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Figure S1. The first-level (a) and second-level (b) basins in China.

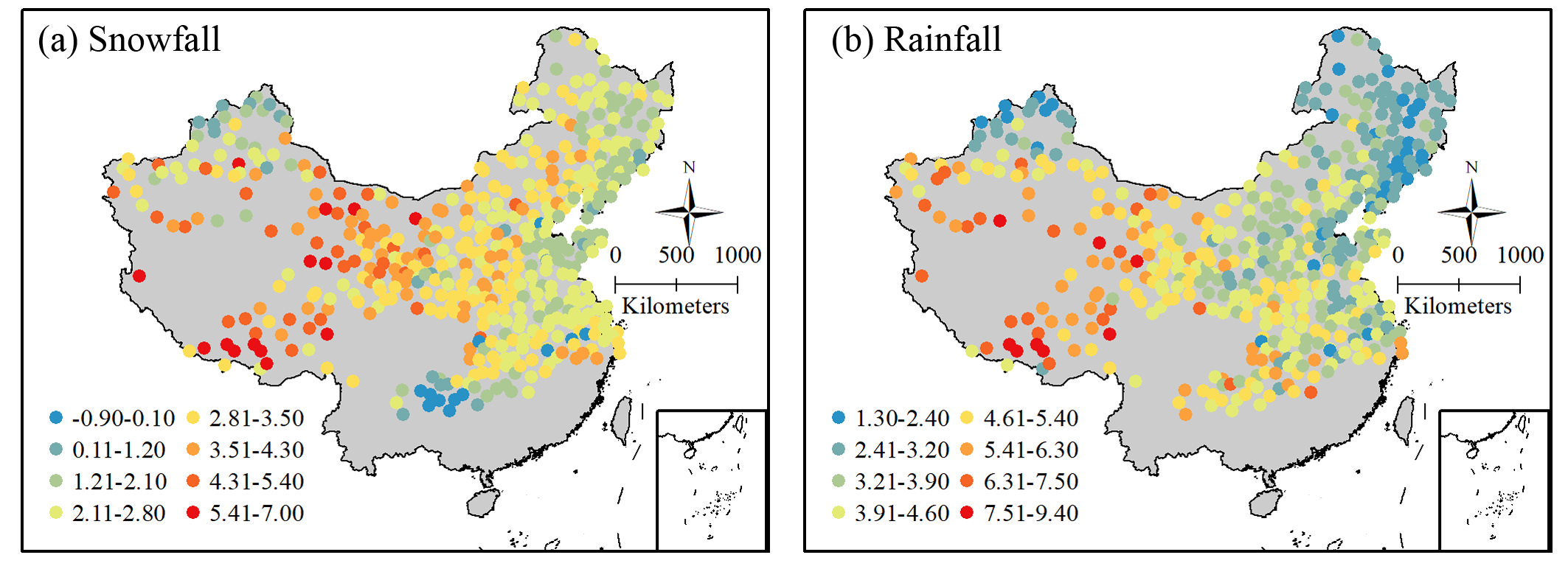


Figure S2. The threshold temperature (℃) for snowfall (a) and rainfall (b) at 485 meteorological stations in China.

