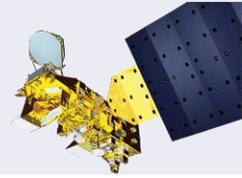


netCDF4 files for AIRS and CrIMSS

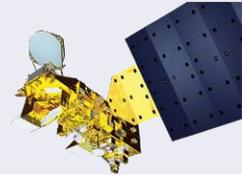
Evan M. Manning

Jet Propulsion Laboratory, California Institute of Technology,
4800 Oak Grove Dr., Pasadena, CA 91109



Our new format for **SounderCDF** is:

- Easy to use
- Interoperable with future products
 - Standard conformant:
 - **CF**
 - **ACDD**
- Flexible – other instruments, products are “the same but different”

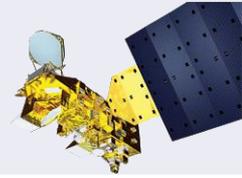


CF:

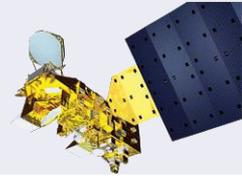
- **C**limate and **F**orecast Metadata
- **COARDS** heritage
- Stated goals include:
 - Locate data in space–time and as a function of other independent variables, to facilitate processing and graphics
 - Identify data sufficiently to enable users of data from different sources to decide what is comparable, and to distinguish variables in archives
- Conventions for dimensions, units, and variable and file attributes
- Users will need to consult an interface specification document much less

ACDD:

- **A**tttribute **C**onventions for **D**ataset **D**iscovery
- Mostly file-level or collection-level metadata emphasizing letting users find our data set

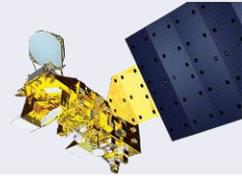


- netCDF4
 - Built on HDF5 – but users should not use the HDF5 library directly
- Compared to classic netCDF adds:
 - **Strings**
 - **Groups**
 - **Compound types** (structures)
 - etc.
- We minimize use of these new features:
 - **Strings** are used but not arrays of strings
 - **Groups** are used but sparingly – most parameters are in the root group for most granule products
 - **Compound types** are not used.



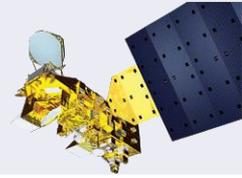
- Like AIRS, SounderCDF Level-1 and Level-2 granule files are six minutes in duration – 45 8-second cycles
- But unlike AIRS these granules are closely aligned with UTC time, the first one starting within 8 seconds of midnight.
- File names have both **start time** to the nearest minute and **granule number**:
SNDR.SNPP.ATMS.**20120228T2354**.m06.g**240**.L1B.std.v01_00_00.J.160908005508.nc
SNDR.SNPP.CRIMSS.**20130415T1154**.m06.g**120**.L2_RET_CLIMCAPS_NSR.std.v01_23_01.J.180328160143.nc
- The structure is swath-like with primary cross-scan and along-scan dimensions: **atrack**, **xtrack**
 - Plus **fov** for selected variables: clouds, OLR, etc.

Group structure

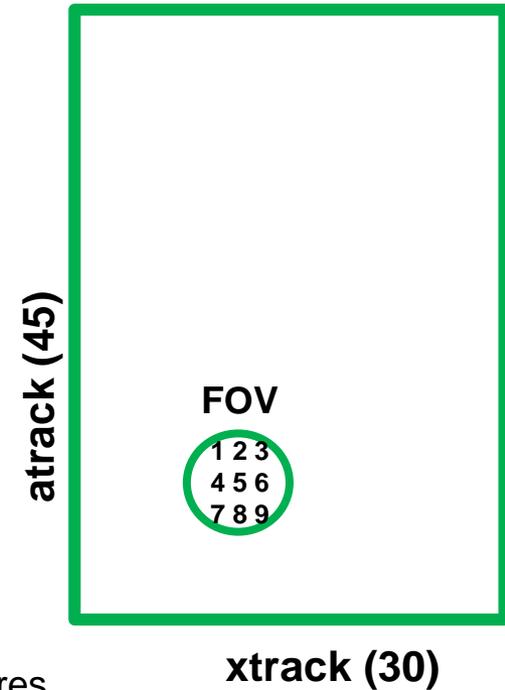


- netCDF4 allows a hierarchical structure – “groups”.
 - This allows useful partitioning of data.
 - But too much use of the group structure imposes a burden on users, so we keep it simple.
- Granule Level-1 and Level-2 files have all of the most commonly used variables in the **root** group (“/”):
 - Data
 - Geolocation
 - QC
 - Casual users can ignore the group feature entirely.
 - It will be easy to order data with any additional groups stripped out.
 - An “**aux**” group holds extra information of interest to the algorithm team but not most users
 - L2 **aux** varies by algorithm
 - L2 **aux** for CHART includes neural net first guess output, QC predictors
 - L2 **aux** for CLIMCAPS includes MERRA2 first guess, Chi-squared
 - L2 also has:
 - A “**mol_lay**” group with column density profiles.
 - A “**mw**” group with outputs from the Microwave-Only retrieval step.
 - An “**ave_kern**” group with averaging kernels. (Not included in initial release.)
- Level-3 also has all of its basic information in the root group: gridded means of all variables.
 - Almost all users will find everything they need in the root group
 - A “**nobs**” group contains information about the **number** of **obs**ervations associated with the means in the root group.

Key Level-2 dimensions



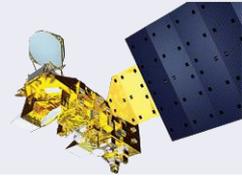
- **atrack**
 - Along-track horizontal dimension: 45
- **xtrack**
 - Cross-track horizontal dimension: 30
- **fov**
 - FOV dimension within FOR: 9
 - Not 3x3 as for AIRS
- **air_pres**
 - 100 pressure levels
 - Coordinate variable **air_pres** has the pressures
- **air_pres_h2o**
 - 66 pressure levels up to 50 hPa
 - Coordinate variable **air_pres_h2o** has the pressures
- **air_pres_lay**
 - 100 pressure layers
 - Coordinate variable **air_pres_lay** has the mid-layer pressures
 - Boundary variable **air_pres_lay_bnds** has the layer boundaries



For Cloud-cleared radiances:

- **wnum_lw, wnum_mw, wnum_sw**
 - CrIS channel dimensions
 - Coordinate variables **wnum_lw** etc. have frequencies in wavenumber

