OSLANDIA

Point Cloud

Concepts, tools and technologies

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Licence GNU FDL

Plan

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4 - LAS, LAZ and LAStools/libLAS (WS step 1)

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Introduction

Oslandia

- Open Source GIS Expertise
- Training
- Development
- Consulting
- Support

Technologies

- QGIS, PostGIS (core committers)
- PDAL, PGPointCloud
- Business applications C++/Python

Working Environment

```
git clone  https://github.com/Oslandia/workshop-pointcloud
```

Environnement

Slides : *supports.ods*

WS : *README.md*

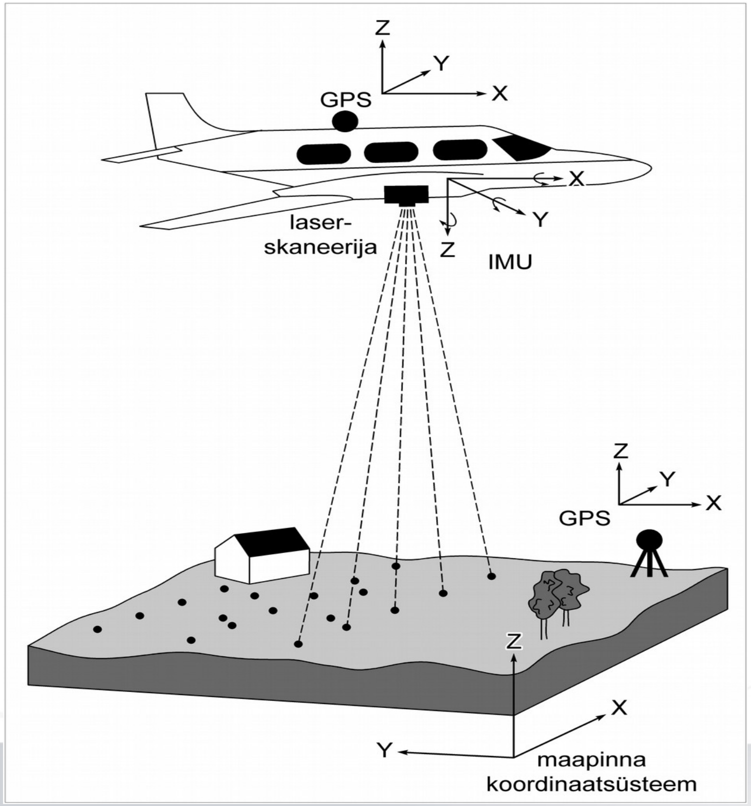
Ubuntu virtual machine (Virtualbox)

LIDAR : LIght Detection And Ranging (1)

Ground or embedded sensor (plane, car, ...)

