Content Standard for Computational Models

Metadata for Models Work Group
Alexandria Digital Earth Prototype Project

University of California, Santa Barbara

**Version 1.0
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Content Standard for Computational Models
(CSCM)

OBJECTIVES:

The objectives of the standard are to provide a common set of terminology and definitions for the documentation of computer models. The standard establishes the names of data elements and compound elements (groups of data elements) to be used for these purposes, the definitions of these compound elements and data elements, and information about the values that are to be provided for the data elements.

SCOPE:

In 1989, Science Magazine had an article titled "Is it real or is it Crazy?" (Pool, 1989) in which they were introducing a whole new field of science referred to as computer experimentation. At that time only a handful of laboratories across the globe had the "super computers" large enough; powerful enough to operate computer models.

Now, nearly 12 years later, computer models can be transferred "over the web" or "burned" onto a plastic disk, and downloaded into a palm-held computer. As technology continues, I'm sure that in the near future we'll look back at today's greatest technology as if were archaic.

This sudden boom in technology has been paralleled by a sudden influx of computer models into the scientific community. Models are being used for research and understanding of everything from Hydrology to Yarn manufacturing, from gold deposits to survival rates in ICU's. With this sudden flux, comes a bit of confusion.

The problem that arises is that, to date, there has been no standard method for one person to communicate with another about the model that they have, and with this breakdown in communication, there lies a breakdown in the ease of sharing knowledge and experience. For this cause, a Computer Model Metadata Standard has been needed.

The driving force behind this effort to develop a computer model metadata standard is the increasing number of digital libraries, registries, and clearinghouses, and the need (and desire) to be able to catalog computer models in these sources. It is through these sources that the knowledge and experience gained in model technology can be shared and distributed.

The effort of creating a model metadata standard is taking place in the academic arena. The academic community has a vested interest in computer models. Not only are models used both in instruction and research, but also it is through said research that many models are developed. The academic circle will be able to develop standards that will be useful for academia, yet applicable and accepted to those both in government and industry.

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METADATA STANDARD

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OVERVIEW:

1. Name of Standard. Content Standard for Computational Models.

2. Explanation. This standard specifies the information content of metadata for computer models. A computer model can be defined as software whose primary function is to model a certain class of physical systems, and may include pre- and post-processing components and other necessary ancillary programs (Dee, 1994). This is often referred to as computer modeling software.

The purpose of the standard is to provide a common set of terminology and definitions for concepts related to these metadata. Metadata are data about the content, quality, condition, and other characteristics of the specified model.

Work began on a computer model metadata standard for the purpose of incorporation of computer models into digital libraries (Specifically, the Alexandria Digital Library at the Univ. of California, at Santa Barbara.)

This draft is currently under public review.

3. Approving Authority. This documentation, as of May 2001, still awaits approval through academic circles.

4. Maintenance Authority. The current maintenance authority for the standard is the Metadata for Models Work Group, the Alexandria Digital Earth Prototype, U.C. Santa Barbara. Questions and comments concerning the standard are to be addressed to Scott Crosier: scott@geog.ucsb.edu.

5. Related Documents. No list of related documents exists as of May 2001.

6. Objectives. The objectives of the standard are to provide a common set of terminology and definitions for the documentation of computer models. The standard establishes the names of data elements and compound elements (groups of data elements) to be used for these purposes, the definitions of these compound elements and data elements, and information about the values that are to be provided for the data elements.

The major uses of metadata are:
*   to maintain an organization's internal investment in computer models,

*   to provide information about an organization's computer model holdings to model catalogues, clearinghouses, digital libraries, and brokerages,

*   to provide information needed to process computer models to be received through a transfer from an external source, and

*   to describe the input data and output data parameters and formats necessary for operating the model as well as hardware and software requirements for running the model

The information included in the standard was selected based on six roles that metadata play:

*   Identity – basic data required in order to identify the model.

*   Functionality – data needed to determine the intended function of the model.

*   Fitness for use – data needed to determine if a computer model meets a specific need.

- Access – data needed to acquire an identified model.

- Validation – data needed to determine the accreditation of a computer model.

- Transfer – data and hardware needed to process and use a model.

The exact order in which data elements are evaluated, and the relative importance of data elements, will not be the same for all users.

7.   Applicability.   This standard is for the documentation of computer based models. Computational models refer to software whose function is to model a certain class of physical systems, and may include pre- and post-processing components and other ancillary programs.(Dee, 1994)

8. Specifications. The standard provides specifications for terminology of data elements and compound elements, definitions for this terminology, and information about values to be provided for the data elements.
Information about terms that are mandatory, mandatory under certain conditions (conditional), and optional (provided at the discretion of the data provider) is provided by the standard.

9. Where to Obtain Copies. Copies of this publication are available from Scott Crosier, UC Santa Barbara: scott@geog.ucsb.edu or downloadable in word.doc format from:
www.geog.ucsb.edu~scott/standard/standard.doc

COMPOUND ELEMENTS

A compound element is a group of data elements and other compound elements. All compound elements are described by data elements, either directly or through intermediate compound elements. Compound elements represent higher-level concepts that cannot be represented by individual data elements.

