The International Workshop on Agromet and GIS Applications for Agricultural Decision Making

QGIS Tutorial for Agrometeorological Practice

Date : December 5(Mon)~9(Fri), 2016 Place : MSTAY Hotel JEJU Hosted by : Korea Meteorological Administration(KMA) Organized by : National Institute of Meteorological Sciences(NIMS) Sponsored by : WMO CAgM / NCAM / APCC / OSGeo / PKNU / DU



Korea Meteorological Administration



National Institute of Meteorological Sciences

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	QGIS Tutorial for Agrometeorological Practice
	Organized by Dr. PAEK, Doojin and Dr. LEE, Seongkyu
Instructor	Dr. PAEK, Doojin (Seoul Housing and Community Corporation), 1002jeen@daum.net
	Dr. LEE, Seongkyu (APEC Climate Center), geolegend@apcc21.org_
Who is for	Anyone who is interested in GIS application for Agro-meteorology and this
	program is for beginner and low intermediate. It will be a good starting point
	for those who want to know how to apply climate/weather data with GIS tool to
	their own fields, especially agriculture field.
Prerequisite	The following items must be brought to the tutorial session :
	1. His/her own notebook computer
Contents	The detailed programs are as follows:
	1. GIS training beginning – 1
	- Introduction for OSGEO Korean Chapter
	- Introduction for FOSS4G (Free and Open Sources Softwares (FOSS) for
	Geospatial
	- Overview of GIS (Geographic Information System)
	- QGIS installation: program and example data
	2. GIS training beginning – 2
	- QGIS' practice : introduction for GIS data (vector & raster etc)
	3. GIS training intermediate – 1
	- QGIS spatial analysis I
	4. GIS training intermediate – 2
	- QGIS spatial analysis II with agrometeorological example
Remarks	The contents may be subject to change without notification. The text book and
	sample data for GIS tutorial will be distributed in the tutorial session. Dr.
	CHUNG, Uran (APEC Climate Center) will support agrometeorological practice.



Introduction to QGIS

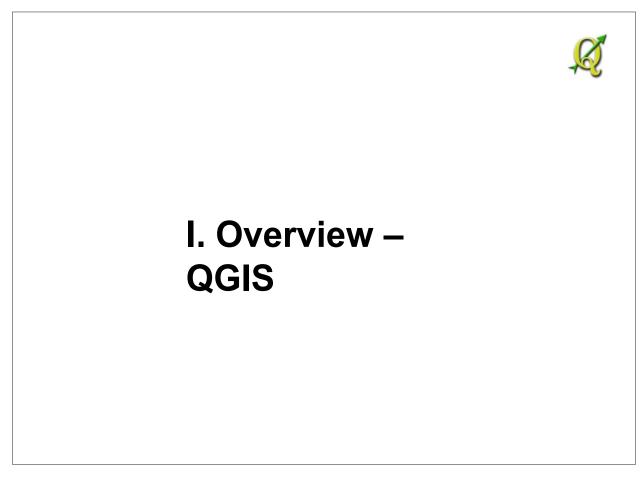
- Using QGIS and ISCGM Global Map -



Introduction to QGIS

- Using QGIS and ISCGM Global Map -

Doojin Paek(1002jeen@daum.net)



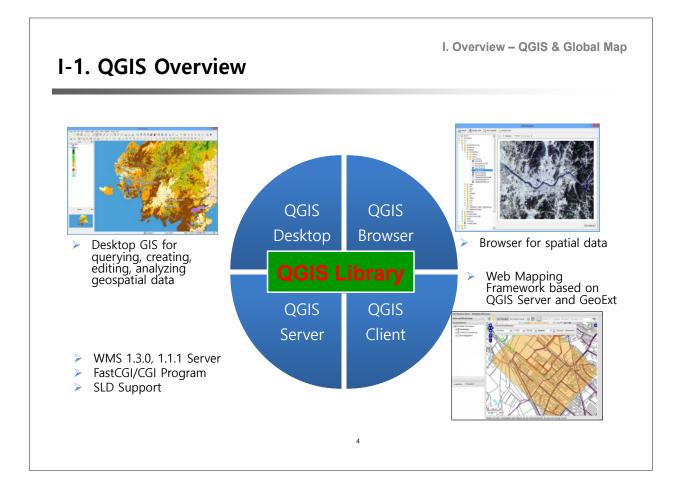


I. Overview - QGIS & Global Map

I-1. QGIS Overview

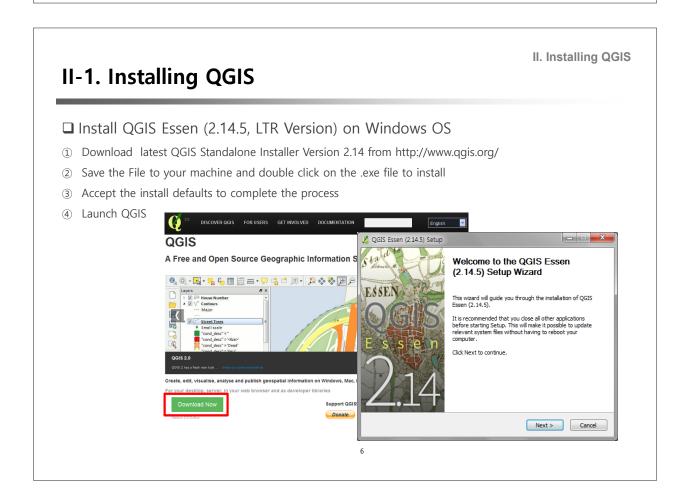
 \Box QGIS \rightarrow Free & Open Source Geographic Information System

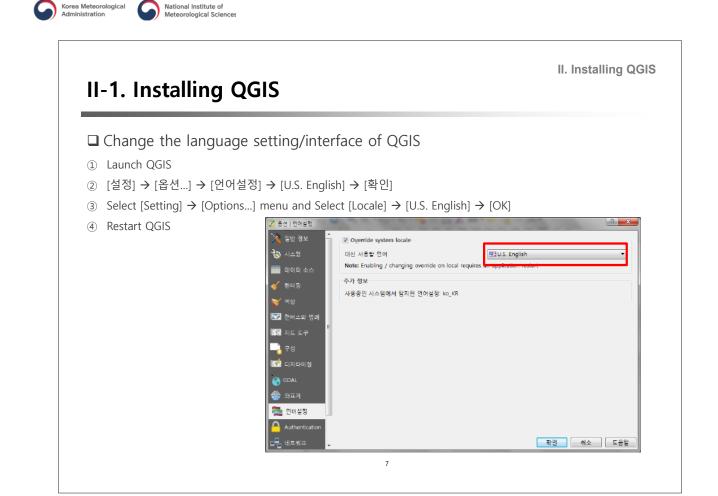
	Release Date	Version	Codename
	Jul-02	0.0.1-Alpha	Start!!!
OS	3-May-08	0.1	"lo"
	21-Jul-08	0.11.0	"Metis"
MS Windows	5-Jan-09	1.0.0	"Kore"
Mac OSX	1-Sep-09	1.2.0	"Daphnis"
Linux, Unix	10-Jan-10	1.4.0	"Enceladus"
- , -	29-Jul-10	1.5.0	"Tethys"
	27-Nov-10	1.6.0	"Copiapó"
License	19-Jun-11	1.7.0	"Wrocław"
License	21-Jun-12	1.8.0	"Lisboa"
	8-Sep-13	2.0.0-2.0.1	"Dufour"
GPL	26-Feb-14	2.2	"Valmiera"
	27-June-14	2.4	"Chugiak"
	31-October-14	2.6	"Brighton"
Language	20-Febrary-15	2.8	"Wein"
	26-June-15	2.10	"Pisa"
C++, Python,	23-October-15	2.12	"Lyon"
	29-February-16	2.14	"Essen"
	08-Jul-16	2.16	"Nødebo"

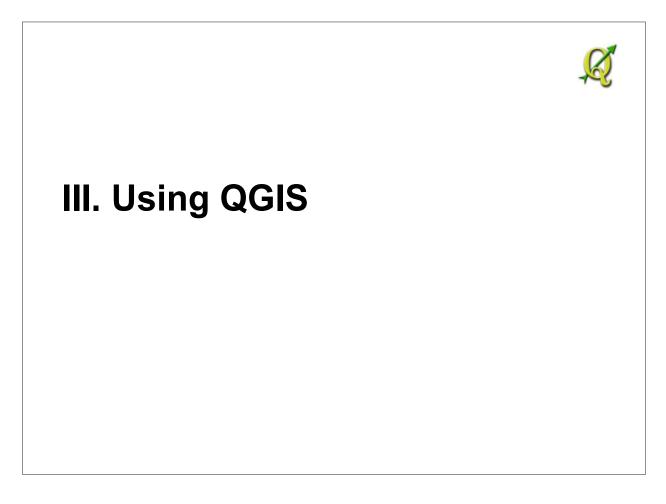


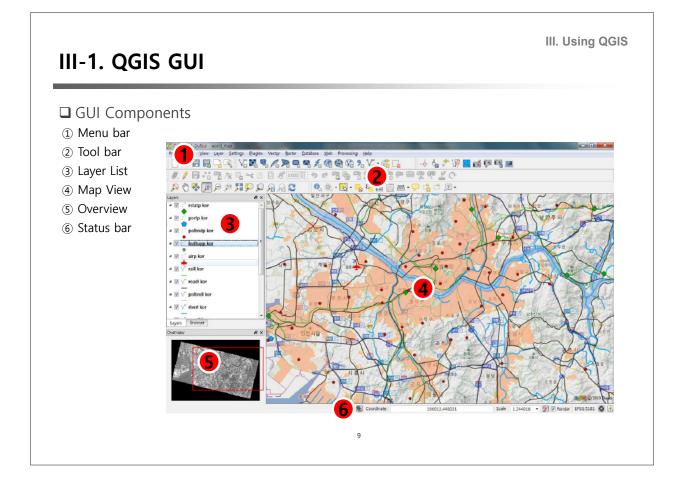


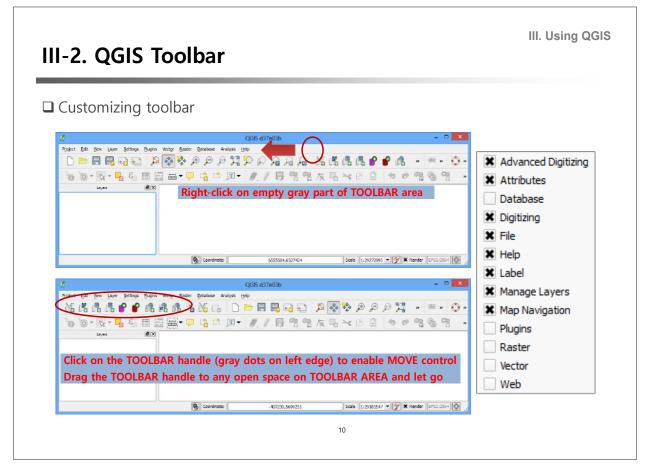
II. Installing QGIS













III-3. Working with Vector Layer

□ Skills to Learn from This Chpater

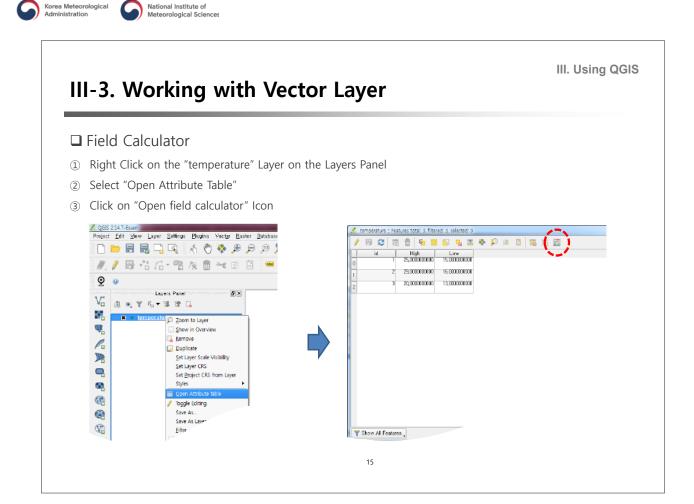
- ① Selecting CRS
- ② Creating a New Shape File
- ③ Adding a New Feature
- ④ How to Use Field Calculator
- 5 Labeling

