GRASS GIS 7 workshop

Introduction to vector data in G7

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OSGeo Ireland – 1st National Symposium 2017

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Session Objectives

- Why a topological vector data model

- Topological vector data model in GRASS GIS 7

- Vector feature extraction

- Vector geometry dissolving

- Geometry editing/digitizing

- Import/export

- Capabilities of GRASS GIS' vector engine

What is vector topology?

Non-topological vector formats:

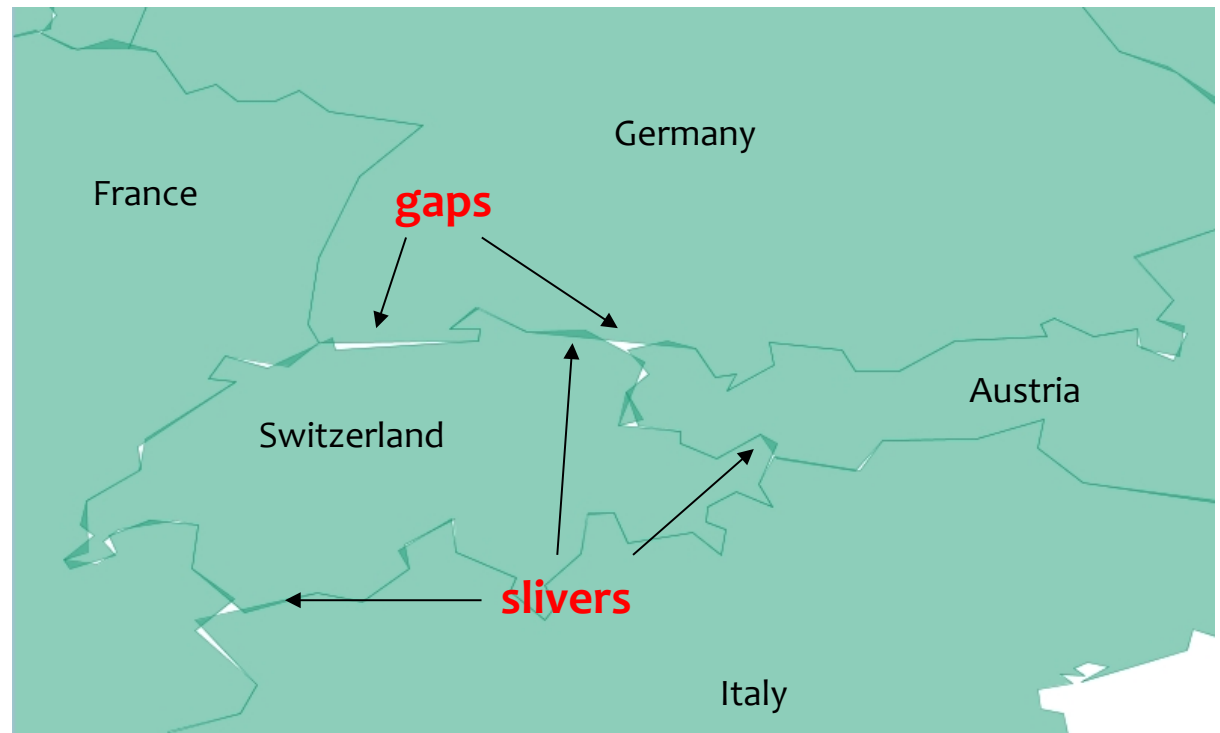E.g. OGC Simple Features, ESRI shapefiles

Geometry types: points, lines, polygons

→ Problem: replicated boundaries for adjacent areas

Faster computations, but extra work for maintenance

Non-topological
polygon map
being generalized

(all polygons are
treated independently,
leading to potential
errors)

