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Synchronous glacier surge events observed in the West Kunlun Shan, Xinjiang, China

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High Mountain Asia is a major centre of glacier surge activity, but the precise surge mechanisms in the region are poorly understood. Satellite-based studies in the region describe unusual surge characteristics that appear to be explained poorly by either of the two classic surge mechanisms (hydrological and thermal surging) firmly established in the literature. Here, we present a record of surging in a ∼40 x 60 km zone of the West Kunlun Shan (WKS), Xinjiang, a poorly researched range ∼250 km northeast of the Karakoram. We use a combination of historic satellite imagery and cross-correlation feature tracking to expand the record of surging in the region and assess surge dynamics.

We use the 1972—2016 Landsat satellite record to observe a total of 9 surge active phases in the past four decades. Of these, 2 occur prior to 2000, but the remaining 7 display a highly unusual near-synchronous surge onset in the 2006—2008 period. This synchronous surge behaviour has not previously been reported for discrete unconnected glaciers. Additionally, the surge characteristics showed similar surge characteristics to those observed in the Karakoram, notably low peak velocities (2—3 m day^{-1}) reminiscent of thermal surges and short active phase periods (∼2-5 years) reminiscent of hydrological surges. We suggest that such observations are indicative of surging via a 'hydro-thermodynamic' mechanism, recently proposed for the Basin-C outlet of Austfonna, Svalbard. In this mechanism, high surface melt rates can raise the temperature of cold-based ice over relatively short timescales compared to thermal surges by rapidly transmitting energy to the base, facilitating enhanced flow by ice deformation. This hypothesis is supported by meteorological data, which show that the 2006-2008 period was marked by a series of all-time highs in seasonal temperatures in southern Xinjiang, suggesting that high surface melt is a valid mechanism by which these surges could have initiated.