**Supplementary Information – Shea et al., Frontiers (2021), doi: 10.3389/frwa.2021.604275**

**Table S1: Modelled and observed peak snow accumulation gradients. References in Table S1 are cited in the main article.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Site** | **γS**  **[mm w.e. m-1]** | **Elevation**  **[m]** | **Description** | **Reference** |
| Alaska | 1.40 – 4.0 | 0 – 2200 | Centreline radar profiles on 6 Alaskan glaciers | McGrath *et al.* (2015) |
| Andes | 0.50 - 1.00 | 2200 - 3000 | Manual SWE observations; logarithmic increases in SWE | Ayala *et al.* (2014) |
| Cascades | 0.25 | 860-2400 | Manual SWE observations; gradients are non-linear and vary seasonally | Fitzharris (1978) |
| Cascades | 1.10 | 600-3000 | Modelled SWE, non-linear | Casola *et al.* (2009) |
| Coast Mountains, BC | 0.55 | 400 – 1300 | Manual SWE observations, non-linear | Fitzharris (1978) |
| Israel | 1.0 | 1500-2100 | Snowline from Landsat imagery | Gil’ad & Bonne (1990) |
| New Zealand | 0.10-0.46 | 1000 - 2400 | Manual SWE observations on Tasman Glacier; gradients are non-linear and vary seasonally | Fitzharris (1978) |
| Sierra Nevada | 0.32 – 0.41 | 3300 | Snow courses, numbers originally in English units | Court (1963) |
| Sierra Nevada | 1.02 – 1.28 | 1650 - 3450 | Used total seasonal melt, not observed SWE; but more melt at higher elevation bands | Rice *et al.* (2011) |
| Sierra Nevada | 0.68\* | Below 3300 | LiDAR observations | Kirchner *et al.* (2014) |
| Sierra Nevada | -2.16\* | Above 3300 | LiDAR observations | Kirchner *et al.* (2014) |
| Svalbard | 0.47\* | 300 – 775 | Radar measurements of snow depth from 2004, windward side of Austfonna Ice Cap | Taurisano *et al.* (2007) |
| Sierra Nevada | 0.33 – 0.75 | 1500 - 4000 | Snow accumulation gradients from min catchment elevation to elevation of max snow accumulation | Huning & Margulis (2018) |
| Swiss Alps | 0.50-1.00 | NA | Mean altitudinal gradients | Keller *et al.* (1984) in Grünewald & Lehning (2011) |
| Swiss Alps | 0.90 – 1.26\* | 2000-3000 | Airborne LiDAR; gradients estimated from elevations of minimum and maximum snow depths | Lehning *et al.* (2011) |
| Swiss Alps | 0.50 - 0.76\* | 1800-2258 | Airborne LiDAR gradients | Grünewald & Lehning (2011) |
| Swiss Alps | 0.68\* | 1800-3500 | LiDAR observations | Grünewald *et al.* (2013) |
| Swiss Alps | 0.45 – 1.17 \* | 1700 – 3500 | LiDAR observations for 7 catchments | Grünewald *et al.* (2014) |

\* Snow depth gradients converted to SWE gradients assuming snow density of 450 kg m-3

