Metadata of Geographic Analysis Model

1. Scope of Application

This standard stipulates the content of metadata related to a geographic analysis model, including the information about the researcher & developer, distributor, distribution identifier, identifier of the associated project, revision, classification, scope of application, performance, reference system, parameters, modeling principle, solving method, running structure, coupling mode, hardware/software conditions for model running, verification, release, metadata reference, and other related characteristics.

This standard provides a comprehensive description of a geographic analysis model, and is applicable to calculation, sharing, integration, and services of the geographic analysis model.

2. Reference Standard

ISO 15046-15 Geographic Information—Metadata (CD 2.0)
Content Standard of FGDC for Digital Geospatial Metadata (CSDGM) v2.0

3. Terms and Definitions

3.1 Geographic Analysis Model

A geographic analysis model represents an abstraction or simplification of geographic elements, phenomena, and processes in real world, and is used to describe the spatiotemporal evolution process and law, and interaction of various geographic elements in geographic environments.

3.2 Metadata

Metadata is a set of the data used to describe a geographic analysis model, and includes the information related to a geographic analysis model, or specifically, the information about the researcher & developer, distributor, distribution identifier, identifier of the associated project, revision, classification, scope of application, performance, reference system, parameters, modeling principles, solving methodology, running structure, coupling mode, hardware/software conditions for model running, verification, release, metadata reference, and other related characteristics. Metadata can also be referred to as model description data or model interpretation data.

3.3 Metadata Element

A metadata element is the rudimentary information unit in metadata.

3.4 Metadata Entity

A metadata entity is the set of metadata elements used to describe the same object.

3.5 Metadata Section

A metadata section is the set of metadata elements and entities used to describe the same object.

3.6 Data Log

A data log provides the profile of a geographic analysis model, including the original data used for obtaining or building a model, and information on the modeling procedure.

3.7 Citation

Citations include the data, data sets, models, and literature that are cited or used for reference.

4. Hierarchy and Property of Metadata

4.1 Hierarchy of Metadata

This standard stipulates that metadata be divided into three layers: metadata section, metadata entity, and metadata element.

A metadata element is the rudimentary information unit in metadata, a metadata entity is the set of metadata elements used to describe the same object, and a metadata section is the set of metadata elements, metadata entities, and metadata sections used to describe the same object. A metadata section is used to describe complex objects (a complex object refers to the object that must be described by a combination of metadata sections, metadata entities, and metadata elements), a metadata entity is used to describe simple objects (a simple object refers to the object that can be described by a combination of metadata elements only), and a metadata element is used to describe a property or identifier of an object.

4.2 Restrictions on Metadata

To provide a comprehensive description of a geographic analysis model, the following restrictions are imposed on the model-related metadata elements, entities, and sections:

- Mandatory (M): M is the core content of metadata, is applicable to various described objects, and refers to the metadata sections, entities, or elements that must be provided in a metadata file.
- Conditional (C): C refers to the metadata sections, entities, or elements that must be provided by a metadata file when the different characteristics of the described objects satisfy specific conditions.
- Optional (O): Metadata sections, entities, or elements are optional, and users can decide at their discretion whether to incorporate them into a metadata file.

5. Characteristics of Metadata

As per this standard, metadata is defined in terms of the following eight types of characteristics.

5.1 Name

The name is the label assigned to a metadata entity or element.

5.2 Meaning

The meaning is the description of a metadata entity or element.

5.3 Identifier

The identifier is the unique code used on a PC to define a metadata entity or element.

5.4 Property

The property is a descriptor indicating whether a metadata entity or element is available always or sometimes. There are the following descriptors:

M: Mandatory

C: Conditional (mandatory under certain conditions)

O: Optional

5.5 Condition

The condition is used to describe under which condition a metadata section, entity, or element is mandatory. If the answer to the described condition is yes, the metadata section, entity, or element is mandatory.

5.6 Maximum Frequency of Occurrence

The maximum frequency of occurrence refers to the maximum number of times that a metadata entity or element may appear repeatedly during actual use. “1” indicates that a metadata entity or element appears only once, and “N” indicates that a metadata entity or element appears repeatedly.

5.7 Data Type

A data type refers to a group of different values of a metadata element—for example, “text,” “integer,” “real,” and “date.”

5.8 Value Range

A value range refers to the range of values of a metadata element. Free Text indicates that there is no restriction on the length of the said content. A real number and code-based integer number can only use the values in a given (closed) value range.

