



Web-Based Spatial Database and Web Services

1. Introduction of GIS, WebGIS & Open Geospatial Consortium (OGC) Standards
2. Introduction of the Spatial Data Infrastructure (SDI) and some SDI-based Applications



Introduction WebGIS & Open Geospatial Consortium (OGC) Standards

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National Institute of Advanced Industrial Science and Technology (AIST)

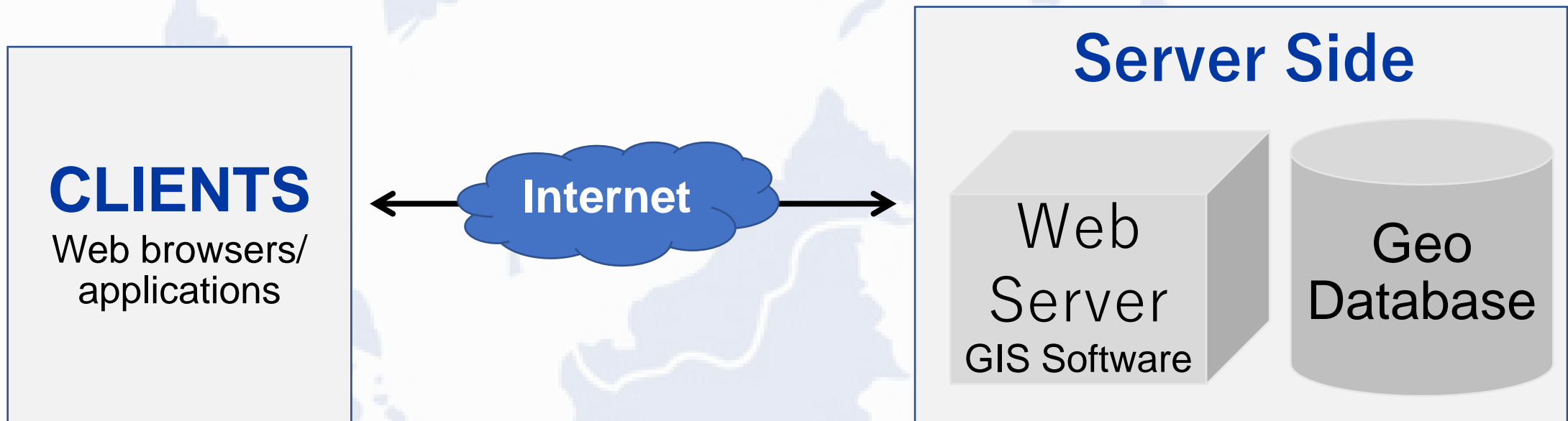


Lecture Outline

- WebGIS
- Standards used for WebGIS
- Open Geospatial Consortium (OGC) Standards
- OGC Web Services and Requests
- Free and Open Source Software (FOSS)
- Web Map Service (WMS) Clients

WebGIS

Information system that allows users to view, edit, manipulate and process geospatial data over the WEB.





Advantages of Using WebGIS

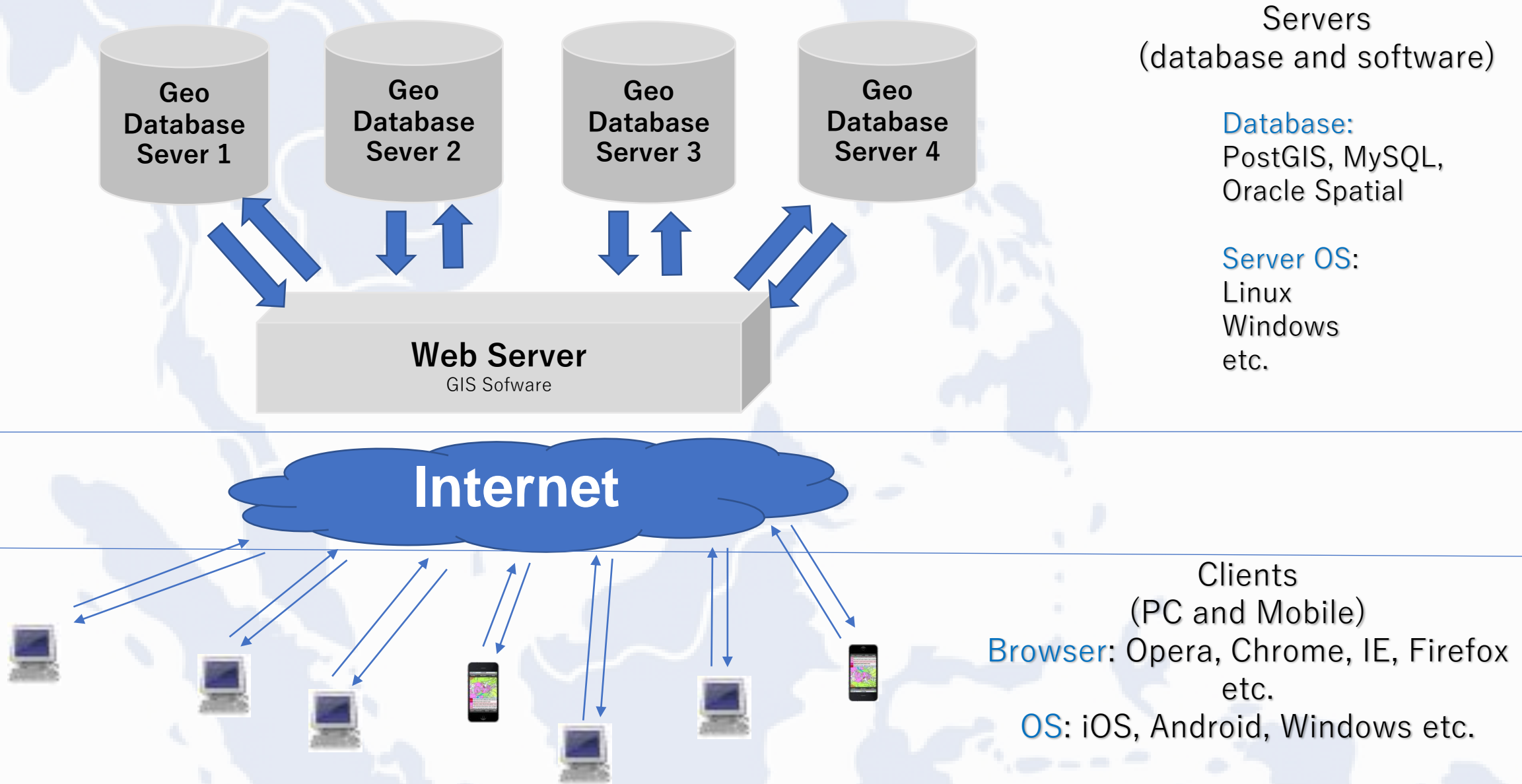
1. Cost effective (free software)
2. Highly accessible to many users
3. Could be run in machines with low memory and storage capacity (e.g. mobile devices)

