PyramidMap Geotools Visualized Toolset Technical White Paper

1 Function introduction

Tips: Ctrl+mouse wheel controls page zoom for optimal reading.

As the world enters the information and digital era, the development of communication and Internet technology has completely changed the way people communicate and perceive the world. GIS (Geographic Information System) has developed from original paper map to holographic digital electronic map. GIS is synchronized with the software and hardware support of operating system, communication interconnection and mobile terminal, and has penetrated into all aspects of social production and people's life. From space launch, satellite remote sensing, express delivery and bus service, almost every link is shining with the glory of GIS. GIS can integrate spatial and dynamic information into holographic digital visual effects, and provide timely and accurate visual services for geographical research, geographical decision-making and residents' lives. The rich and colorful services of GIS come from its massive data support and powerful analysis and processing capabilities. However, the production, storage, analysis, processing and service provision of map data is an extremely professional, arduous and complex work, which has professional requirements for workflow and operators, and the technical cost is very high. Therefore, many enterprises with this demand but weak technology are discouraged. PyramidMap is a simple and practical GIS data processing workflow platform for small and medium-sized enterprises to solve this problem.

PyramidMap is a map full-process service system that can be used as an independent map mapping tool, and can also be used as a GeoServer client. It is simple and easy to use, covering mapping, editing and assignment, rendering, database storage, service publishing, and management. The purpose of PyramidMap is to transform the professional and even daunting GIS data processing into an approachable, easy to use, relaxed and pleasant workflow. On this basis, the original complex process of GeoServer and Geodatabase connection and map service publishing is transformed into a fully guided visualization process, reducing the user threshold and improving the efficiency of map operation, Thus, GIS users are given the ability to independently complete the whole process from map mapping to web map services. Its ultimate goal is to provide efficient data processing process for WebGIS applications. That is to say, PyramidMap tool provides you with the most basic data assurance processing process for WebGIS applications. It belongs to the core layer of map data processing and is also the most complex process. PyramidMap is fully qualified for this work. The process is shown in Figure 1-1.

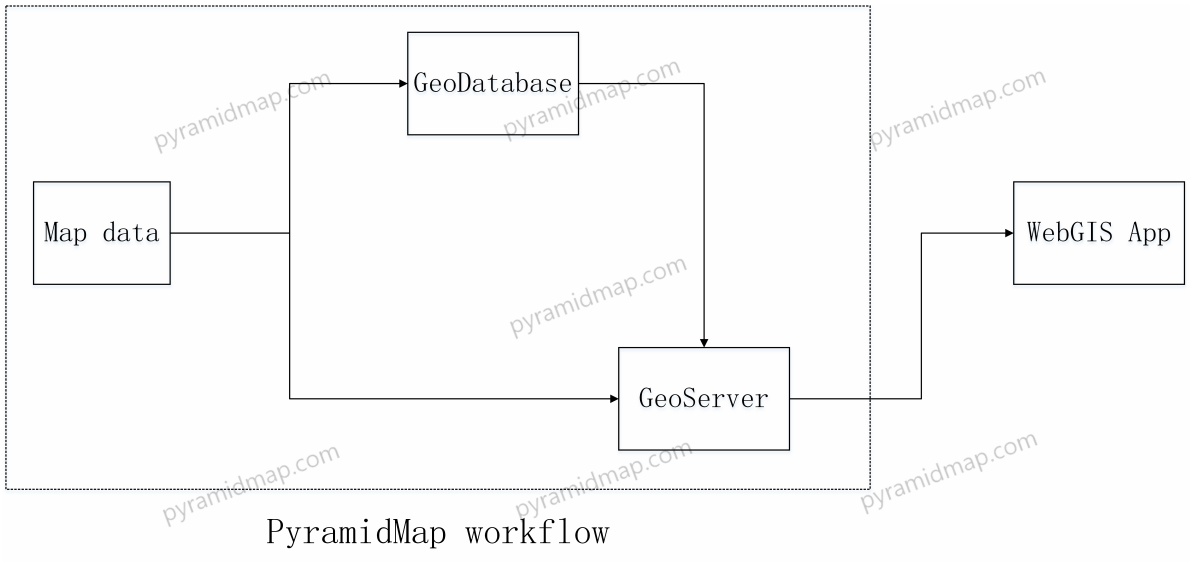

Figure 1-1: Diagram of PyramidMap Total Energy

PyramidMap is positioned at the key link of the whole WebGIS implementation process, and completes the processing and storage of key map data before the feasibility of WebGIS. Traditionally, it is highly dependent on the skills of professional GIS personnel. Now it can be easily completed by PyramidMap, which greatly reduces the access threshold for GIS users and

improves the efficiency of map data processing.

2 Software deployment

2.1 Deployment mode

PyramidMap integrates all the dependencies required for operation internally. You only need to decompress the software to use it (Chinese path is not supported for the moment). Double click the PyramidMapViewer.exe executable to run it. The deployment mode is shown in Figure 2-1.

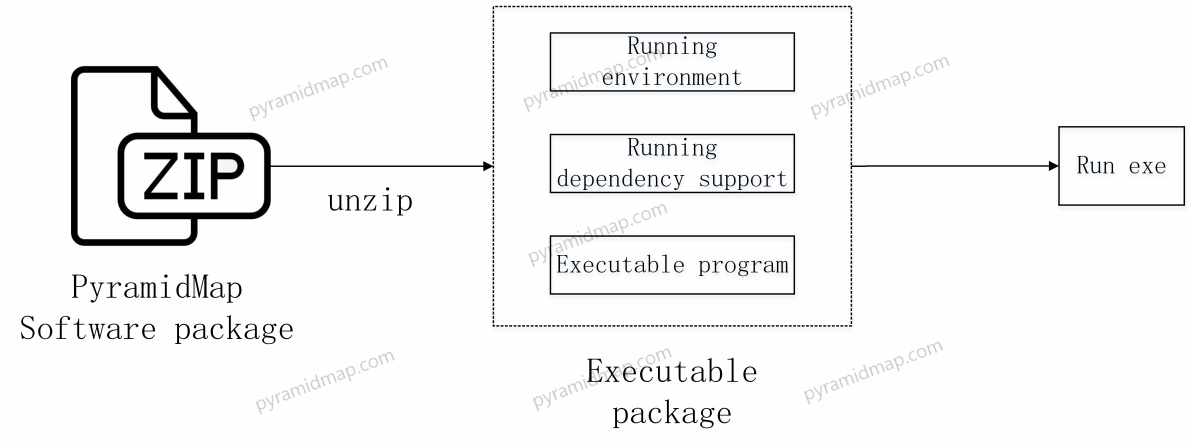

Figure 2-1: Schematic Diagram of PyramidMap Deployment Operation Mode

2.2 Running mode

- Client/Server mode

PyramidMap can complete independent mapping, map editing, symbol definition rendering, Geodatabase geographic database connection, access, map data input and output, GeoServer map server space management, map service publishing, hosting and access and other full process processing. PyramidMap can independently complete all functions from mapping to editing, support multiple spatial geographic databases, including but not limited to Oracle, Postgre, MySQL, and complete the input, output, access and storage of map data. PyramidMap can be seamlessly connected with GeoServer map server, and can be used as a visualization client tool of GeoServer to complete workspace and data storage management of remote server, layer publishing, map symbol production and publishing, server layer and symbol data management, preview and other serialized operations on the client. To sum up, PyramidMap provides map users with a full process function from mapping to Web side use. PyramidMap supports deployment in Internet and intranet environments. It has all the dependencies required for integrated operation. It can be used after decompression without installation (Chinese path is not supported temporarily).The role and operation mode of PyramidMap in WebGIS network architecture are shown in Figure 2-2.

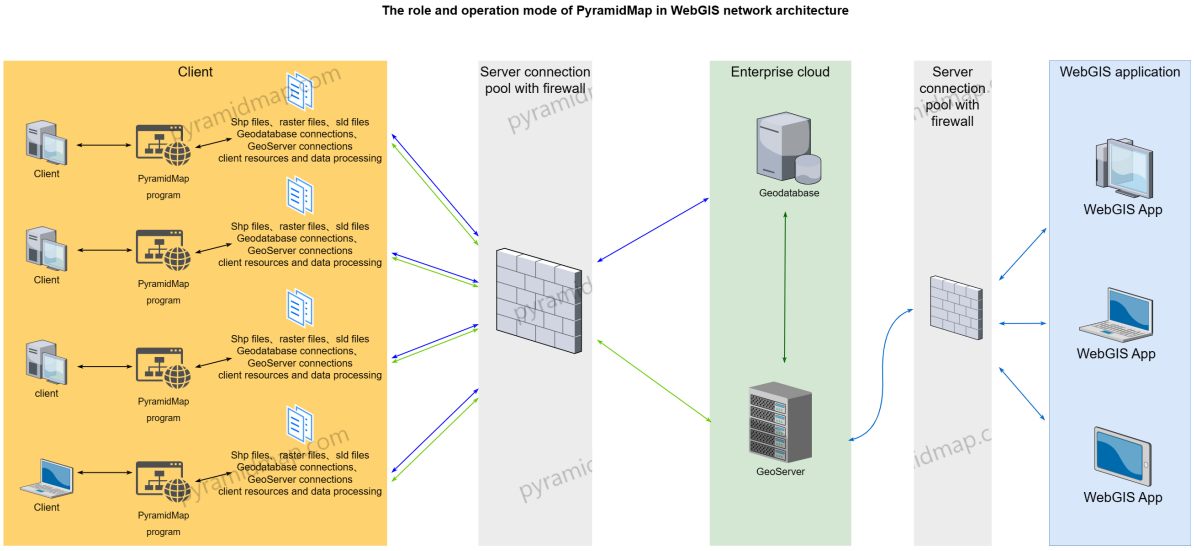

Figure 2-2: The role and operation mode of PyramidMap in WebGIS network architecture

2.3 Function list

Classify	Item	Function description
Map view	Map main view	Map preview and editing operations, support Shp file type, Geodatabase geographic database type, WMS, WFS, WCS, WMTS and other standardized map services from GeoServer, as well as various online map resources that follow standardized specifications, complete the complete process of map preview, editing, submission, and storage, and realize the symbolic management and rendering of maps.
	Layers displaying node control	The layers in the main view of the map will be classified and managed as nodes. It supports the display and right-click menu control on layer nodes through Checkbox, and the corresponding operations are implemented according to the layer type.
	GeoDatabase layers node control	Database connection pool node. Double click the database node to dynamically load its internal layer. The layer node can be dragged to the main view or displayed by double clicking the mouse. Different levels of nodes have corresponding shortcut menus. The database node menu completes database connection testing, editing, layer list management, and deletion; The layer node menu supports layer export, conversion and deletion.

Classify	Item	Function description
	GeoServer layers node control	GeoServer connection pool node. Double click the server node to dynamically load the server's internal workspace and layer nodes; Layer nodes can be dragged to the main view or displayed by double clicking. The nodes at different levels have corresponding shortcut menus. The GeoServer level node menu completes the map server connection test, editing the connection, obtaining the server synchronization data (the GeoServer server workspace, data storage and its database connection configuration), workspace management (the workspace parameters are localized and modified and synchronized to the server), refreshing nodes, and deleting; The workspace node menu completes the data storage management and layer import. In particular, in the data storage list, you can edit and modify the database connection and maintain the layer list for each item in the list, including the details of the layer and the maintenance of addition and deletion.
Map query		It supports SQL queries on layer data tables in the main map view and each independent map view, and the query results are highlighted on the map. Support Shp vector file, Geodatabase layer, GeoServer layer and other data types.
Features Selection		In the main map view and each independent map view, you can select map features, highlight and open the data table, edit, modify, save and submit attribute data. Support Shp vector file, Geodatabase layer, GeoServer layer and other data types.
Map editing	Cartography	In the main map view and each independent map view, according to the geometric type of the current layer, the mouse can be used to dot, draw lines, and save images. Support Shp vector file, Geodatabase layer, WFS map service in GeoServer and other data types.
	Features assignment	In the main map view and each independent map view, you can modify and edit attribute data in the map feature form, and submit it for saving. Support Shp vector file, Geodatabase layer, WFS map service in GeoServer and other data types.
	Data conversion	Shp to Csv,Shp to Kml, Shp to GeoJson, Csv to Shp, Kml to Shp, GeoJson to Shp.
	Data processing	Vector and raster coordinate system conversion, raster NoData processing, raster tiles slice and mosaic merge.

Classify	Item	Function description
Create Shp	Create original Shp	Realize the full process processing of the design, editing, drawing, data saving, importing into the database, and publishing to GeoServer of the original Shp format vector layer.
	Transfer external data to Shp	Realize the conversion of structured data such as Csv, Kml and GeoJson to Shp vector layer.
	Geodatabase export Shp	Support, but not limited to, the export of geographic database features such as Oracle, PostGIS (PostgreSQL+GIS function extension), MySQL, and SQLServer to Shp.
Figure 3-25：Geodatabase node popup menu	GeoServer export Shp	Support the export of vector layers in GeoServer as Shp.
Layer resource management	Vector layers resource management	The client vector layer is brought into the program resource management system by selecting files to achieve a unified resource management pool for the client vector layer.
	Raster layers resource management	The client grid image layer is included in the program resource management system by selecting files, so as to achieve a unified resource management pool for client grid images.
Import layers into Geodatabase		Import the Shp layer in the client's vector layer resource management pool to Oracle, PostGIS, MySQL, SQLServer and other geographic databases.
Layers published to GeoServer	Publish Shp vector file	Publish the Shp layer in the client's vector layer resource management pool to GeoServer, store it in the data cache directory specified by GeoServer in the form of a file, and output such standardized map services as wms/wfs/kml , and provide visual map services for WebGIS.
	Publish raster file	Publish the image layers in the grid layer resource management pool of the client to GeoServer, store them in the data cache directory specified by GeoServer as files, output the standardized map services such as wms/wcs/wmts, and provide visual map services for WebGIS.

Classify	Item	Function description
	Publish Geodatabase vector layer	Import the shp files in the shp resource pool into the geodatabase, each shp will be converted into a feature data table, and then all the feature tables will be data source for the GeoServer which integrates the built-in JDBC engine driver, such then realize the access and processing of the map data in geodatabase, and output the standardized map services such as wms/wfs/kml, and provide visual map services for WebGIS.
Symbol system management	Create sld symbol file	Create sld layer style definition files of different feature types of point、multiPoint、lineString、multiLineString、polygon、multiPolygom to define the rendering mode of the layer.
	Manage sld symbol files	The client sld symbols are incorporated into the program resource management system by selecting files to achieve a unified resource management pool for the client sld symbols.
	Get server sld symbols	Obtain the sld symbol files on the GeoServer, synchronize them to the local client, and incorporate them into the program resource management system to achieve a unified resource management pool for the client sld symbols.
	Edit sld symbol file	Edit the sld symbol file.
	Synchronize the sld files to the server	Submit the sld files in the client sld resource pool to GeoServer.
Geodatabase connection pool	New Geodatabase connection	PyramidMap supports direct connection access to DBMS databases with spatial spatial data storage capabilities to realize the storage and conversion of map data. It supports (but is not limited to) Oracle, PostGIS (PostgreSQL+GIS function extension), MySQL, SQLServer and other databases. After the connection parameters are configured and tested, the above database resource connection pool is created and maintained.
	Maintain Geodatabase connection pool	PyramidMap manages the resource allocation of the geodatabase in the way of connection pool, which is selected when the Shp layer is imported into the database and published. In the resource list, you can select operations such as modification, connection test, and layer import/export.

Classify	Item	Function description
	Geodatabase layers management	Import the Shp files that have been included in the PyramidMap resource pool into the geodatabase; Export the feature layers in the geodatabase to Shp or Kml, GeoJson and other format files in the specified path.
	Geodatabase layers preview	Select the feature layer under the geodatabase in the database connection pool,for data query and layer preview.
GeoServer connection pool	New GeoServer connection	PyramidMap supports direct connection access with GeoServer map server, realizes multi type layer publishing function, and provides layer service interface for WebGIS. After the connection parameters are configured and tested successfully, create and maintain the GeoServer resource connection pool.
	Manage GeoServer connections	PyramidMap manages the resource configuration of the GeoServer in the way of connection pool. You can select modification, connection test, layer import and export and other related operations in the resource list.
	Manage workspace and data storage	PyramidMap can be used as a visual client of GeoServer to assist users in managing the workspace and data storage in a graphical interface. Usually, these operations require professional GIS personnel on the web console of GeoServer. The operations are complex and require high professional skills for operators. PyramidMap helps users realize this process through visual interface guidance, making this process very simple.
	Manage Server Layers	PyramidMap can be used as a visual client of GeoServer to assist users in uploading and publishing client layers, exporting and converting server layers in a graphical interface. Usually, these operations require professional GIS personnel on the web console of GeoServer. The operations are complex and require high professional skills for operators. PyramidMap helps users realize this process through visual interface guidance, making this process very simple.
	GeoServer layers preview	PyramidMap can be used as the visualization client of GeoServer. It can display the layers in GeoServer in the map view of the main interface, and export and convert the layers accordingly, thus simplifying the difficulty of secondary development and application.

Classify	Item	Function description
	Management GeoServer sld symbols	Sld (Styled layer description), the layer rendering style description file, and the map is drawn according to the description of sld, to realize the symbolization, color matching, transparency, text annotation and other rendering display of different types of elements of points, lines, and surfaces. PyramidMap can be used as the visualization client of GeoServer. It can help users to realize the localization creation and maintenance of sld files, keep synchronization with the server, and preset the server layer and the client layer during the release process. Usually, these operations require professional GIS personnel on the web console of GeoServer. The operations are complex and require high professional skills for operators. PyramidMap helps users realize this process through visual interface guidance, making this process very simple.

Table 2-1: PyramidMap functions list

2.4 Release

Functions	Release version			Application scenarios
	Basic	Standard	Professional	
Map view	●	●	●	Shp, Tiff, database and GeoServer layer, online base map display.
Map query	●	●	●	Shp, database and GeoServer vector layer data query and list.
Map features Selection	●	●	●	Select features on the map for editing and deleting.
Map drawing(point, line, polygon)	●	●	●	Create points, lines, and polygons on the map.
Map editing(graphics and attribute)	●	●	●	Edit and delete map element attribute data.
Map saving(file, database, GeoServer)			●	Submit saving the new, modified map features or delete them.
Map data conversion		●	●	Interconversion between Shp、Csv、Kml、GeoJson and other formats
Coordinate system conversion		●	●	Interconversion between all standardized coordinate system.
Vector and Raster spatial processing		●	●	Raster noData processing, raster tiles and mosaic together.
Design map symbols	●	●	●	Map symbols including shape,graphics,size,color and annotation.
Get GeoServer sld symbols	●	●	●	The client obtains the sld symbols on the GeoServer.
Client slds submitted to GeoServer			●	Synchronize the client's sld symbols to the GeoServer.
Client vector layers pool	●	●	●	The list of vector layer resources maintained by the client.
Client raster layers pool	●	●	●	The list of raster layer resources maintained by the client.
Vector layer imported to Geodatabase			●	Import the client's shp files into the Geodatabase.
Publish vector layers to GeoServer			●	Publish the client's shp files to GeoServer data directory.
Publish database layers to GeoServer			●	Import the shp to the Geodatabase, and then publish to the GeoServer.
Publish raster layers to GeoServer			●	Publish the client's raster files to GeoServer data directory.
Geodatabase layers exported		●	●	The layers in Geodatabase exported to Shp, Kml, GeoJson.
GeoServer layers exported		●	●	The layers in GeoServer exported to Shp, Kml, GeoJson.
GeoServer workspace and data storage			●	Managing GeoServer workspace and data storage in client.
Geodatabase connections pool	●	●	●	Create and maintain Geodatabase connections pool in client.
GeoServer connections pool	●	●	●	Create and maintain GeoServer connections pool in client.

