

An Open Repository of Earthquake-Triggered Ground-Failure Inventories



Data Series 1064

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By Robert G. Schmitt, Hakan Tanyas, M. Anna Nowicki Jessee, Jing Zhu, Katherine M. Biegel, Kate E. Allstadt, Randall W. Jibson, Eric M. Thompson, Cees J. van Westen, Hiroshi P. Sato, David J. Wald, Jonathan W. Godt, Tolga Gorum, Chong Xu, Ellen M. Rathje, and Keith L. Knudsen

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U.S. Department of the Interior
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U.S. Geological Survey
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Contents

Abstract.....	1
Overview.....	1
Purpose.....	1
Data Access.....	1
Organization.....	1
Citation.....	4
Inclusion of New Inventories.....	4
Original Data Sources and Processing Steps.....	4
Data Sources.....	4
Initial Processing.....	6
Database Creation and Processing.....	6
Update Process.....	6
Field Names—Definitions, Data Types, and Descriptions.....	6
Metadata.....	6
Limitations.....	6
Acknowledgments.....	7
Disclaimers.....	7
Disclaimer for a Provisional Data Series.....	7
References Cited.....	7
Appendix 1. Earthquake-Triggered Landslide Inventory Author Method-Summary Form.....	9
Appendix 2. Earthquake-Triggered Liquefaction Inventory Author Method-Summary Form.....	13
Appendix 3. Earthquake-Triggered Ground-Failure Inventory Author’s Permission Form.....	17

Figures

1. Image of the ScienceBase Community landing.....	2
2. Images showing an example of the organization structure of the ScienceBase Community.....	5

Table

1. Attribute field names, types, and descriptions.....	4
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Abstract

Earthquake-triggered ground failure, such as landsliding and liquefaction, can contribute significantly to losses, but our current ability to accurately include them in earthquake-hazard analyses is limited. The development of robust and widely applicable models requires access to numerous inventories of ground failures triggered by earthquakes that span a broad range of terrains, shaking characteristics, and climates. We present an openly accessible, centralized earthquake-triggered ground-failure inventory repository in the form of a ScienceBase Community to provide open access to these data with the goal of accelerating research progress. The ScienceBase Community hosts digital inventories created by both U.S. Geological Survey (USGS) and non-USGS authors. We present the original digital inventory files (when available) as well as an integrated database with uniform attributes. We also summarize the mapping methodology and level of completeness as reported by the original author(s) for each inventory. This document describes the steps taken to collect, process, and compile the inventories and the process for adding additional ground-failure inventories to the ScienceBase Community in the future.

Overview

To improve our ability to assess earthquake-triggered ground-failure hazard, the research community needs access to historical ground-failure inventory data. An inventory is a detailed map of individual ground failures that can be tied to a

single triggering event. These data can be used to improve our understanding of earthquake-triggered ground-failure hazard and allow us to produce models for probabilistic, scenario, and deterministic real-time hazard assessments.

Purpose

The purpose of this report is to outline the methods used to create a centralized repository for earthquake-triggered ground-failure inventories (“inventories”). The goal of this work is to help accelerate research progress by making it easier for the research community to access these datasets. When selecting data for a given research objective, researchers need to know the methodologies used to create the inventories and the limitations of the datasets. To address this need, we also report details from the original authors regarding mapping methodologies and levels of completeness.

Data Access

The data are hosted through a U.S. Geological Survey (USGS) ScienceBase Community. The ScienceBase Community, titled “An Open Repository of Earthquake-Triggered Ground-Failure Inventories” is accessible at the following web address: <https://doi.org/10.5066/F7H70DB4> (Schmitt and others, 2017). We structure the repository in a way that facilitates its inclusion in interactive web applications that could make the data even easier for the community to navigate.

Organization

Figure 1 shows the ScienceBase Community landing page for the data repository (<https://doi.org/10.5066/F7H70DB4>; Schmitt and others, 2017). A single combined geodatabase (“ground_failure_database_v#.zip”) and zip files of point and polygon shapefiles (“ground_failure_points_v#.zip,” “ground_failure_polygons_v#.zip”) are hosted on the landing page for the ScienceBase Community, where v# refers to the version of the release starting at v1. A Geodatabase is a native data structure for Esri ArcGIS, but it is proprietary so also included

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⁸University of Texas, Austin, Texas.