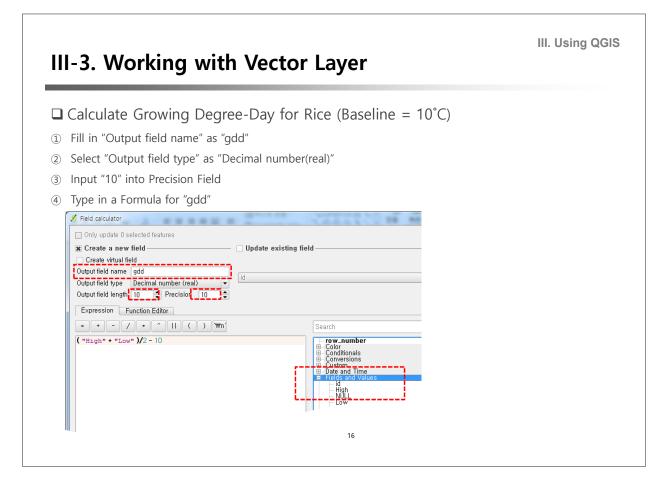
III. Using QGIS III-3. Working with Vector Layer □ Start with Selecting CRS ① Click on the CRS Status Icon in the Lower Right-Hand Corner of the Status Bar ② Enter "5174" in "Filter" Field x Enable 'on the fiv' CRS tran ③ Select "Korea 2000 / Unified CS Filter St 79 合 CRS Recently used coordinate reference a Coordinate Ref 4uthority I 1 4 1 Hide deprecated CRSe cordinate reference systems of the world ordinate Reference System Projected Coordinate Systems B Transverse Macader - Korea 2000 / United CS Authority ID ED03-6179 EPSG:4326 (OTF) Selected CRS: Korea 2000 / United CS
 122 5 de0 4 1 +proj=tmerc +lat_D=38 +lon_D=127,5 +lc=0,9996 +units+m +nc_dets 4=0.0.0.0.0.0 OK Cancel Apply Help 12

11

III. Using QGIS III-3. Working with Vector Layer □ New Shapefile Layer 8 X 💋 New Shapefile Layer 1 Layer \rightarrow Create Layer \rightarrow New Shapefile Layer... Туре Point Line ② Add a New Field Named "High" Polygon File encoding System • ③ Add a New Field Named "Low" EPSG:5179 - Korea 2000 / Unified CS - 🌚 ④ Click "OK" and Save Layer as "temperature" New field -Name High Type Decimal number -Length 20 Precision 10 📙 Add to fields list New Shapette Layer...
 New SpatiaLite Layer...
 New Temporary Stratch Layer...
 Endate new GPX layer Add Layer Embed Layers and Groups... Add trom Layers Definition File... 0.-Fields list ₩. / 日: . Name Type Integer Length 10 Precision Copy style
Prote style
Prote style
Copy Styl Q 😐 V₀ ■₀ So No Ro Sava As... Sava As Layer Definition File Fernove Layer/Group C111+D sibility of Lay • •• Remove field OK Cancel Help 13

III-3. Working with Vector Layer	III. Using QGIS
Add a New Feature	
① Click on the "Toggle Editing" Icon	
② Click on the "Adding Feature" Icon	(\cdot)
③ Click on Any Place on the Canvas	
④ Fill in "id", "High" and "Low" Fields	
(5) Add 2 More New Features on the Canvas (3 New Features Total)	
6 Finish Editing by Clicking on the "Toggle Editing" Icon and "Save"	\bigcirc
When a Prompt Window Pops Up	
Voiet Edit View Layers Edit View Feature Attributes Voiet Edit View Layers Panel View Image: State of the sta	5
14	





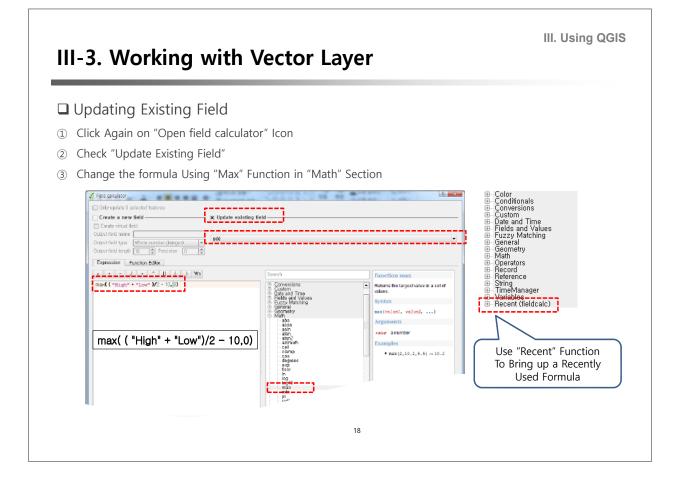
III. Using QGIS

III-3. Working with Vector Layer

□ Field Calculator - Resu	lt
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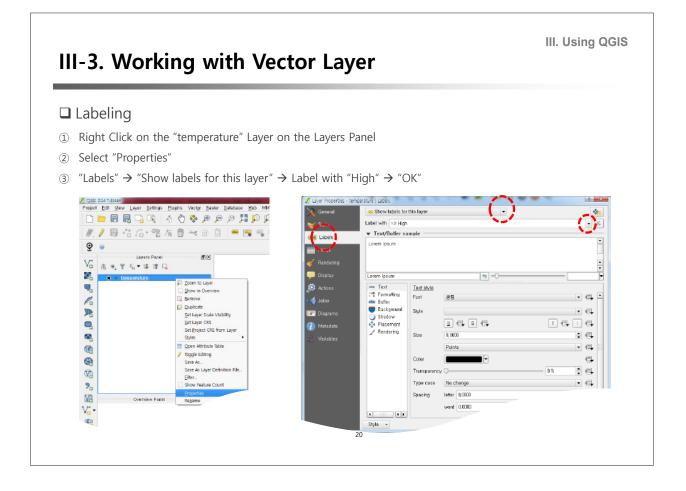
- ① Right Click on the "temperature" Layer on the Layers Panel
- ② Select "Open Attribute Table"
- 3 Click on "Open field calculator" Icon

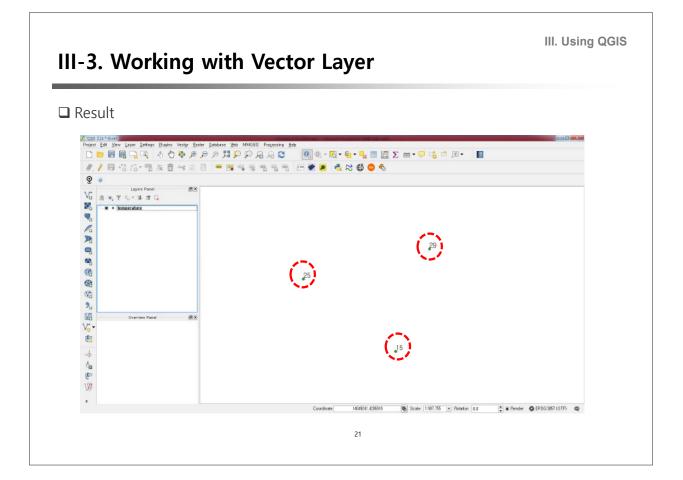
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123 id 🔻 = 😢							
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1 2	29,0000000000	16,0000000000	12,5000000000				
2 3	15,0000000000	4,0000000000	-0, 5000000000]			
					\mathbf{i}	The Result Below	





III. Using QGIS III-3. Working with Vector Layer Result temperature :: Features total: 3, filtered: 3, selected: 0 💼 🗧 들 💫 📭 🛅 🌺 💭 🗈 3 🗧 1. 1. 📰 æ. ? 3 = 🔻 123 id id High Low gdd 15,000000000 10, 0000000000 25,000000000 0 29,0000000000 16,000000000 12,5000000000 1 4,0000000000 0,0000000000 15,0000000000 3 2 19





III-4. Interpolation

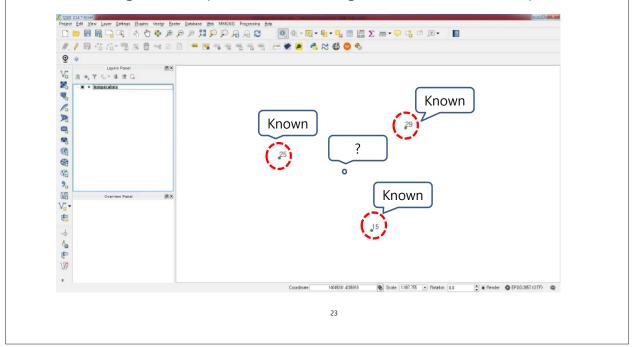
□ Skills to Learn from This Chapter

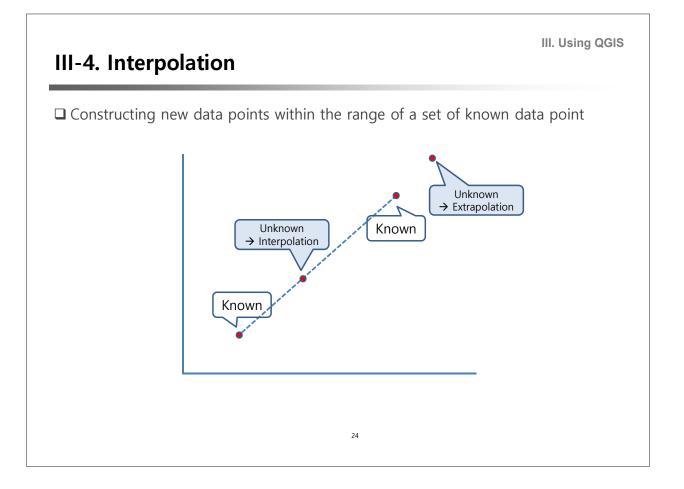
- ① Capturing Coordinate
- ② Calculating Distance from Field Calculator
- ③ Using Field Calculator Built-in Functions
- ④ Built-in Interpolation Tool
- $\ensuremath{\textcircled{}}$ 5 How to Style a Raster Layer