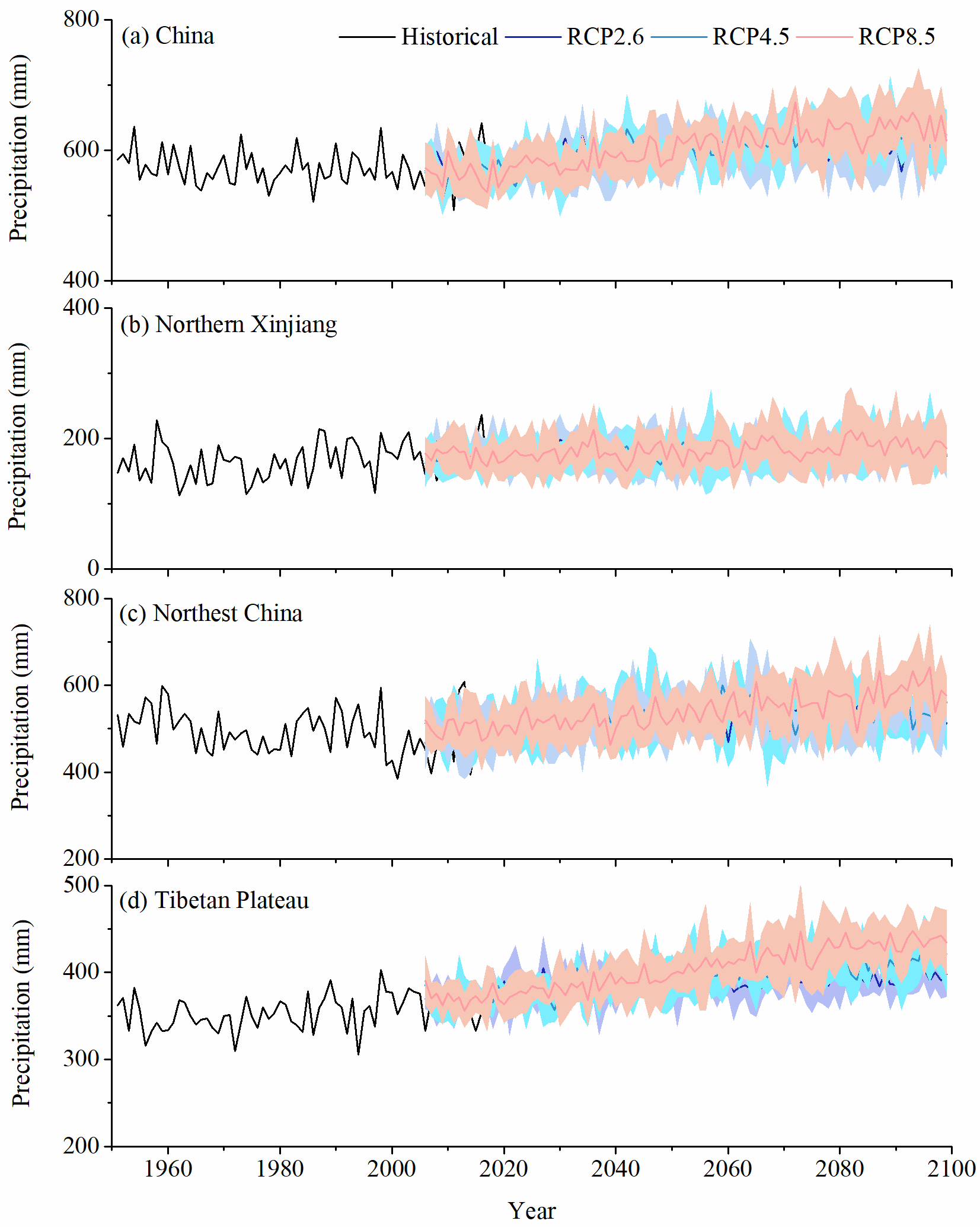


Figure S3. Projected future changes in precipitation in China and its three main stable snow cover regions. Historical: 1951-2017; RCP: representative concentration pathway.

