

DEBRIS-FLOW HAZARD MITIGATION. Bridging Science and Practice in Debris Flow Management

Original

DEBRIS-FLOW HAZARD MITIGATION. Bridging Science and Practice in Debris Flow Management / Pirulli, Marina; Leonardi, Alessandro; Vagnon, Federico. - (2023).

Availability:

This version is available at: 11583/2991208 since: 2024-07-26T15:58:35Z

Publisher:

EDP Sciences

Published

DOI:

Terms of use:

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

Publisher copyright

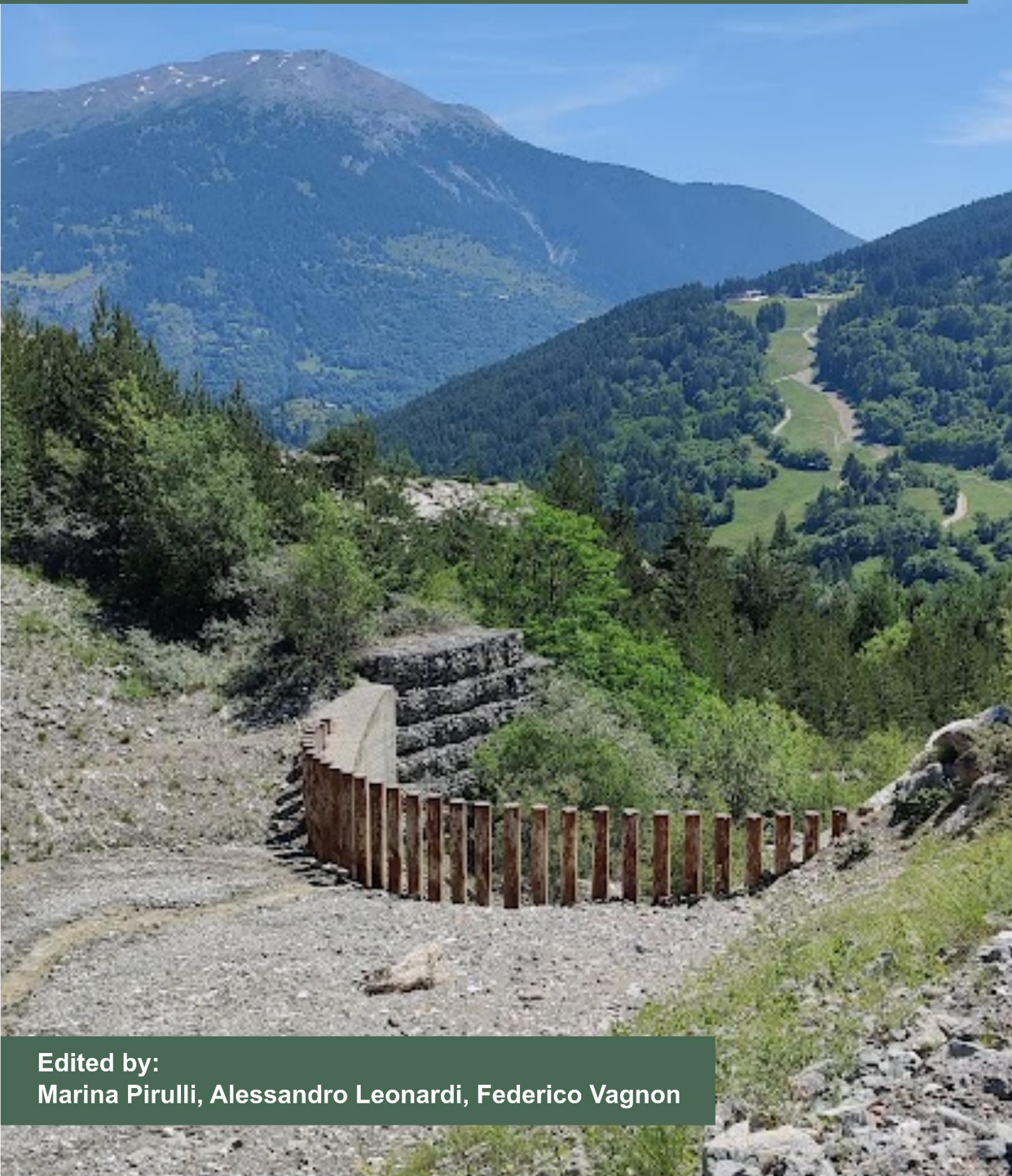
EDP preprint/submitted version e/o postprint/Author's Accepted Manuscript

© EDP Sciences. The original publication is available at <https://www.e3s-conferences.org/articles/e3sconf/abs/2023/52/contents/contents.html>

(Article begins on next page)

DEBRIS FLOW HAZARD MITIGATION

Bridging Science and Practice in Debris Flow Management



Edited by:
Marina Pirulli, Alessandro Leonardi, Federico Vagnon

PROCEEDINGS OF THE EIGHT INTERNATIONAL CONFERENCE ON
DEBRIS-FLOW HAZARD MITIGATION, TORINO, ITALY, JUNE 26-29, 2023

DEBRIS-FLOW HAZARD MITIGATION

Bridging Science and Practice in Debris Flow Management

Edited by

Marina Pirulli
Politecnico di Torino, Italy

Alessandro Leonardi
University of Sheffield, UK

Federico Vagnon
Politecnico di Torino, Italy

2023



DFHM8 logo by Alessandro Leonardi

On the Cover: Filter barrier for debris flows, Bardonecchia, Italy. Alessandro Leonardi

Preface

The Eighth International Conference on Debris-Flow Hazard Mitigation was held in Torino, Italy on June 26-29, 2023.

The conference gathered together some 250 participants from 22 countries, representing a global community of researchers and practitioners who deal with challenges on debris flow hazards and mitigation strategies. The agenda consisted of 11 keynote presentations, 40 shorter oral presentations, and 124 poster presentations. The conference sessions were preceded by a 1-day field trip in the Susa Valley and followed by a 2-day field trip in the Aosta Valley.