France

Germany

gaps

Switzerland

Austria

slivers

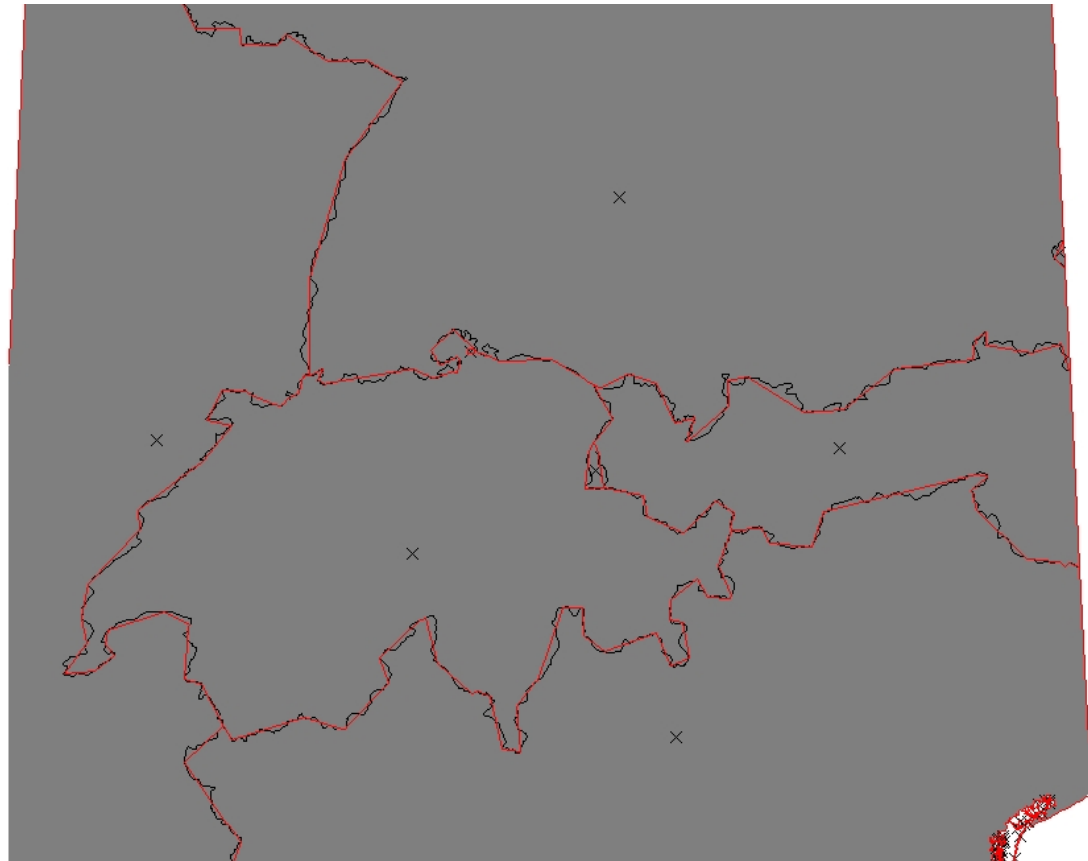Italy

What is vector topology?

True topological vector format:

- Areas are constructed from boundaries

- Boundaries are shared between adjacent areas

Slower computations, but less (nearly no manual) maintenance

Topological
polygon map
being generalized

(no errors possible
since common lines
are shared)

GRASS GIS 7 Vector features

Native vector format

- Vector topology

- m:n mapping of geometry features to attributes

- Support of vector layers

- OGC Simple Features ←→ Topological Vector Conversion

- Database Management system (DBMS) with SQL support

- SQLite (default DB backend), PostgreSQL + PostGIS, MySQL, ODBC (, DBF)

http://grasswiki.osgeo.org/wiki/Vector_Database_Management

GRASS GIS Vector model
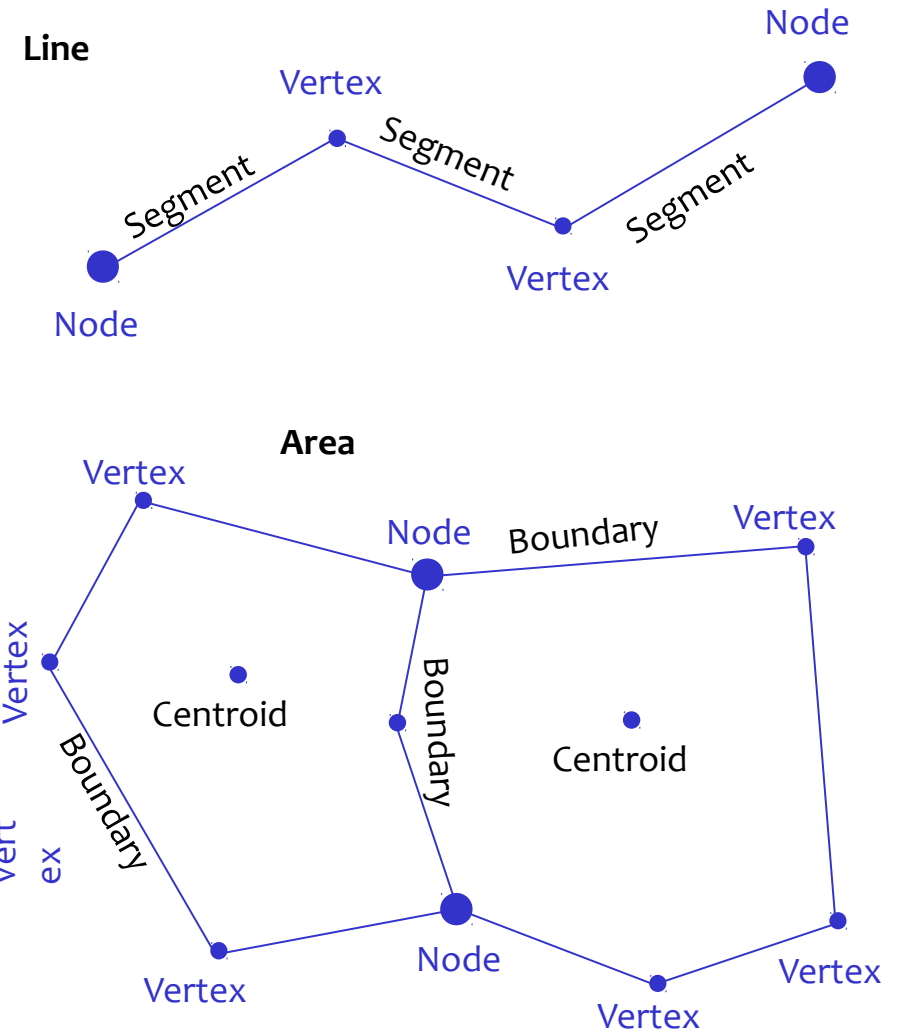
Vector geometry types

Point

Centroid

Line
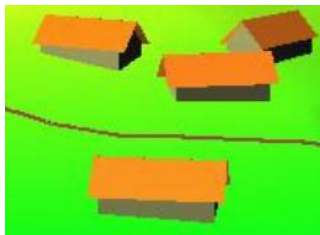
Boundary

Area (Boundaries + Centroid)

