Working with Scientific Data in ArcGIS Platform

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What we will cover today

• Scientific Multidimensional data

• Using Scientific Data in ArcGIS
  • Ingesting and Managing
  • Visualizing and Analyzing
  • Disseminating and Consuming

• ArcGIS is an Open Platform

• Application(s) and Use case
Scientific Multidimensional Data
Diverse Scientific Multidimensional Data

Oceanographic
- Salinity
- Sea Temperature
- Ocean current

Meteorological
- Temperature
- Water Vapor/Precipitation
- Wind speed/direction

Terrestrial
- Soil moisture
- NDVI
- Land cover
Challenges

- variety of formats
- volume & velocity
- redundancy

- portability
- scalability
- reproducibility

- integration
- standards
- accessibility
Ingesting and Managing Data
Multidimensional Mosaic Dataset

Representing multivariate collection of multidimensional rasters in ArcGIS
ArcGIS Multidimensional Data Model

Multidimensional Mosaic Dataset in Geodatabase

- Ingest variables from netCDF, HDF & GRIB using raster types
  - Aggregate multiple variables, multiple files
- Support on-the-fly processing

<table>
<thead>
<tr>
<th>ID</th>
<th>RASTER</th>
<th>PRODUCT</th>
<th>VARIABLE</th>
<th>TIME</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
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<td>temperature</td>
<td>T1</td>
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<td>temperature</td>
<td>T2</td>
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<td>netCDF</td>
<td>temperature</td>
<td>T3</td>
<td>20</td>
</tr>
</tbody>
</table>
Raster Types for Multidimensional data

data on disk

netCDF
HDF
GRIB

d-aware rasters

raster type

crawls disk
identifies rasters
extracts metadata
attaches processing

mosaic dataset

stores no pixels
references rasters
stores processing & metadata

Format-agnostic direct ingestion of rasters into a mosaic dataset
Creating a Multidimensional Mosaic Dataset

Using Geoprocessing Tools

• Create a empty mosaic dataset
• Add select variables
Visualizing and Analyzing
Slicing your data

• Slicing
  • By variable, using variable selector
  • By dimension using Select by Dimension Geoprocessing tool

• Visualizing
  • Time slider
  • Range slider
  • Vector field renderer
Raster Analysis

Geoprocessing Tools (GP)

• Tons of GP tools
• GP tools, Python scripting and ModelBuilder → perfect automation of data management and analysis.

Dynamic On-the-Fly Processing using Raster Functions

• Manage and analyze large collection of rasters on the fly as the data is accessed and viewed
• Quick and save time by not required to write the processed product to disk
• Functions can be applied to various rasters (images) including:
  • Raster dataset layers
  • Mosaic datasets
  • Image service layers

Raster Function: Transforming Raster Data

Choose from dozens of built-in functions or implement your own algorithm using Python

Learn more at: github.com/Esri/raster-functions
Chaining Raster Functions

Elevation

Slope

Conservation area

Soil Type

Soil Acidity

... to compose a complex analytic model
Raster Function Templates

A portable & reusable chain of raster functions

raster variables
Mosaic Data must contain:

• Field stored with variable names (tag)
• Field defines groups(GroupName)

<table>
<thead>
<tr>
<th>Raster</th>
<th>Tag</th>
<th>StdTime</th>
<th>GroupName</th>
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<tbody>
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<tr>
<td>...</td>
<td>mean</td>
<td>t1</td>
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<tr>
<td>...</td>
<td>Temperature</td>
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<tr>
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<tr>
<td>...</td>
<td>Temperature</td>
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<tr>
<td>...</td>
<td>mean</td>
<td>t4</td>
<td>4</td>
</tr>
</tbody>
</table>
Applying a Raster Function Template to Mosaic Dataset

Apply RFT to Mosaic Dataset:

Process each row
Process each group
Disseminating and Consuming
Disseminating

professional geospatial analysts

multivariate multidimensional mosaic dataset

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Serving Multidimensional Data

Multidimensional Image Services

Serve data (not a picture)

- LERC compression to maintain data quality
- Perform analysis and analysis through the web

Multiple clients:

- Desktop clients
- Web Map Viewers
- JavaScript etc.
- WMS/WCS
  - Time=t1&Elevation=z1
  - DIM_Time=t1&DIM_depth
Sharing data & information products

- Mosaic Dataset > Share As Web Layer

Enable access to a dynamic representation of your information product as an image service.
Consuming your services

• In any ArcGIS application or any WMS client

• In a web map
  • Identify web services driven by maps or datasets
  • Bring service layers into a web map

• In a map-based application
  • Configurable apps
  • Story Maps
  • Web AppBuilder
  • Custom web apps using ArcGIS API for JavaScript
Demo

Scientific data support in ArcGIS
ArcGIS: An Open Platform
ArcGIS is an Open Platform

Open Specifications
Open APIs
Open Standards
Open Data
Open Community
Open Source

Configurable
Flexible
Open ArcGIS Platform
Interoperable
Scalable
Customizable
Deployable
Scientific Data Interoperability in ArcGIS

- Ingesting many scientific data formats
- Supporting common scripting language in scientific computing
- Support OGC specifications in serving scientific data through web
Scientific Data Formats

- Support multidimensional raster formats
  - NetCDF
  - GRIB 1 and GRIB 2
  - HDF 4 and HDF 5

- Use Open Source GDAL
- Extendable by developing custom format driver
Scientific Data Formats - HDF

- HDF4
  - Support HDFEOS4
- HDF5
  - Support HDFEOS5 (for HDF5)
  - Support some custom CF style HDF5
  - SMAP
  - Will provide generic support for CF style HDF5
Scientific Computing

• Perform scientific computing using Geoprocessing tool
• Extendable by creating a custom Geoprocessing tool
• Performing scientific computing using Raster Function
• Extendable by developing a custom python raster function
• Support Python Scripting
  • NumPy
  • SciPy
Serving Scientific Data

• Serve gridded raster data as image service with OGC capabilities
  • WCS
  • WMS
• Dimensional query of Time and Depth
Few Take Away

1. Mosaic Dataset is a robust data model that allows you to manage your large collections of scientific multidimensional data.
2. Raster function(s) can help with your efficient on the fly computing that saves Time and Resources.
3. Mosaic Dataset is a quick way to build the live web service.
4. Make your scientific data and research output usable with repeatable workflow to your larger community.
5. ArcGIS is an open platform that provides opportunity to expand the capabilities to collaborate and support your work.
Want to learn more….please join these sessions:

Scientific and Multidimensional Raster Support in ArcGIS (SDCC Room 17A)
When: July 12, 2017 8:00-10:00 AM.

Raster Analytics-Envision Center Presentation (SDCC: Envision Center 1)
When: July 12, 2017 2:00-3.30 PM

Image Management using Mosaic Datasets and Image Services (Room 3)
When: July 13, 2017 8:30-9:45 AM

Session 2084: Weather, Forecasting, and Radar Site-selection (Room 29 A/B)
When: July 13, 2017 10:00AM-12PM.
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