Table 2-2: PyramidMap release functions list

3 Map view

The main map interface is divided into four functional areas, as shown in Figure 3-1. They are the main map view and the display container of all map data. They accept the loading and display of various map resource data from Shp files, image files, Geodatabase, GeoServer, online maps, etc; The online layer node on the left is the layer data source node that has been loaded into the main map view. It is classified according to the path layer, and has the corresponding level menu to complete the operation as instructed; On the upper right is the Geodatabase data source node, which is classified according to the data connection layer table, and has the corresponding level

menu. The operation can be completed according to the instructions. The layer table can be dragged to the map view area or displayed by double clicking the mouse, and automatically added to the layer display node on the left; The lower right side is the GeoServer workspace and layer data source node, which are classified according to GeoServer connection - workspace - layer, and have the corresponding level menu. The operation is completed according to the instructions. The layer can be dragged to the map view area or displayed by double clicking the mouse, and automatically added to the layer display node on the left.

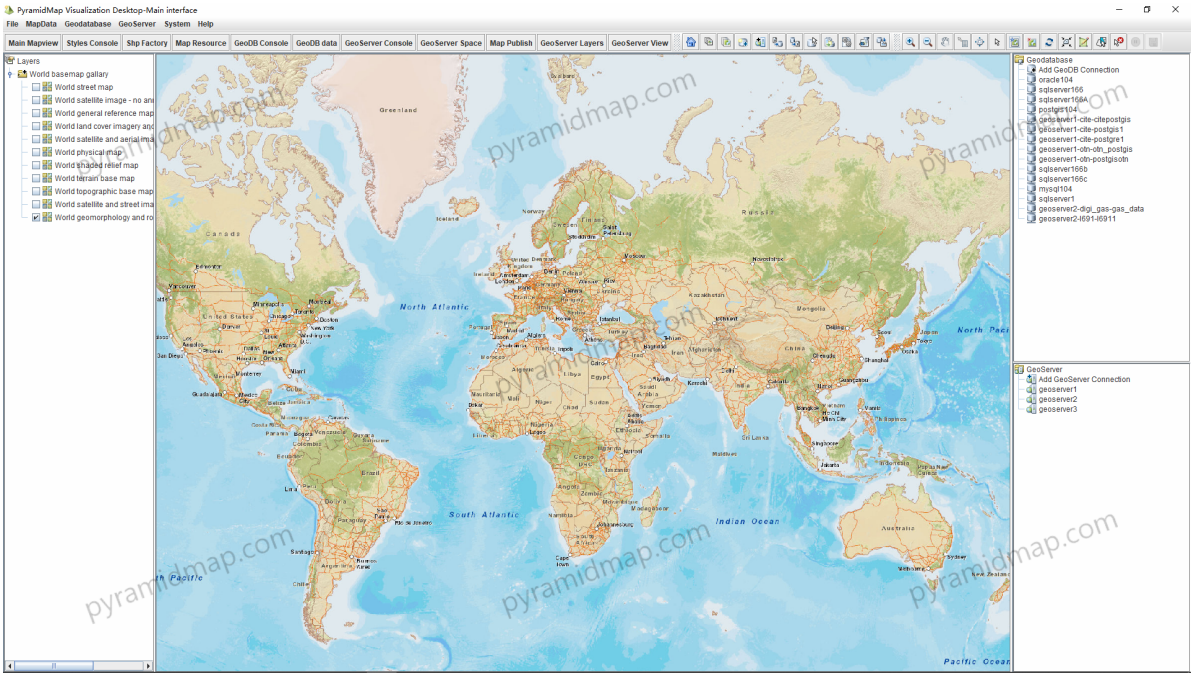

Figure 3-1: Main map viewer

3.1 Load basemap

The base map provides a reference map for the system and an environment for the content to be displayed in the map. When creating a new map, you can select an underlay to use. PyramidMap currently supports many base map resource based on Web Mercator coordinate system and others standard coordinate system. You can change the base map of the current map at any time: you can select the base map from the base map library. With the help of the base map, accurate spatial location calibration can be carried out, map data related to location can be processed, dot, line and picture can be plotted on the map, and accurate positioning and track query can be carried out. The main interface loads and switches the base map through the shortcut menu in the toolbar, as shown in Figure 3-2.

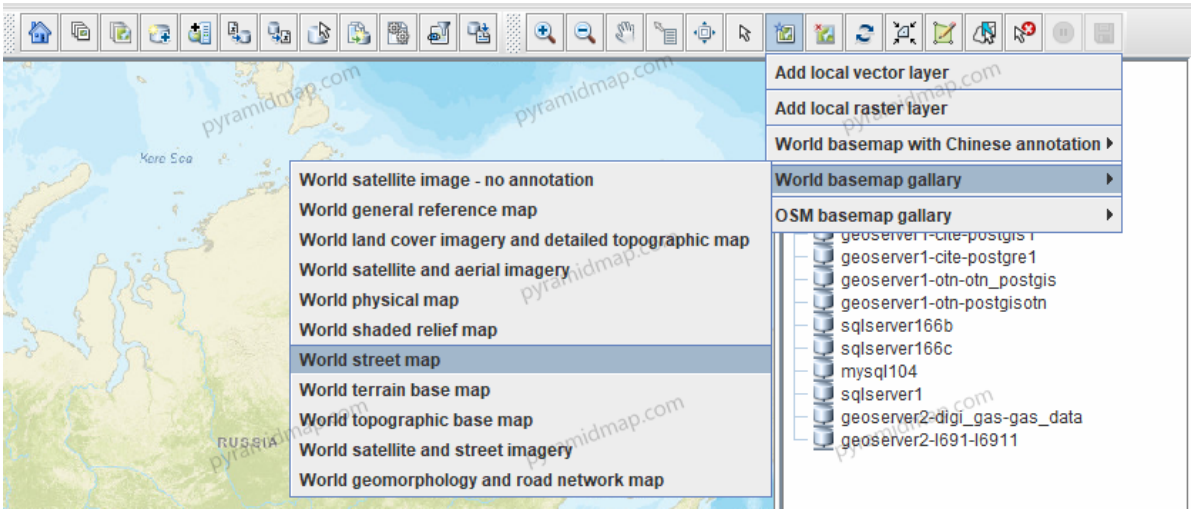

Figure 3-2: Main viewer base map menu

PyramidMap supports vector and raster type base map resources，This base map is designed to be used as a general reference map for informational purposes as well as for GIS professionals and other users to creating web maps and web mapping applications.

The world general reference map includes administrative boundaries, cities, protected areas, highways, roads, railways, water features, buildings and landmarks, overlaid on shaded relief and land cover imagery for added context. This reference map display effect is shown in Figure 3-3.

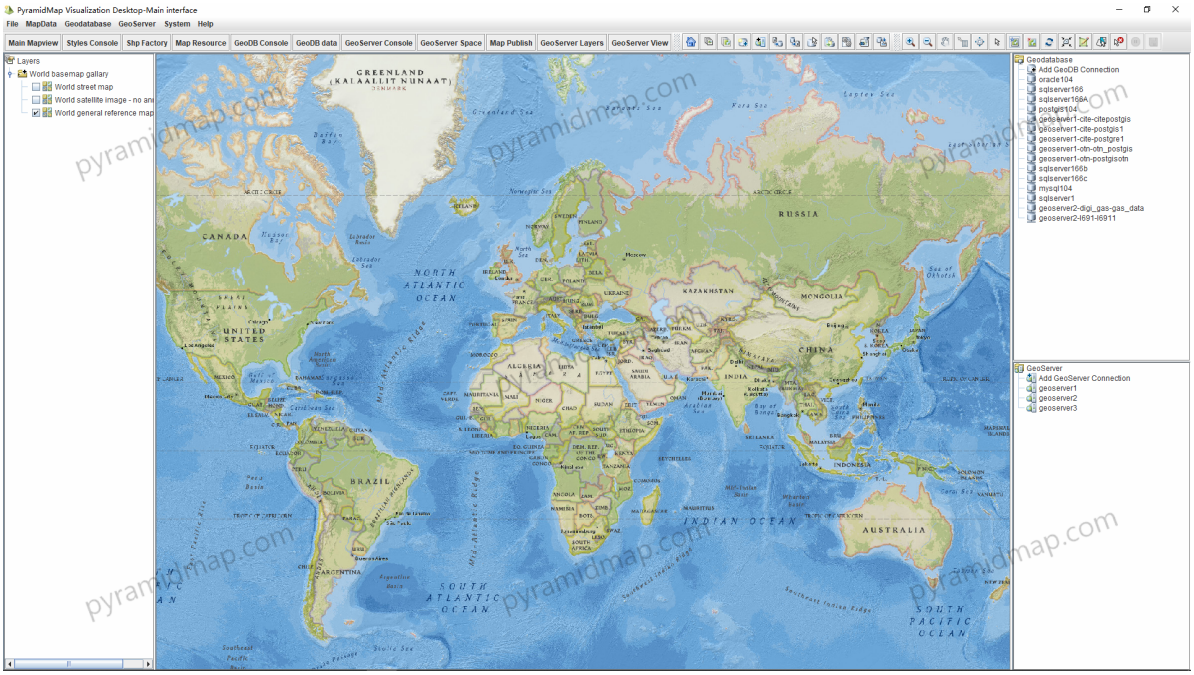

Figure 3-3：The world general reference map display effect

The local details somewhere for the world general reference map are shown in Figure 3-4.

Figure 3-4：The world general reference map somewhere local details

The world land cover imagery and detailed topographic map presents land cover imagery and detailed topographic maps for the world. This map display effect is shown in Figure 3-5.

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3.2 Load business layer

The map view supports the following map data: Shp file type, Geodatabase geographic database type, WMS, WFS, WCS, WMTS and other standardized map services from GeoServer, and various online map resources that follow standardized specifications. The layers added to the view are classified according to the data source path and displayed in the layer node on the left. The hierarchical operation is implemented through the right-click shortcut menu.

3.2.1 Load local Shp layer

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3.2.2 Load Geodatabase layer

In the node tree of the database connection pool on the main interface, double-click the database node to dynamically load its internal layer. Drag the layer node to the map view or double-click the mouse to display it. At the same time, the layer mount node on the left is formed, as shown in Figure 3-24.

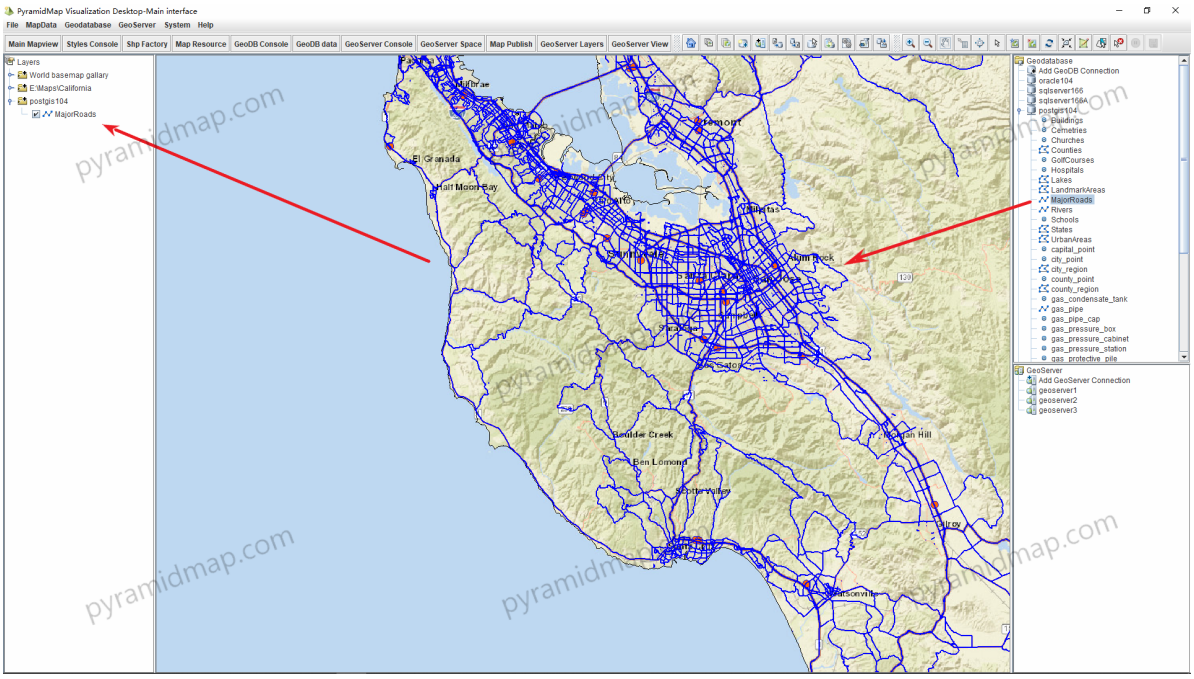

Figure 3-24：Loading and displaying vector layers in Geodatabase

3.2.3 Geodatabase node catalog and operation

On the upper right side of the main interface, there is a Geodatabase connection pool node, which provides a Geodatabase data source. Double click the database node to dynamically load its internal layers. The layer nodes can be dragged or double clicked to displaying in the map viewer. Different levels of nodes have corresponding shortcut menus. The database node menu completes database connection test, editing, layer list management, and deletion operations, as shown in Figure 3-25.

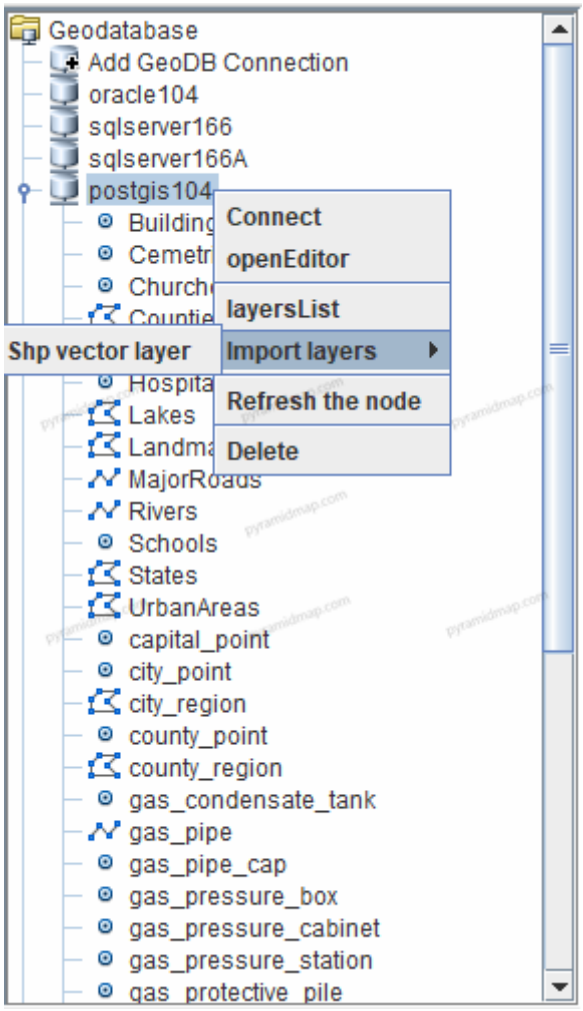

Figure 3-25：Geodatabase node popup menu

The layer node menu supports exporting database layers to Shp, Kml, Csv, GeoJson and other formats or being deleted, as shown in Figure 3-26.

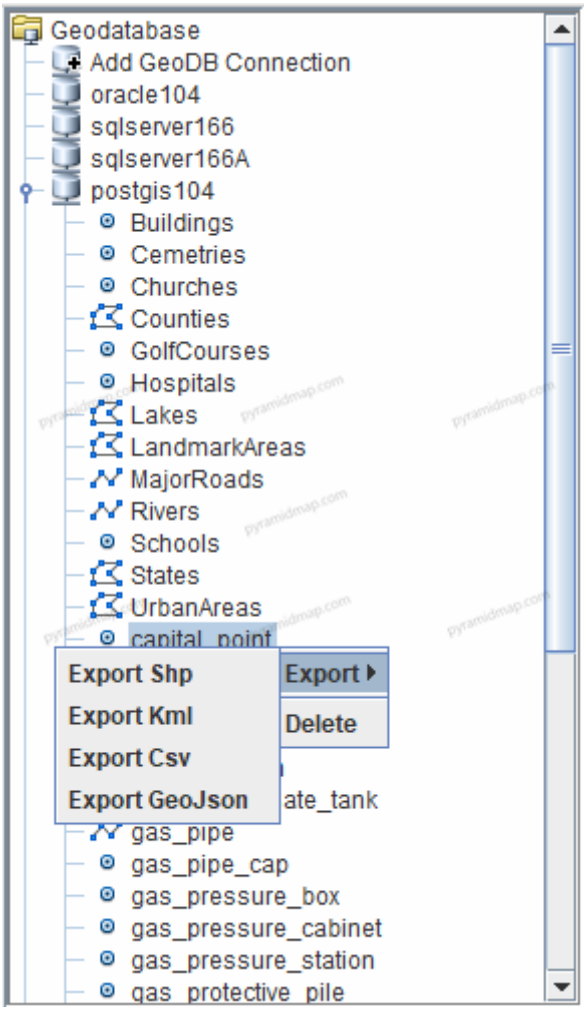

Figure 3-26：Geodatabase layer node popup menu

3.2.4 Load GeoServer layer

In the node tree of the GeoServer connection pool in the main interface, double-click the GeoServer node to dynamically load its internal workspace and its layers. The layer nodes can be dragged or double clicked to displaying in the map viewer, at the same time, the layer mount node on the left is formed, as shown in Figure 3-27.

