



# *OPEN SOURCE TOOLS FOR SPATIAL ANALYSIS AND GEOPROCESSING ON THE DESKTOP*



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# Workshop Outline



## ■ Introduction

to Free and Open Source GIS Tools on the Desktop

about 60 minutes

## ■ Examples

for Spatial Analysis and Geoprocessing

about 90 minutes

- **OGR/GDAL** - Utilities raster and vector processing
- **gvSIG and the Sextante extension** – Desktop GIS
- **PostGIS** – Spatial Database

## ■ Using OS tools

for your *everyday* Spatial Analysis and Geoprocessing Tasks

about 60 minutes

# **Part I**

## **Introduction**

## ■ What is Open Source (GIS)?

Open source means that the source code is available to the general public for use, distribution, and modification from its original design free of charge (among a long list of other requirements)

### Open Source ≠ Open Standards



While most open source geospatial software is built on the standards of the Open Geospatial Consortium (OGC) the term "Open Source" it is not synonymous with Open Standards because both proprietary and open source software can be compliant with the OGC Open Standards.  
<http://www.opengeospatial.org>



OSGeo is the organization that supports the development of the highest quality open source geospatial software.  
<http://www.osgeo.org>

## ■ Why use it ? General and incomplete listing

### ■ User is in control

- Pick you favorite operating system: supports many operating systems: Windows-Linux-Solaris-...
- No licensing issues (did we install one to many PCs with software XY?)
- Vendor independency
- Access to source code: don't like something, need changes to the core system, need extensions – hire somebody to change it right now

### ■ High performance, high quality, high interoperability

- Distributed programming effort, highly modular...
- System heterogeneity - less prone to hacker attacks and viruses
- Interoperable – very advanced support of OGC open standards

### ■ Exceptional Support - Commercial and non commercial

- Mailing lists, user groups, Conferences, IRC channels
- Fast response times for bug fixes  
typically tracked on the web accessible and open to everybody to report or fix a bug

### ■ It is free

## ■ Licenses

Table 1: List of common FOSS software licenses

Name	Style	software
GNU-GPL	strong copyleft license, derived works have to be available under the same copyleft	GRASS, QGIS, gvSIG, Mapbender, PostGIS, GeoServer, AveiN!
LPGL	compromise between copyleft and more permissive licenses, has copyleft restrictions on the program itself, but not on other software linking with the program.	Mapnik, MapGuide
MIT	permissive license, permits reuse within proprietary software (license has to be distributed with that software)	MapServer, GDAL/OGR, Proj4
BSD	permissive license, little restriction, close to the public domain	Ka-Map, Feature-Server, TileCache, OpenLayers
Mozilla (MPL)	hybrid of modified BSD and GPL.	MapWindow, Mozilla Firefox

## Overview

- OS Software uses synergies: sharing of libraries
  - ▶ not too much duplication of effort
- Different tribes use different tools:

### “Tribe”

### Examples

- C/C++ Tribe  
Mapserver, GRASS, Mapguide, QGIS  
PostGIS, OGR/GDAL, PROJ4, GEOS, FDO
- Java Tribe  
GeoTools, GeoServer, uDig, DeeGree  
JUMP, gvSIG, JTS
- Web tribe  
MapBender, OpenLayers, Ka-map
- .Net Tribe  
SharpMap, WorldWind, MapWindow

## ■ Some Foundations (Tools)

A few libraries that are the foundation of many Open Source and commercial Geospatial Software Packages

### ■ GDAL (Raster) and OGR (Vector)

Geospatial Data Abstraction Library / OpenGIS Simple Features Reference Implementation

- Tools for reading, writing and processing of raster and vector data sets -> [formats](#)
- Important base for many Desktop GIS systems e.g. ArcGIS
- OGR extends Mapserver formats  
Oracle Spatial, ESRI Geodatabase (MDB), TIGER, MapInfo...

### ■ PROJ4 is a library for cartographic projection routines

- stand alone projection utility "proj"
- libraries for more than 2500 projections (e.g. EPSG list)



# PROJ4 Library - EPSG Definitions

```
# USA Contiguous Albers Equal Area Conic
<102003> +proj=aea +lat_1=29.5 +lat_2=45.5 +lat_0=37.5 +lon_0=-96 +x_0=0 +y_0=0 +ellps=GRS80 +datum=NAD83 +uni
# Spherical Mercator
<900913> +proj=merc +a=6378137 +b=6378137 +lat_ts=0.0 +lon_0=0.0 +x_0=0.0 +y_0=0 +k=1.0 +units=m +nadgrids=@nu
# SR-ORG Projection 6627 - Google Mercator - Open Street Map
<6627> +proj=merc +lon_0=0 +k=1 +x_0=0 +y_0=0 +ellps=WGS84 +datum=WGS84 +units=m +no_defs
```

```
# Anguilla 1957 / British West Indies Grid
<2000> +proj=tmerc +lat_0=0 +lon_0=-62 +k=0.999500 +x_0=400000 +y_0=0 +ellps=clrk80 +units=m +no_defs no_defs
```

## Projection definition

### # USA Contiguous Albers Equal Area Conic

```
<102003> +proj=aea +lat_1=29.5 +lat_2=45.5
+lat_0=37.5 +lon_0=-96 +x_0=0 +y_0=0
+ellps=GRS80 +datum=NAD83 +units=m
no_defs <>
```

```
<2008> +proj=tmerc +lat_0=0 +lon_0=-55.5 +k=0.999900 +x_0=304800 +y_0=0 +ellps=clrk66 +units=m +no_defs no_de
# NAD27(CGQ77) / SCoPQ zone 3
<2009> +proj=tmerc +lat_0=0 +lon_0=-58.5 +k=0.999900 +x_0=304800 +y_0=0 +ellps=clrk66 +units=m +no_defs no_de
# NAD27(CGQ77) / SCoPQ zone 4
<2010> +proj=tmerc +lat_0=0 +lon_0=-61.5 +k=0.999900 +x_0=304800 +y_0=0 +ellps=clrk66 +units=m +no_defs no de
```

## Desktop GIS

Grass

<http://grass.osgeo.org>

Udig

JGrass

<http://udig.refractions.net><http://jgrass.wiki.dev.fsc.bz.it/jgrass>

QGIS



Open Ocean Map

<http://www.qgis.org><http://trac.infodrizzle.org/openocean>

gvSig

<http://www.gvsig.gva.es/index.php?id=gvsig&L=2>

OpenJump

<http://openjump.org>

MapWindow

<http://www.mapwindow.org>

Spring

<http://www.dpi.inpe.br/spring>

## Tools

### Simple Feature Library (OGR) Geospatial Data Abstraction Library (GDAL)

[www.gdal.org/ogr](http://www.gdal.org/ogr)  
[www.gdal.org](http://www.gdal.org)



GeoTools

<http://sourceforge.net/projects/geotools>

PROJ4


<http://www.remotesensing.org/proj>

FWTools (utility collection )

<http://fwtools.maptools.org>

GMT 

<http://gmt.soest.hawaii.edu>

TerraLib 

<http://www.terralib.org>

Spatial Data Integrator 

[www.spatialdataintegrator.com](http://www.spatialdataintegrator.com)

Open Source Software Image Map (OSSIM)

<http://www.ossim.or>

The R Project for Statistical Computing

<http://www.r-project.org/>

PostgreSQL 

[www.postgresql.org](http://www.postgresql.org)

PostGIS



<http://postgis.refrations.net>



## GDAL (Raster) and OGR (Vector)

- Tools for reading, writing and processing of raster and vector data sets
- Important base for many Desktop GIS systems e.g. ArcGIS
- OGR extends Mapserver formats Oracle Spatial, ESRI Geodatabase (MDB), TIGER, MapInfo...

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Main supporter of GDAL/OGR Project Management Committee, Frank Warmerdam  
**GDAL/OGR**

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Functionality	libraries and utilities for raster and vector geospatial data processing
Operating systems	Unix/Linux, Windows, Mac
Project started	1998
Implementation	C++
OS libraries	Proj.4, other external libraries to support specific data formats
PostGIS support	Yes
License	MIT

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## GDAL Utilities - raster

The following utility programs are distributed with GDAL.

