Supplement of The Cryosphere Discuss., 8, 3629–3663, 2014
http://www.the-cryosphere-discuss.net/8/3629/2014/
doi:10.5194/tcd-8-3629-2014-supplement

The Cryosphere Discussions
Open Access

Supplement of

Climate regime of Asian glaciers revealed by GAMDAM Glacier Inventory

A. Sakai et al.

Correspondence to: A. Sakai (shakai@nagoya-u.jp)

Table S1. List of names of glaciers, locations, ELA observation periods, and acquired dates of Landsat images used to delineate glacier outlines in the GGI.

Glacier	Country	Geogr. Area	Lat	Long	ELA observation period and data source	LANDSAT acquired date (dd/mm/yyyy)	path	row
M. Aktru	Russia	Altai	50°05'N	87°45'E	1962–1999[1], 2000–2005[2]	22/07/2000	144	25
Abramov	Kirghizstan	Pamir	39°40'N	71°30'E	1968–1983, 1985–1998[1]	16/09/2000	152	33
Shumskiy	Kazakhstan	Dzhungariya	45°05'N	80°14'E	1967–1991[1]	18/09/1999	148	29
Ts. Tuyuksu	Kazakhstan	Tien Shan	43°00'N	77°06'E	1957–1999[1], 2000–2005[3]	09/09/1999	149	30
Kara-Batkak	Kirgizstan	Tien Shan	42°06'N	78°18'E	1976–1997[1], 1998[2]	25/08/2002	148	31
Golubina	Kirgizstan	Tien Shan	42°27'N	74°30'E	1972–1994[1]	24/08/2000	151	30
Urumqihe S. No 1	China	E.Tien Shan	43°05'N	86°49'E	1959–1999[1], 2000–2005[3]	17/09/2000	143	30
Xiao Dongkemadi	China	Tibet	33°10'N	92°08'E	1989–1995[4], 1996–2002[5]	15/05/2002	138	37
Shaune Garang	India	Himalaya	31°17'N	78°20'E	1982–1990[1]	05/08/2000	146	38

Dokriani	India	Himalaya	30°51'N	78°49'E	1993–1995, 1998–2000[6]	01/12/2002	146	39

[1]Dyurgerov (2002).

[2]WGMS (2005).

[3]WGMS (2008).

[4]Fujita et al. (2000).

[5]Pu et al. (2008).

[6]Dobhal et al. (2008).

Table S2. Summary of the location and period of AWS observed temperatures and solar radiation on or adjacent to glaciers.

Site	Latitude degree	Longitude degree	Altitude (m a.s.l.)	Period		Data source
				Temperature	Solar radiation	
Belukha	49.808	86.560	4100	25 Jul. 2002 –28 Apr. 2003	–	Okamoto et al. (2011)
Gregoriev	41.976	77.914	4600	13 Jul. 2005 – 8 Jun. 2007	13 Jul. 2005 – 8 Jun. 2007	Fujita et al. (2011)
Qiyi	39.254	97.752	4295	11 Jun. 2002 – 25 Aug. 2005	11 Jun. 2002 – 25 Aug. 2005	Sakai et al. (2006)
Xiao Dongkemadi	33.070	92.082	5600	22 Sep. 1991 –25 May 1994	22 Sep. 1991 – 25 May 1994	Fujita and Ageta (2000)
Rikha-samba	28.800	83.512	5270	1 Oct. 1998 – 4 Oct. 1999	–	Fujita et al. (2001b)
Yala	28.232	85.610	5090	28 Sep. 2008 – 12 Jun. 2010	28 Sep. 2008 – 12 Jun. 2010	Fujita and Nuimura (2011)
Tsho Rolpa	27.870	86.463	4540	8 Jun. 1993 – 12 Sep. 1996	8 Jun. 1993 – 12 Sep. 1996	Yamada (1998)
AX010	27.714	86.556	5247	21 Jun. 1995 – 24 Oct. 1999	–	Fujita et al. (2001a)
Lugge	28.099	90.284	4524	7 Oct. 2002 – 29 Sep. 2004	7 Oct. 2002 – 29 Sep. 2004	Suzuki et al. (2007)

1 Table S3. List of glacier names, locations, median elevations, and periods of winter balance data, in which winter balance was observed.