6. Content of Metadata

6.1 Model Metadata Profile

Any geographic analysis model (including data sets, data set series, elements, and properties) should usually have a basic metadata file, which should contain at least the entities and elements with the properties of M and C (if available). The profile of metadata is described as follows:

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
1	Model Metadata Profile	It is used to describe the metadata profile of the model.	M	1	Metadata subset	Serial number 2-40
2	Model Cataloguing Information	It is used to identify a complete geographic analysis model uniquely.	M	1	Text	Free text （coding）
3	Chinese Full Name of Model	It refers to the Chinese full name of the model.	M	1	Text	Free text

4	Chinese Abbreviation of Model	It refers to the Chinese abbreviated name of the model.	O	1	Text	Free text
5	English Full Name of Model	It refers to the English full name of the model.	O	1	Text	Free text
6	English Abbreviation of Model	It refers to the English abbreviated name of the model.	O	1	Text	Free text
7	Version	It provides the version information of the model.	O	1	Text	Free text
8	Series Name	It refers to the general term for a series of products to which the model belongs.	C/ Series publications	1	Text	Free text
9	Release Date	It refers to the date on which the model is released.	M	1	Date	YYYYMMDD
10	Information on Researcher & Developer	It refers to the information on the R&D individual or organization of the model.	M	N	Metadata entity	Serial number 41-51
11	Information on Distributor	It refers to the information on the distribution individual or organization of the model.	O	N	Metadata entity	Serial number（52-53）+（43-51）
12	Information on Model	It refers to the information on	O	N	Metadata subset	Serial number（54-55）+11

	Distribution Identifier	the model distributors and model acquisition.				
13	Identifier Information on Associated Project	It refers to the identifier information on the project that supports the research and production of the model.	O	N	Metadata entity	Serial number 56-57
14	Information on Model Revision	It refers to the information on the revision of the model.	O	N	Metadata subset	Serial number (58-62)+(43-51)
15	Model Development Language	It refers to the language used in the process of model development.	M	N	Text	Free text
16	Abstract	It refers to the brief introduction to the model.	M	1	Text	Free text
17	Objective	It refers to the objective of model development.	O	1	Text	Free text
18	Progress	It refers to the progress of the model.	O	1	Integer	1—Finish 2—In production 3-- Planned 4-- Have requests 5-- Will be done 6-- History file 7-- Abolished

19	Model Classification Information	It refers to the high-grade classification information on the model topic used for grouping and querying the available geographic analysis models.	M	N	Metadata entity	Serial number 63-70
20	Keyword	It is used to specify the words or phrases frequently used by the model topic.	O	N	Text	Free text
21	Restriction Information	It refers to the restrictive conditions for access or use of the model.	O	1	Text	Free text
22	Access Restriction	It refers to the provisions on confidentiality or intellectual property protection and special constraints or restrictions at the time of model access.	O	1	Text	Free text-- For example: arbitrary browsing and download, read-only, need to register, need specific equipment, etc.
23	Use/Revision Restriction	It refers to the provisions on confidentiality or intellectual property protection, special constraints, or restrictions, and	O	1	Text	Free text—For example: "public", "private", "copyright", "non-commercial", etc.

		revisability at the time of use of the model.				
24	Description of Data Log	It refers to the descriptive information on data sources, parameters, and essential events in the process of model calculation.	O	1	Text	Free text
25	Information on the Scope of Application	It refers to the spatiotemporal scope within which the model is suitable for calculation and simulation.	O	N	Metadata entity	Serial number 71-76
26	Information on Model Performance	It refers to the information on the performance of the geographic analysis model.	O	1	Metadata entity	Serial number 77-79
27	Information on Model Reference System	It refers to the type and related information of the reference system used by the model for spatial positioning.	O	1	Metadata subset	Serial number 80-93
28	Brief of Model Parameter	It refers to brief description of the required parameters for the model.	M	1	Text	Free text
29	Information on Model Parameter	It refers to the detailed information on the parameter	O	1	Metadata subset	Serial number 94-96

		required for the model.				
30	Information on Modeling Principle	It provides a description of the modeling principle of the geographic analysis model.	O	1	Metadata entity	Serial number 129-134
31	Information on Model-solving Method	It provides a description of the method for solving the geographic analysis model.	O	1	Metadata entity	Serial number 135-137
32	Information on Model Running Structure	It provides a description of the running structure of the geographic analysis model.	O	1	Metadata entity	Serial number 138-139
33	Information on Model Coupling	It refers to the information on the coupling of the geographic analysis model.	O	1	Metadata subset	Serial number 140-151
34	Hardware Condition for Model Running	It refers to the hardware conditions required for model running.	O	1	Metadata entity	Serial number 152-159
35	Software Condition for Model Running	It refers to the software conditions required for model running.	O	1	Metadata entity	Serial number 160-161
36	Information on Model Verification	It refers to the information on verification of the built geographic analysis model.	O	1	Metadata entity	Serial number 162-166

37	Information on Model Release	It refers to the information on the release of the geographic analysis model.	O	N	Metadata subset	Serial number 167-198
38	Data Size	It refers to the total amount of model data stored in the distribution format.	O	1	Real	>0 unit：MB
39	Price	It refers to the price at which the model is distributed (by RMB).	C/ Paid use	1	Real	>0 unit：YUAN
40	Reference Information on Model Metadata	It refers to the related information on the creation and maintenance of metadata of the model.	M	1	Metadata entity	Serial number 199-206

6.2 Information on Model Metadata Entries

6.2.1 Information on Model Researcher & Developer

The following entries are used to describe the R&D individuals or organizations of the model. Researchers & developers are required for the model, and the model may have multiple R&D individuals or organizations.

