Chinese-Russian collaboration in debris flow research in 2008-2012: review of results

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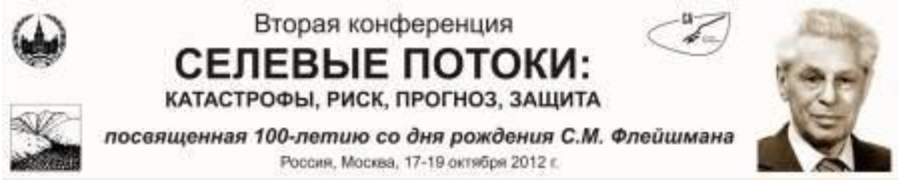
Before

Prof. S. Fleishman (1912-1984), MSU.

Two his books translated to Chinese in IMHE, CAS:

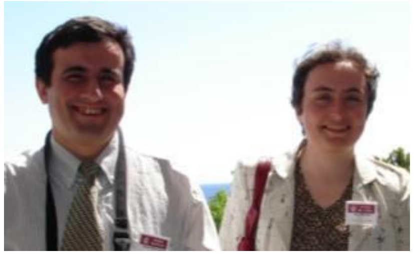
- *Debris Flows and Design of Roads in Areas Affected by Them, 1955*
- *Debris Flows, 1978*

Now we celebrate his 100th anniversary.



Before

Meetings on debris-flow conferences:



- First International Conference on Monitoring, Simulation, Prevention and Remediation of Dense and Debris Flow (Rhodes, Greece, 2006)

- 4th International Conference on Debris-Flow Hazards Mitigation: Mechanics, Prediction, and Assessment (Chengdu, China, 2007), and field trip to Dongchuan Station

Collaboration Agreement

Prepared during the visit of F. Wei and
K. Hu to Moscow in January-February 2008

罗蒙诺索夫莫斯科国立大学地理学系主任
俄罗斯科学院通讯院士

批准。

Nikolay Sergeevich Kasimov
"31" 2008

中国科学院水利部成都山地灾害与环境研究所所长，教授

批准。

"5" Feb 2008

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科学研究合作协议

中国科学院水利部成都山地灾害与环境研究所所长邓伟教授代表中国科学院水利部成都山地灾害与环境研究所（下面简称IMHE）基于研究所的规章，与罗蒙诺索夫莫斯科国立大学地理学系主任、俄罗斯科学院通讯院士Kasimov Nikolay Sergeevich代表罗蒙诺索夫莫斯科国立大学地理学系（下面简称FG MSU）基于系的法规，共同达成以下协议。

1. 协议的目的

本协议的目的是在IMHE和FG MSU间开展合作研究，合作解决双方专家共同关注的重要基础和应用性科学问题。双方主要致力于中国和俄罗斯的泥石流灾害评估、泥石流性质和动力学行为的研究，开展冰川泥石流预测、预警和危险分区的方法研究，研发泥石流、溃决洪水和其他山地灾害的减灾与防护技术。FG MSU在研的与未来研究相关的项目包括"自然和人为灾害过程的分析，评估和建模。IMHE在研的与未来研究相关的研究项目包括"泥石流垂向流速观测和实验研究"，"泥石流预报系统研制"。

2. 双方的义务

2.1. 在本协议中，双方一致表达了下列意向：
2.1.1. 开展与本协议第1部分指定内容相关的野外联合考察、实验研究和学术讨论会。
2.1.2. 在泥石流研究方面举行双方的咨询，研究生和研究人员培训。
2.1.3. 在双方同意的基础上，发表共同合作的出版物。
2.1.4. 交换泥石流的资料和信息，包括在俄罗斯和中国出版的定期科学期刊上发表的论文。
2.1.5. 若未经双方事先同意，IMHE和FG MSU均不得将合作研究期间从对方获得的资料进行出版，分发或转交给第三方。
2.2. 本协议中双方的合作不是商业性活动，也不可从中索求获利并将其在双方中进行分配。

Projects

- Hazard assessment and risk zoning for debris flows in Russia and China (2008-2010)

The project goal is to study evolution of debris flow activity, assess debris flow hazard and risk in stage of modern climate change in different environment in the Central Caucasus (Russia) and in mountains in Southern China. We conducted joint field investigations in Mt.Elbrus area and Mt.Gongga area (Hengduanshan, Sichuan Province) to study glacial debris flows, in Longmenshan Mts. (Sichuan Province) to study rain and barrier lake induced debris flows. We have investigated phenomena of simultaneos formation of debris flows in Longmenshan Mts. after the Wenchuan earthquake and found that a lower precipitation threshold is required to trigger the debris flows. We noticed that mobility of debris flows in this region is significantly lower than in other parts of Southern China and the Caucasus. We conducted surveys and compiled DEMs for key areas in Adyl-su and Gerkhozhan-su valleys in the Central Caucasus, Moxi, Mozigou and Tongkou valleys in China. Bathymetric survey of Tangjiashan barrier lake formed after the Wenchuan earthquake 12.05.2008 was conducted first time. For these areas we obtained data required for further debris flow modeling, hazard assessment and risk zoning. To compare debris flow activity in different environment we have analyzed morphometry of 3 debris flow catchments: Baksan, Chapinghe and Shitingjiang. Shear force-based measurement for internal velocity of debris flow were organized at Dongchuan research station. We continued monitoring of glacial debris flow initiation zones (outburst type – Bashkara lakes, proglacial lakes on Mt. Elbrus slopes, non-outburst type – Gerkhozhan-su) in the Central Caucasus. We have developed a new 3D model for debris flows and slope failures, called DEBRIS (Digital Elementary Balls & Relief Interaction Simulation). Using this software we simulated debris flows in Gerkhozhan-su (Russia) and Moxi (China) valleys, and Yigong landslide in Tibet (China). Possible glacier lake outburst flood in Adyl-su valley (Russia) was simulated using FLO-2D software. Basing on hydrodynamic modeling we obtained flow depth, velocity, area and conducted a hazard assessment for Adyl-su valley. A method for regional forecast of debris flow activity in a region with uniform debris flow formation conditions has been proposed on the basis of the experience of long-term debris flow monitoring. We have compiled results of research of glacio-volcanic and nival-volcanic lahars in Kamchatka peninsula.

Projects

- Mountain disasters assessment and forecast in the region influenced by the Wenchuan earthquake (2008-2009)
- Examination of key parameters for large-scale debris flows induced by earthquakes and volcanism: implications for hazard assessment (2012-2013)
- Bilateral seminar on Debris Flows: Movement Behaviour, Numerical Simulation and Hazard Assessment (2012)

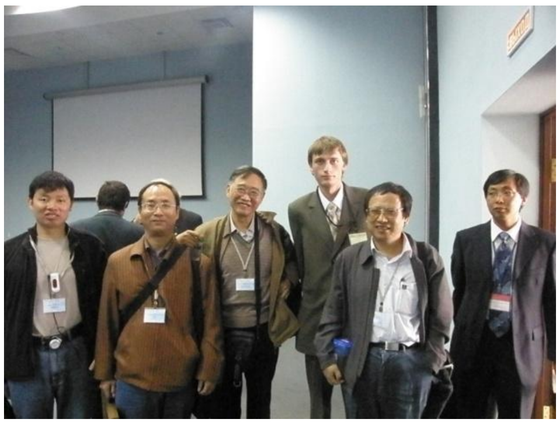
Visits, expeditions, workshops

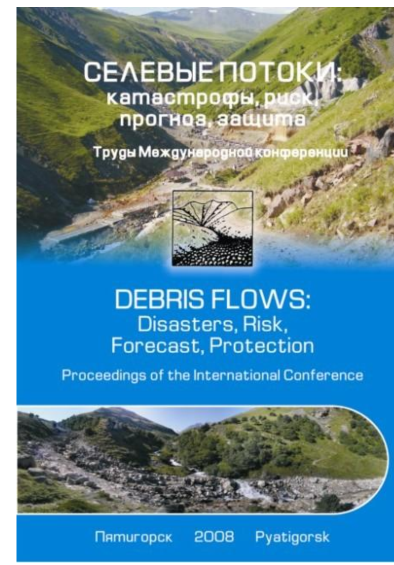
- 2008, Moscow, preparation of agreement, F. Wei and K. Hu
- 2008, Pyatigorsk and Mt. Elbrus (Caucasus), Intl. Conf. on Debris Flows: Disasters, Risk, Forecast, Protection, F. Wei, K. Hu, H. Xie, Y. Zhang, S. Wang
- 2008. Kolka Glacier, Caucasus (expedition), F. Wei and K. Hu
- 2008, Chengdu, Wenchuan earthquake zone and Mt. Gongga, S. Chernomorets, K. Aristov
- 2009, Moscow and Vladimir (workshop), F. Wei and Z. Cheng
- 2009, Chengdu, Beichuan, Yingxiu (fieldwork), S. Chernomorets, A. Petrasov
- 2009, Caucasus (expedition), K. Hu, X. Chen, P. Su, Y. Jiang
- 2010, Moscow (modelling workshop). K. Hu, H. Yang, G. Zhou

