



# Create your own Spatial Data Infrastructure (SDI) with Open Source Software

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FOSS4G Europe 2018 Guimarães (Portugal)



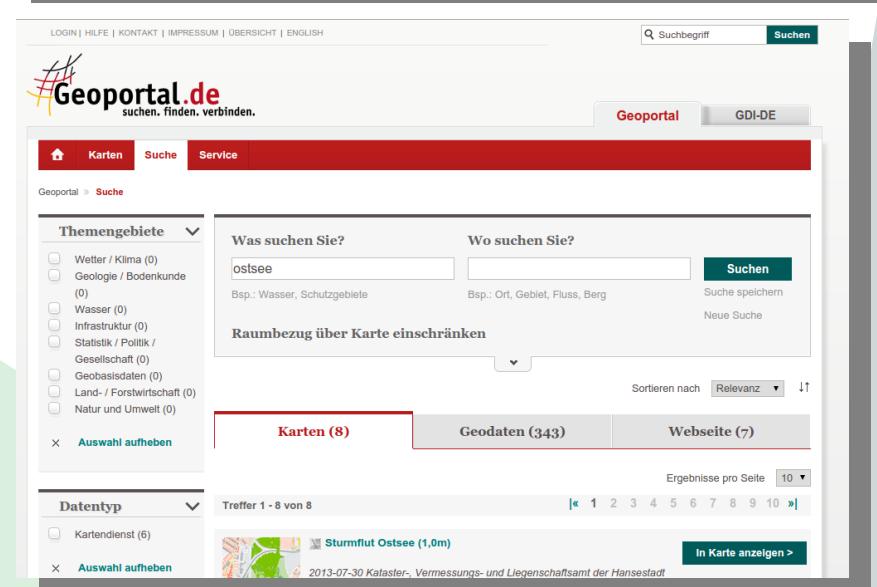
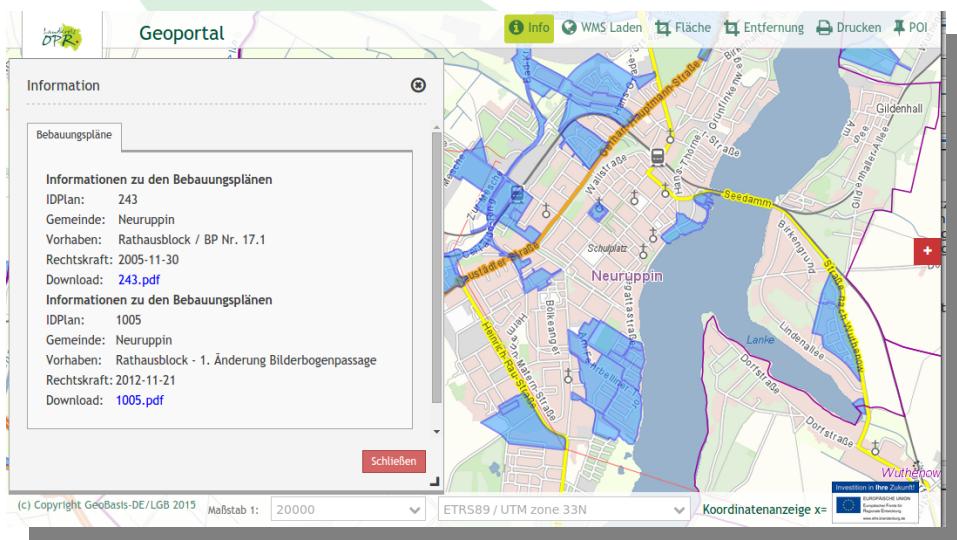
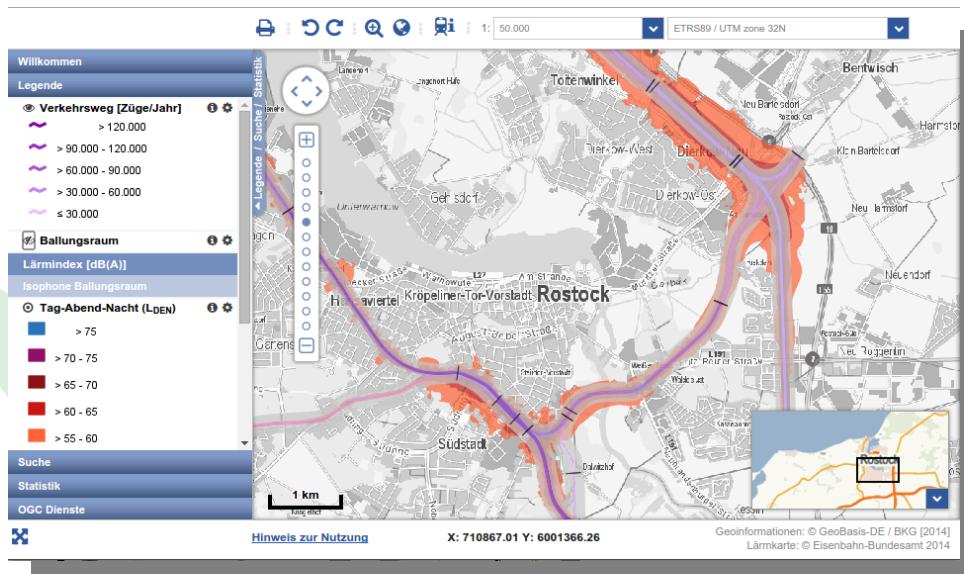
# Astrid Emde

- Project management and development, trainings for MapServer, PostgreSQL/PostGIS, Mapbender, GeoServer, QGIS
- Part of Mapbender Team & PSC, Concept, Testing, Documentation
- OSGeoLive PSC since 2017
- OSGeo Board since 2017
- Local Chapter FOSSGIS e.V. & FOSSGIS Konferenz
-  WhereGroup Bonn



WhereGroup

# WhereGroup



# WhereGroup

- > 30 employees - developers, consultants & geospatial experts
- Working with Open Source Software for more than 15 years
- Company behind Mapbender, Metador & Mops
- Bonn – Berlin – Freiburg
- FOSSGIS e.V. member & OSGeo sponsor
- We are hiring!