Face (3D Area)

[Kernel (3D Centroid)]

[Volumes (Faces + Kernel)]

All types are **true 3D**: x,y,z

Line

Node
Vertex
Segment
Segment
Segment
Vertex
Node

Area

Vertex
Node
Boundary
Vertex
Vertex
Boundary
Centroid
Boundary
Centroid
Vertex
Boundary
Vertex
Node
Vertex
Vertex

Types 1: Basic vector geometry types

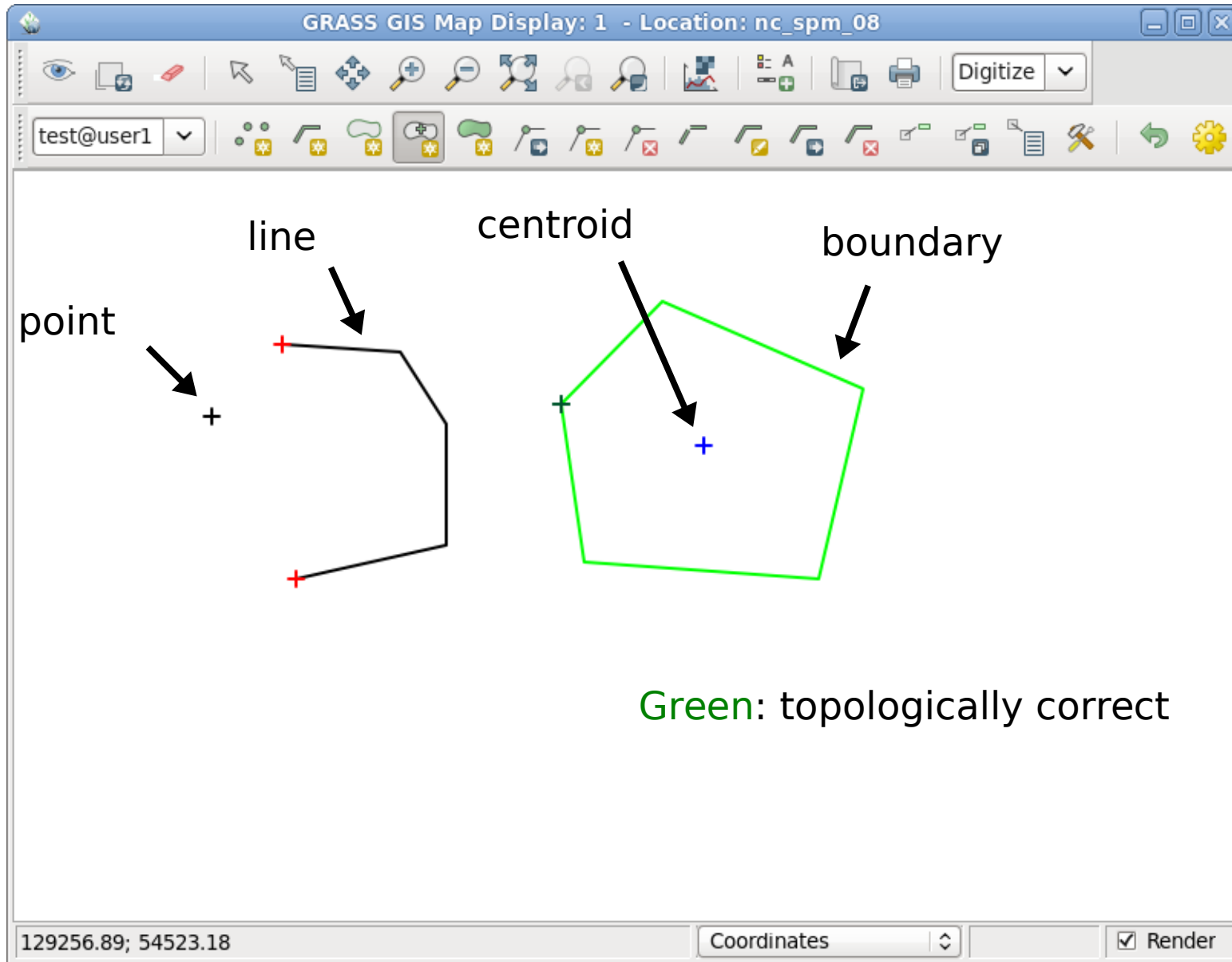**Basic** geometry types, they can be edited **directly**:

