Introduction to GDAL

This workshop is hosted by RCC GIS

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What is GDAL?

GDAL/OGR : Started in 1998 by Frank Warmerdam

Tools for reading, writing, and processing

GDAL - Geospatial Data Abstraction Library

Raster

OGR - OpenGIS Simple Features Reference

Vector

What is GDAL?

Presents an “abstract data model” for processing spatial data

Can be used directly from C/C++ and can be “wrapped” for use with Python, Perl, VB, C#, R, Java …

Early developers have chosen Python as their scripting language and documentation is relatively good for this.

A Workhorse for a lot of GIS's!

Many Commercial venders are using GDAL

Software Using GDAL

- 3D DEM Viewer from MS MacroSystem
- Bluemapia: Multi-Map(Google,Microsoft,Open Street Map, NOAA/BSB Charts,self-calibrated raster) location-based GPS app for Windows Mobile
- Cadcorp SIS: A Windows GIS with a GDAL and OGR plugins.
- Cartographica: Macintosh GIS package
- CatchmentSIM: A Windows terrain analysis model for hydrologic applications.
- Daylon Leveller: A terrain/heightfield/bumpmap modeler
- Demeter: Another OpenGL based terrain engine somewhat similar to VTP.
- Eonfusion: Analysis and visualization of time-varying spatial datasets integrated via true data fusion.
- ERDAS ER Viewer: Image viewer for very large JPEG 2000 and ECW files. Can also read most other common file types
- ESRI ArcGIS 9.2+: A popular GIS platform.
- Eternix Blaze: Advanced geo-spatial visualization application and SDK
- FalconView: Windows based GIS platform with roots in military mission planning, now available as a free GIS visualization and analysis package.
- Feature Data Objects (FDO): Open source spatial data access libraries.
- flighttrack: GPS track viewing and downloading software for Mac.
- FME: A GIS translator package includes a GDAL plugin.
- Fortified GIS VantagePoint(TM): GIS desktop viewer and analysis tool
- GdalToTiles: C# Program (open source) for make image tiles for Google Earth with KML Superoverlay.
- GenGIS: Software for geospatial analysis of genetic data.
- Geographic Imager: DEM / aerial / satellite image processing GIS plug-in for Adobe Photoshop, by Avenza Systems
- GeoDjango: A framework for building geographic web applications.
- GeoMatrix Toolkit, and GeoPlayerPro from GeoFusion: 3D visualization.
- GeoServer: a open source software server written in Java that allows users to share and edit geospatial data
- Geoweb3d: A 3D virtual globe that provides on-the-fly, game-quality visualization of GIS data.
- GMT (Generic Mapping Tools): an open source collection of tools for processing and displaying xy and xyz datasets
- Google Earth: A 3D world viewer.
- **GRASS GIS**: A raster/vector open source GIS uses GDAL for raster/vector import and export (via r.in.gdal/r.out.gdal and v.in.ogr/v.out.ogr).
- gstat: a geostatistical modelling package.
- gvSIG: Desktop GIS Client.
- **IDRISI**: A GIS and Image Processing Windows Desktop application. Uses GDAL for import/export/warp raster data.
- ILWIS: Remote Sensing and GIS Desktop Package.
- Image I/O-Ext: includes gdalframework, a framework leveraging on GDAL via SWIG's generated JAVA bindings to provide support for a reach set of data formats.
- IONIC Red Spider: an OGC Web Services platform includes a GDAL plugin.
- IntraMap: A GIS Software for spatial data display/management, spatial inquiries, and many other various analyses.