PROPERTIES OF DATA ELEMENTS

DATA ELEMENT
A data element is a logically primitive item of data. The entry for a data element includes the name of the data element, a short name, the definition of the data element, the obligation requirements of the element, the maximum occurrence of the element, or repeatability, the data type and the domain of the element.

SHORT NAME
Each element and compound element is provided with a short name. These short names are unique within the standard and may be used with the Extensible Mark-Up Language (XML), Unified Modeling Language (UML) or other similar implementation techniques. A naming convention similar to that used to create the longer entity and element names was used.

NOTE: Implementation using Standard Generalized Markup Language (SGML) and Extensible Mark-Up Language (XML) is not mandatory; other implementation methods may be accommodated.

DEFINITION
Each Compound and Data Element is provided with a description.

OBLIGATION / CONDITION

A descriptor indicating whether a metadata entity or metadata element shall always be documented or sometimes be documented (i.e., contain value(s)). This descriptor may have the following values: M (mandatory), C (conditional), or O (optional).

Mandatory (M):
The metadata entity or metadata element shall be documented.

Conditional (C):
Specifies an electronically manageable condition under which at least one metadata entity or a metadata element is mandatory. 'Conditional' is used for one of the three following possibilities:
- Expressing a choice between two or more options. At least one possible option or more is mandatory and must be documented.
- Documenting a metadata entity or a metadata element if another element has been documented.
- Documenting a metadata element if a specific value for another metadata element has been documented.

To facilitate reading by humans, the specific value is used in plain text. However, the code shall be used to verify the condition in an electronic user-interface.
If the answer to the condition is positive, then the metadata entity or the metadata element shall be mandatory.
The condition identifies also the metadata entity identifier or the metadata element identifier and the allowed value where appropriate, upon which the condition is formulated.

Optional (O):
The metadata entity or the metadata element may be documented or not documented. Optional metadata entities and optional metadata elements have been defined to provide for fully documented data.
(Use of this common set of defined elements will help promote interoperability among model users and producers world-wide.) If an optional entity is not used, the elements contained within that entity (including mandatory elements) will also not be used. Optional entities may have mandatory elements, those elements only become mandatory if the optional entity is used.

MAXIMUM OCCURENCE
Specifies the maximum number of instances the metadata entity or the metadata element may have. Single occurrences are shown by "1"; repeating occurrences are represented by "N".

DATA TYPE
The information about the values for the data elements includes a description of the type of the value, and a description of the domain of the valid values. The type of the data element describes the kind of value to be provided. The choices are "integer" for integer numbers, "real" for real numbers, "text" for ASCII characters (including those characters relating to a URL address or an electronic mail address), "date" for day of the year, and "time" for time of the day. Where values are to be selected from a predetermined vocabulary or a code list provided with the standard, the data type is "class."

DOMAIN
The domain describes valid values that can be assigned to the data element. The domain may specify a code list of valid values or restrictions on the range of values that can be assigned to a data element.

The domain also may note that the domain is free from restrictions, and any values that can be represented by the "type" of the data element can be assigned. These unrestricted domains are represented by the use of the word "free" followed by the type of the data element (that is, free text, free date, free real, free time, and free integer).

Some domains can be partly, but not completely, specified. To allow a producer to describe its model in these circumstances, the convention of providing as one of the options in a list of values being "other". In the case where the option "other" is used, the following optional element allows the producer to specify the value and from which standardized list it was drawn.

CALENDER DATES (Years, Months, and Days)
Character encoding of a date is a string, which shall follow the format for date specified by ISO 8601 + extension proposed by OGC Web Mapping Testbed (Basic Service Model Draft). According to that standard, dates shall be recorded as follows: YYYY-MM-DD. Further information relating to ISO standard 8601 can be found at the following URL address: http://www.iso.ch/markete/8601.pdf

MODEL vs. MODULE OF MODEL
If the metadata is in regards to a specific module of a model, this shall be so noted in the model title (line 2)

The following is the recommended bibliographic citation for this publication:

Alexandria Digital Earth Prototype, Metadata for Models Work Group. Content standards for computer model metadata. 2001

In the creation of this Metadata standard, the ISO TC 211 "Geographic Information Metadata Standard Committee Draft" (CD19115.3; 211N930) was used as a guide. The U.S. Federal Geographic Data Committee's "Content Standard for Digital Geospatial Metadata" has also provided guidance. As this Metadata for Models is further developed, a goal will be to harmonize it as much as possible with these and other metadata standards.

Element Definitions for Computational Model Metadata

Sec. 1: Identification Information

No.	Element Name	Short Name	Definition	Obligation / Condition	Max. Occurrence	Data Type	Domain
1	**Identification Information**	IdInfo	Basic identification information about the model	M	1	Compound	lines 2-7
2	Model Title	title	Selected and agreed upon name referring to the model, modeling package, or model instance.	M	1	Text	free text
3	Version of Model	version	Version of model for which the metadata documentation has been created.	C - Is there now or will there be more than one version?	1	Text	free text
4	Responsible Party of Model	respParty	Identification of, and means of communication with, person(s) and organization(s) associated with the model.	M	N	Compound	sec 1.1, lines 8-11
5	Date of Creation	createDate	Date that this version of the model was released.	M	1	Date	ISO 8601
6	Model Citation	citation	Recommended citation to the model established by the group or individual responsible for the model.	M	1	Text	free text
7	Model Identification Number	id	Any identification number associated with this model.	O	N	Text	free text

