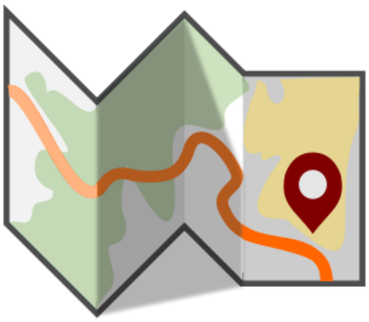
Basic Raster Styling and Analysis

QGIS Tutorials and Tips



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網格式影像的基本分析與樣式設定

許多的科學觀測與研究產生的是網格式影像（Raster）資料。這種資料以點陣圖的方式呈現，點陣中的每個像素都有自己的特定數值。只要使用一些數學運算，就可以拿這些數值進行有趣的分析。QGIS 中的 ■■■■ 功能具有許多基本的指令可供使用，在本教學中，會展示基本的 ■■■■ 功能操作，以及一些設定網格式影像樣式的選項。

內容說明

我們要使用人口密度的網格資料，呈現 1990 到 2000 年間，人口密度具有大幅度改變的地方。

■■■■■■■

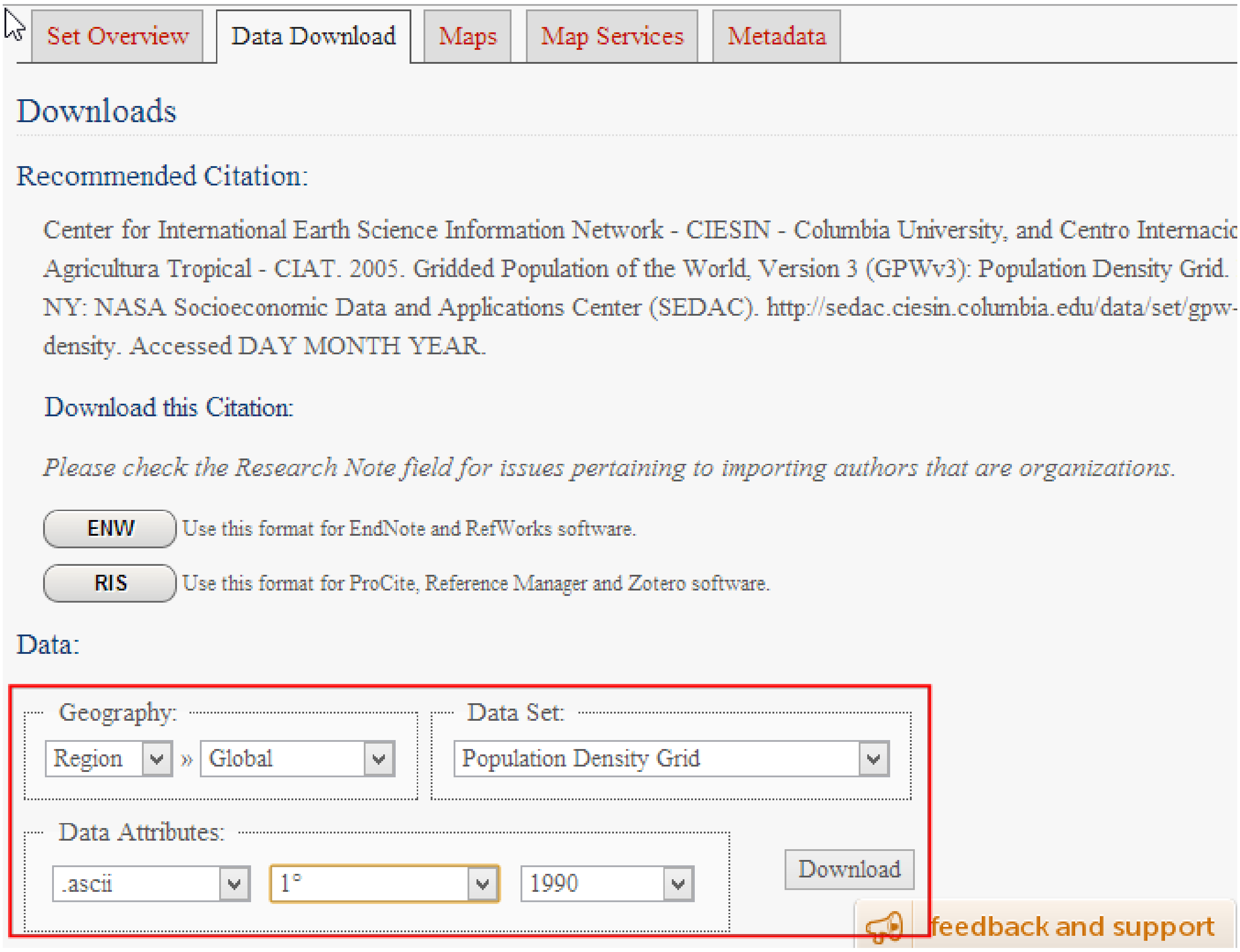
- 在 QGIS 中一次讀取多個資料集。

取得資料

這邊要使用的是 Columbia University 公布的 世界網格化人口分佈 (GPW) v3 資料庫中，以 ASCII 格式儲存的、1990 年和 2000 年的全球網格化人口資料。

以下說明如何搜尋與下載相關資料。

1. 前往 Population Density Grid, v3 download page.，在 Data Attributes 中選擇 .ascii format、1° resolution 與 1990 年，然後按 Download。接下來你可能要建立一個免費帳號然後登入，或是直接使用底下的 Guest Download 來下載。接者以同樣的方式取得 2000 年的資料。



Downloads

Recommended Citation:

Center for International Earth Science Information Network - CIESIN - Columbia University, and Centro Internacio
Agricultura Tropical - CIAT. 2005. Gridded Population of the World, Version 3 (GPWv3): Population Density Grid.
NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://sedac.ciesin.columbia.edu/data/set/gpw-
density. Accessed DAY MONTH YEAR.

Download this Citation:

Please check the Research Note field for issues pertaining to importing authors that are organizations.

ENW Use this format for EndNote and RefWorks software.

RIS Use this format for ProCite, Reference Manager and Zotero software.

Data:

Geography: Region » Global

Data Set: Population Density Grid

Data Attributes: .ascii 1° 1990

完成後會有 2 個 zip 檔。

為了方便起見，你也可以直接用下面的連結下載：

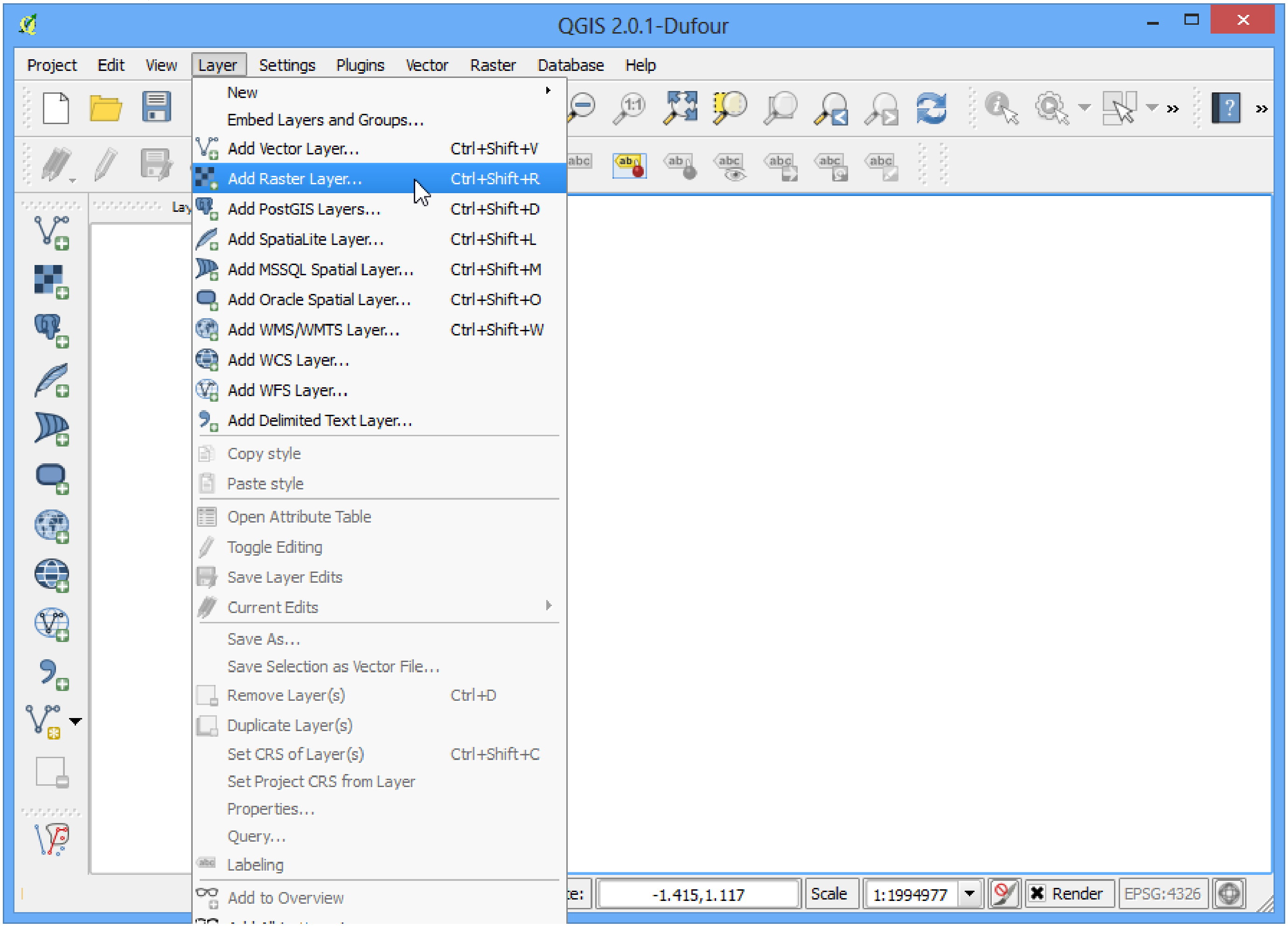
gl_gpwv3_pdens_90_ascii_one.zip

gl_gpwv3_pdens_00_ascii_one.zip

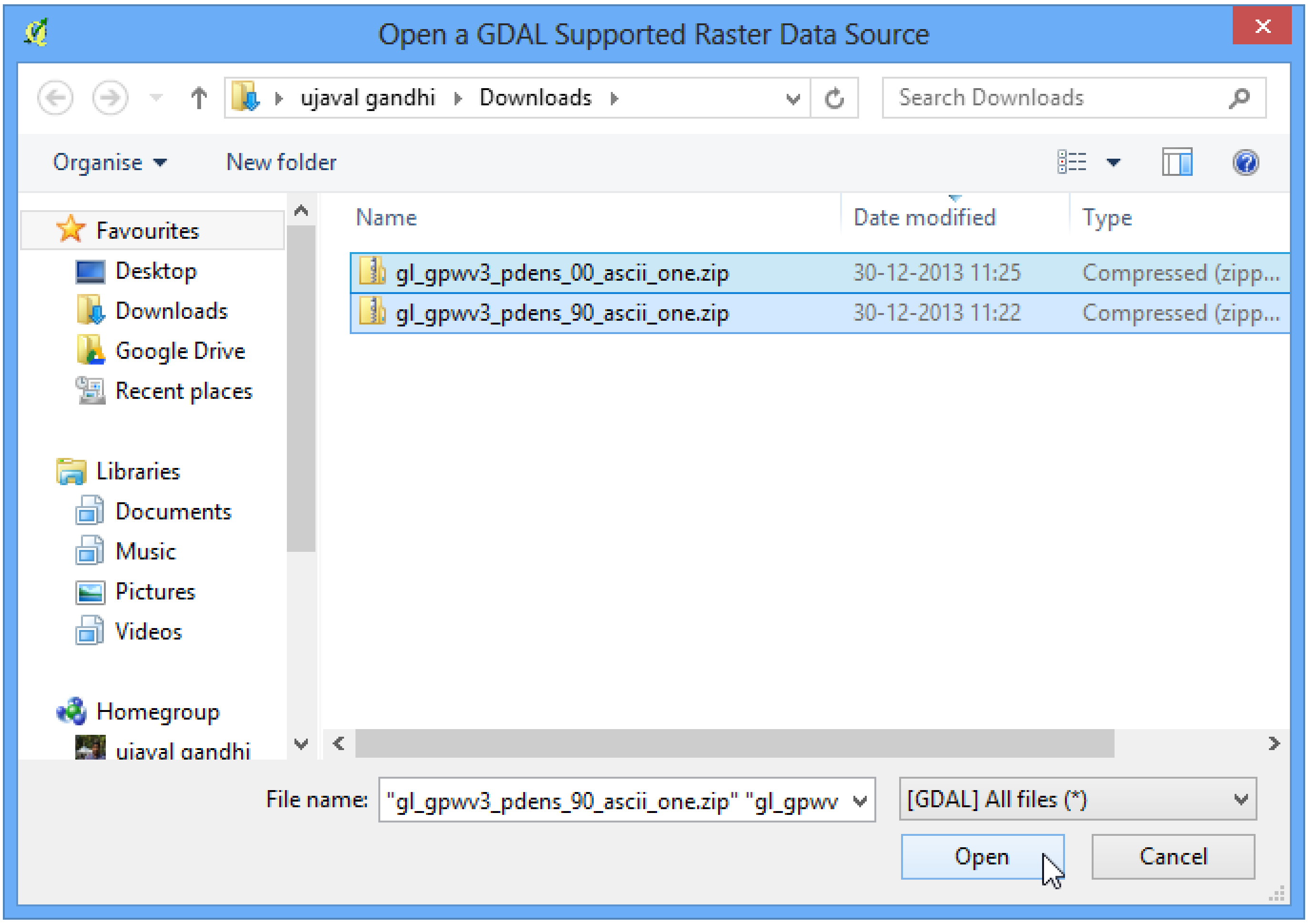
資料來源 [GPW3]