ScienceBase Catalog → An Open Repository of Earth...

An Open Repository of Earthquake-triggered Ground-failure Inventories

Citation

Schmitt, R., Tanyas, H., Jessee, M.A., Zhu, J., Biegel, K.M., Allstadt, K.E., Jibson, R.W., Thompson, E.M., van Westen, C.J., Sato, H.P., Wald, D.J., Godt, J.W., Gorum, T., Xu, C., Rathje, E.M., Knudsen, K.L., 2017, An Open Repository of Earthquake-triggered Ground Failure Inventories, U.S. Geological Survey data release collection, accessed DAY MONTH YEAR, at <https://doi.org/10.5066/F7H70DB4>.

Summary

Earthquake-triggered ground-failure, such as landsliding and liquefaction, can contribute significantly to losses, but our current ability to accurately include them in earthquake hazard analyses is limited. The development of robust and transportable models requires access to numerous inventories of ground failure triggered by earthquakes that span a broad range of terrains, shaking characteristics, and climates. We present an openly accessible, centralized earthquake-triggered ground-failure inventory repository in the form of a ScienceBase Community to provide open access to these data, and help accelerate progress. The Community hosts digital inventories created by both USGS and non-USGS authors. We present the original digital inventory files (when available) as well as an integrated database with uniform attributes. We also summarize the mapping methodology and level of completeness as reported by the original authors for each inventory.

Contributing Inventories

Contact gs-haz_groundfailure@usgs.gov for more information on how to contribute inventories to this effort.

Child Items (2)

-  [Landslide Inventories](#)
-  [Liquefaction Inventories](#)

Contacts

Contact : gs-haz_groundfailure@usgs.gov

Attached Files

Click on title to download individual files attached to this item or [download all](#) files listed below as a compressed file.

↓ landslide_methods_summary_v1.xlsx "Summary of methods information provided by original authors"	2017-07-06 11:13	kallstadt@usgs.gov	49.73 KB
↓ ground_failure_known_events_v1.xlsx "Summary of published information on earthquakes that triggered ground failure"	2017-07-06 11:14	kallstadt@usgs.gov	70.98 KB
↓ ground_failure_database_v1.zip "Geodatabase and metadata files"	2017-07-06 14:37	rschmitt@usgs.gov	73.03 MB
↓ ground_failure_points_v1.zip "Point shapefile and metadata"	2017-07-06 14:38	rschmitt@usgs.gov	3.43 MB
↓ ground_failure_polygons_v1.zip "Polygon shapefile and metadata"	2017-07-06 14:41	rschmitt@usgs.gov	187.96 MB

Figure 1. Image of the ScienceBase Community landing page located at <https://doi.org/10.5066/F7H70DB4>.

Related External Resources

Type: ArcGIS Online Web Application

Ground-failure Database Web Application	https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=de583ade9e9e4c4e89303ecf90359535
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Purpose

The goal of this work is to help accelerate research progress by making it easier for the research community to access these datasets. When selecting data for a given research objective, researchers need to know the methodologies used to create the inventories and the limitations of the datasets. To address this need, we also report details from the original authors regarding mapping methodologies and levels of completeness. We have chosen to structure the collection of inventories as a ScienceBase Community that can be updated regularly as new inventories are made available. The procedures and policies described in the accompany U.S. Geological Survey data series report, linked below, would be applied to new inventories prior to inclusion.

Additional Information

Identifiers

Type	Scheme	Key
DOI	https://www.sciencebase.gov/vocab/category/item/identifier	10.5066/F7H70DB4

Figure 1. Image of the ScienceBase Community landing page located at <https://doi.org/10.5066/F7H70DB4>.—Continued

