


# D4.5

## Online database of empirical evidence of dynamics and feedbacks of risk drivers



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## D4.5/ Online database of empirical evidence of dynamics and feedbacks of risk drivers

Lead by VUA

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## Abstract

Existing risk models often do not account for dynamics in risk elements. Here we present the [Metadatabase for Dynamics of Risk Drivers](#), an online catalogue of data, algorithms and methods to (empirically) assess dynamics and feedbacks of risk drivers. The metadatabase contains information on methods, algorithms and data produced within MYRIAD-EU and beyond. It is intended to be used by scientists and practitioners in the field of disaster risk modelling and presents them with metadata attributes and references. We apply existing terminology frameworks from within MYRIAD-EU and from other international standards to ensure consistency between entries. Further integration into MYRIAD-EU products within the duration of the project are discussed, like the integration in the Disaster Risk Gateway Wiki with semantic search functions, and inclusion of several of the metadatabase's entries into the multi-risk software from WP5. Future expansion efforts rely on additional funding and the ability to attract external contributors, which we aim to involve via conferences and future research calls.

## Dissemination level of the document

- ☒ Public
- ☐ Restricted to other programme participants (including the Commission Services)
- ☐ Restricted to a group specified by the consortium (including the European Commission Services)
- ☐ Confidential, only for members of the consortium (including the European Commission Services)

## Version History

Version	Date	Authors/Reviewers	Description
V1	30/04/2025	Tristian Stolte (VUA), Wiebke Jäger (VUA), Philip Ward (VUA), Marleen de Ruiter (VUA), Timothy Tiggeloven (VUA), Kelley De Polt (VUA; MPG Jena), Sophie Buijs (VUA), Judith Claassen (VUA), Nicole van Maanen (VUA), Benedetta Sestito (VUA), Irene Benito Lazaro (VUA), Davide Ferreira (CMCC), Ngoc Diep Nguyen (CMCC), Maria Katherina Dal Barco (CMCC), Julius Schlumberger (VUA; Deltares), Silvia Torressan (CMCC), Rene Orth (MPG Jena), James Daniell (Risklayer), Melanie Duncan (UKRI BGS), Lara Smale (UKRI BGS), and Julia Crummy (UKRI BGS)	Sent for review to the MYRIAD Quality Unit.
V2	31/05/2025	Same as above	Final version, including minor revisions based on reviews.

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## 1. Introduction and rationale

Traditional risk models often overlook the complex interplays between hazards and the dynamics between the different risk elements (i.e., hazard, exposure, and vulnerability). MYRIAD-EU's Work Package 4 (WP4) has therefore developed several methods to address these dynamics in Task 4.3 ("Quantifying the dynamics and feedbacks of multi-hazard risk drivers"; Jäger et al., 2024). These were the foundation of the *Metadatabase for Dynamics of Risk Drivers*, an online catalogue of data, algorithms and methods that serves as an online database to (empirically) assess dynamics and feedbacks of risk drivers. With the metadatabase, we conclude Task 4.4 ("Database of empirical evidence of dynamic feedbacks between risk drivers").

We have opted for a metadatabase over a traditional database (i.e., where the actual data are displayed) because information on dynamics of risk drivers is too diverse to be stored directly in a structured database (e.g., methods vs data, quantitative vs qualitative, different risk elements, etc.). The information in the metadatabase is structured using different attributes, which can be used to search and filter the metadata. The metadatabase is developed as an open community effort and maintained by the Vrije Universiteit Amsterdam (VU Amsterdam), the British Geological Survey (BGS), and Risklayer GmbH. Please review each entry's license before using the corresponding methods, algorithms or data.

The Metadatabase for Dynamics of Risk Drivers can be accessed via Zenodo:

<https://doi.org/10.5281/zenodo.15310737> (Stolte et al., 2025).

Note that we intend to integrate the metadatabase in the Disaster Risk Gateway Wiki in the near future, making it possible to access its contents from there (for more information, see Section Integration of the metadatabase in existing MYRIAD-EU products5).