Sec. 1.1: Responsible Party of Model   (Mandatory, Repeatable)

No.	Element Name	Short Name	Definition	Obligation / Condition	Max. Occurrence	Data Type	Domain
8	Responsible Party Individual Name	rpIndName	Name of the responsible person.	M	1	Text	free text
9	Organization Affiliated with Responsible Party	rpOrg	Business, school, government agency, or other organization with which the creator or creators was affiliated during the time of model creation.	O	N	Text	free text
10	Position Name of Responsible Party	rpPost	Role or position of the responsible person.	O	1	Text	free text
11	Responsible Party Contact Information	rpCntInfo	Contact information of the responsible party.	O	N	Compound	sec. 1.1.1, lines 12-19

Sec. 1.1.1: Contact Information   (Optional, Repeatable)

No.	Element Name	Short Name	Definition	Obligation / Condition	Max. Occurrence	Data Type	Domain
12	Delivery Point	delPoint	Address line for the location. (street name, box number, suite)	O	N	Text	free text

13	City	city	City of the location.	C - Is there a delivery point (line 12)?	1	Text	free text
14	Administrative Area	adminArea	State or providence of the location.	C - Is there a delivery point (line 12)?	1	Text	free text
15	Postal Code	postCode	ZIP or other postal code.	C - Is there a delivery point (line 12)?	1	Text	free text
16	Country	country	Country abbreviation of the physical address.	C - Is there a delivery point (line 12)?	1	Text	ISO 3166
17	Electronic Mail Address	email	Address of the electronic mailbox of the organization or individual.	O	N	Text	free text
18	Telephone Number	tele	Telephone number of the organization or individual.	O	N	Text	free text
19	Facsimile Number	fax	Facsimile number of the organization or individual.	O	N	Text	free text

Sec. 2: Intended Use

20	**Intended Use**	intendUse	Level of understanding and/or expertise required, and intended use of the computer model.	M	1	Compound	lines 21-23
21	Application Purpose	appPurpose	Application purpose of the model.	M	N	Class	code list 1
22	Other Application Purpose	otherAppPur	Specified application purpose of the model.	C- Was "other" selected in line 21?	1	Text	free text
23	Educational Level	eduLevel	Intended educational level for which the model was created to instruct.	C- Was "education" selected for the purpose in line 21?	N	Class	code list 2

Sec. 3: Description

24	**Description**	descrip	Description of the model, including the modeling process and functionality of the model.	M	1	Compound	lines 25-31
25	Conceptual Model Description	concpModDesc	Description of the modeled environment, model function, conceptual and theoretical basis, and nature of transformations involved in the modeling process.	M	1	Text	free text
26	Symbolic Representation	symbolRep	Description of considerations of the modeler in the development of the model from the natural system to the computational model.	O	1	Text	free text
27	Model Typology	typology	Type of processing performed by the model.	M	N	Class	code list 3

28	Other Typology	otherType	Additional types of processing preformed by the model.	C- Was "other" selected as the type in line 27?	1	Text	free text
28	Topic or Field of Study	topic	Related word or words for topic of study of model.	M	N	Class	code list 4
29	Other Topic	otherTopic	Any other topic or field of study that was not available on code list 4.	O	N	Text	free text
28	Geographic Coverage	geogCover	The geographic coverage of the model, including overall location and sub-locations.	C- Is the model limited to a specific geographic location?	1	Compound	section 3.1, lines 32-37
29	Temporal Coverage	tempCover	The temporal coverage of the model.	C- Is the model limited to a specific temporal range?	N	Compound	section 3.2, lines 65-68
30	Related Model	refMod	Information about a related model that is likely to be of interest and how it compares or differs from the computer model.	O	N	Compound	section 3.3, lines 69-70
31	Source of Additional Information	addInfo	Source for documentation for the model. (preferably a journal article or paper citation or URL reference)	O	N	Compound	section 3.4, lines 71-72

Sec. 3.1: Geographic Coverage   (Conditional, Non-Repeatable)

32	Planetary Body	planet	Name of the planet to which the latitude and longitude values pertain. (default is "Earth")	M	1	Class	code list 5
33	Other Planetary Body	otherPlanet	Any planetary body that was not available on code list 5.	C- Was "Other Planetary Body" selected for line 32?	1	Text	free text
34	Geodetic Reference System	geodetic	Basis for the geospatial values (i.e., latitude and longitude coordinates),such as WGS-84.	C- Is the geodetic system known?	1	Text	free text
35	Bounding Box	boundBox	Generalized geographic coverage footprint for the model as a whole in the form of a bounding rectangle. If Detailed Geometry(ies) are also described, this box must be generated from it (them).	M	1	Compound	section 3.1.1, lines 38-47
36	Place or Event Name	placeEvtName	Name for place or event that the model is about.	O	N	Compound	section 3.1.2, lines 51-54
37	Detailed Geometry	detailGeo	Footprints(s) for the sub-locations or more detailed footprint(s) for the overall location.	O	N	Compound	section 3.1.3, lines 55-64

