

# 히스토그램 및 필터링 처리

Application services and process

about satellite information

# 히스토그램과 필터링

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## 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



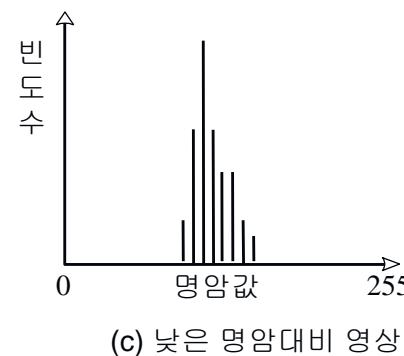
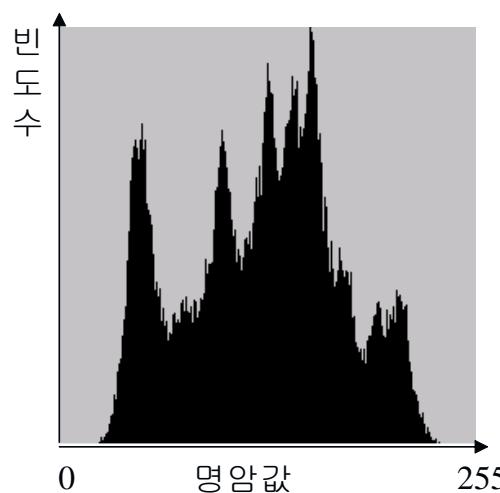
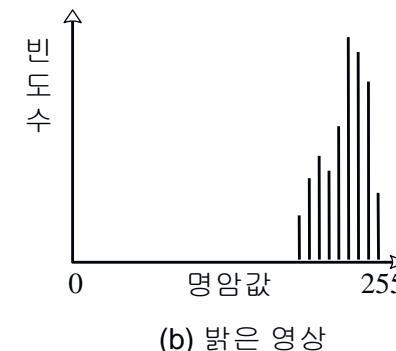
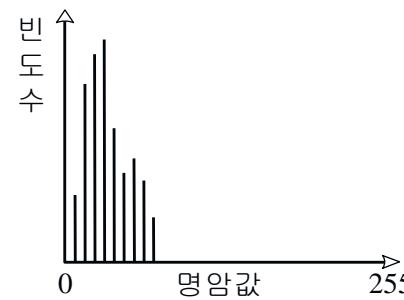
화소에 일정한 값을 더하거나 빼거나 나누거나 곱하는 연산으로  
덧셈/뺄셈 -> 영상 밝기 조절  
곱셈 /나눗셈 -> 명암 대비 조절

# 히스토그램과 필터링



## 히스토그램

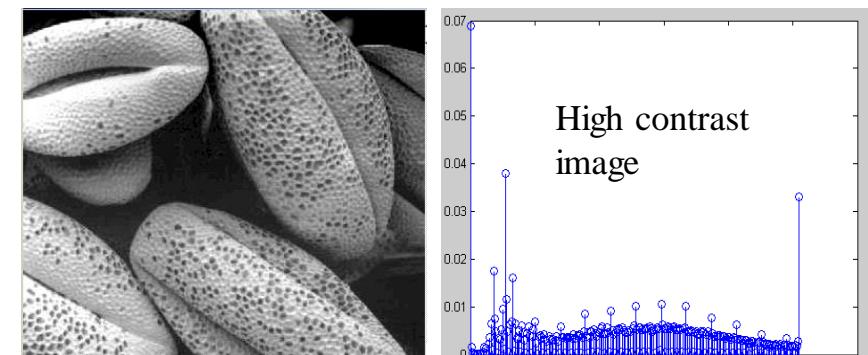
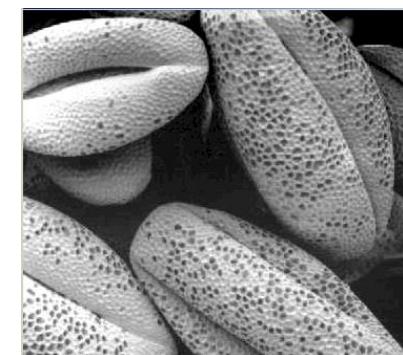
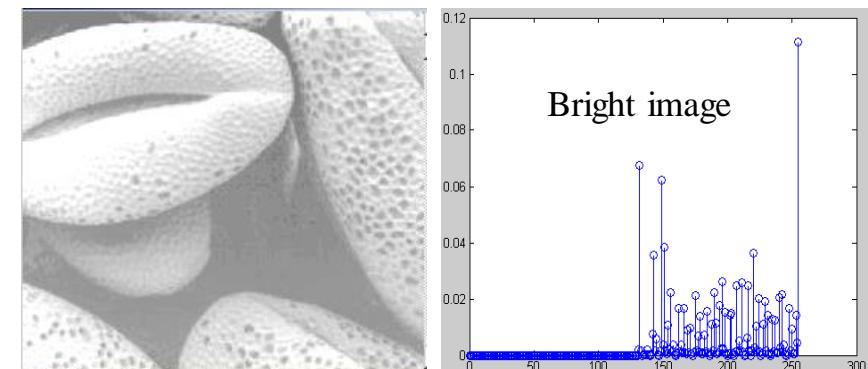
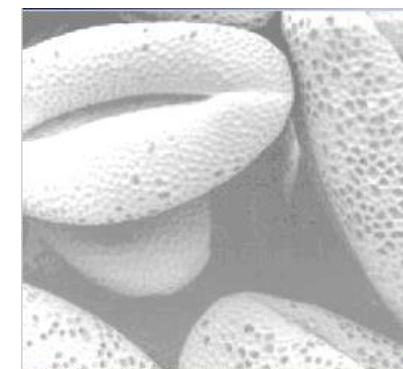
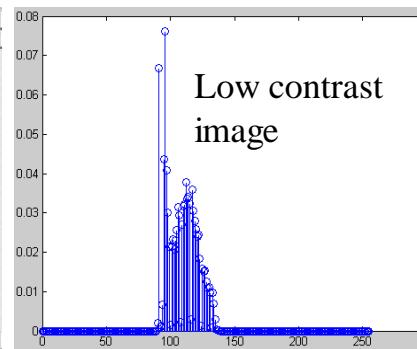
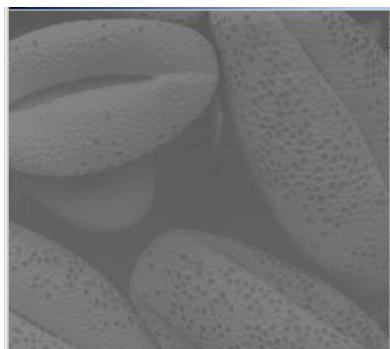
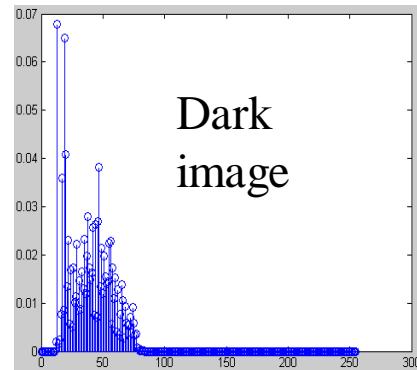
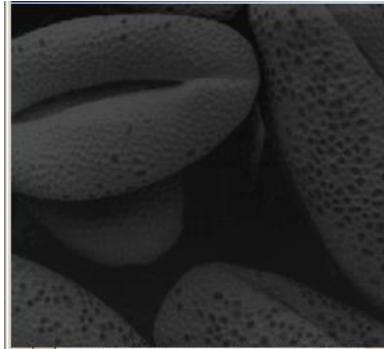
- 화사가 가진 명암 값에 대한 막대 그래프



# 히스토그램과 필터링



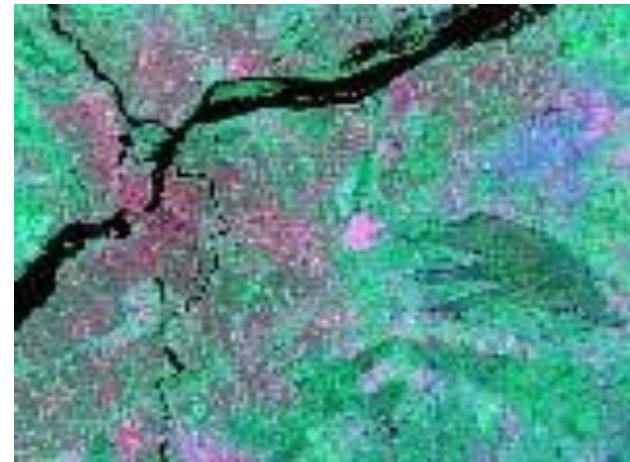
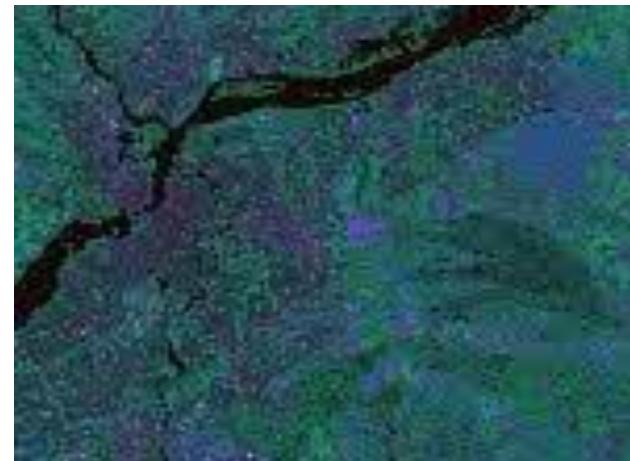
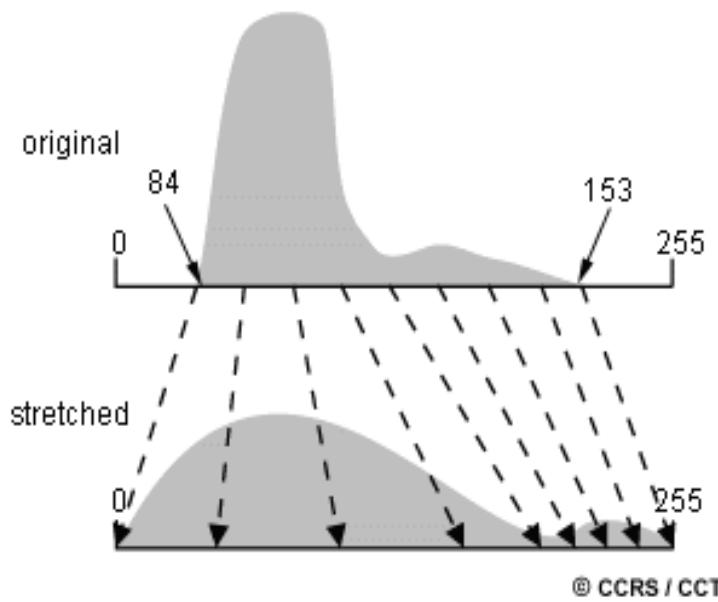
## 히스토그램



# 히스토그램과 필터링



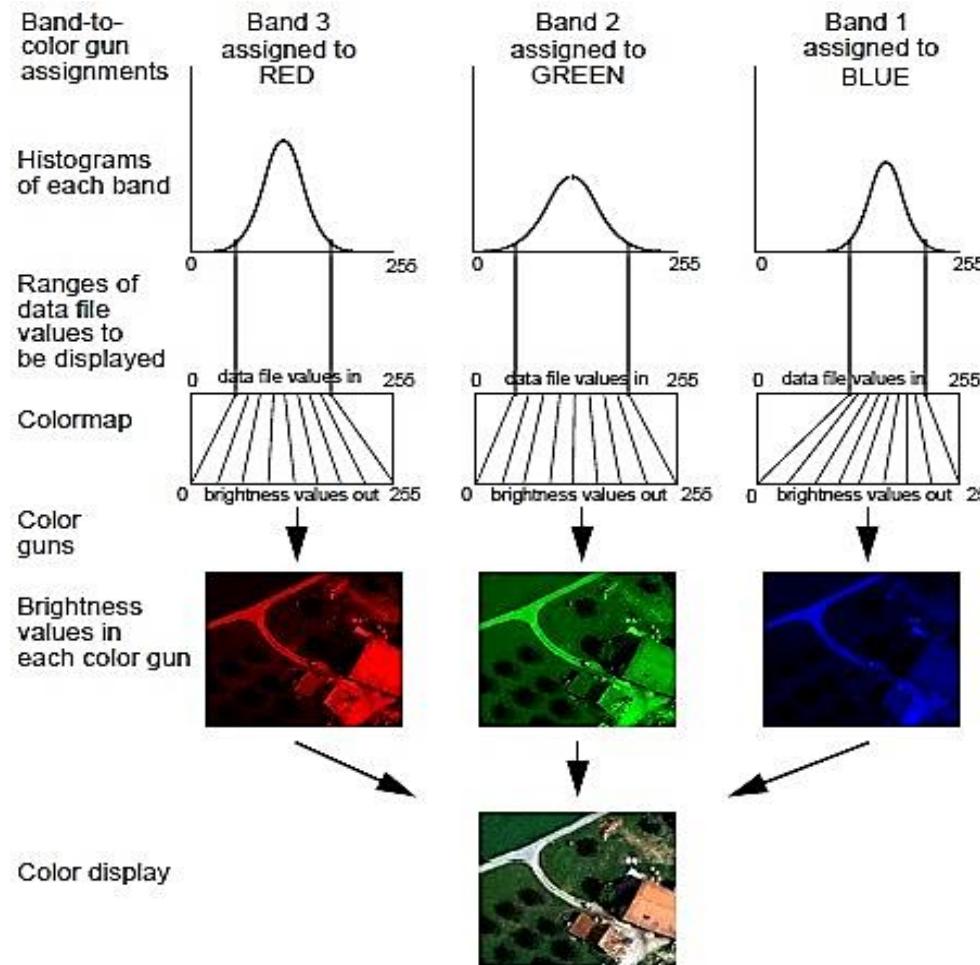
## 히스토그램



# 히스토그램과 필터링



## 히스토그램



# 히스토그램과 필터링



## 히스토그램 평활화

- 기존 영상의 명암 값 분포를 재분배하여 일정한 분포를 가진 히스토그램 생성
- 처리 과정
  1. 입력영상의 히스토그램 생성
    - 명암 값  $j$ 의 빈도수  $hist[j]$ 를 계산
  2. 각 명암 값  $i$ 에 대하여 0부터  $i$  까지의 빈도수의 누적 값을 계산
  3. 단계 2에서 구한 누적 값을 정규화
  4. 입력영상에서 픽셀 값  $i$ 를 정규화된 값  $n[i]$ 로 변환하여 결과 영상 생성

$$sum[i] = \sum_{j=0}^i hist[j]$$

(2)

$$n[i] = sum[i] \times \frac{1}{N} \times 255$$

(4)

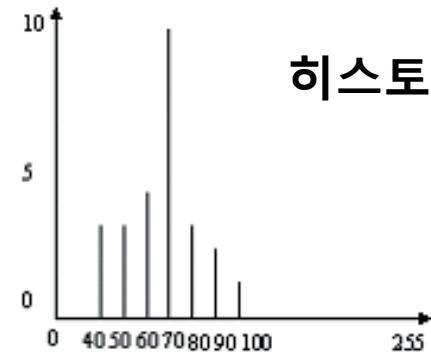
# 히스토그램과 필터링



## 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



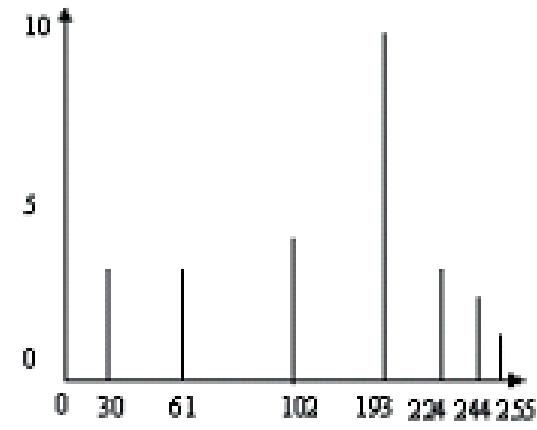
명암값	누적합 sum[i]	정규화 값 n[i]
40	3	30
50	6	61
60	10	102
70	19	193
80	22	224
90	24	244
100	25	255

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

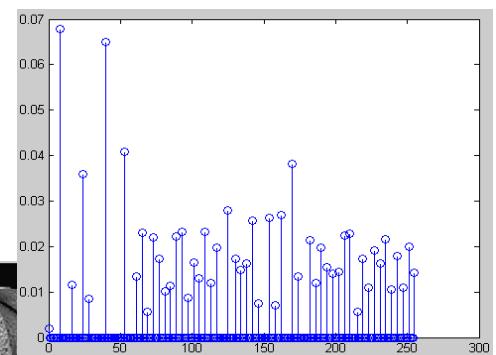
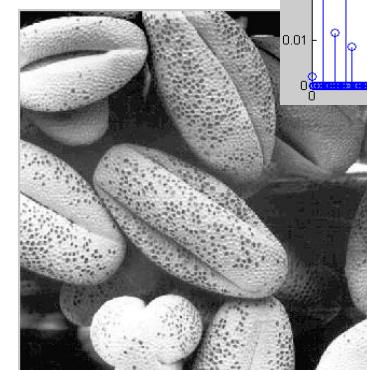
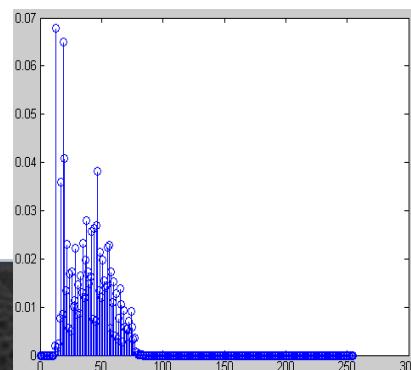
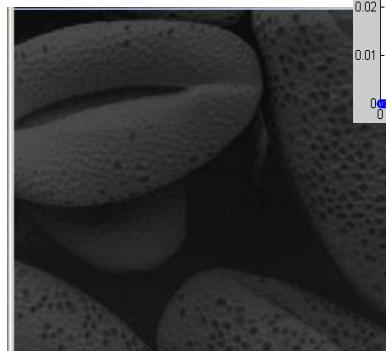
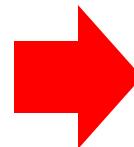
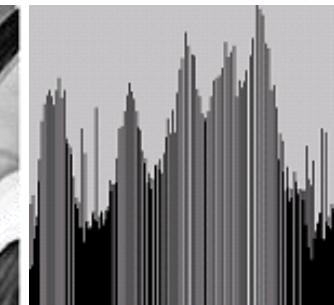
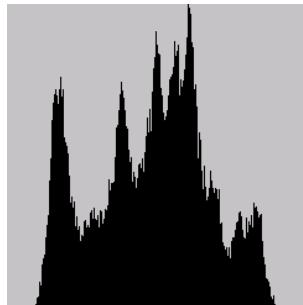


