Design Features

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Agenda

• Design Features	Larry Klein	55 min
• The HDF-EOS Library: Interfaces and Examples	Doug Ilg	40 min
• Population of Granule Metadata	Richard Morris	30 min
• HDF-EOS Development: Version 1 and Beyond	Larry Klein	10 min

Goals for Standard Data Format

Goals for a Standard Data Format include:

- **Making Data Self-Describing**
  - by, for example, adding annotations to data arrays and tables

- **Making Data Easily Accessible**
  - by providing instrument-independent data structures
  - by using widely available standards and software

- **Standardizing Information Classes**
  - ODL Metadata, Geolocation, Annotations, Organization

- **Providing Instrument-Independent Services**
  - Geolocation Services: row/column to/from latitude/longitude
  - Subsetting and subsampling by parameter, row/col, lat/long

Goals for Standard Data Format (cont.)

Supports Core System Development:

- **Provides interface standard for passing of data**
  - Focus conventions for writing data
  - Production to Ingest
  - Ingest to inventory and data archive population
  - Archive to distribution

- **Allows Collection-Independent Development and Services**
  - Geolocation Services: row/column to/from latitude/longitude
  - Subsetting and subsampling by parameter, row/col, lat/long

What is HDF-EOS

HDF-EOS is our way of addressing these standard data format needs.

- **HDF-EOS is HDF with EOS conventions**
  - We have made no changes to the HDF standard or HDF library
  - HDF-EOS is HDF plus ECS core metadata
  - Consistent metadata location and format - ODL
- **HDF-EOS files are readable by standard HDF libraries**
  - However, EOS specific services may not be available
- **The HDF-EOS Library is needed only for HDF-EOS services**
  - Such as subsetting or subsampling by geolocation
- **The HDF-EOS Library is merely an extension to the HDF library**
  - Similar API philosophy

For more info on HDF and HDF-EOS: http://eos.nasa.gov/esdis/InfoArch

HDF-EOS Data Objects

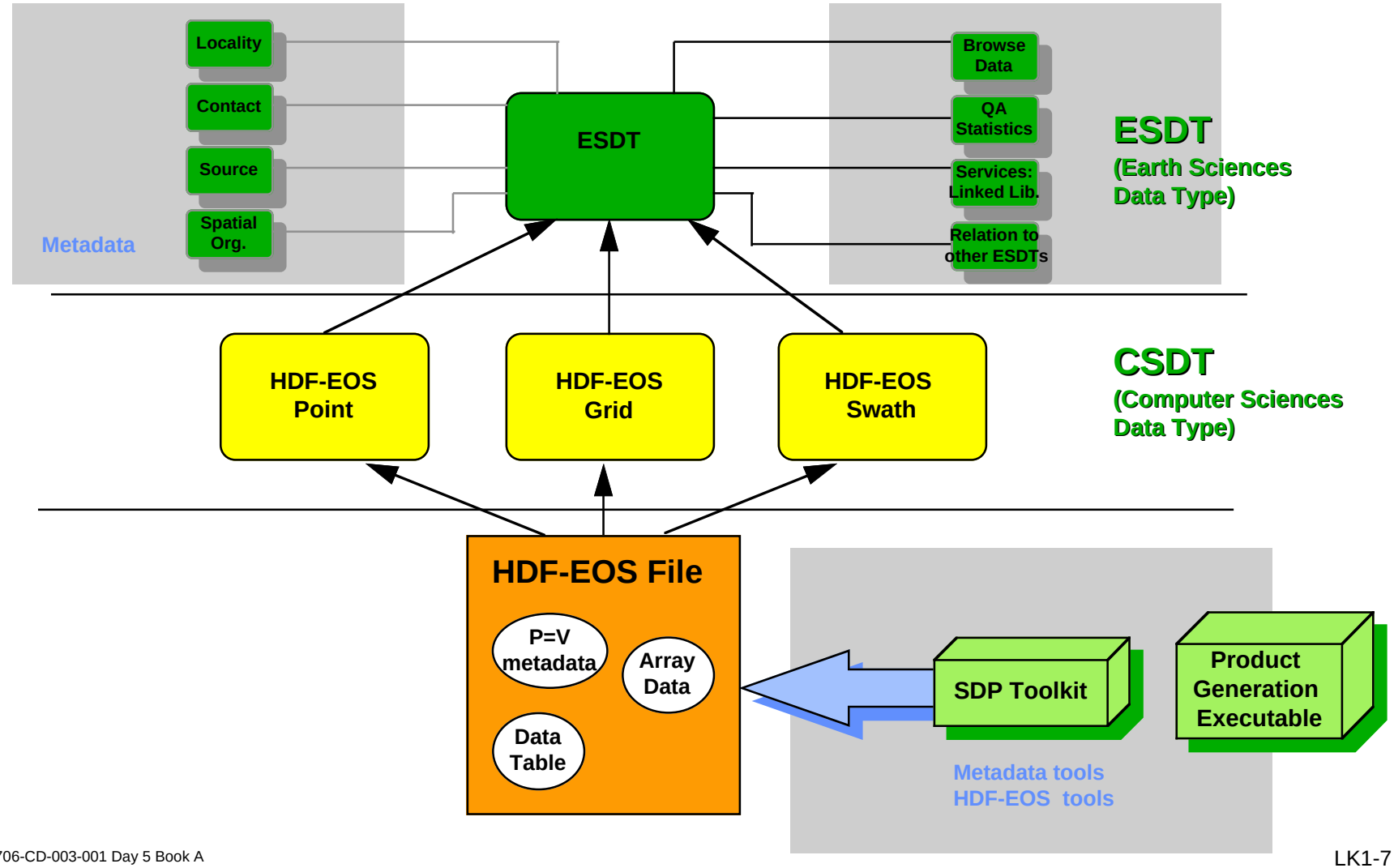
Non-Geolocated Structures (HDF)