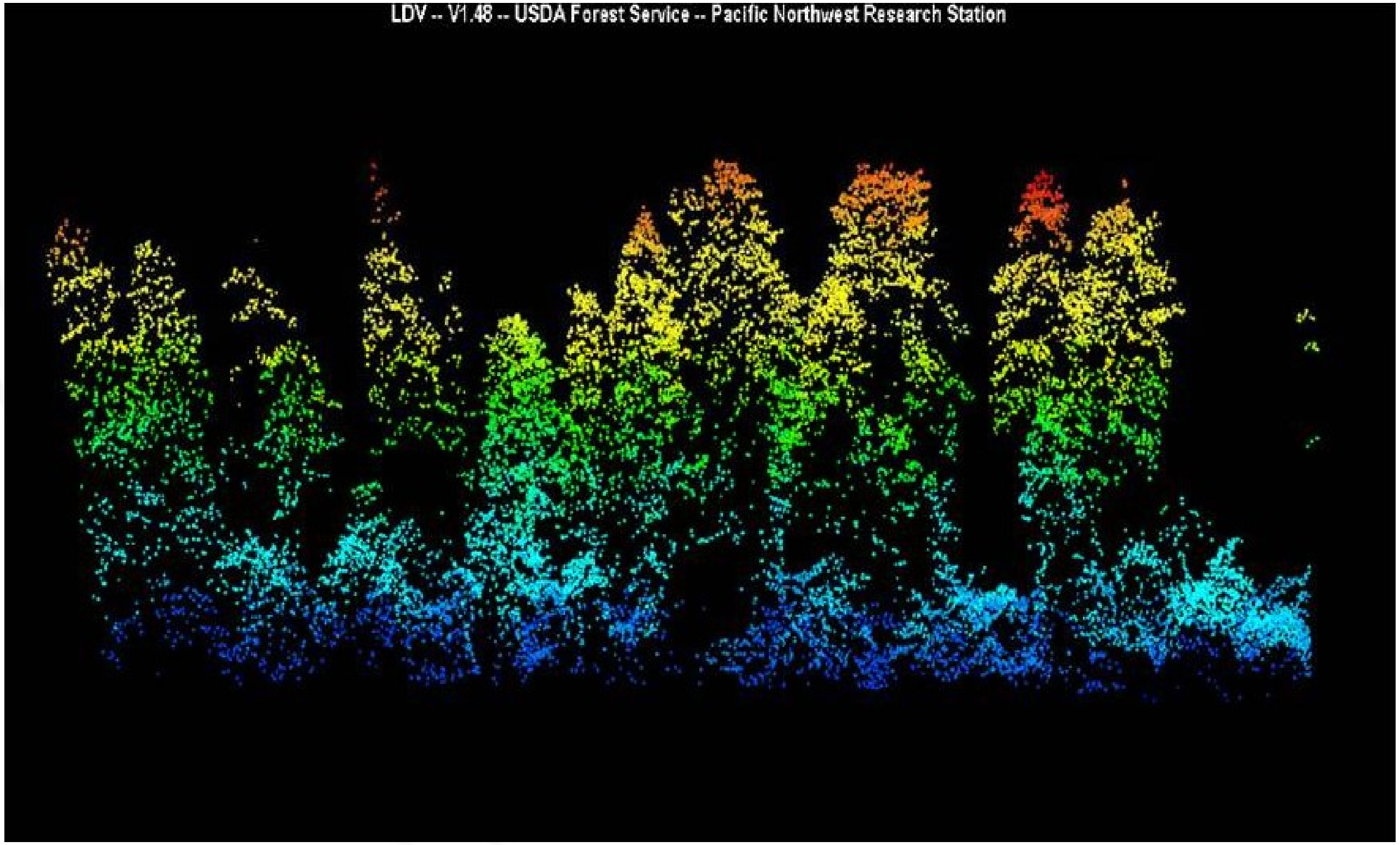
More than 100 000 pulses per second

Reflected pulses (vegetation, buildings, ground, ...) are caught by the scanner



LIDAR : LIght Detection And Ranging (2)

Waveform analysis: we keep a “return” for each main intensity peak (threshold)


LDV -- V1.48 -- USDA Forest Service -- Pacific Northwest Research Station

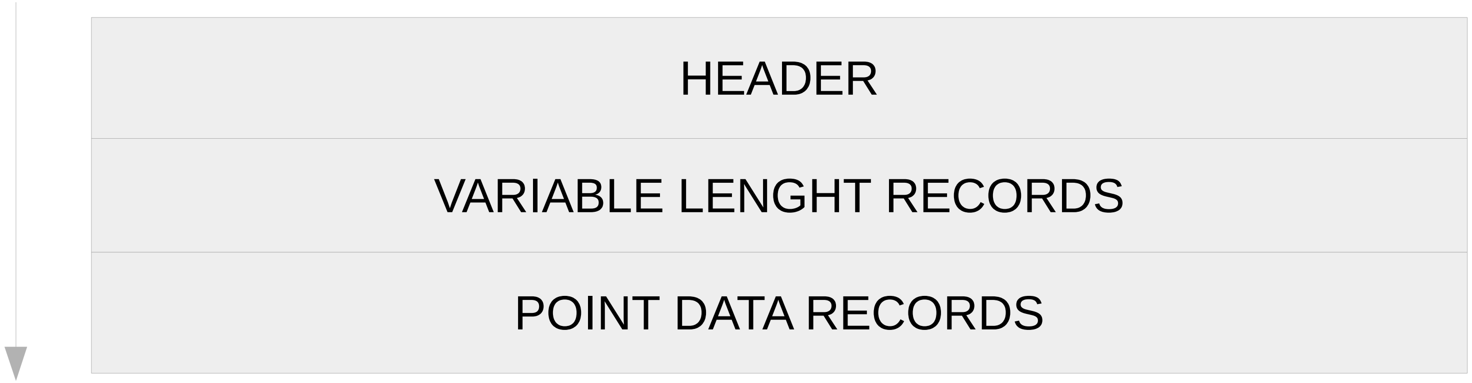
$$z = \frac{t * c}{2}$$

LAS

Public file format for the interchange of point cloud data

Specifications

http://www.asprs.org/committee-general/laser-las-file-format-exchange-activities.html



HEADER

VARIABLE LENGHT RECORDS

POINT DATA RECORDS

LAZ: compressed version of LAS (public format)

https://www.cs.unc.edu/~isenburg/lastools/download/laszip.pdf

LAStools/libLAS

Tools to work with LAS files

- https://github.com/LAStools
- https://github.com/libLAS/libLAS

Which one ?