No	Name	Definition	Property/ Condition	Maximum Times	Data Type	Value Range
10	Information on Researcher & Developer	It refers to the information on the R&D individuals or organizations of the model.	M	N	Metadata entity	Serial number 41-51

41	Name of R&D Individual	It refers to the name of the main R&D individual of the model.	C/ The model is personally responsible	1	Text	Free text
42	Name of R&D Organization	It refers to the name of the main R&D organization of the model.	C/ The model is the responsibility of the unit	1	Text	Free text
43	Country	It refers to the code of the country to which the R&D individual or organization belongs.	M	1	Integer	See GB/T2659-94
44	Administrative Region	It refers to the name of the prefecture, province, or county in which the R&D individual or organization is located.	M	1	Text	Free text
45	City	It refers to the name of the city in which the R&D individual or organization is located.	M	1	Text	Free text
46	Address	It refers to a street name, doorplate number, or mailbox number.	M	1	Text	Free text
47	Postal Code	It refers to a postal code.	M	1	Text	Free text
48	Website	It refers to the electronic address (namely, URL) of the organization concerned.	O	1	Text	Free text
49	E-mail Address	It refers to the e-mail address of	O	N	Text	Free text

		the individual or organization concerned.				
50	Telephone Number	It refers to the telephone number of the individual or organization concerned.	O	N	Text	Free text
51	Fax Number	It refers to the fax number of the individual or organization concerned.	O	N	Text	Free text

6.2.2 Information on Model Distributor

The following entries are used to describe the distribution individuals or organizations of the model. The model may have multiple distribution individuals or organizations.

No	Name	Definition	Property/ Condition	Maximum Times	Data Type	Value Range
11	Information on Distributor	It refers to the information on the distribution individual or organization of the model.	O	N	Metadata entity	Serial number（52-53）+（43-51）
52	Name of Distributor	It refers to the name of the main distributor of the model.	M	1	Text	Free text
53	Role of Distributor	It refers to the copyright share or role that the distribution individual or organization holds or plays in the shared model.	M	1	Integer	1－All copyright 2－Part of the copyright 3－organization 4－management 5－produce 6－Content provision

43	Country	It refers to the code of the country to which the distribution individual or organization belongs.	M	1	Integer	See GB/T2659-94
44	Administrative Region	It refers to the name of the prefecture, province, or county in which the distribution individual or organization is located.	M	1	Text	Free text
45	City	It refers to the name of the city in which the distribution individual or organization is located.	M	1	Text	Free text
46	Address	It refers to a street name, doorplate number, or mailbox number.	M	1	Text	Free text
47	Postal Code	It refers to the postal code.	M	1	Text	Free text
48	Website	It refers to the electronic address (namely, URL) of the organization concerned.	O	1	Text	Free text
49	E-mail Address	It refers to the e-mail address of the individual or organization concerned.	O	N	Text	Free text
50	Telephone Number	It refers to the telephone number	O	N	Text	Free text

		of the individual or organization concerned.				
51	Fax Number	It refers to the fax number of the individual or organization concerned.	O	N	Text	Free text

6.2.3 Information on Model Distribution Identifier

The following entries provide the identifier information on the model distributor and model acquisition and are used to maintain the records of model distribution.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
12	Information on Model Distribution Identifier	It refers to the identifier information on the model distributors and model acquisition.	O	N	Metadata subset	Serial number （54-55）+11
54	Digital Transmission Option	It refers to transmission mode by which the model is obtained.	O	N	Integer	1、 HTTP download 2、 FTP download 3、 E-mail 4、 BT 5、 Other methods of obtaining
55	Model Acquisition Address	It is used to obtain the network resource information on the model.	M	N	Text	Free text
11	Information on Distributor	It refers to the information on the distribution individual or organization of the model.	M	N	Metadata entity	Serial number （52-53）+ （43-51）

6.2.4 Identifier Information on Associated Project

The following entries provide the information on project support for R&D of the model. One model may be supported by multiple projects.

No	Name	Definition	Property/ Condition	Maximum Times	Data Type	Value Range
13	Identifier Information on Associated Project	It refers to the identifier information on the project that supports the research and production of the model.	O	N	Metadata entity	Serial number 56-57
56	Project Title	It refers to the title of a project.	O	1	Text	Free text
57	Project Type	It refers to the type of a project.	O	1	Text	For example: National Research Project, National Natural Science Foundation, National Plan, Departmental Research Project, Department Planning, Unit Self-Funding, Testing, Public Welfare Activities, Reprocessing, Investigation, Trial, etc.

6.2.5 Information on Model Revision

The following entries provide the related information on revision of the model.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range

14	Information on model revision	It refers to the information on the revision of the model.	0	N	Metadata subset	Serial number(58-62)+(43-51)
58	Revision Time	It refers to the time of model revision.	O	1	Date	CCYYMMDD（GB/T 7408-94，ISO 8601-1988）
59	Revision Objective	It refers to the objective of model revision.	0	1	Integer	1、 initial 2、 modify Bug 3、 Add new features 4、 adjustment
60	Revision Content	It refers to the details of model revision.	O	1	Text	Free text
61	Reviser	It refers to the related information on the reviser.	0	1	Metadata entity	Serial number 62+(43-51)
62	Reviser Name	It refers to the name of the reviser.	C/ The model is personally responsible	1	Text	Free text
43	Country	It refers to the code of the country to which the reviser belongs.	O	1	Integer	See GB/T2659-94
44	Administrative Region	It refers to the name of the prefecture, province, or county in which the reviser is located.	0	1	Text	Free text
45	City	It refers to the name of the city in which the reviser is located.	O	1	Text	Free text
46	Address	It refers to a street name, doorplate	0	1	Text	Free text