Sec 3.1.1: Bounding Box   (Based on use of Sec.3.1, Non-Repeatable)

38	West Coordinate	westCoord	Longitude value for the west edge of the coverage extent. Negative values are used for west of the prime meridian.	M	1	Real	-180 to 180
39	East Coordinate	eastCoord	Longitude value for the east edge of the coverage extent. Negative values are used for west of the prime meridian.	M	1	Real	-180 to 180
40	South Coordinate	southCoord	Latitude value for the south edge of the coverage extent. Negative values are used for south of the equator.	M	1	Real	-90 to 90
41	North Coordinate	northCoord	Latitude value for the north edge of the coverage extent. Negative values are used for south of the equator.	M	1	Real	-90 to 90
42	Bounding Box Source Name	bbSrce	Document the source of the bounding box.	M	1	Text	free text
43	Bounding Box Source Entry ID	bbSrceID	Entry ID that identifies the bounding box in a published source.	O	1	Text	free text
44	Bounding Box Source URL	bbSrceURL	URL address for the source and for the specific entry if possible.	O	1	Text	free text
45	Bounding Box Source Description	bbSrceDesc	Description of the source of the bounding box, such as description of a complex geometry used to create it (found through the URL).	O	1	Text	free text
46	Bounding Box Accuracy Estimate	bbAccurEst	Statement about the estimated accuracy of the bounding box footprint.	O	1	Text	free text
47	Bounding Box Vertical Dimension	bbVert	Range of meters for the altitude or depth of the coverage area.	O	1	Compound	sec. 3.1.1.1, lines 48-50

Sec 3.1.1.1: Vertical Dimension   (Optional, Non-Repeatable)

48	Vertical Base Level	vertBase	Indication of the basis for the vertical dimension values.	M	1	Class	(sea level, local surface level, specified geodetic reference system)
49	Vertical Minimum	vertMin	Values in meters for the minimum altitude or depth value. Negative values represent distance below base level.	M	1	Real	free real
50	Vertical Maximum	vertMax	Values in meters for the maximum altitude or depth value. Negative values represent distance below base level.	M	1	Real	free real

Sec. 3.1.2: Placename or Event Name   (Optional, Repeatable)

51	Place- or Event Name	plEvtName	Name of the place or event included in the model.	M	N	Text	free text
52	Place or Event Name Source Name	plEvtSrce	Name of the gazetteer or other source that documents the source of the place- or event name.	O	1	Text	free text
53	Place or Event Source Entry ID	plEvtSrceID	Entry ID that identifies the bounding box uniquely in the source.	O	1	Text	free text
54	Place or Event Source URL	plEvtSrceURL	URL address for the source and for the specific entry if possible.	O	1	Text	free text

Sec. 3.1.3: Detailed Geometry (Optional, Repeatable)

55	Type of Detailed Geometry	typeDetGeo	Category of geometry.	M	1	Class	(point, bounding box, polyline, polygon)
56	Number of Points	geoNumPts	Number of points in the geometry.	M	1	Integer	1 - N
57	Point Order	geoPtOrder	Clockwise or counter-clockwise order.	C- Was "polygon" declared as the "Type of Detailed Geometry" in line 55?	1	Class	(clockwise, counter-clockwise)
58	Longitude, Latitude Values	longLatValu	List point coordinates as a string of latitude/longitude pairs. (Separate latitude and longitude with a comma and separate points with a single space. For example: 32.5,-125.2 33.0,-127.5 …22.5,-115.7)	M	1	Text	free text
59	Detailed Geometry Source Name	dtGeoSrcNm	Name of the gazetteer or other source that documents the source of the detailed geometry.	O	1	Text	free text
60	Detailed Geometry Source ID	dtGeoSrcID	Entry ID that identifies the detailed geometry uniquely in the source.	O	1	Text	free text
61	Detailed Geometry Source URL	dtGeoSrcURL	URL address for the source and for the specific entry if possible.	O	1	Text	free text
62	Detailed Geometry Source Description	dtGeoSrcDesc	Description of the source of the detailed geometry (found through the URL).	O	1	Text	free text
63	Detailed Geometry Accuracy Estimate	dtGeoAccEst	Statement about the estimated accuracy of the detailed geometry.	O	1	Text	free text

64	Detailed Geometry Vertical Dimension	dtGeoVertDim	Range of values for the altitude or depth of the detailed geometry.	O	1	Compound	sec. 3.1.1.1, lines 48-50

Sec. 3.2: Temporal Coverage   (Conditional, Repeatable)

65	Beginning Date and Time	beginDate	Beginning date and time for the temporal coverage of the model.	O	1	Date	ISO 8601
66	Ending Date and Time	endDate	Ending date and time for the temporal coverage of the model.	C- Is there a beginning date (line 65)?	1	Date	ISO 8601
67	Named Temporal Period	namTempPer	Name of a temporal period that indicates the temporal coverage of the model.	O	N	Text	free text
68	Date Comment	dateComnt	Comment that explains the temporal period if necessary.	O	1	Text	free text

Sec. 3.3: Related Model   (Optional, Repeatable)

69	Related Model Citation	relatedDesc	Citation or description of the related model sufficient to locate it.	M	1	Text	free text
70	Related Model Contact Information	relatedContact	Description of the steps to obtain the related model, including a URL address leading to information about the related model.	O	1	Text	free text

