

Supporting Information

Table SII List of gridded and reanalysis data investigated in this study with relevant technical specifications.

Meteorological variables	Product	Version	Temporal resolution	Temporal coverage	Spatial resolution	Spatial coverage	Produced by	Web site	Reference
Gridded data									
Temperature	GHCN CAMS (Global Historical Climatology Centre, the Climate Anomaly Monitoring System)	-	monthly	1948-present	0.5°	Global land (89.75°S - 89.75°N, 0.25°E - 359.75°E)	Climate Prediction Center (CPC) of the National Centers for Environmental Prediction (NCEP).	http://www.esrl.noaa.gov/psd/data/gridded/data.ghecams.html	Fan, van den Dool (2008)
Temperature/Precipitation	CRU TS (Climate Research Unit - Time Series)	V3.2	monthly	1901-2011	0.5°	Global	Climate Research Unit - University of East Anglia	http://badc.nerc.ac.uk/view/badc.nerc.ac.uk__ATOM__ACTIVITY_3ec0d1c6-4616-11e2-89a3-00163e251233	Harris et al. (2015)
Precipitation	APHRODITE	V1101	daily	1951-2007	0.25°	Regional land (15°S - 55°N, 60°E - 150°E)	APHRODITE (Asian Precipitation Highly Resolved Observational Data Integration Towards Evaluation of Water Resources) project in collaboration with the Research Institute for Humanity and Nature and the Meteorological Research Institute of the Japan Meteorological Agency	http://www.chikyu.ac.jp/precip/products/index.html	Yatagai et al. (2012)
Precipitation	GPCC (Global Precipitation Climatology Centre)	V6	monthly	1901-2010	0.5°	Global	Deutscher Wetterdienst (National Meteorological Service of Germany) in the framework of the World Climate Research Program	http://www.esrl.noaa.gov/psd/	Schneider et al. (2013)
Reanalysis data									
Temperature/Precipitation	NCEP CFS (National Centers for Environmental Prediction- Climate Forecast System)	V2	hourly	1979-present	0.5°	Global	National Centers for Environmental Prediction (NCEP)	http://cfs.ncep.noaa.gov/cfsr/	Saha et al. (2010)
Temperature/Precipitation	ERA Interim	-	6-hourly	1979-present	0.25°	Global	ECMWF (European Centre for Medium-Range Weather Forecasts)	http://apps.ecmwf.int/datasets/data/interim-full-daily/levtype=sfc/	Dee et al. (2011)

Table SI2. Data sources used for tracing the inter-annual variations of glaciers and ponds since the early 1960s

Abbreviation used in the text	Topographic map	Acquisition date	Scale	Acquisition technique	
TISmap-63	Topographic map of Indian Survey	1963	1:50 000	Vertical aerial photographic survey 1957-1959 and field survey in 1963 (Yamada, 1998)	

Abbreviation used in the text	Satellite image	Acquisition date	Spatial resolution (m)	Sensor	Scene ID
Landsat-92	Landsat 5	17 Nov 1992	30	TM	ETP140R41_5T19921117
Landsat-00	Landsat 7	30 Oct 2000	15 ^a	ETM+	LE71400412000304SGS00
ALOS-08	ALOS	24 Oct 2008	10	AVNIR-2	ALAV2A146473040
Landsat-11	Landsat 7	30 Nov 2011	15 ^{a,b}	ETM+	LE71400412011334EDC00
Landsat-13	Landsat 8	10 Oct 2013	15 ^a	OLI	LC81400412013283LGN00

a Pan-sharpened images; b SLC-off image

Table SI3. Data sources used for the inter-annual variations analysis carried out during the 2000-2013 period