are shapefiles, an open format that can be used outside of ArcGIS but does not preserve symbology. Each file contains all of the publicly released ground-failure inventories that have the same attributes as the geodatabase (table 1). Additionally, the landing page hosts spreadsheets that summarize the responses of the corresponding author(s) for each inventory questionnaire regarding how the inventory was created (Appendixes 1 and 2). These are titled “*landslide_methods_summary_v#.xlsx*” and “*liquefaction_methods_summary_v#.xlsx*.” As of the time of this writing, the liquefaction inventories are not yet prepared for release so the liquefaction methods summary file does not exist in version 1 and the known events summary is not yet as complete for liquefaction as it is for landslides. Also included is a summary of published information about earthquakes that are known to have triggered ground failure, including those that are not included in the inventory database. These data are included in a spreadsheet on the main ScienceBase Community landing page called “*ground_failure_known_events_v#.xlsx*.” Events include (1) earthquakes that are included in the inventory database, (2) earthquakes for which inventories have been published but are not currently included in the inventory database, (3) earthquakes with reported ground failures but no known inventories, such as those reported by Marano and others (2010), and (4) null events, which are defined as earthquakes that triggered little to no ground failure. A null event is distinct from an earthquake for which we have no information. Defining an event as null requires a report stating that no or minimal ground failure was observed despite a thorough survey of the affected area. Such events are rarely documented, but they are useful for modeling as they provide information about areas

where ground failure did not take place despite earthquake shaking.

The inventories themselves can be found on the earthquake-event web pages, which are located under two folders on the main ScienceBase Community landing page: “Landslide Inventories” and “Liquefaction Inventories.” Within each of these folders are links to earthquake-event web pages, named by the date (year, month, day as YYYY-MM-DD), earthquake name, and magnitude (for example, 1986-10-10 San Salvador, El Salvador M 5.7) (fig. 2A). The earthquake names are derived from the USGS ShakeMap Atlas (García and others, 2012) event description field, for entries where a ShakeMap Atlas event exists. This is because these names correspond more closely to the commonly used name for each event than the geographical name automatically produced and used as the name on the USGS earthquake-event web page. If no ShakeMap Atlas event exists, the geographical name was used. Each ScienceBase earthquake-event web page (fig. 2B) contains a short summary statement about the earthquake, a link to the USGS earthquake-event web page, and one or more inventory web pages, which in ScienceBase fall under the “child items” subheading.

Each inventory web page is organized by the author name(s) and the publication year of the inventory (for example, Gorum and others, 2014). Author name(s) are the most commonly used discriminator between inventories for the same earthquake. Since many of the inventories from a given earthquake have similar titles, inventory web pages are labeled by author name(s) instead of the title for ease of navigation. Each individual inventory web page (fig. 2C) contains a short statement describing the inventory, a link to the original

4 An Open Repository of Earthquake-Triggered Ground-Failure Inventories

Table 1. Attribute field names, types, and descriptions.

[GIS, geographic information system; USGS, U.S. Geological Survey; UTC, Coordinated Universal Time]

Field name	Field type	Description
OBJECTID	Long integer	Identifier given to each feature when imported into the GIS
area	Float	Area calculated within the GIS for each polygon (square meters)
event_name	Text	USGS official event name or ShakeMap Atlas name if available
event_date	Date or short integer	Earthquake event date in the format MM/DD/YYYY HH:MM:SS (UTC)
magnitude	Float	USGS event magnitude
source_link	Text	Link to the inventory web page on ScienceBase
epicentral_country	Text	Country where epicenter of triggering earthquake is located
type	Text	Landslide or liquefaction indicator
description	Text	Additional information from original source related to the individual polygon or point (for example, landslide type)
comments	Text	Additional information from the original source related to the triggering event (for example, part of an earthquake sequence)
volume	Float	Volume of ground failure (cubic meters) if available from original dataset
event_link	Text	Link to the respective USGS earthquake-event web page
inventory_name	Text	Name of the inventory from which the data originated

data source (typically a journal paper), as well as a series of individual files that contain the original data with the original attributes. These files are also named by the author names and year of the original publication. Each inventory web page also contains a pdf of the original questionnaire filled out by the contributing author(s) regarding how the inventory was created (Appendixes 1 and 2).

Citation

Though many of the inventories were originally developed and analyzed as part of journal publications or reports, the inventories themselves—either in the form of analog maps or digital files—were rarely published with the article or report. Some inventories were never formally published at all. Inventories are also re-projected to a coordinate system consistent with other inventories in the repository. Therefore, in most cases, each inventory is considered a new data release, and each is granted a digital object identifier (doi) and a new citation. The author list and title from the original publication are used unless the original author(s) want to update the citation information or if the title needs to be modified to better describe the inventory dataset rather than the findings of the original research paper. In cases where the inventory has already been published on ScienceBase (which is the case for some USGS-affiliated inventories), the child item links to the existing ScienceBase entry.