- Point
- Centroid
- Line
- Boundary

A GRASS vector map can contain a combination of several different types

GRASS GIS Vector model (1): Basic geometry types
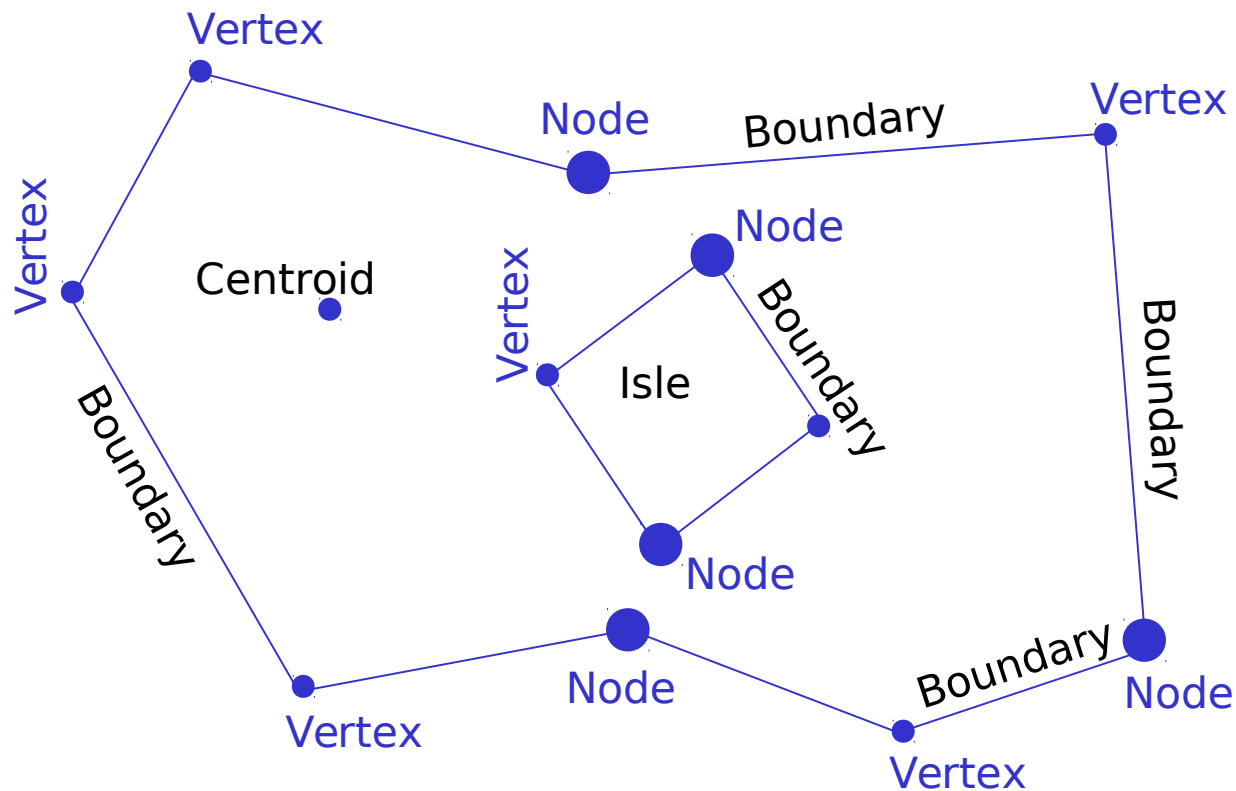
Types 1: Basic vector geometry types

Types 2: Derived vector geometry types

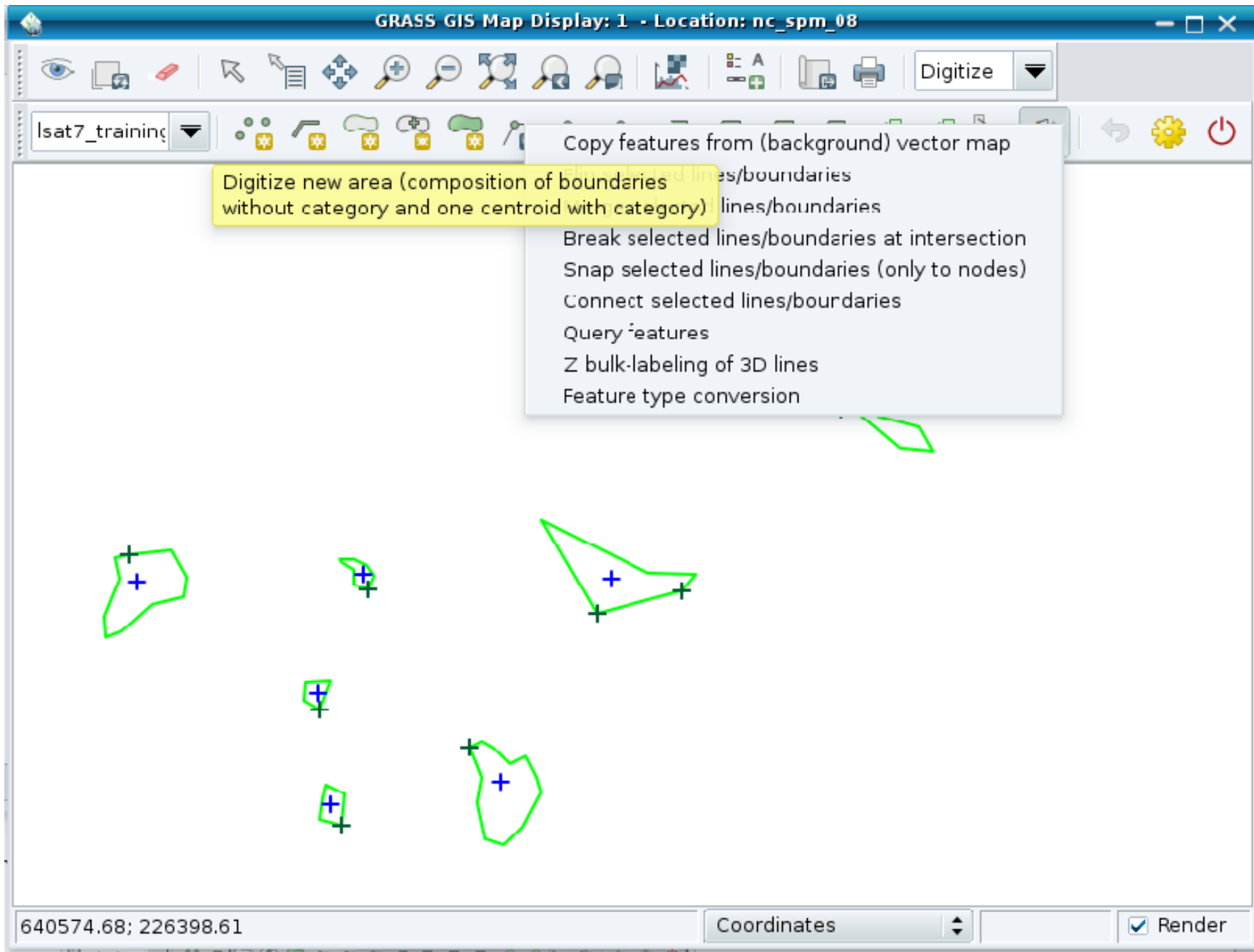**Derived** geometry types, constructed from basic types