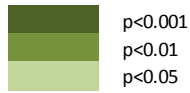
Satellite image	Acquisition date	Spatial resolution (m)	Sensor	Scene ID
Landsat 7	30 Oct 2000	15 (pan sharpened)	ETM+	LE71400412000304SGS00
	17 Oct 2001			LE71400412001290SGS00
	20 Oct 2002			LE71400412002293SGS00
	8 Nov 2003			LE71400412003312ASN01
	10 Nov 2004			LE71400412004315PFS00
	28 Oct 2005			LE71400412005301PFS00
	16 Nov 2006			LE71400412006320PFS00
	19 Nov 2007			LE71400412007323PFS00
	07 Dec 2008			LE71400412008342SGS00
	08 Nov 2009			LE71400412009312SGS00
	11 Nov 2010			LE71400412010315PFS00
	30 Nov 2011			LE71400412011334EDC00
17 Nov 2012	LE71400412012321PFS00			
Landsat 8	10 Oct 2013	15 (pan sharpened)	OLI	LC81400412013283LGN00

Table SI4. Data sources used for the intra-annual variations analysis carried out during the 2001 year

Satellite image	Spatial Resolution (m)	Sensor	Acquisition date	Scene ID
Landsat 7	15 (pan sharpened)	ETM+	11 Jun 2001	LE71400412001162SGS00
			14 Aug 2001	LE71400412001226SGS00
			15 Sep 2001	LE71400412001258SGS00
			17 Oct 2001	LE71400412001290SGS00
			20 Dec 2001	LE71400412001354SGS00

Table S15. Correlation Coefficient Matrix between pond surface area variations during the 2000-2013 period and selected drivers of change.

Driver/Pond Code		LCN139	LCN93	LCN141	LCN11	LCN77	LCN76	LCN24	LCN9	LCN3	LCN68
Mean Temperature (Tmean)	pre-monsoon	-0.40	-0.53	-0.51	-0.34	-0.45	-0.51	-0.06	-0.04	-0.10	-0.18
	monsoon	0.02	0.18	0.14	0.27	0.05	0.15	0.54	0.08	0.32	0.09
	post-annual	-0.41	-0.36	-0.27	-0.35	-0.20	-0.29	0.06	-0.03	-0.04	-0.24
Minimum Temperature	pre-monsoon	-0.47	-0.52	-0.45	-0.37	-0.36	-0.42	0.08	-0.06	-0.10	-0.29
	monsoon	-0.51	-0.52	-0.54	-0.43	-0.52	-0.54	-0.15	-0.26	-0.33	-0.40
	post-annual	-0.31	-0.20	-0.25	-0.17	-0.23	-0.05	0.21	-0.40	-0.38	-0.42
Maximum Temperature (Tmax)	pre-monsoon	-0.49	-0.47	-0.45	-0.51	-0.32	-0.37	-0.02	-0.18	-0.27	-0.36
	monsoon	-0.54	-0.52	-0.53	-0.54	-0.53	-0.54	-0.10	-0.31	-0.41	-0.51
	post-annual	-0.16	-0.33	-0.29	-0.12	-0.23	-0.37	0.22	0.29	0.35	0.25
Glacier Melt (Tmax)	pre-monsoon	0.38	0.44	0.40	0.51	0.30	0.25	0.65	0.58	0.83	0.61
	monsoon	-0.19	-0.10	0.02	-0.07	0.05	-0.06	0.29	0.17	0.28	0.02
	post-annual	-0.06	-0.12	-0.01	0.08	0.05	-0.09	0.45	0.42	0.54	0.29
Glacier Melt (Tmean)	pre-monsoon	-0.15	-0.34	0.48	0.05	-0.16	-0.26	0.22	0.21	0.27	0.03
	monsoon	0.35	0.39	0.37	0.49	0.29	0.23	0.65	0.61	0.87	0.65
	post-annual	0.23	0.45	0.41	0.37	0.56	0.52	0.30	0.37	0.23	0.12
Precipitation	pre-monsoon	0.32	0.24	0.36	0.48	0.36	0.27	0.51	0.60	0.68	0.41
	monsoon	-0.45	-0.42	-0.45	-0.31	-0.54	-0.38	-0.35	-0.47	-0.51	-0.51
	post-annual	-0.05	-0.01	-0.03	0.15	-0.14	-0.07	0.44	0.06	0.24	-0.02
Potential Evaporation	pre-monsoon	-0.03	-0.08	0.03	-0.25	0.11	-0.01	-0.39	-0.22	-0.46	-0.50
	monsoon	-0.07	-0.03	-0.05	0.11	-0.16	-0.09	0.39	0.01	0.17	-0.09
	post-annual	0.46	0.73	0.69	0.83	0.41	0.59	0.75	-0.22	0.37	0.21
Precipitation	pre-monsoon	0.50	0.70	0.72	0.76	0.55	0.65	0.44	-0.27	0.17	0.12
	monsoon	0.39	0.52	0.67	0.62	0.30	0.45	0.60	-0.09	0.36	0.16
	post-annual	0.50	0.64	0.69	0.74	0.55	0.61	0.41	-0.38	0.10	0.03
Potential Evaporation	pre-monsoon	-0.54	-0.54	-0.52	-0.37	-0.30	-0.40	-0.22	-0.22	-0.37	-0.54
	monsoon	-0.32	-0.45	-0.52	-0.36	-0.52	-0.52	0.04	-0.08	-0.04	-0.17
	post-annual	0.17	0.47	0.31	0.25	0.52	0.53	0.52	-0.02	0.10	0.27
Potential Evaporation	pre-monsoon	-0.47	-0.41	-0.52	-0.36	-0.44	-0.44	0.27	-0.20	-0.14	-0.24
	monsoon										
	post-annual										