An individual inventory web page should be cited like a chapter in a book, where the book is the ScienceBase Community landing page. An access date should also be included in the citation of the data release to take into account that new inventories may be added regularly. Suggested citations are presented on each ScienceBase earthquake-event web page. An example for the described citation format is as follows:

Harp, E.L., Tanaka, Kohei, Sarmiento, John, and Keefer, D.K., 2017, Landslides from the May 25–27, 1980, Mammoth Lakes, California, earthquake sequence,

<https://doi.org/10.5066/F7M043X2>, in Schmitt, R.G., Tanyas, Hakan, Nowicki, Jesse, M.A., Zhu, Jing, Biegel, K.M., Allstadt, K.E., Jibson, R.W., Thompson, E.M., van Westen, C.J., Sato, H.P., Wald, D.J., Godt, J.W., Gorum, Tolga., Xu, Chong, Rathje, E.M., and Knudsen, K.L., 2017, An open repository of earthquake-triggered ground-failure inventories: U.S. Geological Survey data release collection, accessed June 26, 2017, at <https://doi.org/10.5066/F7H70DB4>.

Inclusion of New Inventories

The collection of inventories is structured as a ScienceBase Community that can be updated regularly, following the procedures and policies described in this document, as new inventories are made available.

Researchers who wish to make their inventories available for inclusion in this effort should fill out the “author’s method-summary form” and “author’s permission form” (Appendixes 1–3). These forms are provided on the ScienceBase Community landing page. The forms and the data, preferably in shapefile format, should be sent to gs-haz_groundfailure@usgs.gov. Submission is not a guarantee of inclusion. Inventories that are associated with peer-reviewed reports or scientific papers are preferred.

Original Data Sources and Processing Steps

Data Sources

The ground-failure inventories included in this repository were generated independently by numerous USGS and non-USGS authors. The authors of inventories who agree to include their inventories as part of this effort share the digital files and fill out a questionnaire describing how the inventory

A

Child Items (2)

-  Landslide Inventories
 -  1971-02-09 San Fernando, California M 6.6
 -  1976-02-04 Guatemala M 7.5
 -  1980-01-24 Livermore, California M 5.8
 -  1980-05-25 Mammoth Lakes, CA M 6.5
 -  1983-05-02 Coalinga, California M 6.7
 -  1986-10-10 San Salvador, El Salvador M 5.7
 -  1989-10-18 Loma Prieta, California M 6.9
 -  1991-04-22 Valle de la Estrella, Costa Rica M 7.6
 -  1994-01-17 Northridge, California M 6.7
 -  1995-01-16 Kobe, Japan M 6.9
 -  2001-01-13 San Miguel, El Salvador M 7.7
 -  2001-02-13 San Salvador, El Salvador M 6.6
 -  2002-11-03 Denali, Alaska M 7.9
 -  2003-08-14 Lefkada, Greece M 6.3
 -  2004-10-23 Niigata-Chuetsu, Japan M 6.6
 -  2005-10-08 Kashmir, Pakistan M 7.6
 -  2006-10-15 Kiholo Bay, Hawaii M 6.7
 -  2007-04-21 Aisen, Chile M 6.2
 -  2008-05-12 Wenchuan, China M 7.9
 -  2010-01-12 Haiti M 7.0
 -  2011-03-11 Tohoku-Oki, Japan M 9.1
 -  2013-04-20 Western Sichuan, China M 6.6
 -  2013-07-21 Gansu, China M 5.9
 -  2014-08-03 Sichuan-Yunnan-Guizhou Region, China M 6.2
 -  2015-04-25 Nepal M 7.8
 -  Not Releasing
 -  Liquefaction Inventories

B

ScienceBase Catalog → An Open Repository of Earth... → Landslide Inventories → 2010-01-12 Haiti M 7.0

2010-01-12 Haiti M 7.0

Summary

This folder contains landslide inventories of the Mw 7.0 Haiti earthquake, which occurred on 2010-01-12 at 21:53:10 UTC. The hypocenter was located at 18.443°N 72.571°W at a depth of 13.0 km. For further information see the link to the full USGS event page for this earthquake under "Related External Resources" below.