히스토그램

# 히스토그램과 필터링



## 히스토그램 평활화



# 히스토그램과 필터링

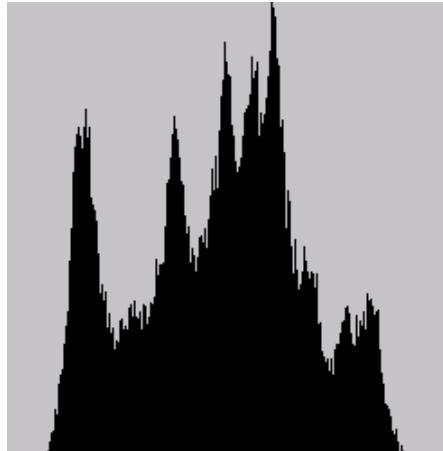


## 명암 대비 스트레칭

- 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

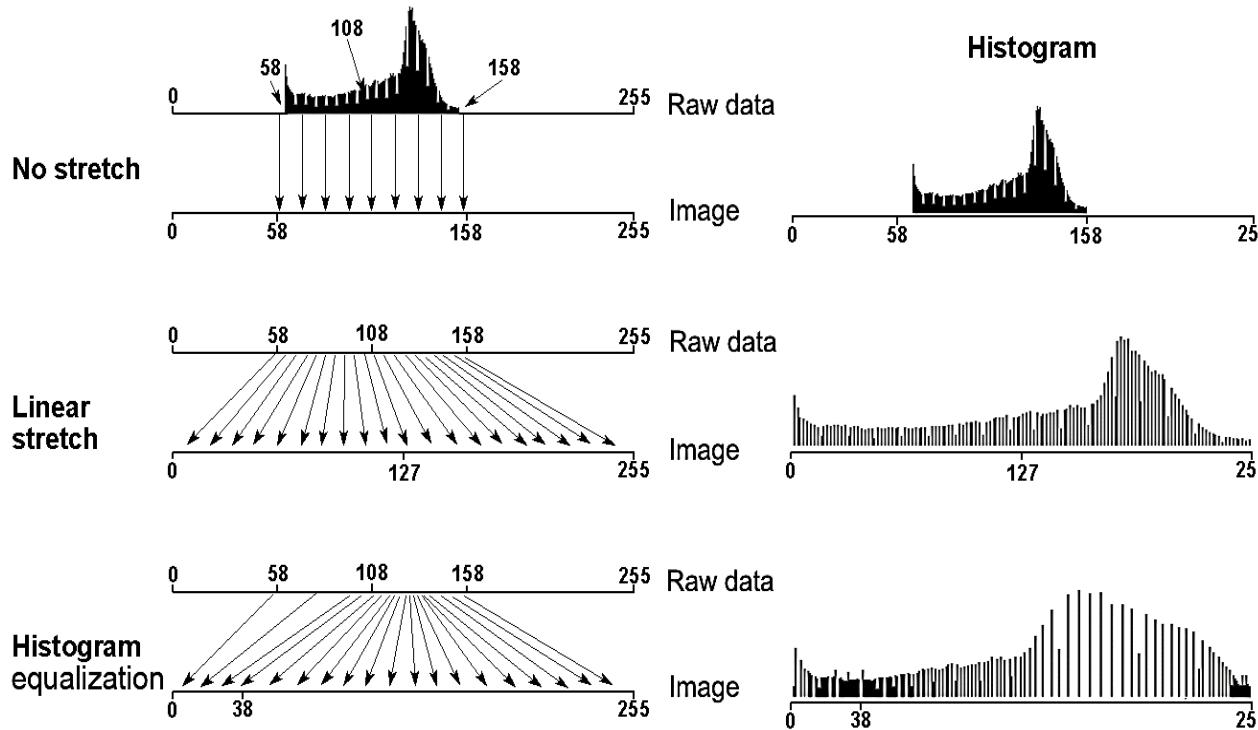


# 히스토그램과 필터링

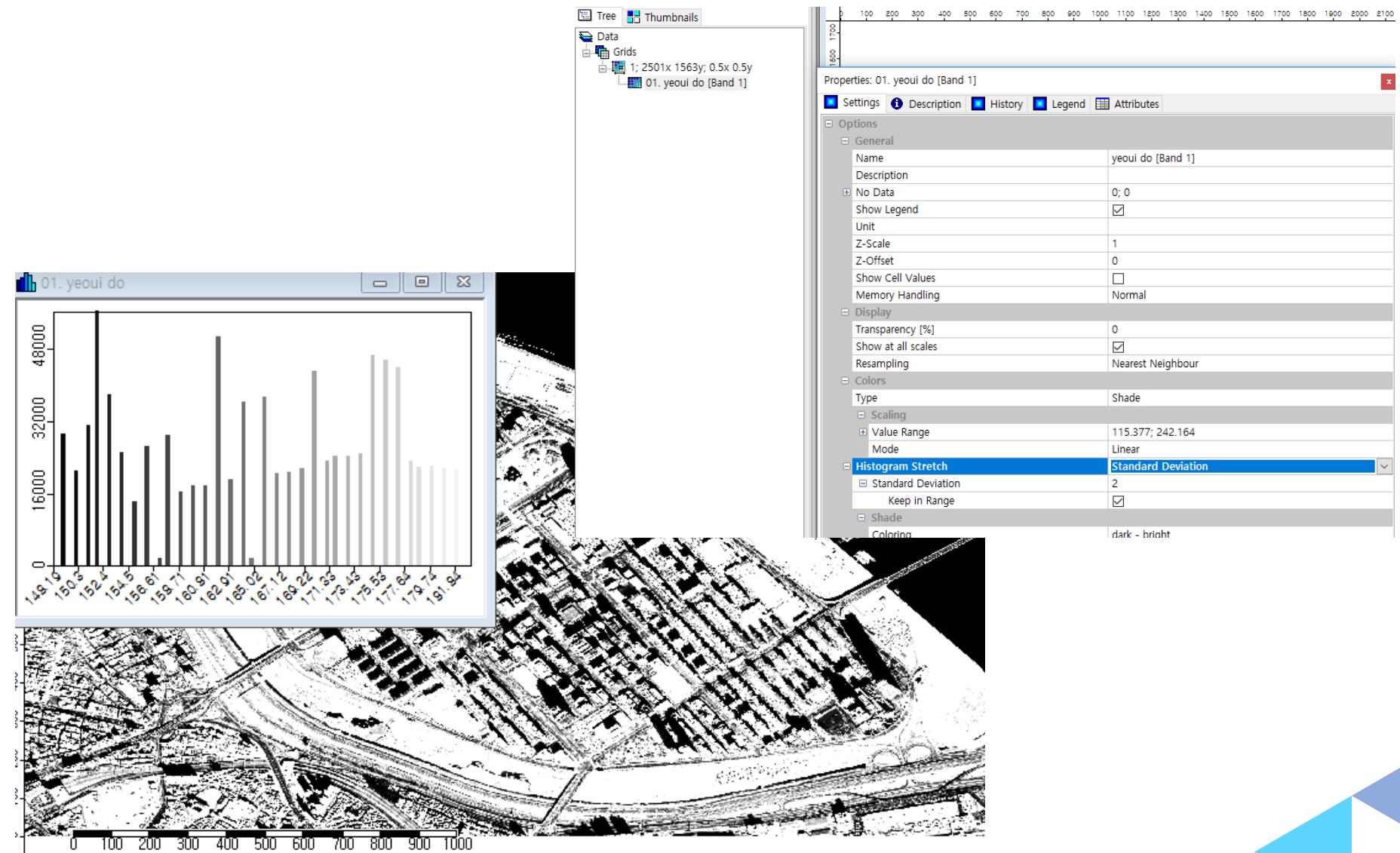


## 차이점 (스트레칭 VS 평활화)

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

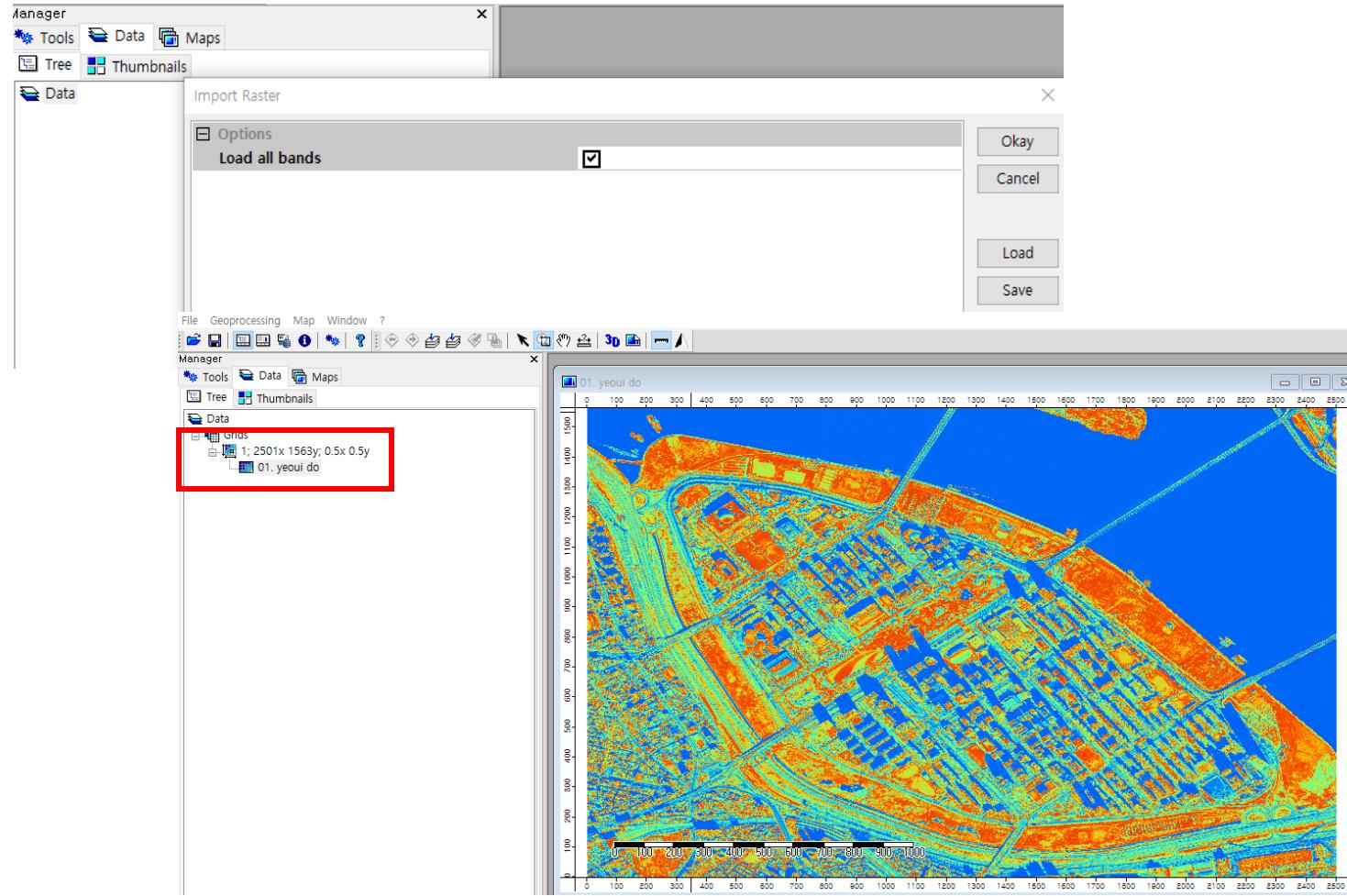


# 히스토그램 스트레칭 실습



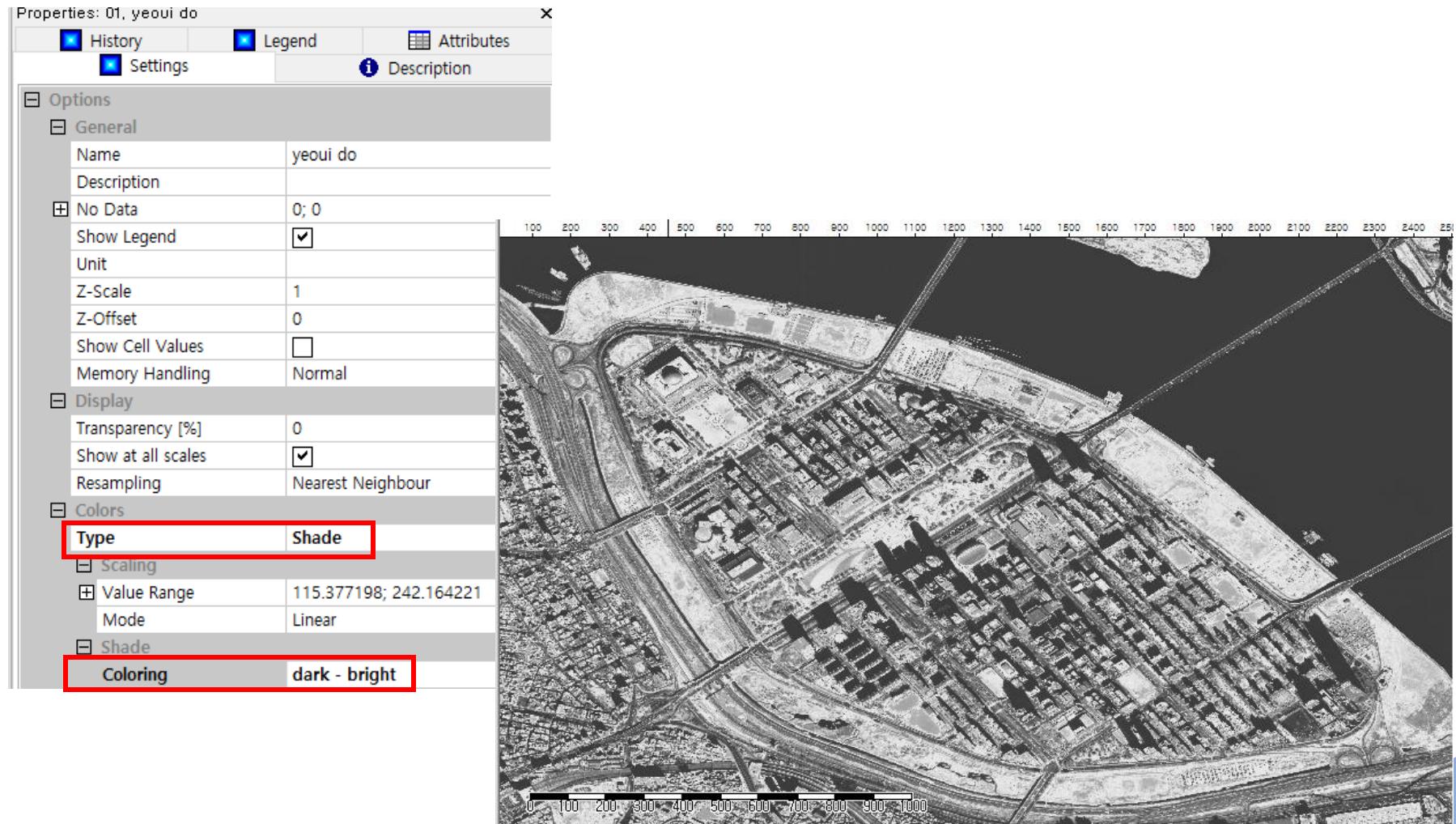
# 히스토그램 분석 실습

## ❖ 여의도 지역 영상 불러오기



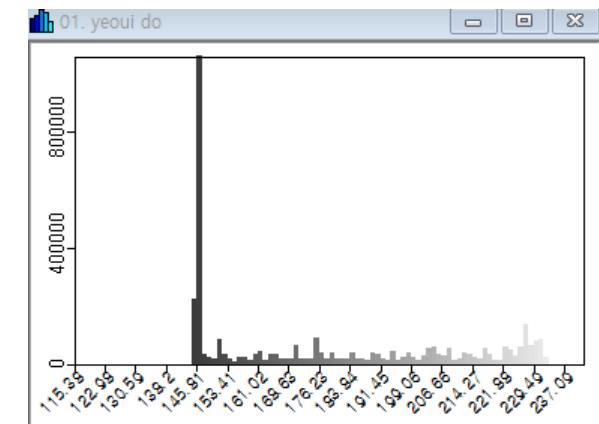
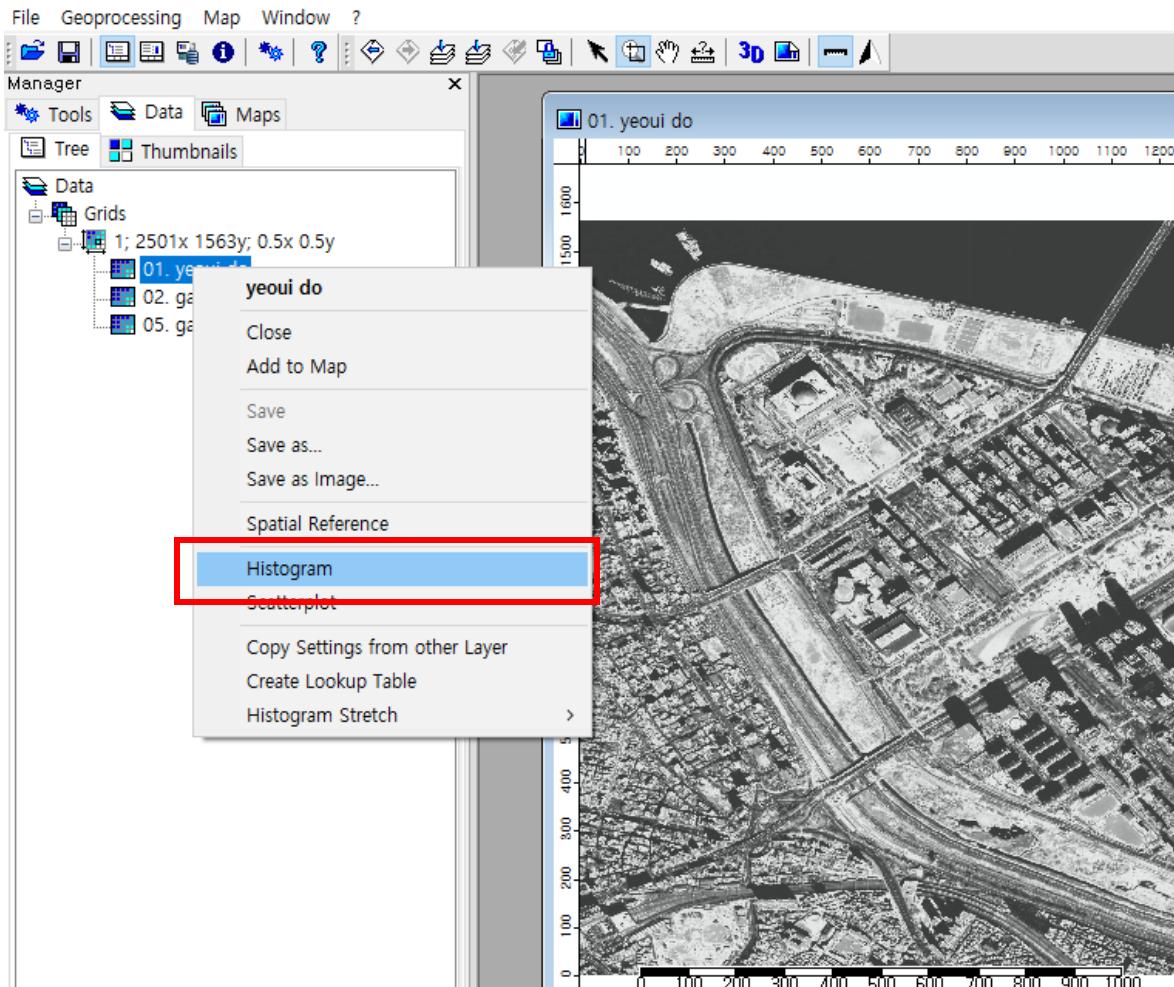
# 히스토그램 분석 실습

