Within the framework of the BMBF funded project **YANGTZE GEO** (2012 - 2015), German and Chinese scientists jointly focus on the ecological and geological risks in the reservoir of the Three Gorges Dam after the impoundment of the Yangtze River and its tributaries. Together with their Chinese partners from the China University of Geosciences in Wuhan and the Chinese Academy of Sciences, five German research groups conduct collaborating studies on soil erosion, mass movements, diffuse matter inputs, and sediment pathways. An integrative approach was set up in order to combine multi-scale investigation methods and state-of-the-art techniques from soil science, geology, hydrology, geophysics, geodesy, remote sensing, and data survey and monitoring.

Together with its partner network **YANGTZE HYDRO**, **YANGTZE GEO** will contribute to a better understanding of the dimensions and dynamics of the ecological consequences of such large dam projects at the Yangtze River and worldwide.

Project Partner

University of Tübingen, Department of Geosciences, Physical Geography and Soil Science, Tübingen, Germany

University of Erlangen-Nuremberg, Department of Applied Geology, Erlangen, Germany

DMT GmbH & Co. KG, Exploration & Geosurvey, Essen, Germany

University of Kiel, Department of Hydrology and Water Resources Management

University of Trier, Remote Sensing and Geoinformatics Department, Trier, Germany

China University of Geosciences, Department of Geotechnical Engineering and Engineering Geology, Wuhan, China

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YANGTZE GEO 2012 - 2015

Sino-German BMBF collaborative research project

YANGTZE PROJECT

Introducing

The Three Gorges Dam (TGD) is among the most prominent human-induced examples for large-scale environmental impacts. Due to the flooding alongside the Yangtze River and its main tributaries, the region is largely characterized by an enormous boost of typical georisks such as soil erosion, mass movements, and diffuse matter inputs.

Within the immediate reservoir area, the uphill-movement of farmers to the steep sloping uphill sites can result in a high conflict potential between the available and suitable land. Combined with a very steep topography, subtropical monsoon climate, and fragile soils, the population pressure and rapid ecosystem changes still foster the ecological and geological consequences and environmental risks of the TGD.

Subproject 'Soil Erosion'

'Mechanisms and control factors of soil erosion by water in the Three Gorges Dam ecosystem'

The subproject Soil Erosion, situated at the University of Tübingen, aims at a deeper understanding of the mechanisms and control factors of soil erosion by water in highly dynamic mountainous ecosystems. A specific modeling approach will be developed that allows to predict soil loss on terraced land and the subsequent sediment pathways under changing climate and land use. Worldwide in mountainous regions, terracing serves as key technology for sustainable land management. Terrace maintenance and conditions control their functioning with respect to soil loss and food production. Therefore, new methods to incorporate terracing in soil erosion modeling serve as important tool for environmental and resource planning aiming at sustainable land management. Data on long-term average soil loss for different land use and climate change scenarios and the identification of areas at risk for soil erosion will be used to create a monitoring and measuring network and early warning system for soil erosion.

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Subproject 'Mass Movements'

'Identification, modeling, and early-warning of mass movements in the area of influence of the Three Gorges Dam'

The goal of the subproject `Mass Movements` at the University Erlangen-Nuremberg is the development and application of a method to analyze the risk of landslides and mass movements by using Geographic Information Systems and Artificial Neuronal Networks. The study pursues to assess the dependencies of landslide processes from external factors such as precipitation and seasonal water level fluctuations at the TGD. The methodological framework includes the geotechnical mapping of mass movements in test sites and a detailed investigation of landslides classified as potentially extreme hazardous. Generally, the spatial distribution of control factors such as lithology and terrain parameters will be analyzed using digital elevation models and remote sensing data. A three-dimensional dynamic model will be developed in order to simulate the mass movements. Hereby, the focus lies on the threshold values for the activation of mass movements in order to include them into the monitoring and early-warning system. Finally, the subproject 'Mass Movements' will transfer the applied methods regarding classifications, analyzes and monitoring onto further regions in China. Thereby large-scale risk maps and concepts for monitoring with respect to early-warning systems will be obtained.

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Subproject 'Monitoring'

'Quantifcation of geogene structures and processes by geophysical and geodetic monitoring (Ground Truth)'

The subproject 'Monitoring' deals with the identification of geohazards and the development of geomonitoring systems. It will obtain data for model parameterization and process studies in context of YANGTZE GEO. Methodologically, the subproject 'Monitoring' applies tools referring to seismoacoustics and terrestrial radarinterferometry. Furthermore, a feasibility study on the application of hydroacoustic methods will be conducted. Seismoacoustics and terrestrial radarinterferometry observe and analyze changes of the earth surface as well as of the deeper subsurface by state-of-the-art, high precision, and sensitive tools. The hydroacoustic feasibility study aims at the potential in order to analyze the structure, composition and changes of the sediment in the reservoir of the TGD. The challenges of the studies are: (i) the identification of weak seismic signals from mass movements in the subsurface by seismoacoustics, (ii) the assessment of slope movements within a range of millimetres by radarinterferometry, (iii) the modeling of upheaval-and drawdown-processes by stochastic and dynamic 3D model approaches, (iv) a feasibility study to improve data quality of the sediment structure by hydroacoustics. Within the joint research of YANGTZE GEO, the industrial project partner DMT will refine own developments and participate in the scientific work of further subprojects. In the long-term, the subproject 'Monitoring' pursues the technical development of systems for scientific and commercial use.