This proceedings volume contains 174 papers that accompanied all three types of presentations. The papers are arranged over 7 thematic sessions:

- Processes and Mechanics
- Experiments and Modelling
- Monitoring, Detection and Warning
- Role of Disturbance
- Case Studies and Hazard Assessment
- Engineering and Mitigation
- Needs of End Users

All papers underwent blind peer review, with each paper receiving at least one technical and one editorial review. Reviewer names and affiliations are given on the following pages.

For all the work done in organizing this event, we want to address our deepest gratitude to the International Scientific Committee, and to the institutions, companies and volunteers who have directly and indirectly contributed to this event. Special thanks go to Claudio Scavia, Giulia La Porta, Giulia Messina and Andrea Pasqua, who worked behind the curtains and greatly contributed to the success of the conference. Several organizations provided sponsorship through financial support. Their names are listed on the following pages. Our sincerest thanks goes out to all of these individuals and groups.

The Editors,

Marina Pirulli
Politecnico di Torino

Alessandro Leonardi
University of Sheffield

Federico Vagnon
Politecnico di Torino

International Organizing Committee

Elisabeth Bowman	University of Sheffield, United Kingdom
Marcel Hürlimann	UPC BarcelonaTECH, Spain
Roland Kaitna	BOKU, Vienna, Austria
Brian McArdell	Swiss Federal Institute WSL, Switzerland
Marina Pirulli	Politecnico di Torino, Italy
Mark Reid	U.S. Geological Survey, USA
Paul Santi	Colorado School of Mines, USA
Yoshifumi Satofuka	Ritsumeikan University, Japan

Local Organizing Committee

Marina Pirulli	Politecnico di Torino
Alessandro Leonardi	University of Sheffield (UK)
Federico Vagnon	Politecnico di Torino
Massimo Arattano	Consiglio Nazionale delle Ricerche
Monica Barbero	Politecnico di Torino
Marco Barla	Politecnico di Torino
Matteo Berti	University of Bologna
Lorenzo Brezzi	University of Padua
Domenico Calcaterra	University of Naples Federico II
Giovanna Capparelli	University of Calabria
Francesco Castelli	University of Enna Kore
Chiara Deangeli	Politecnico di Torino
Anna Maria Ferrero	University of Turin
Michele Iervolino	University of Campania Luigi Vanvitelli
Valentina Lentini	University of Enna Kore
Giuseppe Mandrone	University of Turin
Lorenzo Marchi	Consiglio Nazionale delle Ricerche
Maria Rita Migliazza	Politecnico di Torino
Lorella Montrasio	University of Brescia
Maria Nicolina Papa	University of Salerno
Paola Revellino	University of Sannio
Claudio Scavia	Politecnico di Torino
Andrea Segalini	University of Parma
Gessica Umili	University of Turin
Roberto Valentino	University of Parma

Reviewers

The editors thank the following people who peer-reviewed manuscripts submitted to the conference:

Jordan	Aaron	Swiss Federal Institute for Forest, Snow and Landscape Research WSL-Birmensdorf (Switzerland)
Massimo	Arattano	IRPI-Consiglio Nazionale delle Ricerche (Italy)
Monica	Barbero	Politecnico di Torino (Italy)
Marco	Barla	Politecnico di Torino (Italy)
Katy	Barnhart	University of Colorado (USA)
Perry	Bartelt	WSL Institute for Snow and Avalanche Research SLF-Davos (Switzerland)
Matteo	Berti	Università di Bologna (Italy)
Sabrina	Bonetto	Università di Torino (Italy)
Elisabeth	Bowman	The University of Sheffield (UK))
Lorenzo	Brezzi	Univerità di Padova (Italy)
Miguel	Cabrera	Universidad de los Andes (Colombia)
Domenico	Calcaterra	Università degli Studi Napoli Federico II (Italy)
Giovanna	Capparelli	Università della Calabria (Italy)
Francesco	Castelli	Università degli Studi di Enna Kore (Italy)
Sergey	Chernomorets	Lomonosov Moscow State University (Russia)
Clarence	Choi	The University of Hong Kong SAR
Chiara	Colombero	Politecnico di Torino (Italy)
Velio	Coviello	Free University of Bozen-Bolzano (Italy)
Sabatino	Cuomo	Università degli Studi di Salerno (Italy)
Tim	Davies	University of Canterbury (New Zeland)
Tjalling	De Haas	Utrecht University (The Netherlands)
Chiara	Deangeli	Politecnico di Torino (Italy)
Enrico	Foti	Università di Catania (Italy)
Giandomenico	Fubelli	Università di Torino (Italy)
Fabio	Gabrieli	Università di Padova (Italy)
Saoirse Robin	Goodwin	University Grenoble Alpes INRAE (France)
Carlo	Gregorette	Università di Padova (Italy)
Marcel	Hurlimann	UPC Barcelona TECH (Spain)
Michele	Iervolino	Università degli Studi della Campania Luigi Vanvitelli (Italy)
Matthias	Jakob	BGC Engineering Inc-Vancouver (Canada)
Roland	Kaitna	University of Natural Resources and Life Sciences, Vienna (Austria)
Julia	Kowalski	Faculty of Mechanical Engineering-Aachen (Germany)
Laurie Yaine	Kurilla	Università di Torino (Italy)
Giulia	La Porta	Politecnico di Torino (Italy)
Valentina	Lentini	Università degli Studi di Enna Kore (Italy)
Giuseppe	Mandrone	Università di Torino (Italy)
Maddalena	Marchelli	Politecnico di Torino (Italy)
Lorenzo	Marchi	IRPI-Consiglio Nazionale delle Ricerche (Italy)