- http://www.liblas.org/lastools.html

PostGIS

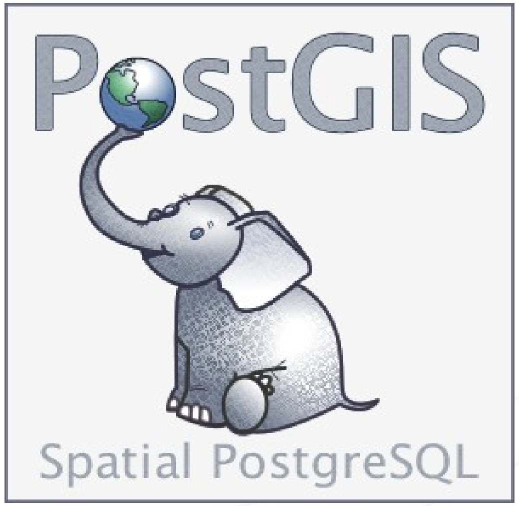
Each point of the cloud is georeferenced

natural will to store points in a spatial database!

Database

PostgreSQL : ORDBMS, libre, possibility of adding new data type, operators, functions, …

PostGIS : add support for geographic objects to PostgreSQL



PGPointcloud (1)

A point cloud

may contains several billions of points

… where each point can be represented by more than 10 dimensions

BIG DATA

Store each point one by one in a database is unthinkable!

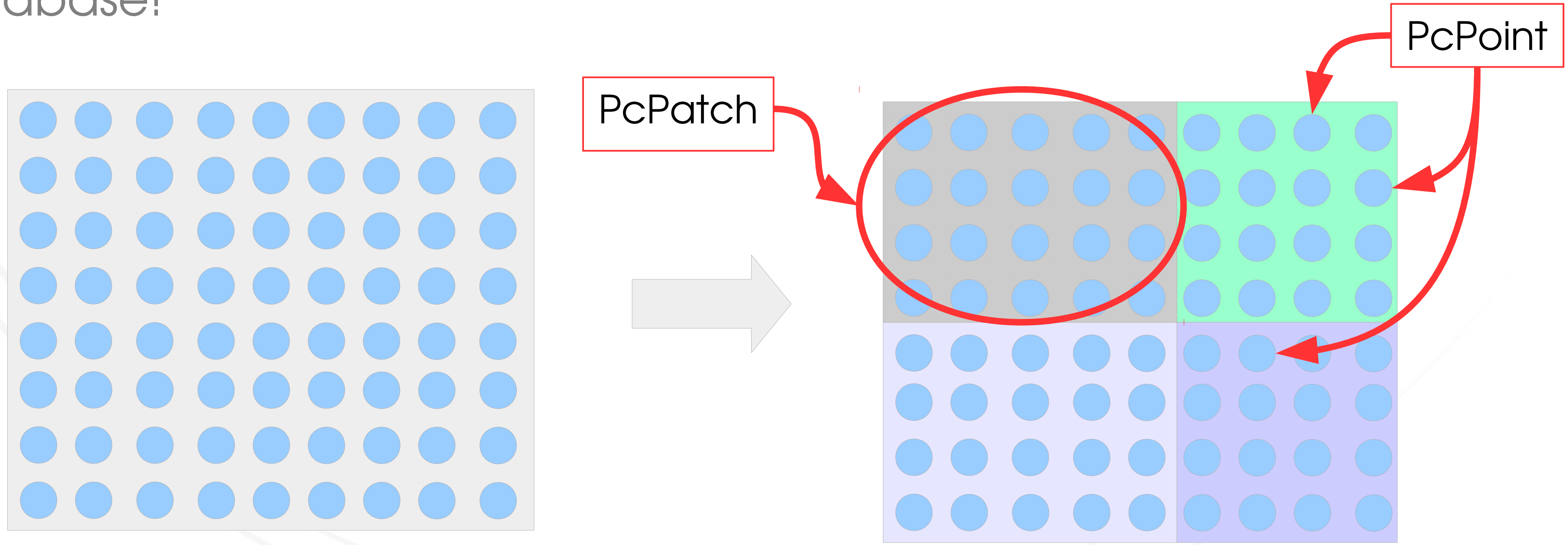
PGPointcloud (2)

PGPointcloud

https://github.com/pgpointcloud/pointcloud

PotgreSQL extension for storing point cloud data

Organizes points by patch to reduce the size of the table stored in the database!