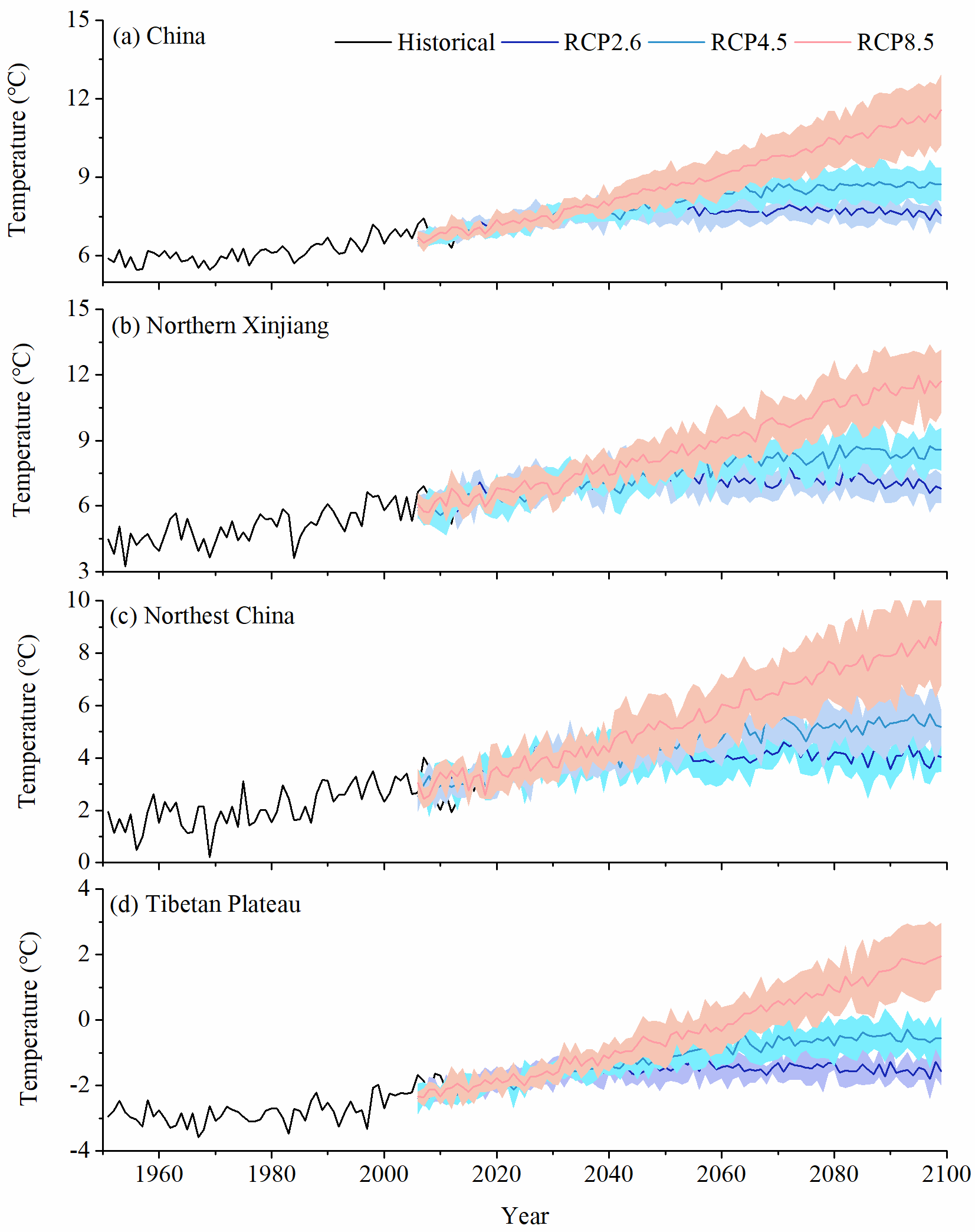


Figure S4. Projected future changes in temperature in China and its three main stable snow cover regions. Historical: 1951-2017; RCP: representative concentration pathway.

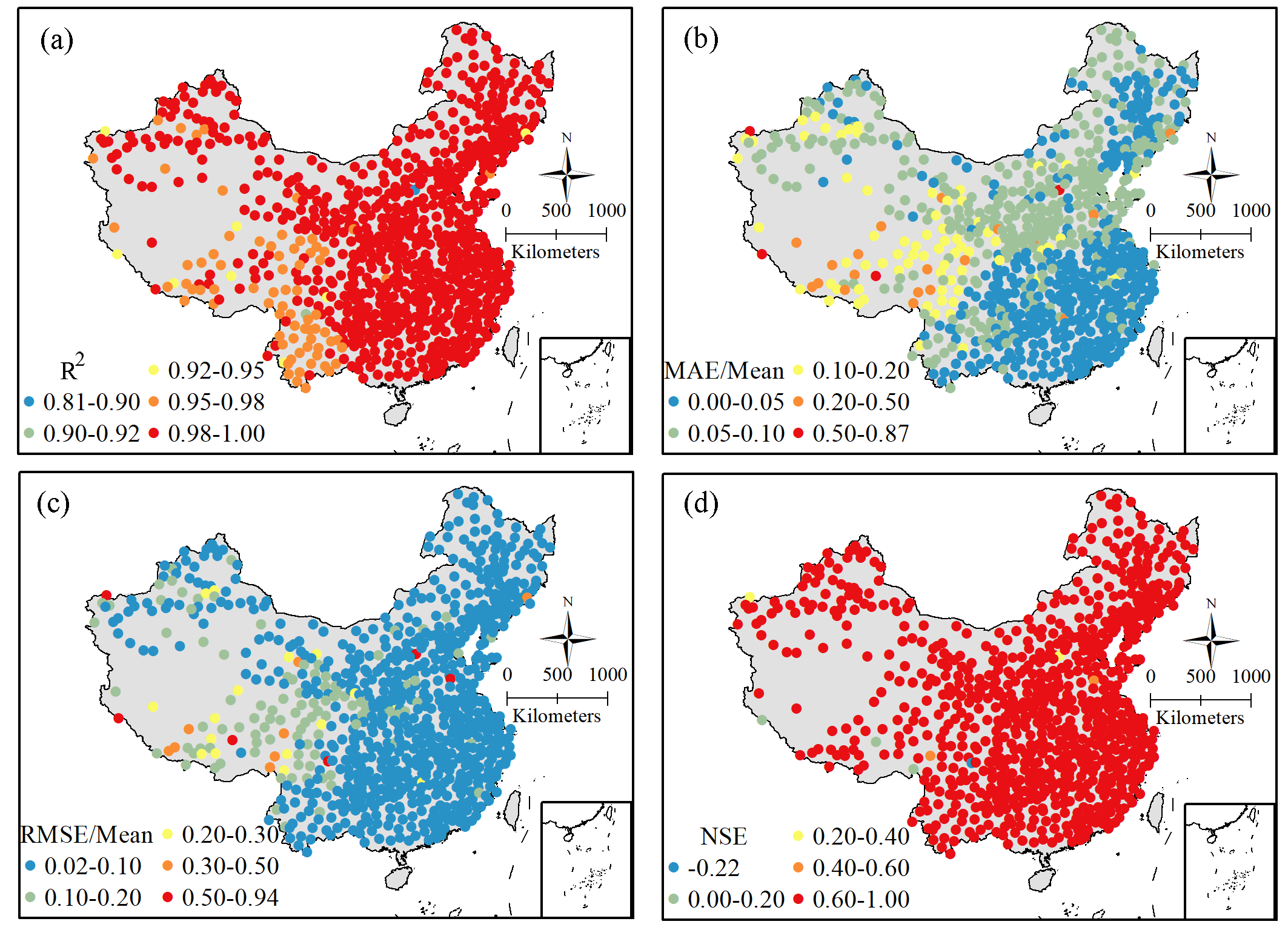


Figure S5. Statistical criteria of the calculated monthly PDD (accumulated positive air temperature) against observed PDD at 824 meteorological stations (a, *R*2, coefficient of determination; b, *MAE*/*Mean*, *MAE*, mean absolute error; *Mean*, monthly mean PDD; c, *RMSE*/*Mean*, *RMSE*, root mean square error; d, *NSE*, Nash-Sutcliffe efficiency).

