
# Hierarchical Data Format for Earth Observing System Data Product Developer's Guide

## HDF-EOS Workshop XXI / The 2018 ESIP Summer Meeting

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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* https://wiki.earthdata.nasa.gov/display/ESDSWG/Data+Product+Developers+Guide+Working+Group
- WG Mission Statement: *Help Data Product developers make data usable for End Users*
- WG chairs
  - Hampapuram Ramapriyan (hampapuram.ramapriyan@ssaihq.com)
  - Peter Leonard (pleonard@sesda3.com)
- WG POCs
  - Chris Lynnes (chris.lynnes@nasa.gov)
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  - John Moses (john.f.moses@nasa.gov)
- The HDF Group members
  - Joe Lee (hyoklee@hdfgroup.org) and Aleksandar Jelenak (ajelenak@hdfgroup.org)

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# Broader HDF-EOS Definition

- **H**ierarchical **D**ata **F**ormat for **E**arth **O**bserving **S**ystem
- 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

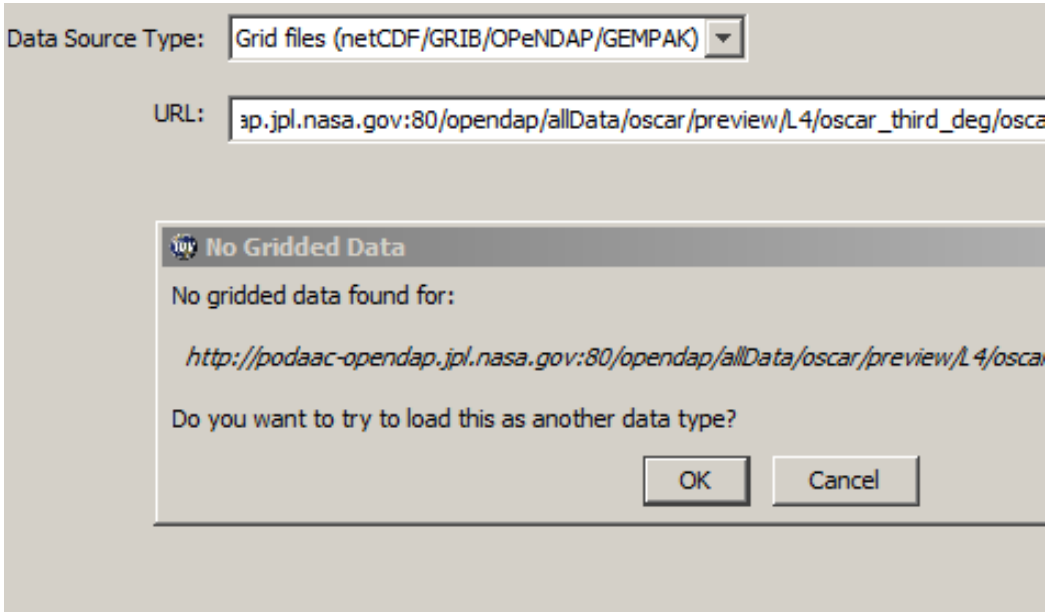
- Improve Earth data user experience
- Self-describing = self-serviceable data
- How to create better data products?