## ❖ 색상 변경



# 히스토그램 분석 실습

## ❖ 히스토그램 출력



# 히스토그램 분석 실습

## ❖ 테이블 연산

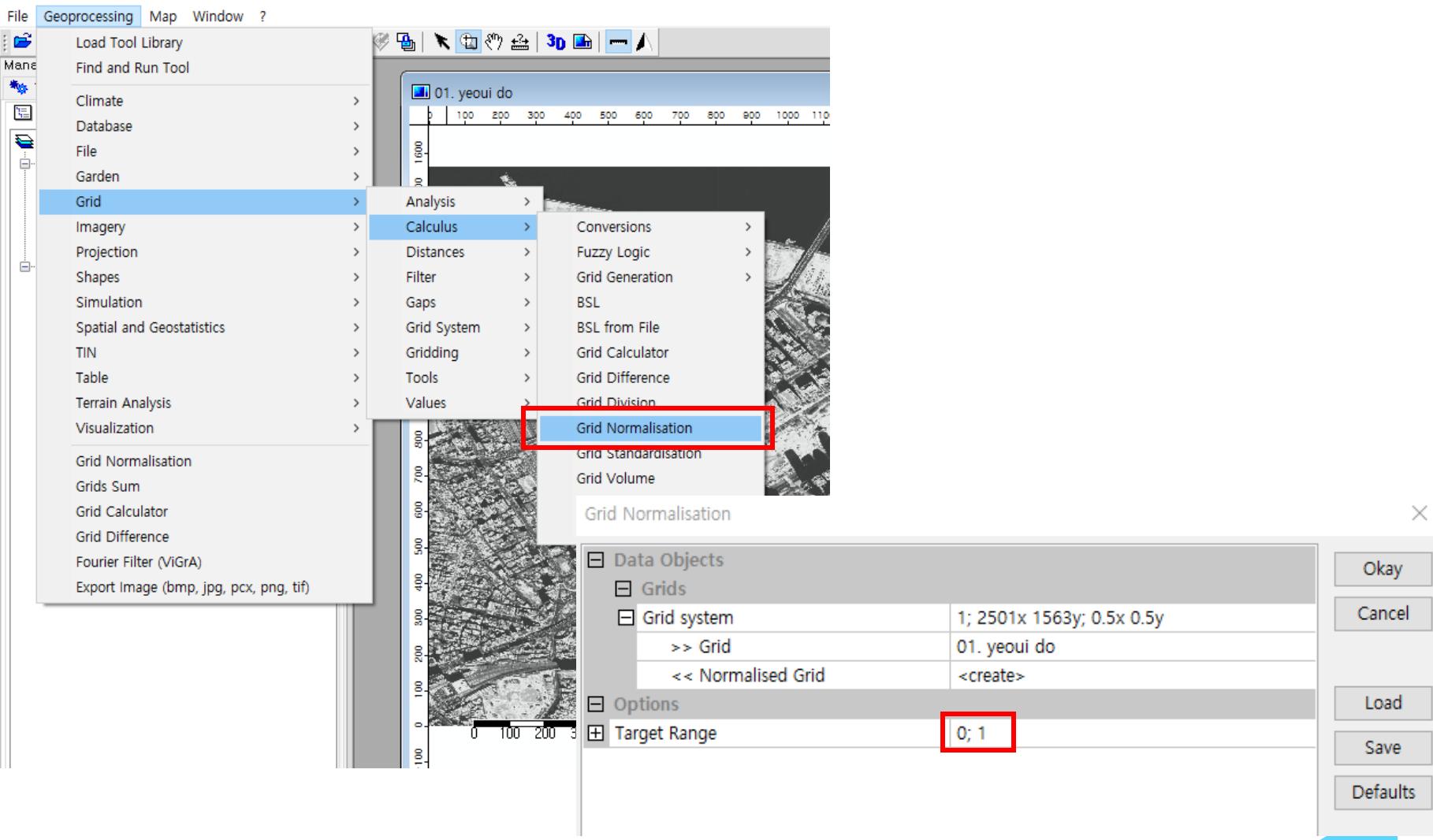
The screenshot illustrates the process of analyzing a histogram in ArcGIS Pro. It shows three main windows:

- Top Left Window:** Shows the ArcGIS ribbon with the "Histogram" tab selected. A red box highlights the "Convert To Table" option in the dropdown menu.
- Top Middle Window:** Displays a histogram titled "01. yeoui do" showing pixel counts across a grayscale image. The x-axis represents pixel values from 153.5 to 176.5, and the y-axis represents count from 0 to 800,000.
- Bottom Middle Window:** Shows the "Tables" pane with a table named "01. Histogram; yeoui do". A red box highlights this table.
- Bottom Left Window:** Shows the "Table" ribbon tab selected. A red box highlights the "Add Field" option in the dropdown menu.
- Bottom Right Window:** Displays a detailed histogram table titled "01. Histogram; yeoui do [Band 1]". The table includes columns for CLASS, AREA, COUNT, CUMUL, and NAME. The data is as follows:

CLASS	AREA	COUNT	CUMUL	NAME
1	1	66502	66502	66
2	2	36379	36379	102
3	3	29228	29228	132
4	4	21103	21103	153
5	5	31059	31059	184
6	6	56389	56389	240
7	7	0	0	240
8	8	38050	38050	278
9	9	25267	25267	303
10	10	14216	14216	318
11	11	26449	26449	344642
12	12	1753	1753	155.5 < 156.3
13	13	29051	29051	346395
14	14	0	0	156.35 < 157
15	15	16505	16505	375446
16	16	17916	17916	158.75 < 160
17	17	17878	17878	427745
18	18	50840	50840	160.6 < 162
19	19	10220	10220	478585
20	20	10220	10220	161.45 < 162
21	21	1282.000000	1282	161.875
22	22	2603.000000	2603	162.3

# 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:

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

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.

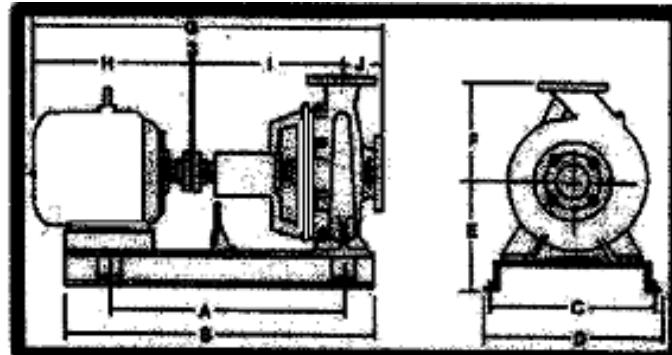
# 영상 처리



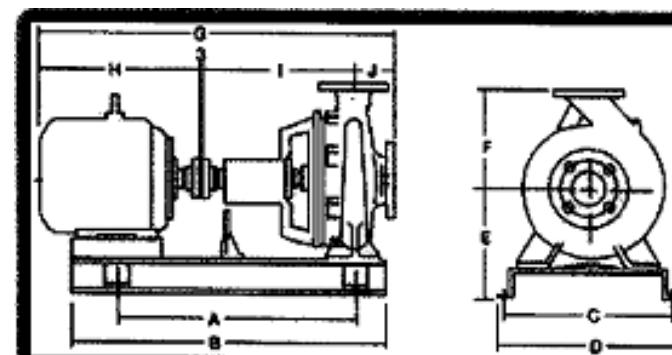
## 이진화

- 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

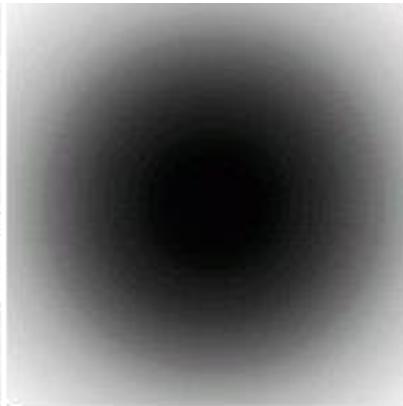
# 영상 산술 처리



## 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

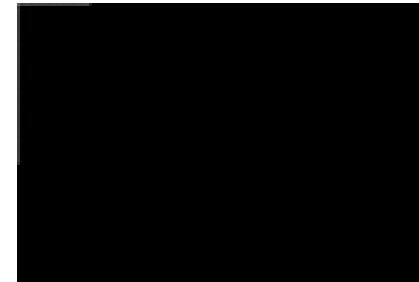
- 두개의 이전 영상에 뺄샘 연산을 수행하여 차이를 보고 싶을 때 사용
- 보안 시스템이나 영상 분석 시스템에서 이용



영상 1



영상 2



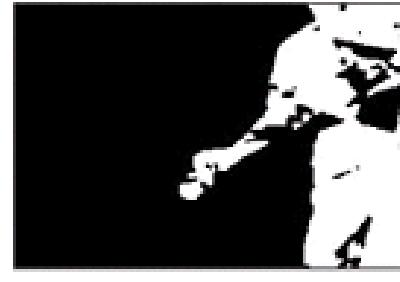
영상 1 - 영상 2



영상 3



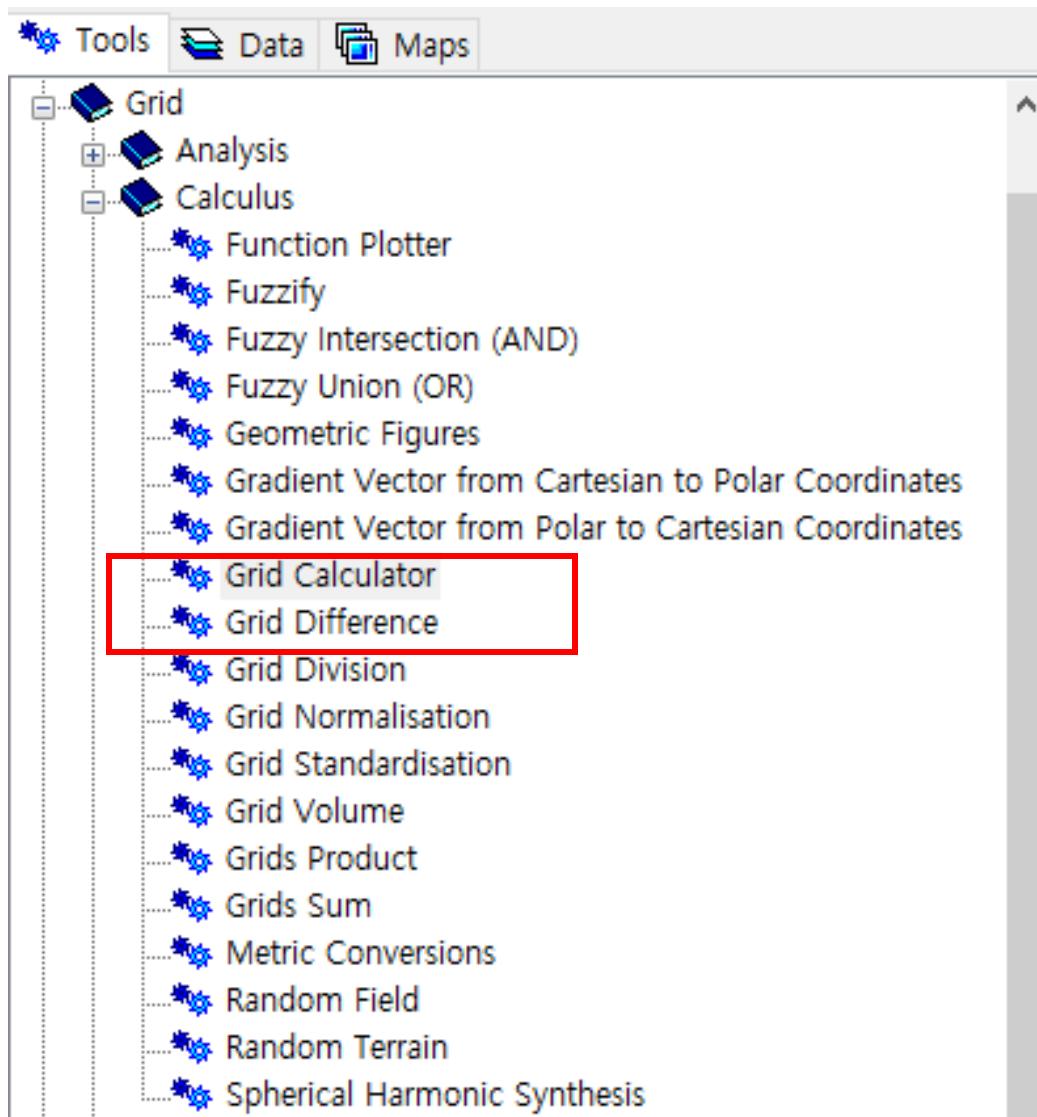
영상 4



영상 3 - 영상 4

침입자  
감지

# 영상 산술 처리 방법



# 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

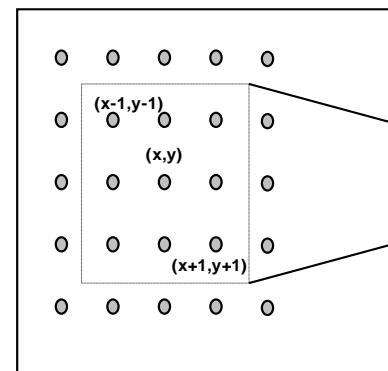
$M_1$	$M_2$	$M_3$
$M_4$	$M_5$	$M_6$
$M_7$	$M_8$	$M_9$

회선마스크

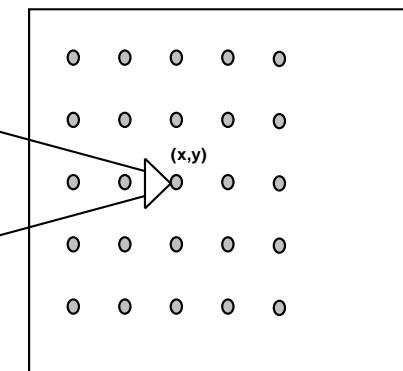
출력 픽셀 값 =

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

Input image  $f(x,y)$



Output image  $g(x,y)$

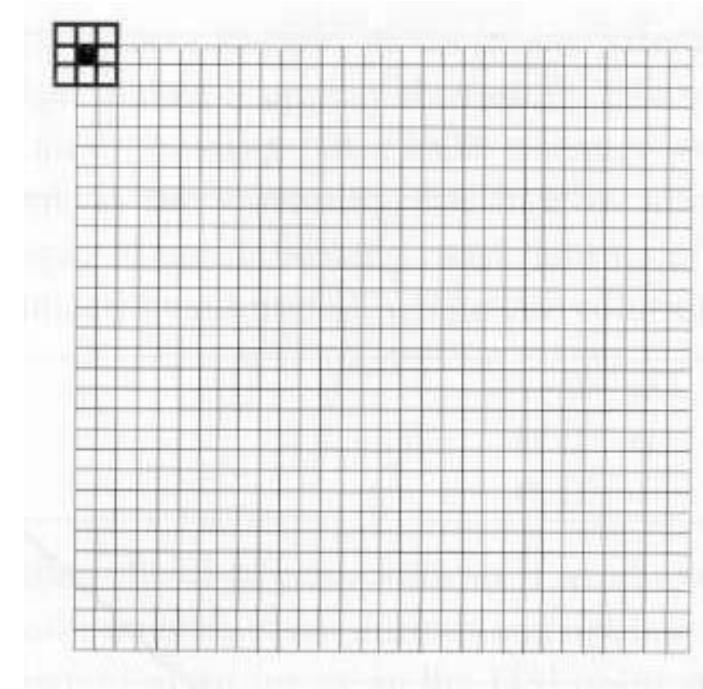


# 필터링 처리



## 회선 수행 방법

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



# 필터링 처리



## 영상 흐리게(블러링)

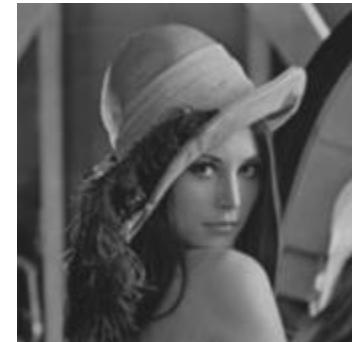
- 입력 픽셀 값을 주위 픽셀 값들과의 평균 값으로 변환하는 다음과 같은 회선 마스크 사용



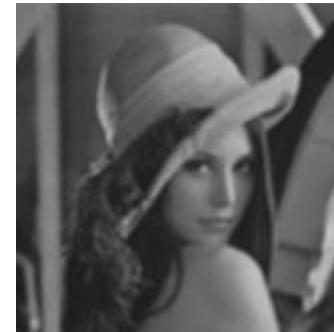
평균 마스크

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

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



3x3 마스  
크 적용



5x5 마스크적  
용

# 필터링 처리



## 영상 선명화(샤프닝)

- 입력 픽셀 값을 주위 픽셀 값들과의 평균 값으로 변환하는 다음과 같은 회선 마스크 사용

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

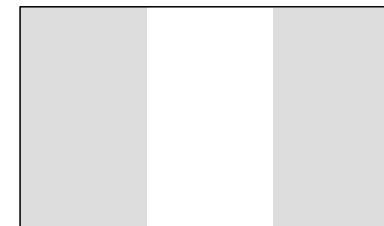
# 필터링 처리



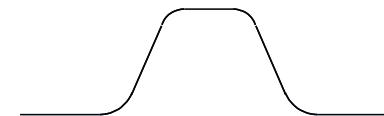
## 경계선 검출

- 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

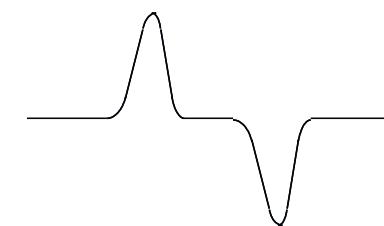
영상



명암도 변화



미분값 변화



# 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



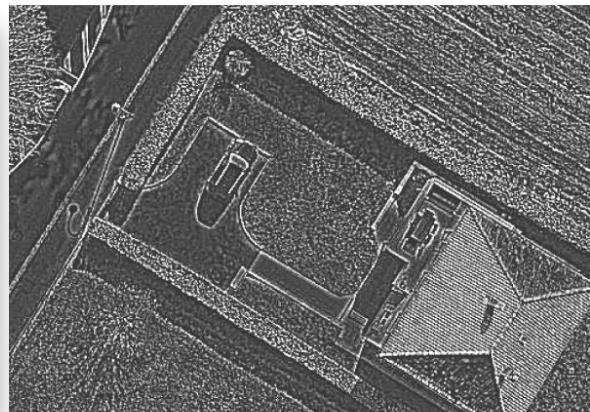
a. Original contrast stretched.



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



c. Median filter.



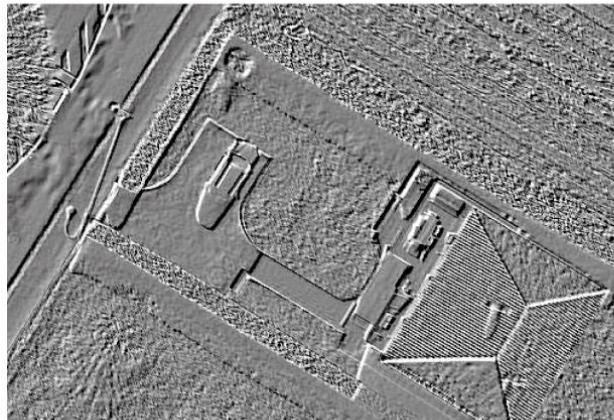
d. High-frequency sharp edge filter applied to the red band.

