**Supplementary material**

**Supplementary Table 1:** Summary of mass balance measurements for 2021/22. The different permanent ablation stakes situated on the glaciers are shown alongside their corresponding coordinates in UTM 44. Quantification of accumulation (acc) at these stakes is performed via snow probing at various locations within the indicated elevation range surrounding the ablation stake. The number of snow probing measurements is enclosed within parentheses. The determination of the ablation value (abl) is derived from the readings obtained from the stakes, utilising a density conversion factor of 0.9 for the conversion from ice to water equivalent. At the highest elevations, the data is only acquired from snow pits and snow probings.

Bordu glacier:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number | Elevation (m) | Lon. (utm X) | Lat. (utm Y) | Acc. (mm w.e. a-1) | Abl. (mm w.e. a-1) | MB (mm w.e. a-1) |
| Stake 1 | <4000 | 264132.00 | 4633866.00 | 180 (46) | -4480 | -4300 |
| Stake 2 | <4000 | 264375.00 | 4633740.00 | 180 (46) | -3518 | -3338 |
| Stake 2a | <4000 | 264183.20 | 4633612.98 | 180 (46) | -2990 | -2810 |
| Stake3 | 4000-4100 | 264676.00 | 4633531.10 | 240 (110) | -2298 | -2058 |
| Stake 3а | 4000-4100 | 264464.04 | 4633336.99 | 240 (110) | -2722 | -2482 |
| Stake 4 | 4000-4100 | 265008.00 | 4633312.08 | 240 (110) | -2290 | -2050 |
| Stake 4а | 4000-4100 | 264795.00 | 4633096.00 | 240 (110) | -2867 | -2627 |
| Stake 5 | 4100-4200 | 265360.10 | 4633020.10 | 310 (109) | -2070 | -1760 |
| Stake 5а | 4100-4200 | 265003.00 | 4632884.00 | 310 (109) | -2236 | -1926 |
| Stake 6а | 4100-4200 | 265614.20 | 4632780.00 | 310 (109) | -859 | -549 |
| Stake 7 | 4100-4200 | 265756.00 | 4632849.00 | 310 (109) | -1770 | -1460 |
| Stake 9 | 4100-4200 | 265509.00 | 4632764.00 | 310 (109) | -1718 | -1408 |
| Stake 8 | 4200-4300 | 265830.00 | 4632753.00 | 260 (310) | -1749 | -1489 |
| Stake 10 | 4200-4300 | 265761.00 | 4633212.00 | 260 (310) | -1666 | -1406 |
| Stake 11 | 4200-4300 | 265994.00 | 4633026.00 | 260 (310) | -952 | -692 |
| Stake 12 | 4200-4300 | 265918.00 | 4632852.00 | 260 (310) | -1148 | -888 |
| Snowpits | 4300-4400 | Scattered | 320 (5) | -1140 (extrapolated) | -820 |
| Snowpits | 4400-4500 | Scattered | 630 (5) | -610 (5) | 20 |
| Snowpits | >4500 | Scattered | 680 (6) | -550 (6) | 130 |

Sary-Tor glacier:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number | Elevation (m) | Lon. (utm X) | Lat. (utm Y) | Acc. (mm w.e. a-1) | Abl. (mm w.e. a-1) | MB (mm w.e. a-1) |
| Stake 2 | <4000 | 264911.71 | 4635513.39 | 290 (13) | -3504 | -3214 |
| Stake 2a | <4000 | 264862.86 | 4635427.20 | 290 (13) | -3227 | -2937 |
| Stake 3 | 4000-4100 | 265159.13 | 4635318.46 | 260 (66) | -3053 | -2793 |
| Stake 3a | 4000-4100 | 264955.89 | 4635068.85 | 260 (66) | -3042 | -2782 |
| Stake 4 | 4000-4100 | 265159.00 | 4635068.00 | 260 (66) | -2898 | -2638 |
| Stake 4a | 4000-4100 | 265083.59 | 4634999.72 | 260 (66) | -2888 | -2628 |
| Stake 5 | 4000-4100 | 265316.74 | 4634696.84 | 260 (66) | -2567 | -2307 |
| Stake 5a | 4000-4100 | 265182.35 | 4634655.66 | 260 (66) | -2515 | -2255 |
| Stake 6 | 4100-4200 | 265350.14 | 4634365.33 | 310 (30) | -2101 | -1791 |
| Stake 6a | 4100-4200 | 265535.37 | 4634433.97 | 310 (30) | -2121 | -1811 |
| Stake 8 | 4100-4200 | 265829.98 | 4634323.20 | 310 (30) | -2308 | -1998 |
| Stake 9 | 4100-4200 | 265302.53 | 4634201.67 | 310 (30) | -2266 | -1956 |
| Stake 10 | 4200-4300 | 265588.00 | 4633891.00 | 240 (25) | -2218 | -1978 |
| Stake 11 | 4200-4300 | 265978.00 | 4633772.00 | 240 (25) | -1883 | -1643 |
| Stake 12 | 4300-4400 | 266469.00 | 4633810.00 | 330 (10) | -1559 | -1229 |
| Snow pits | 4400-4500 | Scattered | 560 (5) | -520 | 40 |
| Snow pits | >4500 | Scattered | 570 (6) | -430 | 140 |