WhereGroup





WhereGroup

# WhereGroup

The screenshot shows the Metador interface with a sidebar for tools like CSV-Download and a search bar at the top. The main area displays three dataset cards:

- Koloss von Rhodos**: A bronze statue of Helios, located in Rhodes, built around 292 BC.
- Maussolleion**: The tomb of Mausolus, King of Caria, located in Halicarnassus (modern Bodrum).
- Pharos von Alexandria**: The first lighthouse of Alexandria, built by Sostratus of Cnidus.

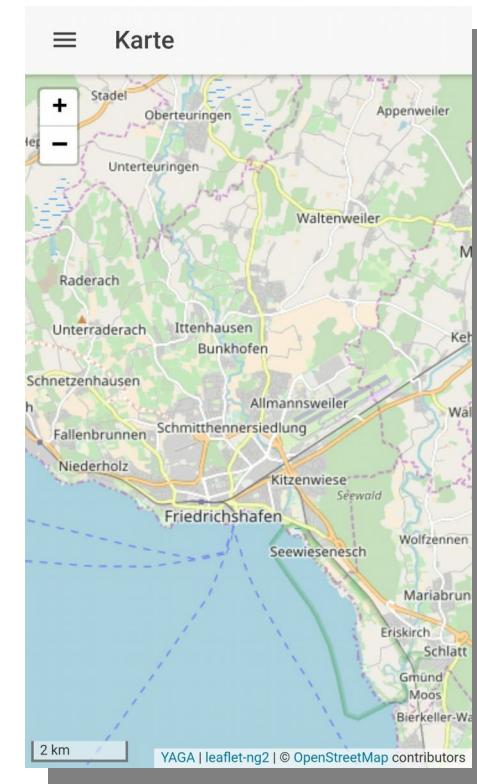
Each card includes a thumbnail, a brief description, and download links for PDF, HTML, and XML.

## Metador Metadata editor



# Mops

Offline Client using  
Yaga, Leaflet, Angular



## Consulting, Training & more

# SDI Workshop

- **What is a Spatial Data Infrastructure (SDI)**
- **Components of an SDI**
- **Data**
- **Services & OGC Standards**
- **Clients**
- **Metadata**
- **Get to know OSGeo Software**



# Workshop with OSGeoLive

- OSGeoLive 11.0  
(August 2017)

- OSGeoLive  
<http://live.osgeo.org>
- Download Data & Presentation  
[http://trac.osgeo.org/osgeo/wiki/Live\\_GIS\\_Workshop\\_Install](http://trac.osgeo.org/osgeo/wiki/Live_GIS_Workshop_Install)



# What is a SDI?



## What is an SDI?

A spatial data infrastructure (SDI) is a data infrastructure implementing a framework of geographic data, metadata, users and tools that are interactively connected in order to use spatial data in an efficient and flexible way. Another definition is "the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data".

Zitat: Wikipedia

[https://en.wikipedia.org/wiki/Spatial\\_data\\_infrastructure](https://en.wikipedia.org/wiki/Spatial_data_infrastructure)

# SDI

- **Data infrastructure that provides geographic data and metadata**
- **Data network to exchange data**
- **Data producer and data user are connected via a physical network f.e internet / intranet**
- **it is accessible for several users**
- **Users can use different tools for different processes**
- **It helps you to make data accessible, maintainable and findable throughout your organization**
- **Increases efficiency and flexibility**



## Was ist eine GDI?

Als Geodateninfrastruktur (GDI) wird ein Netzwerk zum Austausch von Geodaten bezeichnet, in dem Geodaten-Produzenten, Dienstleister im Geo-Bereich sowie Geodatennutzer über ein physisches Datennetz, in der Regel das Internet, miteinander verknüpft sind.

Aufgrund der Bedeutung von raumbezogenen Informationen (=Geodaten) ist es das Ziel der GDI, diese Geodaten allen Nutzern zur Verfügung zu stellen. Dabei beinhaltet der Begriff „Nutzer“ sowohl die öffentliche Verwaltung als auch die Wirtschaft, die Wissenschaft und den Bürger. [...]

Zitat: Wikipedia

<https://de.wikipedia.org/wiki/Geodateninfrastruktur>

Create your own Spatial Data Infrastructure with Open Source Software – Astrid Emde



# Was ist eine GDI?

Werden Geodatendienste und die dazugehörigen Geodaten strukturiert und systematisch koordiniert sowie verwaltungsebenen- und fachübergreifend angeboten, wird dies als Geodateninfrastruktur (GDI) bezeichnet. Eine GDI besteht im Kern aus Geodaten einschließlich Metadaten zu deren Beschreibung, Geodatendiensten und Netzen.