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 balance | (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 equation | (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.

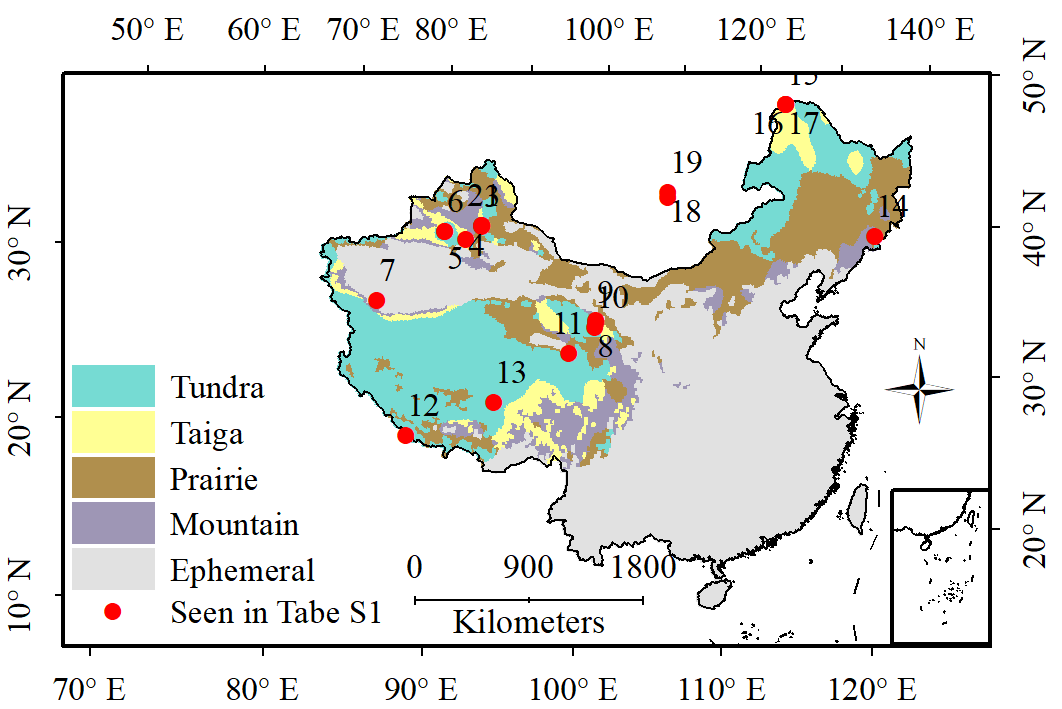


Figure S6. Spatial distribution of the study regions on the ratios of snow sublimation to snowfall from published literatures. (Numbers in the Figures were explained in Table S1)