操作流程

2. 打開 QGIS，選擇 圖層 ‣ 加入影像圖層。


QGIS 2.0.1-Dufour
Project
Edit
View
Layer
Settings
Plugins
Vector
Raster
Database
Help
New
Embed Layers and Groups...
Add Vector Layer... Ctrl+Shift+V
Add Raster Layer... Ctrl+Shift+R
Add PostGIS Layers... Ctrl+Shift+D
Add SpatiaLite Layer... Ctrl+Shift+L
Add MSSQL Spatial Layer... Ctrl+Shift+M
Add Oracle Spatial Layer... Ctrl+Shift+O
Add WMS/WMTS Layer... Ctrl+Shift+W
Add WCS Layer...
Add WFS Layer...
Add Delimited Text Layer...
Copy style
Paste style
Open Attribute Table
Toggle Editing
Save Layer Edits
Current Edits
Save As...
Save Selection as Vector File...
Remove Layer(s) Ctrl+D
Duplicate Layer(s)
Set CRS of Layer(s) Ctrl+Shift+C
Set Project CRS from Layer
Properties...
Query...
Labeling
Add to Overview
-1.415,1.117
Scale
1:1994977
Render
EPSG:4326

3. 移到下載檔案的資料夾，按住 Ctrl 鍵後點選兩個 zip 檔，這樣就可以一次讀取它們。（譯註：如果出現錯誤訊息的話，先解壓縮到同一個資料夾中，然後再參考下一步，選擇目標檔案即可。）

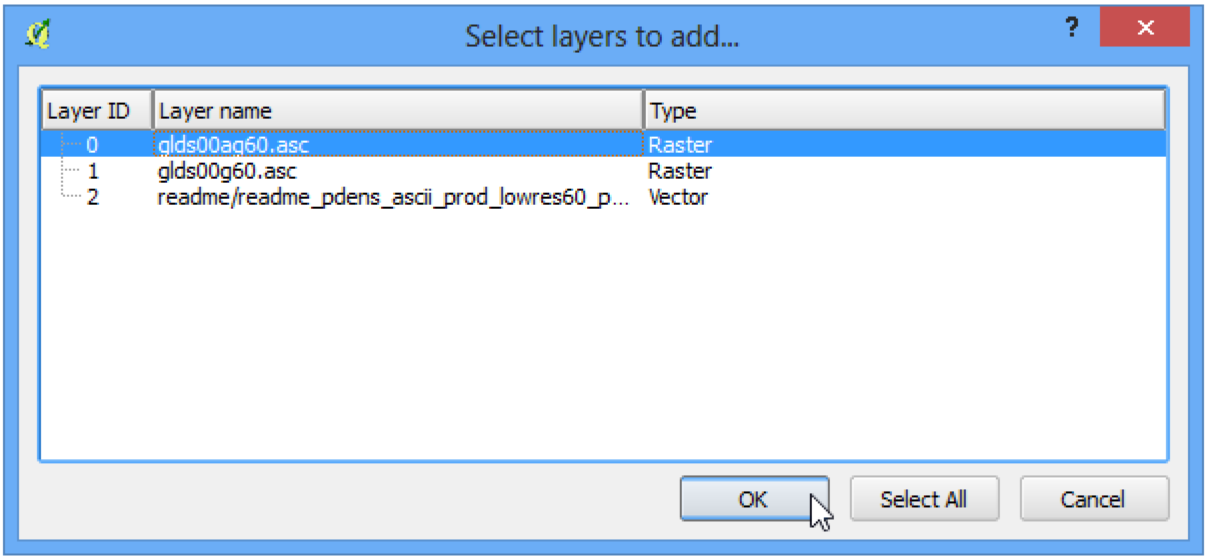

Open a GDAL Supported Raster Data Source
ujaval gandhi ▸ Downloads ▸
Search Downloads
Organise ▾
New folder
Favourites
Desktop
Downloads
Google Drive
Recent places
Libraries
Documents
Music
Pictures
Videos
Homegroup
ujaval gandhi
Open
Cancel

Name	Date modified	Type
gl_gpwv3_pdens_00_ascii_one.zip	30-12-2013 11:25	Compressed (zipp...
gl_gpwv3_pdens_90_ascii_one.zip	30-12-2013 11:22	Compressed (zipp...

File name: "gl_gpwv3_pdens_90_ascii_one.zip" "gl_gpwv

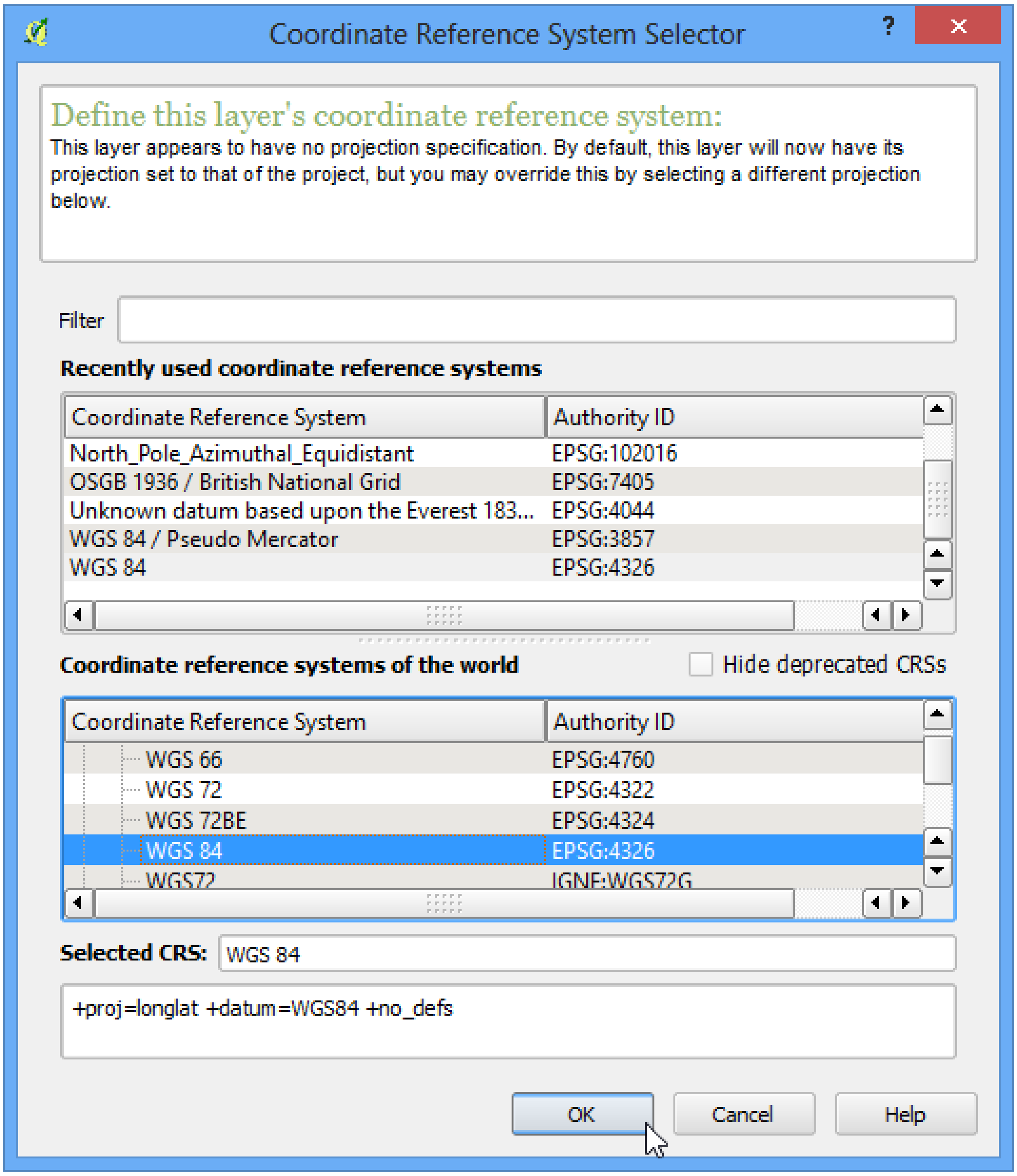
[GDAL] All files (*)

4. 每個 zip 檔都有 2 個網格檔。有 ***a*** 的那個檔表示人口數量有經過調整以符合聯合國的統計數值。本教學使用調整過後的資料。選擇 ***glds00ag60.asc*** 圖層，然後按下 確定。


Select layers to add...
OK
Select All
Cancel

Layer ID	Layer name	Type
0	glds00ag60.asc	Raster
1	glds00g60.asc	Raster
2	readme/readme_pdens_ascii_prod_lowres60_p...	Vector

5. 這個圖層並沒有定義 CRS，因此我們得手動選擇 ***EPSG:4326*** 作為這個以經緯度為單位的圖層之座標參考系統。



Define this layer's coordinate reference system:

This layer appears to have no projection specification. By default, this layer will now have its projection set to that of the project, but you may override this by selecting a different projection below.

Filter

Recently used coordinate reference systems

Coordinate Reference System	Authority ID
North_Pole_Azimuthal_Equidistant	EPSG:102016
OSGB 1936 / British National Grid	EPSG:7405
Unknown datum based upon the Everest 183...	EPSG:4044
WGS 84 / Pseudo Mercator	EPSG:3857
WGS 84	EPSG:4326

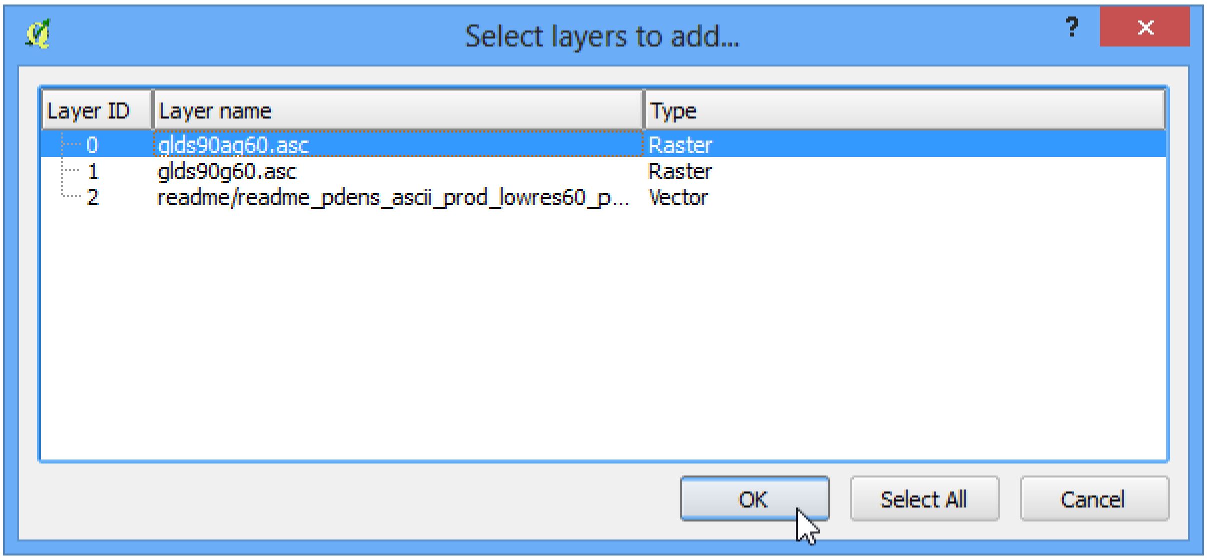
Coordinate reference systems of the world ☐ Hide deprecated CRSs

Coordinate Reference System	Authority ID
WGS 66	EPSG:4760
WGS 72	EPSG:4322
WGS 72BE	EPSG:4324
WGS 84	EPSG:4326
WGS72	IGNF:WGS72G