# 필터링 처리

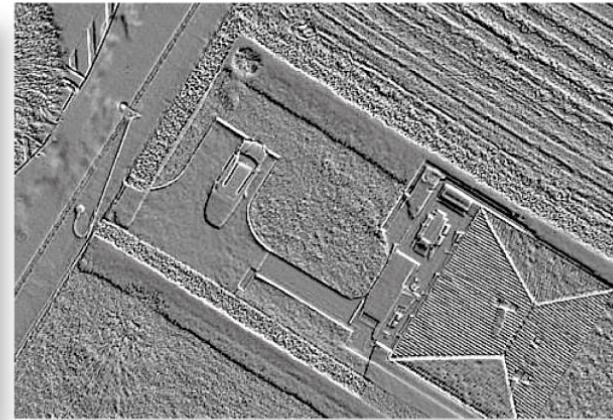


## 위성 영상 필터링 적용 예

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 ?

The screenshot shows the ArcGIS Pro interface with the following details:

- Tools Pane:** On the left, under the "Tools" tab, the "Filter" category is expanded, listing various filtering tools. A red box highlights the "User Defined Filter" option at the bottom of this list.
- Properties Dialog:** A floating window titled "Properties: User Defined Filter" is open. It has two tabs: "Settings" (selected) and "Description".
  - Data Objects:** This section contains settings for "Grids".
    - "Grid system": <not set>
    - ">> Grid": <not set>
    - "<< Filtered Grid": <create>
  - Tables:** This section contains a setting for "Filter Matrix": <not set>
  - Options:** This section contains two settings:
    - "Absolute Weighting": checked (indicated by a red box)
    - "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:

$$z' = \bar{z} \quad (7.1)$$

Where  $\bar{z}$  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:

$$z' = 2 * z - \bar{z} \quad (7.2)$$

- **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:

$$z' = z - \bar{z} \quad (7.3)$$

# 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.

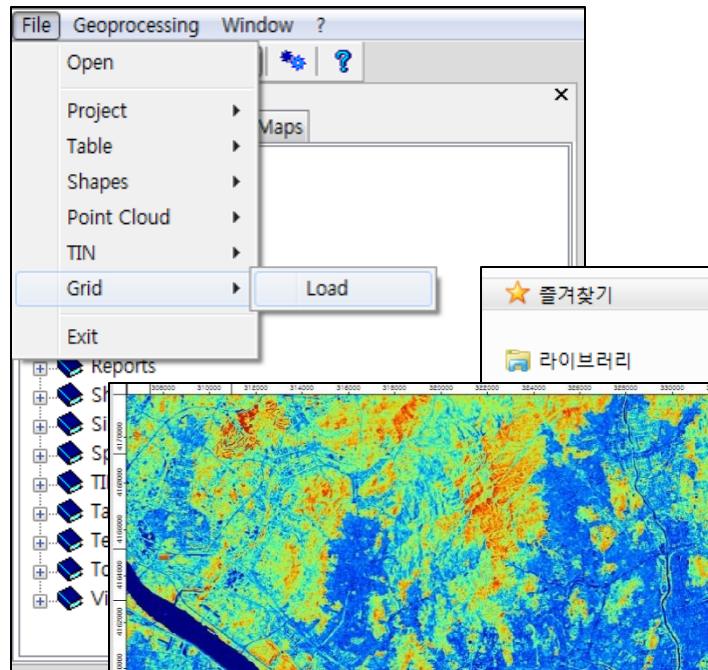
The second filter menu item you can found is the *Gauss Filter for Grid*. A Gaussian filter is an smoothing filter, but its mathematical background its a bit more complex than the simple filter. Also, its smoothing effect is “stronger” then the one you can get with the simple filter.

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)

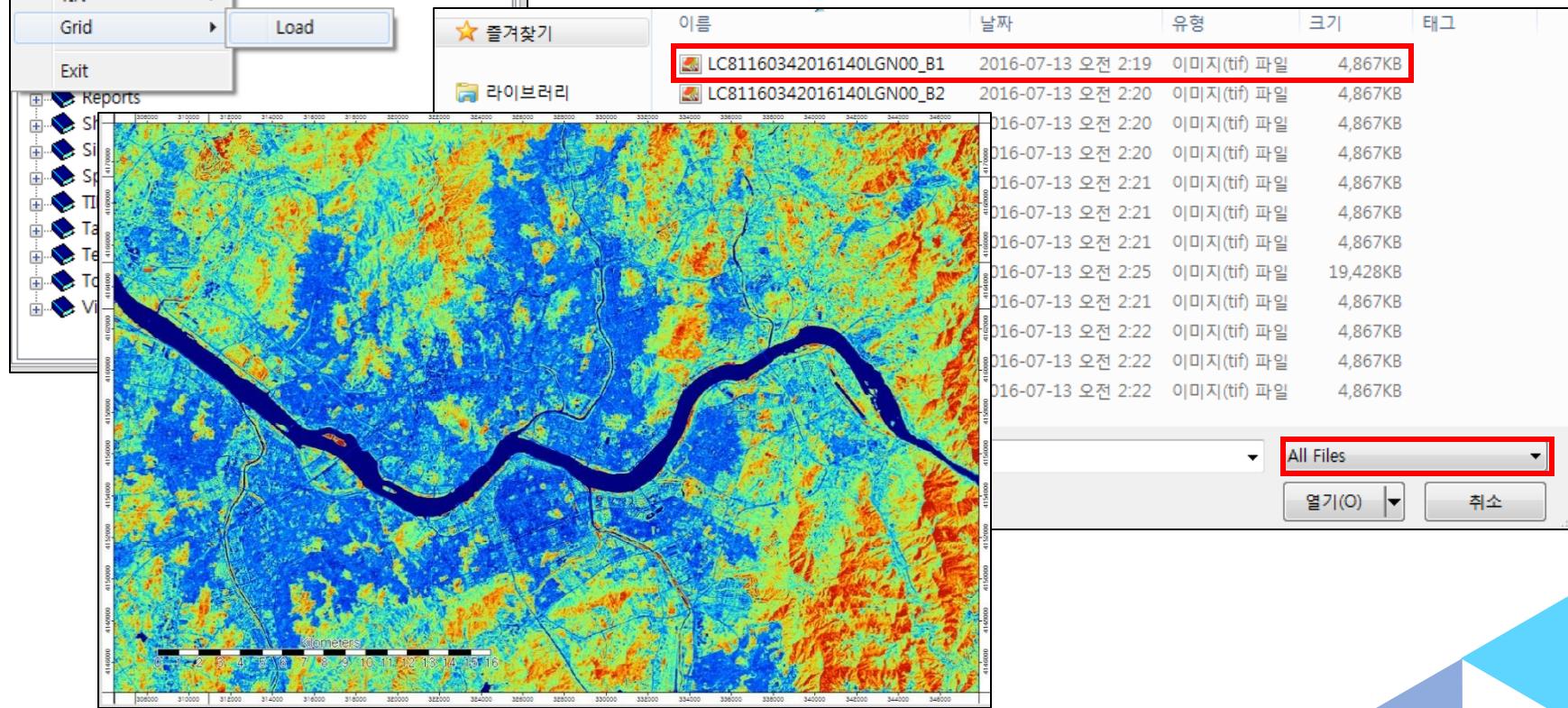
❖ 1번 랜드 선택 후 데이터 확인



## 도수 분포표

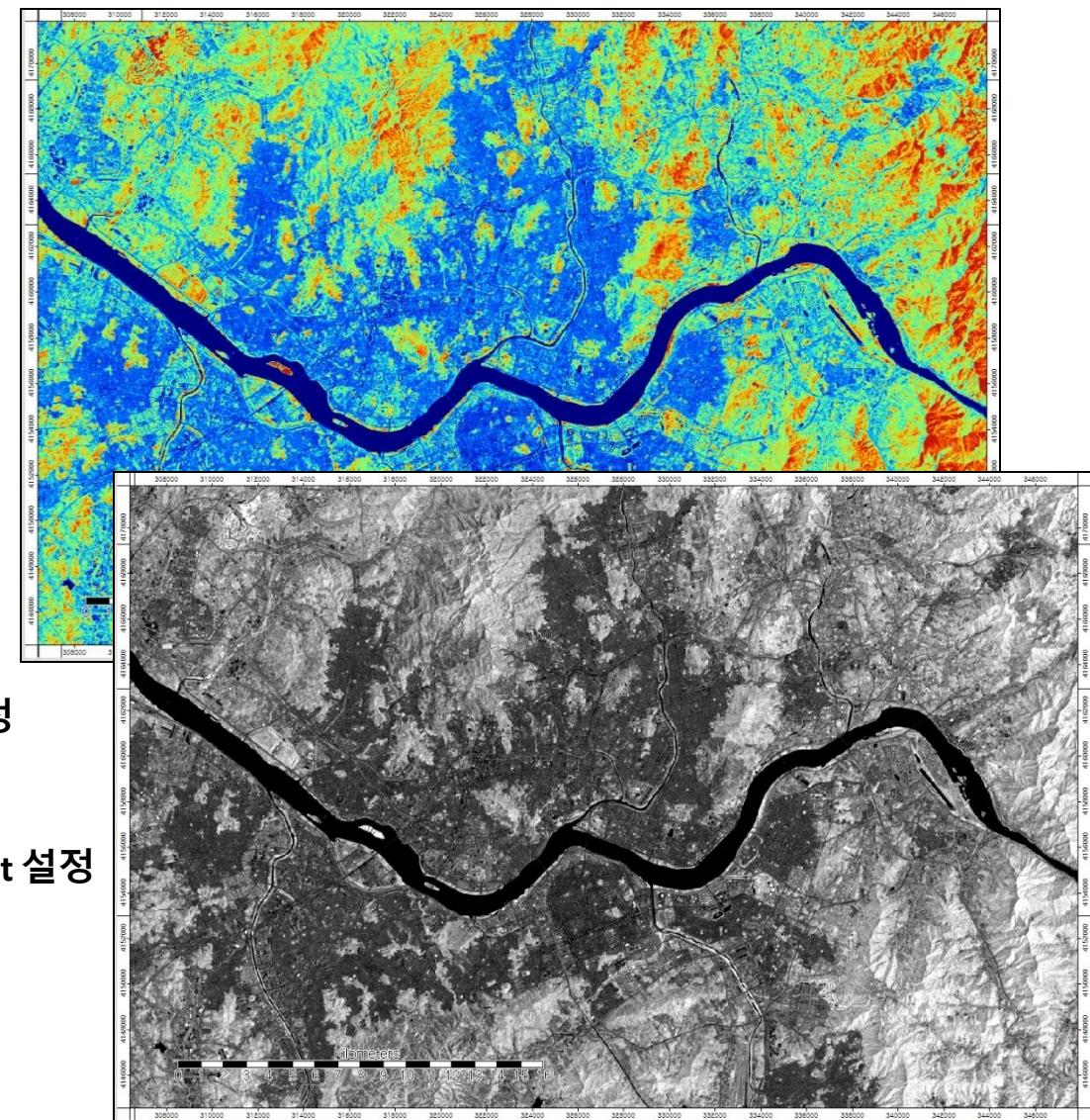
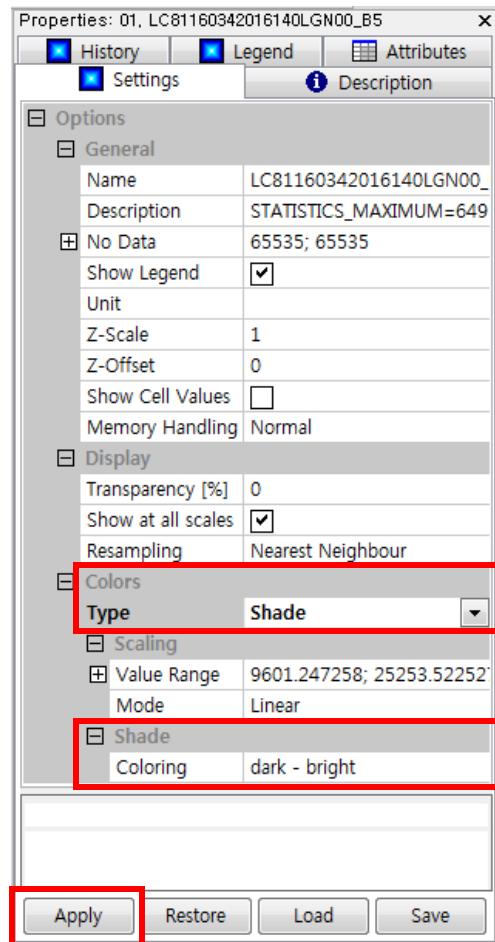
> 특정 구간에 속하는 자료의 개수를 나타내는 표  
히스토그램

> 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

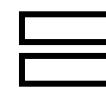
1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9



Mask

6	7	4
8	9	7
4	3	6

Pixel Value



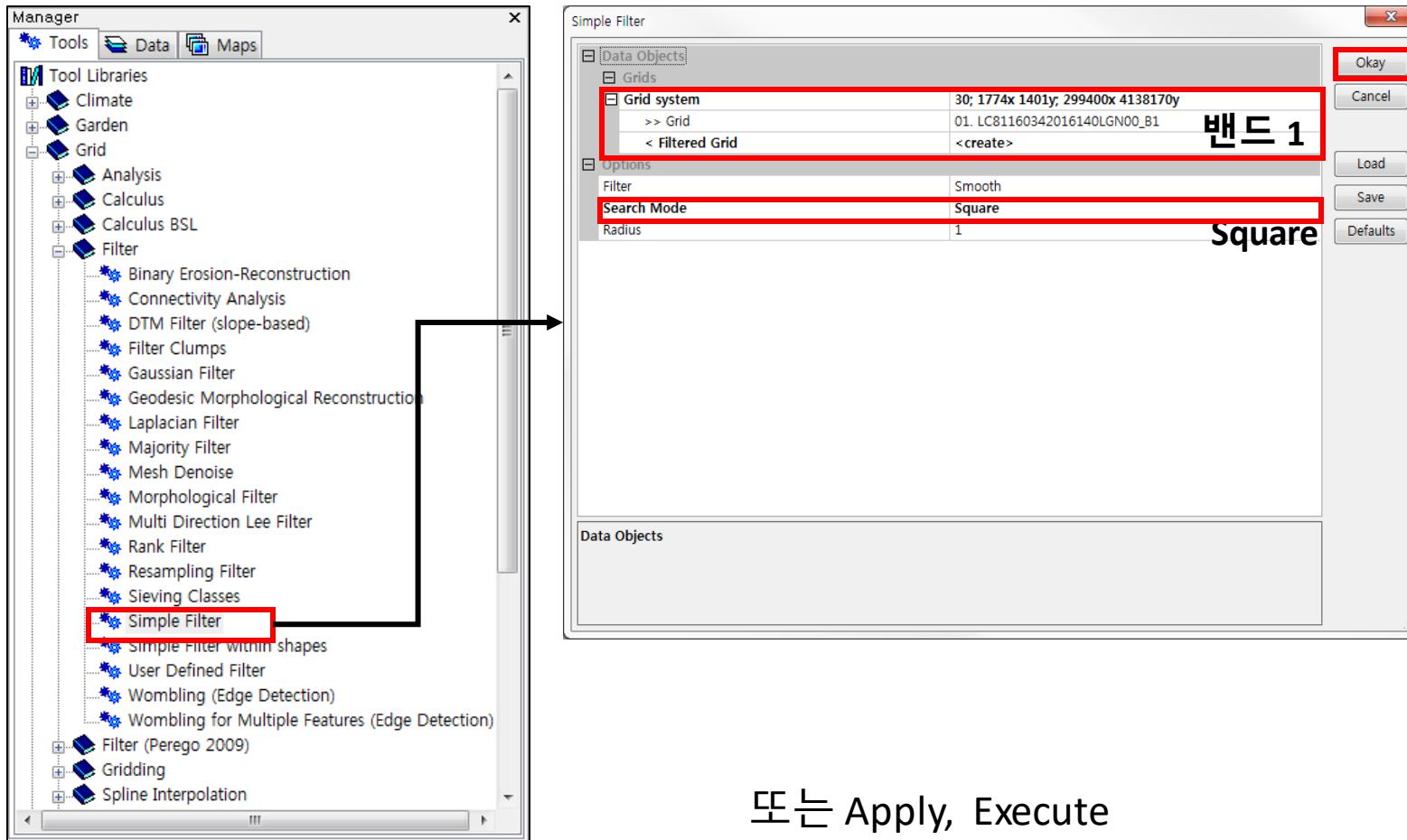
6	7	4
8	6	7
4	3	6

$$(6 \times 1 + 7 \times 1 + 4 \times 1 + 8 \times 1 + 9 \times 1 + 7 \times 1 + 4 \times 1 + 3 \times 1 + 6 \times 1) / 9 = 6$$

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

# 영상 흐림 실습

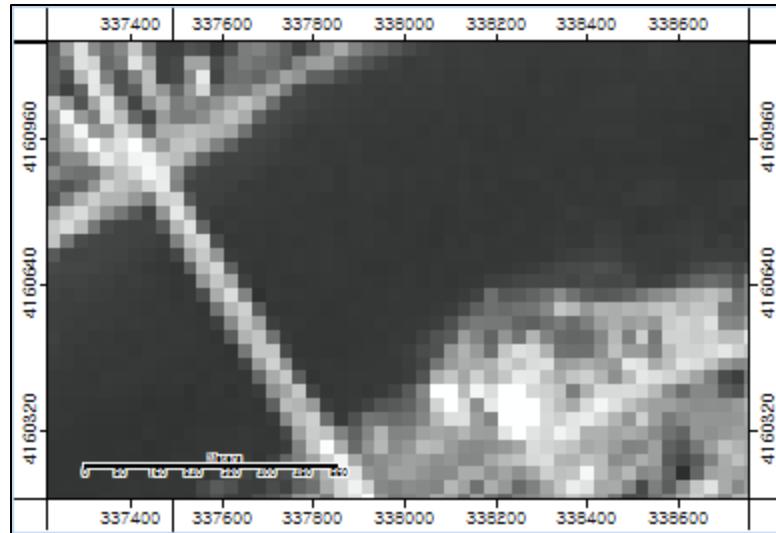
## ❖ Simple Filter(Tools 탭 -> Grid -> Filter -> Simple Filter)