**Table S2: List of snow pillow stations used to evaluate the linear gradient of snow accumulation. Data are available at** <https://aqrt.nrs.gov.bc.ca/Data/> (last accessed 4 August 2020)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Station ID** | **Name** | **Latitude (dd)** | **Longitude (dd)** | **Elev (m)** | **Period of record** |
| 1A01P | Yellowhead | 52.92 | -118.54 | 1860 | 1996 - 2020 |
| 1A02P | McBride Upper | 53.31 | -120.31 | 1611 | 2006 – 2020 |
| 1E08P | Azure River | 52.59 | -119.73 | 1620 | 1996 - 2020 |
| 1E14P | Cook Creek | 52.17 | -119.30 | 1280 | 1999 – 2020 |
| 1F03P | Park Mountain | 50.44 | -118.63 | 1890 | 1984 – 2020 |
| 1F06P | Celista | 51.41 | -119.00 | 1500 | 2004 – 2020 |
| 2A06P | Mount Revelstoke | 51.07 | -118.15 | 1850 | 1992 – 2020 |
| 2A18P | Keystone Creek | 51.42 | -118.37 | 1850 | 2015 - 2020 |
| 2A21P | Molson Creek | 52.22 | -118.23 | 1860 | 2003 – 2019 |
| 2A30P | Colpitti Creek | 51.61 | -117.61 | 2131 | 1976 - 2020 |
| 2A32P | Wildcat Creek | 51.70 | -116.63 | 2122 | 2015 – 2020 |
| 2B06P | Barnes Creek | 50.07 | -118.36 | 1620 | 1992 – 2020 |
| 2B08P | St. Leon Creek | 50.43 | -117.70 | 1800 | 1992 – 2020 |
| 2C10P | Moyie Mountain | 49.25 | -115.78 | 1930 | 1971 – 2020 |
| 2C14P | Floe Lake | 51.05 | -116.14 | 2090 | 1992 – 2020 |
| 2C09Q | Morrissey Ridge | 49.45 | -114.98 | 1860 | 1983 – 2020 |
| 2D08P | East Creek | 50.64 | -116.93 | 2030 | 1980 – 2020 |
| 2D14P | Redfish Creek | 49.69 | -117.09 | 2104 | 2001 – 2020 |

**Table S3: List of manual snow course stations used to evaluate the linear gradient of snow accumulation. Data are available at** [**http://www.env.gov.bc.ca/wsd/data\_searches/snow/asws/data/allmss\_archive.csv**](http://www.env.gov.bc.ca/wsd/data_searches/snow/asws/data/allmss_archive.csv)(last accessed 4 August 2020)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Station ID** | **Name** | **Latitude** | **Longitude** | **Elev (m)** | **Start** | **End** |
| 1A05 | Longworth (Upper) | 53.97 | -121.44 | 1693 | 1953 | 2018 |
| 1A06A | Hansard | 54.07 | -121.86 | 608 | 1973 | 2018 |
| 1A11 | Pacific Lake | 54.37 | -121.58 | 755 | 1963 | 2018 |
| 1A15 | Knudsen Lake | 54.31 | -120.78 | 1602 | 1967 | 2018 |
| 1C13A | Horsefly Mountain | 52.34 | -121.05 | 1550 | 1970 | 2018 |
| 1C17 | Mount Timothy | 51.92 | -121.25 | 1660 | 1961 | 2018 |
| 1C23 | Penfold Creek | 52.75 | -120.56 | 1685 | 1970 | 2018 |
| 1E01B | Blue River | 52.12 | -119.29 | 670 | 1983 | 2018 |
| 1E03A | Trophy Mountain | 51.81 | -119.95 | 1860 | 1974 | 2018 |
| 1F01A | Aberdeen Lake | 50.15 | -119.05 | 1310 | 1939 | 2018 |
| 1F02 | Anglemont | 51.00 | -119.19 | 1190 | 1956 | 2018 |
| 1F04 | Enderby | 50.66 | -118.93 | 1900 | 1963 | 2015 |
| 2A02 | Glacier | 51.25 | -117.49 | 1250 | 1937 | 2018 |
| 2A03A | Field | 51.39 | -116.51 | 1285 | 1939 | 2018 |
| 2A07 | Kicking Horse | 51.44 | -116.36 | 1650 | 1947 | 2018 |
| 2A11 | Beaverfoot | 51.27 | -116.90 | 1890 | 1948 | 2018 |
| 2A14 | Mount Abbot | 51.24 | -117.51 | 2010 | 1959 | 2018 |
| 2A16 | Goldstream | 51.69 | -118.44 | 1920 | 1963 | 2018 |
| 2A17 | Fidelity Mountain | 51.24 | -117.69 | 1870 | 1963 | 2018 |
| 2A18 | Keystone Creek | 51.41 | -118.36 | 1890 | 1966 | 2018 |
| 2A19 | Vermont Creek | 50.97 | -116.95 | 1520 | 1966 | 2018 |
| 2A22 | Sunbeam Lake | 51.59 | -117.66 | 2010 | 1967 | 2018 |
| 2A23 | Bush River | 51.73 | -117.42 | 1920 | 1967 | 2018 |
| 2A25 | Kirbyville Lake | 51.58 | -118.78 | 1750 | 1972 | 2018 |
| 2A27 | Downie Slide (Lower) | 51.51 | -118.53 | 980 | 1977 | 2018 |
| 2A29 | Downie Slide (Upper) | 51.51 | -118.56 | 1630 | 1978 | 2018 |
| 2B02A | Farron | 49.27 | -118.12 | 1220 | 1973 | 2018 |
| 2B05 | Whatshan (Upper) | 50.19 | -118.03 | 1525 | 1958 | 2018 |
| 2B07 | Koch Creek | 49.73 | -117.98 | 1860 | 1959 | 2018 |
| 2B09 | Record Mountain | 49.10 | -117.88 | 1890 | 1975 | 2018 |
| 2C01 | Sinclair Pass | 50.66 | -117.97 | 1370 | 1936 | 2018 |
| 2C04 | Sullivan Mine | 49.73 | -116.02 | 1550 | 1946 | 2018 |
| 2C07 | Fernie East | 49.51 | -115.02 | 1250 | 1951 | 2018 |
| 2C15 | Mount Assiniboine | 50.92 | -115.61 | 2230 | 1969 | 2018 |
| 2C16 | Mount Joffre | 50.54 | -115.12 | 1750 | 1969 | 2018 |
| 2C17 | Thunder Creek | 50.03 | -115.24 | 2010 | 1969 | 2018 |
| 2D02 | Ferguson | 50.68 | -117.47 | 880 | 1938 | 2018 |
| 2D03 | Sandon | 49.98 | -117.22 | 1070 | 1938 | 2018 |
| 2D04 | Nelson | 49.42 | -117.23 | 930 | 1938 | 2018 |
| 2D05 | Gray Creek (Lower) | 49.61 | -116.68 | 1550 | 1948 | 2018 |
| 2D06 | Char Creek | 49.10 | -116.95 | 1310 | 1965 | 2018 |
| 2D07A | Duncan Lake No. 2 | 50.25 | -116.97 | 630 | 1991 | 2017 |
| 2D09 | Mount Templeman | 50.71 | -117.20 | 1860 | 1968 | 2018 |
| 2D10 | Gray Creek (Upper) | 49.61 | -116.66 | 1940 | 1969 | 2018 |

