



M.V.Lomonosov Moscow State University,
Faculty of Geography,

University Centre for Engineering
Geodynamics and Monitoring



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Moscow, Russia



Initiation zones of debris flows and glacial disasters:

research experience of Moscow University

Regional Climate Risk Resilience Workshop on "Fostering Resilience to Remote Geo-Hazards"

Dushanbe, Tajikistan, 2 June 2010

Kulob, Tajikistan



Image: <http://www.president.tj>

Debris flow disaster, 7 May 2010



Image: <http://rugzor.tj>

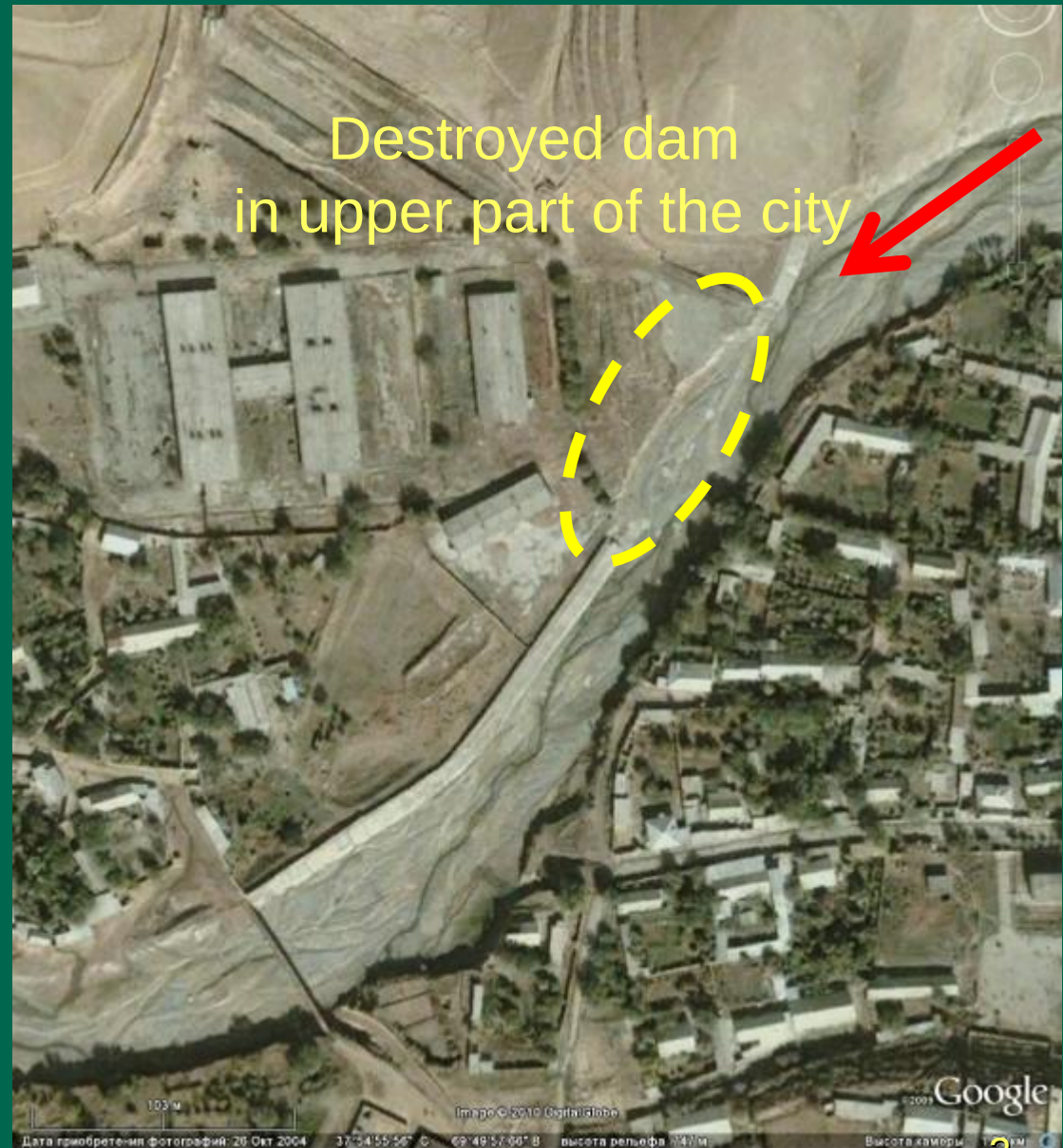
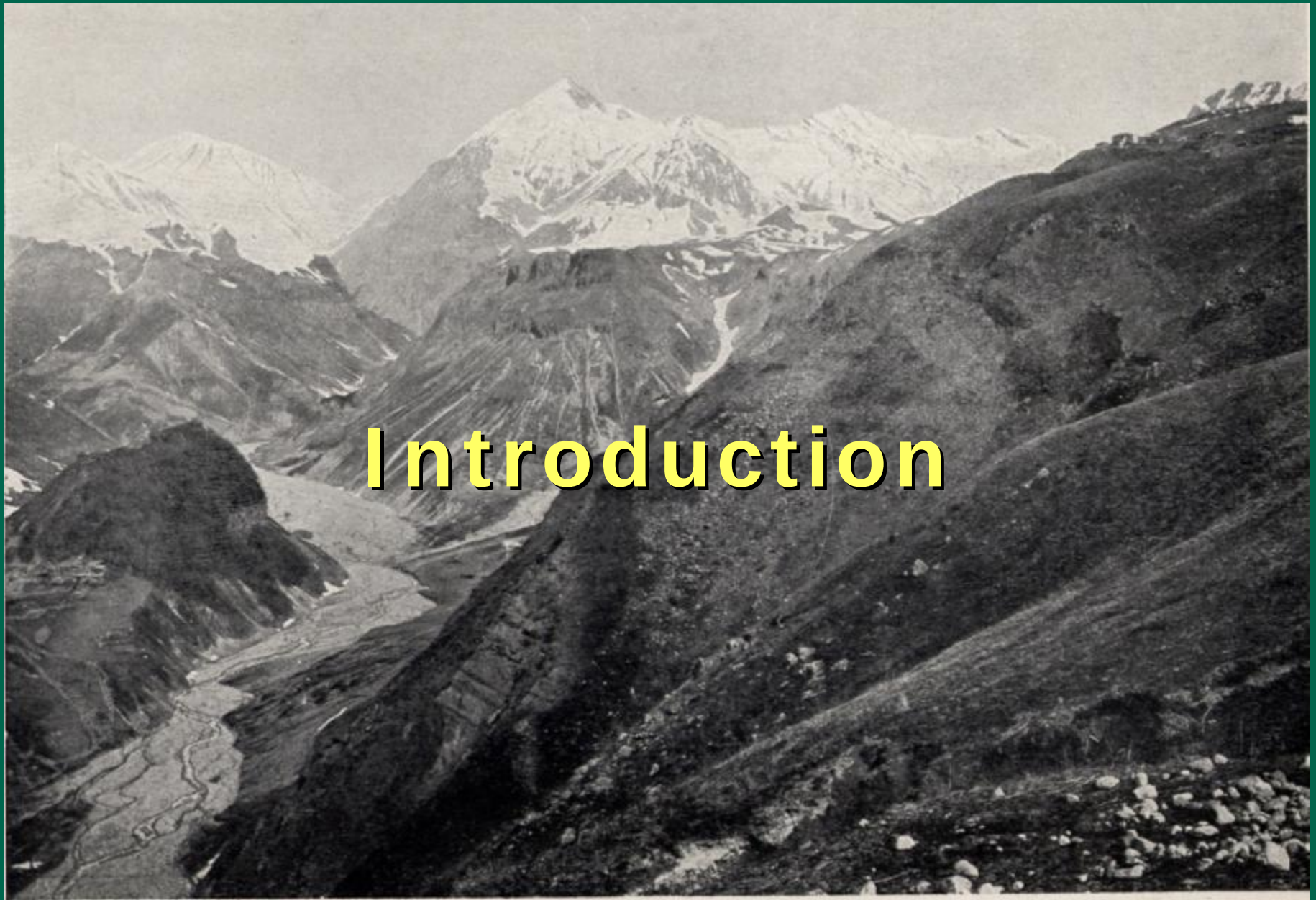


Image: Google, 26.10.2004



Introduction

M.V. Lomonosov Moscow State University (MSU)

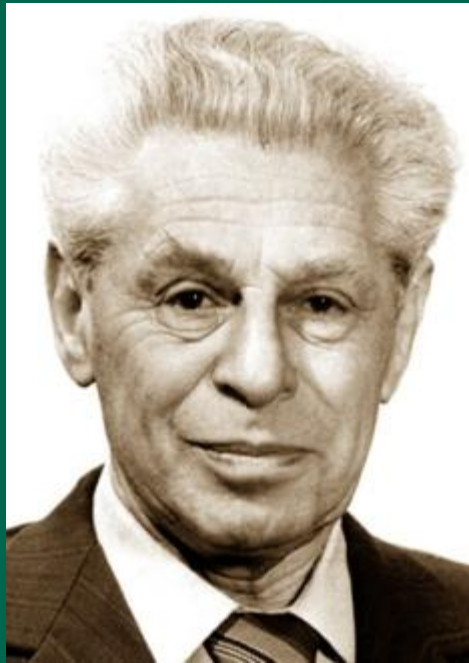


Founded in 1755



MSU, Faculty of Geography,

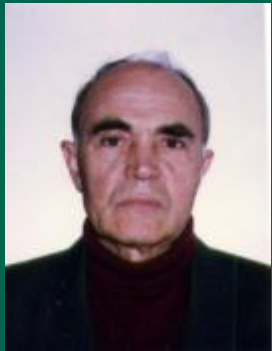
Laboratory of Snow Avalanches and Debris Flows (founded in 1964)



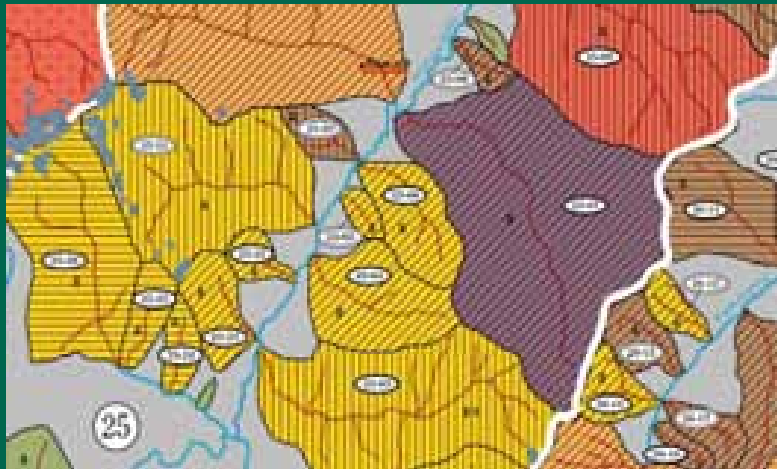
Semen Fleishman (1912-1984)
First Head of the Debris Flow Division in Laboratory

MSU, Faculty of Geography,

Laboratory of Snow Avalanches and Debris Flows



Veniamin Perov
Second Head of the
Debris Flow Division
in Laboratory



Part of the 1:200,000 scale map of Northern Caucasus debris-flow basins for the territory of Dagestan Republic, Andiyskoe Koisu river (Perov et al., 2007)



Laboratory staff in 1970s

Research team

Institutions

Moscow State University Faculty of Geography

- Laboratory of Snow Avalanches and Debris Flows
Glacial and Debris Flow Disasters Research Expedition
- Department of Cryolithology & Glaciology
- Department of Cartography and Geoinformatics
Laboratory of Aerospace Methods



