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Working Draft - Version 2: Remote Sensing Swath Data Content Standard

Standards Working Group
Federal Geographic Data Committee

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Federal Geographic Data Committee

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1. INTRODUCTION

1.1 Objective

The primary objective of this standard is to define the minimum content for remote sensing swath data (hereinafter called the swath data model). Such a content standard will provide a solid basis upon which to develop interoperable data formats for this common form of remote sensing data.

The standard has the following goals:

1. To provide a common conceptual framework for encoding swath and swath-like data,
2. To encourage interuse of swath and swath-like data through implementation of transfer standards within the conceptual framework,
3. To involve non-federal organizations in the development of this standard, thus encouraging broad applications.

1.2 Scope

The standard defines the minimal content requirements for a remote sensing swath and the relationships among its individual components. It also discusses the treatment of optional supporting information within the swath model. Under the Federal Geographic Data Committee Standards Reference Model (FGDC 1997b), this standard is classified as a **Data Content Standard**. Data content standards provide semantic definitions of a set of objects and of the future time by a separate standard or standards.

The standard specifies only the information that varies with time or from pixel to pixel. Information that is constant for all data points, such as the axes about which platform roll, pitch, and yaw are measured or the orientation of individual instruments relative to the platform, would be specified elsewhere, for example, in a content standard for remote sensing metadata.

1.3 Applicability

The swath data standard for remote sensing supports the development of the NSDI by providing a common framework for the organization of a wide range of remotely sensed data. The standard will be particularly useful for data from scanning, profiling, staring, or push-broom type remote sensing instruments, whether they be ground based, shipboard, airborne, or spaceborne.

1.4 Related Standards

The Remote Sensing Swath Data Content Standard integrates with existing standards as much as possible. This standard is an outgrowth of standards work done for the Earth Observing System Data and Information System (EOSDIS), part of the Earth Observing System, under NASA's Mission to Planet Earth. As such, it draws heavily on the NASA EOSDIS concepts and data model for remote sensing swath data (HAIS 1995), which were, themselves, developed from in no way depends upon them. In fact, it is the tools that rely on the existing EOSDIS data model. The Committee on Earth Observation Satellites (CEOS), an international information exchange body, has endorsed the development of data models for remotely sensed swath data, through the Data Subgroup of its Working Group on Information Systems and Services (WGISS).

The Spatial Data Transfer Standard (SDTS) addresses the transfer of geospatial data among computer systems (FIPS 1994). The Raster Profile of SDTS, because it can be used to transfer remote sensing data, is remotely related to the proposed swath standard. However, the SDTS Raster Profile is a transfer standard, while the proposed swath standard is a content standard. So, while the SDTS Raster Profile could probably be adapted to transfer remote sensing swath data, there is no overlap between the standards, because they deal with different aspects of the data standardization described by the FGDC Standards Reference Model.

No other current FGDC, national, or international standard addresses this facet of sharing remote sensing swath data.

1.5 Standards Development Procedures

This standard has been developed by the Imagery Subgroup of FGDC's Standards Working revised, where appropriate, in accordance with these comments, and the author of the comments either notified that the comments had been incorporated or provided an explanation of why they had not been. The revised draft was then submitted to the Imagery Subgroup, and as there were no further changes recommended, on the Standards Working Group. The development of this standard is guided by the FGDC Standards Reference Model (FGDC 1997). The Standards Reference Model, developed by the Standards Working Group of the FGDC, provides guidance to FGDC subcommittees and working groups for the standards development process. It also defines the expectations for FGDC standards, describes different types of geospatial standards, and documents the FGDC standards process.

1.6 Maintenance Authority

The Earth Science Data and Information System (ESDIS) Program of the National Aeronautics and Space Administration (NASA) maintains this standard for the Federal Geographic Data Committee. Address questions concerning this standard to: NASA Goddard Space Flight Center, Code 505, Greenbelt, MD 20771.

2. THE SWATH CONCEPT

2.1 What is a Swath

A *swath* is produced when an instrument scans approximately perpendicular to a moving point. The path of this point, along which time or a time-like variable increases or decreases monotonically, is defined as the *'Track'* dimension (sometimes referred to as 'along track'). The direction of the scan, which is orthogonal to the 'Track' dimension, is called the *'Cross-Track'* dimension. These two dimensions are fundamental because determining geolocation depends on knowing which array dimensions correspond to the 'Track' and 'Cross-Track' conceptual dimensions. Other conceptual dimensions, such as 'Detector', 'Band', 'Channel', and 'Parameter', also can be defined. However, since these dimensions are not used for geolocation, this standard does not prescribe their usage. The swath concept can be applied to measurements from a variety of platforms, including satellite, aircraft, and surface.

