



Jet Propulsion Laboratory

Cartography and Imaging  
Sciences Node

U.S. Geological Survey

# PDS4 GIS Products:

## Status update

**Moses Milazzo**

**PDS IMG: USGS, Astrogeology**

*PDSMC F2F, April 19, 2017*

# A Recap: What is GIS?

Windows 10 [Running]

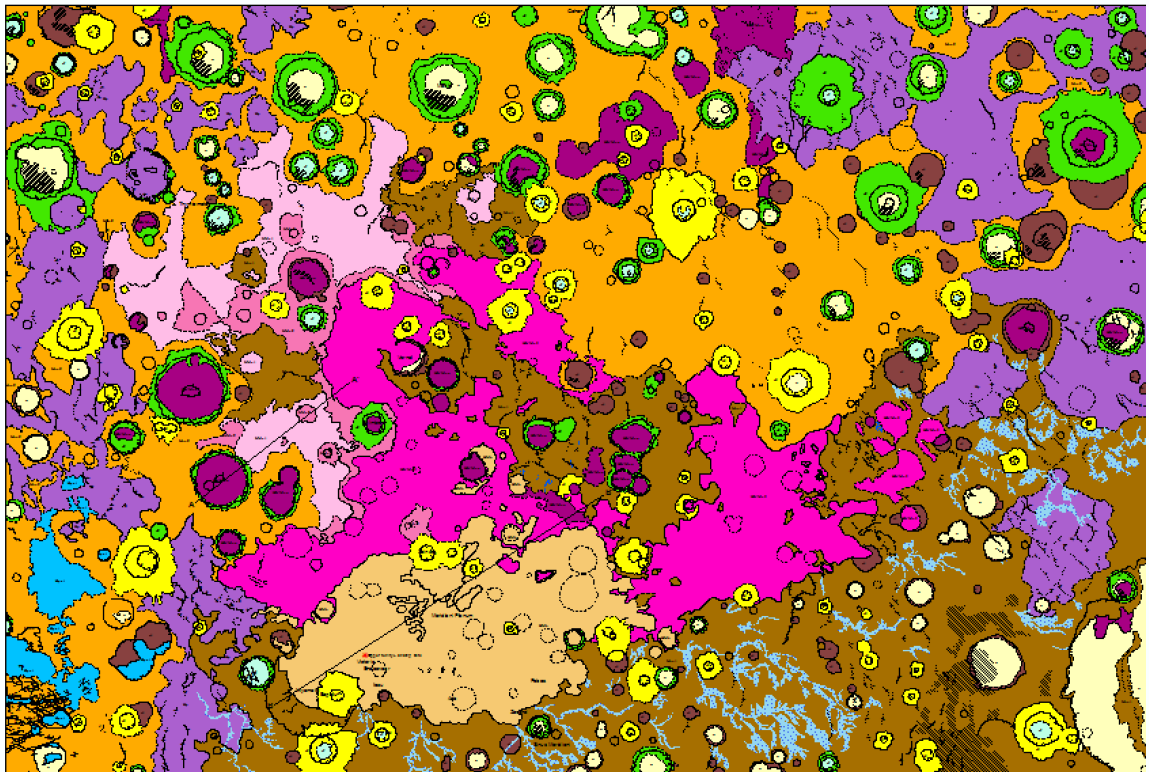
Meridiani\_2M\_Hynek\_ArcMap10.3 - ArcMap

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

1:8,000,000 17%

Table Of Contents

- Meridiani Mercator (clon0)
  - E:\PROJECTS\PDS\2017\GIS\_PRODUCT\00\_GIS\_FILES
    - Meridiani\_Geology\_Merc0\_FD
      - Geologic Contacts
      - Linear Features
      - Cross Section Lines
      - Surface Features
      - Geologic Units
      - IAU Nomenclature
      - Opportunity Landing Site
      - \*
      - MapBoundary
    - E:\PROJECTS\PDS\2017\GIS\_PRODUCT\00\_GIS\_FILES
      - meridiani\_mola128.tif
      - meridiani\_mola128\_hlshd.tif
      - meridiani\_themis\_daytimeIR.tif
      - geoconfinalnovns\_checkgeo