# 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?

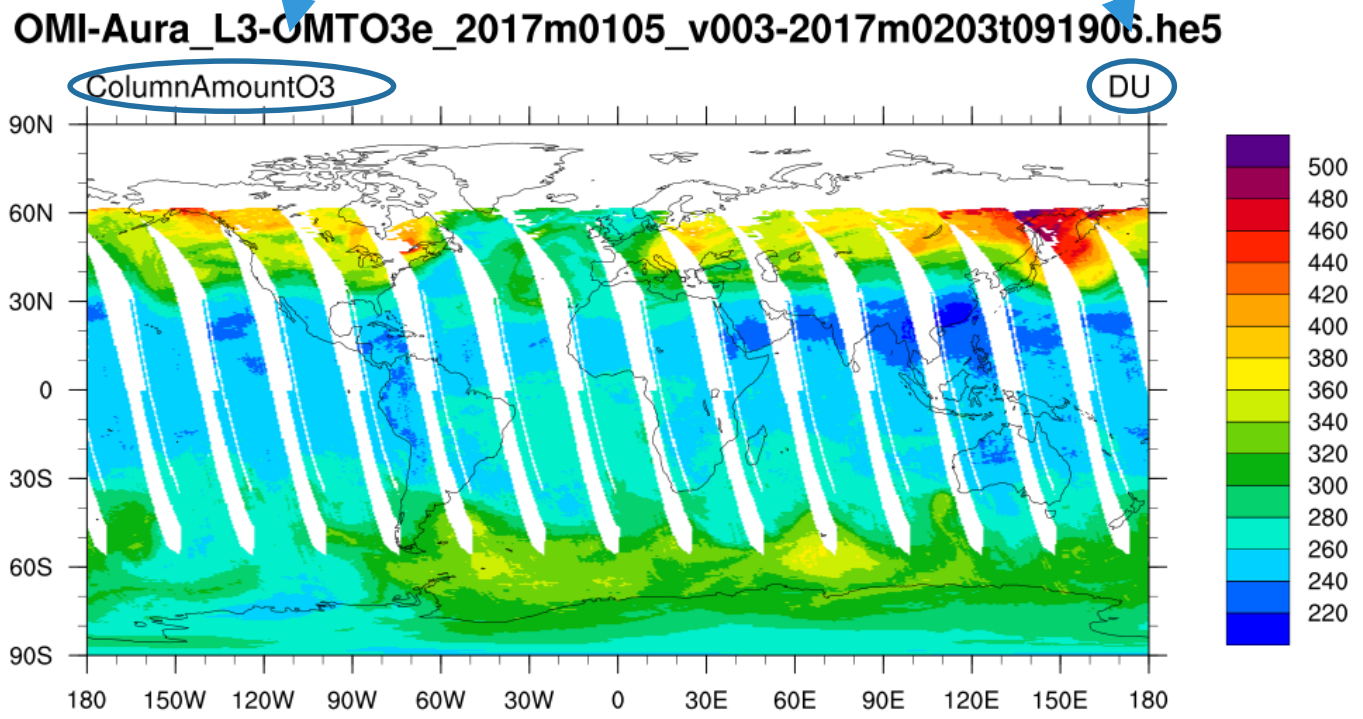
- Strange phony_dim_0 will appear for netCDF tools.
- Dimension names are heavily used by netCDF-Java tools to identify feature types.
- If 1D variable name matches dimension name, it becomes a coordinate variable automatically.

# 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!




NCAR Command Line Language

Image from http://hdfeos.org/zoo

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# 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!

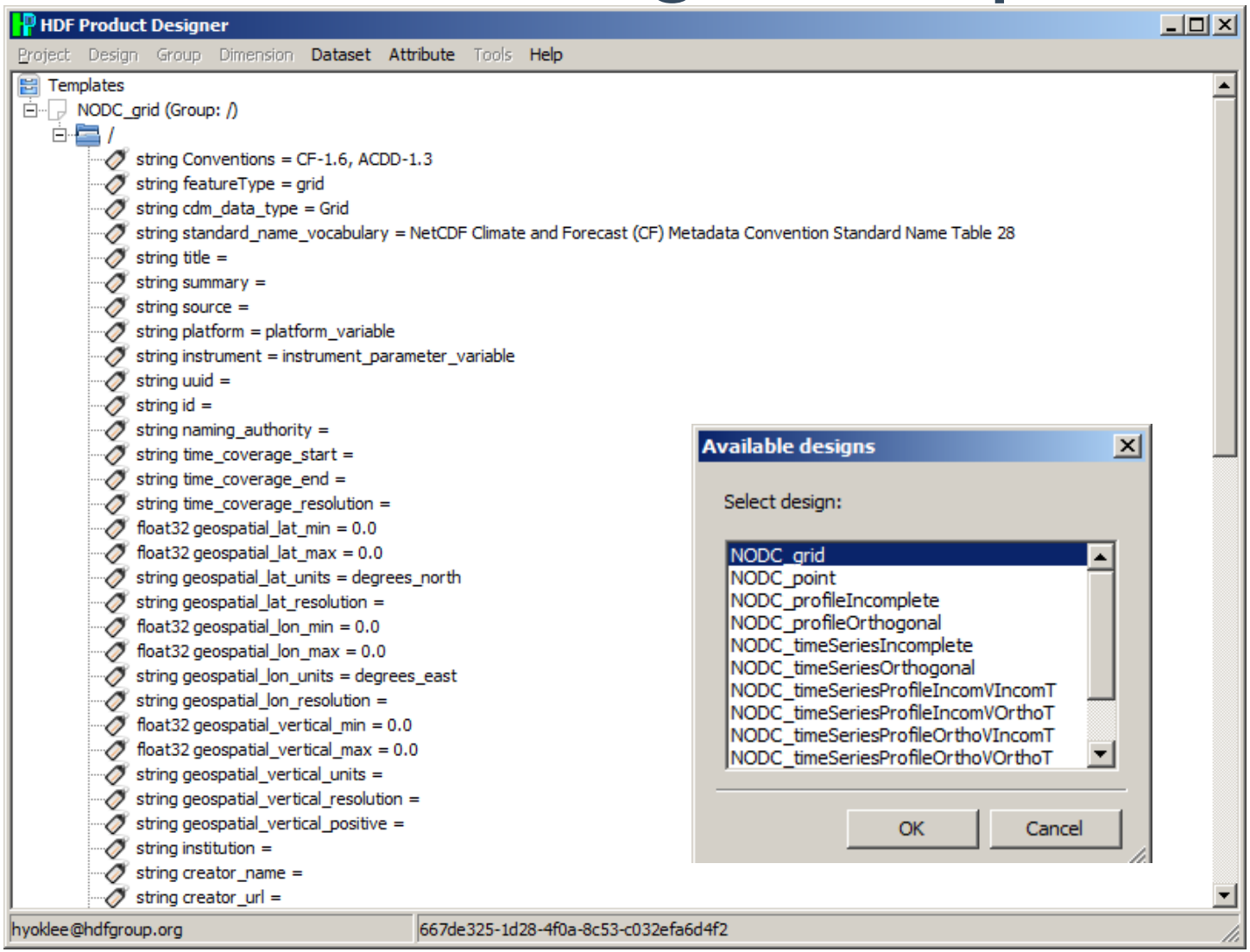
# HDF Product Designer (HPD)

