Hierarchical Data Format for Earth Observing System Data Product Developer’s Guide

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Motivation and Related Work

• The work presented in this talk is done in support of Data Product Developers Guide Working Group

• WG Mission Statement: Help Data Product developers make data usable for End Users

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Broader HDF-EOS Definition

• **Hierarchical Data Format for Earth Observing System**

• Any Earth data stored in HDF format
  – HDF4, HDF5, and netCDF-4
HDF-EOS Data Product

• Data is a consumer product like food, clothing, and house.
• Design and package it well.
• Users (=consumers) will appreciate it.
What Users Ask through Help Desk

- Geolocation retrieval
- Sampling over region & time
- Creating plots (e.g., Journal publication)
- GDAL* tools (e.g., ESRI ArcGIS)
- netCDF tools (e.g., Panoply)
- Programming in MATLAB

*Geospatial Data Abstraction Library
Better Products = Less Questions

- Improve Earth data user experience
- Self-describing = self-serviceable data
- How to create better data products?
Guide I: Geo-location

- Add latitude/longitude variables
  - Regardless of projection parameters in metadata
- For grids and points, use 1D dataset.
- For swath, use 2D dataset.
  - This will help visualization tools.
- No 3D dataset / No fill value
- Use `units` attribute (e.g., `degrees_east` and `degrees_north`)
Why Geo-location?

- Integrated Data Viewer throws “No Gridded data found” error message.
- NCAR Command Line Language cannot plot data if lat / lon has fill values.
Guide II: Named Dimensions

- Essential for netCDF interoperability
- Have named dimensions.
- 1-D coordinate variable, use the same name as dataset name (COARDS*).
- Use netCDF APIs but store as netCDF-4/HDF5 (easy).
- Use HDF5 dimension scale APIs if you don’t want to use netCDF APIs (difficult).
- Check with netCDF-Java tools.

* Cooperative Ocean/Atmosphere Research Data Service
Why named dimensions?

- Strange phony_dim_0 will appear for netCDF tools.
- Dimension names are heavily used by netCDF-Java tools to identify feature types.
- If 1D variable name matches dimension name, it becomes a coordinate variable automatically.
Guide III: The CF Conventions

- CF: Climate and Forecast Metadata
- `long_name` attribute
- `units` attribute
- `coordinates` attribute
- Use templates
Why long_name and units?

Some tools utilize them automatically!

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NCAR Command Line Language
Image from http://hdfeos.org/zoo
Guide IV: Test with tools.

- MATLAB, Python
- Geospatial Data Abstraction Library (GDAL) tools (e.g., gdal_translate)
- NCAR Command Line Language (NCAR) toolsUI and Panoply
- Integrated Data Viewer (IDV)
- Interactive Data Language (IDL)
- OPeNDAP (e.g., Hyrax*, THREDDS**)

*Hyrax is the data server from OPeNDAP.
**Thematic Real-time Environmental Distributed Data Services
Question: any tool for guidelines?

Answer: HDF Product Designer (HPD) can help data producers!
HDF Product Designer (HPD)

- Design is key.
- Design twice, produce data once.
- Testing and validation is a must.
  - CF checker from JPL
  - Testing with netCDF-C tool (e.g., ncdump)
  - Testing with THREDDS / Hyrax
Why HDF Product Designer?

• Design and test product quickly.
• Graphical User Interface (GUI)
• Design Templates
  – CF feature types
  – Existing NASA HDF4/HDF5 products
• Testing and validation is built-in.
  – CF convention checker
  – Hyrax/THREDDS
HPD GUI & Design Template
Case Study: JAXA* (Before)
Case Study: JAXA (After 90 min.)
HPD References

- [http://hpd.readthedocs.io](http://hpd.readthedocs.io)
- [http://youtube.com/hdfeos](http://youtube.com/hdfeos)

HPD Future Work?

- Common Metadata Repository (CMR) integration
- Web-based GUI
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