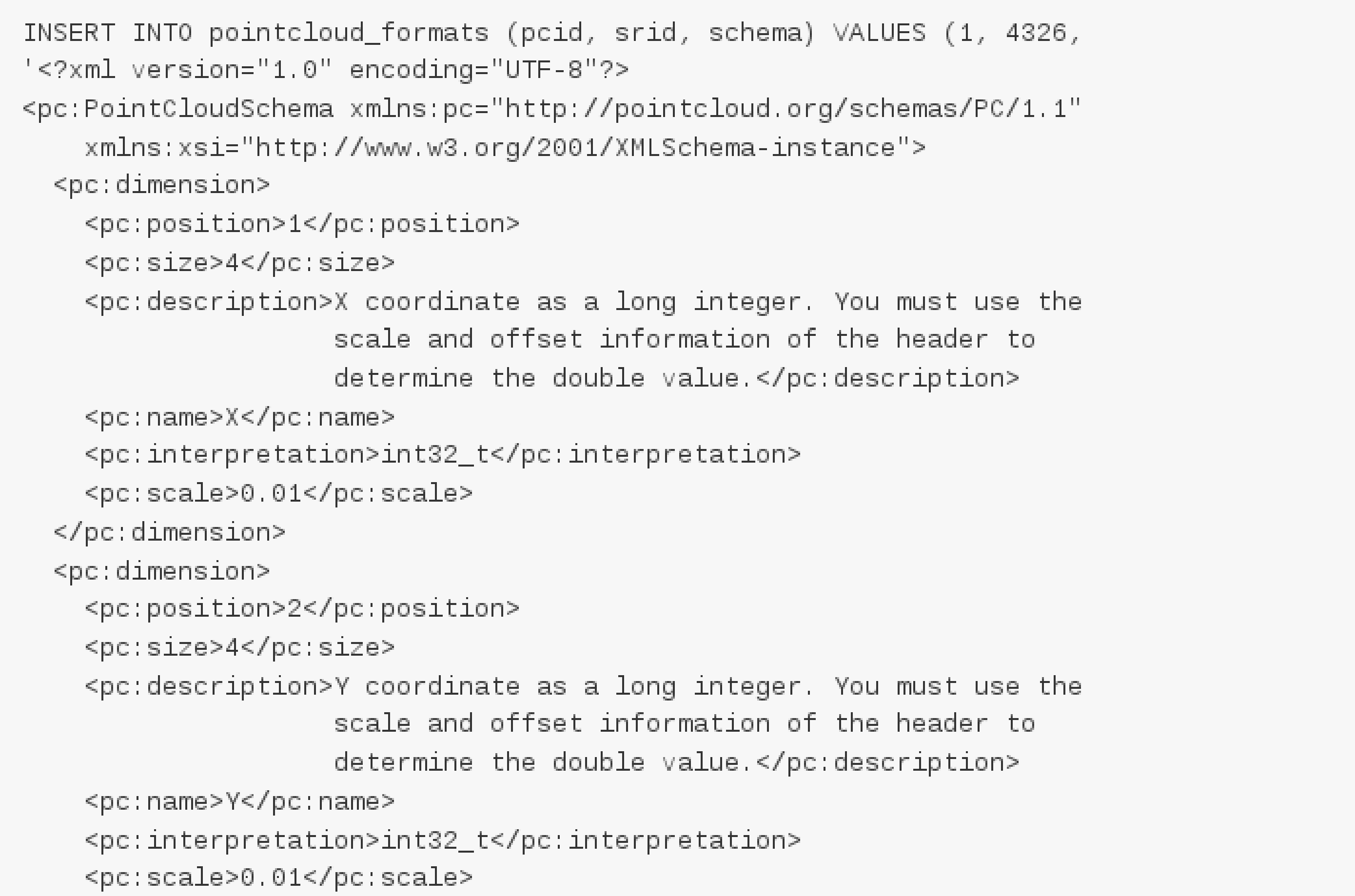
PGPointcloud (3)

Schema

Takes care of the variability of points' format

XML Document

Stored within the *pointcloud_formats table*



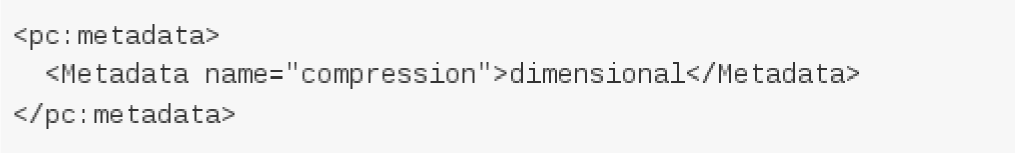
```
INSERT INTO pointcloud_formats (pcid, srid, schema) VALUES (1, 4326,
'<?xml version="1.0" encoding="UTF-8"?>
<pc:PointCloudSchema xmlns:pc="http://pointcloud.org/schemas/PC/1.1"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <pc:dimension>
    <pc:position>1</pc:position>
    <pc:size>4</pc:size>
    <pc:description>X coordinate as a long integer. You must use the
                    scale and offset information of the header to
                    determine the double value.</pc:description>
    <pc:name>X</pc:name>
    <pc:interpretation>int32_t</pc:interpretation>
    <pc:scale>0.01</pc:scale>
  </pc:dimension>
  <pc:dimension>
    <pc:position>2</pc:position>
    <pc:size>4</pc:size>
    <pc:description>Y coordinate as a long integer. You must use the
                    scale and offset information of the header to
                    determine the double value.</pc:description>
    <pc:name>Y</pc:name>
    <pc:interpretation>int32_t</pc:interpretation>
    <pc:scale>0.01</pc:scale>
```