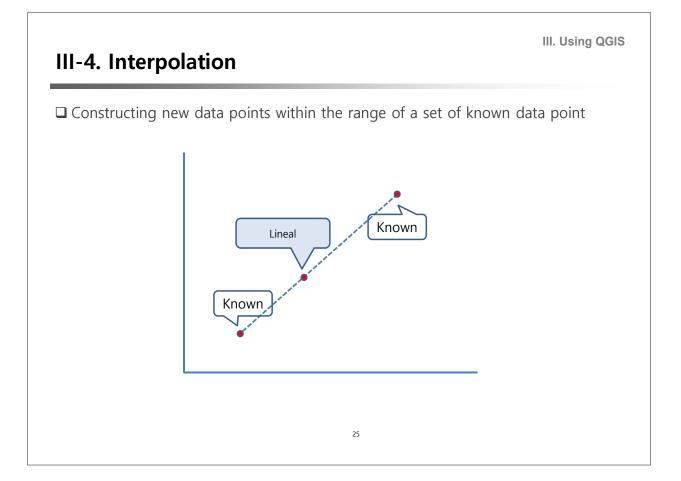


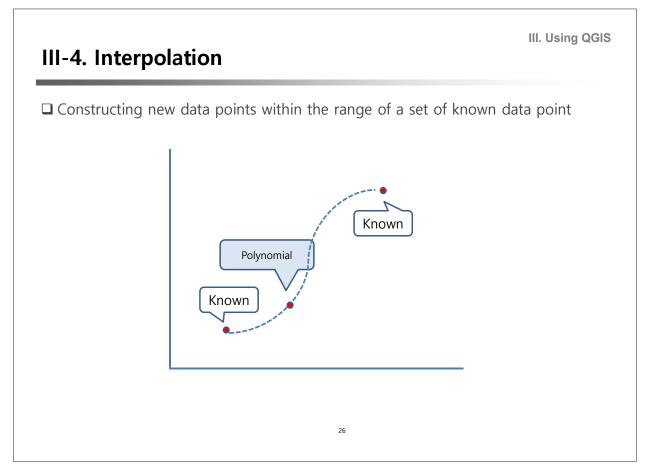
III-4. Interpolation

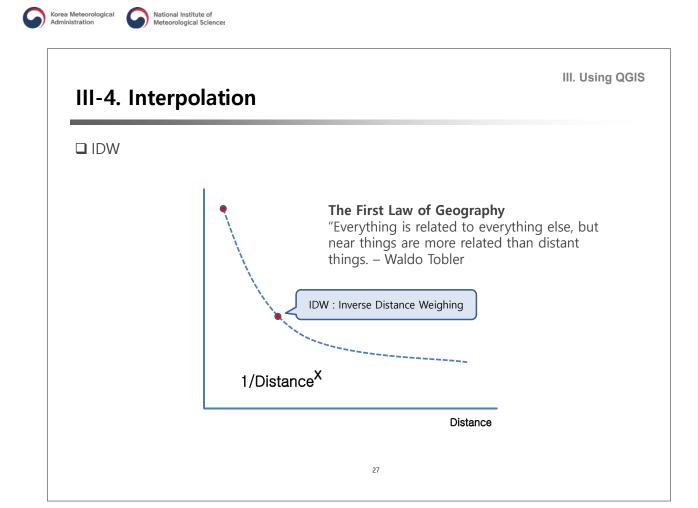
Constructing new data points within the range of a set of known data point

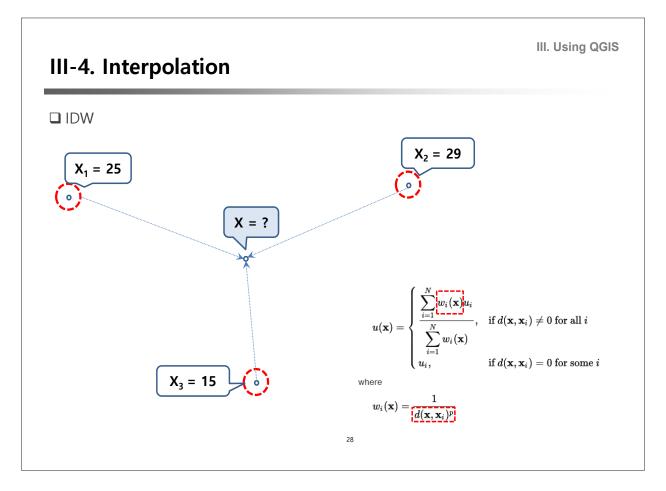










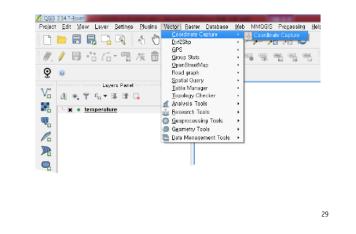


III. Using QGIS

III-4. Interpolation

Capture Coordinate of the Unknown Point

- (1) Vector \rightarrow Coordinate Capture \rightarrow Coordinate Capture
- ② Click on the Canvas Where the Unknown Point Located
- ③ Copy the Coordinate



II-4. Interpolation	III. Using QGIS
Calculate Distance Using Field Ca	itor
Open Field Calculator	
Create a New Field "distance"	
Convert Copied Coordinate to WKT(Well-K	
Cores denoted textures Create a new field Create data field Create data field Create data field Cutor field kingth Cutor field Cutor field kingth Cutor field	 126.94034.34,87210 948850.252.1653187.848 Copy to clipboard Start capture
• • Output preview*: 'Point(\$48950 16531877'	
	30