Key Level-3 dimensions



- **orbit_pass**

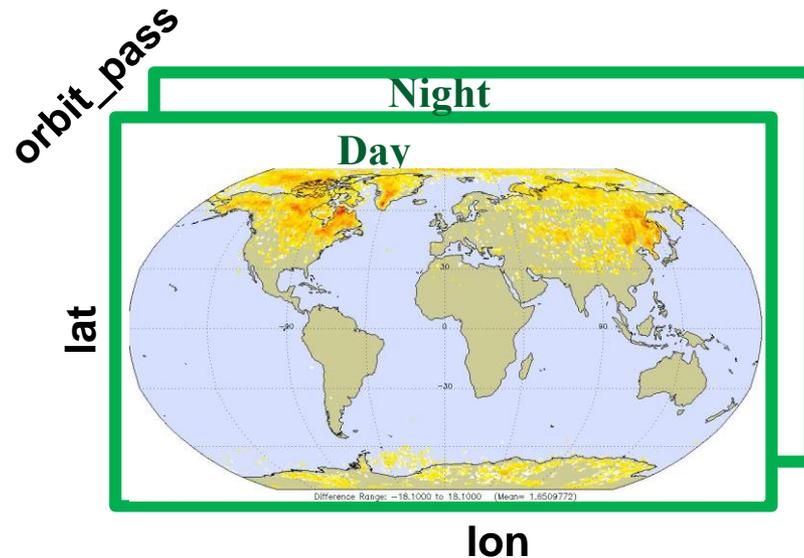
- Day/night dimension: 2
- No longer have 2 grids

- **lon**

- Longitude dimension: 360

- **lat**

- Latitude dimension: 180

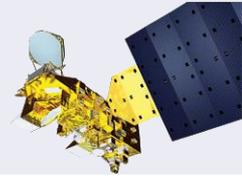


- **air_pres**

- 100 pressure levels
- Coordinate variable **air_pres** has the pressures

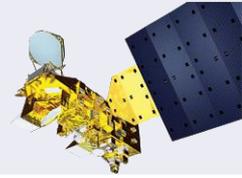
- **air_pres_h2o**

- 66 pressure levels up to 50 hPa
- Coordinate variable **air_pres_h2o** has the pressures



- SounderCDF files contain many attributes.
 - Global attributes are like metadata giving info at the file level or higher
 - Many are required or recommended by **CF** or **ACDD**
 - **ACDD** attributes generally describe the data set to a new user: instrument, platform, publisher, ...
 - Some are helpful for selecting granules of interest:
 - **geospatial_*** give location as center lat/lon, bounding box, and polygon
 - Variable attributes provide information about each variable
 - **long_name** -- for plots
 - **description** -- internal documentation
 - **standard_name** – CF compliance / interoperability
 - **units** – CF uses UDUnits. We use raw SI where possible.
 - **coverage_content_type** -- ISO 19115 {physicalMeasurement, qualityInformation, thematicClassification, referenceInformation, coordinate, modelResult}
 - **valid_range** – min & max
 - **coordinates** – links to coordinate variables, especially lat & lon
 - **bounds** -- optional link to another variable with boundary info for layers, grid cells, FOVs, etc.
 - **_FillValue** – A special value when there is no valid data
 - **ancillary_variables** -- points to error estimate, QC, nobs
 - **cell_methods** – we only use area means & time means for L3
 - **flag_values, flag_masks, flag_meanings** -- for flags

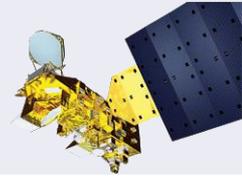
Variable names



Each variable has several “**names**”:

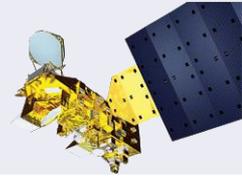
- The actual name of the variable
 - We have complete freedom
 - We go with easy-to-type, short but not cryptic, underscores, no caps:
 - **lat**
 - **air_temp**
 - **h2o_vap_tot**
 - **o3_mmr**
- “**standard_name**”
 - CF maintains a table of all acceptable values. Not all variables have standard names. New names can be added after discussion.
 - Names are precise:
 - **latitude**
 - **air_temperature**
 - **atmosphere_mass_content_of_water_vapor**
 - **mass_fraction_of_ozone_in_air**
- “**long_name**”
 - Freeform, suitable for use as an axis label by automatic plotting tools
 - Long for a name but short for a description:
 - “**latitude**”
 - “**air temperature profile**”
 - “**total water vapor**”
 - “**ozone MMR profile**”
- “**description**”
 - A full description, excluding things like units covered in other attributes
 - Similar to what you might find in a format specification, but right there in the file:
 - “**latitude of FOV center**”
 - “**air temperature profile**”
 - “**total precipitable water vapor**”
 - “**ozone mass mixing ratio to moist air**”

Variable attribute example: o3_mmr



```
float o3_mmr(atrack, xtrack, air_pres);  
string o3_mmr : units = "1";  
string o3_mmr : ancillary_variables = "o3_mmr_qc o3_mmr_err";  
string o3_mmr : long_name = "ozone MMR profile";  
string o3_mmr : standard_name = "mass_fraction_of_ozone_in_air";  
string o3_mmr : coordinates = "lon lat";  
string o3_mmr : description = "ozone mass mixing ratio to moist air";  
string o3_mmr : AIRS_name = "O3mmrLevSup";  
float o3_mmr : _FillValue = 9.9692099683868690e+36f;  
string o3_mmr : cell_methods = "area: mean";  
string o3_mmr : coverage_content_type = "physicalMeasurement";
```

L2 Ancillary variables



Each L2 science variable typically has two “ancillary variables”:

- *_qc is the equivalent of AIRS *_QC:
 - 0: “Best”
 - 1: “Good”
 - 2: “Do not use”
 - flag_values and flag_meanings attributes are used to communicate this information in a standard way.
- *_err is an error estimate in physical units

```
byte o3_mmr_qc(atrack, xtrack, air_pres);
```

```
[...]
```

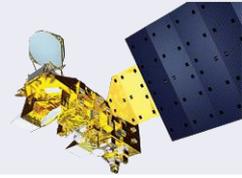
```
string o3_mmr_qc : coverage_content_type = "qualityInformation";
```

```
byte o3_mmr_qc : flag_values = 0, 1, 2;
```

```
string o3_mmr_qc : flag_meanings = "Best Good Do_Not_Use";
```

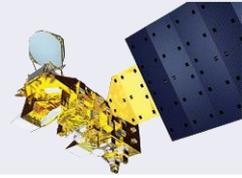
```
float o3_mmr_err(atrack, xtrack, air_pres);
```

```
string o3_mmr_err : coverage_content_type = "qualityInformation";
```