A typical satellite swath consists of a series of instrument scans perpendicular to the ground track over which the satellite moves. Figure 2-1 shows this traditional *physical* view. The term *swath* is sometimes used to refer to a single scan of the instrument's various detectors. For the purposes of this standard, however, a series of one or more scans is considered to form a swath. For this example, the 'Track' dimension, the moving point, corresponds to the ground track and the 'Cross-Track' dimension to the direction of the scans perpendicular to it. The instrument records

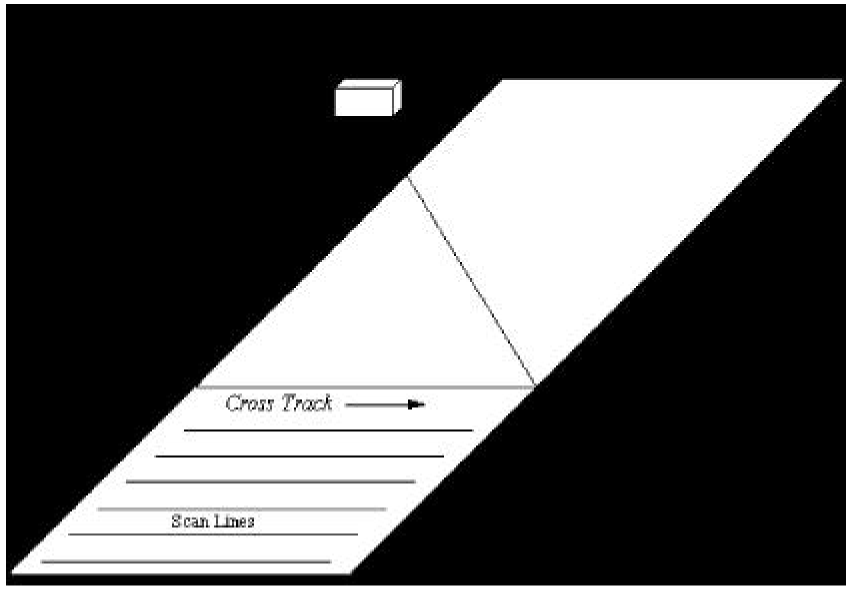

Figure 2-1 Physical view of a simple swath: a time-ordered series of scan lines

An example of the application of the swath concept to ground-based data is a radar map. Figure 2-2 provides an illustration. The instrument sweeps in an azimuthal direction, with each sweep beginning and ending along a particular radial path. In this case, the ‘Track’ dimension corresponds to the radial path corresponding to the beginning and end of a sweep (labeled T in the figure), while the ‘Cross-Track’ dimension corresponds to the direction of the sweeps (labeled CT in the figure). Note that in this case, the two orthogonal dimensions are those of a polar coordinate system, while in the case of airborne and spaceborne measurements, the two

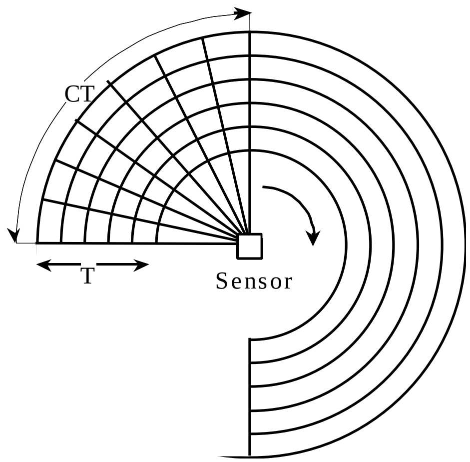

Figure 2-2 Physical view of a swath derived from ground-based radar: a time ordered series of sweeps

The *data* view of a swath is that the data are ordered by *time* or a *time-like variable* (e.g., scan line counter). Every scan consists of one or more sets of date/time and/or geolocation information (e.g., latitude, longitude), and data. Each time entry records the time when one particular measurement was made. Each geolocation set corresponds to an individual sensor measurement (e.g., a pixel) within the scan, and provides a means of associating the data with the point on the geoid where it was taken. The data can be in the form of scalar values, 1D arrays of values (e.g., scan lines or profiles), or nD arrays of values (e.g., scan lines observed in multiple channels or profiles).