## 2. Metadatabase Structure

The metadatabase is a 2D table where each row is one method/dataset/algorithm and where the columns contain several metadata attributes or fields to help the user understand and decide if the method/dataset/algorithm fits their purpose. Each attribute comes with a concise definition to reduce ambiguity. To ensure consistency within the metadatabase and between other MYRIAD-EU products, we also:

- added formatting requirements for each attribute.
- used definitions based on existing terminology standards used within MYRIAD-EU, like the MYRIAD-EU Handbook (Gill et al., 2022) and the Hazard Information Profiles (Murray et al., 2021)
- shared our attribute formatting and definitions with MYRIAD-EU WP3 to align the *Metadatabase for Dynamics of Risk Drivers* with Task 3.6 on upscaling and transferability (Deliverable 3.4 - Final report on forward-looking DRM pathways and recommendations for upscaling and transferability).

See Table 1 for a full overview of attributes, definitions, and formatting requirements.

Table 1 Attributes, definitions, and formatting requirements for the Metadatabase for Dynamics of Risk Drivers.

Attribute name	Attribute definition and formatting requirements
ID	Unique ID number of the entry. Consecutive integer numbers, starting at 1.
Contributor ID	Unique ID of the contributor.
Title	Title of the entry, which should clearly refer to the corresponding data or method.
Description	Write a short description on your method, algorithm or data. Please do not copy-paste the resource's abstract or other existing summary texts to avoid (self-)plagiarism! The description can be max. 500-character incl. spaces.
Keywords	<p>All entries must be tagged either as: <i>Qualitative research</i>; <i>Quantitative research</i>; or <i>Mixed-method research</i>:</p> <ul style="list-style-type: none"> <li>• <b>Qualitative research</b> = Non-numerical data, method or results. It often involves text analysis, surveys or interview data.</li> <li>• <b>Quantitative research</b> = Numerical data, method or results. It usually involves calculus, statistics, or other mathematical transformations.</li> <li>• <b>Mixed-method research</b> = A combination of the above two research types.</li> </ul> <p>In addition, entries can have up to five additional keywords which are meant to further characterise the method or data that are not captured by any of the other attributes. Current suggestions are, for example: <i>Statistics</i>; <i>Multi-hazard / Multi-risk</i>; <i>Compound events</i>; <i>Case study</i>; <i>Disaster forensics</i>; <i>Map</i>; <i>Intensity-damage function</i>; <i>Definition</i>; <i>Hazard metric</i>; <i>NUTS0/1/2/3</i>; <i>EM-DAT</i>; <i>Indicators of change*</i>; <i>Temporal dynamics</i>; <i>Spatial dynamics</i></p> <p>* indicator of change refers to a qualitative measure for a difference or change, such as 'decrease' or 'increase'. See for example, <a href="#">Kreibich et al. (2022)</a>)</p>
Risk elements	<p>The element(s) of risk that the data or method deals with. Entries can be labelled <i>Hazard</i>, <i>Exposure</i>, <i>Vulnerability</i>, <i>Impact</i> and <i>Recovery</i>. Note that the 'impact' and 'recovery' are not risk-elements in the strict sense of the term, but rather an outcome or a consequence of the risk. We still include them here because some dynamic risk assessments look beyond the moment of impact.</p> <p>To maintain consistency across entries, we ask contributors to adhere to the definitions of <a href="#">UNDRR (2016)</a>:</p> <p><b>Hazard</b> = A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption, or environmental degradation.</p> <p><b>Exposure</b> = The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.</p> <p><b>Vulnerability</b> = The conditions determined by physical, social, economic, and environmental factors or processes which increase the susceptibility</p>