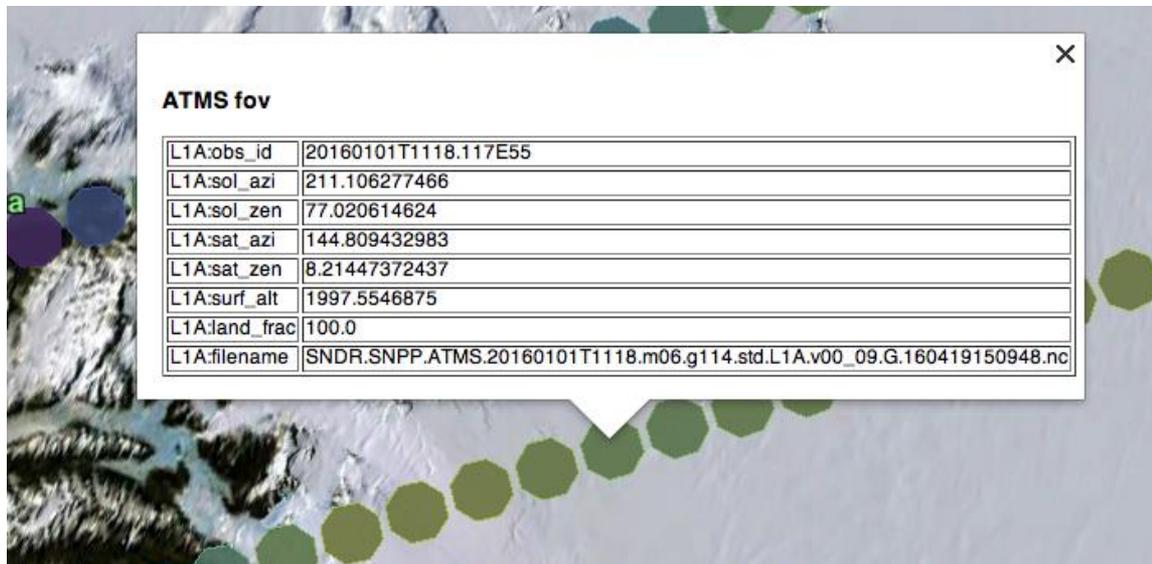


- Each observation (granule, FOR, and FOV) has a unique identifier over the entire mission.
- These will be kept alongside the data in subsets like SNO, match-ups, calibration subset
- They should be used when sample granules, spectra, or profiles are included in papers or presentations
- **gran_id**: `yyyymmddThhmm – 20160914T1124`
- **obs_id**:
 - ATMS: `yyyymmddThhmm.aaaExx -- 20160914T1124.135E96`
 - CrIS FOR, FOR-oriented L2: `yyyymmddThhmm.aaExx -- 20160914T1124.45E30`
 - CrIS FOV, FOV-oriented L2: `yyyymmddThhmm.aaExx.f -- 20160914T1124.45E30.9`

FOV boundaries



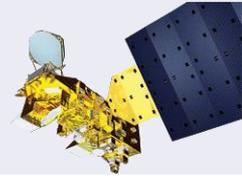
- One key feature of CF is boundaries.
- For each ATMS and CrIS FOV we are able to provide a 8-point bounding polygon.
- This will greatly simplify the task of users who want to plot data on a map.



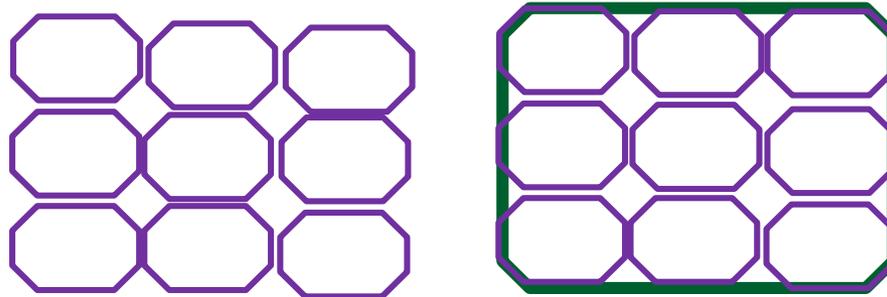
This image shows Elevation data displayed in Google Earth using ATMS FOV polygons

Tool: Jia Zong

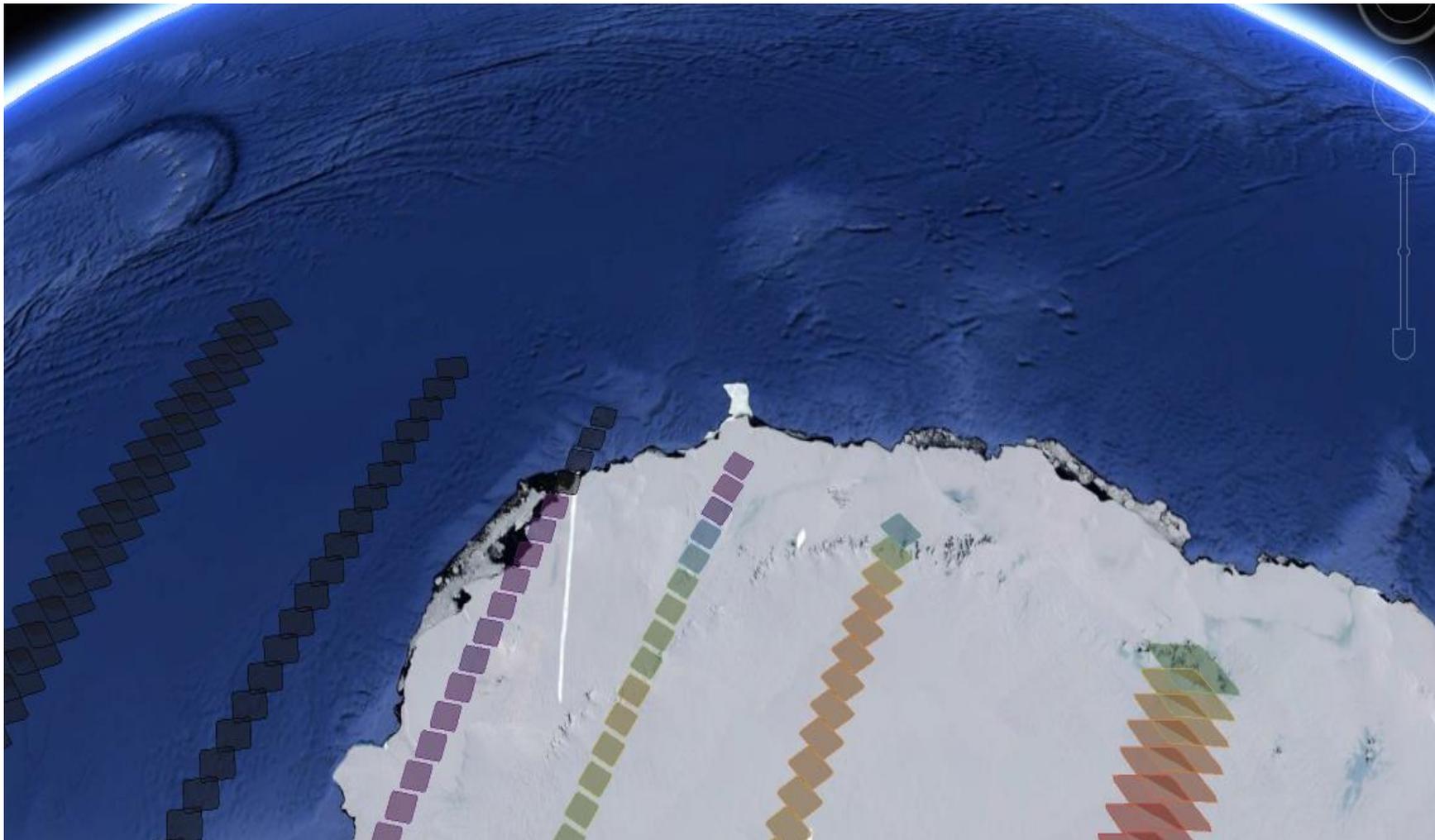
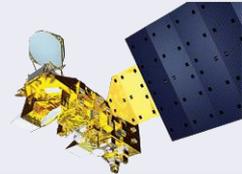
L2 FOR boundaries