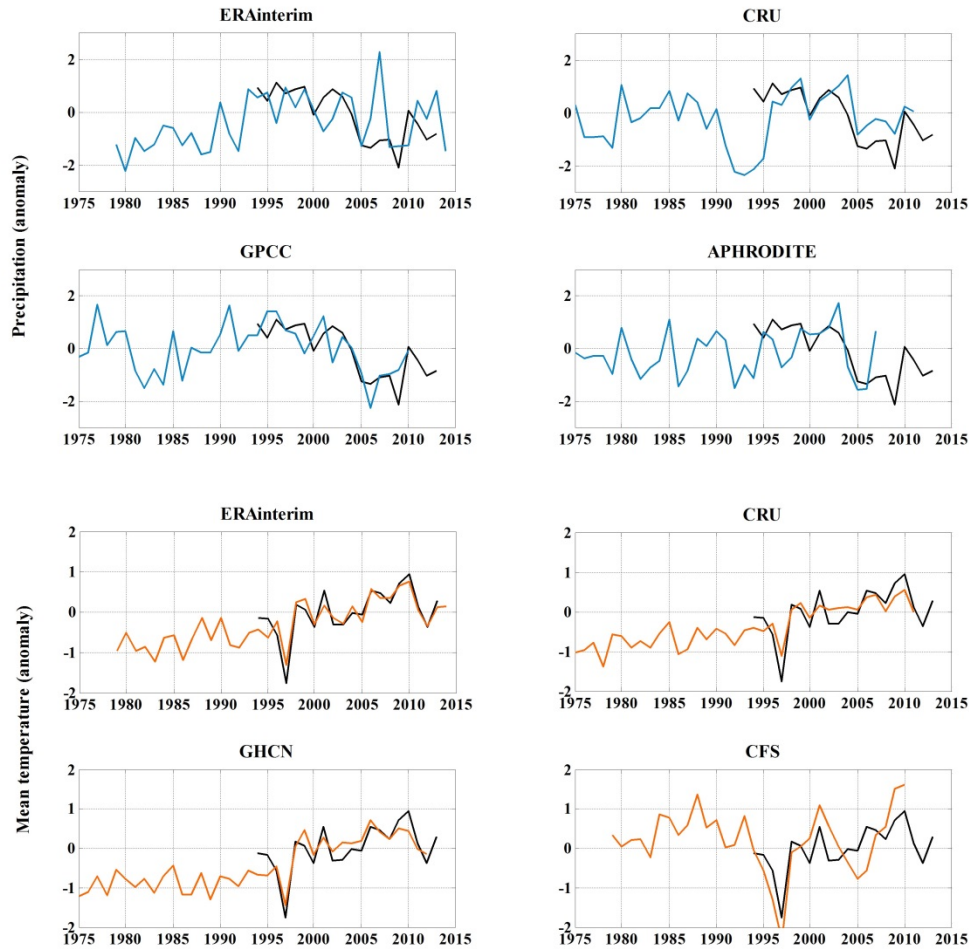


Figure SII. Comparison between annual precipitation and mean temperature time series recorded at Pyramid station since 1994 (black lines) with the selected regional gridded and reanalysis datasets. Table 1 are reported the relevant coefficients of correlation.