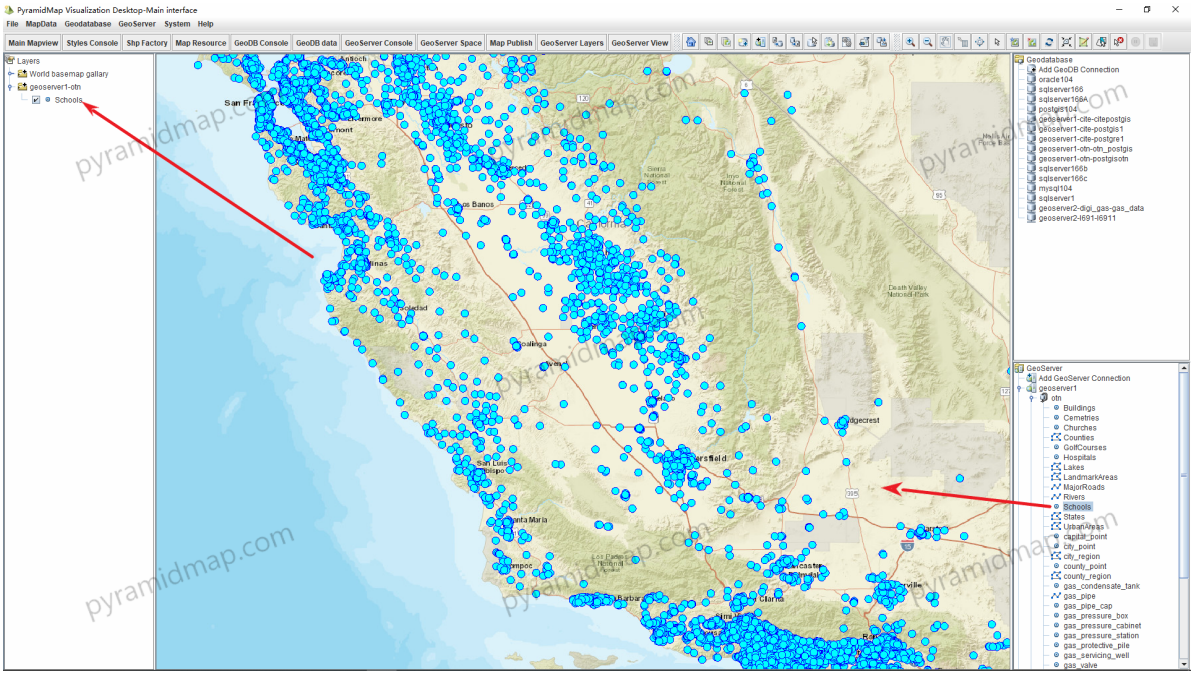

Figure 3-27：Loading and displaying vector layers in GeoServer

3.2.5 GeoServer node catalog and operation

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3.3 Visible layer node operations

3.3.1 Layer control

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3.3.2 Symbol rendering

Select New sld Symbol from the shortcut menu of the vector layer display node to enter the sld symbol definition interface, as shown in Figure 3-36.

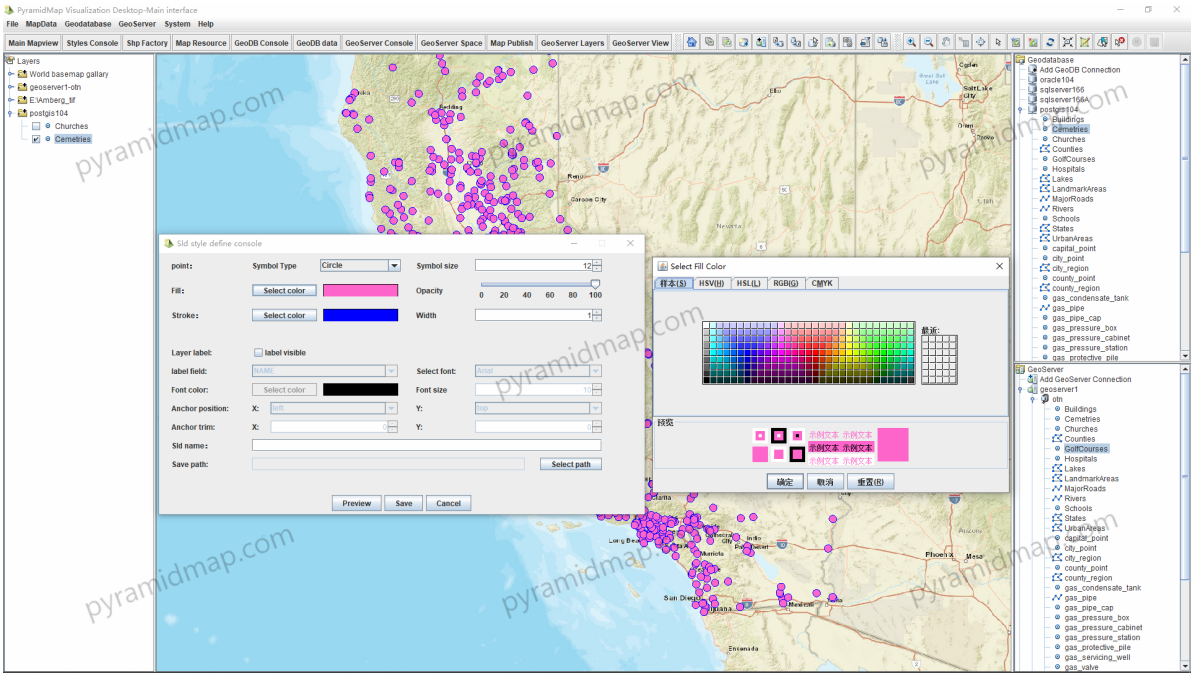

Figure 3-36：Definition and effect of map Sld symbols

With this operation, create a style definition file for point (Point, MultiPoint), line (LineString, MultiLineString), polygon (Polygon, MultiPolygon) type layers, and set the annotation field and font type, size, color, and annotation location. After the effect preview is satisfactory, save it as an sld file and include it in the PyramidMap resource pool for maintenance, The SLD resource pool maintained by PyramidMap client can provide feature symbol selection for layers. Select the SLD symbol on the layer node, as shown in Figure 3-37.----------
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3.3.3 Feature data table

Select the "Open shp table" option in the layer node on the left, as shown in Figure 3-40.

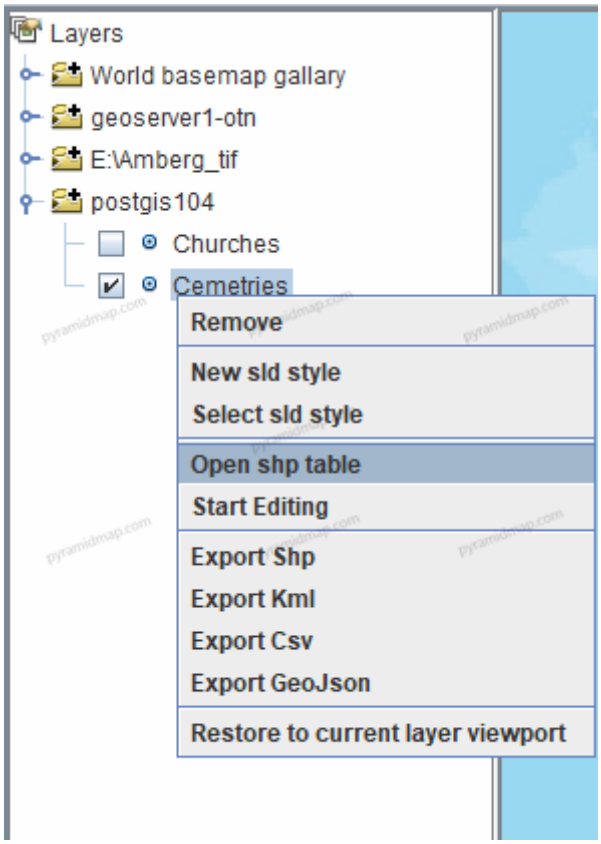

Figure 3-40：Open shp table

The feature data table and query page of the selected layer are shown in Figure 3-41.

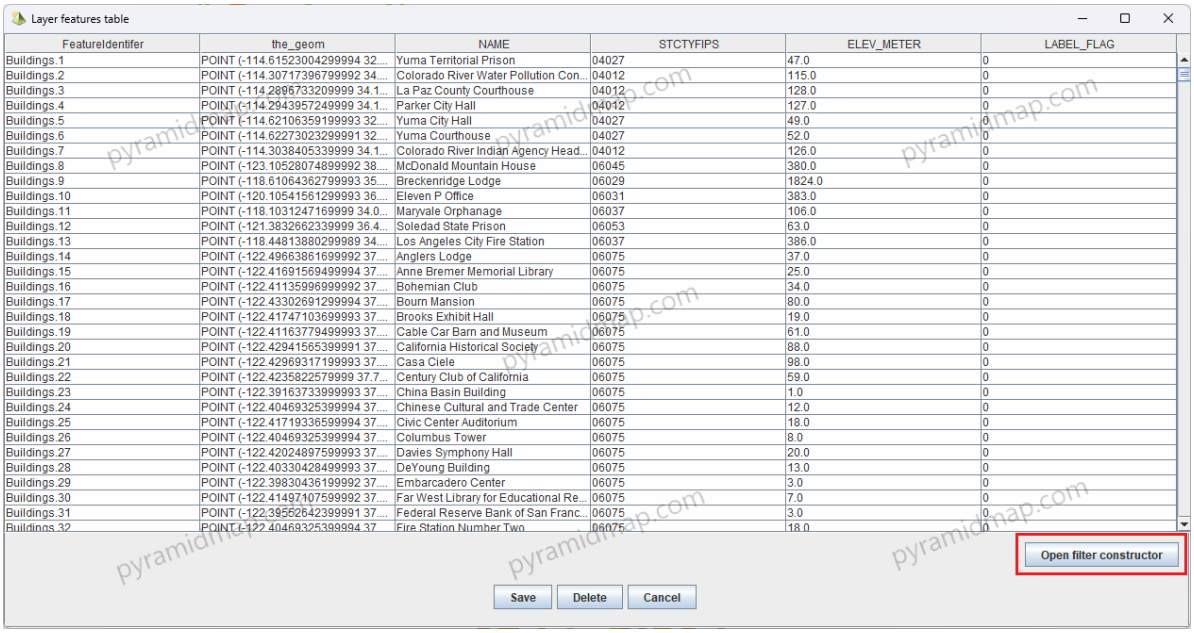

Figure 3-41：Shp table and query interface

In the layer data table interface, you can build a combined query condition based on all fields through the query tool to realize simple and complex queries on layers, as shown in Figure 3-42.

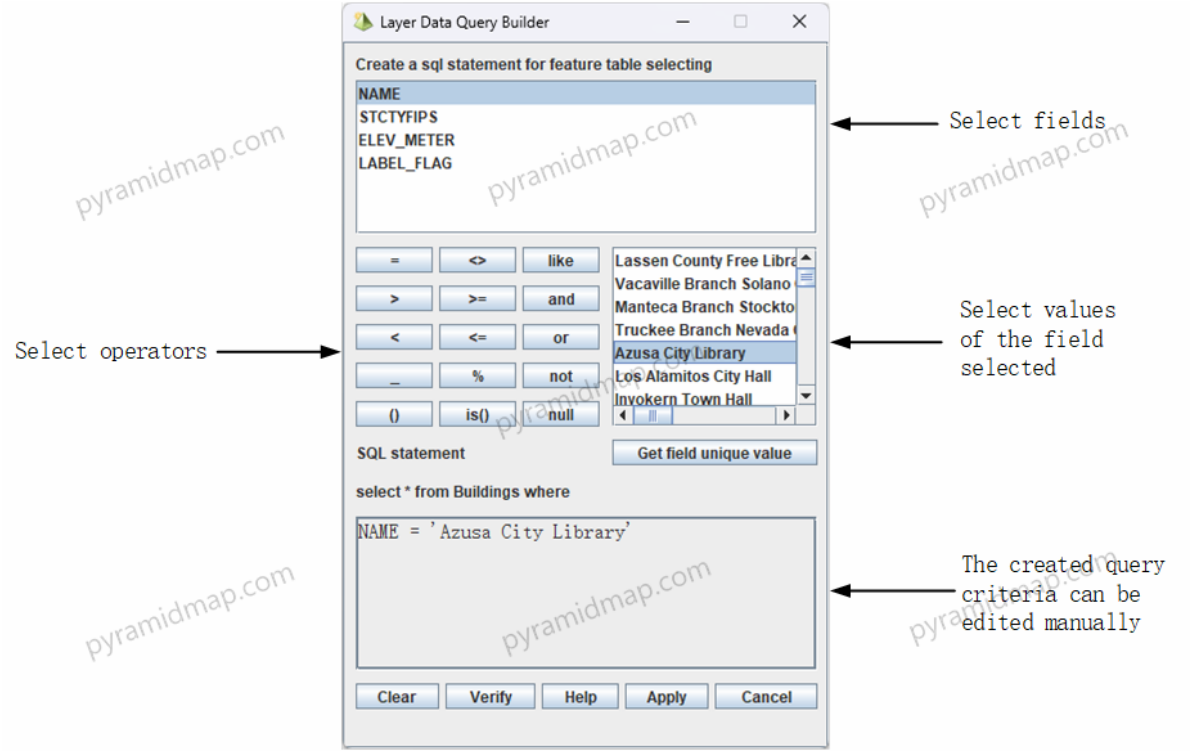

Figure 3-42：Layer table query constructor

In the query constructor, you can verify the validity of the built query statements, as shown in Figure 3-43.

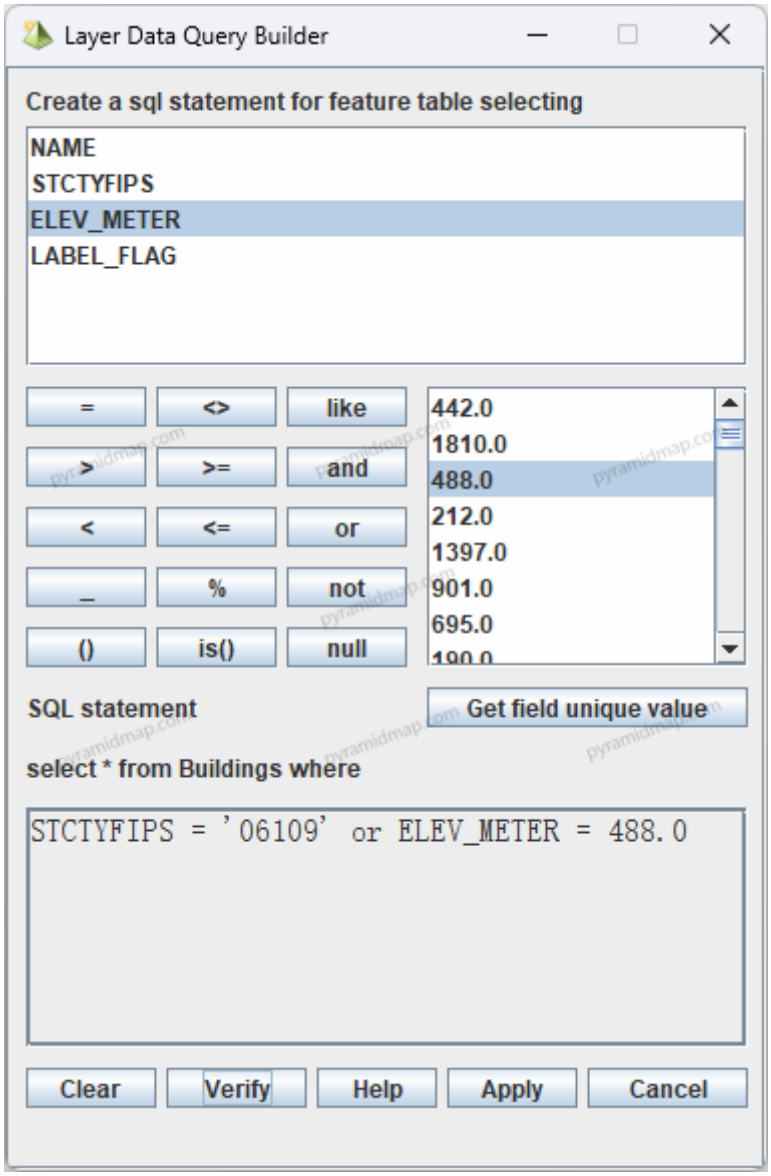

Figure 3-43：Query statement validation

The validation results are shown in Figure 3-44.

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4 Map editing

4.1 Create Shp

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4.2 Graphical Editing

Map data consists of geometric shapes representing space vectors and feature attributes data. Therefore, map editing includes two parts, they are graphical editing and attributes data editing.

4.2.1 Main view editor

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4.2.2 Independent view editor

In the Shp layer resource management and Geodatabase layer resource management modules, the independent display view of each layer can be opened through the "Preview and Edit" button to complete the editing operation function, as shown in Figure 4-11.

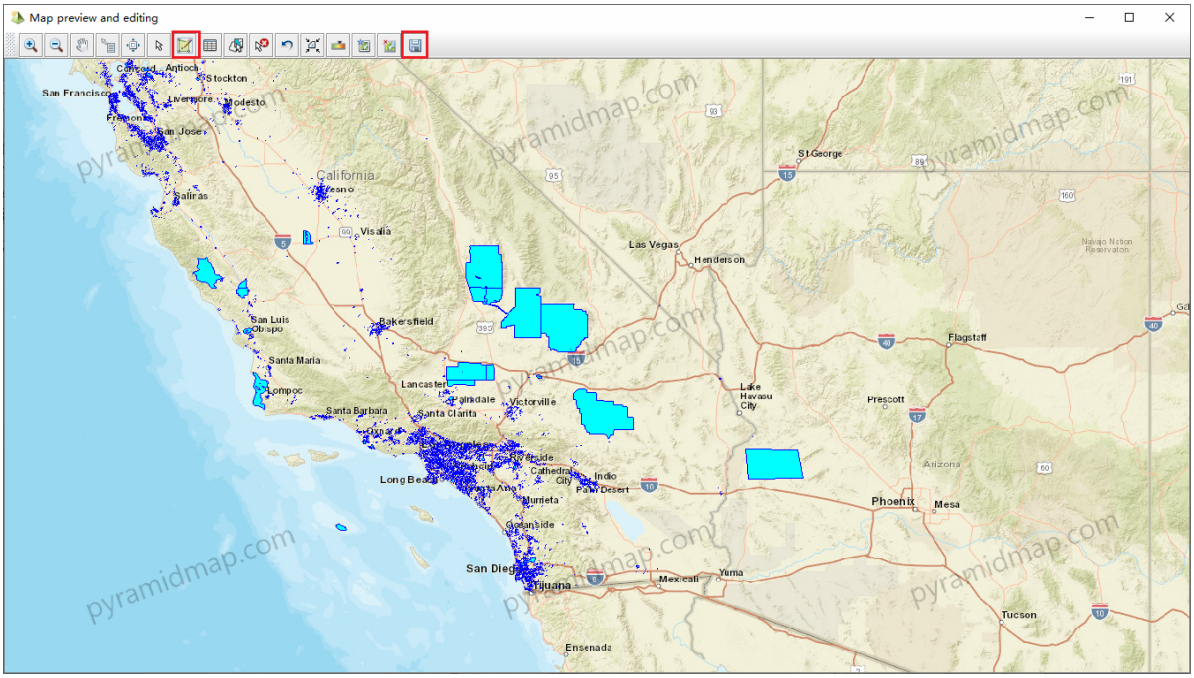

Figure 4-11： Layer independent display editing function page

Click the drawing button to realize the interactive drawing of the mouse on the map view. After that, click the "Save" button to update and save the data to the data source corresponding to the layer, Shp to the layer file, and the database layer to the feature table.