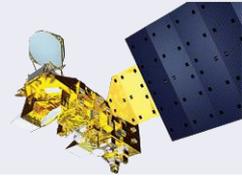


For each L2 FOR we have a 8-side polygon with two points from each of the corner CrIS FOVs.

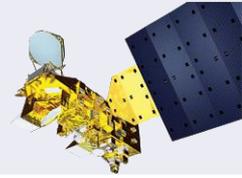


L2 FOR boundaries



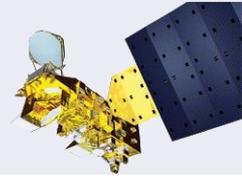


- We have sample data sets of Level-1B for CrIS and ATMS
 - At JPL and public at GES DISC DAAC.
- Level-2 and Level-3 daily CrIMSS data for the 8 comparison months * 2 algorithms is ready at JPL and coming soon to the GES DISC DAAC.
- Level-3 monthly is coming soon.
 - Format is identical to Level-3 daily.
- AIRS will use this format for v7.
 - Hopefully other instruments will also adopt aspects of this format.

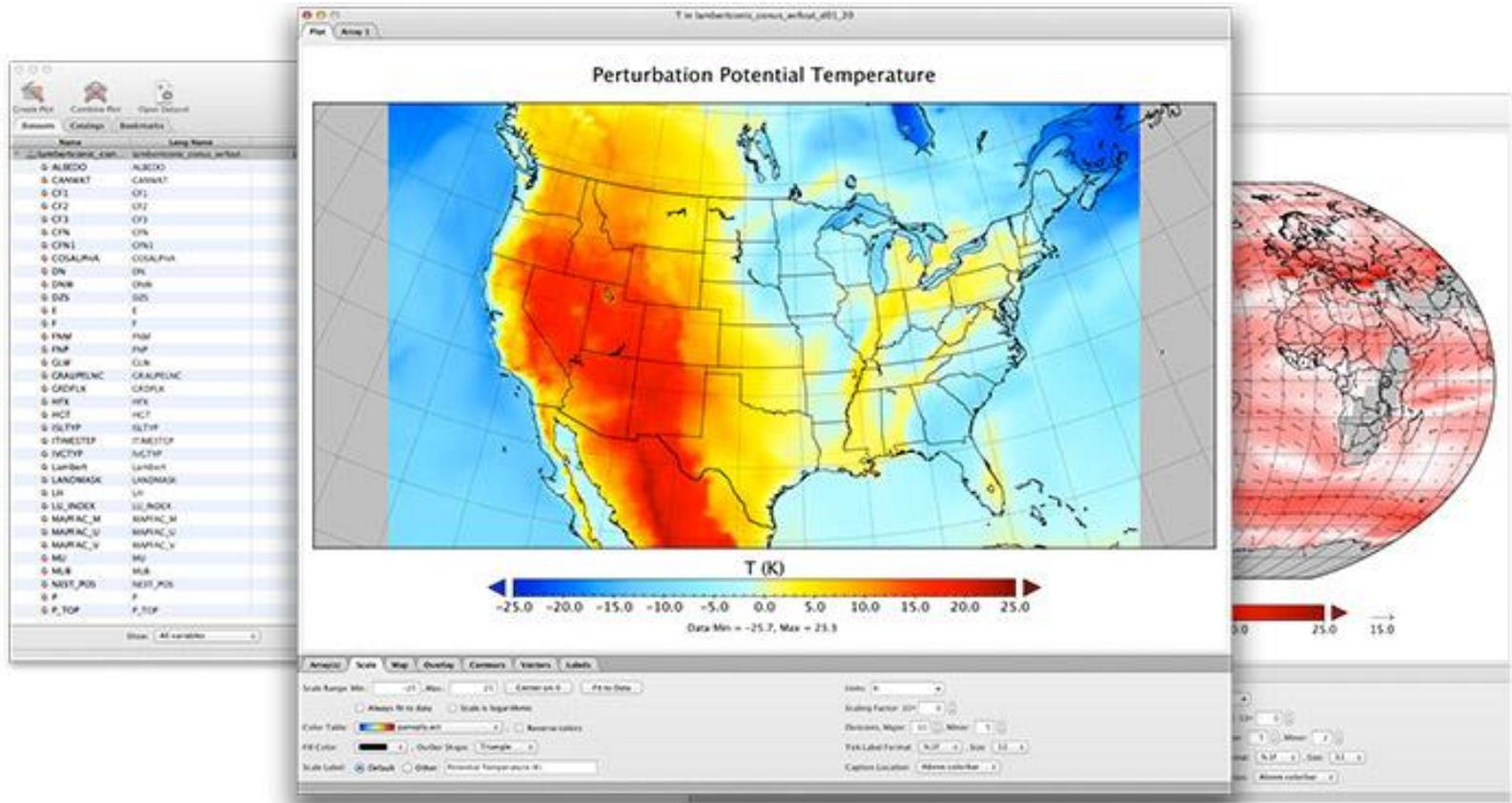


Back Off

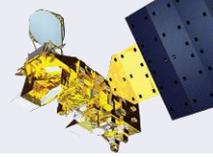
Sample tool -- Panoply



- Panoply is a cross-platform geo-aware tool from NASA GISS
- It works well for granule files and even better for Level-3



