Table S1. Ratios of snow sublimation to snowfall from published literatures

Numbers	Longitude	Latitude	Elevation (m)	Climate zones	Snow types	Ratio (%)	Methods	Reference
1	87°56′	44°22′	460	TCZ	Ephemeral	23.63	Snow lysimeters	(Zhou et al., 2012)
2	87°55′	44°22′	440	TCZ	Ephemeral	6.51	Evaporation pan measurements	(Zhou, 2009)
3	87°56′	44°17′	460	TCZ	Ephemeral	7.37	Evaporation pan measurements	(Zhou, 2009)
4	86°50′	43° 06′	3540	TCZ	Tundra	50-100	Evaporation pan measurements	(Yang and Zhang, 1992)
5	84°24′	43°16′	1776	TCZ	Tundra	4.0-12.5	Snow lysimeter and surface energy	(Lu et al., 2016)
6	84°24′	43°16′	1776	TCZ	Tundra	11.3	Evaporation pan measurements	(Wang and Wei, 1994)
7	71°39′-93°45′	34°20′-43°39′	750-7623	TCZ	All types	50	Hydrological model	(Paix et al., 2011)
8	100°15′	38°32′	2835	MPZ	Taiga	High	Energy balance method	(Zhu et al., 2014)
9	100°11′-100°18′	38°05′-38°50′	3440-4400	MPZ	Mountain/taiga	47	Hydrological model	(Zhou et al., 2014)
10	100°13′	38°04′	3449.4	MPZ	Mountain	68.8	Energy balance method	(Li et al., 2009)
11	97°30′-101°16′	37°30′-34°10′	1600-5500	MPZ/TCZ	All types	38.9	Hydrological model	(Li et al., 2019)
12	85.6167°	28.2333°	5120	MPZ	Tundra	21	Bulk-aerodynamic method	(Stigter et al., 2018)
13	92.06°	31.48°	4700	MPZ	Tundra	42.5-100	Heat budget method	(Ueno et al., 2007)
14	128°6′	42°24′	738	TMZ	Tundra	33.3	Eddy covariance and snow lysimeters	(Li et al., 2016)
15	122°20′	53°28′	323	TMZ	Taiga	7.9-9.0	Eddy covariance method	(Lin et al., 2021)
16	122°20′	53°28′	323	TMZ	Taiga	9.8-11.4	Surface temperature technique	(Lin et al., 2021)
17	122°20′	53°28′	323	TMZ	Taiga	11.1-14.5	Penman combination	(Lin et al., 2021)
18	107°20′	47°42′	1415	TCZ	Prairie	20.3	Aerodynamic profile method	(Zhang et al., 2008)
19	107°25′	47°68′	1640	TCZ	Prairie	21.6	Aerodynamic profile method	(Zhang et al., 2008)

Note. MPZ, mountain plateau zone; TMZ, temperate monsoon zone; TCZ, temperate continental zone. The spatial distribution of the study regions was shown in Figure S1.

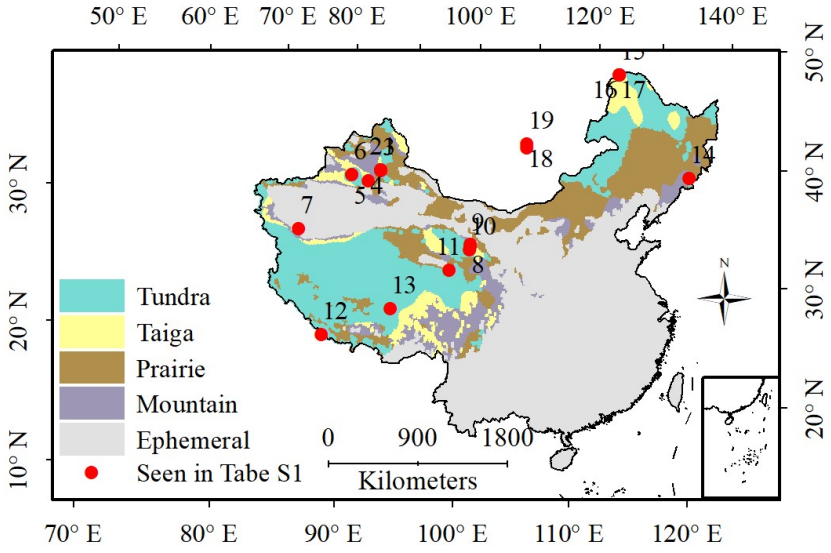

Figure S1. Spatial distribution of the study regions on the ratios of snow sublimation to snowfall from published literatures. (Numbers in the Figures were explained in Table S1)