Zitat: Geodatendienste im Internet (3. Auflage, KSt. GDI-DE)

[http://www.geoportal.de/SharedDocs/Downloads/DE/GDI-DE/Flyer-Broschueren/Leitfaden-Geodienste-im%20Internet.pdf?\\_\\_blob=publicationFile](http://www.geoportal.de/SharedDocs/Downloads/DE/GDI-DE/Flyer-Broschueren/Leitfaden-Geodienste-im%20Internet.pdf?__blob=publicationFile)



## Clients

## Zentrale Datenhaltung

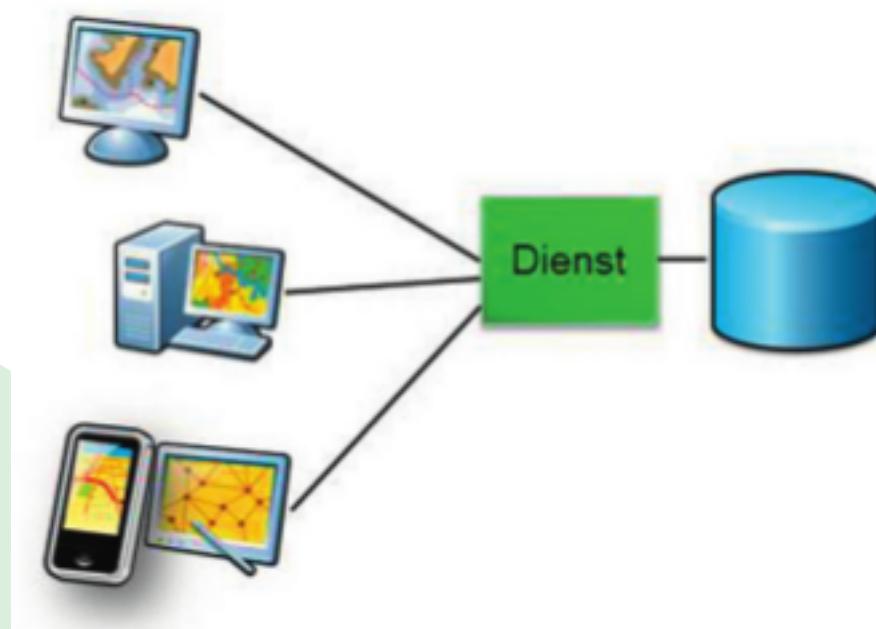
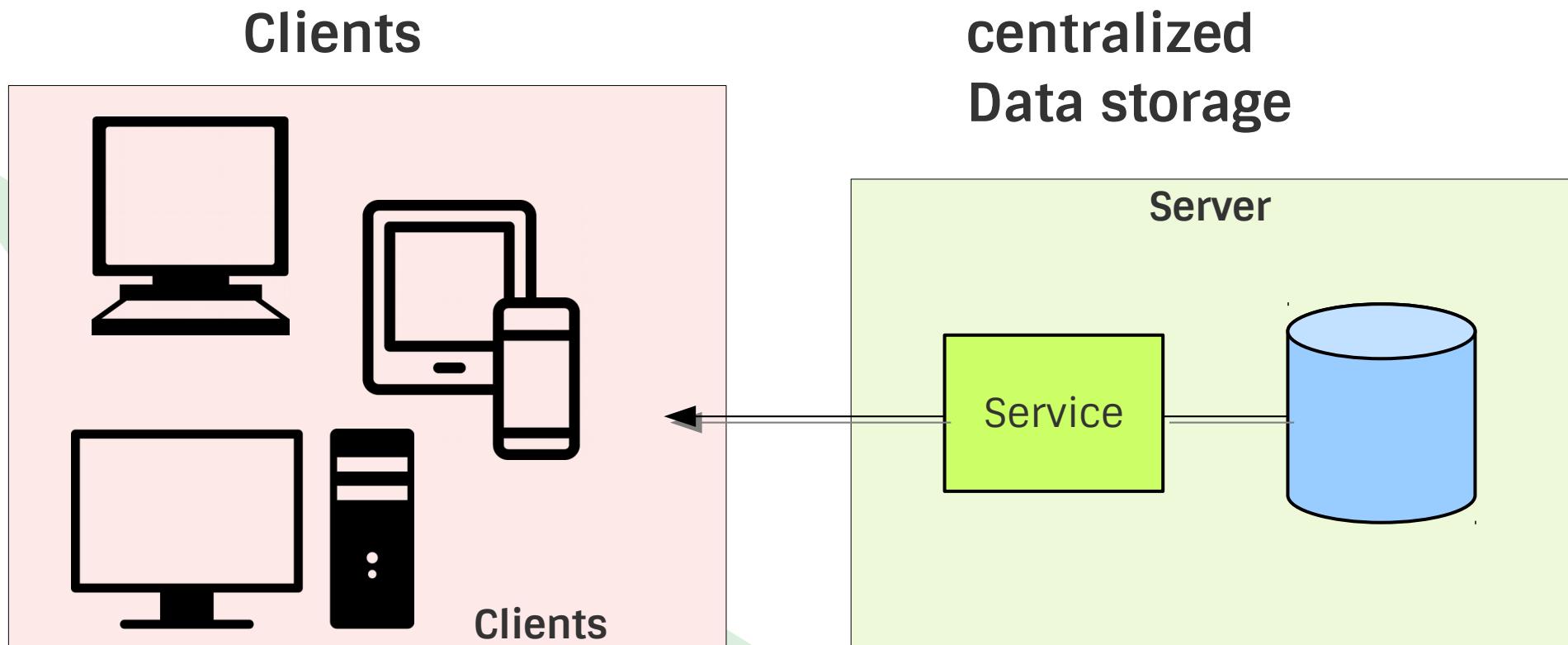