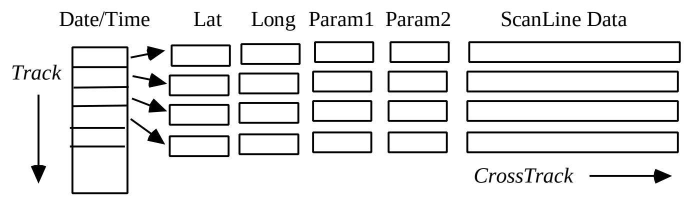

Figure 2-3 Data view of a sample swath: a time-ordered series of scalars and arrays

In this example, the information for each scan consists of a Date/Time value, one geolocation set (Lat/Long), two single-valued parameters (Param1, Param2) containing information related to the scan, and a 1D array of values for Scan Line Data (the sensor measurements). Thus, in this case, only one pixel in the entire scan has a time tag and one pixel, not necessarily the same one, has the geolocation tag. Conceptually, each named item can be considered as a separate array. For example, in the figure above, Date/Time would be a 1D array, as would Lat, Long, Param1, and Param2. The Scan Line Data would be a 2D array.

Another way to supply geolocation information is in the form of attitude and ephemeris data for the observing platform. In this case, the geolocation data consist of date/time, the three components of the attitude vector — ξ_r (roll), ξ_p (pitch), and ξ_y (yaw) — for the platform and the three components of the position vector in geocentric coordinates (x, y, z) for the platform. Section 2.3.2.3 provides detailed information about how to define this type of geolocation. The data stored for a scan can consist of the sensor measurements as well as multiple sets of date/time swath scheme.

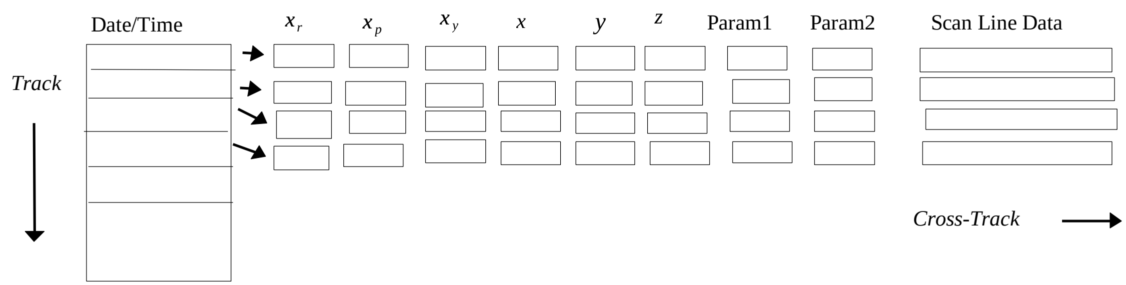

Figure 2-4 Data view of a sample swath: Attitude/ephemeris used for geolocation

In this example, the value for Date/Time has associated with it values for the components of the attitude vector (ξ_r, ξ_p,ξ_y) and the position vector (*x*, *y*, *z*), scalar values (Param1, Param2), and a 1D array containing values for Scan Line Data. Date and Time would be 1D arrays, as would each of ξ_r, ξ_p , ξ_y *x*, *y*, *z*, Param1, and Param2, while the Scan Line Data would be a 2D array. The platform attitude and position data, along with the relationship between geolocation and sensor data defined in Section 2.3.3, can be used with metadata on platform axes and/or instrument orientation relative to the platform to derive latitude and longitude of the

A third way to supply geolocation information, as an analytic function of grid position, is not illustrated here but is described in Section 2.3.2.2.

Table 2-1 shows required and optional conceptual dimensions for *scanning* instruments. Table 2-2 shows the same information for *profiling* instruments, and Table 2-3 shows the same information for a *combination scanning-profiling* instrument, such as the Tropical Rainfall Measuring Mission (TRMM) precipitation radar.