Glacier	Country	Geogr. Area	Lat	Long	Elev. Med, m	Period of winter balance data (1979–2000)	ave±σ (mm yr^{-1})
L.Aktru	Russia	Altaiy	50°05'N	87°44'E	3250	1988–1989, 1991–1995	790±225
M.Aktru	Russia	Altaiy	50°05'N	87°45'E	3200	1979–1999	659±106
Pr.Aktru	Russia	Altaiy	50°05'N	87°44'E	3000	1988–1989	1044±48
Abramov	Kirghizstan	Pamir	39°40'N	71°30'E	4200	1979–1995	1403±310
No.314	Kirghizstan	Pamir	39°21'N	70°08'E	3980	1983–1985	1253±155
Shumskiy	Kazakhstan	Dzhungariya	45°05'N	80°14'E	3660	1979–1991	600±196
Ts. Tuyuksu	Kazakhstan	Tien Shan	43°00'N	77°06'E	3770	1991–1995	451±161
No.131	Kirgizstan	Tien Shan	41°51'N	77°46'E	4151	1987–1990	498±85
Kara-Batkak	Kirgizstan	Tien Shan	42°06'N	78°18'E	3886	1979–1990	588±175
Golubina	Kirgizstan	Tien Shan	42°27'N	74°30'E	3970	1979–1994	630±169
Davidov	Kirgizstan	Tien Shan	41°50'N	78°12'E	4280	1984–1985	503±91
Sary-Tor	Kirgizstan	Tien Shan	41°50'N	78°11'E	4252	1985–1989	493±85
Qiyi	China	Qilian Shan	39°14'N	97°54'E	4720	1984–1985	317±116