Abbildung: Geodatendienste im Internet (3. Auflage, KSt. GDI-DE)

[http://www.geoportal.de/SharedDocs/Downloads/DE/GDI-DE/Flyer-Broschueren/Leitfaden-Geodienste-im%20Internet.pdf?\\_\\_blob=publicationFile](http://www.geoportal.de/SharedDocs/Downloads/DE/GDI-DE/Flyer-Broschueren/Leitfaden-Geodienste-im%20Internet.pdf?__blob=publicationFile)

# Communication with the Clients



From Geodatendienste im Internet (3. Auflage, KSt. GDI-DE)

[http://www.geoportal.de/SharedDocs/Downloads/DE/GDI-DE/Flyer-Broschueren/Leitfaden-Geodienste-im%20Internet.pdf?\\_\\_blob=publicationFile](http://www.geoportal.de/SharedDocs/Downloads/DE/GDI-DE/Flyer-Broschueren/Leitfaden-Geodienste-im%20Internet.pdf?__blob=publicationFile)



## Data storage

file system

database

## Edit data

editors f.e. Desktop GIS

command line tools

scripts

## Spatial Services Provide data access

OGC Services

WMS Web Map Service  
WFS Web Feature Service  
WCS Web Coverage Service  
WMC Web Map Context  
WPS Web Processing Service  
& more

## Spatial Services View Data

Browser  
Desktop GIS

## Catalog & find Data

Metadata Catalog  
CSW Catalog Service Web

**Excercise 1:** Please assign Open Source Software to the components of a SDI. See <https://live.osgeo.org>



## Data storage

file system  
database

ESRI Shape  
OGC GeoPackage  
PostgreSQL/PostGIS...

## Edit data

editors f.e. Desktop GIS  
QGIS, gvSIG, uDIG,  
Saga, GRASS, OpenJump

command line tools  
ogr2ogr gdal shp2pgsql

scripts f.e. python

## Spatial Services Provide data access

OGC Services

MapServer  
GeoServer  
deegree  
QGIS Server  
pyWPS

## Spatial Services View Data

Browser: Mapbender,  
OpenLayer,  
Leaflet, Marble,  
Cesium  
DesktopGIS: QGIS,  
GRASS GIS, Saga,  
OpenJump

## Catalog & find Data

Metadata Catalog  
CSW Catalog Service Web  
  
GeoNetwork  
pyCSW



# Data - Status

- Users work with different data
- Different formats
- Different tools to view and edit
- Data can be spread and copied
- Data can have different versions that are in use



# Data

## Goals

- Central data storage
- Editing does not have to take place always in the central data storage, but define how to exchange
- Easy import & export of data
- Flexible visualisation with different tools
- Data storage with defined access
- Data storage with authentication/authorisation and multi user access
- Data history



# Data

## Goals

- **First Goal: centralized data storage**



# Database





## PostgreSQL & PostGIS

<https://live.osgeo.org/de/overview/overview.html>



# PostgreSQL

- Supported by several other programs and programming languages
- Fast, powerful, reliable, robust, easy to maintain
- PostGIS is an extension for PostgreSQL
- Let PostGIS do the work - not your Desktop GIS
- Follows standard - OGC Simple Feature Spezification for SQL and OGC ISO SQL/MM Spezification
- Provides many spatial functions
- Control access to your data



## Excercise 2: Create Database in PostgreSQL

- Open Database Client pgAdmin III
- Create database: context menu on database → new database → name **foss4g**
- Load postgis Extension
  - Context menu on database **foss4g** → new <sup>fourth</sup> objekt → new extension → name: postgis



# Data

## Goals

- First Goal: centralized data storage
- **Second Goal: Easy import & export of data**
- **Third Goal: Flexible visualisation with different tools**



# Excercise 3: Load Natrual Earth data (Shapes) in Desktop GIS QGIS

- /home/user/data/natural\_earth2/ne\_10m\_admin\_1\_states\_provinces\_shp.shp
- Provinces of Portugal
- Filter show only admin = 'Portugal'
- Label mit [name]