Disadvantages

1. Needs internet connection
2. Should work with a wide array of hardware and software

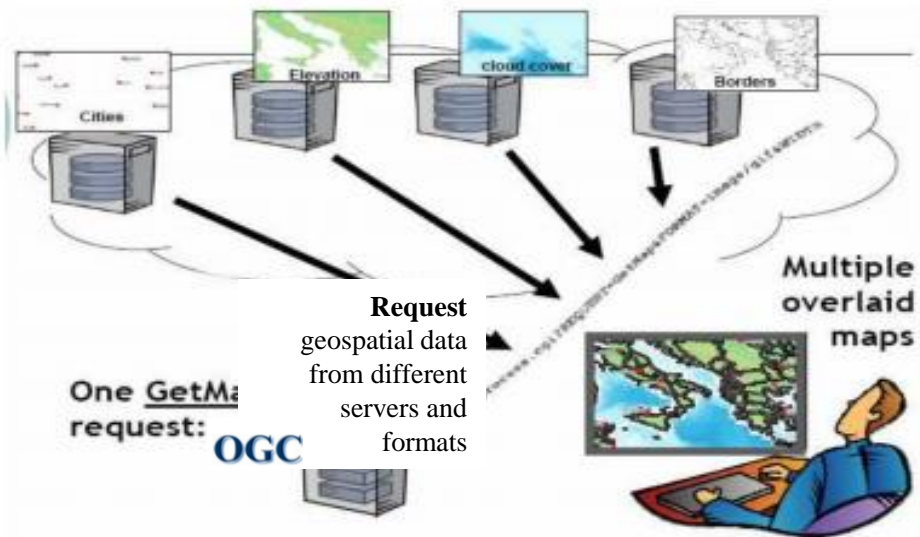


Web-Based Geospatial Information System



Geospatial Data Interoperability

Interoperability is very important for data sharing through the World Wide Web. **International standards** for geospatial data are pre-requisites for “Interoperability”.



Percivall (2009)

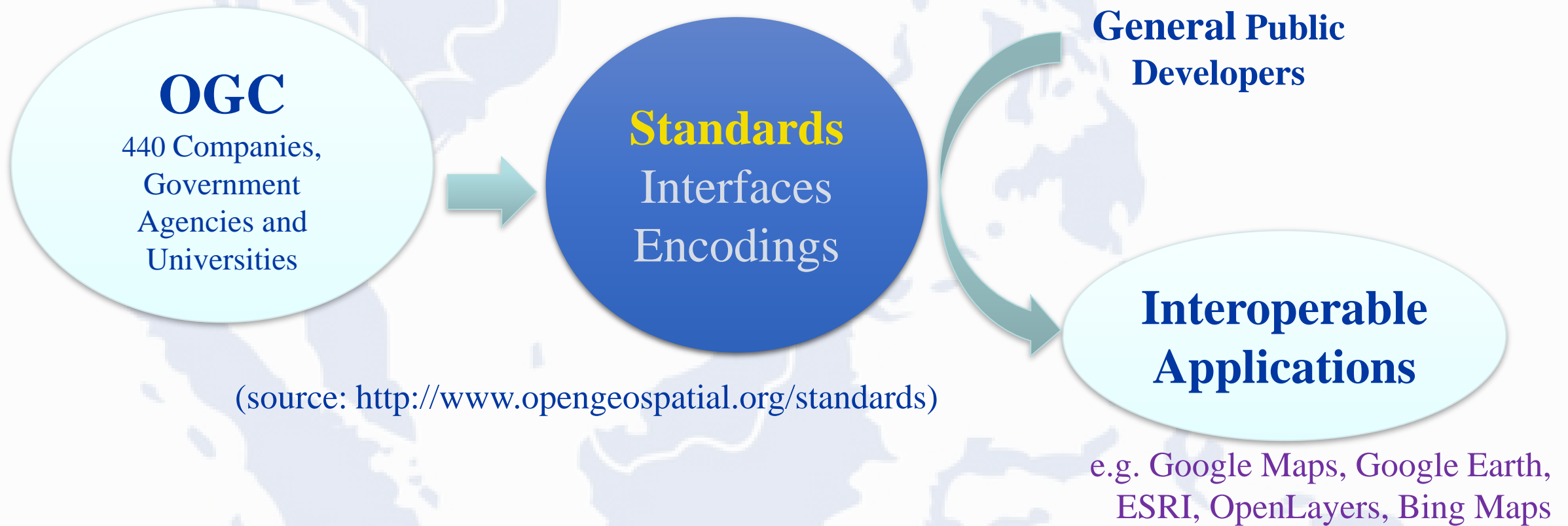
International standards have been formulated to facilitate geospatial data exchange through the World Wide Web

- ✓ Open Geospatial Consortium (OGC)
- ✓ Spatial Data Infrastructure (SDI)



Open Geospatial Consortium (OGC)

Interoperability is established following OGC-based standards





OGC Web Services

OGC Web Services are software developed for Web-based applications.

Web Coverage Service (WCS)

Web Coverage Processing Service (WCPS)

Web Feature Service (WFS)

Web Map Service (WMS)

Web Map Tile Service (WMTS)

Web Processing Service (WPS)

(http://www.webopedia.com/TERM/W/Web_Services.html)



Web Map Service (WMS)