		number, or mailbox number.				
47	Postal Code	It refers to a postal code.	O	1	Text	Free text
48	Website	It refers to the electronic address (namely, URL) of the organization in which the reviser is employed.	O	1	Text	Free text
49	E-mail Address	It refers to the e-mail address of the revision individual or organization.	O	N	Text	Free text
50	Telephone Number	It refers to the telephone number of the individual or organization concerned.	O	N	Text	Free text
51	Fax Number	It refers to the fax number of the individual or organization concerned.	O	N	Text	Free text

6.2.6 Information on Model Classification

The following entries are used to describe the category that the model falls under, and to identify the model category and build an index to the model.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
19	Information on Model Classification	It refers to the information on the classification of the model in terms of its content, modeling method, and	M	N	Metadata entity	63 to 70 (Serial number)

		organizational hierarchy.				
63	Earth System Science Classification	It refers to the classification of the geographic analysis model in terms of earth system science.	M	N	Integer	For details, refer to the classification standard of earth system science.
64	Representation Method Classification	It refers to the classification of the model in terms of the model representation method.	C	1	Integer	×× 01: conceptual model ×× 02: physical model ×× 03: mathematical model
65	Hierarchical Classification	It refers to the classification of the model in terms of model hierarchy.	C	1	Integer	×× 01: conceptual model ×× 02: logical model ×× 03: physical model ×× 04: computer implementation model
66	Spatiotemporal Classification	It refers to the classification of the model in terms of its relationship with time and space.	C	N	Integer	×× 01: dynamic model ×× 02: static model ×× 03: continuous model ×× 04: discrete model
67	Mathematical Classification	It refers to the classification of the model in terms of the	C	N	Integer	×× 01: differential model

		mathematical method used by it.				×× 02: difference model ×× 03: matrix model ×× 04: stochastic model ×× 05: deterministic model
68	Mechanism Classification	It refers to the classification of the model in terms of the geographic process mechanism involved in it.	C	1	Integer	×× 01: phenomenon model ×× 02: mechanism model ×× 03: process model
69	Spatial Information Classification	It refers to the classification of the model in terms of the processing mode of spatial information or degree of spatial heterogeneity.	C	1	Integer	×× 01: non-spatial model ×× 02: quasi-spatial model ×× 03: spatially explicit model
70	Spatial Data Representation Classification	It refers to the classification of the model in terms of the representation of spatial data.	C	1	Integer	×× 01: grid model ×× 02: vector model

6.2.7 Information on Scope of Application

The following entries are used to describe the spatiotemporal scope within which model calculation is applicable.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
25	Information on Scope of Application	It describes the scope of application of the geographic analysis model.	O	N	Metadata subset	Serial number 71-76
71	Application Field of Model	It refers to the applicable main research fields and scope of the geographic analysis model.	M	1	Text	Free text
72	Temporal Scale of Model	It refers to the temporal scale on which the geographic analysis model is applicable.	M	N	Integer	1: Millions of years or more 2: Million years scale 3; Millennial Scale 2: Millennium scale 3: Centennial Scale 4: Decade scale 4:year 5: month 6; day 7: Day or less 8: (based on events (times, such as precipitation))
73	Time Range	It refers to the time range within which model simulation is applicable.	M	1	Text	Free text
74	Spatial Scale of Model	It refers to the spatial scale on which the geographic	M	N	Integer	1: Global scale 2: Intercontinental scale

		analysis model is applicable.				3: Regional scale 4: Basin Scale 5: Basic Scale (Plot Size)
75	Spatial Region	It refers to the spatial region within which model simulation is applicable.	M	1	Text	Free text
76	Scope of Application of Model Error	It refers to the scope within which the different errors of the model are applicable in various fields.	M	1	Text	Free text

6.2.8 Information on Model Performance

The following entries provide the information on model performance, including stability and precision.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
26	Information on Model Performance	It refers to the information on the performance of the geographic analysis model.	M	1	Metadata entity	Serial number 77-79
77	Model Objective	It refers to the objective of the geographic analysis model.	M	1	Text	Free text
78	Model Stability	It provides a description of the stability of the model.	M	1	Text	Free text
79	Model Precision	It describes the precision of the model on the	M	1	Text	Free text

		temporal scale and spatial scale.				