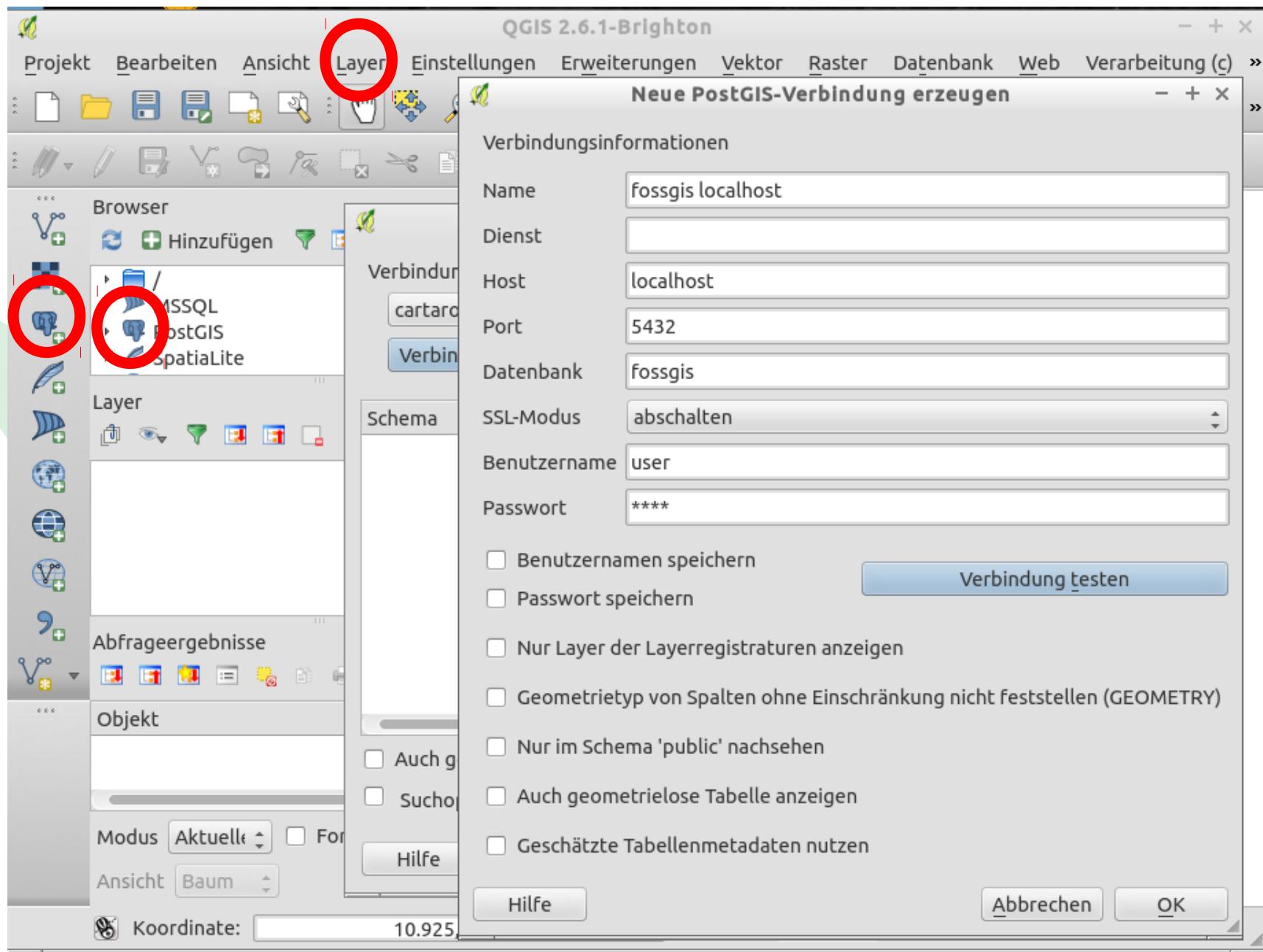


# Data import from QGIS to PostgreSQL

- You can import Shape to PostgreSQL via
  - QGIS DB Manager
  - or
  - `shp2pgsql`
  - `ogr2ogr`
  - `python`
  - ...