- **gdalinfo** - report information about a file.
- **gdal\_translate** - Copy a raster file, with control of output format.
- **gdaladdo** - Add overviews to a file.
- **gdalwarp** - Warp an image into a new coordinate system.
- **gdaltindex** - Build a MapServer raster tileindex.
- **gdalbuildvrt** - Build a VRT from a list of datasets.
- **gdal\_contour** - Contours from DEM.
- **gdaldem** - Tools to analyze and visualize DEMs.
- **rgb2pct.py** - Convert a 24bit RGB image to 8bit paletted.
- **pct2rgb.py** - Convert an 8bit paletted image to 24bit RGB.
- **gdal\_merge.py** - Build a quick mosaic from a set of images.
- **gdal2tiles.py** - Create a TMS tile structure, KML and simple web viewer.
- **gdal\_rasterize** - Rasterize vectors into raster file.
- **gdaltransform** - Transform coordinates.
- **nearblack** - Convert nearly black/white borders to exact value.
- **gdal\_retile.py** - Retiles a set of tiles and/or build tiled pyramid levels.
- **gdal\_grid** - Create raster from the scattered data.
- **gdal\_proximity.py** - Compute a raster proximity map.
- **gdal\_polygonize.py** - Generate polygons from raster.
- **gdal\_sieve.py** - Raster Sieve filter.
- **gdal\_fillnodata.py** - Interpolate in nodata regions.
- **gdal-config** - Get options required to build software using GDAL.



## OGR Utilities – vector

- ogrinfo  
list information about data source
- ogr2ogr  
convert data between file formats
- ogrtindex  
create tile index (“cut up” shape files)



# gvSIG – Generalidad Valenciana

Conselleria d'Infraestructures i Transport

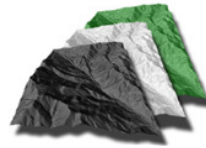
- project - Spanish Community of Valencia
- mid range Desktop GIS
- based on open standards
- part of gvPONTIS [project](http://www.gvpontis.gva.es/fileadmin/conselleria/images/Documentacion/memoria/gvpontis_ingles.pdf)

[http://www.gvpontis.gva.es/fileadmin/conselleria/images/Documentacion/memoria/gvpontis\\_ingles.pdf](http://www.gvpontis.gva.es/fileadmin/conselleria/images/Documentacion/memoria/gvpontis_ingles.pdf)



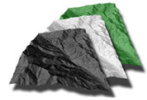
- project - Spanish province of Extremadura  
Sistema Extremeno de Analisis Territorial
- java based plug-in for gvSIG
- offers more than 270 spatial functions  
raster and vector processing  
originally targeted at forestry usage  
initially based on SAGA GIS



**SEXTANTE**

gvSIG is a project of the Spanish province of Valencia. The goals of the project are to provide an open source GIS that is platform independent and based on open source standards. Basically the capabilities should be comprehensive enough to replace ESRI's ArcView 3 desktop GIS. The user interface and functionalities of gvSIG are similar to ArcView 3, but in addition has capabilities to connect to Internet mapping services.

Another Java based project of the autonomous region of Extremadura called Sextante can be installed as a plug-in and offers more than 270 spatial functions.



SEXTANTE



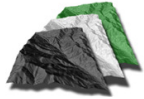
Main supporter of Generalitat Valencia (GVA) - Province of Valencia, Spain  
**gvSIG**

Type	Desktop GIS
Functionality	Multilingual Desktop GIS - Analysis functions can be greatly extended when installing Sextante. Many extensions.
Operating systems	Unix/Linux, Windows
Project started	2003
Implementation	Java
OS libraries	GeoTools and JTS
PostGIS support	Yes
License	GPL

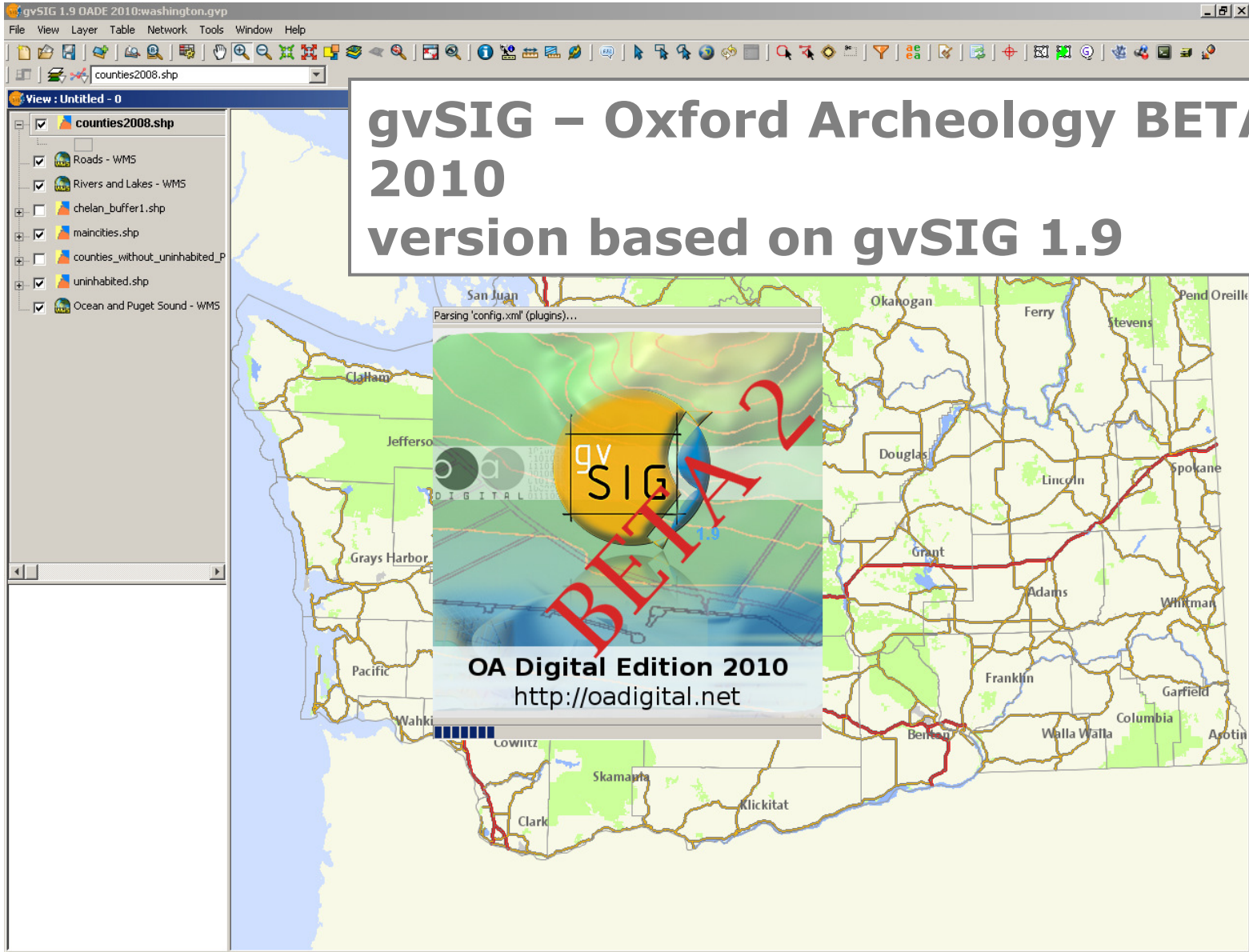
**gvSIG and Sextante facts**

Main supporter of Sextante Team, Victor Olaya, Juan Carlos Giménez  
**Sextante**

Functionality	Comprehensive set of spatial vector data and image analysis tools
Operating systems	Unix/Linux, Windows
Project started	2004
Implementation	Java
OS libraries	built on top of SAGA GIS functionality
PostGIS support	Yes
License	GPL



SEXTANTE



# gvSIG – Oxford Archeology BETA 2010 version based on gvSIG 1.9



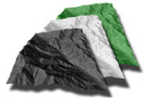
wa\_shade\_1km\_2285.tif

Vista: WA Map

- wa\_shade\_1km\_2285.tif
- counties2008.shp
- Roads - WMS
- Rivers and Lakes - WMS
- chelan\_buffer1.shp
- maincities.shp
- counties\_without\_uninhabited\_P
- uninhabited.shp
- Ocean and Puget Sound - WMS

# Map View – Cartography transparent hillshade





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# Table tools - add, rename, delete

QGIS 1.9 OADE 2010:mci\_region.gvp

File View Table Tools Window Help

View: Untitled - 0

- ✓ mci\_region\_counties2.shp
- ✓ mci\_region
- ✓ 2008\_mci

0 / 967 Total records selected.

