

Study of the National Spatial Information Infrastructure (NSII) Standards

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ABSTRACT The NSII construction is a project that the integration, network-linking operation and standardized information sharing of the key databases and their application of the national resources, environmental and regional economies. It is realized through the study of the key technologies of spatial information sharing, transmitting and exchanging and network managing under the environments of open networks and the study of operational national resources, environmental and regional economic information systems and the national spatial clearinghouse. Based on this, the development of the spatial decision-making support system for the national land plan, regional plans, evaluating continuous development, and monitoring and fast forecasting agricultural conditions focusing on ecology can be developed to effectively enhance the macro adjusting and controlling abilities.

Aiming at the urgent needs for information sharing, data exchanging, spatial decision-making supporting and so on in the NSII construction, this paper presents the main standards for the NSII and their roles, functions and their interrelationship in the NSII construction. They are NSII Spatial Metadata Standard, NSII Index System and Classification Encoding, NSII Spatial Data Transfer Standard.

1. Introduction

The NSII standard system is that the bases and guarantees for the NSII operation will be set up through the integration of spatial structure and standardization of scattered and disordered spatial data set and spatial databases. The study of the standard system is an important component part of the NSII project, which mainly includes the standards of information property right, information sharing, information management, information security and network transfer; the index system and classification encoding of the national resources, environmental and regional economic information systems, the standard of spatial metadata, the standard of spatial data transfer, etc. Among them, the index system and classification encoding of the national resources, environmental and regional economic information systems are the elementary bases and guiding plans of spatial data integration and transfer. The standard of spatial metadata is one of the core standards realizing spatial data

sharing. The standard of spatial data transfer is the general abstraction of geographical spatial phenomenon to build up an overall general abstract model for geographical spatial phenomena in order to realize data transfer or spatial data modeling without any semantic damages among different geographical spatial databases, which is also one of the core standards realizing spatial data sharing. This article will describe the study focusing on the above aspects.

2. The Standard Of Spatial Metadata

Following the wide application of electronics and information technologies, the spatial information as the basic spatial support to various kinds of information is getting more and more attention in the whole world, and the needs for spatial information by all fields of the society are becoming more and more strong. Along with the combination of Internet with GIS, the division of GIS function is penetrating, step by step, into Internet. Spatial data

is collected, processed and restructured from their angles by different organizations, and the above data can also meet the needs of other application. However, the current situation is that we do not know what data exists, what quality of the existing data is, and how the data results can be accessed and used. Therefore, a certain way is earnestly needed to avoid repeated data collecting and processing, and to coordinate resources sharing among different sectors. So, it is imperatively demanded to provide a standardized way meeting the needs for spatial data sharing in the spatial information infrastructure in pace with the increases of the volume, complexity and variety of geographical spatial data sets.

Additionally, as the abstract description to the geographically real world, spatial data has its own limitation; through metadata, the limitation can be fully understood by users, and the adaptability to special application purpose can be properly valued. Thus, in the wake of the increases of geographical spatial data producers and users, utilizing proper metadata documents to describe data will become a certain trend in data producing, storing, updating and reusing.

Along with the development of informatization and the separation of data producing departments from application sectors, data sharing has become one of the critical targets in the construction of the spatial information infrastructure. Among which, the formulation of a spatial metadata standard and a metadata management system is the key point for spatial data sharing. Comprehensively speaking, the main demands for and the functions of spatial metadata are as follows:

1. Organizing and safeguarding the Investment in Data by an Organization

Metadata can guarantee an organization to invest in data. After the setting up of data sets, the latter staff taking over the job will arouse suspicion against the reliability of previous data because they know little or nothing about it in pace with personnel exchange and time elapse. Data sets can be fully described in detail through metadata contents. When there are contradictions among users, data-providing organizations can also safeguard their own interests with metadata.

2. Providing Information for Data Directory and the Data Clearinghouse

In GIS application, information with different contents is generally needed, such as information on agriculture, forest, transportation, water conservancy, etc., and few organizations can provide data contents in all fields. Hence, the data produced by one organization may be usable to other ones, the metadata contents provided by the

data clearinghouse can be very easily used by users, the data sets can be commonly shared, the data results can be mutually maintained and optimized, etc. For instance, the National Geographical Data Clearinghouse (NGDC) in the USA is a good typical example. Users can search their needed data on the network through NGDC.