- **N-Dimensional Array** (implemented using SDS)
- **Science Data Table** (implemented using Vdata)
- **Raster Image** (implemented using RIS8, RIS24)
- **Text** (implemented using global character Attribute)
- **Inventory and Product-Specific Metadata** (uses global character Attribute)

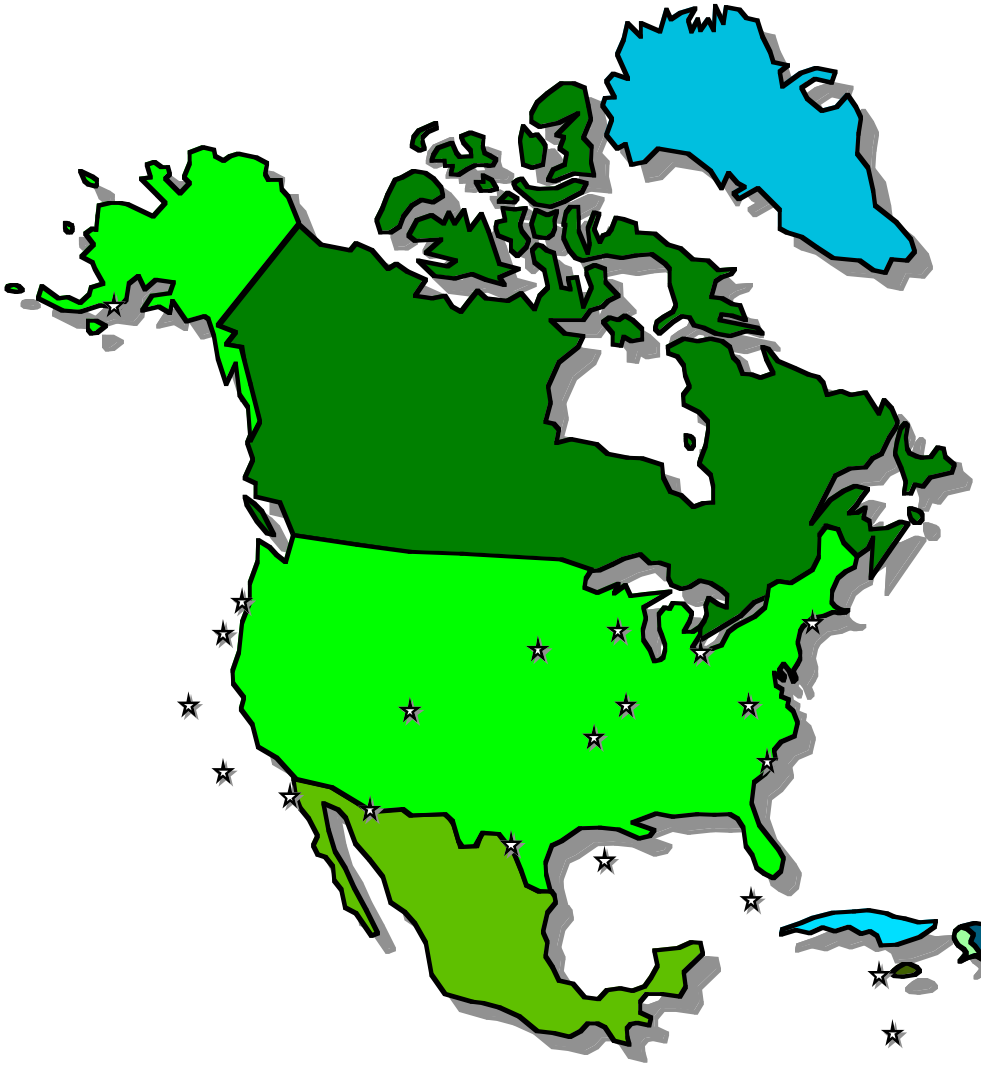
Geolocated Structures (HDF-EOS)

- **Point** (implemented using one or several Vdatas)
- **Grid** (implemented using one or several SDSs, with structural metadata)
- **Swath** (uses one or several SDSs and/or Vdatas, with structural metadata)

Building Blocks



Point Concept



X-coord	Y-coord	Temp(F)	Dewpt(F)	Press(Mb)
4158095.30	2769728.30	15.00	5.00	1020.60
4206175.00	2711076.00	17.00	5.00	1022.30
4157729.80	2479427.00	24.00	7.00	1025.70
3925337.00	2395113.80	27.00	11.00	1026.70
3975751.30	2386686.80	22.00	7.00	1025.40
4151424.80	2401246.50	25.00	10.00	1026.70
4089275.00	2322289.50	27.00	4.00	1027.10
4105378.00	2298648.30	30.00	14.00	1027.80
4102765.80	2221281.00	25.00	4.00	1026.40
4157063.30	2257515.30	32.00	8.00	1029.10
4135176.50	2259278.80	30.00	10.00	1028.40
4143326.00	2199940.30	28.00	7.00	1029.10
4241048.50	2213741.80	30.00	9.00	1029.80
4155608.00	2183512.00	28.00	9.00	1029.80
4057283.50	2164707.50	30.00	8.00	1029.80
4053443.80	2075632.50	32.00	15.00	1031.50
4168271.50	2124656.30	31.00	16.00	1030.80
4042344.00	2107557.00	28.00	7.00	1030.10
4228692.50	2255477.30	32.00	13.00	1029.10
4192218.50	2193917.50	28.00	9.00	1029.50
4121272.00	2593960.50	19.00	3.00	1021.00
4274966.00	2181822.00	29.00	18.00	1029.50