Emily	Mark	BGC Engineering Inc-Vancouver (Canada)
Brian	Mcardell	Swiss Federal Institute WSL (Switzerland)
Scott	Mcdougall	University of British Columbia (Canada)
Maria Rita	Migliazza	Politecnico di Torino (Italy)
Lorella	Montrasio	Università degli Studi di Parma (Italy)
Maria	Papa	
Nicolina		Università degli Studi di Salerno (Italy)
Andrea	Pasqua	Politecnico di Torino (Italy)
Manolo	Pastor	Universidad Politécnica de Madrid (Spain)
Guillaume	Piton	University Grenoble Alpes INRAE (France)
Mark	Reid	U.S. Geological Survey (USA)
Paola	Revellino	Università degli Studi del Sannio- Benevento (Italy)
Vincent	Richefeu	University Grenoble Alpes (France)
Dieter	Rickenmann	Swiss Federal Research Institute WSL (Switzerland)
Giorgio	Rosatti	Università degli Studi di Trento (Italy)
Paul	Santi	Colorado School of Mines (USA)
Yoshifumi	Satofuka	Ritsumeikan University (Japan)
Claudio	Scavia	Politecnico di Torino (Italy)
Christian	Scheidl	University of Natural Resources and Life Sciences-Vienna (Austria)
Andrea	Segalini	Università degli Studi di Parma (Italy)
Alex	Strouth	BGC Engineering Inc-Vancouver (Canada)
Davide	Tiranti	Regional Agency for Environmental Protection of Piemonte-ARPA Piemonte (Italy)
Gessica	Umili	Università di Torino (Italy)
Roberto	Valentino	Università degli Studi di Parma (Italy)
Davide	Vianello	Università di Torino (Italy)
Hervé	Vicari	WSL Institute for Snow and Avalanche Research SLF (Switzerland)
Chan-Young	Yune	Wonju National University- Gangneung (South Korea)
Gordon	Zhou	University of Chinese Academy of Sciences-Beijing (China)
Daniel	Zugliani	Università degli Studi di Trento (Italy)

Keynote Speakers

Processes and Mechanics

Claudio di Prisco (Italy)

Olivier Pouliquen (France)

Experiments and Modeling

Manuel Pastor (Spain)

Miguel Cabrera (The Netherlands)

Monitoring, Detection and Warning

Fausto Guzzetti (Italy)

Velio Coviello (Italy)

Role of Disturbance

Katy R. Barnhart (USA)

Case Studies and Hazard Assessments

Julia Kowalski (Germany)

Giorgio Rosatti (Italy)

Engineering and Mitigation

Gordon G.D. Zhou (PRC)

Sabatino Cuomo (Italy)

Needs of End Users

Guillaume Piton (France)

Sponsors

The Conference was financially supported by:

BGC Engineering

CSG Centro Servizi di Geoingegneria

Geobrugg

Hortus

IBTP KOSCHUCH E U

Kane Geotech

Officine Maccaferri Italia

Risp

Techfab India Industries

TRUMER Schutzbauten

Table of Contents

Processes and Mechanics

Debris-flow monitoring with high-frequency LiDAR scanners: a new method to infer the internal dynamics of debris flows

Jordan Aaron, Raffaele Spielmann, Brian W. McArdell, Christoph Graf

Analysis of superelevation and debris flow velocities at Illgraben, Switzerland

Amanda Åberg, Jordan Aaron, Tjalling de Haas, Brian McArdell, Jacob Hirschberg

Particle size segregation and diffusion in saturated granular flows: implications for grain sorting in debris flows

Kahlil Fredrick Cui, Gordon G.D. Zhou, Lu Jing, Yunxu Xie, Xueqiang Lu

Factors controlling bed and bank erosion in the Illgraben (CH)

Tjalling de Haas, Brian McArdell, Wiebe Nijland, Amanda Åberg, Jacob Hirschberg, Steven de Jong, Pierre Huguenin

Effects of flow-bed interactions on barrier impact

W. A. Roanga K. De Silva, Haiming Liu, Clarence E. Choi, Charles W. W. Ng

Keynote lecture. Constitutive modelling of phase transitions in granular soils

Claudio di Prisco, Pietro Marvaggio

Numerical investigation of particle dynamic behaviours in geophysical flows considering solid-fluid interaction

Jun Fang, Yifei Cui, Xinyue Li, Hui Tang

Mass exchange between geophysical flows and beds: idealised computational modelling using a Herschel-Bulkley rheology

Saoirse Robin Goodwin, Guillaume Piton, Guillaume Chambon

Critical states observed in triaxial compression tests on volcanic pumice soil related to debris flow in the 2008 Iwate-Miyagi Nairiku Earthquake

Hiroyuki Hashimoto, Itsuki Sato, Reiko Kuwano

Entrainment maps considering hydrological conditions for mass movement runout modelling: application to debris-flow bulking at Pizzo Cengalo

Jacob Hirschberg, Brian W. McArdell, Anna L. Könz, Marc Christen, Peter Molnar, Perry Bartelt

The influence of particle size on the spread distance and angle of friction of granular materials

Chyan-Deng Jan, Litan Dey

Triggering-runout modelling of rainfall-triggered debris flows: a case study in the Campania region, Italy

Giulia La Porta, Francesco Cafaro, Alessandro Leonardi, Marina Pirulli

A robust method to identify the occurrence of a runoff-generated debris flow

Scott W. McCoy, David B. Cavagnaro, Jason W. Kean, Matthew A. Thomas, Donald N. Lindsay

Formation of dry granular fronts and watery tails in debris flows

Xiannan Meng, Chris G. Johnson, John M.N.T. Gray

A dilatant two-phase debris flow model with erosion validated by full-scale field data from the Illgraben test station

Guillaume Meyrat, Perry Bartelt, Brian McArdell

A novel approach to measuring pore fluid sediment concentrations of debris flows in a volcanic torrent

Shusuke Miyata, Michinobu Nonaka, Seiki Kubo, Kenshi Fukunaga, Shohei Ando, Masaharu Fujita

