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Supplement of

The path to FAIR research models: lessons learned

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Supplement

Supplement Table 1.

Data for Figure 1, the relative proportion of domain tags for the two model catalogs at the time of the writing of this paper. A single model may have more than one domain tag.

Domain	CSDMS	USGS
Hydrology	221	89
Terrestrial	288	18
Coastal	113	2
Marine	75	7
Ecosystems	28	23
Climate	41	7
Cryosphere	40	1
Geodynamic	25	15
Geologic or Hydrogeologic	0	34
Human Dimensions	5	10
Atmosphere	0	1
Natural Resources	0	1

Supplement Table 2.

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USGS Model Catalog metadata fields. See more information at: https://github.com/DOI-USGS/modelcatalog-tam/blob/main/metadata_schema/BasicProfileSchema.py (last access: May 2026), which is a copy of the USGS software release (Serna, B. S. and Hsu, L.: USGS Model Catalog Tools and Metadata, U.S. Geological Survey, <https://doi.org/10.5066/P9WU0F71>, 2022.).

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field	description
item_type*	Model, tool, framework, testbed
name*	Name of model, recommended format: "Acronym/Short name - longer description"
description*	General description of the model, recommended length of 4-5 sentences. HTML is allowed.
organization*	True = USGS; False = external only
external_organization_name	Organization(s) other than USGS related to the model.
release_date	Date, in YYYY-MM-DD format. May be year only.
last_update	Date, in YYYY-MM-DD format. May be year only.
person	Person(s) (author(s) or developer(s)) responsible for maintenance of the model or item or content.
version	Latest release version, ex. v1.0
how_to_cite	Preferred citation format: Authors, Year, Title, Publisher, DOI.
usgs_missionarea	USGS Mission Area
identifier	Identifiers related to the model, especially the identifier assigned by the USGS identifier tool
programming_language	Primary programming language(s) used for the modeling
license	Software license, Default to CC0 see: https://creativecommons.org/publicdomain/zero/1.0/legalcode (last access: May 2026)
data	Custom object containing data section
software	Custom object containing software section
publications	Custom object containing publications section
other_links	Custom object containing other links section
science_keywords	Topical science keywords that will help for discovering the item. Terms must come from the USGS Thesaurus please see: https://apps.usgs.gov/thesaurus/ (last access: May 2026)

type_keywords	Keywords describing the type of model. For example, "Numerical"
other_keywords	Other keywords that are not in the USGS Thesaurus or other controlled keyword lists. For example, platform and mode (Jupyter, Graphical User Interface, etc).
image	Header image for the model profile page
related_modelcatalog_assets	Related catalog items for the model

Supplement Table 3.

20 Community Surface Dynamics Modeling System metadata fields. See more information at: https://csdms.colorado.edu/wiki/Available_model_questionnaire_conditions (last access: May 2026).

field	description
model name*	
Model_also_known_as	Additional field to hold an alternative name for a model, for if the model is also known under another name.
ModelFramework	Describe the model framework, if the model is part of a larger framework.
Incorporated_modules	Include names of module or components, if the model incorporates one or more of these.
Model_type*	Describe if a model is more like a tool, build out of multiple modules or is just a single model.
ModelDomain	The various domains (marine, terrestrial, hydrological, etc.) a model simulates
Spatial_dimensions	Range or specific spatial dimensions a model operates under (1D, 2D, etc.).
Spatialscale	Spatial extent of simulated domain

One-line_model_description*	Short description of the model
Extended_model_description*	Extended description of the model
Model_keywords	Keywords describing the model.
First_name*	Given name of contact person
Last_name*	Family name of contact person
Type_of_contact	State where contact person is located
Institute	Affiliated institute of contact person
Postal_address1	Address of contact person
Postal_address2	Additional field for address of contact person
City*	City or name of town where institute contact person is located
Postal code*	Postal code of institute
Country*	Country where contact person is located
State	State where contact person is located
Email_address*	Email address of contact person
Phone	Phone number of contact person
Fax	Fax number of contact person
Supported_platforms	Supported computer platforms by the model (Mac, Windows, etc.)
Supported_platforms_other	Define other than the platform options indicated under 'Supported platforms' the model can run on.
Programming_language	Identify the used program language
Programming_language_other	Define other than the program languages indicated under 'Programming language' used
Code_optimized	Indicate if the model uses single or multiple processors
Start_year_development	The first year the model was developed
Development_still_active*	Indicates if model development is still ongoing
End_year_development	The year model development ended

Model_availability	How the model is made available to the community, "As code" or "As teaching tool"
Source_code_availability	Pointer towards repository where source code can be found "Through web repository" or "Through CSDMS repository"
Program_license_type*	Source code license
Memory_requirements	Memory requirements to run model
Run_time_model	Typical run time for model
Describe_input_parameters_model	Describe input parameters
Input_format_model	Describe input format, "ASCII" or "Binary"
Input_format_model_other	Describe alternative input formats
Describe_output_parameters_model	Describe output parameters
Output_format_model	Describe output format, "ASCII" or "Binary"
Output_format_model_other	Describe alternative output formats
Pre_processing_software	Indicate if pre-processing software is needed
Describe_pre-processing_software	If pre-processing software is needed, indicate which packages could be used
Post_processing_software	Indicate if post-processing software is needed
Describe_post-processing_software	If post-processing software is needed, indicate which packages could be used
Visualization_software_needed	Indicate if visualization software is needed
Visualization_software	If visualization software is needed, indicate which packages
Visualization_software_other	Indicate alternative visualization packages that can be used
Describe_processes	Describe processes represented by the module
Describe_key_physical_parameters_and_equations	Describe key physical parameters and equations
Describe_length_scale_and_resolution	Describe length scale and resolution constraints
Describe_time_scale_and_resolution	Describe time scale and resolution constraints

Describe_numerical_limitations	Describe any numerical limitations and issues
Describe_available_calibration_data	Describe available calibration data sets
Model_calibration_data	Upload calibration data sets if available
Describe_available_test_data_sets	Describe available test data sets
Model_test_data	Upload test data sets if available
Describe_ideal_data_for_testing	Describe ideal data for testing
Current_future_collaborators	Indicate current or future plans for collaborating with other researchers
Manual_model_available	Indicate if a manual is available
Model_manual	Option to upload a model manual
Model_website	URL of external model website
Model_forum	URL to module forum / discussion board
Additional_comments_model	Additional comments
CodeReviewed	If source code is reviewed through e.g. JOSS publication or not
Code_openmi_compliant_or_not	If module is openmi compliant
Code_IRF_or_not	If module is BMI compliant
Code_CMT_compliant_or_not	If module is WMT compliant
DOI_model	DOI information of source code
DOI_assigned_to_model_version	Version of model to which a DOI is assigned
DOI-filelink	DOI link to the released version