4.3 Attribute data editing

PyramidMap implements digital editing of the layer attribute table, which is respectively implemented in the main interface visualization layer node and the preview and editing in the Shp or Geodatabase geographical database layer list.

4.3.1 Editing in main map view

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4.3.2 Editing in individual map view

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5 Geodatabase and GeoServer

5.1 Geodatabase connection pool

PyramidMap supports direct connection access with geographic databases to realize the import, export, storage and conversion of map data, and supports (but is not limited to) Oracle, PostGIS (PostgreSQL+GIS function extension), MySQL, SQLServer and other databases. After PyramidMap creates a database connection, it is managed in the database connection pool mode to import, export, preview, edit and other operations of the map. PyramidMap provides two ways to create a geographic database connection: 1. create a database connection through the map database node on the main map display interface; 2. create a database connection on the database configuration page through "System" - "Geodatabase console" entrance.

5.1.1 Geodatabase data source node

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5.1.2 Geodatabase connection pool

Open the Geodatabase connection pool interface through "System" - "Geodatabase console", or directly click the "GeoDB console" button in the toolbar， as shown in Figure 5-3.

Figure 5-3：Create a Geodatabase connection through the system settings portal

The geodatabase connection configuration page is shown in Figure 5-4.

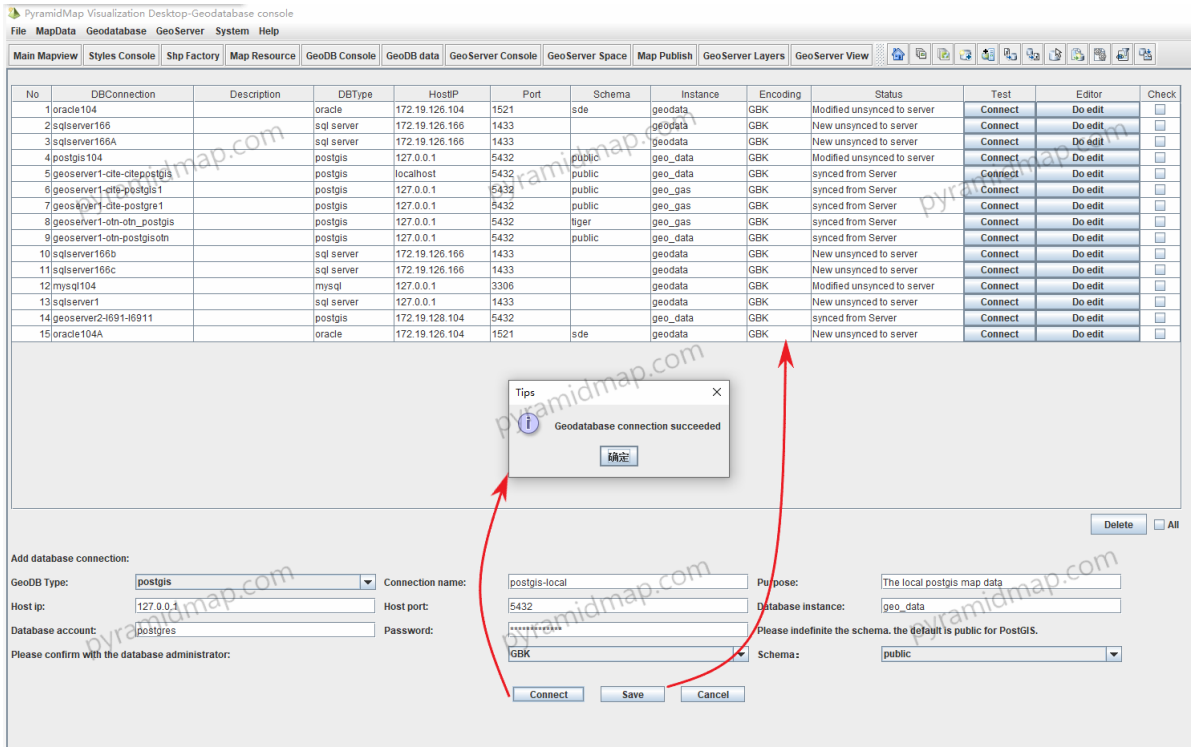

Figure 5-4：Geodatabase Connection Configuration and pool

The connections in the pool can be retested, edited and deleted, as shown in Figure 5-5.

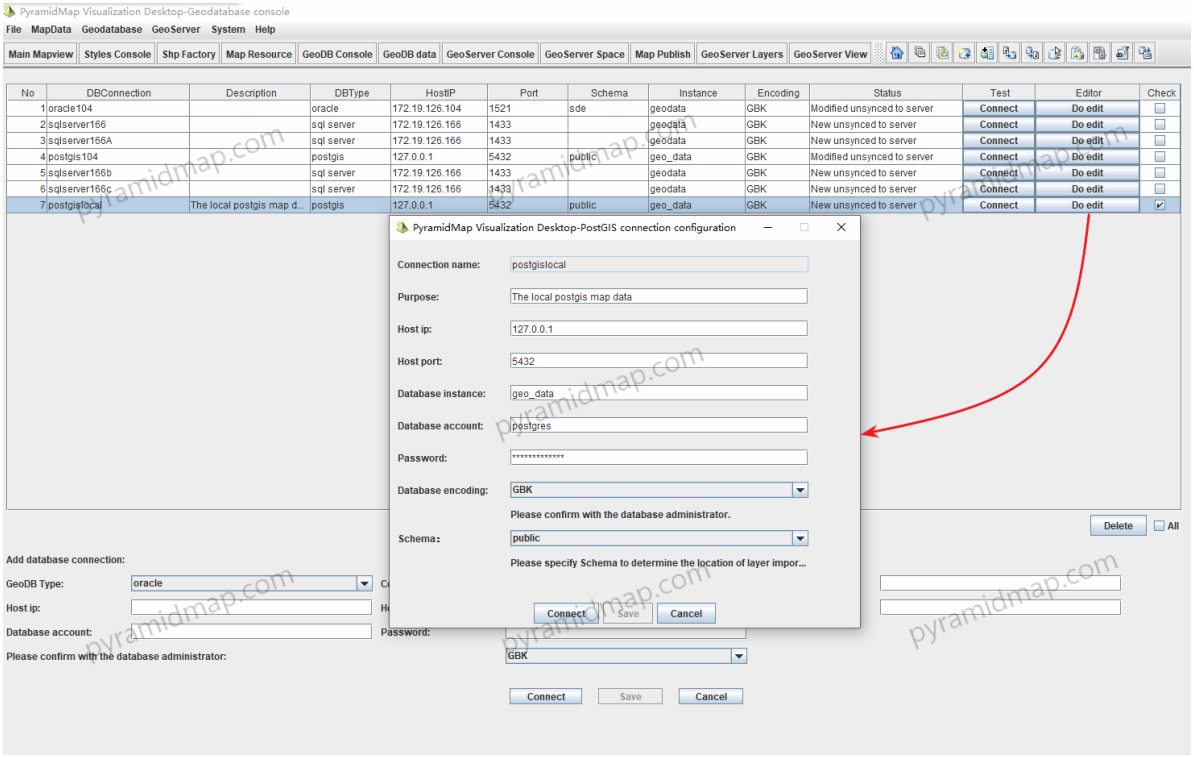

Figure 5-5： The connections in the pool can be retested, edited and deleted

Use the connection pool list to test, edit, modify, and delete the Geodatabase connection. Each connection has two button options : Connect and Do Edit.

.Connect: test whether the database connection is successful.

.Do edit: Re edit the Geodatabase connection to make it available.

5.2 GeoServer connection pool

PyramidMap supports direct connection access with GeoServer, realizes multi type layer publishing function, and provides layer service interface for WebGIS. After the connection parameters are configured and tested successfully, create and maintain the GeoServer resource connection pool. PyramidMap provides two ways to create a GeoServer connection: 1. Through the GeoServer tree node on the main interface; 2. Implement it on the GeoServer connection configuration module through "System" - "GeoServer console".

5.2.1 GeoServer data node

In the GeoServer connection node of the main interface, double-click Add GeoServer Connection, as shown in Figure 5-6.

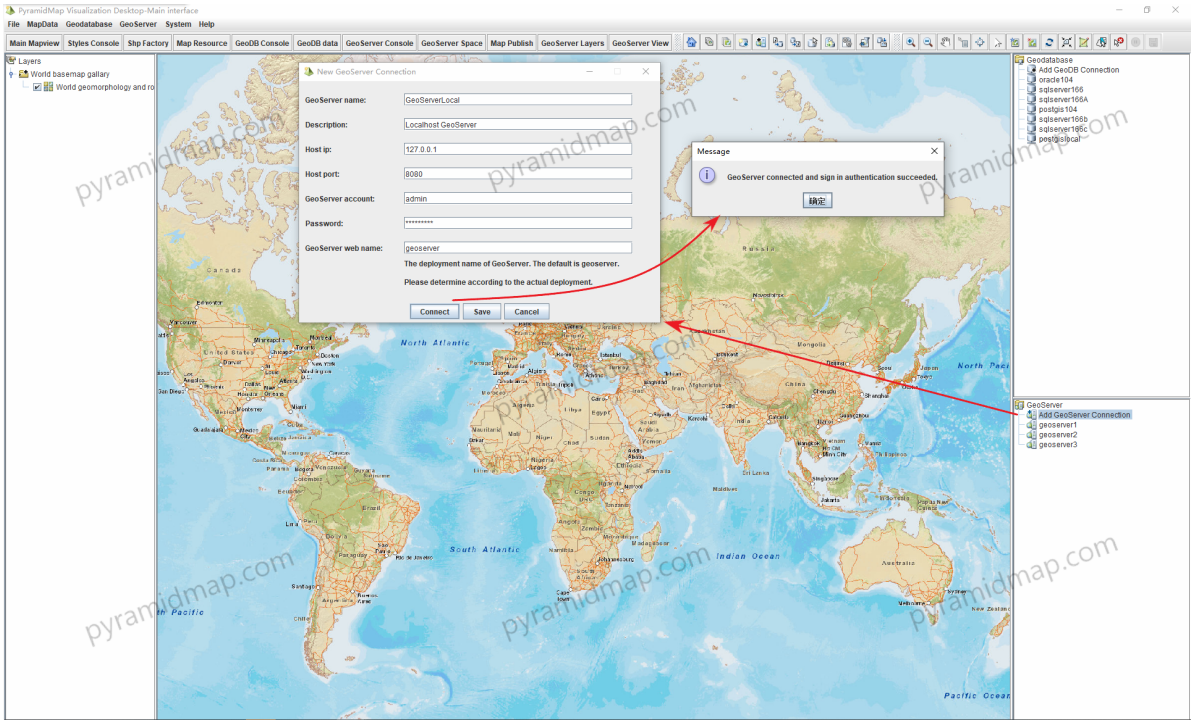

Figure 5-6：Create GeoServer connection through double-clicking on the GeoServer node in the main interface

Open the GeoServer connection configuration interface, enter the correct connection parameters, after the connection testing successful, you can save and create a valid GeoServer connection and hosting the connection in resource pool, and dynamically add it to the GeoServer connection node. Description of interface input parameters:

- GeoServer name: Customize the GeoServer server connection naming.
- Description：Customize the GeoServer connection purpose describe.
- Host IP：IP address of the server where the GeoServer is hosted.
- Port：GeoServer port number. (The port number of the web server hosting GeoServer, such as Tomcat)
- GeoServer account：GeoServer administrator account, default admin, please contact the web administrator for confirmation.
- Password: GeoServer administrator password, please contact the web administrator for confirmation.
- GeoServer web name：The deployment name of GeoServer in the web service. The default is geoserver. Please contact the web administrator for confirmation.

5.2.2 GeoServer connection pool

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5.2.3 Manage GeoServer connections

PyramidMap maintain the GeoServer connections in resource pool, manage the server internal workspace, data storage and layers in the function

modules, as shown in Figure 5-9.

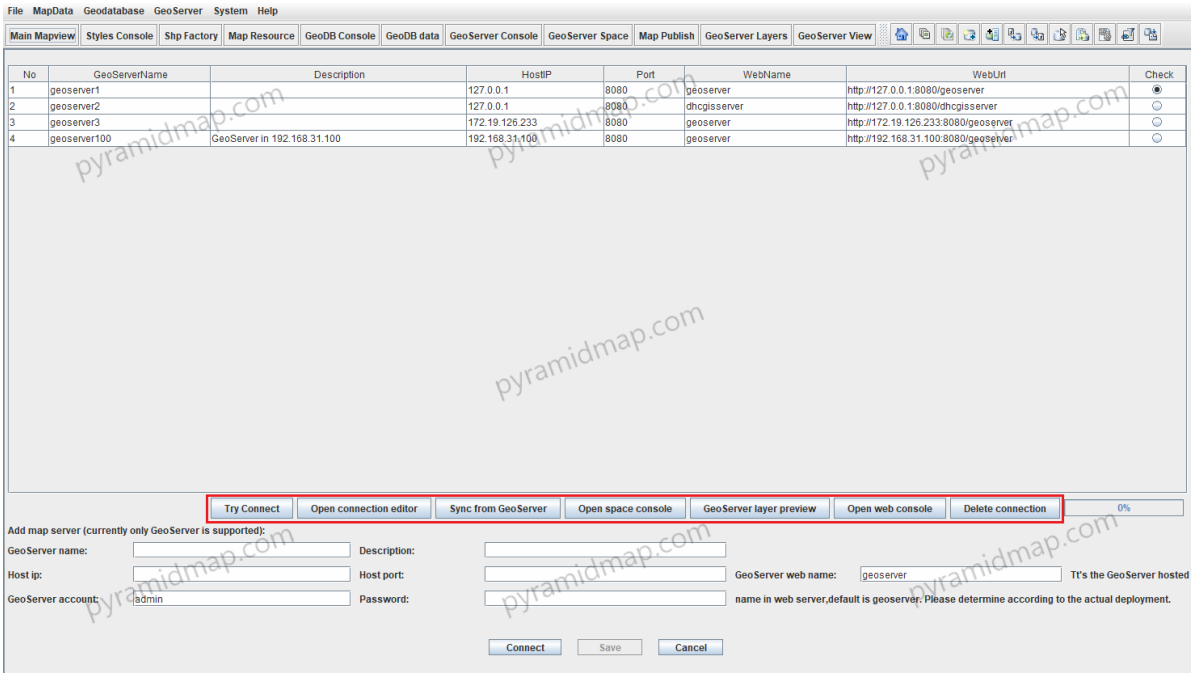

Figure 5-9：Internal management of GeoServer

GeoServer internal management identify：

- Try connect: test whether the selected map server connection is available.
- Open Connection editor: Edit the selected GeoServer connection properties.
- Sync from GeoServer: obtain the selected GeoServer workspace, data storage and database connection properties data, and synchronizing them to the client.
- Open space console: query, edit and modify, delete the workspace and data storage of the selected GeoServer.
- GeoServer layer preview: get the list of selected GeoServer layers and preview them.
- Delete connection: Delete the selected GeoServer connection.

5.3 GeoServer internal operate

The internal space of GeoServer is divided into three levels: workspaces, data storages and layers. As the client of GeoServer, PyramidMap can visually maintain these modules. PyramidMap provides multiple forms of access management to GeoServer server space.

5.3.1 GeoServer Workspace

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5.3.2 GeoServer data storage

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5.3.3 GeoServer pool console

PyramidMap centrally manages GeoServer connections in the form of resource management pools, as shown in Figure 5-17.

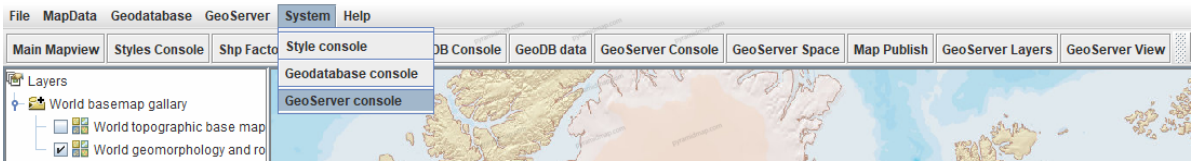

Figure 5-17：GeoServer connections resource management pool entrance

PyramidMap creates and maintains the GeoServer resource connection pool, and manages and maintains its internal service space for each GeoServer connection. The module is shown in Figure 5-18.

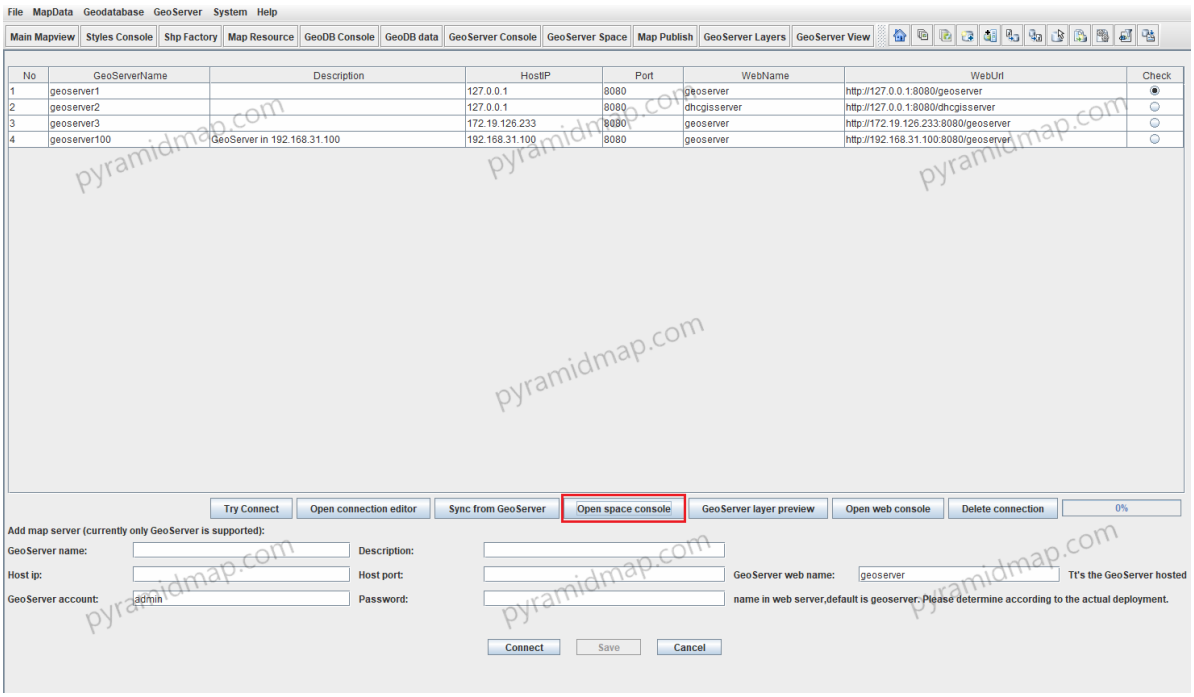

图5-18：GeoServer connections pool and operation options

Select the GeoServer and click “open space console“ button, as shown in Figure 5-19.