Coordinate Capture

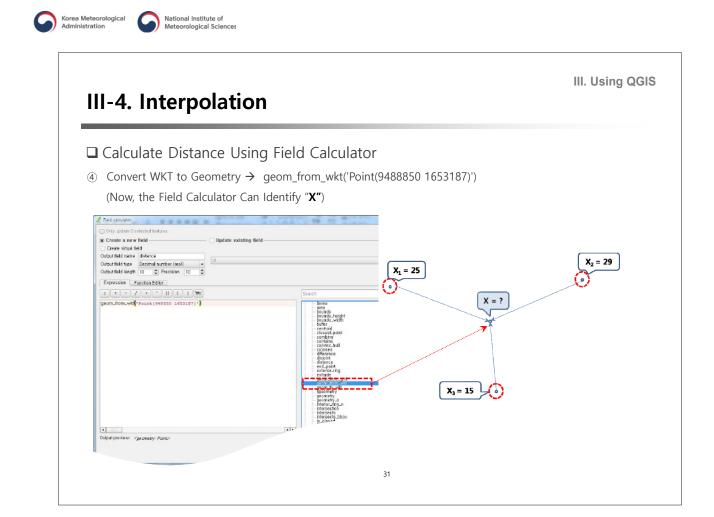
8

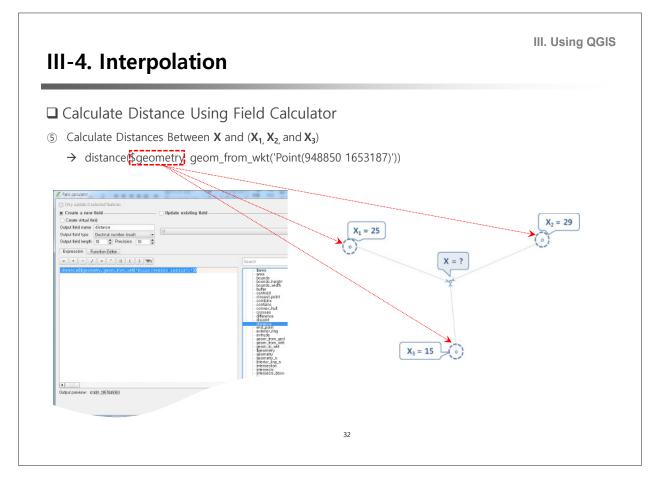
126, 94034, 34, 87210

948850, 252, 1653187, 848

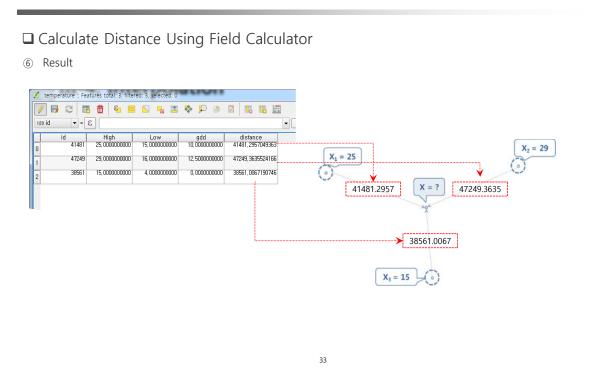
Copy to clipboard

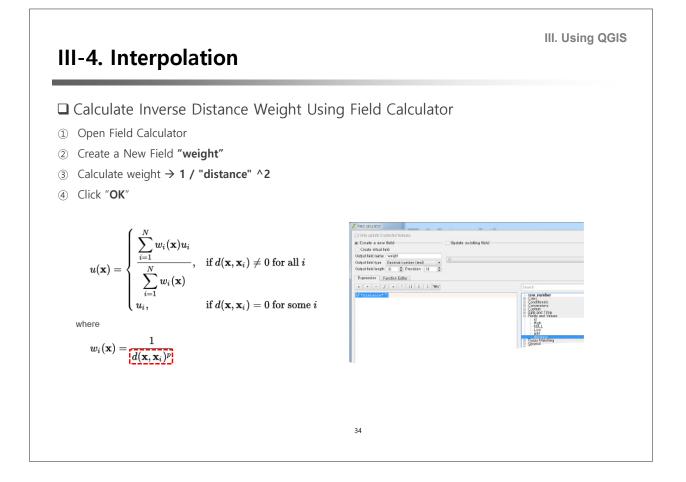
👍 Start capture

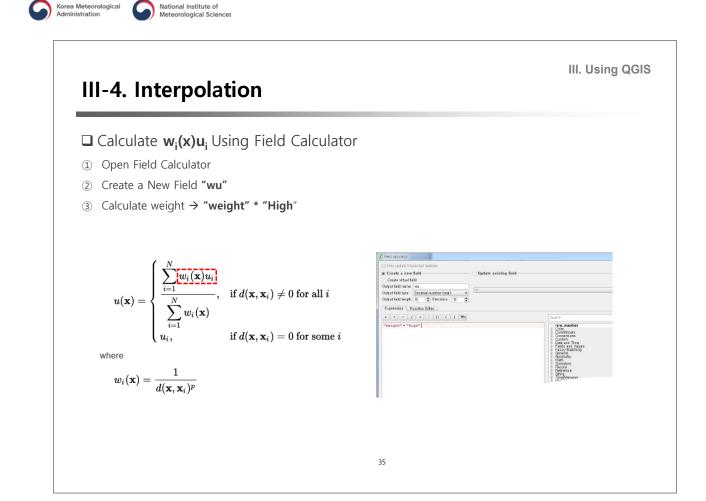


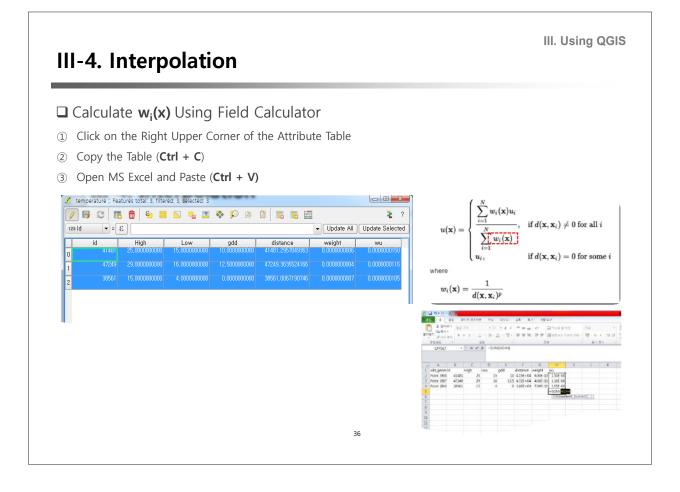


III-4. Interpolation







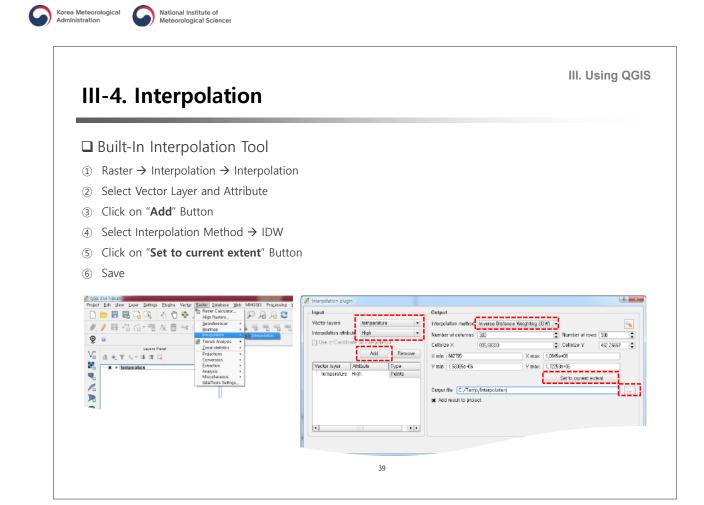


III. Using QGIS

III-4. Interpolation

Calculate Interpolated X Using Excel 1 Click on the Right Upper Corner of the Attribute Table ② Copy the Table (**Ctrl + C**) ③ Open MS Excel and Paste (Ctrl + V) 1.50E-08 1.16E-08 1.05E-08 Point (908 Point (987 Point (966 distance weight 10 4.15E+04 6.00E-10 25 4.72E+04 4.00E-10 0 3.86E+04 7.00E-10 $w_i(\mathbf{x})u_i$ 41481 47249 25 10 125 $ext{ if } d(\mathbf{x},\mathbf{x}_i) eq 0 ext{ for all } i$ 38561 15 $u(\mathbf{x}) =$ 3.71E-08 1.1 $w_i(\mathbf{x})$ $\text{if } d(\mathbf{x},\mathbf{x}_i) = 0 \text{ for some } i \\$ 9 10 11 12 13 14 15 where $w_i(\mathbf{x}) = rac{1}{d(\mathbf{x},\mathbf{x}_i)^p}$ 16 37

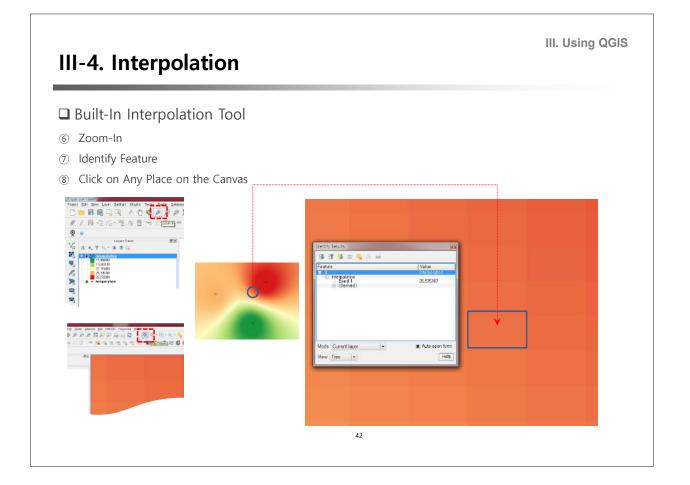
I-4. In	nterpo	olatio	n					111.	Using QG
Result									
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Point (908	41481	. 25	15	10	4.15E+04	6.00E-10	1.50E-08		
Point (987	47249	29	16	12.5	4.72E+04	4.00E-10	1.16E-08		
Point (966	38561	. 15	4	0	3.86E+04	7.00E-10			
						1.70E-09	3.71E-08	21.8235	
					X ₁ = 2	5	X=?	0	(₂ = 29)
					38	X ₃ = 1	5 ()		



II-4. Int	erpolatio	n				III. Using QGI
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Via 4: 7: 1: 3	Zoom to Layer Torview Torvie		Color rende Blending mote Brightness Salusion Hue Resampling Zeorned: in [N] Style •	Komal	Contact Graystale OT	(0
Coordinate 2 127,01310,34,81480 2 2 2 2 2 2 2 2 2 2 2 2 2	Regame			40		

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II-4. Interpolatic	on				III. Using Q
Built-In Interpolation Check "Invert" Check "Invert" Click on "Classify" Button Click on "OK" Button					
	Mage Properties and Mage Properties Mage Provides Mage Provide	Operation 1944 Item description Band Carlo Diane Dian	jand 1 Liner	Generate aux calar may host Contracts - Calar host Contracts - Calar host Contracts - Calar host Contracts - Calar host See Estimate canadate and host contract of 20 - 9 Min / has host of deviation & 200 Entert Extend Extend Calar deviation & 200 Extend Extend Extend Calar deviation & 200 Extend Ex	Nar (21.272 Claicath Ul aotest E0 (2) (2
		Color readaring Bentina mote Normal Brightness Saturdon Hue Date			O ferrer O O O O O O O O O O IOX © O K. Cancel Acoly He





III-5. Modeling with Vector Grid

Scenario

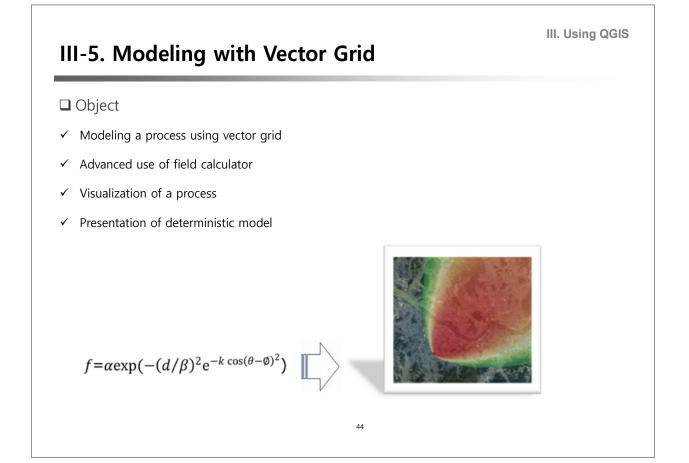
- ✓ Chemicals leaked from a special vehicle that was carrying toxic substance.
- \checkmark This chemical is a colorless and odorless that diffuses into the air
- ✓ It is not a problem if it is exposed to less than 11,900 nanograms, but exposed to more than that, the exposed need to be examined.

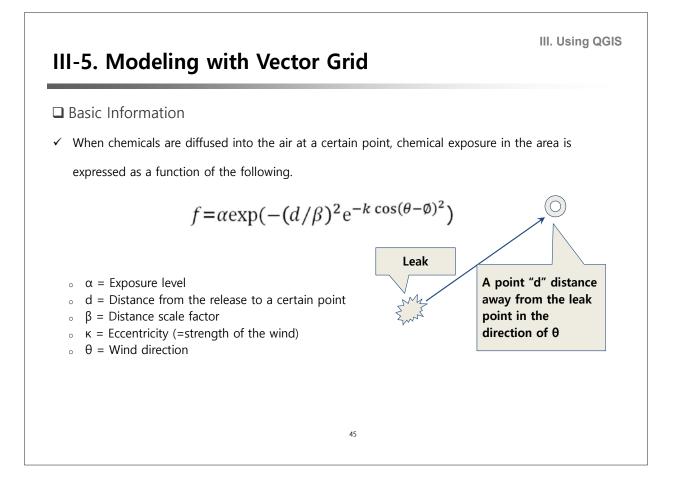
III. Using QGIS

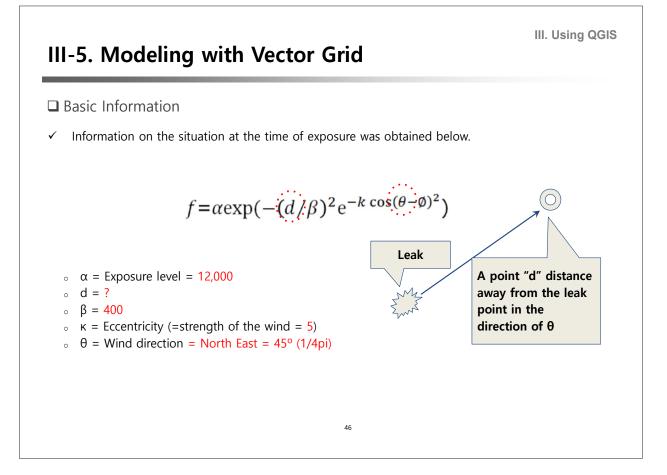
- ✓ Thus, the authority made the following request to you.
- ✓ What is the range of areas exposed above 11,900 nanograms?

