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# Brief communication: Evaluation of the near-surface climate in ERA5 over the Greenland Ice Sheet

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Centered RMSE equation:

$$RMSEc = RMSE - bias = \sqrt{\frac{\sum_{i=0}^{n}(m_i - o_i)^2}{n} - (\overline{m} - \overline{o})^2}$$ (S1)

Where n is the number of observation, $m_i$ is the modelled value, $o_i$ is the observed value and $\overline{m}$ and $\overline{o}$ are respectively average of modelled and observed values.

| AWS | Lat | Lon | Elev. (m) | Difference in elevation (m) with : | | | |
|---|---|---|---|---|---|---|---|
| | | | | MAR | ASR | E5 | EI |
| KPC_L | 79.91 | -24.09 | 370 | 176 | 140 | 172 | 229 |
| KPC_U | 79.83 | -25.17 | 870 | -15 | -71 | -83 | -65 |
| SCO_L | 72.23 | -26.82 | 460 | 881 | 895 | 743 | 723 |
| SCO_U | 72.39 | -27.24 | 970 | 245 | 385 | 360 | 350 |
| TAS_A | 65.78 | -38.90 | 890 | -95 | -251 | -401 | 87 |
| QAS_U | 61.18 | -46.82 | 900 | -42 | -292 | -55 | 233 |
| QAS_A | 61.24 | -46.73 | 1000 | 20 | -167 | -139 | 159 |
| NUK_U | 64.51 | -49.27 | 1120 | -51 | -104 | -16 | 22 |
| NUK_N | 64.95 | -49.89 | 920 | -67 | -92 | -84 | 30 |
| KAN_L | 67.10 | -49.95 | 670 | -112 | -112 | -70 | 164 |
| KAN_M | 67.07 | -48.83 | 1270 | 12 | -10 | 30 | -12 |
| KAN_U | 67.00 | -47.02 | 1840 | 3 | 1 | -3 | -30 |
| UPE_U | 72.89 | -53.57 | 940 | 33 | -3 | -27 | -8 |
| THU_L | 76.40 | -68.27 | 570 | -43 | -106 | -280 | -187 |
| THU_U | 76.42 | -68.14 | 760 | -159 | -281 | -454 | -379 |
| NUK_L | 64.48 | -49.54 | 530 | 299 | 216 | 298 | 537 |
| QAS_L | 61.03 | -46.85 | 280 | 119 | 6 | 151 | 770 |
| QAS_M | 61.10 | -46.83 | 630 | -31 | -251 | 117 | 451 |
| TAS_L | 65.64 | -38.90 | 250 | 14 | -29 | 239 | 736 |
| TAS_U | 65.70 | -38.87 | 570 | -142 | -275 | -83 | 410 |
| UPE_L | 72.89 | -54.30 | 220 | 2 | 319 | 350 | 449 |

**Table S1.** Differences in elevation (m) with AWS of the PROMICE network for the four models (MAR, ASR, E5 and E5).

**Table S2.** Dismissed PROMICE AWS per studied variable (2-m temperature, 10-m wind speed, longwave and shortwave downward radiative flux) and justifications.

| Variable | AWS | Justification |
|---|---|---|
| Surface Pressure | SCO_L | Difference between AWS and interpolated model elevations higher than 250 m in absolute value for all models |
| | TAS_A | Inconsistencies and period of malfunction have been evidenced from visual inspection of the time series : |
| | TAS_A | Feb 2014 |
| | QAS_A | Feb 2015 |
| | TAS_L | May-Jun 2011, Mar 2012, Nov 2013 |
| T2M | SCO_L | Difference between AWS and interpolated model elevations higher than 250 m in absolute value for all models |
| | | Inconsistencies and period of malfunction have been evidenced from visual inspection of the time series : |
| | NUK_L | Jan-Jun 2012 |
| Wind Speed | SCO_L | Difference between AWS and interpolated model elevations higher than 250 m in absolute value for all models |
| | | Inconsistencies and period of malfunction have been evidenced from visual inspection of the time series : |
| | NUK_L | Jun-Jul 2013 |
| LWD | SCO_L | Difference between AWS and interpolated model elevations higher than 250 m in absolute value for all models |
| | | Inconsistencies and period of malfunction have been evidenced from visual inspection of the time series : |
| | QAS_U | Feb-May and Jul-Aug 2012, Feb-Jul 2015 |
| | NUK_U | Dec 2010, Jan-Aug 2011 |
| | TAS_U | Jan-Jul 2011 |
| SWD | SCO_L | Difference between AWS and interpolated model elevations higher than 250 m in absolute value for all models |
| | | Inconsistencies and period of malfunction have been evidenced from visual inspection of the time series : |
| | QAS_U | Feb-May and Jul-Aug 2012, Nov-Dec 2013, Jan-Apr 2014 and Feb-Jul 2015 |
| | NUK_U | Jan-Aug 2011 |
| | NUK_L | Jan-Jun 2011 |
| | TAS_U | Jan-Jul 2011 |