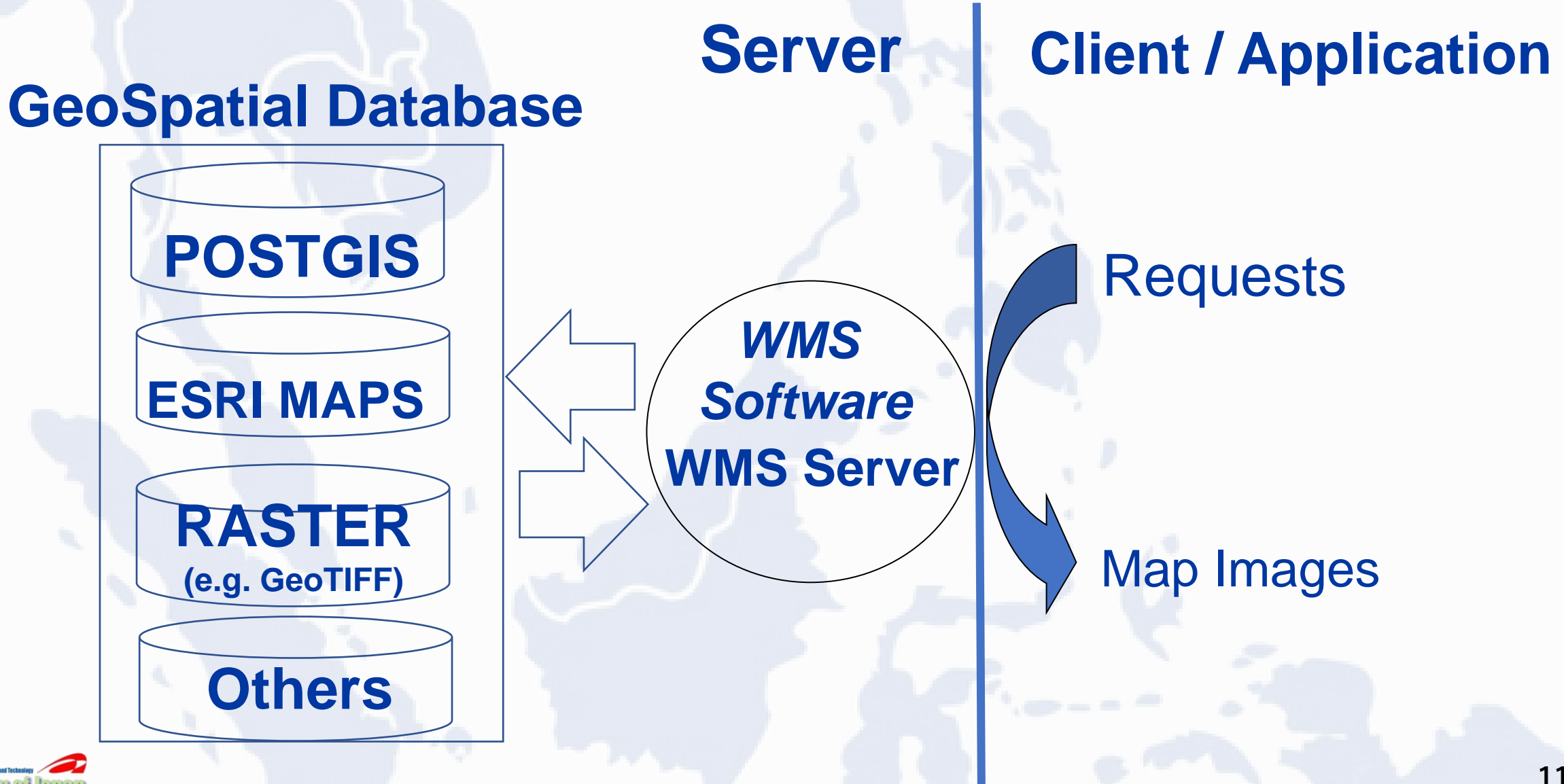
A **Web Map Service (WMS)** is a standard protocol for serving georeferenced map images over the Internet that are generated by a map server using data from a GIS database (Wikipedia).

It provides a simple HTTP interface for requesting georegistered map images from one or more distributed geospatial databases (OGC).



Web-Based Geospatial Information System

Web Map Service (WMS)





WMS Requests

Required

- **GetCapabilities** - returns parameters about the WMS and available layers
- **GetMap** - returns a map image

Optional

- GetFeatureInfo
- DescribeLayer
- GetLegendGraphic

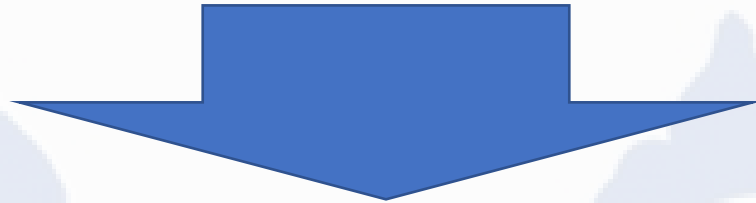


WMS Request URI

URI → Uniform Resource Identifier

URL → Uniform Resource Locator

URI = URL + Query Fragment/Parameters



Example of a WMS GetMap Request URI

https://ccop-gsi.org/ows/dynamic_wms/2015/M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H_wms?LAYERS=M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H&REQUEST=GetMap&SERVICE=WMS&VERSION=1.1.1&FORMAT=image/png&SRS=EPSG:4326&BBOX=117.1,5.3,126.4,19.3&WIDTH=600&HEIGHT=700



WMS Request URI

WMS of Philippines Non-Metallic Mineral Map

WMS URL

[https://ccop-gsi.org/ows/dynamic_wms/2015/
M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H_wms](https://ccop-gsi.org/ows/dynamic_wms/2015/M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H_wms)

WMS URI to get information about the Philippine Map
(GetCapabilities Request)

[https://ccop-gsi.org/ows/dynamic_wms/2015/
M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H_wms?
SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities](https://ccop-gsi.org/ows/dynamic_wms/2015/M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H_wms?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities)



Example of WMS URI GetCapabilities Request Result

https://ccop-gsi.org/ows/dynamic_wms/2015/M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H_wms?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities



```

- <WMT_MS_Capabilities version="1.1.1">
  <!-- MapServer version 6.2.2 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG SUPPORTS=PROJ SUPPORTS=GD SUPPORTS=AGG SUPPORTS=FREETYPE SUPPORTS=ICONV
  SUPPORTS=WMS_SERVER SUPPORTS=WMS_CLIENT SUPPORTS=WFS_CLIENT SUPPORTS=WCS_SERVER SUPPORTS=SOS_SERVER SUPPORTS=THREADS
  SUPPORTS=GEOS INPUT=JPEG INPUT=POSTGIS INPUT=OGR INPUT=GDAL INPUT=SHAPEFILE -->
- <Service>
  <Name>OGC:WMS</Name>
  <Title>PHL MGB 1:1 M Philippine Non-Metallic Mineral Resources</Title>
  <Abstract>None</Abstract>
- <KeywordList>
  <Keyword>None</Keyword>
</KeywordList>
<OnlineResource xlink:href="https://ccop-
gsi.org/ows/dynamic_wms/2015/M_portal_maps_philippine_nonmet_minerals_table_
xmlns:xlink="http://www.w3.org/1999/xlink"/>
- <ContactInformation>
- <ContactPersonPrimary>
  <ContactPerson>Michael Santiago Luna</ContactPerson>
  <ContactOrganization>Mines and Geosciences Bureau</ContactOrganization>
</ContactPersonPrimary>
- <ContactAddress>
  <AddressType>postal</AddressType>
  <Address>North Avenue Diliman, Quezon City</Address>
  <WARNING: Metadata not available because of missing or invalid xslt>
  <SRS>EPSG:3097</SRS>
  <SRS>EPSG:3857</SRS>
  <SRS>EPSG:4326</SRS>
  <SRS>EPSG:900913</SRS>
  <LatLonBoundingBox maxy="19.4276" maxx="126.557" miny="5.3198" minx="1
  <BoundingBox maxy="2.14815e+06" maxx="873628" miny="590820" minx="-1
- <Layer cascaded="0" opaque="0" queryable="1">
  <Name>M_portal_maps_philippine_nonmet_minerals_table_201510271
  <Title>PHL MGB 1:1 M Philippine Non-Metallic Mineral Resources</Title>
  <Abstract>None</Abstract>
  <SRS>EPSG:3097</SRS>
  <SRS>EPSG:3857</SRS>
  <SRS>EPSG:4326</SRS>
  <SRS>EPSG:900913</SRS>