Selected CRS: WGS 84

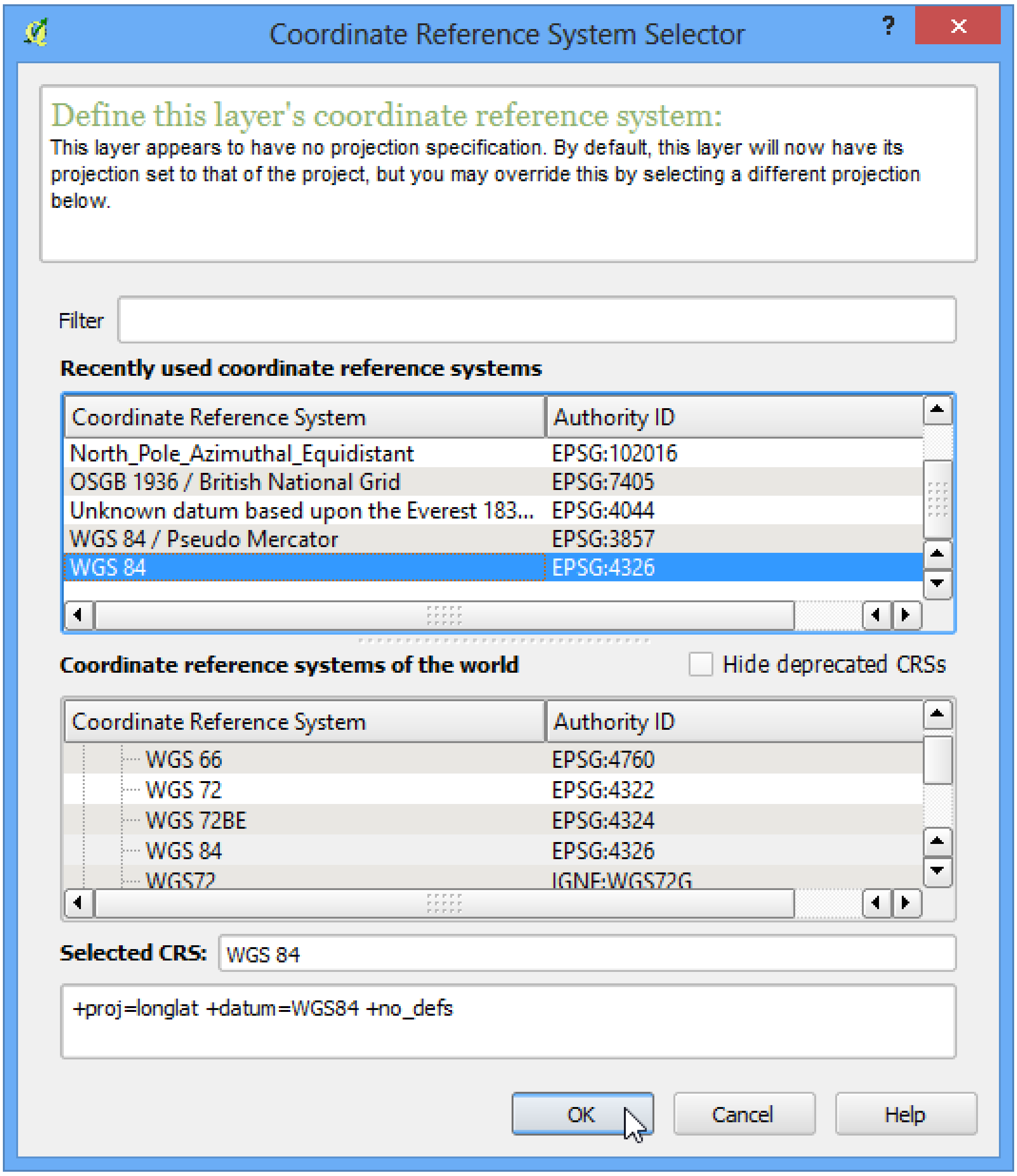
+proj=longlat +datum=WGS84 +no_defs

6. 由於我們選擇了兩個 zip 檔，因此同樣的步驟要做兩次。重複以上步驟，這次選擇 **`glds90ag60.asc`** 加到專案中。



Layer ID	Layer name	Type
0	glds90ag60.asc	Raster
1	glds90g60.asc	Raster
2	readme/readme_pdens_ascii_prod_lowres60_p...	Vector

7. 再一次選 ***EPSG:4326*** 作為 CRS。



Define this layer's coordinate reference system:

This layer appears to have no projection specification. By default, this layer will now have its projection set to that of the project, but you may override this by selecting a different projection below.

Filter

Recently used coordinate reference systems

Coordinate Reference System	Authority ID
North_Pole_Azimuthal_Equidistant	EPSG:102016
OSGB 1936 / British National Grid	EPSG:7405
Unknown datum based upon the Everest 183...	EPSG:4044
WGS 84 / Pseudo Mercator	EPSG:3857
WGS 84	EPSG:4326

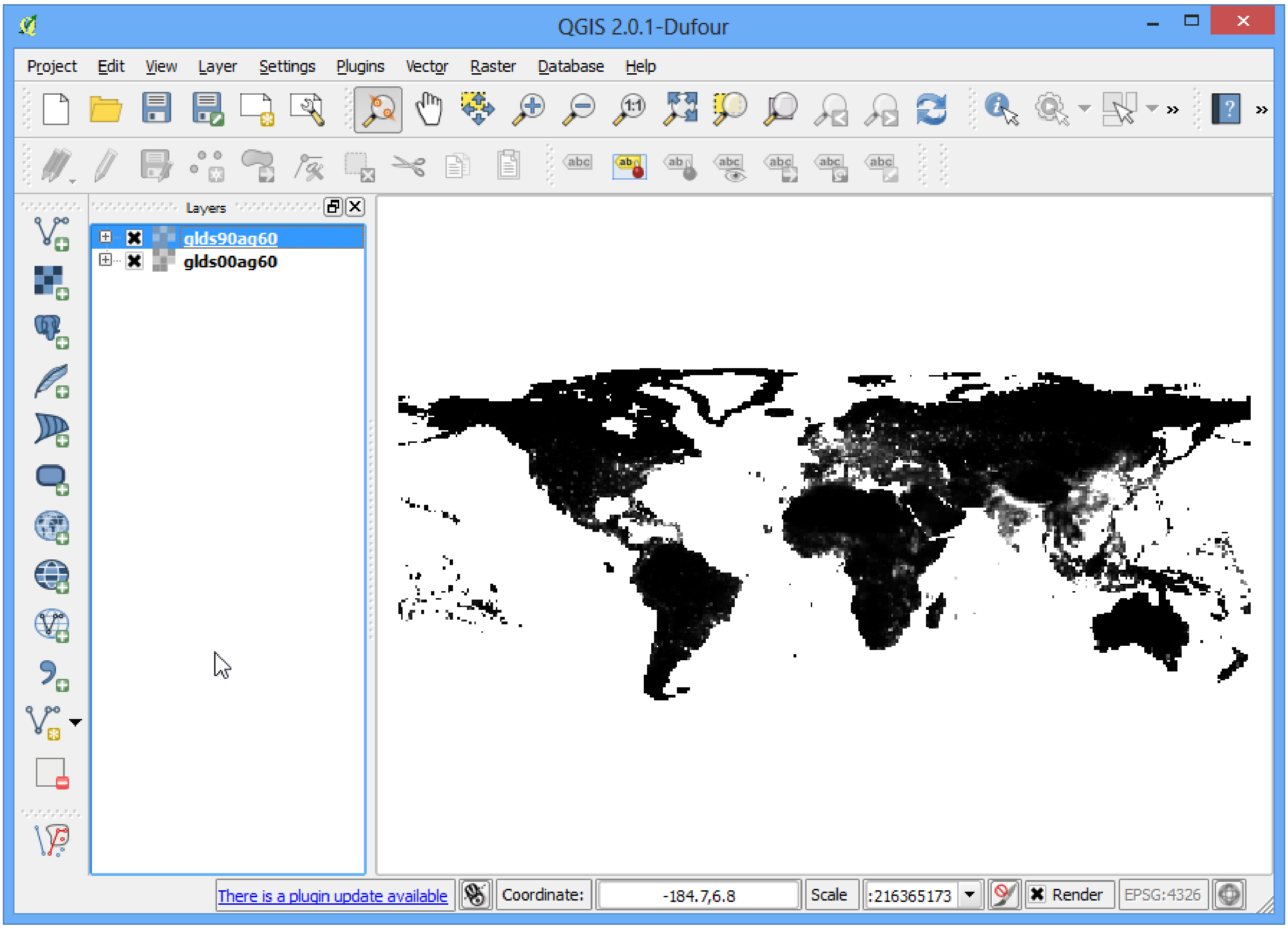
Coordinate reference systems of the world ☐ Hide deprecated CRSs

Coordinate Reference System	Authority ID
WGS 66	EPSG:4760
WGS 72	EPSG:4322
WGS 72BE	EPSG:4324
WGS 84	EPSG:4326
WGS72	IGNF:WGS72G

Selected CRS: WGS 84

+proj=longlat +datum=WGS84 +no_defs

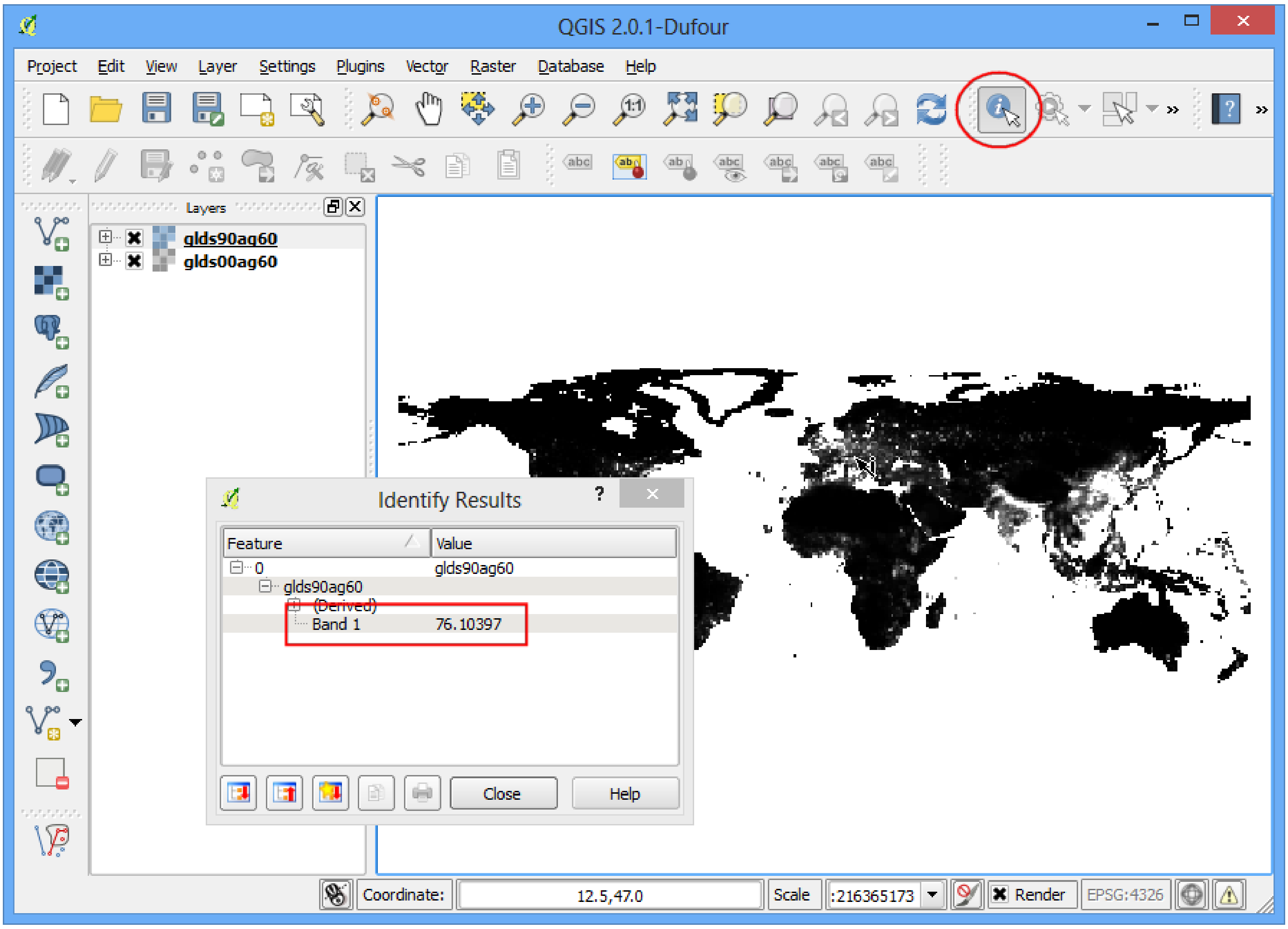
8. 現在兩個圖層都讀到 QGIS 內了。網格式影像會使用灰階來呈現，顏色越深表示像素值越低，而顏色越淺表示像素值越高。


QGIS 2.0.1-Dufour
Project
Edit
View
Layer
Settings
Plugins
Vector
Raster
Database
Help
Layers
glds90ag60
glds00ag60
There is a plugin update available
Render
EPSG:4326

