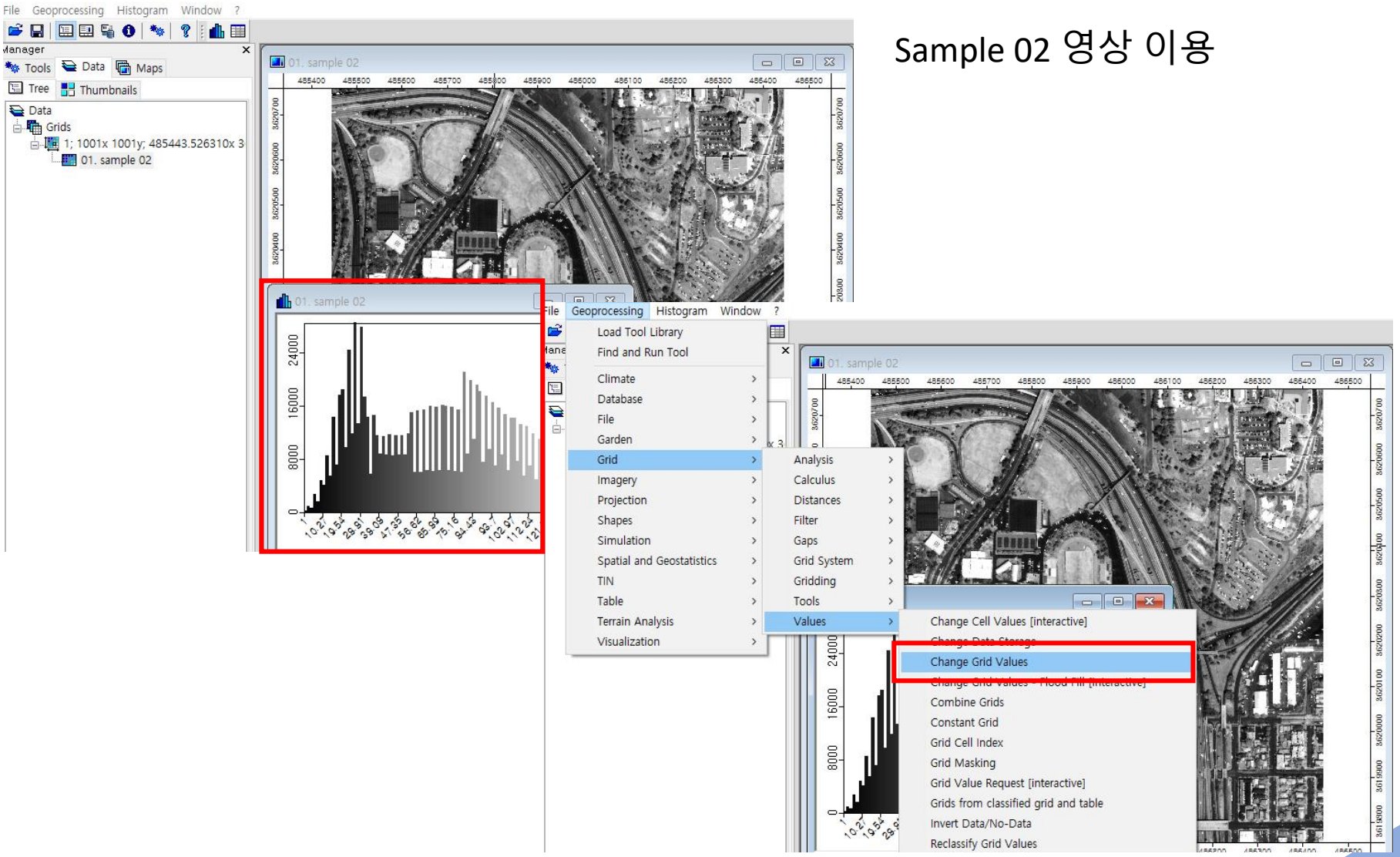
영상 융합 실습(Pan Sharpening)





