**Supporting Information**

Contents of this file

**Table S1** and **S2**

**Fig. S1**, **S2**, and **S3**

**Table S1**. Landsat images used for the generation of area, length, and surface velocity for Longbasaba Glacier, and area for Longbasaba Lake. The areas and lengths of the glacier/lake were obtained based on Bands 3/4/5 of TM/ETM+ sensor, or Bands 2/5/6 of OLI sensor. The surface velocities of the glacier were calculated from Band 4 of TM/ETM+/OLI sensor.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ID** | **Image ID** | **Date** | **Sensor** | **Time interval (days)** | **Usage** |
| 1 | LT51390411988256BKT00 | 1988-09-12 | TM | - | Glacier area, length, and surface velocity; lake area |
| 2 | LT41390411989266XXX01 | 1989-09-23 | TM | 376 | Glacier area, length, and surface velocity; lake area |
| 3 | LT51390411990165BKT00 | 1990-06-14 | TM | 264 | Glacier area, length, and surface velocity; lake area |
| 4 | LT51390411991264BKT00 | 1991-09-21 | TM | 464 | Glacier area, length, and surface velocity; lake area |
| 5 | LT51390411992267BKT00 | 1992-09-23 | TM | 368 | Glacier area, length, and surface velocity; lake area |
| 6 | LT51390411993285BKT00 | 1993-10-12 | TM | 384 | Glacier area, length, and surface velocity; lake area |
| 7 | LT51390411994272ISP00 | 1994-09-29 | TM | 352 | Glacier area, length, and surface velocity; lake area |
| 8 | LT51390411995099BKT01 | 1995-04-09 | TM | 192 | Glacier surface velocity |
| 9 | LT51390411995211BKT00 | 1995-07-30 | TM | - | Glacier area and length; lake area |
| 10 | LT51390411996294ISP00 | 1996-10-20 | TM | 560 | Glacier area, length, and surface velocity; lake area |
| 11 | LT51390411997184BKT01 | 1997-07-03 | TM | 256 | Glacier area, length, and surface velocity; lake area |
| 12 | LT51390411998283BKT00 | 1998-10-10 | TM | 464 | Glacier area, length, and surface velocity; lake area |
| 13 | LT51390411999142BKT00 | 1999-05-22 | TM | 224 | Glacier area, length, and surface velocity; lake area |
| 14 | LT51390412000289BKT01 | 2000-10-15 | ETM+ | 512 | Glacier area, length, and surface velocity; lake area |
| 15 | LE71390412001299SGS00 | 2001-10-26 | ETM+ | 376 | Glacier area, length, and surface velocity; lake area |
| 16 | LE71390412002302SGS00 | 2002-10-29 | ETM+ | 368 | Glacier area, length, and surface velocity; lake area |
| 17 | LT51390412003329BKT00 | 2003-11-25 | TM | 392 | Glacier area, length, and surface velocity; lake area |
| 18 | LT51390412004284BKT00 | 2004-10-10 | TM | 320 | Glacier area, length, and surface velocity; lake area |
| 19 | LT51390412005286BKT00 | 2005-10-13 | TM | 368 | Glacier area, length, and surface velocity; lake area |
| 20 | LT51390412006289BKT00 | 2006-10-16 | TM | 368 | Glacier area, length, and surface velocity; lake area |
| 21 | LT51390412007276BKT01 | 2007-10-03 | TM | 352 | Glacier area, length, and surface velocity; lake area |
| 22 | LT51390412008295BKT00 | 2008-10-21 | TM | 384 | Glacier area, length, and surface velocity; lake area |
| 23 | LT51390412009265KHC00 | 2009-09-22 | TM | 336 | Glacier area, length, and surface velocity; lake area |
| 24 | LT51390412010172KHC00 | 2010-06-21 | TM | 272 | Glacier surface velocity |
| 25 | LE71390412010276SGS00 | 2010-10-03 | ETM+ | - | Glacier area and length; lake area |
| 26 | LT51390412011159BKT00 | 2011-06-08 | TM | 352 | Glacier area, length, and surface velocity; lake area |
| 27 | LE71390412012282PFS00 | 2012-10-08 | ETM+ | - | Glacier area and length; lake area |
| 28 | LE71390412013284SG100 | 2013-10-11 | ETM+ | - | Glacier area and length; lake area |
| 29 | LC81390412013356LGN01 | 2013-12-22 | OLI | 928 | Glacier surface velocity |
| 30 | LC81390412014279LGN01 | 2014-10-06 | OLI | 288 | Glacier area, length, and surface velocity; lake area |
| 31 | LC81390412015282LGN01 | 2015-10-09 | OLI | 368 | Glacier area, length, and surface velocity; lake area |
| 32 | LC81390412016285LGN01 | 2016-10-11 | OLI | 368 | Glacier area, length, and surface velocity; lake area |
| 33 | LC81390412017303LGN00 | 2017-10-30 | OLI | 384 | Glacier area, length, and surface velocity; lake area |
| 34 | LC81390412018290LGN00 | 2018-10-17 | OLI | 352 | Glacier area, length, and surface velocity; lake area |