6.2.9 Information on Model Reference System

The following entries provide the related information on the reference system of the model.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
27	Information on Model Reference System	It refers to the type and related information of the reference system used by the model for spatial positioning.	O	1	Metadata subset	Serial number 80-93
80	Spatial Reference System Based on Geographic Indication	It refers to the spatial reference system that defines the earth's positional relationship by geographic elements.	Constraints depend on the object	Maximum Times depends on the object	Metadata entity	Serial number 81
81	Name	It refers to the name of the spatial reference system that uses geographic indications.	M	1	Text	Free text

82	Coordinate-based Spatial Reference System	It refers to the spatial reference system that defines the earth's positional relationship by coordinates.	Constraints depend on the object	Maximum Times depends on the object	Metadata subset	Serial number 83-93
83	SC_Geodetic Reference System	It provides a description of the geodetic reference system.	M	1	Metadata entity	Serial number 84
84	Name of Geodetic Reference System	It refers to the identifier of the geodetic reference system.	M	1	Text	Free text
85	SC_Coordinate System	It refers to a coordinate system.	M	1	Metadata entity	Serial number 86-87
86	Type of Coordinate System	It refers to the type of a coordinate system.	M	1	Text	Free text
87	Name of Coordinate System	It refers to the identifier of a coordinate system.	M	1	Text	Free text
88	SC_Elevation Reference System	It provides a description of the elevation reference system.	C/采用高程参照系统	1	Metadata entity	Serial number 89

89	Name of Elevation Reference System	It refers to the identifier of the elevation reference system.	M	1	Integer	01: elevation datum of the Yellow Sea in 1956 01: China's national elevation datum in 1985 03: independent elevation datum 04: lower low water (Indian spring low water) 05: theoretic depth datum 06: China gravity control network (57 network) 07: China control basic network in 1985
90	Coordinate reference system	It refers to the metadata of the coordinate reference system.	O	Maximum number of occurrences of using reference objects	Metadata entity	91 to 93 (Serial number)
91	Projection	It refers to the name of the projection used.	0	1	Text	Free text
92	Spheroid	It refers to the name of the spheroid used.	0	1	Text	Free text
93	Code of Reference Name	It refers to the name code of the reference used.	O	1	Integer	01: Beijing geodetic coordinate system in 1954 02: Xi'an geodetic coordinate system in 1980

						03: independent coordinate system 04: worldwide reference system 05: geodetic reference system in 1979 (IAG) 06: world geodetic system

6.2.10 Information on Model Parameter

The following entries provide the related information on model parameters.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
29	Information on Model Parameter	It refers to the detailed information on the parameter required for the model.	O	1	Metadata subset	Serial number 94-96
94	Input Parameter	It provides the information on the input parameter required for running the geographic analysis model.	M	N	Metadata subset	Serial number
95	Output Parameter	It provides the parameter information obtained by running the geographic analysis model.	M	1	Metadata entity	Serial number
96	Control Parameter	It refers to the control parameter in the process of model running.	0	N	Metadata entity	Serial number

The entries on Input Parameter are used to describe the input parameters required for model running.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
94	Input Parameter	It provides the information on the input parameter required for running the geographic analysis model.	M	N	Metadata subset	Serial number 97-118
97	Dimension Information	It refers to the unit features and consistency information of the corresponding model parameter.	M	1	Text	Free text
98	Physical Parameter	It refers to the attributive characteristics of the substances in the study area of the geographic analysis model.	O	1	Metadata entity	Serial number 99-102
99	Constraint Set of Physical Parameter	It provides an overall description of the classification, grade, and physical connotation of the physical parameter.	0	1	Text	Free text
100	Representation Form of	It refers to the digital representation	O	1	Text	Free text

	Physical Parameter	form of the physical parameter.				
101	Value Range of Physical Parameter	It refers to the effective value range of the physical parameter.	O	1	Text	Free text
102	Input Format of Physical Parameter	It refers to the output format of different physical parameters.	M	1	Text	Free text
103	Initial Response Parameter/Data	It refers to the related input parameter or data required when the model begins to run.	M	1	Metadata entity	Serial number 104-107
104	Constraint Set of Initial Parameter/Data	It provides an overall description of the constraint set of the initial response parameter/data.	0	1	Text	Free text
105	Parameter/Data Representation Form	It refers to the representation form of the initial response parameter/data.	O	1	Text	Free text
106	Parameter/Data Value Range	It refers to the effective value range of the initial response parameter/data.	O	1	Text	Free text
107	Parameter/Data Input Format	It refers to the input format of different initial response parameter/data.	M	1	Text	Free text

108	Parameter Value of Mathematical Meaning	It refers to the parameter value of mathematical meaning required by a specific model.	0	1	Metadata entity	Serial number 109-112
109	Constraint Set of Mathematical Meaning Parameter	It provides an overall description of the constraint set of the mathematical meaning parameter.	0	1	Text	Free text
110	Parameter Representation Form	It refers to the representation form of the parameter.	0	1	Text	Free text
111	Parameter Value Range	It refers to the effective value range of the parameter.	O	1	Text	Free text
112	Parameter Input Format	It refers to the input format of different parameters.	0	1	Text	Free text
113	Boundary Parameter	It refers to the boundary parameter required by a specific geographic analysis model.	O	O	Metadata entity	Serial number 114-118
114	Constraint Set of Boundary Parameter	It provides an overall description of the physical connotation of the boundary parameter.	0	1	Text	Free text

115	Type of Boundary Parameter	It refers to the type of boundary parameter required by a specific geographic analysis model.	O	O	Integer	01 One type of boundary parameter 02 Two types of boundary parameters 03 Three types of boundary parameters
116	Representation Form of Boundary Parameter	It refers to the representation form of the boundary parameter.	O	n	Integer	01 Word 02 Chart 03 Number
117	Value Range of Boundary Parameter	It refers to the effective value range of the boundary parameter.	O	1	Text	Free text
118	Input Format of Boundary Parameter	It refers to the input format of the boundary parameter/data.	O	1	Text	Free text