Sample tool -- Panoply

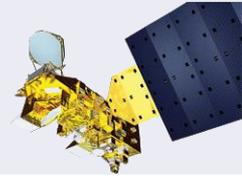


The screenshot displays the Panoply software interface. On the left is a 'Datasets' catalog with columns for Name, Long Name, and Type. The 'antenna' dataset is selected. The main window shows a plot of 'antenna_temp' in Kelvin, with the X-axis labeled 'atrack 0' and the Y-axis labeled 'v-axis: xtrack 0'. The plot shows a series of data points with error bars. Below the plot are controls for 'Arrays', 'Scale', 'Grid', 'Contours', and 'Labels'. The bottom of the interface shows a Windows taskbar with various application icons.

0.0000	0.0000	1.000	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000	10.000	11.000	12.000	13.000	14.000	15.000	16.000	17.000	
0.0000	204.6	204.6	204.8	206.0	206.6	208.0	209.0	210.7	211.9	213.0	214.6	216.1	217.8	220.1	222.5	225.0	228.2	230.0	230.0
1.000	213.3	212.9	212.5	212.6	212.5	213.2	213.6	214.2	214.9	216.0	217.7	219.4	221.7	224.3	227.7	231.3	235.4	239.0	239.0
2.000	219.8	218.7	218.2	217.9	217.2	216.2	216.4	216.8	216.9	217.5	218.9	221.1	223.4	226.7	231.0	235.5	241.4	246.0	246.0

Image: Mark Apolinski

Sample tool -- Panoply



Sources

Create Plot Combine Plot Open Dataset

Datasets Catalogs Bookmarks

Name	Long Name	Type
SNDR.SNPP.ATMS.20160429T1148.m06...	SNDR.SNPP.ATMS.20160429T1148.m06.g119.L...	Local File
SNDR.SNPP.ATMS.20160429T1954.m06...	SNDR.SNPP.ATMS.20160429T1954.m06.g200.L...	Local File
antenna	antenna name	—
antenna_temp	antenna temperature	Geo2D
asc_flag	ascending orbit flag	1D
attitude_lbl	rotational direction	—
aux	aux	—
cold_temp	cold space temperature	2D
gain	calibration gain	2D
nonlin	nonlinearity correction	Geo2D
offset	calibration offset	2D
warm_temp	warm calibration temperature	2D
band_geoloc_chan	band geolocation channel	1D
band_land_frac	band land fraction	Geo2D
band_lat	band latitude	2D
band_lat_bnds	band fov boundary latitudes	2D
band_lbl	Band name	—
band_lon	band longitude	2D
band_lon_bnds	band fov boundary longitudes	2D
band_surf_alt	band surface altitude	Geo2D
bandwidth	total bandwidth	1D
beam_width	Beam width	1D
calib_degraded	calibration degradation flags	2D
center_freq	channel center frequency	1D
chan_band	channel band	—
channel	channel number	1D
cold_nedt	cold NEDT	1D
geo_qual	geolocation quality	2D
if_offset_1	first intermediate frequency offset	1D
if_offset_2	second intermediate frequency offset	1D
instrument_state	instrument state	Geo2D
land_frac	land fraction	Geo2D
lat	latitude	2D
lat_bnds	FOV boundary latitudes	2D
lat_geoid	latitude	2D
lon	longitude	2D
lon_bnds	FOV boundary longitudes	2D
lon_geoid	longitude	2D
moon_ang	moon angle	2D
obs_id	earth view observation id	—
obs_time_tai	earth view FOV midtime	2D
obs_time_utc	earth view UTC FOV time	2D
polarization	Polarization	—
sat_alt	satellite altitude	1D
sat_att	satellite attitude	2D
sat_azi	satellite azimuth angle	Geo2D
sat_pos	satellite position	2D
sat_range	satellite range	Geo2D
sat_vel	satellite velocity	2D
sat_zen	satellite zenith angle	Geo2D
scan_mid_time	midscan TAI93	1D
sol_azi	solar azimuth angle	Geo2D
sol_zen	solar zenith anole	Geo2D

Show: All variables

File "SNDR.SNPP.ATMS.20160429T1148.m06.g119.L1A.std.v01_00_00J.160907133052.nc"

File type: Hierarchical Data Format, version 5

```
netcdf file:/Users/mdap01/Library/Group%20Containers/G695CX94XU.duck/Library/Application%20Support/duck/
dimensions:
  spatial = 3;
  fov_poly = 8;
  utc_tuple = 8;
  attitude = 3;
  atrack = 135;
  xtrack = 96;
  channel = 22;
  band = 5;
  spaceextract = 4;
  bbxtrack = 4;
  engtrack = 45;
  kav4wtemp = 8;
  wg4wtemp = 7;
  shelftemp = 4;
variables:
  String obs_id(atrack=135, xtrack=96);
    :units = "1";
    :long_name = "earth view observation id";
    :description = "unique earth view observation identifier: yyyyymmddThhmm.aaaExx . Includes gran_id
    :coverage_content_type = "referenceInformation";

  byte instrument_state(atrack=135, xtrack=96);
    :units = "1";
    :long_name = "instrument state";
    :coordinates = "lon lat";
    :description = "instrument/data state: 0\'Process\' - Data is usable for science; 1\'Special\' -
    :_FillValue = -108; // byte
    :coverage_content_type = "qualityInformation";
    :flag_meanings = "Process Special Erroneous Missing";
    :flag_values = 00B, 10B, 20B, 30B; // byte
    :_Unsigned = "true";

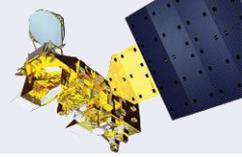
  double obs_time_tai(atrack=135, xtrack=96);
    :units = "seconds since 1993-01-01 00:00";
    :valid_range = -2.934835217E9, 3.376598409E9; // double
    :long_name = "earth view FOV midtime";
    :standard_name = "time";
    :description = "earth view observation midtime for each FOV";
    :_FillValue = 9.969289968386869E36; // double
    :coverage_content_type = "referenceInformation";

  short obs_time_utc(atrack=135, xtrack=96, utc_tuple=8);
    :units = "1";
    :long_name = "earth view UTC FOV time";
    :coordinates = "utc_tuple_lbl";
    :description = "UTC earth view observation time as an array of integers: year, month, day, hour, m
    :_FillValue = -105; // short
    :coverage_content_type = "referenceInformation";
    :_Unsigned = "true";

  float lat(atrack=135, xtrack=96);
    :units = "degrees_north";
    :valid_range = -90.0f, 90.0f; // float
    :long_name = "latitude";
```