Table: Attribute table: mci\_region\_counties2.shp

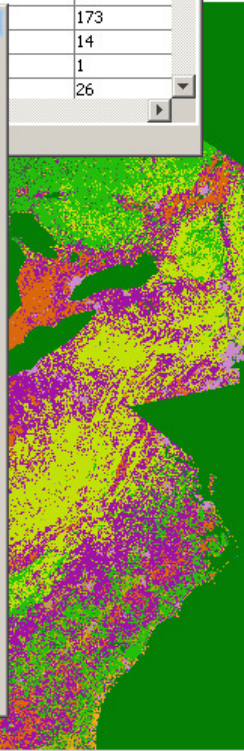
ObjectID	NAME	STATE_NAME	STATE_FIPS	CNTY_FIPS	FIPS	POP2000	POP2004	POP00_SQMI	POP04_SQMI	WHITE	BLACK	AMERI_ES
173	Beltrami	Minnesota	27	007	27007	39650	42397.0	13.0	13.9	30394	142	8071
181	McKenzie	North Dakota	38	053	38053	5737	5653.0	2.0	2.0	4438	4	1215
182	Grant	North Dakota	38	037	38037	2841	2776.0	1.7	1.7	2753	0	49
183	Dewey	South Dakota	46	041	46041	5972	6241.0	2.4	2.6	1442	2	4429
191	McLean	North Dakota	38	055	38055	9311	8994.0	4.0	3.9	8615	2	554
192	Dunn	North Dakota	38	025	38025	3600	3499.0	1.7	1.7	3117	1	448
193	Mercer	North Dakota	38	026	38026	3600	3499.0	1.7	1.7	3117	1	448
194	Golden Valley	North Dakota	38	027	38027	3600	3499.0	1.7	1.7	3117	1	448
195	Billings	North Dakota	38	028	38028	3600	3499.0	1.7	1.7	3117	1	448
196	Oliver	North Dakota	38	029	38029	3600	3499.0	1.7	1.7	3117	1	448

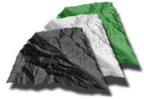
Manage fields (schema)

Add, delete or rename field:

Field name:	Type	Length	Decimal precision	Default value:
ObjectID	Integer	9	0	
NAME	String	32	0	
STATE_NAME	String	25	0	
STATE_FIPS	String	2	0	
CNTY_FIPS	String	3	0	
FIPS	String	5	0	
POP2000	Integer	9	0	
POP2004	Double	10	6	
POP00_SQMI	Double	11	6	
POP04_SQMI	Double	8	6	
WHITE	Integer	9	0	
BLACK	Integer	9	0	
AMERI_ES	Integer	9	0	
ASIAN	Integer	9	0	
HAWN_PI	Integer	9	0	
OTHER	Integer	9	0	
MULT_RACE	Integer	9	0	
HISPANIC	Integer	9	0	
MALES	Integer	9	0	
FEMALES	Integer	9	0	
RACE_UNDEFR	Integer	9	0	

Buttons: Add..., Rename..., Delete..., Accept





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# gvSIG Geoprocessing Tools

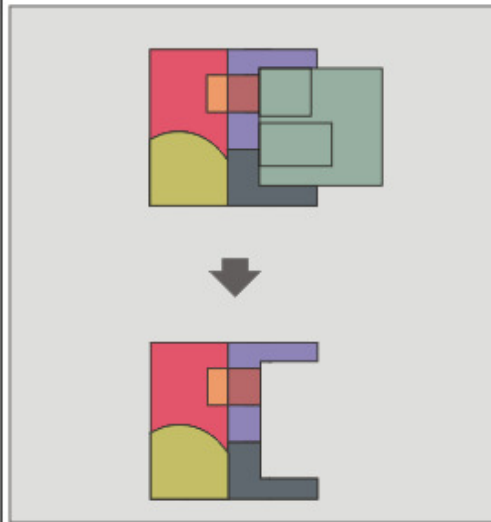
## Geoprocessing tools...

- Geoprocessing tools
  - Analysis
    - Proximity
      - Buffer zones
      - Spatial join
    - Overlay
      - Clip
      - Difference**
      - Intersection
      - Union
    - Computational geometry
      - Convex hull
      - Voronoi/Delaunay
    - Aggregation
      - Dissolve
  - Data conversion
    - Merge
    - XY shift (2D)
    - Reproject
    - Generalize
    - Smooth
    - Transform
  - Topology
    - Flip lines
    - Reduce to lines
    - Reduce to points
    - Clean
    - Build polygons

### Difference

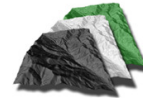
This tool performs a geometric *overlay* operation. It works on two layers, an input layer **A** and an overlay layer **B**. The procedure is also called a "spatial NOT" operation, because it includes all geometries of **A** that are *not* present in **B**.

Owing to its geometric nature, this operation only works for *polygon* type layers. The result layer will have a copy of the attribute table of the input layer.



Open tool...

Close



# Sextante Toolbox (in gvSIG)

## SEXTANTE

### Tools

- + Buffers
- + Cost, distances and routes
- + Fire modeling
- + Focal statistics for neighbourhoods
- + Fuzzy logic
- + Geomorphometry and terrain analysis
- + Geostatistical simulations
- + Geostatistics
- + Hydrological analysis tools
- + Hydrological indices and parameters
- + Image processing
- + Local statistics
- + Location/allocation
- + Models
- + Pattern analysis
- + Profiles
- + Raster algebra
- + Raster categories analysis
- + Raster creation tools
- + Rasterization and interpolation
- + Raster layer analysis
- + Raster tools
- + Reclassify raster layers
- + Statistical methods
- + Table tools
- + TIN
- + Topology
- + Vectorization
- + Vector layer tools
- + Vector line layers
- + Vector point layers
- + Vector polygon layers
- + Vegetation indices
- + Visibility and lighting

Execute as batch process

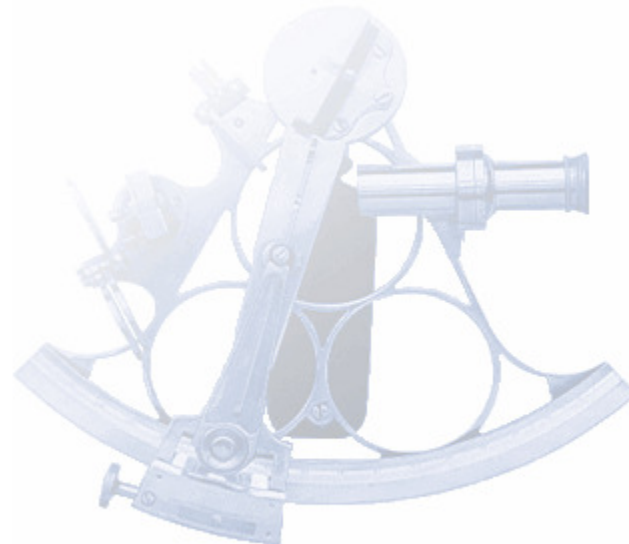
Execute as batch process (using layers from GIS app)

Expand all

Collapse all

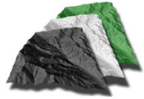
Show active only

Show help



Search





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# Layout

The screenshot displays the QGIS 1.9.0 DADE 2010: washington.gvp interface. The main map window, titled "Map : WA Overview Uninhabited Areas", shows a map of Washington State with a legend on the right. The legend includes "Counties" (white), "Main Cities" (brown), and "Uninhabited Lands" (green). The map is overlaid with a grid and a scale bar at the bottom. The Project manager window on the left shows document types: View, Table, and a grid. The Session window at the bottom left shows the session name "washington.gvp", saved as "F:\dokumente\conferences\waurisa2010", and creation date "Apr 6, 2010". The status bar at the bottom indicates "Project file saved: washington.gvp" and "Kilometers".