The entries on Output Parameter are used to describe the output parameters obtained by model running.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
95	Output Parameter	It refers to the representation of the model running result.	M	1	Metadata entity	Serial number 97+（119-124）
97	Dimension Information	It refers to the unit features and consistency information of the corresponding	M	1	Text	Free text

		model parameter.				
119	Constraint Set of Output Parameter	It provides an overall description of the classification, grade, and physical connotation of the output parameter.	0	1	Text	Free text
120	Type of Output Parameter	It refers to the parameter type of the calculation result.	M	1	Text	Free text
121	Representation Form of Output Parameter	It refers to the representation of the calculation result.	O	1	Integer	1;word 2;chart 3;number ……
122	Effective Value Range of Output Parameter	It provides an effective control of the output result.	O	1	Text	Free text
123	Output Format	It refers to the output format of different output parameters.	M	1	Text	Free text
124	Error Control Form of Output Parameter	It provides error check for the output parameter.	O	1	Text	Free text

The entries on Control Parameter are used to describe the control parameters in the process of model running.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range

96	Control Parameter	It refers to the control parameter in the process of model running.	O	1	Metadata entity	Serial number 97+（125-128）
97	Dimension Information	It refers to the unit features and consistency information of the corresponding model parameter.	M	1	Text	Free text
125	Constraint Set of Control Parameter	It provides an overall description of the mathematical or physical connotation of the control parameter.	0	1	Text	Free text
126	Control Parameter of Model Error	It refers to the error correction parameter required for model running.	O	1	Text	Free text
127	Control Parameter of Equation Solving	It refers to the equation-solving parameter in the process of model solving.	O	1	Text	Free text
128	Model-specific Control Parameter	It refers to the specific control parameter in the process of model running.	O	1	Text	Free text

6.2.11 Information on Modeling Principle

The following entries are used to describe the basic principle for modeling.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range

30	Information on Modeling Principle	It describes the basic principle for building the geographic analysis model.	O	1	Metadata entity	Serial number 129-134
129	Modeling Method	It refers to the modeling method.	O	1	Text	Free text
130	Modeling Principle	It refers to the basic modeling principle.	O	1	Text	Free text
131	Modeling Process	It refers to the basic modeling process.	O	1	Text	Free text
132	Model Data Transfer Process	It provides an overall description of data driving in the process of model running.	O	1	Text	Free text
133	Model Implementation Algorithm	It describes the source, main structure, and method of the model implementation algorithm.	O	1	Text	Free text
134	Mathematical Representation of Model	It refers to the model information represented by a mathematical formula.	O	1	Text	Free text

6.2.12 Information on Model-solving Method

The following entries provide the related information on the model-solving method.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range

31	Information on Model-solving Method	It refers to the related information on model solving.	O	1	Metadata entity	135 to 137 (Serial number)
135	Mathematical Method for Model Solving	It refers to the mathematical method used for solving the model.	O	1	Text	Free text
136	Source of Model-solving Method	It refers to the source of the model-solving method.	O	1	Text	Free text
137	Type of Model-solving Method	It refers to the type of the model-solving method.	O	1	Integer	By the model classification system: 1: statistical method 2: physical simulation method 3: balancing method 4: numerical simulation method 2.1 finite difference 2.2 finite element 2.3 boundary element 5: optimization method 5.1 simplex method 5.2 genetic algorithm 5.3 neural network ……

6.2.13 Information on Model Running Structure

The following entries are used to describe the internal running structure of the model.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
32	Information on Model Running Structure	It provides a description of the running structure of the geographic analysis model.	O	1	Metadata entity	Serial number 138-139
138	Legend of Running Structure	It refers to the logical legend of the model running structure.	O	1	Image	Image
139	Type of Running Structure	It refers to the type of the model running structure	O	1	Integer	1. complex type (usually represented by the running structure legend) 2. simple calculation 3. time marching 4. event response

6.2.14 Information on Model Coupling

The following entries are used to describe the internal coupling mode and coupling between different models.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
33	Information on Model Coupling	It refers to the information on the coupling of the geographic analysis model.	0	1	Metadata subset	Serial number 140-151
140	Model Coupling Mode	It refers to the mode of coupling between different geographic analysis models.	O	1	Metadata subset	Serial number 141-151

141	Data-driven Mode	The coupling between different models is implemented in a data-driven manner.	O	1	Metadata entity	Serial number 142-145
142	Model Running/Process Data	It refers to the data on model running results and intermediate data generated in the process of model running.	O	1	Text	Free text
143	Driving Data Set for Model Coupling	It provides an overall description of the running data and process data of the model working in a data-driven coupling mode.	O	1	Text	Free text
144	Value Range	It refers to the value range of the model running and output data.	O	1	String	Free text
145	Data Structure (and Format)	It refers to the structure (and format) of the model running data and output data.	O	1	String	Free text
146	Boundary Variable Interaction Mode	The coupling between different models is implemented by the interaction of boundary variables.	O	1	Metadata entity	Serial number 147-151