Image: Mark Apolinski

Sample tool -- Panoply



The screenshot shows the Panoply software interface. On the left, a tree view lists various datasets under the 'Sources' tab. A context menu is open over the 'antenna' dataset, showing options like 'Create Extra Small Plot', 'Export CDL...', and 'Remove Dataset'. The main table displays the following data:

Name	Long Name	Type
SNDR.SNPP.ATMS.20160429T1148.m06...	SNDR.SNPP.ATMS.20160429T1148.m06.g119.L...	Local File
SNDR.SNPP.ATMS.20160429T1954.m06...	SNDR.SNPP.ATMS.20160429T1954.m06.g200.L...	Local File
antenna	antenna name	—
antenna	antenna temperature	Geo2D
asc_flg	ascending orbit flag	1D
attitude	attitude	—
azimuth	azimuth direction	—
aux	auxiliary variables	—
cold	space temperature	2D
gain	radiation gain	2D
nonl	nonlinearity correction	Geo2D
offset	radiation offset	2D
warm	calibration temperature	2D
band_g	geolocation channel	1D
band_l	land fraction	Geo2D
band_l	latitude	2D
band_l	fov boundary latitudes	2D
band_l	name	—
band_l	longitude	2D
band_lon_bnds	band fov boundary longitudes	2D
band_surf_alt	band surface altitude	Geo2D
bandwidth	total bandwidth	1D
beam_width	Beam width	1D
calib_degraded	calibration degradation flags	2D
center_freq	channel center frequency	1D
chan_band	channel band	—
channel	channel number	1D
cold_nedt	cold NEDT	1D
geo_qual	geolocation quality	2D
if_offset_1	first intermediate frequency offset	1D
if_offset_2	second intermediate frequency offset	1D
instrument_state	instrument state	Geo2D
land_frac	land fraction	Geo2D
lat	latitude	2D
lat_bnds	FOV boundary latitudes	2D
lat_geoid	latitude	2D
lon	longitude	2D
lon_bnds	FOV boundary longitudes	2D
lon_geoid	longitude	2D
moon_ang	moon angle	2D
obs_id	earth view observation id	—
obs_time_tai	earth view FOV midtime	2D
obs_time_utc	earth view UTC FOV time	2D
polarization	Polarization	—
sat_alt	satellite altitude	1D
sat_att	satellite attitude	2D
sat_azi	satellite azimuth angle	Geo2D
sat_pos	satellite position	2D
sat_range	satellite range	Geo2D
sat_vel	satellite velocity	2D
sat_zen	satellite zenith angle	Geo2D
scan_mid_time	midscan TAI@3	1D
sol_azi	solar azimuth angle	Geo2D
sol_zen	solar zenith angle	Geo2D

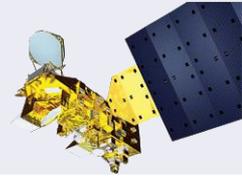
On the right, the 'Variable "antenna_temp"' definition is shown:

```

float antenna_temp(atrack=135, xtrack=96, channel=22);
:units = "Kelvin";
:ancillary_variables = "antenna_temp_err";
:valid_range = 0.0f, 400.0f; // float
:long_name = "antenna temperature";
:standard_name = "brightness_temperature";
:coordinates = "lon lat";
:description = "Calibrated scene brightness temperature for each ATMS channel and beam position. This";
:_FillValue = 9.96921E36f; // float
:coverage_content_type = "physicalMeasurement";
    
```

Image: Mark Apolinski

Sample tool -- Panoply



The screenshot shows the Panoply software interface. The main window displays a tree view of datasets and variables. A variable definition window for 'antenna_temp' is open, showing its metadata. A 'Create Plot' dialog box is also open, allowing the user to select a plot type and axes for the 'antenna_temp' variable.

Name	Long Name	Type
SNDR.SNPP.ATMS.20160429T1148.m06...	SNDR.SNPP.ATMS.20160429T1148.m06.g119.L...	Local File
SNDR.SNPP.ATMS.20160429T1954.m06...	SNDR.SNPP.ATMS.20160429T1954.m06.g200.L...	Local File
antenna	antenna name	—
antenna_temp	antenna temperature	Geo2D
asc_flag	ascending orbit flag	1D
attitude_lbl	rotational direction	—
aux	aux	—
cold_temp	cold space temperature	2D
gain	calibration gain	2D
nonlin	nonlinearity correction	Geo2D
offset	calibration offset	2D
warm_temp	warm calibration temperature	2D
band_geoloc_chan	band geolocation channel	1D
band_land_frac	band land fraction	Geo2D
band_lat	band latitude	2D
band_lat_bnds	band fov boundary latitudes	2D
band_lbl	Band name	—
band_lon	band longitude	2D
band_lon_bnds	band fov boundary longitudes	2D
band_surf_alt	band surface altitude	—
bandwidth	total bandwidth	—
beam_width	Beam width	—
calib_degraded	calibration degradation flags	—
center_freq	channel center frequency	—
chan_band	channel band	—
channel	channel number	—
cold_nedt	cold NEDT	—
geo_qual	geolocation quality	—
if_offset_1	first intermediate frequency offset	—
if_offset_2	second intermediate frequency offset	—
instrument_state	instrument state	—
land_frac	land fraction	—
lat	latitude	2D
lat_bnds	FOV boundary latitudes	2D
lat_geoid	latitude	2D
lon	longitude	2D
lon_bnds	FOV boundary longitudes	2D
lon_geoid	longitude	2D
moon_ang	moon angle	2D
obs_id	earth view observation id	—
obs_time_tai	earth view FOV midtime	2D
obs_time_utc	earth view UTC FOV time	2D
polarization	Polarization	—
sat_alt	satellite altitude	1D
sat_att	satellite attitude	2D
sat_azi	satellite azimuth angle	Geo2D
sat_pos	satellite position	2D
sat_range	satellite range	Geo2D
sat_vel	satellite velocity	2D
sat_zen	satellite zenith angle	Geo2D
scan_mid_time	midscan TAI93	1D
sol_azi	solar azimuth angle	Geo2D
sol_zen	solar zenith angle	Geo2D

```

Variable "antenna_temp"
float antenna_temp(atrack=135, xtrack=96, channel=22);
:units = "Kelvin";
:ancillary_variables = "antenna_temp_err";
:valid_range = 0.0f, 400.0f; // float
:long_name = "antenna temperature";
:standard_name = "brightness_temperature";
:coordinates = "lon lat";
:description = "Calibrated scene brightness temperature for each ATMS_channel and beam position. This
:_FillValue = 9.96921E36f; // float
:coverage_content_type = "physicalMeasurement";
    
```

Create Plot dialog:

 More than one type of plot can be created from the variable 'antenna_temp'. What type would you like to create?