## PostGIS – Spatial Database

- PostGIS is an extension for PostgreSQL
- adds support for geographic objects to PostgreSQL
- enables PostgreSQL server to be used as a backend spatial database for GIS
- Spatial operations and analysis simply mean running a (spatial) SQL query in the database
- Similar functions as SDE and much more ....

## PostGIS facts

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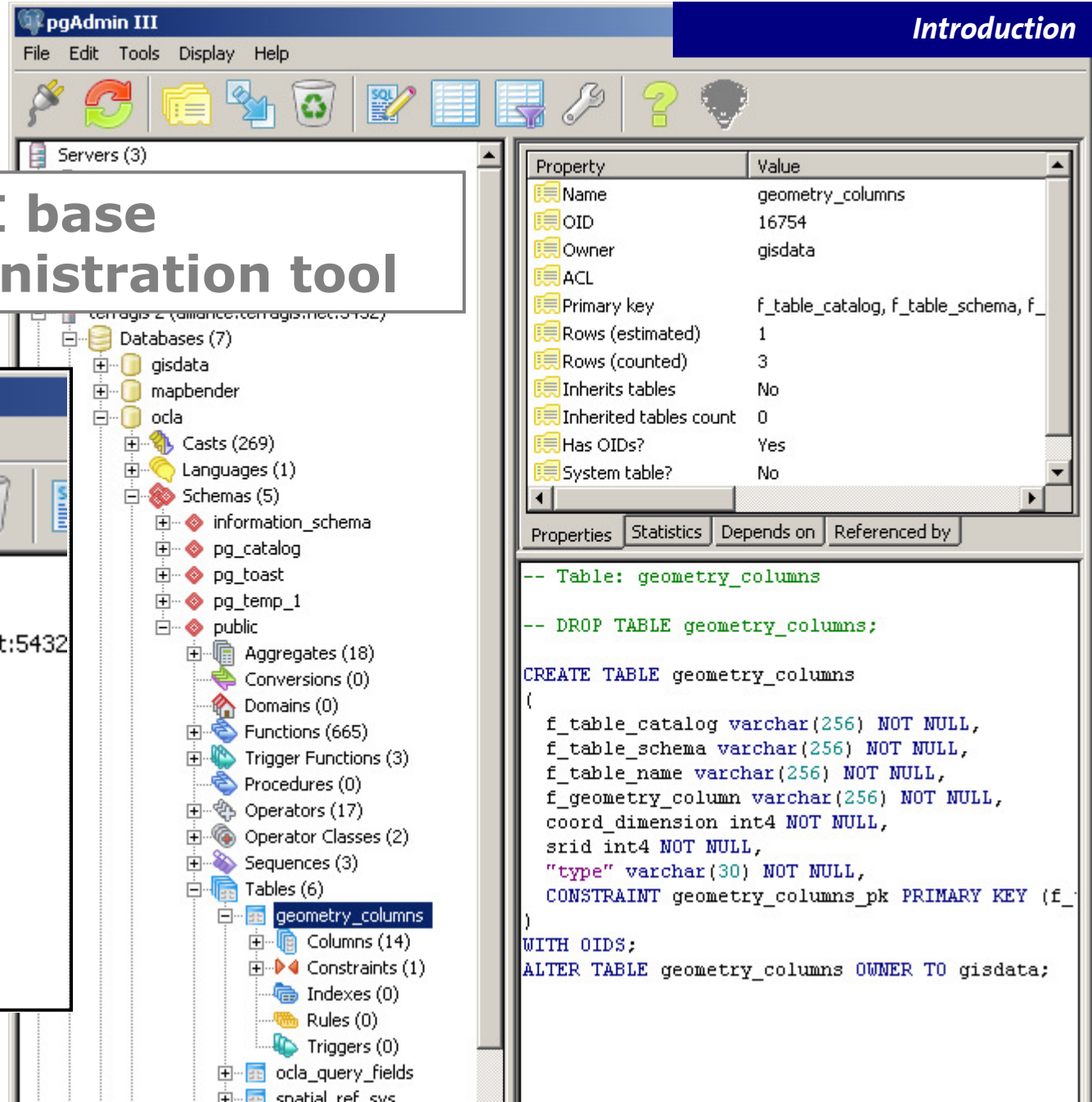
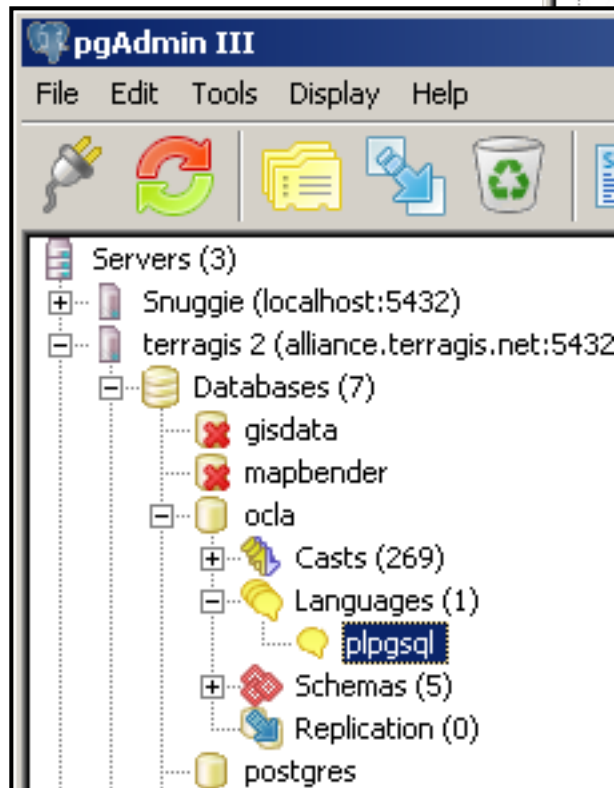
Main supporter of Refrations Research, Victoria, Canada  
**PostGIS**

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Type	Spatial database. PostGIS is an extension for PostgreSQL
Functionality	Storage and retrieval of spatial data (geometries such as point, line, polygon, multipoint, multiline, multipolygon, geometry collection). Spatial indexing. GIS functions via spatially enabled SQL. E.g. intersections, distance calculations, reprojection
Operating systems	Linux, Windows, Mac
Project started	2001
Implementation	C
OS libraries	GEOS, Proj4
License	GPL

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# pgAdmin – GUI base Database administration tool



pgAdmin III Edit Data - terragis 2 (alliance.terragis.net:5432) - ocla - geometry\_columns

	oid	table_schem	table_name	geometry_column	d_dimension	srid	type
	[PK] int4	[PK] varchar	[PK] varchar	[PK] varchar	int4	int4	varchar
1	63153	public	wa_counties	the_geom	2	2285	MULTIPOLYGON
2	63206	public	wa_counties_wv	the_geom	2	2285	MULTIPOLYGON
3	63226	public	wa_tracts	the_geom	2	2285	MULTIPOLYGON
*							

PostGIS tables      geometry columns  
 spatial reference table

pgAdmin III Edit Data - terragis 2 (alliance.terragis.net:5432) - ocla - spatial\_ref\_sys

	srid	auth_name	auth_srid	srtext	proj4text
	[PK] int4	varchar	int4	varchar	varchar
1614	4324	EPSG	4324	GEOGCS["WGS 72BE",DATUM["WGS_1972",SP	+proj=longlat +ellps=WGS72 +t
1615	4326	EPSG	4326	GEOGCS["WGS 84",DATUM["WGS_1984",SP	+proj=longlat +ellps=WGS84 +d
1616	4600	EPSG	4600	GEOGCS["Anguilla 1957",DATUM["Anguilla_1	+proj=longlat +ellps=clrk80 +no
1617	4601	EPSG	4601	GEOGCS["Antigua 1943",DATUM["Antigua_1	+proj=longlat +ellps=clrk80 +no
1618	4602	EPSG	4602	GEOGCS["Dominica 1945",DATUM["Dominica	+proj=longlat +ellps=clrk80 +to
1619	4603	EPSG	4603	GEOGCS["Grenada 1953",DATUM["Grenada_	+proj=longlat +ellps=clrk80 +to
1620	4604	EPSG	4604	GEOGCS["Montserrat 1958",DATUM["Montse	+proj=longlat +ellps=clrk80 +to

## ■ Articles

### **The State of Open Source GIS,**

Version September 2007. By Paul Ramsey, formerly Refrations Research, Victoria. 49pages.