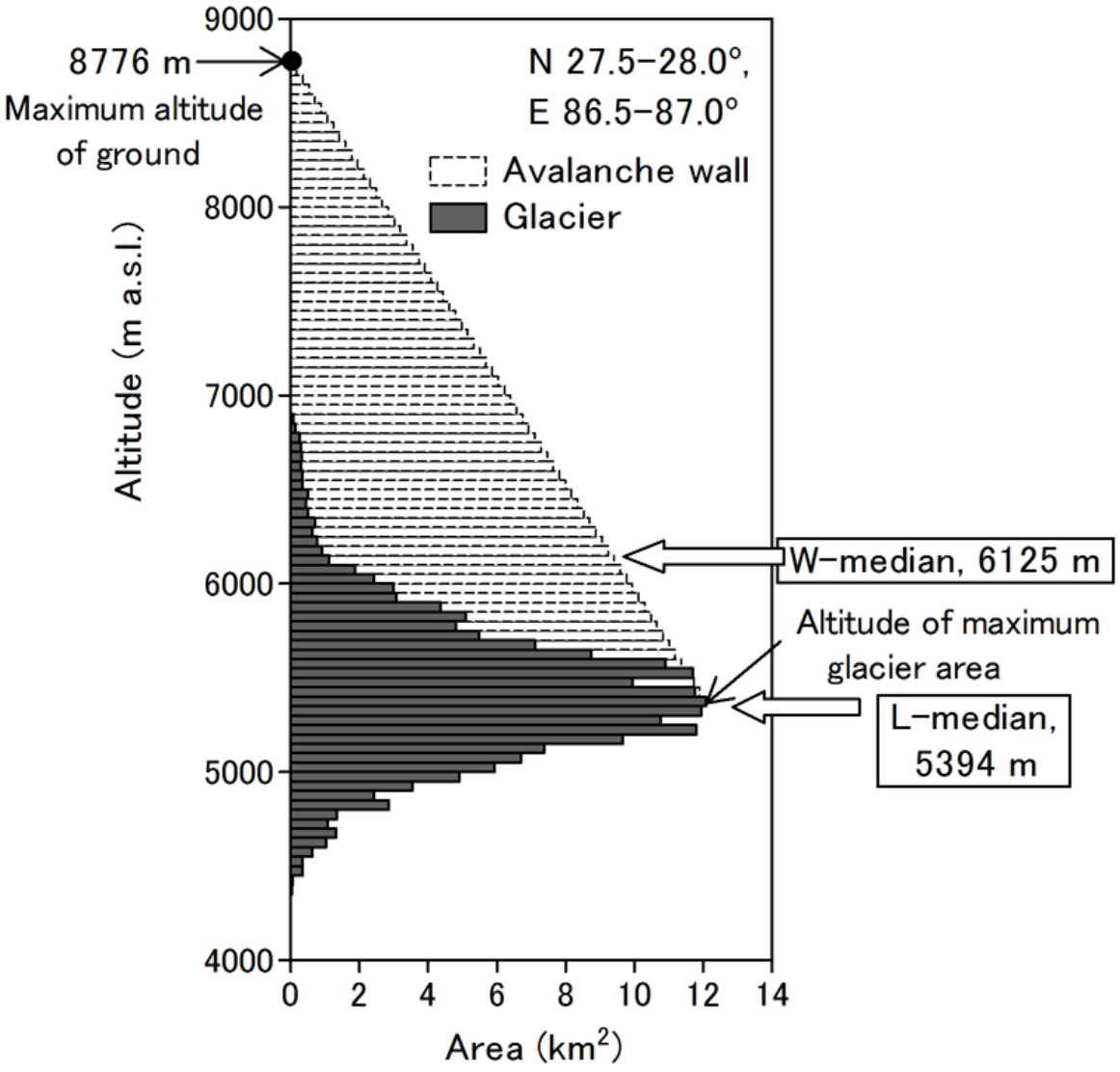


Fig. S1. Example of estimation for median glacier altitude, including steep avalanche walls (G-median elevation) at certain grids by area-altitude distribution. In this grid, median elevation was increased from 5394 m a.s.l. (L-median elevation) to 6125 m a.s.l. (W-median elevation) by taking into account the steep avalanche wall.