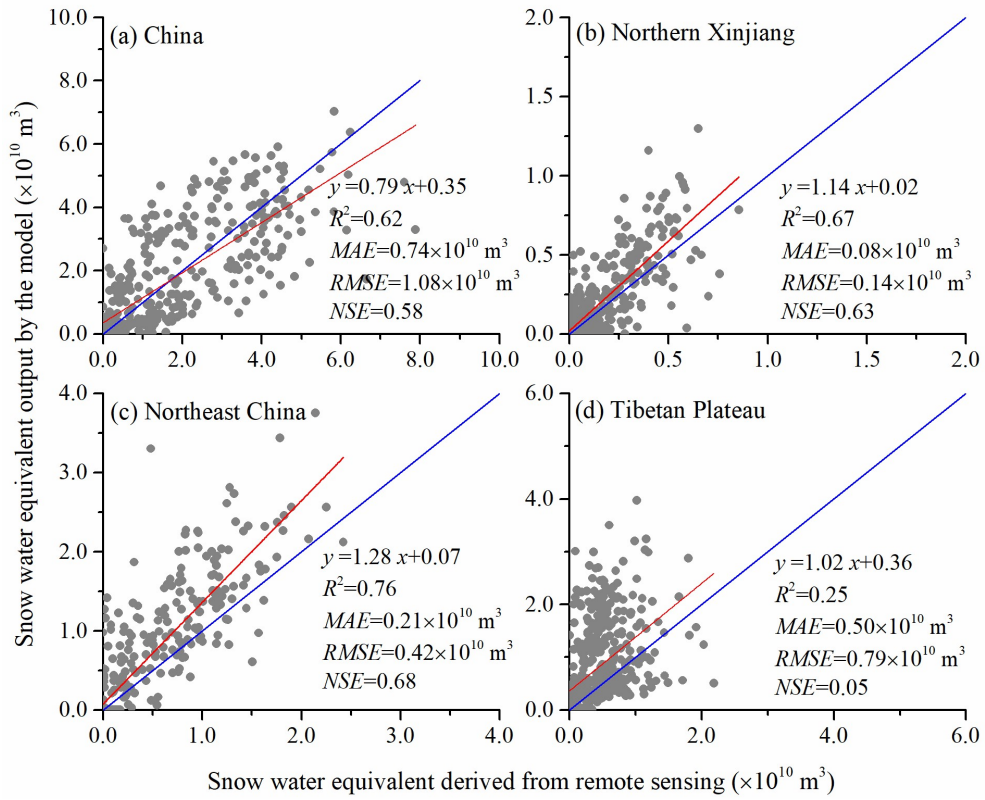

Figure S2. Scatterplots of the snow water equivalent output by the model and derived from remote sensing in China and its three main stable snow cover regions (snow water equivalent was removed from the glacier areas, and the glacier distribution data were obtained from the second glacial catalogue data set of China, the National Cryosphere Desert Data Center, https://www.ncdc.ac.cn). The red and blue solid lines are the linear fit and the 1:1 line, respectively.

