Stetl:
Geo-Conversion-Engine for NLExtract and Smart Emission

www.stetl.org

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About Me

Independent Open Source Geospatial Professional

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+ Member of the Dutch OpenGeoGroep

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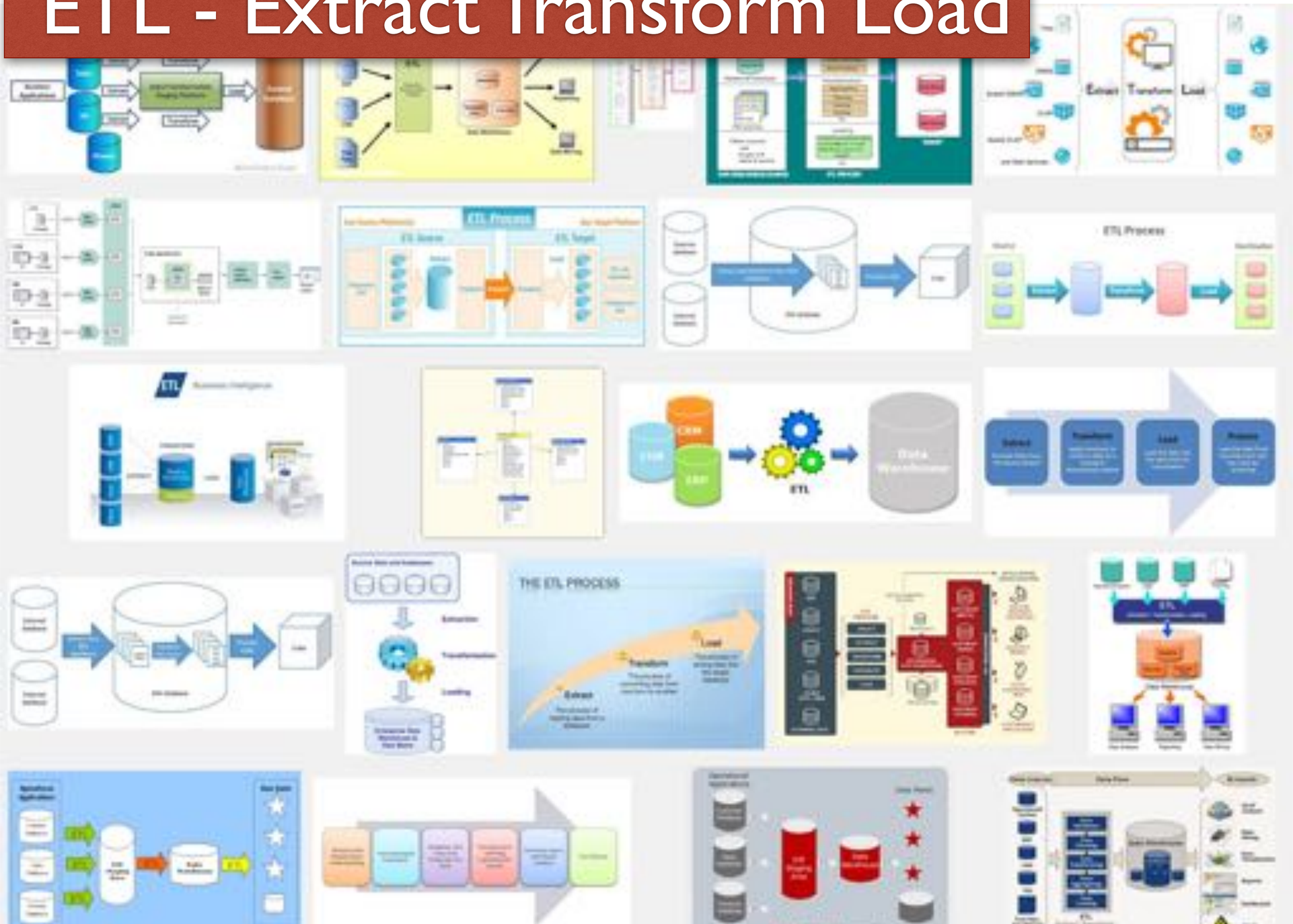
Agenda

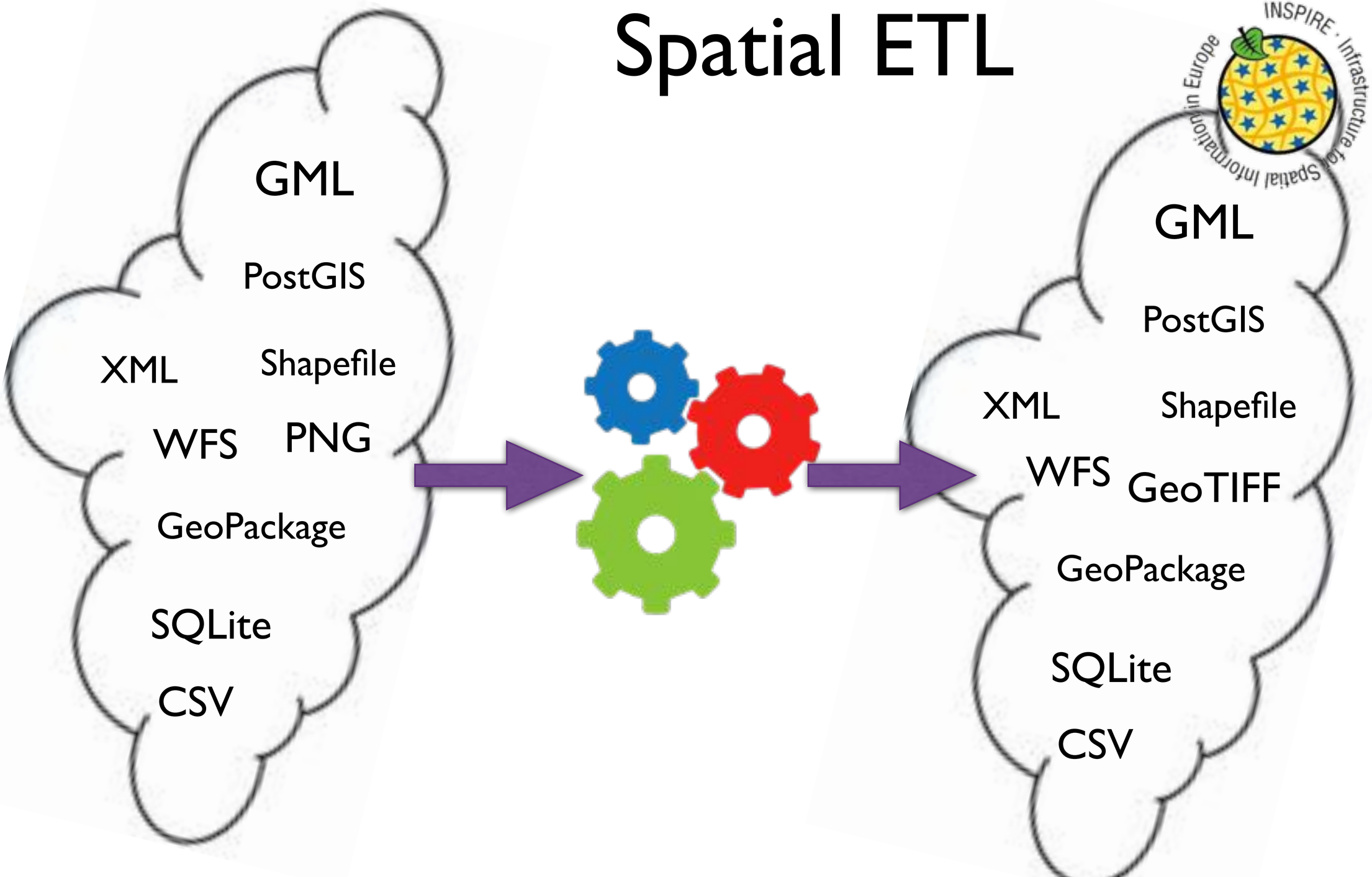
- Spatial ETL
- Stetl Concepts
- **Cases**
  - NLExtract
  - Smart Emission
- Q & A

Spatial ETL

ETL - Extract Transform Load



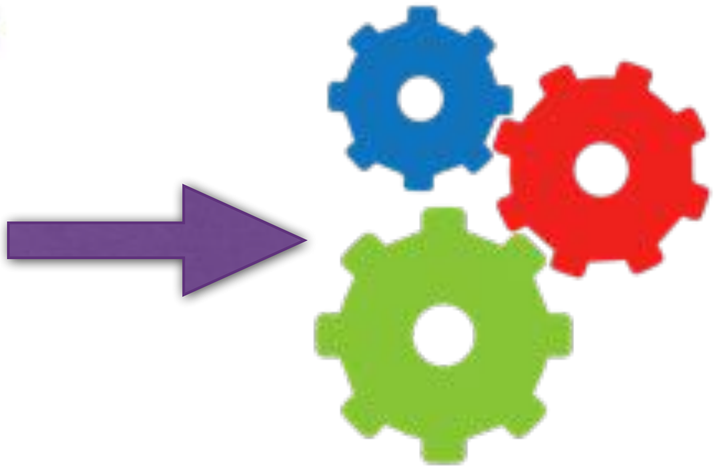
Spatial ETL


GML
PostGIS
XML
Shapefile
WFS
PNG
GeoPackage
SQLite
CSV
GML
PostGIS
XML
Shapefile
WFS
GeoTIFF
GeoPackage
SQLite
CSV

Spatial ETL

Example non-standard source

```xml
<?xml version='1.0' encoding='utf-8'?>
<cities>
    <city>
        <name>Amsterdam</name>
        <lat>52.4</lat>
        <lon>4.9</lon>
    </city>
    <city>
        <name>Bonn</name>
        <lat>50.7</lat>
        <lon>7.1</lon>
    </city>
    <city>
        <name>Rome</name>
        <lat>41.9</lat>
        <lon>12.5</lon>
    </city>
</cities>
```