[http://www.foss4g2007.org/presentations/viewattachment.php?attachment\\_id=8](http://www.foss4g2007.org/presentations/viewattachment.php?attachment_id=8)

### **Comparison Of Geographic Information System Software (Arcgis 9.0 And Grass 6.0): Implementation And Case Study**

MS Thesis by Todd R. Buchanan, Fort Hays State University. 89pages

<http://covenant-tech.com/thesis.pdf>

### **Geospatial Interoperability Return on Investment Study,**

National Aeronautics and Space Administration, Geospatial Interoperability Office, April 2005. 80pages

[http://www.egy.org/files/ROI\\_Study.pdf](http://www.egy.org/files/ROI_Study.pdf)

## ■ Web Sites

**Free GIS Project** <http://www.freegis.org/>

**Open source GIS list** <http://opensourcegis.org/>

**Map Tools** <http://maptools.org/>

**OSGeo** <http://www.osgeo.org/>

# Live DVD background

- Examples
- Washi
- GISdata.txt



- Install
- pgAdmin
- Terminal
- waurisa2010

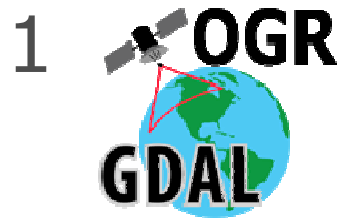


Open Source Tools for Spatial Analysis and Geoprocessing on the Desktop  
 Live DVD provided by  
**TERRA GIS**  
 TERRESTRIAL ENVIRONMENT REGIONAL ANALYSIS  
 www.terrakis.org

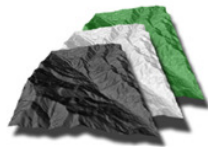
# **Part II**

# **Examples**

# Examples for Spatial Analysis and Geoprocessing using OGR/GDAL, gvSIG and PostGIS



desktop utilities to manipulate vector and raster data sources



SEXTANTE



desktop utilities to manipulate vector and raster data sources



desktop utilities to manipulate vector and raster data sources



## ogrinfo (vector data)

- list shape file attributes

```
ogrinfo -so counties2008.shp counties2008
```

- list PostGIS table attributes

```
ogrinfo -so PG:"host=127.0.0.1 user=postgres  
password=postgres dbname=workshop port=5432"  
counties -summary
```

- list personal geodatabase table attributes

```
ogrinfo -so streamnet_fishdist.mdb  
Fish_AllSpeciesCombined
```



## ogr2ogr (vector data)

- convert shape file to KML

```
ogr2ogr -f "KML" newcounties.kml counties.shp
```

- select from shape file and write to new shape file

```
ogr2ogr -sql "SELECT * FROM uninhabited  
WHERE AREA > 5000000000" biguninhabited.shp  
uninhabited.shp
```

# gdalinfo, gdal\_translate (raster data)

- list raster file attributes

```
gdalinfo wa_shade_1km.tif
```

- convert format

```
gdal_translate -of "png" wa_shade_1km.tif  
wa_shade_1km.png
```



# gdalwarp (raster data)

- reproject to geographic 4326

```
gdalwarp -t_srs "epsg:4326" wa_shade_1km.tif  
wa_shade_1km_4326.tiff
```

# gdaldem

Tools to analyze and visualize DEMs. (GDAL 1.7.0)

- shaded relief map

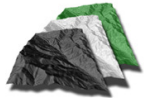
```
gdaldem hillshade input_dem output_hillshade
```

- slope map

```
gdaldem slope input_dem output_slope_map
```

- aspect map

```
gdaldem aspect input_dem output_aspect_map
```



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# Overlay - Difference

**Geoprocessing tools...**

- Geoprocessing tools
  - Analysis
    - Proximity
      - Buffer zones
      - Spatial join
    - Overlay
      - Clip
      - Difference**
      - Intersection
      - Union
    - Computational geometry
      - Convex hull
      - Voronoi/Delaunay
    - Aggregation
      - Dissolve
    - Data conversion
      - Merge
      - XY shift (2D)
      - Reproject

**PluginServices.Procesando**

**Difference tool...**

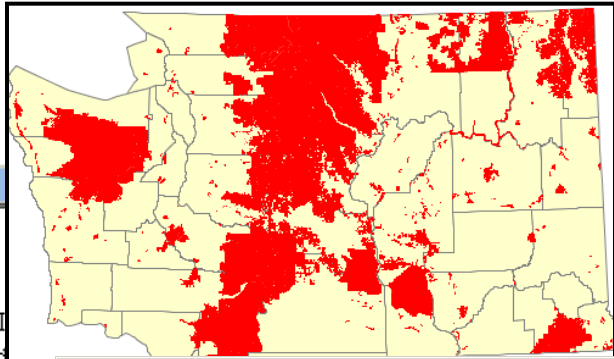
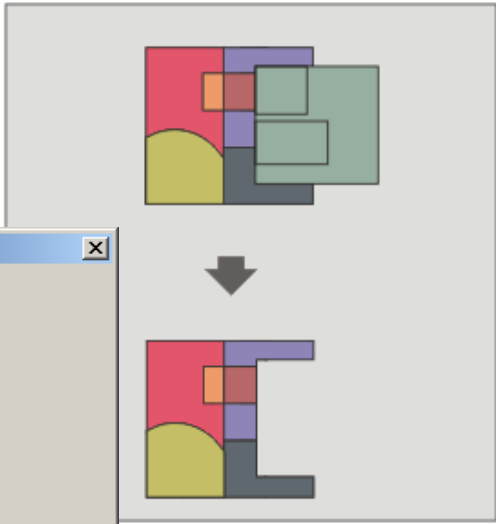
Computing differences... 2 of 39

cancelar

**Difference**

This tool performs a geometric *overlay* operation. It takes an input layer **A** and an overlay layer **B**. The procedure is also called *difference* because the resulting layer includes all geometries of **A** that are *not* present in **B**.

Owing to its geometric nature, this operation only works with vector layers. The output layer will have a copy of the attribute table of the input layer.



**Analysis tools**

Data input for difference:

Input layer: counties2008.shp

Use selected features only

Number of selected features: 39

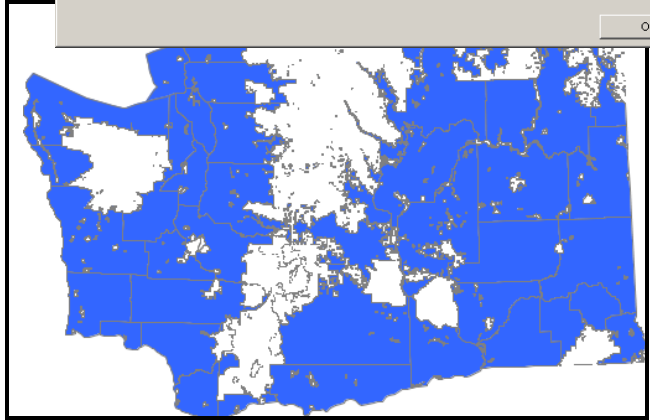
Overlay layer: counties2008.shp

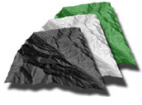
Use selected features only

Number of selected features: 39

Output layer:  Choose...