	<p>of an individual, a community, assets, or systems to the impacts of hazards.</p> <p><b>Impact</b> = The total effect, including negative effects (e.g., economic losses) and positive effects (e.g., economic gains), of a hazardous event or a disaster. The term includes economic, human and environmental impacts, and may include death, injuries, disease and other negative effects on human physical, mental and social well-being.</p> <p><b>Recovery</b> = The restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and “build back better”, to avoid or reduce future disaster risk.</p>
<b>Hazard types</b>	<p>The type of hazard or hazards that the data or method refers to. To maintain consistency across entries, we ask contributors to define (where possible) their hazards as per the Hazard Information Profiles (HIPs; Murray et al., 2021).</p>
<b>Spatial resolution</b>	<p>The size of a single spatial unit of measure in the data.</p> <p>For consistency, please use the following:</p> <p><u>For tabular or vector data:</u></p> <ul style="list-style-type: none"> <li>• <b>Local:</b> Values for one or more well defined localities (villages, towns, cities, metropolitan areas)</li> <li>• <b>Subnational:</b> Values for one or more areas within national boundaries that are larger than that nation’s localities.</li> <li>• <b>National:</b> Values for one or more nations.</li> <li>• <b>Regional:</b> Values for one or more regions that cross national boundaries.</li> <li>• <b>Continental:</b> Values for one or more continents</li> <li>• <b>Global:</b> Values that are valid across the globe (e.g., a uniform intensity-damage curve for masonry buildings).</li> </ul> <p>If you would like to highlight NUTS level, add it as a keyword.</p> <p><u>For gridded or raster data:</u></p> <ul style="list-style-type: none"> <li>• Please give the resolution in arcseconds. To convert meters to arcseconds, please visit: <a href="https://www.opendem.info/arc2meters.html">https://www.opendem.info/arc2meters.html</a></li> </ul>
<b>Location</b>	<p>The geographical location that your method or data applies to. For administrative areas, please adhere to the international naming convention of your places, if available. For example: Den Haag (nationally used Dutch name) becomes The Hague (Internationally used English name). Multiple locations are allowed (separated with a semicolon).</p>
<b>Temporal resolution</b>	<p>The timestep between each datapoint. Only applicable if your method or data has multiple data points throughout time. Please provide temporal resolution in seconds, minutes, hours, days, weeks, months or years. Always use the highest unit of measurement (i.e., minutes is higher than seconds, hours is higher than minutes, etc.) that can be expressed in full numbers (e.g., 36 hours rather than 1.5 days, but 2 days rather than 48</p>

	<p>hours). If there are multiple resolutions, please add them all and separate them with semicolons like this: <i>12 hours; 1 day; 1 year</i>.</p> <p>If the timestep is irregular, but based on events, please write: <i>Event-based</i></p>
<b>Timeframe</b>	<p>The temporal extent of the data or method. Please fill in the time period that your data or method is relevant to. For consistency, please stick to the following format:</p> <p>For a continuous time series: &lt;YYYY&gt; - &lt;YYYY&gt;</p> <p>For discrete moments in time: &lt;YYYY&gt;; &lt;YYYY&gt;; &lt;YYYY&gt;; etc.</p> <p>Where Y = year.</p> <p>If needed, you are allowed to combine continuous and discrete timeframes. For instance, if your data look at the period 2010-2015 and additionally at two discrete moments in time, 2000 and 2018, these can be added as: <i>2000; 2010-2015; 2018</i></p>
<b>Year of publication</b>	<p>The year your data or method was <b>published</b>. For consistency, stick to the following format:</p> <p>&lt;YYYY&gt;</p> <p>Where Y = year.</p> <p>For <b>unpublished</b> work, please fill in either:</p> <ul style="list-style-type: none"> <li>• 'In review' for work that is submitted and in review.</li> <li>• 'Submitted' for work that is submitted but not yet in review.</li> <li>• 'In progress' for work that is not yet submitted.</li> <li>• 'n.a.' if none of the above instances apply to your entry</li> </ul>
<b>Year of last update</b>	<p>The year your data or method had its latest official update. 'Official' means that the updated data/method should be shared and available. For consistency, stick to the following format:</p> <p>&lt;YYYY&gt;</p> <p>Where Y = year.</p>
<b>Resources</b>	<p>Please select one or more of the following:</p> <ul style="list-style-type: none"> <li>• Method/Article</li> <li>• Data set</li> <li>• Algorithm/Software</li> </ul>
<b>Resources accessibility status</b>	<p>What is the accessibility status of your resource*? Leave this question unanswered if you do not have a resource*.</p> <p>Choose between:</p> <ul style="list-style-type: none"> <li>• Publicly accessible</li> <li>• Available upon request</li> <li>• Non-open access</li> </ul> <p>*'resource' is either "Method/Article" or "Data set" or "Algorithm/Software".</p>
<b>Proof of availability upon request</b>	<p>If any of the resources are only available upon request, please provide proof that this is possible. This could for instance be a quote from the article stating that this is possible.</p>