- **Area** (closed ring of boundaries + centroid)
- **Isle** (closed ring of boundaries, no centroid)
- **Node** (at both ends of lines/boundaries)

Isles and Nodes are not visible to the user

GRASS GIS topological vector digitizer

Exercise: Vector feature extraction

Extract by attributes

GRASS GIS module:

`v.extract`

Input: boundary_county

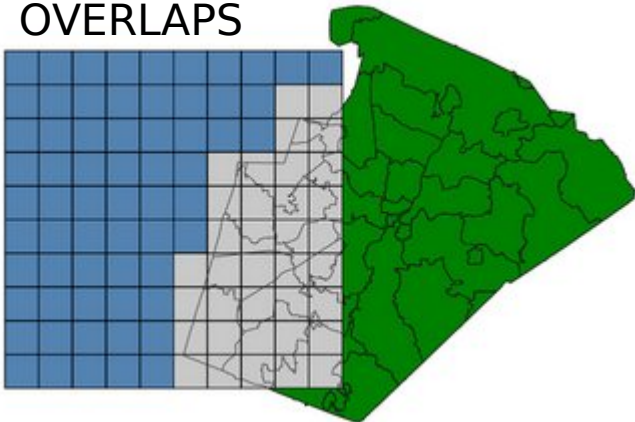Output: boundary_wake

Command:

```
v.extract input=boundary_county \
        output=boundary_wake \
        where="NAME = 'WAKE'"
```
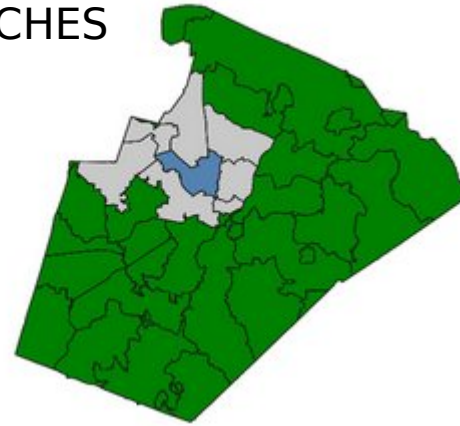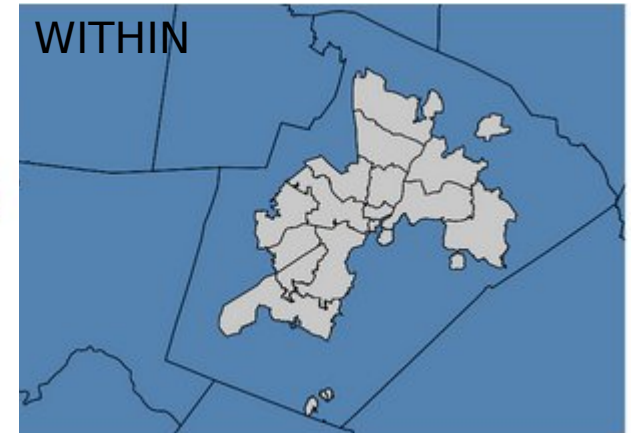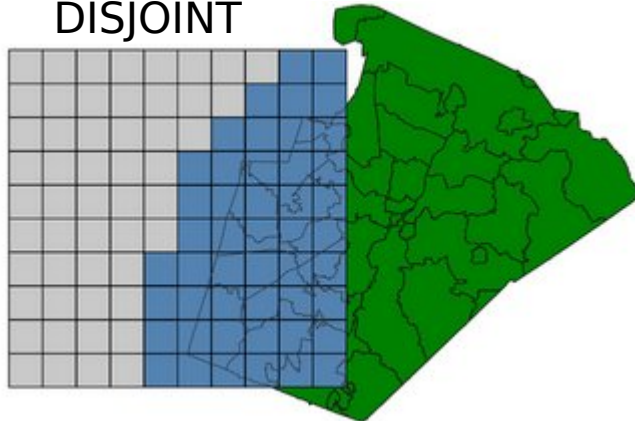
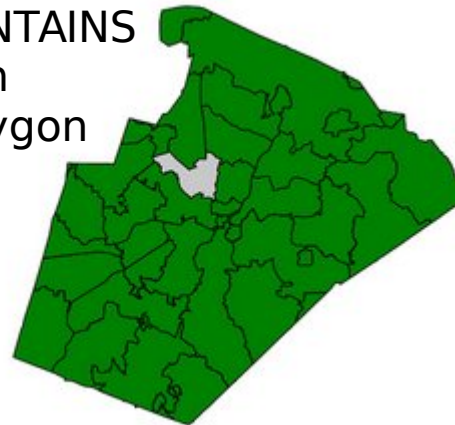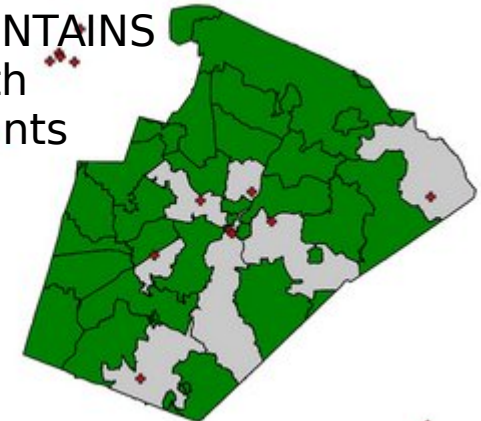# Vector feature select operations: v.select (GEOS)
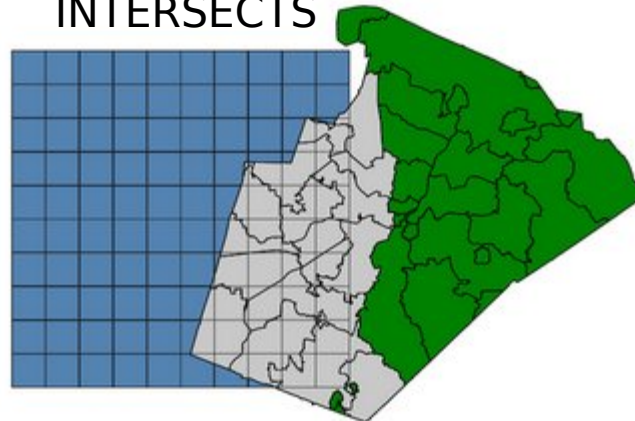
OVERLAPS
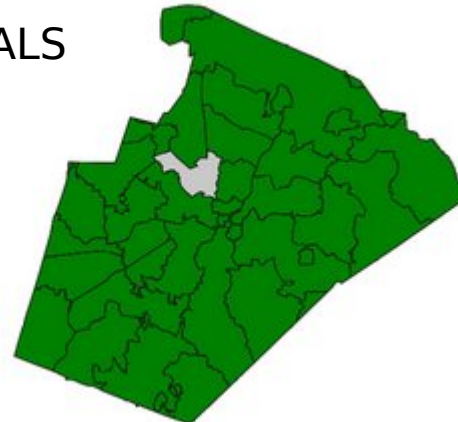
TOUCHES