Table 2-1. Dimension definitions for a generic scanning instrument

Dimension	Description	Comments
Track	Path of moving point perpendicular to which instrument scans	Required
Cross-Track	Perpendicular to the track and parallel to the surface of the Earth	Required
Detector	Number of footprints per dwell	Optional
Band or Channel	Generally used for lower level data that have not been processed into science parameters	Optional; Band and Parameter are mutually exclusive
Parameter	No physical mapping; generally used for higher level data that have been processed into science parameters	Optional; Band and Parameter are mutually exclusive

Table 2-2. Dimension definitions for a generic profiling instrument

Detector	Number of foot prints per dwell	Optional; ordering is unimportant
Band or Channel	Generally used for lower level data that have not been processed into science parameters	Optional; ordering is unimportant; Band and Parameter are mutually exclusive
Parameter	No physical mapping; generally used for higher level data that have been processed into science parameters	Optional; ordering is unimportant; Band and Parameter are mutually exclusive

Table 2-3. Dimension definitions for a generic scanning-profiling instrument

Dimension	**Description**	**Comments**
Track	Path of moving point perpendicular to which instrument scans.	Required
CrossTrack	Perpendicular to the track and parallel to the surface of the Earth	Required
Profile	Perpendicular to the track and in the line of sight to the Earth	Required; equivalent to atmospheric level
Detector	Number of foot prints per dwell	Optional
Band or Channel	Generally used for lower level data that have not been processed into science parameters	Optional; Band and Parameter are mutually exclusive
Parameter	No physical mapping; generally used for higher level data that have been processed into science parameters	Optional; Band and Parameter are mutually exclusive

quantities measured at each point. Each point in the data array would correspond to a given (Track, Cross-Track, Parameter)

To apply these concepts to a particular instrument, the producer must determine the appropriate dimensions to use and arrange them in an acceptable order (see comments in Tables 2-1, 2-2 and 2-3). The names given in the tables for the dimensions are meant only as points of reference. The data producer assigns the actual names of the dimensions within a swath structure.

2.2 The Components of a Swath

A swath structure consists of three components:

1. the sensor data,
2. the geolocation information, and
3. the relationships between data and geolocation.

The elementary data structures for storing both the sensor data and the geolocation information are tables, arrays, or combinations of the two. A single swath structure can contain any number of *tables* and *multidimensional arrays*.

The *geolocation information* has a special role. It allows identification of the geographical location on the Earth surface corresponding to the data measurements for an individual pixel. Every swath is required to contain some geolocation component. Geolocation information can be stored as a table, as a series of arrays, or as a combination of a table and arrays. For example, when geolocation is provided in Time/Location form, it is permissible to store values for Latitude and Longitude at every (Track, Cross-Track) grid location in two 2D arrays — one for Latitude and one for Longitude — and also a Date/Time value for every scan line or point, as one 1D or 2D table, respectively.

Table 2-4 summarizes these possible components of a swath. A particular swath may have

Table 2-4. Possible Components of a Swath Structure

Component Type	Dim.	Comments
Data Field	nD	Scalar values per Track entry
2D Data Array (scanner)	2D	Scan Lines per Track entry
2D Data Array (profiler)	2D	Profiles per Track entry
3D Data Array (scanner)	3D	Multiple Scan Lines per Track entry
3D Data Array (profiler)	3D	Multiple profiles per Track entry
Geolocation Field	1D/2D	Date/Time, scan number, Lat/Lon, attitude, position, Track counter, etc.
Geolocation relationships	N/A	Relationship between the data and the geolocation information

2.3 Defining a Swath

The swath structure has been created to make it possible to provide services on the swath that are instrument independent. For example, subsetting and subsampling by geolocation can be provided for data stored in a swath structure, independent of the instrument and product that the data represent. Of course, the same services *could* be provided even if the data were not stored according to the swath conventions. However, the code to supply those services would have to be custom-written for every instrument product.

2.3.1 Sensor Data

The sensor data, which are the direct instrument measurements from which information about the Earth can be derived, are the major component of the swath data. The nature of the measurement may vary from instrument to instrument. Normally, sensor data will be processed by scientific algorithms for retrieving useful information. The sensor data, as stored in digital form, have the following properties:

1. Data type. Examples are
   - ASCII representation of numerical values
   - 8, 16, 32 and n-bit (n>0) binary integers.
   - 32 and 64 bits binary floats
2. Data structure. The actual data can be stored in tables or multidimensional arrays in the swath.
3. Data unit. Examples are
   - digital numbers (DN) read from the sensor unit,
   - a physical unit, e.g., wind speed in m/s,
   - a transformed value of a physical unit, or
   - a transformed value of the sensor digital numbers

Transformed values are sometimes used in order to use storage space more efficiently.