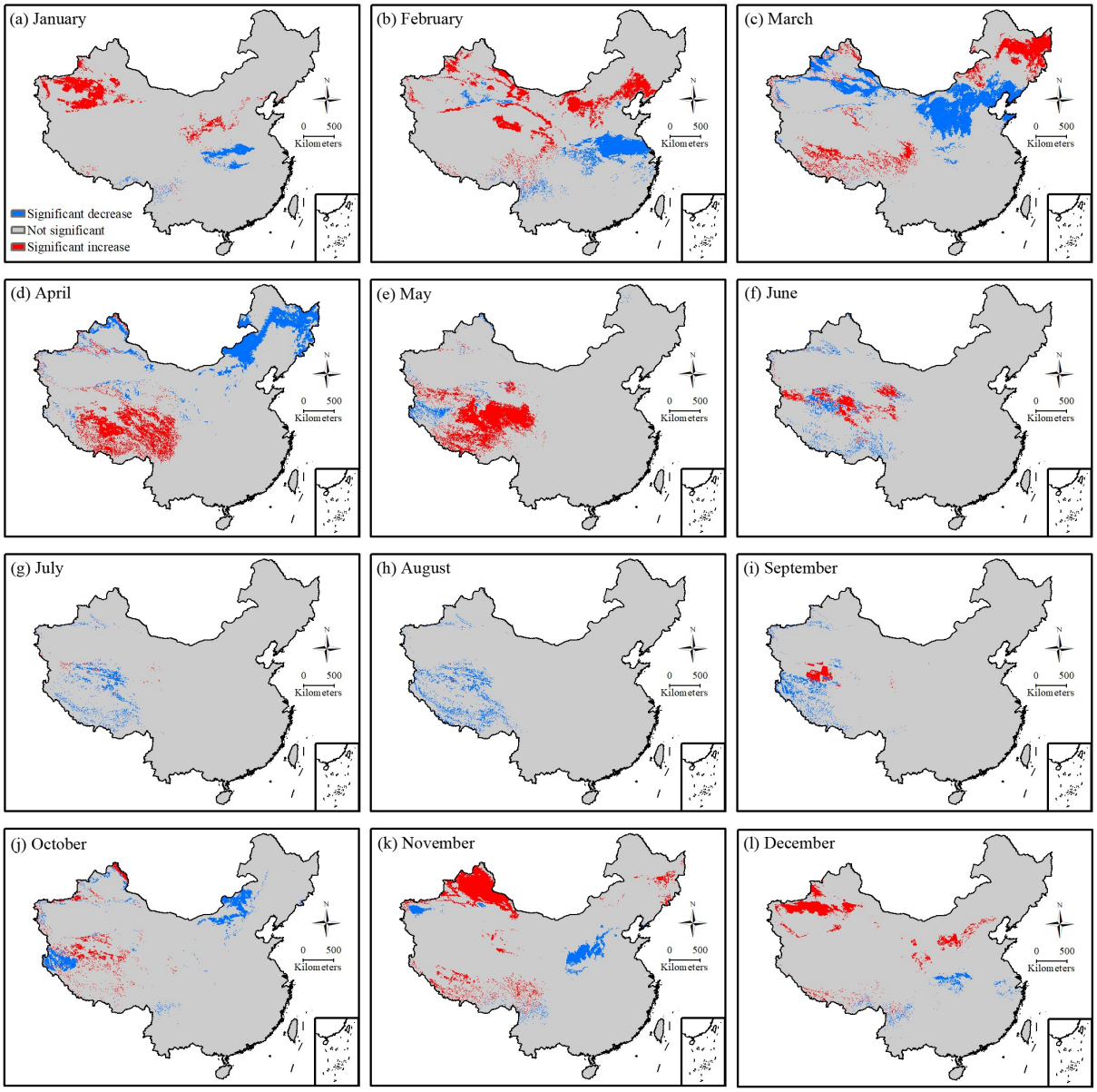

Figure S3. Trends of snowmelt in 12 months based on the Mann-Kendall method in China during the 1951-2017 period.