Multi-component avalanches from rock- and ice-falls to potential debris flow transition modelling

Jessica Munch, Perry Bartelt, Marc Christen

Debris flow susceptibility mapping in Colorado Front Range, USA: a comparison of physics-based and data-driven approaches

Te Pei, Tong Qiu

Keynote lecture. Granular flows

Olivier Pouliquen

Effects of debris-flow and bed composition on erosion and entrainment

Lonneke Roelofs, Pauline Colucci, Eise Nota, Tom Flipsen, Tjallingde Haas

Segregation of water and gravel using large ball mill device laid roughness bed

Kazuki Saito, Toshiyuki Horiguchi

Laboratory investigation of the effects of grain size on the dynamics of debris flows: Measurement of pore fluid pressure in an open channel

Yuichi Sakai, Norifumi Hotta

Analysis on the dynamic characteristics of debris flow in Jiangjia Ravine, China

Dongri Song

Inferring spatial variations in velocity profiles and bed geometry of natural debris flows based on discharge estimates from high-frequency 3D LiDAR point clouds; Illgraben, Switzerland

Raffaele Spielmann, Jordan Aaron, Brian W. McArdell

Quantifying lateral bedrock erosion caused during a hyperconcentrated flow in a narrow alpine limestone gorge

Verena Stammberger, Michael Krautblatter

Experimental study on the effects of local sediment accumulation on a debris flow surge in a steep channel

Shoki Takayama, Naoya Hayashi, Fumitoshi Imaizumi

How are fine sediments described in sediment sheet flow?

Taro Uchida, Yuki Nishiguchi, Satoshi Niwa, Takeshi Kubo, Yutaka Gonda, Yoshifumi Satofuka

Measurements of debris flow entrainment and dynamics

Hervé Vicari, Charles W. W. Ng, Steinar Nordal, Vikas Thakur, W. A. Roanga K. De Silva, Haiming Liu, Clarence E. Choi

Effect of Including Sand Component in a Debris Flow on Concentration of Coarser Particle at the Flow Front

Takashi Wada, Hiroto Mushiake, Hiroshi Miwa

Fines-controlled drainage in just-saturated, inertial column collapses

William Webb, Charles Heron, Barbara Turnbull

Simulations of non-stationary flows of dry granular material along an inclined chute

Francesco Zarattini, Fabio Gabrieli

Impact force of post-fire debris flows over erodible bed
Min Zheng, Haiming Liu, Sunil Poudyal, Charles W. W. Ng

Experiments and Modeling

Small-scale study of Debris-Flows Interactions with a Lateral Debris Basin and Crossings: The Manival Torrent case study

Damien Alliau, Guillaume Piton, Guillaume Chambon, Anne-Sophie Drouet, Vincent Koulinski, Damien Kuss, Dominique Laigle, Vincent Mano, Clément Misset, Christophe Peteuil, Sébastien Roux, Pierre Verry

Simulations of the occurrence of runoff-generated debris flows by means of hydrological models in headwater rocky basins

Martino Bernard, Matteo Barbini, Leonardo Battistel, Matteo Berti, Alessandro Simoni, Carlo Gregoret

The Rosetta Stone Project – Integrating experimental results on debris flow mechanics across the scales: next results

Elisabeth T. Bowman, Amanda Fawley, Roland Kaitna, Shuai Li, Brian McArdell, Jim McElwaine, Nicoletta Sanvitale, W. Andrew Take, Lisa Tauskela, Alex Taylor-Noonan, Yuting Zhao

Keynote lecture. The planar setup: a window through the complex interactions in granular flows
Miguel Cabrera, Laura Cote, Santiago Caro

Impact of a dry granular flow against a rigid wall: MPM simulations with a new constitutive approach
Claudio di Prisco, Pietro Marveggio, Irene Redaelli, Matteo Zerbi

Laboratory experiments to analyse the influence of bridge profiles on debris-flow impact forces
Caroline Friedl, Christian Scheidl, Susanna Wernhart, Dirk Proske

faDebrisFOAM validation using field data surveyed in Crucecita (Chile) alluvial fan for the event of 13th May 2017

Alex Garcés, Álvaro González, Aldo Tamburrino, Santiago Montserrat

Hydraulic model test on channel shifting and yielding woody debris on the fan after sediment disaster in the past

Kenji Hashimoto, Haruki Watabe, Hiroshi Kisa, Tomoyuki Hoya, Takahiro Itoh, Yasuharu Watanabe, Ryosuke Akahori

Pilot study to explain runout distances of debris flow and immature debris flow considering depositing rate

Hiroaki Izumiyama, Takao Yamakoshi, Yuya Takahashi, Yuki Nishiguchi, Ryosuke Okuyama

Object impacted and transported by dry granular flow: 3D MPM-SDEM

Wei Ji, Zhengyu Liang, Clarence E. Choi

Numerical Simulation Reflecting Buildings in Area Damaged by Debris flow

Bae-Dong Kang, Kye-Won Jun, Ho-Jin Lee, Chang-Deok Jang, Hang-Il Jo

Evaluation of a method to calculate debris-flow volume based on observations of flow depth

Brian W. McArdell, Jacob Hirschberg, Jordan Aaron, Alexandre Badoux

Influence of approach shape of debris flow on impact load subjected to open Sabo dam under an overturning experiment of open Sabo dam

Yuta Miyahara, Toshiyuki Horiguchi, Yoshiharu Komatsu

Statistical modelling of sediment supply in torrent catchments of the Northern French Alps

Maxime Morel, Guillaume Piton, Damien Kuss, Guillaume Evin, Caroline Le Bouteiller

Coupling Depth-Averaged and 3D numerical models to study debris flow: Saint-Vincent event

Andrea Pasqua, Alessandro Leonardi, Marina Pirulli

Keynote lecture. A general two phase depth integrated model considering pore water pressure and dewatering