2.3.2 Defining Geolocation

In a swath structure, one or more of the following methods must be used to provide geolocation information:

- Time/Location
- Analytic fit
- Attitude/Ephemeris data for spacecraft or airborne platforms

The data provider should consult the potential users when selecting the method or methods used to provide geolocation information. For example, for cloud or other studies where the areas of surfaces or volumes of elements observed must be known, enough information must be provided to the user to allow calculation of the viewing geometry. Rueden (1998) discusses the question of what information should be provided with satellite data in order to make the data most useful.

2.3.2.1 Time/Location Method

When geolocation information for a swath structure is provided in Time/Location form, at least one of the following geolocation parameters must be provided:

- *Date/Time*

that listed above into a swath.

Figure 2-5 shows a geolocation table that contains Date/Time, Latitude, and Longitude columns for geolocation information for each scan line.

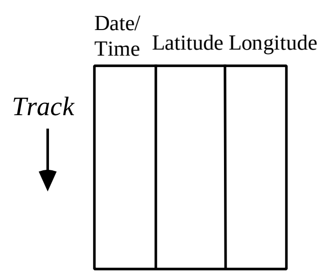

Figure 2-5. Geolocation Table with 1D Geolocation Information Included

Where geolocation information exists for multiple locations in a scan, then the Date/Time, Latitude, and Longitude arrays should be two-dimensional. Figure 2-6 shows two 2D arrays of Latitude and Longitude, which for convenience have been combined into a single 3D array. Geolocation information is not required for every scan. Having geolocation information only in one of every several scans is permissible.

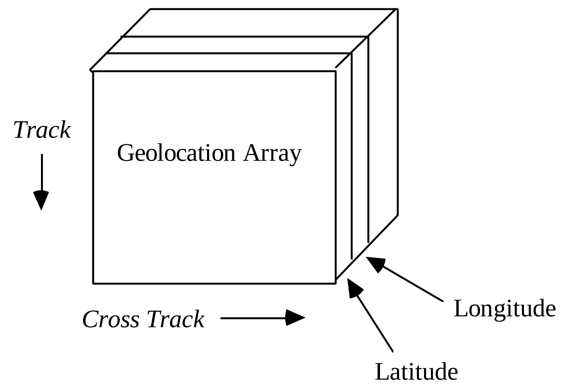

Figure 2-6. Geolocation Array containing Latitude and Longitude planes

2.3.2.2 Analytic Fits

When the geolocation information is presented in the form of a function that gives latitude or colatitude and longitude as a function of data array index coordinates (Cross-Track and Track), the required information depends on the form of the function. The function may be a polynomial or some other function of the coordinate array position (x,y).

If the function is a polynomial, then the latitude may be written as

$$latitude = \sum_{m,n} a_{mn} x^m y^n$$

and the longitude as

$$longitude = \sum b \quad x^m y^n$$

When the geolocation information uses other functional forms, then the form of the function, definitions of any coefficients of terms, and the values of those coefficients should be provided.

2.3.2.3 Attitude/Ephemeris Data

When attitude and ephemeris data are provided for a swath structure describing measurements from satellite or airborne platforms, the following information is required to enable the user to calculate both geolocation and viewing geometry for the measurements:

- Date/Time
- Platform attitude roll, pitch, and yaw angles (x_r , x_p , x_y)
- Platform position vector (x,y,z)

The data set may provide the platform attitude and position information directly or it may contain other information from which attitude and position can be calculated.

The following information is optional:

- Platform velocity vector (u,v,w)

The velocity vector may be calculated from successive values of position vector and time and thus need not be provided explicitly. This standard also allows data producers to add geolocation of the metadata, if it does not vary during the flight. It may be added to the geolocation information if it does vary.

Figure 2-7 shows a geolocation table that contains Date, Time, and three columns each (x, y, z) for Attitude and Position for deriving geolocation information for a scan.

