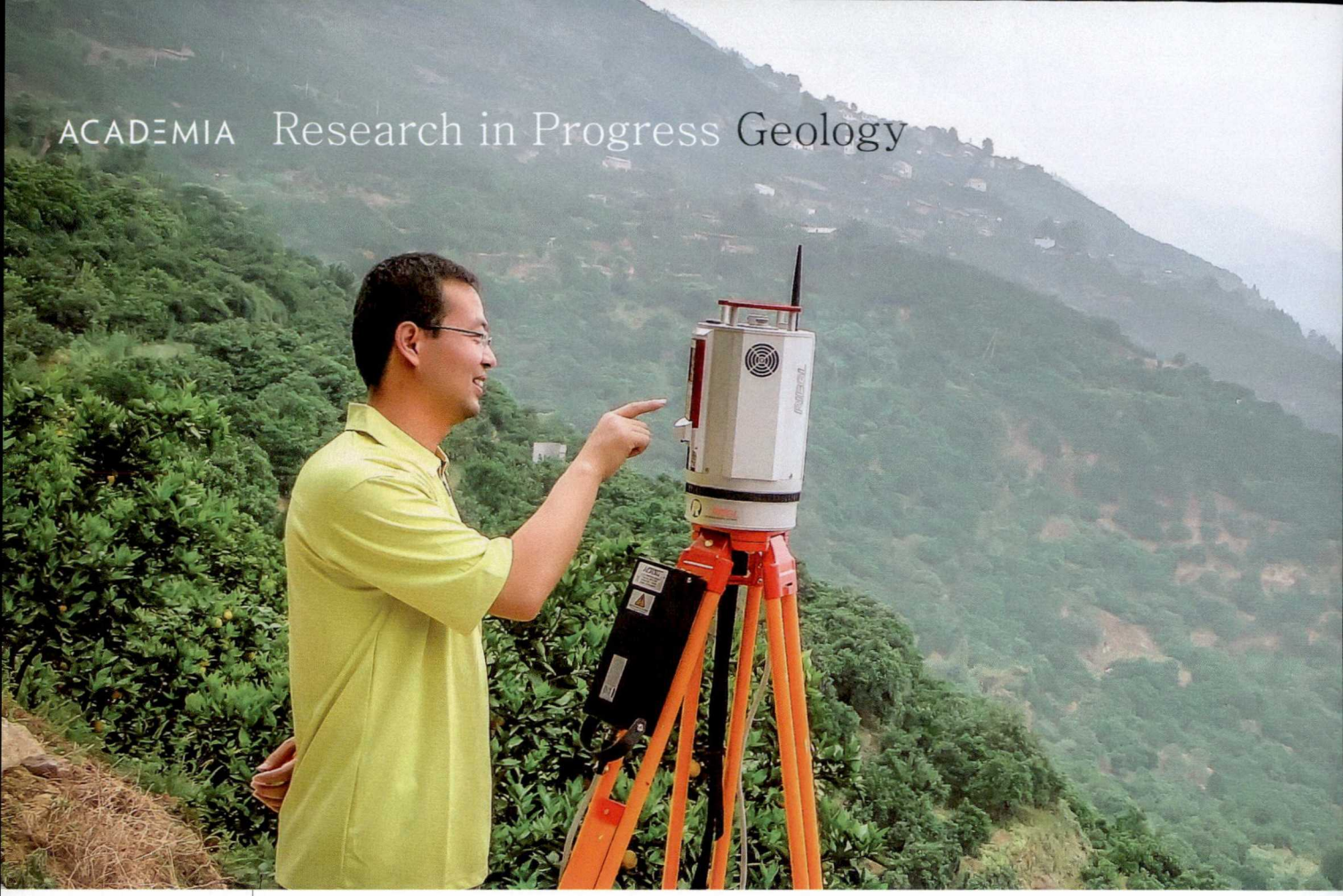


Scanning the Shuping landslide – Dr. Fan Jinghui sets the parameters of a laser scanner

Monitoring the Mountains

Dr. Zbigniew Perski

is the director of the Carpathian Branch of the National Geological Institute – National Research Institute. He applies satellite radar interferometry in studying surface deformation, laser scanning, and monitoring landslide activity.

Active landslides are a significant problem in today's world, especially in highly urbanized mountain regions. We are now able to monitor changes to the existing landform using increasingly sensitive technologies. Our joint team of scientists from Poland and China is working on implementing state-of-the-art technologies for monitoring landform deformation, which will be used to assess future threats.

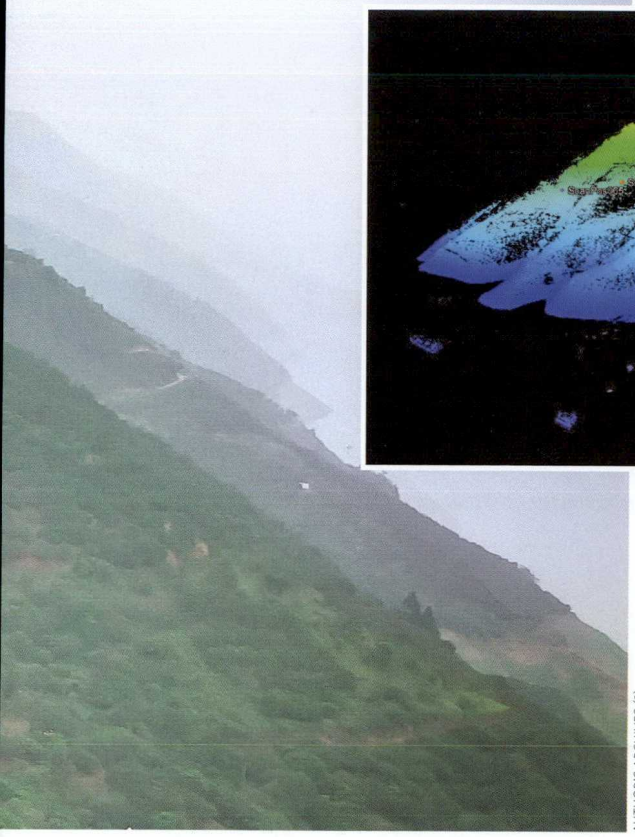
Dr. Zbigniew Perski

National Geological Institute
– National Research Institute
Carpathian Branch in Kraków

Geologic threats, in particular landslides, are currently an important topic in both Poland and China, causing vast monetary and economic losses almost every year. In China, the disasters they provoke frequently take a heavy toll in terms of human lives.