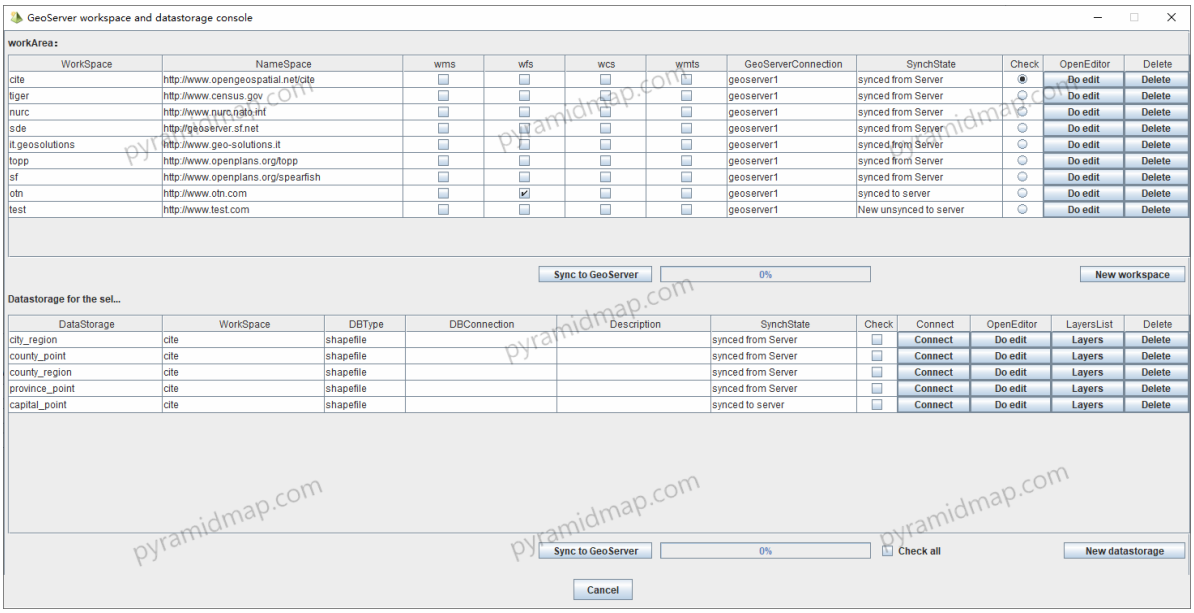

Figure 5-19：GeoServer workspace and data storage managing pool

The GeoServer workspace and data storage managing pool module displays the list of all workspaces of the server and the data storages list of each workspace. The client side and the server side maintain two-way synchronization to achieve visual management of the server side data by the client side.

In particular, PyramidMap implements a client cache maintenance mechanism for GeoServer. New and modified workspaces and data stores are temporarily stored on the client. When necessary, they are submitted to the GeoServer server in batches. At the same time, the GeoServer server data can be synchronized to the client at any time. This is the two-way synchronization mechanism between PyramidMap and GeoServer.

6 Map data and conversion

PyramidMap supports five types of map data sources, namely Shp file vector layer, file image layer, Geodatabase vector layer, GeoServer vector layer and raster tile layer.

6.1 Shp layers pool

PyramidMap imports the client's Shp file vector layers into the resource pool through a file browser to form a Shp management list pool and supports various operations with corresponding buttons, as shown in Figure 6-1.

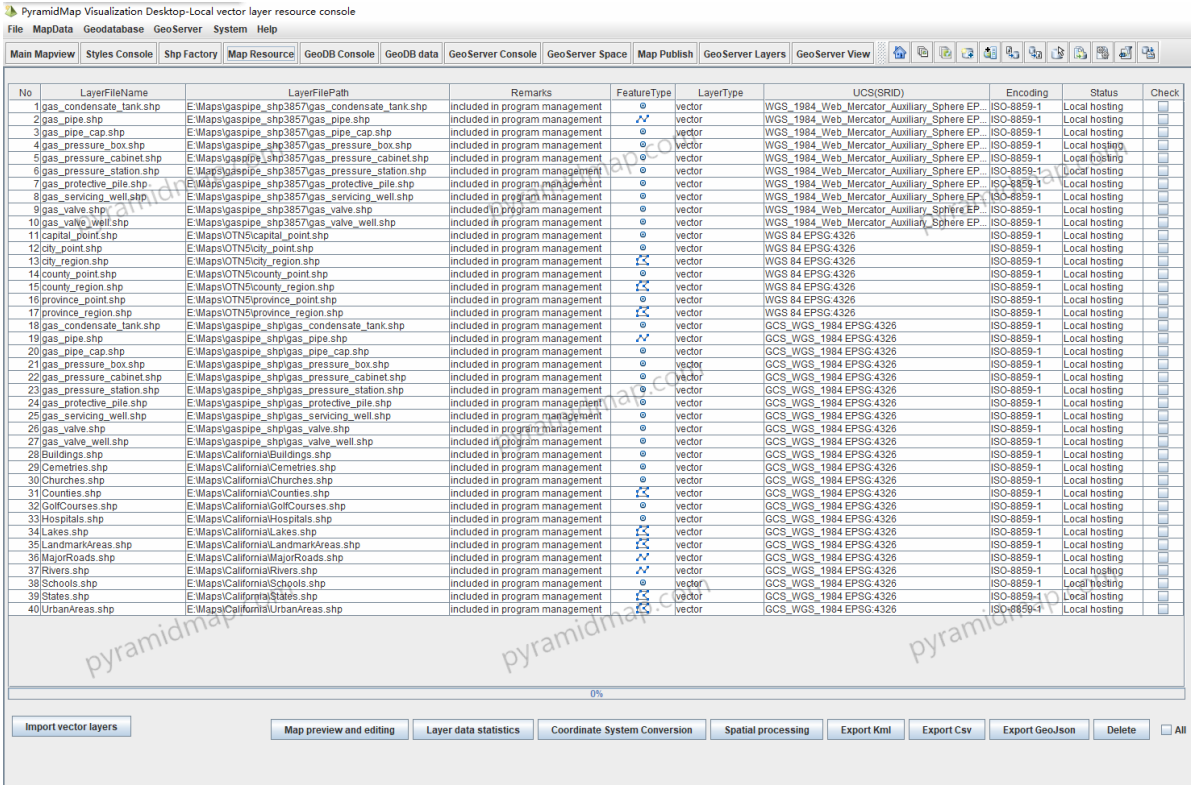

Figure 6-1 : Shp layers resource pool

Support various operations on Shp layer resources, including:

- Import vectorlayers: import client Shp files and GeoJson files into the resource management pool.
- Map preview and editing: preview and edit the Shp layer in independent view of each layer in the list pool.
- Layer data statistics: perform the features data statistics of the shp layer in the list pool.
- Coordinate system conversion: perform coordinate system conversion on the shp layer in the list pool.

- Spatial processing: perform spatial processing on shp layers in the list pool, including merging and intersection.
- Data conversion: Shp to Kml, Shp to Csv, Shp to GeoJson.
- Delete: Delete the shp layer in the list pool.

In particular, through the map preview and editing options, the selected layer file will be opened in an independent map view to preview and edit the layer, as shown in Figure 6-2.

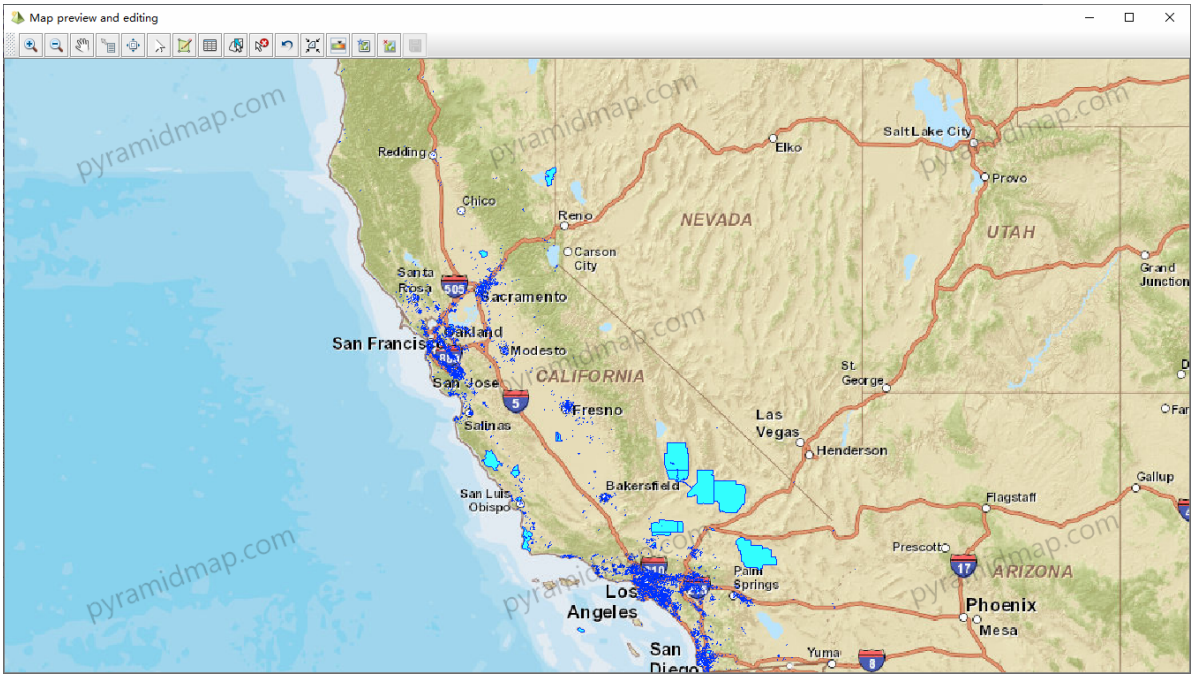

Figure 6-2：Open independent preview and editing view of single shp vector layer

Independent map view provides each layer with separate display, rendering, base map selection and overlay, graphical editing, attribute data editing in table, feature selection and deletion operations. It is a comprehensive map service for a single layer.

6.2 Raster layers pool

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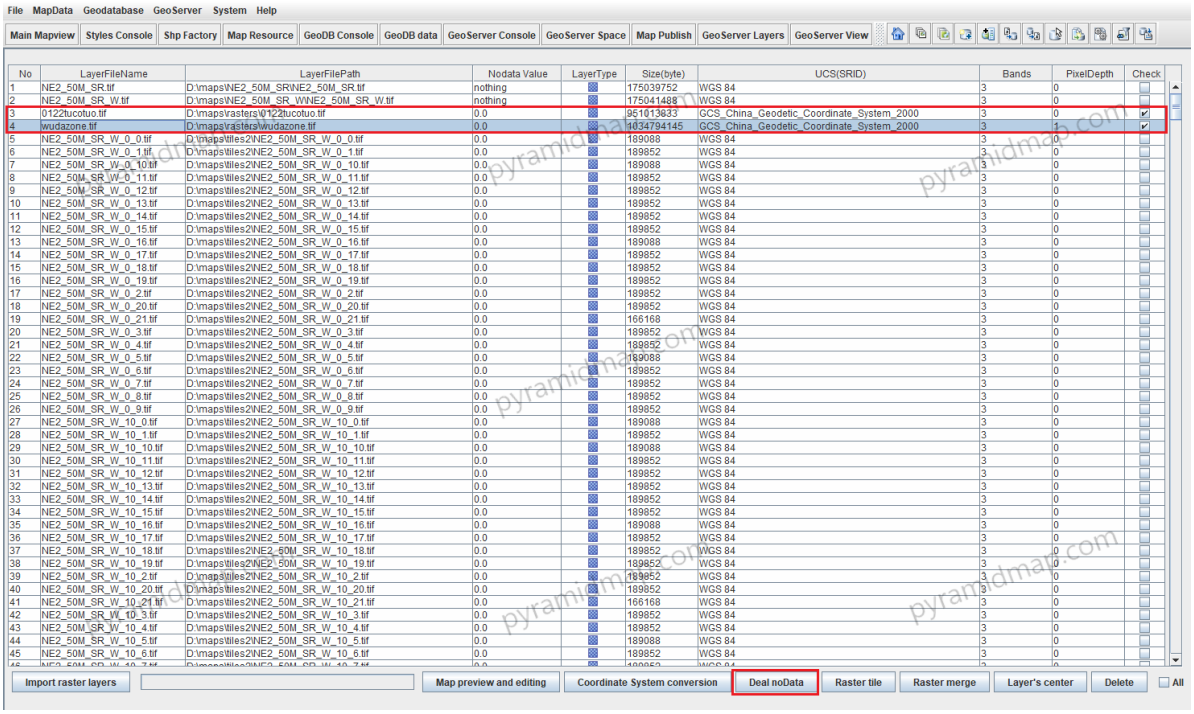
6.2.1 NoData processing

In general, raster images will have NoData values. These NoData are invalid values that do not have actual value and will interfere with image data analysis. Black image frame is a common NoData error, which is particularly common for UAV images and raster data sets after geographical reference processing. In this example, we remove the black border of raster image through NoData invalid value processing. The processing process is shown in Figure 6-5.

Figure 6-5：Remove the black border of raster image through NoData invalid value processing

PyramidMap perform batch NoData processing on images in the resource pool, as shown in Figure 6-6.



No	LayerFileName	LayerFilePath	Nodata Value	LayerType	Size(byte)	UCS(SRID)	Bands	PixelDepth	Check
1	NE2_50M_SR.tif	D:\maps\NE2_50M_SR\NE2_50M_SR.tif	nothing		175039752	WGS 84	3	0	
2	NE2_50M_SR_W.tif	D:\maps\NE2_50M_SR_W\NE2_50M_SR_W.tif	nothing		175041488	WGS 84	3	0	
3	0122tucotuo.tif	D:\maps\rasters\0122tucotuo.tif	0.0		951013833	GCS_China_Geodetic_Coordinate_System_2000	3	0	✔
4	wudazone.tif	D:\maps\rasters\wudazone.tif	0.0		1034794145	GCS_China_Geodetic_Coordinate_System_2000	3	1	✔
5	NE2_50M_SR_W_0_0.tif	D:\maps\tiles2\NE2_50M_SR_W_0_0.tif	0.0		189088	WGS 84	3	0	
6	NE2_50M_SR_W_0_1.tif	D:\maps\tiles2\NE2_50M_SR_W_0_1.tif	0.0		189852	WGS 84	3	0	
7	NE2_50M_SR_W_0_10.tif	D:\maps\tiles2\NE2_50M_SR_W_0_10.tif	0.0		189088	WGS 84	3	0	
8	NE2_50M_SR_W_0_11.tif	D:\maps\tiles2\NE2_50M_SR_W_0_11.tif	0.0		189852	WGS 84	3	0	
9	NE2_50M_SR_W_0_12.tif	D:\maps\tiles2\NE2_50M_SR_W_0_12.tif	0.0		189852	WGS 84	3	0	
10	NE2_50M_SR_W_0_13.tif	D:\maps\tiles2\NE2_50M_SR_W_0_13.tif	0.0		189852	WGS 84	3	0	
11	NE2_50M_SR_W_0_14.tif	D:\maps\tiles2\NE2_50M_SR_W_0_14.tif	0.0		189852	WGS 84	3	0	
12	NE2_50M_SR_W_0_15.tif	D:\maps\tiles2\NE2_50M_SR_W_0_15.tif	0.0		189852	WGS 84	3	0	
13	NE2_50M_SR_W_0_16.tif	D:\maps\tiles2\NE2_50M_SR_W_0_16.tif	0.0		189088	WGS 84	3	0	
14	NE2_50M_SR_W_0_17.tif	D:\maps\tiles2\NE2_50M_SR_W_0_17.tif	0.0		189852	WGS 84	3	0	
15	NE2_50M_SR_W_0_18.tif	D:\maps\tiles2\NE2_50M_SR_W_0_18.tif	0.0		189852	WGS 84	3	0	
16	NE2_50M_SR_W_0_19.tif	D:\maps\tiles2\NE2_50M_SR_W_0_19.tif	0.0		189852	WGS 84	3	0	
17	NE2_50M_SR_W_0_2.tif	D:\maps\tiles2\NE2_50M_SR_W_0_2.tif	0.0		189852	WGS 84	3	0	
18	NE2_50M_SR_W_0_20.tif	D:\maps\tiles2\NE2_50M_SR_W_0_20.tif	0.0		189852	WGS 84	3	0	
19	NE2_50M_SR_W_0_21.tif	D:\maps\tiles2\NE2_50M_SR_W_0_21.tif	0.0		166168	WGS 84	3	0	
20	NE2_50M_SR_W_0_3.tif	D:\maps\tiles2\NE2_50M_SR_W_0_3.tif	0.0		189852	WGS 84	3	0	
21	NE2_50M_SR_W_0_4.tif	D:\maps\tiles2\NE2_50M_SR_W_0_4.tif	0.0		189852	WGS 84	3	0	
22	NE2_50M_SR_W_0_5.tif	D:\maps\tiles2\NE2_50M_SR_W_0_5.tif	0.0		189088	WGS 84	3	0	
23	NE2_50M_SR_W_0_6.tif	D:\maps\tiles2\NE2_50M_SR_W_0_6.tif	0.0		189852	WGS 84	3	0	
24	NE2_50M_SR_W_0_7.tif	D:\maps\tiles2\NE2_50M_SR_W_0_7.tif	0.0		189852	WGS 84	3	0	
25	NE2_50M_SR_W_0_8.tif	D:\maps\tiles2\NE2_50M_SR_W_0_8.tif	0.0		189852	WGS 84	3	0	
26	NE2_50M_SR_W_0_9.tif	D:\maps\tiles2\NE2_50M_SR_W_0_9.tif	0.0		189852	WGS 84	3	0	
27	NE2_50M_SR_W_10_0.tif	D:\maps\tiles2\NE2_50M_SR_W_10_0.tif	0.0		189088	WGS 84	3	0	
28	NE2_50M_SR_W_10_1.tif	D:\maps\tiles2\NE2_50M_SR_W_10_1.tif	0.0		189852	WGS 84	3	0	
29	NE2_50M_SR_W_10_10.tif	D:\maps\tiles2\NE2_50M_SR_W_10_10.tif	0.0		189088	WGS 84	3	0	
30	NE2_50M_SR_W_10_11.tif	D:\maps\tiles2\NE2_50M_SR_W_10_11.tif	0.0		189852	WGS 84	3	0	
31	NE2_50M_SR_W_10_12.tif	D:\maps\tiles2\NE2_50M_SR_W_10_12.tif	0.0		189852	WGS 84	3	0	
32	NE2_50M_SR_W_10_13.tif	D:\maps\tiles2\NE2_50M_SR_W_10_13.tif	0.0		189852	WGS 84	3	0	
33	NE2_50M_SR_W_10_14.tif	D:\maps\tiles2\NE2_50M_SR_W_10_14.tif	0.0		189852	WGS 84	3	0	
34	NE2_50M_SR_W_10_15.tif	D:\maps\tiles2\NE2_50M_SR_W_10_15.tif	0.0		189852	WGS 84	3	0	
35	NE2_50M_SR_W_10_16.tif	D:\maps\tiles2\NE2_50M_SR_W_10_16.tif	0.0		189088	WGS 84	3	0	
36	NE2_50M_SR_W_10_17.tif	D:\maps\tiles2\NE2_50M_SR_W_10_17.tif	0.0		189852	WGS 84	3	0	
37	NE2_50M_SR_W_10_18.tif	D:\maps\tiles2\NE2_50M_SR_W_10_18.tif	0.0		189852	WGS 84	3	0	
38	NE2_50M_SR_W_10_19.tif	D:\maps\tiles2\NE2_50M_SR_W_10_19.tif	0.0		189852	WGS 84	3	0	
39	NE2_50M_SR_W_10_2.tif	D:\maps\tiles2\NE2_50M_SR_W_10_2.tif	0.0		189852	WGS 84	3	0	
40	NE2_50M_SR_W_10_20.tif	D:\maps\tiles2\NE2_50M_SR_W_10_20.tif	0.0		189852	WGS 84	3	0	
41	NE2_50M_SR_W_10_21.tif	D:\maps\tiles2\NE2_50M_SR_W_10_21.tif	0.0		166168	WGS 84	3	0	
42	NE2_50M_SR_W_10_3.tif	D:\maps\tiles2\NE2_50M_SR_W_10_3.tif	0.0		189852	WGS 84	3	0	
43	NE2_50M_SR_W_10_4.tif	D:\maps\tiles2\NE2_50M_SR_W_10_4.tif	0.0		189852	WGS 84	3	0	
44	NE2_50M_SR_W_10_5.tif	D:\maps\tiles2\NE2_50M_SR_W_10_5.tif	0.0		189088	WGS 84	3	0	
45	NE2_50M_SR_W_10_6.tif	D:\maps\tiles2\NE2_50M_SR_W_10_6.tif	0.0		189852	WGS 84	3	0	

Figure 6-6：Batch NoData processing of images in the resource pool

The image with black background before processing is shown in Figure 6-7.