147	Variable Name	It refers to the name of a boundary variable.	O	1	String	Free text
148	Boundary Variable Data Set	It provides an overall description of the mathematical and physical connotations of the boundary variables working in an interactive coupling mode.	O	1	String	Free text
149	Variable Interaction Format	It refers to the format of data interaction between boundary variables.	O	1	String	Free text
150	Interaction Interface	It refers to the related information on the interface used for interaction between boundary variables.	O	1	Text	Free text
151	Multigrid Nested Coupling	Model coupling is implemented by multigrid nesting.	O	1	Text	Free text

6.2.15 Hardware Conditions for Model Running

The following entries are used to describe the related hardware conditions for model calculation.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range

34	Hardware Condition for Model Running	It refers to the hardware conditions required for model running.	0	1	Metadata entity	Serial number 152-159
152	Minimum CPU Requirement	It refers to the minimum CPU configuration (including dominant frequency and external frequency) required for model running.	O	1	Text	Free text
153	Recommended CPU Requirement	It refers to the recommended CPU configuration (including dominant frequency and external frequency) required for model running.	O	1	Text	Free text
154	Minimum Memory Requirement	It refers to the minimum memory configuration required for model running.	O	1	Text	Free text
155	Recommended Memory Requirement	It refers to the recommended memory configuration required for model running.	O	1	Text	Free text
156	Minimum Hard Disk Requirement	It refers to the minimum hard disk configuration	O	1	Text	Free text

		required for model running.				
157	Recommended Hard Disk Requirement	It refers to the recommended hard disk configuration required for model running.	O	1	Text	Free text
158	Minimum Display Card Requirement	It refers to the minimum display card configuration required for model running.	O	1	text	Free text
159	Recommended Display Card Requirement	It refers to the recommended display card configuration required for model running.	O	1	Text	Free text

6.2.16 Software Conditions for Model Running

The following entries are used to describe the related software conditions for model calculation.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
35	Software Condition for Model Running	It refers to the software conditions required for model running.	0	N	Metadata entity	Serial number 160-161
160	Operating System	It refers to the operating system required for model running.	M	1	Integer	1 DOS 2 Linux 3 FreeBSD 4 Windows 9X 5 Windows NT4 6 Windows 2K/XP/2003

						7 Windows Vista
161	Other Software Requirement	It refers to other software conditions required for model running (not for other types of models).	O	N	Text	Free text

6.2.17 Information on Model Verification

The following entries are used to describe the methods and data involved in model verification.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
36	Information on Model Verification	It is used to verify the built geographic analysis model.	O	1	Metadata entity	Serial number 162-166
162	Verification of Data Integrity	It is used to verify the integrity of the data required for model running and the correctness of data format.	O	1	Text	Free text
163	Conceptual Model Verification	It is used to verify whether the conceptual model is designed accurately.	O	1	Text	Free text
164	Certainty Verification	It is used to verify whether the model can depict a conceptual model accurately.	O	1	Text	Free text
165	Effectiveness Verification	It is used to verify the precision of the model—specifically,	O	1	Text	Free text

		whether the model is effective.				
166	Data Assimilation Method	It refers to the data assimilation method to be used on a varying spatiotemporal scale.	O	1	Text	Free text

6.2.18 Information on Model Release

The following entries provide the related release and service information.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
37	Information on Model Release	It provides the related information on the released geographic analysis model.	M	1	Metadata subset	167 to 198 (Serial number)
167	Model Release Mode	It refers to the mode of model release.	M	1	Enum	Source code Function library Executable program Component Web service
168	Whether Source Codes are Published	It is used to specify whether the source codes are published.	M	1	Boolean	yes/no
169	Open-sourcing Law	It refers to the law that governs the development of source codes.	C	1	Enum	GPL BSD GNU ……
170	Information on Source-code Released Model	It provides the related information on the model released in a source-code form.	M	1	Metadata entity	Serial number 171-175

171	English Name of Source Package	It refers to the English description of the software package.	M	1	Text	Free text
172	Compression Mode	It refers to the compression mode used for the source package.	M	1	Enum	unzip zip rar rpm z
173	Development Language	It refers to the development language used for the source package.	M	N	Enum	C\C++ Fortran Python Java ……
174	Used Compiler	It refers to the compiler used for the source package.	M	N	Enum	GCC MSVC Intel C++ ……
175	Third-party Software Dependence	It refers to the third-party software required for compiling and running the source codes.	M	N	Free text	Free text
176	Identifier Information on Function-library Released Model	It refers to the identifier information on the model released in a function-library form.	M	1	Metadata entity	Serial number 177-180
177	English Name of Function Library	It refers to the English name of a function library.	M	1	text	Free text
178	Distribution Mode of Function Library	It refers to the distribution mode of a function library.	M	1	Enum	exe unzip zip rar Rpm Z ……