```

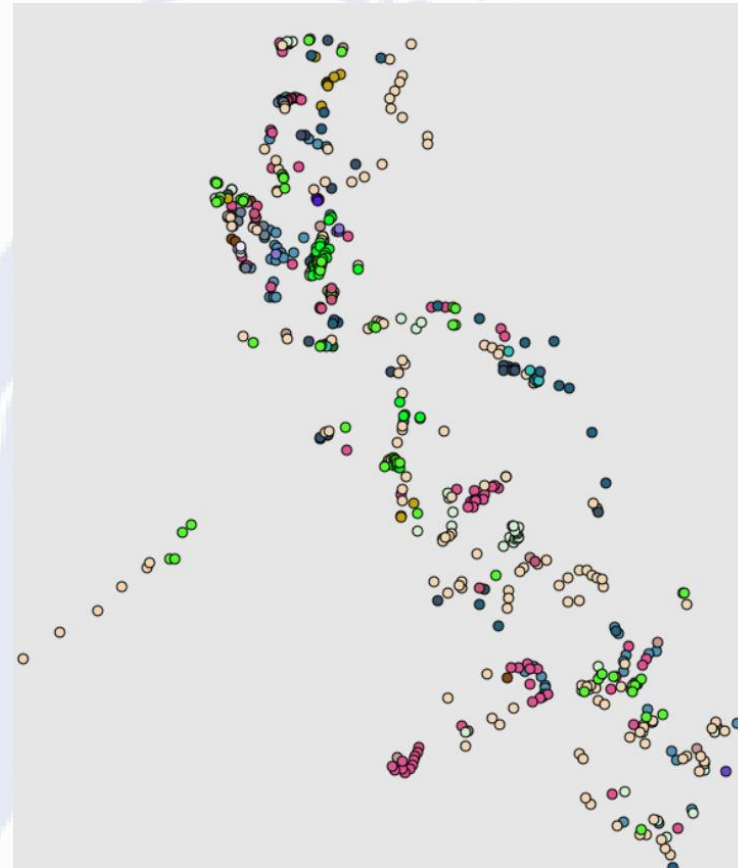


Web-Based Geospatial Information System

WMS URI GetMap request to display the map using a web browser

https://ccop-gsi.org/ows/dynamic_wms/2015/

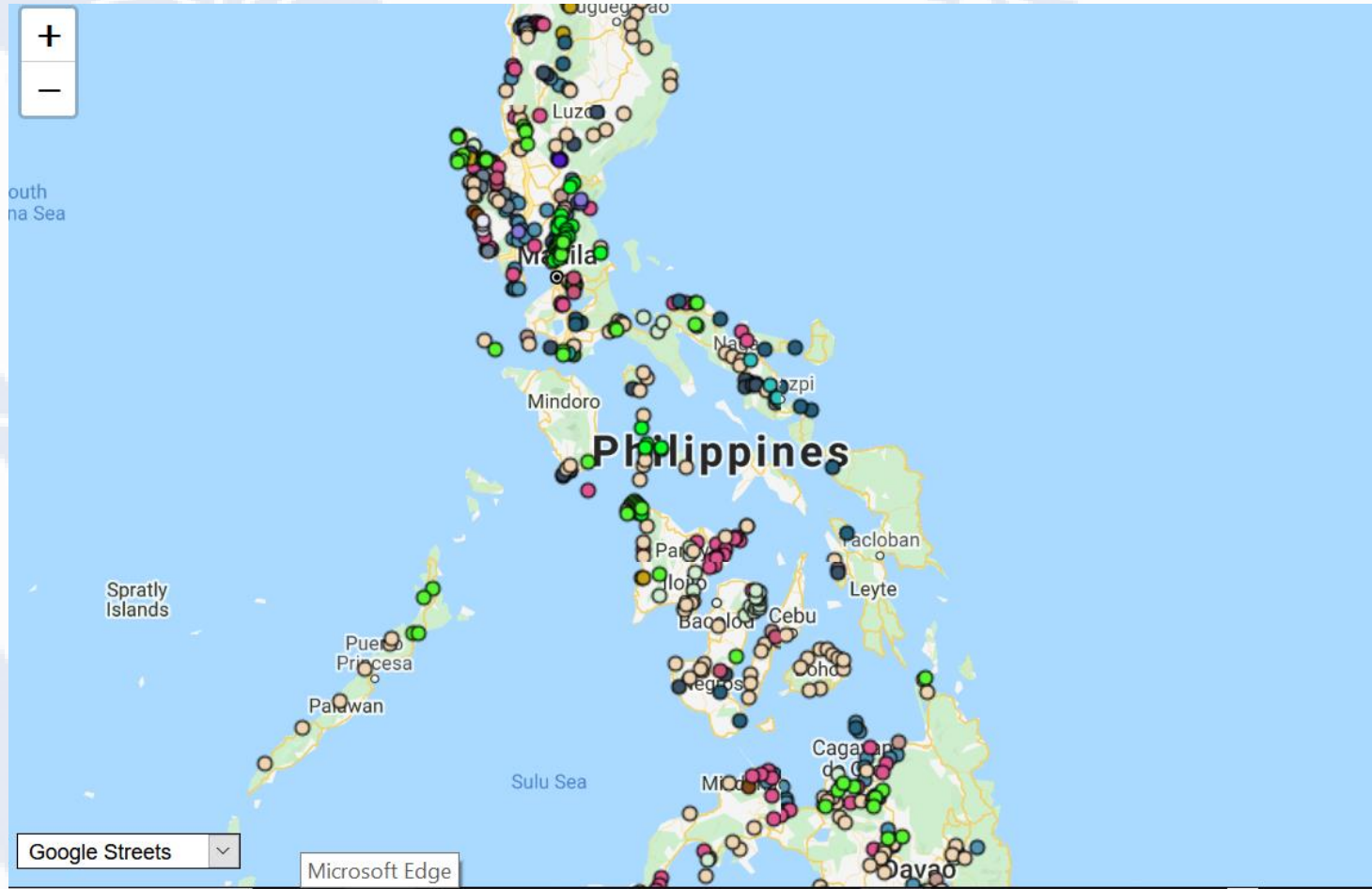
[M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H_wms?LAYERS=M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H&REQUEST=GetMap&SERVICE=WMS&VERSION=1.1.1&FORMAT=image/png&SRS=EPSG:4326&BBOX=117.1,5.3,126.4,19.3&WIDTH=600&HEIGHT=700](https://ccop-gsi.org/ows/dynamic_wms/2015/M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H_wms?LAYERS=M_portal_maps_philippine_nonmet_minerals_table_20151027193301_z8H&REQUEST=GetMap&SERVICE=WMS&VERSION=1.1.1&FORMAT=image/png&SRS=EPSG:4326&BBOX=117.1,5.3,126.4,19.3&WIDTH=600&HEIGHT=700)