|  | | | | Difference in elevation (m) with : | | | |
| AWS | Lat | Lon | Elev. (m) | MAR | ASR | E5 | EI |
|---|---|---|---|---|---|---|---|
| Swiss_Camp | 69.56 | -49.33 | 1176 | -36 | -148 | -117 | 168 |
| Crawford_P1 | 69.88 | -47.00 | 2022 | -76 | -75 | -81 | -186 |
| NASA-U | 73.84 | -49.51 | 2334 | -10 | -1 | -17 | -27 |
| Humboldt | 78.53 | -56.83 | 1995 | -40 | -24 | -60 | -107 |
| Summit | 72.58 | -38.51 | 3199 | 3 | 2 | 0 | -39 |
| Tunu-N | 78.02 | -33.98 | 2052 | 23 | 35 | 25 | 22 |
| DYE-2 | 66.48 | -46.28 | 2099 | 0 | 17 | -3 | -62 |
| JAR-1 | 69.41 | -50.09 | 932 | -96 | -189 | -189 | -59 |
| Saddle | 66.00 | -44.50 | 2467 | -14 | -5 | -17 | -75 |
| South-Dome | 63.15 | -44.82 | 2901 | -35 | -78 | -106 | -345 |
| NASA-E | 75.00 | -30.00 | 2614 | -23 | -37 | -34 | -96 |
| NASA-SE | 66.47 | -42.50 | 2373 | 3 | -11 | 1 | -14 |
| Petermann-ELA | 80.08 | -58.07 | 965 | -11 | 56 | 16 | 18 |
| GITS | 77.14 | -61.04 | 1869 | -15 | -26 | -44 | -185 |
| NEEL | 77.50 | -50.87 | 2454 | -5 | 1 | 4 | -10 |
| JAR2 | 69.41 | -50.09 | 507 | 13 | -92 | -145 | 116 |

**Table S3.** Differences in elevation (m) with AWS of the GC-Net network for the four models (MAR, ASR, E5 and E5).

**Table S4.** Dismissed GC-Net AWS per studied variable (2-m temperature, 10-m wind speed and shortwave downward radiative flux) and justifications.

| Variable | AWS | Justification |
|---|---|---|
| | | Inconsistencies and period of malfunction have been evidenced from visual inspection of the time series : |
| | NASA-U | May 2011 |
| | Crawford P1 | May 2010 |
| | GITS | Apr 2016 |
| Surface | DYE-2 | May 2014 - May 2016 |
| Pressure | JAR1 | Apr 2014 |
| | JAR2 | Sep 2011 |
| | Petermann-ELA | Apr 2013, Apr 2016 |
| | Neel | Jun 2012 |
| | Summit | Dec 2016 - Jun 2016 |
| | JAR2 | Time shift of a few weeks |
| T2M | | Inconsistencies and period of malfunction have been evidenced from visual inspection of the time series: |
| | JAR1 | Jan-Aug 2011 |
| | | Inconsistencies and period of malfunction have been evidenced from visual inspection of the time series : |
| | Swiss Camp | Jun, Jul 2014, Jun 2015 - Mar 2016 |
| Wind | NASA-E | Jan-Apr, Dec 2010, Jun 2015 - Apr 2016 |
| Speed | NASA-SE | Nov 2010 - Feb 2011, Dec 2012 - Jan 2013, Feb, Apr - May 2016 |
| | Saddle | Nov 2011, Oct-Dec 2012, Mar-Apr 2013, Mar-Apr, Sep, Oct, Nov 2014, Apr-Nov 2015, Jan-Feb, Apr, Dec 2016 |
| | JAR2 | Jul 2010, Sep 2010 |
| | | Inconsistencies and period of malfunction have been evidenced from visual inspection of the time series : |
| | GITS | May-Sep 2014, May-Oct 2016 |
| SWD | JAR2 | Sep-Oct 2010, Time shift |
| | Petermann-ELA | Jun-Oct 2011, Mar-May 2012, May-Oct 2013, Mar-May 2014, May-Oct 2016 |
| | NEEL | Mar-Apr 2010, Mar-May 2014, May-Oct 2016 |