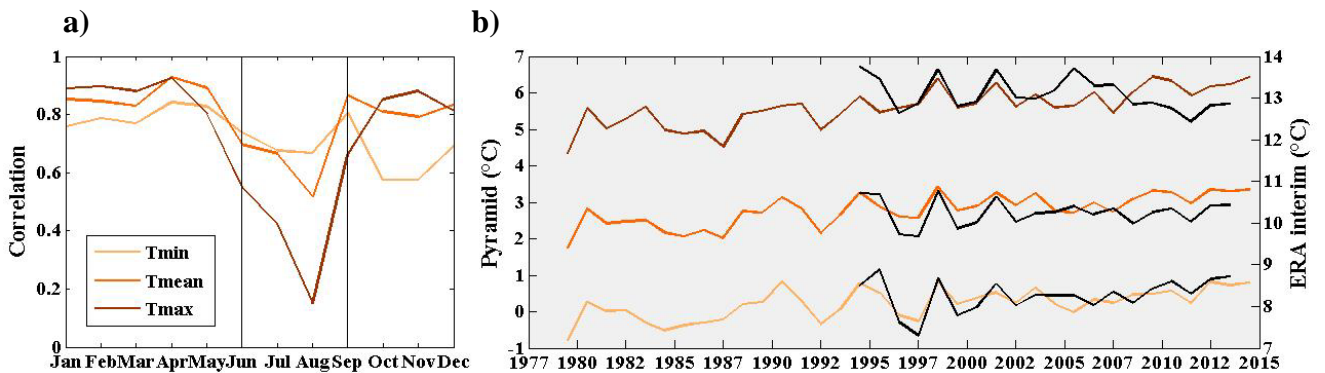


Figure SI2: a) Monthly coefficients of correlation between temperature recorded at Pyramid Station and Era Interim data (1994-2013 period). b) Temporal comparison among Era Interim and Pyramid data (black lines).