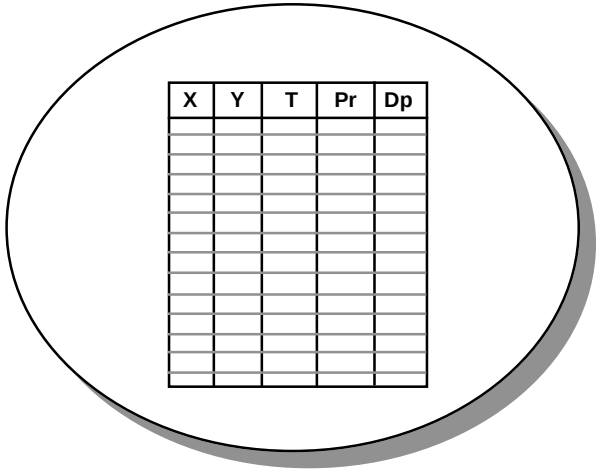
HDF-EOS Point Structure

A Point Structure consists of individual data values, each with geolocation.
All data values in the same row share the same geolocation.
It contains at least one of the following:

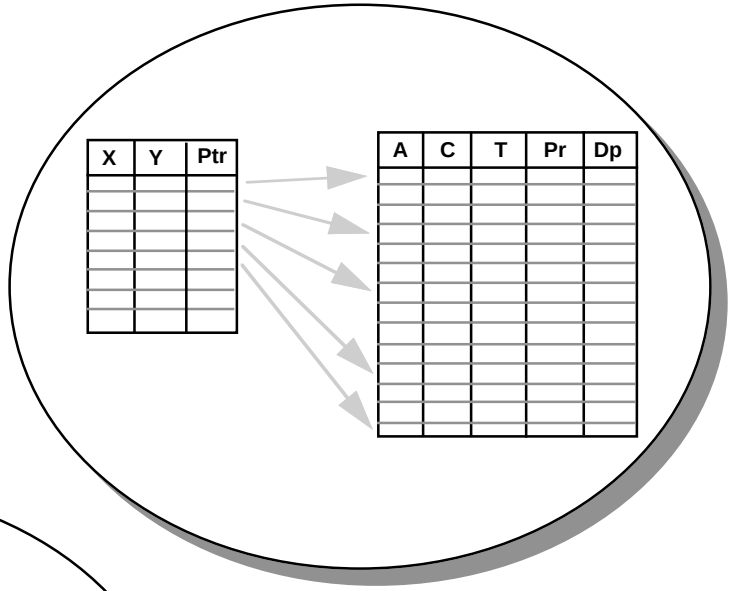
- **A Geolocated Table**
  - Some columns in the table must contain geolocation information

- **A non-Geolocated Table**
  - No columns of geolocation information
  - However, this table may point into geolocated table, or a geolocated table may point into it