**Table S5.** Mean bias, RMSE, centered RMSE (RMSEc) and correlation between daily observations from the GC-Net dataset and $MAR_{EI}$, $MAR_{E5}$, EI, E5 and ASR. Annual and summer statistics are given for the 2-m temperature (T2M), the 10-m wind speed (W10M) and the shortwave downward radiative flux (SWD) over 2010 – 2016. For the wind speed of both MAR simulation, statistics are given for 10-m high (UV1) and 2-m high (UV2).

| | | Annual | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean Bias | RMSE | RMSEc | Correlation | Mean Bias | RMSE | RMSEc | Correlation |
| | $MAR_{EI}$ | 0.44 | 4.49 | 2.74 | 0.96 | -0.48 | 3.18 | 1.32 | 0.97 |
| Pressure | $MAR_{E5}$ | -0.34 | 4.53 | 2.78 | 0.96 | -1.38 | 3.24 | 1.33 | 0.97 |
| (hPa) | EI | 8.81 | 10.32 | 2.62 | 0.96 | 7.76 | 9.45 | 1.18 | 0.97 |
| | E5 | 3.36 | 5.26 | 2.6 | 0.96 | 2.25 | 4.11 | 1.1 | 0.97 |
| | ASR | 2.96 | 5.65 | 2.59 | 0.96 | 1.8 | 4.37 | 1.16 | 0.97 |
| Mean obs 2010 – 2016 | | | 767.29 | | | | 778.16 | | |
| Std obs 2010 – 2016 | | | 12.28 | | | | 6.41 | | |
| | $MAR_{EI}$ | 0.36 | 4.45 | 3.71 | 0.94 | -0.5 | 2.68 | 2.33 | 0.84 |
| T2M | $MAR_{E5}$ | 0.49 | 4.53 | 3.76 | 0.94 | *-0.66 | 2.72 | 2.36 | 0.83 |
| (°C) | EI | 1.60 | 4.59 | 3.11 | 0.96 | 1.02 | 3.05 | 2.07 | 0.85 |
| | E5 | 0.71 | 4.22 | 3.27 | 0.96 | -0.99 | 2.60 | 2.04 | 0.85 |
| | ASR | -1.74 | 4.05 | 3.30 | 0.96 | -0.98 | 2.81 | 2.31 | 0.85 |
| Mean obs 2010 – 2016 | | | -19.94 | | | | -7.02 | | |
| Std obs 2010 – 2016 | | | 11.48 | | | | 4.15 | | |
| | UV1 $MAR_{EI}$ | 1.05 | 2.15 | 1.76 | 0.74 | 0.36 | 1.42 | 1.21 | 0.80 |
| | UV2 $MAR_{EI}$ | -0.21 | 1.91 | 1.72 | 0.75 | -0.67 | 1.54 | 1.23 | 0.79 |
| Wind | UV1 $MAR_{E5}$ | 1.23 | 2.25 | 1.78 | 0.75 | 0.53 | 1.47 | 1.25 | 0.79 |
| Speed | UV2 $MAR_{E5}$ | -0.03 | 1.94 | 1.75 | 0.75 | -0.50 | 1.51 | 1.27 | 0.78 |
| (ms$^{-1}$) | EI | 0.69 | 2.28 | 1.86 | 0.75 | 0.10 | 1.62 | 1.37 | 0.80 |
| | E5 | 1.15 | 2.23 | 1.67 | 0.79 | 0.72 | 1.48 | 1.15 | 0.84 |
| | ASR | 1.48 | 2.60 | 2.01 | 0.71 | 0.67 | 1.77 | 1.48 | 0.74 |
| Mean obs 2010 – 2016 | | | 5.43 | | | | 4.77 | | |
| Std obs 2010 – 2016 | | | 2.66 | | | | 2.00 | | |
| | $MAR_{EI}$ | -2.26 | 36.92 | 35.06 | 0.97 | 1.60 | 44.20 | 39.89 | 0.86 |
| SWD | $MAR_{E5}$ | -2.72 | 36.97 | 35.02 | 0.96 | 1.21 | 44.16 | 39.89 | 0.86 |
| (Wm$^{-2}$) | EI (forecast) | 0.58 | 36.64 | 34.94 | 0.97 | 2.66 | 45.91 | 41.50 | 0.88 |
| | E5 (forecast) | 6.54 | 31.01 | 28.33 | 0.98 | 8.41 | 35.08 | 28.84 | 0.92 |
| | ASR (forecast) | 15.03 | 34.91 | 29.94 | 0.98 | 25.87 | 42.35 | 29.98 | 0.92 |
| Mean obs 2010 – 2016 | | | 141.43 | | | | 287.42 | | |
| Std obs 2010 – 2016 | | | 133.97 | | | | 76.00 | | |