This tutorial is inspired by Barry Rowlingson's online R workshop linked below. Barry Rowlingson. 2012. Geospatial Data in R and Beyond. Available at: <u>http://www.maths.lancs.ac.uk/~rowlings/Teaching/UseR</u> 2012/plume.html

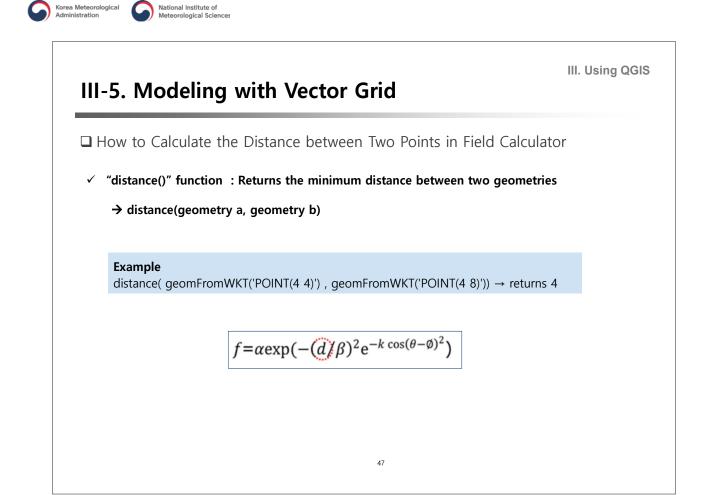
43

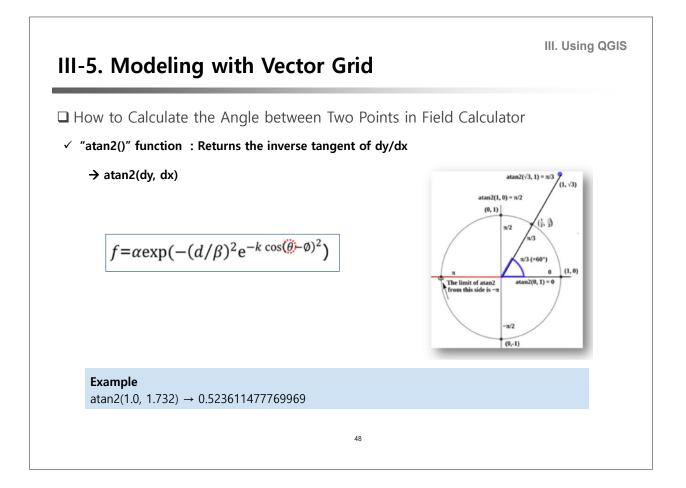


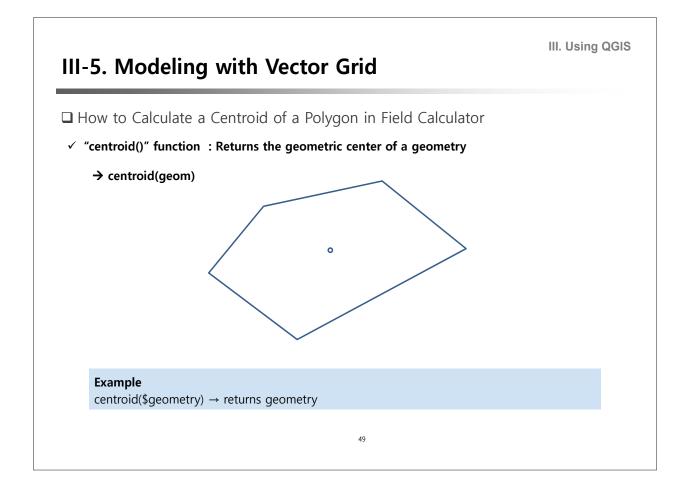


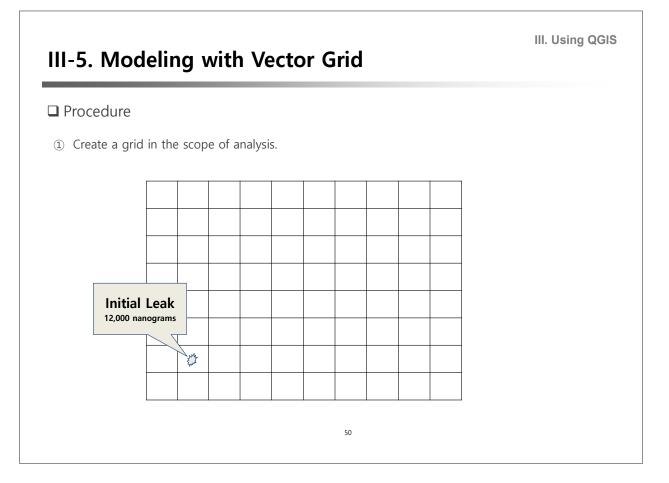


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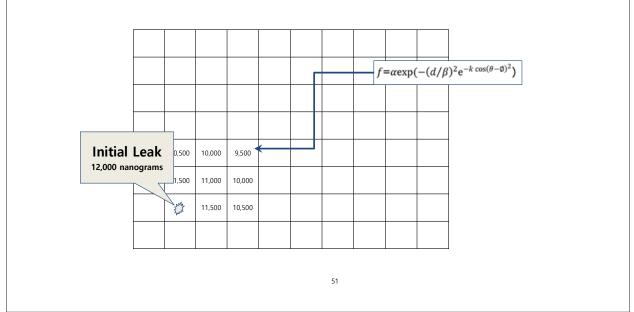


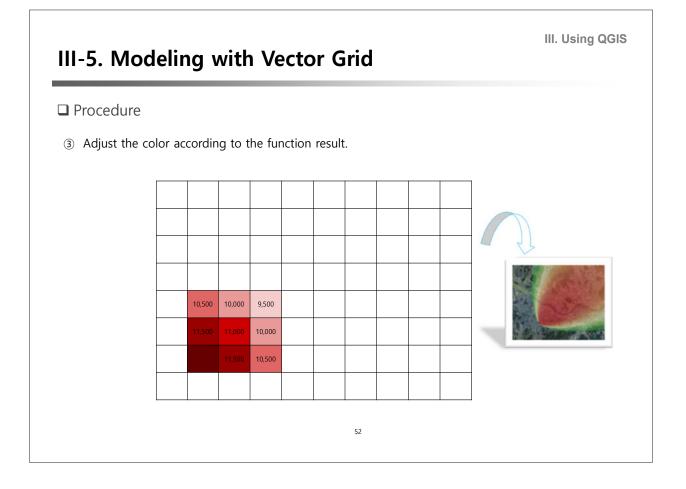


III-5. Modeling with Vector Grid

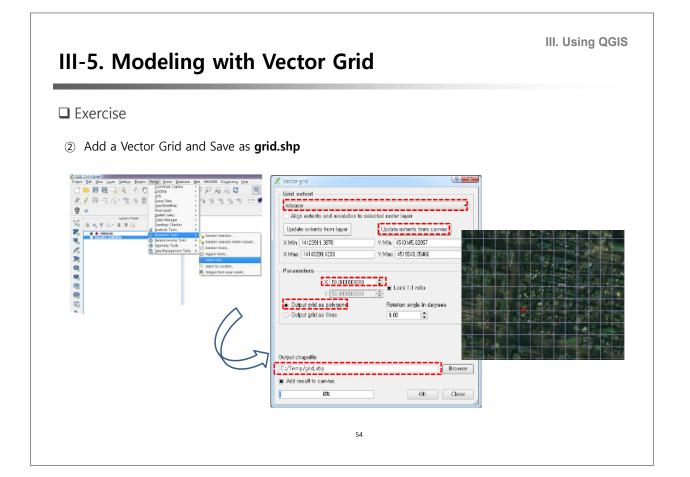
□ Procedure

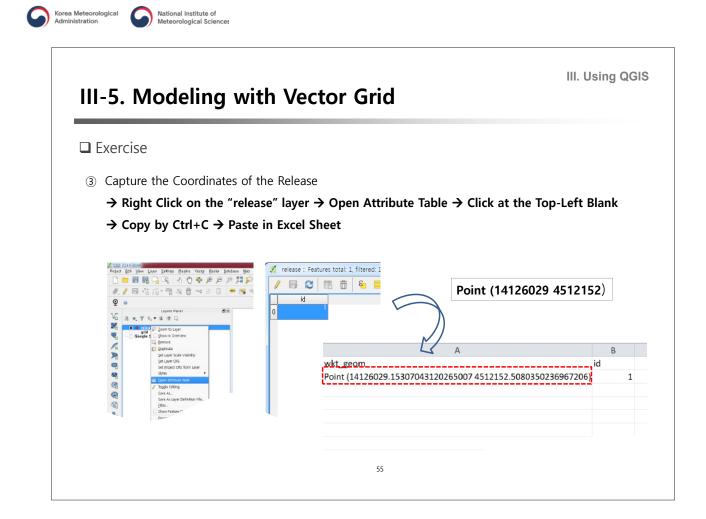
② Fill each grid with a function result.



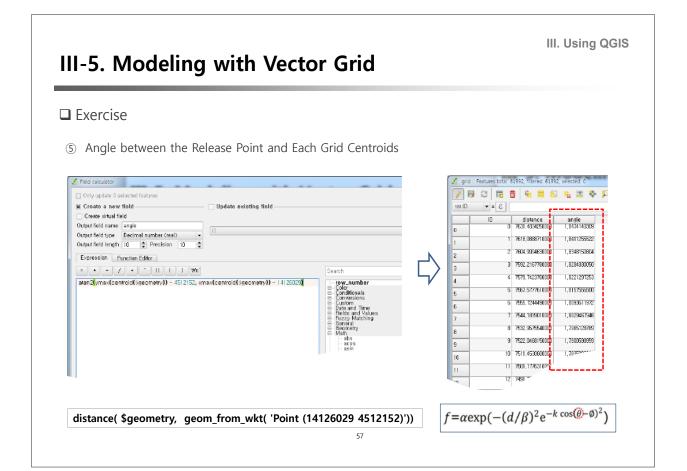


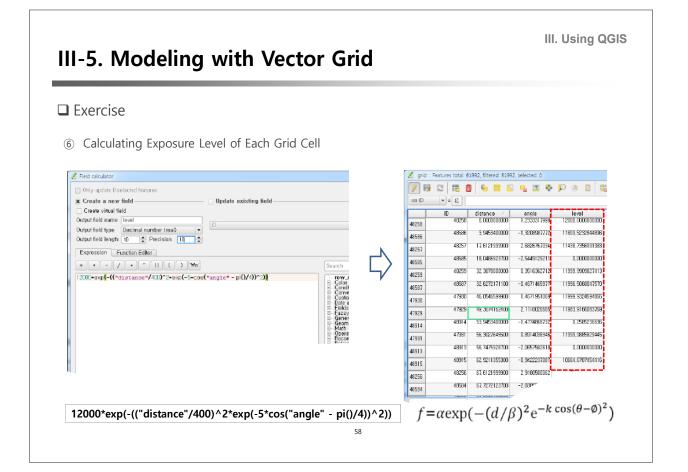
III. Using QGIS III-5. Modeling with Vector Grid **Exercise** ① Add a leak point layer (release.shp) and a background map(EPSG=3857) Google Satellite can be imported by Web → Openlayers Plugin → Google Maps 🗮 🕇 🖏 📲 🖬 → Google Satellite ×
 <u>release</u>
 <u>x</u> Google Satellite 🔍 🔍 = 🔣 = 🗞 = OpenLayers Overview 2 🗳 😊 🐁 Terms of Service / About MapQuest S OSM/Stamen Apple Maps ✓ Plugins can be installed from Plugins → Manage and Install Plugins ... 53