WITHIN

DISJOINT

CONTAINS
with
polygon

CONTAINS
with
points
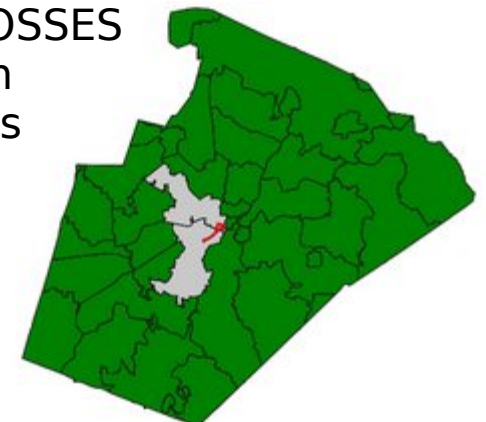
INTERSECTS

EQUALS

CROSSES
with
lines

Exercise: Vector feature extraction

Extract with another vector (selecting full vector)

GRASS GIS module:

```
v.select
```

Input: boundary_wake, railroads

Output: railroads_wake

Command:

```
v.select ain=railroads bin=boundary_wake \
         out=railroads_wake \
         atype=line btype=area \
         operator=overlap
```

Extract with another vector (clipping vector)

GRASS GIS module:

```
v.overlay
```

Input: boundary_wake, railroads

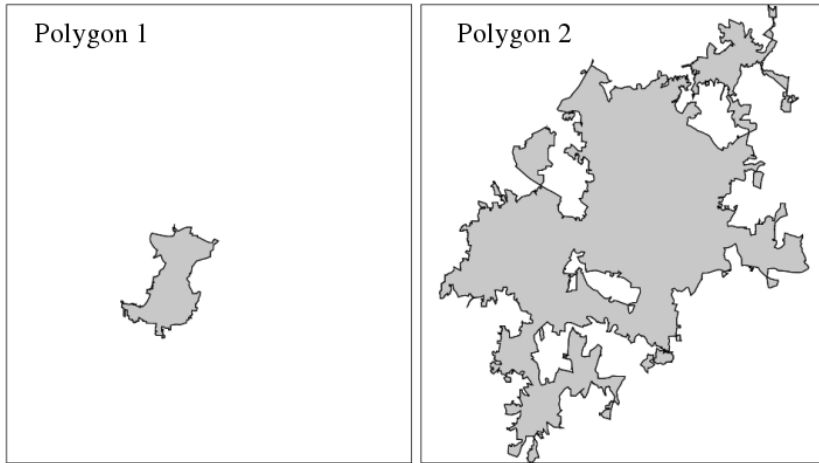Output: railroads_wake_clip

Command:

```
v.overlay ain=railroads bin=boundary_wake \
         out=railroads_wake_clip \
         atype=line btype=area \
         operator=and
```

