U.S. FGDC CONTENT STANDARD FOR DIGITAL GEOSPATIAL METADATA: EXTENSIONS FOR REMOTE SENSING METADATA

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ABSTRACT

The U. S. *Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata* defines common geospatial metadata that allow prospective users to determine the following information about a geophysical data set: its availability, its fitness for an intended use, and the means of accessing and successfully transferring it. Because of its generality, the standard may not meet the metadata needs for specific geospatial domains. The *Extensions for Remote Sensing Metadata* (hereafter *Remote Sensing Extensions*) are to provide additional information particularly relevant to remote sensing: the geometry of the measurement process, the properties of the measuring instrument, the processing of raw readings into geospatial information, and the distinction between metadata applicable to an entire collection of data and those applicable only to component parts. For that purpose, the *Remote Sensing Extensions* establish the names, definitions, and permissible values for new data elements and the compound elements of which they are the components. These new elements are placed within the structure of the *FGDC Metadata Content Standard*, allowing the combination of the original standard and the new extensions to be treated as a single entity. These extensions are intended to support the collection and processing of geospatial metadata for data derived from remote sensing and to be useable by all levels of government and the private sector.

The standard was drafted by a NASA-led team in the FGDC Imagery Subgroup with wide participation from federal agencies, universities, and private industry. Currently the standard is in the FGDC standard approval process. We welcome input and comments from the international remote sensing community for improving the draft standard.

1 INTRODUCTION

The United States Federal Geographic Data Committee (FGDC) was established under U.S. President Executive Order 12906, dated April 13, 1994, to coordinate the development of the National Spatial Data Infrastructure (NSDI). The NSDI encompasses policies, standards, and procedures for organizations to cooperatively produce and share geographic data. The 15 U.S. federal agencies that make up the FGDC are developing the NSDI in cooperation with organizations from state, local, and tribal governments, the academic community, and the private sector [FGDC, 2000a]**.**

In the FGDC Standards Reference Model [FGDC, 1996] FGDC classifies standards into several categories. One of the categories of standards is data standards. Most FGDC standards are of this type. Data standards describe geographic objects, features or items that are collected, automated, or affected by activities or functions of agencies. There are five types of data standards defined by FGDC. One of them is data content standards, which provides semantic definitions of a set of objects and the relationship between the objects [FGDC, 1996].

NASA, as a member of FGDC, has actively participated in the development of FGDC geospatial data standards. Currently, NASA is leading the development of the FGDC Content Standard for Digital Geospatial Metadata-- Extensions for Remote Sensing Metadata. This paper describes the standard.

2 BACKGROUND

The FGDC develops geospatial data standards for implementing the NSDI, in consultation and cooperation with State, local, and tribal governments, the private sector and academic community, and, to the extent feasible, the international community [FGDC, 2000b]. The FGDC Standards Working Group (SWG) oversees the standards development activities of FGDC. U.S. federal government agencies are required to comply with FGDC standards if the standards are applicable to their geospatial data.

In order to formalize the standards development processes, FGDC has developed a set of Standards Directives [FGDC 2000c]. The FGDC standards development processes consist of 12 steps, grouped into proposal stage, development stage, draft stage, review stage, and final stage. Normally, a project for developing an FGDC standard starts when FGDC SWG, after proper internal and public review, approves a proposal submitted by an FGDC disciplinary subcommittee or a federal agency. Then, a development team, with expert members from federal agencies, academia, and industry, is organized under a FGDC subcommittee or working group. The team is responsible for developing the draft standard, modifying the draft during the review process, and replying to comments from internal SWG and public reviews. After the working draft has passed the subcommittee review, SWG review, and public review, the working draft is endorsed by FGDC as an FGDC standard. So far, FGDC has developed more than 10 standards to cover various aspects of geospatial data. Some of them have been adopted by the American National Standard Institute (ANSI) and National Committee on Information Technology Standards (NCITS) as U.S. national standards. Meanwhile, several new FGDC standards are under development by standard development teams.

One of the most widely used FGDC standards is the *FGDC Content Standard for Digital Geospatial Metadata* [FGDC, 1998]. The standard defines common geospatial metadata that provide information for prospective users to determine the following information about a geospatial data set: its availability, its fitness for an intended use, and the means of accessing and successfully transferring it. Because of its generality, the standard may not meet the metadata needs for specific geospatial domains, which may require more detailed and domain-specific metadata. In order to meet those requirements, the FGDC metadata standard allows development of profiles and extensions. One such metadata profile, the *Biological Data Profile*, has become an official FGDC standard [FGDC, 1999]

Remote sensing is one of most important sources of geospatial data for building the NSDI. As the major producers of remote sensing data, U.S. federal agencies collect, process, archive, and distribute huge amount of remote sensing data annually. In order to maximize data utilization and facilitate data interoperability, a standardized way of describing those data accurately is needed. However, the FGDC metadata standard is too generalized to fulfil this role. For example, it does not contain a way to describe the spatial representation for most raw remote sensing data. Therefore, an extension to the FGDC metadata standard for remote sensing data needs to be developed. NASA, as one of the leading agencies in the U.S. federal government in collecting, analyzing, archiving, and distributing remote sensing, has the experience and expertise needed to develop the remote sensing metadata standard. During the design and development of the Earth Observation System (EOS) Data and Information Systems (EOSDIS), NASA developed an internal metadata standard for remote sensing data [Hughes Applied Information Systems, 1994]. This internal standard was developed by a panel of experts through the similar processes as FGDC. Therefore, it has been natural for NASA to propose the development of the FGDC remote sensing metadata standard by using the NASA internal standard as the basis and lead the development efforts.