GML

XML PostGIS

Shapefile

WFS

CSV

SQLite

GDAL/OGR and PROJ.4

http://www.gdal.org

http://proj.osgeo.org

GDAL for Raster Data - The Geospatial Data Abstraction Library

Arc/Info ASCII Grid, **Arc/Info** Binary Grid (.adf), AIRSAR Polarimetric, Microsoft Windows Device Independent Bitmap (.bmp), BSB Nautical Chart Format (.kap), VTP Binary Terrain Format (.bt), CEOS (Spot for instance), First Generation USGS DOQ (.doq), DODS / OPeNDAP, New Labelled USGS DOQ (.doq), Military Elevation Data (.dt0, .dt1), **ERMapper** Compressed Wavelets (.ecw), **ESRI** .hdr Labelled, ENVI .hdr Labelled Raster, Envisat Image Product (.n1), EOSAT FAST Format, FITS (.fits), Graphics Interchange Format (**.gif**), GMT Compatible netCDF, **GRASS Rasters**, Golden Software ASCII Grid, Golden Software Binary Grid, Golden Software **Surfer** 7 Binary Grid, TIFF / **GeoTIFF** (.tif), GXF - Grid eXchange File, Hierarchical Data Format Release 4 (**HDF4**), Hierarchical Data Format Release 5 (HDF5), **Erdas Imagine** (.img), Vexcel MFF2, **Idrisi** Raster, Image Display and Analysis (WinDisp), ILWIS Raster Map (.mpr,.mpl), Japanese DEM (.mem), **JPEG** JFIF (.jpg), **JPEG2000** (JPEG2000, JP2KAK, JP2ECW, JP2MrSID), NOAA Polar Orbiter Level 1b Data Set (**AVHRR**), Erdas 7.x .LAN and .GIS, Daylon Leveller Heightfield, In Memory Raster, Vexcel **MFF**, Multi-resolution Seamless Image Database, Meteosat Second Generation, NDF, NITF, **NetCDF**, OGDI Bridge, PCI .aux Labelled, PCI Geomatics Database File, Portable Network Graphics (**.png**), PCRaster (.map), Netpbm (.ppm,.pgm), Swedish Grid RIK (.rik), RadarSat2 XML (product.xml), **ArcSDE** Raster, USGS SDTS DEM (*CATD.DDF), Raster Matrix Format (*.rsw, .mtw), SAR CEOS, **SGI** Image Format, USGS ASCII DEM (.dem), OGC Web Coverage Server, X11 Pixmap (.xpm)

OGR for Vector Data - Simple Feature Library

Arc/Info Binary Coverage, Comma Separated Value (**.csv**), DODS/OPeNDAP, DWG, **DXF**, ESRI Personal GeoDatabase, ESRI ArcSDE, **ESRI Shapefile**, FMEObjects Gateway, GML, **GMT Mapping**, **GRASS Vectors**, INTERLIS, **Google Earth KML**, Mapinfo File, Microstation DGN, Spatial **MySQL**, OGDI Vectors, ODBC generic database access layer, **Oracle** Spatial, PostgreSQL **PostGIS**, S-57 (ENC), SDTS, SQLite, UK .NTF, U.S. Census TIGER/Line, VRT - Virtual Datasource, Informix DataBlade

From: https://live.osgeo.org/en/overview/gdal_overview.html

Kersten
@Fernerkundung

Follow

When people describe #GDAL als the "swiss army knife of GIS data" this is what I think of.

RETWEETS 20 LIKES 21

12:49 PM - 25 Jan 2016

20 21

Plenty of Tools…

ogr2ogr

Each tool is powerful by itself but cannot do the entire ETL

FOSS ETL - How to Combine Components?

+

+

+ .. = ?

Solution: Add Python to the Equation

(+ + + ..) =

Stetl

Stetl

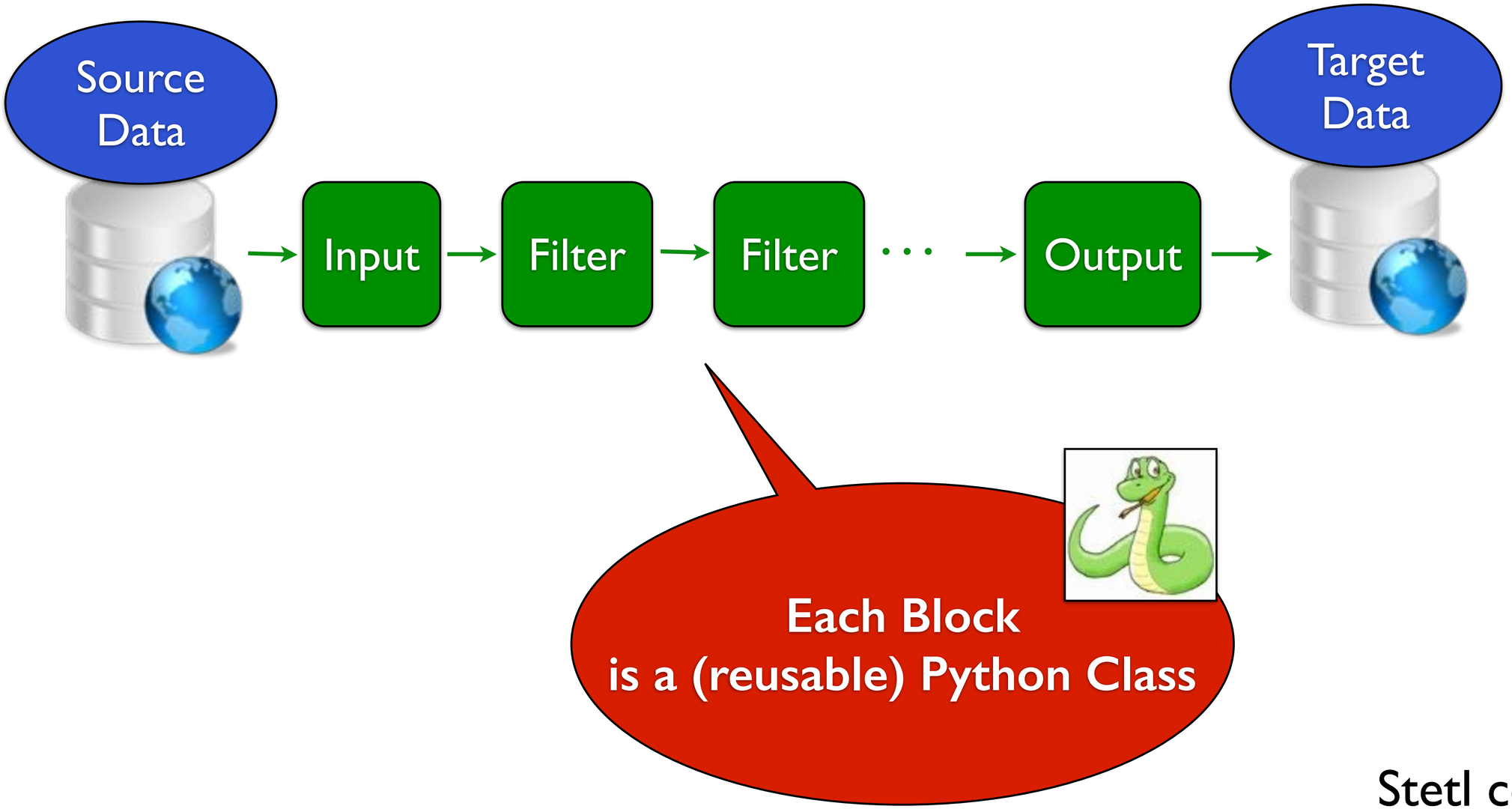
=

Simple
Streaming
Spatial
Speedy
ETL

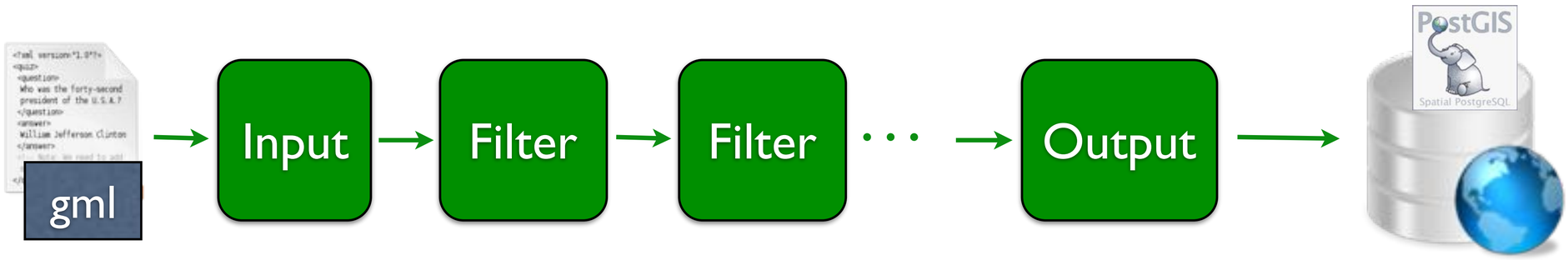
And what about?

