Date of Submission	

IPL Project (IPL-Number) Annual Report Form

Period of activity under report
from 1 January 2025 to 31 December 2025

1. **Project Number and Title:**

IPL-238 Landslides Threatening Russian Cultural Heritage Sites

2. **Main Project Fields**

(2) Targeted Landslides: Mechanisms and Impacts

B. Landslides Threatening Heritage Sites

(3) Capacity Building

B. Collating and Disseminating Information/ Knowledge

3. **Name of Project Leader**

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Core members of the Project

Igor Fomenko – Ph.D., professor of Department of Engineering geology, Russian State geological Prospecting University;

Daria Shubina – master, Senior Lecturer of Department of Engineering geology, Russian State geological Prospecting University;

Margarita Novgorodova – master, Senior Lecturer of Department of Engineering geology, Russian State geological Prospecting University.

4. **Objectives:**

Development and approbation of the landslides modeling methodology within historical natural-technical systems.

5. **Study Area:**

Different objects of Russian cultural heritage, including UNESCO cultural heritage sites.

6. **Project Duration:** 5 years

7. **Report**

1) Progress in the project (2025)

In 2025, the research team continued comprehensive studies of landslides threatening cultural heritage sites, focusing on both detailed local investigations and regional-scale hazard assessments. Particular attention was paid to objects where instrumental monitoring had already been launched in previous years, allowing the researchers to analyze temporal trends and verify modeling results.

Field and analytical work was carried out at several key sites, including the landslide-prone slopes of the Sparrow Hills in Moscow, historical complexes in the Moscow Region and Crimea, as well as selected territories in the North Caucasus and Karelia. For these areas, extended pseudostatic analyses of slope stability were updated using refined input data on geotechnical parameters, groundwater conditions and dynamic loading.

The project team further developed and tested GIS-based methods for landslide susceptibility assessment, building on experience gained in Tajikistan and Vietnam and adapting the methodology to Russian cultural heritage objects. Special emphasis was placed on the integration of frequency-ratio and fractal approaches with high-resolution digital elevation models and archival information on past landslide events.

Instrumental monitoring networks were enhanced at selected sites, including the landslide massif in the area of the metro bridge in the Kolomenskoye Museum-Reserve and slopes in the Vorobyovy Gory area. Geophysical surveys and repeated deformation measurements made it possible to detect zones of active displacement and to update stability calculations for critical slope sections.

Within the framework of cooperation with the Russian Science Foundation grant on landslides triggered by strong earthquakes in tectonically active regions of China and Russia, the project participants contributed case studies and modeling results relevant to cultural heritage protection. This collaboration helped to improve understanding of rock-slope failure mechanisms in historical mountain settlements and fortified structures.

The research team also actively presented the results at national and international conferences and workshops on engineering geology, landslide hazard and cultural heritage preservation. These activities facilitated exchange of experience, dissemination of methodological approaches and integration of the project outcomes into the broader scientific and professional community.

2) Planned future activities or statement of completion of the Project

In the coming period, the project team plans to continue detailed investigations of landslide processes in the vicinity of key cultural and historical monuments, with a focus on long-term monitoring and model validation. It is envisaged to expand the monitoring network, improve early-warning criteria and prepare practical recommendations for responsible authorities and site managers.

Particular attention will be given to the development of user-oriented GIS products and decision-support tools, allowing non-specialists to better understand landslide hazard levels and scenario outcomes. The project will also further strengthen cooperation with experts in archaeology,

architecture and conservation in order to integrate geological information into comprehensive heritage management plans.

3) Beneficiaries of Project for Science, Education and/or Society

- Ministry of Culture of the Russian Federation
- Russian Orthodox Church
- UNESCO
- Regional and municipal administrations responsible for cultural heritage protection
- Academic and educational institutions involved in engineering geology and geohazard studies

4) Results (e.g. publications)

The main results of the reporting period include:

Refined models of landslide stability for several cultural heritage sites, including updates of extended pseudostatic analyses and 3D numerical simulations based on Scoops3D and related tools.

Updated GIS-based landslide susceptibility maps for selected regions, integrating geomorphological, geological and hydrological factors with historical evidence of slope failures.

Enhanced instrumental monitoring datasets for key sites, including long-term deformation, groundwater-level and geophysical observations.

Scientific papers submitted or prepared on landslide mechanisms in historical natural-technical systems and on methodologies for hazard assessment at cultural heritage objects.

Educational and outreach activities, such as lectures and seminars for professionals and students on landslide hazard assessment and protection of cultural heritage