Manuel Pastor, Saeid Moussavi Tayyebi, Andrei Hernandez, Lingang Gao, Miguel Martín Stickle, Pedro Navas, Diego Manzanal, Ángel Yagüe, Miguel Molinos

Granular column collapse: the role of particle size polydispersity on the velocity and runout

Oscar Polanía, Nicolás Estrada, Mathieu Renouf, Emilien Azéma, Miguel Cabrera

Chute flows of dry granular media: numerical simulations by a well-posed multilayer model and comparisons with experiments

Luca Sarno, Yongqi Wang, Yih-Chin Tai, Maria Nicolina Papa, Paolo Villani

Testing applicability of image analysis for measurement of sediment concentration in laboratory experiments

Kohei Sato, Taro Uchida

Development of an open source Debris Flow Simulator for "Sabo" (DFSS)

Takeshi Shimizu, Yusuke Yamazaki, Naoki Imamori

Growth of debris flows by soil bed erosion: Effects of frictional and hydrodynamic shear stresses

Pengjia Song, Clarence E. Choi

A simplex multi-phase approach for modelling debris flows in smoothed-terrain-following coordinate system

Yih-Chin Tai, Hock-Kiet Wong, Ching-Yuan Ma

Experiments on and numerical calculations of debris flows passing through narrowed and widened channel regions

Jun'ichiro Takahama, Kouhei Shintani

Shear-thinning, Coulomb friction and grain collisions in debris-flow waterfalls: Applications of a 3D phase mixture model with a single calibration parameter and a complex 4-way coupled resolved CFD-DEM approach

Albrecht von Boetticher, Catherine Berger, Jürg Speerli

Micromechanical simulations of the collapse of a submerged granular column

Francesco Zarattini, Antonio Pol, Fabio Gabrieli, Bruno Chareyre

Mixture theory-based SPH model for submerged landslide

Chengwei Zhu, Chong Peng, Wei Wu

Monitoring, Detection and Warning

A new real-time debris flow and avalanches detection system based on optical fiber sensing

Santina Aiassa, Francesco Antolini, Marco Barla, Alessandra Insana, Roberto Gaudino, Giuseppe Rizzelli Martella, Saverio Pellegrini

Performance of the debris flow alarm system ALMOND-F on the Rochefort Torrent (Val d'Aosta) on August 5, 2022

Massimo Arattano, Marta Chiarle, Velio Coviello, Guido Nigrelli

The July 2015 debris flow in Barsem, Western Pamir (GBAO) Tajikistan: description and causes

Zafar Avzalshoev, Taro Uchimura

Characterization of a debris flow event using an affordable monitoring system

Matteo Berti, Andreas Schimmel, Velio Coviello, Mario Venturelli, Luca Albertelli, Luca Beretta, Francesco Brardinoni, Massimo Ceriani, Marco Pilotti, Roberto Ranzi, Marco Redaelli, Riccardo Scotti, Alessandro Simoni, Laura Turconi, Fabio Luino

A model-based early warning system for runoff-generated debris flow occurrence: preliminary results

Federico Cazorzi, Matteo Barbini, Alberto Beinat, Martino Bernard, Mauro Boreggio, Matteo Cesca, Sara Cucchiaro, Roberta Dainese, Alberto De Luca, Christian Demmler, Carlo Gregoretti, Karl Hagen, Veronika Lechner, Eleonora Maset, Michael Neuhauser, Paolo Nicolosi, Christoph Zingerle

Towards a better understanding of debris flow sediment sources: Monitoring of an active rock slope at Spitze Stei, Switzerland

Małgorzata Chmiel, Lena Husmann, Fabian Walter, Huw Horgan, Giacomo Belli, Emanuele Marchetti, Christian Kienholz

Keynote lecture. Debris-flow detection for early warning purposes: recent advances open problems and future challenges

Velio Coviello

When instrument location makes the difference on rainfall thresholds definition: Lessons learned at Cancia, Dolomites

Stefano Crema, Velio Coviello, Matteo Cesca, Roberta Dainese, Lorenzo Marchi, Alessandro Pasuto, Marco Cavalli

What does landslide triggering rainfall mean?

Richard Guthrie, Thad Wasklewicz, Graham Knibbs, Eric Hertzman, Sanaz Imen, David Bigelow

Keynote lecture. Landslide early warning systems: Resources or problems?

Fausto Guzzetti

Monitoring and modelling of debris-flow erosion in the Rebaixader catchment (Pyrenees Spain)

Marcel Hürlimann, Vicente Medina, Roger Ruiz-Carulla, Laura Molano, Ona Torra, José Moya

Study of debris flow peak discharge at Kamikamihorizawa Creek

Akihiko Ikeda, Takahiro Itoh, Takahisa Mizuyama

Initiation and runout characteristics of partially saturated debris flows in Ohya landslide scar, Japan

Fumitoshi Imaizumi, Shunsuke Oya, Shoki Takayama

Study of debris-flow initiation through the analysis of seismic signals

Elena Ioriatti, Velio Coviello, Matteo Berti, Francesco Comiti

Continuous debris flow monitoring using DFLP and LVP in Sakura-jima Island

Takahiro Itoh, Tadaaki Iwao, Seiki Kubo, Takaya Tsurumoto, Satoshi Tagata, Misa Furuya, Takahisa Mizuyama

Volume, peak discharge and Froude number of debris-flow surges: 10 years of monitoring on the Réal Torrent (France)

Suzanne Lapillonne, Firmin Fontaine, Guillaume Piton, Vincent Richefeu, Frédéric Liébault

Soil water content regression analysis of measurement data from hyperspectral camera in weathered granite soils

Hwan-Hui Lim, Seung-Rae Lee, Enok Cheon, Yeeun Nam

Monitoring debris flows in the Gadria catchment (eastern Italian Alps): Data and insights acquired from 2018 to 2020

Lorenzo Marchi, Velio Coviello, Marco Cavalli, Francesco Comiti, Stefano Crema, Pierpaolo Macconi