Visits, expeditions, workshops

- 2010, Wenchuan earthquake zone (fieldwork), D. Petrakov, I. Seynova, I. Krylenko, V. Mikhailov, V. Kidyaeva
- 2011, Chengdu (preparation of project proposals), S. Chernomorets and D. Petrakov
- 2012, Chengdu and Wenchuan earthquake zone (observation of debris flow control measures), S. Chernomorets and V. Karavaev
- 2012, Dujiangyan (bilateral workshop), S. Chernomorets, D. Petrakov, I. Seynova, I. Krylenko, E. Zaporozhchenko, N. Kazakov

Pyatigorsk: debris flow conference (2008)



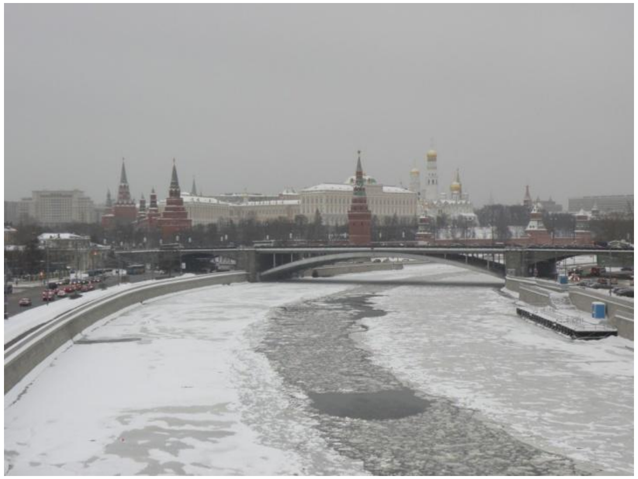


Caucasus: post-conference field trip (2008)

The 2002 Kolka Glacier disaster site, Caucasus (2008)

Fieldwork in Beichuan (2008)

Workshop in Moscow and Vladimir (2009)



Wenchuan earthquake zone (2009)

Wenchuan earthquake zone (2009)

Moxi River basin and Tangjiashan, 2009

Kabardino-Balkariya, Caucasus (2009)

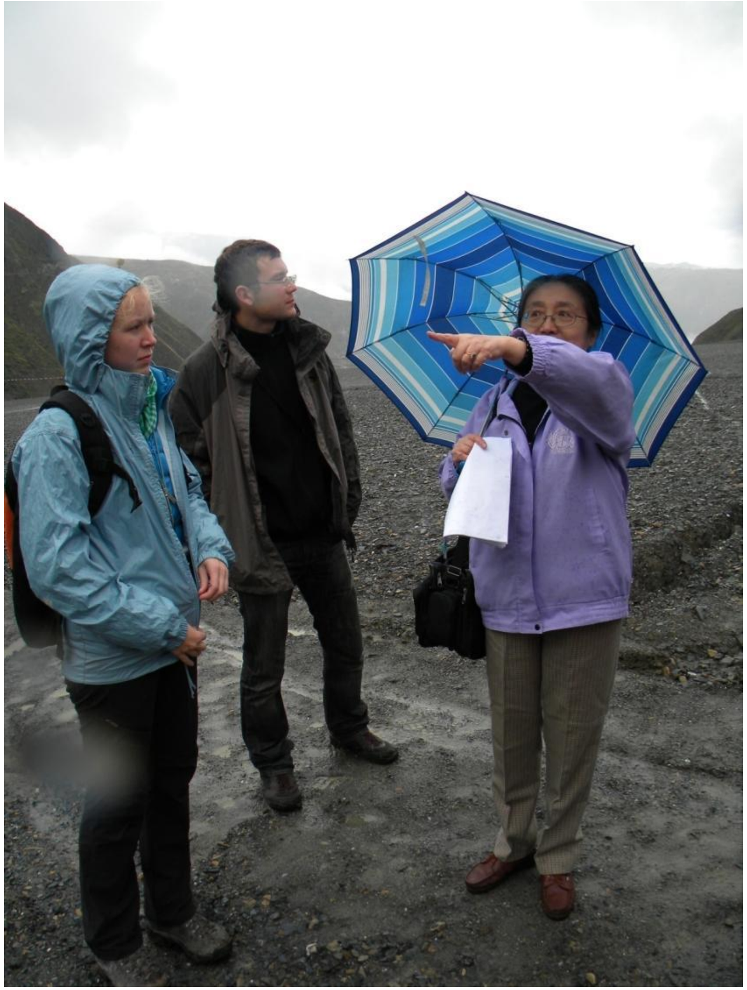
Kabardino-Balkariya, Caucasus (2009)

Gerkhozhan valley, Caucasus (2009)

Moscow University: presentation about 2010 Zhouqu disaster (2010)

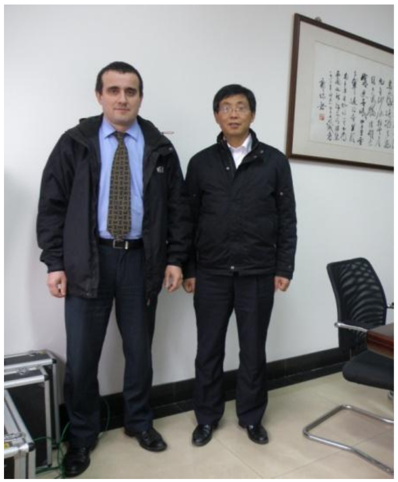
Project meetings in Moscow (2009-2010)

Earthquake zone (2010)



Bathymetry of Tangjiashan Lake (2010)