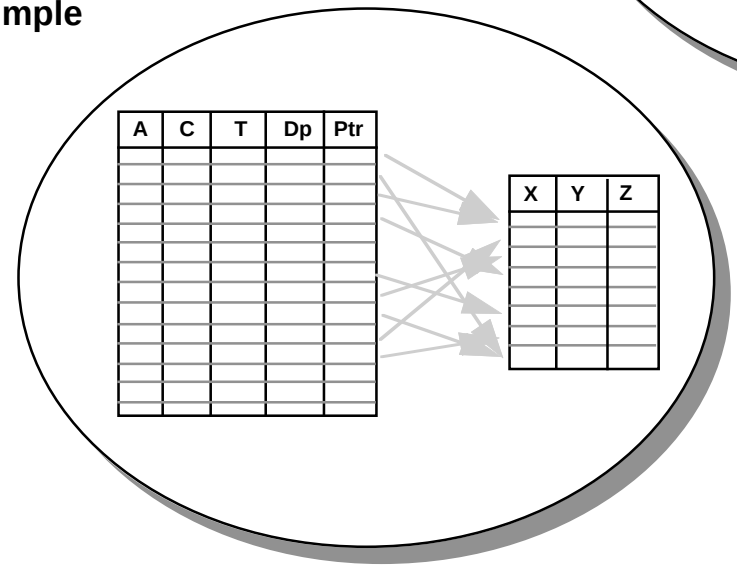
HDF-EOS Point Layout



Simple



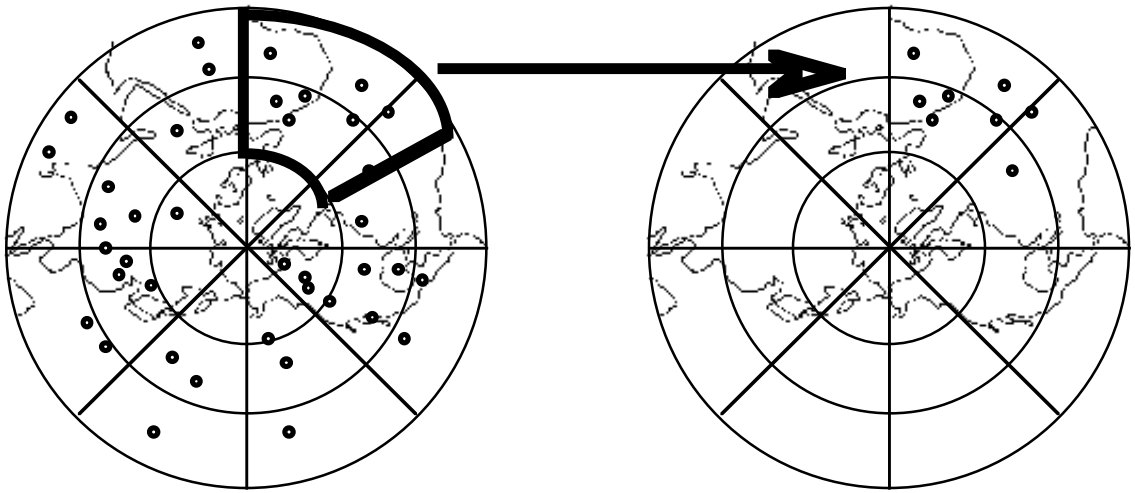
Index from Geo



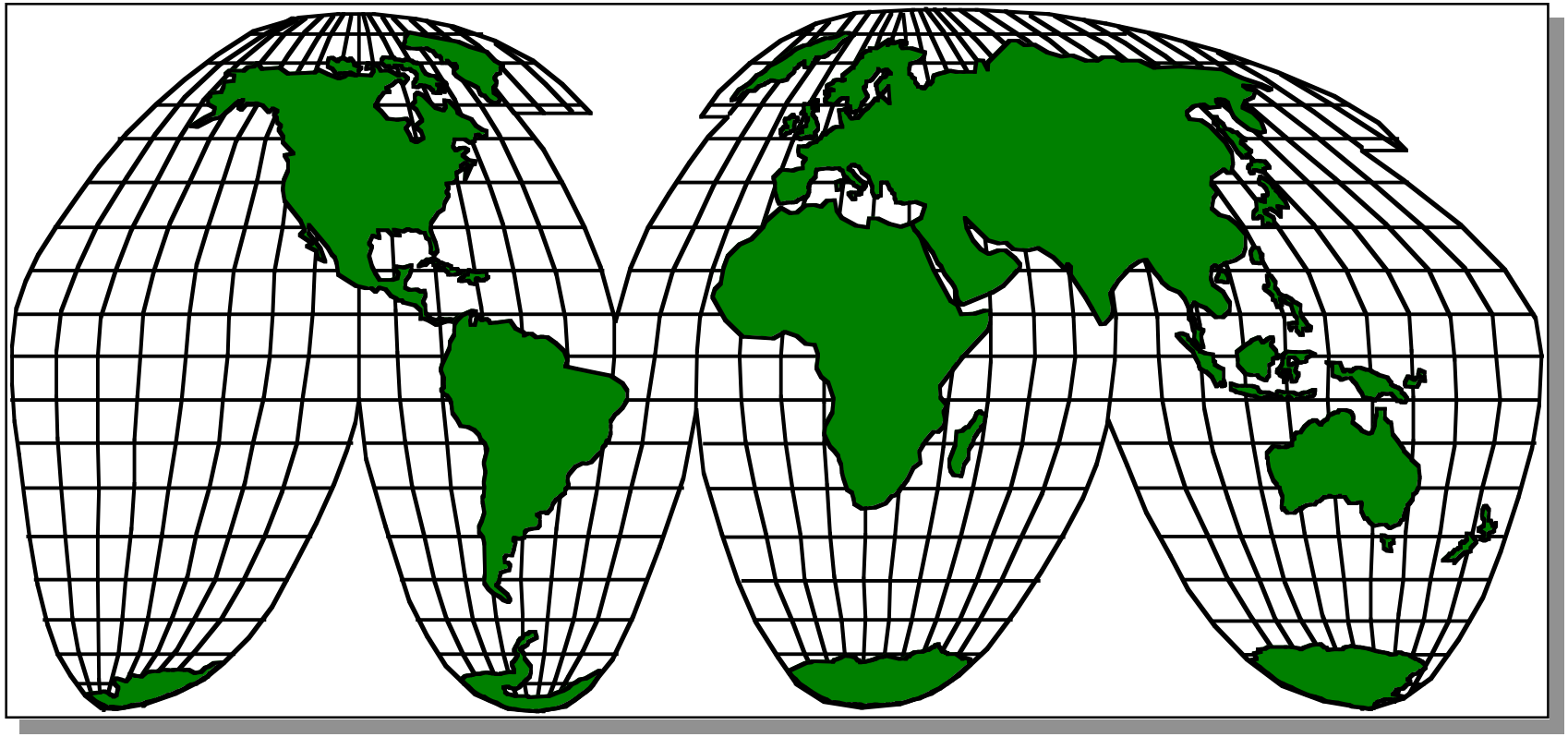
Index to Geo

HDF-EOS Services on Point

- **Subset by Parameter - Select a Field (column) out of a Table**
- **Subset by Row - Select row range for Fields**
- **Subset by Geolocation**
  - Subset Field entries by Latitude/Longitude bounding rectangle
  - Subset by time



