Analysing multiple interrelationships between environmental and societal processes in mountainous regions of Georgia

Subproject B: Climate change and mass wasting events

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Project Summary

Georgia is one of the former Soviet Union states that have undergone dramatic transformation processes since its declaration of independence in 1991. Processes like privatisation of land and implementation of new organisational structures for land management and product delivery have caused environmental problems such as land degradation, soil erosion, and decrease in biodiversity. Climate change has aggravated environmental problems resulting in additional societal changes such as pauperisation followed by migration. Thus, research that aims to foster sustainable land use, land development, and quality of life in this part of the world is urgently needed. In this context, this research project aims at developing and applying an interdisciplinary and multi-scale approach, focussing on two study regions in the Greater and in the Lesser Caucasus Range of Georgia. The research concentrates on mountainous regions (>1,000 m above see level), since mountainous areas cover about 55 % of the nation's territory. Environmental and societal processes in these regions may strongly affect landscape functions (e.g., production function, habitat function) and the socio-economic development (e.g., food supply, expansion of tourism), not only there, but also in more densely populated low-lying areas of Georgia. Thus, our research in mountainous regions may also contribute to a more sustainable development of Georgia. The project is divided into four well coordinated subprojects (A, B, C, D).

Research topics and aims of subproject B: "Climate change and mass wasting events"

The number and dimension of mass wasting events have increased in the recent past in the project areas, especially in the Kazbegi region. In the Bakuriani region, pipeline construction and related work has led to vast terrain disturbances with slope instabilities. The origin of these processes is not fully understood, especially the contribution of climate and land use change in the post Soviet period. This problem will be analysed in the subprojects B1 and B2, and future risk zones will be identified.
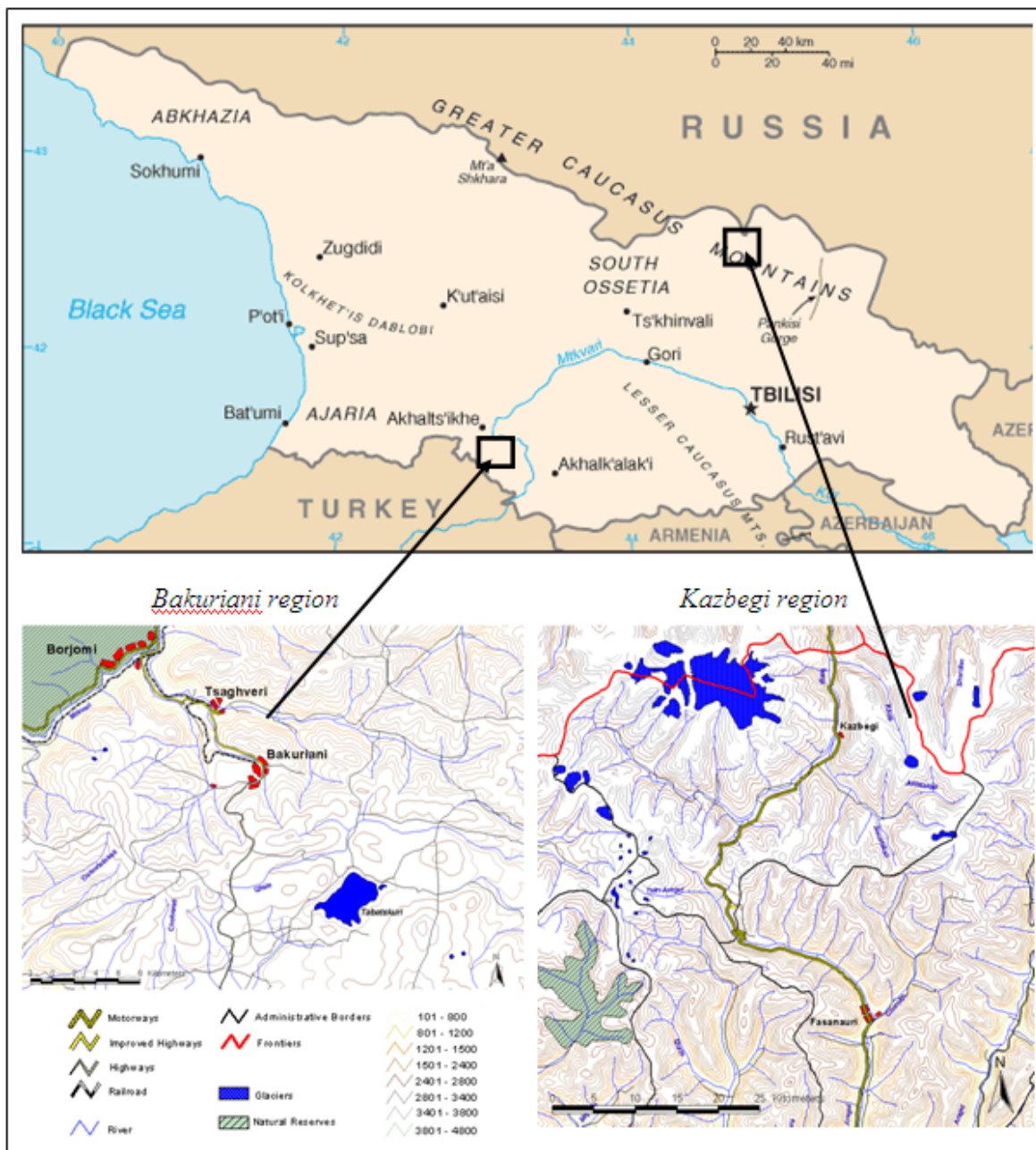
Study regions in the Greater and Lesser Caucasus Range