PGPointcloud (4)

Patch compression

None, dimensional, GHT or LAZ

Defined in the XML schema

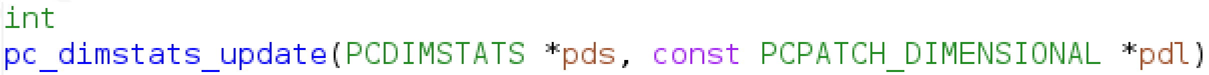


```
<pc:metadata>
  <Metadata name="compression">dimensional</Metadata>
</pc:metadata>
```

Dimensional compression

Well-suited for small patches (low variability)

Each dimension of a PcPatch uses it's own dimensional compression algorithm (RLE, ZLIB, SIGBITS)



```
int
pc_dimstats_update(PCDIMSTATS *pds, const PCPATCH_DIMENSIONAL *pdl)
```

PDAL (1)

Point Data Abstraction Library

- Command line tools
- Allows to work with point cloud (reading, filtering, writing,...)

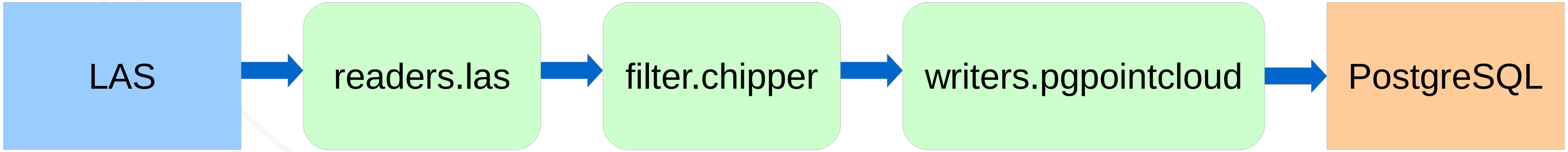
Pipeline

- Sequence of operations for building a processing chain
- JSON format since v1.2 (XML for earlier version)

PDAL (2)

Example :

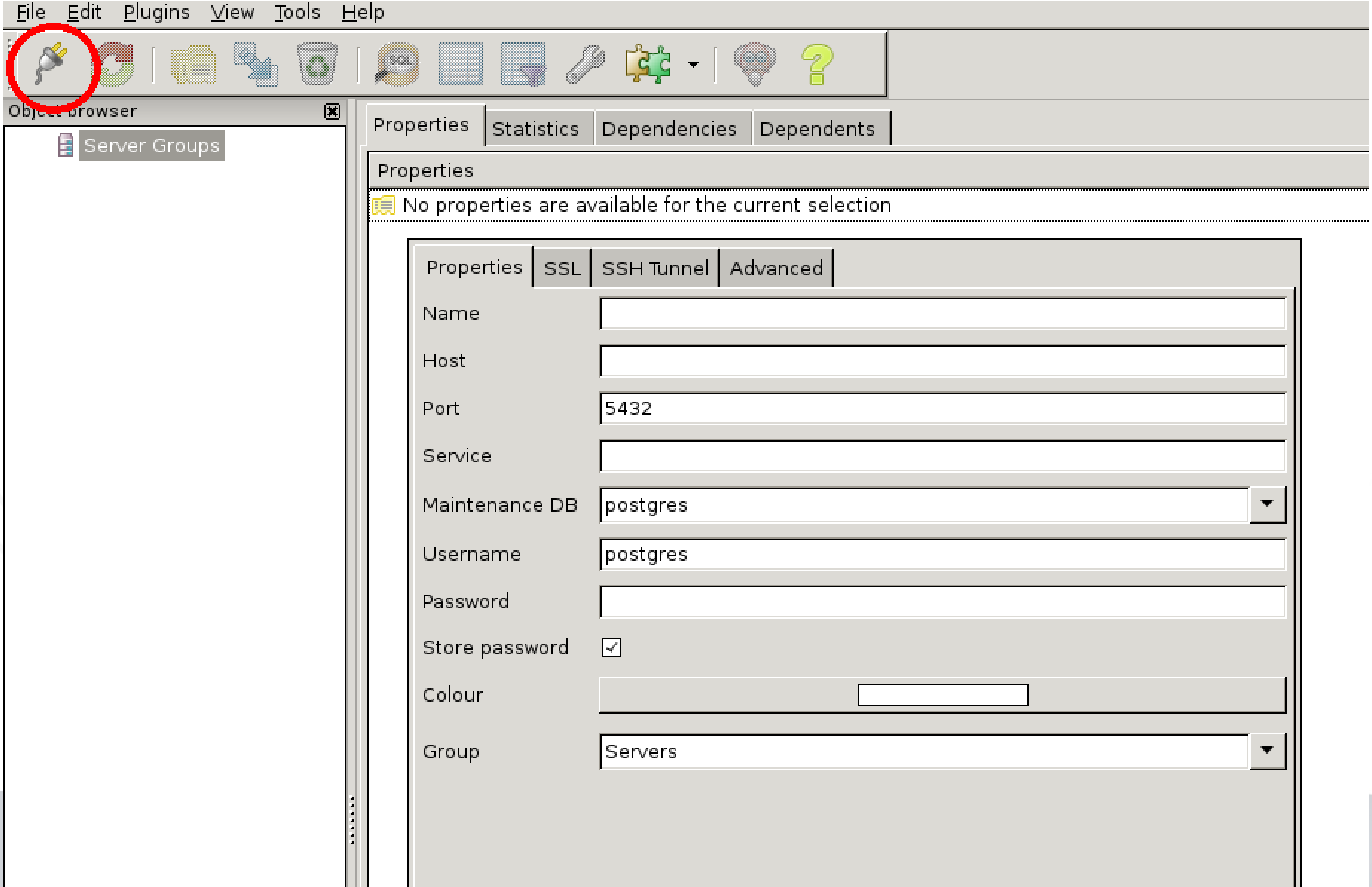
```
{
  "pipeline": [
    "/home/vpi/data/auvergne/lidarverne/opendata.craig.fr/opendata/lidar/agglos/2013_clermont-ferrand/clermont.las",
    {
      "type":"filters.chipper",
      "capacity":"1000"
    },
    {
      "type":"writers.pgpointcloud",
      "connection":"dbname='foss4g' user='postgres' port='5433'",
      "table":"lidar",
      "compression":"dimensional",
      "srid":"2154"
    }
  ]
}
```