17.93 -1.57 Decimal Degrees

11:31 AM  
4/19/2017

Left

# A Recap: What is GIS?

- **Geographic Information System is a system capable of capturing, storing, displaying, analyzing geographically referenced information.**
- **GIS's power is that it provides a way to relate different information in a spatial context and to allow scientists to reach conclusions about the relationships.**
- **GIS is a framework for the “Science of Where.”**

# What does GIS provide?

- ⦿ Complex analysis is enabled
  - **Information retrieval of all data at a specific location**
  - Topology, Adjacency, Containment, Proximity, Networks, Overlays, ...
- ⦿ Re-Use
  - Derived data can be re-incorporated into the GIS so inferences from the derived data can contribute to further analysis of the original data.
- ⦿ Cooperation
  - GIS provides a common interface and standards.
  - Planetary data collection, organization, and analysis is expensive.
  - **GIS allows to share.**

# What is GML?

- **Geography Markup Language** is the XML grammar defined by the Open Geospatial Consortium (OGC) to express geographical features in a GIS.
- GML is a modeling language for GIS
- GML is an open interchange format for GIS software applications.

# What is GML?

- ◎ GML primitives include:
  - Geometry
  - Feature
  - Coordinate Reference System
  - Topology
  - Time
  - Dynamic feature
  - Coverage
  - Unit of measure
  - Direction
  - Observations
  - Map presentation styling rules

# What is GML?

- GML is an ISO standard for GIS data (ISO 19136 for GML 3.2.1, approved in 2007)
- An OGC standard for GIS use (GML 3.2.1)
- Approved by the Library of Congress for archival of GIS products
- Used by the Federal Geographic Data Consortium (FGDC) and National Spatial Data Infrastructure (NSDI).

# Why GML for PDS4?

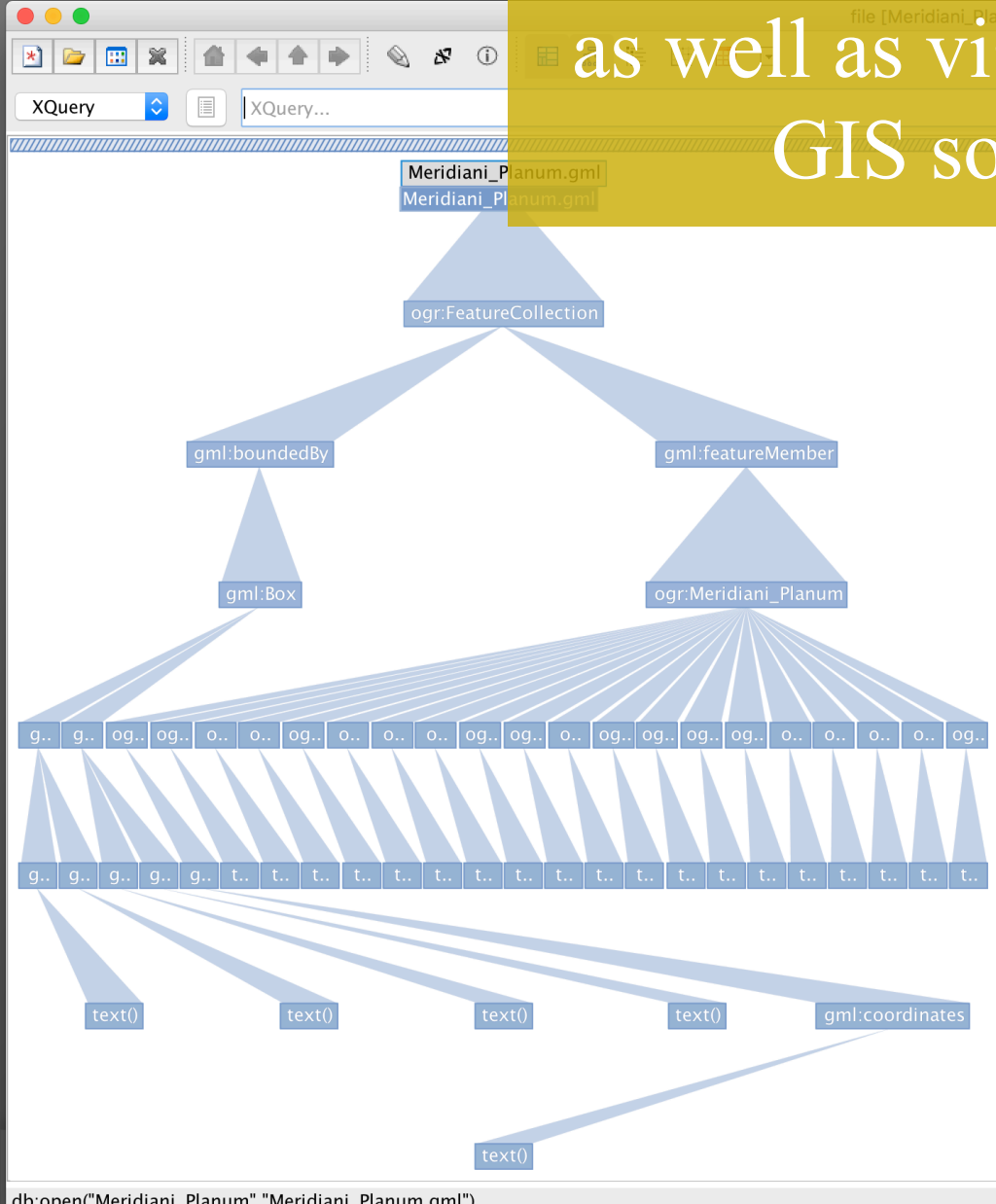
- GIS products are being delivered to USGS regularly. We “archive” these in the Annex and also archive full geological maps with the USGS.
- GML is a standard and stable language for GIS storage, interchange, and implementation
- It is supported by all major and many minor GIS packages, including Free and Open software.
- The FGDC/NSDI have implemented a GML Application Schema.