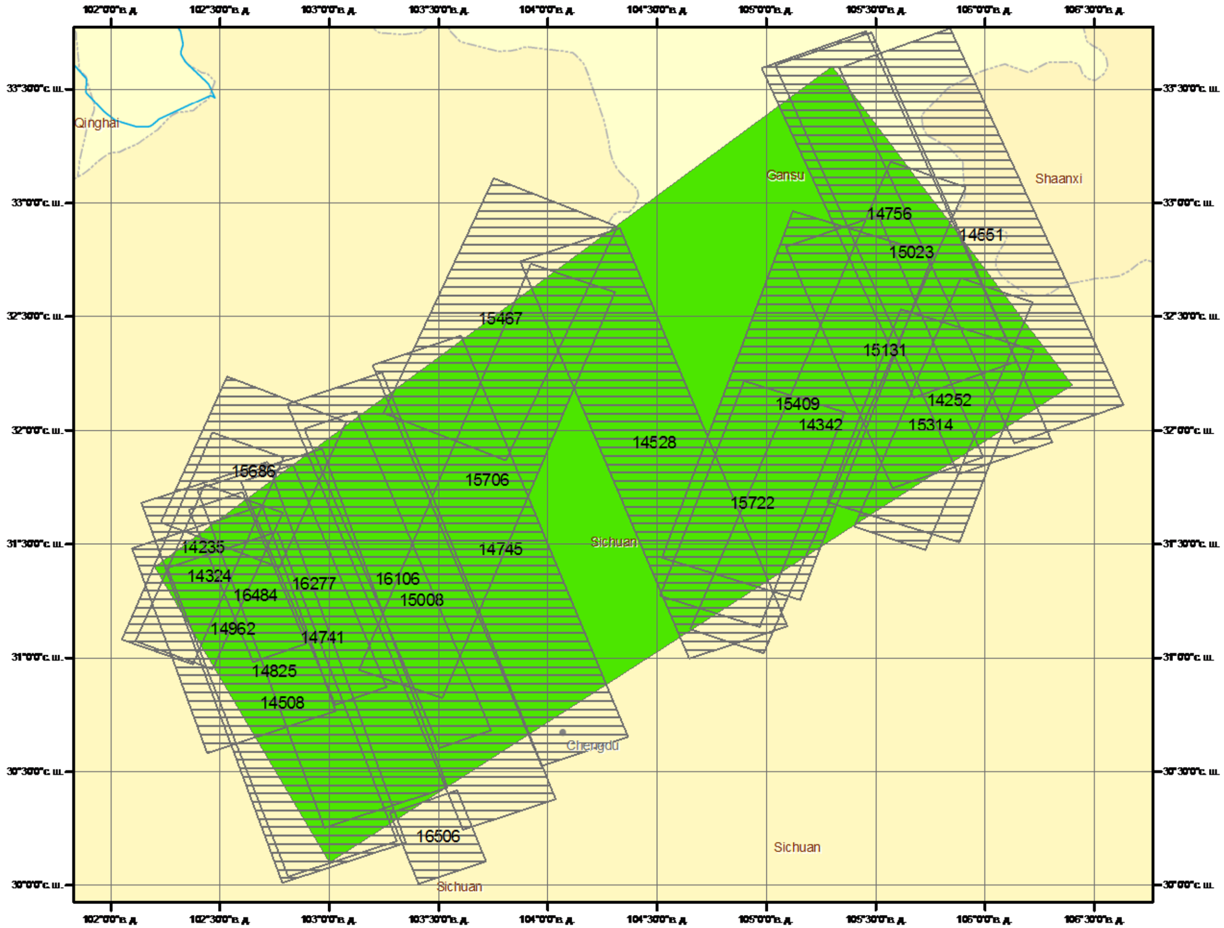
Chengdu and Longxi (2011)



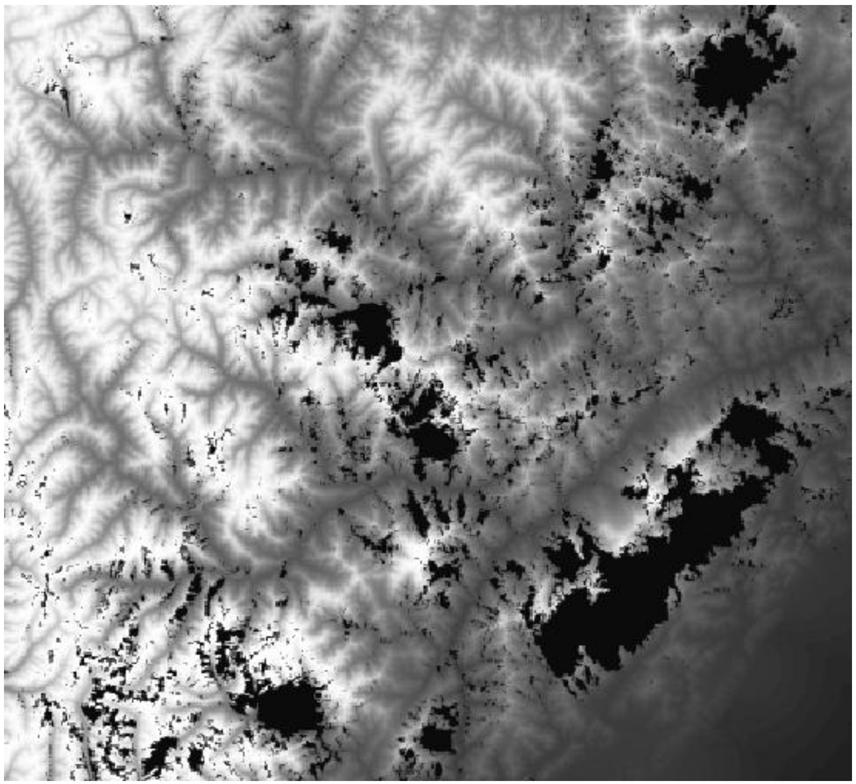
Observation of debris flow control measures in Zhouqu and Qinping (2012)

Selected results

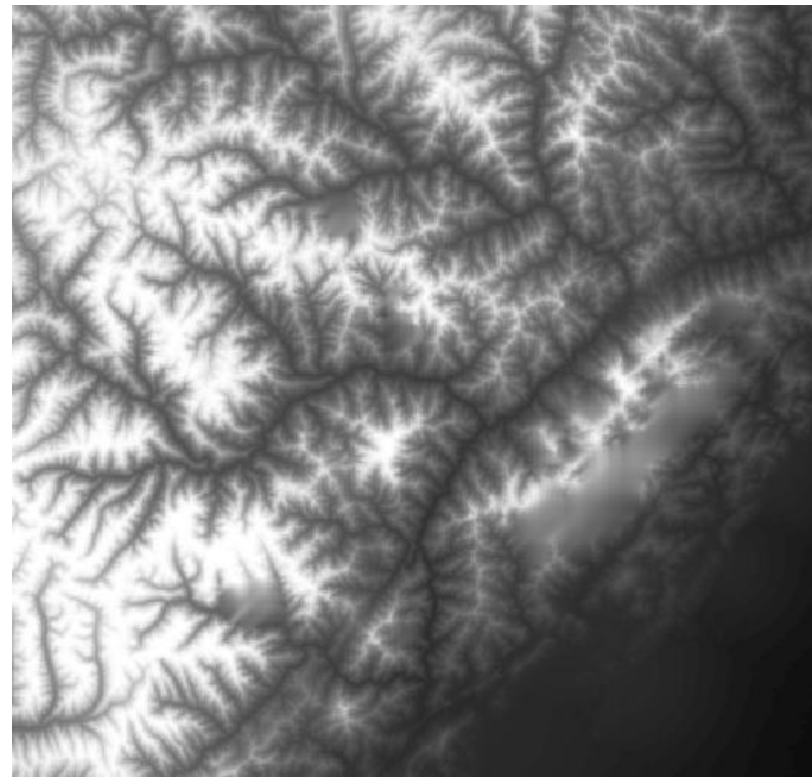
Remote sensing: Resurs-DK satellite survey of Wenchuan earthquake zone