Ok Cancel





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## ■ functionality examples

- reprojection
- batch processing
- dissolve
- format conversion
- editing

# Importing data into PostGIS

## shp2pgsql + pgsql2shp

```
shp2pgsql -l -s 2285 counties2008.shp counties_pg > counties.sql
psql -U postgres -d weave -f counties.sql
```

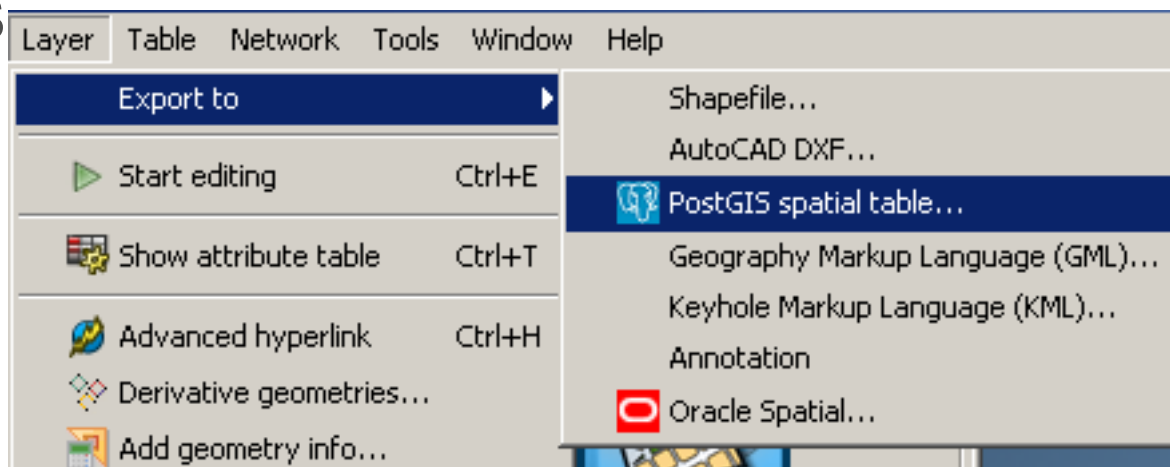
Can combine both with “|”

## ogr2ogr

```
ogr2ogr -f "PostgreSQL" PG:"host=localhost user=postgres port=5432
dbname=workshop password=postgres" streamnet_fishdist.mdb -lco
GEOMETRY_NAME=the_geom -t_srs "EPSG:2285" -nln
"Fish_AllSpeciesCombined" fishspecies
```

## user interfaces

### gvSIG etc.





# Interacting with PostGIS

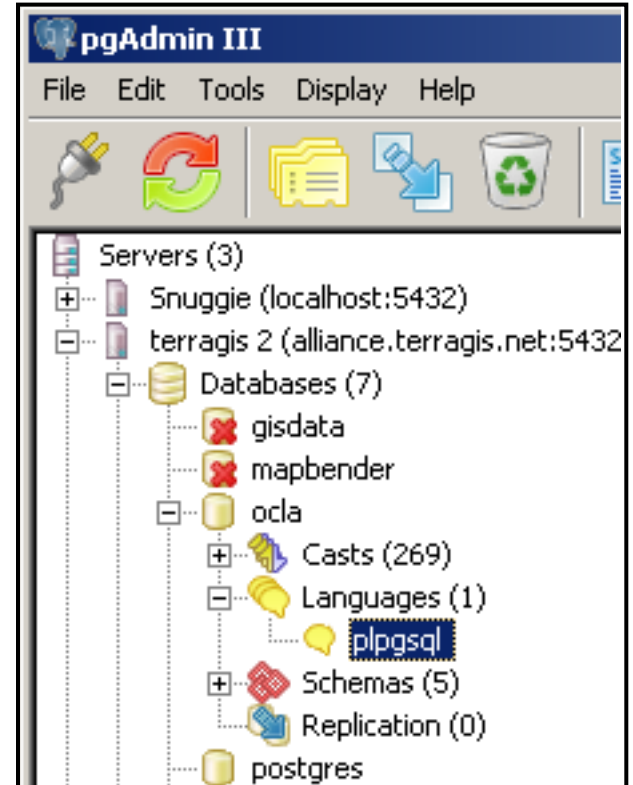
- Command line pgsqll
 

```
psql -U postgres -d workshop
```

```
weave=# select name, gid, area from counties_pg where
name ilike 'king';
 name | gid |      area
-----+-----+-----
  King |  18 | 64346858869.577
(1 row)
```

- Graphical user interfaces (gui)

- pgAdmin
- Squirrel SQL Client
  - <http://squirrel-sql.sourceforge.net/>



# PostGIS Functions

## ■ Spatial SQL

Functions (780)

- `_st_asgeojson(integer, geography, integer, integer)`
- `_st_asgeojson(integer, geometry, integer, integer)`
- `_st_asgml(integer, geography, integer, integer)`
- `_st_asgml(integer, geometry, integer, integer)`
- `_st_askml(integer, geography, integer)`
- `_st_askml(integer, geometry, integer)`
- `_st_bestsridd(geometry, geography)`
- `_st_bestsridd(geometry)`
- `_st_buffer(geometry, double precision,cstring)`
- `_st_contains(geometry, geometry)`
- `_st_containsproperly(geometry, geometry)`
- `_st_coveredby(geometry, geometry)`
- `_st_covers(geography, geography)`
- `_st_covers(geometry, geometry)`
- `_st_crosses(geometry, geometry)`
- `_st_dfullywithin(geometry, geometry, double precision)`
- `_st_distance(geography, geography, double precision, boolean)`
- `_st_dumppoints(geometry, integer[])`
- `_st_dwithin(geometry, geometry, double precision)`
- `_st_dwithin(geography, geography, double precision, boolean)`
- `_st_equals(geometry, geometry)`
- `_st_expand(geography, double precision)`
- `_st_intersects(geometry, geometry)`
- `_st_linecrossingdirection(geometry, geometry)`
- `_st_longestline(geometry, geometry)`
- `_st_maxdistance(geometry, geometry)`

# Simple spatial operations

## Output format

```
select askml(the_geom) from counties2008 where name ilike 'king';
```

## Human readable geometry

```
select astext(the_geom) from counties where name ilike 'King';
```

## Distance

```
select distance(setsrid((MakePoint(1622794, 150532)),2285),  
setsrid((MakePoint(1622845, 150937)),2285));
```

## Transform

```
Select transform((setsrid(MakePoint(1622794,  
150532),2285)),4326);
```

## More spatial operations

### Buffer

```
Select st_buffer(ST_Simplify(the_geom, 700), 9000)
from wa_counties where name ilike 'King';
```

### Intersect

```
select name from counties where counties.the_geom &&
(setsrid((MakePoint(1622794, 150532)),2285))
and intersects
(counties.the_geom,setsrid((MakePoint(1622794,
150532)),2285));
```

# Aggregate functions - Union of polygons

Union all counties of the county polygon data set "us\_counties " to create one polygon encompassing the area of the entire US.

```
select st_union(the_geom)
into us_border
from us_counties
```

This operation unions all individual datasets and groups them by states.