# Why *NOT* GML for PDS4?

- ARCInfo Shapefiles might be better.
- Shapefiles are also a standard interchange format.
- The Shapefile format is an “open” (but proprietary and binary) format.
- Shapefiles are supported by all major and minor GIS packages as well as most shapefile visualization software.
- Shapefiles are easier to generate for most users.

GML XML files can be explored with existing tools as well as visualized with GIS software.



0 Results

<code>gml:Box</code>						
<code>gml:coord</code>		<code>gml:coord</code>				
<code>gml:X</code>	<code>gml:Y</code>	<code>gml:X</code>	<code>gml:Y</code>			
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<code>ogr:Meridiani_Planum</code>						
<code>ogr:geometryProperty</code>		<code>ogr:clean_name</code>	<code>ogr:approval</code>	<code>ogr:min_lat</code>		
<code>gml:Point</code>		Meridiani Planum	Adopted by IAU	-3.99976158142		
<code>gml:coordinates</code>		<code>ogr:approvaldt</code>	<code>ogr:min_lon</code>	<code>ogr:max_lat</code>		
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<code>ogr:name</code>		<code>ogr:origin</code>		<code>ogr:ethnicity</code>		
Meridiani Planum		Classical albedo feature name.		Latin		
<code>ogr:diameter</code>		<code>ogr:center_lon</code>	<code>ogr:type</code>	<code>ogr:continent</code>	<code>ogr:quad...</code>	<code>ogr:link</code>
1058. 53000000000		356. 86005734100	Planum, plana	Europe	mc19	<a href="http://planet..wr.usgs.gov/Feature/3854">http://planet..wr.usgs.gov/Feature/3854</a>
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-0.04087474425		PM		Margaritifer Sinus		