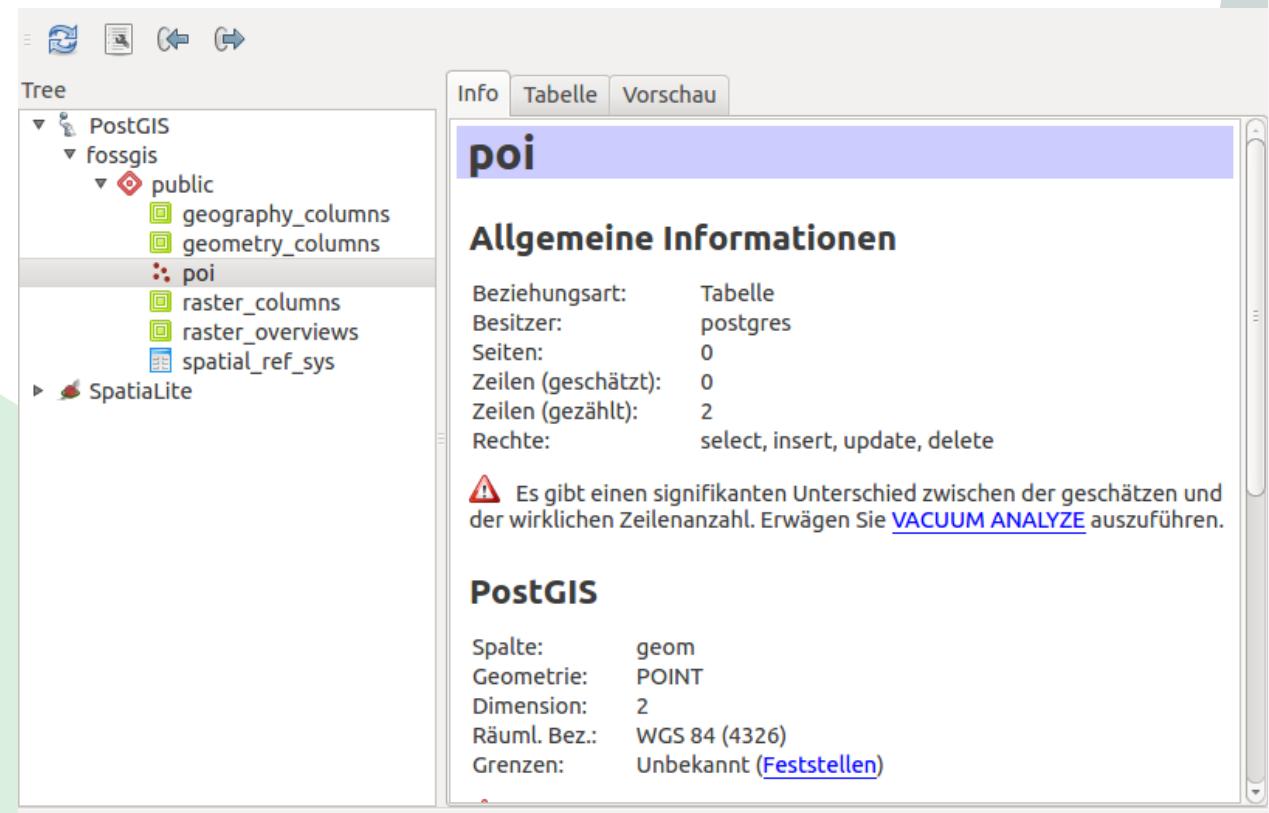


# Create a new PostgreSQL Connection in QGIS

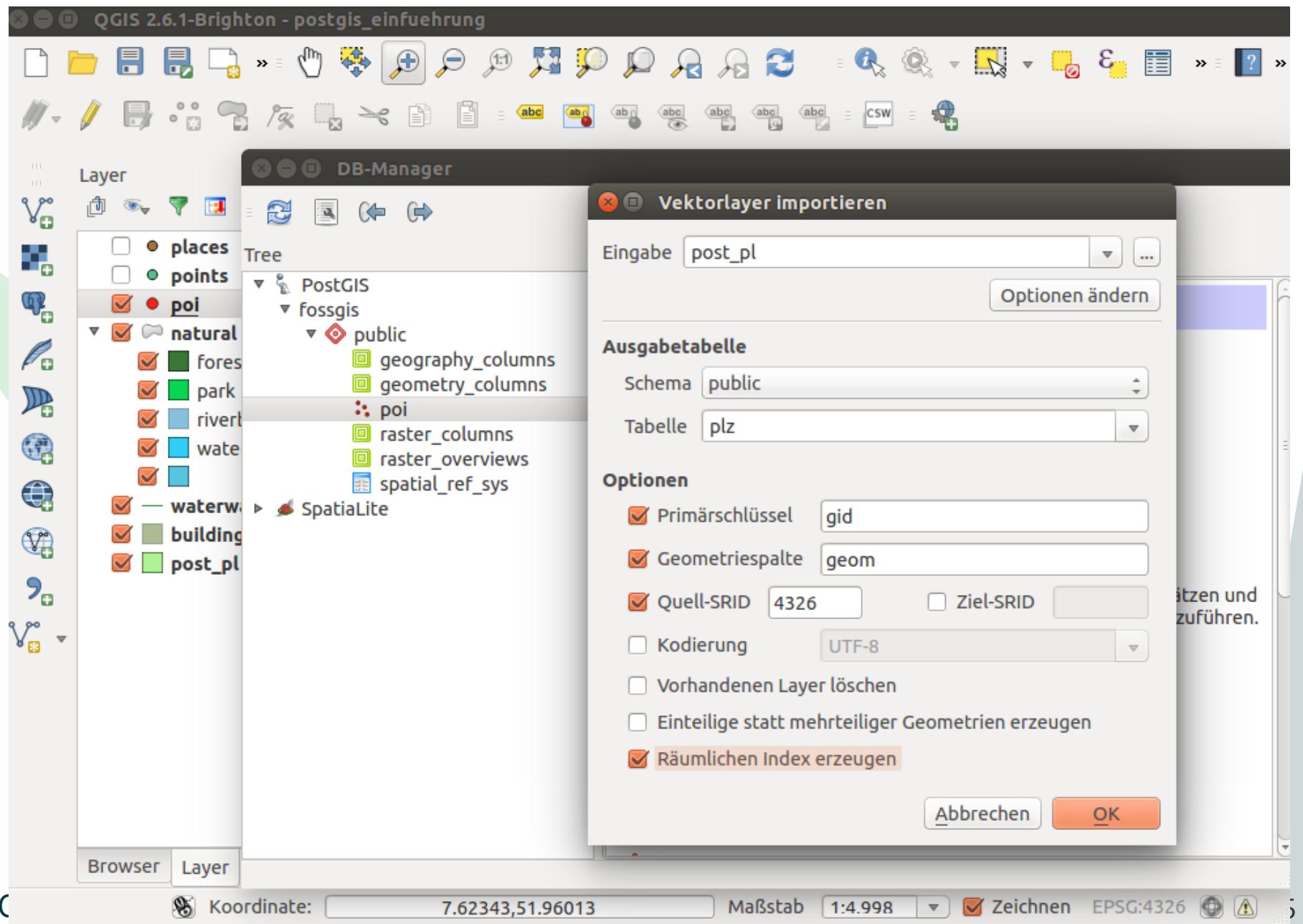


# QGIS DB Manager

- Easy Import / Export
- Supports many data formats
- Visualize your data
- Show & edit table structure
- Create index
- Vacuum / Analyze



# QGIS DB Manager Import



## Exercise 3 Import & Export

- Import provinces from Natural Earth data (only Portugal)
- Import populated places from Natural Earth data (only Portugal)
- Add the table from your database to your QGIS project (drag & drop)
- Save populated places as geopackage via DB Manager or via QGIS save as...