University Centre for Engineering Geodynamics and Monitoring





Sergey Chernomorets,
Ph. D., geomorphologist



Olga Tutubalina, Ph.D., cartographer
and remote sensing expert



Dmitry Petrakov, Ph.D.,
glaciologist



Irina Seynova, Ph. D., hydrologist
and lichenometry expert



Inna Krylenko, Ph.D., hydrologist
and modelling expert



Ivan Krylenko, hydrologist



Alexandr Aleynikov, Ph.D.,
glaciologist and photogrammetrist



Vladimir Mikhailov,
M.Sc., modelling expert



Aleksey Petrasov,
PhD. Student,
geomorphologist



Marina Shakhmina, Ph.D. Student,
cartographer

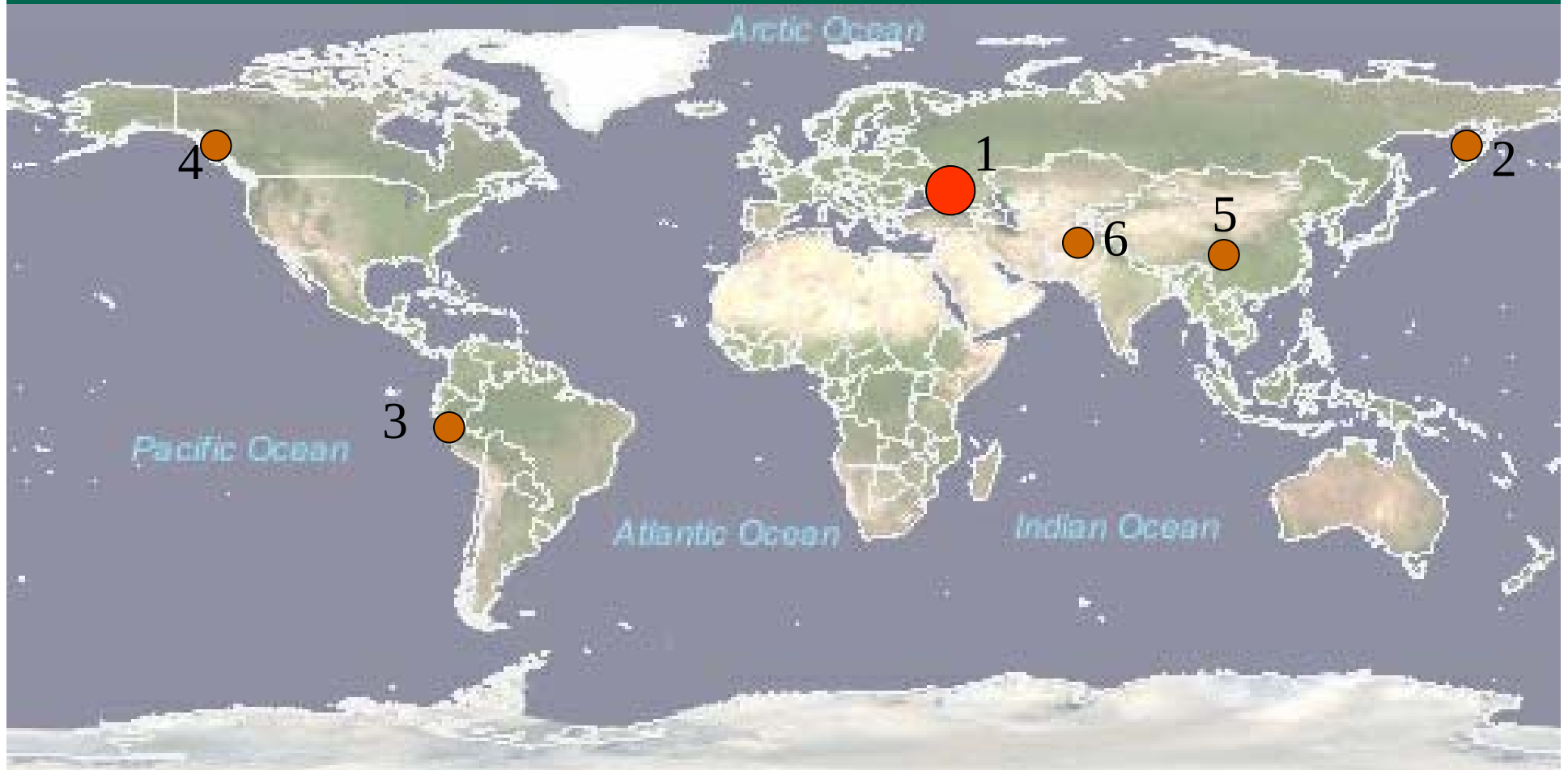


Vera Kidyaeva,
M.Sc., hydrologist



Konstantin Aristov,
M.Sc., cartographer

- Areas of detailed research
- Expeditions



1 - Caucasus (Russia & Georgia), 1964-present
2 – Kamchatka (Russia), 2008
3 - Cordillera Blanca (Peru), 2007

4 - St. Elias Mts (Canada), 2008
5 - Sichuan Province (China), 2008-present
6 - Tajikistan, 2009

A photograph showing a person's hand holding a large, dark, clumpy mass of soil or sediment. The hand is positioned on the left side of the frame, with the fingers gripping the material. The background is a dark, textured surface, possibly a wall or a large piece of fabric. The word "Methods" is overlaid in the center of the image in a bold, yellow, sans-serif font.

Methods

Field investigations



Photo: Olga Tutubalina, Sergey Chernomorets

Geodetic surveys



Photo: Sergey Chernomorets

Dendrochronology



Photo: Olga Tutubalina

Field geotechnical analysis



Photo: Sergey Chernomorets

Geophysical research (jointly with University of Oslo)

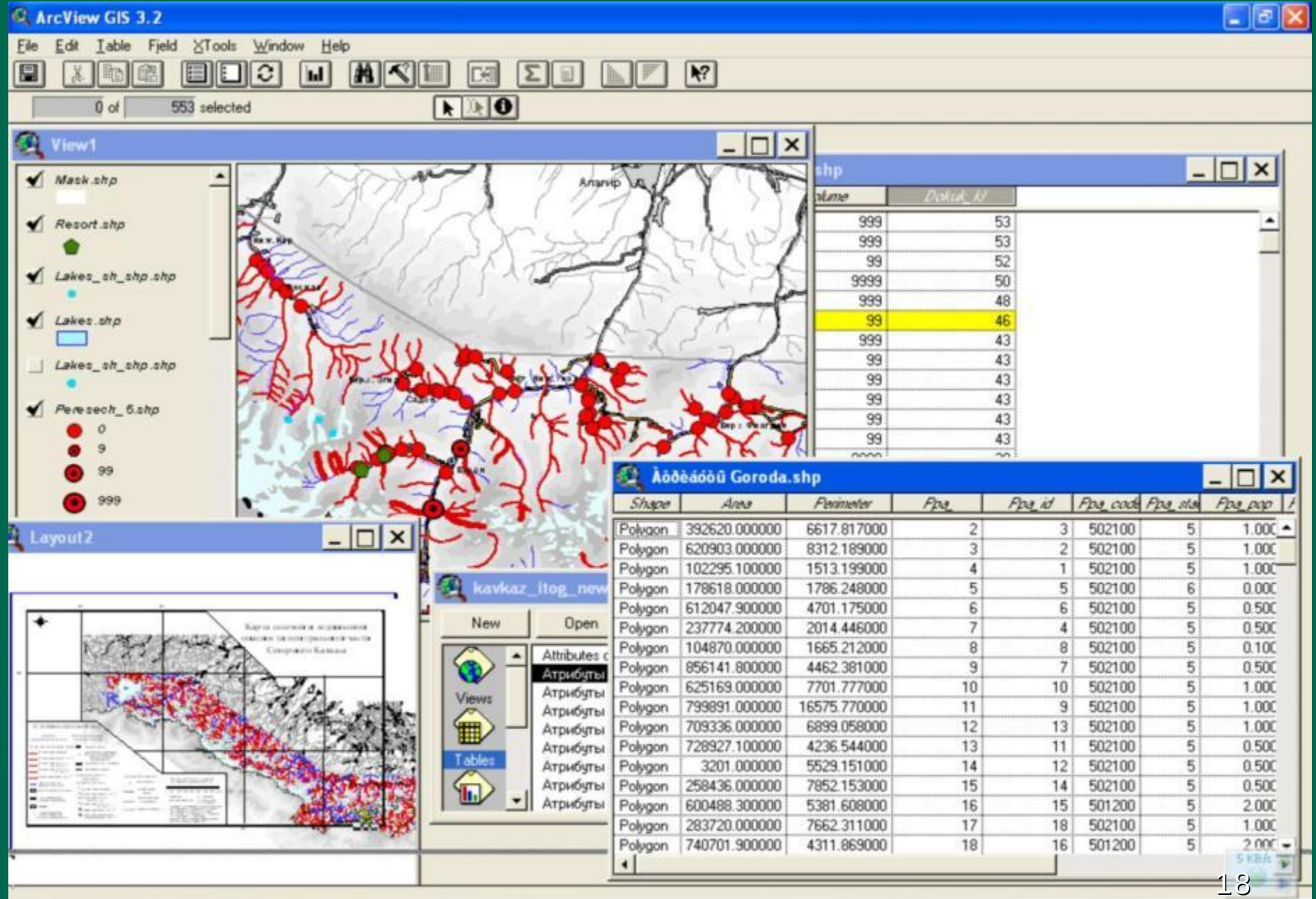


Photo: Sergey Chernomorets

Temperature logging



Mapping using GIS techniques



**Monitoring of debris flow
activity:
Gerkhozhan-Su River,
Caucasus, Russia**

Debris flow disaster: Gerkhozhan-Su River, 2000

House in the town of Tyrnyauz, Kabardino-Balkariya, Russia,
destroyed by a glacial debris flow in July 2000