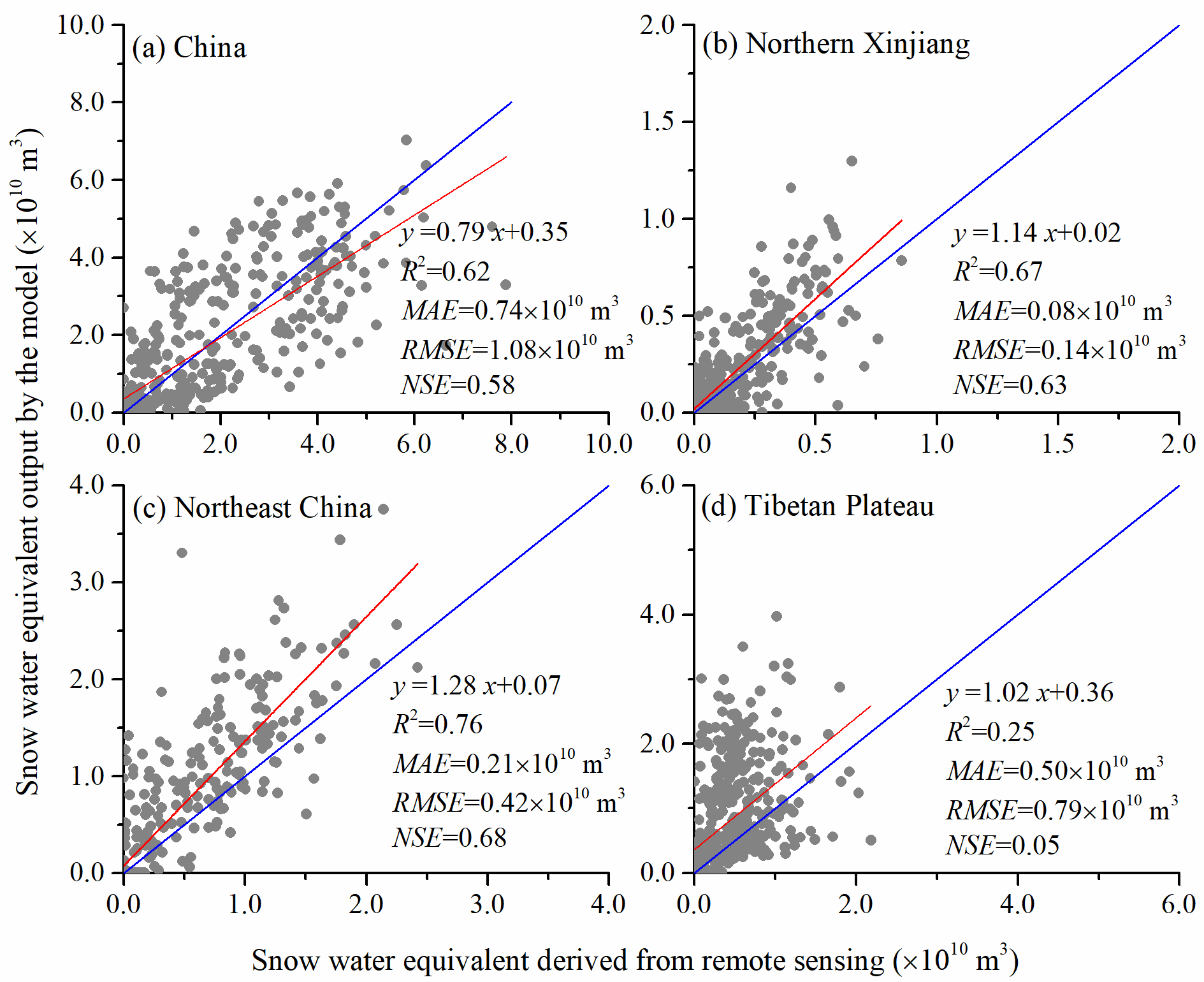


Figure S7. Scatterplots of the snow water equivalent output by the model and derived from remote sensing in China and its three main stable snow cover regions (snow water equivalent was removed from the glacier areas, and the glacier distribution data were obtained from the second glacial catalogue data 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.

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Figure S8. The location of the Qaidam Basin, Qiangtang Plateau and Mountains on the Tibetan Plateau.

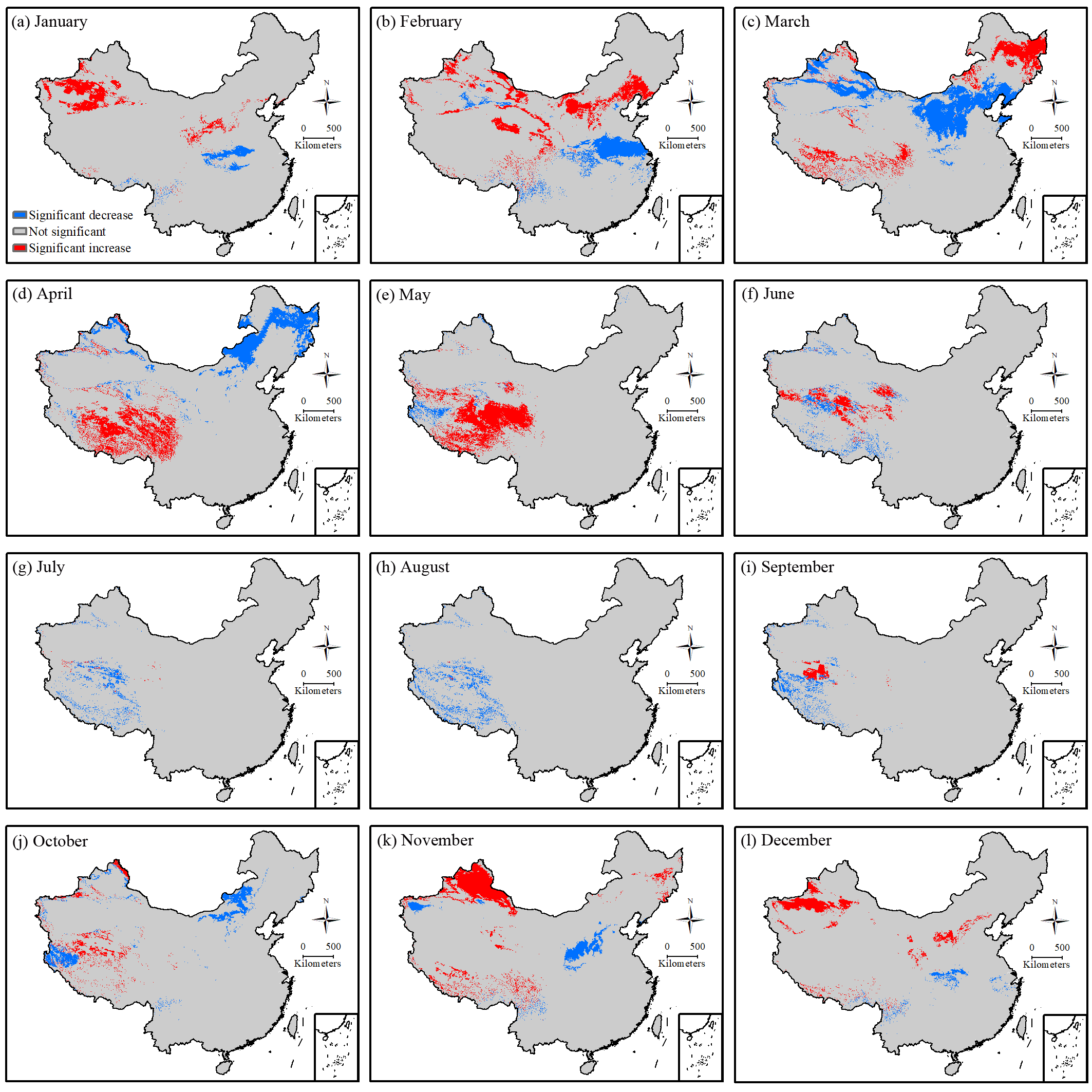


Figure S9. Trends of snowmelt in 12 months based on the Mann-Kendall method in China during the 1951-2017 period.