Stetl
Concepts

Process Chain

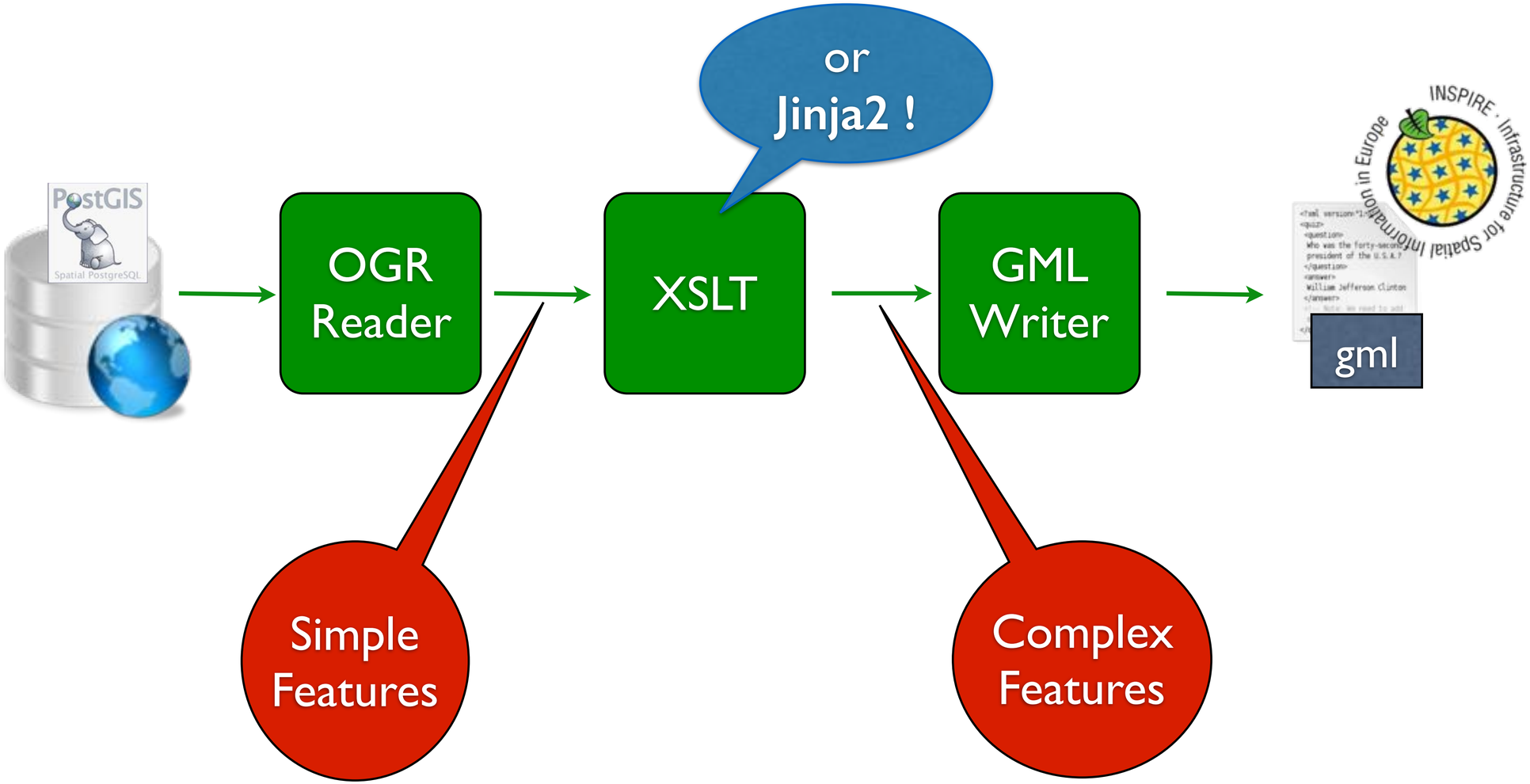


Process Chain - GML to PostGIS

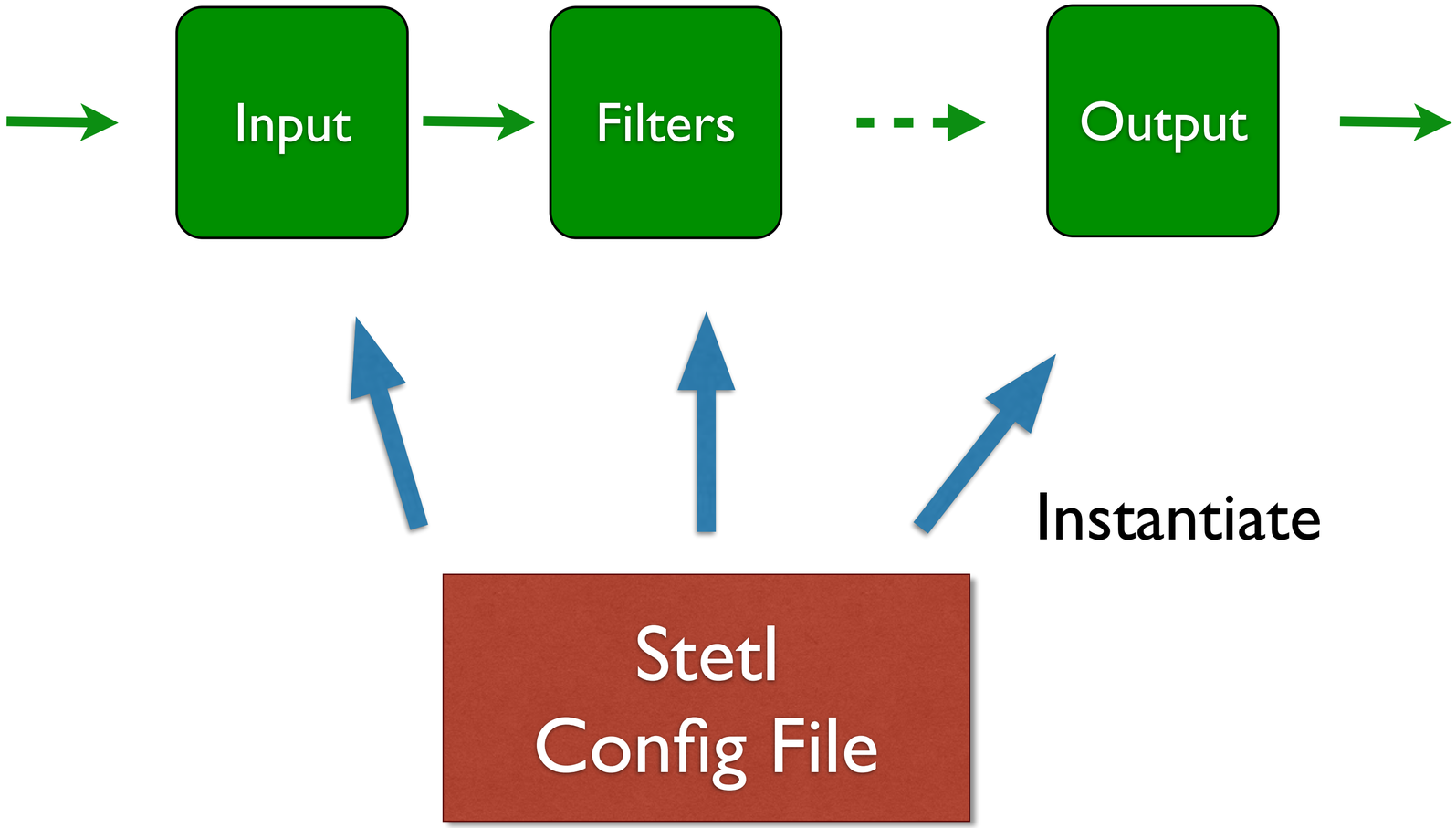


Stetl concepts

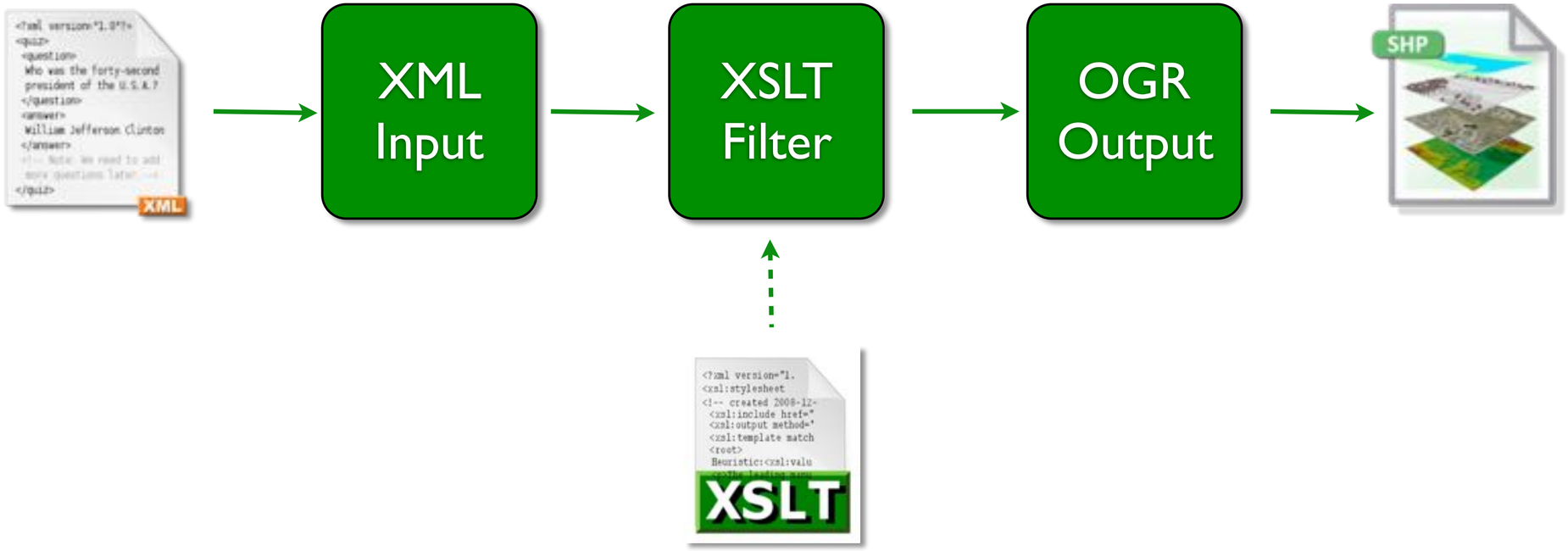
Example: Data Model Transform



Process Chain - How?



Example: XML File to Shapefile

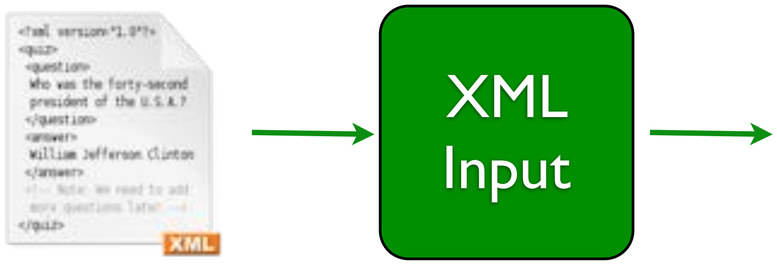


Example: XML to Shape

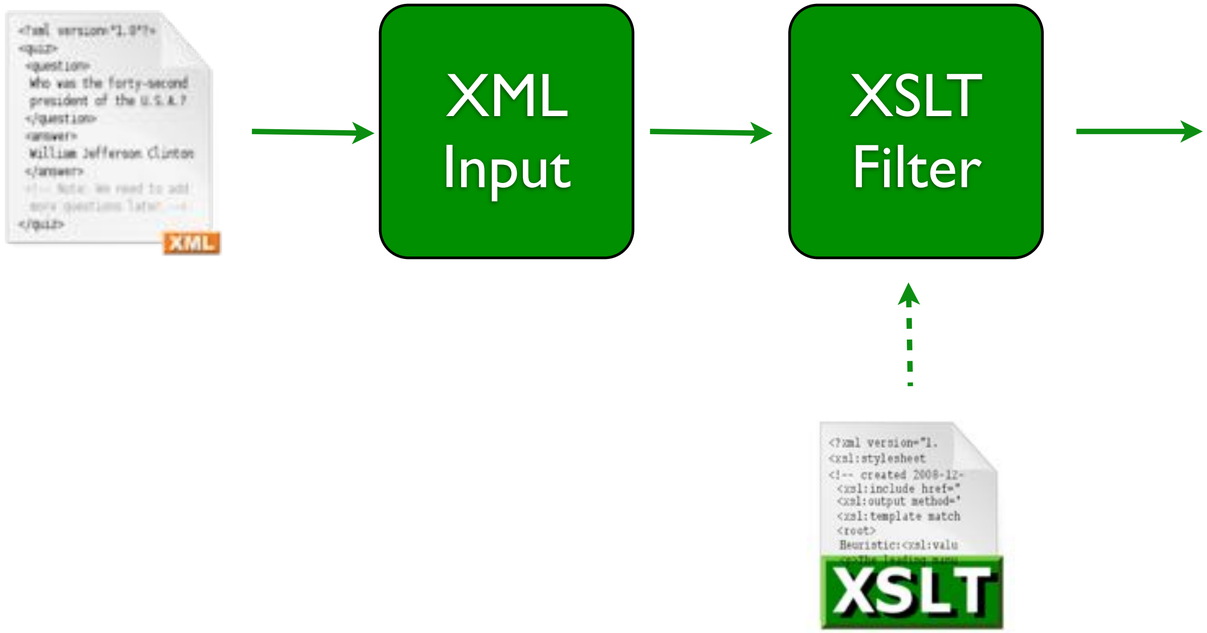
```xml
<?xml version='1.0' encoding='utf-8' ?>
<cities>
    <city>
        <name>Amsterdam</name>
        <lat>52.4</lat>
        <lon>4.9</lon>
    </city>
    <city>
        <name>Boom</name>
        <lat>50.7</lat>
        <lon>7.1</lon>
    </city>
    <city>
        <name>Rome</name>
        <lat>41.9</lat>
        <lon>12.5</lon>
    </city>
</cities>
```