- LandXplorer: A realtime 3D visualization system for 3D city and landscape models.
- Leica TITAN: a geospatial data sharing and visualization environment.
- libLAS: Open Source LAS 1.0/1.1 ASPRS LiDAR data translation toolset
- libral: A raster algebra implementation and an experimental GUI+CLI GIS with Perl and GTK+.
- MapGuide: Open source web mapping server.
- Mapnik: C++/ Python mapping toolkit
- **MapServer**: A popular web mapping application with GDAL support.
- MapWindow: open source ActiveX control with GIS functionality.
- MicroImages TNT products: advanced software for geospatial analysis (Windows, LINUX, Mac OS X and UNIX)
- Mirone: Matlab based package for geospatial, oceanographic and geophysical analysis of grids
- MyGeodata Converter: Online converter of GDAL raster and OGR vector formats
- ogr2gui: a graphical user interface for ogr2ogr
- OPALS: Orientation and Processing of Airborne Laser Scanning Data
- OpenCPN: A concise ChartPlotter/Navigator?. A cross-platform ship-borne GUI application.
- **OpenEV**: An OpenGL/GTK/Python based graphical viewer which exclusively uses GDAL for raster access.
- OpenSceneGraph: 3D rendering engine with osgdem and osgEarth plugins
- Opticks: an open source remote sensing application and development framework, with a GDAL plugin.
- Orfeo Toolbox (OTB): a general remote sensing image processing library.
- OSSIM: Another geospatial viewing and analysis environment which uses GDAL as one of several plugins.
- the PYXIS innovation: An application for viewing performing analysis and modeling on user's geo-located data. *(not yet generally available)*
- **Quantum GIS (QGIS)**: A cross platform desktop GIS.
- QlandkarteGT/M: QLandkarte GT is the ultimate outdoor aficionado's tool for GPS maps in GeoTiff? format as well as Garmin's img vector map format.
- R: A free software environment for statistical computing and graphics, with bindings to GDAL via the rgdal package.
- SAGA GIS : a free geographic information system (GIS), with a special 'Application Programming Interface' (API) for geographic data processing
- ScanMagic: Win32 application for visualization, analysis and processing of remote sensing data (lite version for free).
- Scenomics: Software for building terrain databases uses GDAL for projection and data import/export.
- SkylineGlobe: The Skyline suite of interactive applications allows you to build, view, query and analyze customized, virtual 3D landscapes.
- SpaceEyes3D: 3D visualization software for cartographic data.
- Carmenta Engine (previously known as SpatialAce?): A GIS Rapid Application Development environment.
- StarSpan: raster/vector analysis.
- TacitView: An imagery visualization and exploitation package for military intelligence.
- TatukGIS: Desktop GIS mapping and data editing application.
- TerraGo Technologies: The GeoPDF file format is used to distribute and collaborate geospatial data and uses GDAL for data import/export.
- TerrainView: Interactive real-time 3D GIS Software.
- Thuban: A multi-platform interactive geographic data viewer.
- TravTime: .NET Application for visualizing, processing and analyzing GPS data for travel time, speed, and delay traffic studies.
- vGeo: Interactive data fusion and visual analysis tool.
- **Virtual Terrain Project**: fostering tools for easy construction of the real world in interactive, 3D digital form.
- WindNinja: wind model for fire behavior modeling.

