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Kinematic behaviour of a large landslide in the three gorges reservoir – Constraints from field monitoring

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It has been well recognized that activities of landslides in a reservoir are strongly influenced by the reservoir's filling-drawdown circles. However, kinematic behaviour of landslides in a reservoir varies due to their difference in slope geometry and properties of slope forming materials. Chaiwan landslide, one of the representative old landslides in the three gorges reservoir of China with a volume of about 2,000,000 m3, has shown a clear sign of reactivated deformation shortly following operation of the reservoir evidenced by both occurrence of surface cracks and field monitoring data. Field monitoring data during the period from 2007 and 2015 revealed that the reactivity of landslide varies both spatially and temporally. In terms of spatial reactivity, middle and lower part of the landslide has been reactive, while its upper part shows no evidence of instability. Inclinometer monitoring disclosed that active part of the landslide has been slowly deformed along three slip zones at different depths and with relatively strongest deformation along the slip zone at the shallow depth. Data from GPS and inclinometer monitoring indicated that the landslide's lower part has been experienced stronger deformation than its middle part, suggesting the landslide's spatial kinematics is of retrogressive nature. In terms of temporal reactivity, the landslide deformation displayed quite different behaviour during the reservoir's filling and drawdown phases. Both surface and subsurface displacement of the landslide had a sharp increase following each drawdown of the reservoir with a delay of 7 to 10 days, while its displacement had a gentle increase during the reservoir's filling phases. This gives two indications that the reservoir's drawdown has a stronger influence on the landslide's instability than its impoundment, and that the landslide has been experienced a progressive failure during the filling phases. Moreover, the landslide's deformation nonlinearly increase with the reservoir's drawdown rate, implying that control of the reservoir's drawdown rate may be critical to prevent the landslide from rapid displacement. It is further analysed that spatial kinematics of landslide should be attributed to geometry of the landslide' slope surface and its slip zones, while the landslide' temporal behaviour is largely related complex hydrogeological response of the landslide's materials to the reservoir's drawdown and filling circles and occurrence of different groundwater, including both phreatic and artesian water.