## S1 GC-Net comparison

The GC-Net observations have two major drawbacks: the fact that they are assimilated in reanalyses (ERA-Interim, ERA5 and ASR) that does not enable for a statically independent comparison, and then numerous measurement errors which is why we only used the observations from the PROMICE network. We used 16 AWS of the GC-Net network which have available data for the period 2010-2016. A selection of weather stations has been made (Table S4), similarly to the PROMICE selection. The main conclusions of this supplementary analysis (Table S5) are presented here.

### S1.1 Pressure

All statistical comparisons of the surface pressure demonstrate that all models succeed in representing the daily variability of the surface pressure, except the correlation which is in general lower when observations are compared to GC-Net than when compared to PROMICE. This is probably due to errors measurements as several GC-net data present discontinuities in the surface pressure records.

### S1.2 Temperature

The comparisons of ERA5 and ERA-Interim 2-m temperature (T2M) are almost identical. All GC-Net AWS are located in the accumulation area of the Greenland ice sheet where the spatial variability of the topography is weaker than in the ablation zone and can be represented even at lower resolution. Despite the increase in resolution, ERA5 does not improve the representation of the temperature relative to ERA-Interim in the accumulation area. The mean bias of modelled temperature from MAR is lower than the temperature bias in the reanalysis products, as already shown when compare to PROMICE observations, but the correlations are lower than those of the reanalyses. However, as mentioned before, the assimilation of the GC-Net observations by the reanalyses biases this comparison and probably leads to artificially better results for ERA5, ERA-Interim and ASR than MAR.

### S1.3 Wind speed

ERA5 outperforms other models to represent the 10-m wind speed (W10M), as in the comparison with the PROMICE AWS. Correlations are also the highest and RMSEc in ERA5 are the lowest. The mean biases in ERA5 are not the lowest but there are lower than in other reanalyses (ERA-Interim and ASR).

### S1.4 SWD

ERA5 outperforms ERA-Interim to represent SWD, especially in summer. Only mean biases are lower in ERA-Interim than in ERA5. Such an improvement in ERA5 was already a conclusion of the comparison with the PROMICE observations, but this improvement is more significant in the accumulation area. ASR and ERA5 better represent SWD than MAR for the same explanations discussed in the main manuscript.