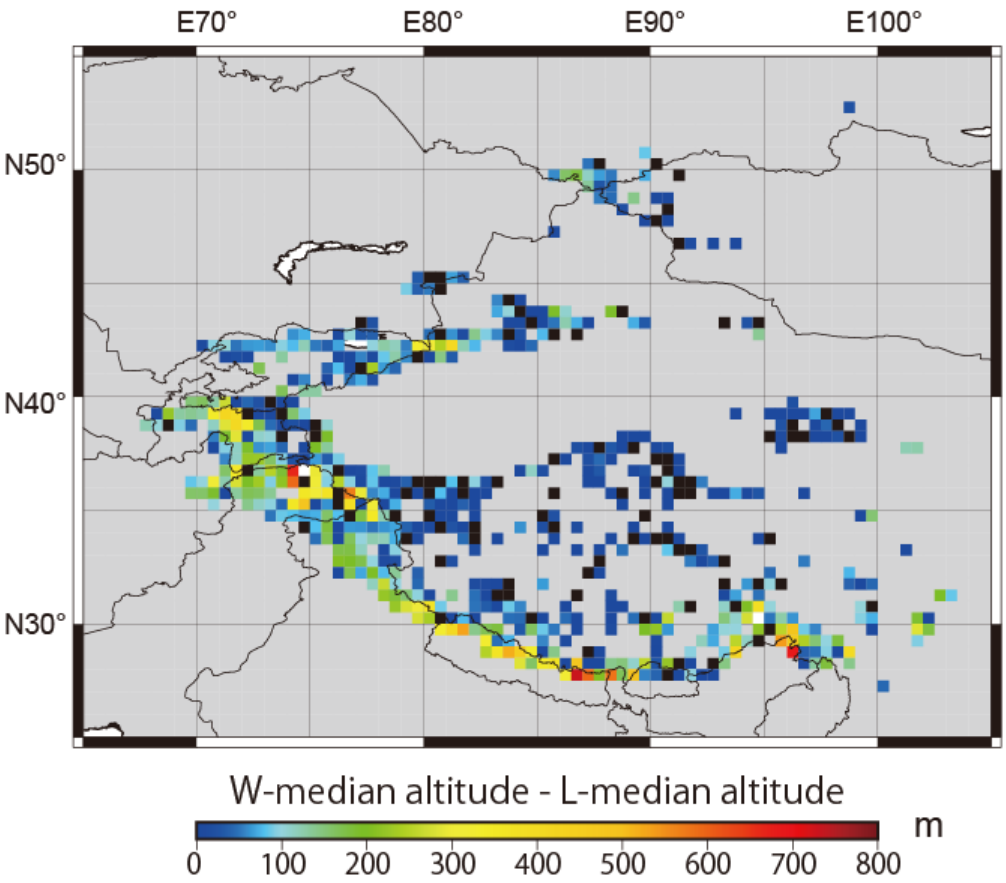
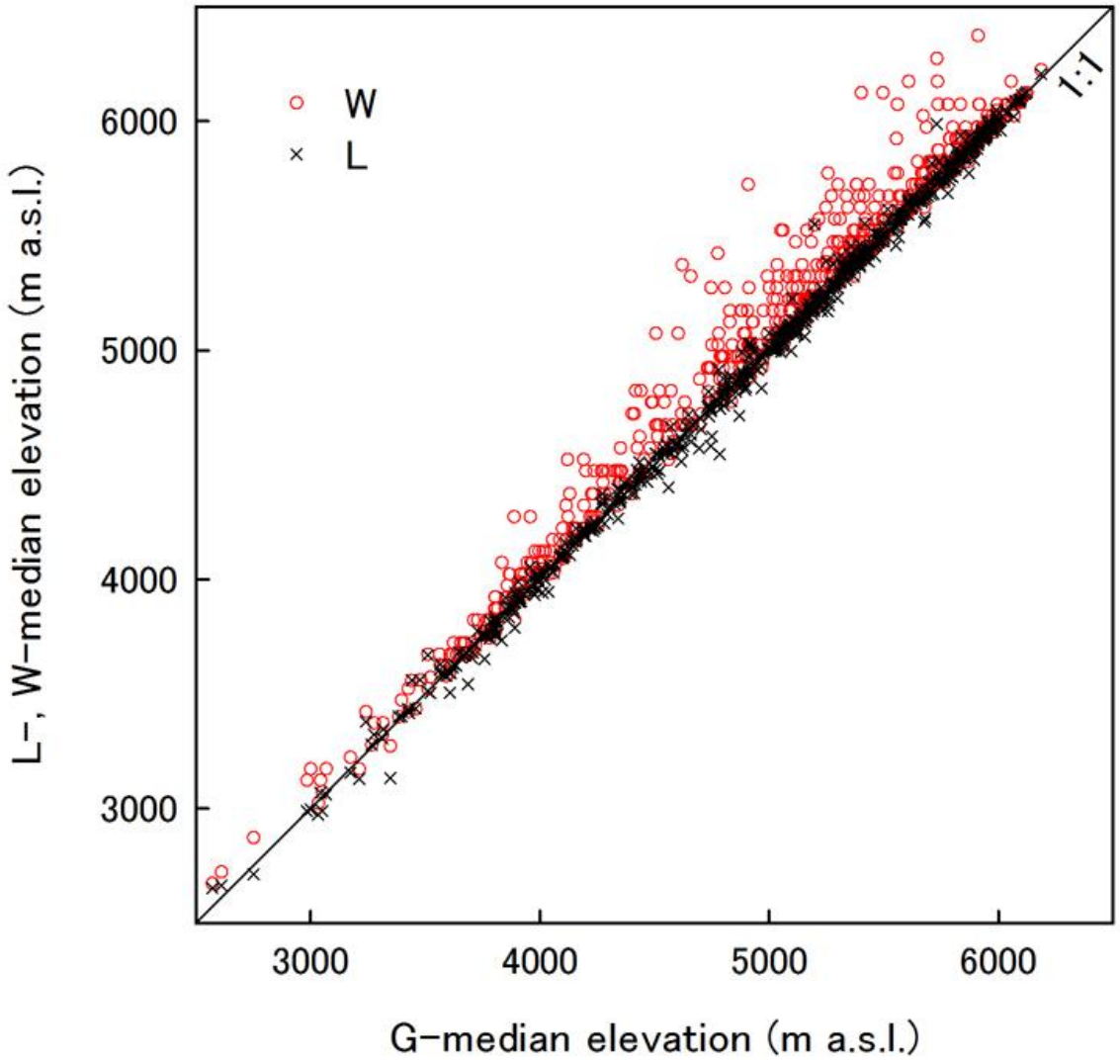


Fig. S2. Distribution of altitudinal difference between W-median altitude and L-median altitudes (W–L).