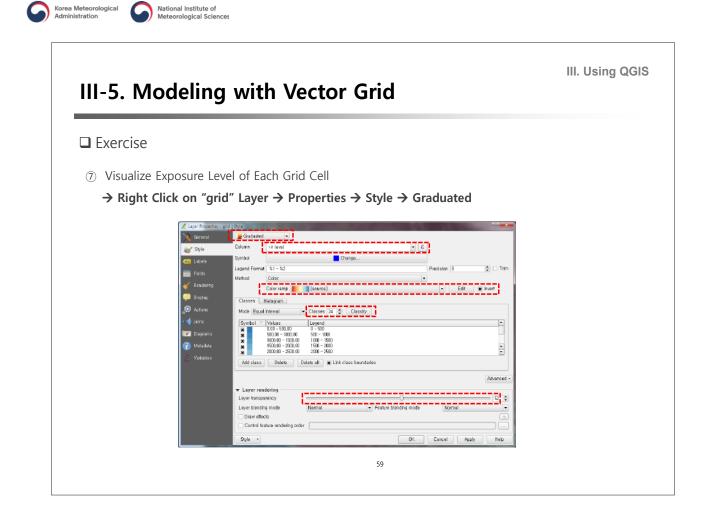


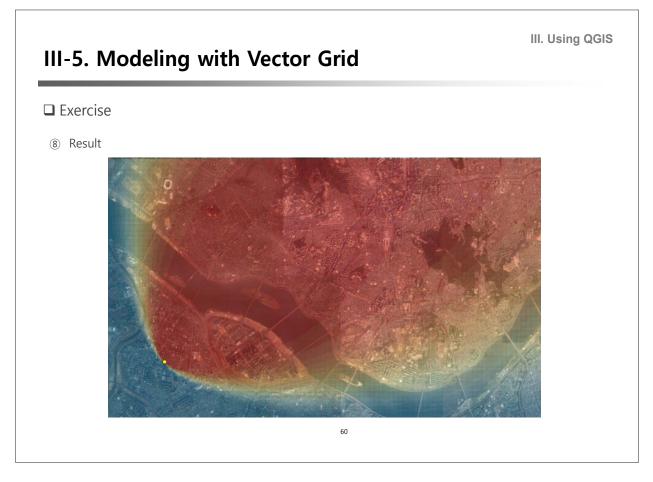


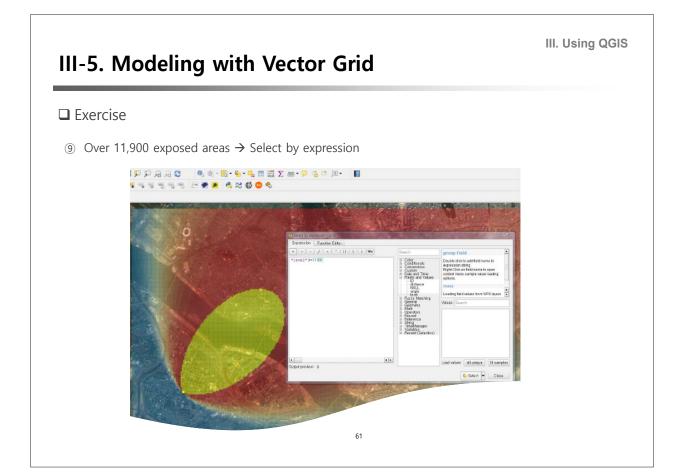
Exercise			
Distance between the Rele	ase Point and Each Grid Centr		ator on " grid " layer
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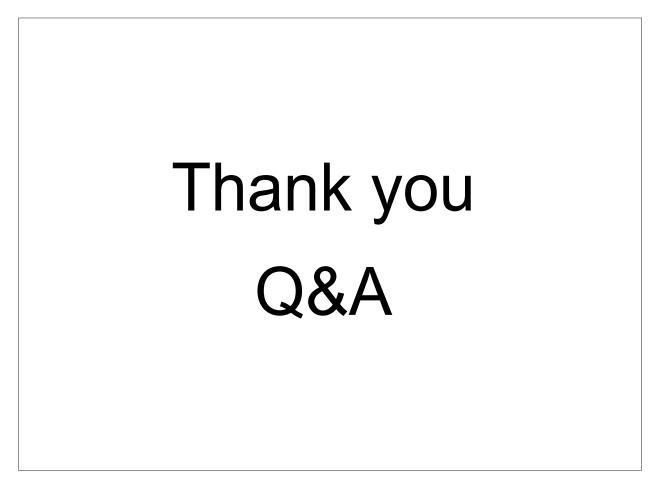












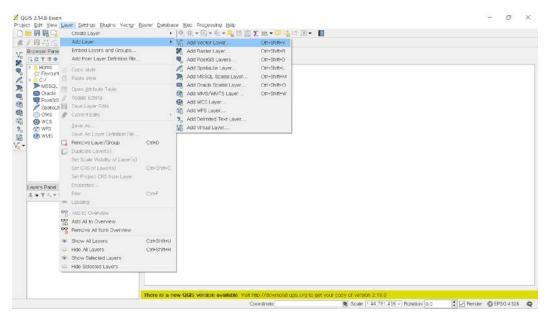


Calculation of GDD from the digital map of temperature

Exercise 1 - Calculation of GDD from the digital map of temperature

Objectives: The goal of the first exercise for Agro-meteorology is to generate the digital map of growing degree day (GDD) from the digital map of temperature. In order to create the digital map of temperature, we first need to join CSV/Text file which has temperature information (i.e., maximum temperature or minimum temperature) to vector data (i.e., shape file) having coordination such as latitude and longitudes and interpolate. In particular, we need the base temperature to calculate GDD of crops; in case of rice, a summer crop, it starts growing at 10 Celsius degree.

- Open the weather shape file. You can open the shape file from two ways. First one is using the menu and the other one is just adding layers from "Drag and Drop from Window Explorer" (see Note 1, Fig. 3).
 - go to the file menu "Layer" >> click "Add Layer" >> select "Add Vector Layer"
 (Fig. 1)
 - click "Browse" button in 'Add vector layer' box and find the shape file: (Fig.2)
 - file location: QGIS Tutorial Data Tutorial Session 2 ASOS Observation: kma_asos58.shp







Browser Panel	1 * Regent Designet	
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Fig. 2.

Note 1: the way of "Drag and Drop"

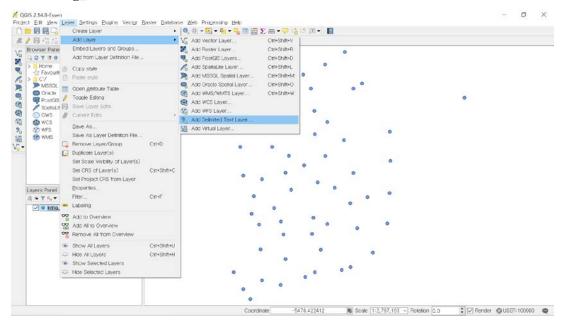
Drag a shape file from the Windows Explorer and drop it on the 'Layers Panel'.

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Fig. 3.

- 2. Open the text file which has the monthly maximum temperature of Normal (1981-2010).
 - go to file menu "Layer" >> click "Add Layer' >> Select "Add Delimited Text Layer" (Fig. 4)

- click "Browse" button in 'Create a Layer from a Delimited Text File' box and find the text file. In addition, should select the options of 'CSV' and 'No geometry' (Fig. 5)
- file location: QGIS Tutorial Data Tutorial Session 2 ASOS Observation: m30avg_tx8110.csv





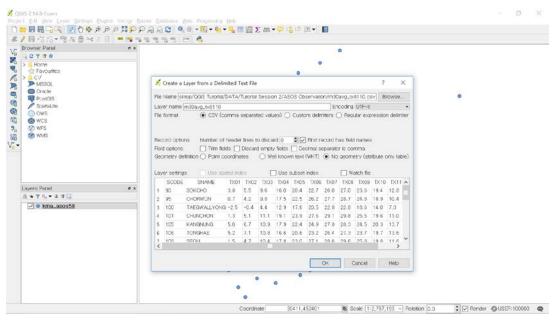


Fig. 5.

3. In order to Join the text file to the vector. First of all, select 'kma_asos58.shp' on the



'Layers Panel' and click the right button of Mouse to open properties box.

- click the right button of Mouse and select "Properties" (Fig. 6)
- click the 'Joins' tab in the left contents' list of 'Layer Properties kma_asos58' box (Fig. 7)

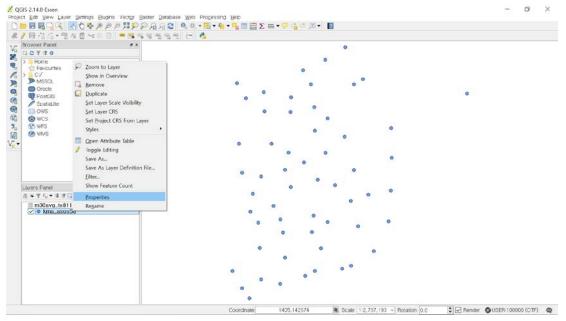
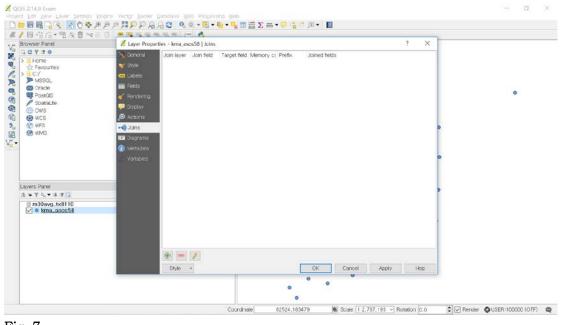


Fig. 6.





4. Select the icon (cross symbol) in the 'Lay properties – kma_asos58' box and

you set up configurations to join the two files in 'Add vector join' box as below (Fig. 8).

- Join layer: m30avg_tx8110
- Join field: SCODE
- Target field: SCODE
- if you want to choose which fields are joined: you click combo box 'Choose which fields are joined' and you can select fields you want to join
- additionally, we need to make prefix to avoid the long name of field. So, click 'Custom field name prefix' and input the text what you want to be shown for the field. For this exercise, we input the prefix 'M30_' as figure 8.

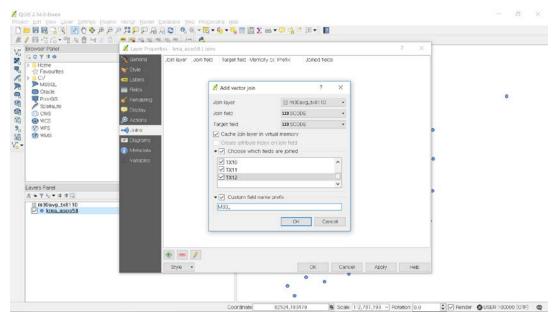
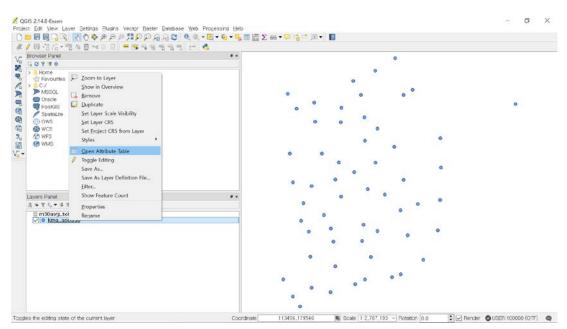


Fig. 8.

 you can check by opening the attribute table: Select 'kma_asos58.shp' on the 'Layers Panel' and click the right button of Mouse, then click 'Open Attribute Table' (Fig. 9 and Fig. 10).