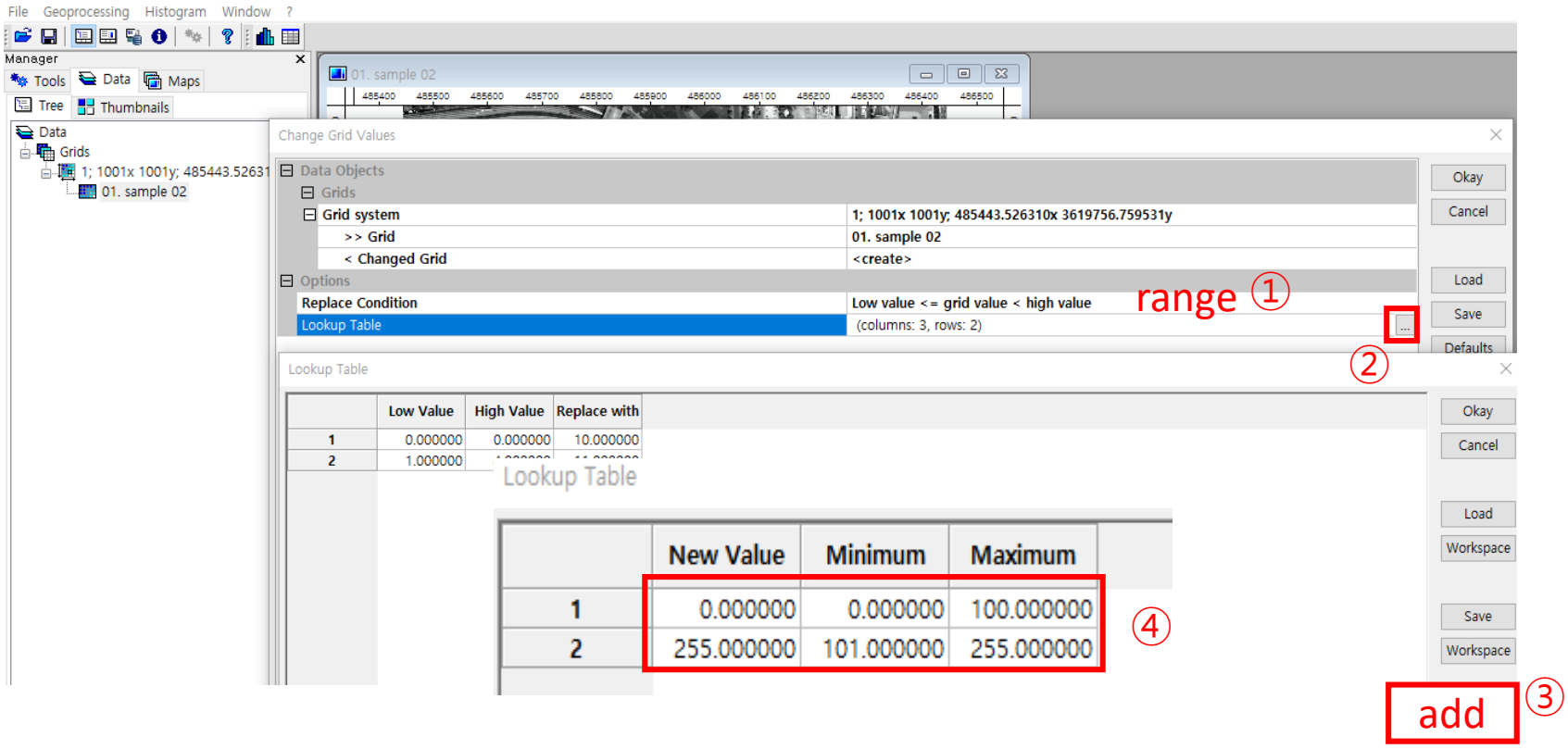
Pan sharpening 처리 알고리즘을 여러 가지 변수로 변경하면서 실험해 볼 것