The Source File

Example: XML to Shape



Example: XML to Shape



Example: XML to Shape

```
    <xsl:template match="/">
        <ogr:FeatureCollection
                xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                xmlns:ogr="http://ogr.maptools.org/"
                xmlns:gml="http://www.opengis.net/gml"
                xsi:schemaLocation="http://ogr.maptools.org/ ../gmlcities.xsd  http://www.opengis.net/gml http://schemas
                >
            <gml:boundedBy>
              <gml:Box>
                <gml:coord><gml:X>-180.0</gml:X><gml:Y>-90.0</gml:Y></gml:coord>
                <gml:coord><gml:X>180.0</gml:X><gml:Y>90.0</gml:Y></gml:coord>
              </gml:Box>
            </gml:boundedBy>
            <!-- Loop through all cities. -->
            <xsl:apply-templates/>
        </ogr:FeatureCollection>
    </xsl:template>

    <!-- Make each city an ogr:featureMember. -->
    <xsl:template match="city">
        <gml:featureMember>
            <ogr:City>
                <ogr:name>
                    <xsl:value-of select="name"/>
                </ogr:name>
                <ogr:geometry>
                    <gml:Point srsName="urn:ogc:def:crs:EPSG:4326">
                        <gml:coordinates><xsl:value-of select="lat"/>,<xsl:value-of select="lon"/></gml:coordinates>
                    </gml:Point>
                </ogr:geometry>
            </ogr:City>
        </gml:featureMember>
    </xsl:template>
</xsl:stylesheet>
```

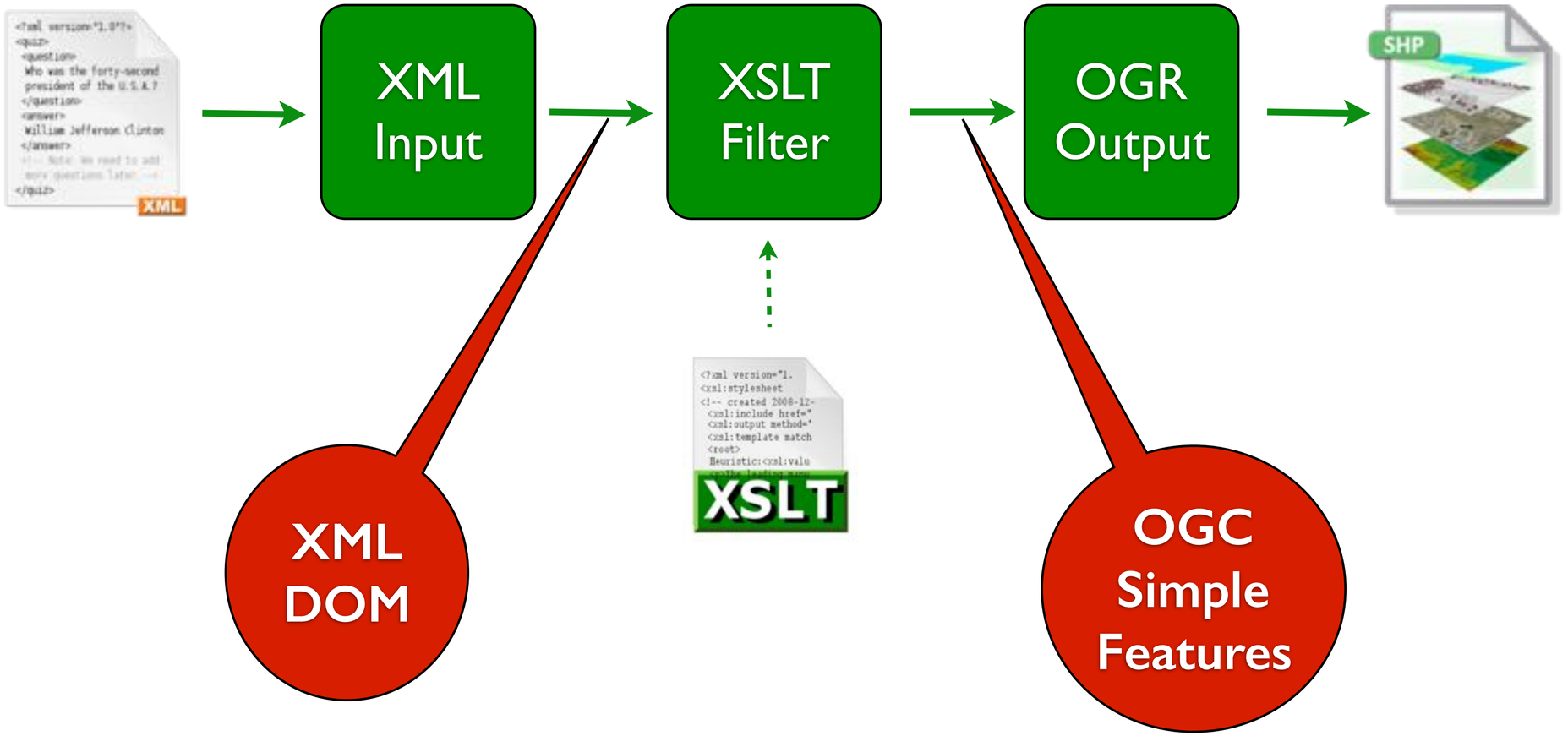
Prepare XSLT Script

Example: XML to Shape

```
<?xml version='1.0' encoding='utf-8'?>
<ogr:FeatureCollection xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:ogr="http://
  <gml:boundedBy>
    <gml:Box>
      <gml:coord>
        <gml:X>-180.0</gml:X>
        <gml:Y>-90.0</gml:Y>
      </gml:coord>
      <gml:coord>
        <gml:X>180.0</gml:X>
        <gml:Y>90.0</gml:Y>
      </gml:coord>
    </gml:Box>
  </gml:boundedBy>
  <gml:featureMember>
    <ogr:City>
      <ogr:name>Amsterdam</ogr:name>
      <ogr:geometry>
        <gml:Point srsName="urn:ogc:def:crs:EPSG:4326">
          <gml:coordinates>52.4,4.9</gml:coordinates>
        </gml:Point>
      </ogr:geometry>
    </ogr:City>
  </gml:featureMember>
  <gml:featureMember>
    <ogr:City>
      <ogr:name>Bonn</ogr:name>
      <ogr:geometry>
        <gml:Point srsName="urn:ogc:def:crs:EPSG:4326">
          <gml:coordinates>50.7,7.1</gml:coordinates>
        </gml:Point>
      </ogr:geometry>
    </ogr:City>
  </gml:featureMember>
```

XSLT GML Output

Example: XML to Shape



Example: XML to Shape

```
# Transform input xml to valid GML file and then to Shape.

[etl]
chains = input_xml_file | transformer_xslt | output_ogr_shape

[input_xml_file]
class = inputs.fileinput.XmlFileInput
file_path = input/cities.xml

[transformer_xslt]
class = filters.xsltfilter.XsltFilter
script = cities2gml.xsl

# The ogr2ogr command-line.
[output_ogr_shape]
class = outputs.ogroutput.Ogr2OgrOutput
temp_file = temp/gmlcities.gml
ogr2ogr_cmd = ogr2ogr \
    -overwrite \
    -f "ESRI Shapefile" \
    -a_srs epsg:4326 \
   output/gmlcities.shp \
   temp/gmlcities.gml
```

Process Chain

XML Input

XSLT Filter

ogr2ogr Output

The Stetl Config File

Data Structures

- Components exchange *Packets*
- *Packet* contains data and status
- Data formats, e.g. :

  xml_line_stream
  etree_doc
  etree_element (feature)
  etree_element_array
  record (dict)
  string
  any
  .
  .

Running Stetl

```
stetl -c etl.cfg
```

```
stetl -c etl.cfg [-a <properties>]
```

Example Components

Input	Filters	Output
XMLFile	XSLT	GML
ogr2ogr	XMLAssembler	GDAL/OGR
LineStream	XMLValidator	WFS-T
Postgres/PostGIS	Jinja2	Postgres/PostGIS
CSV, JSON etc	FeatureExtractor	SOS, SensorThings API
YourInput	*YourFilter*	*YourOutput*

Example: XsltFilter Python Code

```
class XsltFilter(Filter):
    """
    Invokes XSLT processor (via lxml) for given XSLT script on an etree doc.
    """

    @Config(ptype=str, required=True)
    def script(self):
        """
        Path to XSLT script file.
        """
        pass

    def __init__(self, configdict, section):
        Filter.__init__(self, configdict, section, consumes=FORMAT.etree_doc, produces=FORMAT.etree_doc)

        self.xslt_file = open(self.script, 'r')

        # Parse XSLT file only once
        self.xslt_doc = etree.parse(self.xslt_file)
        self.xslt_obj = etree.XSLT(self.xslt_doc)
        self.xslt_file.close()

    def invoke(self, packet):
        packet.data = self.xslt_obj(packet.data)
        return packet
```

Your Own Components

```
class MyFilter(Filter):
    # Constructor
    def __init__(self, configdict, section):
        Filter.__init__(self, configdict, section, consumes=FORMAT.etree_doc,
                                                   produces=FORMAT.etree_doc)

    def invoke(self, packet):
        log.info("CALLING MyFilter OK!!!!")
        return packet
```

Step 1- Define Class

```
[etl]
chains = input_xml_file|my_filter|output_std

[input_xml_file]
class = inputs.fileinput.XmlFileInput
file_path = input/cities.xml

# My custom component
[my_filter]
class = my.myfilter.MyFilter

[output_std]
class = outputs.standardoutput.StandardXmlOutput
```

Step 2- Configure Class

Installing Stetl - PyPi

```
sudo pip install stetl
```

Deps

- GDAL+Python bindings
- lxml (xml proc)
- psycopg2 (Postgres)

Installing Stetl - Docker

https://hub.docker.com/r/geopython/stetl

Case 1 - NLExtract

What is NLExtract?