Remote sensing:
patching holes in SRTM DEM



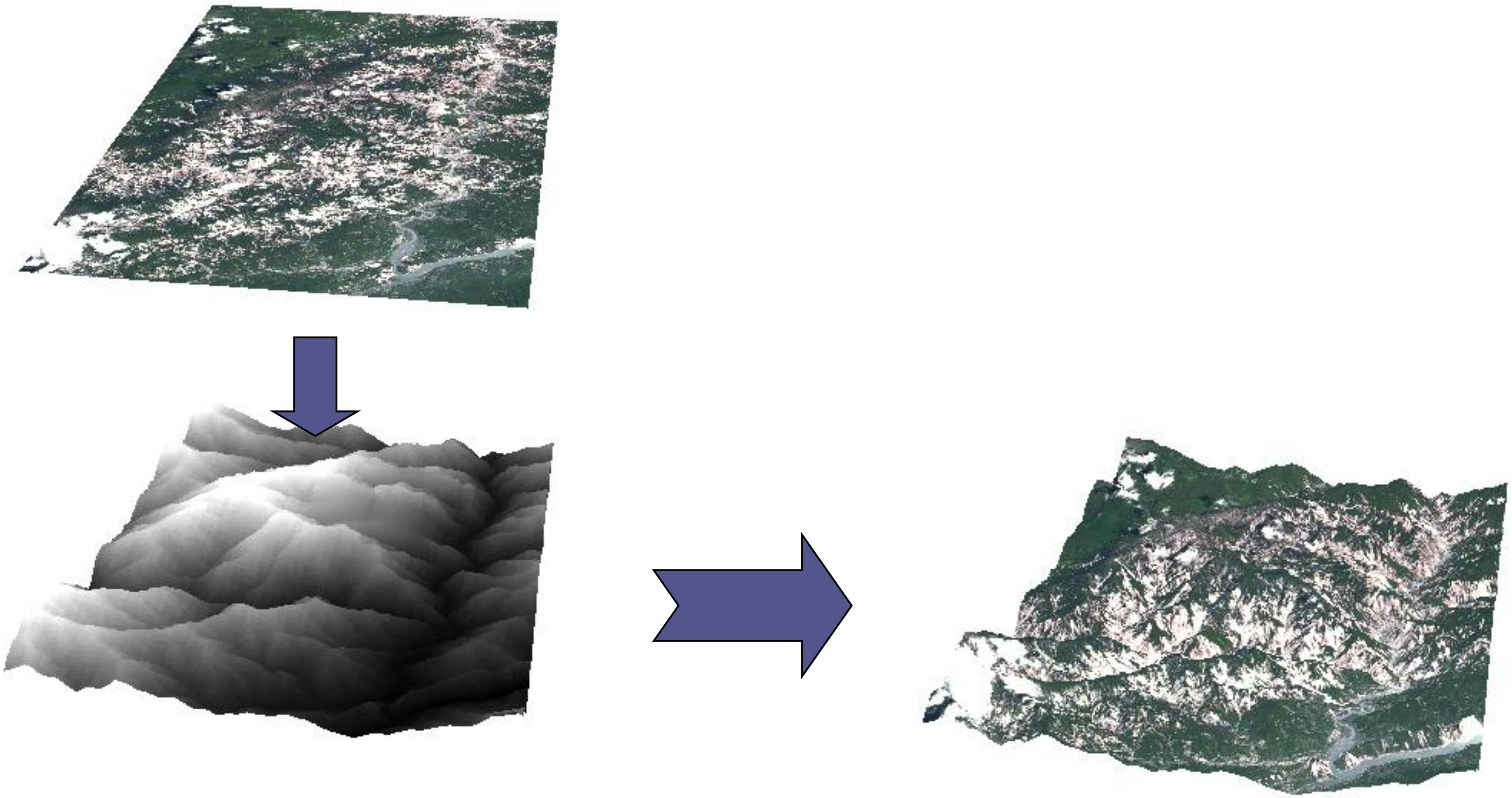
BEFORE



AFTER

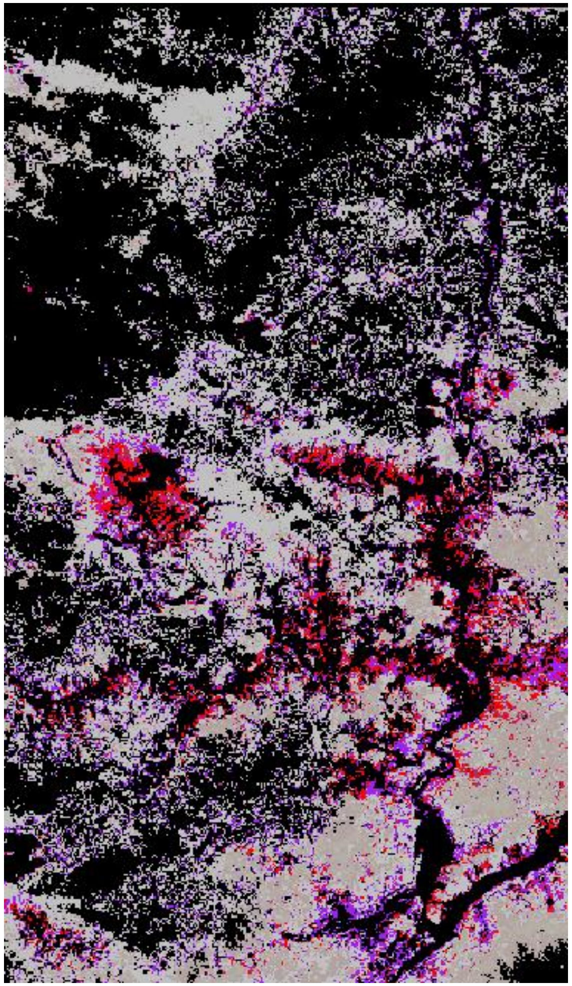
* Executed in 3 DEM (Visualization Software LLC)

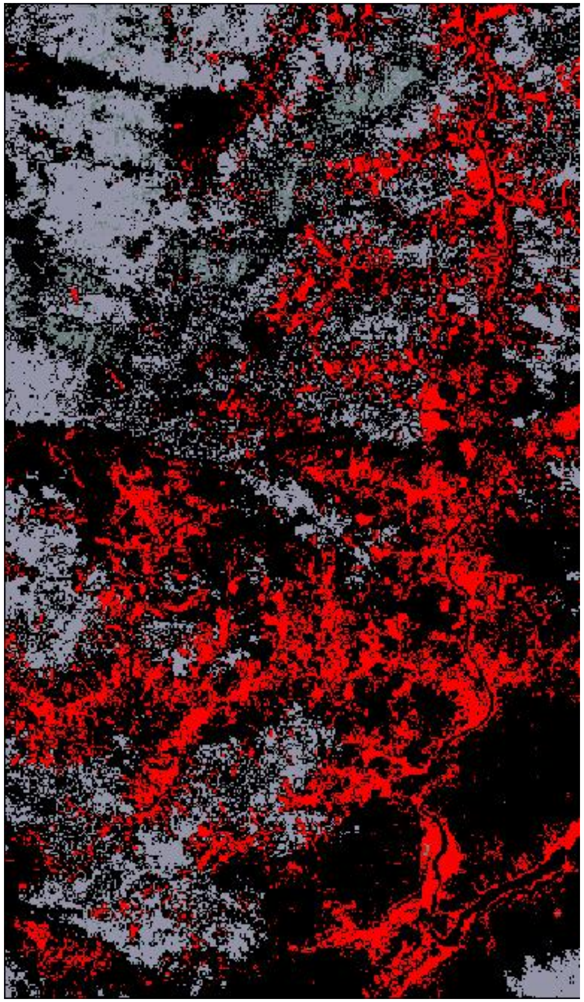
Remote sensing: orthorectification



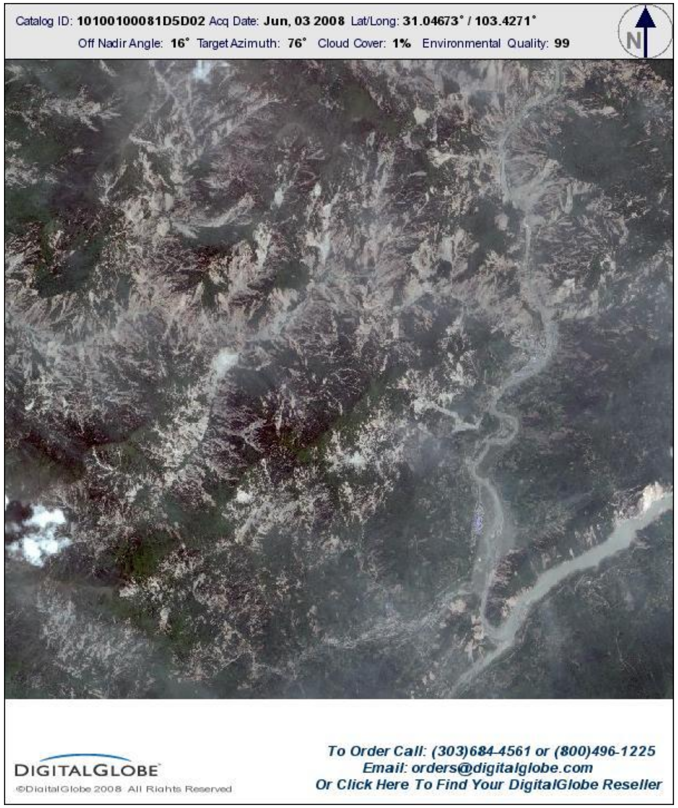
Orthorectification process helps to eliminate terrain distortion