이진 영상 실습

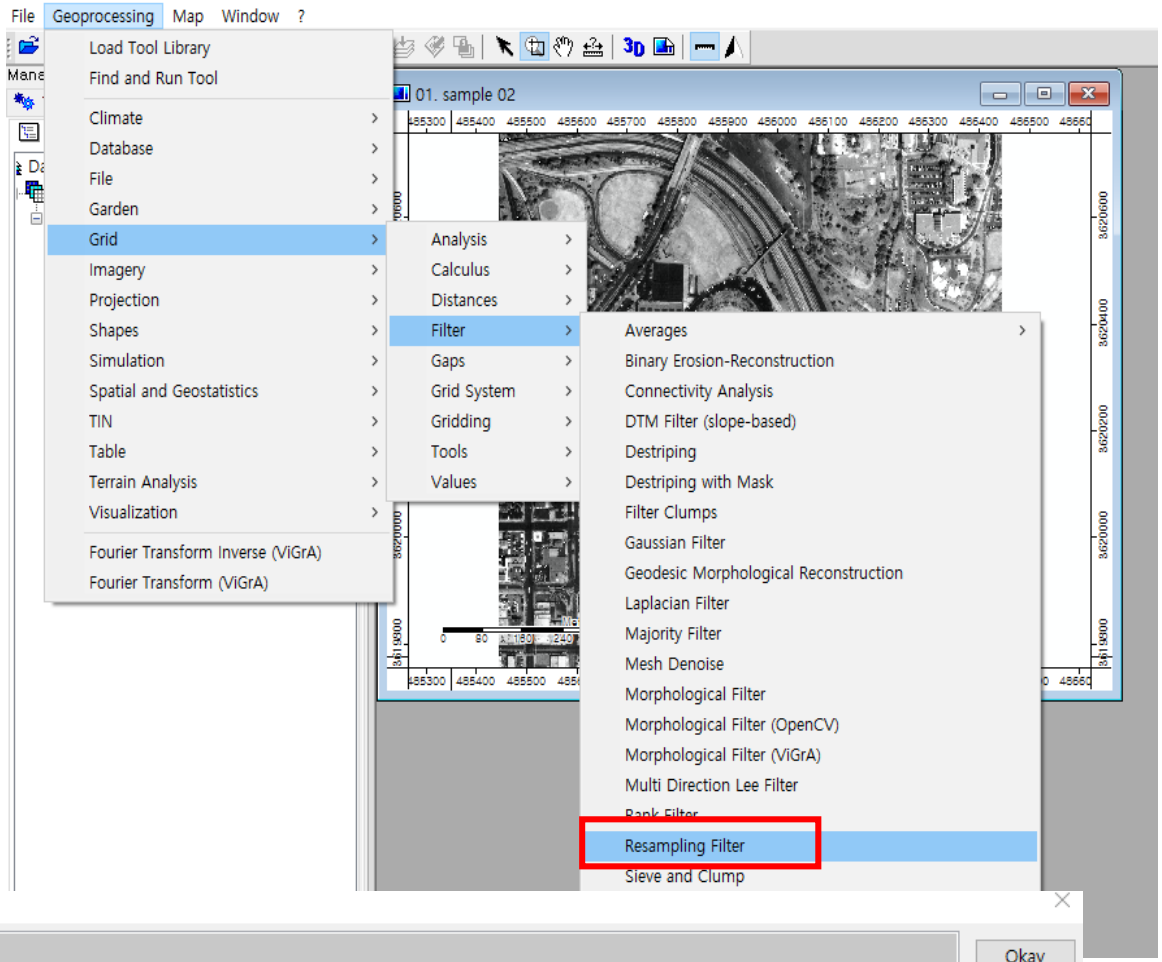


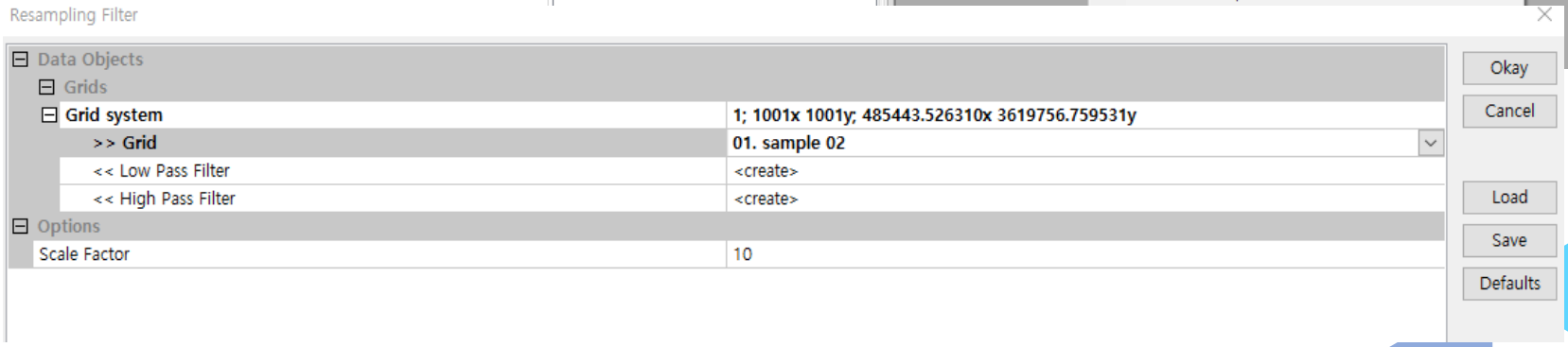
Sample 02 영상 이용

이진 영상 실습

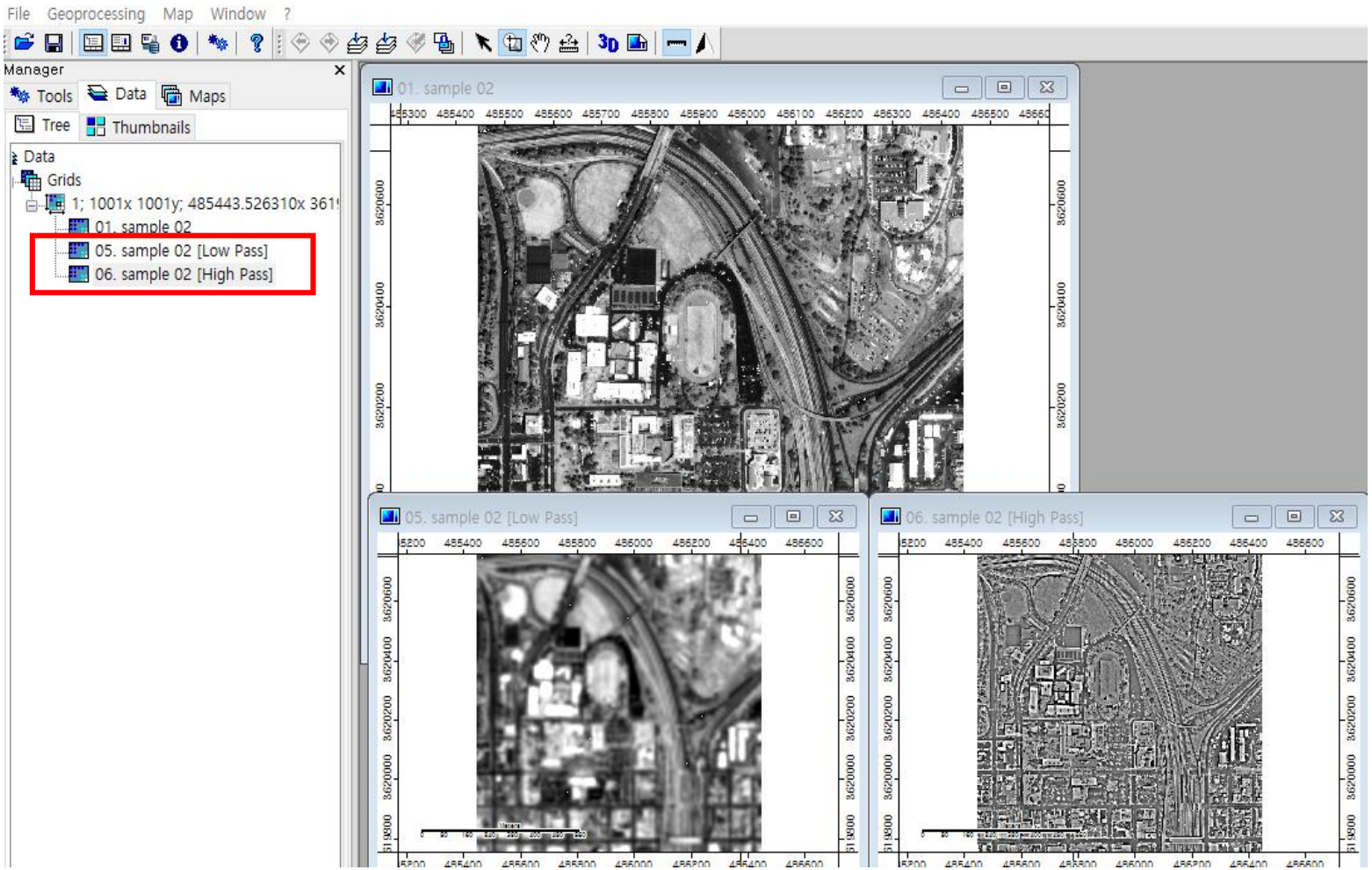

File Geoprocessing Histogram Window ?
Manager
Tools Data Maps
Tree Thumbnails
Data
Grids
1; 1001x 1001y; 485443.52631
01. sample 02
01. sample 02
Change Grid Values
Data Objects
Grids
Grid system
1; 1001x 1001y; 485443.526310x 3619756.759531y
>> Grid
01. sample 02
< Changed Grid
<create>
Options
Replace Condition
Low value <= grid value < high value
Lookup Table
(columns: 3, rows: 2)
Okay
Cancel
Load
Save
Defaults
range ①
②
Lookup Table