| Surface pressure (hPa) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| MAR$_{E5}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -22.62 | 22.66 | 1.47 | 0.99 | -21.63 | 21.66 | 1.01 | 0.99 |
| KPC_U | 0.59 | 1.27 | 1.12 | 0.99 | 0.21 | 0.9 | 0.88 | 0.99 |
| SCO_L* | -102.07 | 102.12 | 3.1 | 0.96 | -98.48 | 98.49 | 1.53 | 0.98 |
| SCO_U | -28.08 | 28.11 | 1.28 | 0.99 | -27.29 | 27.31 | 0.94 | 0.99 |
| TAS_A* | 11.37 | 11.97 | 3.76 | 0.96 | 11.02 | 11.05 | 0.83 | 0.99 |
| QAS_U | 3.73 | 4.15 | 1.83 | 0.99 | 3.65 | 3.77 | 0.92 | 0.99 |
| QAS_A* | -1.84 | 4.23 | 3.81 | 0.95 | -0.87 | 4.26 | 4.17 | 0.83 |
| NUK_U | 5.2 | 5.31 | 1.03 | 1 | 4.87 | 4.94 | 0.84 | 0.99 |
| NUK_N | 5.78 | 5.86 | 0.98 | 1 | 5.34 | 5.4 | 0.77 | 0.99 |
| KAN_L | 12.94 | 12.98 | 0.98 | 1 | 12.27 | 12.29 | 0.76 | 0.99 |
| KAN_M | -2.58 | 2.73 | 0.88 | 1 | -2.7 | 2.77 | 0.63 | 1 |
| KAN_U | -0.84 | 1.2 | 0.85 | 1 | -0.9 | 1.12 | 0.67 | 0.99 |
| UPE_U | -2.38 | 2.98 | 1.78 | 0.99 | -2.64 | 3.1 | 1.63 | 0.97 |
| THU_L | 1.84 | 2.21 | 1.22 | 0.99 | 1.6 | 1.82 | 0.87 | 0.99 |
| THU_U | 16.65 | 16.69 | 1.13 | 1 | 15.59 | 15.6 | 0.56 | 1 |
| NUK_L | -34.72 | 34.78 | 2.03 | 0.98 | -33.72 | 33.75 | 1.43 | 0.98 |
| QAS_L | -13.67 | 13.79 | 1.87 | 0.99 | -13.57 | 13.66 | 1.49 | 0.98 |
| QAS_M | 2.42 | 2.72 | 1.22 | 0.99 | 2.39 | 2.47 | 0.61 | 1 |
| TAS_L* | -0.33 | 8.35 | 8.34 | 0.84 | 0.19 | 10.07 | 10.07 | 0.45 |
| TAS_U | 17.28 | 17.36 | 1.66 | 0.99 | 16.34 | 16.37 | 0.98 | 0.99 |
| UPE_L | -1.69 | 2.1 | 1.25 | 0.99 | -1.8 | 2.08 | 1.03 | 0.99 |
| All AWS | -8.42 | 16.17 | 1.83 | 0.98 | -8.54 | 15.75 | 1.41 | 0.96 |
| 17 selected AWS | -2.87 | 10.71 | 1.35 | 0.99 | -3.18 | 10.35 | 0.97 | 0.99 |

* Dissmissed in the study. see Table S2

**Table S6.** Annual and summer surface pressure (hPa) mean bias (MB). RMSE. centered RMSE (RMSEc) and correlation (r) between daily observations at PROMICE AWS and MAR$_{E5}$ over 2010 – 2016.

| Surface pressure (hPa) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| MAR$_{EI}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -21.86 | 21.9 | 1.37 | 0.99 | -20.87 | 20.89 | 0.96 | 0.99 |
| KPC_U | 1.35 | 1.7 | 1.03 | 0.99 | 0.99 | 1.29 | 0.82 | 0.99 |
| SCO_L* | -101.47 | 101.52 | 3.11 | 0.96 | -97.79 | 97.81 | 1.56 | 0.97 |
| SCO_U | -27.46 | 27.49 | 1.25 | 0.99 | -26.59 | 26.61 | 0.92 | 0.99 |
| TAS_A* | 11.85 | 12.44 | 3.78 | 0.96 | 11.48 | 11.51 | 0.78 | 0.99 |
| QAS_U | 4.3 | 4.71 | 1.91 | 0.99 | 4.23 | 4.34 | 0.97 | 0.99 |
| QAS_A* | -1.33 | 4.06 | 3.84 | 0.95 | -0.32 | 4.12 | 4.11 | 0.84 |
| NUK_U | 5.93 | 6.03 | 1.08 | 1 | 5.59 | 5.66 | 0.87 | 0.99 |
| NUK_N | 6.45 | 6.52 | 1 | 1 | 6.04 | 6.09 | 0.79 | 0.99 |
| KAN_L | 13.76 | 13.79 | 0.98 | 1 | 13.08 | 13.1 | 0.77 | 0.99 |
| KAN_M | -1.79 | 2 | 0.9 | 1 | -1.88 | 1.98 | 0.63 | 1 |
| KAN_U | -0.09 | 0.9 | 0.9 | 1 | -0.1 | 0.68 | 0.68 | 0.99 |
| UPE_U | -1.28 | 2.21 | 1.8 | 0.99 | -1.56 | 2.26 | 1.64 | 0.97 |
| THU_L | 3.92 | 4.09 | 1.18 | 0.99 | 3.61 | 3.71 | 0.84 | 0.99 |
| THU_U | 18.73 | 18.76 | 1.13 | 1 | 17.58 | 17.59 | 0.65 | 1 |
| NUK_L | -34 | 34.07 | 2.08 | 0.98 | -33.01 | 33.04 | 1.48 | 0.97 |
| QAS_L | -13.09 | 13.24 | 1.98 | 0.99 | -13.01 | 13.1 | 1.54 | 0.98 |
| QAS_M | 2.99 | 3.29 | 1.37 | 0.99 | 3.08 | 3.13 | 0.58 | 1 |
| TAS_L* | 0.18 | 8.32 | 8.32 | 0.84 | 0.58 | 10.04 | 10.02 | 0.46 |
| TAS_U | 17.76 | 17.85 | 1.74 | 0.99 | 16.75 | 16.78 | 0.99 | 0.99 |
| UPE_L | -0.46 | 1.33 | 1.25 | 0.99 | -0.68 | 1.25 | 1.04 | 0.99 |
| All AWS | -7.58 | 16.22 | 1.85 | 0.98 | -7.69 | 15.77 | 1.42 | 0.96 |
| 17 selected AWS | -1.97 | 10.8 | 1.37 | 0.99 | -2.28 | 10.41 | 0.99 | 0.99 |