<b>Resources URLs</b>	<p>Please provide URLs for all resources indicated, if possible using a permanent identifier such as DOI, in the following format:</p> <ul style="list-style-type: none"> <li>• Method/Article: &lt;url&gt;</li> <li>• Dataset: &lt;url&gt;</li> <li>• Software/Algorithm: &lt;url&gt;</li> </ul>
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### 3. Users and use cases

We envision the metadatabase to be used by scientists and practitioners in the field of disaster risk modelling to improve their models by adding (more) dynamic components. Several of the methods and data developed in WP4 - and which lay at the foundation of the metadatabase - are also integrated into the multi-risk software from WP5, making it available for a wider audience, like disaster risk managers, and industry representatives that need to make decisions regarding disaster risk. Furthermore, when the metadatabase grows over time, analyses of the metadata could become a viable option to monitor the evolution of dynamic risk assessments over time and to address best practices as well as remaining gaps in dynamic risk assessments (e.g., how is the development of methods per risk element? Are there regions left behind in dynamic risk assessments?). For more information on our future growth strategy, see Section 6.

### 4. Contributing and entry requirements

The metadatabase is an open resource where everyone can participate via a [Google Form](#) that guides them through the different attributes and their formatting (Table 1). New entries need to adhere to the entry criteria as described in the next paragraph. For now, VUA will review new entries to the metadatabase to ensure that they fit the entry criteria.

The entry criteria refer to the type of risk dynamics and ensures that only relevant entries are recorded. “Dynamics of risk drivers” is a relatively new and still evolving field, and so are the definition of terms. In our metadatabase, we refer to dynamics of risk drivers as any behavior contributing to risk that cannot be sufficiently explained by a single, constant value.

We welcome entries with an explicit dynamic risk component, like temporally dynamic risk assessments (see e.g., Meijer et al., 2023; de Ruiter & van Loon, 2022; Formetta & Feyen, 2019), directional dynamics (Stolte et al., 2024), assessments of management dynamics (see e.g., Eriksen et al., 2021; Schipper, 2020), and other methods to describe dynamic risk elements. We only include peer-reviewed and open-source contributions. Contributors are allowed to enter contributions that are not saved on a public resource (e.g., Zenodo or Figshare) as long as their data set/software/method/etc. is demonstrably available upon reasonable request. For conciseness and to maintain the focus on risk elements, we do **not** accept the following:

- Risk assessments that only look at spatial dynamics (i.e., risk values changing from place to place; for instance the Social Vulnerability Index - Cutter et al., 2003; Cutter, 2024). Nearly every risk assessment has a spatially dynamic component such that it is the norm rather than the exception and collecting these in our metadatabase could potentially cloud the other entries.
- Timeseries data without a clear link to risk dynamics. For instance a timeseries of the average age per country could be relevant as a dynamic vulnerability indicator, but this would require additional analytical steps first, which is why we do not include such data timeseries in our metadatabase. However, a temporal vulnerability index that uses that data would be eligible.

We also allow updates (e.g., completing columns for previously unfinished work) by the contributors.