 Create georeferenced Longitude-Latitude plot

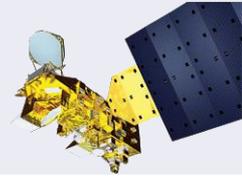
 Create 2D plot using atrack for X axis and xtrack for Y axis

 Create horizontal line plot along atrack axis

 [Cancel] [Create]

Image: Mark Apolinski

Sample tool -- Panoply



The screenshot shows the Panoply software interface. The main window displays a tree view of datasets and variables. A variable definition window for 'antenna_temp' is open, showing its metadata. A 'Create Plot' dialog box is also open, allowing the user to select a plot type and axes for the variable.

Name	Long Name	Type
SNDR.SNPP.ATMS.20160429T1148.m06...	SNDR.SNPP.ATMS.20160429T1148.m06.g119.L...	Local File
antenna	antenna name	—
antenna_temp	antenna temperature	Geo2D
asc_flag	ascending orbit flag	1D
attitude_lbl	rotational direction	—
aux	aux	—
cold_temp	cold space temperature	2D
gain	calibration gain	2D
nonlin	nonlinearity correction	Geo2D
offset	calibration offset	2D
warm_temp	warm calibration temperature	2D
band_geoloc_chan	band geolocation channel	1D
band_land_frac	band land fraction	Geo2D
band_lat	band latitude	2D
band_lat_bnds	band fov boundary latitudes	2D
band_lbl	band name	—
band_lon	band longitude	2D
band_lon_bnds	band fov boundary longitudes	2D
band_surf_alt	band surface altitude	—
bandwidth	total bandwidth	—
beam_width	Beam width	—
calib_degraded	calibration degradation flags	—
center_freq	channel center frequency	—
chan_band	channel band	—
channel	channel number	—
cold_nedt	cold NEDT	—
geo_qual	geolocation quality	—
if_offset_1	first intermediate frequency offset	—
if_offset_2	second intermediate frequency offset	—
instrument_state	instrument state	—
land_frac	land fraction	—
lat	latitude	2D
lat_bnds	FOV boundary latitudes	2D
lat_geoid	latitude	2D
lon	longitude	2D
lon_bnds	FOV boundary longitudes	2D
lon_geoid	longitude	2D
moon_ang	moon angle	2D
obs_id	earth view observation id	—
obs_time_tai	earth view FOV midtime	2D
obs_time_utc	earth view UTC FOV time	2D
polarization	Polarization	—
sat_alt	satellite altitude	1D
sat_att	satellite attitude	2D
sat_azi	satellite azimuth angle	Geo2D
sat_pos	satellite position	2D
sat_range	satellite range	Geo2D
sat_vel	satellite velocity	2D
sat_zen	satellite zenith angle	Geo2D
scan_mid_time	midscan TAI93	1D
sol_azi	solar azimuth angle	Geo2D
sol_zen	solar zenith angle	Geo2D

```

Variable "antenna_temp"
float antenna_temp(atrack=135, xtrack=96, channel=22);
:units = "Kelvin";
:ancillary_variables = "antenna_temp_err";
:valid_range = 0.0f, 400.0f; // float
:long_name = "antenna temperature";
:standard_name = "brightness_temperature";
:coordinates = "lon lat";
:description = "Calibrated scene brightness temperature for each ATMS_channel and beam position. This
:_FillValue = 9.96921E36f; // float
:coverage_content_type = "physicalMeasurement";
    
```

Create Plot dialog:

 More than one type of plot can be created from the variable 'antenna_temp'. What type would you like to create?

 Create georeferenced Longitude-Latitude plot

 Create 2D plot using atrack for X axis and xtrack for Y axis

 Create horizontal line plot along atrack axis

 [Cancel] [Create]