Grid Concept



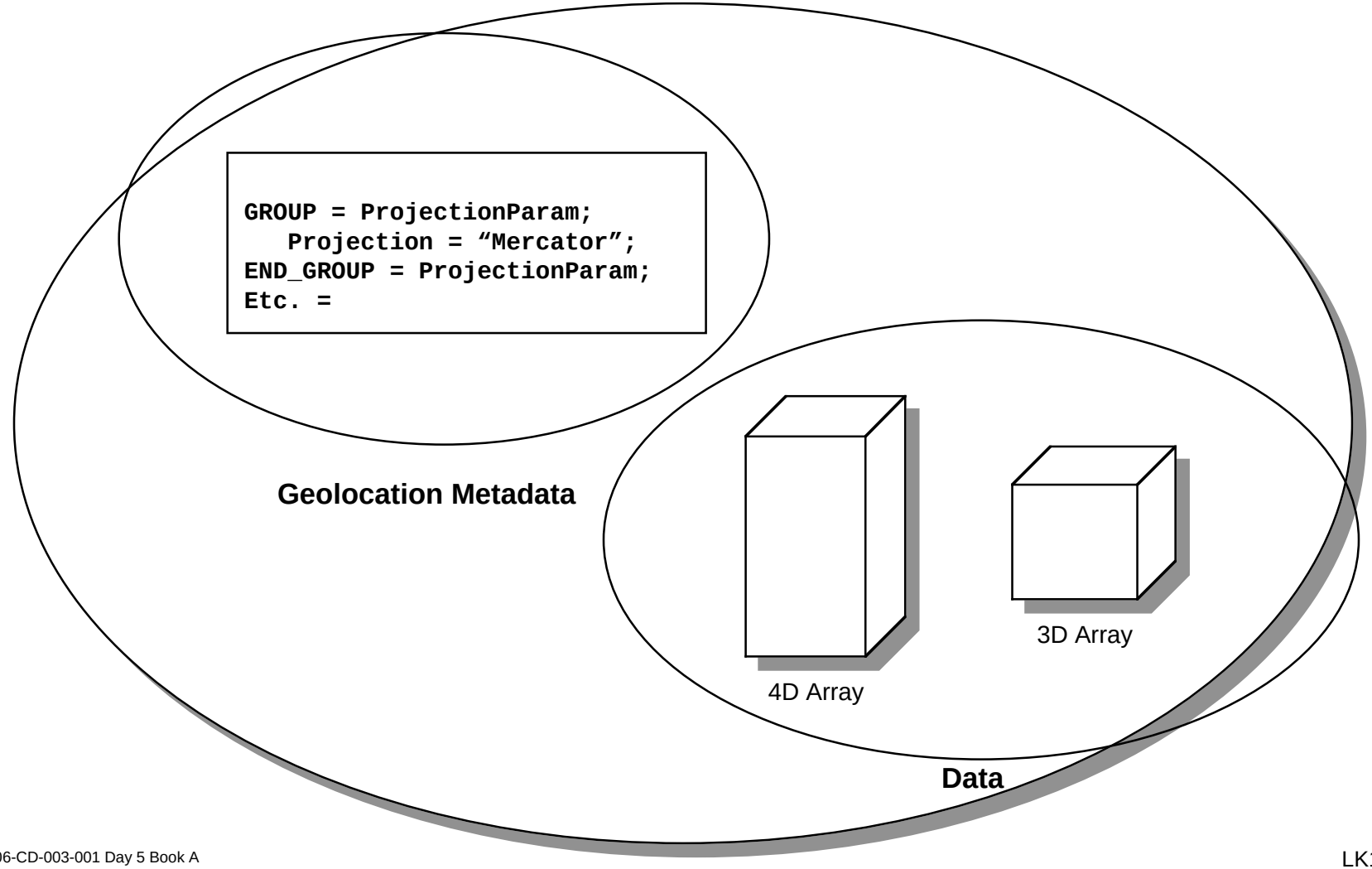
HDF-EOS Grid Structure

Grid contains arrays of data in a projection with a known mathematical transformation between row/col and lat/long. All arrays share the same geolocation. A grid structure contains:

- **Data Arrays**
  - 2D, 3D, or even 4D Arrays
- **ODL Metadata - describes projection information and relation to data.**

```
GROUP = “GridStructure”;
  Name = “Voyager_Grid”;
   GROUP = ProjectionParameter;
       Projection = “Mercator”;
   END_GROUP = ProjectionParameter;
   GROUP = Dimension;              /* define dimension */
       OBJECT = “X”;
          Size = 300;
       END_OBJECT = “X”;
   END_GROUP = Dimension;
   GROUP = DataParameter;          /* list data array */
       OBJECT = “Temperature”;     /* 1D array */
          DimList = (“X”);         /* with dimension X */
       END_OBJECT = “Temperature”;
   END_GROUP = DataParameter;
END_GROUP = “GridStructure”;
```