Sec. 3.4: Source of Additional Information   (Optional, Repeatable)

71	Additional Information Text	addText	Citation or description leading to additional information relating to the model sufficient to find it.	M	1	Text	free text
72	Additional Information URL Address	addURL	URL address leading to additional information relating to the model.	O	1	Text	free text

Sec. 4: Access or Availability

73	**Access and Availability**	availablity	Availability of the model.	M	1	Compound	lines 74-79
74	Access or Use Constraints	constraints	Any access or use constraints or conditions.	M	N	Class	code list 6
75	Other Constraints	otherConstrnt	Description of other constraints if so selected in line 74.	C- Was "other" selected in line 74?	1	Text	free text
76	Availability Comment	AvailCom	Additional explanation of access or use constraints.	O	1	Text	free text

77	Availability Contact	availContact	Person or organization to contact in regards to obtaining or using the model.	C- Is the contact person(s) different from the model creator?	N	Compound	sec 4.1, lines 80-83
78	Ordering or Access Procedure	access	Steps necessary in order to obtain or use the model.	O	1	Text	free text
79	Cost of Model	cost	A general statement of how to find current cost information if the model is available at a cost.	C - Is there a cost?	1	Text	free text

Sec. 4.1: Availability Contact   (Conditional, Repeatable)

80	Availability Contact Individual Name	acIndName	Name of the availability contact.	M	1	Text	free text
81	Organization Affiliated with Availability Contact	acOrg	Business, school, government agency, or other organization associated with the availability contact.	O	1	Text	free text
82	Position Name of Availability Contact	acPost	Role or position of the availability contact.	O	1	Text	free text
83	Availability Contact Information	acCntInfo	Address of the availability contact.	O	N	Compound	sec. 1.1.1, lines 12-19

Sec. 5: System Requirements

84	**System Requirements**	sysReq	Computer system and human requirements needed to run the model.	M	1	Compound	lines 87-90
85	Hardware Requirements	hardwReq	Computer hardware (including processor size and/or type and amount of memory space) required to store and operate the model.	M	1	Text	free text
86	Software Requirements	softwReq	Computer software or other programs needed to store or operate the model and/or process the input or output data.	M	1	Text	free text
87	Operating System	operSys	Operating system requirements to run the model.	M	1	Text	free text
88	Expertise Required	humanReq	Indication of the level of expertise required to download, install, run, and interpret the model.	M	1	Compound	sec. 5.1, lines 89-91

Sec. 5.1: Expertise Required   (Mandatory, Non-Repeatable)

| 89 | Expertise to Obtain | expertObtain | Description of the level of expertise required to download and install the model. | O | 1 | Text | free text |

| 90 | Expertise to Run | expertRun | Description of the level of expertise required to run the model once it is installed. | O | 1 | Text | free text |
| 91 | Expertise to Interpret | expertInterp | Description of the level of expertise required to understand the model and its results. | O | 1 | Text | free text |

Sec. 6: Input Data Requirements

92	**Input Data Requirements**	inParameter	Variability and format of the input data required to run the model.	M	1	Compound	lines 93-96
93	Input Data Extent and Resolution	inCoverage	Temporal and spatial extent and resolution for which the model was designed.	O	1	Compound	sec 6.1, lines 97-102
94	Input Data File	inFile	URL address to an external file containing description of the data input requirements in detail.	O	1	Text	free text
95	Input Modeling Construct Description	inConstDesc	Parameter and variable constructs of the model.	C- Is there no reference to an external file containing this information provided in line 96?	N	Compound	sec 6.2, lines 103-114
96	Input Dataset Description	datasetDesc	A description of a dataset required in the processing of the model.	C- Is there no reference to an external file containing this information provided in line 96?	N	Compound	sec 6.3, lines 115-119

Sec. 6.1: Input Data Extent and Resolution   (Optional, Non-Repeatable)

97	Spatial Resolution	spatRes	Smallest spatial unit of analysis.	O	1	Text	free text
98	Spatial Extent	spatExtent	Extent of the total relevant geographic area.	O	1	Text	free text
99	Spatial Resolution and Extent Explanation	spatExp	Explanation of the spatial resolution and extent range required or recommended.	O	1	Text	free text
100	Temporal Resolution	tempRes	Time Steps: Temporal units of analysis.	O	1	Text	free text
101	Temporal Extent	tempExtent	Duration of total relevant period of time.	O	1	Text	free text
102	Temporal Resolution and Extent Explanation	tempExp	Explanation of the temporal resolution and extent range required or recommended.	O	1	Text	free text

Sec. 6.2: Input Modeling Construct Description   (Conditional, Repeatable)