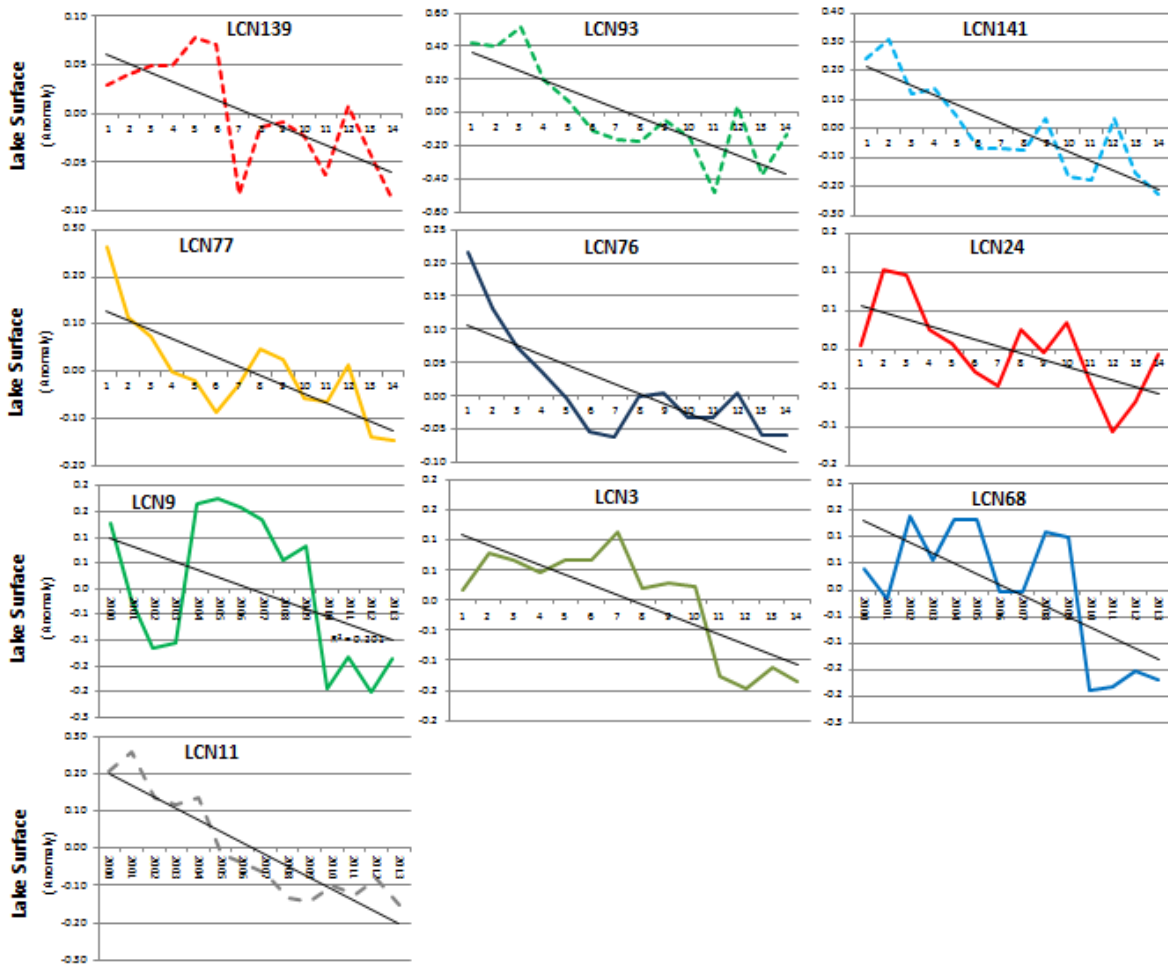


Figure SI3. Surfaces area variations during the period 2000-2013 of 10 selected ponds.