A multi-year record of topographic changes on debris-flow fans in south-western British Columbia, Canada

Andrew Mitchell, Sophia Zubrycky, Eimile McSorley, Scott McDougall, Mitch D'Arcy

Long-term monitoring of sediment runoff for an active sediment control in Joganji River

Kenji Miwa, Koso Mikami, Takahiko Nagayama, Tomohiko Furuya, Seiya Hayashi, Masaharu Fujita, Syusuke Miyata, Yoshifumi Satofuka, Takahisa Mizuyama, Kuniaki Miyamoto, Akihiko Ikeda, Takahiro Itoh

Real-time debris flow detection using deep convolutional neural network and Jetson Nano

Minh-Vuong Pham, Chang-Ho Song, Thanh-Nhan Nguyen, Ji-Sung Lee, Yun-Tae Kim

Landslide analysis combining laser scanning and photogrammetry

Pedro Pinto, Juliana Barros, Marisa Pinheiro, Roberto Tomás, Tiago Miranda, Eduardo Pereira

Experimental study of seismo-acoustic frequency and flow velocity of debris flow

Sudhan Regmi, Ko-Fei Liu, Shih-Chao Wei

Bedrock erosion by debris flows at Chalk Cliffs, Colorado, USA: Implications for Bedrock Channel Evolution

Francis Rengers, Jason Kean, Jeffrey Coe, Megan Hanson, Joel Smith

MAMODIS - A low-cost monitoring system for debris flows based on infrasound and seismic signals

Andreas Schimmel, Matteo Berti

Photogrammetrically UAV based terrain data generation and automatic extraction of torrential properties

Gregor Rafael Schmucki, Perry Bartelt, Yves Bühler, Andrin Caviezel, Christoph Graf, Mauro Marty, Andreas Stoffel, Christian Huggel

Pulse-Doppler radar measurements of debris flows: High-resolution monitoring of surge dynamics from two events in the Gadria Creek (Italy)

Tobias Schöffl, Georg Nagl, Johannes Hübl, Roland Kaitna

The RES approach for debris flow susceptibility analysis: a case study

Battista Taboni, Davide Vianello, Federico Vagnon, Anna Maria Ferrero, Sabrina Maria Rita Bonetto

Objective definition of discharge thresholds for post-fire debris flows

Hui Tang, Luke McGuire, Ann Youberg

The territorial debris flow early warning system of Piemonte (North-western Italy)

Davide Tiranti, Paolo Bertolotto, Roberto Cremonini, Armando Riccardo Gaeta, Naima Vela

Seismic measurements of roll waves in debris flows

Fabian Walter, Zhen Zhang, Jordan Aaron, Brian McArdell, Christoph Graf

Debris flow seismo-acoustic wave in a finite layer waveguide

Shih-Chao Wei, Ko-Fei Liu, Sudhan Regmi

Detection of debris-flow events from seismic signals using Benford's law

Qi Zhou, Hui Tang, Jens M. Turowski, Jean Braun, Ci-Jian Yang, Michael Dietze, Sophie Lagarde, Ahmed Abdelwahab, Fabian Walter

Role of Disturbance

Debris-flow activity and sediment dynamics in the landslide-influenced Lattenbach catchment, Austria

Philipp Aigner, Erik Kuschel, Leonard Sklar, Christian Zangerl, Markus Hrachowitz, Tjalling de Haas, Johannes Huebl, Roland Kaitna

Keynote lecture. Forecasting the inundation of postfire debris flows

Katherine R. Barnhart, Ryan P. Jones, David L. George, Francis K. Rengers, Jason W. Kean

The spatial distribution of debris flows in relation to observed rainfall anomalies: insights from the Dolan Fire, California

David B. Cavagnaro, Scott W. McCoy, Matthew A. Thomas, Jaime Kostelnik, Donald N. Lindsay

Study on the relationship between rainfall, topography and landslide volume in the recent debris flow disasters in Hiroshima, Japan

Tomoaki Eguchi, Hiroya Umemura, Mizuho Arai, Atsushi Okamoto, Yusuke Sakai, Taro Uchida, Shinichiro Hayashi, Makoto Ohyama

Rainfall-induced shallow landslides triggered after vegetation removed because of fires: G-XSLIP application to Gioiosa Marea (Sicily, Italy)

Michele Placido Antonio Gatto, Valentina Lentini, Lorella Montrasio, Francesco Castelli

Snowmelt-triggered debris flows in seasonal snowpacks

Benjamin Hatchett, Steven Bacon, W. Tyler Brandt, Anne Heggli, Jeremy Lancaster

Future global debris flow susceptibility considering climate change, wildfire probability, and glacier retreat

Laurie J. Kurilla, Giandomenico Fubelli

Debris flow: Simulating the mitigation properties of vegetation

Alessandro Leonardi, Andrea Pasqua, Luca Flammini, Marina Pirulli

Post-wildfire erosion rates and triggering of debris flows: A case study in Susa Valley (Bussoleno)

Giuseppe Mandrone, Damiano Vacha, Jessica Chicco

Triggering rainfall intensities for post-wildfire debris flows in the Sonoran Desertscrub plant community

Luke McGuire, Ann Youberg, Alexander Gorr, Rebecca Beers

Rheology of hail-debris flow and implications in flow mobility

Santiago Montserrat, Alex Garcés, Jorge Romero, Germán Aguilar, Aldo Tamburrino

Study on debris flow monitoring in Mt. Fuji

Naoki Nishimura, Nobuhiro Usuki, Masaru Touhei, Takahisa Mizuyama, Atsushi Okamoto

Projected effects of climate change on post wildfire debris-flow hazards applied to the 2017 Thomas Fire, California USA

Zane White, Paul Santi

Case Studies and Hazard Assessments

Hydrologic-hydraulic modelling in the Vezza catchment (Alpi Apuane, Italy): An area prone to flash floods and debris flows