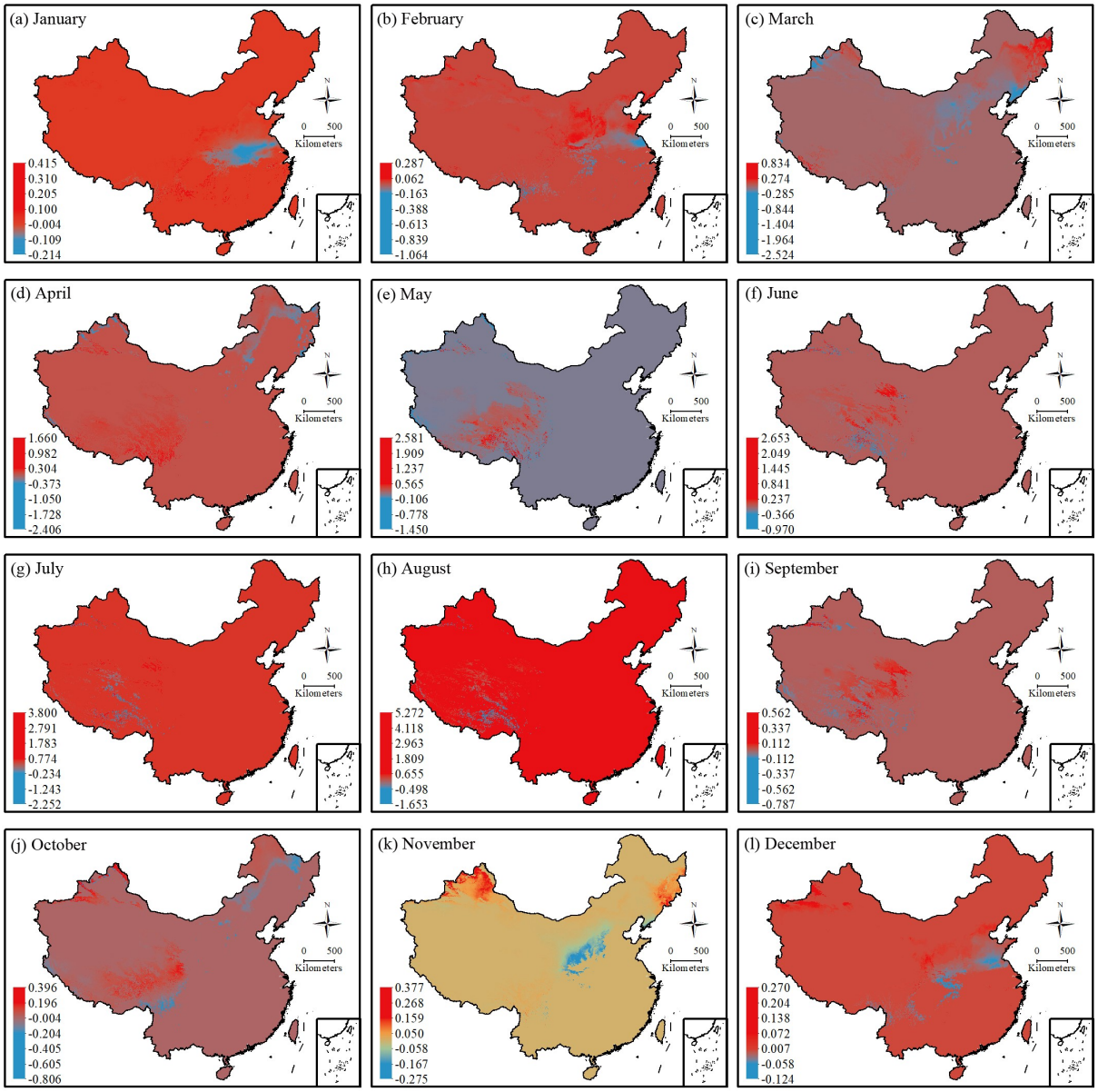

Figure S4. Sen's slope (mm month^{-1}) of snowmelt in 12 months in China during the 1951-2017 period.

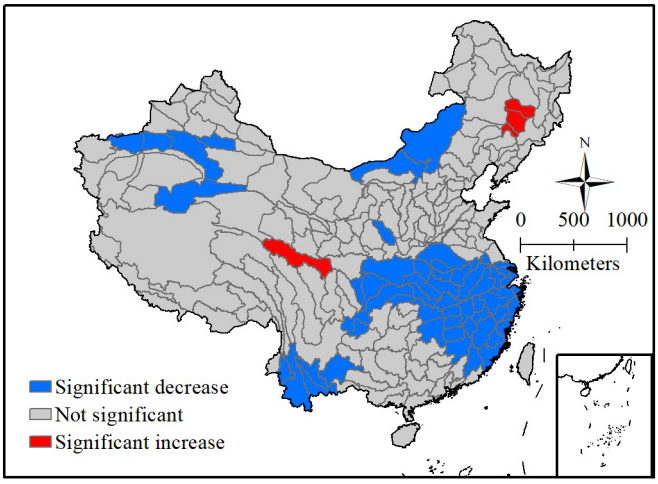

Figure S5. Trends of annual snowmelt runoff ratio at third-level basins based on the Mann-Kendall method in China during the 1951-2017 period.