- 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

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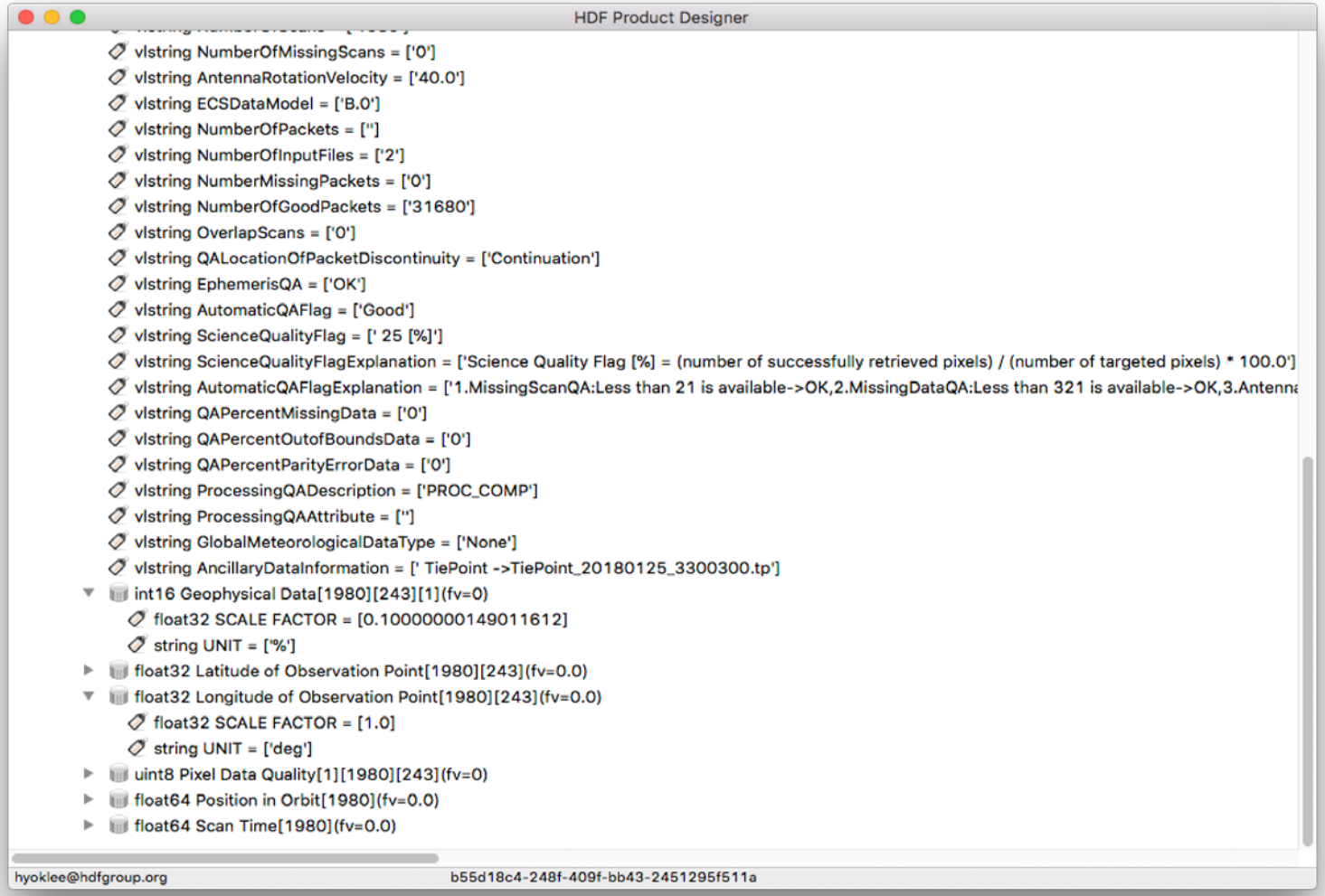
# Case Study: JAXA* (Before)