1

2 Fig. S3. Relation between G-median elevation and L-median (black crosses), W-median (red
3 circles) elevations.

4

5

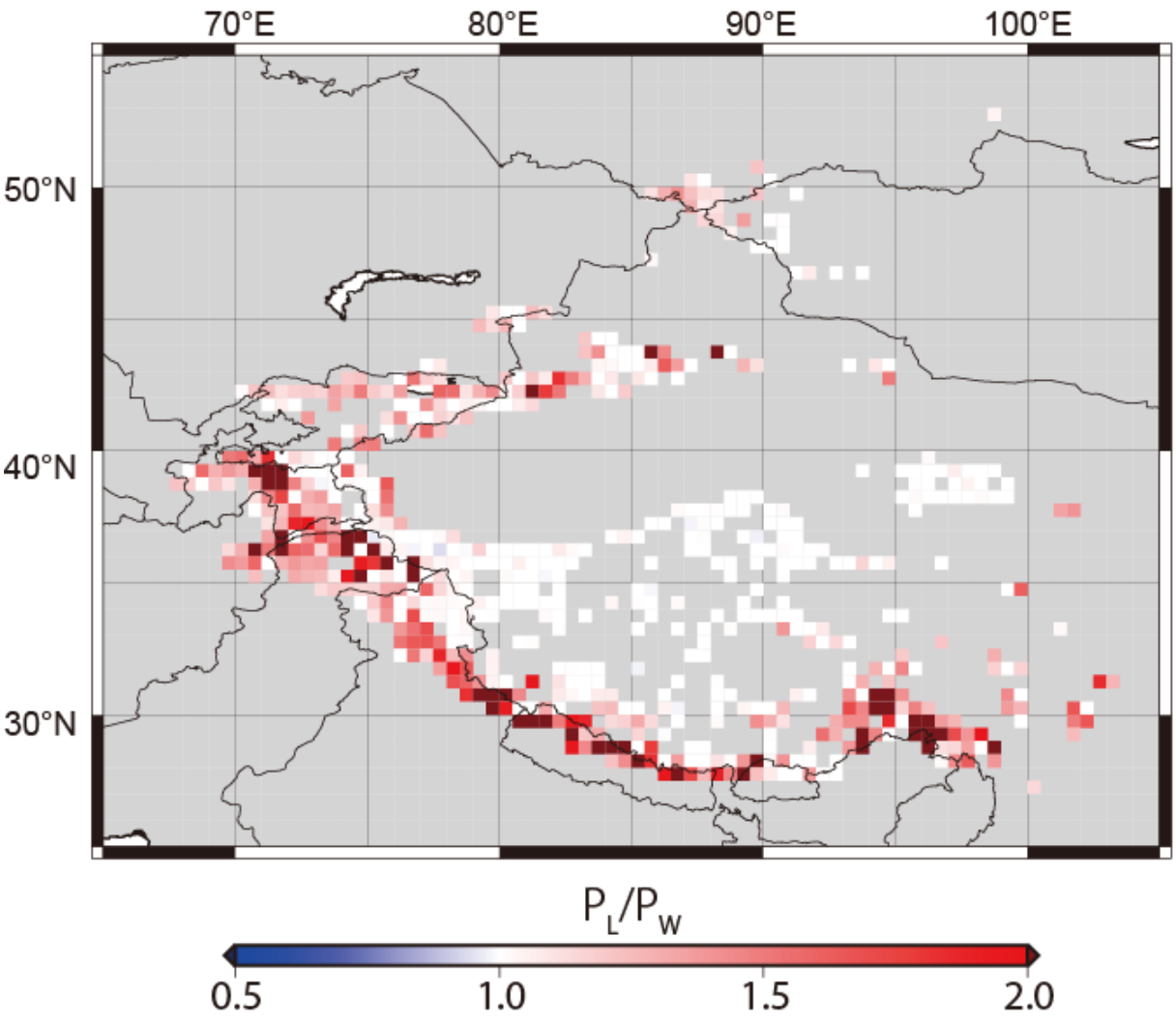


Figure S4 Ratio of P_L to P_W.