ETL for Dutch National Open Datasets

http://nlextract.nl

- GML to PostGIS:
  BAG, BRT (Top10NL), BGT, BRK (Cadastral Parcels)
- Downloads data.nlextract.nl

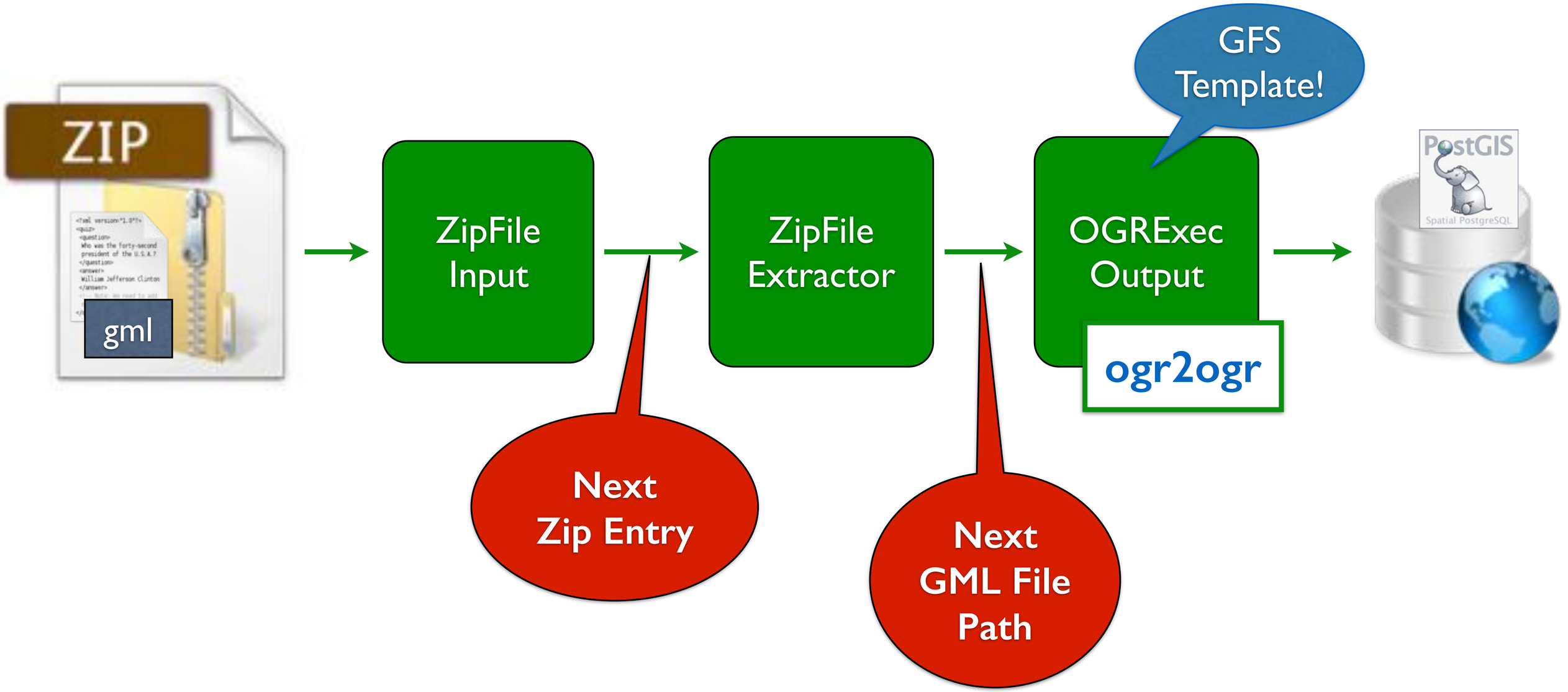

app.map5.nl
Otterlo
Jan-Willem van Aalst
Imergis organisatieblooi
Send a message
Map5.nl
Map5.nl: de fijnste kaarten voor al je toepassingen
Wat kost het?

BRK - Input GML from PDOK

```
$ ls -lh
total 3.6G
-rw-rw-r-- 1 mlx mlx 3.6G May  7 10:32 kadastralekaartv3-gml-nl-nohist.zip

$ unzip -l kadastralekaartv3-gml-nl-nohist.zip

 Length      Date    Time    Name
---------  ---------- -----   ----
16562827212  2018-01-01 13:42   Bebouwing.gml
 4737201554  2018-01-02 09:00   Annotatie.gml
20883080403  2018-05-01 15:15   Perceel.gml
27532931147  2018-05-01 20:19   Kadastralegrens.gml
---------                     -------
69716040316                    4 files
```

About 70GB in 4 GML Files!

Stetl Config BRK to PostGIS



Stetl Config - BRK .zip to PostGIS

```
[etl]
chains = input_zip_file|extract_zip_file|output_ogr2ogr

[input_zip_file]
class=inputs.fileinput.ZipFileInput
file_path = {input_dir}
filename_pattern = {zip_files_pattern}
name_filter = {filename_match}

# Filter to extract a ZIP file one by one to a temporary location
[extract_zip_file]
class=filters.zipfileextractor.ZipFileExtractor
file_path = {temp_dir}/fromzip-tmp.gml

[output_ogr2ogr]
class = outputs.execoutput.Ogr2OgrExecOutput
# destination format: OGR vector format name
dest_format = PostgreSQL
# destination datasource: name of datasource
dest_data_source = "PG:dbname={database} host={host} port={port} user={user} password={password} active_schema={schema}"
# layer creation options will only be added to ogr2ogr on first run
lco = -lco LAUNDER=YES -lco PRECISION=NO
# spatial_extent, translates to -spat xmin ymin xmax ymax
spatial_extent = {spatial_extent}
# gfs template
gfs_template = {gfs_template}
# miscellaneous ogr2ogr options
options = -append -gt 65536 {multi_opts} --config PG_USE_COPY NO --config CPL_ZIP_ENCODING CP437
```

GFS for Table+Column Mapping

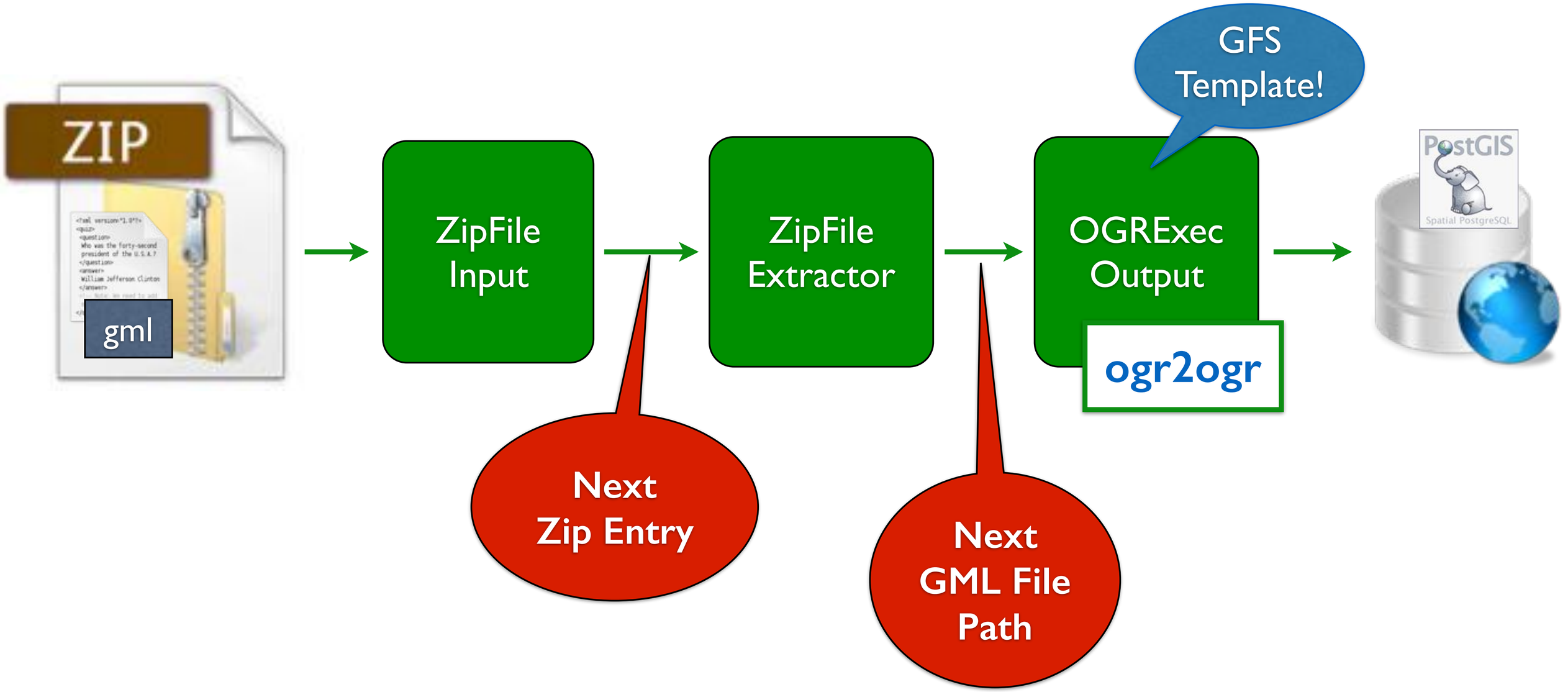
```
<GMLFeatureClassList>
    .
    <GMLFeatureClass>
        <Name>Perceel</Name>
        <ElementPath>Perceel</ElementPath>
        <!--<GeometryType>1</GeometryType>-->
        <SRSName>urn:ogc:def:crs:EPSG::28992</SRSName>
         .
        <PropertyDefn>
            <Name>gemeente</Name>
            <ElementPath>kadastraleAanduiding|TypeKadastraleAanduiding|kadastraleGemeente|KadastraleGemeenteKeuze|
AKRKadastraleGemeenteCode</ElementPath>
            <Type>String</Type>
            <Width>5</Width>
        </PropertyDefn>
        <PropertyDefn>
            <Name>sectie</Name>
            <ElementPath>kadastraleAanduiding|TypeKadastraleAanduiding|sectie</ElementPath>
            <Type>String</Type>
            <Width>2</Width>
        </PropertyDefn>
        <PropertyDefn>
            <Name>perceelnummer</Name>
            <ElementPath>kadastraleAanduiding|TypeKadastraleAanduiding|perceelnummer</ElementPath>
            <Type>Integer</Type>
        </PropertyDefn>
        .
        <GeomPropertyDefn>
            <Name>begrenzing</Name>
            <!-- OGR geometry name -->
            <ElementPath>begrenzingPerceel</ElementPath>
            <!-- XML element name possibly with '|' to specify the path -->
            <Type>Polygon</Type>
        </GeomPropertyDefn>
   </GMLFeatureClass>
</GMLFeatureClassList>
```