Coordinate: -184.7,6.8

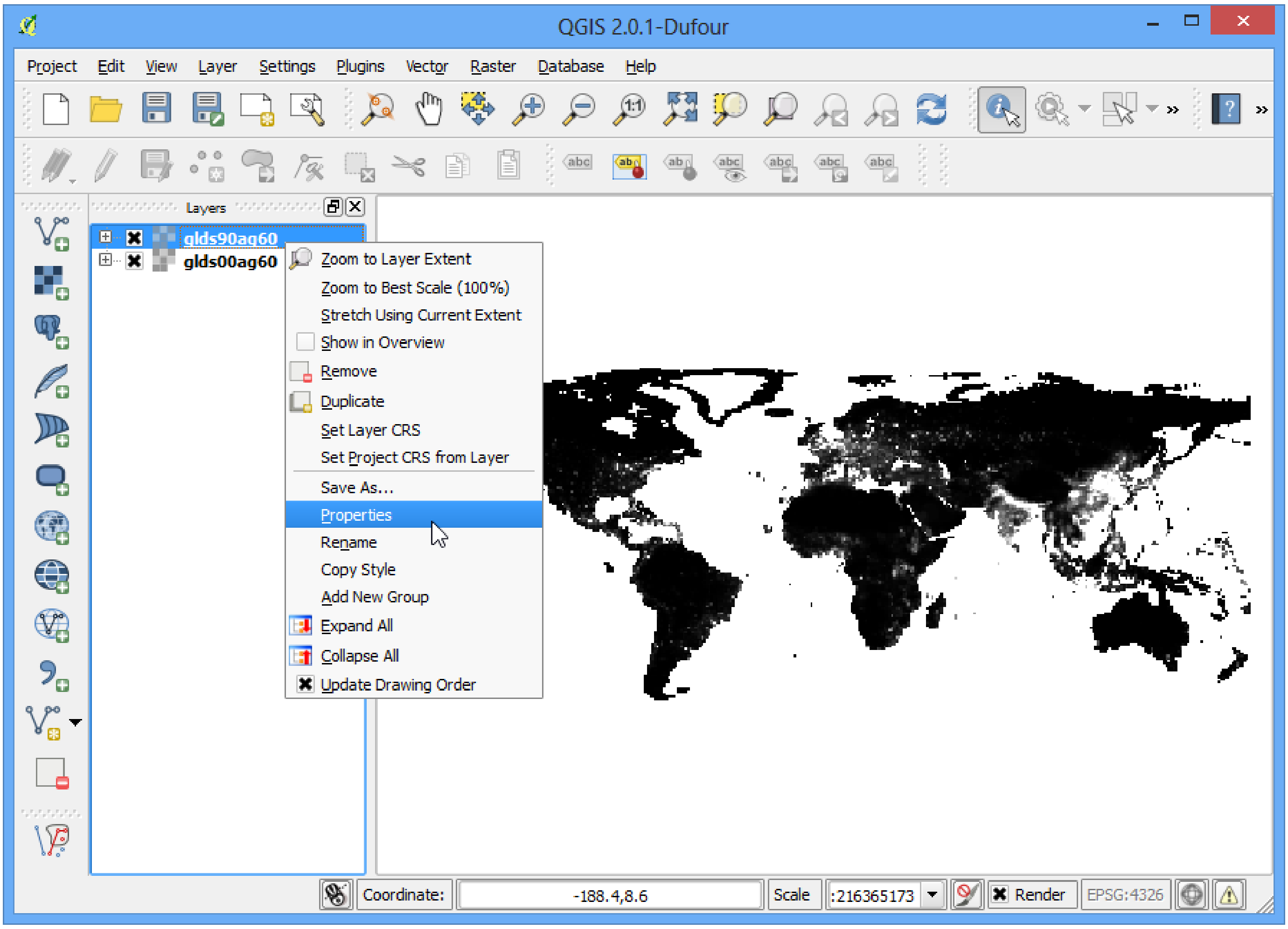
Scale :216365173

9. 影像中的每個像素都有自 身值，在這 兩 個檔案中，這個值就是人口密度。選 擇 識別 圖 徵
後在影像的 任 一 處點一下，就可以 看到這個像素的人口密度值。

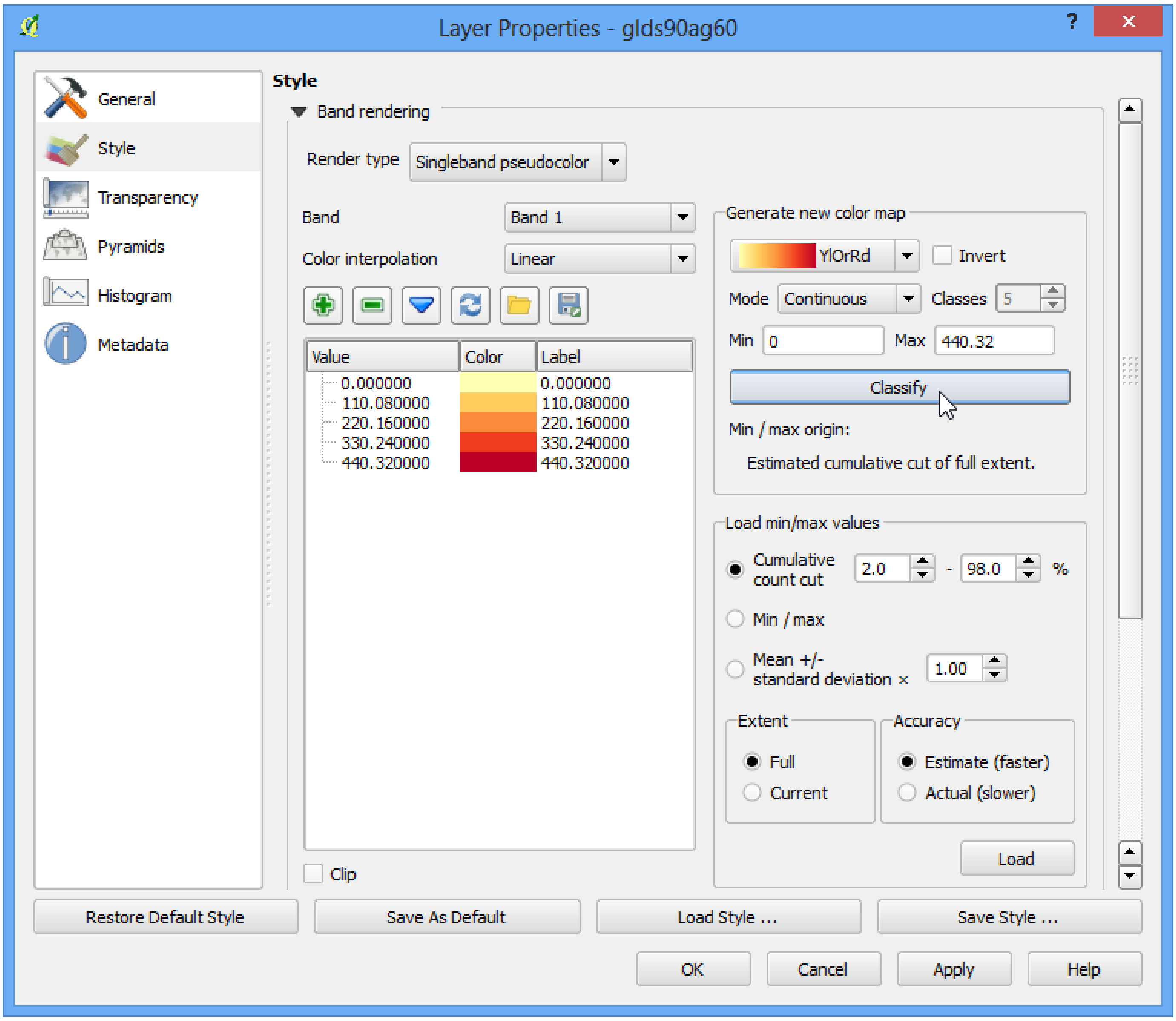

QGIS 2.0.1-Dufour
Project Edit View Layer Settings Plugins Vector Raster Database Help
Layers
glds90ag60
glds00ag60
Identify Results
Close
Help
Coordinate:
12.5,47.0
Scale
:216365173
Render
EPSG:4326

Feature	Value
0	glds90ag60
glds90ag60	
(Derived)	
Band 1	76.10397

10. 為了適當的呈現人口密度分佈的圖樣，得調整一下樣式才行。在圖層名字上按右鍵選擇屬性，或是直接在圖層名字上按兩下，都可以進到圖層屬性的視窗。


QGIS 2.0.1-Dufour
Project Edit View Layer Settings Plugins Vector Raster Database Help
Layers
glds90ag60
glds00ag60
Zoom to Layer Extent
Zoom to Best Scale (100%)
Stretch Using Current Extent
Show in Overview
Remove
Duplicate
Set Layer CRS
Set Project CRS from Layer
Save As...
Properties
Rename
Copy Style
Add New Group
Expand All
Collapse All
Update Drawing Order
Coordinate:
-188.4,8.6
Scale
:216365173
Render
EPSG:4326

11. 在 樣式 分頁下，把 繪圖類型 換成 單波段偽彩色，然後按下位於 產生新的色彩對映表 中的 分類 鈕。會有 5 個新顏色和值跑出來，最後按下 確定。


Layer Properties - glds90ag60
General
Style
Transparency
Pyramids
Histogram
Metadata
Style
Band rendering
Generate new color map
Classify
Load min/max values
Load
Restore Default Style
Save As Default
Load Style ...
Save Style ...
OK
Cancel
Apply
Help

Render type: Singleband pseudocolor

Band: Band 1

Color interpolation: Linear

Value	Color	Label
0.000000	🟨	0.000000
110.080000	🟧	110.080000
220.160000	🟧	220.160000
330.240000	🟥	330.240000
440.320000	🟥	440.320000

☐ Clip

YlOrRd ☐ Invert

Mode: Continuous Classes: 5

Min: 0 Max: 440.32

Min / max origin:

Estimated cumulative cut of full extent.