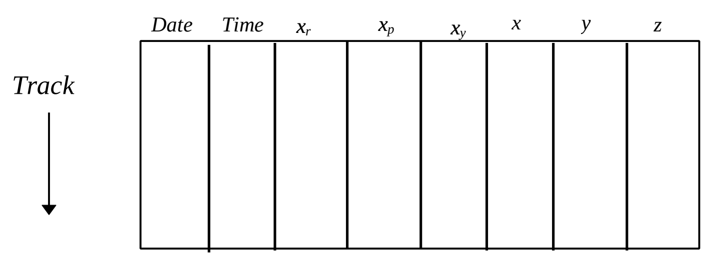

Figure 2-7. One-dimensional Attitude/Position Geolocation Table

Where multiple sets of attitude and position information are available for a scan, then the Date/Time, Attitude, Position, and Velocity arrays should be two-dimensional. Figure 2-8 shows six 2D arrays of Attitude and Position components, which for convenience have been combined into a single 3D array. Geolocation information is not required for every scan. Having

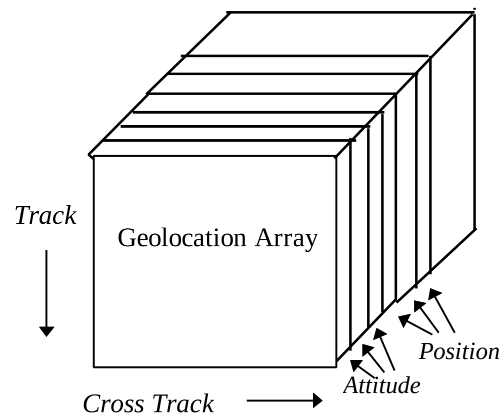

Figure 2-8. Geolocation Array containing Attitude and Position planes

2.3.3 The Relationship between Geolocation and Sensor Data

The next step is to match the data elements with the geolocation parameters. To do so, dimensions of the data elements are mapped to the 'Track' and 'Cross-Track' dimensions of the geolocation parameters. In order to define the relationship between geolocation data and sensor data, two items must be defined:

1) Dimension definition: It defines a dimension of geolocation data or sensor data. It is required for each dimension in both geolocation data and the sensor data. The dimension definition consists of two parts:

   - Dimension Name: The name of a dimension. The name could be a string of up to 256 dimensions and the data dimensions. A dimension mapping should consist of the following four parts:

- Data Dimension: the name of the dimension of the data object being mapped.
- Geolocation Dimension: the name of the dimension of the geolocation object to which the data object is being mapped.
- Offset: if positive, the index number along Data Dimension of the point in the data array where the first geolocation value applies. If negative, the index number along Geolocation Dimension of the point in the geolocation array where the first data value applies, which is useful in cases where the geolocation object is larger than the data object.
- Increment: if positive, the increment along Data Dimension for which there is geolocation data in the Geolocation object; if negative, the increment along GeoDimension at which there are data points[1], which is useful in cases where the geolocation object is larger than the data object.

This standard does not specify how the mappings are encoded. The encoding standard corresponding to this content standard will specify an encoding method. The informative Appendix of this standard (section 4.2) gives some examples on how to use Object Description Language (ODL) to encode the relationship between geolocation and sensor data. Those

3. REFERENCES

Di, L. and Carlisle, C., The Proposed FGDC Content Standard for Remote Sensing Swath Data. Proceedings, ASPRS/RTI 1998 Annual Conference, Tampa, Florida.

FGDC, 1997a. Proposal for SDTS Part 5 with BIIF extension. http://www.fgdc.gov

FGDC, 1997b. FGDC Standards Reference Model. http://www.fgdc.gov

FIPS Publication, 1994, Spatial Data Transfer Standards, FIPSPUB 173-1, U. S. Department of Commerce, Technology Administration, National Institute of Standards and Technology, U. S. Government Printing Office, Washington, D. C.

HAIS, 1995. The HDF-EOS Swath Concept, White Paper 170-WP-005-001. http://edhs1.gsfc.nasa.gov

HITS, 1996. SDP Toolkit User's Guide for the ECS Project, 333-CD-003-003. http://edhs1.gsfc.nasa.gov.

HITS, 1997. HDF-EOS Library User's Guide for the ECS Project, Volume 1: Overview and

4. APPENDICES

4.1 Glossary

This Glossary is a normative appendix and part of the FGDC Remote Sensing Swath Data Content Standard.

CEOS – Committee on Earth Observation Satellites.

Channel – A wavelength position or range.

Cross-track – The on-ground dimension perpendicular to the track dimension.

Data dimension – The name of the dimension of a data object being mapped to geographic location.

Dimension name – An identifier assigned to a particular dimension.

Dimension size – The number of points in a given dimension.

Dimension Map – The data object describing a mapping between data and their geographic location.

Dwell – Instantaneous field of view.

EOSDIS – Earth Observing System Data and Information System.

ESDIS – Earth Science Data and Information System.