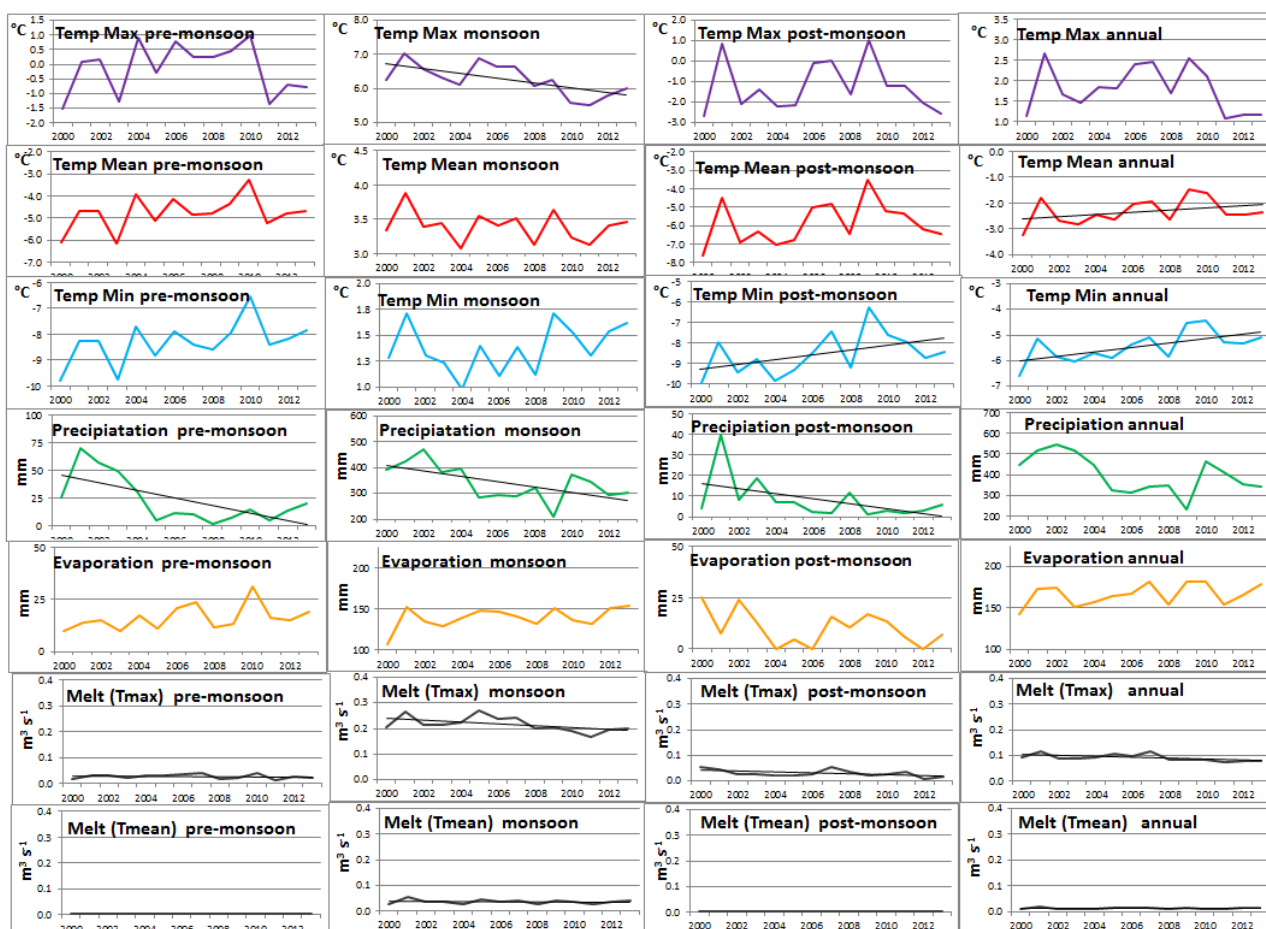


Figure S14. Climatic trends for the period 2000-2013 at the Pyramid Laboratory (5050 m a.s.l.) for mean (T_{mean}), maximum (T_{max}), minimum temperature, precipitation, potential evaporation, and glacier melt calculated for each glacier considering the T_{max} and T_{mean} . The regression line is indicated only in those graphs for which the trend is significant.

References

- Dee, D. P., et al.: The ERA-Interim reanalysis: configuration and performance of the data assimilation system, *Q. J. R. Meteorol. Soc.*, 137, 553-597, doi:10.1002/qj.828, 2011.
- Fan, Y., and van den Dool, H.: A global monthly land surface air temperature analysis for 1948-present, *J. Geophys. Res.*, 113, D01103, doi: 10.1029/2007JD008470, 2008.
- Harris, I., Jones, P. D., Osborn, T. J., and Lister, D. H.: Updated high resolution grids of monthly climatic observations – the CRU TS3.10 dataset, *Int. J. Climatol.*, 34, 623–642, doi: 10.1002/joc.3711, 2015.
- Saha, S., et al.: The NCEP Climate Forecast System Reanalysis, *Bull. Amer. Meteorol. Soc.*, 91, 1015–1057, doi: <http://dx.doi.org/10.1175/2010BAMS3001.1>, 2010.
- Schneider, U., Becker, A., Finger, P., Meyer-Christoffer, A., Ziese, M., and Rudolf, B.: GPCP's new land surface precipitation climatology based on quality-controlled in situ data and its role in quantifying the global water cycle. *Theor. Appl. Climatol.*, 115,15-40, doi: 10.1007/s00704 013-0860-x, 2013.

Yatagai, A., Yasutomi, N., Hamada, A., Kitoh, A., Kamiguchi, K., and Arakawa O.: APHRODITE: Constructing a long-term daily gridded precipitation dataset for Asia based on a dense network of rain gauges, *Bull. Am. Meteorol. Soc.*, 93, doi: <http://dx.doi.org/10.1175/BAMS-D-11-00122.1>, 1401–1415, 2012.