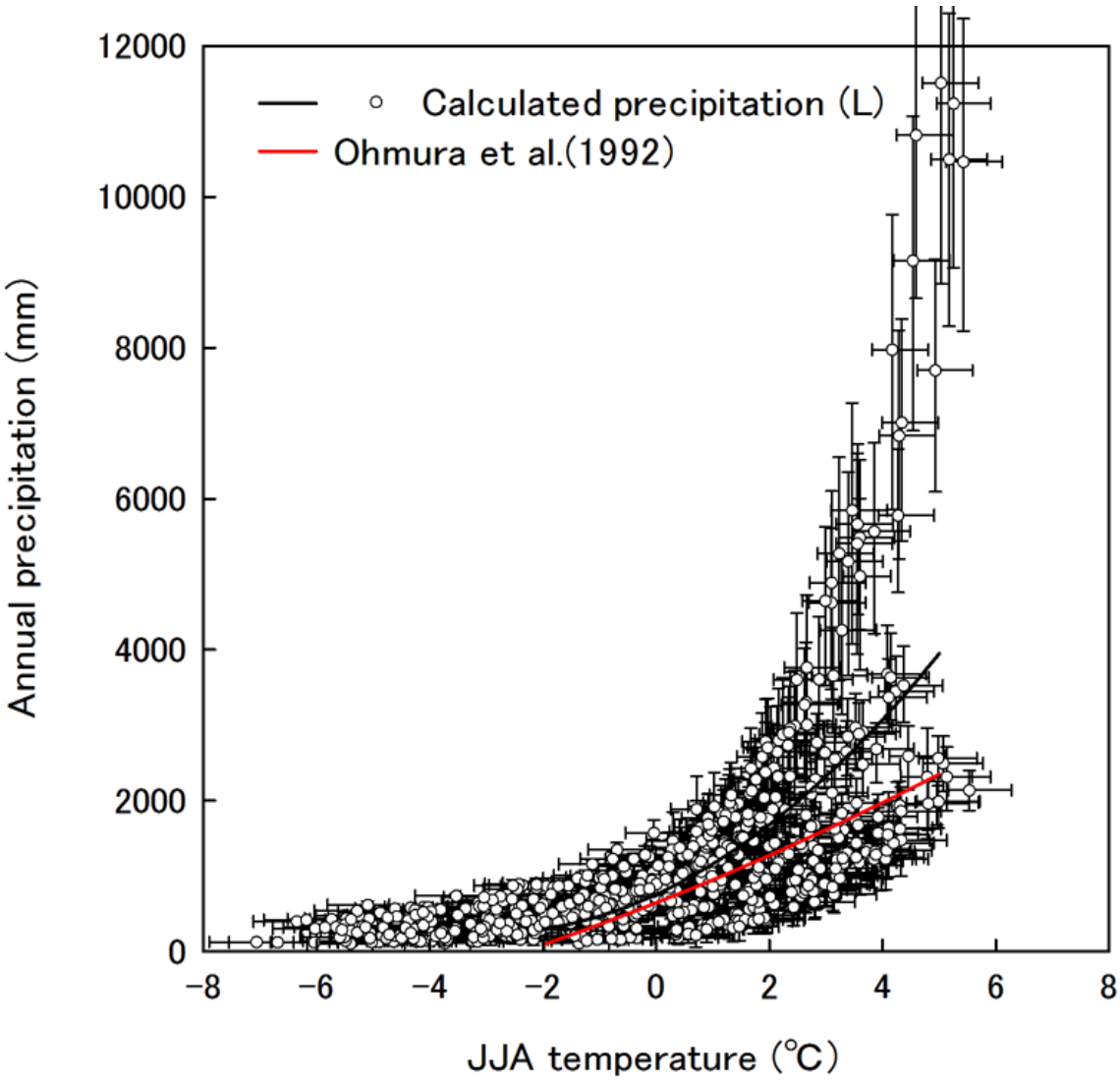
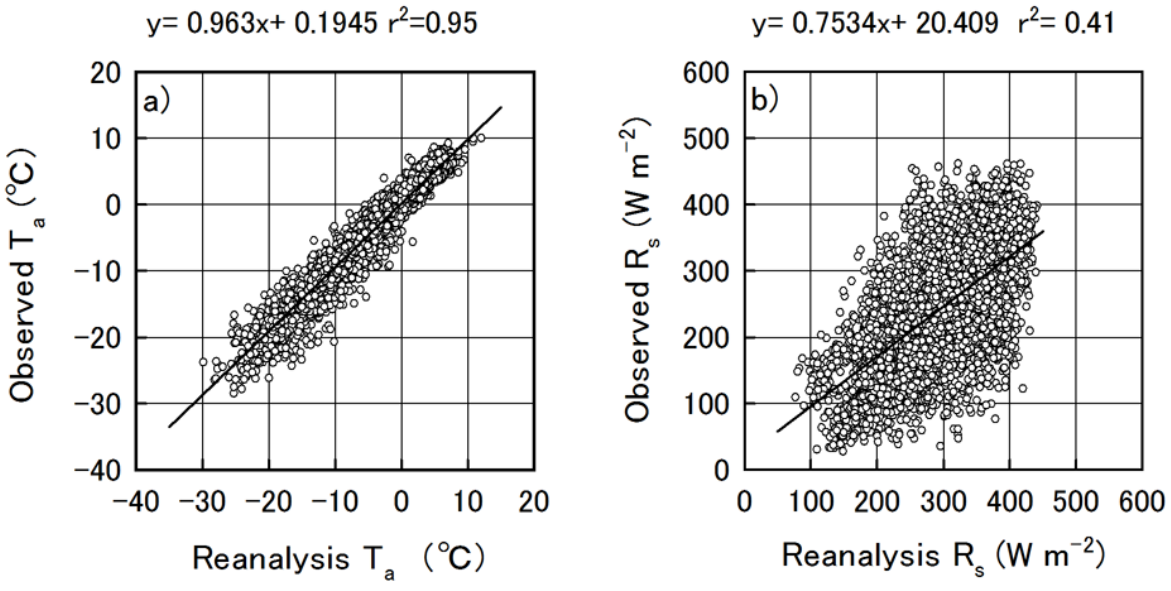