Web-Based Geospatial Information System

GetMap request result displayed using WMS client





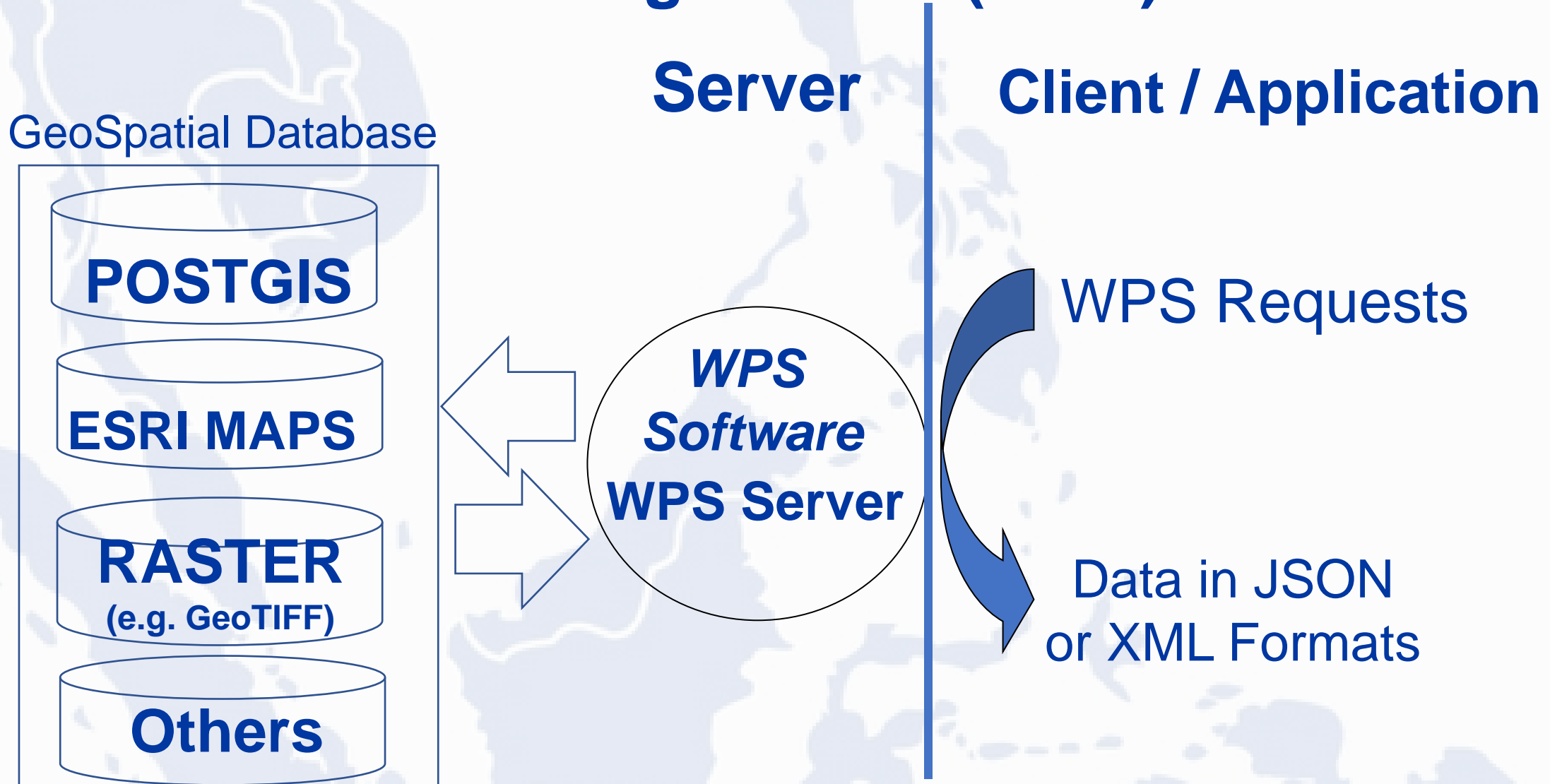
Web Processing Service (WPS)

WPS requests are in the form of URI which could trigger geoprocessing by executing server-side script or executable file to perform specific task like querying the database.



Web-Based Geospatial Information System

Web Processing Service (WPS)



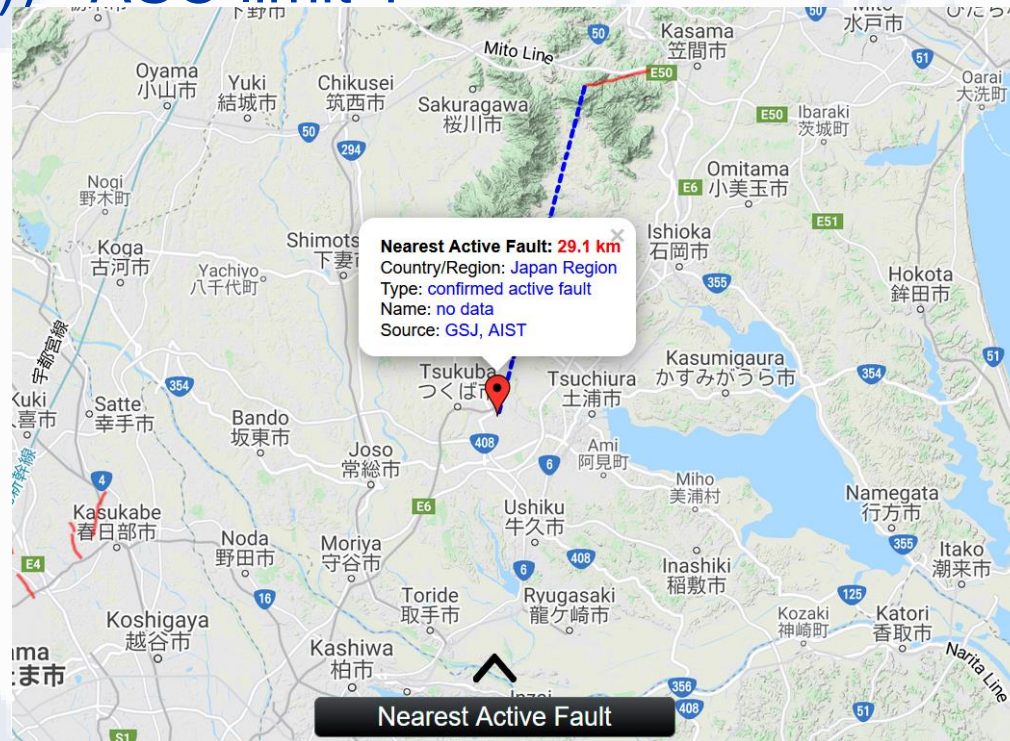


Web-Based Geospatial Information System

Web Processing Service (WPS)

SQL to determine the nearest active fault from my office.

```
SELECT ST_AsText(geom),region,type,name,region_j,type_j,name_j from $dbtable  
ORDER by ST_Distance_Sphere (ST_GeomFromText('$point',4326),  
ST_Transform(geom,4326)) ASC limit 1
```





Web-Based Geospatial Information System

Software providing WMS and WPS Capabilities

Open Source

MapServer
Geoserver

Commercial Software

ArcGIS Server
Oracle MapViewer

** AMDIS System uses FOSS*



Formulating WMS

1. Install WMS software on the server
2. Upload map data to the server
3. Enter map data (vector data) to a database (optional)
4. Create mapfile containing information about the data
5. Write an executable script (WMS script) that will run the the WMS software (parse mapfile), accept WMS request, query the database (read data) and respond to WMS request.