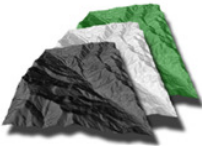
```
select st_union (the_geom), state_name
into us_states
from us_counties
group by state_name;
```

# **Part III**

## **Real world tasks using OS tools**

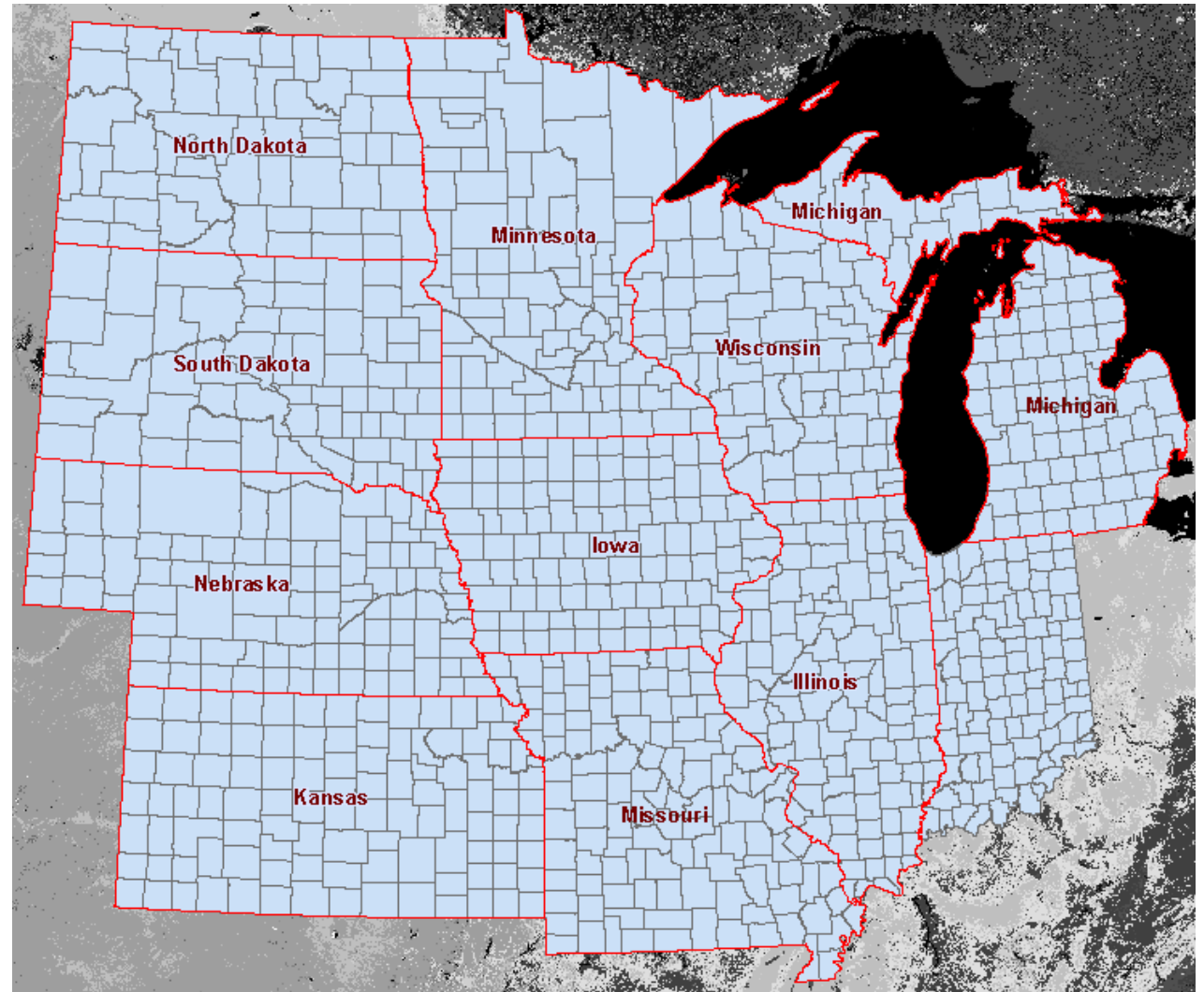
# Using OS tools for your everyday Spatial Analysis and Geoprocessing Tasks

We are using a real project to illustrate usage of our OS GIS tools



Our task: determine land cover classes coverage for each State and break down by County.

For each of the 962 Counties in the 12 State region report area in  $m^2$





# Using NASA MODIS 500m Imagery

Land Cover Type Yearly L3  
Global 500m MCD12Q1

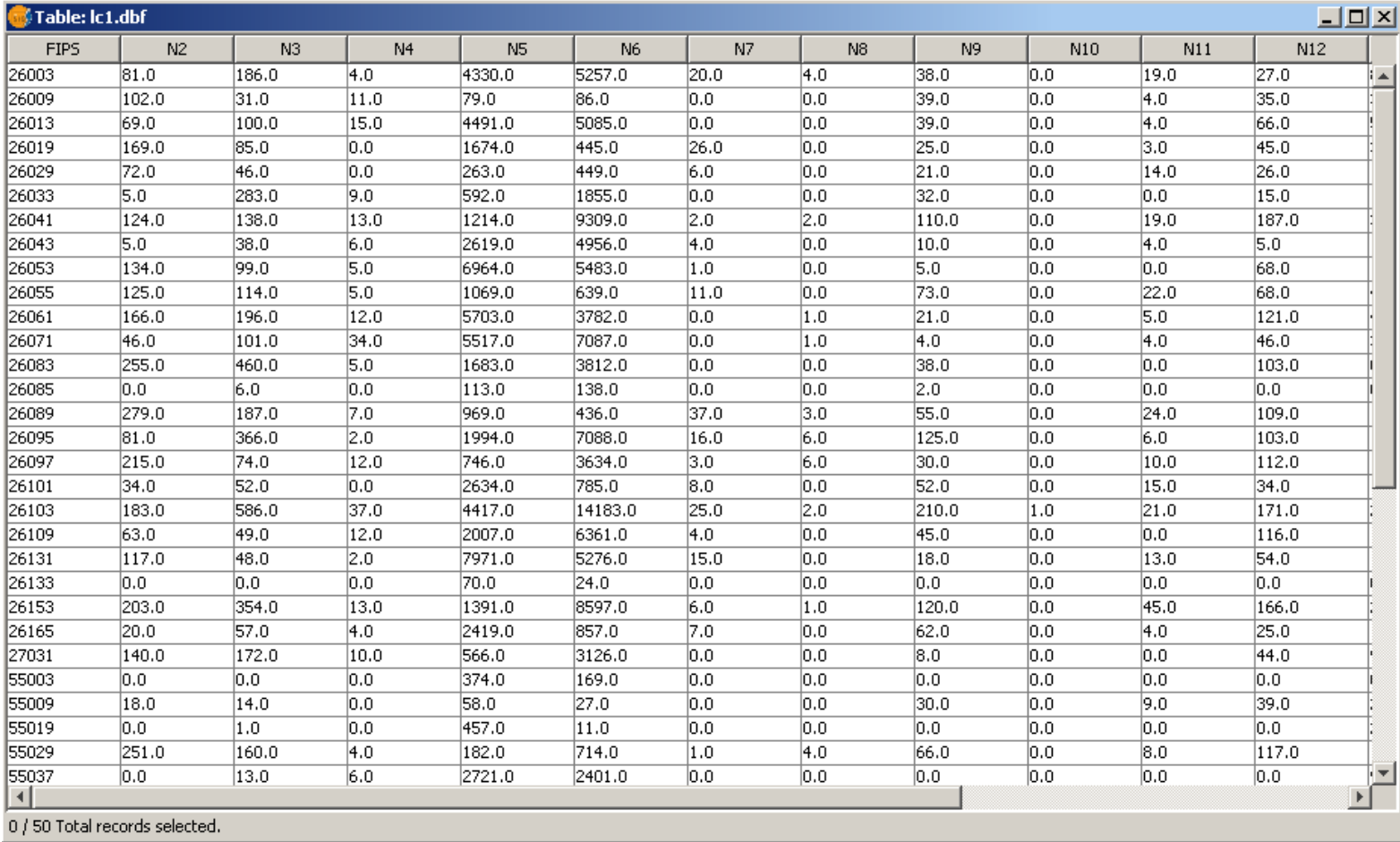
<ftp://e4ftl01u.ecs.nasa.gov/MOTA/MCD12Q1.005/>

+

Counties Layer

class	value
water	0
evergreen needleleaf forest	1
evergreen broadleaf forest	2
deciduous needleleaf forest	3
deciduous broadleaf forest	4
mixed forests	5
closed shrubland	6
open shrublands	7
woody savannas	8
savannas	9
grasslands	10
permanent wetlands	11
croplands	12
urban and built-up	13
cropland/natural vegetation mosaic	14
snow and ice	15
barren or sparsely vegetated	16
unclassified	254

Result would be a table like this  
(Counties shown with FIPS code ids)



The screenshot shows a window titled "Table: lc1.dbf" containing a table with 12 columns and 50 rows. The columns are labeled FIPS, N2, N3, N4, N5, N6, N7, N8, N9, N10, N11, and N12. The data consists of numerical values for each county's FIPS code and its corresponding values in columns N2 through N12. The status bar at the bottom indicates "0 / 50 Total records selected."