● Cumulative count cut 2.0 - 98.0 %

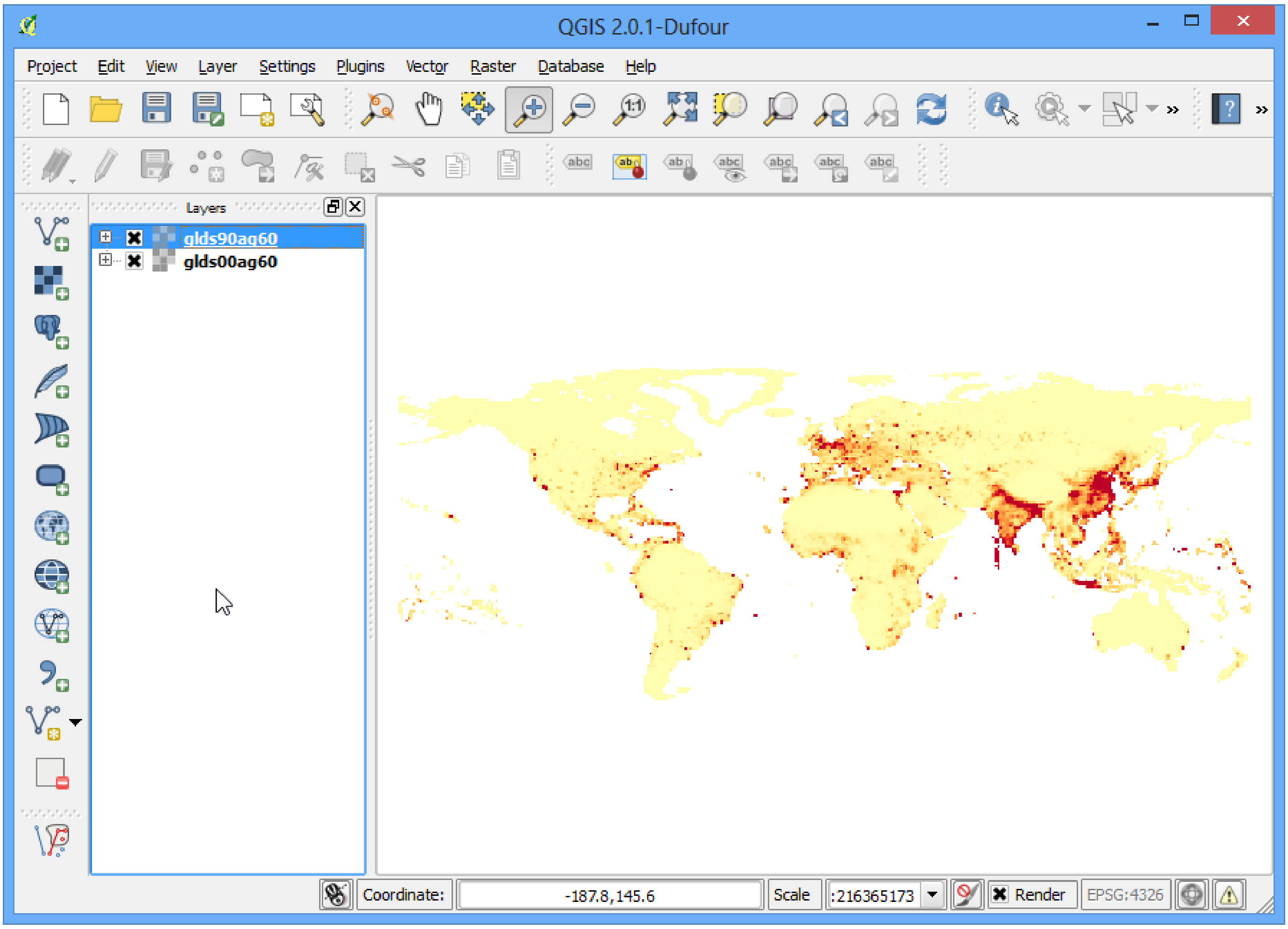
○ Min / max

○ Mean +/- standard deviation × 1.00

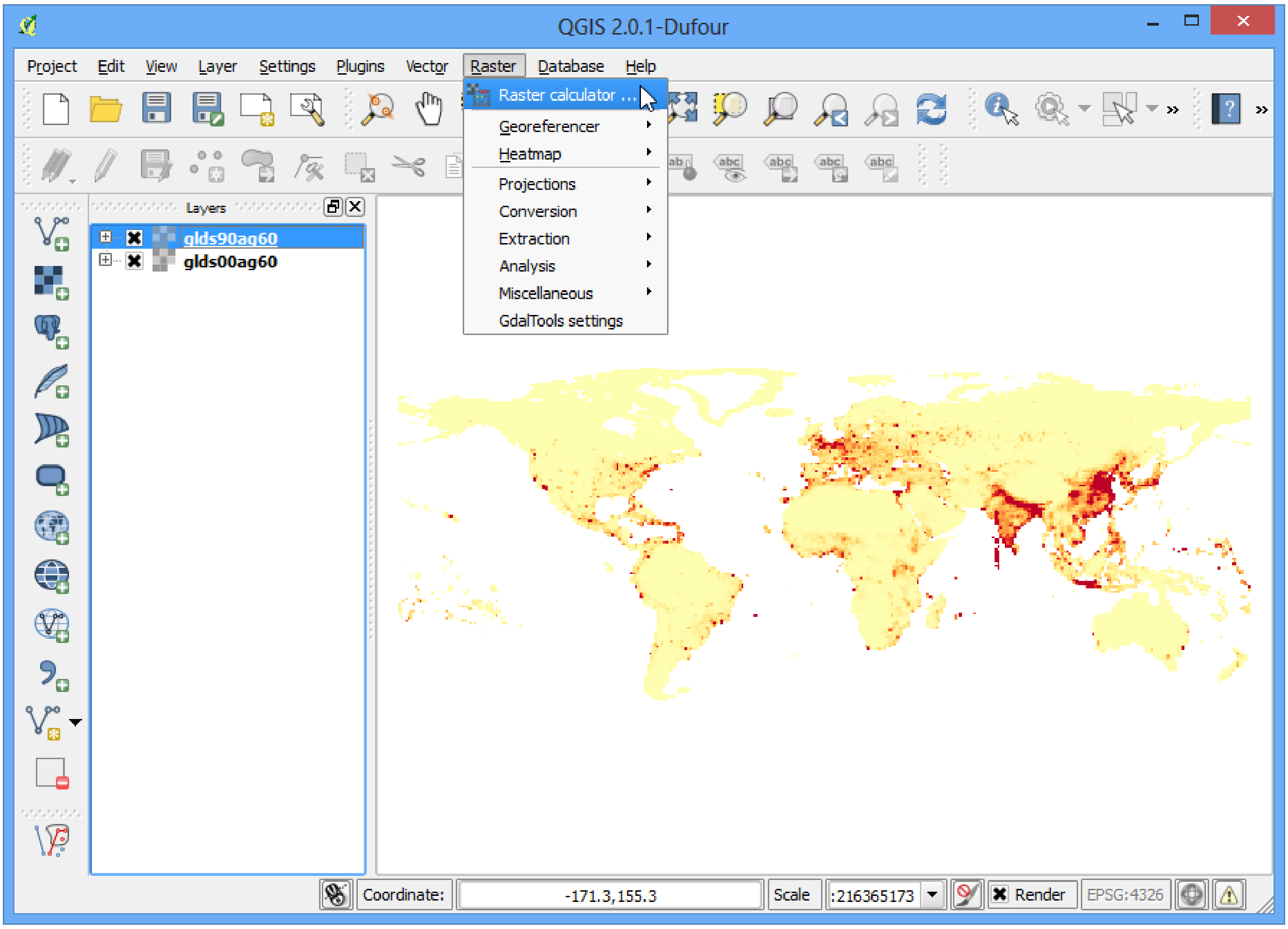
Extent: ● Full ○ Current

Accuracy: ● Estimate (faster) ○ Actual (slower)

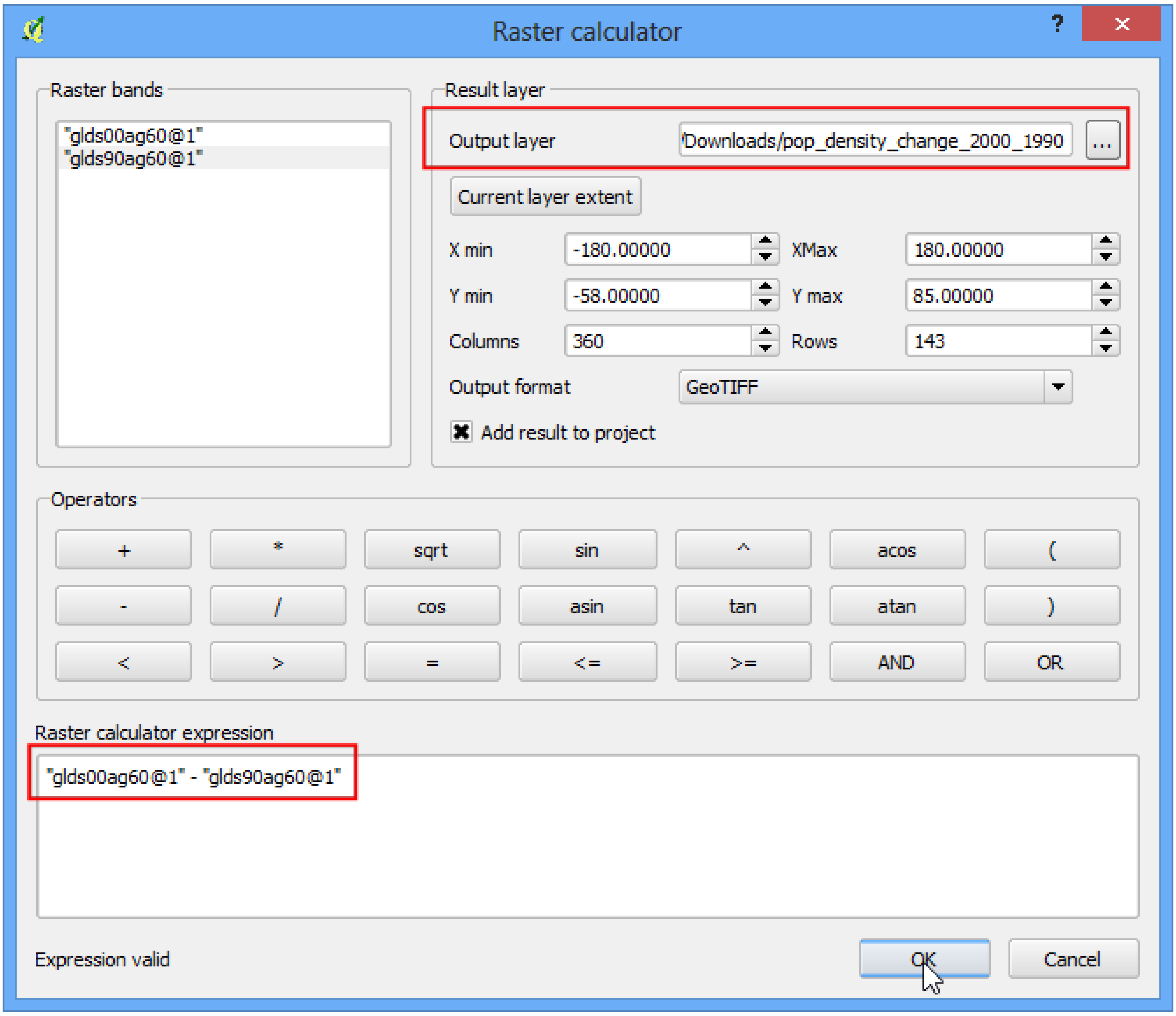
12. 回到 QGIS 主畫面，就可以看到影像使用類似溫度分佈圖的概念著色。順便也對另一個影像執行相同步驟。


QGIS 2.0.1-Dufour
Project
Edit
View
Layer
Settings
Plugins
Vector
Raster
Database
Help
Layers
glds90ag60
glds00ag60
Coordinate:
-187.8,145.6
Scale
:216365173
Render
EPSG:4326

13. 我們的分析目標是找出在1990年到2000年間有劇烈的人口變動的地方，方法則是計算這兩個影像的每個像素數值的差異。選擇 影像 ‣ 影像計算，


QGIS 2.0.1-Dufour
Project
Edit
View
Layer
Settings
Plugins
Vector
Raster
Database
Help
Raster calculator ...
Georeferencer
Heatmap
Projections
Conversion
Extraction
Analysis
Miscellaneous
GdalTools settings
Layers
glds90ag60
glds00ag60
Coordinate:
-171.3,155.3
Scale
:216365173
Render
EPSG:4326

14. 在 影像波段 的選擇框中，可以點兩下以選擇某個圖層。這裡的波段命名方式是圖層名稱加上「@」再加上波段編號，由於我們的影像都只有 1 個波段，所有每個影像都只會有「編號 1」。在影像計算的功能中，可以針對像素進行基本的數學運算，為了找出人口密度差異，必須要在 2000 年的資料中減掉 1990 年的資料，所以計算式要輸入 ***glds00ag60@1 - glds90ag60@1***。把輸出檔命名為 ***pop_density_change_2000_1990.tif***，勾選 將結果加入專案，最後按 確定。


Raster calculator
?
Raster bands
Result layer
...
Current layer extent
Operators
+
*
sqrt
sin
^
acos
(
-
/
cos
asin
tan
atan
)
<
>
=
<=
>=
AND
OR
OK
Cancel

Raster bands: "glds00ag60@1" "glds90ag60@1"

Output layer: Downloads/pop_density_change_2000_1990

X min: -180.00000
XMax: 180.00000
Y min: -58.00000
Y max: 85.00000
Columns: 360
Rows: 143

Output format: GeoTIFF

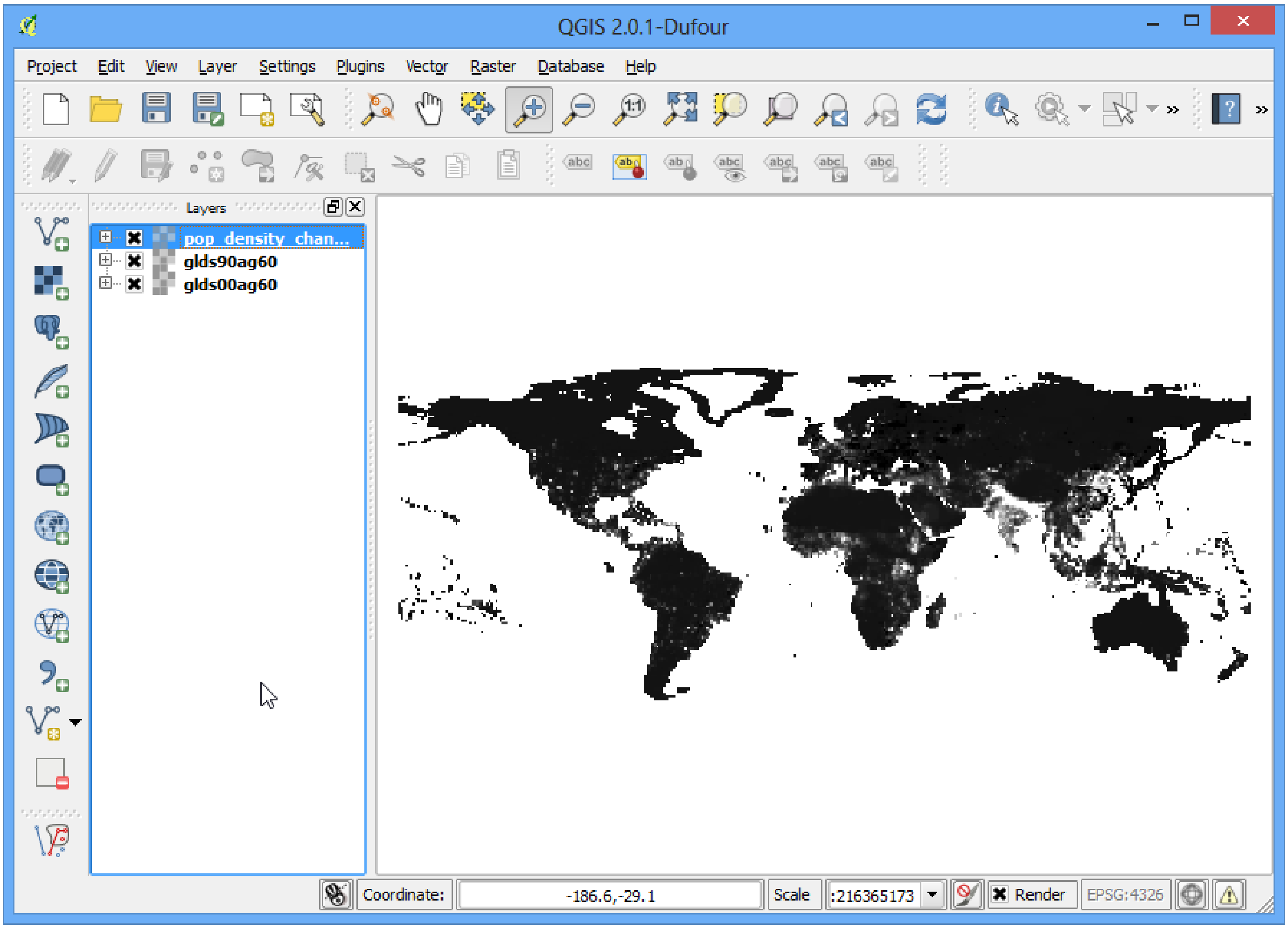
☒ Add result to project

Raster calculator expression:

"glds00ag60@1" - "glds90ag60@1"