Michele Amaddii, Giorgio Rosatti, Daniel Zugliani, Lutz Weirhermuller, Cosimo Brogi, Mehdi Rahmati, Leonardo Disperati, Pier Lorenzo Fantozzi

Debris flow hazard assessment: Laboratory experiences and numerical modelling

Francesco Castelli, Valentina Lentini, Alessandra Di Venti

Rainfall-induced debris flows and shallow landslides in Ribeira Valley, Brazil: main characteristics and inventory mapping

Vivian Cristina Dias, Helen Cristina Dias, Carlos Henrique Grohmann

Constraining post-fire debris-flow volumes in the southwestern United States

Alexander Gorr, Luke McGuire, Ann Youberg

A novel downstream flood hazard grade index incorporating upstream hydrograph characteristics to predict debris flow runoff

Norio Harada, Kana Nakatani, Masamitsu Fujimoto, Yoshifumi Satofuka

Simulating two-phase debris flows in HEC-RAS at Hummingbird Creek, British Columbia, Canada

Kathleen Horita

Reconstruction of debris flow in the Gerkhozhan-Su river valley based on the chain modeling

Viktoriia Iudina (Kurovskaia), Sergey Chernomorets, Inna Krylenko, Tatyana Vinogradova, Eduard Zaporozhchenko

The Emerging widespread debris flow disasters in tropical terrain of peninsular Malaysia:

Understanding the risk and policy intervention

Abd Rasid Jaapar, Mohamad Faruq Syahmi Md Aripin, Ibrahim Komoo, Che Aziz Ali, Zamri Ramli, Abd Rahim Harun, James Bachat, Zakaria Mohamad, Rohayu Che Omar, Khamarrul Azahari Razak, Choun Sian Lim

Definition of rainfall thresholds for shallow landslides in Colombian tropical mountainous catchments as debris flow triggering mechanism

Ricardo Jaramillo-González, Luis Martínez, Edier Aristizábal, Edwin García, Roberto J. Marín

A Study on the comparative analysis of the FLO-2D model according to debris flow sediment amount

Hang-Il Jo, Chang-Deok Jang, Kye-Won Jun, Ho-Jin Lee, Bae-Dong Kang

Impact of climate change on hydro-meteorological trigger conditions for debris flows in Austria

Roland Kaitna, David Prenner, Matt Switanek, Markus Stoffel, Douglas Maraun, Markus Hrachowitz

Proposal of hazard connectivity index for debris flow disaster management

Masato Kobiyama, Alessandro Gustavo Franck

Keynote lecture. Towards reliability-management for debris flow risk assessment

Julia Kowalski, Hu Zhao, Anil Yildiz

Field investigations of sandstone escarpment stability at East Mountain, Utah, USA

Hamid Maleki, Chuck Semborski, Ken Fleck

Morphological characteristics of drainage networks related to landslide cluster in the Colombian Andean

Karolina Naranjo, Edier Aristizábal, Johnnatan Palacio

Integration of meteorology and geomorphology for enhanced understanding of post-fire debris-flow hazards

Nina Oakley, Luke McGuire, Jeremy Lancaster

Topographical criteria for the occurrence of landslides causing debris flows in the 2017 torrential rain in northern Kyushu, Japan

Takehiro Ohta, Kanako Hamamoto, Seiya Eguchi

Anthropogenic gravitational mass movements and the fluvial geomorphological changes: The Vale (2019) and Samarco (2015) tailing dam disasters, Brazil

Jefferson Picanço, Maria José Mesquita, Renato Eugenio de Lima

Modeling the runout behavior of the July 23rd, 2015 Cancia debris-flow event using two numerical models

Zhitian Qiao, Matteo Berti, Wei Shen, Tonglu Li

Satellite-based monitoring of an open-pit mining site using Sentinel-1 advanced radar interferometry: A case study of the December 21, 2020, landslide in Toledo city, Philippines

Ryan Ramirez, Rajiv Eldon Abdullah, Woojae Jang, Shin-Kyu Choi, Tae-Hyuk Kwon

Using integrated growth to delineate debris-flow inundation

Mark E. Reid, Dianne L. Brien, Collin Cronkite-Ratcliff, Jonathan P. Perkins

Keynote lecture. The debris flow event of 29 October 2018 in the Rio Rotiano (Italy) and its challenges for the mathematical and numerical modelling

Giorgio Rosatti, Daniel Zugliani, Luigi Fraccarollo

Extreme precipitation on dry ground in western Norway – characteristics of induced landslides call for adaption of the Norwegian practice in landuse planning

Denise Christina Rüther, Lena Rubensdotter, Heidi Hefre

Rockfalls change the runout and frequency of debris flows at Punta Nera (Eastern Italian Alps)

Alessandro Simoni, Matteo Barbini, Leonardo Battistel, Martino Bernard, Matteo Berti, Osvaldo Cargnel, Pier Paolo Ciuffi, Carlo Gregoretti

Development of debris flow vulnerability curve for data-driven method

Chang-Ho Song, Ji-Sung Lee, Ho-Hong Duy Nguyen, Yong-Soo Ha, Yun-Tae Kim

Quantifying debris-flow hazard and risk based on fan sector

Alex Strouth, Sophia Zubrycky, Scott McDougall

Spatial variation in specific sediment discharge volume from first-order catchment due to heavy rainfall and its factors

Misa Tsushima, Taro Uchida

Debris flows and debris avalanches initiation and runout susceptibility assessment in Campania region (Italy)

Rita Tufano, Davide Mazza, Francesco Maria Guadagno, Pantaleone De Vita, Giacomo Russo, Paola Revellino

Advancing debris flow hazard and risk assessments using debris flow modeling and radar derived rainfall intensity data

Thad Wasklewicz, Richard Guthrie, Graham Knibbs, Rebecca Rossi

Probabilistic prediction method of erosion volume and deposition area from rainfall observation data
Kazuki Yamanoi, Kaori Shikakura, Kenji Kawaike, Satoru Oishi

