

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

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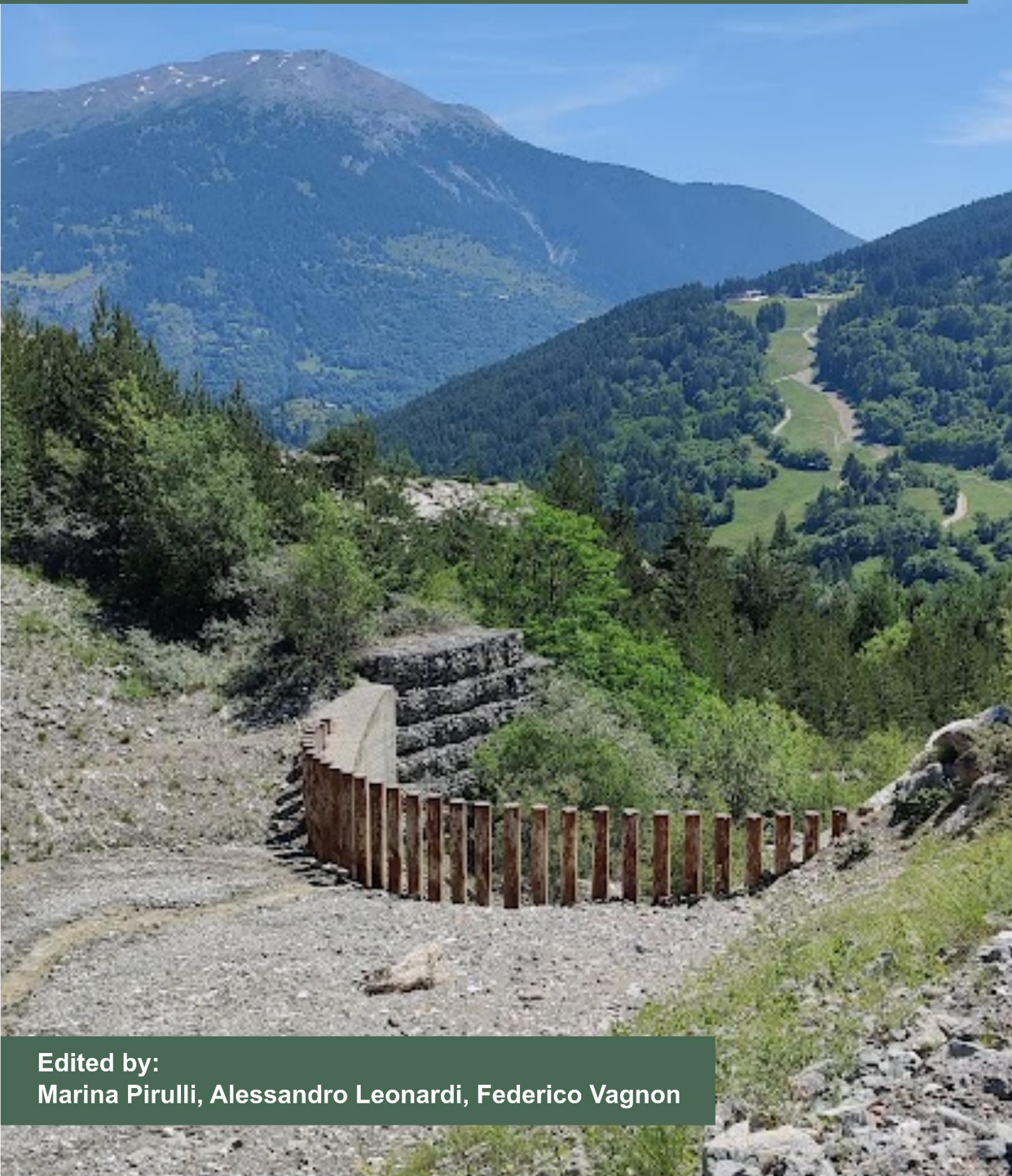
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# DEBRIS FLOW HAZARD MITIGATION

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

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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.

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*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 Ventì*

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*

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*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 23<sup>rd</sup>, 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*

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*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*

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*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*

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*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*

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