** WMS url points to the location of the WMS script.*

Formulating WMS

Documents Needed to Serve Maps/Satellite Images as WMS

1. Mapfile
2. WMS Script

Web-Based Geospatial Information System

WMS Mapfile

MAP

```
NAME OGC_WMS
STATUS ON
SIZE 256 256
EXTENT 102.707992553711 9.48721981048584 109.325004577637 23.1601009368896
UNITS dd
IMAGECOLOR 255 255 255
IMAGETYPE gif
CONFIG "MS_ERRORFILE" "/var/tmp/ms.log"
  DEBUG 5
PROJECTION
  "init=epsg:4326"
END
```

METADATA

```
WMS_TITLE "Mineal Occurrence Map of the Philippines"
WMS_ABSTRACT "Mineral occurrence map of the the Philippines."
WMS_ONLINERESOURCE "http://ccop-gsi.org/cgi-bin/gsj_wms/phl_ore_occurence2?"
WMS_CONTACTPERSON "Dr. Horacio Ramos"
WMS_CONTACTORGANIZATION "Mines and Geoscience Bureau (MGB), DENR, Philippines"
WMS_CONTACTVOICETELEPHONE "+63 2 37720346"
WMS_CONTACTFACSIMILETELEPHONE "+63 2 38351789"
WMS_CONTACTELECTRONICMAILADDRESS "mgb@gmail.com"
WMS_FEES "none"
WMS_ACCESSCONSTRAINTS "This digital map is available for free download for your personal, teaching or non-commercial use."
WMS_FEATURE_INFO_MIME_TYPE "text/html"
WMS_SRS "EPSG:4326 ESRI:54004 EPSG:4326 EPSG:4612 EPSG:4301 EPSG:900913"
END
END
```

Web-Based Geospatial Information System

WMS Mapfile

LAYER

NAME **phl_metallic_minerals**

METADATA

WMS_TITLE "Philippines Mineral Ore Occurence"

WMS_ABSTRACT "Philippines mineral map."

WMS_SRS "EPSG:4326 ESRI:54004 EPSG:4326 EPSG:4612 EPSG:4301 EPSG:900913"

END

connectiontype postgis

connection "user=postgres password=**** dbname=mydb host=localhost port=5432"

data "geom from **mymaps_schema.phl_mgb_metallic_mineral_resources** using unique gid"

TYPE POINT

STATUS ON

DUMP TRUE

PROJECTION

"init=epsg:4326"

END

Web-Based Geospatial Information System

WMS Mapfile

Philippines Metallic Mineral Occurrence Map

CLASSITEM "mineral"

class
name "Au"
expression "Au"
style
symbol "Circle"
color 0 107 243
outlinecolor 0 0 0
size 15

end

end

class
name "Au/Cu"
expression "Au/Cu"
style
symbol "Circle"
color 78 107 243
outlinecolor 0 0 0
size 15

end

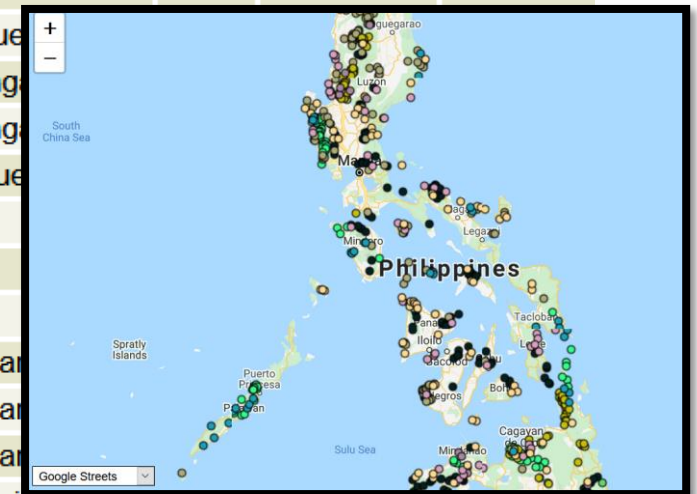
end

phpPgAdmin: PostgreSQL: portal_maps: mymaps_schema: phl_mgb_metallic_mineral_resource

Browse

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Actions		gid	id	mineral	status	uses	province	region	commodityt	ope
Edit	Delete	1	887	Au	Prospect	NULL	Aklan	6	Metallic	NULL
Edit	Delete	2	890	Au	Prospect	NULL	Antique	6	Metallic	NULL
Edit	Delete	3	893	Au	Prospect	NULL	Antique			
Edit	Delete	4	895	Au	Abandoned/Stopped Operation	NULL	Batangas			
Edit	Delete	5	896	Au	Explored	NULL	Batangas			
Edit	Delete	6	923	Au	Prospect	NULL	Benguet			
Edit	Delete	7	940	Au	Explored	NULL	Bohol			
Edit	Delete	8	941	Au	Explored	NULL	Bohol			
Edit	Delete	9	942	Au	Explored	NULL	Bohol			
Edit	Delete	10	948	Au	Explored	NULL	Bulacan			
Edit	Delete	11	949	Au	Explored	NULL	Bulacan			
Edit	Delete	12	950	Au	Prospect	NULL	Bulacan			
Edit	Delete	13	951	Au	Abandoned/Stopped Operation	NULL	Camarines Norte	5	Metallic	NULL
Edit	Delete	14	952	Au	Abandoned/Stopped Operation	NULL	Camarines Norte	5	Metallic	NULL
Edit	Delete	15	953	Au	Abandoned/Stopped Operation	NULL	Camarines Norte	5	Metallic	NULL



Web-Based Geospatial Information System

WMS Mapfile for Serving Satellite False Color Composite Image as WMS

```
LAYER
NAME M_ASTER_ASTB210108024025_vnir3nvir2vnir1_2021-01-08_PaM
DATA ASTB210108024025/2101080240252101099016/ASTB210108024025_derived_jc.b.vnir3nvir2vnir1.tif
TYPE RASTER
STATUS ON
OFFSITE 0 0 0
PROCESSING "SCALE_1=0,105"
PROCESSING "SCALE_2=0,61"
PROCESSING "SCALE_3=0,85"
```

METADATA

```
WMS_TITLE "ASTER(VNIR3N-VNIR2-VNIR1) 2021-01-08 Subic Bay Philippines 1"
WMS_ABSTRACT "This data is obtained from the publicly accessible MADAS (METI AIST Data Archive System) ASTER satellite database at https://gbank.gsj.jp/madas/map/index.html. WMS_SRS "EPSG:4326 EPSG:4326 EPSG:3857 EPSG:900913"
END
```



