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Displacement prediction of Shengjibao landslide based on an ensemble model in Three Gorges Reservoir Area, China

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The Three Gorges Reservoir area (TGRA) is one of the most landslide-prone areas in China. Landslide prediction is important for the mitigating of geohazards and it is also an essential component for developing landslide early warning systems. In the TGRA, the preparatory, triggering and controlling factors of landslides are very diverse. The local geological conditions and variations in the controlling factors result in pulsed movements of landslides, the so-called “step-like” deformation of landslides. Most of the existing predictive models are based on a single algorithm including static models and dynamic models. This study proposes an Ensemble model combined with a static model and a dynamic model which combined the advantages of the two models for landslide displacement prediction.

Based on displacement monitoring data of the Shengjibao landslide in the Three Gorges Reservoir area(TGRA), which is not a typical “step-like” landslide but with the “step-like” characteristic in its displacement-monitoring curve, long short-term memory neural networks (LSTM) model, support vector regression (SVR) model and an Ensemble model based on LSTM model and SVR model were proposed to predict its displacement. Moving average methods (MAM), were used to decompose the cumulative displacement into two parts: trend and periodic terms. The single-factor LSTM model and the single factor SVR model were proposed to predict the trend terms of displacement. Multi-factors LSTM model and multi-factors SVR model were proposed to predict the periodic terms of displacement. Precipitation, reservoir water level, and previous displacement are considered as the candidate factors for the multi-factors LSTM model and the multi-factors SVR model predictions. Meanwhile, an Ensemble model combined with the LSTM model and the SVR model was also proposed to predict the decompositions of displacement.

The results show that the LSTM model and the SVR model display good performance, the Ensemble model outperforms the other models, and the prediction accuracy can be improved by considering advantages from different models.

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