With the exception of the data from USGS sources, the inventory data and associated metadata were not acquired by the U.S. Geological Survey (USGS) and thus have not been reviewed for accuracy and completeness by the USGS. They are presented as part of this data series for convenience of the user only, as part of an effort to make published ground-failure inventories more accessible from a single aggregated site. No warranty, expressed or implied, is made regarding the display or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty.

Child Items (2)

-  Gorum and others (2013)
-  Harp and others (2016)

Related External Resources

Type: Web Link

USGS Earthquake Event Page	http://earthquake.usgs.gov/earthquakes/eventpage/usp000h60h
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C

Harp and others (2016)

Map of landslides triggered by the January 12, 2010, Haiti earthquake

Dates

Publication Date : 2017
 Start Date : 2010-01-12
 End Date : 2016

Citation

Harp, E.L., Jibson, R.W., Schmitt, R.G., 2017, Map of landslides triggered by the January 12, 2010, Haiti earthquake, <https://doi.org/10.5086/F7C8275R>, in Schmitt, R., Tanyas, H., Nowicki-Jesse, M.A., Zhu, J., Biegel, K.M., Allstadt, K.E., Jibson, R.W., Thompson, E.M., van Westen, C.J., Sato, H.P., Wald, D.J., Godt, J.W., Gorum, T., Xu, C., Rathje, E.M., Knudsen, K.L., 2017, An Open Repository of Earthquake-triggered Ground Failure Inventories, U.S. Geological Survey data release collection, accessed June 26, 2017, at <https://doi.org/10.5086/F7H70DB4>.

Summary

This inventory was originally created by Harp and others (2016) describing the landslides triggered by the M 7.0 Haiti earthquake that occurred on 12 January 2010 at 21:53:10 UTC. Care should be taken when comparing with other inventories because different authors use different mapping techniques. This inventory also could be associated with other earthquakes such as aftershocks or triggered events. Please check the author methods summary and the original data source for more information on these details and to confirm the viability of this inventory for your specific use.

Contacts

Point of Contact : GHSC Data Steward
 Originator : Harp, E.L., Jibson, R.W., Schmitt, R.G.
 Metadata Contact : GHSC Data Steward
 Publisher : None
 Distributor : ScienceBase

Attached Files

Click on title to download individual files attached to this item or [download all files listed below as a compressed file.](#)

 Harp_end_others_2016_FGDC.xml Original FGDC Metadata		2017-06-27 10:56	kbiegel@usgs.gov	11.73 KB
---	---	------------------	------------------	----------

Shapefile: [Harp_end_others_2016.zip](#)

 Harp_end_others_2016.cpg		2017-02-03 10:04	5 Bytes
 Harp_end_others_2016.dbf		2017-02-03 10:04	2.81 MB
 Harp_end_others_2016.prj		2017-02-03 10:04	145 Bytes
 Harp_end_others_2016.sbn		2017-02-03 10:04	226.39 KB
 Harp_end_others_2016.sbx		2017-02-03 10:04	10.51 KB
 Harp_end_others_2016.shp		2017-02-03 10:05	32.66 MB
 Harp_end_others_2016.shp.xml		2017-02-03 10:04	15.21 KB
 Harp_end_others_2016.shx		2017-02-03 10:04	184.21 KB

Related External Resources

Type: Publication that references this resource

Harp, E.L., Jibson, R.W., and Schmitt, R.G., 2016, Map of landslides triggered by the January 12, 2010, Haiti earthquake: U.S. Geological Survey Scientific Investigations Map 3353, 15 p., 1 sheet, scale 1:150,000, doi: 10.3133/sim3353.	https://doi.org/10.3133/sim3353
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Figure 2. Images showing an example of the organization structure of the ScienceBase Community. *A*, Organization scheme for the earthquake-event web pages listed as child items on the main ScienceBase Community landing page. *B*, Example of an individual earthquake-event web page for which there are multiple inventories listed as child items. *C*, Example of an individual ground-failure inventory web page.