Low Value
High Value
Replace with
1
0.000000
0.000000
10.000000
2
1.000000
Okay
Cancel
Load
Workspace
Save
Workspace
Lookup Table
New Value
Minimum
Maximum
1
0.000000
0.000000
100.000000
2
255.000000
101.000000
255.000000
④
add
③

재배열 필터 실습


File
Geoprocessing
Map
Window
?
Load Tool Library
Find and Run Tool
Climate
Database
File
Garden
Grid
Imagery
Projection
Shapes
Simulation
Spatial and Geostatistics
TIN
Table
Terrain Analysis
Visualization
Fourier Transform Inverse (ViGrA)
Fourier Transform (ViGrA)
Analysis
Calculus
Distances
Filter
Gaps
Grid System
Gridding
Tools
Values
Averages
Binary Erosion-Reconstruction
Connectivity Analysis
DTM Filter (slope-based)
Destriping
Destriping with Mask
Filter Clumps
Gaussian Filter
Geodesic Morphological Reconstruction
Laplacian Filter
Majority Filter
Mesh Denoise
Morphological Filter
Morphological Filter (OpenCV)
Morphological Filter (ViGrA)
Multi Direction Lee Filter
Resampling Filter
Sieve and Clump
01. sample 02


Resampling Filter
Data Objects
Grids
Grid system
1; 1001x 1001y; 485443.526310x 3619756.759531y
>> Grid
01. sample 02
<< Low Pass Filter
<create>
<< High Pass Filter
<create>
Options
Scale Factor
10
Okay
Cancel
Load
Save
Defaults