LAS → readers.las → filter.chipper → writers.pgpointcloud → PostgreSQL

PgAdmin (1)

GUI to work with PostgreSQL



No properties are available for the current selection

Name	
Host	
Port	5432
Service	
Maintenance DB	postgres
Username	postgres
Password	
Store password	☑
Colour	
Group	Servers

PgAdmin (2)

QGIS (1)

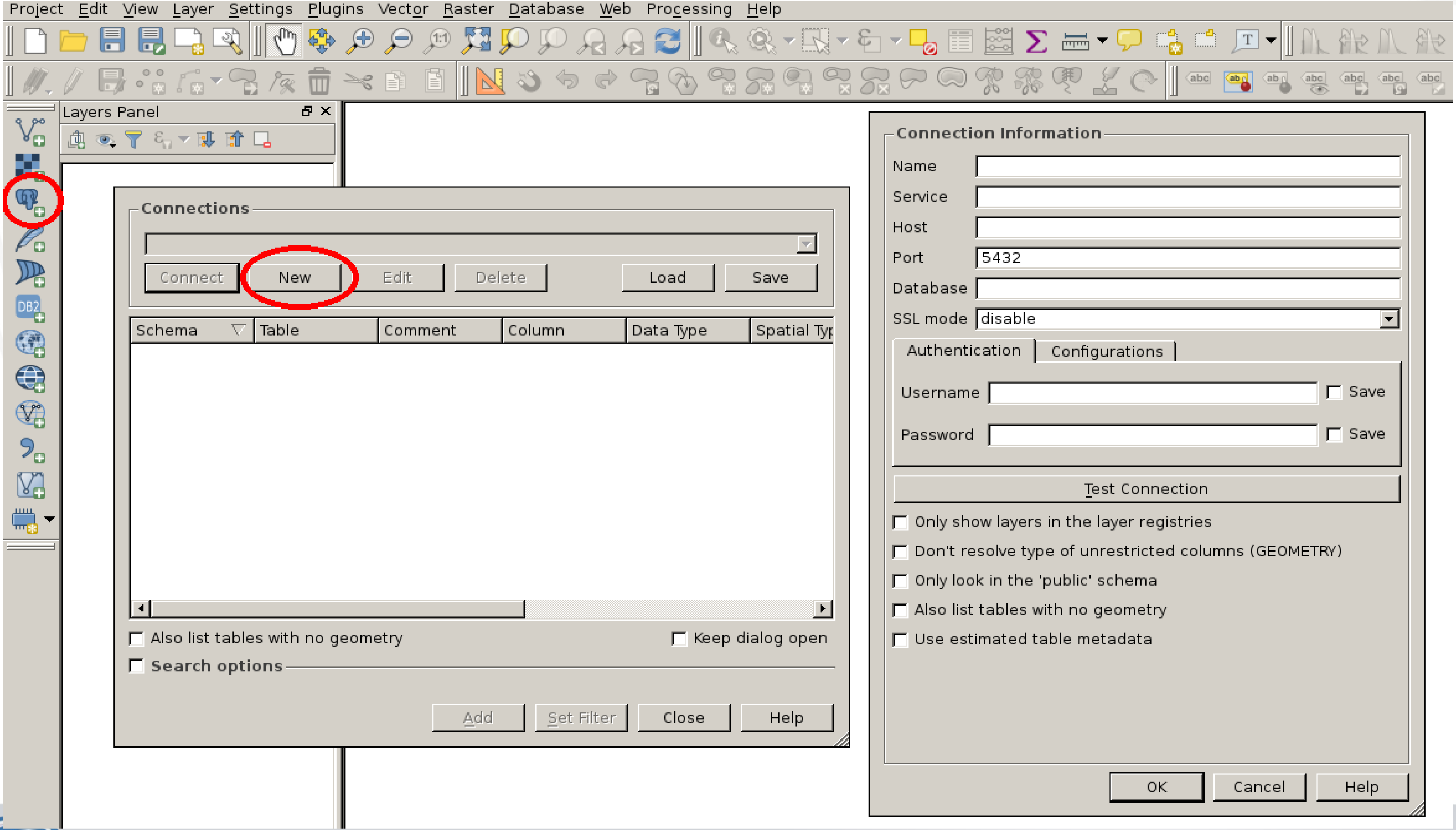
GIS Software :