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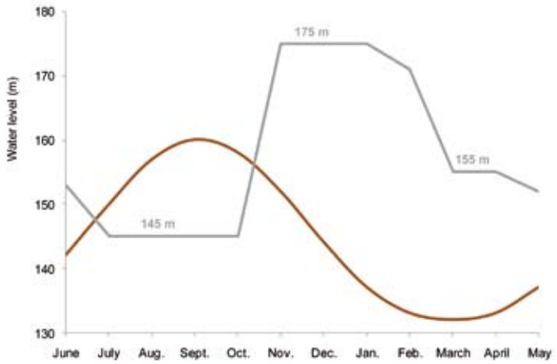

Seasonal water level of the natural, unregulated Yangtze before impoundment (red line, water level is not scaled, at Yichang the water level is 70 to 80 m a.s.l. in June) and water level of the regulated Yangtze River after impoundment (grey line, data from CAS Institute of Hydroecology).

Subproject 'Diffuse Matter Inputs'

'Ecohydrological and hydraulic modeling of water quantity and quality under land use change – a spatially distributed analysis in the Three Gorges Dam Region'

The goal of the subproject `Difuse Matter Inputs`, situated at the University of Kiel, is a model-based, spatially and temporally differentiated simulation of the water budget as well as the balance of difuse matter such as phosphorus and sediment. The ecohydrological model SWAT (Soil and Water Assessment Tool) is used to assess the impact of land use change on catchment scale. Based on the results of the first project phase (2009-2011), the simulation of water quantity and quality of the Xiangxi Catchment will be refined by additional field and literature research. SWAT results will be used as boundary conditions for the parameterization of the one-dimensional hydraulic model HEC-RAS, which can contribute to a better assessment of in-stream processes. Both models will be used for the simulation of land use scenarios in order to quantify the impacts of past and possible future land use changes in the Xiangxi Catchment. After successful implementation of both models, the applicability of the linked model system will be tested in two additional watersheds, the Daninghe and the Xiaojiang Catchments. Results from all three watersheds will be used in order to develop sustainable land use and management alternatives for the Three Gorges Region, which can aid the adjustment of the local agriculture to the new environmental conditions and challenges created by the construction of the TGD. The use of open source software facilitates the transferability of the model system to large dam projects in other regions of China and all over the world.

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Subproject 'Remote Sensing'

'Remote sensing-based assessment and evaluation of the land use change and biophysical characteristics of the vegetation at the Yangtze River'

The subproject 'Remote Sensing' resided at the University of Trier pursues the assessment and analyses of dynamic processes taken/taking place before and after the start of operation of the TGD. Further focus lies on the derivation of the spatial and temporal surface characteristics that will be also used for process studies, for instance for soil erosion modeling. The methodological framework covers the (i) preparation and supply of spatially quantitative and qualitative geobasis data and data preprocessing, (ii) multi-temporal land use classification from recent and historical remote sensing data, (iii) conduction of reference data and derivation of the leaf area index and the land use cover, (iv) spectral reference measurements of the dominant soil types and classification of the lithology in the area of Badong, and creation of a high-resolution digital elevation model using terrestrial laser scanning, and (v) assessment of the land use changes and the TGD reservoir. The results of the subproject 'Remote Sensing' will serve as important input for the process studies in the other subprojects and for further remote sensing-based analyses. All developed algorithms and source codes will be available for the joint research project and the scientific community.

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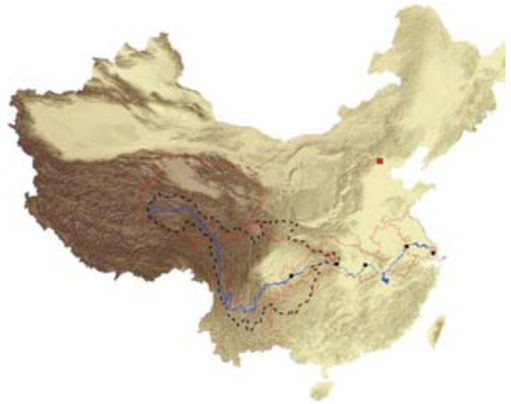

The stream of the Yangtze River at a length of 6,380 kilometers in China (blue line) from the Quinghai Tibetan Plateau into the East China Sea. The black dashed line marks the upper Yangtze catchment from the Three Gorges Dam upstream. The red line marks the borders of the provinces. The black squares symbolize the cities Chongqing, Yichang, Wuhan, Nanjing, and Shanghai from West to East. The Three Gorges Reservoir reaches fom Yichang (Three Gorges Dam) to Chongqing at a length of 660 km.