**Fig. S1.** (a) The Landsat image taken on 30 July 1995. This image is not suitable to obtain the glacier surface velocity due to the impact of the shadow of the cloud cover (yellow circle), and was just used to generate the glacier/lake outlines. (b) The Landsat SLC-off scene taken on 8 October 2012. The scanline error created obstacles in generating the glacier/lake outlines, but without the impact to identify the glacier front position.



**Fig. S2.** Processing of the reconstruction of the basin morphology for Longbasaba Lake. The original lake basin morphology was built from the sonar measuring points (Yao et al., 2012) with the lake boundary with the depth of 0 m (a), and then the original lake isobaths were generated (b). As the lake depths at the glacier front were not 0 m, the lake isobaths were modified by deleting the segments near the glacier front (c). The original glacier bed isobaths were extracted from the model of Farinotti and others (2019) (d). Based on the modified lake isobaths and the original glacier bed isobaths, these isobaths were manually extrapolated into the ‘hole’ region by taken into account the basin’s continuity (e). As the basin morphology at the downstream of the glacier was inconsistent with the shape of the ice cliff (d), the segment of the glacier bed morphology lower than the glacier terminus position in 2015 was not considered in the following processing. Based on the sonar point depths, the max glacier boundary, and the merged isobaths, the 2018 basin morphology was reconstructed (f).



**Fig. S3.** Sketch maps of the rope (a) and sonar (b) measurements. (a) PN is the true lake depth, NN’ is the lake basin bed, and PN’ is the lake depth obtained by the rope measurements. is the horizontal error contributed by the rope drift, equal to the mean distance of the rope drift. is the slope of the rope measurement point in the lake basin bed, and could be considered to be the mean slope of the lake basin. The rope measuring angle, . The vertical error controlled by the rope drift, . Here, we used the mean lake depth, , as the value of PN’. Then, the vertical error from the rope drift, . (b) PN is the true lake depth, NN’ is the lake basin bed, and P’N’ is the lake depth obtained by the GPS measurement. is the GPS horizontal error. The vertical error controlled by the GPS horizontal error, . The drift distances of the measuring rope, with a plumb attached to the end, were hard to be acquired exactly. Considering the still lake water and the heavy plumb, was assumed to be less than 1 m in this study, resulting a vertical error of ± 0.2 m. The horizontal precision of the echo sounding points acquired by the GPS receiver was about 3-6 m (Yao and others, 2012), leading to a vertical error of ± 1.5 m. According to the law of error propagation, the depth accuracy of sonar measurements, = ± 2.5 m. The parameters to estimate the lake depth accuracy of sonar measurements were listed in Table S2.

**Table S2.** Parameters to estimate the lake depth accuracy of sonar measurements, considering the sonar measuring error and horizontal errors controlled by the measuring rope drift and GPS horizontal errors.

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Mean lake depth, | 50.7 m |
| Mean slope of the lake basin, | 14.0° |
| Horizontal error |  |
| Rope measurements, | ± 1.0 m |
| GPS measurements, | ± 6.0 m |
| Measuring Angle, |  |
| Vertical error |  |
| Rope measurements, | ± 0.2 m |
| GPS measurements,  Sonar measurements, | ± 1.5 m  ± 2.0 m |
| Lake depth accuracy, | ± 2.5 m |

**Reference:**

**Farinotti D and 6 others** (2019). A consensus estimate for the ice thickness distribution of all glaciers on Earth. *Nature Geoscience* **12**(3), 168-173. doi:10.1038/s41561-019-0300-3.

**Yao X, Liu S, Sun M, Wei J and Guo W** (2012) Volume calculation and analysis of the changes in moraine-dammed lakes in the north Himalaya: a case study of Longbasaba lake. *Journal of Glaciology* **58**(210), 753-760. doi: 10.3189/2012JoG11J048.