103	Name of Construct	inConstName	Name assigned by the model or modeler to the specified model construct.	M	1	Text	free text
104	Construct Classification	inConstClass	Functional properties of the specified construct.	M	1	Class	code list 7
105	Construct Description	inConstDesc	Description of the specified dataset.	M	1	Text	free text
106	Construct Input Source	inConstSource	Method in which the construct is introduced to the model.	M	1	Class	(fixed model setting, dataset member, user input)
107	Dataset	inConstDataset	Dataset in which the construct is found.	C- was "dataset member" selected as "Construct Input Source" (line 106)?	1	Text	dataset name selected in line 115
108	Construct Type	inConstType	Data type of the construct.	M	1	Text	free text
109	Construct Units	InConstUnit	Standard of measurement of given construct. (feet, meters, coded values, etc.)	M	N	Text	free text
110	Minimum Value	inConstMin	Minimum value accepted for processing in the model.	O	1	Real	free real
111	Maximum Value	inConstMax	Maximum value accepted for processing in the model.	O	1	Real	free real
112	Default Values	inConstDefault	The default value(s) assigned by the modeling software and/or modeler.	C - Does the model come with default value(s) for the parameter?	1	Text	free text
113	Construct Repeatability	inConstRepeat	Indication of how many times this construct occurs in the input. (Zero signifies an "optional" construct)	M	1	Integer	0 to N
114	Construct Comments	inConstComnt	Any additional comments required to describe the particular input construct	O	1	Text	free text

Sec. 6.3: Input Dataset Description   (Conditional, Repeatable)

115	Name	inDatsetName	Name assigned by the model or modeler to the specified input dataset.	M	1	Text	free text
116	Input Dataset File	inDatsetFile	URL address to an external file containing descriptions for the particular dataset.	O	1	Text	free text

117	Conceptual Data Structure	inDatsetStruc	A textual description expounding on the concept of the required dataset.	C- Is there no reference to an external file containing this information provided in line 116?	1	Text	free text
118	Computational Representation	inDatsetRep	The physical data structure of the dataset required for the model.	C- Is there no reference to an external file containing this information provided in line 116?	1	Text	free text
119	Dataset Repeatability	inDataRepeat	Indication if more than one of these datasets may be provided. (Zero signifies an "optional" dataset.)	M	1	Integer	0 to N

Sec. 7: Data Processing

120	**Data Processing**	process	Description of the processes applied to the input data in order to produce the output data.	M	N	Compound	lines 121-123
121	Programming Language	ProgramLang	Computer language in which the modeling software was written.	M	1	Text	free text
122	Algorithmic Representation	AlgorithmRep	Description of the steps or equations used by the model to transform and or manipulate the input modeling constructs to the output data.	O	1	Text	free text
123	Iterative Cycles	iterativeCycle	Description of the use of the output of one run of the model as the input for a following run of this model.	O	1	Text	free text

Sec. 8: Model Output

124	**Model Output**	modelOutput	The data or visualization produced by the model.	M	N	Compound	lines 125-128
125	Output Representation	outDatRep	Presentation of all potential outputs supported by the model.	M	N	Compound	sec. 8.1, lines 129-136
126	Data Post-Processing Requirements	outPostProc	Any formatting that is required or recommended for post-processing that is not part of the model software.	C - Is post-processing required?	1	Text	free text
127	Output Documentation	outDatDoc	Link to file containing documentation for the output dataset.	O	1	Text	free text
128	Output Comment	OutComnt	Comment about the overall output of the model.	O	1	Text	free text

Sec. 8.1: Output Representation   (Mandatory, Repeatable)

129	Output Name	outName	The name assigned by the model or modeler to the specified dataset or visualization.	M	1	Text	free text
130	Output Description	outDesc	A narrative description of the output dataset or visualization.	M	1	Text	free text
131	Output Type	outType	Form of the output.	M	1	Class	(dataset, visualization, raw output)
132	Output Symbolic Representation	outSymbRep	Indication of the symbolic representation of the output data, dataset or visualization.	M	1	Class	(Numeric/Not Numeric)
133	Output Computational Representation	outDataStruct	The physical data structure produced by the model.	O	1	Text	free text
134	Output Visualization	outVisual	Indication of the visualization format of the output dataset.	C - Is the output visual?	1	Class	(Static/Dynamic)
135	Output Modeling Construct Description	outConstDesc	Constructs of the output data, dataset or visualization; that is, individual values represented in the output.	M	N	Compound	sec. 8.1.1, lines 137-143
136	Output Optionality	outOpt	Indication of the optionality of the output dataset or visualization. Is this output always produced or is it optionally produced?	M	1	Class	(Standard Output/Optional Output)

Sec. 8.1.1: Output Modeling Construct Description   (Mandatory, Repeatable)

137	Output Construct Name	outConstName	Name assigned by the model or modeler to the specified model construct.	M	1	Text	free text
138	Output Construct Description	outConstDesc	Description of the specified dataset.	M	1	Text	free text
139	Output Construct Dataset	outConstDataset	Dataset in which the construct is found.	C- Is the construct a member of a dataset?	1	Text	dataset name selected in line 129
140	Output Construct Type	outConstType	Data type of the construct.	M	1	Text	free text
141	Output Construct Units	outConstUnit	Standard of measurement of given construct. (feet, meters, coded values, etc.)	M	1	Text	free text
142	Output Construct Repeatability	outConstRepeat	Indication of how many times this construct occurs in the output. (Zero signifies an "optional" construct.)	M	1	Integer	0 to N
143	Output Construct Comments	outConstComnt	Additional comments required to describe the particular output construct	O	1	Text	free text