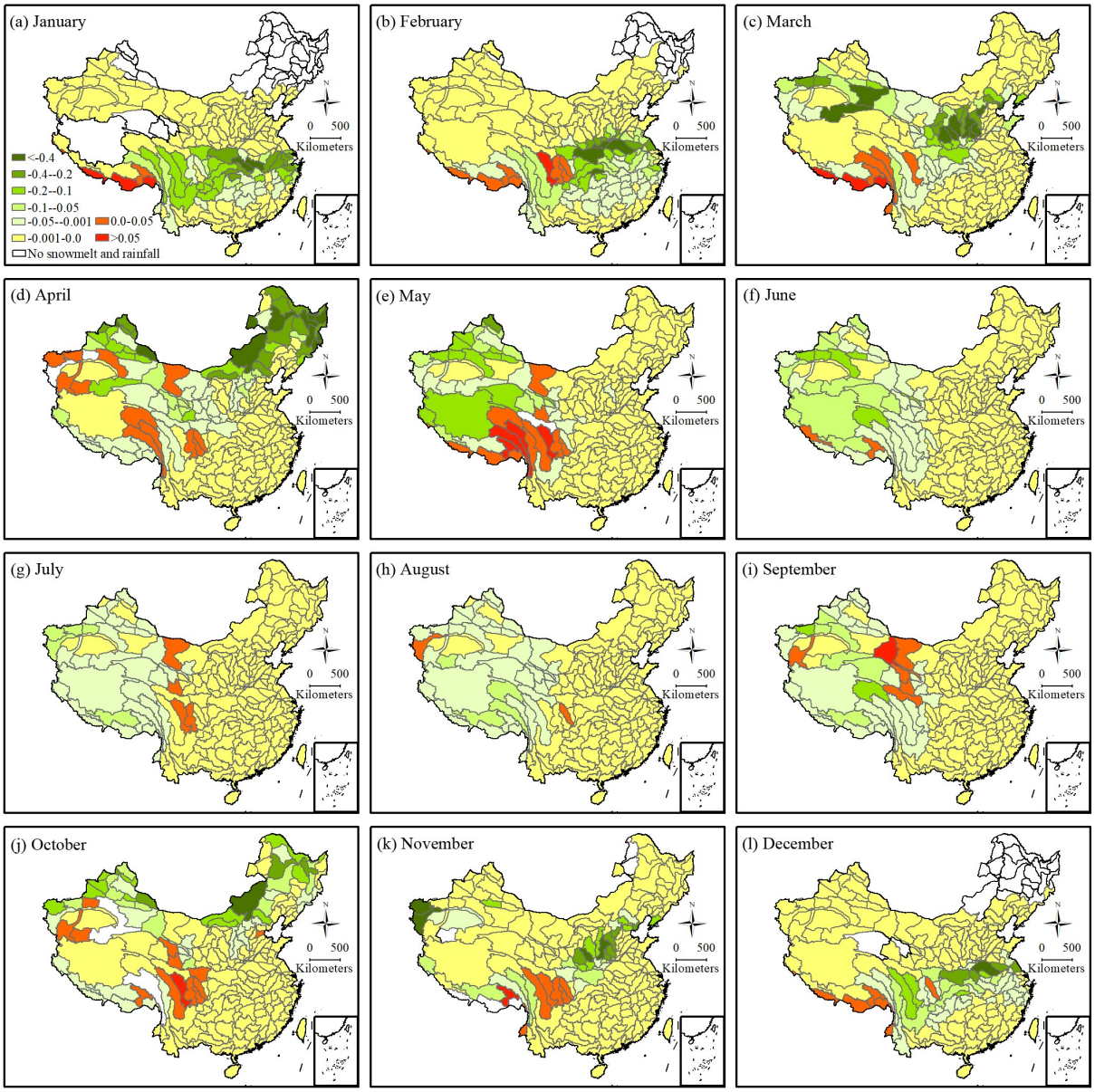

Figure S6. Spatial distributions of the Sen's slope of snowmelt runoff ratio (% month^{-1}) in 12 months in third-level basins in China during the 1951-2017 period.