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11	135			127.994 ··· Chupuno···	135 CHUPUN-	2.6	5.5	11.3		23.4	26.6						
2	138			129.379 Pohang	138 POHANG	6.5	8.6	12.7		23.2	25.5						
13	140			126.761 Gunsan	140 KUNSAN	3.4	5.1	9.9		23.2	25.5						
14	140			128.619 Daegu	143 TAEGU	5.4	8.3	(3.5		25.3	28.3	1					
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16	140			129.320···· Usan	152 ULSAN	7.3	9.2	13.2		29.0	21.3		3				
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22	168			127.740···· Yeosu	168 YOSU	6.2	8.2	12.1	17.4	21.4	24.2						
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7	202	C 202		127.494 Yangpya	202 YANGPY	2.3	5.7	11.5	1.512	24.1	27.9					11.8	
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- 5. Save the vector file which have the temperature information by using 'Save as'.
 - select 'kma_asos58.shp' and click the right button of Mouse, and then click 'Save as' (Fig. 11)
 - select the button 'Browse' in 'Save vector layer as' and type in the file name. We will type in 'm30_tx8100' to the folder 'exercise' (Fig. 12)
 - file location: QGIS Tutorial exercise

- ø × Z QGIS 2.14.8-Essen Project Edit View Laver Settings Plugins ★ ▲ 日本は・19 本目を見たいの Browser Pariel ð x SES BBBBBBBBBBBB Brower Panel C ▼ 3 ● Home F Provumss C / D racle Poscili C Show in Overview Set Layer Scale Visibility Set Layer CRS OWS WCS WFS WMS Set Project CRS from Laye Styles Qpen Attribute Table
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- You do not need to change any other configurations and just click the button 'OK'.

Fig. 11.

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Fig. 12.

6. Open the saved vector file at the step 5.

- go to the file menu "Layer" >> click "Add Layer" >> select "Add Vector Layer"
- file location: QGIS Tutorial Data Tutorial Session 2 exercise: m30_tx8110.shp



- this shape file would be that you saved at the step 5. (Fig. 13)

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7. We will interpolate with the temperature information. First, go to the menu 'Raster' and click 'Interpolation' and then click again "Interpolation" at the extended pulldown menu (Fig. 14).

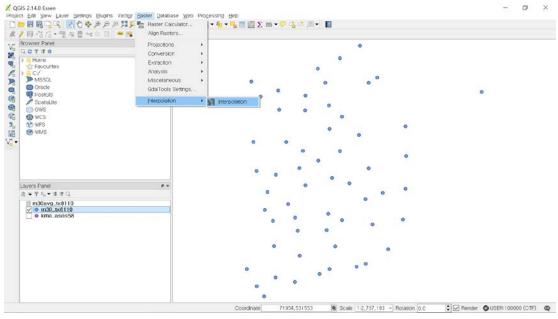


Fig. 14.

8. Set up the configurations as below (Fig. 15):

- first, look at 'Input' panel in the left of 'Interpolation plugin' box, then
- click the combo box at 'Vector layers' and choose 'm30_tx8110'
- again click the combo box at 'Interpolation attribute' and choose 'M30_TX01'
- click the button 'Add' to input the selected field to the text box
- look at 'Output' panel in the right of 'Interpolation plugin' box,
- select 'Inverse Distance Weighting (IDW)' in 'Interpolation method'
- type in '400' for 'Number of columns' and '427' for 'Number of rows', respectively.
- we need to setup extent of map, type in X min and Y min, respectively: 51832.3 for X min,-33145 for Y min
- additionally, 546767.24 for X max, 569052.49 for Y max
 (see Extent_Interpolation.txt file in DATA Tutorial Session 2 folder)
- type in 'm30_tx01' in the folder 'exercise' to save the interpolation.
- file location: QGIS Tutorial Data Tutorial Session 2 exercise (Fig. 15)

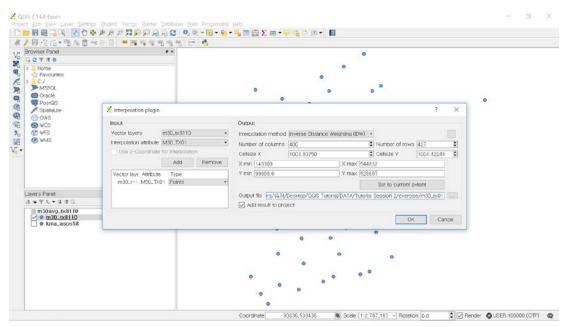


Fig. 15.

6	Korea Meteorological Administration	9	National Institute of Meteorological Sciences
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nput	Output						
/ector layers m30_tx8110 💌	Interpolation method	Inverse Distance We	ighting (ID	W) 🔻			
nterpolation attribute m30_TX01 💌	Number of columns	400		-	Number of rows	427	-
Use z-Coordinate for interpolation	Cellsize X	1237, 33735		-	Cellsize Y	1410,29857	¢
Add Remove	X min 51832,3		X max [546767,	24		
Vector layer Attribute Type	Y min -33145		Y max 🛛	569052,	49		
m30_tx8110 m30_TX01 Points					Set to current exte	ent	
٩	Output file LT-23/De		DATA/Tuto	orial Se	ssion 2/exercise/	/m30_tx01	



- 9. You can make interpolation from February to December
 - file names for saving: m30_tx02 ~ m30_tx12
- Likewise, you open the text file which has the minimum temperature and the shape file. You interpolate then them. Remember from the step 2 to 9. So, you can have 24 digital temperature maps to calculate GDD of crop.
 - file location to open the text file: QGIS Tutorial Data Tutorial Session 2 ASOS Observation: m30avg_tn8110.csv
 - file location to open the shape file: QGIS Tutorial Data Tutorial Session 2 ASOS Observation: kma_asos58.shp
 - file location and file name to save the vector file joined with the minimum temperature: QGIS Tutorial – Data – Tutorial Session 2 – exercise: m30_tn8110.shp
 - then, save the interpolations as those filenames: $m30_tn01 \sim m30_tn12$
- Now, you can calculate GDD by using 'Raster calculator' if you have 24 digital temperature maps. Go to the menu 'Raster Calculation' and open 'Raster calculator' box. (Fig. 17 and Fig. 18)

We will GDD equation as below (Kim et al., 2008):

$$GDD = N \times \left[\left(\frac{(T_x - T_n)}{2} \right) - T_b + L \times \sigma \times \sqrt{N} \right]$$

N: the number of month, T_{x} : the maximum temperature, T_{n} : the minimum

temperature, T_b : the base temperature of crop, L: constant, σ : the standard deviation of the average temperature

You can refer Thom (1954) since the constant L was calculated from that.

- should open the raster, constant L and standard deviation:
 file location to open the raster, constant L: QGIS Tutorial GDD Constant L:
 m30_L01 ~ m30_L12
 file location to open the raster, standard deviation of the average temperature:
 QGIS Tutorial GDD SD Tavg: m30_ta_sd01 ~ m30_ta_sd12
- type in equitation for January GDD as below, click operators as well (Fig. 17), 31 * (("m30_tx01@1" + "m30_tn01@1") / 2) - 10 + "m30_L@1" * "m30_ta_sd01@1" * sqrt (31)
- click the button '...' of 'Output layer' in 'Result layer'
- file location and file name to save the calculated GDD: QGIS Tutorial Data -Tutorial Session 2 - exercise: m30_gdd01
- just check 'GeoTIFF' of 'Output format'

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1 * (("m3	80_tx01@1" +	"m30_tn01@1	.") /2) -	10 + "m30_LC	1@1" * "m30	D_ta_sd01@1"	'* sqrt(31)	
pression va	lid							

Fig. 18.

- 12. You calculate the rest of GDDs from February to December
 - file location and file names to save the results from February to December: QGIS
 Tutorial Data Tutorial Session 2 exercise: m30_gdd02 ~ m30_gdd12
- 13. Then, accumulate 12 GDDs from January to December, or 10 GDDs from January to October.
 - type in equation: "m30_gdd01@1" + "m30_gdd02@1" + "m30_gdd03@1" + "m30_gdd04@1" + "m30_gdd05@1" + "m30_gdd07@1" + "m30_gdd08@1" + "m30_gdd09@1" + "m30_gdd10@1" + "m30_gdd11@1" + "m30_gdd12@1"
 - click the button '...' of 'Output layer' in 'Result layer'
 - file location and file name to save the accumulated all GDDs: QGIS Tutorial Data
 Tutorial Session 2 exercise: m30_tb10_gdd_tiff
- 14. Convert the GeoTIFF to ASCII
 - go to the menu "Raster" >> click "Conversion" >> click "Translate (Convert Format...)" (Fig. 19)

- if you want to translate the files are not in 'Layers Panel', can click the button 'Select' in 'Translate (Convert format)' box.
- but, we will translate the file which already opened in 'Layers Panel', so just click the combo box and click 'm30_tb10_gdd_tiff' (Fig. 20).
- select the format 'Arc/Info ASCII Grid (*.asc *.ASC)' in the list and type in the file name to save (Fig. 20).
- if finish type in the file name, do not change any options, and click 'OK'.

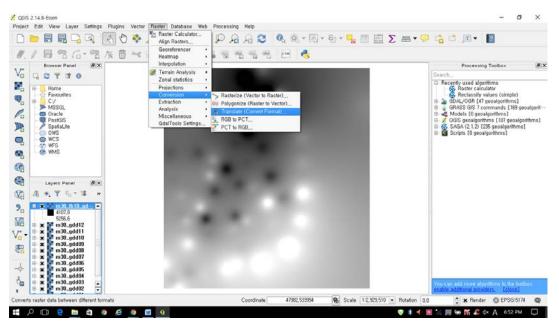


Fig. 19.



🚀 Translate (Convert format) ? 🗙	
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Input Laver m30_tb10_gdd Select,	
Output file Select	
Target SRS Select,	GeoTIFF (*.tif *.tiff *.TIF *.TIFF) ACE2 (*.ace2 *.ACE2)
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No data	ASCII Gridded XYZ (*xyz *.XYZ)
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Prjwin	구성 ▼ 새 폴더 ECRG TOC format (*.xml *.XML)
□ Sds	ERDAS Compressed Wavelets (*.ecw *.ECW)
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Profile Default	UMETSAT Archive native (*.nat *.NAT) Envisat Image Format (*.n1 *.N1)
Name Value + -	B 홍영 GMT NetCDF Grid Format (*.nc *.NC)
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	♪ 음악 Golden Software ASCII Grid (*.grd *.GRD) Golden Software Binary Grid (*.grd *.GRD)
Load into canvas when finished	windows (C.) Graphics Interchange Format (*.gif *.GIF)
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Session 2/exercise/m30_tb10_gdd,asc"	파일 이름(N): HF2/HFZ heightfield raster (*.hF2 *.HF2) Hierarchical Data Format Release 4 (*.hdf *.HDF)
	파일 형식(T): GeoTIFF (*.tif *.TIFF *.TIFF) ~
OK Close Help	▲ 폴더 숨기기 저장(S) 취소

Fig. 20.

- when finish conversion, the popup boxes 'Finished' and 'qgis-ltr-bin' will be shown, click 'OK' and 'OK' in order, and just click 'Close' (Fig. 21).

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🖻 🗙 🚰 m30_gdd07			0K Close	Help		You can add more algorithms to the toolbox: enable additional providers. [close]
* m30_gdd12 * m30_gdd11 * m30_gdd10 * m30_gdd08	- 20	LT-23/m30.tb10. LT-23/Desktop/0	gdd_tiff,tif "C:/Users/APCi JGIS Tutorial/DATA/Tutori ise/m30.tb10.gdd,asc"			You can add more algorithms to the

Fig. 21.