- Libre
- Cross-platform
- C++, Python plugins

QGIS with point cloud??

- Connexion with spatial databases like PostGIS
- Knows what a PcPatch is!

Add PostGIS layer



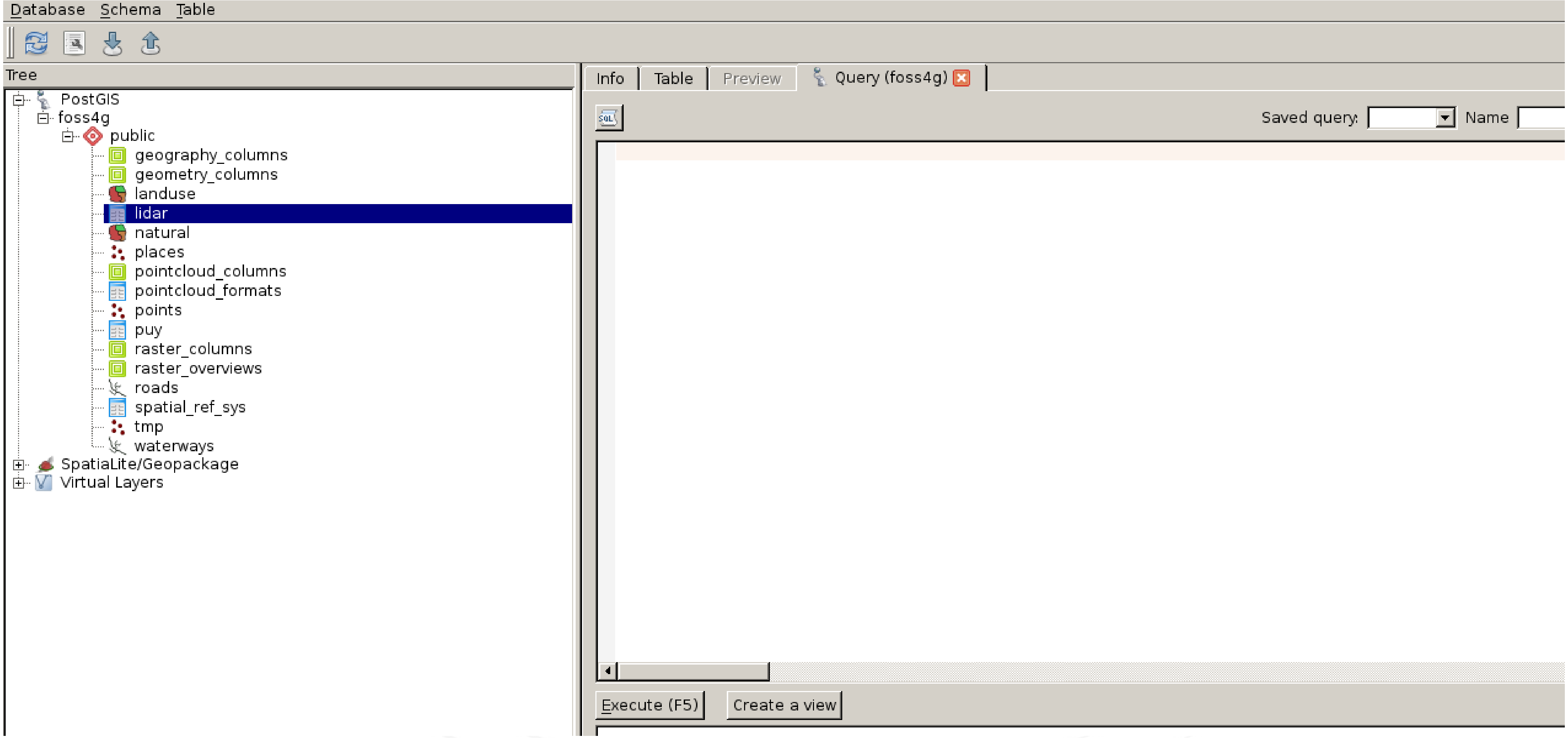
□ Also list tables with no geometry
□ Keep dialog open
□ Search options