B 1. Climate change

Subproject B1 aims (i) to identify trends, and to model changes of air temperature and precipitation amount and variability. Furthermore (ii), glacier retreat, and related surface run-off in the study regions will be quantified. The research will be based on existing studies that analyse climate data from selected Georgian climate stations from 1961-1990 and additional climate data, where available from 1950-2007, and (ii) on remote sensing techniques, and run-off data analysis considering these time periods.

With respect to (i), the deviation from averages are considered at high temporal and spatial resolution, and extreme climate events will be detected and analyzed. Regional climate scenarios will be developed for 2020 and 2050, based e.g. on the general circulation coupled model HadCM3. With respect to (ii), remote sensing data from ASTER will be used to localise and quantify past glacier retreat in the Kazbegi region. Estimations on future water run-off regimes (including effects of retreat of Kazbegi glaciers) will be modelled in consideration of the developed regional climate scenarios.

Main links to other subprojects: The results concerning past climate change and future scenarios will be essential for the understanding of changes in landscape structure / land use (subproject A) and phytodiversity (subproject C). Further on, results on glacier, permafrost and snow cover retreat, and run-off will scenarios be indispensable for subprojects B2. All scenario results will be essential for the interdisciplinary formulation of recommendations on sustainable land use and land development.

B 2. Mass wasting events

Subproject B 2 aims at strengthening the understanding of the often catastrophic mass wasting events. The degree of soil degradation will be evaluated in relation to climate data and land-use changes. Geological and soil information of the project region will be saved in a GIS. Remote sensing data, especially existing and available air photos from the time period between 1960 and today will be used to localise, to categorize and to quantify past mass wasting events. Additional ASTER imagery data is also suitable for this analysis. Including the recent knowledge on mass wasting processes, our results will be related to environmental data such as soil data (including permafrost occurrences), topographical data derived from a digital elevation model, climate data (including extreme precipitation events) and data on run-off regimes (project part B1), data on earthquakes, data on land-use change (subproject A), and data on root-soil systems (subproject C). Possible mass wasting events related to the glacier retreat and run off extremes (project part B1) will be analysed, and high-risk zones for future mass wasting events will be localised on a risk map.