Reference:

Thom, H. C. S., 1954: The relationship between heating degree-days and temperature. Monthly Weather Review, 82(9), 1-6.

Kim, J. H., J. I. Yun, 2008: On mapping growing degree-Days (GDD) from monthly digital climatic surfaces for South Korea. Korean Journal of Agricultural and Forest Meteorology, 10 (1), 1~8.



Exercise 2 - Exploration of the areas which reach to the effective GDD

Objectives: In the second exercise for Agrometeorology, we will explore the effective GDD of the crop. For example, we can find the pixels which reach to the flowering or the maturity time from the effective GDD of the crop. We already calculated the GDD of rice. When the growth of rice reaches the maturity, the range of the effective GDD at the base temperature 10°C is known as from 3800°C to 4800°C. Find the pixels that reach to the effective GDD of crop 'Rice'.

- 1. Open the accumulated GDD 'm30_tb10_gdd'and open 'Raster calculator' as well.
 - file location to open raster file: QGIS Tutorial Data Tutorial Session 2 exercise: m30_tb10_gdd
 - this raster file, m30_tb10_gdd would be that you saved at the step 14 in excise I.
- 2. Go to the menu 'Raster calculator" and type in the equation.
 - type in the box as below: (Fig. 22)
 - ("m30_tb10_gdd@1" >= 3800.0 AND "m30_tb10_gdd@1" <= 4800.0) * "m30_tb10_gdd@1"
 - file location to save the result: QGIS Tutorial Data Tutorial Session 2 exercise: rice_gdd

laster band	8		Result la	ayer								
m30_L01@1		^	Output la	iyer	al/DATA/Tutorial Session 2/exercise/rice_gdd							
m30_L02@1 m30_L03@1			Output fo	ormat	GeoTIFF							
m30_L04@1 m30_L05@1		10	Current	layer extent								
m30_L06@1 m30_L07@1			X min	143309.00	inter inter		XMax	544832.00000	Ę			
m30_L08@1 m30_L09@1			Y min	99808.600			Y max	528697.00750				
m30_L10@1 m30_L11@1			Columns	400		5	Rows	427	l R			
m30_L12@1 m30_gdd01@			Output C	RS	Selected CRS (USER: 100000,			nerated CRS (+proj				
m30_ta_sd0 m30_ta_sd0 operators	2@1	~	Add r	esult to proj	ect							
+	*	sart	COS	sin	4	tan	log10	(
-	/	^	acos	asin	ε	itan	In)				
<	>	=	!=	<=		>=	AND	OR				
laster calcu	lator expres	sion										
m30_b10_gd	id@1" >= 320(0 AND "m30_b1	10_gdd@1" <	= 3800) * "n	n30_b10_gd	ld@1"						

Fig. 22.

Exercise 3 - Presentation of layout GDD

Objectives: We will make presentation with your results in the last exercise. First, change legend and color scheme using 'Style layer' in properties of the raster, and then make layout from "Map composer" (you already practiced at Introduction part of QGIS – day I (7 December)).

- Select the raster file, 'm30_tb10_gdd' in 'Layers Panel', click the right button of Mouse and 'Properties' (Fig. 23).
 - click 'Style' in 'Layer Properties m30_tb10_gdd' box.
 - click 'Singleband pseudocolor' of 'Render type' in the combo box.
 - select 'Classify' of 'Generate new color map' in the right.
 - if you change mode of classification, there two modes 'Continuous' and 'Equal Interval'.
 - let's change 'Continuous' to 'Equal Interval', then change 5 to 8 in Classes.
 - lastly, select 'Apply' and 'OK'.

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😻 Style	Render type Singleband pseudocolor 🝷]			
🚾 Transparency	Band 1 (Gray) 🔹	Generate new color map			
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	Blending mode Normal	•	4	Reset	
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	 Resampling 				
	Zoomed: in Nearest neighbour 🝷 out	Nearest neighbour 🔹 Oversampling	2.00 🗘		~
	Style -	ОК	Cancel Apply	Help	

Fig. 23.



- you can see the color legend of the raster, 'm30_t b10_gdd' in 'Layers Panel' (Fig. 24).
- if you want to overlap a vector has the administration boundary, open the vector, 'Ws_Sido.shp' (Fig. 25).
- file location: QGIS Tutorial Data Tutorial Session 2 ASOS Observation: WS_sido.shp

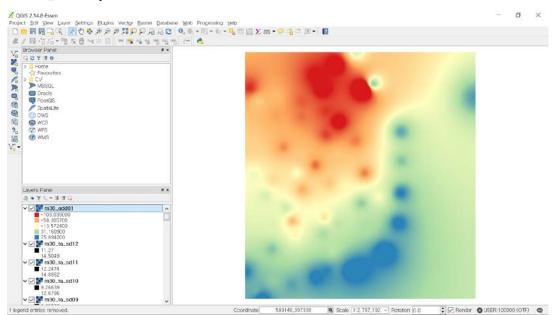
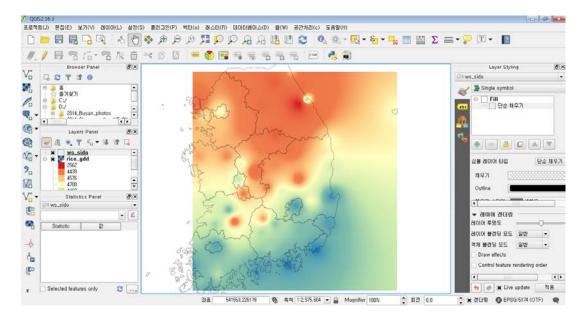


Fig. 24.





- 2. Go to the menu 'Project' and select 'Composer manager' (Fig. 26).
 - Click 'ADD' button in 'Composer manager', and in order to create map, type in the name of map: Rice_GDD in 'Composer title' box and click 'OK' (Fig. 27 and Fig. 28)

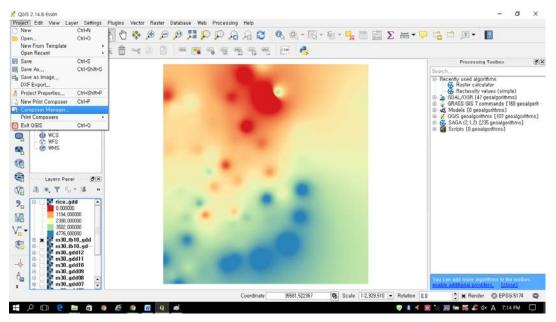


Fig. 26.

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National Institute of Meteorological Science



Korea Meteorological Administration

- You can see a new window 'Rice_GDD' (Fig. 29).

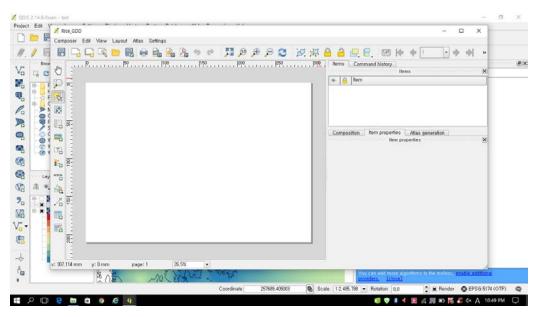


Fig. 29.

- go to the menu 'Layout' and click 'Add Map' in the pull-down menu (Fig. 30).
- you can check the figure of mouse pointer '+' (cross). So, you drag the box in the white box, then the map will be shown (Fig. 31).
- in addition, you can make other components of map, in instance legend, scale-bar, and labels such as text (Fig. 32).
- click 'Add Scalebar' and drag the box to make scalebar.
- click 'Add Legend' and drag the box to make legend.

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Fig. 30.

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Fig. 31.



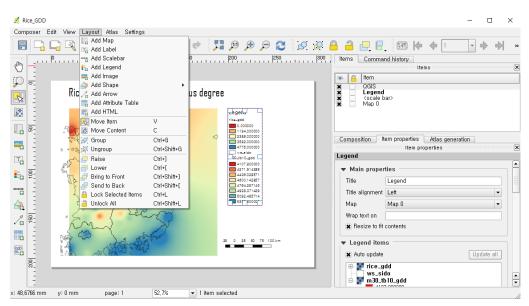
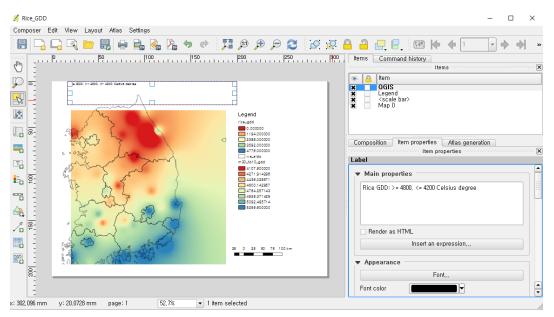


Fig. 32.

- let's make the title of map. Go to the menu 'Layout' and click 'Add Label', then drag the box at top of the layout (Fig. 33).





- click the tab 'Items' in the right panel and click 'QGIS' (Fig. 34).
- click the tab 'Items properties' and the black triangle toggle symbol of 'Label' to spread 'Main properties' box and type in the title: Rice GDD: >= 4800, <= 4200 Celsius degree (Fig. 34).
- click the toggle to expand of 'Appearance' and click the button 'Font' (Fig. 35).

- change the size of font as 36 in 'Select Font' box (Fig. 36).
- click the option 'Center' for 'Horizontal alignment' and click the option 'Middle' for 'Vertical alignment' (Fig. 37).
- now, finish making the map layout (Fig. 38). If you want to make image, or PDF etc, go to the menu 'Composer' and click 'Export as Image...' or 'Export as PDF...' (Fig. 39).

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Fig. 34.

Fig. 35.

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Any	OK Cancel	▼ Position and size

Fig. 36.

Fig. 37.



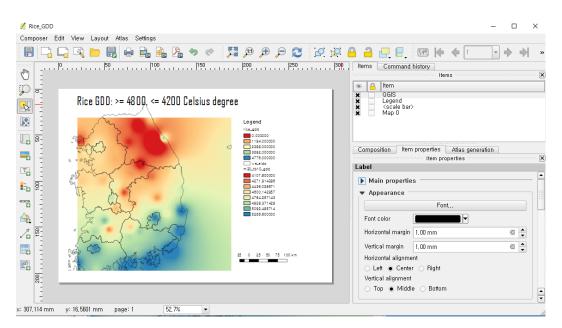
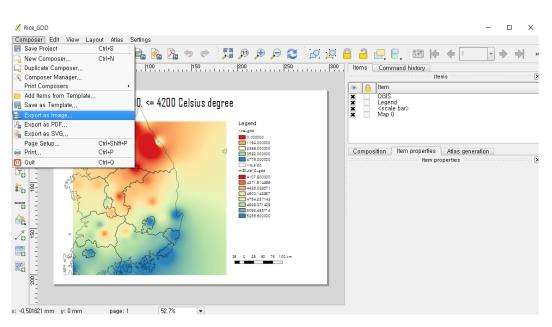


Fig. 38.





Note 2:

TM coordination in QGIS: EPSG:5174 WGS 84 in QGIS: EPSG:4326