재배열 필터 실습

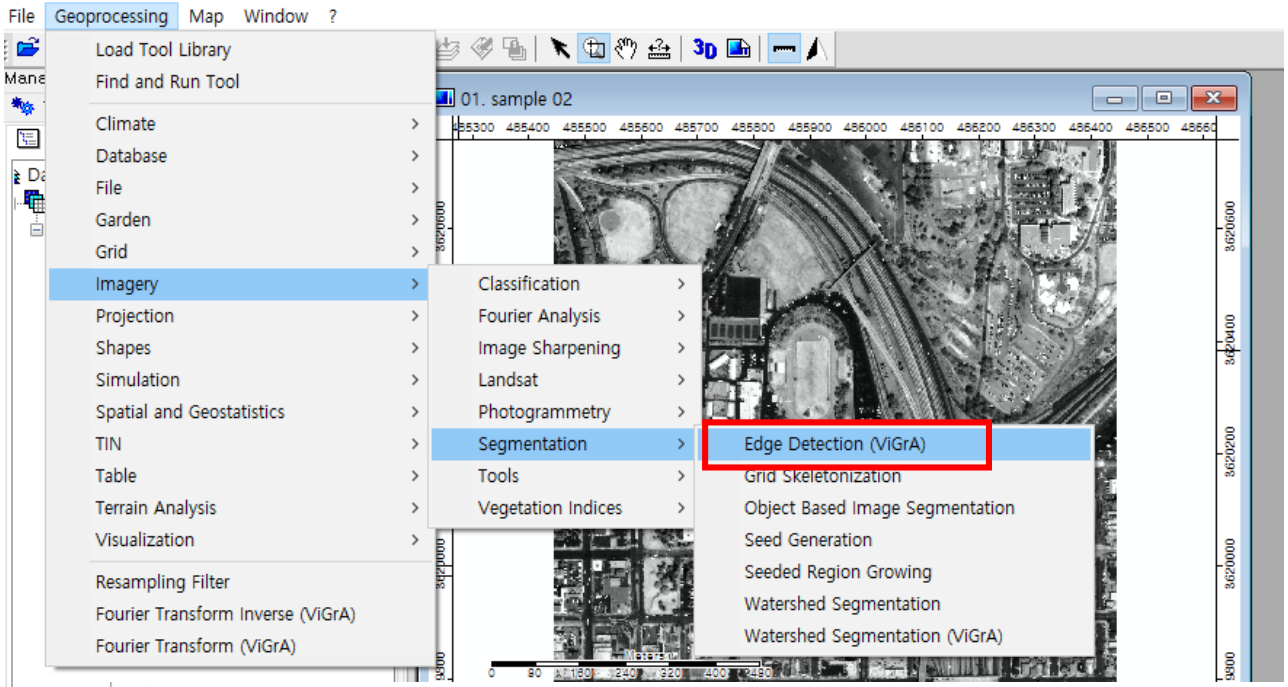

File Geoprocessing Map Window ?
Manager
Tools Data Maps
Tree Thumbnails
Data
Grids
1; 1001x 1001y; 485443.526310x 361
01. sample 02
05. sample 02 [Low Pass]
06. sample 02 [High Pass]
01. sample 02
05. sample 02 [Low Pass]
06. sample 02 [High Pass]

