EGU24-14201, updated on 13 Aug 2024
https://doi.org/10.5194/egusphere-egu24-14201
EGU General Assembly 2024

Assessing instability of slow-moving landslides over Three Gorges area using InSAR techniques considering hydrogeological triggering factors

Zhuge Xia[1,2], **Mahdi Motagh**[1,2], Wandi Wang[1,2], Tao Li[3], Mimi Peng[4], and Chao Zhou[1,5]
[1]Section of Remote Sensing and Geoinformatics, GFZ German Research Centre for Geosciences, Germany (zhuge@gfz-potsdam.de)
[2]Institute for Photogrammetry and Geoinformation, Leibniz University Hannover, Germany
[3]GNSS Research Centre, Wuhan University, China
[4]Department of Remote Sensing Science and Technology, School of Electronic Engineering, Xidian University, China
[5]School of Geography and Information Engineering, China University of Geosciences, China

Since the first impoundment in 2003 of the Three Gorges Reservoir (TGR), one of the largest reservoirs in the world, the issues of slope instability in the Three Gorges Area (TGA) have attracted significant worldwide attention. The operation of TGR, coupled with anthropogenic activities, has influenced slope instability and reactivation of plenty of landslides in the region. This study introduces a methodology to assess the slope instabilities over TGA using advanced integration of hydrological triggering factors with multi-temporal InSAR (MT-InSAR) techniques.

Our approach involves characterizing the transient deformation of reservoir bank slopes under the coupling effect of rainfall and reservoir water level (RWL) changes. To achieve this, we propose a methodology that uses MT-InSAR analysis and regression analysis to identify triggering factors, taking into account the periods when slope instability is influenced by the drainage/storage period of the reservoir and seasonal rainfall. Determining the optimal window size for the triggering factors involves iterative searching through wavelet analysis, considering the time-lag between rainfall and RWL data. To extract step-like kinematic features for slowing-moving landslides, we apply a constrained least-squares optimization to InSAR-derived displacement time series. We then use independent component analysis (ICA) to isolate and recover the dominant source features, facilitating unsupervised spatiotemporal clustering to elucidate slope kinematics.

This study utilized nearly 100 high-resolution Spotlight TerraSAR-X (TSX) and 50 medium-resolution Sentinel-1 (S1) SAR images captured between 2019 and 2021 to assess the slope instability. Here, we first test our proposed approaches for the single Huangtupo landslide in the TGA, which is one of China's largest reservoir-wading landslides along the Yangtze River; then, the approaches have been expanded to the whole study region near the Badong County. Overall, our proposed framework is transferable and can be applied to other local landslide or regional studies for monitoring slope instability and analyzing complicated cascading hazard chains.