64 MB

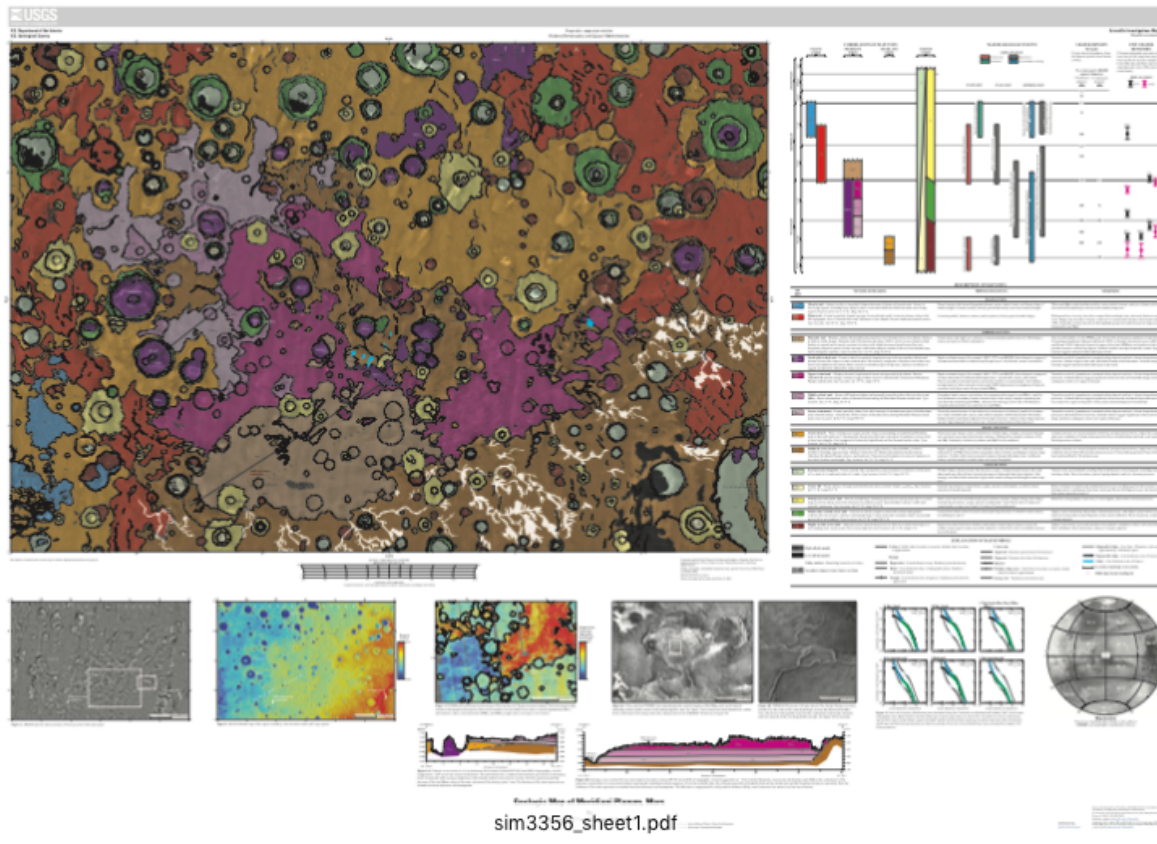
db:open("Meridiani\_Planum","Meridiani\_Planum.gml")

# PDF document and browse products can easily be viewed with existing tools.

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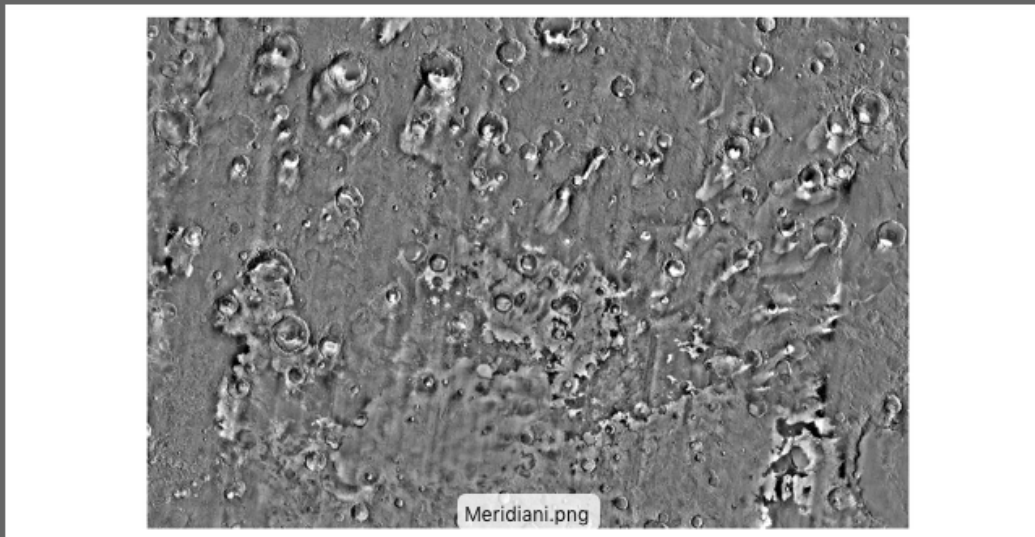
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▼ browse	Today, 2:34 PM	--	Folder
.DS_Store	Today, 2:34 PM	6 KB	Document
Collection_browse_inventory.tab	Oct 3, 2016, 7:48 AM	71 bytes	Document
Collection_browse.xml	Oct 3, 2016, 7:48 AM	8 KB	XML S...rce File
sim3356_namblat.pdf	Apr 10, 2017, 12:18 PM	612 KB	PDF Document