Web-Based Geospatial Information System

WMS Script

Philippines Metallic Mineral Map

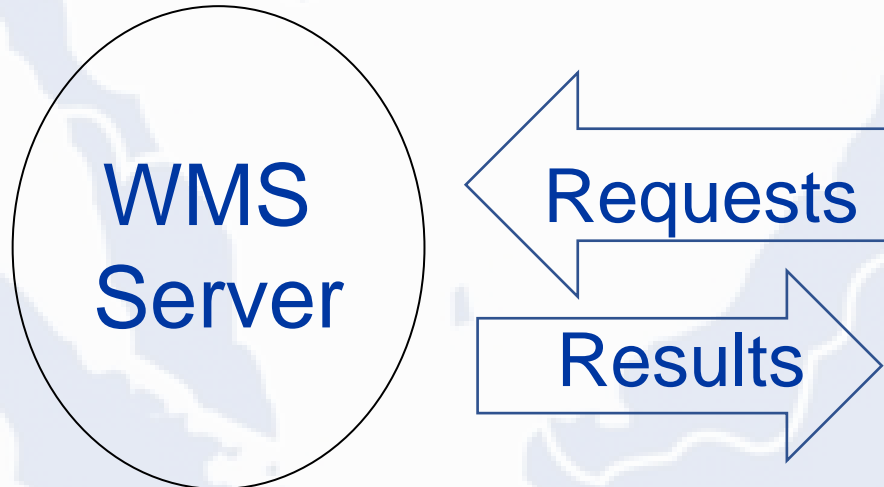
```
#!/bin/sh
export MS_MAPFILE=/var/www/wms/dynamic_wms/2021/
M_portal_maps_phl_mgb_metallic_mineral_resources_20210114162038_VZ9.map
exec /usr/local/bin/mapserv
```

ASTER Satellite Image False Color Composite

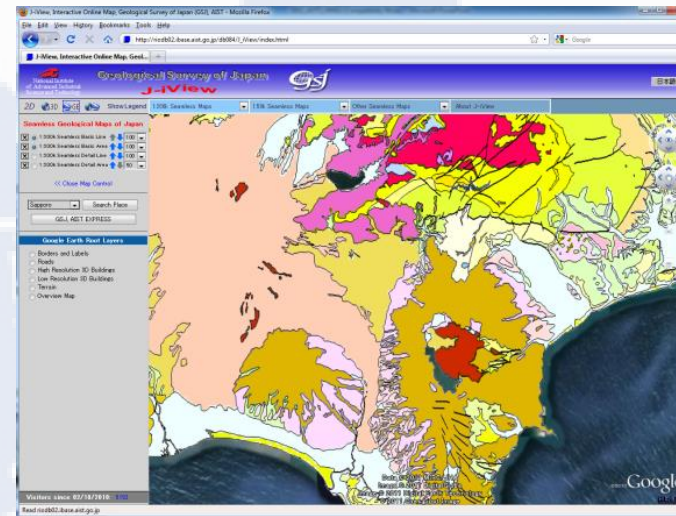
```
#!/bin/sh
export MS_MAPFILE=/var/www/wms/dynamic_wms/2021/
M_ASTER_ASTB210108024025_vnir3nvir2vnir1_2021-01-08_PaM.map
exec /usr/local/bin/mapserv
```

WMS Clients

WMS Clients are software that provide Graphic User Interface for implementing WMS requests (mostly GetMap request) and viewing results.



WMS Client





WMS Clients

1. Open Source

OpenLayers

Leaflet

OneGeology

2. Commercial

Google Maps

Google Earth

Bing Maps

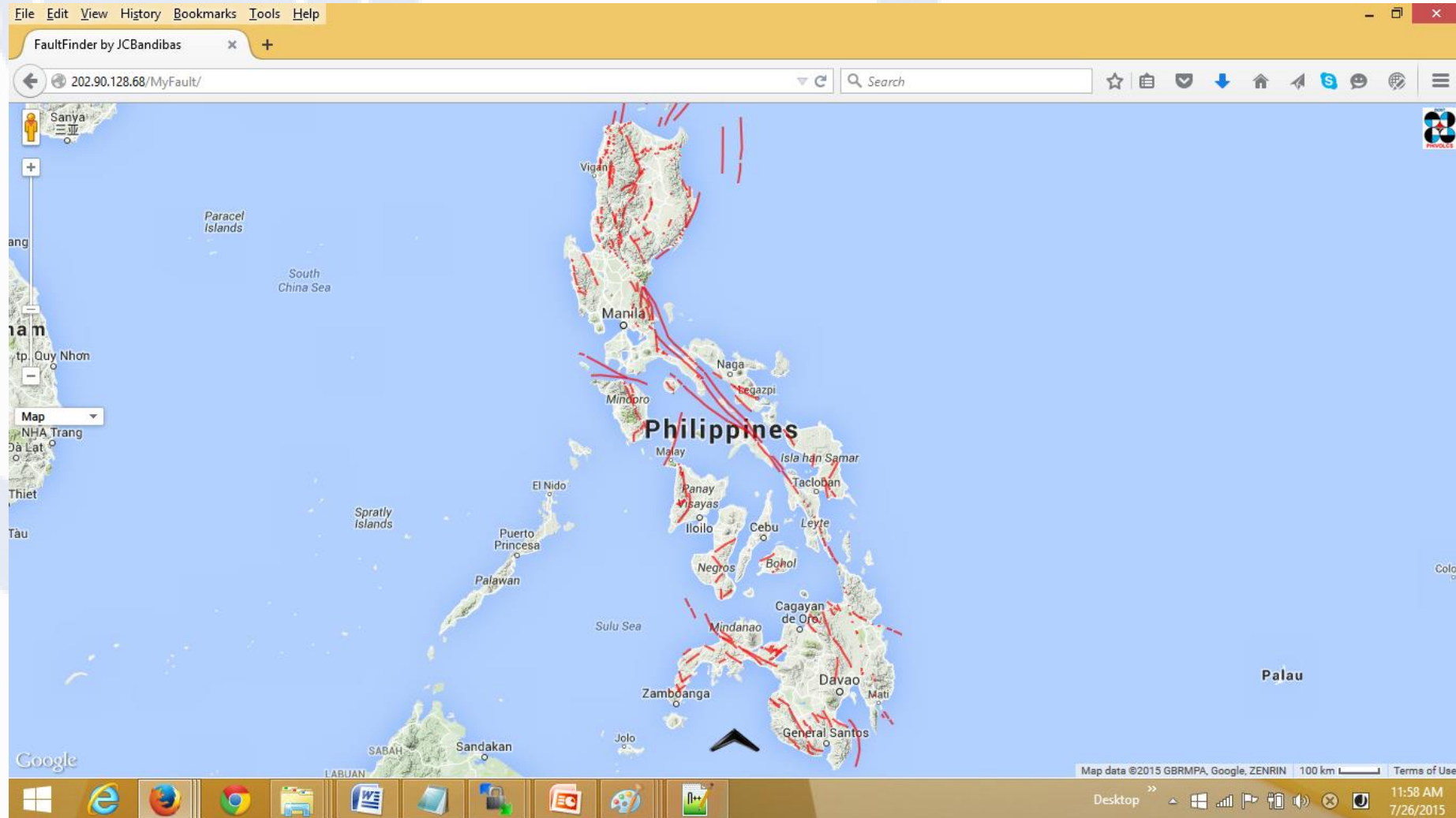
3. Customized WMS Client

GSI, AMDIS



Web-Based Geospatial Information System

WMS Clients: Google Maps (Google Maps API)