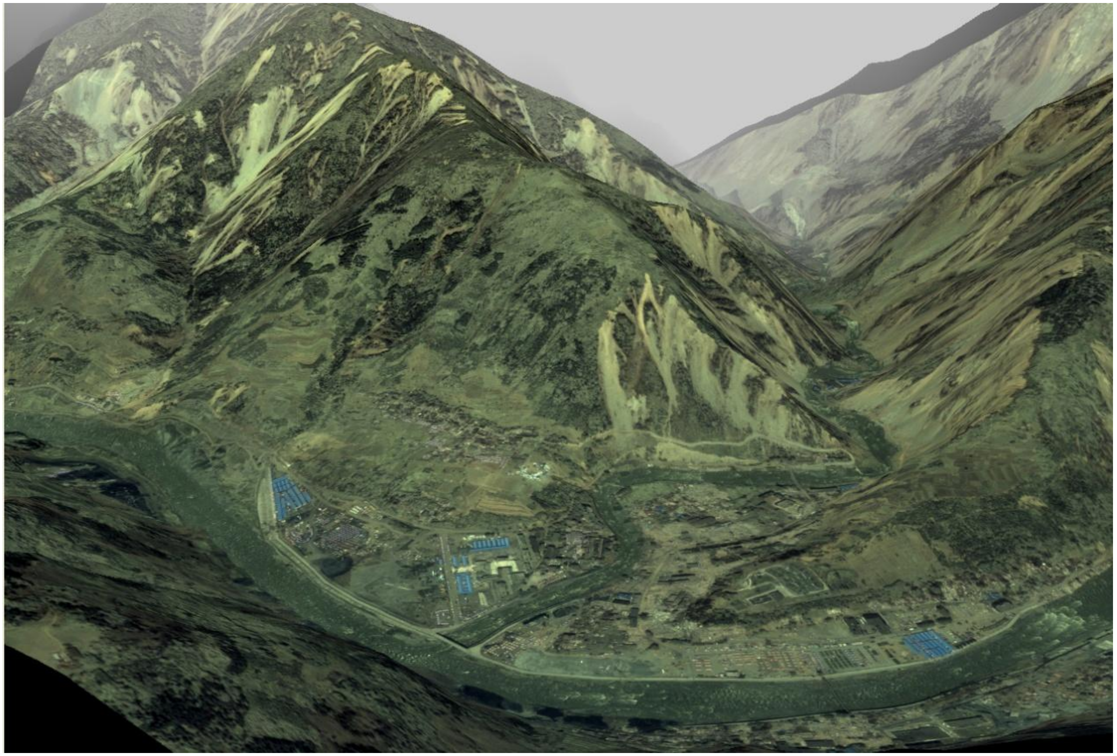
Satellite image interpretation



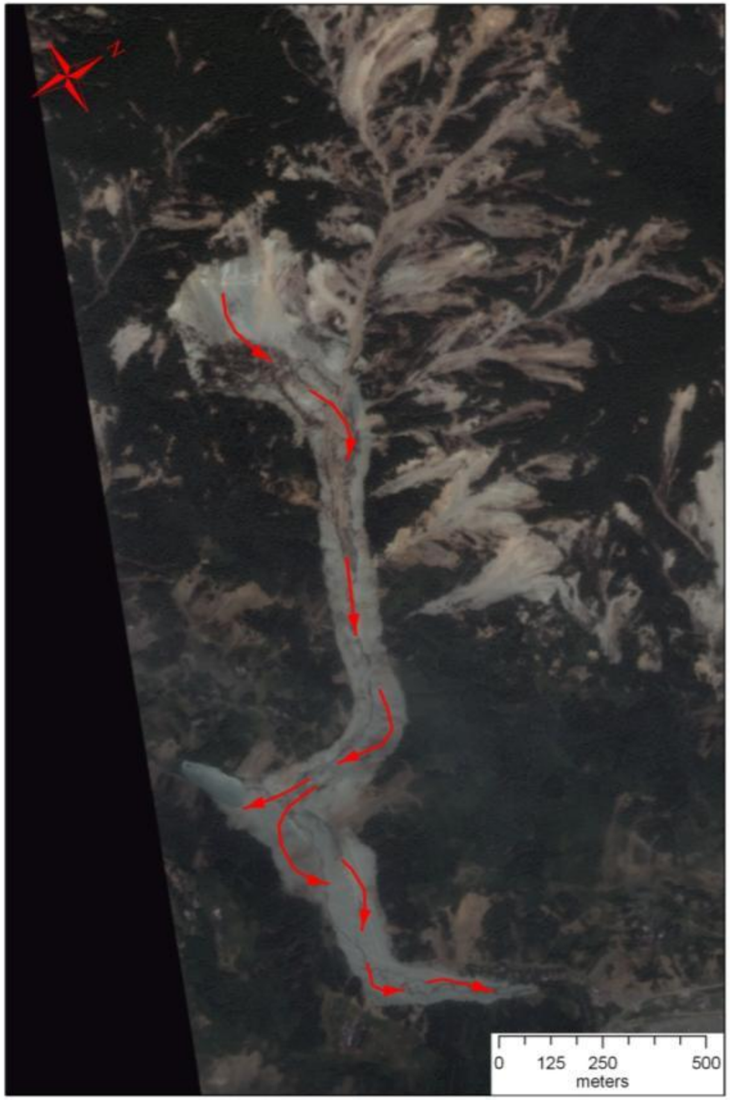


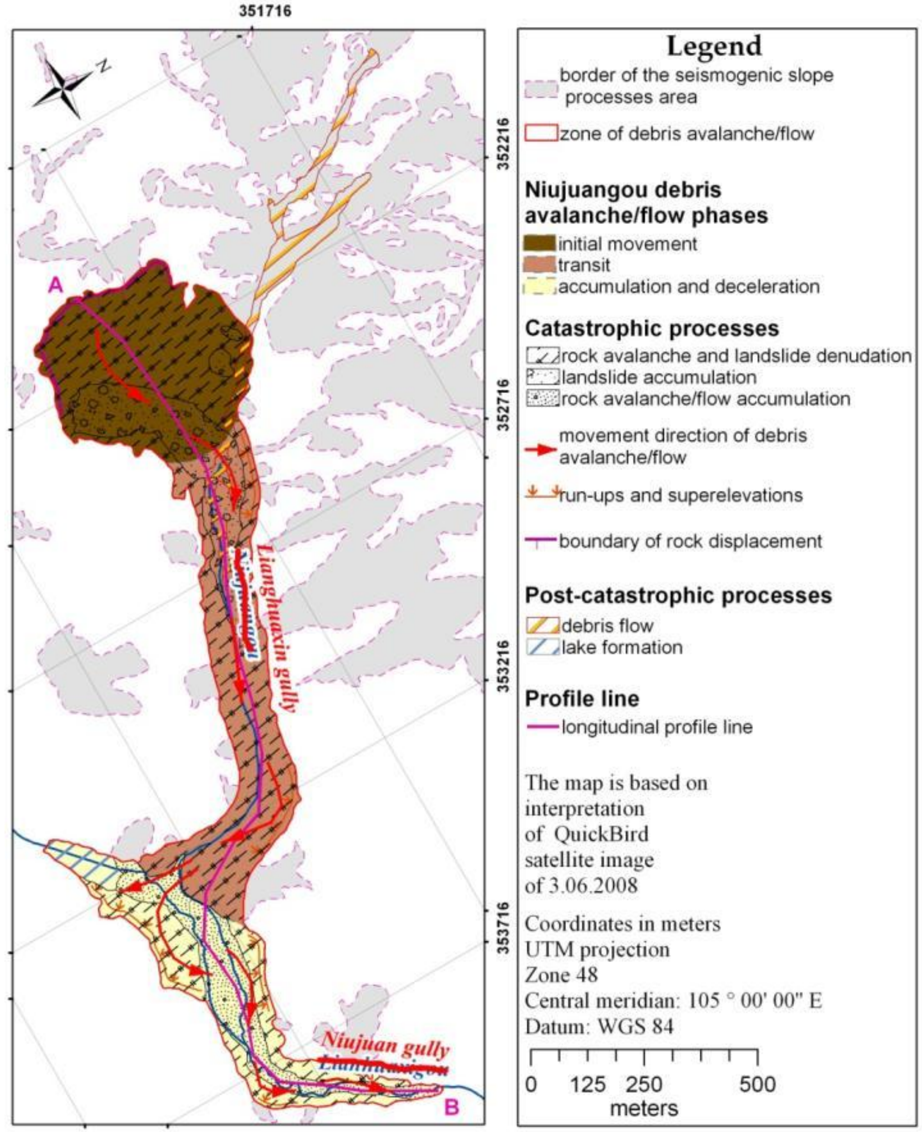
3D modelling



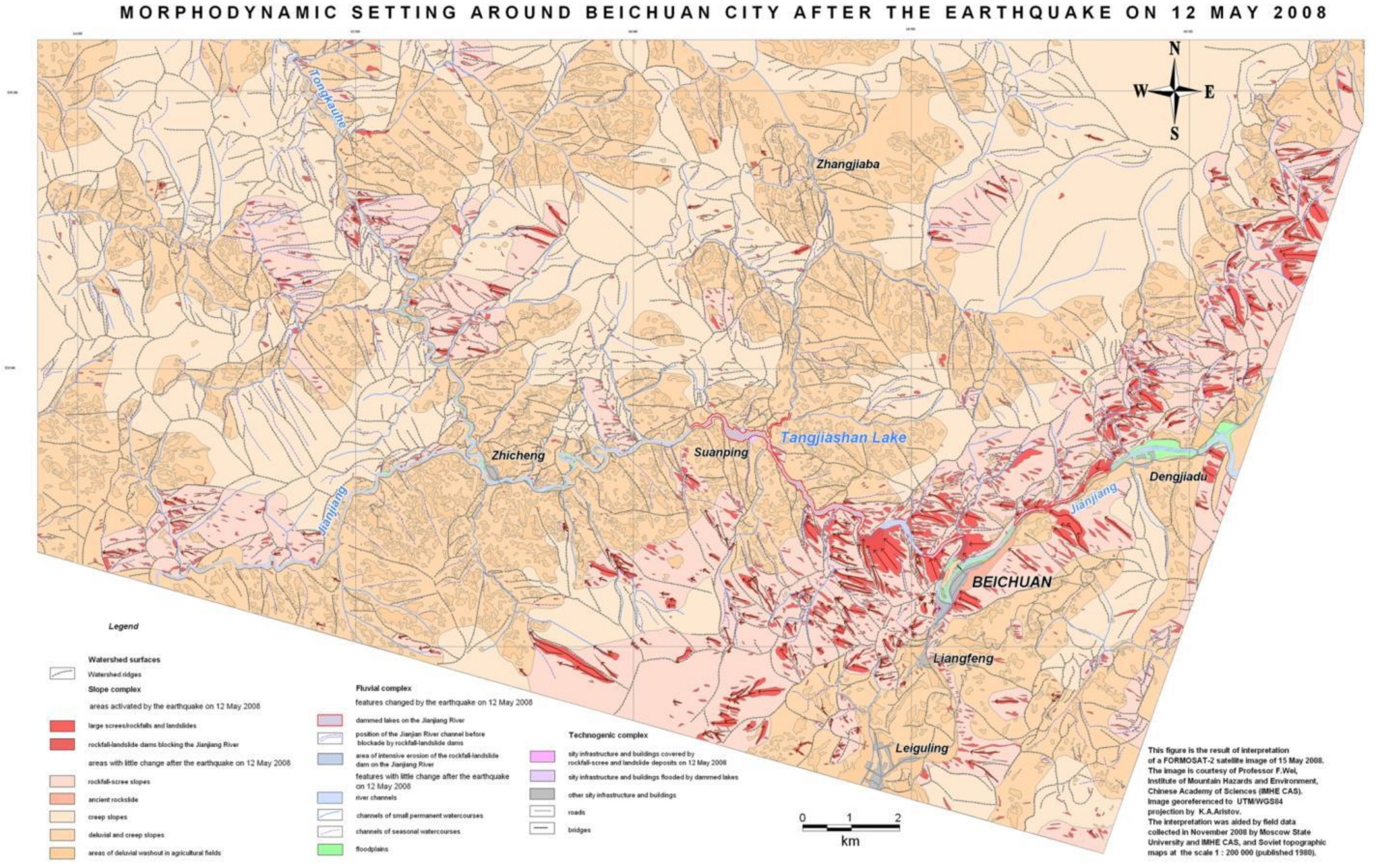