Raster layers can easily be viewed with PDS4 viewer tools.

GML



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.layers	Today, 4:28 PM	--	Folder
.prj	Today, 3:08 PM	--	Folder
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Mellit.gml	Yesterday, 2:25 PM	2 KB	GML document
Meridiani_Planum.gml	Yesterday, 2:25 PM	2 KB	GML document
meridiani_themis_daytimeIR.tif	Yesterday, 2:19 PM	428.4 MB	TIFF image
meridiani_themis_davtimeIR.tif.aux.xml	Today, 4:37 PM	2 KB	XML S...rce File

# Backup Slides



April 2017

# What is GML?

- ⦿ GML comprises a set of primitives which are used to build application-specific schemas.
  - Geometry
    - Describes a location or region, Point, LineString, Polygon
  - Feature
    - Application object that represents a physical entity (crater, lineament, etc.)
    - A feature's location, extent, etc. is defined by associated Geomtries

# A Recap: What is GIS?

- **Data incorporated into a GIS include**
  - Image data
  - Spot data (LiDAR, spectral, etc.)
  - Geophysical data (seismographs, etc.)
  - Topography (contours, elevations, etc.)
  - Chemical data (*in situ*, spectral, etc.)
  - Geological maps
  - Geometry data
  - Tabular information
  - Etc., Etc., Etc.

# Why include GIS in PDS4?

- GIS is used for research and creation of derived data across the planetary science community, for data throughout the Solar System, and for Earth analog research.
- It is a fundamental requirement to data fusion techniques that disparate data (imagery, LiDAR, geometry, etc.) be geolocated, visualized, and manipulated in a common software scheme.
- Astrogeology provides unofficial archival of the human and robotic landing site studies as well as many other scientific studies.
- Every geologic map published by USGS (terrestrial or planetary) is required to be in a GIS format.
- The Library of Congress archives GIS-formatted data regularly.



# What is GML?

- A GML Profile is a restricted subset of the whole of GML and live within GML namespace.
- GML Application Schemas are GML/XML vocabularies intended for domain- or community-specific uses.
  - Support interoperability within a community of interest.
  - Live in an application-defined target namespace.
  - “Application” does not necessarily imply a software implementation, but rather an application of GML to a specific need.