Expression valid

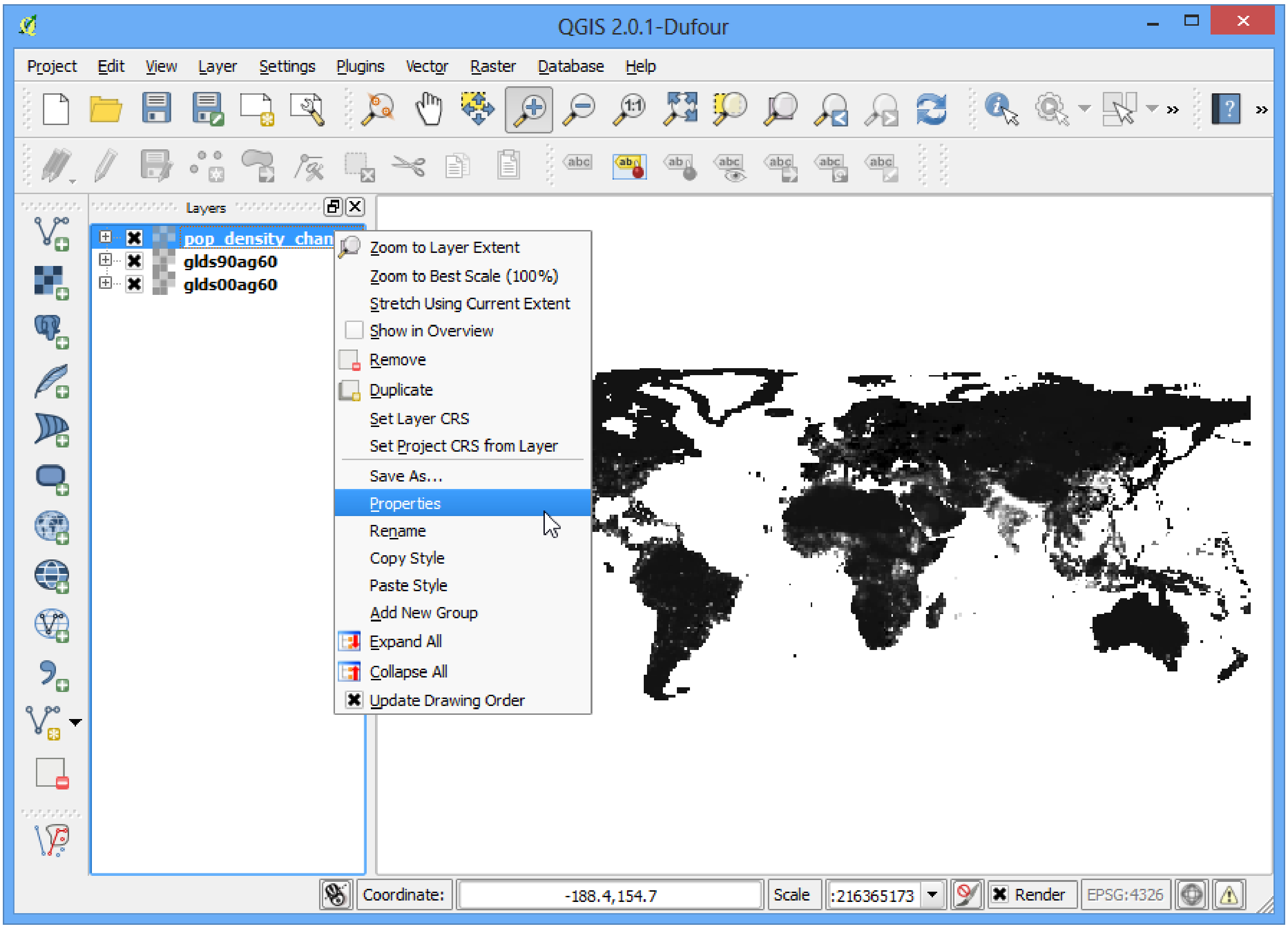
15. 操作完成後，新圖層會被加入到 QGIS 中。


QGIS 2.0.1-Dufour
Project
Edit
View
Layer
Settings
Plugins
Vector
Raster
Database
Help
Layers
pop_density_chan...
glds90ag60
glds00ag60
Render
EPSG:4326

Coordinate: -186.6,-29.1

Scale :216365173

16. 雖然灰階看起來還不錯，但我們還是可以改一個更能表達資訊的樣式。在 ***pop_density_change_2000_1990*** 圖層上按右鍵後進入 屬性，

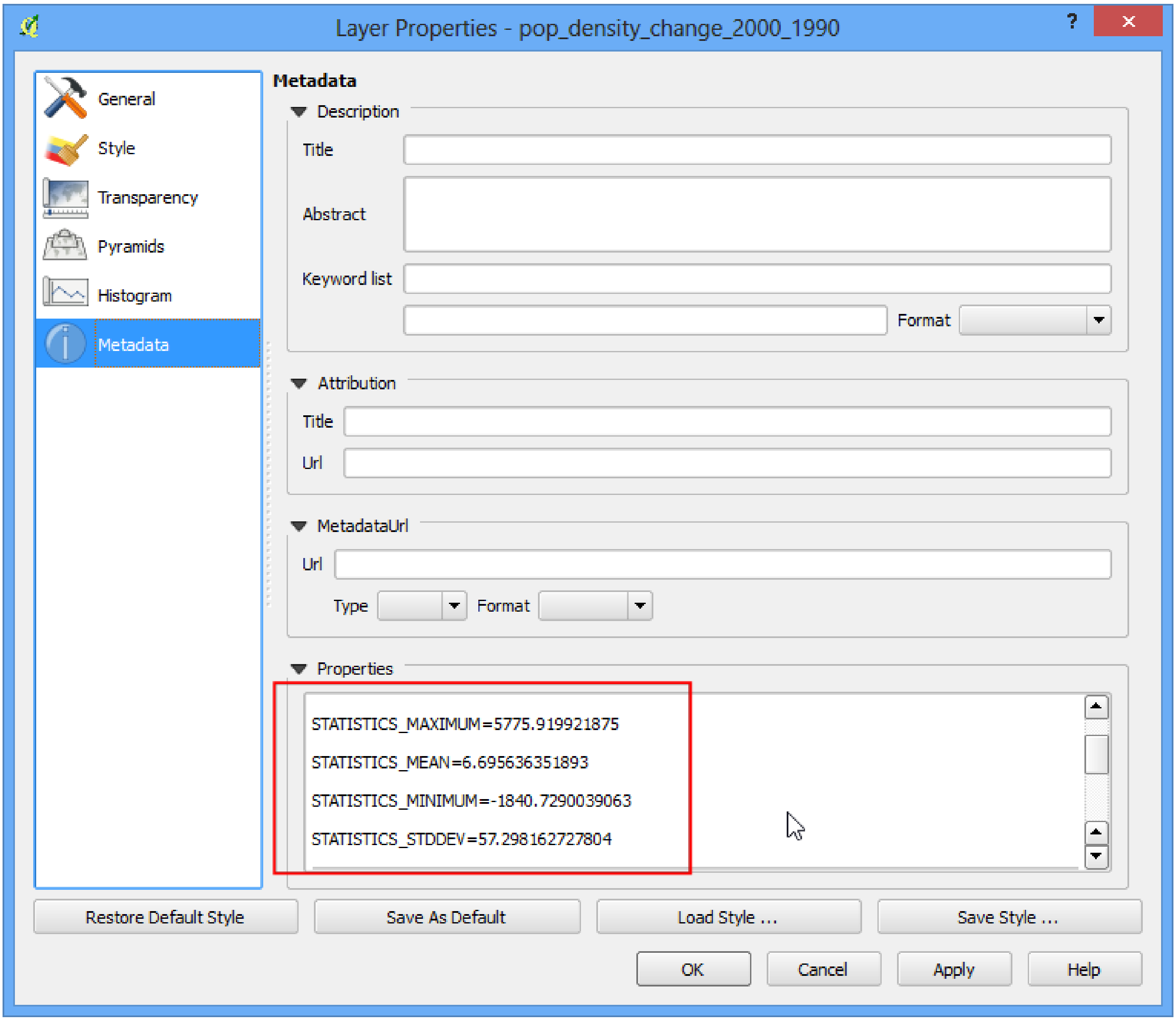

QGIS 2.0.1-Dufour
Project
Edit
View
Layer
Settings
Plugins
Vector
Raster
Database
Help
Layers
pop_density_chan
glds90ag60
glds00ag60
Zoom to Layer Extent
Zoom to Best Scale (100%)
Stretch Using Current Extent
Show in Overview
Remove
Duplicate
Set Layer CRS
Set Project CRS from Layer
Save As...
Properties
Rename
Copy Style
Paste Style
Add New Group
Expand All
Collapse All
Update Drawing Order
Render
EPSG:4326

Coordinate: -188.4,154.7

Scale :216365173

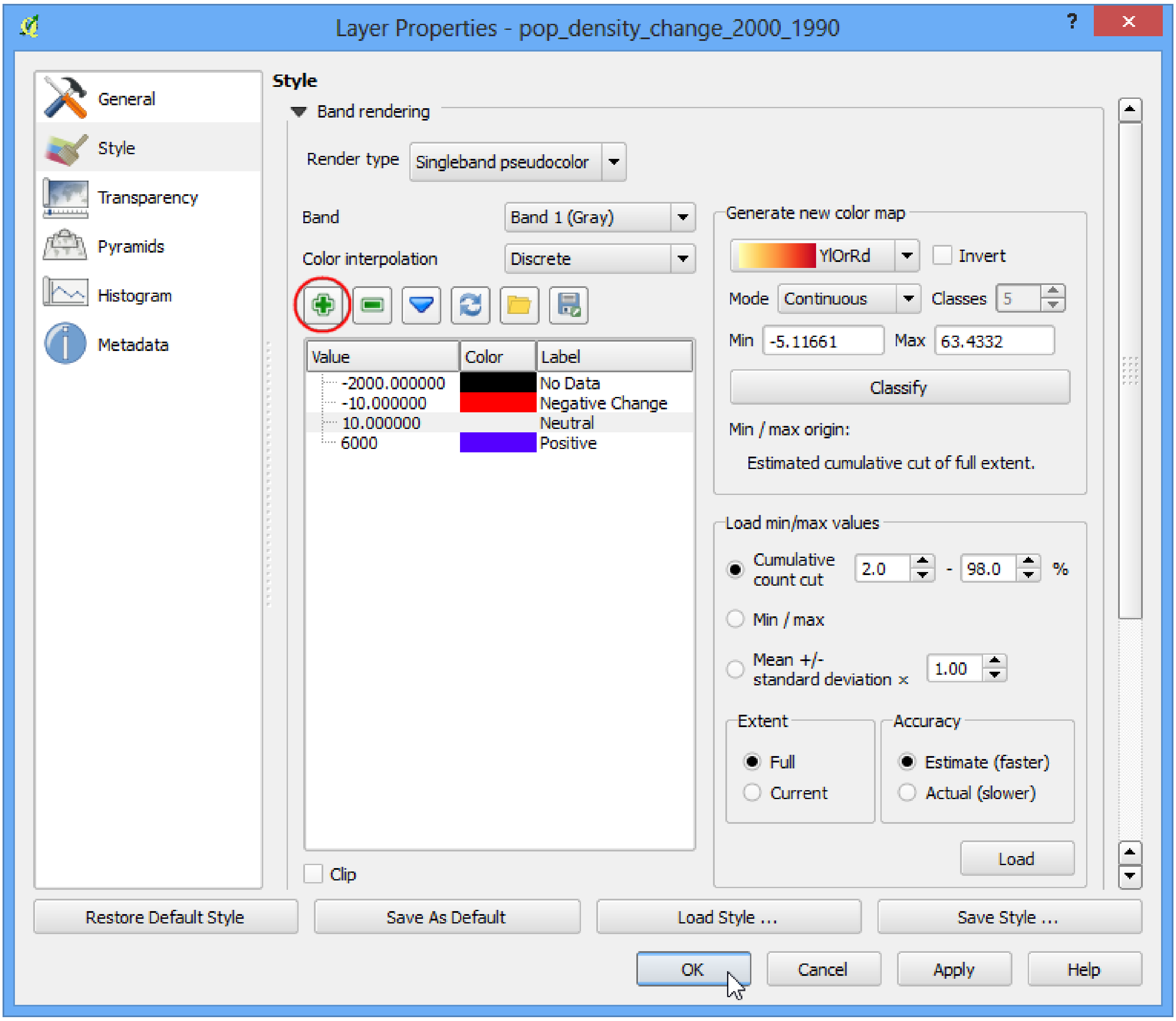
17. 這次我們要把在同一個範圍之內的像素值設成相同顏色。在設定之前，先到分頁內看一下這個影像的屬性，尤其是最大值和最小值。

詮釋資料


Layer Properties - pop_density_change_2000_1990
General
Style
Transparency
Pyramids
Histogram
Metadata
Metadata
Description
Title
Abstract
Keyword list
Format
Attribution
Title
Url
MetadataUrl
Url
Type
Format
Properties
Restore Default Style
Save As Default
Load Style ...
Save Style ...
OK
Cancel
Apply
Help

```
STATISTICS_MAXIMUM=5775.919921875
STATISTICS_MEAN=6.695636351893
STATISTICS_MINIMUM=-1840.7290039063
STATISTICS_STDDEV=57.298162727804
```

樣式 分頁下，把 繪圖類型 換成 單波段偽彩色，再把 色彩內插 調成 離散。之後按下 手動新增值 4
一下類別的數值就可以進行更改。在這裡，色彩對應的規則是「像素值比這個類別的值低的所有像素，都會被設成這個類別的顏色」。因為我們的影
還高一點，所以我們把第一個類別的值設成 −2000，這樣這個顏色代表的就是「沒有資料值」（No
。照如下的方式把所有類別都設定完成，然後按下 確定。


Layer Properties - pop_density_change_2000_1990
General
Style
Transparency
Pyramids
Histogram
Metadata
Style
Band rendering
Generate new color map
Load min/max values
Extent
Accuracy
Classify
Load
Restore Default Style
Save As Default
Load Style ...
Save Style ...
OK
Cancel
Apply
Help

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Color interpolation: Discrete

Value	Color	Label
-2000.000000	■	No Data
-10.000000	🟥	Negative Change
10.000000	□	Neutral
6000	🟦	Positive

☐ Clip

Color ramp: YlOrRd ☐ Invert

Mode: Continuous Classes: 5

Min: -5.11661 Max: 63.4332

Min / max origin:

Estimated cumulative cut of full extent.