HDF-EOS Grid Layout

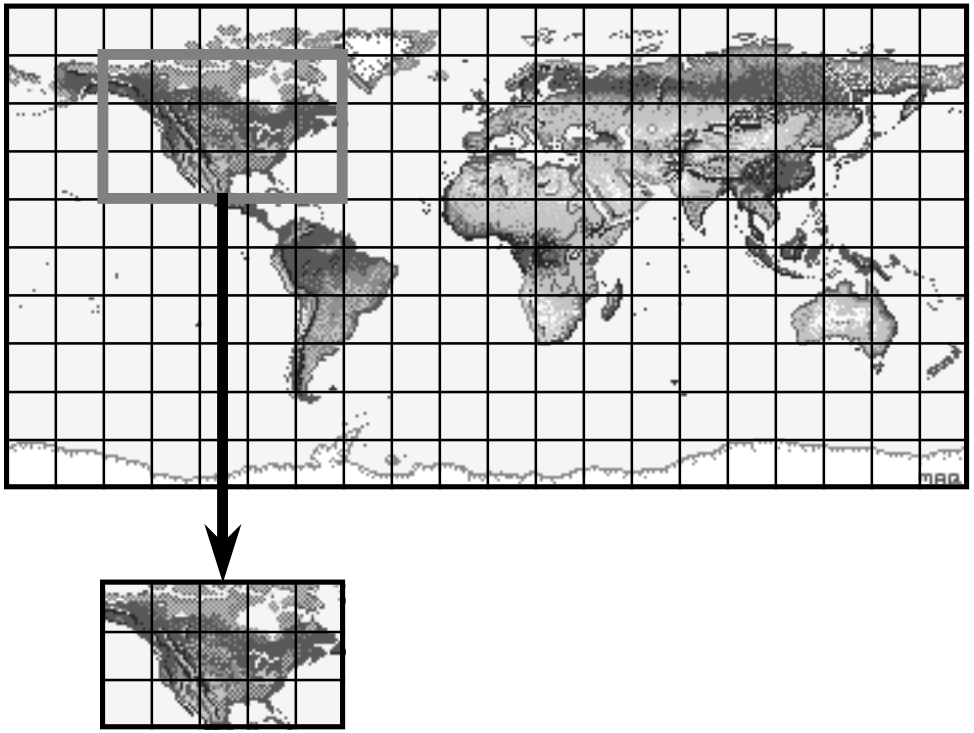


HDF-EOS Services on Grid

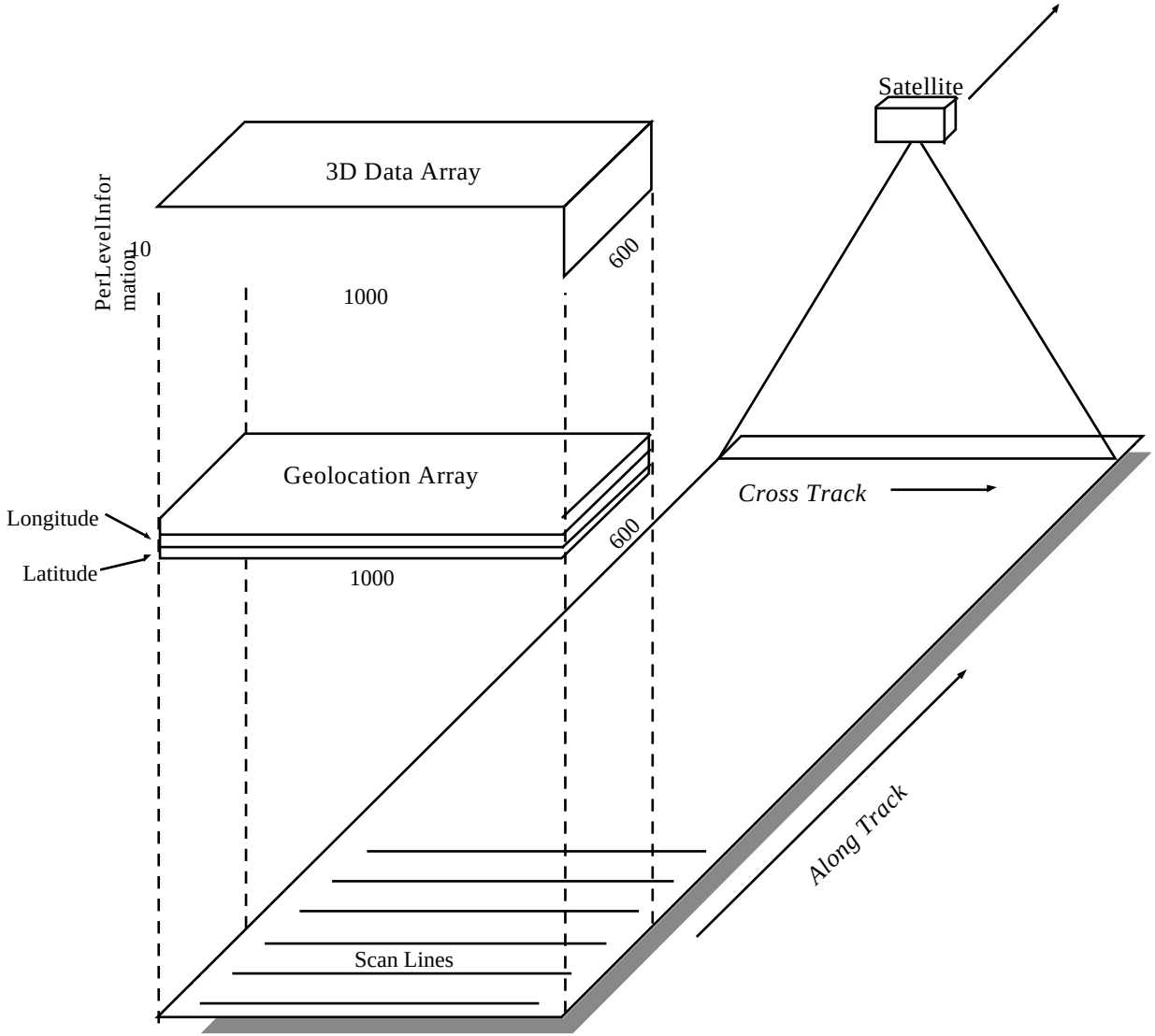
- **Subset by Parameter**
  - Select single array or a 2D plane out of a 3D array
- **Subset and Subsample by Row/Column**
  - Enter bounding Row/Column coordinates (uses straight HDF calls)
- **Geolocation Services**
  - Latitude/Longitude to/from Row/Column
  - Time services

HDF-EOS Services on Grid

- **Subset by Geolocation**
  - Convert Latitude/ Longitude pairs to row/column rectangle
  - Deliver row/column rectangular region
  - Very Rapid—based on geolocation services