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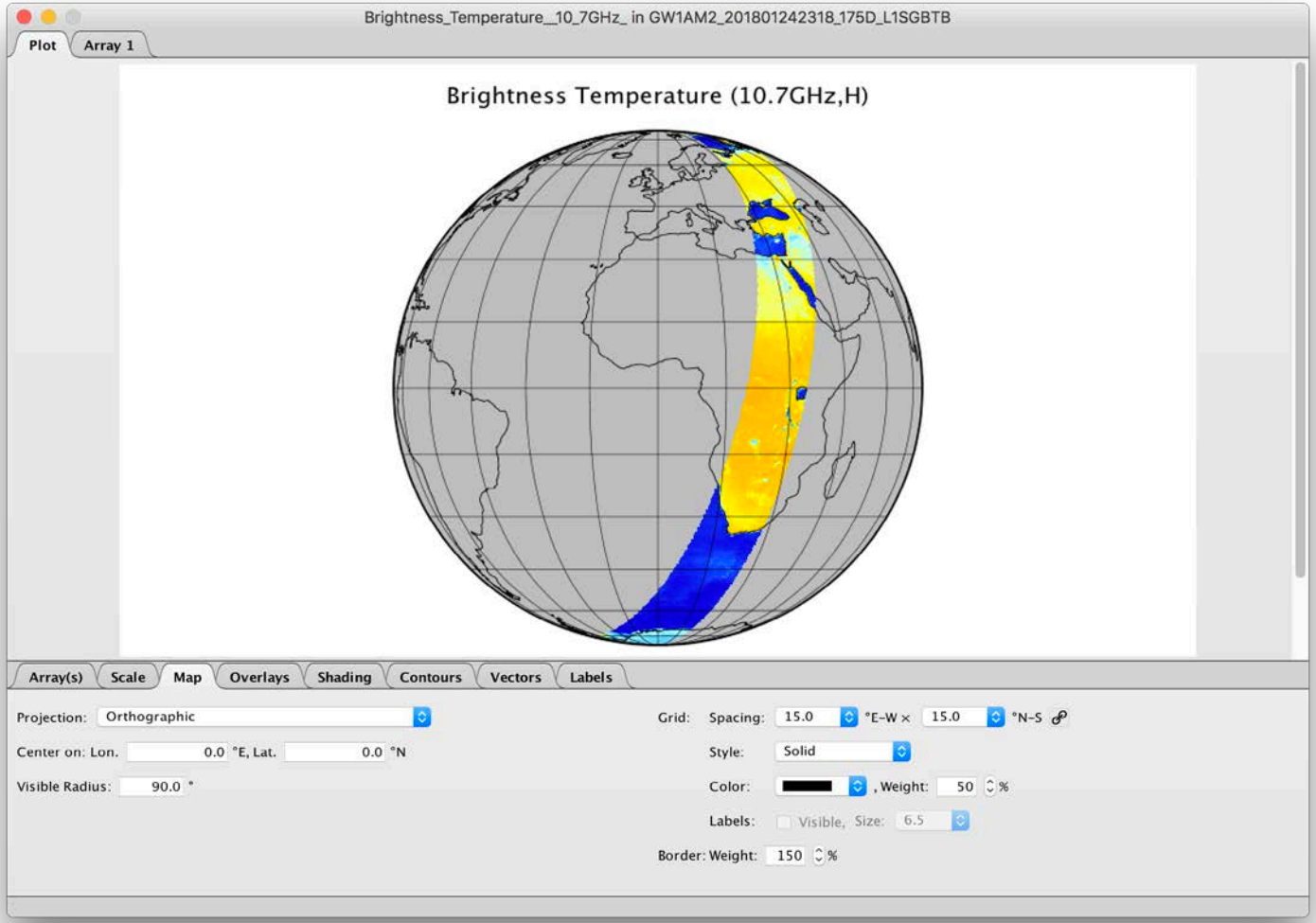
*Japan Aerospace Exploration Agency

# Case Study: JAXA (After 90 min.)



# HPD References

- http://hpd.readthedocs.io
- http://youtube.com/hdfeos

# HPD Future Work?

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

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