The project "Landslide identification, movement, monitoring and risk assessment over rugged mountain areas using advanced Earth observation techniques" is financed as part of Polish-Chinese bilateral collaboration. We are developing methods to be implemented in practice, and in the longer term we aim to use them to monitor landslide risk.

Radar satellite imaging makes it possible to measure altitude changes with an accuracy of a few millimeters.



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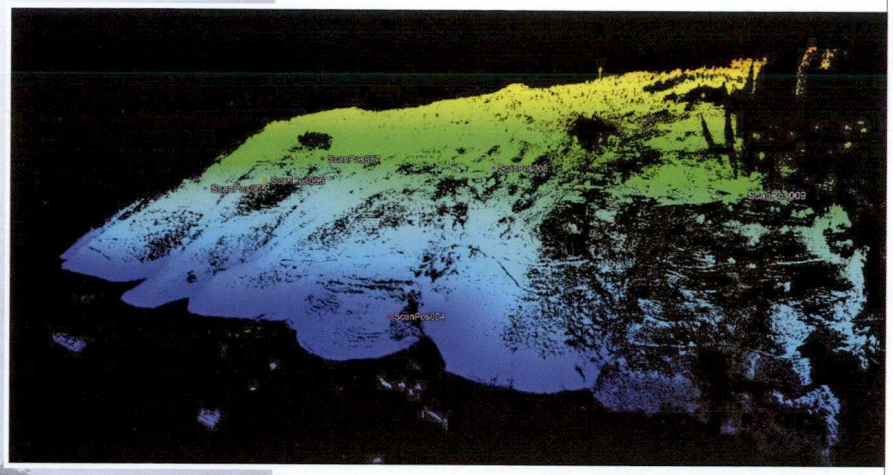

Results of terrestrial scanning of the Shuping landslide – a cloud of altitude data

This is achieved by using satellite radar interferometry, which measures phase differences in radar reflections registered during subsequent satellite passes. Such measurements span vast areas, and by using data registered on a cyclical basis researchers are able to calculate the magnitude of deformations across several years. The method involves complex algorithms and demanding calculations, and it has been used in urbanized regions for many years. However, it needs to be improved considerably before it can be implemented in mountain regions, which are frequently subject to rapid changes in atmospheric conditions and can also be covered in dense vegetation and persistent snow cover. These factors limit the effectiveness of existing interferometric measurement techniques; our project strives to overcome at least some of these limitations. Terrestrial laser scanning, providing highly precise altitude data, and aerial flights are important auxiliary methods supplying supplementary data, important for making topographic corrections to interferometry data.

Our monitoring team from the Carpathian Branch of Poland's National Geological Institute – National Research Institute works alongside scientists from the Center for Earth Observation and Digital Earth, the Chinese Academy of Sciences and the China Aero Geophysical Survey & RS Center for Land and Resources (Chinese Geological Survey). The joint project is supported by the European Space Agency (ESA) as part of the Dragon 3 program. Collaboration with ESA provides the team access to satellite data for the study regions, also to organized meetings.

The research focuses on two regions: the Lake Rożnów reservoir on the Dunajec River in Poland, and the Three Gorges Dam on the Yangtze River in China. As part of a research exchange, in June 2014 representatives of the Polish team visited partner institutions in China and took part in field studies at the Shuping landslide on the Yangtze. Polish experts assisted in conducting terrestrial laser scanning of the landslide, as well as learning about the monitoring infrastructure at the site.

The Shuping landslide is located in the Zigui County in the Hubei Province, approx. 50 km west of the Three Gorges Dam. The tip of the landslide ends in the water of the Three Gorges Reservoir, making it a direct threat to the stability of the reservoir banks. The Shuping landslide covers an area of approx. 37 hectares and is characterized by rapid movement estimated at approx. 25 centimeters/year. There is a danger that in the event of intensive and prolonged rainfall, the speed may increase significantly. A catastrophic collapse of the landslide may trigger a tsunami threat to villages on the opposite bank of the reservoir, as well as the dam itself. The landslide comprises two parts – eastern and western. Interferometry data indicate that the eastern part is currently more active. This has been confirmed by field studies revealing visible fissures and damage to the reservoir architecture.

Existing results have underscored the high value of advanced landslide monitoring research. Terrestrial laser scanning is routinely used in landslide monitoring, while satellite radar interferometry is also increasingly being adopted.

The collaboration between the Polish and Chinese teams continues, with joint work on landslides in Poland being planned for later in 2016. ■

The author would like to extend his thanks to participants in the project: Tomasz Wojciechowski, Antoni Wójcik (National Geological Institute – National Research Institute), Guang Liu (Center for Earth Observation and Digital Earth, Chinese Academy of Sciences) and Fan Jinghui (China Aero Geophysical Survey & RS Center for Land and Resources – Chinese Geological Survey)

Further reading:

„Ziemia z perspektywy nieba" *[The Earth from the Perspective of the Sky]* – *Świat Nauki*, luty 1995

This is the translation of an article that was approved by the author in its Polish version.