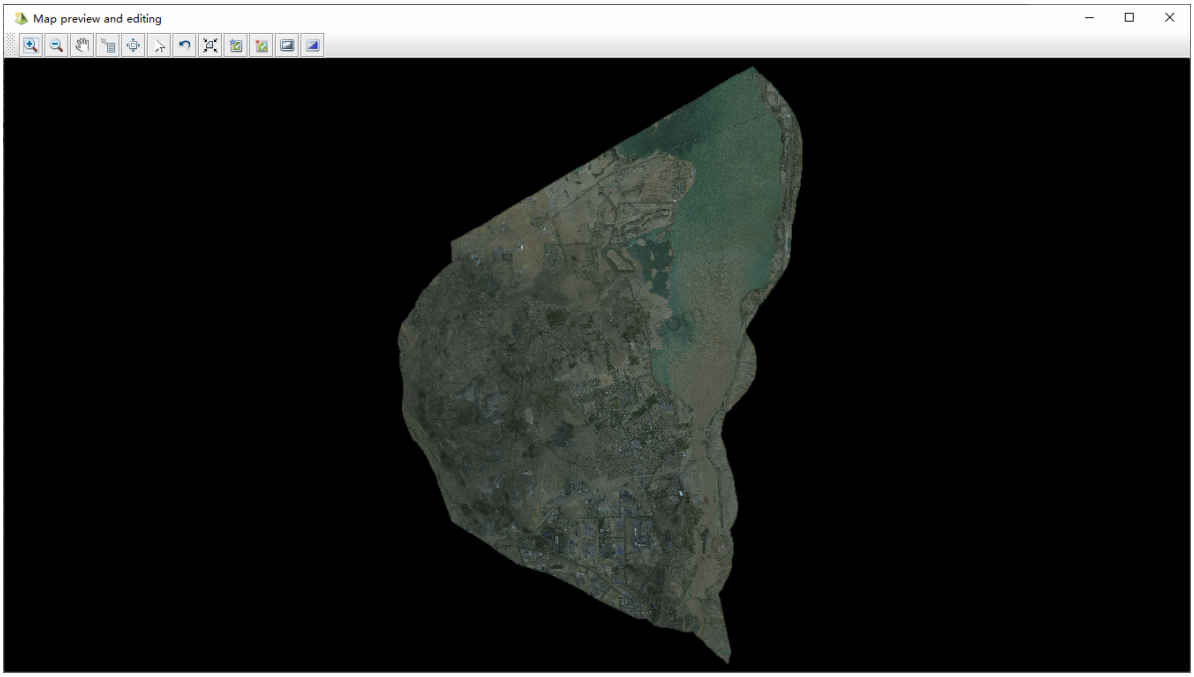


Figure 6-7：The image with black background before processing

After processing, remove the black background, as shown in Figure 6-8.

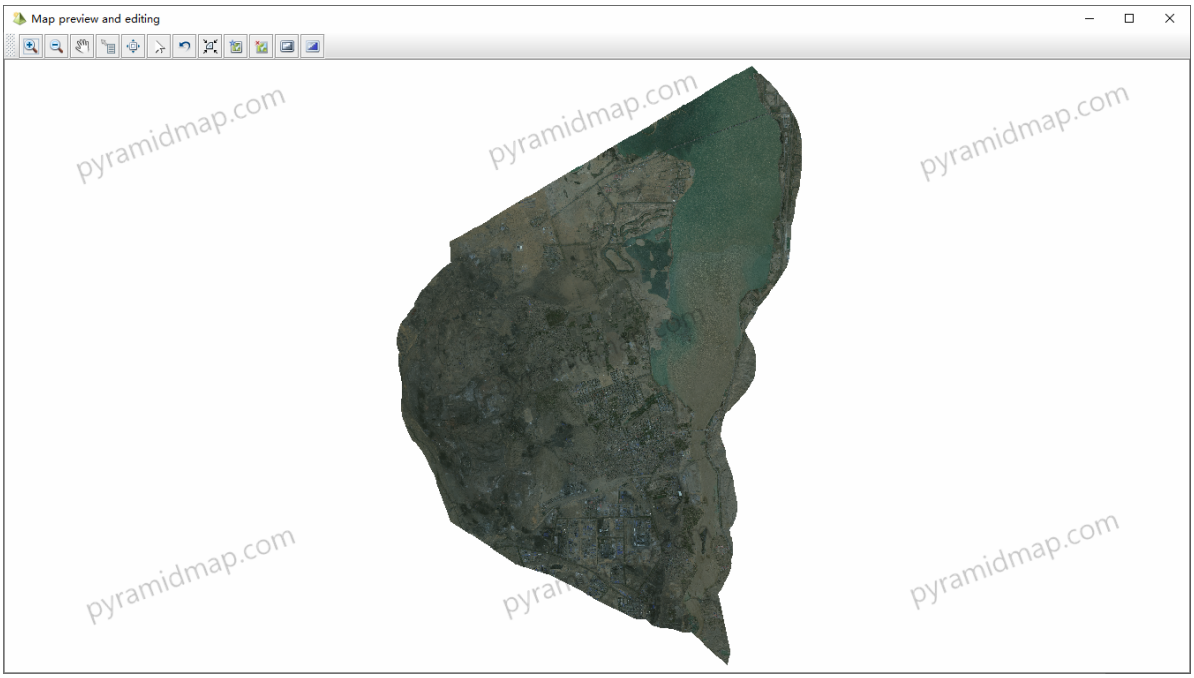


Figure 6-8：Eliminate black background after NoData processing

6.2.2 Raster tile processing

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6.2.3 Raster mosaic processing

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6.3 Geodatabase layers pool

PyramidMap imports client shp vector layers into Geodatabase through database connection pool, obtains layer list through database connection pool, and supports various operations with corresponding buttons.

6.3.1 Importing Shp into Geodatabase

PyramidMap maintains the Geodatabase connection pool and the Shp vector layer resource pool to import the Shp vector layer into the Geodatabase in batches. It supports but is not limited to Oracle, PostGIS and MySQL. The import interface and process are shown in Figure 6-20.

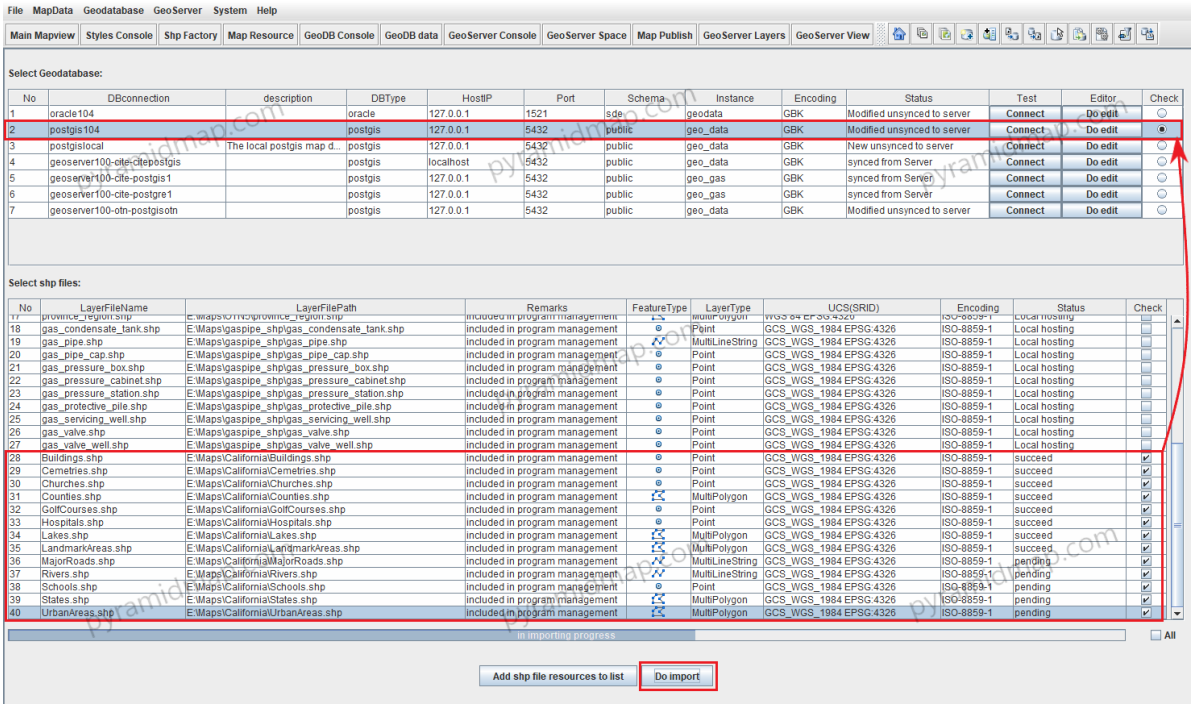

Figure 6-20：Shp vector layerS imported to Geodatabase workflow

In this module, users can selectively import Shp vector layers into Geodatabase in batches. After importing, each Shp layer generates a layer feature table with the same name. As a reciprocal process, the layer feature table in Geodatabase can also be exported to different geographic feature data such as Shp, Csv, Kml, GeoJson, etc.

6.3.2 Geodatabase exporting out shp

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6.3.3 Geodatabase layers preview and edit

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6.4 GeoServer vector layers pool

PyramidMap publishes vector layers of client Shp file to GeoServer through GeoServer connection, and obtains the Internal layers through GeoServer connection in the pool, supporting various operations with corresponding buttons.

6.4.1 GeoServer layers preview

Select the GeoServer connection to dynamically acquire its internal layers and perform corresponding processing., as shown in Figure 6-26.

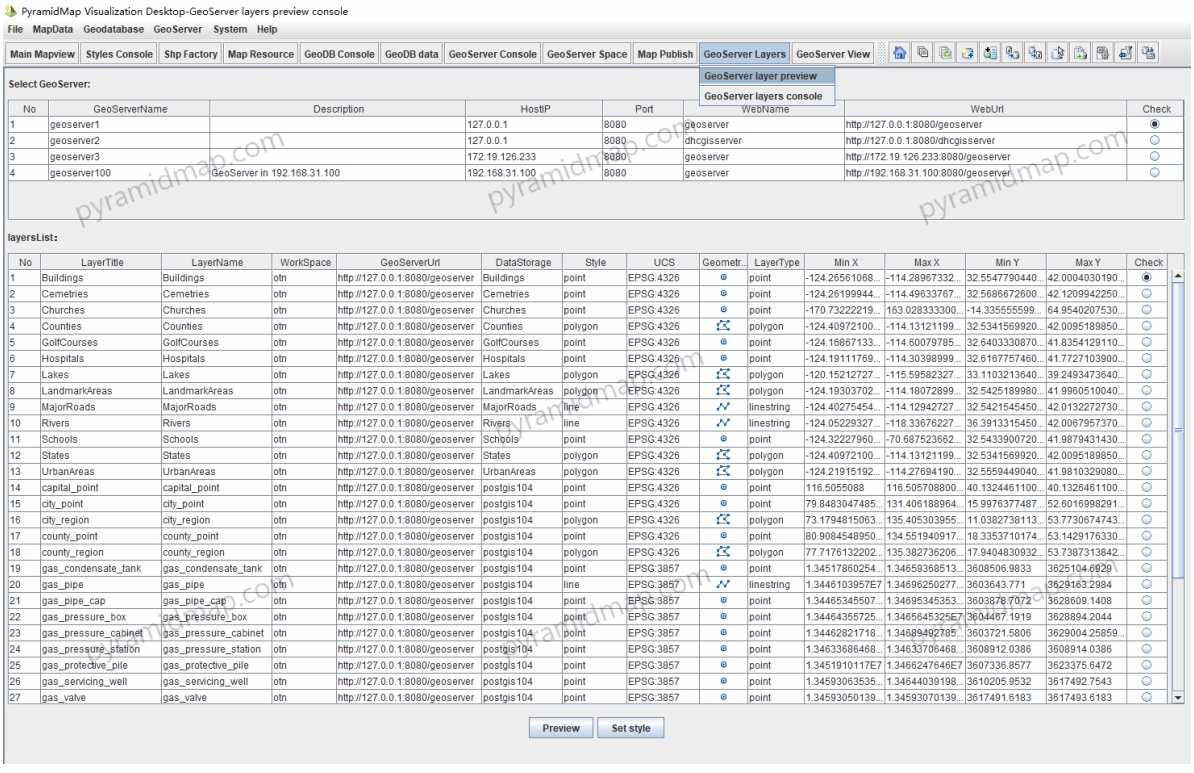

Figure 6-26：GeoServer connections pool and its internal layers pool

Various operations on layer resources are supported, including:

- Preview: preview the selected layer through WMS service mode.
- Set Style: set the sld display symbol matching its geometric type for the selected layer, as shown in Figure 6-27.

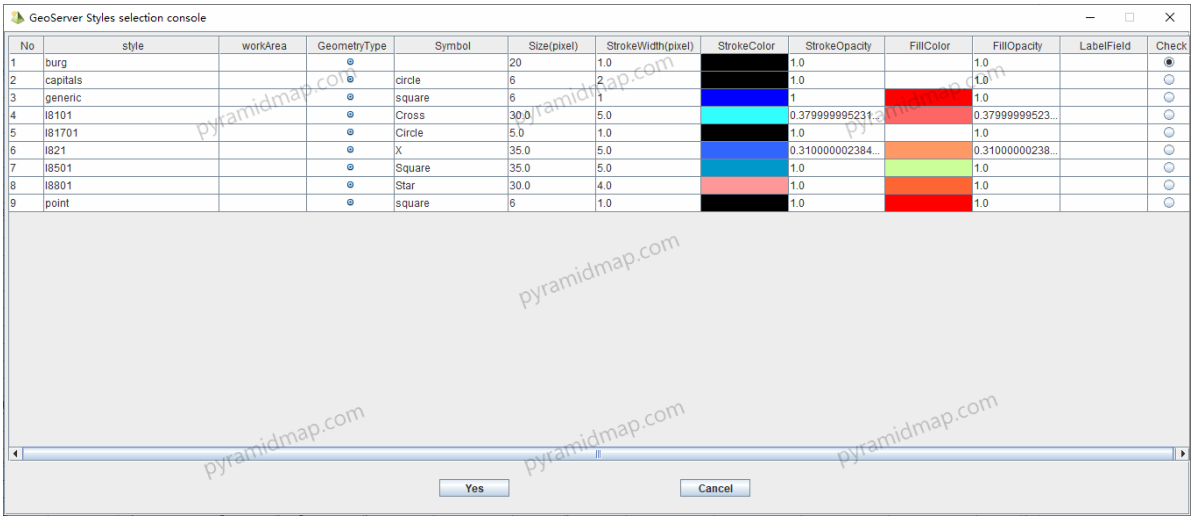

Figure 6-27：Get the internal styles in the GeoServer selected and form styles list pool

Select style in the list and assign it to the selected layer.

In particular, through the map preview and editing options, the selected layer file will be opened in the independent GeoServer map view to preview the layer. The editing function is not supported temporarily, as shown in Figure 6-28.

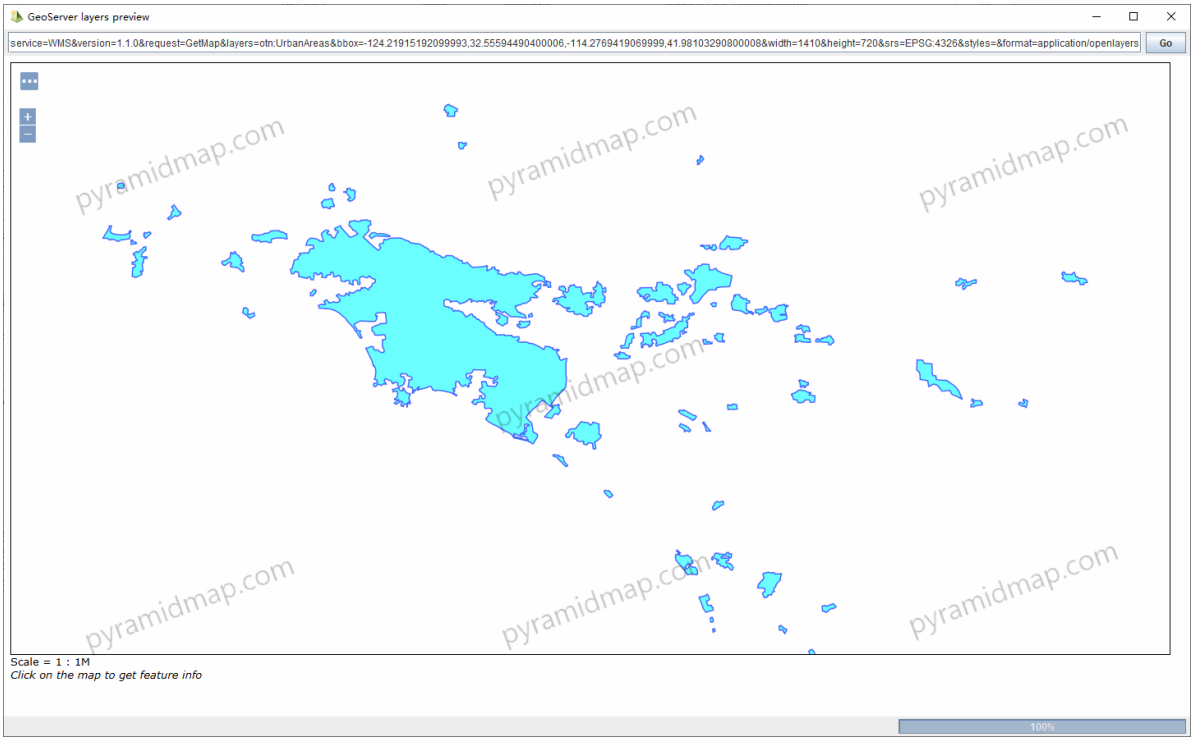

Figure 6-28：The GeoServer vector layer is previewed according to the preset sld style

6.4.2 GeoServer layers exporting

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The selected layer is exported to the specified target path, and the export progress is displayed through the progress bar. The exported map is reloaded into the map view in the form of Shp vector file, as shown in Figure 6-31.