# Data

## Goals

- First Goal: centralized data storage
- Second Goal: Easy import & export of data
- Third Goal: Flexible visualisation with different tools
- **Fourth Goal: Defined access to data**



# PostgreSQL roles

- PostgreSQL has roles
  - groups
  - User with login
- You can give access to databases, schema, tables, views ... to roles
- Write or read access



# Create roles in PostgreSQL

- Create role, create login role
- Give read access to table places
- Give write access to table countries



## Exercise 4 – control data access

- Create a role `workshop_read` and `workshop_writer`
- Create a login role `robert` with a password and add to `workshop_reader`
- Create a new login role `wilma` and add `wilma` to the `workshop_writer` role
- Grant read access to table `places` to your new role `workshop_reader`
- Grant write access to table `countries` to your new role `workshop_writer`
- Try to access and edit via QGIS



## Excercise 4 - solution

```
CREATE ROLE workshop_reader;
```

```
CREATE ROLE workshop_writer;
```

```
CREATE ROLE robert WITH LOGIN PASSWORD 'foss4g';
```

```
GRANT workshop_reader TO robert;
```

```
CREATE ROLE wilma WITH LOGIN PASSWORD 'foss4g';
```

```
GRANT workshop_writer TO wilma;
```



## Excercise 4 - solution

**GRANT SELECT ON places to workshop\_reader;**

-- change to user robert

**Select \* from places;**

**GRANT ALL ON countries to workshop\_writer;**

**GRANT USAGE ON SEQUENCE countries\_gid\_seq TO workshop\_writer;**

-- change to user wilma

**Select \* from countries;**

**Update countries set name = 'TEST' WHERE name = 'Porto';**



# Provide Data via OGC Services

## Goals

- **Provide Data in the web - Intra- or Internet**
- **Provide data via standards that many tools support**
- **OGC WMS Web Map Service – show data and get information (advantage: styling is already defined)**
- **OGC WFS Web Feature Service – download service, provide data, edit data**
- **Provide INSPIRE conform Services in Europe**
- **<https://live.osgeo.org/de/standards/standards.html>**



# OSGeo Software with OGC WMS Support

- MapServer
- GeoServer
- QGIS Server
- deegree
- MapProxy



OGC WMS – map service, provide maps as raster, information as html, plain text, GML

# OSGeo Software with OGC WFS Support

- MapServer
- GeoServer
- QGIS Server
- deegree
- MapProxy



OGC WFS – feature service, data access f.e. via GML

# Provide Data via OGC Services

## Goals

- **First Goal: Provide Data in the web - Intra- or Internet**
- **Provide data via standards that many tools support**
- **OGC WMS Web Map Service – show data and get information (styling is already defined)**



# WMS example with QGIS Server

Publish your data via QGIS Server as WMS

Menu → Project → Project properties → OWS Server

- Name and title, extent, layer access
- (make sure you saved the password for your database access)
- `http://localhost/cgi-bin/qgis_mapserv?SERVICE=WMS&VERSION=1.3.0&REQUEST=GetCapabilities&map=/home/user/service_wms.qgs`



# WMS Capabilities Document

http://lo...e\_wms.qgs ×

localhost/cgi-bin/qgis\_mapserv.fcgi?Service=WMS&REQUEST=GetSchemaExtension"

- <**WMS\_Capabilities** version="1.3.0" xsi:schemaLocation="http://www.opengis.net/wms http://schemas.opengis.net/wms/1.3.0/capabilities\_1\_3\_0.xsd http://www.opengis.net/sld http://schemas.opengis.net/sld/1.1.0/sld\_capabilities.xsd http://www.qgis.org/wms http://inspire.ec.europa.eu/schemas/inspire\_vs/1.0 http://inspire.ec.europa.eu/schemas/inspire\_vs/1.0/inspire\_vs.xsd http://localhost/cgi-bin/qgis\_mapserv.fcgi?map=/home/user/service\_wms.qgsSERVICE=WMS&REQUEST=GetSchemaExtension">

- <**Service**>

  <**NameName**>

  <**TitleTitle**>

  <**Abstract**/>

  - <**KeywordList**>

    <**Keyword vocabulary**= "ISO">infoMapAccessService</**Keyword**>

    </**KeywordList**>

    <**OnlineResource xlink:type**= "simple" **xlink:href**= ""/>

  - <**ContactInformation**>

    - <**ContactPersonPrimary**>

      <**ContactPersonContactPerson**>

      <**ContactOrganizationContactOrganization**>

      <**ContactPosition**/>

    </**ContactPersonPrimary**>

    <**ContactVoiceTelephone**/>

    <**ContactElectronicMailAddress**/>

  </**ContactInformation**>

  <**FeesFees**>

  <**AccessConstraintsAccessConstraints**>

</**Service**>

## Exercise 5: WMS example with QGIS Server

- Publish your data via QGIS Server as WMS
- Create a WMS with two layers countries and places – style them nicely with labeling
- Save your project at: `/home/user/service_wms.qgs`
- Load your WMS in an empty QGIS project



# Exercise 5: Load external Services to QGIS

- You find WMS all over the world
- Add some services to your QGIS project
- <http://osm-demo.wheringroup.com/service?REQUEST=GetCapabilities&Service=WMS&Version=1.3.0>

## Portugal

- <http://mapas.dgterritorio.pt/geoportal/catalogo.html>
- [http://snig.dgterritorio.pt/portal/index.php?option=com\\_wrapper&view=wrapper&Itemid=354&lang=pt](http://snig.dgterritorio.pt/portal/index.php?option=com_wrapper&view=wrapper&Itemid=354&lang=pt)
- <http://www.igeo.pt/dadosabertos/listagem.aspx>