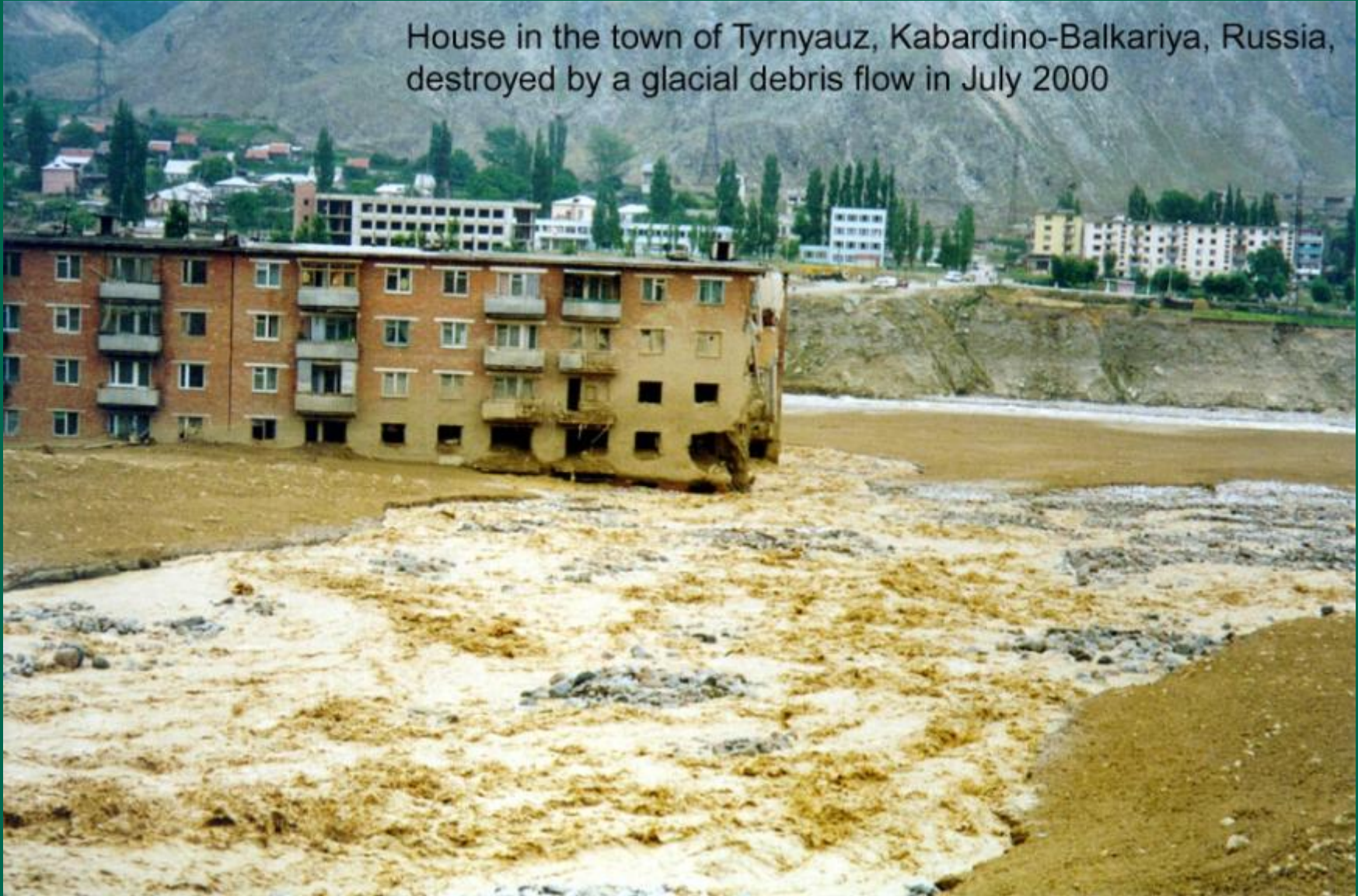


Photo: Sergey Chernomorets

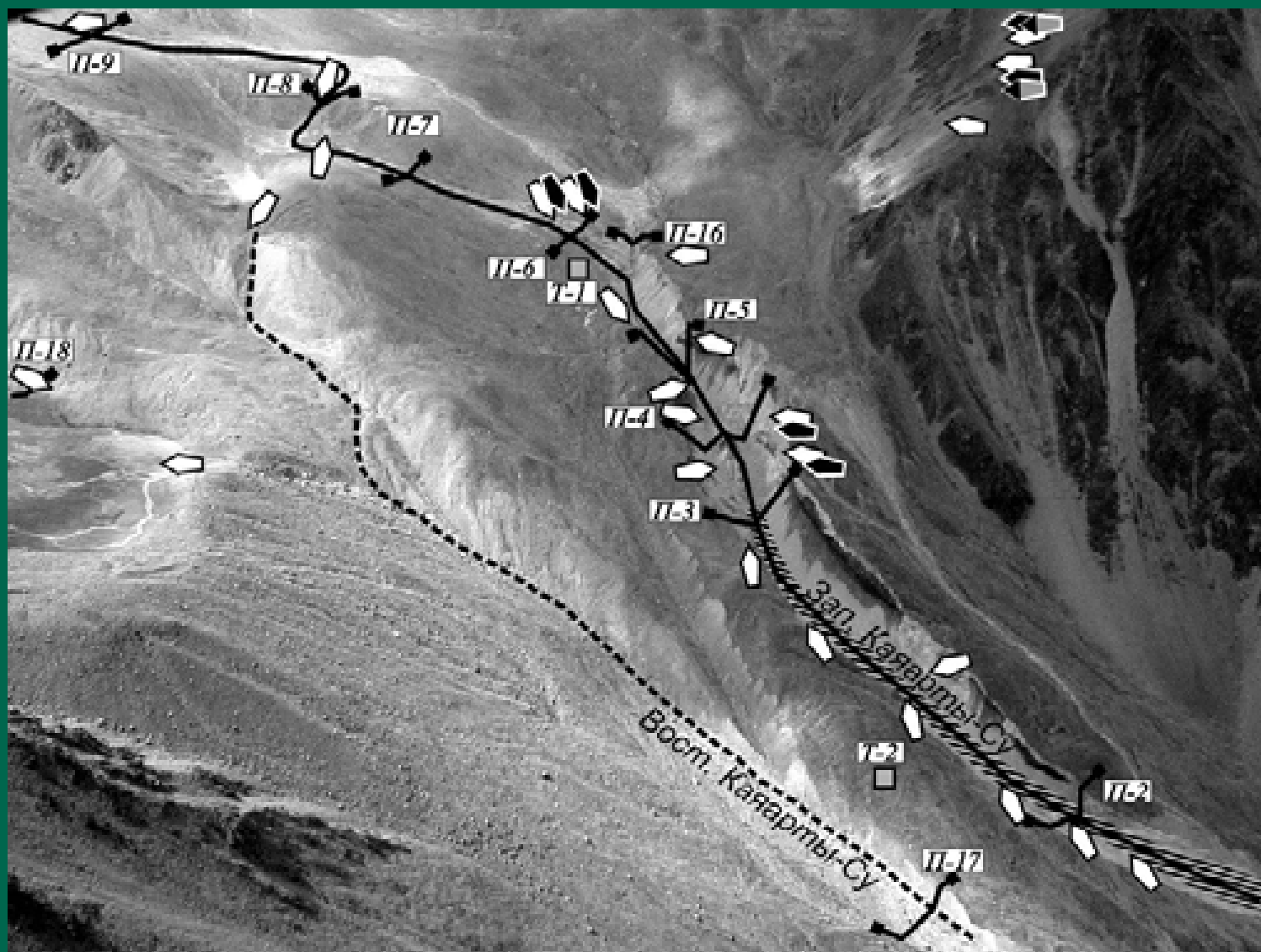


Changes 1 year after the disaster



Photo: Sergey Chernomorets

Monitoring network: repeat photography, geodetic measurements, temperature loggers etc.

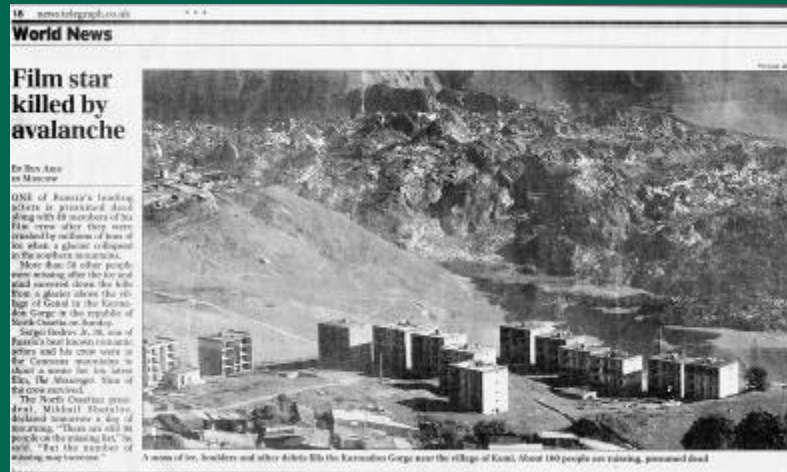


Helicopter photo: Mikhail Nikitin

A photograph of Mount Kazbek, a large, snow-capped mountain peak. In the foreground, on a dark, grassy hill, stands a small church with two towers. The sky is filled with white, fluffy clouds. The text "Glacier disasters around Mt. Kazbek, Russia / Georgia" is overlaid in yellow on the lower part of the image.

Glacier disasters around Mt. Kazbek, Russia / Georgia

Kolka Glacier Disaster, North Ossetia, 20 September 2002



Destruction of New
Karmadon village
Costs 17 M Euro
125 victims

Destroyed infrastructure
Tourist facilities ruined

Photo: Aleksandr Polkvoy

Origin – remains of
Kolka Glacier; 133 M
m³ of glacier ice lost –
largest recorded in the
world



Path of glacier
flow

25

Advancing glacier



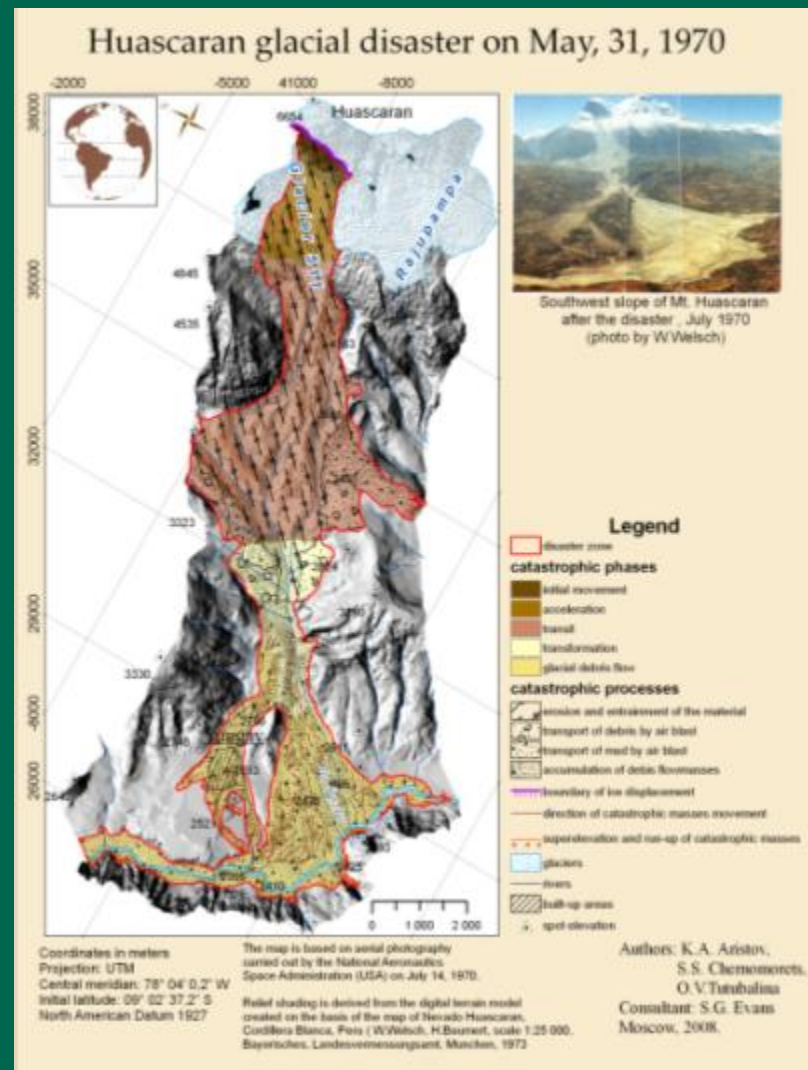
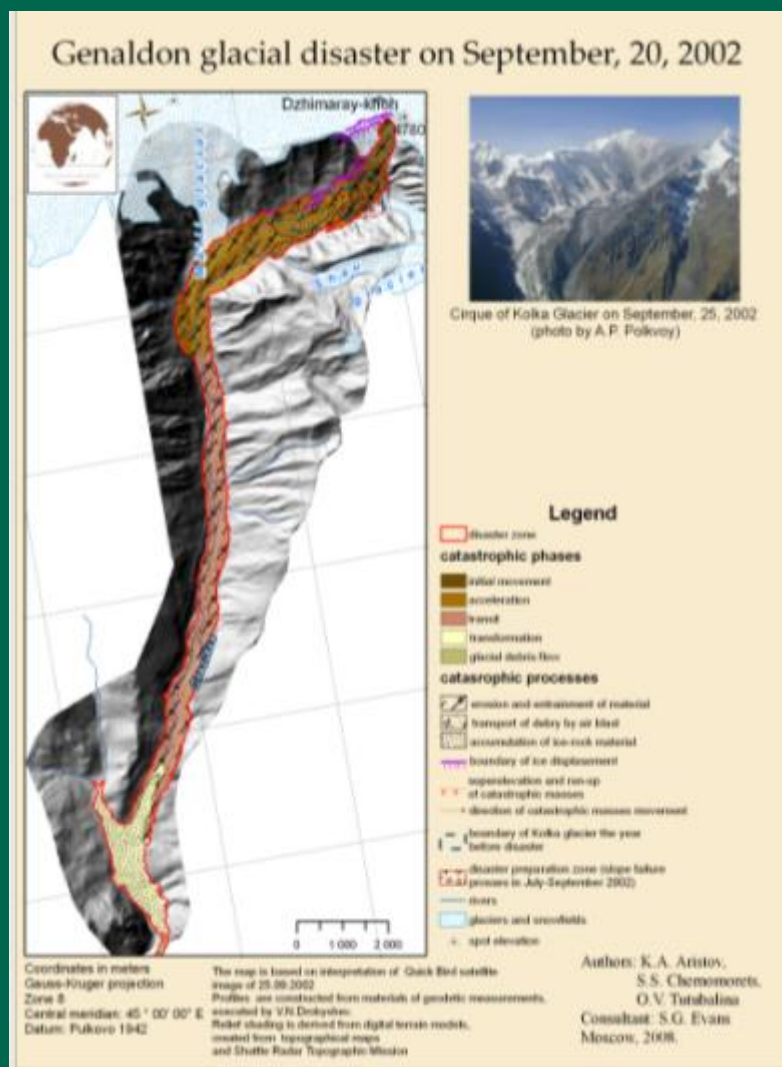
2004