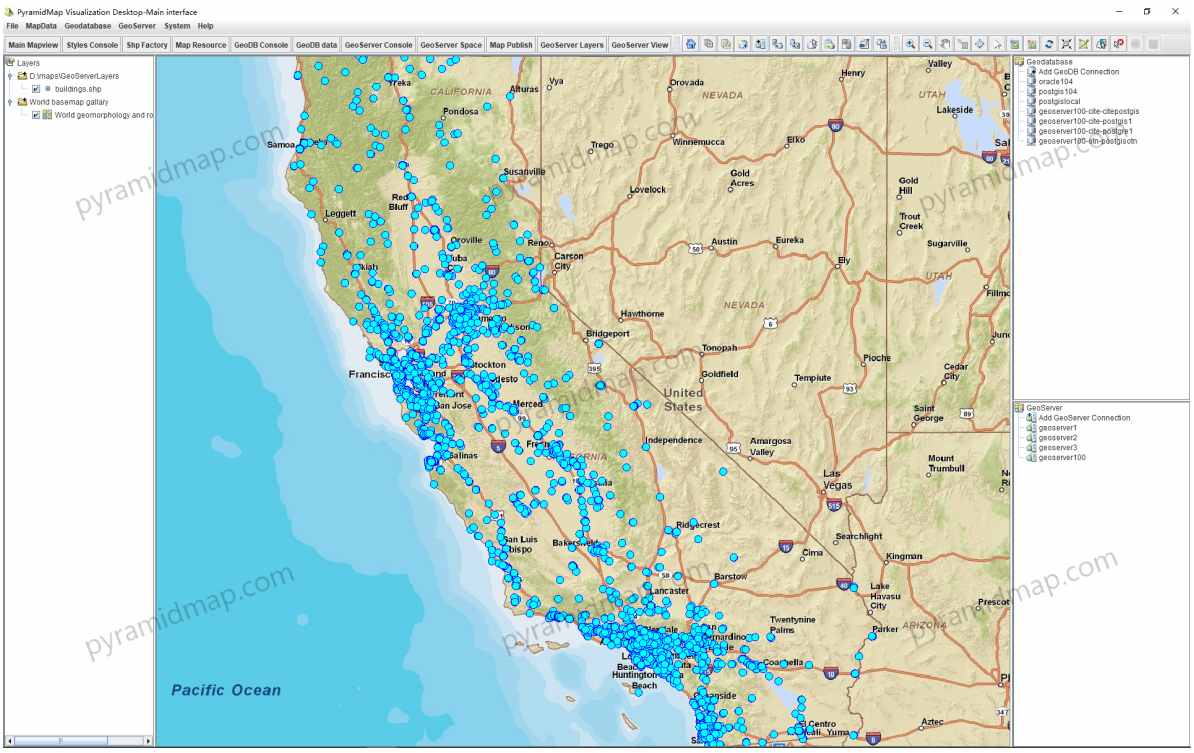

Figure 6-31：The exported Shp vector layer of GeoServer is reloaded to the map view for display

6.5 GeoServer raster layer pool

Select the raster layer in the Figure 6-8 GeoServer map server connection pool and its list, and the selected layer file will be opened in the independent GeoServer map view to preview the layer. The editing function is not supported temporarily, as shown in Figure 6-32.

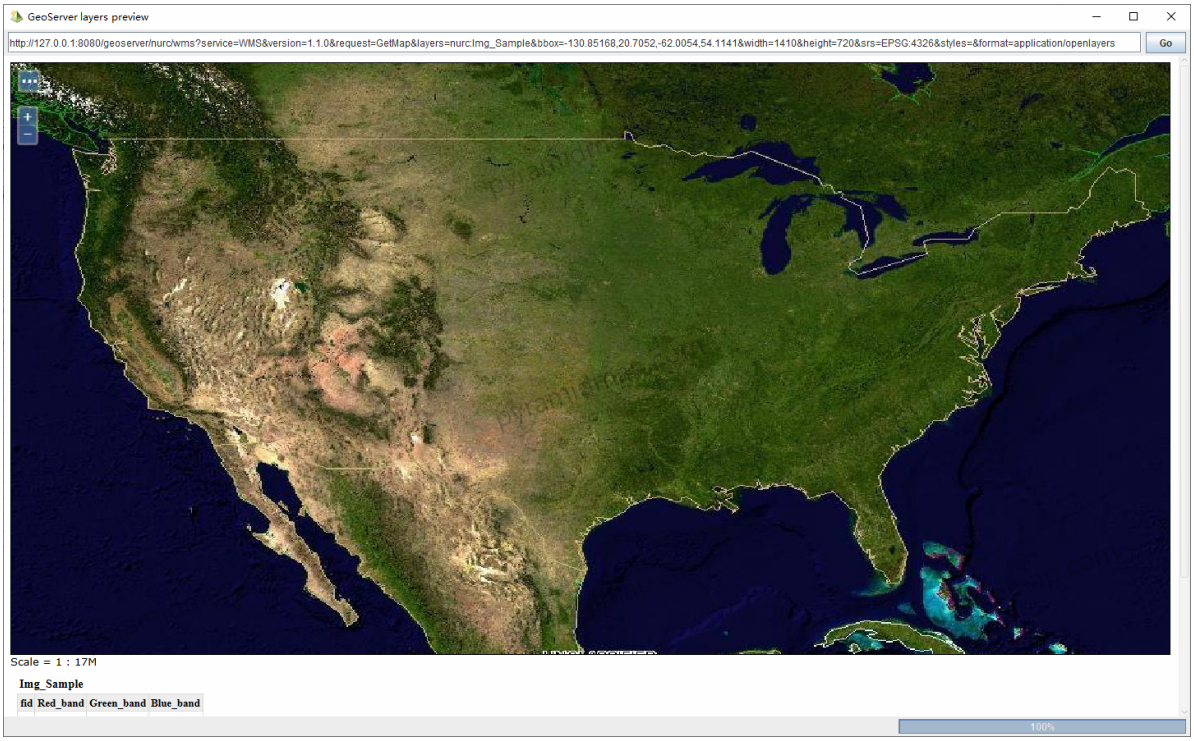

Figure 6-32：The GeoServer raster layer is previewed

6.6 Coordinate System Conversion

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6.7 Data conversion

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7 Map rendering and sld symbol

The map symbol system determines the rendering effect of map elements, and refined symbol design allows you to make beautiful maps. PyramidMap visual symbol design tool can make your map more colorful and vivid. Through the color palette, you can create map symbols of different geometric types for points, lines and surfaces. The symbol features include: stroke color, stroke width, fill color, transparency, size, icon, label field, label font, font color, font size, font normal or bold, label position, fine adjustment offset, etc. Finally, you can save them as an sld file. The Sld file describes the display mode of map elements. PyramidMap realizes sld localization creation, editing in maintenance pool, maintains two-way synchronization with the GeoServer server, and remotely sets the sld symbol of the GeoServer layers internal at client.

7.1 Define sld symbols at client

7.1.1 Create sld on visualizing layer nodes

At the visualization layer node on the left of the main map interface, create the sld symbol through the right-click shortcut menu, as shown in Figure 7-1.

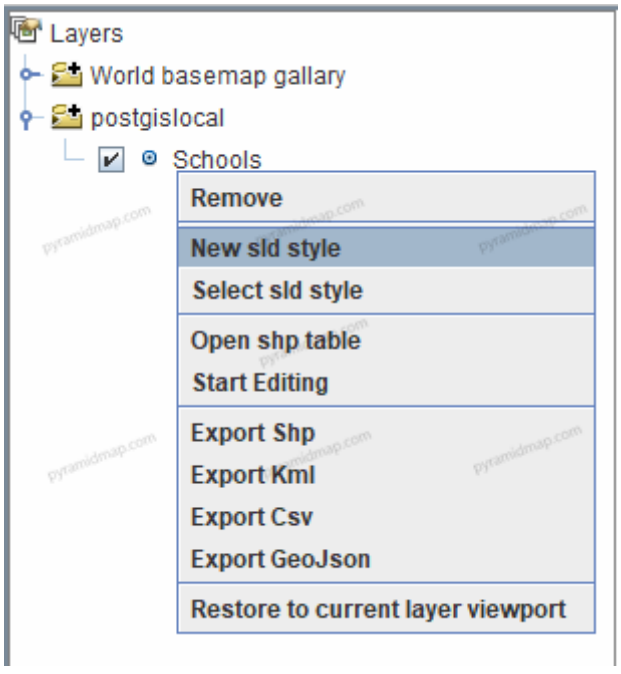

Figure 7-1：Creating sld symbols on visualization layer node

PyramidMap will implement the sld symbol definition method through the visual palette according to the geometric type (point, line, polygon) of the selected layer, as shown in Figure 7-2.

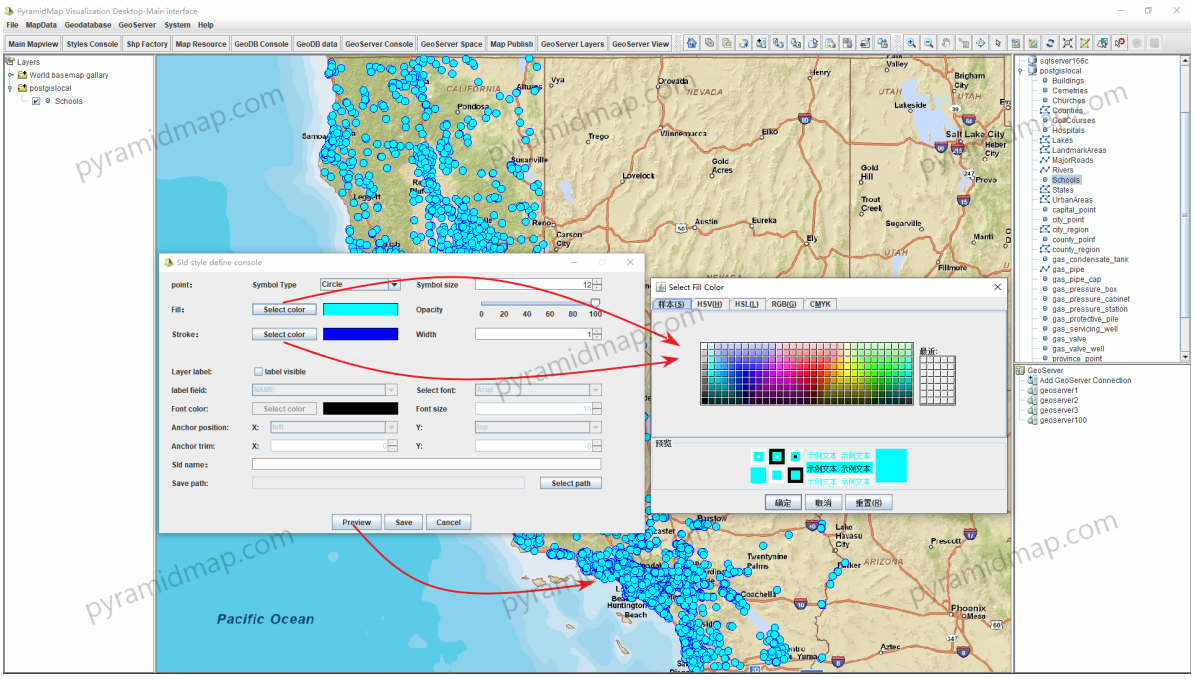

Figure 7-2：Create sld symbol definition on layer node through palette

In the sld definition module, create map symbols for different geometric types of points, lines, and surfaces through the color palette. The symbol features include: stroke color, stroke width, fill color, transparency, size, icon, annotation field, font, font color, size, normal or bold, annotation position, fine adjustment offset, etc. The display effect can be previewed in real time on the layer, saved as an sld file, and maintained in the sld resource pool at the same time, As shown in Figure 7-3.

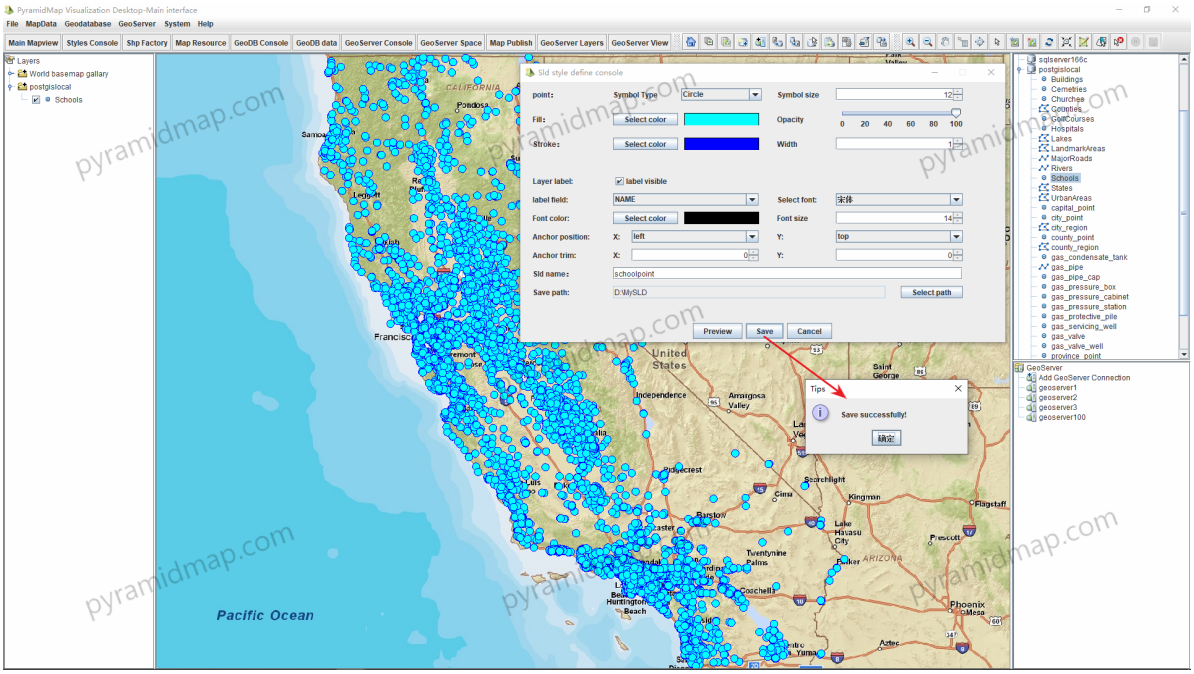

Figure 7-3：Create and save sld symbol definition on layer node through palette

7.1.2 Create map symbols in the sld resource pool

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7.1.3 Get GeoServer sld symbols

Obtain sld symbols from the GeoServer through connection pool and add to the local SLD resource pool, as shown in Figure 7-9.

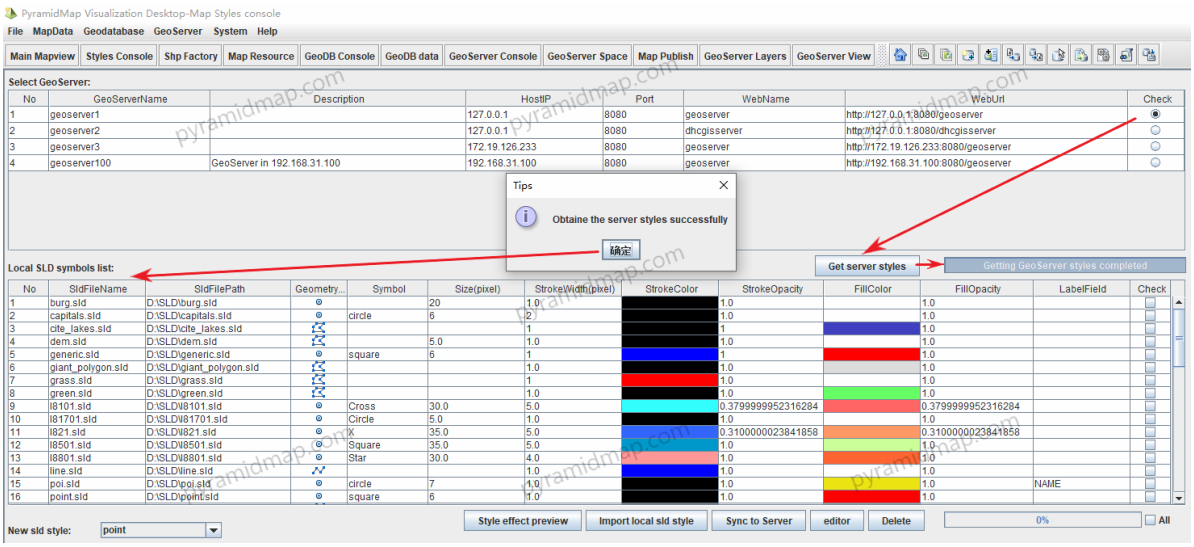

Figure 7-9：Obtain sld symbols from the GeoServer through connection pool

Select the GeoServer connection, click "Get server styles", PyramidMap gets the global SLDs in GeoServer and the SLDs in each workspace, and downloads them to the client resource pool for sharing.

7.2 Map rendering effect with sld

At the visualization layer node on the left side of the main interface, right-click the shortcut menu to Open the sld selection list. In this module, the sld resource files of the same type will be automatically filtered from the sld symbol resource pool maintained by the system according to the geometric type (point, line, and face) of the selected layer to form a selectable list. You can select the corresponding sld symbol definition to achieve the desired map rendering effect ,all of the workflow as shown in Figure 7-10.