6 An Open Repository of Earthquake-Triggered Ground-Failure Inventories

was produced. Separate but similarly structured forms are used for landslides and liquefaction. Blank copies of these forms are included as Appendixes 1 and 2, respectively. Authors not affiliated with the USGS also fill out a form to grant permission to share their data through ScienceBase (Appendix 3). Some older inventories only exist as paper maps; these are digitized, georeferenced using the given coordinate system of each hardcopy map, and converted to shapefiles that can be used in a geographic information system (GIS).

Initial Processing

In most cases, inventories are received from their original authors as shapefiles with a defined georeferencing system, as noted by the authors in the corresponding “author’s method-summary form.” The individual datasets are then loaded into a GIS, retaining their original attributes, and the dataset is exported to a new shapefile using the World Geodetic System 1984 (WGS84) coordinate system for consistency. Each inventory is then loaded onto its corresponding inventory web page on the ScienceBase Community.

Database Creation and Processing

A single-file geodatabase contains feature classes for ground-failure points, lines, and polygons. We also create a zip file of shapefiles containing the same information to make the database accessible outside proprietary platforms. Many open-source software packages can read and write shapefiles, but geodatabase files are accessible only in ArcGIS. Each dataset includes the same attribute schema (table 1). Each individual dataset is appended to the geodatabase, and attributes are populated based on the details of the inventory being added. The geodatabase is projected into WGS84 Web Mercator for an optimized web-viewing experience.

Update Process

The repository is structured as a ScienceBase Community to allow updates as more inventories become available. The update workflow will follow the same steps described in this document for the initial version of the database. All of the database files (geodatabase, shapefiles, excel spreadsheet summaries) are versioned to reflect new additions, and the most recent versions are available on the ScienceBase Community landing page.

Field Names—Definitions, Data Types, and Descriptions

Table 1 describes the attribute schema. Note that the description, comment, and volume fields are only populated if the relevant information is available from the original source. We did not derive any new values for these fields. The description field is reserved for information about the individual point

or polygon, such as the type of landslide (for example, rock fall, debris flow). No classification information found in this field is altered. Since different groups use different classification schemes, these are not necessarily consistent between inventories and users should refer to the original publication for details. The comment field is reserved for information about the triggering event. For example, “This inventory includes landslides triggered by a sequence of earthquakes rather than a single main shock. Check original data source for details on the earthquake sequence.”

Metadata

The information from the author-provided method-summary forms is aggregated and transferred into an Excel spreadsheet containing all inventories, including the corresponding author(s). Using an automated python script, a separate preliminary metadata file in XML format is created for each inventory, sourcing the information from the Excel spreadsheet. Each automated metadata file includes author-provided information as well as database-wide USGS metadata information such as USGS personnel contacts and disclaimers.

The preliminary metadata file is then used as the starting template to complete the geospatial section of the final metadata xml file. Each inventory is loaded into the USGS Metadata Wizard tool for ArcGIS. The tool uses the template created for each submission to populate the necessary fields in the XML file that pertained to that submission. The Metadata Wizard then adds geospatial attributes associated with the corresponding inventory to the XML file. The geospatial attributes include the datum and projection, attribute definitions, and geoprocessing steps. The newly created XML files with the author(s) and geospatial information are then loaded onto the correct ScienceBase inventory web page.

Limitations

This database does not include all of the earthquake-induced ground-failure inventories that exist. Inventories are not included for which we do not have permission from the original authors to redistribute data and there may be datasets of which we are not aware, such as in the international literature or in non-English-language journals or gray-literature reports.

Many different researchers with varying methods, objectives, and priorities generated the inventories included in this database. Therefore, the inventories vary in quality, completeness, and representation. The geographic and thematic accuracy of the mapped features differs significantly between inventories. The level of detail, such as whether source areas and runouts are mapped separately for landslides or whether the ground failure is represented as a point or as a polygon, also varies significantly. The author’s method-summary forms,

which were completed by the original authors of the inventories and were not independently verified, are provided in the database. In addition, users should verify the spatial accuracy of the landslide locations. Except for the conversion of the coordinate system, the original inventories were not modified. Therefore, the spatial accuracy of the shared data depends on the quality of the original data. In the inventories that were digitized, the accuracy of the ground-failure localities differs based on the scale and accuracy of the original map.

The inventories are linked to the largest triggering earthquake both on ScienceBase and in their metadata and attributes. A statement is placed on the ScienceBase inventory web page and in the metadata of inventories for which the original report noted that the mapped landslides were triggered by a sequence of earthquakes rather than a single main shock. However, other inventories may also include landslides triggered by other earthquakes or other causes, so the user should refer to the original report of the corresponding inventory for more information.