179	Application Language of Function Library	It refers to the development language required for the use of the function library.	M	1	Enum	c\c++ Fortran Java Perl Python
180	Description of Function Library Interface/Method	It is used to describe the interface methods and global variables that can be invoked by the function library.	M	1	Text	Free text
181	Identifier Information on Executable-program Released Model	It refers to the identifier information on the model released in an executable-program form.	M	1	Metadata entity	Serial number 182-185
182	English Name of Executable Program	It refers to the English name of an executable program.	M	1	Text	Free text
183	Release Mode of Executable Program	It refers to the release mode of an executable program.	M	1	Enum	Setup program Single executable program Compressed package
184	Compression Mode of Executable Program	It refers to the compression mode of an executable program.	C	1	Enum	Zip Rar Z Rpm ……
185	Description of Running Method	It provides a detailed description of the running method.	O	1	Text	Free text
186	Identifier Information on	It refers to the identifier information on the	M	1	Metadata entity	Serial number 187-194

	Component Released Model	model released in a component form.				
187	English Name of Component	It refers to the English name of a component.	M	1	Text	Free text
188	Component Encapsulation Mode	It refers to the encapsulation mode of a component.	M	1	Enum	JavaBean dotNet 1.0 dotNet 1.1 dotNet 2.0 Com Dll AciveX Ocx Ejb Corba
189	Component Release Mode	It refers to the release mode of a component.	M	1	Enum	Exe file UnZip Zip Rar Rpm Z ……
190	Description of Component Installation	It is used to describe how to install a component.	M	1	Text	Free text
191	Component-used Language	It refers to the development language used for the component.	M	N	Enum	c\c++ Fortran Java Perl Python
192	Description of Component Interface	It is used to describe the interface that can be invoked by a component.	M	N	Text	Free text
193	Description of Component Event	It is used to describe a component-related event.	O	N	Text	Free text

194	Description of Accessible Variable in Component	It is used to describe the accessible variables in a component.	O	N	Text	Free text
195	Identifier Information on Web-service Released Model	It refers to the identifier information on the model released in a Web-service form.	O	1	Metadata entity	Serial number 196-198
196	English Name of Web Service	Web service	O	1	Text	Free text
197	WSDL Address	It refers to the address required for invoking the Web service.	O	1	Text	Free text
198	Use Description of Web Service Interface	It is used to describe how to use the Web service interface.	O	1	Text	Free text

6.2.19 Reference Information on Model Metadata

The following entries are used to describe the metadata of the model, as well as the related information generated by the metadata.

No	Name	Definition	Property / Condition	Maximum Times	Data Type	Value Range
40	Reference Information on Model Metadata	It refers to the related information on the creation and maintenance of metadata of the model.	M	1	Metadata entity	Serial number 199-206
199	Data Level of Metadata	It refers to the level of detailedness of metadata.	M	1	Integer	1—One 2—Two
200	Metadata Accountability Organization	It refers to the name of the organization	M	1	Text	Free text

		accountable for the content of the metadata.				
201	Metadata Author	It refers to the name of the individual accountable for the content of the metadata.	C/ Metadata is personally responsible	1	Text	Free text
202	Administrative Region	It refers to the name of the prefecture, province, or county where the individual or organization accountable for the content of metadata is located.	O	1	Text	Free text
203	City	It refers to the name of the city where the individual or organization accountable for the content of metadata is located.	O	1	Text	Free text
204	Address	It refers to a street name, doorplate number, or mailbox number.	O	1	Text	Free text
205	Postal Code	It refers to a postal code.	O	1	Text	Free text
206	Telephone Number	It refers to the telephone number of the organization or individual accountable for	O	N	Text	Free text

		the content of the metadata.				

7. Principles and Methodology for Metadata Extension

When the content of metadata cannot satisfy the needs of specific applications, metadata may be extended based on the stipulated principles:

7.1 Types of Extension

1. Extend the value range of a metadata element;

2. Add new metadata elements;

3. Add new types of metadata entities;

4. Add new metadata sections;

5. Impose a more rigorous restriction on the existing metadata elements;

6. Impose a more rigorous restriction on the value range of the existing metadata elements;

7.2 Principles for Extension

1. The extended metadata elements should not be generated by renaming or redefining the existing metadata elements or changing the type of data.

2. The extended metadata may be defined as entities, and contain the extended or existing metadata elements, but the characteristics of such contained existing metadata elements should not be changed.

3. A more rigorous restriction may be imposed on the existing metadata elements (for example, metadata elements are optional as per this standard, but the extended metadata elements may be mandatory).

4. A more rigorous restriction may be imposed on the thresholds of the existing metadata elements (for example, after a metadata element with the threshold as “free text” is extended, a closed value range can be defined for it).

5. A restriction may be imposed on the scope of application of the thresholds specified by this standard (for example, the threshold of a metadata element has five available values as per this standard; it can be stipulated that only three of them are used

for the threshold of an extended metadata element and users need to choose one from the three values).

6. It is prohibited to use the content not specified by this standard for the extended metadata elements (for example, this standard stipulates that the threshold of a metadata element should have four available values; the values other than the four values should not be used for the threshold of the extended metadata element).

7.3 Methodology for Extension

1. Check the metadata content specified by this standard, and identify the content that is not suitable for specific applications or that should be extended or supplemented;

2. Determine the metadata sections, entities, and/or elements to be extended as instructed in sections 7.1 and 7.2;

3. Define the characteristics of each extended metadata section, entity, and/or element;

4. Perform a standard consistency test for the extended content.