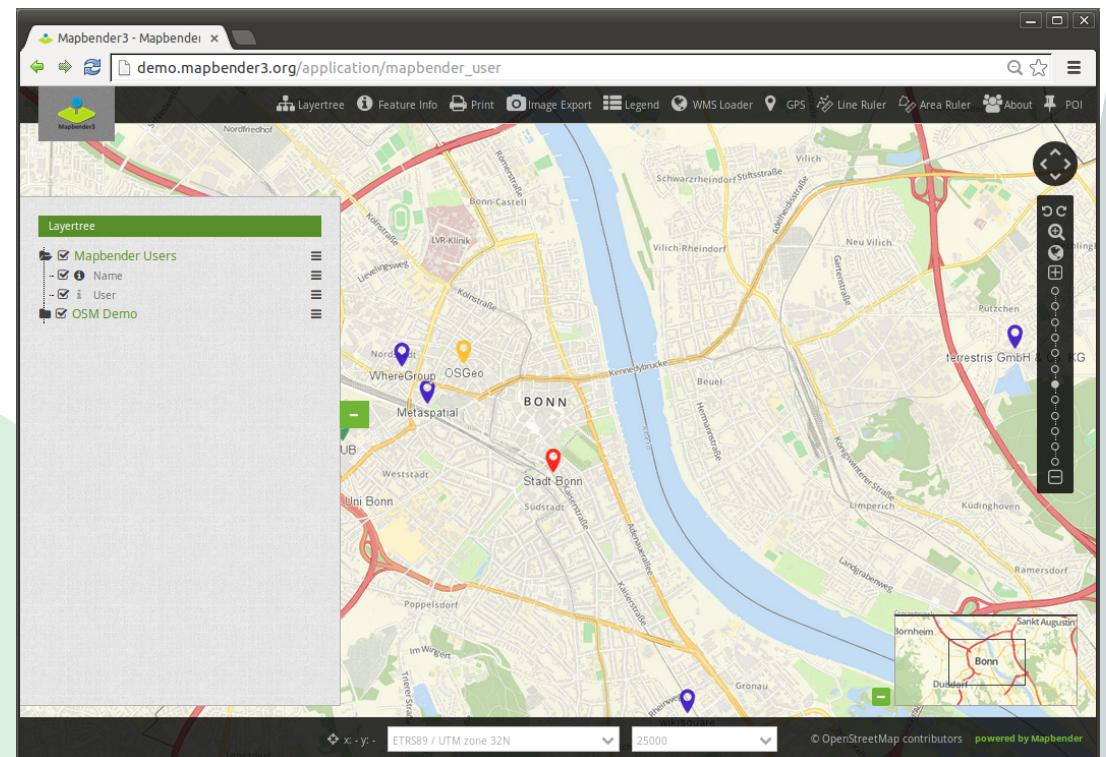
# How to spread your service in the web?

- Refer to your GetCapabilities-Urls
- Add your GetCapabilities & Metadata in a Metadata catalog
- Offer your WMS in WebGIS Client in a ready to use application f.e. OpenLayers, Leaflet, Mapbender, GeoMoose, MapStore, QGIS Map Client



# Provide services in a Geoportal f.e. Mapbender

- <http://localhost/mapbender3/>
- Login via: root / root
- Provide Applications  
for different needs



# Publish WMS in Mapbender

- **Menu → New DataSource**
- **Load GetCapabilities Url (do not check only valid)**



## **Exersize 6: Load WMS in Mapbender**

- Load your QGIS WMS and some other WMS in Mapbender**



## Excercise 6: Create a new Application in Mapbender

- Your application should start with the extent of Guimarães
- Copy Application mapbender\_user and rename it to FOSS4G
- Switch to tab Layout and set SRS EPSG:4326
- Modify MAX EXTENT to Portugal  
**lower left -12 36 – upper right -3 43**
- Modify Start Extent to Guimarães  
**lower left -8.32 41.42 upper right -8.28 41.46**



# Excercise 6: Add Services to your application

- Your application should show your QGIS WMS and some other external WMS
- Go to Tab Layerset
- Add WMS via +



# **Metadata Catalog to find your data**

## **Goals**

- **Your user should find your data**
- **Provide a catalog for you data**



# Provide Metadata for your data and Services

- Metadata should be provided & has to be up-to-date
- OGC Catalogue Service Web (CSW)
- GeoNetwork, GeoNode, pycsw, Metador
- f.e Germany: GDI-DE & 16 Catalogues for provinces
- INSPIRE
  - <https://inspire.ec.europa.eu/INSPIRE-in-your-Country/DE>
  - <https://inspire.ec.europa.eu/INSPIRE-in-your-Country/PT>  
<http://snig.dgterritorio.pt/portal/>



# Exercise 8: Search in the Portugal Metadata Catalog for a Service

- <http://www.igeo.pt>



## **Exercise 9: Add your new QGIS WMS to GeoNetWork or GeoNode**

- **Open GeoNetwork**
- **Login: admin/admin**
- **Add a new Metadata entry for you WMS**
- **Follow the quickstart**  
**[https://live.osgeo.org/en/quickstart/geonetwork\\_quickstart.html](https://live.osgeo.org/en/quickstart/geonetwork_quickstart.html)**



## Wrap things up

- Central data storage in a database offers lot of advantages
- Data Sharing via Services is easy and supported by many programs
- Offering ready-to-use applications covers the needs of many not advanced users
- Metadata helps you to find the data you need
- Metadata should be up-to-date
- A SDI is a profit for all involved parties