A Workhorse for a lot of GIS's!

Used by many FOSS and proprietary software packages

http://trac.osgeo.org/gdal/wiki/SoftwareUsingGdal

QGIS	**ArcGIS**
GRASS GIS	**FME**
MapServer	**ISRISI**
MapGuide	**Google Earth Engine**
OSSIM	**ERDAS**
OpenEV	**gvSIG**

A Workhorse for a lot of GIS's!

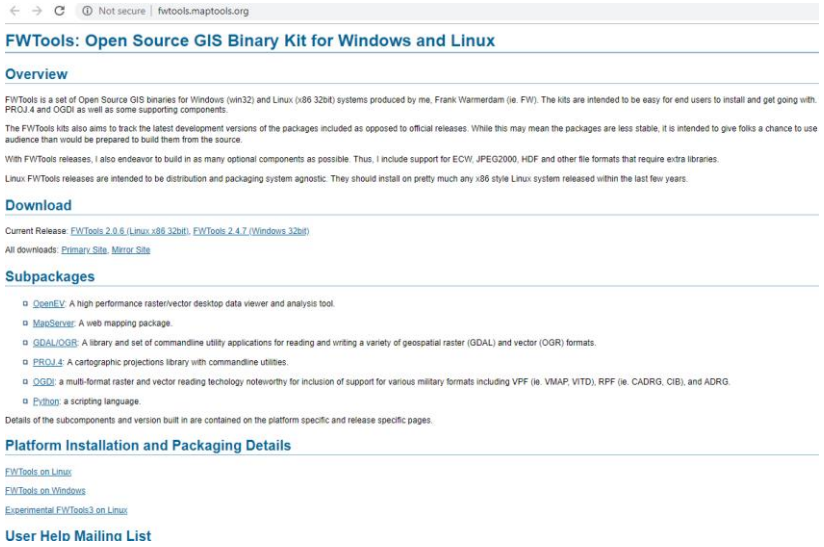
Also available as command line utilities via:

OsGeo

FWTools – Frank Warmerdam tools

OSGeo

OSGeo4W



OGR

Tools for manipulating vector data

Over 40 vector data formats supported

Commandline Utilities

ogrinfo - Lists information about an OGR supported data source

ogr2ogr - Converts simple features data between file formats

ogrtindex - Creates a tileindex

ogrlineref – provide linear reference

https://gdal.org/drivers/vector/index.html

OGR Vector Formats

Format Name	Code	Creation
Arc/Info .E00 (ASCII) Coverage	AVCE00	No
AutoCAD DXF	DXF	Yes
Comma Separated Value (.csv)	CSV	Yes
ESRI Personal GeoDatabase	PGeo	No
ESRI ArcSDE	SDE	No
ESRI Shapefile	ESRI Shapefile	Yes
GeoRSS	GeoRSS	Yes
GML	GML	Yes
GPX	GPX	Yes
GRASS	GRASS	No
KML	KML	Yes
Mapinfo File	MapInfo File	Yes
Microstation DGN	DGN	Yes
MySQL	MySQL	No
Oracle Spatial	OCI	Yes
EPIInfo .REC	REC	No
SDTS	SDTS	No
U.S. Census TIGER/Line	TIGER	No

GDAL

Tools for manipulating raster data

Over 100 raster data formats supported

https://gdal.org/drivers/raster/index.html

GDAL Raster Formats

Long Format Name	Code	Creation	Georeferencing
Arc/Info ASCII Grid	AAIGrid	Yes	Yes
Microsoft Windows Device Independent Bitmap (.bmp)	BMP	Yes	Yes
ERMapper Compressed Wavelets (.ecw)	ECW	Yes	Yes
Erdas Imagine Raw	EIR	No	Yes
ENVI .hdr Labelled Raster	ENVI	Yes	Yes
Graphics Interchange Format (.gif)	GIF	Yes	No
GRASS Rasters	GRASS	No	Yes
Erdas Imagine (.img)	HFA	Yes	Yes
JPEG JFIF (.jpg)	JPEG	Yes	Yes
JPEG2000 (.jp2, .j2k)	JPEG2000	Yes	Yes
JPEG2000 (.jp2, .j2k)	JP2MrSID	Yes	Yes
Portable Network Graphics (.png)	PNG	Yes	No
ArcSDE Raster	SDE	No	Yes
USGS ASCII DEM (.dem)	USGSDEM	Yes	Yes
GDAL Virtual (.vrt)	VRT	Yes	Yes
OGC Web Coverage Server	WCS	No	Yes
WKTRaster	WKTRaster	No	Yes
OGC Web Map Server	WMS	No	Yes

GDAL Command Line Utilities

gdalinfo - report information about a file.
gdal_translate - Copy a raster file, with control of output format.
gdaladdo - Add overviews to a file…pyramids
gdalwarp - Warp an image into a new coordinate system.
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 Command Line Utilities

gdal_merge.py - Build a quick mosaic from a set of images.
gdal_rasterize - Rasterize vectors into raster file.
gdaltransform - Transform coordinates.
nearblack - Convert nearly black/white borders to exact value.
gdal_grid - Create raster from the scattered data.
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.