Contributors will also have to fill in a consent form where they express their consent for their information to be published publicly on Zenodo and the Disaster Risk Gateway. For more

information, see the [Google Form](#) and Section 5.2.1. We are currently also investigating how to safe personal information from contributors (specifically email and name) compliant to the General Data Protection Regulation (GDPR). The MYRIAD-EU templates on GDPR are not fully applicable here since the metadatabase is different from earlier products in MYRIAD-EU where a consent form was required. The required changes to those templates should be ready in June 2025. In the meantime, we do not ask contributors for their personal information.

## 5. Integration of the metadatabase in existing MYRIAD-EU products

MYRIAD-EU has developed several products to aid in multi-hazard/multi-risk understanding, analysis, and management. Integration of these products is important to ensure not only consistency but also findability and comprehensiveness.

### 5.1 Current state of integration

In the current phase of the metadatabase, we have a standalone version on Zenodo (Stolte et al., 2025), which, after completing this deliverable, we will link to in the [MYRIAD-EU Dashboard](#) and the [Disaster Risk Gateway \(DRG\) Wiki](#). Besides a link, we will create a page on the DRG wiki, explaining more about the metadatabase (e.g., its aims, attributes, entry requirements, etc.). The individual entries in the metadatabase will be or already have been added to the DRG Wiki as individual pages as well. These pages will be tagged as belonging to the metadatabase, so that pages related to the metadatabase can be distinguished from existing pages and lists, making the metadatabase's pages easy to identify. This is important for further integration into the DRG Wiki (Section 5.2).

### 5.2 Future state of integration

#### 5.2.1 For the remainder of MYRIAD-EU (short term)

We are currently exploring the possibility of further integrating the Metadatabase for Dynamics of Risk Drivers in the DRG Wiki by upgrading the DRG Wiki with semantic function capabilities. If the semantic function can be added then we will be able to tag content in DRG with attributes – like the ones in our metadatabase – which would be queryable, enabling advanced searches and auto-generation of lists and tables. Specifically, this means that each page in DRG that relates to the metadatabase could be tagged with the attributes from Table 1. An additional ‘metadatabase’ tag would be used to identify them as being part of the metadatabase. This enables querying the metadatabase from within DRG, making it accessible to a wider audience. We are also investigating if we can centralise the contributors form by replacing the Google Form with a form for direct entry into the DRG. This way, we could update both the metadatabase and the corresponding DRG pages at the same time. Note that it does not allow us to automatically update the metadatabase on Zenodo, which we would then need to periodically update every x-months, depending on the number of new entries we get over time.

Next to the wiki, we also aim at incorporating several of the data and methods from the metadatabase into the software package and user guide for multi-hazard and multi-risk scenario generation (Task 5.4). WP4 and WP5 identified several options and will explore these further in the remaining months of MYRIAD-EU.

#### 5.2.2 After MYRIAD-EU (long term)

We will seek additional resources (see Section 6) to maintain and enhance the metadatabase on DRG. Potential future enhancements include functionality to query and download data according to user needs from the metadatabase, and to analyse and create visualisations of data within the metadatabase.

## 6. Future upkeep and growth strategy

The metadatabase is intended to be a living document, growing over time with new entries. This also comes with progressive insights which we use to improve the metadatabase's structure. So far, we have had several versions of the metadatabase, based on internal feedback from early contributors and from a poster sessions at the MYRIAD-EU General Assembly 5. We would like to apply similar strategies in the (near) future. At EGU25, we have presented another poster to attract external contributors (Ward et al., 2025; feedback yet to be processed). By collecting feedback from non-MYRIAD-EU researchers we can continue to improve our attribute definitions and formatting. Furthermore, we are drafting a paper and a research brief on the metadatabase to bring it to the attention of a wider group of researchers, policy makers, and others who are interested. After MYRIAD-EU, we plan to incorporate the metadatabase in new proposals on dynamic risks. We hope to attract funding in this way to enable further growth and better integration into the DRG wiki.

## 7. Data and Ethics Statement

The information in the deliverable respects the principles set out in the MYRIAD-EU Ethics Plan and in the Data Management Plan.

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