Users interested in utilizing the landslide inventories in this database should be aware of these limitations and work with the most suitable datasets for their purpose with knowledge of the accompanying uncertainties.

Acknowledgments

For the sharing of their data up to the time of this report, the authors are very grateful to following researchers: Kristin Marano, Daisuke Higaki, Fumitoshi Imaizumi, Gen Li, George Papathanassiou, Hiroshi Yagi, Jianqiang Zhang, Joseph Wartman, Kaushal Raj Gnyawali, Mario Reyes, Muhammad Basharat, Odin Marc, Pascal Lacroix, Salvatore Martino, Sergio Sepúlveda, Taro Uchida, and Tsuyoshi Wakatsuki.

Disclaimers

With the exception of the data from USGS sources, the inventory data and associated metadata were not acquired by the USGS, are published as they were submitted, and thus have not been reviewed for accuracy and completeness by the USGS. They are presented as part of this data series for convenience of the user only, as part of an effort to make published ground-failure inventories more accessible by aggregating them onto a single website. No warranty, expressed or implied, is made regarding the display or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty.

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Appendix 1. Earthquake-Triggered Landslide Inventory Author Method-Summary Form

Complete a separate metadata form for each inventory. Please fill in all items, even though they might be in associated publications, in order to provide a complete metadatabase. Return form and necessary attachments to gs-haz_groundfailure@usgs.gov.

1. Earthquake-induced-landslide inventory name

Name of inventory (include earthquake name):	Date of triggering earthquake (Coordinated Universal Time):
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2. Projection system of the inventory

Projection system:

Remarks:

3. Method(s) used for generating the inventory

Method	Estimate of percentage of the inventory	Image type (for example, Landsat 8)	Spatial resolution of images
Image classification using post-earthquake satellite and (or) aerial imagery	_____ %		_____ m
Image classification using both pre- and post-earthquake imagery	_____ %		_____ m
Monoscopic image interpretation using post-earthquake imagery	_____ %		_____ m
Monoscopic image interpretation using both pre- and post-earthquake imagery	_____ %		_____ m
Stereoscopic image interpretation using post-earthquake imagery	_____ %		_____ m
Stereoscopic image interpretation using both pre- and post-earthquake imagery	_____ %		_____ m
Interpretation of unmanned aerial vehicle imagery	_____ %		_____ m
Interpretation of helicopter imagery	_____ %		_____ m
Field mapping	_____ %		
Other:	_____ %		_____ m
Other:	_____ %		_____ m
Other:	_____ %		_____ m

Remarks:

10 An Open Repository of Earthquake-Triggered Ground-Failure Inventories

4. Completeness of the inventory

Was a minimum size threshold used for mapping landslides?	<input type="checkbox"/> Yes: _____ m ² <input type="checkbox"/> No
Estimated percentage of landslides from the triggering earthquake that were mapped	_____ %
Is the boundary of the mapped area indicated? If yes, send this as an attachment, if possible.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Were pre-earthquake landslides removed from the inventory? If yes, explain how.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Percentage of landslides mapped as points	_____ %
Percentage of landslides mapped as polygons	_____ %
Were source and deposition parts of the landslides differentiated?	<input type="checkbox"/> Yes, for _____ % of landslides <input type="checkbox"/> No
Were contiguous landslides mapped separately or as a single landslide?	<input type="checkbox"/> Separately, for _____ % of the landslides <input type="checkbox"/> As a single feature, for _____ % of the landslide
Were the landslide types classified? If yes, based on which classification method?	<input type="checkbox"/> Yes <input type="checkbox"/> No
What other landslide attributes were included?	
Attribute:	How was this attribute obtained?
Attribute:	How was this attribute obtained?
Attribute:	How was this attribute obtained?