Swath Concept

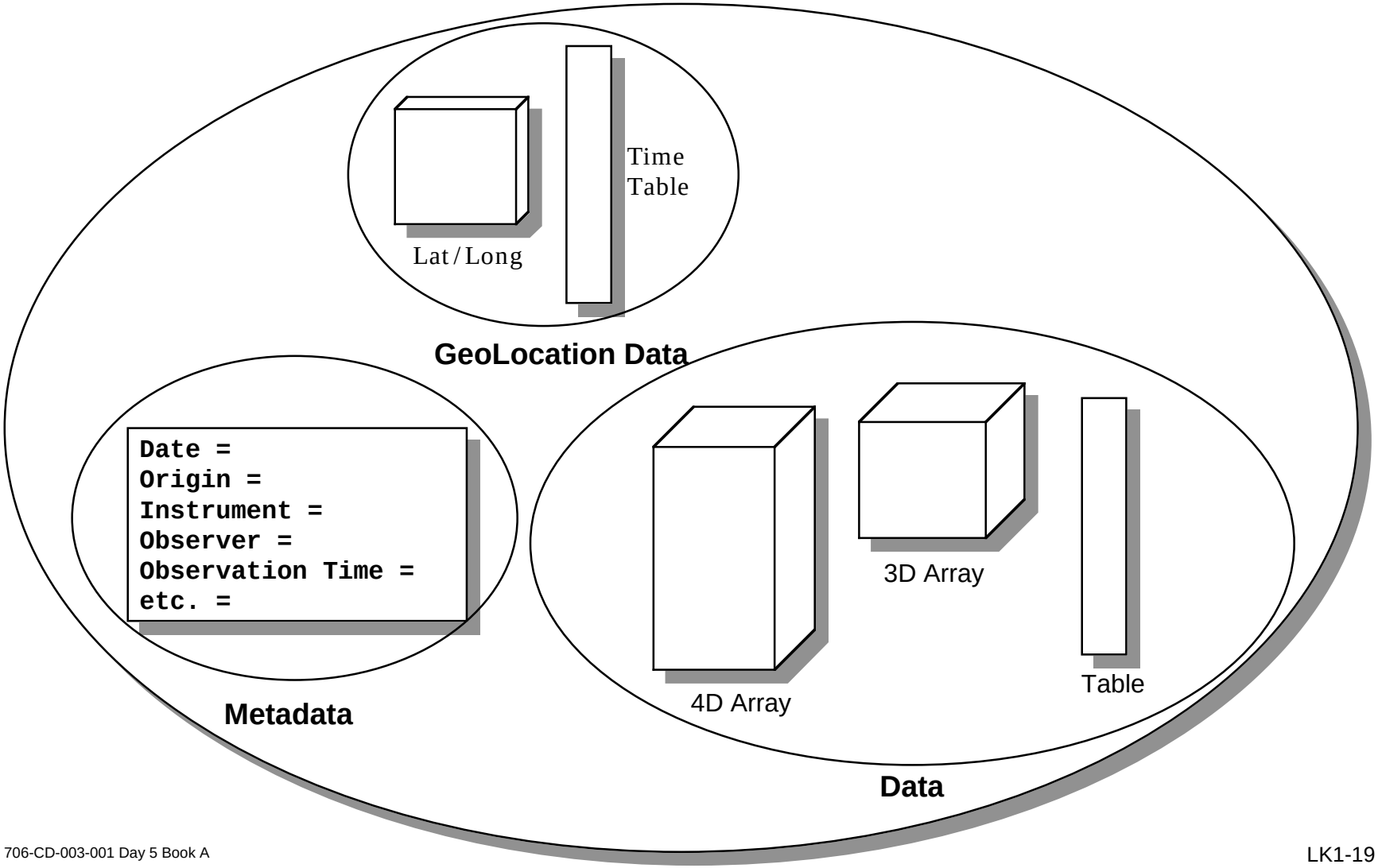


HDF-EOS Swath Structure

Arrays and tables of data with geolocation per data element or scan line.
All data shares same geolocation, albeit with different skip factors. Contains:

- **Geolocation Info**
  - 2D arrays of geolocation (latitude, longitude, time), and/or
  - 1D table of geolocation values per scan line
- **Data Arrays and Tables**
  - 2D, 3D, or 4D Arrays
  - Science data tables (scalars per scan line)
- **ODL Metadata**
  - Describes the relationship between geolocation and data