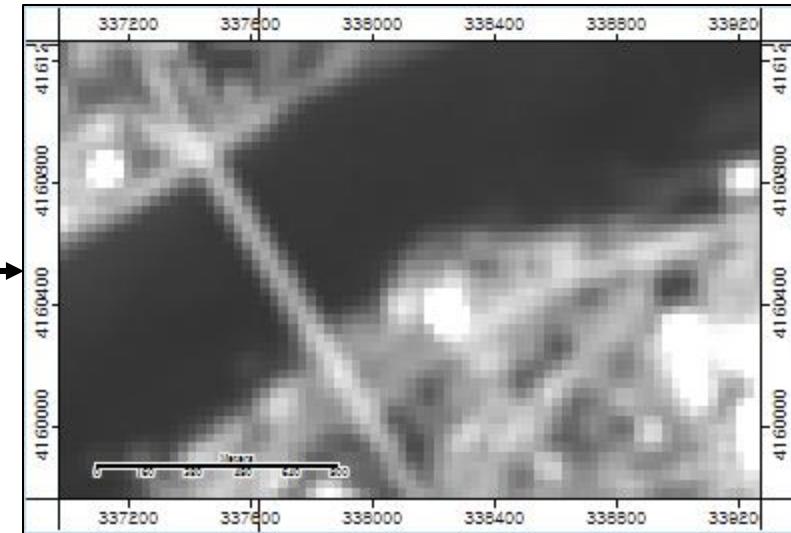
또는 Apply, Execute

# 영상 흐림 실험

## ❖ 필터 적용 전과 후 이미지 확인



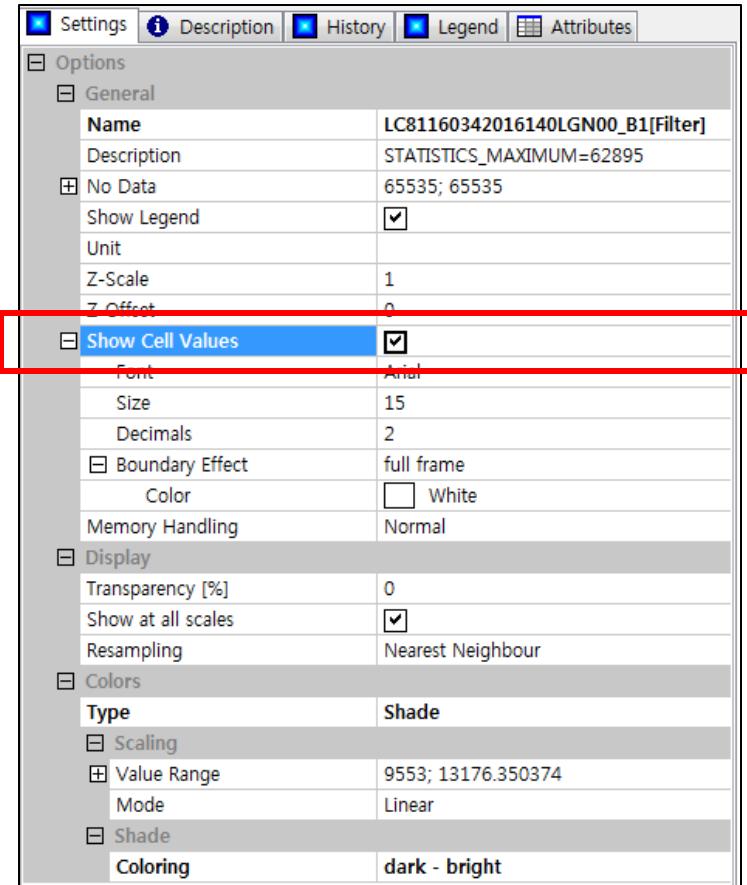
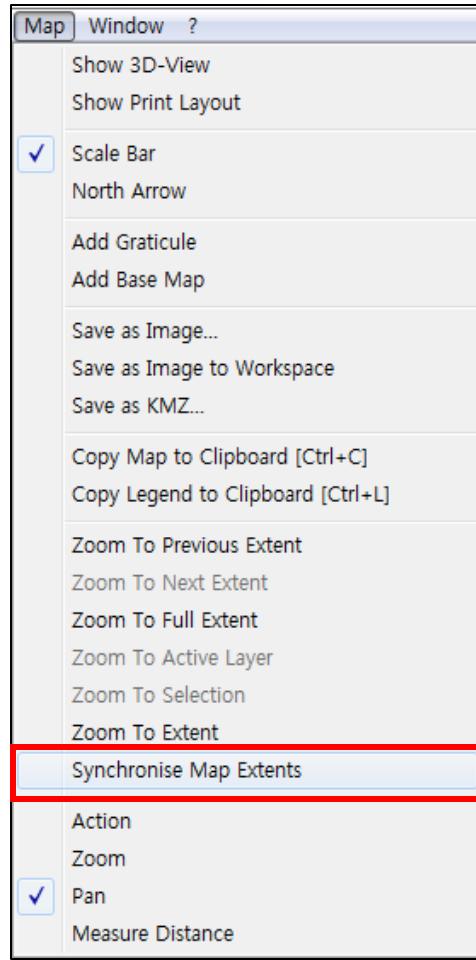
필터 적용 전



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

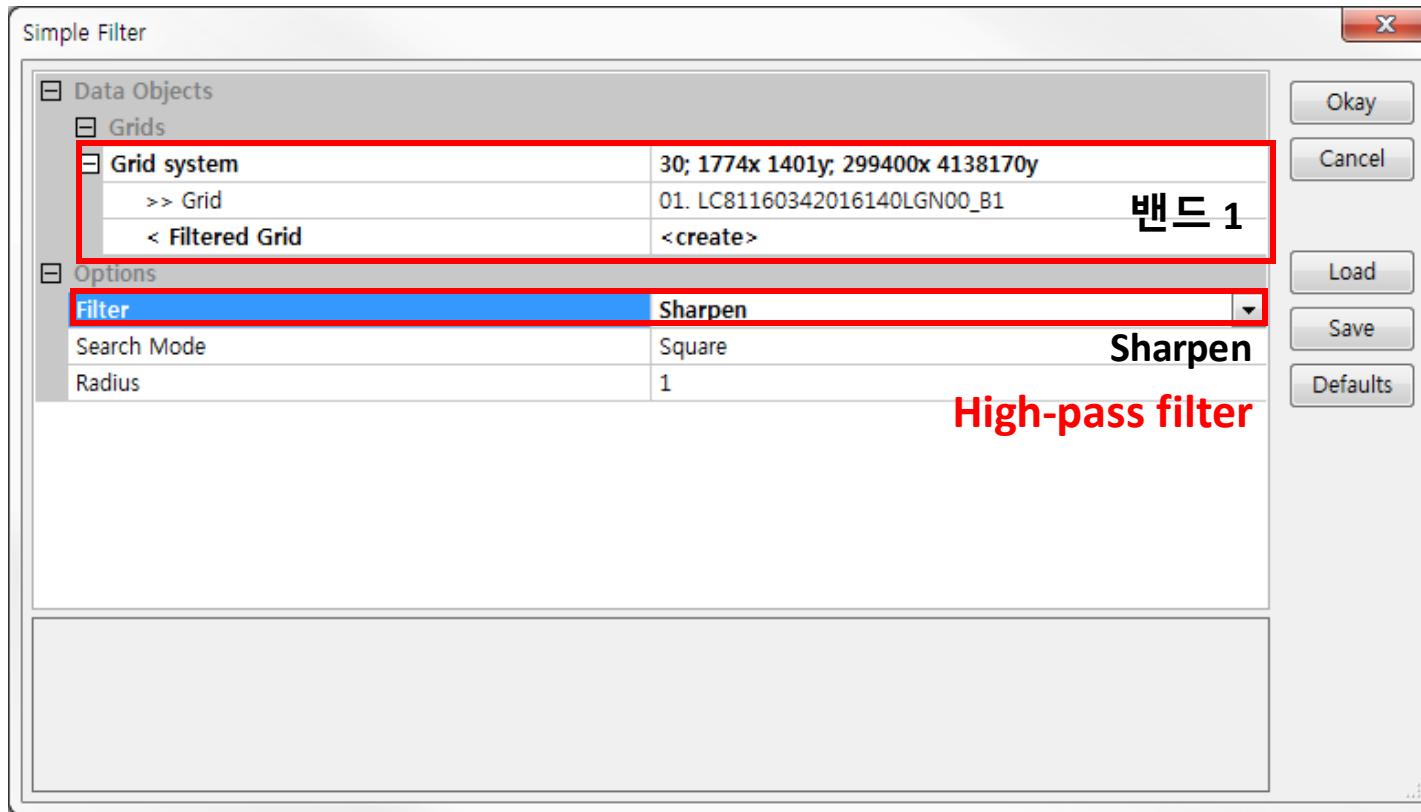
	332820	332840	332860	332880	332900	332920	332940	332960	332980	
415532	10886.00	12344.00	11830.00	11451.00	11015.00	10848.00	10			415532
4155280	10926.00	11590.00	12201.00	11822.00	10305.00	10373.00	11			4155280
4155240	10968.00	11067.00	11772.00	12302.00	11583.00	11280.00	11			4155240
	11049.00	11139.00	11536.00	12135.00	12548.00	12161.00	11			
	332820	332840	332860	332880	332900	332920	332940	332960	332980	

	332820	332840	332860	332880	332900	332920	332940	332960	332980	
415532	11516.22	11673.22	11704.78	11835.11	11076.22	10954.56	11			415532
4155280	11264.22	11508.73	11819.89	11653.44	11314.33	11089.89	11			4155280
4155240	11181.78	11362.33	11731.56	11863.78	11707.11	11409.78	11			4155240
	11147.89	11259.33	11539.00	11907.00	12074.33	11872.56	11			
	332820	332840	332860	332880	332900	332920	332940	332960	332980	

$$(12344 \times 1 + 11830 \times 1 + 11451 \times 1 + 11590 \times 1 + 12201 \times 1 + 11822 \times 1 + 11067 \times 1 + 11772 \times 1 + 12302 \times 1) / 9 = 11819.89$$

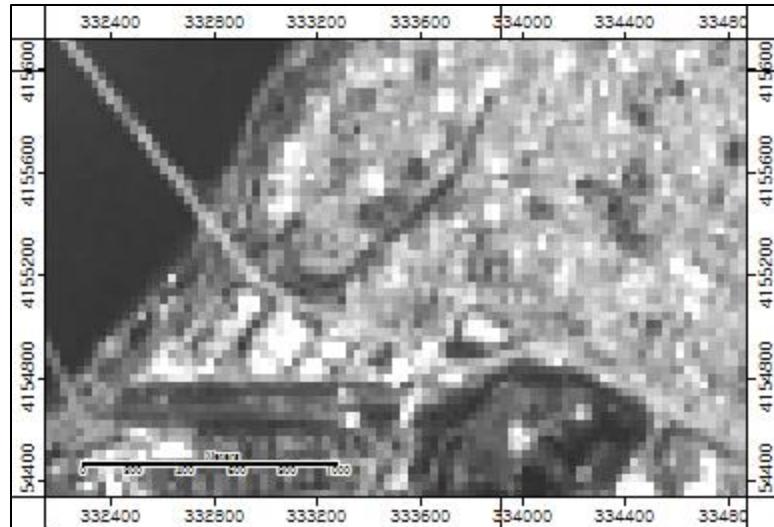
# 영상 선명화 실습

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

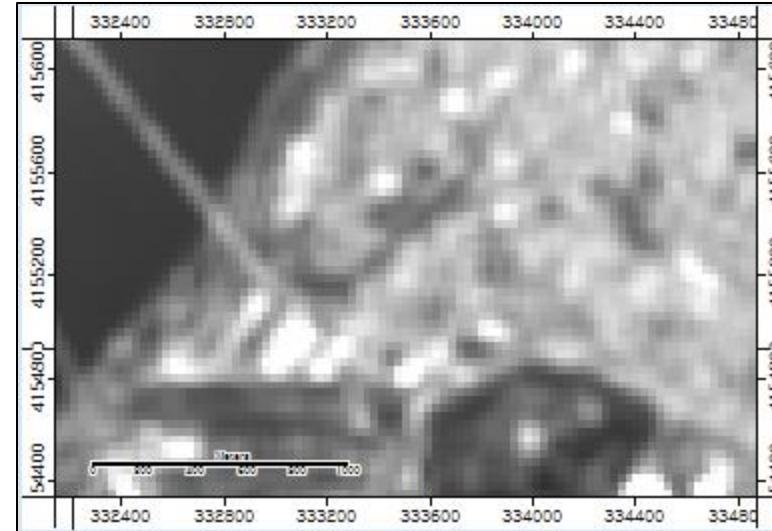


# 영상 선명화 실습

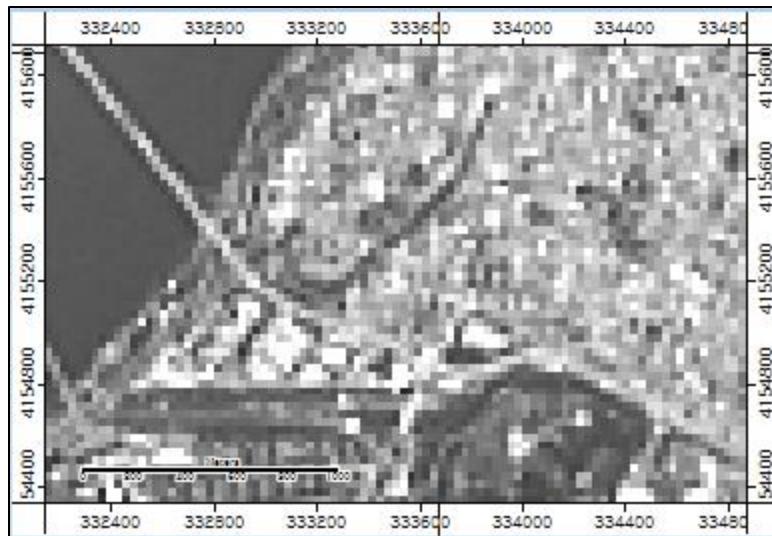
## ❖ 필터 영상 확인



필터 적용 안함



필터(Smooth) 적용 후

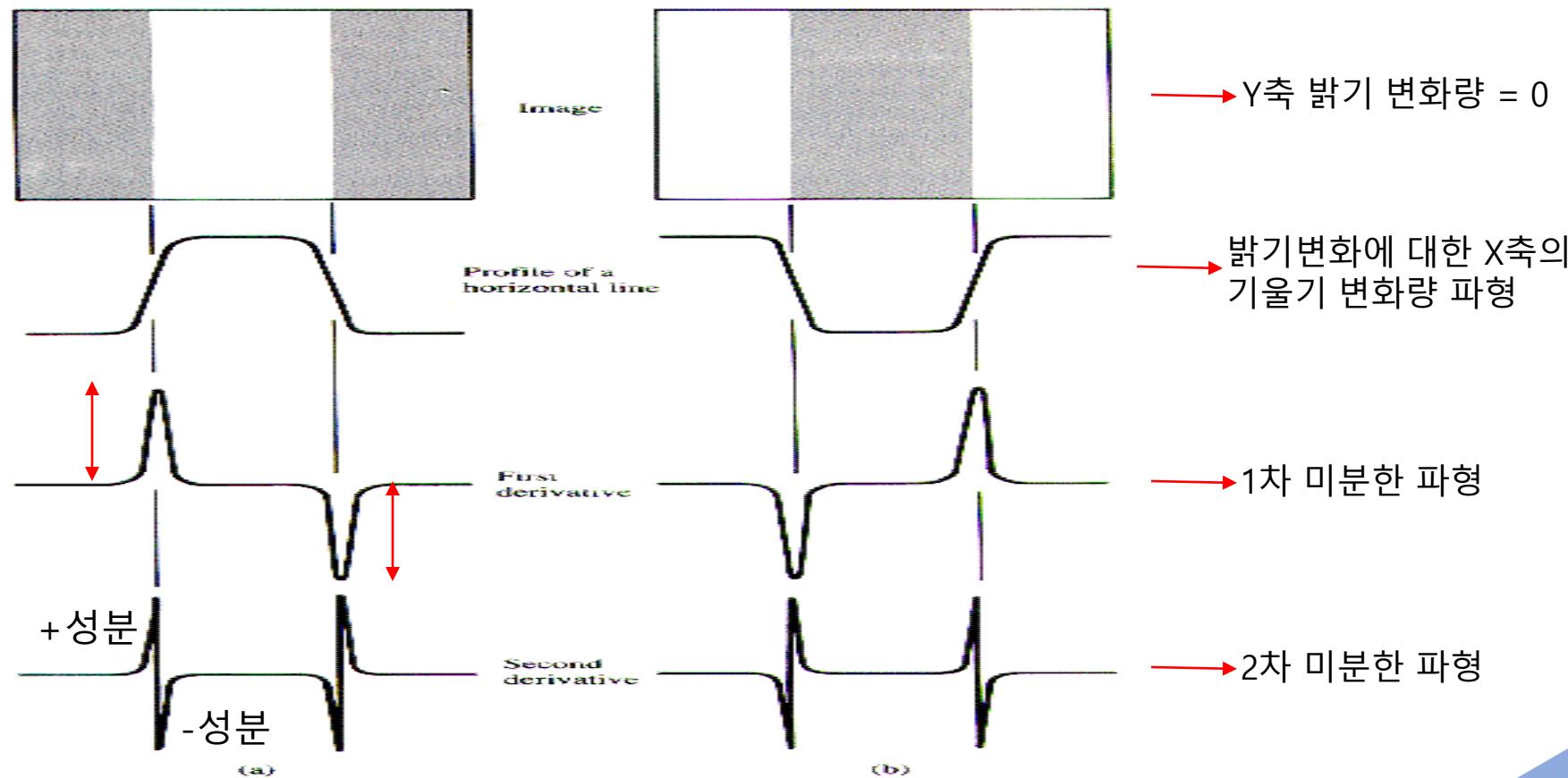


필터(Sharpen) 적용 후

Simple filter가 제공하는  
다른 설정을 수행

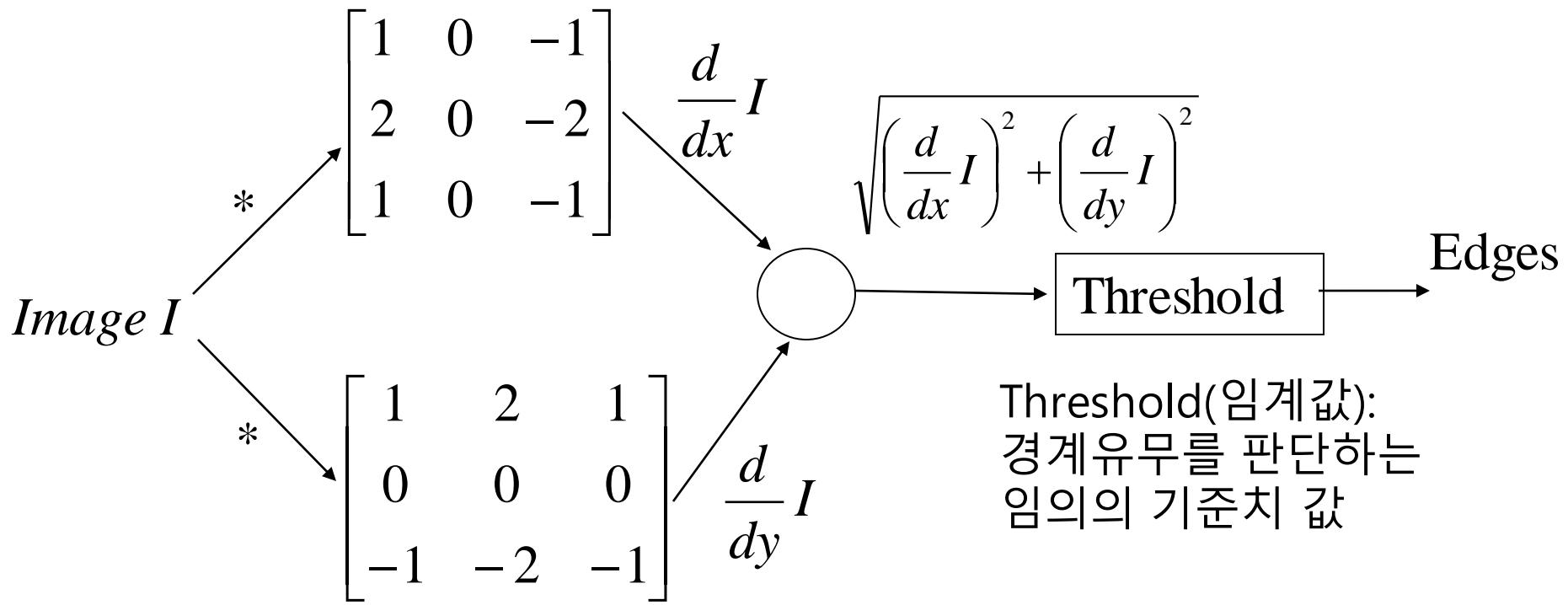
# 윤곽선 검출(Edge Detection)