2007

Photos: Sergey Chernomorets

Comparison of glacier disasters: Kolka (Genaldon), Russia and Huascaran, Peru



Field discussion with Prof. S.G.Evans (University of Waterloo, Canada)

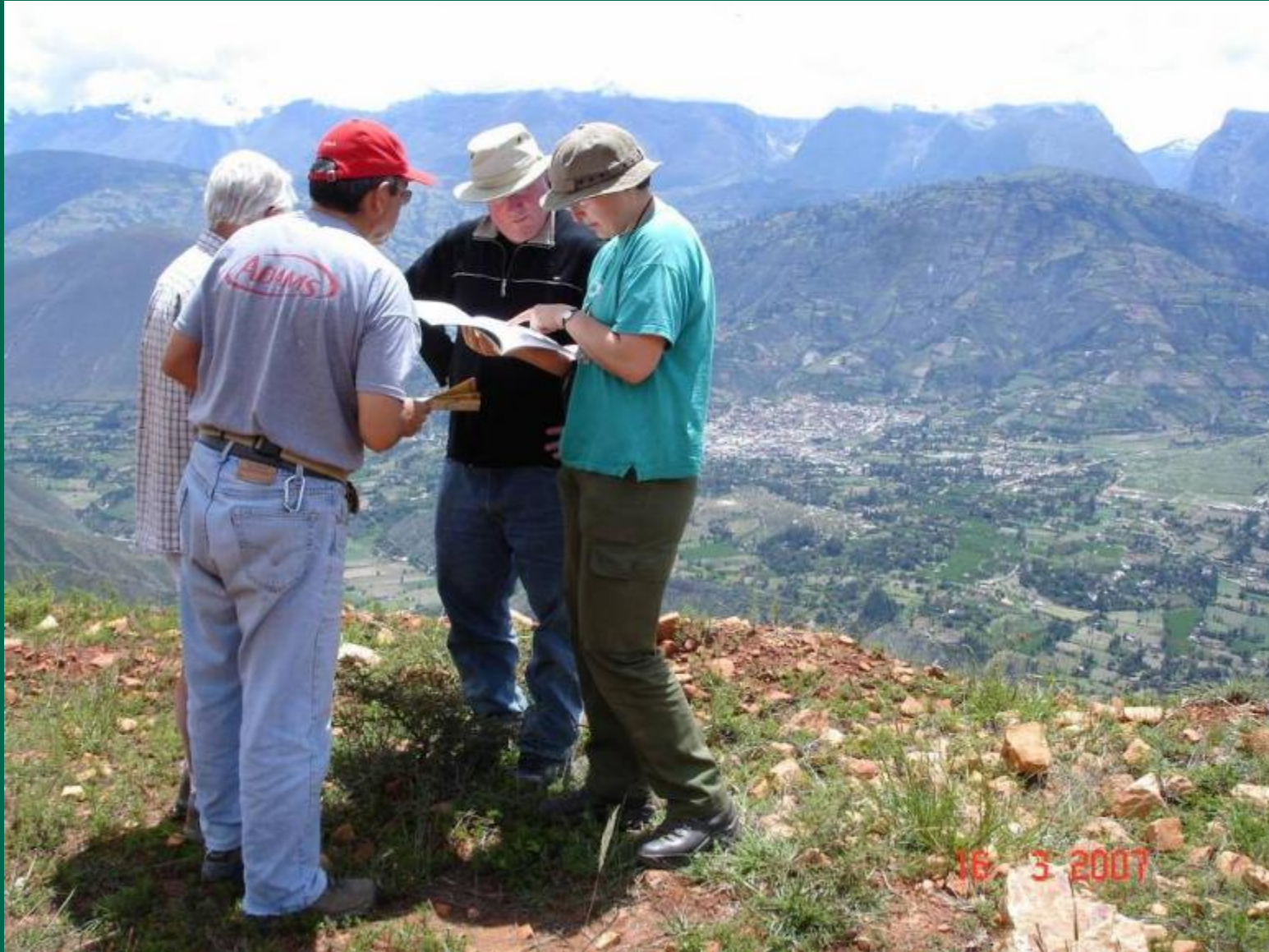
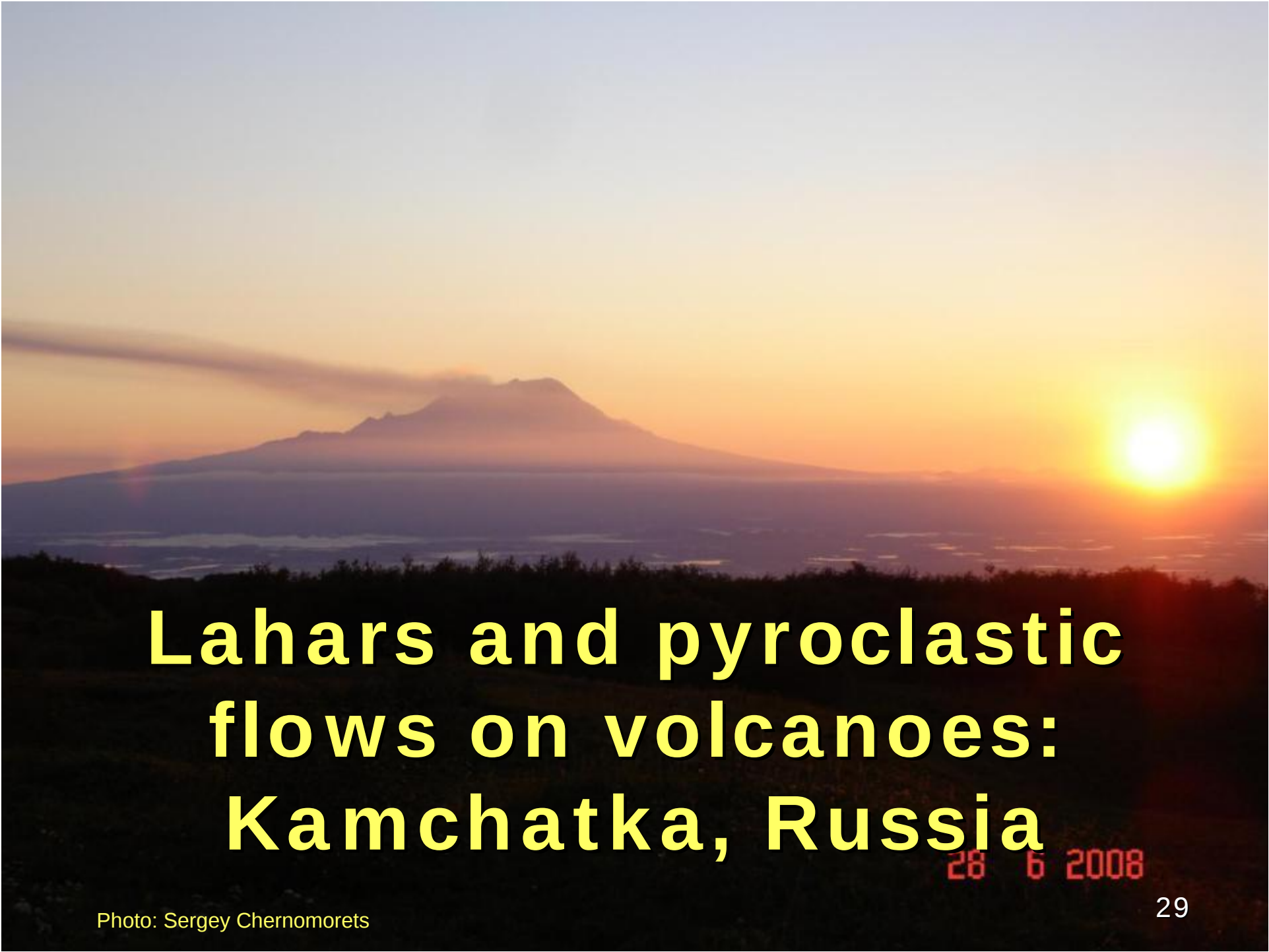