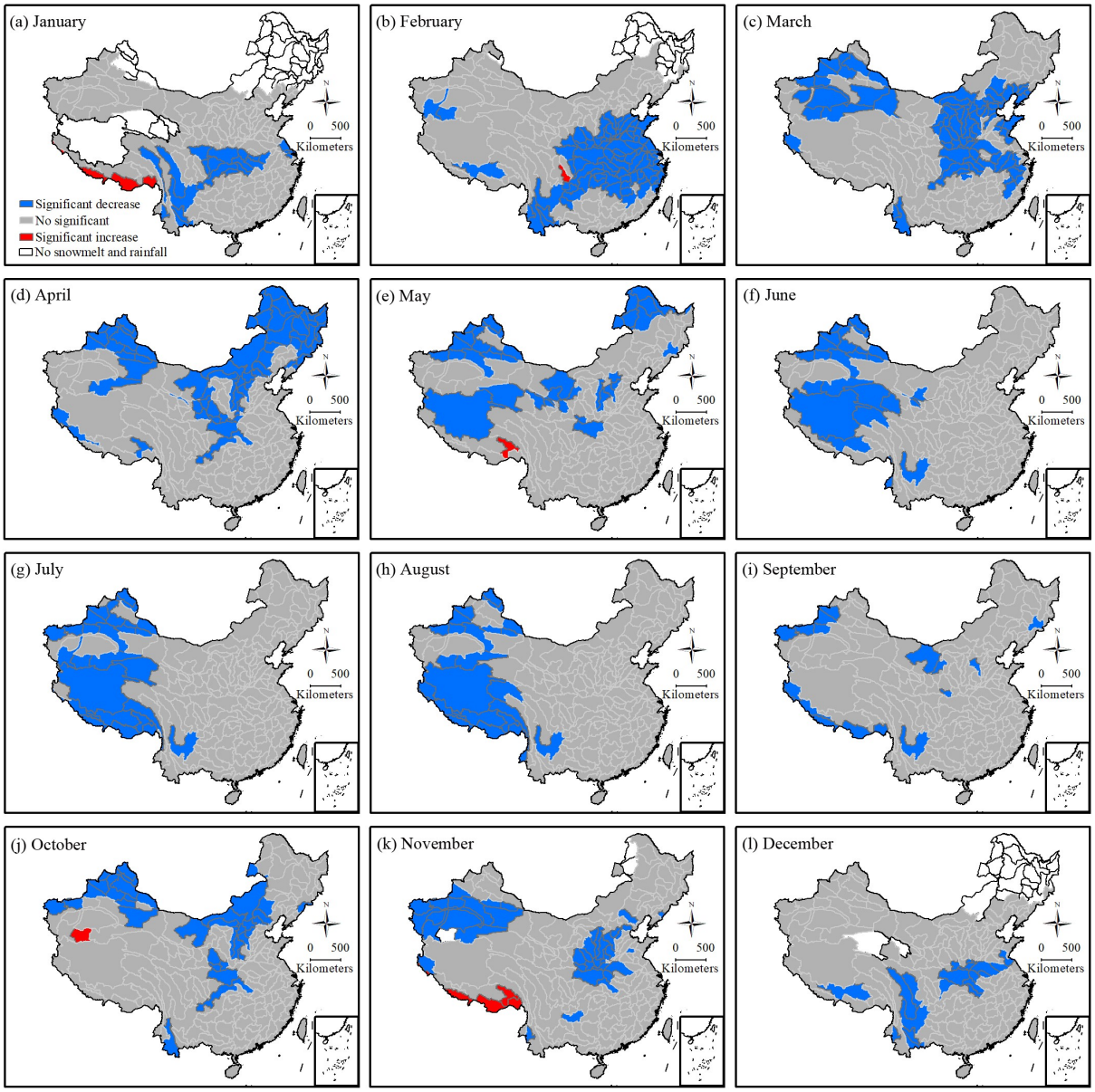

Figure S7. Trends of snowmelt runoff ratio in 12 months based on the Mann-Kendall method in China during the 1951-2017 period.

Table S2. The meanings of the numbers in the legend in Figure 15.

Numbers in the legend	Snowmelt	Precipitation	Snowfall	Air temperature	Numbers of grids
1	-1	-1	-1	0	100230
2	-1	-1	-1	1	39239
3	-1	-1	0	0	6627
4	-1	-1	0	1	5945
5	-1	0	-1	0	416556
6	-1	0	-1	1	1224917
7	-1	0	0	0	40844
8	-1	0	0	1	20032
9	-1	1	-1	0	32084
10	-1	1	-1	1	11236
11	-1	1	0	0	26046
12	-1	1	0	1	186
13	1	-1	-1	0	32
14	1	-1	0	0	73333
15	1	-1	0	1	63650
16	1	-1	1	0	120886
17	1	-1	1	1	161717
18	1	0	-1	0	333
19	1	0	0	0	96879
20	1	0	0	1	86846
21	1	0	1	0	119324
22	1	0	1	1	330432
23	1	1	0	0	18137
24	1	1	0	1	98
25	1	1	1	0	5369
26	1	1	1	1	446

Note. -1, significant decrease; 0, not significant; 1, Significant decrease.