● Cumulative count cut 2.0 - 98.0 %

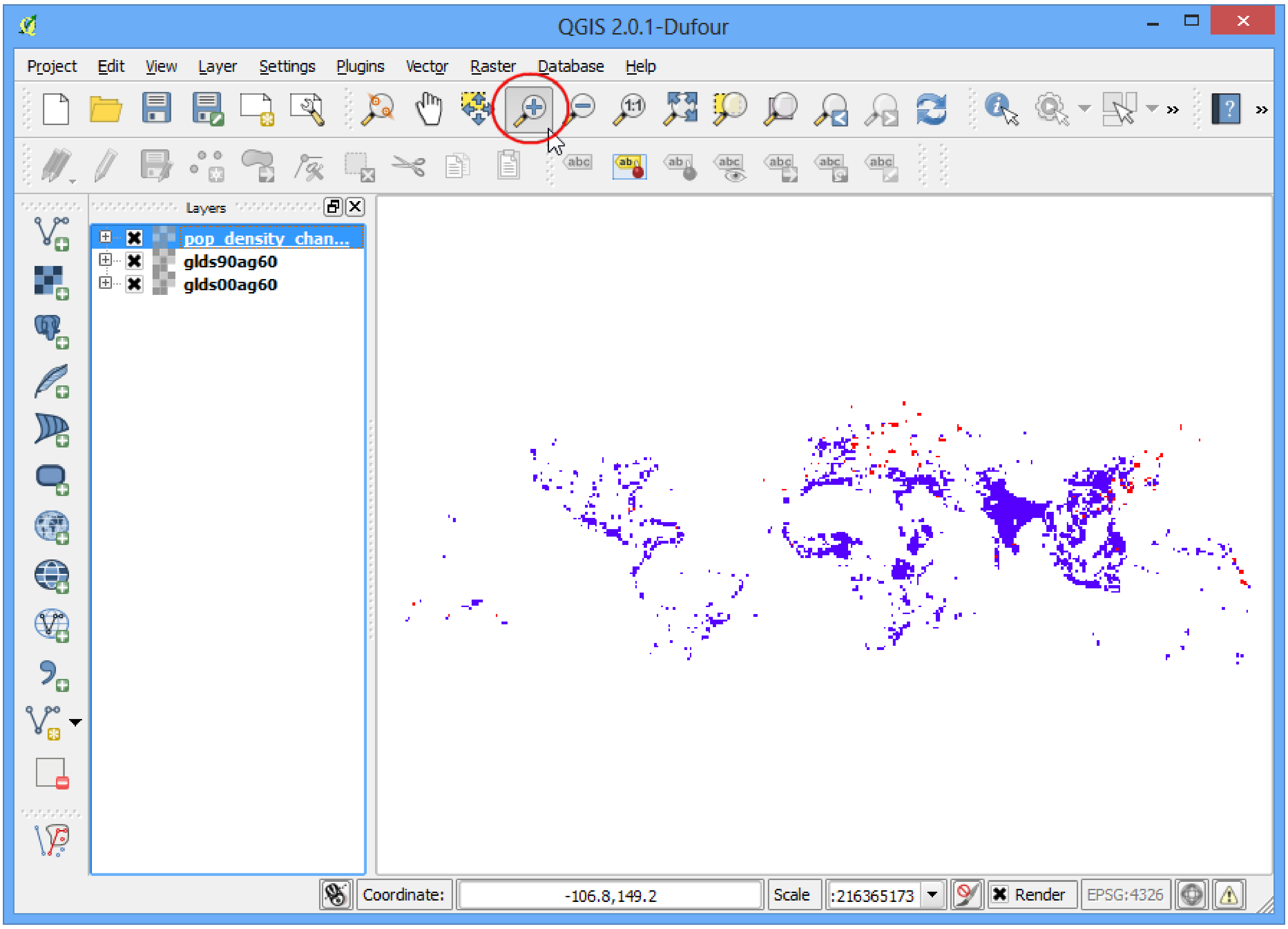
○ Min / max

○ Mean +/- standard deviation × 1.00

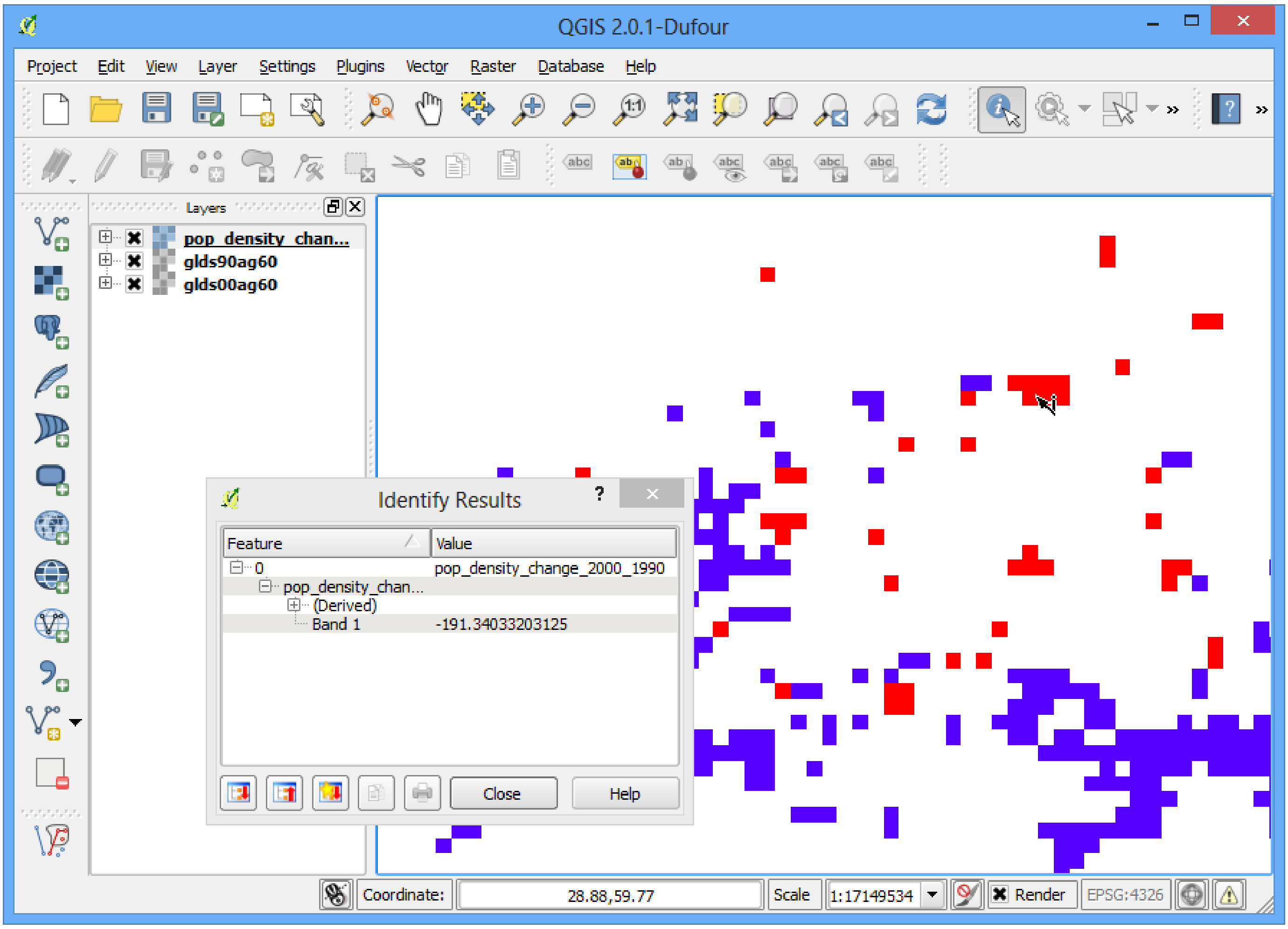
Extent: ● Full ○ Current

Accuracy: ● Estimate (faster) ○ Actual (slower)

19. 現在人口變多或變少的地方就清楚的顯示出來了。接下來按下 放大 鈕在歐洲附近拉一個矩形，縮進去看看細節。


QGIS 2.0.1-Dufour
Project
Edit
View
Layer
Settings
Plugins
Vector
Raster
Database
Help
Layers
pop_density_chan...
glds90ag60
glds00ag60
Coordinate:
-106.8,149.2
Scale
:216365173
Render
EPSG:4326

20. 選擇 識別圖徵 後在影像紅色含藍色處點看看，就可以確認剛剛的樣式設定是沒問題的。

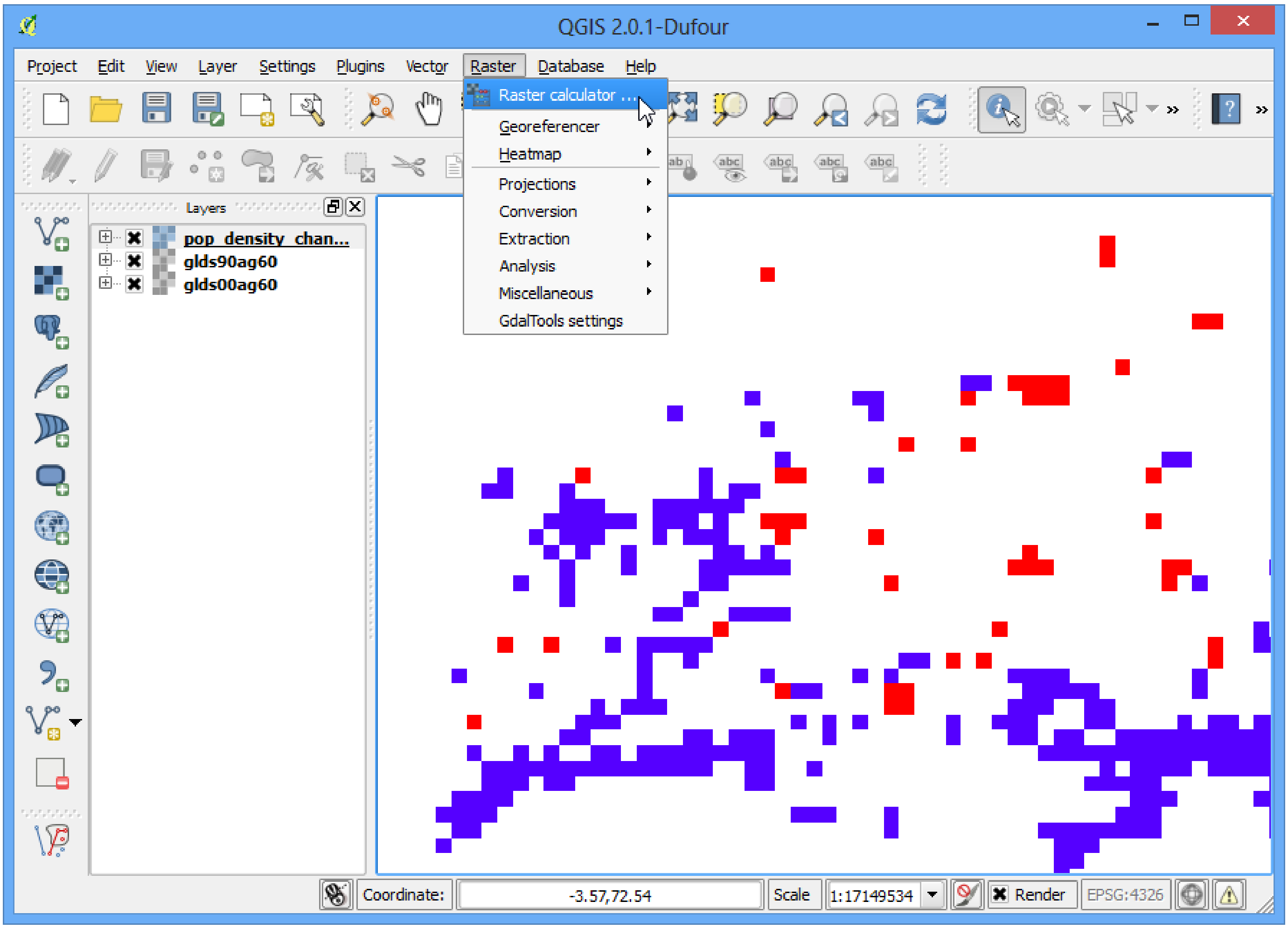

QGIS 2.0.1-Dufour
Project Edit View Layer Settings Plugins Vector Raster Database Help
Layers
Identify Results
Close
Help
Render

pop_density_chan...
glds90ag60
glds00ag60

Feature	Value
0	pop_density_change_2000_1990
pop_density_chan...	
(Derived)	
Band 1	-191.34033203125