**Supplementary Table 2:** Mean accumulation, ablation and surface mass balance in altitudinal belts.

Bordu glacier:

|  |  |
| --- | --- |
| Elevation bin (m) | **Accumulation (mm w.e. a-1)** |
| 2015/16 | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
| <4000 | 240 | 80 | 100 | 140 | 120 | 90 | 180 |
| 4000-4100 | 290 | 140 | 200 | 210 | 150 | 120 | 240 |
| 4100-4200 | 470 | 180 | 260 | 240 | 290 | 160 | 310 |
| 4200-4300 | 450 | 280 | 320 | 340 | 320 | 280 | 260 |
| 4300-4400 | 500 | 240 | 320 | 340 | 370 | 230 | 320 |
| 4400-4500 | 860 | 400 | 550 | 590 | 560 | 400 | 630 |
| >4500 | 890 | 450 | 610 | 630 | 630 | 460 | 680 |
|  | **Ablation (mm w.e. a-1)** |
|  | 2015/16 | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
| <4000 | -2100 | -2930 | -2520 | -2450 | -1990 | -2890 | -3570 |
| 4000-4100 | -1230 | -2110 | -1530 | -1760 | -860 | -2200 | -2540 |
| 4100-4200 | -950 | -1870 | -1360 | -1410 | -620 | -990 | -1840 |
| 4200-4300 | -810 | -1490 | -990 | -1210 | -100 | -690 | -1310 |
| 4300-4400 | -840 | -1290 | -1030 | -1090 | -10 | -460 | -1140 |
| 4400-4500 | -490 | -610 | -520 | -540 | 0 | -180 | -610 |
| >4500 | -480 | -550 | -510 | -520 | 0 | -70 | -550 |
|  | **Mean specific mass balance (mm w.e. a-1)** |
|  | 2015/16 | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
| <4000 | -1860 | -2850 | -2420 | -2310 | -1870 | -2800 | -3390 |
| 4000-4100 | -940 | -1970 | -1330 | -1550 | -710 | -1540 | -2300 |
| 4100-4200 | -480 | -1690 | -1100 | -1170 | -330 | -830 | -1530 |
| 4200-4300 | -360 | -1210 | -670 | -870 | 220 | -410 | -1050 |
| 4300-4400 | -340 | -1050 | -710 | -760 | 360 | -230 | -820 |
| 4400-4500 | 370 | -210 | 30 | 50 | 560 | 220 | 20 |
| >4500 | 410 | -100 | 100 | 110 | 630 | 390 | 130 |
|  | **Glacier wide mean specific mass balance (mm w.e. a-1)** |
|  | 2015/16 | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
| 3900-4700 | -450 | -1340 | -870 | -960 | -70 | -650 | -1270 |

Sary-Tor glacier:

|  |  |
| --- | --- |
| Elevation bin (m) | **Accumulation (mm w.e. a-1)** |
| 2014/15 | 2015/16 | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
| <4000 | 170 | 250 | 80 | 120 | 190 | 170 | 150 | 290 |
| 4000-4100 | 270 | 290 | 90 | 160 | 200 | 200 | 150 | 260 |
| 4100-4200 | 310 | 320 | 180 | 260 | 250 | 270 | 90 | 310 |
| 4200-4300 | 360 | 330 | 160 | 320 | 260 | 230 | 130 | 240 |
| 4300-4400 | 410 | 390 | 180 | 330 | 260 | 300 | 190 | 330 |
| 4400-4500 | 570 | 630 | 270 | 500 | 430 | 450 | 300 | 560 |
| >4500 | 580 | 650 | 280 | 520 | 440 | 460 | 310 | 570 |
|  | **Ablation (mm w.e. a-1)** |
|  | 2014/15 | 2015/16 | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
| <4000 | -2630 | -2960 | -3190 | -2470 | -2890 | -1480 | -3310 | -3360 |
| 4000-4100 | -1930 | -1720 | -2340 | -1790 | -1820 | -1180 | -1750 | -2810 |
| 4100-4200 | -1610 | -1080 | -1990 | -1190 | -1440 | -540 | -950 | -2260 |
| 4200-4300 | -1220 | -1200 | -1540 | -970 | -1220 | -90 | -570 | -1510 |
| 4300-4400 | -1060 | -1490 | -1640 | -390 | -800 | -20 | -40 | -1390 |
| 4400-4500 | -840 | -680 | -940 | -330 | -620 | 0 | -10 | -520 |
| >4500 | -820 | -690 | -930 | -330 | -590 | 0 | 0 | -430 |
|  | **Mean specific mass balance (mm w.e. a-1)** |
|  | 2014/15 | 2015/16 | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
| <4000 | -2460 | -2710 | -3110 | -2350 | -2700 | -1310 | -3160 | -3070 |
| 4000-4100 | -1660 | -1430 | -2260 | -1630 | -1620 | -980 | -1600 | -2550 |
| 4100-4200 | -1300 | -760 | -1810 | -930 | -1190 | -270 | -860 | -1950 |
| 4200-4300 | -860 | -870 | -1390 | -650 | -960 | 140 | -440 | -1270 |
| 4300-4400 | -650 | -1100 | -1460 | -60 | -540 | 280 | 150 | -1060 |
| 4400-4500 | -270 | -50 | -670 | 170 | -190 | 450 | 290 | 40 |
| >4500 | -240 | -40 | -650 | 190 | -150 | 460 | 310 | 140 |
|  | **Glacier wide mean specific mass balance (mm w.e. a-1)** |
|  | 2014/15 | 2015/16 | 2016/17 | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
| 3900-4800 | -820 | -790 | -1480 | -540 | -850 | -10 | -410 | -1270 |