**Table S4: List of climate stations with 1980 – 2010 climate normal used to evaluate the temperature forcing. Data available at** [**https://climate.weather.gc.ca/climate\_normals/index\_e.html**](https://climate.weather.gc.ca/climate_normals/index_e.html) **(last viewed 5 August 2020).**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Latitude (dd) | Longitude (dd) | Elevation (m) | Province |
| Beaver Mines | 49.47 | 114.17 | 1257 | AB |
| Bighorn | 52.32 | -116.33 | 1341 | AB |
| Blue River | 52.13 | -119.28 | 690 | BC |
| Brule Black | 53.35 | -117.87 | 1036 | BC |
| Bugaboo Creek Lodge | 51.75 | -116.71 | 1529 | BC |
| Cariboo Lodge | 52.72 | -119.47 | 1095 | BC |
| Coleman | 49.63 | -114.58 | 1341 | AB |
| Creston | 49.10 | -116.52 | 610 | BC |
| Entrance | 53.37 | -117.70 | 990 | BC |
| Fernie | 49.48 | -115.08 | 1001 | BC |
| Glacier NP Fidelity | 51.23 | -117.70 | 1890 | BC |
| Glacier NP Rogers Pass | 51.30 | -118.52 | 1330 | BC |
| Golden | 51.30 | -116.98 | 785 | BC |
| Goldstream | 51.63 | -119.43 | 700 | BC |
| Grand Forks | 49.02 | -118.47 | 531 | BC |
| Jasper East | 53.23 | -117.82 | 1002 | AB |
| Kananaskis | 51.03 | -115.03 | 1391 | AB |
| Kananaskis Pocaterra | 50.71 | -115.12 | 1610 | AB |
| Kootenay NP | 50.88 | -116.05 | 1170 | BC |
| Lake Louise | 51.43 | -116.22 | 1524 | AB |
| Mica Dam | 52.05 | -118.58 | 579 | BC |
| Nordegg | 52.50 | 116.05 | 1320 | AB |
| Sunwapta | 52.45 | -117.45 | 1554 | AB |