3. Providing the Information on Data Transfer

All future's data sets should involve metadata information so that user can get metadata information at the time when they get their needed data sets. With metadata, data can be accepted and understood, and the data sets can be integrated into users' own data sets to do analysis for decision-making in different aspects. Therefore, geographic spatial information sharing will be realized in real sense and its potentiality can be brought into full play.

Of course, current application demands for metadata still focus mainly in the following four respects: directory, historical record, the internal of geographical spatial data set and their readability. The application of metadata in directory can determine many core problems in geographical data, such as the information on special topic and theme, author and producer, resolution ratio and scale, real-time and date, data structure and format, physical format and medium, etc. in geographical application. In historical records, the information involving data proprietary rights can support the storage, updating, production management and maintenance of geographical spatial data. The information on lawful evidence can be provided when contradictions rise in using or misusing geographical spatial data. In the internal of geographical spatial data sets, the application and sharing of geographical spatial data can be supported together with data sets in a certain format, and data sets can be reasonably evaluated. In the aspect of readability, with metadata, computer can locate and search information or manage data storehouse and data production based on standard format so that the usage of geographical spatial data can be not only greatly enlarged but also easily understood by users.

Metadata penetrates into different activities of spatial databases and the data clearinghouse. In accordance with its different functions, it can be summarized as follows:

- metadata used for describing, browsing and navigating spatial data sets;
- metadata used for managing and defining spatial databases;
- metadata used for analyzing and processing spatial data.

In the current system framework, the system manages and maintains only the first category metadata to realize data-browsing, navigating and sharing in the spatial data clearinghouse under the supports of various NSII/NREDIS distributed spatial databases.

The spatial metadata standard of the national land resources, environmental, regional economic information systems and national spatial infrastructure provides spatial data sets with a set of commonly used description elements and norms, and also provides information supports for data sharing of the national land resources, environmental and regional economic information systems. It can be used in the all-round describing and encoding data sets and network information exchange. The standard set up a set of norms used for the description of data set, data set series and the composite elements of entity attributes, elements, the definitions of these elements, element range and their interrelationship. In this standard, the selection of each element was considered based on the following four aspects: the usability of data sets, the adaptability of data sets, how to get the data sets and how to use the data sets. The elements aiming at various users and application purposes in this standard have distinct importance.

The establishment of this standard not only provides standard for their data-filing and data-encoding of the departments concerned in the national land resources, environmental and regional economic information systems, but also can provide services for other departments, organizations and individuals to issue their own spatial data. The establishment and application of the standard can greatly promote the construction of the national spatial information infrastructure and the spatial data clearinghouse, and enlarge and widen the range and quality of the application of data-sharing.

During the stipulation of the standard, we referred mainly to the CSDGM of geographical metadata contents of US FGDC and other related standards, such as ISO 15046-15 on spatial information-metadata, ANSI-standard-Z39.50, etc.

The data elements and composite elements are organized based on layer structure in this standard. One composite element consists of data elements and other composite elements, which is usually used to present the conception of higher layer. Data element is the primary basic information unit of spatial metadata, which includes the abbreviations of element name, definition, category, range and range name and the identifier codes related to Z39.50 GEO profile.

At present, this draft is used in the construction

of the national spatial infrastructure, the standard will certainly be unceasingly developed and perfected in pace with the deepening of application.

3. The Framework of Index System, Classification Encoding and Data Dictionary for The National Resources, Environmental and Regional Economic Information Systems

The framework of index system, classification encoding and data dictionary for the national resources, environmental and regional economic information systems should be higher than that of the databases in each sector, and corresponding data logical description and physically achievable plan should be designed, which should meet the following conditions:

- meeting the self-requirements of the National Resources, Environmental and Regional Economic Information Systems, especially the requirements of the time and space attributes and historical filing;
- being compatible with the databases of various sectors as much as possible;
- unchanging, in principle, the current data structures and codes of the databases of various sectors;
 - having unified format;
 - having the stringency to distinguish especially the multi-meaning data term or value, repeated data term or value and cross data term or value in the previous different periods among sectors or in the internal of some sectors;
 - having completeness, uniqueness, expandability and explicitness;
 - having corresponding and interlink relationship and consistency among the five items of index system framework, encoding system, data dictionary, data logical description and physically achievable plan.