- ① 1차 미분 값에서 그래프 **기울기의 크기**로 영상에서 윤곽선의 존재여부 확인
- ② 2차 미분 값에서 그래프 **기울기의 부호**로 윤곽선 픽셀의 밝고 어두운 부분의 위치 확인



미분연산자에 의한 윤곽선 파형

# 윤곽선 검출(Edge Detection)



# 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

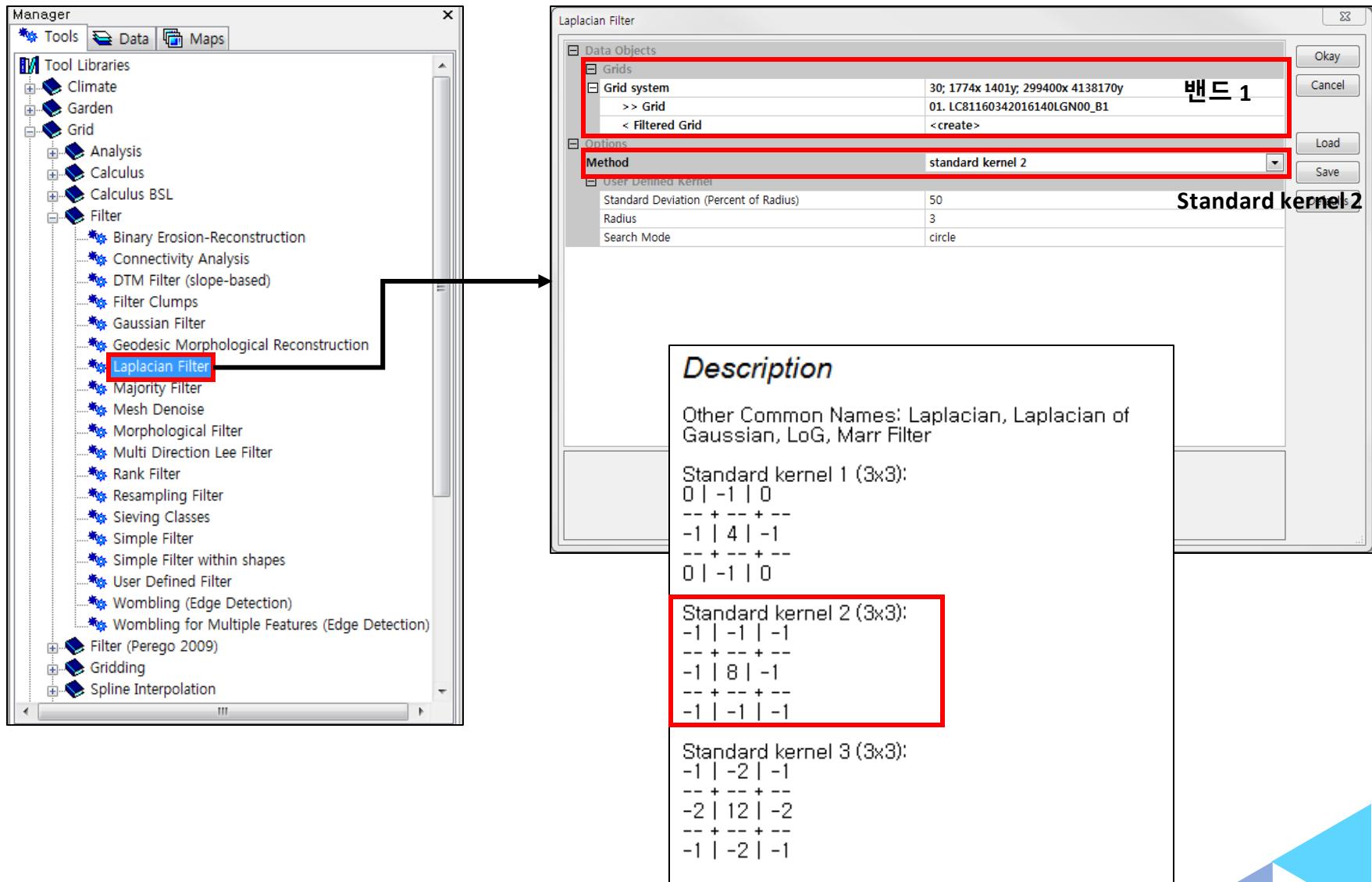
---

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

-1	-1	-1
-1	8	-1
-1	-1	-1

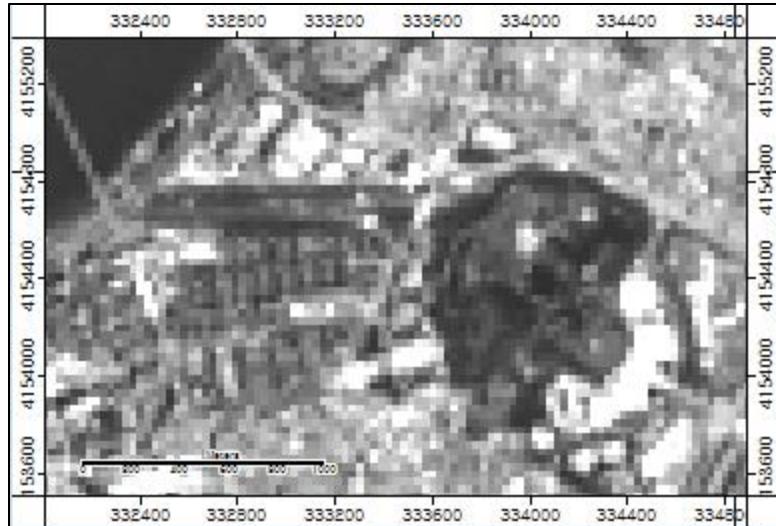
# 엣지 추출 실습 (라플라시안)

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

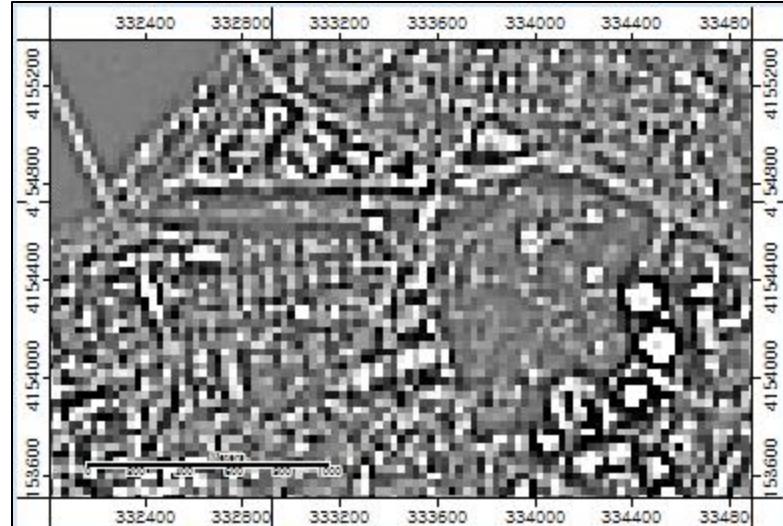


# 엣지 추출 실습 (라플라시안)

## ❖ 필터 적용 전과 후 영상 확인



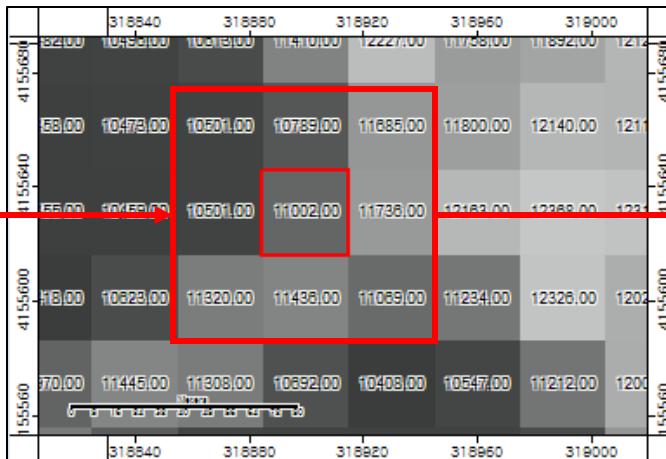
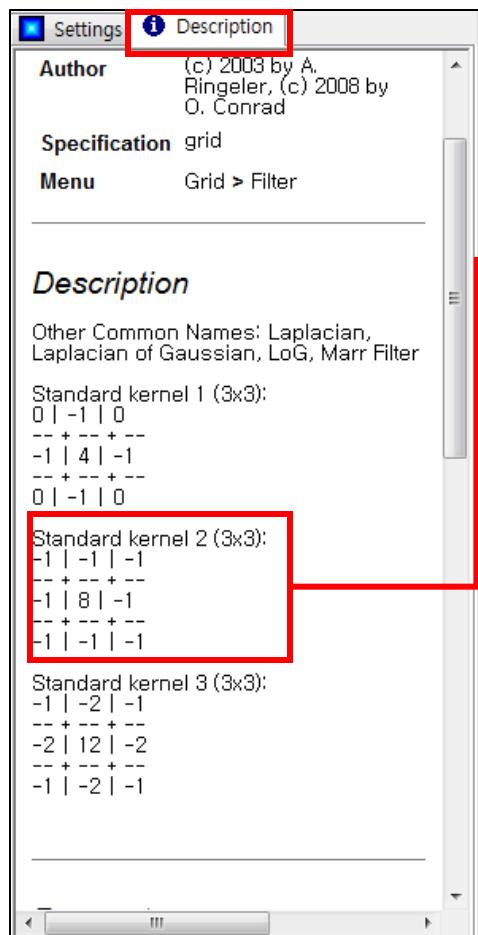
필터 적용 전



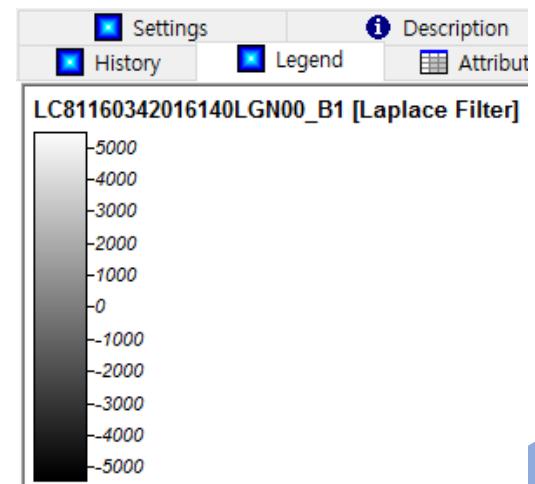
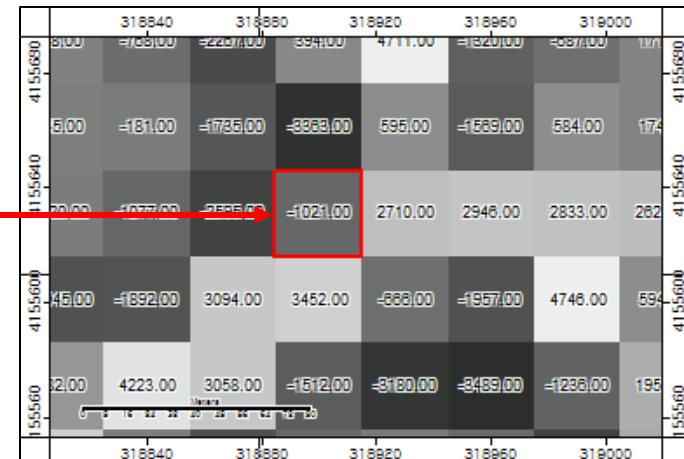
필터 적용 후

# 엣지 추출 실습 (라플라시안)

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

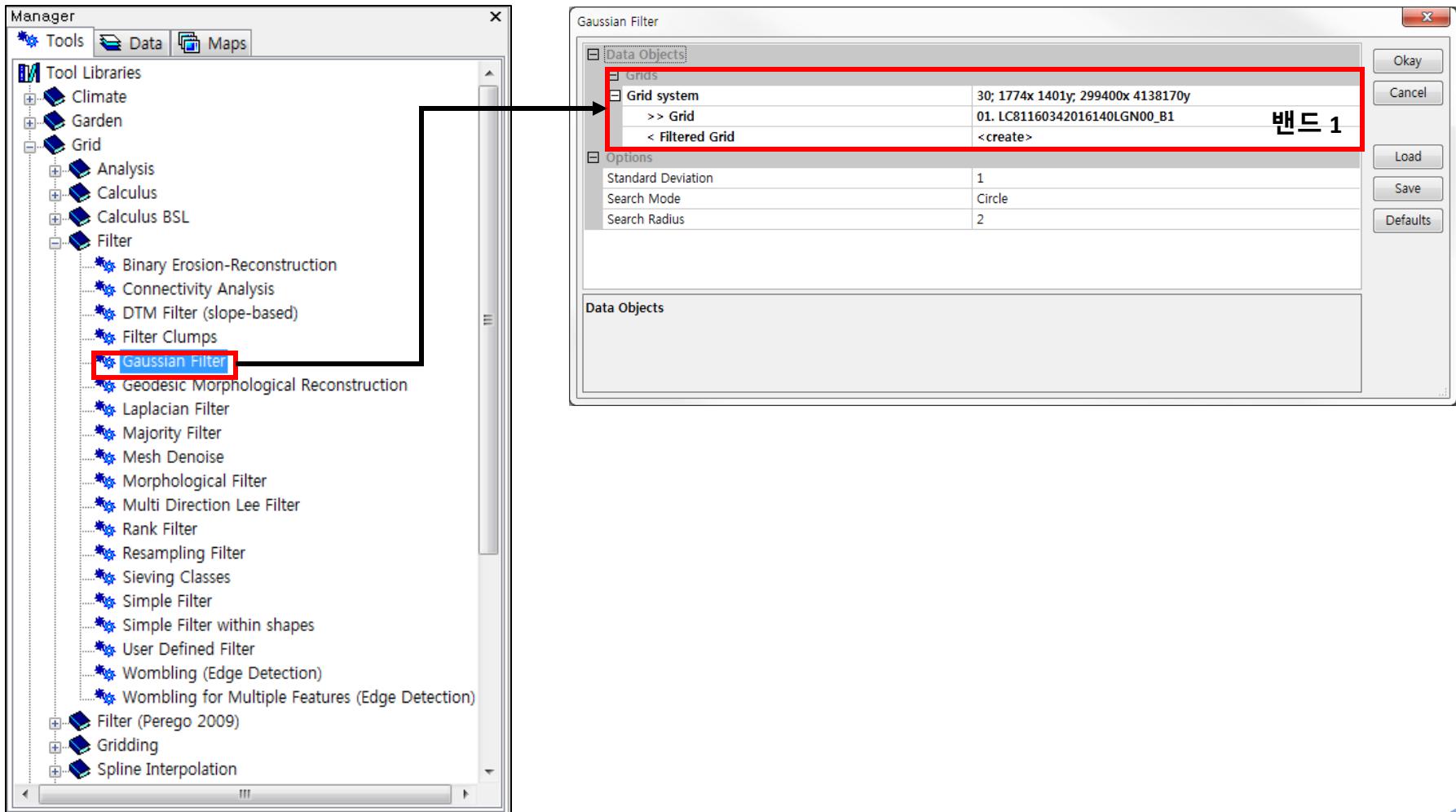


$$(10501x-1 + 10789x-1 + 11685x-1 + 10501x-1 + 11002x8 + 11736x-1 + 11320x-1 + 11436x-1 + 11069x-1) = -1021.00$$



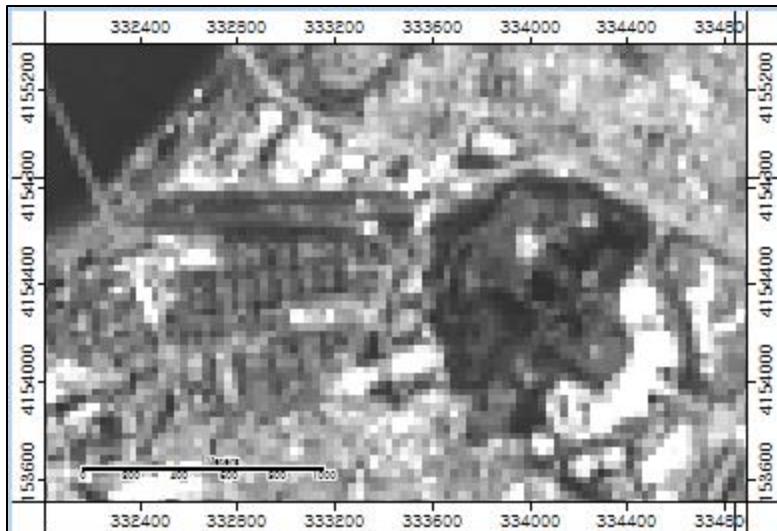
# 영상 흐림 실습 (가우시안)