Fig. S5. T-P plot for P_L with error bar (black). Both vertical and horizontal error bars were calculated. L-median altitude±83 m. The 83 m is derived from rmse between the decadal average of ELA and the median altitude of each glacier. Red line indicates the fitting curve by Ohmura et al. (1992).



1

2

3 Fig. S6. Relations between reanalysis data and observed data on temperature data at each
4 altitude (a), and observed data on downward solar radiation data (b). All data are daily data.

5

6

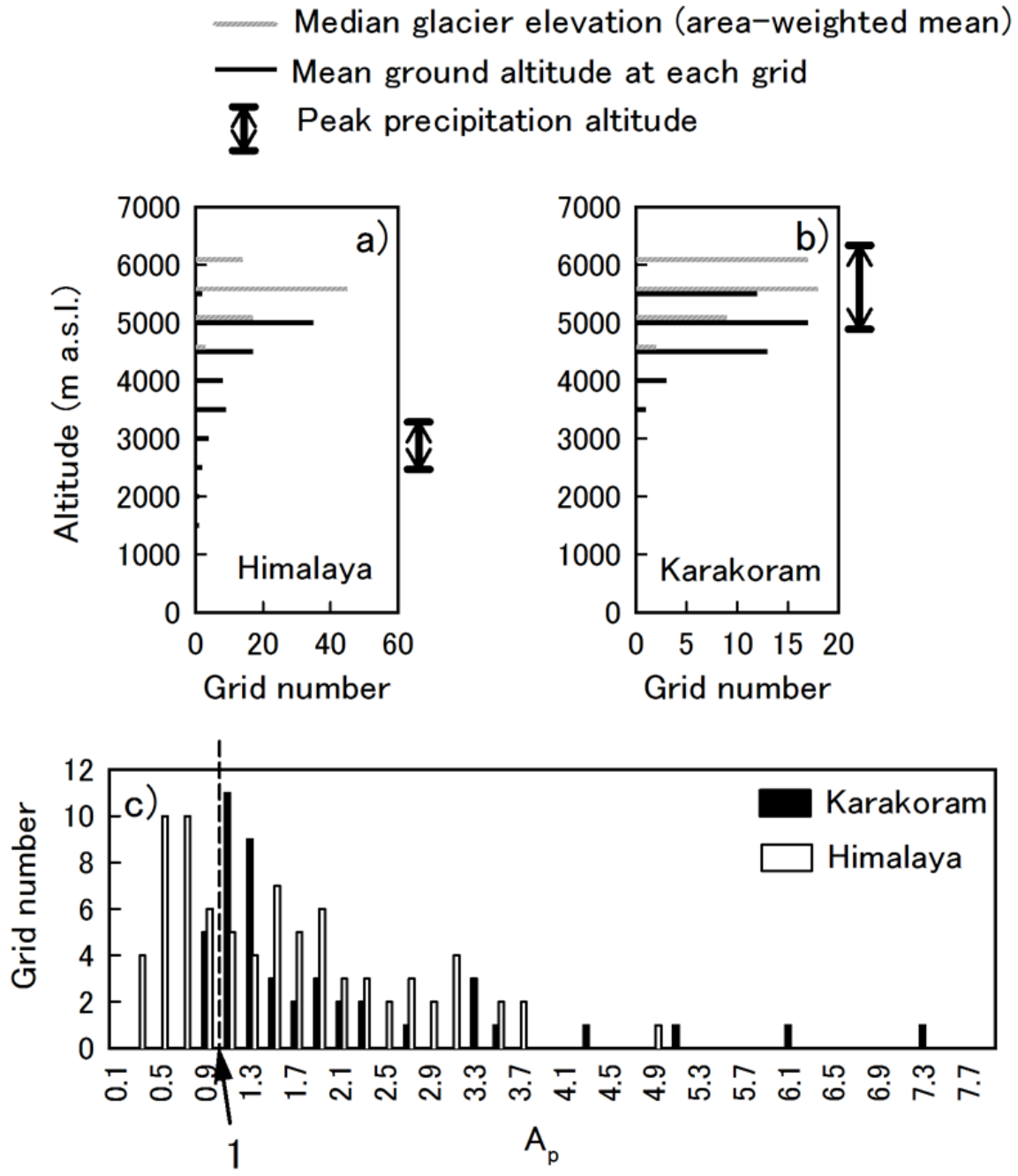


Fig. S7. Altitudinal distribution of W-median glacier altitude and in ground average altitude averaged at each 0.5 degree grid in the Himalayas (a) and in the Karakoram (b). (c) Histogram of the adjustment parameter of precipitation in the Himalayas and in the Karakoram.