Resultaat in PostGIS

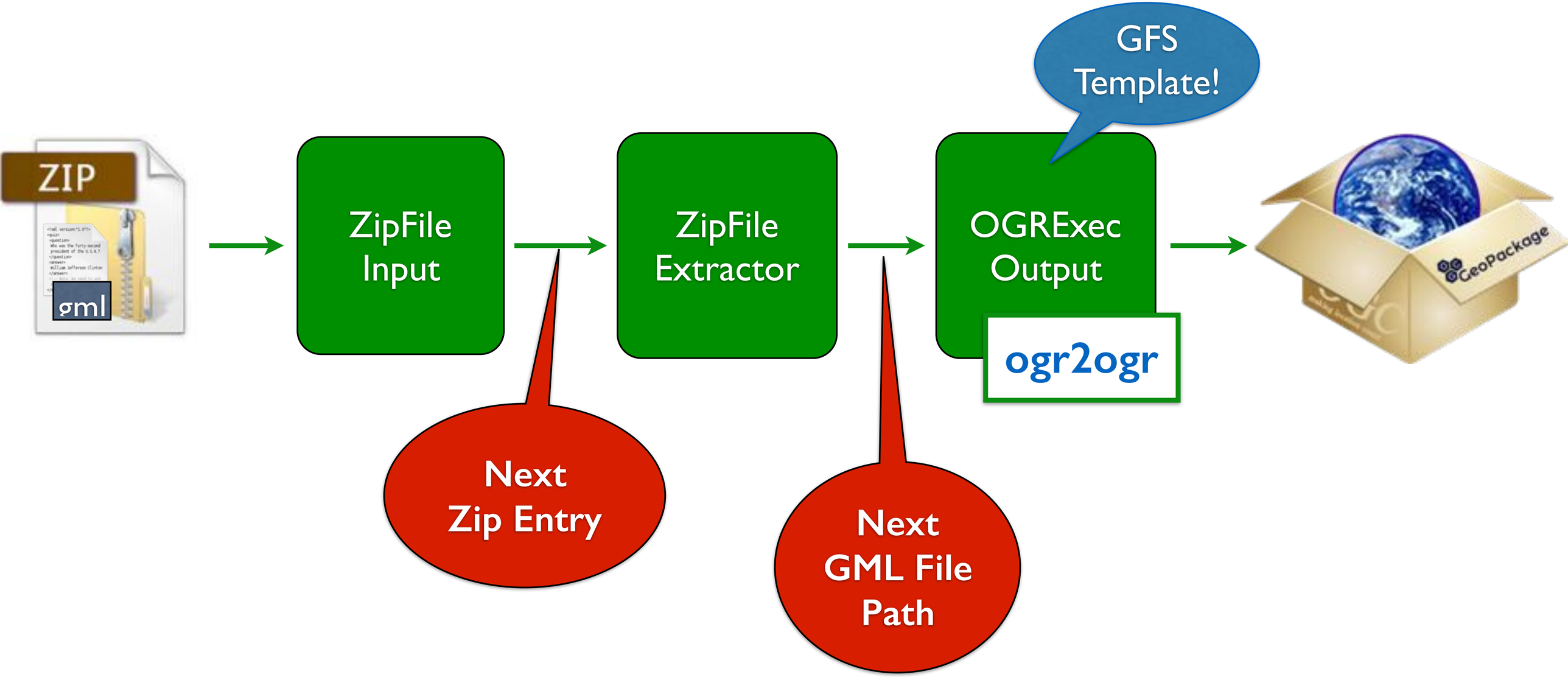
ogc_fid	gml_id	namespace	lokaalid	logischtijdstipontstaan	gemeente	sectie	perceelnummer	waarde
1	NL.IMKAD.KadastraalObject.120031707	NL.IMKAD.KadastraalObject	120031707	2009-03-27T23:59:59.000	AMR04	O	3322	178
2	NL.IMKAD.KadastraalObject.120118807	NL.IMKAD.KadastraalObject	120118807	2009-03-27T23:59:59.000	AMR04	P	3907	446
3	NL.IMKAD.KadastraalObject.120077624	NL.IMKAD.KadastraalObject	120077624	2009-03-27T23:59:59.000	AMR04	O	4482	298
4	NL.IMKAD.KadastraalObject.120119310	NL.IMKAD.KadastraalObject	120119310	2009-03-27T23:59:59.000	AMR04	Q	5520	155
5	NL.IMKAD.KadastraalObject.120095784	NL.IMKAD.KadastraalObject	120095784	2009-03-27T23:59:59.000	AMR04	Q	4128	250

perceelnummerrotatie	deltax	deltay	begrenzing
0	0	0	0103000020407100000100000000C0000003D0AD7A3CF5E014...
0	0	0	0103000020407100000100000006000000 6F1283C072D0014...
0	0	0	0103000020407100000100000006000000D34D6210DB6F014...
-45.6	0	0	0103000020407100000100000009000000046B6F3FD0C2D014...
0	0	0	0103000020407100000100000000A000000C74B3789BE42014...

Stetl Config BRK to PostGIS

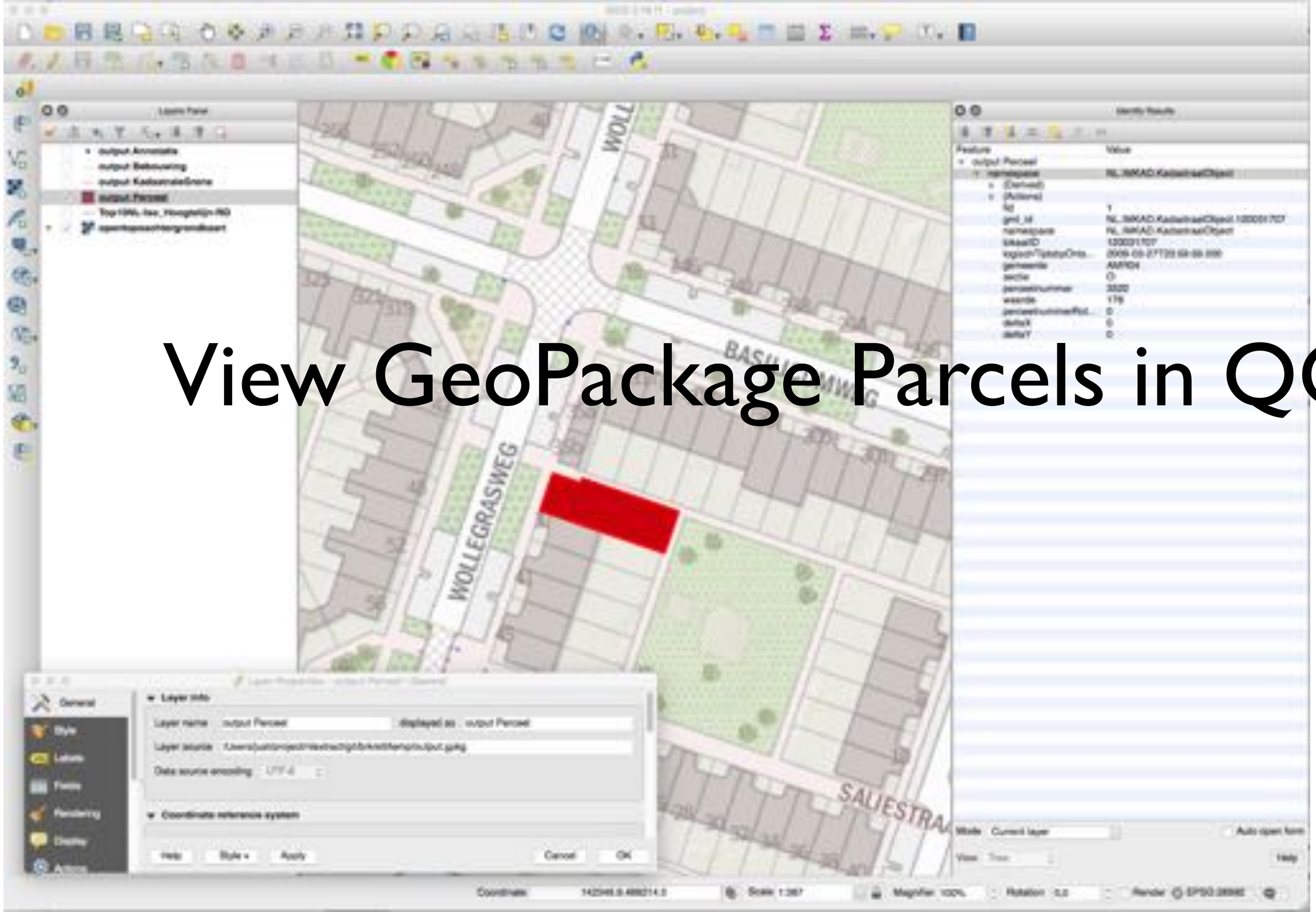


Stetl Config BRK to GeoPackage



Stetl Config - BRK .zip to GeoPackage

```
[etl]
chains = input_zip_file|extract_zip_file|output_ogr2ogr_gpkg

# The source input ZIP-file(s) from dir, producing 'records' with ZIP file name and inner file names
[input_zip_file]
class=inputs.fileinput.ZipFileInput
file_path = {input_dir}
filename_pattern = {zip_files_pattern}
name_filter = {filename_match}

# Filter to extract a ZIP file one by one to a temporary location
[extract_zip_file]
class=filters.zipfileextractor.ZipFileExtractor
file_path = {temp_dir}/fromzip-tmp.gml

[output_ogr2ogr_gpkg]
class = outputs.execoutput.Ogr2OgrExecOutput
# destination format: OGR vector format name
dest_format = GPKG
# destination datasource: path to .gpkg output file
dest_data_source = "{temp_dir}/output.gpkg"
# layer creation options will only be added to ogr2ogr on first run
lco = -lco SPATIAL_INDEX=YES -lco PRECISION=NO
# spatial_extent, translates to -spat xmin ymin xmax ymax
spatial_extent = {spatial_extent}
# gfs template
gfs_template = {gfs_template}
# miscellaneous ogr2ogr options
options = -append -gt 65536 {multi_opts} --config CPL_ZIP_ENCODING CP437
```