Remarks:

5. Landslide inventory mapping effort

Were problematic areas field checked after creating the inventory?	<input type="checkbox"/> Yes, _____% of field was checked <input type="checkbox"/> No
How many persons worked on the landslide inventory?	_____ persons
How much total time was spent on the landslide-inventory mapping?	_____ days
Were the results crosschecked by others?	<input type="checkbox"/> Yes <input type="checkbox"/> No
How long after the earthquake was the inventory completed?	_____ months

Remarks:

6. Please list any additional information collected as part of this inventory (such as samples, lidar, borings)

7. Referencing for the study

Was the inventory published? If yes, please indicate the full reference for the study.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Are there any other related studies that were not converted into an inventory map? If yes, please send as an attachment or provide a link.	<input type="checkbox"/> Yes <input type="checkbox"/> No

Remarks:

8. Additional remarks or comments

Appendix 2. Earthquake-Triggered Liquefaction Inventory Author Method-Summary Form

Complete a separate metadata form for each inventory. Please fill in all items, even though they might be in associated publications, in order to provide a complete metadatabase. Return form and any attachments to gs-haz_groundfailure@usgs.gov.

1. Earthquake-induced-liquefaction inventory name

Name of inventory (include earthquake name):	Date of triggering earthquake (Coordinated Universal Time):
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2. Projection system of the inventory

Projection system:

Remarks:

3. Method(s) used for generating the inventory

Method	Estimate of percentage of the inventory	Image type (for example, Landsat 8)	Spatial resolution of images
Image classification using post-earthquake satellite and (or) aerial imagery	_____ %		_____ m
Image classification using both pre- and post-earthquake imagery	_____ %		_____ m
Image interpretation using post-earthquake imagery	_____ %		_____ m
Image interpretation using both pre- and post-earthquake imagery	_____ %		_____ m
Interpretation of unmanned aerial vehicle imagery	_____ %		_____ m
Field mapping	_____ %		
Other:	_____ %		_____ m
Other:	_____ %		_____ m
Other:	_____ %		_____ m

Remarks:

14 An Open Repository of Earthquake-Triggered Ground-Failure Inventories

4. Completeness of the inventory

Estimated percentage of liquefaction from the triggering earthquake that was mapped	_____%
Is the boundary of the mapped area indicated? If yes, send this as an attachment, if possible.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Are the land routes of the mapping indicated? If yes, send this as an attachment, if possible.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Percentage of liquefaction mapped as points	_____%
Percentage of liquefaction mapped as polygons	_____%
Were the effects of the liquefaction differentiated (for example, sand boil, lateral spreading, ground cracking)?	<input type="checkbox"/> Yes, for _____% of liquefaction <input type="checkbox"/> No
Was horizontal movement due to liquefaction measured?	<input type="checkbox"/> Yes, for _____% of liquefaction <input type="checkbox"/> No
Was vertical settlement due to liquefaction measured?	<input type="checkbox"/> Yes, for _____% of liquefaction <input type="checkbox"/> No
What other liquefaction attributes were included?	
Attribute:	How was this attribute obtained?
Attribute:	How was this attribute obtained?
Attribute:	How was this attribute obtained?

Remarks:

5. Liquefaction inventory mapping effort

If image classification or interpretation was used, were the results field validated?	<input type="checkbox"/> Yes, ___% of mapped features were checked <input type="checkbox"/> No
If image interpretation was used, were the results crosschecked by others?	<input type="checkbox"/> Yes <input type="checkbox"/> No
How long after the earthquake was the inventory completed?	_____ months

Remarks:

6. Please list any additional information collected as part of this inventory (such as samples, lidar, borings)

7. Referencing for the study

Was the inventory published? If yes, please indicate the full reference for the study.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Are there any other related studies that were not converted into an inventory map? If yes, please send as an attachment or provide a link.	<input type="checkbox"/> Yes <input type="checkbox"/> No

Remarks:

8. Additional remarks or comments:

Appendix 3. Earthquake-Triggered Ground-Failure Inventory Author's Permission Form

Name:

Organization:

Address:

E-mail:

Date:

I am interested in becoming a member of an international working group on earthquake-induced ground failure.

I am willing to share the following earthquake-induced inventories on a web-based platform:

Location	Country	Date of triggering earthquake (UTC)

Publishing support provided by:

Denver Publishing Service Center, Denver, Colorado

For more information concerning this publication, contact:

Center Director, USGS Geologic Hazards Science Center

Box 25046, Mail Stop 966

Denver, CO 80225

(303) 273-8579

Or visit the Geologic Hazards Science Center website at:

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