Photo: Sergey Chernomorets



Lahars and pyroclastic flows on volcanoes: Kamchatka, Russia

28 6 2008

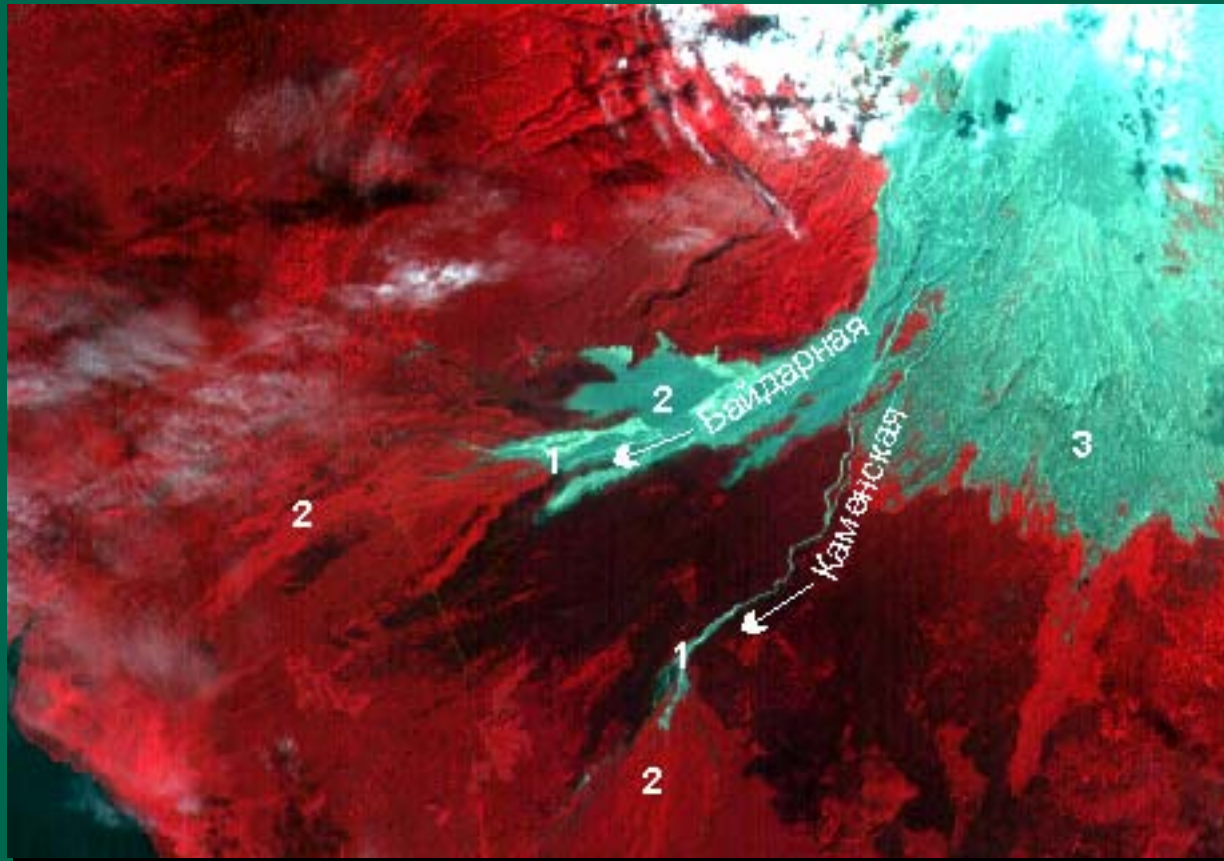
Photo: Sergey Chernomorets

Shiveluch Volcano: lahar deposits



Photo: Sergey Chernomorets

Shiveluch volcano: pyroclastic-induced snow melting as a trigger of lahars



SPOT-2 satellite image

Shiveluch volcano: lahar deposits



Photo: Sergey Chernomorets

Debris flow formation in NE slope of the Klyuchevskoy volcano

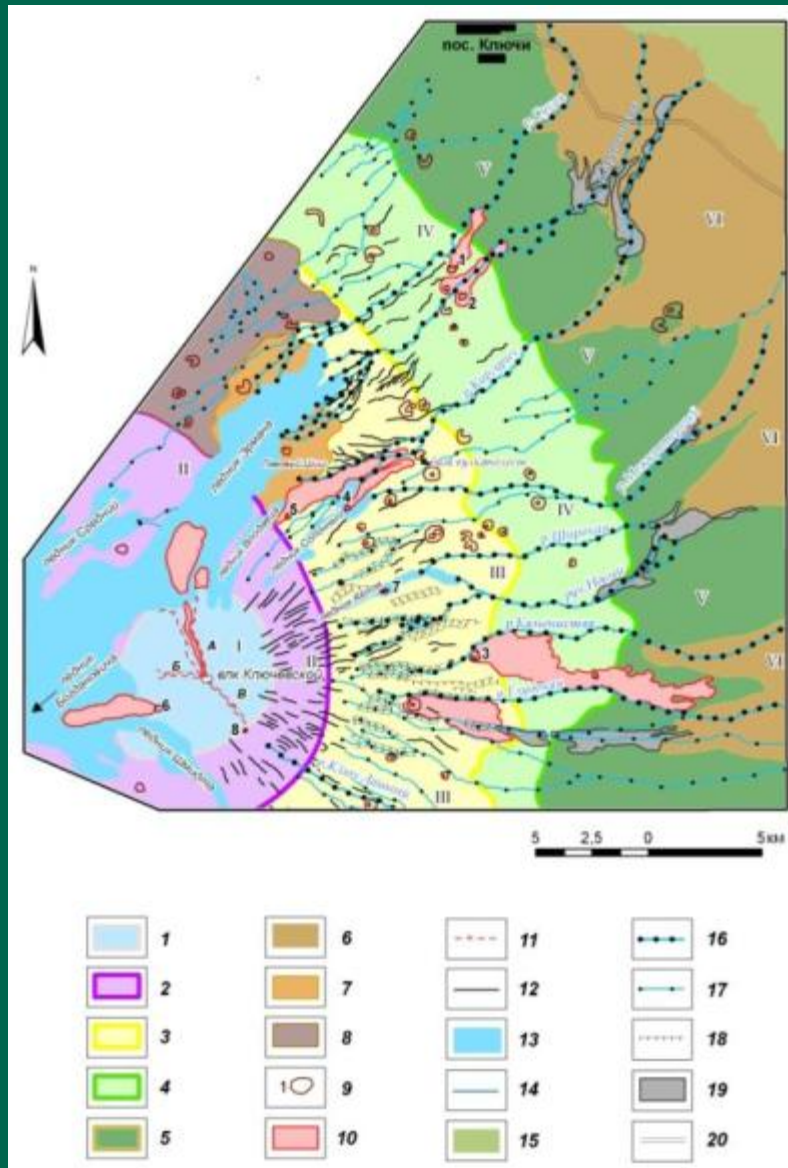


Photo: Sergey Chernomorets

Seismically triggered landslides and debris flows: Wenchuan earthquake area, China



Research
have been
held jointly
with IMHE,
Chinese
Academy of
Sciences

Wenchuan earthquake, 12 May 2008:

Dead	69,000
Missing	18,000
Injured	374,000
Evacuated	1,400,000

Beichuan: landslides and rockfalls



Beichuan

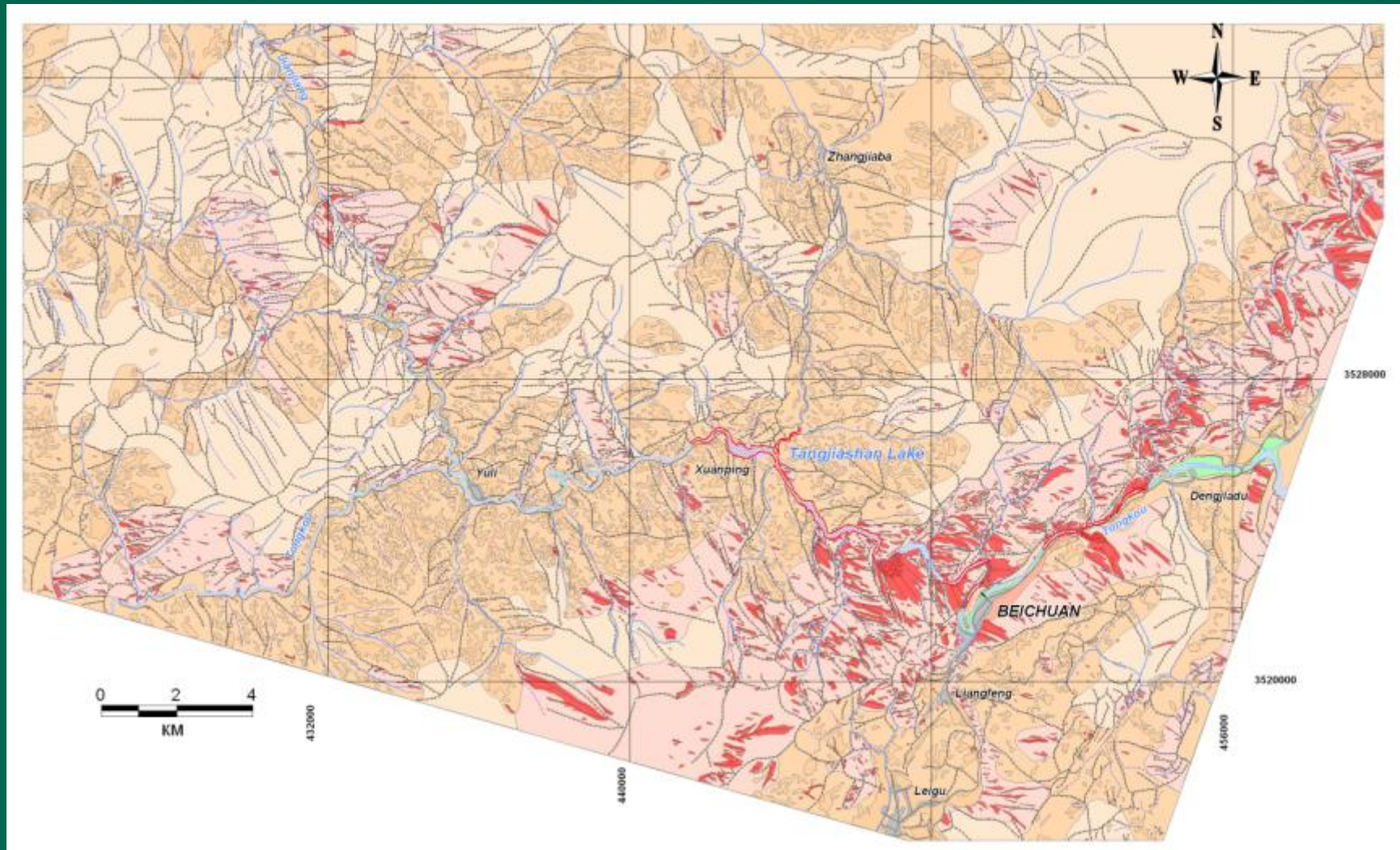


Photo: Sergey Chernomorets

Deposits of the 24 September 2008 debris flow. Beichuan



Geomorphological map of Beichuan area after the earthquake



Debris avalanche in the epicentre area
The Lianhuaxigou River
and the Niujuangou River
near Yingxiu

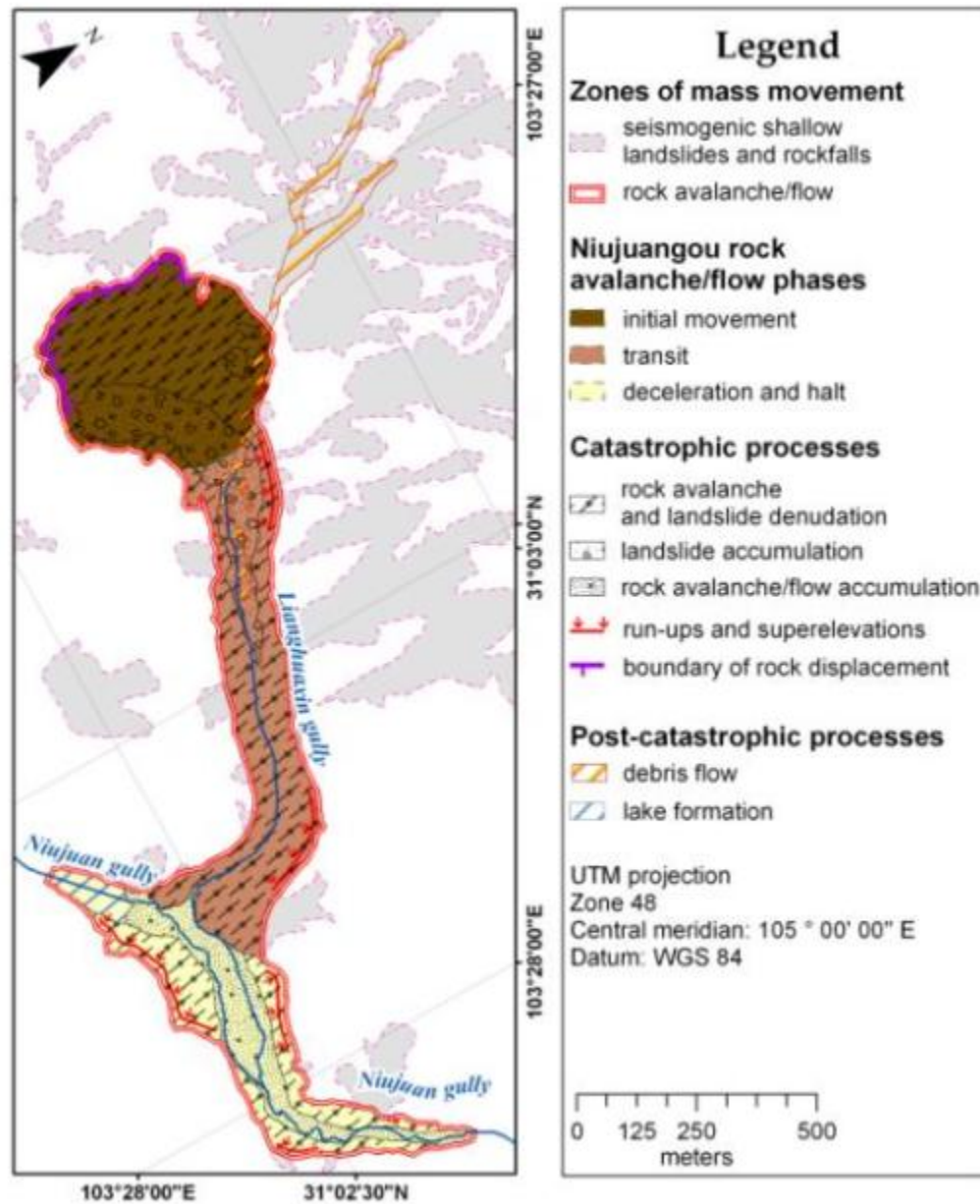


Photos: Sergey Chernomorets

Deposits of a debris flow, which occurred after a cyclone on 25-27 September 2008. The Nijuangou River, Yingxiu County



Photo: Sergey Chernomorets



Zipingpu: rockslides above the reservoir



Photo: Sergey Chernomorets

New dammed lake on the Chaping River:
channel incision and water level drop after creation of an
artificial spillway