HDF-EOS Swath Layout

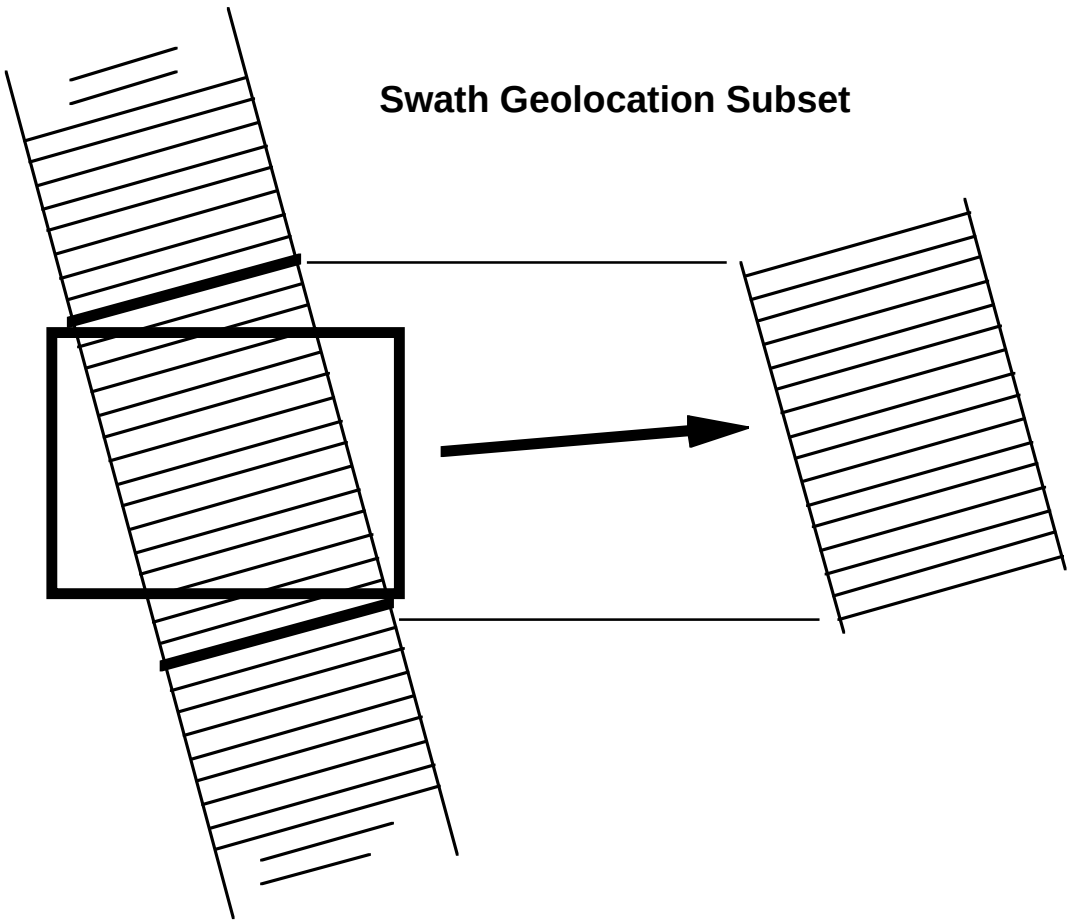


HDF-EOS Services on Swath

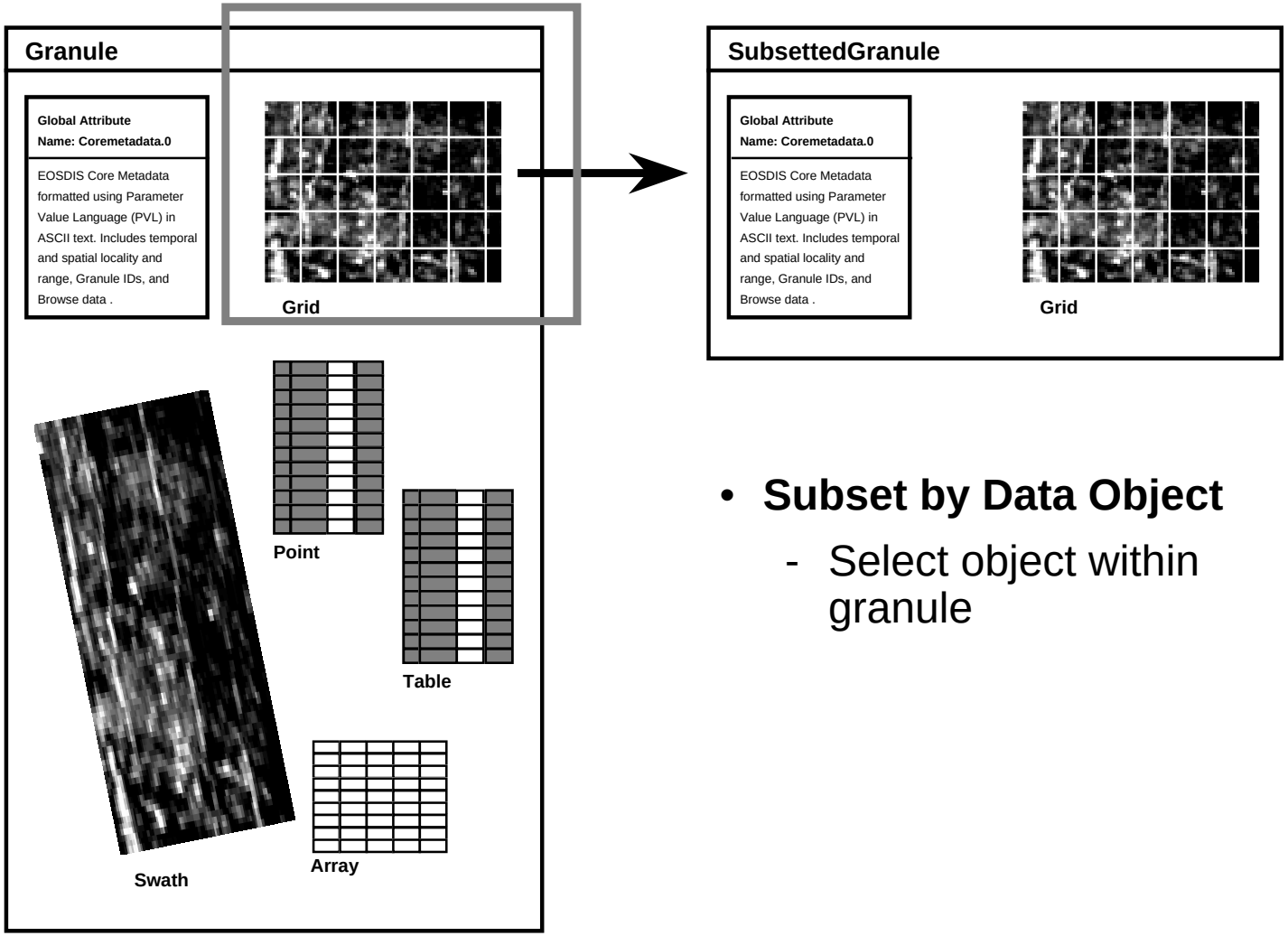
- **Subset by Parameter**
  - Select a single array or a 2D plane out of a 3D array
  - Select a single field out of a table
- **Subset and Subsample by Row/Column**
  - Enter bounding row/column coordinates
  - Select row range for fields, stride parameter
- **Geolocation Services**
  - Row/Column or Scanline Index, to Lat/Long
  - Subset by Lat/Long, time.

HDF-EOS Services on Swath

- **Subset by Geolocation**
  - Select scanlines by specifying bounding Latitude/Longitude rectangle
  - Scanlines are located either by centerpoint or by endpoints
  - No subsetting of individual scanlines currently planned



Subsetting by Object



- **Subset by Data Object**
  - Select object within granule

Services Supplied (Abbreviated)

- **HDF-EOS API and Library**
  - Grid, point, swath, browse package
  - Create, read, write
  - Subset, subsample by time/geolocation
  - ODL metadata parser

- **EOSView**
  - View HDF-EOS contents, i.e. comprehend grid, point, swath
  - Display multiple files simultaneously
  - Display SDSs and Vdatas in table form, SDSs in image form
  - Display metadata
  - Image display, palette control
  - Scripting
  - Save components as ASCII text or binary files