Mapping: Niujuan

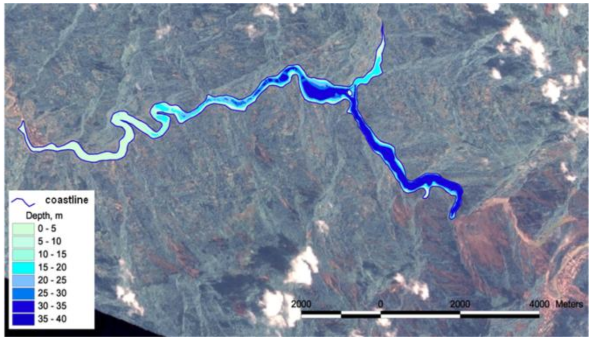




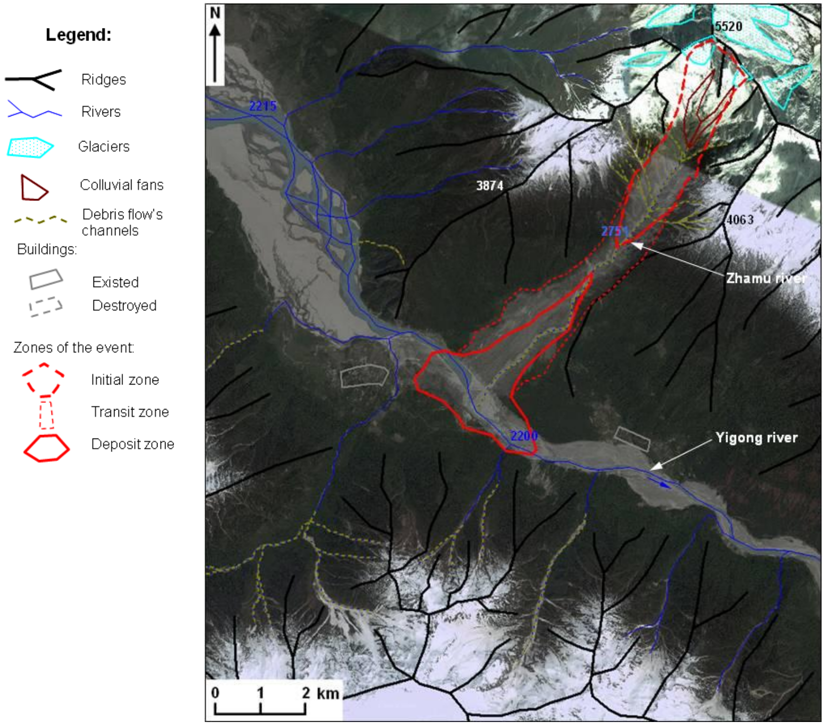
Mapping: Beichuan



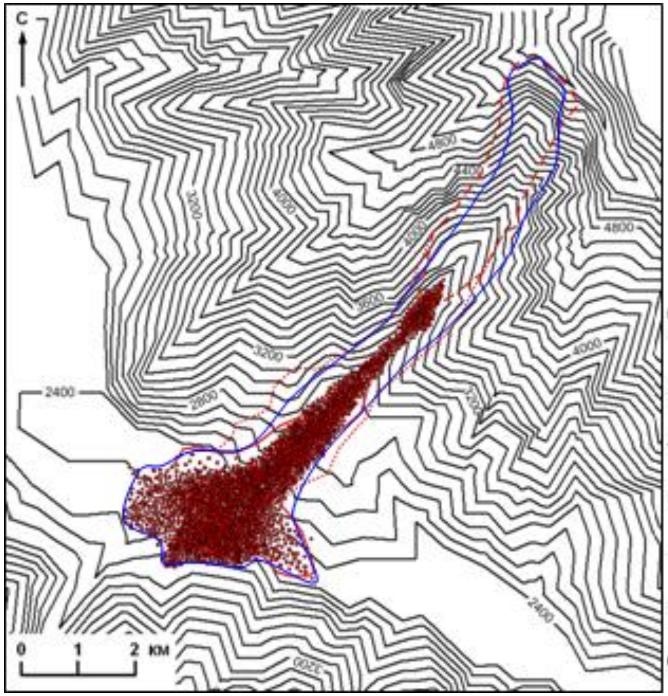
Tangjiashan Lake: bathymetry and potential outburst modelling