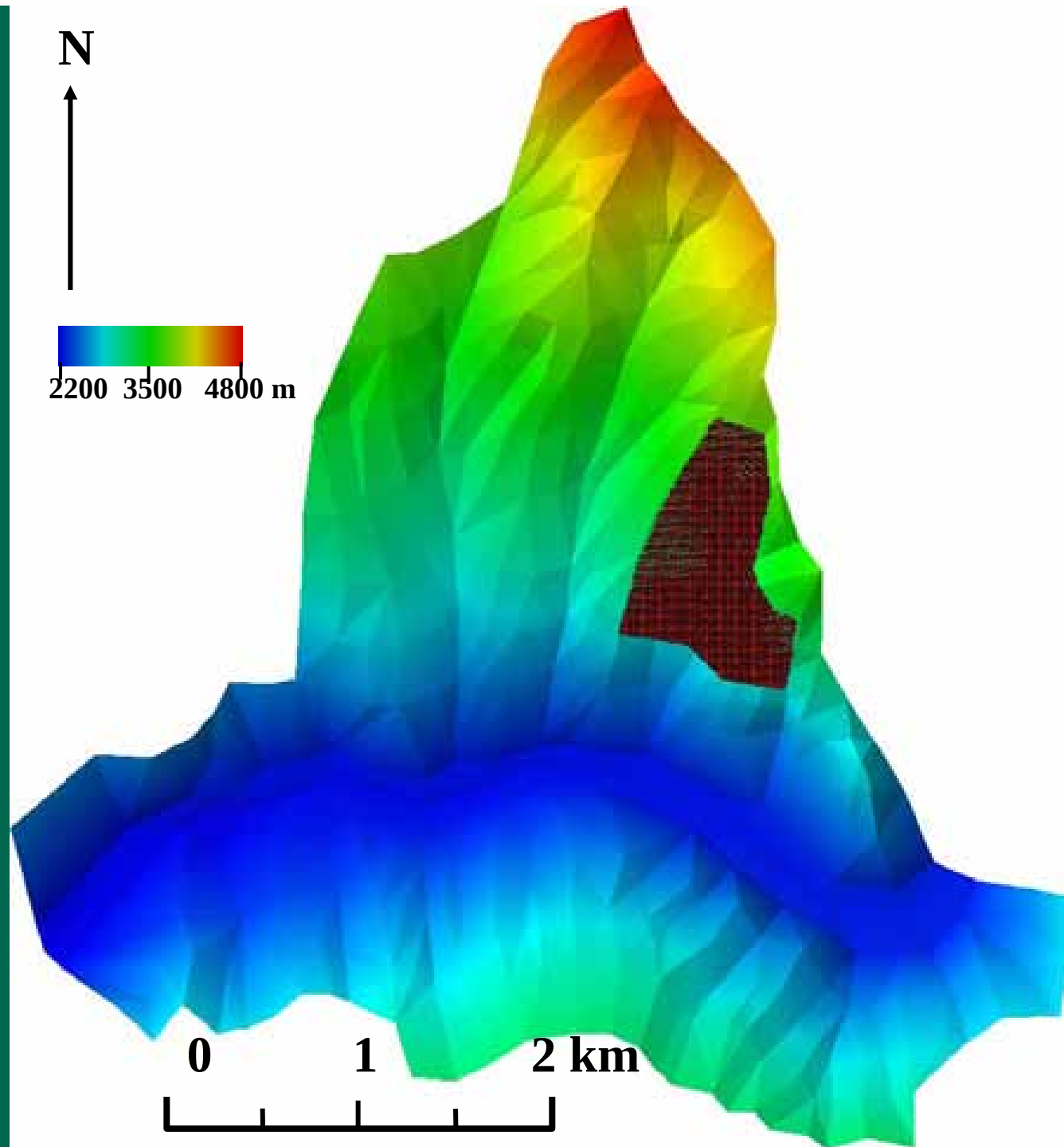


Numerical simulation: Attabad landslide, Pakistan



Photo : Inayat Ali, 4 January 2010 45

T=0 s



DEBRIS model.
(by Vladimir Mikhailov)

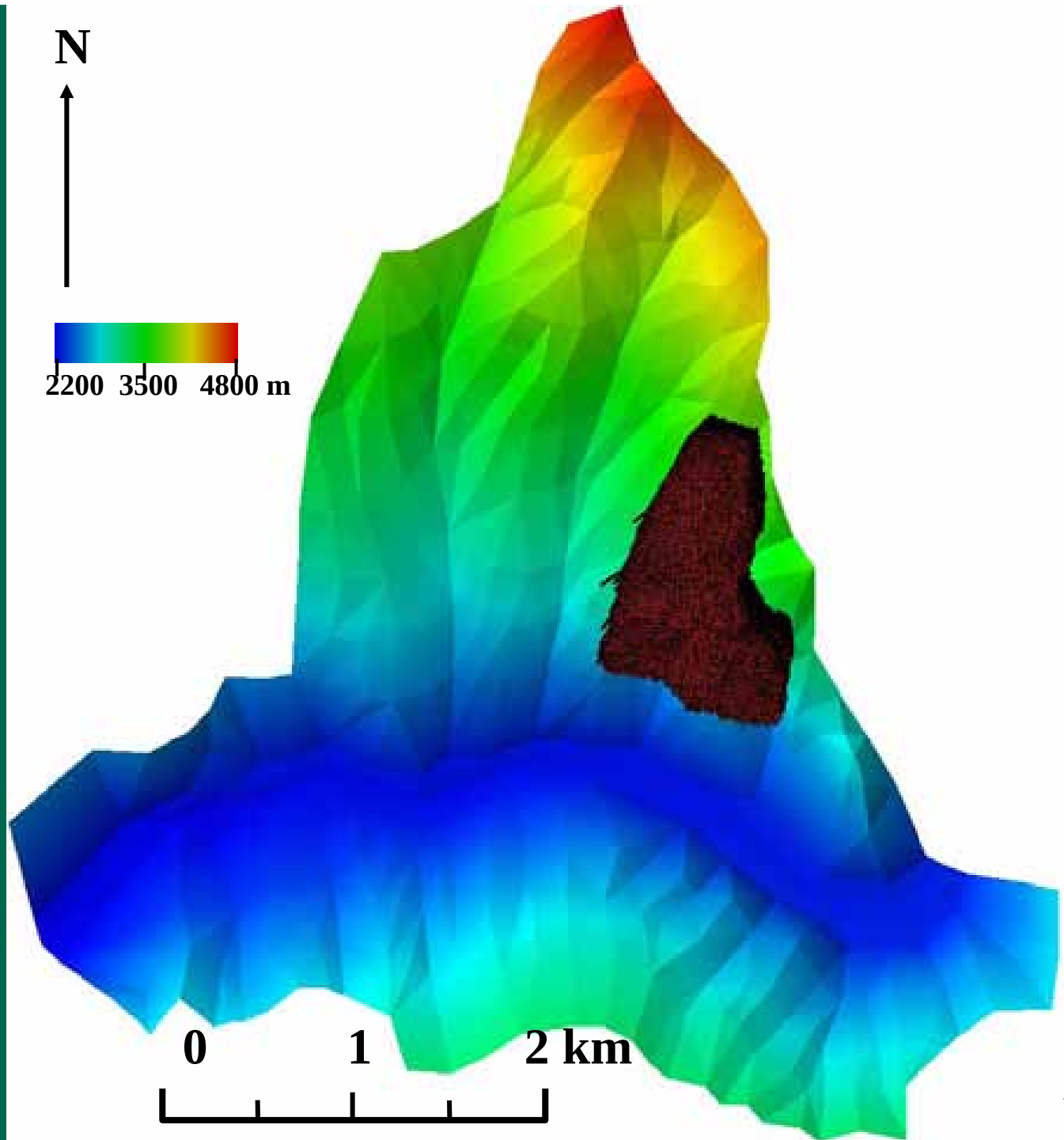
Simulation:
Vladimir Mikahilov,
Sergey Chernomorets

T=10 s

N



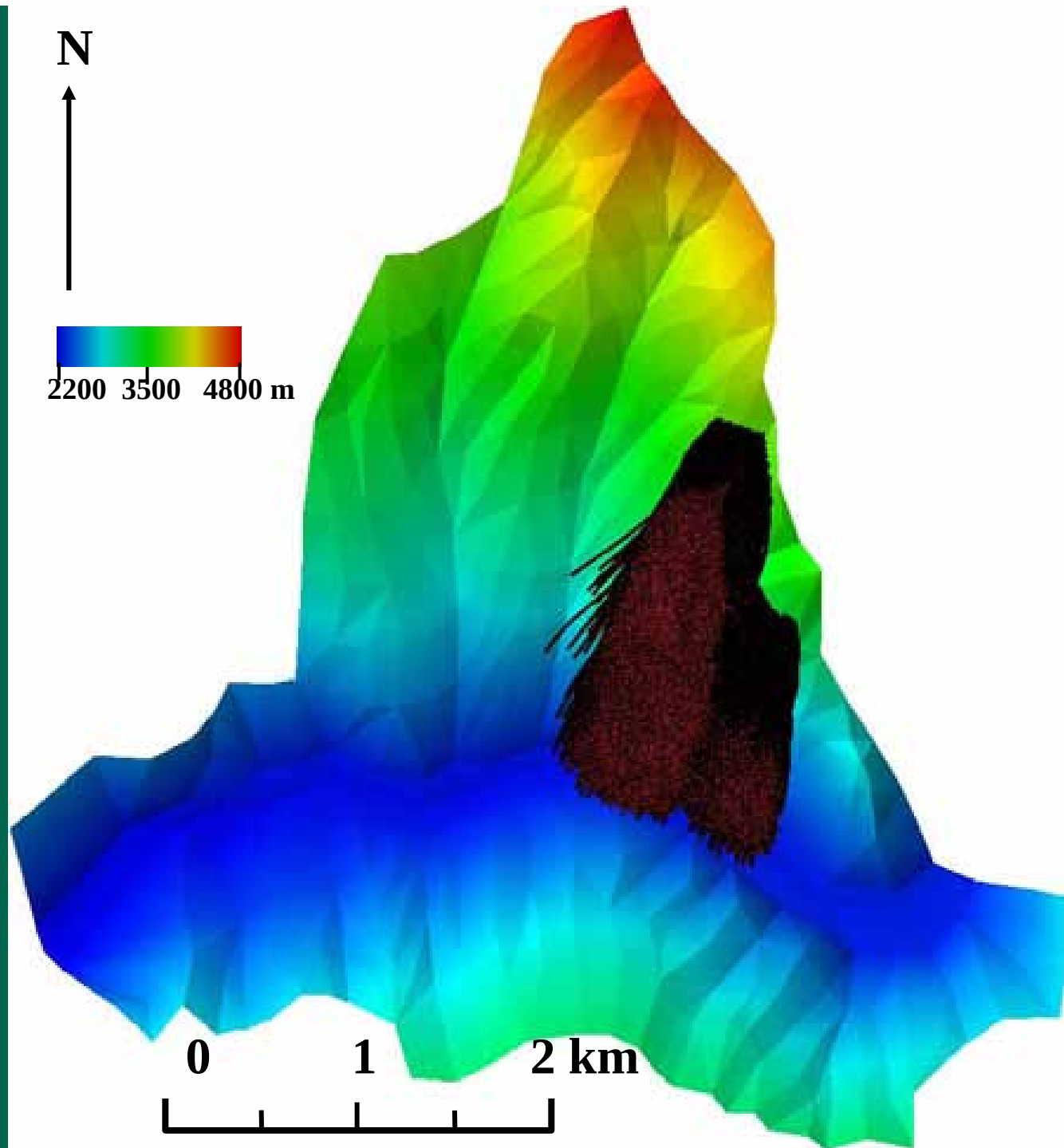
2200 3500 4800 m



DEBRIS model.
(by Vladimir Mikhailov)

Simulation:
Vladimir Mikahilov,
Sergey Chernomorets

T=20 s



DEBRIS model.
(by Vladimir Mikhailov)