3 THE DEVELOPMENT HISTORY AND CURRENT STATUS

In October 1998, NASA submitted a proposal [NASA, 1998] to FGDC for developing the extensions to define remote sensing metadata specific within the framework of the FGDC metadata standard. The FGDC SWG approved the proposal after the proposal had undergone a 30-day public review. SWG assigned the project of developing the standard to the FGDC Imagery Subgroup. The subgroup then formed a NASA-led core development team with members from U.S. federal agencies, industry, and universities. A preliminary draft, prepared by the leadership of the development team in June 1999, drawing heavily from the EOSDIS Core System (ECS) Core Metadata [Hughes Applied Information Systems, 1994] was distributed to the project development team. The team met in July 1999 to discuss the draft standard and review comments and decide on the changes to be made in the next draft. There were three subsequent review cycles, following the same procedure ending in meetings in August, September, and November 1999. This draft standard is now being reviewed by members of the imagery subgroup. Much additional revision to this draft is expected before it becomes an FGDC standard.

4 THE CONTENT OF THE STANDARD

Users of remote sensing data require metadata particularly relevant to that method of acquisition, metadata that are not defined in the base FGDC standard. The purpose of the *Remote Sensing Extensions* is to define that metadata, establishing the names, definitions, and permissible values for the new data elements and the compound elements of which they are the components. These new elements are placed within the structure of the *FGDC Content Standard for Digital Geospatial Metadata*, also called the base standard, allowing the combination of the original standard and the new extensions to be treated as a single entity. The draft *Remote Sensing Extensions* specify only content; they do not specify either the means by which the information is organized in a computer system for data transfer or the means by which this information is transmitted, communicated, or presented to the user.

Because remotely-sensed geographic data are not measured directly but are derived from the quantities measured by the sensor, the user needs information about the measuring system. To the section on Identification Information are added elements that identify the platform and instrument or sensor used to gather the data, and, if relevant, the overall mission or program of which the collection of the data is a part. As part of the instrument or sensor identification information, elements are included to describe such information as the wavelength sensitivity of the instrument, the resolution of individual bands, and modes of measurement. Remote sensing can provide an efficient method of generating large volumes of geographic data. To facilitate access, it is customary to organize the data sets into aggregates based on common origin or theme. The extensions provide metadata to describe the relation between aggregates and their component members, which may themselves be aggregates.

As part of the quality information for a data set, the base standard provides for metadata on the way in which a data set was constructed, its lineage. For remote sensing data, deriving geographic information can be a complex process. The extensions define metadata in detail for this process, describing the processing software, procedures and history, the algorithm used for processing, intermediate data sets for different stages of processing, and the documentation of these stages. These metadata elements extend the lineage element of the base standard.

The geographic location of the remotely sensed data must be identified. There are two ways in which this process may be carried out. Data may be georeferenced. A map grid is overlaid on the geographical area, with the location of one point, the orientation of the axes, and the distance scale along each axis defined, allowing the reader to determine the geographic location of any point from its map coordinates. The extensions provide for metadata that will describe this conversion. For nongeoreferenced data, data and metadata are provided that will allow the derivation of geographic information for each individual point, such as a description of the control points used for georeferencing, information about a swath track or the scaling of a photograph.

Understanding the instrumentation is often important when using remotely sensed data. A new section has been added with metadata describing the physical positions and properties of the platform and instrument. Provisions are made to describe the platform orbit or flight path, the orientation of the instrument relative to the platform, the direction and change with time of the field of view. There is also provision for a description of the instrument calibration

The *FGDC Content Standard for Digital Geospatial Metadata* defines citation information only in the sense of citing a data set. However, there may be additional documentation relevant generation or organization of a data set, such as user's guides, data dictionaries, and technical papers. The extensions broaden the concept of citation information to cover these other documents.

5 FUTURE PLAN AND CONCLUSIONS

Review by the Imagery Subgroup and outside experts is continuing. When the review is complete at this level, these extensions will be submitted to the FGDC SWG for submission for public review. The goal at these stages is to receive comments from as broad an audience as possible, representing all possible users of these extensions. The Imagery Subgroup will respond to the public review comments, revising these extensions as required, and submit the revised document for FGDC approval. Adopting these extensions to the *FGDC Content Standard for Digital Geospatial Metadata* will provide a means to incorporate metadata describing remote sensing data as part of overall metadata

describing a geographic data set within a single FGDC framework. The compilation of this metadata will also be useful in helping to define remote sensing metadata for the ISO TC211 series of geographic information standards.

ACKNOWLEDGEMENTS

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