Bridge obstruction caused by debris flow: A practical procedure for its management in debris-flow simulations
Daniel Zugliani, Atousa Ataieyan, Raffaele Rocco, Nathalie Betemps, Paolo Ropele, Giorgio Rosatti

Engineering and Mitigation

Design of two retention basins along the torrent Liera on the Gares Valley (Dolomites, North East Italy) after the storm Vaia
Matteo Barbini, Martino Bernard, Mauro Boreggio, Fabio Da Re, Carlo Gregoretti

Log crib check dam performance under multiple debris-flow loadings – East Gate Landslide, British Columbia, Canada
Matthias Busslinger, Matthias Jakob, Richard Singer, Ryan Calder

Keynote lecture. Modelling flow-landslides impact against protection structures
Sabatino Cuomo

Application of physical models to improve the mitigation structures of debris flow in a case study
Davood Farshi, Dany Suter

Debris flow mitigation by using biopolymers as a soil stabilizer
Hadi Fatehi, Dominic Ong, Jimmy Yu, Ilhan Chang

Propose of design method on Level II load of open Sabo dam
Toshiyuki Horiguchi, Satoshi Katsuki, Yoshiharu Komatsu

Effect of multiple debris flow countermeasures on flow characteristics and topographic changes through real-scale experiment
Woojae Jang, Beom-Jun Kim, Shin-Kyu Choi, Tae-Hyuk Kwon, Chan-Young Yune

Field investigation and design of debris nets in an environmentally sensitive area
William Kane, Joseph McElhany, Brian Forsthoff

Mitigation strategy for low-frequency large-magnitude debris flows in Hong Kong
Florence Ko, Chris Chan, Hoi-yan Ho, Kevin So

Deciphering controls for the impact of geophysical flows on a flexible barrier: Insights from coupled CFD-DEM modeling
Yong Kong, Mingfu Guan

Analysis of mitigation effect of the open- and closed-type check dam
Seungjun Lee, Hyunuk An, Minseok Kim

Flow-type landslides impacting V-shaped diversions: Physical modelling
Ruoying Li, Clarence E. Choi

Multiple debris-resisting barriers with basal clearance: a study on impact force
Haiming Liu, Clarence E. Choi, Charles W.W. Ng

The Cheekeye debris-flow barrier - unique features of a proposed open check dam in Canada

Emily Mark , Alex Strouth

Spatial distribution of natural debris-flow impact

Georg Nagl, Roland Kaitna, Johannes Hübl

Coupled Eulerian-Lagrangian debris flow model with flexible barrier

Shiyin Sha, Ashley P. Dyson , Gholamreza Kefayati , Ali Tolooiyan

Experimental study on structural behaviour of steel wire mesh under impact loading

Masakazu Sugimoto, Kanako Koizumi, Takeshi Arita, Toshiyuki Horiguchi

Physical model investigation of the transition of a debris flow from the aerial to the water phase

Christian Tognacca, Enea Toschini, Mattia Benagli, Gioele Maddalena

Static and dynamic impact forces on a rigid barrier due to dry debris flow simulated by a DEM-based granular column collapse

Aman Ujjwal, S. Sureka, Govind Kant Mishra, Mousumi Mukherjee, Arindam Dey

Sediment control and logs capturing in sand pocket with combination of sabo dam with large conduit and iron bars

Haruki Watabe, Satoshi Tagata, Tatsuki Yuzawa, Takahiro Itoh

A simplified numerical model for evaluating sediment control by open-type sabo dams in the Joganji River basin

Yusuke Yamazaki, Tomoyuki Noro, Kenji Miwa, Takahisa Mizuyama, Masaharu Fujita, Shusuke Miyata, Akihiko Ikeda, Tomohiko Furuya, Takahiko Nagayama, Takahiro Itoh

Keynote lecture. Impact dynamics of debris flow against slit dam: Experimental and numerical investigation

Gordon G.D. Zhou, Kahlil F.E. Cui, Junhan Du, Nanjun Li, Xueqiang Lu, Yunxu Xie

Needs of End Users

Runout model evaluation based on back-calculation of building damage

Katherine R. Barnhart, Jason W. Kean

MurGame: Protect your village from debris flows!

Catherine Berger, Florian Zimmermann, Ralf Mauerhofer, Marc Christen

A new statistical method to assess debris flow erosion

Gabriele Bertoldi, Tommaso Baggio, Francesco Bettella, Vincenzo D'Agostino

Risk assessment of transport linear infrastructures to debris flow

Francesco Castelli, Enrico Foti, Valentina Lentini, Marina Pirulli

Debris-flow risk-to-life: Upper-bound preliminary screening

Tim Davies, Mark Bloomberg, Dave Palmer, Tom Robinson

Practical guide for debris flow and hillslope debris flow protection nets and its application in case studies

Nadine Feiger, Corinna Wendeler

A CFD-DEM based numerical investigation of debris flow on ballasted railway track

Yufeng Gong, Yu Qian

Tensile stress development and critical behavior of a flexible barrier

Miao Huo, Fucheng Huang, Maojun Yang, Chenjie Jiang

Debris flow hazard mapping along linear infrastructure: An agent based model and GIS approach
Graham Knibbs, Richard Guthrie, Thad Wasklewicz

A time-independent reliability based design approach for debris flow flexible barriers
Maddalena Marchelli, Chiara Deangeli

Keynote lecture. Defining protection works against debris-flow hazards: Industrial standard, tailor-made or haute-couture?
Guillaume Piton

A regional early warning system for summer debris flows
Michel Ponziani, Denise Ponziani, Andrea Giorgi, Hervé Stevenin, Sara Maria Ratto

Modelling of debris-flow deposition: terrain slope, mobility coefficient, and back-calculated basal friction coefficient
Dieter Rickenmann, Christian Scheidl