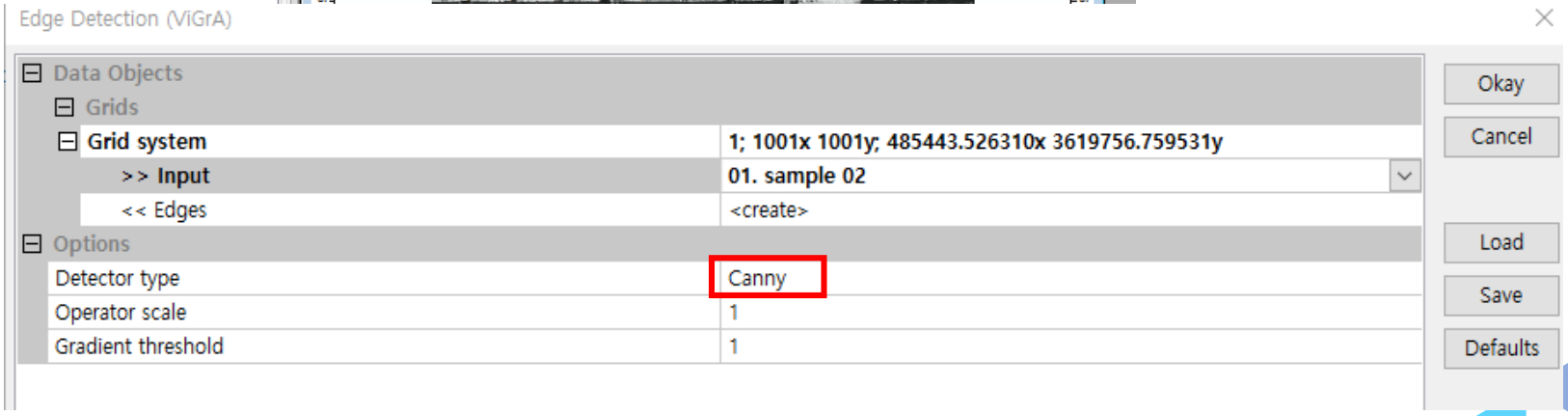
캐니(Canny) 필터링

- 윤곽선 검출 전 잡음 제거 마스크가 사용된다.
- 잡음에 강하다.
- 강한 윤곽선 검출

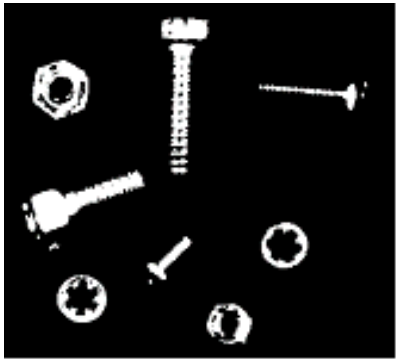
- 방법:
  - Gaussian 필터 적용후 부드러운 영상으로 변경하여 잡음 제거
  - 라플라시안(Laplacian) 필터 마스크를 적용하여 경계선 검출
  - 영점 교차점 중에서 임계값 이상인 픽셀값에 대해서만 최종 경계선으로 인정

캐니(Canny) 필터링 실습

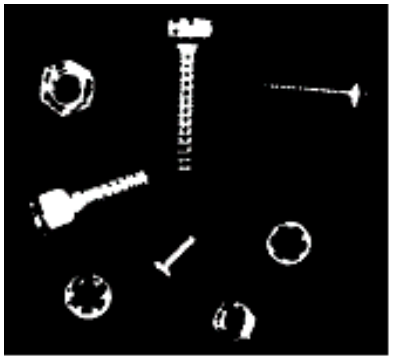




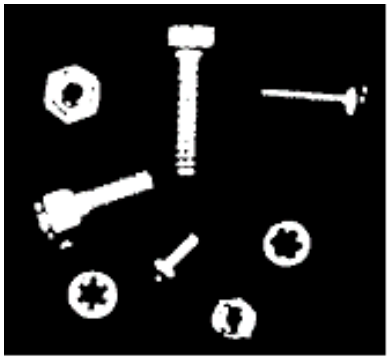
Morphological Filter



입력 영상



침식 연산 (Erosion)



팽창 연산 (Dilation)

열림 연산 (Opening)

- 침식 연산을 적용한 다음에 팽창 연산을 적용
  - 물체를 분리하는데 유용

닫힘 연산 (Closing)

- 팽창 연산을 적용한 다음에 침식 연산 적용
  - 분리된 물체를 결합하는데 유용

Morphological Filter