FIPS	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12
26003	81.0	186.0	4.0	4330.0	5257.0	20.0	4.0	38.0	0.0	19.0	27.0
26009	102.0	31.0	11.0	79.0	86.0	0.0	0.0	39.0	0.0	4.0	35.0
26013	69.0	100.0	15.0	4491.0	5085.0	0.0	0.0	39.0	0.0	4.0	66.0
26019	169.0	85.0	0.0	1674.0	445.0	26.0	0.0	25.0	0.0	3.0	45.0
26029	72.0	46.0	0.0	263.0	449.0	6.0	0.0	21.0	0.0	14.0	26.0
26033	5.0	283.0	9.0	592.0	1855.0	0.0	0.0	32.0	0.0	0.0	15.0
26041	124.0	138.0	13.0	1214.0	9309.0	2.0	2.0	110.0	0.0	19.0	187.0
26043	5.0	38.0	6.0	2619.0	4956.0	4.0	0.0	10.0	0.0	4.0	5.0
26053	134.0	99.0	5.0	6964.0	5483.0	1.0	0.0	5.0	0.0	0.0	68.0
26055	125.0	114.0	5.0	1069.0	639.0	11.0	0.0	73.0	0.0	22.0	68.0
26061	166.0	196.0	12.0	5703.0	3782.0	0.0	1.0	21.0	0.0	5.0	121.0
26071	46.0	101.0	34.0	5517.0	7087.0	0.0	1.0	4.0	0.0	4.0	46.0
26083	255.0	460.0	5.0	1683.0	3812.0	0.0	0.0	38.0	0.0	0.0	103.0
26085	0.0	6.0	0.0	113.0	138.0	0.0	0.0	2.0	0.0	0.0	0.0
26089	279.0	187.0	7.0	969.0	436.0	37.0	3.0	55.0	0.0	24.0	109.0
26095	81.0	366.0	2.0	1994.0	7088.0	16.0	6.0	125.0	0.0	6.0	103.0
26097	215.0	74.0	12.0	746.0	3634.0	3.0	6.0	30.0	0.0	10.0	112.0
26101	34.0	52.0	0.0	2634.0	785.0	8.0	0.0	52.0	0.0	15.0	34.0
26103	183.0	586.0	37.0	4417.0	14183.0	25.0	2.0	210.0	1.0	21.0	171.0
26109	63.0	49.0	12.0	2007.0	6361.0	4.0	0.0	45.0	0.0	0.0	116.0
26131	117.0	48.0	2.0	7971.0	5276.0	15.0	0.0	18.0	0.0	13.0	54.0
26133	0.0	0.0	0.0	70.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0
26153	203.0	354.0	13.0	1391.0	8597.0	6.0	1.0	120.0	0.0	45.0	166.0
26165	20.0	57.0	4.0	2419.0	857.0	7.0	0.0	62.0	0.0	4.0	25.0
27031	140.0	172.0	10.0	566.0	3126.0	0.0	0.0	8.0	0.0	0.0	44.0
55003	0.0	0.0	0.0	374.0	169.0	0.0	0.0	0.0	0.0	0.0	0.0
55009	18.0	14.0	0.0	58.0	27.0	0.0	0.0	30.0	0.0	9.0	39.0
55019	0.0	1.0	0.0	457.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0
55029	251.0	160.0	4.0	182.0	714.0	1.0	4.0	66.0	0.0	8.0	117.0
55037	0.0	13.0	6.0	2721.0	2401.0	0.0	0.0	0.0	0.0	0.0	0.0

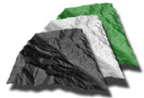


## Workflow

- project raster and vector data into Albers equal area projection
- translate MODIS Raster data transform from .hdf (Hierarchical Data Format) to geotif
- mosaic tiles into one image

## More data preparation

- Create Project Area County layer 
  - add County layer to gvSIG
  - select Counties in the 12 States
  - and export as shape
  
- Create detailed State Boundaries from Counties layer (to be able to easily calculate area by State)
  - select Counties in 11 States region
  - and export as shape file
  
- Import into PostGIS 
  - union (dissolve) County geometries by State

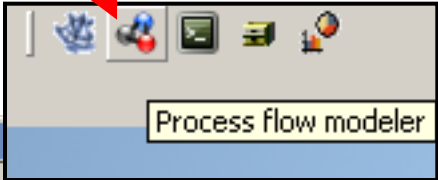


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Real world tasks using OS tools

# Sextante Modeler



Modeler

Procedures

- Tools
  - Buffers
  - Cost, distances and routes
  - Fire modeling
  - Focal statistics for neighborhoods
  - Fuzzy logic
  - Geomorphometry and terrain analysis
  - Geostatistical simulations
  - Geostatistics
  - Hydrological analysis tools
  - Hydrological indices and parameters
  - Image processing
  - Local statistics
  - Location/allocation
- Models
  - calculate landcover type
  - tab area1
  - test1
- Pattern analysis
- Profiles
- Raster algebra
- Raster categories analysis
- Raster creation tools

Inputs Procedures

Help Add

Name: tab area1 Group: Models

landcover

counties

Rasterize vector layer

Tabulate Area

Run New Save Open

```
graph TD; landcover --> TabulateArea; counties --> RasterizeVectorLayer[Rasterize vector layer]; RasterizeVectorLayer --> TabulateArea;
```

# Sextante Modeler

## Create Model



- Input layer 1: counties in project area
- Input layer 2: land cover raster image (layer 3)
  
- Process step 1: rasterize County layer
- Process step 2: tabulate area operation:
  - input rasterized County layer (3) -> regions
  - land cover raster -> values
  - limit to view extent (not to start a lengthy analysis)
  - check tabulated result table
  - export to MS Excel (or open office)
  - process in MS Excel (transpose)
  - join to Counties layer ...



FOSS4G  
Annual International Gathering



FOSS4G 2010  
*Barcelona*

**September 6-9 ,2010**

**<http://2010.foss4g.org>**

## ■ Conferences

Year	Location	Dates	URL
2010	Barcelona, Spain	September 6-9 ,2010	<a href="http://2010.foss4g.org">http://2010.foss4g.org</a>
2009	Sydney, Australia	October 20-23,2009	<a href="http://2009.foss4g.org">http://2009.foss4g.org</a>
2008	Cape Town, South Africa	Sep/Oct 2008	<a href="http://www.foss4g2008.org">www.foss4g2008.org</a>
2007	Victoria, Canada	September 2007	<a href="http://www.foss4g2007.org">http://www.foss4g2007.org</a>
2006	Lausanne, Switzerland	September 2006	<a href="http://www.foss4g2006.org">http://www.foss4g2006.org</a>

## ■ User Groups

CUGOS	Cascadia Users of Geospatial Open Source	Seattle	<a href="http://cugos.org">http://cugos.org</a>
PDX OSGIS	Portland Area	Portland	<a href="http://groups.google.com/group/pdx-osgis">http://groups.google.com/group/pdx-osgis</a>
BAUGOS	Bay Area Users of Geospatial Open Source	San Francisco	<a href="http://groups.google.com/group/baugos">http://groups.google.com/group/baugos</a>
FRUGOS	Front Range Users of Geospatial Open Source	Colorado	<a href="http://groups.google.com/group/frugos">http://groups.google.com/group/frugos</a>



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**TERRA GIS**  
TERRESTRIAL ENVIRONMENT REGIONAL ANALYSIS

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