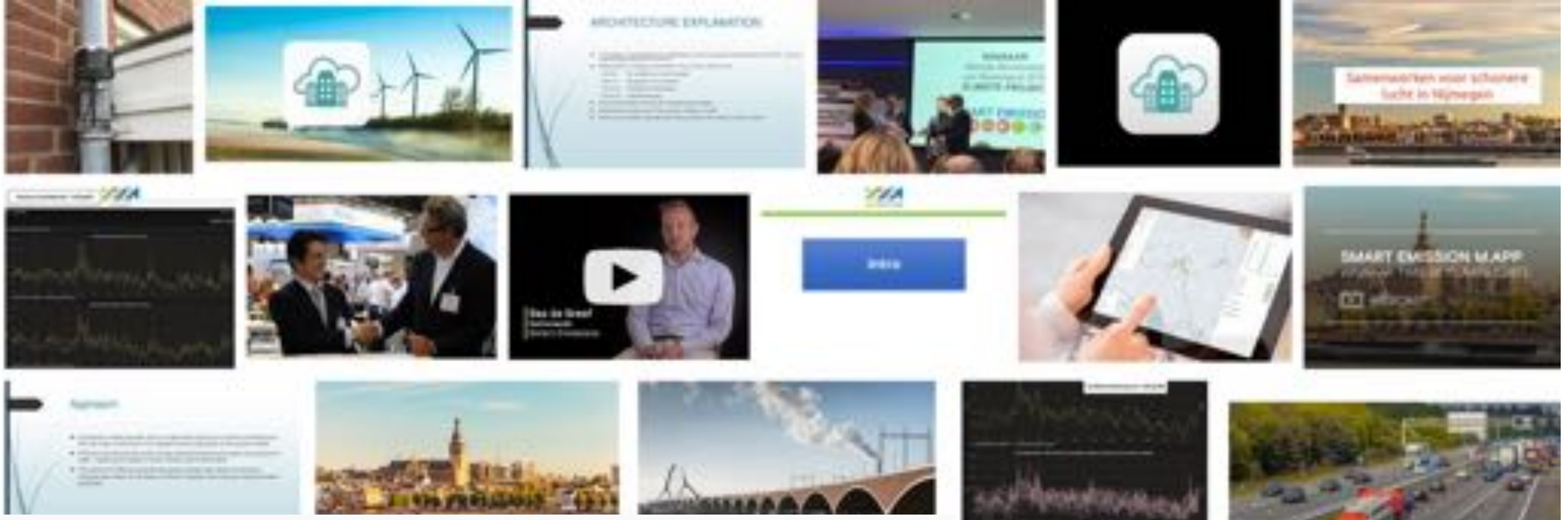


View GeoPackage Parcels in QGIS

BRK .zip to both PostGIS + GeoPackage

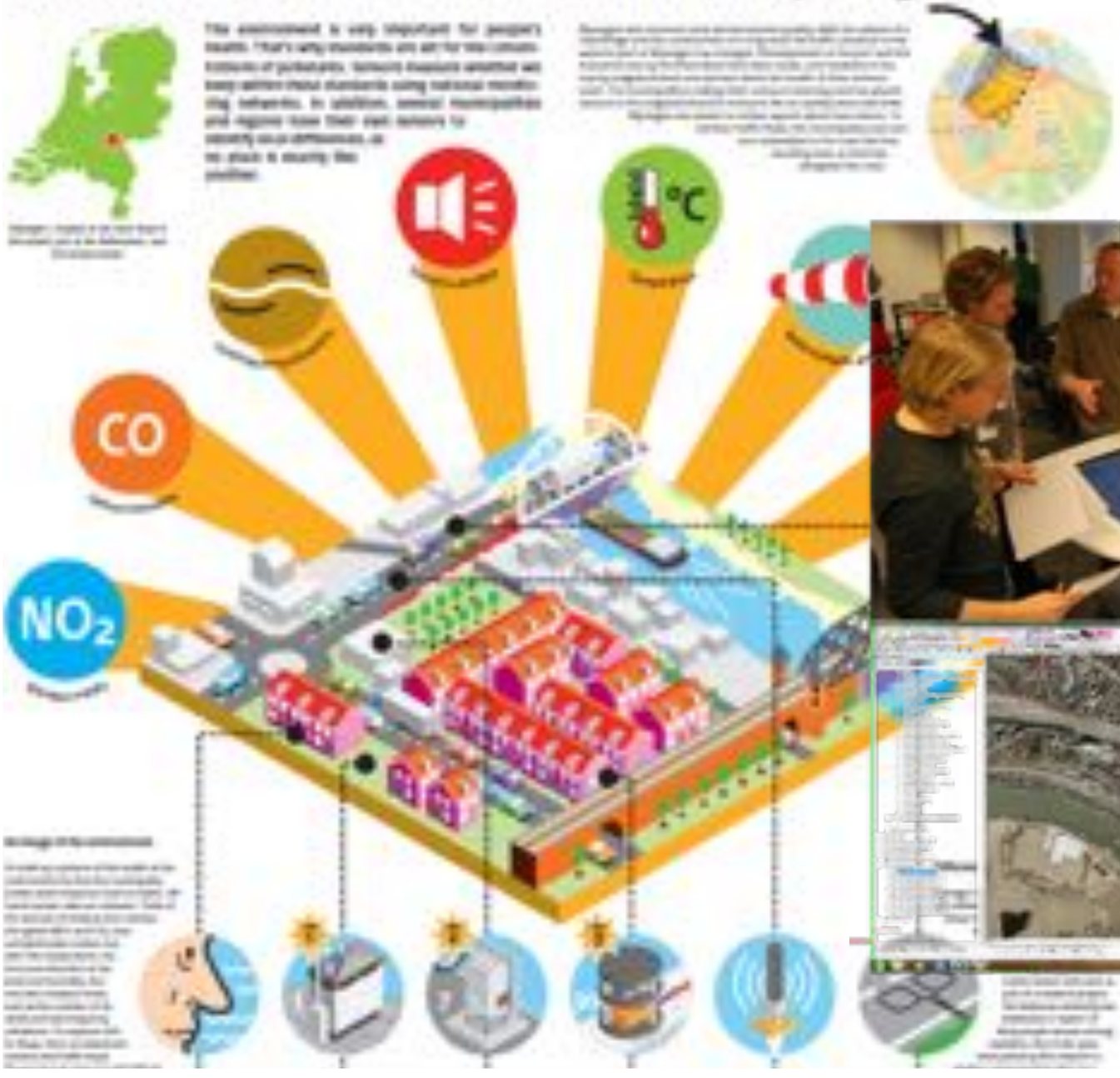
```
[etl]
chains = input_zip_file|extract_zip_file|(output_ogr2ogr_postgis) (output_ogr2ogr_gpkg)

# The source input ZIP-file(s) from dir, producing 'records' with ZIP file name and inner file names
[input_zip_file]
class=inputs.fileinput.ZipFileInput
file_path = {input_dir}
filename_pattern = {zip_files_pattern}
name_filter = {filename_match}

# Filter to extract a ZIP file one by one to a temporary location
[extract_zip_file]
class=filters.zipfileextractor.ZipFileExtractor
file_path = {temp_dir}/fromzip-tmp.gml

[output_ogr2ogr_postgis]
class = outputs.execoutput.Ogr2OgrExecOutput
# destination format: OGR vector format name
dest_format = PostgreSQL
.
.
[output_ogr2ogr_gpkg]
class = outputs.execoutput.Ogr2OgrExecOutput
# destination format: OGR vector format name
dest_format = GPKG
# destination datasource: path to .gpkg output file
dest_data_source = "{temp_dir}/output.gpkg"
.
.
```

Case 2 - Smart Emission



Het 'Smart Emission' project draait om het in kaart brengen van luchtkwaliteit, geluid, trillingen en meteorologische indicatoren in de stad op een fijnmazig schaalniveau, door inwoners met zogenoemde burger-sensor-netwerken. De pilotstudie richt zich op de stad Nijmegen (binnen de gemeentegrenzen van de stad). Hier zal een testbed worden ingericht waar het projectteam, in samenwerking met inwoners de lokale variatie in luchtkwaliteit (NO2, CO, CO2, O3), geluid en trillingen in kaart brengen met behulp van betaalbare sensoren.

Case: Environmental health in Nijmegen



From Pilot to Platform

Radboud Universiteit

Nijmegen

GEONOVUM

Intemo

INNOVATIVE TECHNOLOGY IN MOTION

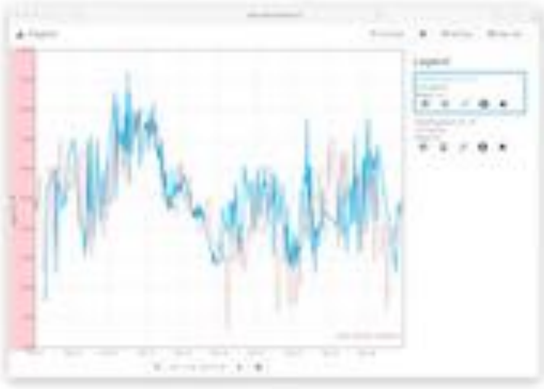
CityGIS

PUBLIC SAFETY

powered by pdok

kadaster

Viewers

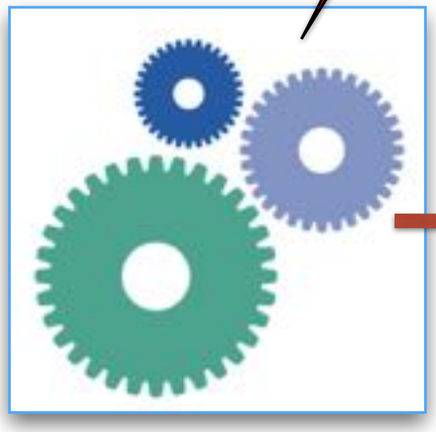


Stetl!