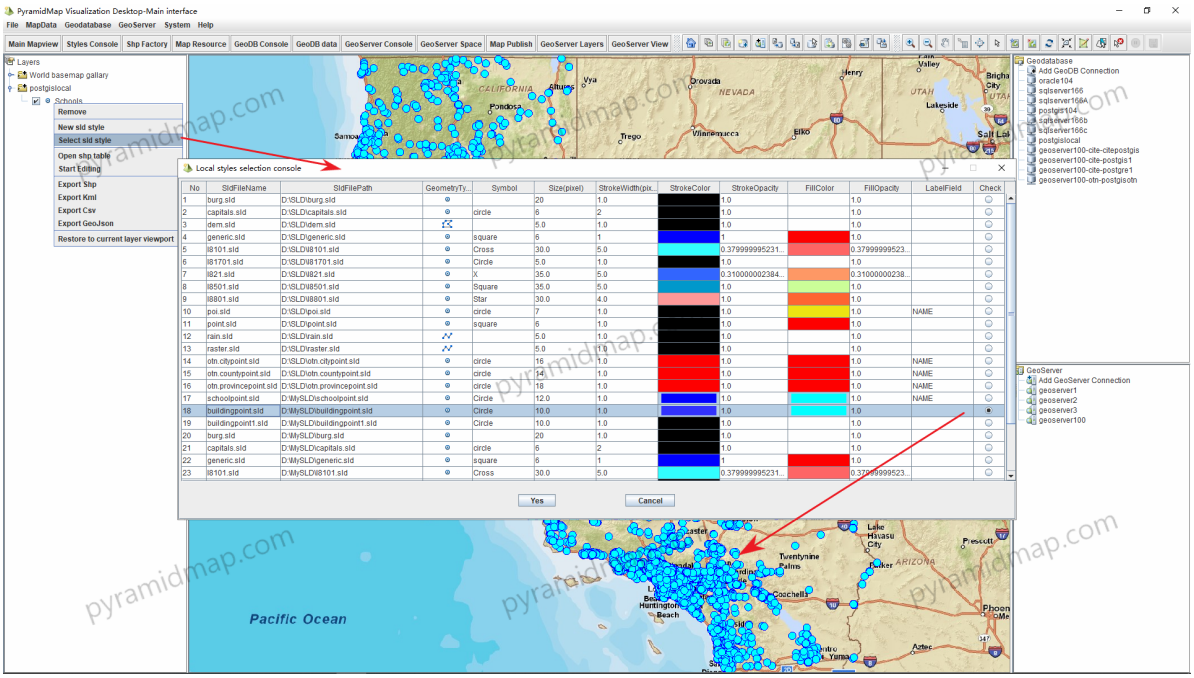

Figure 7-10：Select sld for visualization layer node to achieve map rendering effect

7.3 Client sld symbols submitted to GeoServer

PyramidMap submits the client sld symbols to the GeoServer through the connection pool, as shown in Figure 7-11.

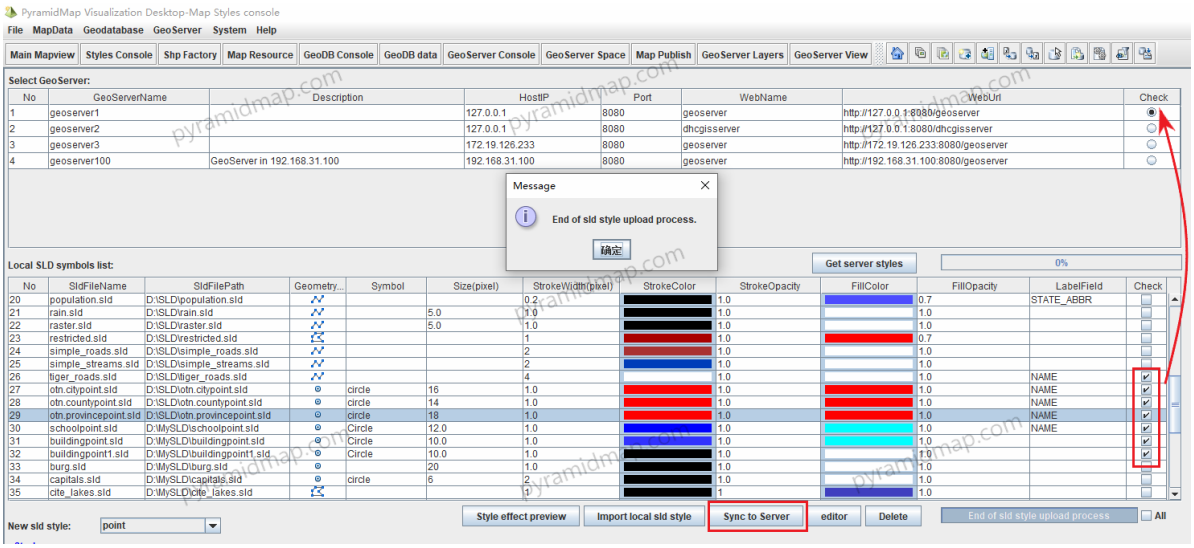

Figure 7-11：Client sld resources submitted to the GeoServer

Select all or part of the sld files and click “Sync to Server” to synchronously submit the selected sld symbols to the global space inside the GeoServer.

8 Publishing map service

WebGIS is the trend of map application development and the most extensive map application mode at present, including browser end, mobile end and embedded terminal application. Vector layer, raster layer and Geodatabase layer must be published as map service url to be applied in WebGIS terminal which hosted in map server such as GeoServer that provides web map service. GeoServer is based on the OpenGIS Web server specification, follows the OGC open standard, and can run in any J2EE/servlet based container, such as tomcat, webLogic, and webSphere, etc. GeoServer has complete functions and supports multiple map service functions, such as WMS/WFS/WCS/WMTS/KML. In the traditional way, using the GeoServer console to publish map services is very complicated and requires highly professional staff.

The significance of PyramidMap is to provide a visual guidance process to publish the layers in the local resource pool to the GeoServer server, which is simpler and easier to use than the traditional web console mode of GeoServer. The human-computer interaction is more friendly and intuitive, and the operation is convenient, which greatly reduces the professional skill requirements for operators. Even companies and individuals without GIS capabilities can easily use it, which is the biggest feature of the software. PyramidMap supports three types of layer publishing: Shp file type layer, image file type layer, and geographic database type layer. The main interface provides shortcut menu entries, as shown in Figure 8-1.

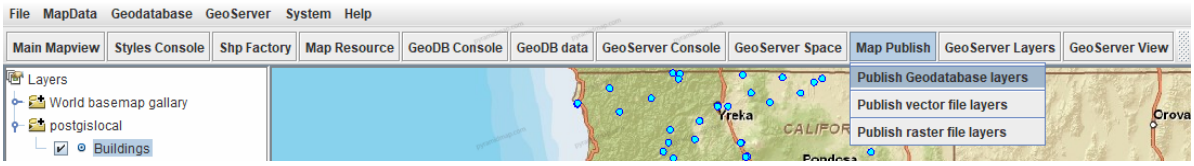

Figure 8-1： Main interface map service publishing shortcut menu entry

GeoServer supports the following three data storage modes of layer services: Geodatabase layer type, Shp vector file type, and raster image file type.

8.1 Publish Shp vector layers

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8.2 Publish raster layers

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8.3 Publish Geodatabase layers

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8.4 Manage GeoServer layers

As the visualization client of GeoServer map server, PyramidMap implements unified management of layers in GeoServer, including layer preview and query. PyramidMap's management of GeoServer layers includes three main functions: GeoServer data source node in the main interface, as shown in Figure 8-5.

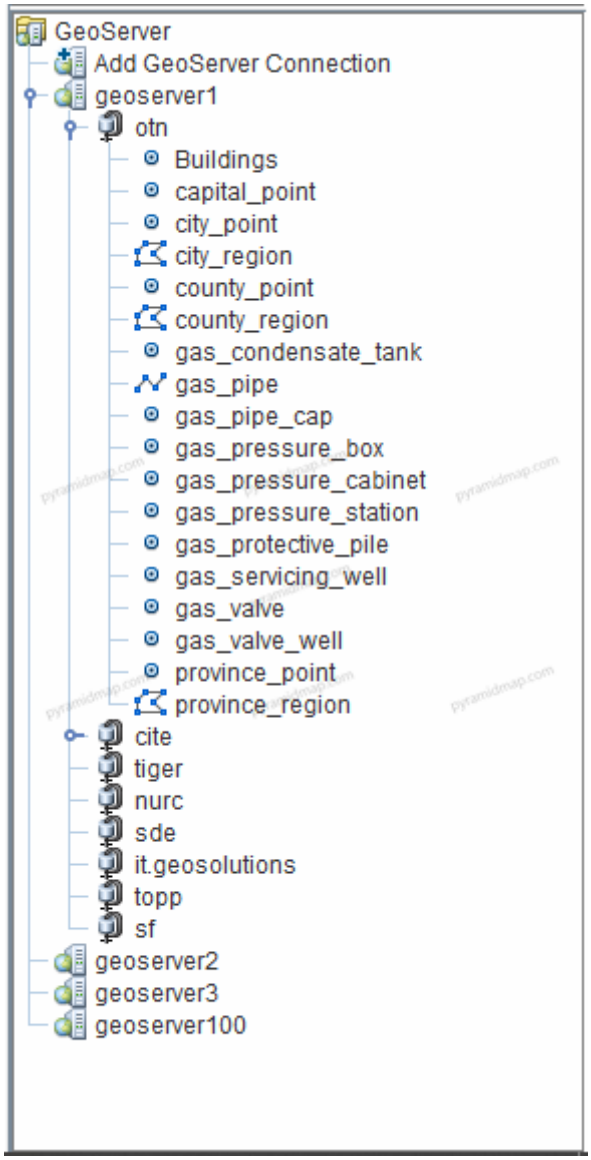

Figure 8-5：GeoServer data source node in the main interface

Through the GeoServer data source node, you can complete various hierarchical operations on the GeoServer workspace, data storage, and layers. PyramidMap provides access to GeoServer layer preview list and GeoServer layer management list through toolbar menu items, as shown in Figure 8-6.

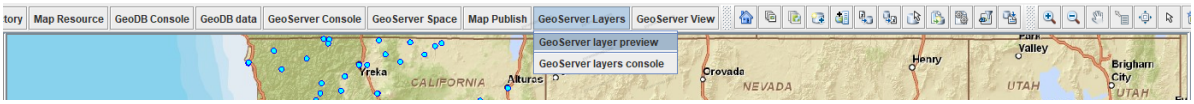

Figure 8-6：Main interface GeoServer layers operation entrance

Through the above menu items, the layer preview and management of GeoServer can be realized.

8.4.1 GeoServer layers preview

PyramidMap previews the layers published by the server through the GeoServer resource connection pool. The list of layers is shown in Figure 8-7.

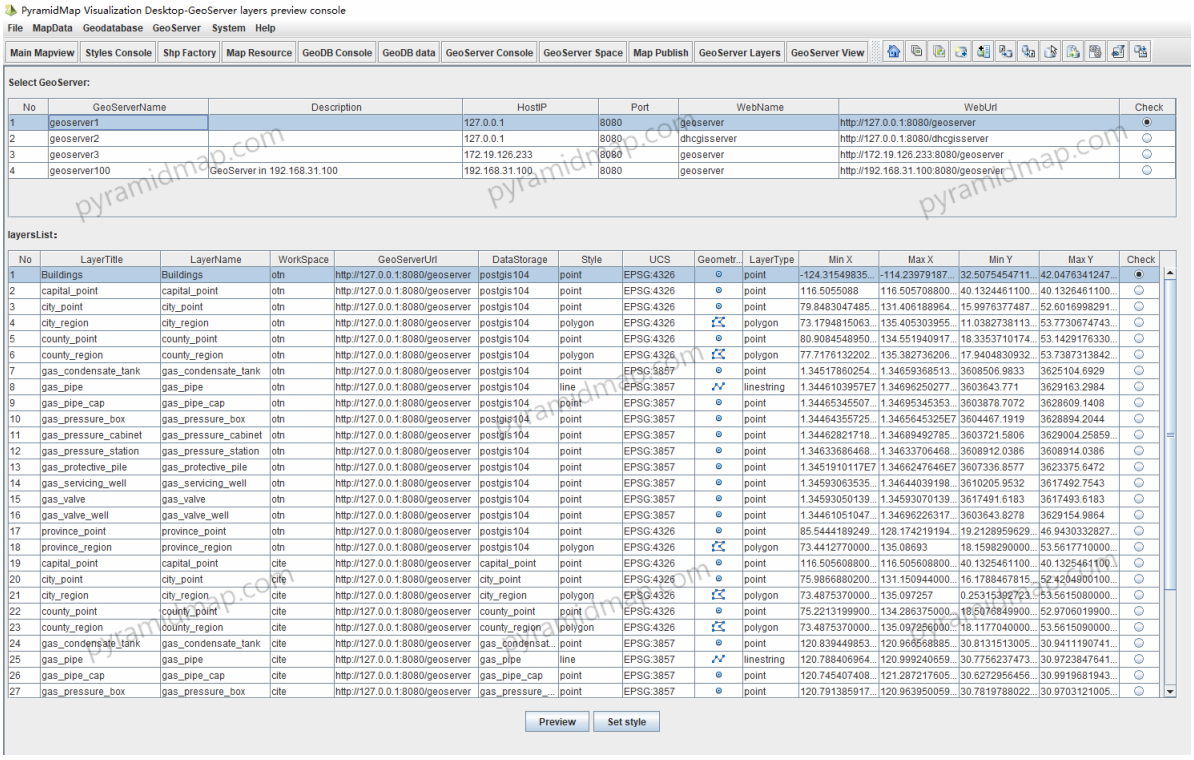

Figure 8-7：GeoServer layer list

The GeoServer layer list includes two types: vector and image. The vector layer is divided into point, line and face types. Select the vector layer and click Preview. PyramidMap will load and display the selected vector layer through WMS, as shown in Figure 8-8.

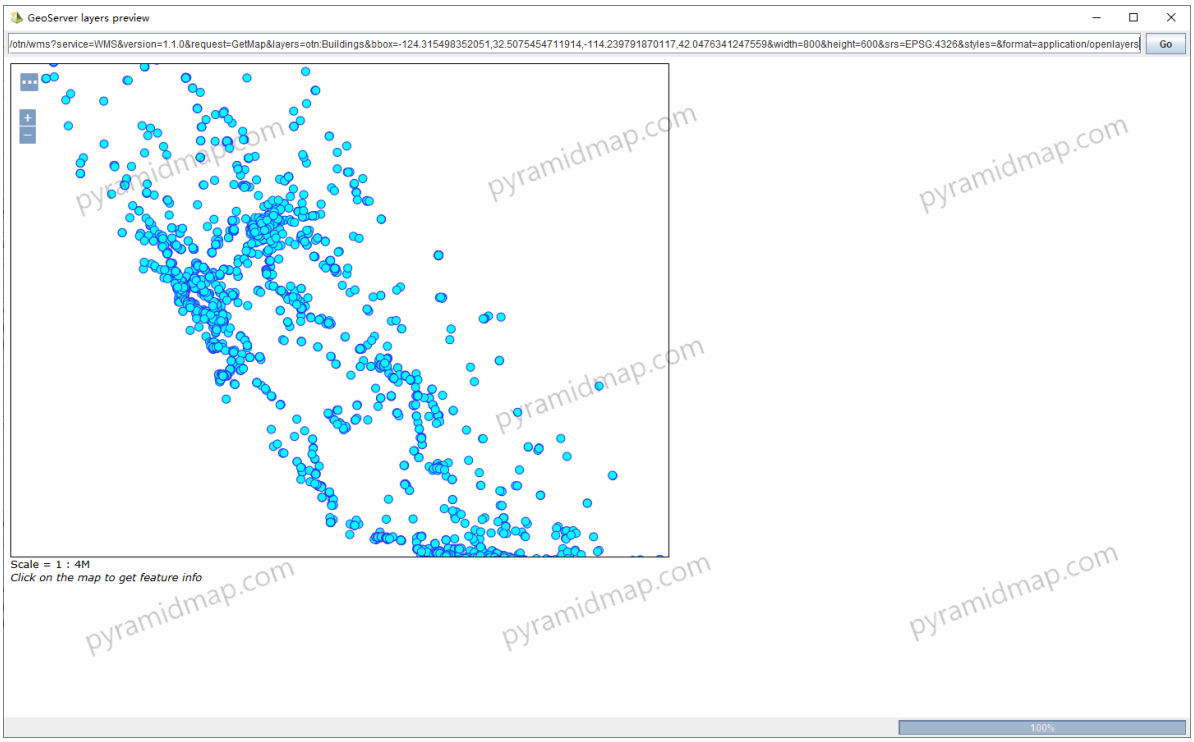

Figure 8-8：GeoServer vector layer preview

Select an raster layer and click Preview. PyramidMap will load and display the selected raster layer in WMS mode, as shown in Figure 8-9.

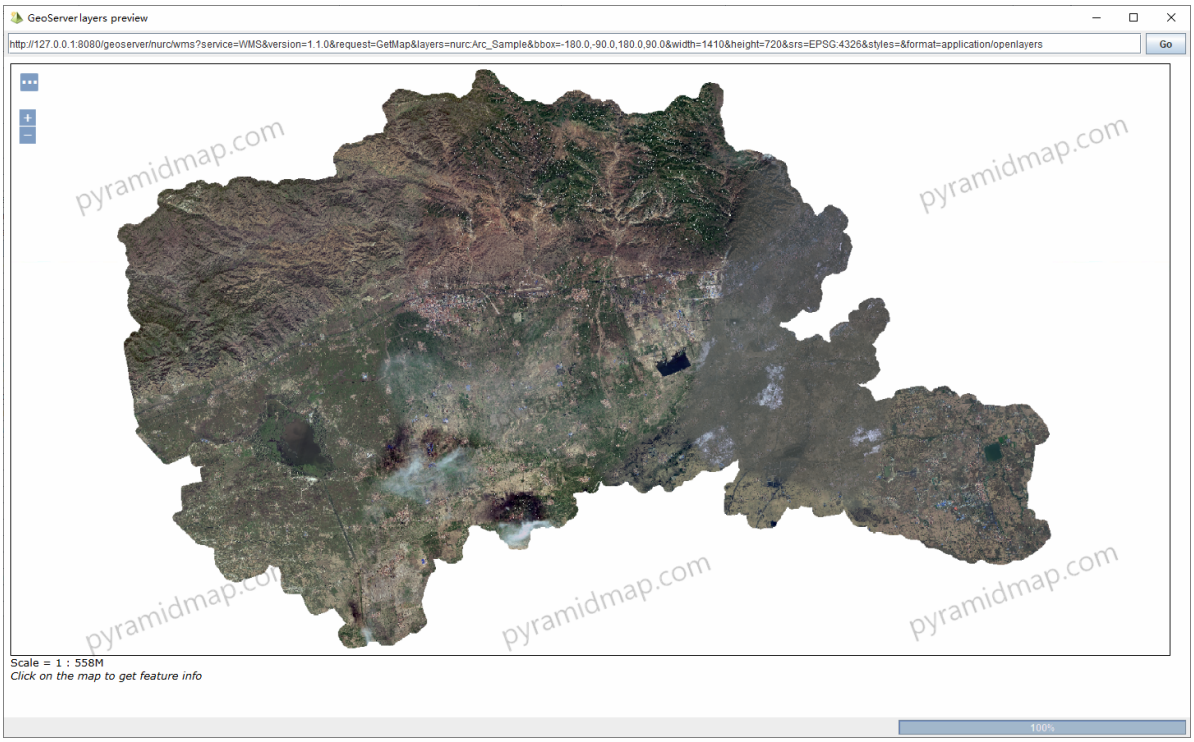

Figure 8-9：GeoServer raster layer preview

8.4.2 GeoServer layers export and conversion

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