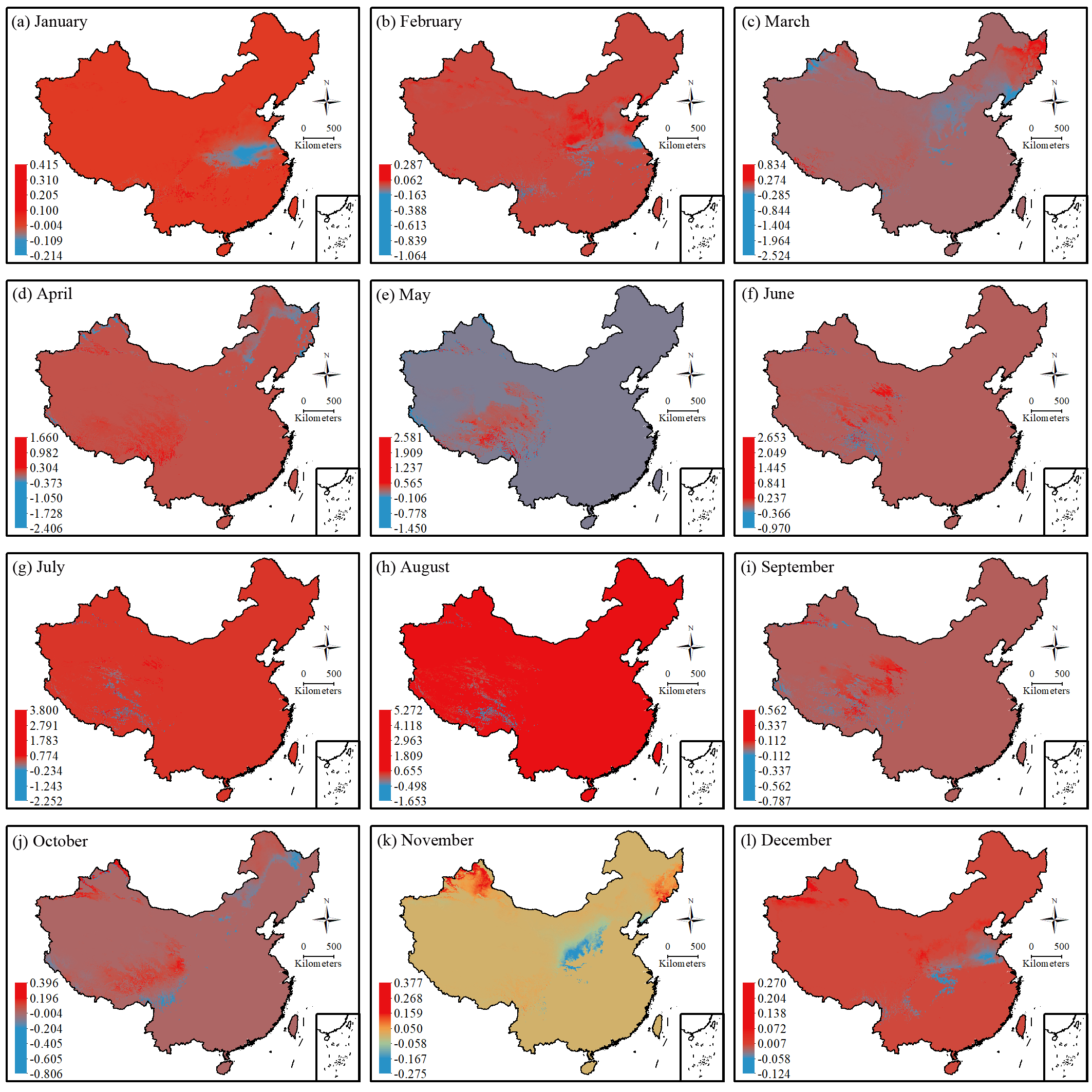


Figure S10. Sen’s slope (mm month-1) of snowmelt in 12 months in China during the 1951-2017 period.