Services

ETL

Sensors

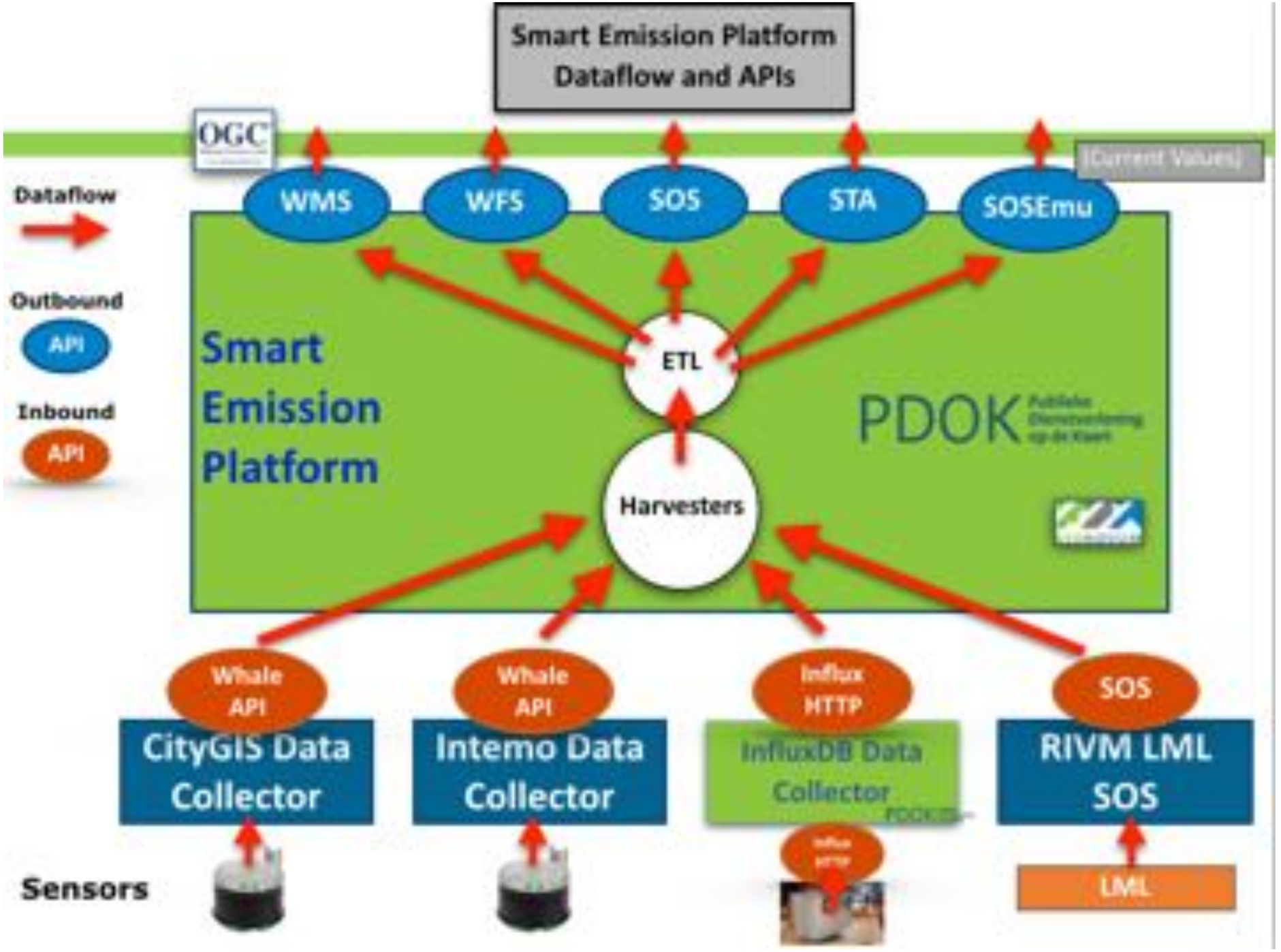


Smart Emission Platform

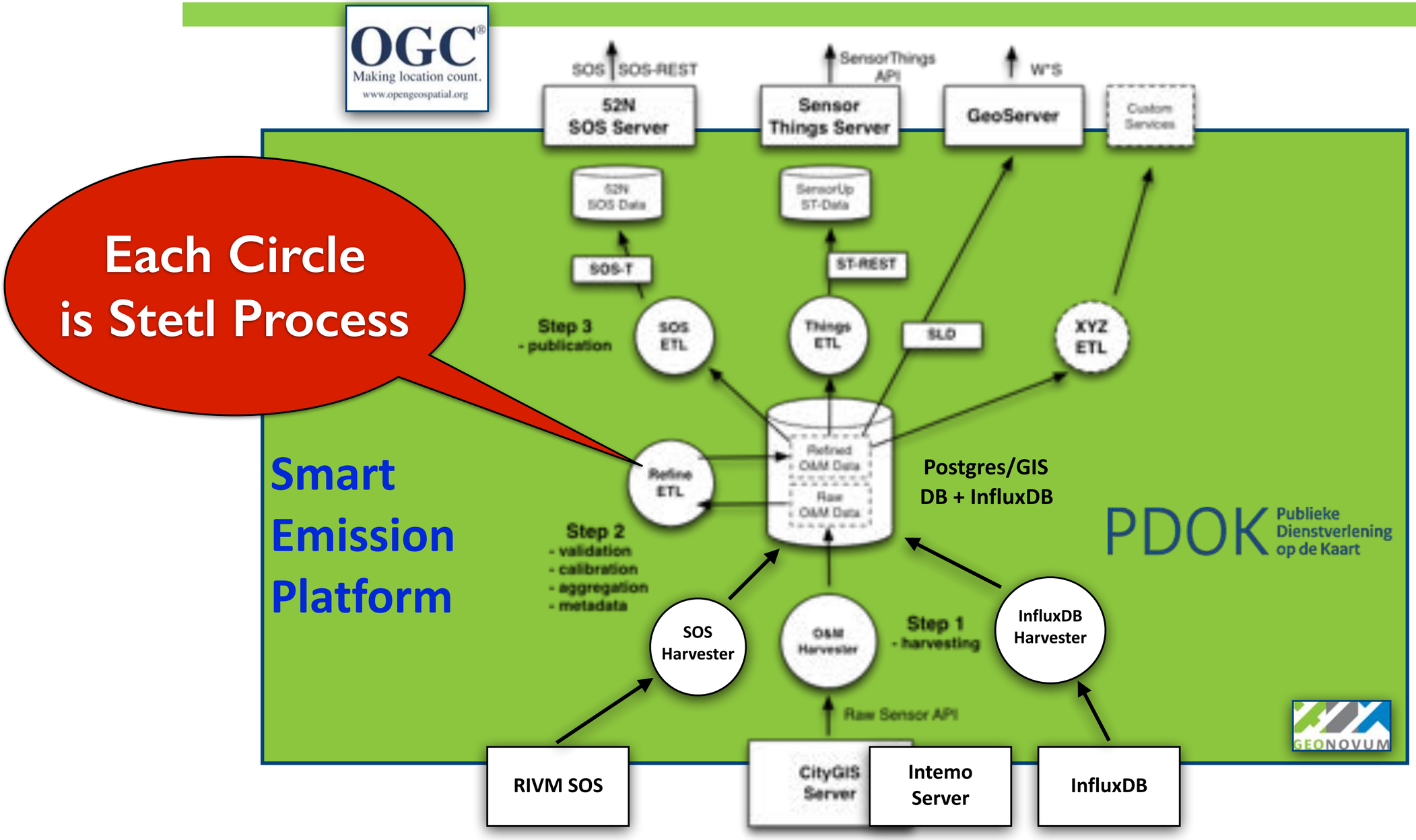
Smart Emission Platform Summary

- Air Quality + Noise + Meteo Sensors hosted by citizens
- Raw sensor data **Harvesting** to SE Platform
- **Validation**, Calibration, Aggregation
- Publication to Web Services (WMS, WFS, SOS, SensorThings API)
- data.smartemission.nl

All ETL
(Harvesting, Validation, Calibration, Aggregation, Publication)
done with Stetl


Smart Emission Platform
Dataflow and APIs
OGC
Dataflow
Outbound
API
Inbound
API
WMS
WFS
SOS
STA
SOSEmu
Smart Emission Platform
ETL
Harvesters
PDOK
Whale API
Whale API
Influx HTTP
SOS
CityGIS Data Collector
Intemo Data Collector
InfluxDB Data Collector
RIVM LML SOS
Sensors
LML

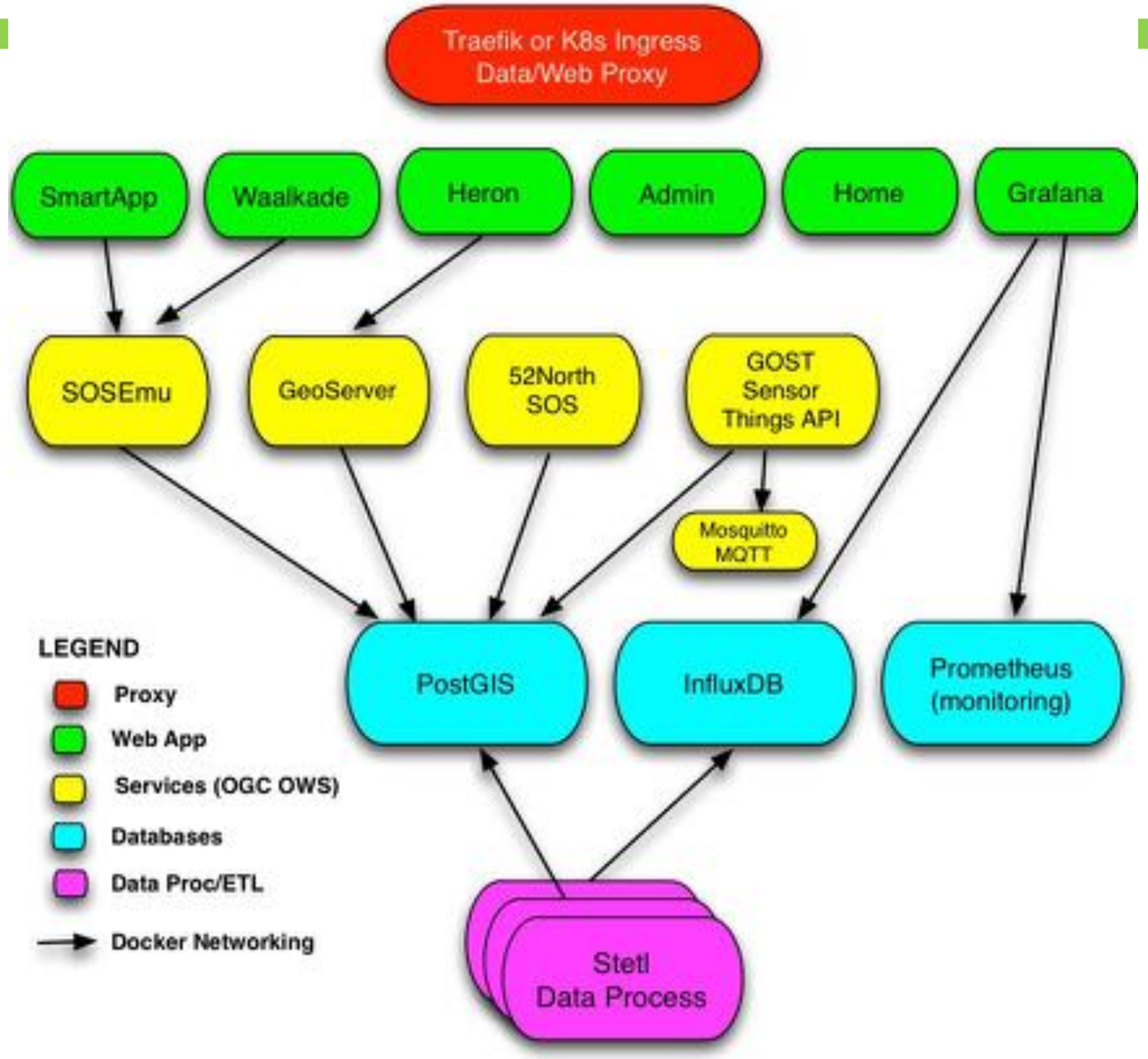
Data Architecture with multi-Step ETL



Each Circle
is Stetl Process

Smart
Emission
Platform

Smart Emission Docker Deployment




GUI ;-)

1. Dockerfile

```
FROM geopython/stetl:1.2

# Use the standard Stetl Docker Image with some additional packages
LABEL maintainer="Just van den Broecke <justb4@gmail.com>"

ENV ADD_PYTHON_DEB_PACKAGES="python-dev python-scipy python-seaborn python-matplotlib"  \
    ADD_PYTHON_PIP_PACKAGES="wheel Geohash influxdb scikit-learn==0.18"

# Not now see: https://github.com/pypa/pip/issues/5240
# RUN pip install --upgrade pip
RUN apt-get update && apt-get --no-install-recommends install  -y \
        ${ADD_PYTHON_DEB_PACKAGES} \

    && pip install ${ADD_PYTHON_PIP_PACKAGES} \
    && apt-get purge -y python-dev \
    && apt autoremove -y  \
    && rm -rf /var/lib/apt/lists/*


# Copy relevant files to work dir
ADD config /work/config
ADD smarten /work/smarten
ADD options/example.args /work/options/default.args
ADD scripts /work/scripts

WORKDIR /work

ENTRYPOINT ["/work/scripts/entry.sh"]
```

2. entry.sh

```
#!/bin/bash
#
# Generic ETL entry: override with specific ETL config and args file.
#

WORK_DIR=/work

cd ${WORK_DIR}

# Shorthand
function log() {
    echo "entry.sh: $1"
}

# Shorthand
function error() {
    log "$@"
    exit -1
}

# ETL Process can be specified via env var or argument
if [ "${ETL_PROCESS}x" = "x" ];
then
    ETL_PROCESS="$1"
fi

# ETL Process can be specified via env var or argument
if [ "${ETL_PROCESS}x" = "x" ];
then
    error "Error: no ETL process specified"
fi

ETL_CONFIG_FILE=config/${ETL_PROCESS}.cfg
if [ ! -f ${ETL_CONFIG_FILE} ]
then
    error "Error: cannot find ETL config file: ${ETL_CONFIG_FILE}"
else
    log "OK using config file: ${ETL_CONFIG_FILE}..."
fi

# Start Stetl with config file
export PYTHONPATH=${WORK_DIR}:${PYTHONPATH}
stetl -c ${ETL_CONFIG_FILE} -a options/default.args
```

3. Run ETL Process

```
$ docker run -t smartemission/se-stetl:1.0.13 refiner
```

Thank You !

www.stetl.org

github.com/geopython/stetl