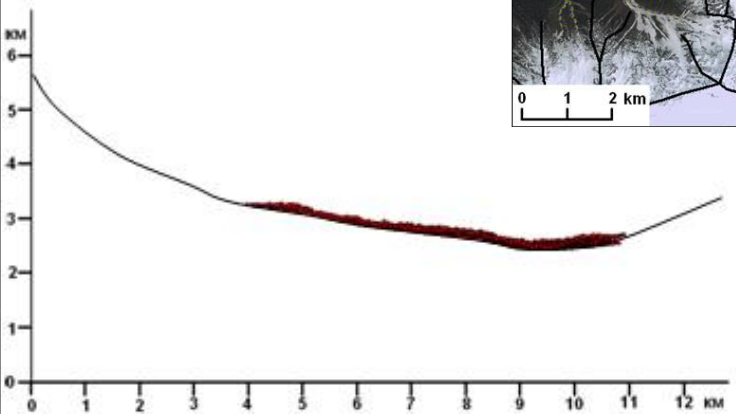


Numerical modelling: Yigong landslide

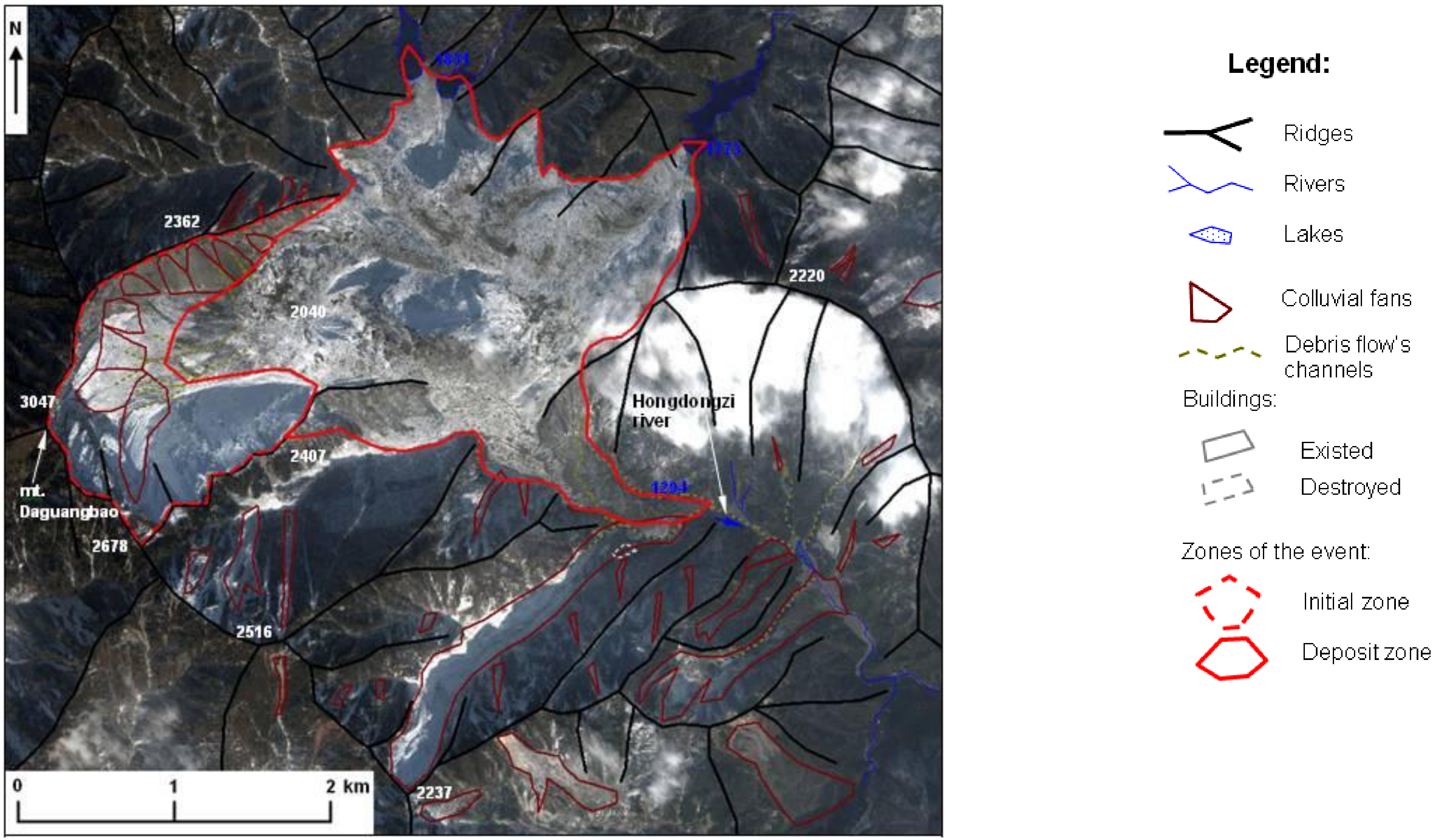


T = 150 s
Deposition

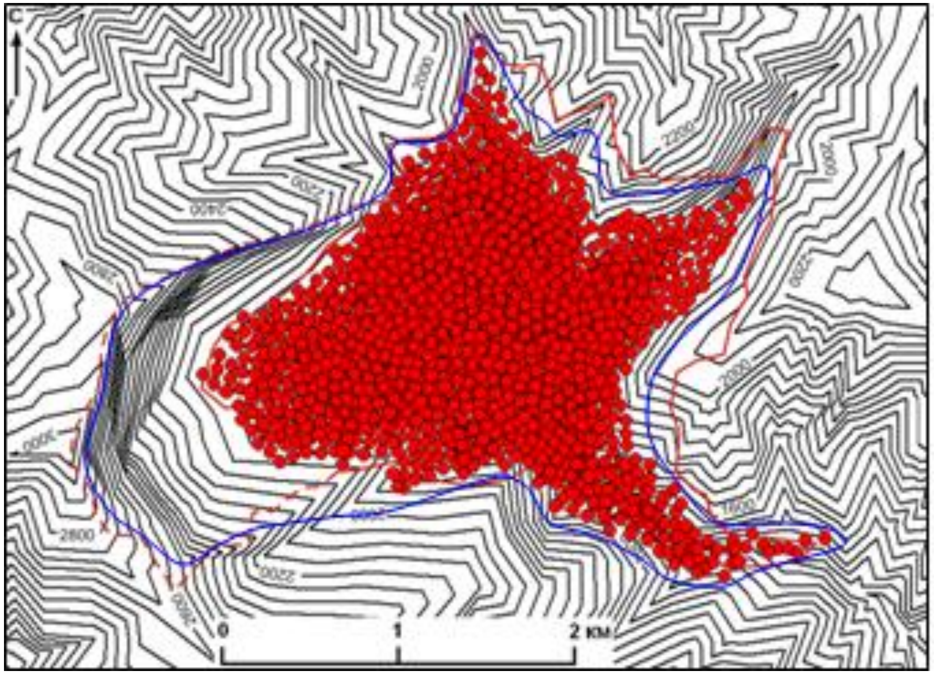


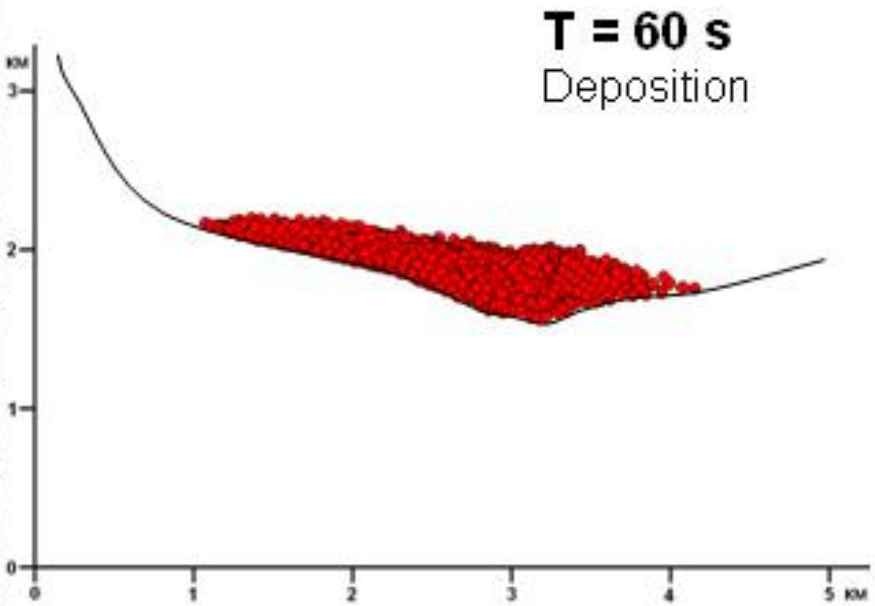


Map of the Daguangbao landslide



Simulation of the Daguangbao landslide





Particle (landslide) parameters: radius R=20 m, density ρ=2500 kg/m³, elasticity Young's module E=40 GPa, dry friction coefficient μ=0.17, viscous friction coefficient η=0 kPa·s²

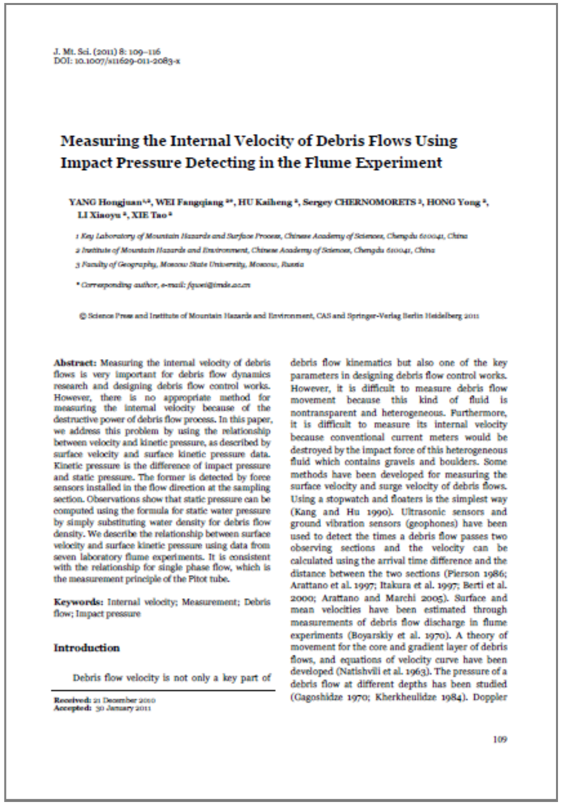
Publications


Journal of Earth Science, Vol. 21, No. 6, p. 901–909, December 2010
Printed in China
DOI: 10.1007/s12583-010-0143-8
ISSN 1674-487X

A Seismically Triggered Landslide in the Niujuan Valley near the Epicenter of the 2008 Wenchuan Earthquake


Journal of Earth Science, Vol. 23, No. 3, p. 373–380, June 2012
Printed in China
DOI: 10.1007/s12583-012-0258-1
ISSN 1674-487X

Measuring Internal Velocity of Debris Flows by Temporally Correlated Shear Forces


J. Mt. Sci. (2011) 8: 109–116
DOI: 10.1007/s11629-011-2083-x

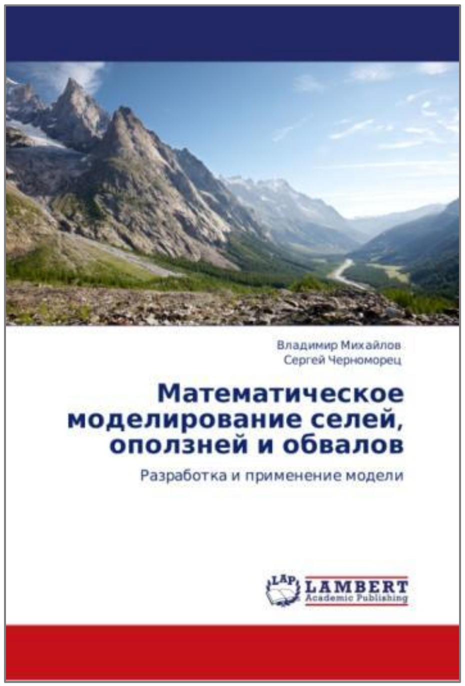
Measuring the Internal Velocity of Debris Flows Using Impact Pressure Detecting in the Flume Experiment

Wei F., Yang H., Hu K., Chernomorets S. Measuring internal velocity of debris flows by temporally correlated shear forces. // Journal of Earth Science, 2012, Vol. 23, No. 3, p. 373-380. DOI: 10.1007/s12583-012-0258-1