Geolocation – Geographic location

HITS – Hughes Information Technology Systems.

Increment – If positive, the interval in positions along the geolocation dimension at which there are data; if negative the interval in positions along the data dimension at which there are geolocation data.

Interuse – Use of the same data by different installations and systems.

NASA – National Aeronautics and Space Administration.

NSDI – National Spatial Data Infrastructure.

Platform - The spacecraft or aircraft carrying an instrument.

SDP – Science Data Production.

SDTS – Spatial Data Transfer Standard.

Staring – Observation at a single geographic location.

Subsample – Data selected from a larger data set by including only those positions at a specified interval.

Subset – Data selected from a larger data set by including only those positions within a limited range of geographic location.

Swath – The pattern formed by one or more scans perpendicular to a track.

TRMM – Tropical Rainfall Measuring Mission.

Track – The path of a moving point, along which time or a time-like variable increases or decreases monotonically.

4.2 Informative

The material in this section is for informational purposes only and is not part of the FGDC Remote Sensing Swath Data Content Standard.

4.2.1 Examples of Dimension Mappings Encoded with ODL

In the NASA EOSDIS standard, the mapping of data to geolocation is described in a block of ODL text that is associated with the swath structure itself.

For example, consider two 2D arrays, one a geolocation array (containing, say, latitude), the other a data array (containing, say, temperature). The following segment of ODL text defines these two arrays and their dimensions (section 4.4.2 discusses details of this code):

Example:

```
object = Dimension
                Name = "GeoTrack";
                Size = 1200;
end_object;

object = Dimension
                Name = "GeoCrossTrack";
```

```
object = Dimension
        Name = "DataX";
        Size = 600;
end_object;

object = Dimension
        Name = "DataY";
        Size = 200;
end_object;

object = GeoParameter
        Name = "Latitude";
        DataType = float32;
        Dimension = "GeoTrack";
        Dimension = "GeoCrossTrack";
end_object;

object = DataParameter
        Name = "Temperature";
        DataType = float32;
```

Now, the next step is to define the relation between the data array and the geolocation array. To do so, another ODL entry, DimensionMap, is created. The ODL code below shows a template for this entry.

Template:

```
object = DimensionMap
        DataDimension = <dimension name>;
        GeoDimension = <dimension name>;
        Offset = <value>;
        Increment = <value>;
end_object;
```

A DimensionMap entry is interpreted as follows:

- DataDimension is the name of the dimension of the data object being mapped.
- GeoDimension is the name of the dimension of the geolocation object to which the data object is being mapped.
- Offset: if positive, the index number along Data Dimension of the point in the data array where the first geolocation value applies; if negative, the index number along GeoDimension of the point in the geolocation array where the first data value applies, which is useful in cases where the geolocation object is larger than the data object.

data points[2], which is useful in cases where the geolocation object is larger than the data object. So for the example of the two arrays used in this section, we would need the following two DimensionMap entries:

ODL Code Example:

```
object = DimensionMap
        DataDimension = "DataX";
        GeoDimension = "GeoTrack";
        Offset = 0;
        Increment = -2;
end_object;

object = DimensionMap
        DataDimension = "DataY";
        GeoDimension = "GeoCrossTrack";
        Offset = 0;
        Increment = 1;
end_object;
```

In the example ODL code above, a value for Increment of -2 in the first DimensionMap means larger than the data array. In the second DimensionMap, a value for Increment of 1 means that the DataY and GeoCrossTrack dimensions are the same size, and map one-to-one.

In cases where a data object and a geolocation object share the same dimension, the relationship can be assumed to be a one-to-one mapping, and there is no need to explicitly define it with a DimensionMap entry.

4.2.2 An Example Swath

This section walks through an example swath to illustrate the concepts discussed in this standard. Consider Figure 4-1, which is a representation of a swath consisting of a 3D data array, a series of 2D geolocation arrays, and a single, 1D geolocation table. Data are available at 600 points along the track. Each point can be identified by a date and time of measurement. For each point along the track, there are 1000 cross-track measurement points across it; geolocation for these points is given by two 600x1000 geolocation arrays, one for latitude and one for longitude, which are combined into a single array. The data are temperatures at 10 different altitudes and are contained in a 600x1000x10 data array, with the dimensions corresponding to track x cross-track x height.