Sec 9: Calibration Efforts and Validation

144	Calibration Efforts and Validation	validation	Efforts taken to justify the model as an accurate representation of real world events or situations.	O	1	Compound	lines 145-151
145	Confirmation Dataset	calibData	Link to a data instance that is known to run with the model and that can be used to test or show an example of the model process.	O	N	Text	free text
146	Calibration Efforts	calibration	Any processes used in order to calculate the accuracy of the model.	O	1	Text	free text
147	Model Experiments and/or Case Studies	experiment	Reference to any tests, case studies, or experiments that have been run on the model in order to determine the validity of the model.	O	N	Compound	sec. 9.1, lines 152-153
148	Expert or Peer Review	review	Citation for review or assessment of the model.	O	N	Text	free text
149	Current Use or Application	currUse	Description of an application of the model, including the application, user, and the application or project dates.	M	N	Text	free text
150	Level of Uncertainty	levUncert	Modeler's estimate of the level of uncertainty of the model.	O	N	Text	free text
151	Known Error	knownError	Any known problem with the model.	O	N	Text	free text

Sec.9.1: Model Experiments and/or Case Studies   (Optional, Repeatable)

152	Model Experiment Description	experimentDesc	Description of a model experiment and/or case study of the model.	O	N	Text	free text
153	Model Experiment URL Address	meURL	URL address leading to data about a model experiment and/or a case study of the model.	C- In line 152, is data not present?	N	Text	free text

Sec. 10: Metadata Source

154	Metadata Source	metaSource	Person, persons, or organizations responsible for the creation the model metadata.	M	1	Compound	lines 155-159
155	Metadata Creation Date	metaCreDate	Date when the metadata documentation was completed.	M	1	Date	ISO 8601
156	Metadata Modification Date	metaModDate	Date when the metadata was last modified.	C- Has the metadata been modified?	1	Date	ISO 8601

157	Metadata Responsible Party	metaRespParty	Person or organization responsible for the creation or modification of the model metadata.	M	N	Compound	sec 10.1, lines 160-164
158	Metadata Source of Information	metaSource	Citation to information source (documentation) that was used in metadata creation.	O	N	Text	free text
159	Metadata Standard Name and Version	metaVersion	Metadata standard and version followed in the production of this metadata document.	M	1	Text	free text

Sec. 10.1: Metadata Responsible Party   (Mandatory, Non-Repeatable)

160	Metadata Responsible Party Individual Name	metaIndName	Name of the person responsible for the creation or modification of the metadata.	M	1	Text	free text
161	Organization Affiliated with Metadata Responsible Party	metaOrg	Business, school, government agency, or other organization affiliated with the metadata creator or modifier.	M	N	Text	free text
162	Position Name of Metadata Responsible Party	metaPost	Role or position of the metadata creator modifier with the organization.	O	1	Text	free text
163	Role of Responsible Party	metaRole	Role of metadata creator or modifier.	M	1	Class	(creator/modifier)
164	Metadata Responsible Party Contact Information	metaCntInfo	Address of the metadata responsible party.	O	N	Compound	sec. 1.1.1, lines 12-19

Code List 1: Application Purpose

Name	Domain Code
Not Applicable	001
Education	002
Production / Manufacturing	003
Public Administration	004
Other	099

Code List 2: Educational Level

Primary School (K-5)	001
Middle School (6-8)	002
High School (9-12)	003
Undergraduate Lower Division (13-14)	004
Undergraduate Upper Division (15-16)	005
Graduate Studies	006
Informal Education	007
Any Level	008

Code List 3: Model Typology

Not Specified	001
Input / Output	002
Black Box	003
Difference Equations	004
Finite Differential Equations	005
Ordinary Differential Equations	006
Partial Differential Equations	007
Algebraic Equations	008
Stochastic	009
Statistic	010
Cellular Automata	011
Logic Based	012
Rule-based	013
Individual Based	014
Other	099

Code List 4: Topic of Field of Study

Arts and Letters	
General Letters	0000
Education	0001
English / literature	0002
Foreign Language	0003
History	0004
Information Studies	0005
Philosophy	0006
Sociology	0007
Theology	0008
Other Letters	0099
General Media	0100
Art	0101
Journalism	0102
Music	0103
Theatrics	0104
Other Media	0199
General Mathematics	0200
Algebra	0201
Arithmetic	0202
Geometry	0203
Physics	0204
Statistics	0205
Other Mathematics	0299
Biological Sciences	
General Biological Studies	0300
Botany	0301
Evolution	0302
Genetics and Development	0303
Physiology	0304
Zoology	0305
Other Biological Studies	0399
General Animal Care	0400
Animal Breeding	0401
Veterinary Medicine	0402
Other Animal Care	0499
Business studies	
General Business Studies	0500
Communication	0501
Economics	0502
Law	0503
Management	0504
Marketing	0505
Real Estate	0506
Tourism	0507
Other Business Studies	0599
Earth Sciences	
General Earth Science	0600
Astronomy and Space Sciences	0601

