Estimation of multi-period glacier mass balance in southeast Tibet using high-resolution remote sensing observations

Yushan Zhou¹,², Zhiwei Li², Xin Li¹, and Donghai Zheng¹
¹National Tibetan Plateau Data Center, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China (yszhou@itpcas.ac.cn)
²School of Geosciences and Info-Physics, Central South University, Changsha, Hunan, China (zwli@csu.edu.cn)

Glaciers in the southeastern part of the Tibet Plateau (TP) have experienced the most rapid mass loss over the High Mountain Asia. Hence, a multi-period investigation on the mass balance with focus on how glaciers evolve is imperative for better understanding of the glacier dynamics responding to climate change. Taking the Yanong glacier connected with a proglacial lake in the southeast TP as an example, we estimate the glacier mass budget at multiple-year and interannual timescales via reproducing a multiple-period DEM datasets, including KH-9 (1975), SRTM (2000), TanDEM-X (2011−2014) and SPOT-7 (2015) DEMs. We also estimate the penetration depths of both X- and C-band radar using Pléiades stereo images and TanDEM-X data, which are found to be 3.2 m and 4.5 m on average in this area. The results show that the Yanong glacier has been subject to an accelerated mass loss over the past four decades (1975−2015), and the tendency of surface thinning spread from low altitudes to high altitudes. Specifically, the mass balance of the Yanong glacier changes from $-0.50 \pm 0.13$ m w.e./a (1974−2000) to $-0.95 \pm 0.13$ m w.e./a (2000−2012) and to $-1.02 \pm 0.31$ m w.e./a (2012−2015) at the multi-year timescale. A serious surface subsidence event is noted in areas that are about 2 km away from the glacier fronts after 2012, which are possibly caused by the internal/basal melting or collapsing. After further analyzing the evolution process of the proglacial lake, we found that the continuous disintegration of the glacier fronts may be the main reason for the accelerated mass deficit.