GDAL / OGR Utilities

Often used programmatically

Batch geoprocessing scripts

Background processing for web mapping apps

Incorporated into scripts for larger workflows

Installation

https://gdal.org/download.html

Windows:	Using network installer at OSGeo4W or using conda install -c conda-forge gdal
Mac:	http://www.kyngchaos.com/software/frameworks/ echo 'export PATH=/Library/Frameworks/GDAL.framework/Programs:$PATH' >> ~/.bash_profile source ~/.bash_profile
Ubuntu:	sudo apt-get install gdal-bin

Basic Vector Commands

cd IND

ogrinfo gadm36_IND_3.shp

Example using an attribute query is used to restrict the output of the features in a layer:

ogrinfo -ro -where 'NAME_2=Delhi’ gadm36_IND_3.shp

Projecting from GCS_WGS_1984 to EPSG:32644 (UTM 44N)

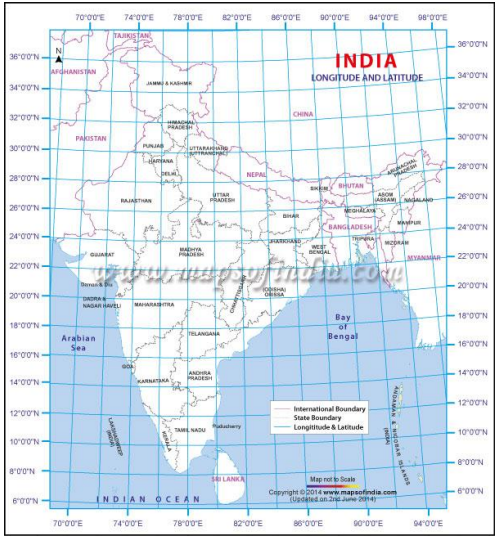
ogr2ogr -t_srs EPSG:32644 IND_prj.shp gadm36_IND_3.shp

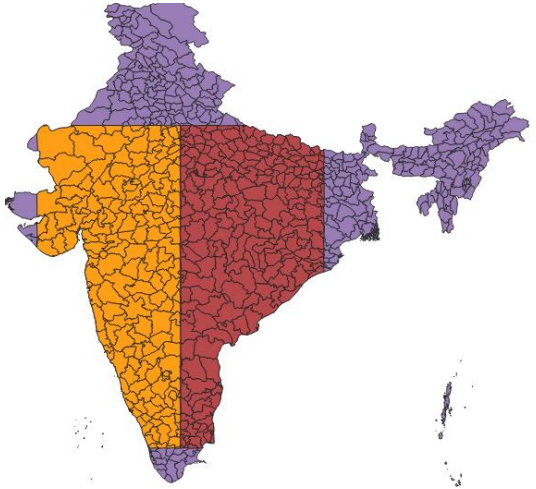
Basic Vector Commands

Example clip vector

ogr2ogr -clipdst 70 10 78 28 IND_clip1.shp gadm36_IND_3.shp
ogr2ogr -clipdst 78 10 86 28 IND_clip2.shp gadm36_IND_3.shp

Inside python use ogrmerge to merge several vector datasets into a single one





Basic Raster Commands

cd data/Lights

gdalinfo lights.tif
gdalinfo mosaic_prj.tif

Merging raster: cd /data/dem
gdal_merge –o mymerge.tif t27elu.dem t28elu.dem –ps 20 20

Basic Raster Commands

Create contour lines

gdal_contour mymerge.tif mycontours.shp –i 20

Hillshade

gdaldem hillshade mymerge.tif hillshade_30.tif –alt 45

Slope

gdaldem slope mymerge.tif slope.tif

Basic Raster Commands

raster calculator

gdal_calc --calc="A*(A>8)" -A slope.tif --outfile=slopebin.tif

gdal_calc --calc="A*B" -A slopebin.tif –B mymerge.tif --outfile=highelev.tif

Using GDAL on Midway

module av gdal

module load gdal

GDAL:
www.gdal.org and http://trac.osgeo.org/gdal/
Listserve: gdal-dev@lists.maptools.org