try operator=not

Vector feature overlay operations

Polygon 1

Polygon 2

Boolean operators

GRASS GIS module:
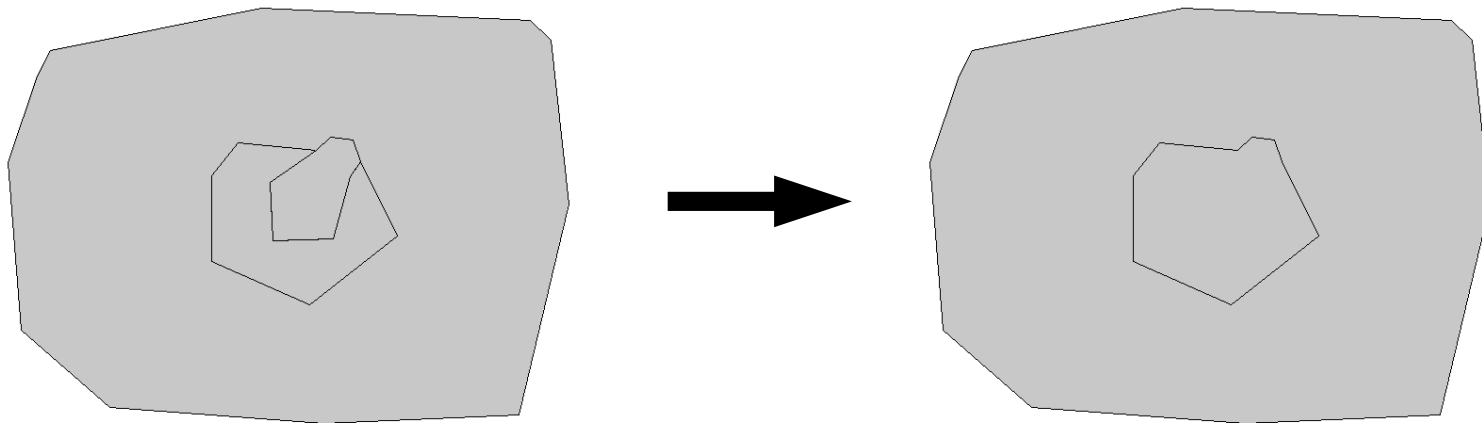
`v.overlay`

AND

OR

NOT

XOR
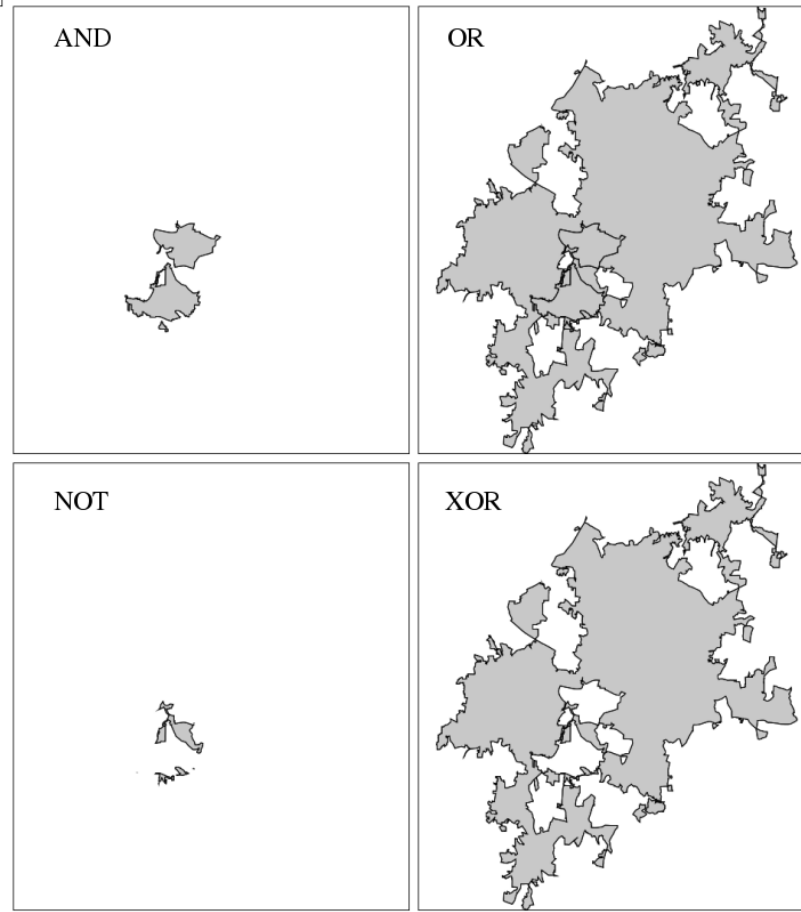
Dissolving vector boundaries

Combination of several areas into one area

based on common categories or attributes

Dissolving common boundaries between the two interior areas:

Exercise: Vector feature dissolving

Dissolving with categories

GRASS GIS module:

    `v.dissolve`
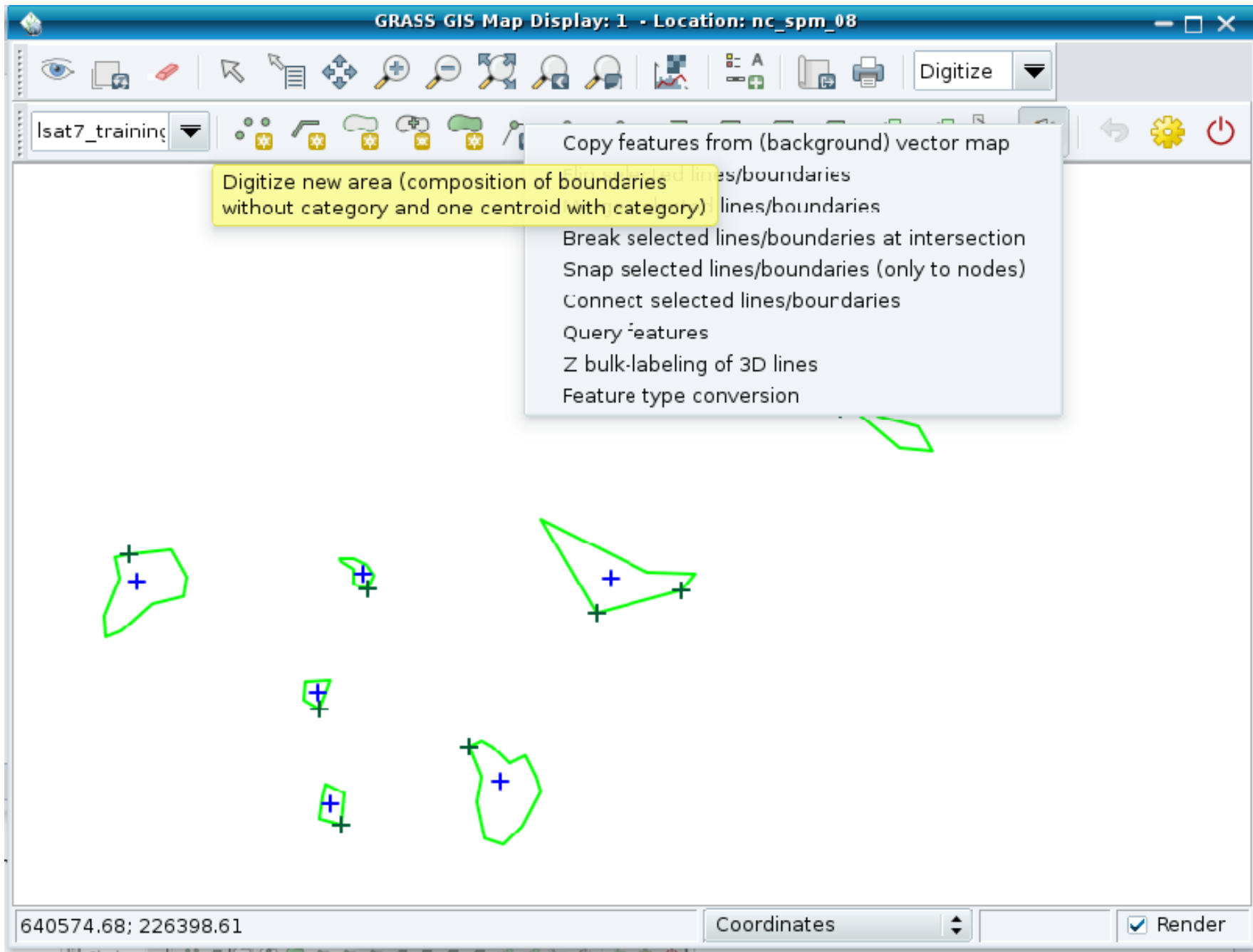
Input: boundary_county

Output: nc_boundary

Commands:

```
v.category in=boundary_county type=centroid \
         out=boundary_county_cat2 \
         layer=2 cat=1 step=0 option=add
v.db.addtable map=boundary_county_cat2 layer=2
v.dissolve in=boundary_county_cat2 out=nc_boundary \
         layer=2 column=cat
```

GRASS GIS topological vector digitizer

GRASS Vector data exchange

Import of vector maps

    v.in.ogr module
    v.import (it also offers reprojection on the fly)!

    Always the full map is imported.

Export of raster maps

    v.out.ogr module

    Always the full map is exported.

   OGR supported > 80 vector formats

GRASS Vector data exchange

**Creating a map from Spreadsheet file
(MS Excel file, OpenDocument ODS, CSV file):**

A new vector point map can be directly created from a selected sheet in a spreadsheet:

```
# the z coordinate is optional
v.in.db table=List1 x=long y=lat z=height \
        output=meteodata \
        driver=ogr datatabase=meteodata.xls
```

Note that in this example the key option is omitted (so the key column is then automatically added)

Vector capabilities
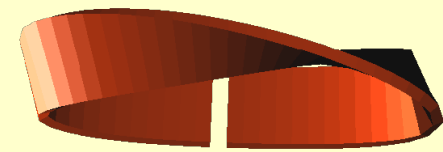
Example vector module groups

Topological geometry feature digitizing/editing

LiDAR analysis:

http://grasswiki.osgeo.org/wiki/LIDAR

Linear referencing (LRS) – v.lrs.*:

http://grasswiki.osgeo.org/wiki/Linear_Reference_System

Network analysis – v.net.*:

http://grasswiki.osgeo.org/wiki/Vector_network_analysis