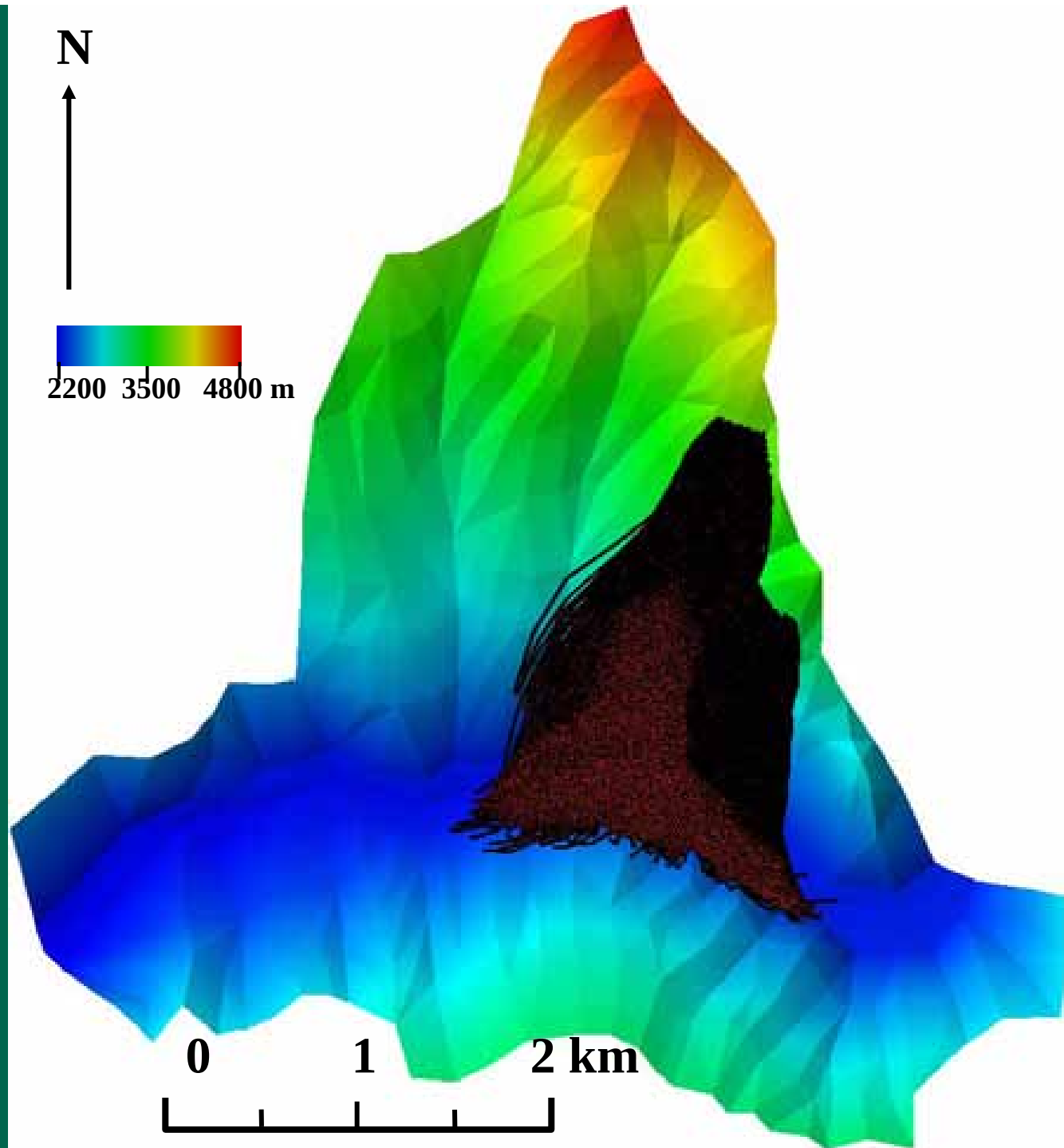
Simulation:
Vladimir Mikahilov,
Sergey Chernomorets

T=30 s

N



2200 3500 4800 m



DEBRIS model.
(by Vladimir Mikhailov)

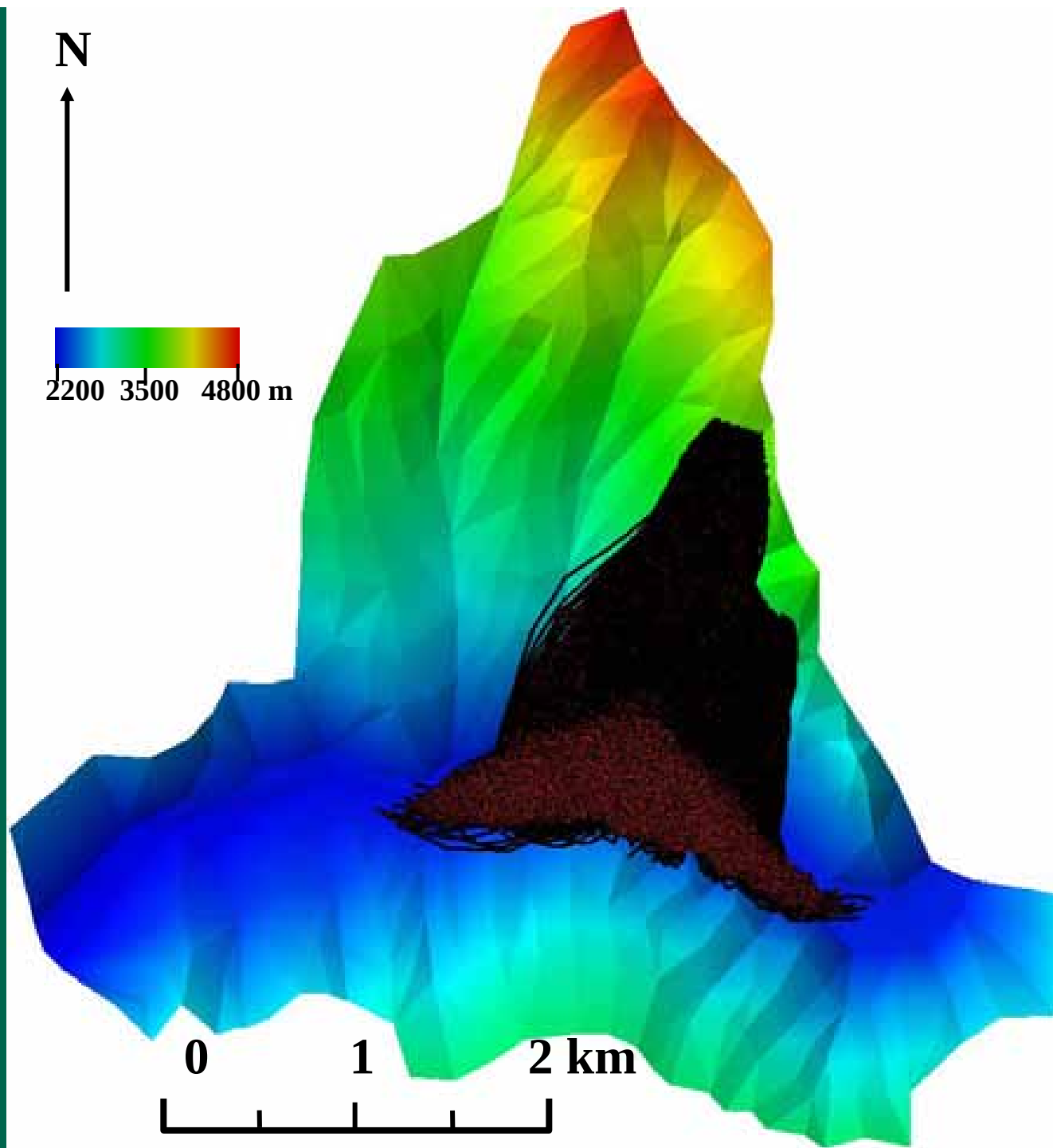
Simulation:
Vladimir Mikahilov,
Sergey Chernomorets

T=40 s

N



2200 3500 4800 m



0

1

2 km



DEBRIS model.
(by Vladimir Mikhailov)

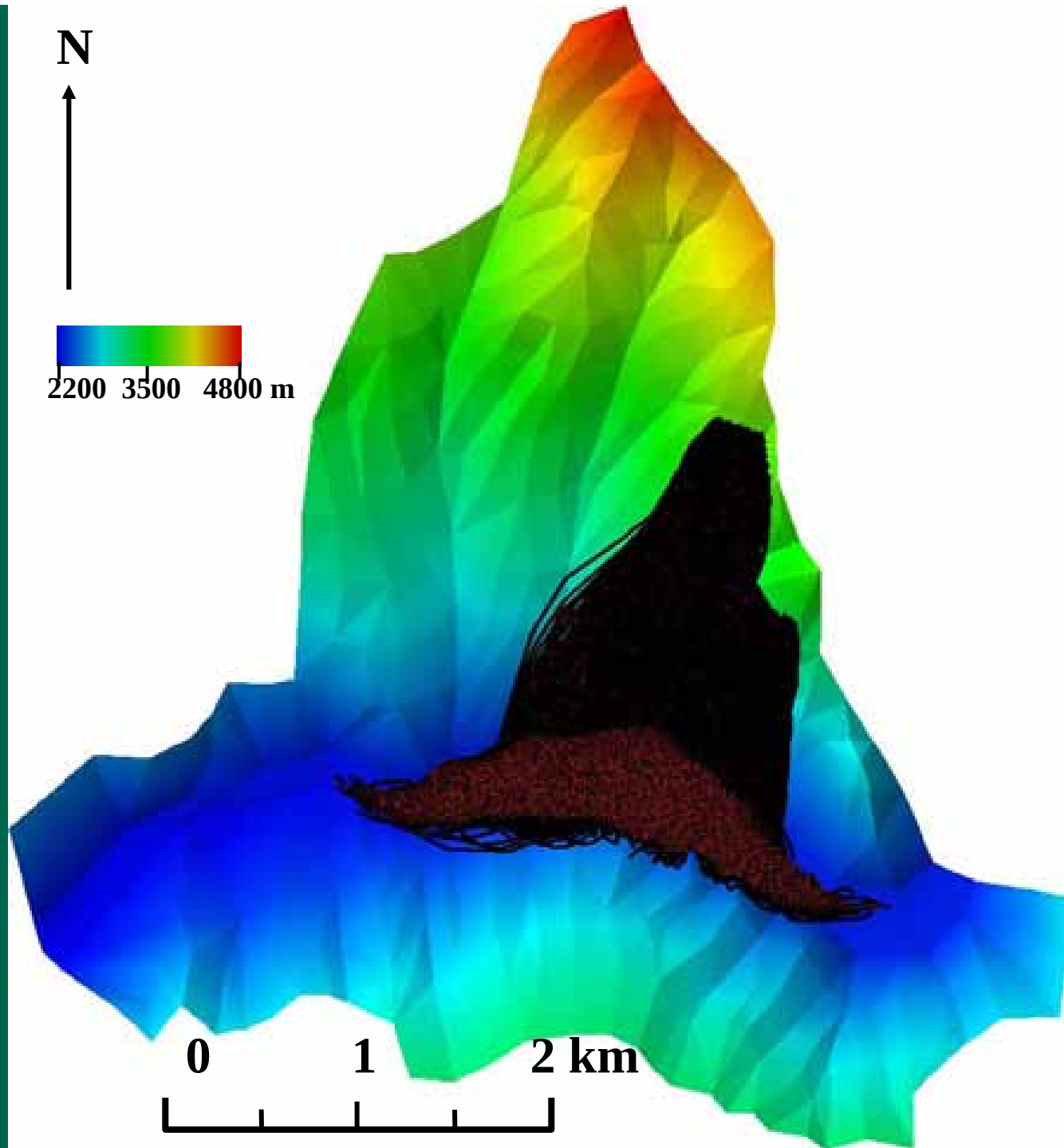
Simulation:
Vladimir Mikahilov,
Sergey Chernomorets

