GDAL
Present and Future

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Overview

- Introduction to GDAL/OGR
- GDAL Data Model
- Focus on Subdatasets
- HDF4
- HDF5
- NetCDF
- Discussion
Who am I?

  - GeoGateway, EASI+, ImageWorks
- Founder of GDAL/OGR project
- Consultant (1998-2011, GDAL, MapServer)
- maintainer: libtiff, libgeotiff, PROJ.4
- Founding director OSGeo
- Now working in Geo at Google
GDAL/OGR Introduction

- Geospatial Data Abstraction Library
- Raster (GDAL) and Vector (OGR)
- read/write access to many geospatial formats
- Widely used (FOSS+proprietary): GRASS, MapServer, QGIS, FME, ArcGIS, G. Earth
- 13 years old
- 40+ committers (perhaps 10 active)
- A project of OSGeo
- MIT/X Open Source license (non-reciprocal)
GDAL Features

- Coordinate systems around OGC WKT.
- Utilities for translation, warping, subsetting,…
- Efficient support for large images - tiling, overviews
- Written in C++ with C-linkage wrapper
- Language bindings: python, perl, c#, java,…
GDAL Formats

- Plain Raster: jpeg, png, gif
- Geospatial Files: GeoTIFF, .img, NITF
- Wavelet: jpeg2000, ecw, mrsid
- RDBMS: Oracle Raster, PostGIS Raster
- Web Service: WMS, WCS, OPeNDAP
- Radar: CEOS, Envisat
- Elevation: DTED, USGS DEM
- Containers: HDF4, HDF5, NetCDF
- Special: In-memory, VRT

Over 100 Formats
GDAL Data Model - Overview

Dataset:

- XSize/YSize (in pixels)
- Coordinate System
- Georeferencing (...)
- Metadata (...)
- Driver
- FileList
- Bands (0+)
GDAL Data Model - Bands

- XSize/YSize in pixels (same as Dataset)
- Pixel Type: Byte, UINT16, INT16, UINT32, INT32, FLOAT32, FLOAT64, and the complex types CINT16, CINT32, CFLOAT32, and CFLOAT64.
- Block Size (for efficient access)
- Metadata (...)
- Description
- Nodata pixel value
- Nodata mask band
- Category Names
- minimum and maximum value.
- offset and scale
- Raster Units (ie. "meters", "pascals").
- Color Interpretation (ie. red, grey, paletted)
- Color Table
GDAL Data Model - Georeferencing

- GeoTransform: Affine (regular, rotation, shear)
- Ground Control Points
  - pixel/line
  - geo x, geo y, elevation
  - name
  - use to create polynomial or thin plate spline transform
- RPCs (ratio of polynomials)
- Geolocation Grids (auxiliary grids of x/y)
GDAL Data Model - Georeferencing

Geolocation:

LINE_OFFSET=0
LINE_STEP=210
PIXEL_OFFSET=0
PIXEL_STEP=249
SRS=PROJCS["UTM Zone 49, Northern Hemisphere",GEOGCS[...UNIT["Meter",1]]
X_BAND=1
X_DATASET=HDF4_EOS:EOS_SWATH_GEOL:"AST.....hdf1":SurfaceRadianceSWIR:Longitude
Y_BAND=1
Y_DATASET=HDF4_EOS:EOS_SWATH_GEOL:"AST...hdf1":SurfaceRadianceSWIR:GeodeticLatitude
GDAL Data Model - Metadata

- string name/value pairs
- on dataset, and band objects
- segregated into subdomains
  - generic: default, IMAGE_STRUCTURE, RPC, GEOLOCATION, SUBDATASETS
  - driver specific: NITF_DES_METADATA, CGM
  - xml: xml:ESRI, xml:XMP
OGR - Features

- OGC WKT coordinate systems
- OGC geometry model
- Commandline utilities for translation (ogr2ogr) and query (ogrinfo)
- SWIG bindings (python, C#, java, perl)
- (potentially) fast spatial query
- GEOS for geometry operations
- SQL:
  - OGR SQL for all formats
  - Passthrough SQL for RDBMS
OGR - Formats

GIS: Shapefile, MapInfo, ESRI Personal/File Geodatabase
CAD: DXF, DGN (pre-V7)
RDBMS: PostGIS, Oracle, MySQL, Ingres, MSSQL, ODBC
NeoGeo: KML, GeoJSON
Web Service: WFS, Fusion Tables
National: SDTS, NAS, NTF, TIGER/Line, Interlis
Misc: CSV, VRT, Memory
OGR Data Model - Datasource

- A list of layers
- Think "directory of shapefiles" or "Personal Geodatabase"
- No metadata
- No layer relationships
OGR Data Model - Layer

- Think Shapefile+DBF or Spatial Table in RDBMS
- Layer name

Defined set of attribute columns

- Geometry type (may be unrestricted)
- Coordinate System
- Collection of Features
OGR Data Model - Attribute

- field name
- type
  - Integer, Float, String
  - List of Integer, Float, String
  - Binary
  - Date
- width, precision (for formatting)
OGR Data Model - Feature

- Attributes matching definitions from Layer
- Attributes may be null
- Geometry
- Feature Style (string)
- Feature Id (32bit integer)
OGC Simple Features (like PostGIS)
  - Point
  - LineString
  - Polygon (contiguous area with holes)
  - MultiPoint
  - MultiLineString
  - MultiPolygon (discontiguous area)
  - GeometryCollection
2.5D (X, Y, Z at each location)
Double precision
Quick Raster Tutorial?

Project Directions

- Grand Unification
- New OGC/ISO Simple Features
  - TINs
  - 2.5D official
  - Curves
- More Formats
- More Fixes
GDAL 2.0: Grand Unification

- Merge GDAL and OGR
- GDAL style metadata for OGR
- unified driver model - datasets with bands and layers
Current Activity

Even Rouault:
● Everything! Bugs, new drivers

Андрей Мигальь:
● GSoC: Image Correlator

Etienne Tourigny:
● NetCDF

Frank Warmerdam:
● PROJ.4 epoch support (places move in time!)
● Libtiff security
Questions?

See Also:
http://www.gdal.org/