References

Li, H., Wang, J., Bai, Y., Li, Z., and Dou, Y.: The snow hydrological processes during a representative snow cover period in Binggou watershed in the upper reaches of Heihe river, J. Glaciol. Geocryol., 31, 293-300, 2009 (in Chinese).

Li, H., Zhang, Y., Li, X., Yang, D., and Hao, X.: Tracing snowmelt paths in an integrated hydrological model for understanding seasonal snowmelt contribution at basin scale, J. Geophys. Res. Atmos., 124, 8874-8895, https://doi.org/10.1029/2019JD030760, 2019.

Li, H., Wang, A., Guan, D., Jin, C., Wu, J., Yuan, F., and Shi, T.: Empirical model development for ground snow sublimation beneath a temperate mixed forest in Changbai Mountain, J. Hydrol. Eng., 21, 04016040, https://doi.org/10.1061/(asce)he.1943-5584.0001415, 2016.

Lin, Y., Cai, T., Ju, C., and Cui, X.: Applicability evaluation and improvement of different snow evaporation calculation methods in the Great Xing'an mountains, Earth Sci. Inform., https://doi.org/10.1007/s12145-021-00597-3, 2021.

Lu, H., Wei, W. S., Liu, M. Z., Han, X., Li, M., and Hong, W.: Variations in seasonal snow surface energy exchange during a snowmelt period: an example from the Tianshan Mountains, China, Meteorol. Appl., 23, 14-25, https://doi.org/10.1002/met.1511, 2016.

Paix, M. J. d. l., Lanhai, L., Jiwen, G., Dieu, H. J. d., and Theoneste, N.: Analysis of snowmelt model for flood forecast for water in arid zone: case of Tarim River in Northwest China, Environ. Earth Sci., 66, 1423-1429, https://doi.org/10.1007/s12665-011-1353-9, 2011.

Stigter, E. E., Litt, M., Steiner, J. F., Bonekamp, P. N. J., Shea, J. M., Bierkens, M. F. P., and Immerzeel, W. W.: The importance of snow sublimation on a Himalayan glacier, Front. Earth Sci., 6, https://doi.org/10.3389/feart.2018.00108, 2018.

Ueno, K., Tanaka, K., Tsutsui, H., and Li, M.: Snow cover conditions in the Tibetan Plateau observed during the winter of 2003/2004, Arct. Antarct. Alp. Res., 39, 152-164, https://doi.org/10.1657/1523-0430(2007)39[152:Sccitt]2.0.Co;2, 2007.

Wang, J. and Wei, W.: Observational experiments on evaporation/condensation on snow surface, Xinjiang Meteorol., 17, 38-41, 1994 (in Chinese).

Yang, D. and Zhang, Y.: Results of snow surface sublimation measurements in the mountain area of Urumqi river basin, J. Glaciol. Geocryol., 14, 122-128, 1992 (in Chinese).

Zhang, Y., Ishikawa, M., Ohata, T., and Oyunbaatar, D.: Sublimation from thin snow cover at the edge of the Eurasian cryosphere in Mongolia, Hydrol. Process., 22, 3564-3575, https://doi.org/10.1002/hyp.6960, 2008.

Zhou, B.: Experimental study on snow evaporation and condensation in Gurbantunggut desert of China, Master's Thesis, Shihezi University, 2009 (in Chinese).

Zhou, H., Zheng, X., Zhou, B., Dai, Q., and Li, Y.: Sublimation over seasonal snowpack at the southeastern edge of a desert in central Eurasia, Hydrol. Process., 26, 3911-3920, https://doi.org/10.1002/hyp.8402, 2012.

Zhou, J., Pomeroy, J. W., Zhang, W., Cheng, G., Wang, G., and Chen, C.: Simulating cold regions hydrological processes using a modular model in the west of China, J. Hydrol., 509, 13-24, https://doi.org/10.1016/j.jhydrol.2013.11.013, 2014.

Zhu, G., Lu, L., Su, Y., Wang, X., Cui, X., Ma, J., He, J., Zhang, K., and Li, C.: Energy flux partitioning and evapotranspiration in a sub-alpine spruce forest ecosystem, Hydrol. Process., 28, 5093-5104, https://doi.org/10.1002/hyp.9995, 2014.