Atmospheric Science	0602
Conservation	0603
Earth Science	0604
Ecology	0605
Forestry	0606
Geography	0607
Geology	0608
Geomorphology	0609
Geophysics	0610
Geostatistics	0611
Hydrology	0612
Meteorology	0613
Natural Resources	0614
Pedology	0615
Other Earth Science	0699
Human Studies / Health Care	
General Human Studies	0700
Anthropology	0701
Archaeology	0702
Cognitive Studies	0703
Culture Studies	0704
Migration / Population	0705
Human Development	0706
Human Resources	0708
Other Human Studies	0799
General Health Care	0800
Food Science and Technology	0801
kinisiology	0802
Nursing	0803
Nutrition	0804
Pharmacology	0805
Psychology	0806
Other Health Care	0899
Production / Manufacturing	
General Production / Manufacturing	0900
Lithography/Printing/Copying	0901
Operations Research	0902
Textiles	0903
Other Production/ Manufacturing	0999
General Design	1000
Architecture	1001
Construction	1002
Landscape Architecture	1003

Other Design	1099
General Engineering	1100
Materials Science and Engineering	1101
Nuclear Science and Engineering	1102
Other Engineering	1199
Public Administration	
General Public Administration	1200
City Planning	1201
International Relations	1202
Political Science	1203
Public Affairs	1204
Urban Development	1205
Other Public Administration	1299

Code List 5: Planetary Bodies

Mercury	001
Venus	002
Earth	003
Mars	004
Jupiter	005
Saturn	006
Uranus	007
Neptune	008
Pluto	009
Earth's Moon	010
Other Planetary Body	099

Code List 6: Access or Use Constraints

None: Public Domain	001
Limited to specific organization	002
Available after registry	003
Available after access purchase	004
for government use only	005
copyrighted	006
other	099

Code List 7: Construct Classification

Variable	01
Adjustable Static Parameter	02
Adjustable Dynamic Parameter	03
Fixed Parameter	04

Appendix A: Glossary

Abstract: A summary of a text, scientific article, document, speech, etc.; epitome. More specifically, a description or summary of computer modeling software.

Application: The quality of being usable for a particular purpose or in a special way; relevance.

Calibrate: To determine, check, or rectify the graduation of any instrument giving quantitative measurements.

Compound element: The heading or title of groups of data elements.

Computer language: A programming language, such as BASIC, COBOL, C++, or FORTRAN, devised for communicating instructions to a computer.

Computer Model Instance: A file containing the output of a modeling process capturing a particular outcome from a set of input data with a particular setting of the modeling parameters.

Computer Model Package: A package of modeling software with a specific set of data.

Computer Model Parameters: A factor of the model that determines a range of variations that restricts what is possible, more specifically, what variables are selectable.

Computational Model Software: Software whose primary function is to model a certain class of physical systems, and may include pre- and post-processing components and other necessary ancillary programs. (Dee, 1994)

Computer Model Variable: An entity of the model capable of assuming a single or set of values restricted in range by the entity parameters.

Data Element: A logically primitive item of data.

Dataset: A logical group of numerical or other information represented in a form suitable for processing and/or derived from a computer.

Domain: A realm or range, more specifically, the range of data sets or other particular values.

Electronic Mail (e-mail): messages from one individual to another sent via telecommunications links between computers or terminals.

Extensible Mark-Up Language (XML): A markup language for documents containing structured information. (Walsh)

Facsimile (FAX): A method or device for transmitting documents, drawings, photographs, or the like, by means of radio or telephone for exact reproduction elsewhere.

Module: A portion of a program that carries out a specific function and may be used alone or combined with other modules of the same program.

Null Value: A particular variable being or amounting to nothing; nil; lacking; nonexistent.

Organization: A group of persons organized for some end or work.

Parameter, Adjustable Dynamic: A model parameter that is user-adjustable prior to running the model that may also change its value when certain modeling conditions exist.

Parameter, Adjustable Static: A model parameter that is user-adjustable prior to running the model which remains fixed throughout the course of the model run.

Parameter, Fixed: A model parameter that is not user-adjustable, and whose value is therefore hard-wired into the model.

Parameter, Model: A numerical input to the model whose value remains fixed through the course of a model run or else only changes under pre-defined circumstances.

Peer: A person who is equal to another in abilities, qualifications, background, or educational level.

Real World Events: The phenomena for which a computer model is designed to simulate.

Standard: A rule or principle that is used as a basis for judgment.

Standard Generalized Markup Language (SGML): An international standard for the definition of device-independent, system-independent methods of representing texts in electronic form. (W3C)

Text: The main body of matter in a manuscript, book, newspaper, etc., as distinguished from notes, appendixes, headings, illustrations, etc.

Type: A number of things or persons sharing a particular characteristic, or set of characteristics, that causes them to be regarded as a group, more or less precisely defined or designated; class; category.

Typology: a systematic classification or study of types, more specifically, a systematic classification of the model in regards to other models and other model related packages.

Uniform Resource Locator (URL): a protocol for specifying addresses on the Internet.

Unified Modeling Language (UML): A standard language for specifying, visualizing, constructing, and documenting the artifacts of software systems. (Feldman)

Validate: v. A process of formulating and substantiating claims about model applicability and accuracy.

Validation: n. The theoretical foundation and to the computational techniques that form the basis for the numerical and graphical results produces by the computer model. (Dee, 1994)

Variable, Model: A numerical input to the model whose value may be altered iteratively by the model during the course of a run.

Appendix B: References

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