# Other files conform to PDS4 Standards

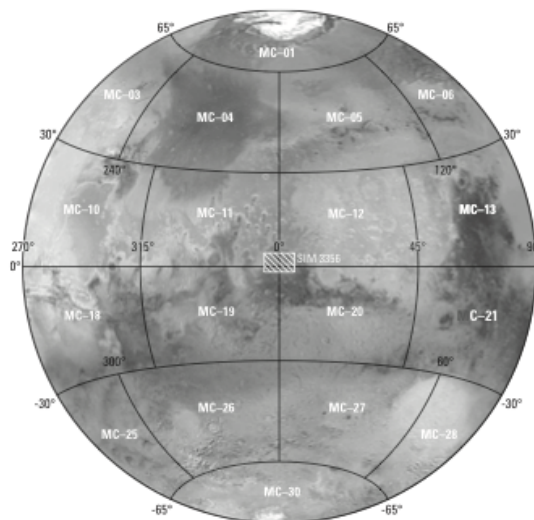


Prepared for the National Aeronautics and Space Administration

## Geologic Map of Meridiani Planum, Mars

By Brian M. Hynek and Gaetano Di Achille

Pamphlet to accompany  
Scientific Investigations Map 3356



2017

U.S. Department of the Interior  
U.S. Geological Survey

sim3356\_pamphlet.pdf

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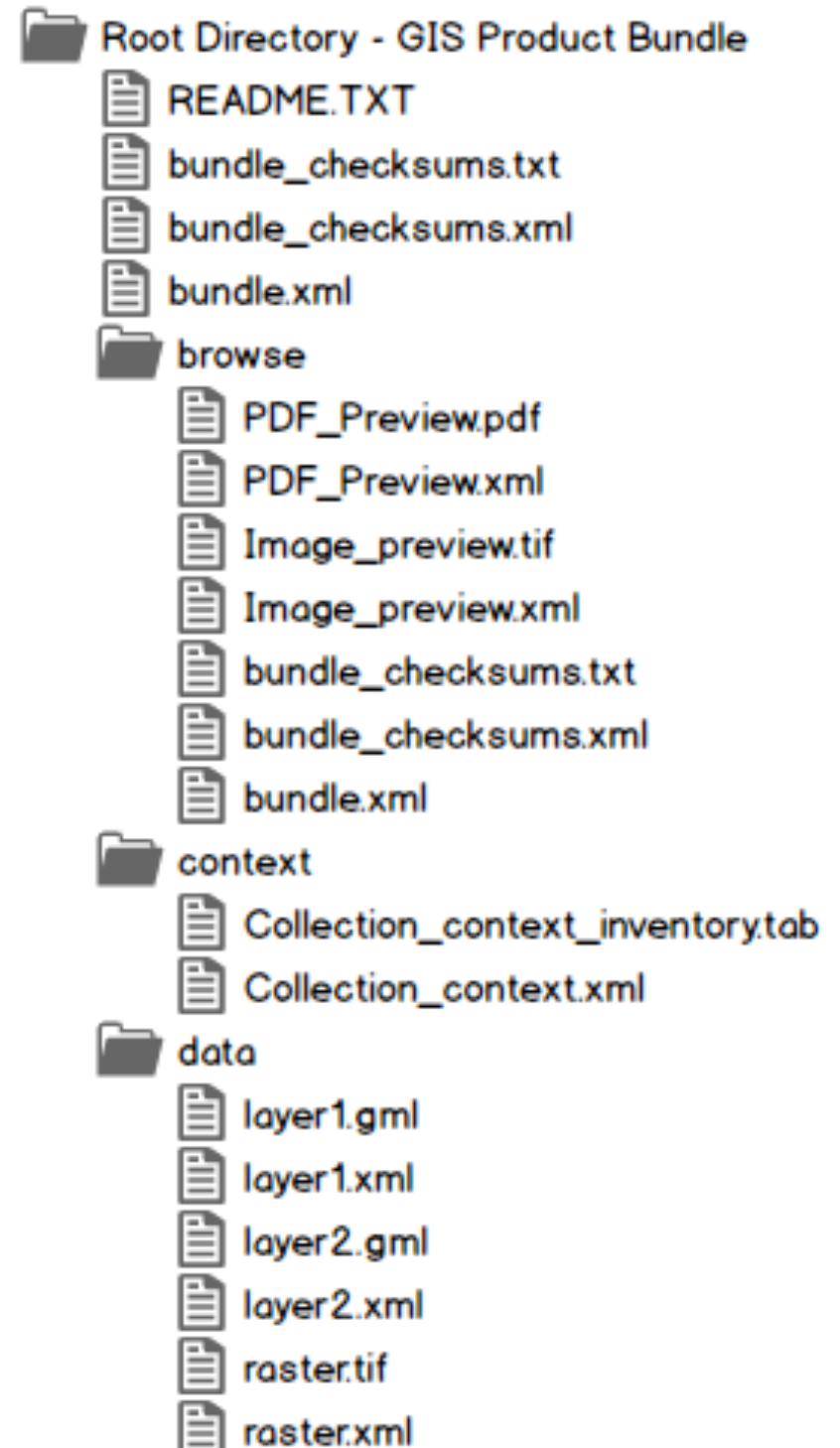
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.DS_Store	Today, 2:34 PM	6 KB	Document
Collection_browse_inventory.tab	Oct 3, 2016, 7:48 AM	71 bytes	Document

**Most layers will be GML files  
(text; XML).**

**Basemaps and other raster  
images can be PDS4-  
compliant images.**

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Browse products can be IMG or PDF format.

Document products (project description, published papers, published map, etc.) can be text or PDF.

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