Name
Service
Host
Port 5432
Database
SSL mode disable

Username □ Save
Password □ Save

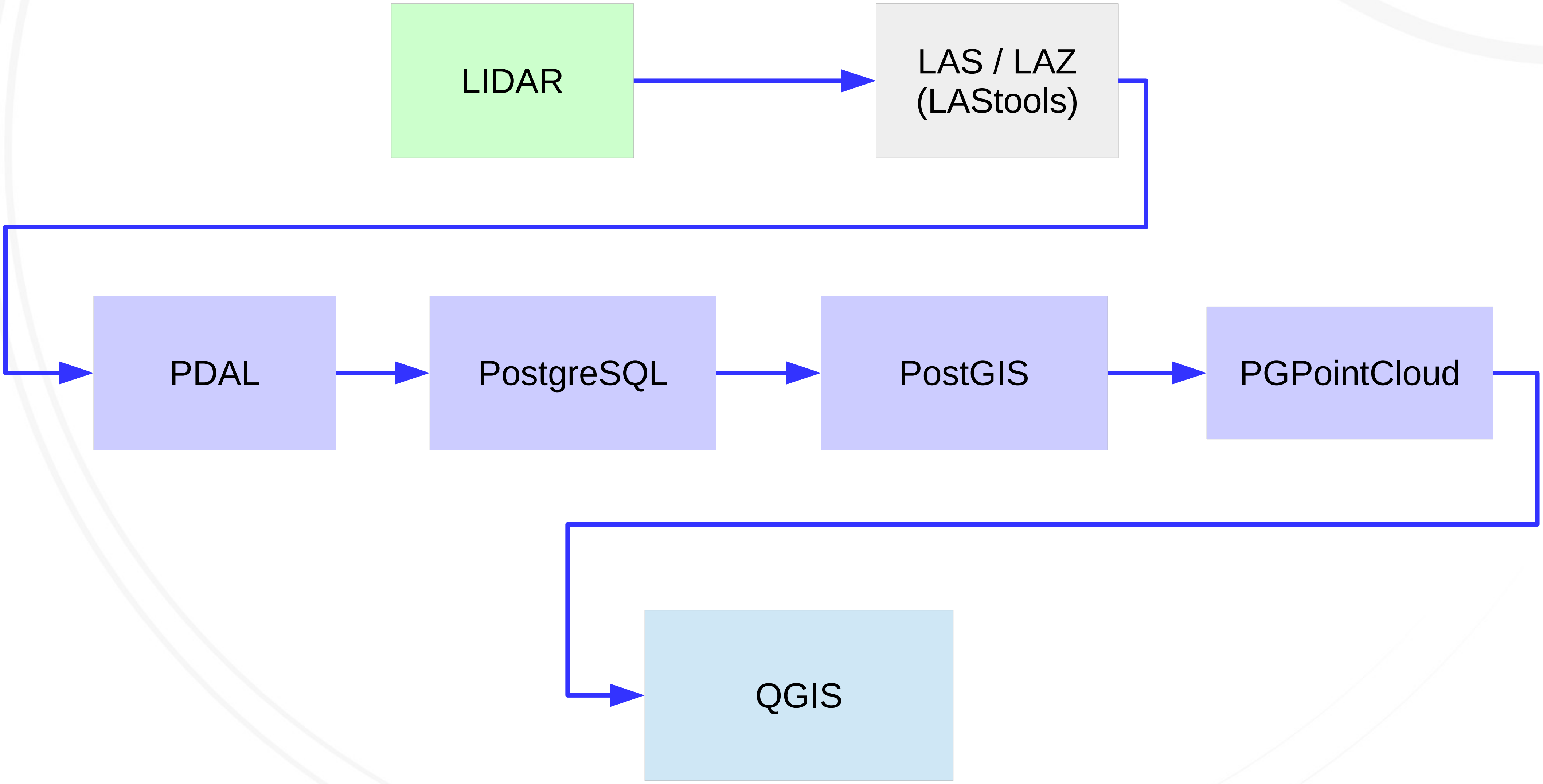
□ Only show layers in the layer registries
□ Don't resolve type of unrestricted columns (GEOMETRY)
□ Only look in the 'public' schema
□ Also list tables with no geometry
□ Use estimated table metadata

Database Manager :



QGIS (4)

Conclusion


LIDAR
LAS / LAZ (LAStools)
PDAL
PostgreSQL
PostGIS
PGPointCloud
QGIS

Questions