References Cited

Dobhal, D. P., Gergan, J. T., and Thayyen, R. J.: Mass balance studies of Dokriani Glacier from 1992 to 2000, Garhwal Himalaya, India. Bull. Glaciol. Res., 25, 9-17, 2008.

Dyurgerov, M. B.: Glacier mass balance and regime: Data of measurements and analysis, Occasional Paper 55 (Institute of Arctic and Alpine Research, University of Colorado, Boulder, CO), 2002.

Fujita, K. and Ageta, Y.: Effect of summer accumulation on glacier mass balance on the Tibetan Plateau revealed by mass-balance model, J. Glaciol., 46(153), 244-252, 2000.

Fujita, K., Kadota, T., Rana, B., Kayastha, R. B., and Ageta, Y.: Shrinkage of Glacier AX010 in Shorong region, Nepal Himalayas in the 1990s, Bull. Glaciol. Res., 18, 51-54, 2001a.

Fujita, K., Nakazawa, F., and Rana, B.: Glaciological observations on Rikha Samba Glacier in Hidden Valley, Nepal Himalayas, 1998 and 1999. Bull. Glaciol. Res., 18, 31-35, 2001b.

Fujita, K. and Nuimura, T.: Spatially heterogeneous wastage of Himalayan glaciers, P. Natl. Acad. Sci. USA, 108(34), 14011-14014. doi:10.1073/pnas.1106242108, 2011.

Fujita, K, Takeuchi, N., Nikitin, S. A., Surazakov, A. B., Okamoto, S., Aizen, V. B., and Kubota, J.: Favorable climatic regime for maintaining the present-day geometry of the Gregoriev Glacier, Inner Tien Shan, The Cryosphere, 5(3), 539-549, doi:10.5194/tc-5-539-2011, 2011.

Ohmura, A., Kasser, P., and Funk, M.: Climate at the equilibrium line altitude, J. Glaciol., 38(130), 397-411, 1992.

Okamoto, S., Fujita, K., Narita, H., Uetake, J., Takeuchi, N., Miyake, T., Nakazawa, F., Aizen, V. B., Nikitin, S. A., and Nakawo, M.: Reevaluation of the reconstruction of summer temperatures from melt features in Belukha ice cores, Siberian Altai. J. Geophys. Res. - Atmos., 116(D2), D02110. doi:10.1029/2010JD013977, 2011.

Pu, J., Yao, T., Yang, M., Tian, L., Wang, N., Ageta, Y., and Fujita, K.: Rapid decrease of mass balance observed in the Xiao (Lesser) Dongkemadi Glacier, in the central Tibetan Plateau. Hydrol. Process., 22, 2953-2958, 2008.

Sakai, A., Matsuda, Y., Fujita, K., Matoba, S., Uetake, J., Satow, K., Duan, K., Pu, J., Nakawo, M., and Yao, T.: Meteorological observation at July 1st Glacier in northwest China from 2002 to 2005, Bull. Glaciol. Res., 23, 23-31, 2006.

Suzuki, R., Fujita, K., Ageta, Y., Naito, N., Matsuda, Y., and Karma,: Meteorological observations during 2002-2004 in Lunana region, Bhutan Himalayas, Bull. Glaciol. Res., 24, 71-78, 2007.

World Glacier Monitoring Service: Fluctuations of Glaciers 1995-2000, eds HaeberliW, et al. (World Glacier Monitoring Service, Zurich, Switzerland), Vol VIII, 2005.

World Glacier Monitoring Service: Fluctuations of Glaciers 2000-2005, eds HaeberliW, et al. (World Glacier Monitoring Service, Zurich, Switzerland), Vol IX, 2008.

Yamada, T.: Glacier lake and its outburst flood in the Nepal Himalaya, Monograph No. 1, March 1998 Data Center for Glacier Research, Japanese Society of Snow and Ice. 1998.