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

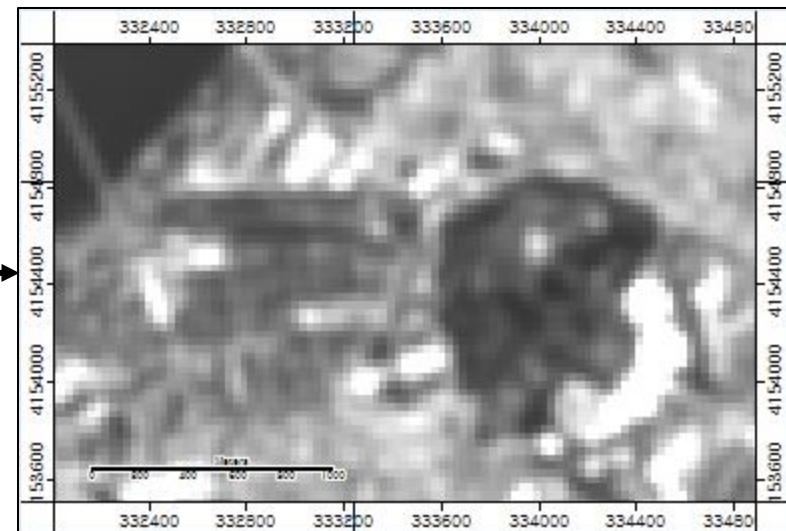


# 영상 흐림 실습 (가우시안)

## ❖ 필터 적용 전과 후 영상 확인



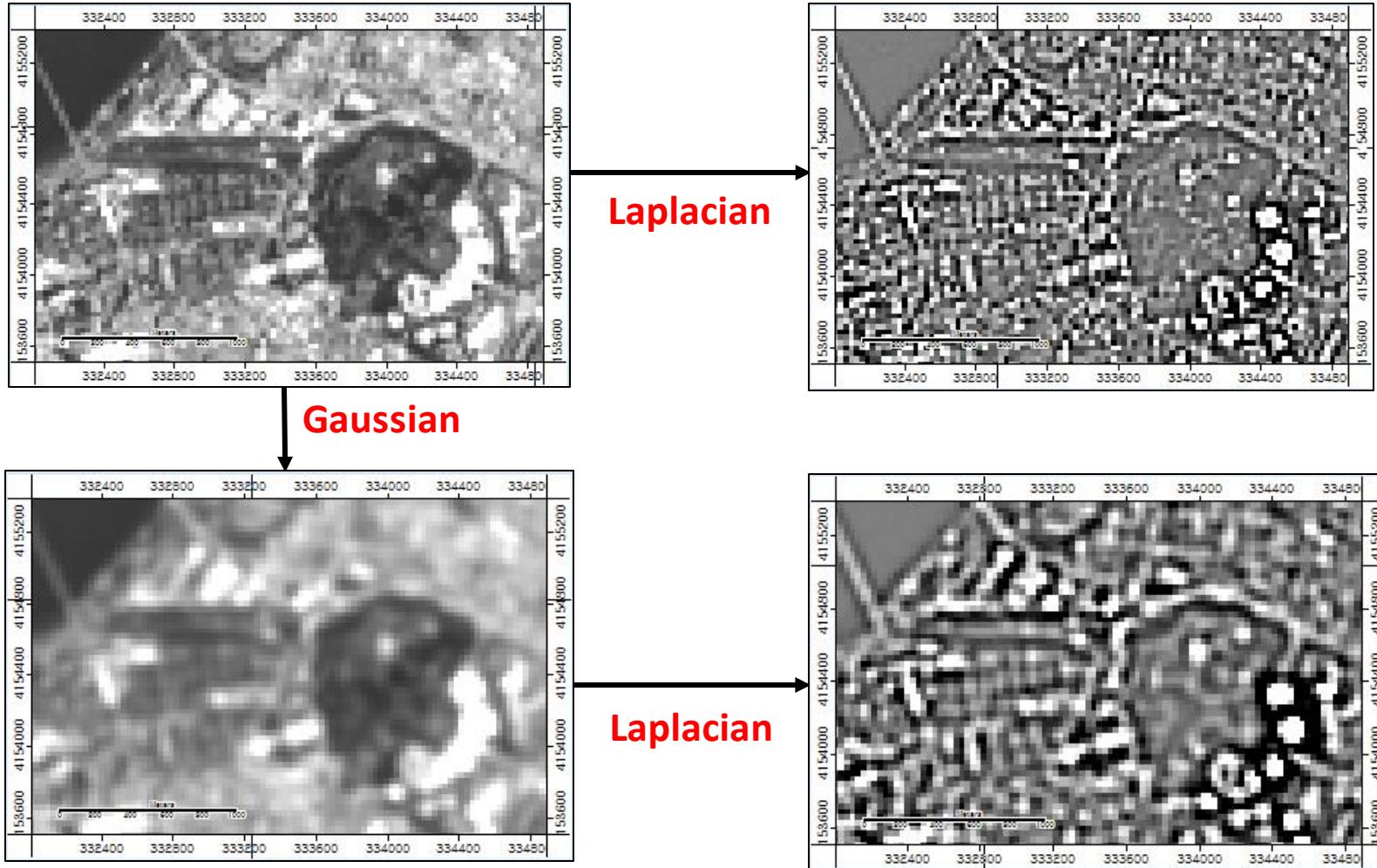
필터 적용 전



필터 적용 후

# 윤곽선 검출 (혼합)

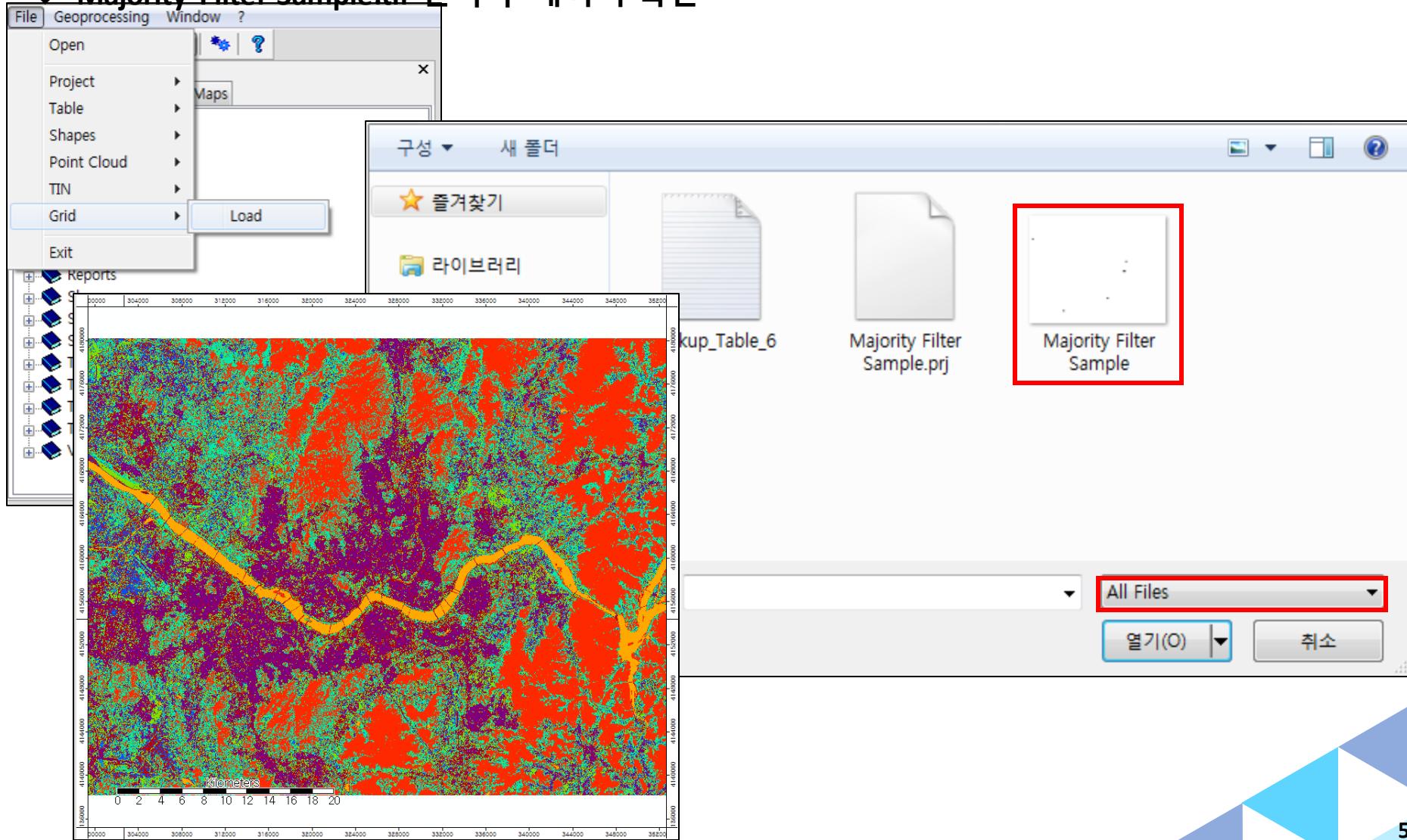
- ❖ Gaussian Filter와 Laplacian Filter를 혼합 사용하여 좀 더 정확한 윤곽선 검출에 사용
- ❖ 원본 영상에 Gaussian Filter 적용 후 Laplacian Filter 순으로 적용 ) LoG filter



# 잡음 제거 실습

❖ 데이터 불러오기(File -> Grid -> Load)

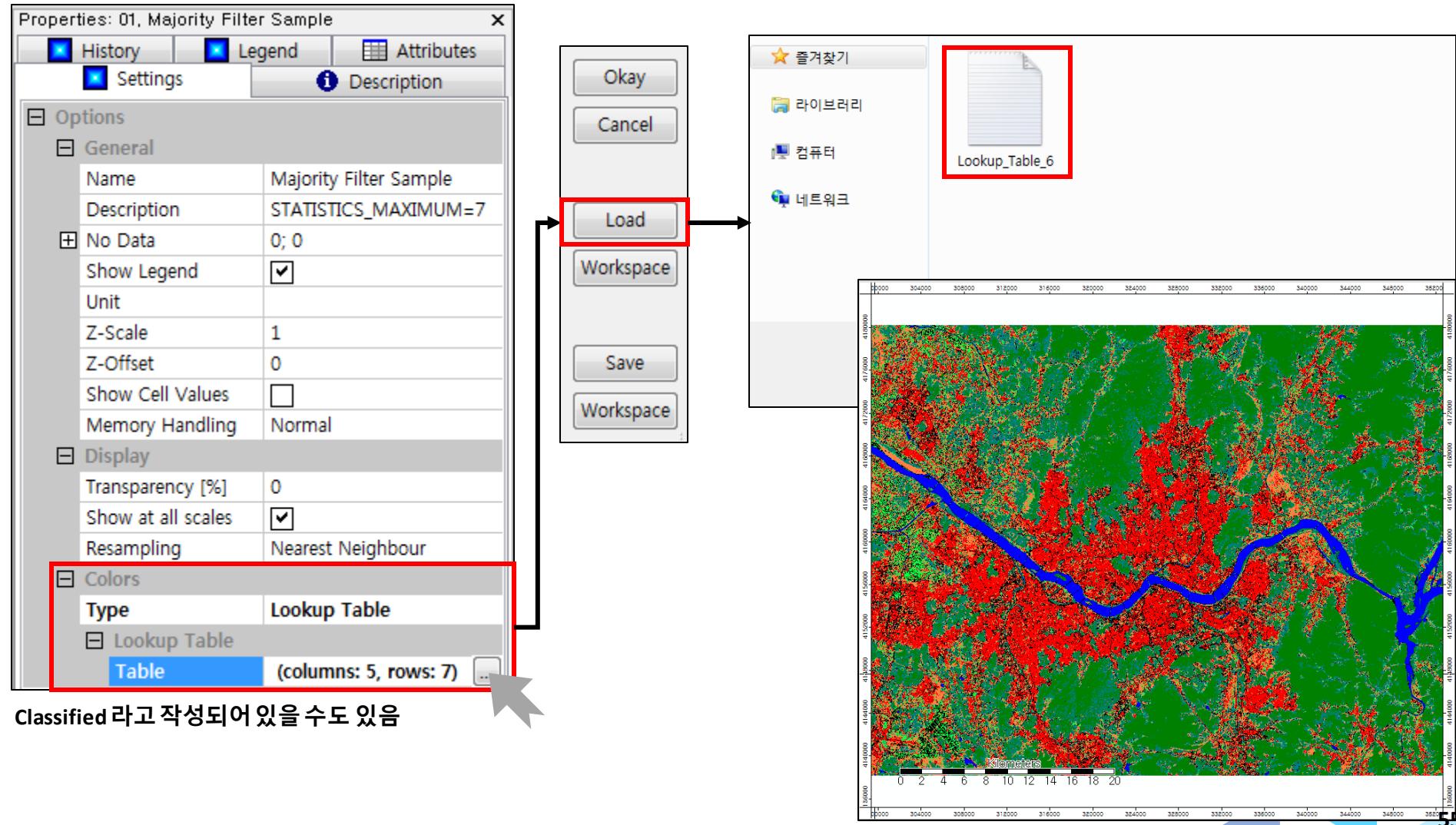
❖ Majority Filter Sample.tif 선택 후 데이터 확인



# 잡음 제거 실습

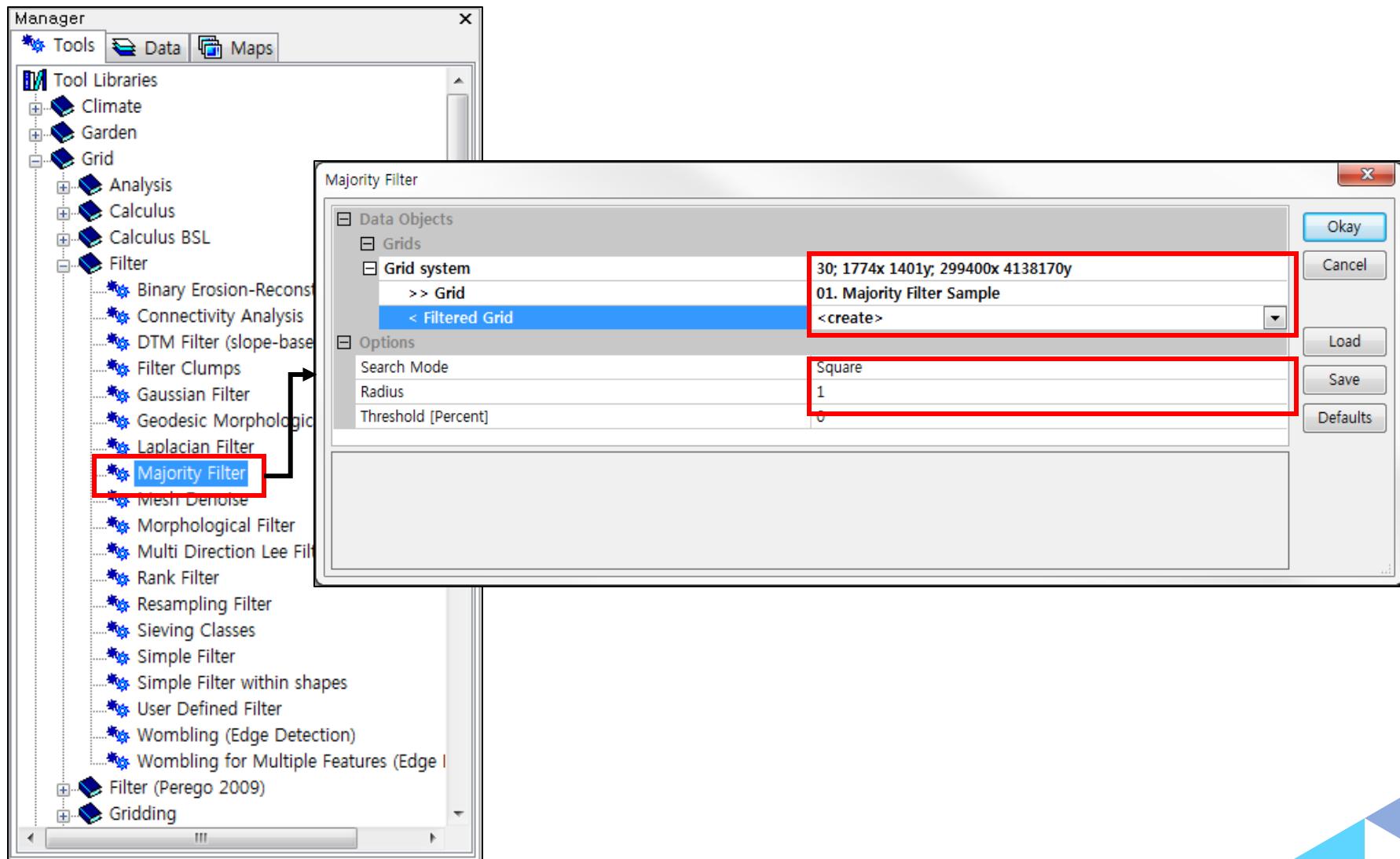
❖ Settings 탭 Colors Type을 Lookup Table로 변경

❖ Lookup Table 속성에서 Lookup\_Table\_6.txt 불러온 후 적용



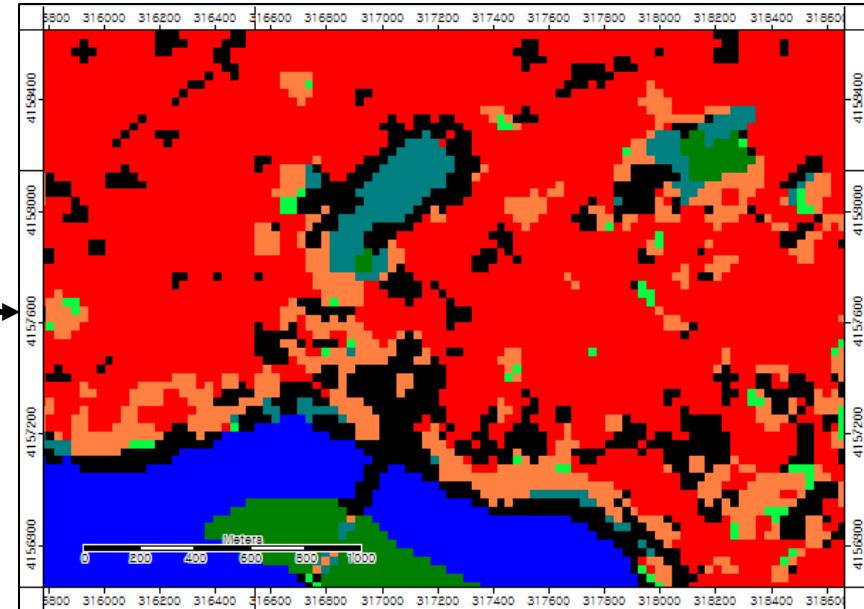
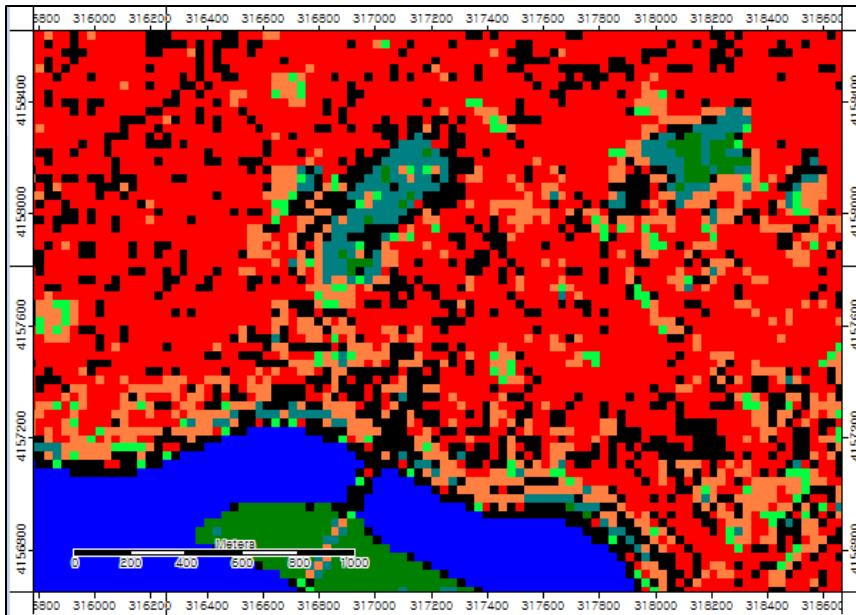
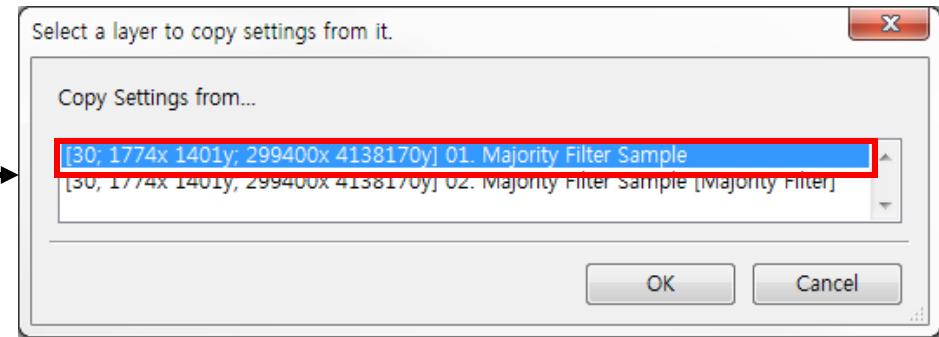
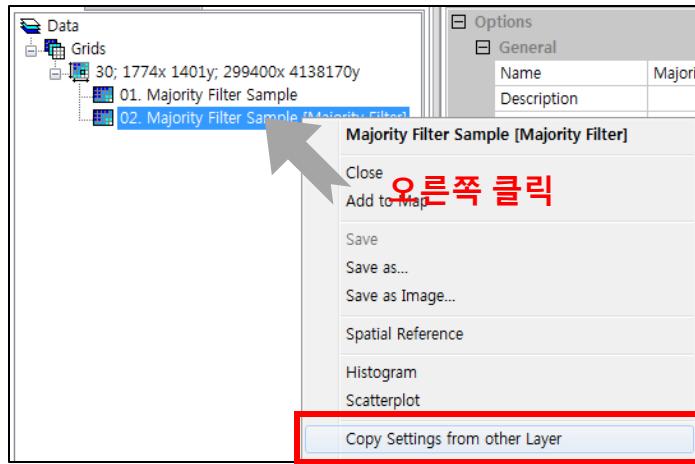
# 잡음 제거 실습