Web-Based Geospatial Information System

WMS Clients: Google Earth

File Edit View History Bookmarks Tools Help

OneGeology Asia

jcbwebgis.com/OneGeologyAsia/

ONE OneGeology Asia

2D Show Legend Geological Maps Spatial Data Catalog OneGeology Asia

OVERLAYS

Philippine Geological Map 1: 100

<< Close Map Control

Google Earth Root Layers

- Borders and Labels
- Roads
- High Resolution 3D Buildings
- Low Resolution 3D Buildings
- Terrain
- Overview Map

1021 km

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat

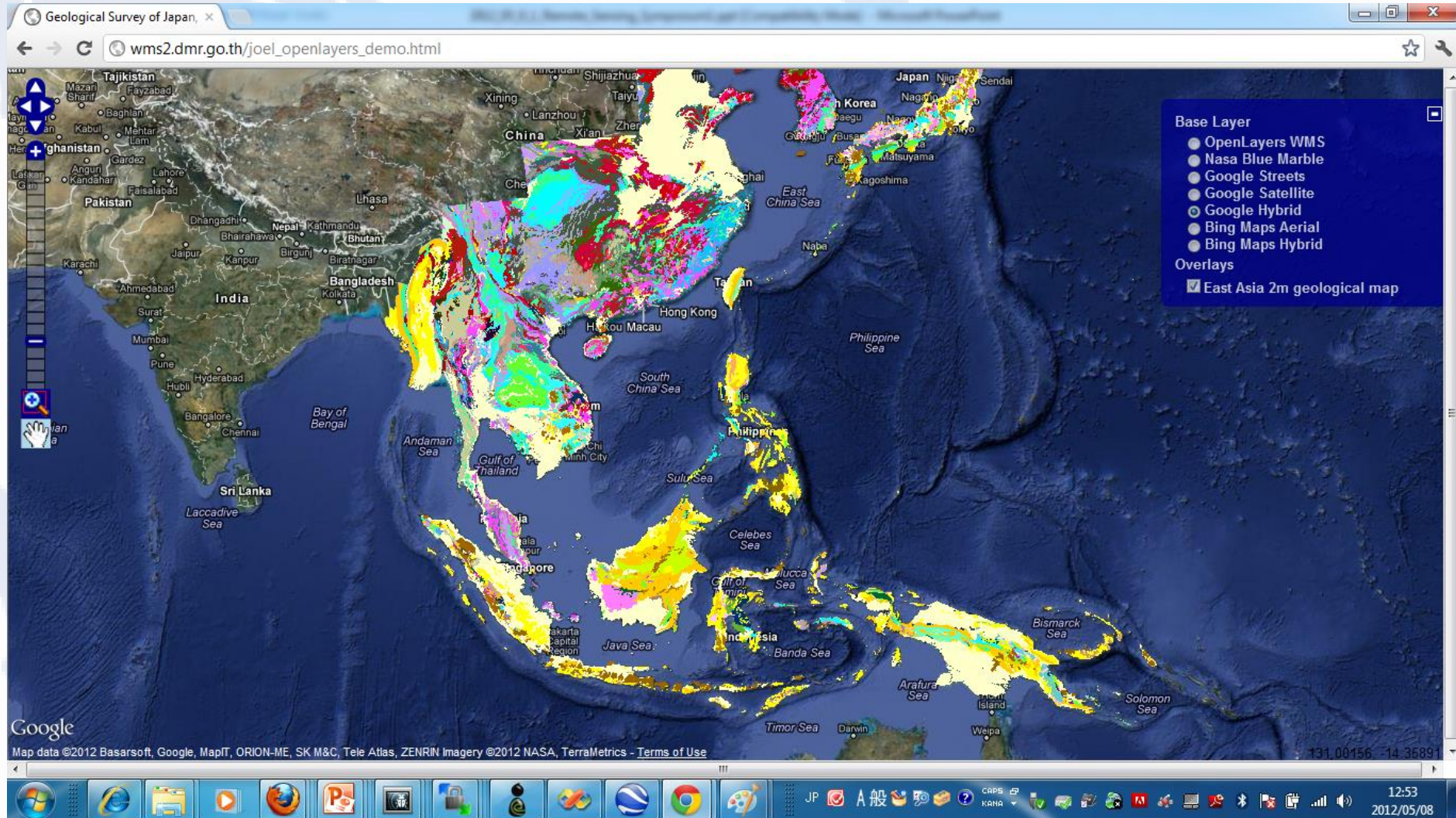
Google earth

Desktop 11:54 AM 7/26/2015



Web-Based Geospatial Information System

WMS Clients: OpenLayers





Web-Based Geospatial Information System

WMS Clients: GSi System

The screenshot displays a web browser window with the following elements:

- Browser Tab:** GSi Portal
- Address Bar:** <https://ccop-gsi.org/main/>
- Page Header:**
 - Logo:** GSi (Geological Survey of Japan)
 - Title:** CCOP Geoinformation Sharing Infrastructure for East and Southeast Asia
 - Subtitle:** Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP)
 - Text:** Geological Survey of Japan (GSJ), AIST
 - User:** guest
 - Navigation:** About GSi, Privacy Statement, GSi Data Policy, User's Guide
- Main Content:** A map of Southeast Asia and surrounding regions (including parts of India, China, and the Philippines) overlaid with a dense distribution of multi-colored circular data points. The map includes labels for various geographical features such as the Bay of Bengal, Andaman Sea, Gulf of Thailand, and several islands.
- Footer:** Windows taskbar showing the search bar and system tray with the date and time: 7:33 PM, 1/18/2021.



Web-Based Geospatial Information System

WMS Clients: AMDIS System

☰
🇲🇵
ASEAN Mineral Database Geospatial Information System (AMDIS)
🇲🇵 🇮🇩 🇵🇭 🇲🇾 🇹🇼 🇸🇮 🇹🇲 🇻🇳 🇵🇾 🇸🇬
guest

ASEAN Member Countries

Map Overlay Control

Tools

About this Site

Login or Register

Brunei Darussalam

Click map to view a country's mineral data.

Search for Minerals

ASEAN

Enter mineral name

Submit
Reset

Upload Data

Formulate WMS

Satellite Image

Add External WMS

+
-
+

Google Streets

ASEAN AMDIS Mineral Maps

- ASEAN ASOMM 1:1M Mineral Occurrence
- CAM GDMR 1:750K Mineral Resources
- IDN GAI 1:1M Indonesia Metallic Minerals
- IDN GAI 1:1M Indonesia Non-metallic Minerals
- LAO DOM 1:1M Mineral Map of Laos
- MMR DGSE 1:1M Myanmar Mineral Resources
- MYS JMG 1:1M Metallic Mineral Map of Malaysia
- MYS JMG 1:1M Non-Metallic Mineral Map of Malaysia
- MYS JMG 1:1M Peninsular Malaysia Mineral Resources
- PHL MGB 1:1M Philippine Metallic Minerals
- PHL MGB 1:1M Philippine Non-Metallic Minerals

Available Map Catalogs

- AMDIS Database Query Results
- AMDIS New WMS Layers
- ASEAN AMDIS Mineral Maps
- Brunei Darussalam AMDIS Mineral Maps
- Cambodia AMDIS Mineral Maps
- Indonesia AMDIS Mineral Maps

Search for GSI Maps

Enter search text

Submit
Reset

Download Maps