The framework of index system of the national resources, environmental and regional economic information systems is different from the index system itself. The framework of index system generalizes and abstracts the existing index systems of the databases of various sectors, and is constructed with the indexes for management and analysis, such as “time period identifier”, “quality identifier”, “sharing identifier”, etc. and metadata indexes. And its indexes, which are not for management and analysis, are abstracted from the existing index systems of the databases of various sectors. The framework of the index system for the national resources, environmental and regional economic information systems is the basis of classification encoding system, data dictionary and data logical description and physically achievable way.

The entity indexes and attribute indexes for geographical units are separately set up in the framework of the index system, in which, the locating indexes in the plane coordinate of a geographical unit entities are underlined, eigen attribute indexes in the attributes of geographical units are emphasized, and the basic features of the attributes of geographical units are reflected. The indexes for time periods, quality and commonly shared identifiers are also set up separately for geographical unit entities and attributes to present the setting ways for data time-period indexes and data quality, background indexes and commonly shared limitation indexes in the index system framework.

The geographical unit entities and attributes are separately classifies and encoded in the national resources, environmental and regional economic information systems. In their dictionaries, each geographical unit entity category and its corresponding geographical unit attribute category is overall, strictly and carefully explained and stipulated, whose contents involve data structure and necessary indexes for management and analysis.

4. The Standard of Spatial Data Transfer

The national spatial infrastructure and the national resources, environmental and regional economic information systems cover large amount of spatial databases with different structures from different sources. Among these databases, the realization of mutual transfer and information abstraction and mix without any semantic damages of the data is the key to the realization of spatial data sharing. The standard of spatial data transfer is generally abstracted from geographical spatial phenomena to build an overall general abstract model for geographical spatial phenomena so that the data transferring or the spatial data modeling without any semantic damages among different geographical spatial databases can be realized, which makes transferred data have its sense in data contents and quality. From the situation on the existing information resources and data format, to provide a unified standard of spatial data transfer for the spatial information sharing among key NSII database groups is becoming one of the core duties in NSII construction.

The standard of spatial data transfer for NSII and the national resources, environmental and regional economic information systems provide a

conceptual resolving plan for spatial data transfer without any semantic damages, which involves the conceptual modeling of spatial data, data structure and logic.

The consistent requirements, the conceptual model of spatial data, quality control, the model of data structure, spatial element and the definition of its attributes and the realization of the standard, and expansion are explained and described in the standard.

The conceptual model of spatial data provides a framework for defining spatial elements and spatial object collection, and carefully defines zero dimension, one-dimension and two-dimension basic space object sets and their main spatial operations, with which, more complex composite objects can be structured so that the real spatial phenomena of the objective world can be described.

The quality control of spatial data mainly covers the detailed description of the report on the quality of objects and their attributes in data transfer. With the report on quality, detailed information can be provided to users to evaluate the adaptability of data for specific applications. The report on spatial data quality involves qualitative and quantitative descriptions.

The model of spatial data transfer mainly defines the norms of achievable logic, elements and descriptions in spatial data transfer.

The expansion and realization of the standard are also explained so that the standard can be widely utilized and continuously perfected.

The constructions of NSII, the national resources, environmental and regional economic information systems are an uninterruptedly developing and perfecting period. In the wake of the broadening of the application scope and application deepening, the standard system also needs unceasing development and perfection, and needs for adapting to international standards with uninterrupted utilization of the experience of international standards concerned for reference to make it meet the needs for spatial information sharing at the most degree.

Reference

- ANSI/NISO Z39.50 –1995 Information Retrieval (Z39.50), <http://lcweb.loc.gov/z3950>
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