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



# 잡음 제거 실습

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



# 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



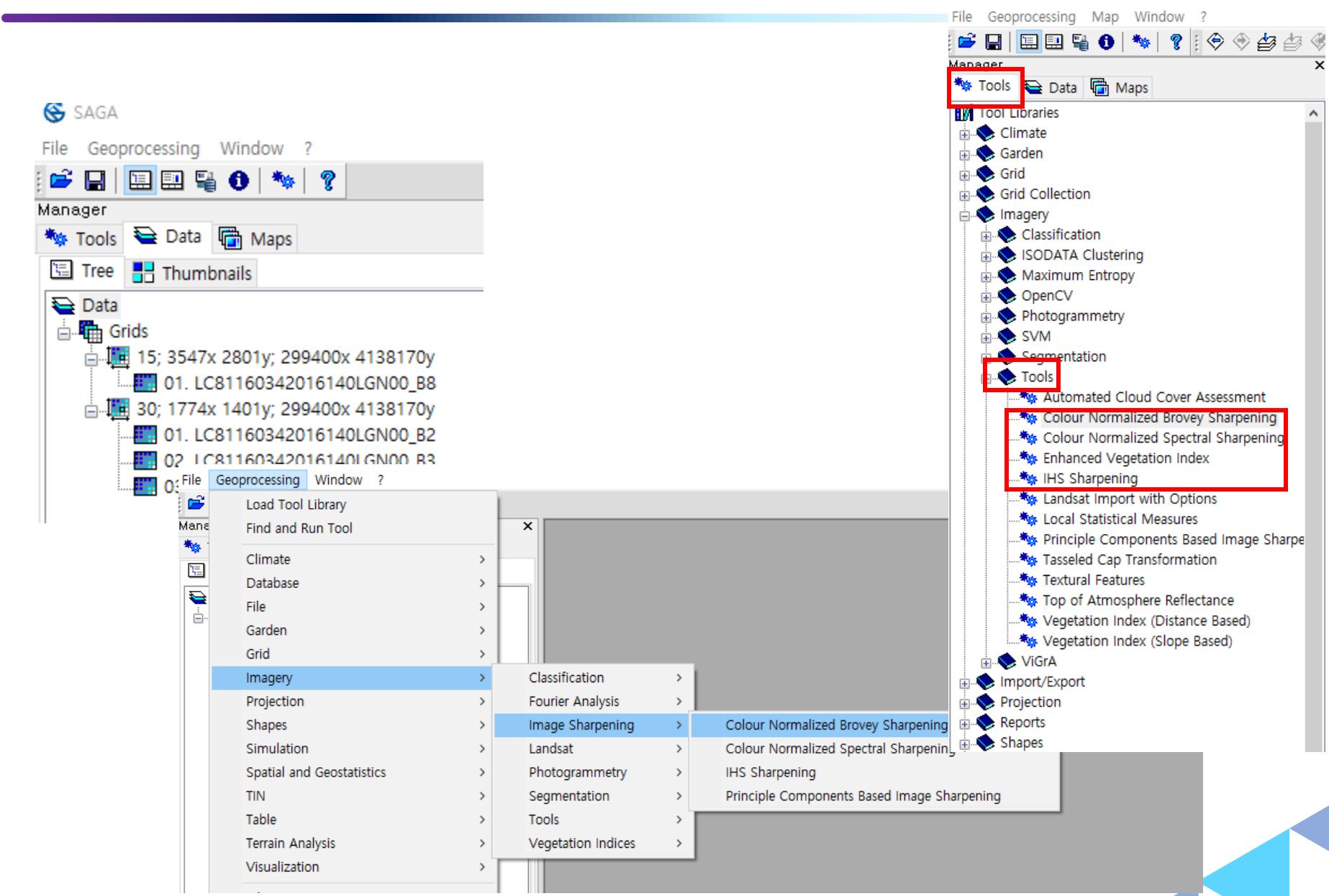
저해상도 다중분광 영상



고해상도 다중분광 영상

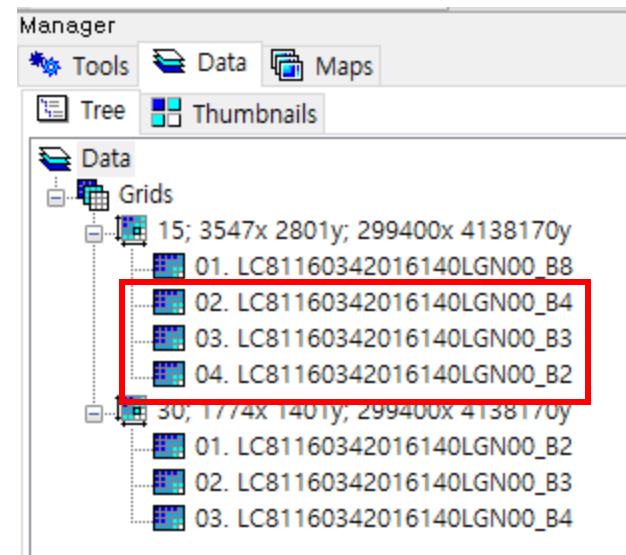
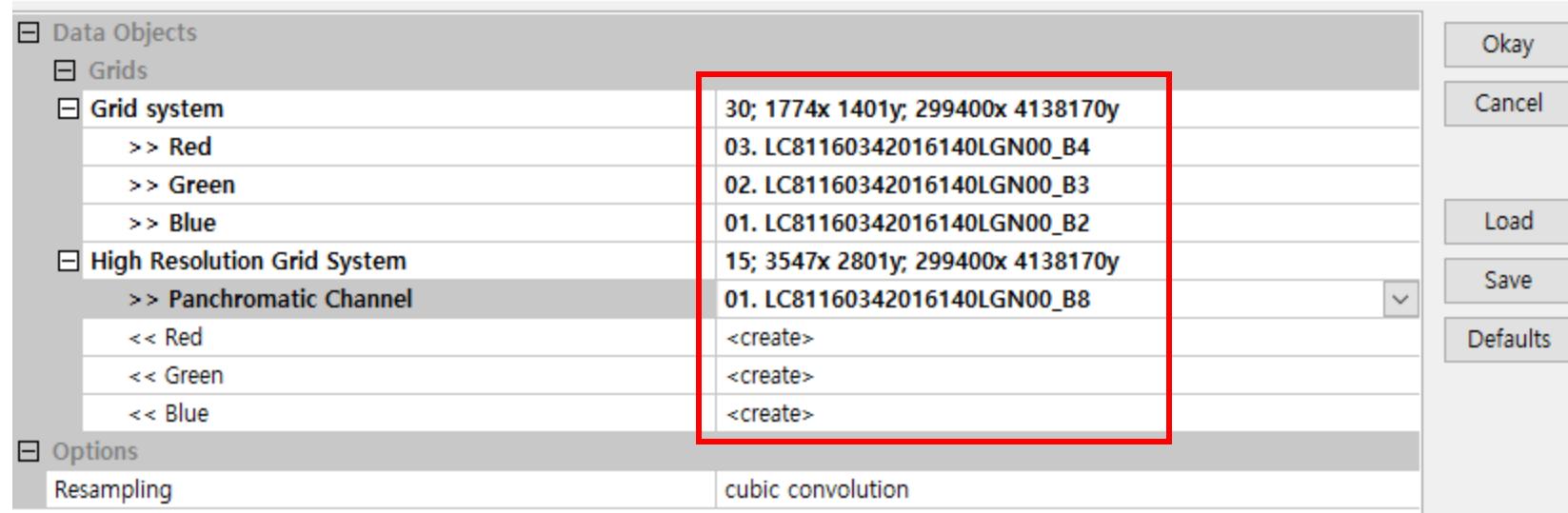
고해상도 전정색 영상

# 영상 융합 실습(Pan Sharpening)

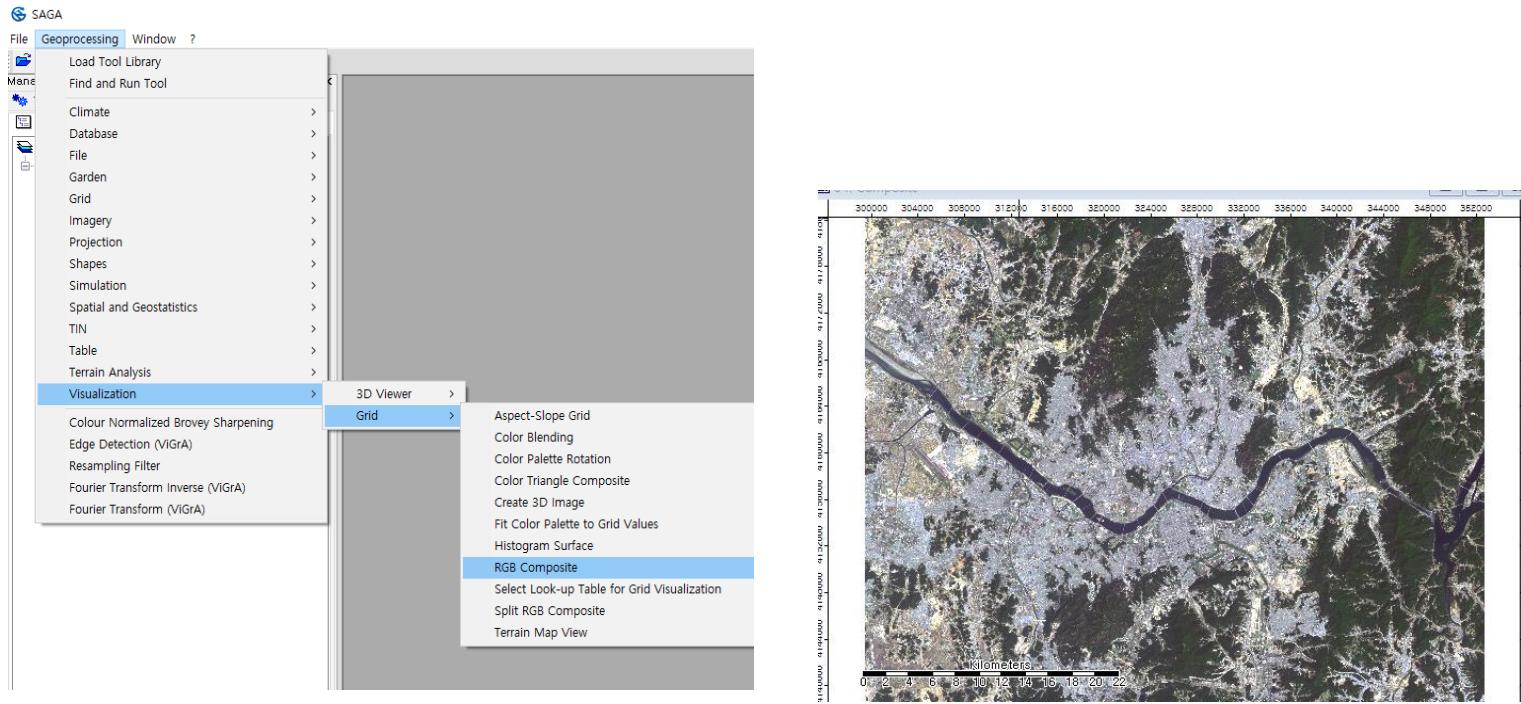


# 영상 융합 실습(Pan Sharpening)

Colour Normalized Brovey Sharpening



# 영상 융합 실습(Pan Sharpening)



■ Data Objects

- Grids
- Grid system
  - >> Red
    - Value Preparation
      - Standard Deviation
  - >> Green
    - Value Preparation
      - Standard Deviation
  - >> Blue
    - Value Preparation
      - Standard Deviation
  - > Alpha
  - << Composite

30; 1774x 1401y; 299400x 4138170y  
03. LC81160342016140LGN00\_B4  
standard deviation  
2  
02. LC81160342016140LGN00\_B3  
standard deviation  
2  
01. LC81160342016140LGN00\_B2  
standard deviation  
2

<not set>  
<create>

Okay Cancel Load Save Defaults

# 영상 융합 실습(Pan Sharpening)

Manager

Tools Data Maps

Tree Thumbnails

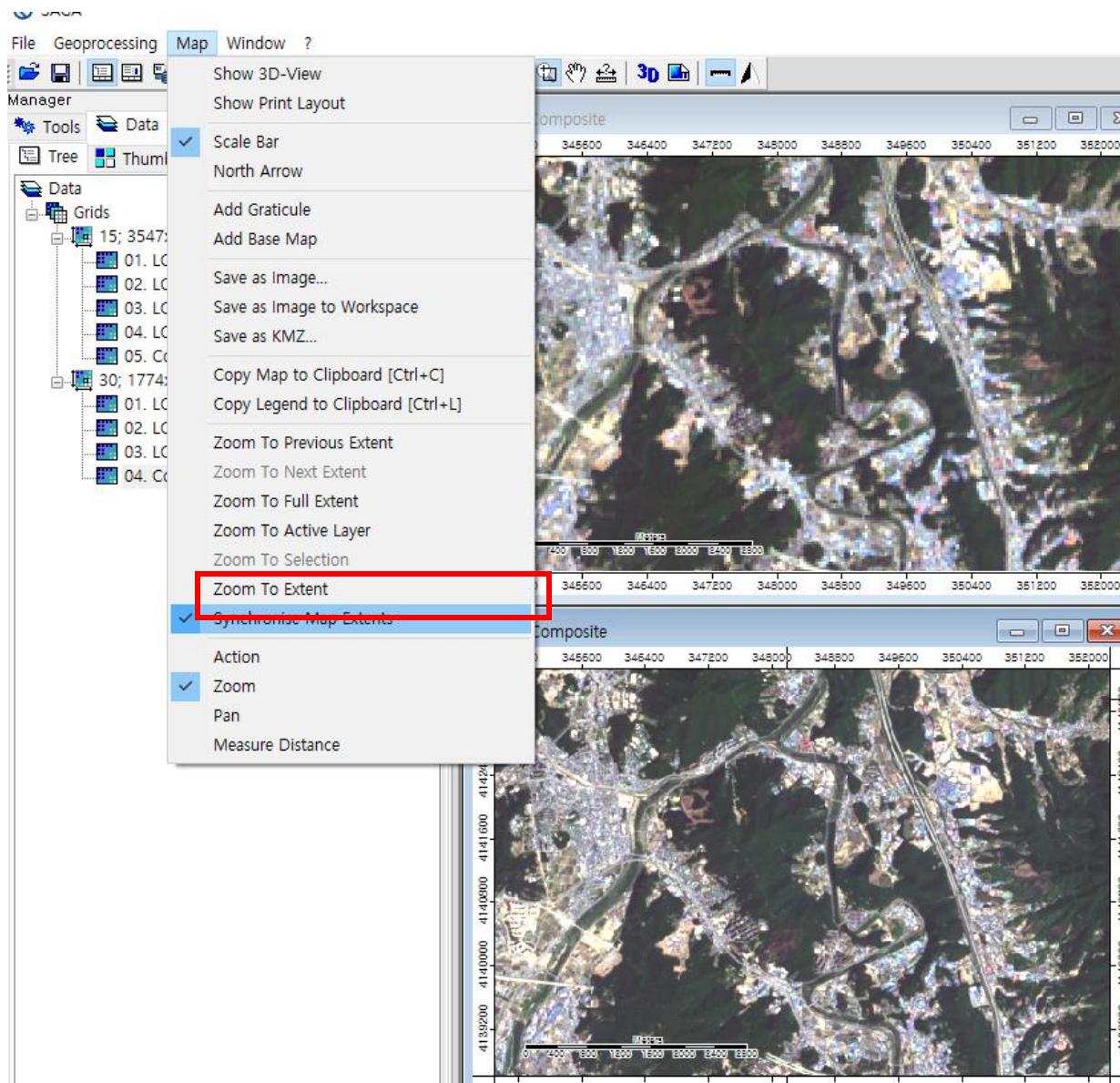
Data Grids

- 15; 3547x 2801y; 299400x 4138170y
  - 01. LC81160342016140LGN00\_B8
  - 02. LC81160342016140LGN00\_B4
  - 03. LC81160342016140LGN00\_B3
  - 04. LC81160342016140LGN00\_B2
  - 05. Composite**
- 30; 1774x 1401y; 299400x 4138170y
  - 01. LC81160342016140LGN00\_B2
  - 02. LC81160342016140LGN00\_B3
  - 03. LC81160342016140LGN00\_B4
  - 04. Composite

05. Composite

The image shows a satellite composite view of a city, likely Seoul, South Korea. The city is densely built with various shades of gray and white, representing different land uses and urban structures. A large, winding river or canal cuts through the center of the city. The image is overlaid with a coordinate grid, with both horizontal and vertical axes ranging from 300,000 to 350,000. A scale bar at the bottom indicates distances in kilometers, ranging from 0 to 22. The overall quality of the image appears slightly grainy or less sharp.

# 영상 융합 실습(Pan Sharpening)



# 영상 융합 실습(Pan Sharpening)

The screenshot shows the ArcGIS Pro application interface. The top menu bar includes File, Geoprocessing, Map, Window, and ?.

The Geoprocessing ribbon tab is selected, displaying the 'Tool Catalog' pane. The 'Imagery' category is expanded, and the 'Image Sharpening' subcategory is selected. A context menu is open over this subcategory, listing several sharpening methods: Colour Normalized Brovey Sharpening, Colour Normalized Spectral Sharpening, IHS Sharpening (which is highlighted with a red box), and Principle Components Based Image Sharpening.

The main workspace displays a satellite composite image titled '04. Composite'. The bottom left corner of the image shows coordinate values: 304000, 312000, 320000, 328000, 336000, 344000, and 352000 along the top edge, and 4176000, 4175000, 4174000 along the left edge.

The Data Objects panel on the left lists various data objects, including Grids, Grid system (with Red, Green, Blue components), High Resolution Grid System (with Panchromatic Channel, Red, Green, Blue components), and Options (Resampling and Panchromatic Channel Matching). A red box highlights a list of grid names: 30; 1774x 1401y; 299400x 4138170y, 03. LC81160342016140LGN00\_B4, 02. LC81160342016140LGN00\_B3, 01. LC81160342016140LGN00\_B2, 15; 3547x 2801y; 299400x 4138170y, 01. LC81160342016140LGN00\_B8, <create>, <create>, and <create>.

The Data panel on the right shows a tree view of data layers. A red box highlights the 'Grids' section, which contains sub-layers for '15; 3547x 2801y; 299400x 4138170y' (with sub-layers 01 through 08) and '30; 1774x 1401y; 299400x 4138170y' (with sub-layers 01 through 04). Another red box highlights the 'Composite' layer under the 'Grids' section.

Pan sharpening 처리 알고리즘을 여러 가지  
변수로 변경하면서 실험해 볼 것

# 캐니(Canny) 필터링

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- 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

