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CaTeNA – Climatic and tectonic natural hazards in Central Asia

Client II – International partnerships for sustainable innovations

Central Asia is one of the most tectonically active regions of the world and is influenced by two major climate systems: the westerlies and the monsoon. "CaTeNA" examines the two most serious natural hazards arising from these conditions: earthquakes and mass movements such as landslides. The goal is to better understand the underlying processes and triggering factors and to better estimate the resulting risks.

Natural hazards in Central Asia

The mountain regions of Central Asia are very severely threatened by natural hazards, in particular earthquakes and mass movements. As Central Asia's population, infrastructure and wealth grow, so too does their vulnerability to natural hazards increase. While the risk associated with earthquakes is readily apparent, the threat of mass movement events is often underestimated. In fact, in Central Asia, and especially in the Tian Shan and Pamir regions, strong earthquakes in the past have often been accompanied by destructive landslides and avalanches which claimed a large number of casualties.

Risk and vulnerability assessments

Risk and vulnerability assessments are therefore a key task in preparing Central Asian states and communities for such extreme recurrent events. However, these also require a deeper understanding of the processes that underlie natural hazards as well as deeper insights into their timescales, rates and interconnections. In order to explain such correlations, in addition to recording observable changes, for instance of the climate or the tectonic activity, investigations must be carried out on the long-term process sequences which go beyond the time scales of instrumental recordings as well as their dimensions and causes.

A building in Kyrgyzstan destroyed by the magnitude 6.8 Nura earthquake.

Central Asia lacks widely available data and tools to better understand the causes of natural disasters and their associated risks to the population. The "CaTeNA" joint project addresses this deficit. It aims to generate new insights, data, products and services and to provide them to authorities, non-governmental organizations, educational and research institutions or other interested parties.

Knowledge of the local tectonic conditions is a central prerequisite for the assessment of natural risks such as earthquakes and mass movements in mountain regions. For this purpose, "CaTeNA" localizes tectonic distortions and determines deformation rates and their changes. The project will determine and describe the localization of deformation to disturbances and its association with the occurrence of mass movement events in the most tectonically active zone of Central Asia, the deformation belts of the Pamir and Tian Shan mountains, over the last 10 million years. Investigations will be conducted at the two most active disturbance sites, the Main Pamir Thrust and the Darvaz Fault, in order to determine the offset rates of the opposing tectonic plate segments and the recurrence intervals of large earthquakes as well as to enable a better understanding of their relationship to mass movements. The current deformation field is to be characterized and quantified using the methods of space geodesy and seismology. In addition to earlier and parallel studies, "CaTeNA" focusses on the north and northeast of the Pamir Mountains, where three major high magnitude earthquakes occurred during the last year. The results will be incorporated into the openly accessible Central Asian Tectonic Database, which is to be developed as part of the project, thus making them accessible to the public, stakeholders and decision-makers. This data will form the basis for a more accurate assessment of earthquake and landslide risks.

Temporary seismic station in the Pamir Mountains.

Long-term goal: early warning system

Another important goal of the project is to develop and implement a dynamic risk assessment for landslides, which includes current seismic soil motion maps and high-resolution, model-based precipitation and snow-melt maps. This allows for an improved estimation of the effects of geological hazards on inhabited areas and transport infrastructure, for example. Direct and efficient risk communication will be achieved through interactive visualization based on a dynamic multilingual online GIS platform. This is an essential step towards creating an early-warning system that takes into account the most important triggering factors.

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