Image: Mark Apolinski

Sample tool -- Panoply

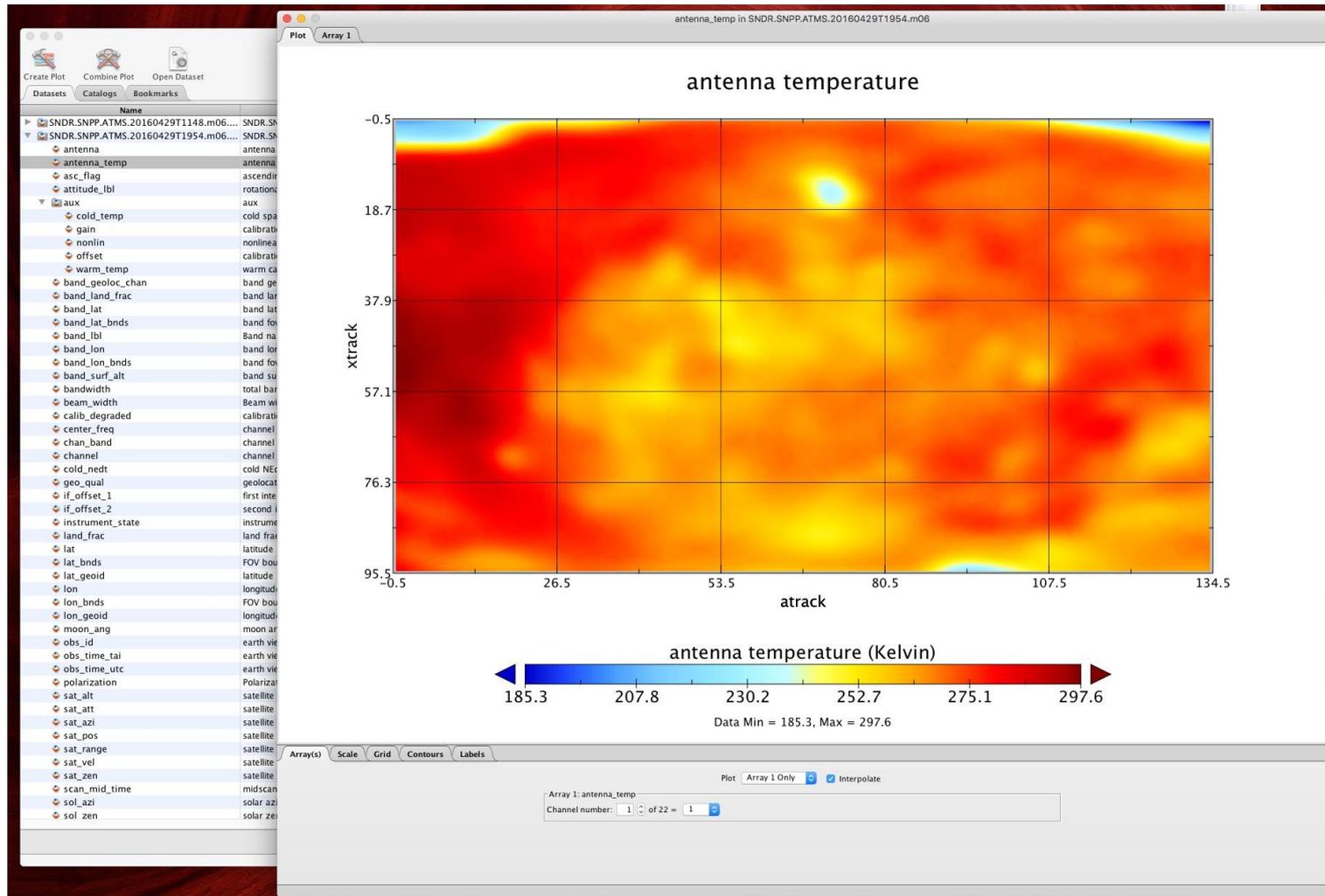
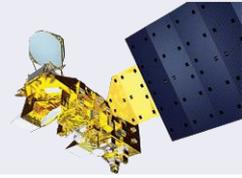
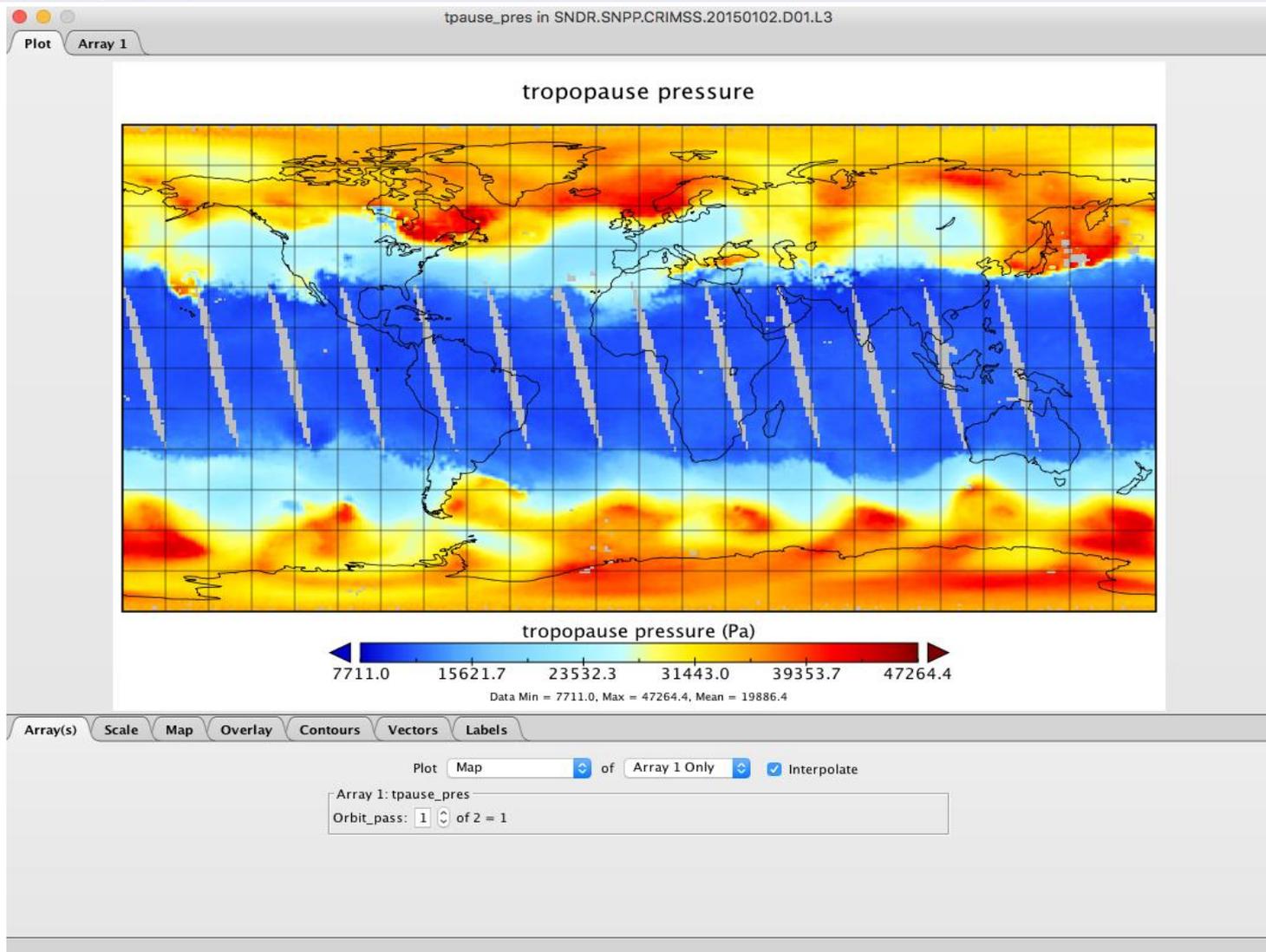
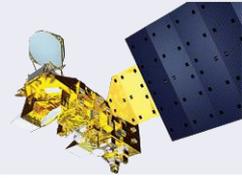
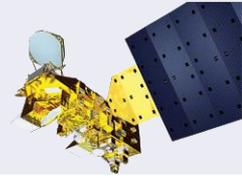


Image: Mark Apolinski

Level-3 sample



Group Structure for subset files



- Subset file types include SNO, Match-Ups, calibration subset
- Subset files add a layer of group structure at the top, so there are groups for L1B ATMS vs L1B CrIS vs L2 CrIMSS and new groups with info on the selection process and per-granule info
- Example: SNO of Aqua AMSU-A with ATMS:
 - **/l1b_amsua** – obs from L1B AMSU-A
 - **/l1b_atms** – obs from L1B ATMS
 - **/select** – info about the match: **distance**, **dtime**, ...
 - **/l1b_amsua_ingran** – AMSU-A attributes as 240-element arrays: **ingran_gran_id**, **ingran_file_name**, **ingran_day_night_flag**, ...
 - **/l1b_atms_ingran**