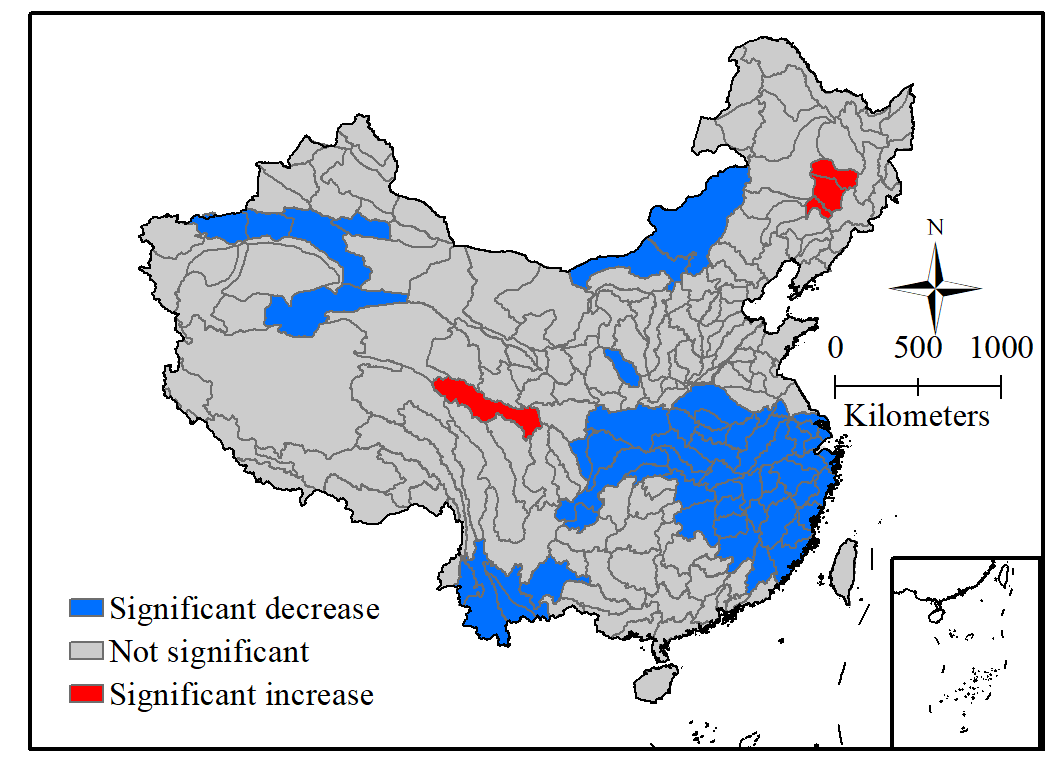


Figure S11. Trends of annual snowmelt runoff ratio at third-level basins based on the Mann-Kendall method in China during the 1951-2017 period.