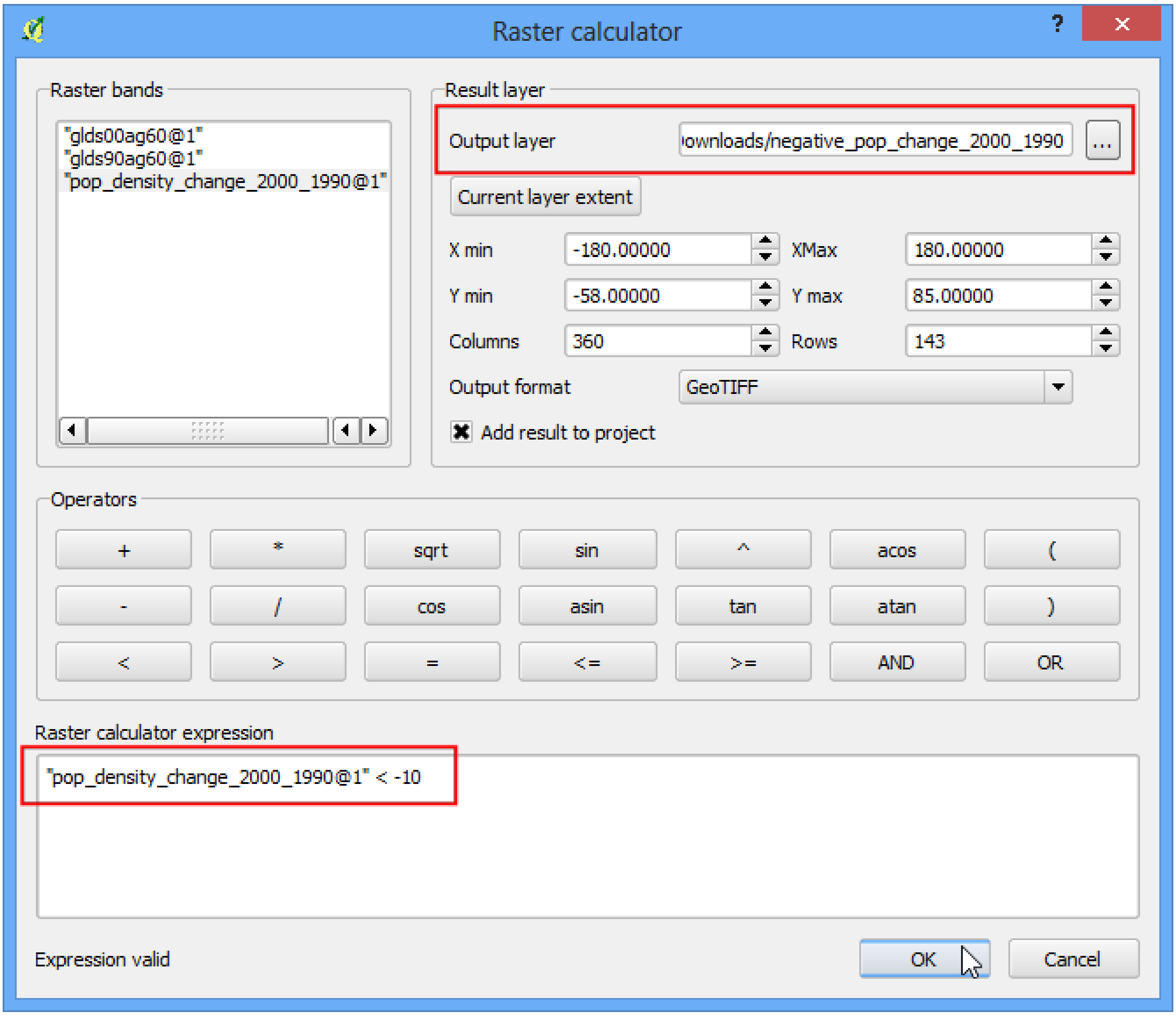
Coordinate: 28.88,59.77
Scale 1:17149534
EPSG:4326

21. 最後再讓我們多做一步，把人口密度呈現負增長的地方篩選出來。開啟 影像 ▸ 影像計算，


QGIS 2.0.1-Dufour
Project
Edit
View
Layer
Settings
Plugins
Vector
Raster
Database
Help
Raster calculator ...
Georeferencer
Heatmap
Projections
Conversion
Extraction
Analysis
Miscellaneous
GdalTools settings
Layers
pop_density_chan...
glds90ag60
glds00ag60
Coordinate:
-3.57,72.54
Scale
1:17149534
Render
EPSG:4326

22. 輸入如下所示的表示式，如果像素值符合表示式，輸出的像素值就是 1 ，如果不符合，就會是 0。這樣我們就可以得到新的影像檔，像素值為 1 時表示負增長，值為 0 時則沒有負增長。把輸出檔命名為 ***negative_pop_change_2000_1990***，勾選 將結果加入專案 ， 最後按 確定。

```
pop_density_change_2000_1990@1 < -10
```


Raster calculator
?
Raster bands
Result layer
Current layer extent
Operators
+
*
sqrt
sin
^
acos
(
-
/
cos
asin
tan
atan
)
<
>
=
<=
>=
AND
OR
OK
Cancel

"glds00ag60@1"
"glds90ag60@1"
"pop_density_change_2000_1990@1"

Output layer ownloads/negative_pop_change_2000_1990

X min -180.00000 XMax 180.00000

Y min -58.00000 Y max 85.00000

Columns 360 Rows 143

Output format GeoTIFF

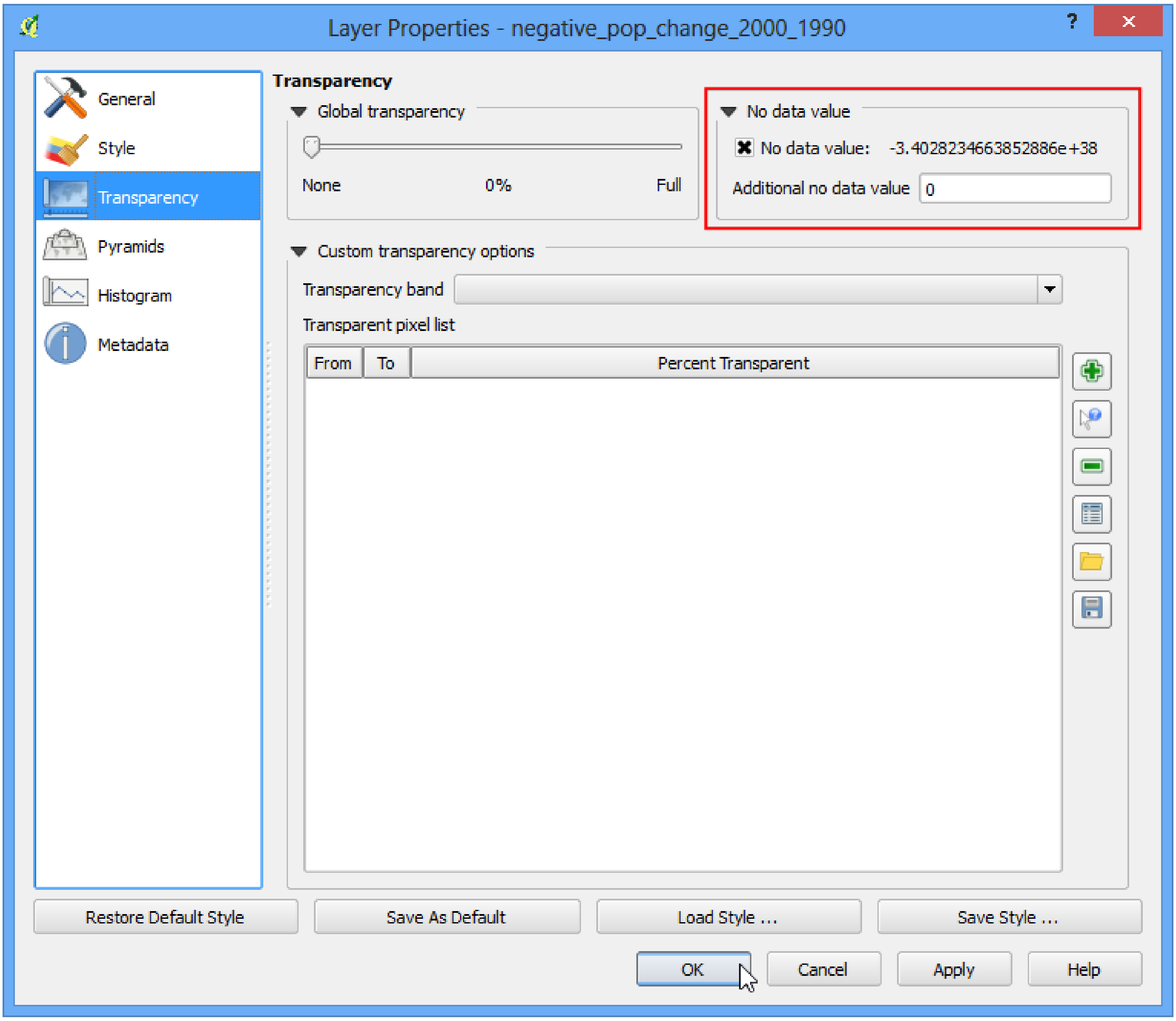
☒ Add result to project

Raster calculator expression

"pop_density_change_2000_1990@1" < -10

Expression valid

23. 新圖層產生後，以右鍵進入 屬性 ，在 透明度 分頁中的 附加無資料值 的地方打上 0 ，這樣的話值為 0 的像素也會被設成透明。最後按下 確定。

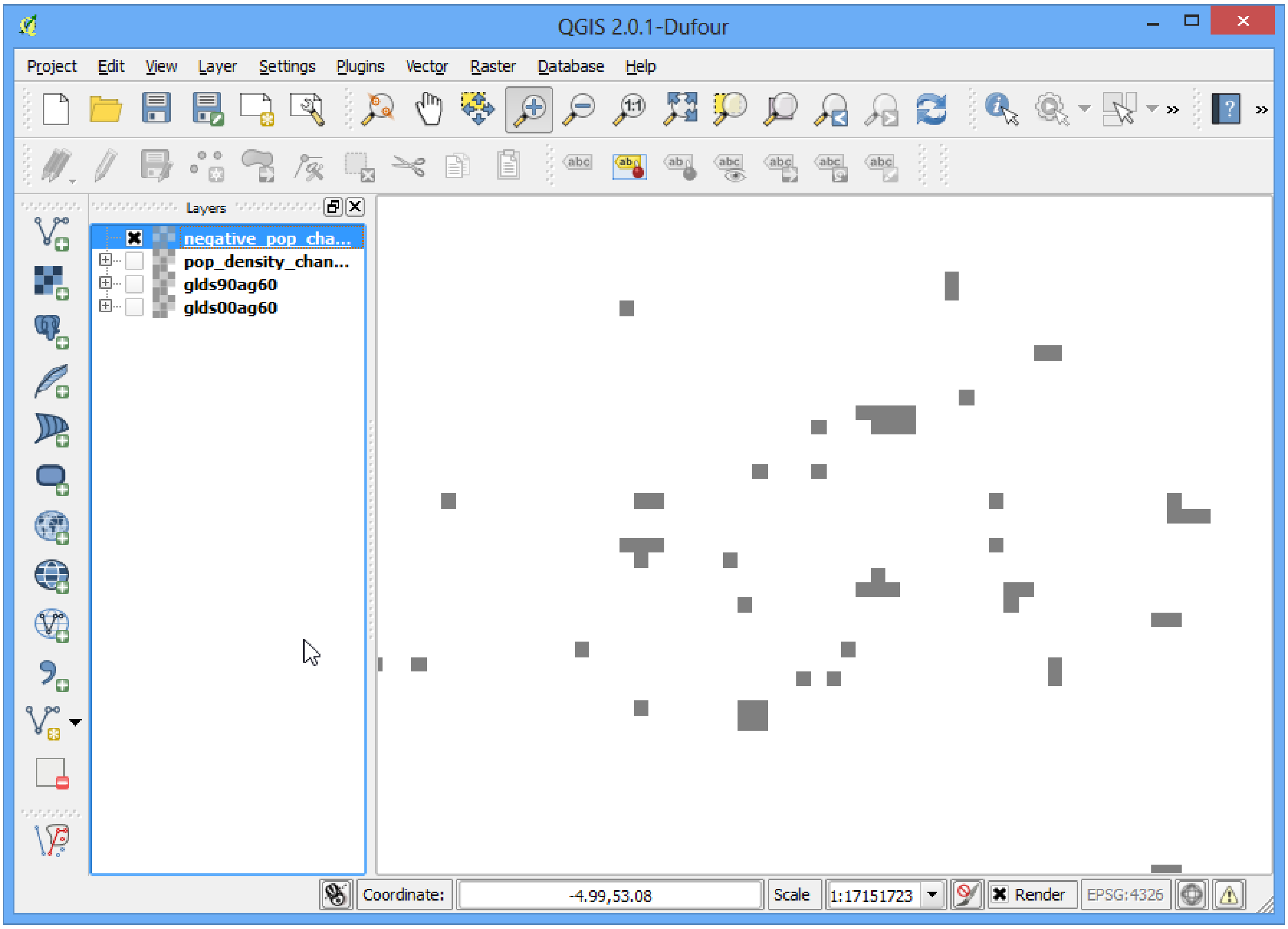

Layer Properties - negative_pop_change_2000_1990
General
Style
Transparency
Pyramids
Histogram
Metadata
Transparency
Global transparency
None
Full
No data value
Custom transparency options
Transparency band
Transparent pixel list
From
To
Percent Transparent
Restore Default Style
Save As Default
Load Style …
Save Style …
OK
Cancel
Apply
Help

Global transparency: 0%

☒ No data value: -3.4028234663852886e+38

Additional no data value 0

24. 最後，就只剩下所有的負人口增長區是灰黑色的了。


QGIS 2.0.1-Dufour
Project
Edit
View
Layer
Settings
Plugins
Vector
Raster
Database
Help
Layers
Render

☒ negative_pop_cha...
☐ pop_density_chan...
☐ glds90ag60
☐ glds00ag60

Coordinate: -4.99,53.08
Scale 1:17151723
EPSG:4326