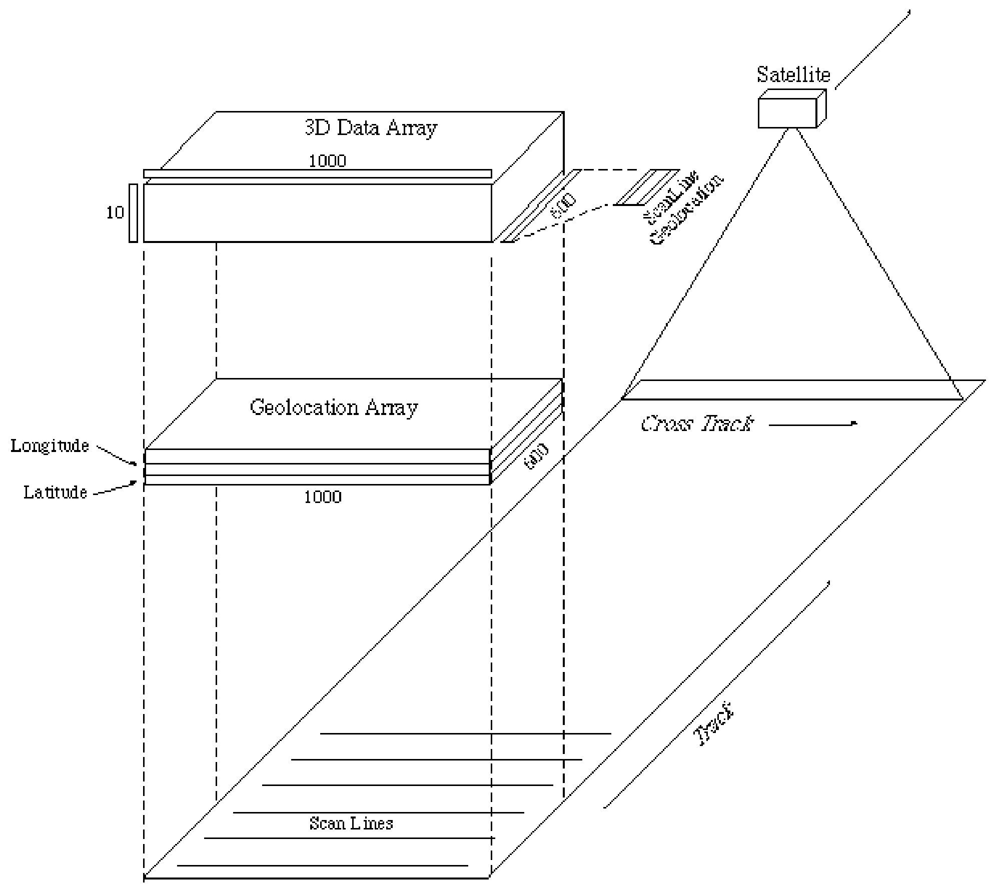

Figure 4-1. Conceptual View of Example Swath, with 3D Array, Time/Geolocation Array, and Geolocation Table.

Table 4-1 lists the components.

Table 4-1. Components of Example Swath.

Component	Dim.	Size	Comments
Data	3D	600*1000*10	Track Dimension, Always

Geolocation Table	1D	600	In this case, one field, but should be several columns

ODL Code Example:

```
object = Dimension
    Name = "GeoTrack";
    Size = 600;
end_object;

object = Dimension
    Name = "GeoCrossTrack";
    Size = 1000;
end_object;

object = Dimension
    Name = "DataX";
    Size = 600;
end_object;
```

```
end_object;

object = Dimension    /* the 3rd dim. of the data array */
    Name = "Band";
    Size = 10;
end_object;

object = GeoParameter
    Name = "Latitude";
    DataType = float32;
    Dimension = "GeoTrack";
    Dimension = "GeoCrossTrack";
end_object;

object = GeoParameter
    Name = "Longitude";
    DataType = float32;
    Dimension = "GeoTrack";
    Dimension = "GeoCrossTrack";
end_object;
```

```
    DataType = float32;
    Dimension = "GeoTrack";
end_object;

object = DataParameter
    Name = "Temperature";
    DataType = float32;
    Dimension = "DataX";
    Dimension = "DataY";
    Dimension = "Band";        /* the 3rd dimension of array */
end_object;

object = DimensionMap
    DataDimension = "DataX";
    GeoDimension = "GeoTrack";
    Offset = 0;
    Increment = 1;
end_object;

object = DimensionMap
```

```
        Increment = 1;
    end_object;
```