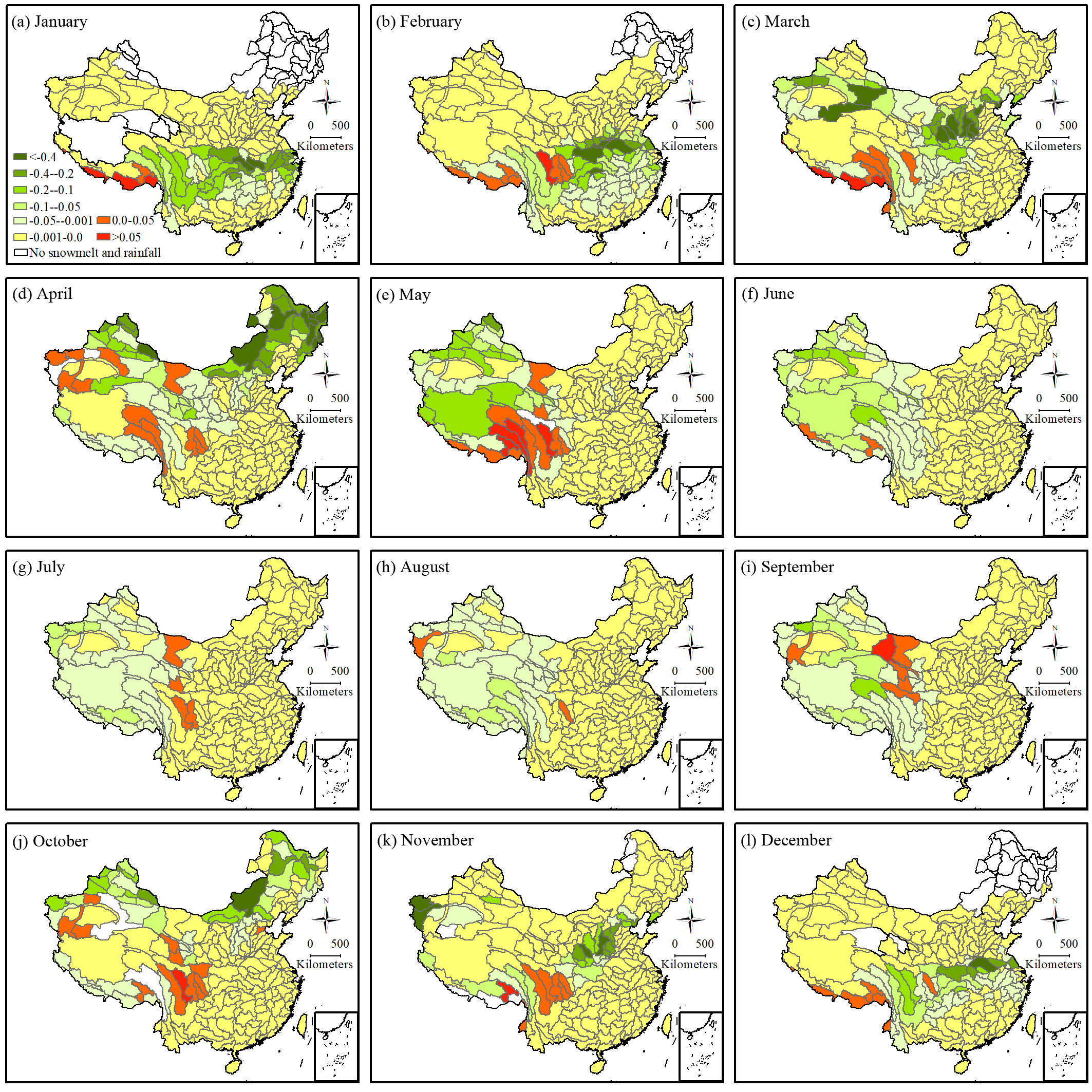


Figure S12. Spatial distributions of the Sen’s slope of snowmelt runoff ratio (% month-1) in 12 months in third-level basins in China during the 1951-2017 period.

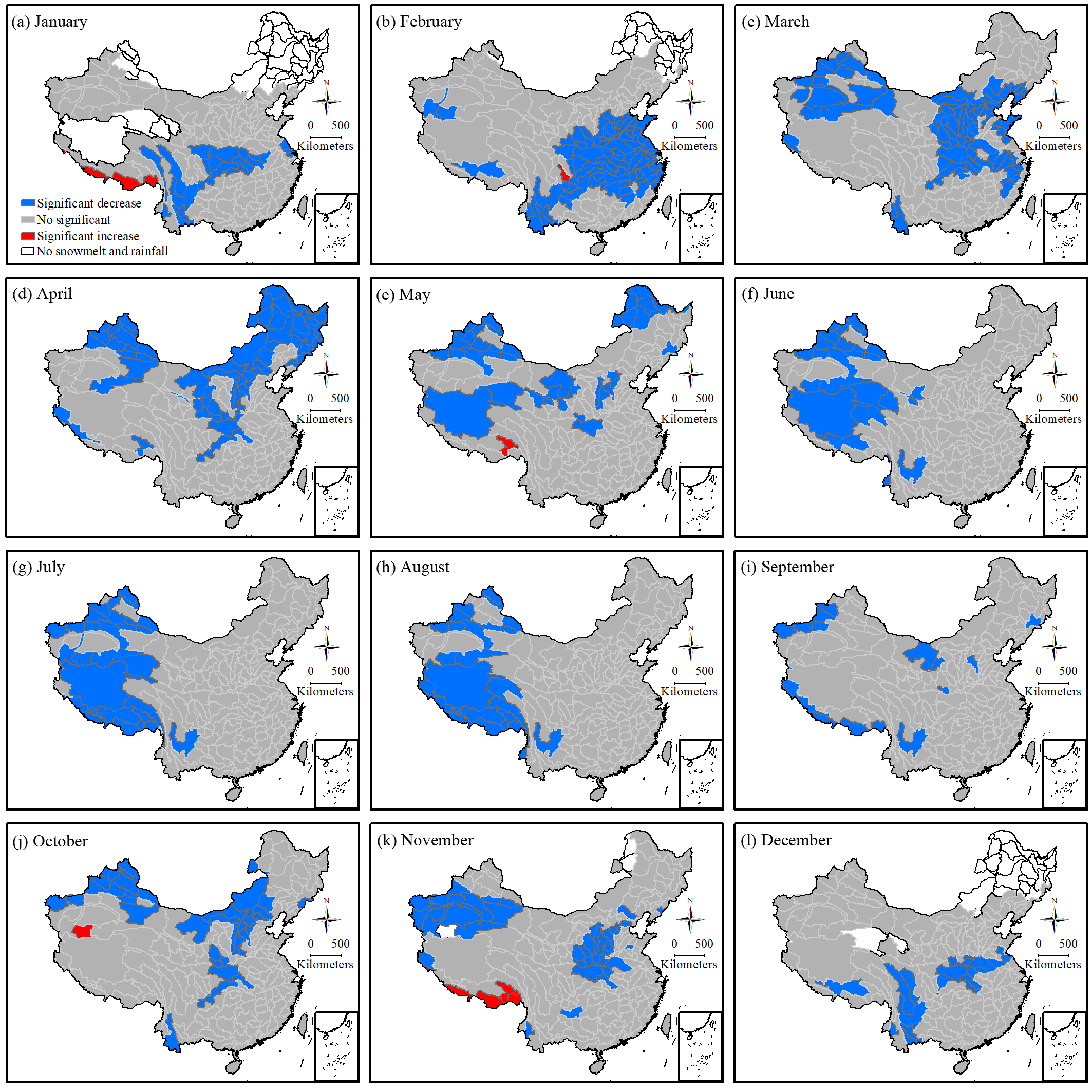


Figure S13. Trends of snowmelt runoff ratio in 12 months based on the Mann-Kendall method in China during the 1951-2017 period.

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.

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