Wei F., Chernomorets S., Aristov K., Petrakov D., Tutubalina O., P. Su, Y. Jiang, Xu A., Petrasov A. A seismically triggered landslide in the Niujuan valley near the epicenter of the 2008 Wenchuan earthquake. - Journal of Earth Science, 2010, Vol. 21, No. 6, p. 901-909. DOI: 10.1007/s12583-010-0143-8

Yang H., Wei F., Hu K., Chernomorets S., Hong Y., Li X., Xie T. Measuring the internal velocity of debris flows using impact pressure detecting in the flume experiment. // Journal of Mountain Science, 2011, Vol. 8, No. 2, p. 109-116. DOI: 10.1007/s11629-011-2083-x

Publications (in Russian)




ГеоРиск

Численное моделирование катастрофических селей, обвалов и оползней с применением трехмерной дискретной модели

Numerical modeling of catastrophic debris flows, rock avalanches and landslides using a discrete three-dimensional model

Михайлов В.О., Черноморец С.С. Математическое моделирование селей, обвалов и оползней. 2011. LAP Lambert, 131 с. ISBN 978-3-8465-5660-3

Черноморец С.С., Михайлов В.О. Численное моделирование катастрофических селей, обвалов и оползней с применением трехмерной дискретной модели. // ГеорИск, №1, 2012, с. 16-27.

Perspectives

- Study of volcano-induced debris flows in Kamchatka, Russia

- Study of glacial hazards in Tibet, China

Thank you for your attention!

We used information and materials prepared by all project participants.