T=50 s

N



2200 3500 4800 m



0

1

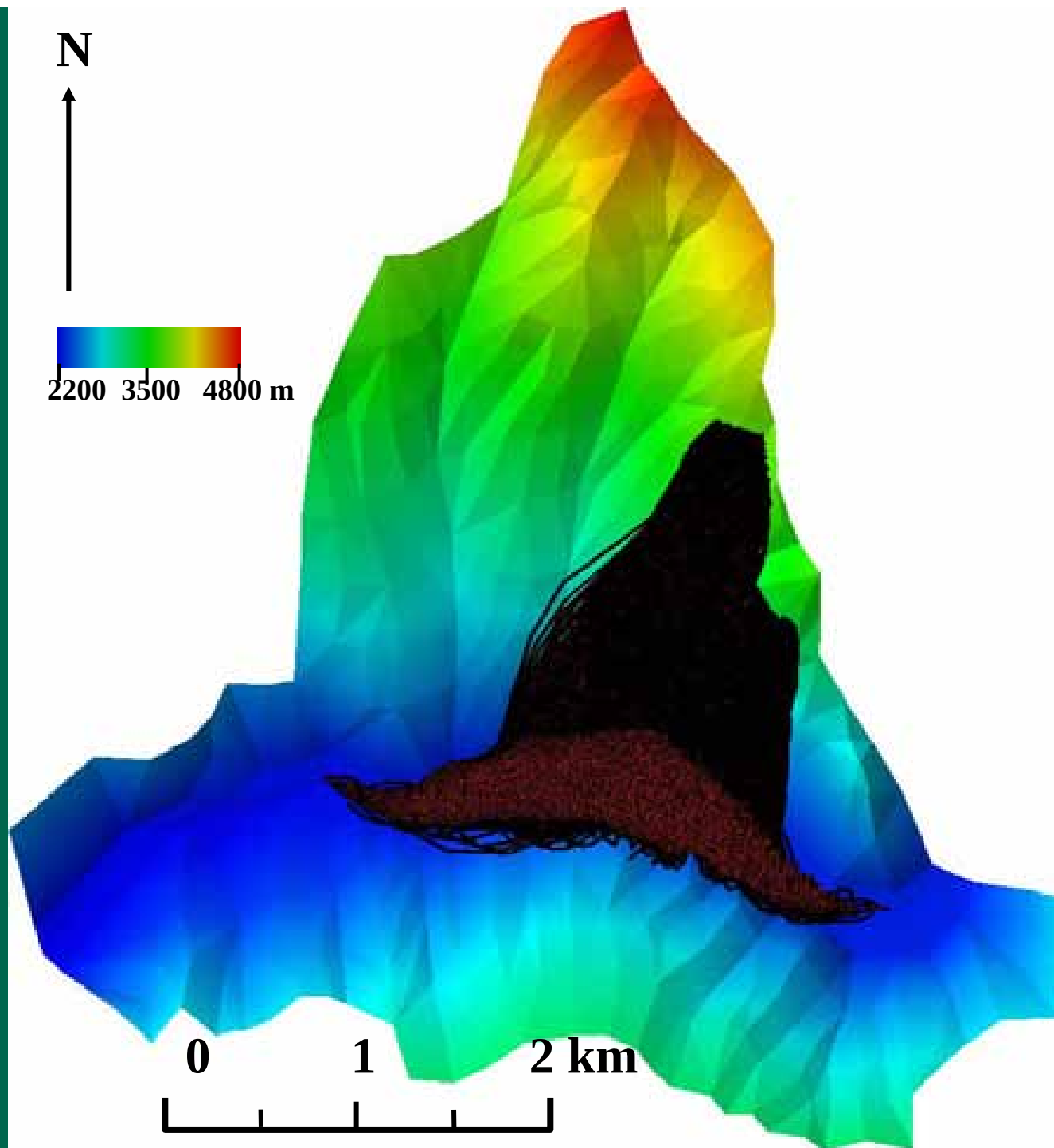
2 km



DEBRIS model.
(by Vladimir Mikhailov)

Simulation:
Vladimir Mikahilov,
Sergey Chernomorets

T=60 s



DEBRIS model.
(by Vladimir Mikhailov)

Simulation:
Vladimir Mikahilov,
Sergey Chernomorets

Modelling results:

- Travel time of the landslide: ~1 min
- Velocity of the landslide frontal part: ~ 50-60 m/s
 - Maximum thickness of landslide deposits in Hunza Valley: 90-100 m
 - Length of landslide deposits: ~ 2 km
 - Volume of landslide deposits: ~ 50 M m³

Attabad (Hunza) Lake

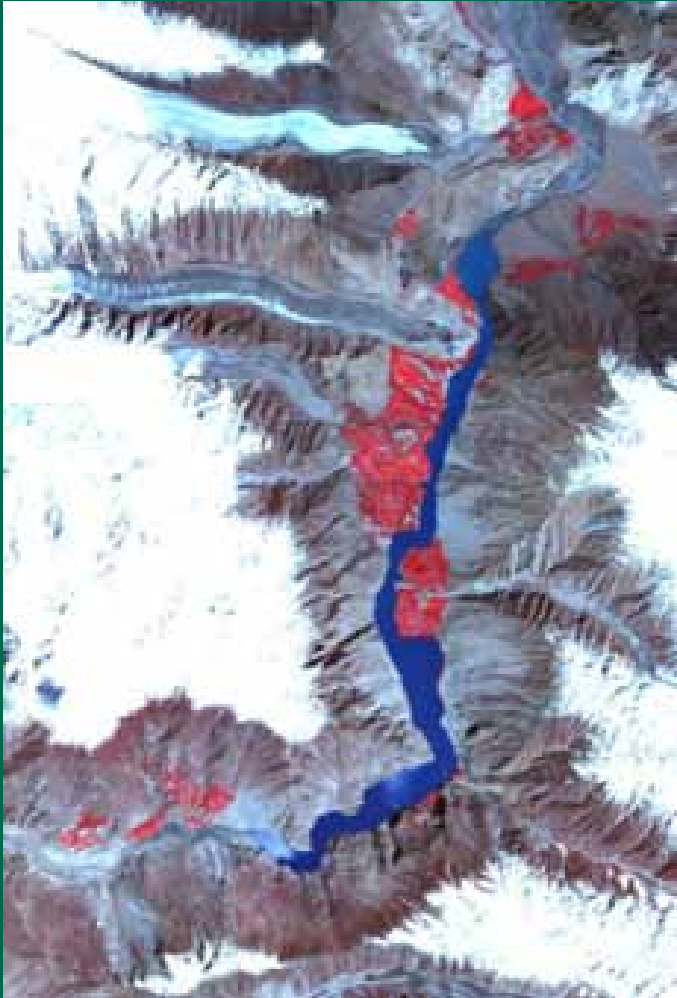


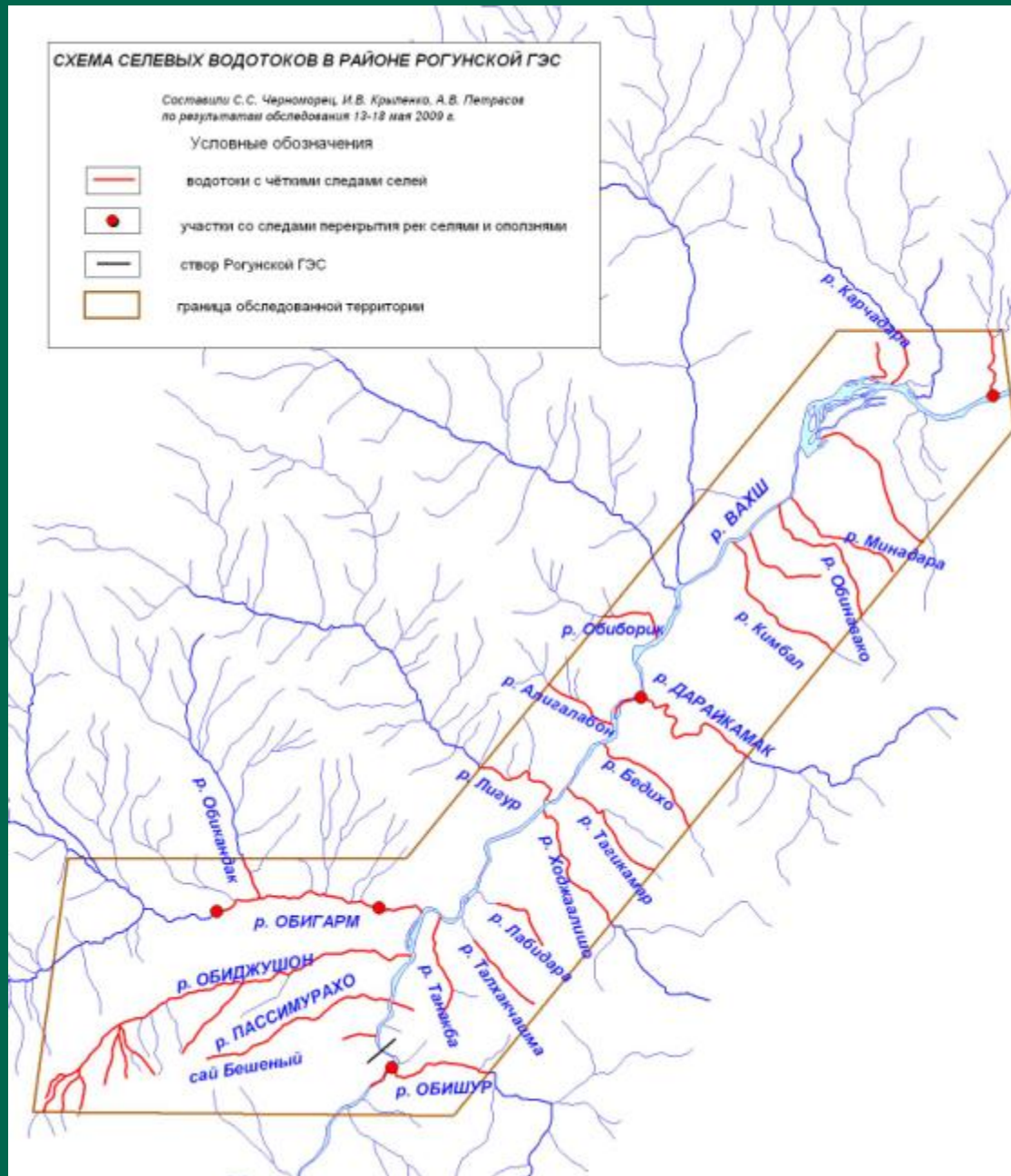
Image: NASA, 25 May 2010



Photo: FOCUS Pakistan, 1 June 2010

**Debris flow hazard
assessment:
Rogun hydroelectric
station, Tajikistan**

Sketch map of debris-flow rivers in Rogun HES area



Map: Sergey Chernomorets, Ivan Krylenko, Alexey Petrasov

Rogun: Obishur and Vakhsh rivers before and after 19 May 2009 debris flow



Photo: Alexey Petrasov, 14.05.2009



Photo: Lyubov' Shurinova, 20.05.2009

Rogun:
flooding of tunnels.

Vakhsh River
before and after
19 May 2009
debris flow on
Obishur River

Photo: Sergey Chernomorets, 14.05.2009



Photo: Lyubov' Shurinova, 20.05.2009

Rogun:
flooding of tunnels.

Vakhsh River
before and after
19 May 2009
debris flow on
Obishur River



Photo: Sergey Chernomorets, 14.05.2009



Photo: Lyubov' Shurinova, 20.05.2009





Place of blockages of Vakhsh River by debris flows from Daraykomok River



Acknowledgements

Many thanks to:



Colleagues from Moscow University and UCEGM:

Dmitry Petrakov, Olga Tutubalina, Irina Seynova, Inna Krylenko, Ivan Krylenko, Konstantin Aristov, Marina Shakhmina, Artur Kapitanov, Igor Sokolov, Anna Tarbeeva, Vladimir Mikhailov, Polina Mikhailyukova

Russian co-authors from other institutes:

Valeriy Drobyshev (Vladikavkaz Scientific Center, RAS), Alexey Rudoy (Tomsk State University), Eduard Zaporozhchenko (Sevkavgirovodkhoz Institute),

International collaborators:

Stephen G. Evans (University of Waterloo, Canada), Andreas Kääb (University of Oslo, Norway), Isabelle Lecomte (ICG, Norway), Marco Zapata (before 2009 – INRENA, Peru), Christian Huggel (Zurich University, Switzerland), Fangqiang Wei (Institute of Mountain Hazards and Environment, CAS, China).



End-users in the Caucasus:

Sergey Shagin, Vladimir Ivanov, Vsevolod Adtseev (EMERCOM), Uzeir Kurdanov (Elbrus village local administration), Marat Gatsiev (Alania National Park), Alexandr Polkvoy (Sevosetinnedra), Husei Ulbashev (Kabbalkgeomonitoring), Konstantin Nosov (Sevkavgirovodkhoz Institute and Debris Flow Association)

This research has been supported by:



NATO Science for Peace Programme



Russian Foundation
for Basic Research



National Natural
Science Foundation of China

***Thank you
for your attention!***

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