\* Dissmissed in the study. see Table S2

**Table S7.** Same as Table S6 but for MAR$_{EI}$.

| Surface pressure (hPa) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| ASR | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -16.69 | 16.72 | 0.98 | 0.99 | -16.06 | 16.08 | 0.71 | 0.99 |
| KPC_U | 8.72 | 8.77 | 0.97 | 1 | 7.92 | 7.94 | 0.64 | 1 |
| SCO_L* | -102.45 | 102.5 | 3.24 | 0.95 | -98.62 | 98.63 | 1.46 | 0.98 |
| SCO_U | -42.31 | 42.33 | 1.42 | 0.99 | -40.88 | 40.88 | 0.69 | 0.99 |
| TAS_A* | 29.88 | 30.09 | 3.59 | 0.97 | 29.49 | 29.5 | 0.59 | 1 |
| QAS_U | 33.12 | 33.16 | 1.69 | 0.99 | 32.72 | 32.73 | 0.72 | 0.99 |
| QAS_A* | 19.74 | 20.09 | 3.73 | 0.95 | 20.43 | 20.83 | 4.07 | 0.84 |
| NUK_U | 11.58 | 11.62 | 0.88 | 1 | 11.34 | 11.35 | 0.66 | 1 |
| NUK_N | 9.58 | 9.61 | 0.71 | 1 | 9.29 | 9.31 | 0.55 | 1 |
| KAN_L | 13.57 | 13.58 | 0.62 | 1 | 13.13 | 13.14 | 0.42 | 1 |
| KAN_M | 0.63 | 0.83 | 0.55 | 1 | 0.61 | 0.7 | 0.34 | 1 |
| KAN_U | 0.21 | 0.59 | 0.55 | 1 | 0.25 | 0.47 | 0.4 | 1 |
| UPE_U | 3.08 | 3.49 | 1.63 | 0.99 | 2.75 | 3.12 | 1.47 | 0.98 |
| THU_L | 11.92 | 11.98 | 1.16 | 0.99 | 11.33 | 11.36 | 0.79 | 0.99 |
| THU_U | 33.51 | 33.55 | 1.51 | 0.99 | 31.82 | 31.83 | 0.65 | 1 |
| NUK_L | -24.21 | 24.27 | 1.69 | 0.99 | -23.31 | 23.34 | 1.21 | 0.98 |
| QAS_L | 0.07 | 1.48 | 1.47 | 0.99 | 0.06 | 1.29 | 1.29 | 0.98 |
| QAS_M | 28.5 | 28.51 | 0.77 | 1 | 28.08 | 28.08 | 0.32 | 1 |
| TAS_L* | 5.39 | 9.82 | 8.21 | 0.85 | 5.98 | 11.56 | 9.9 | 0.47 |
| TAS_U | 33.47 | 33.49 | 1.12 | 1 | 32.38 | 32.39 | 0.6 | 1 |
| UPE_L | -38.94 | 38.98 | 1.73 | 0.99 | -37.38 | 37.4 | 1.07 | 0.99 |
| All AWS | -3.34 | 23.05 | 1.69 | 0.98 | -3.62 | 22.34 | 1.22 | 0.97 |
| 17 selected AWS | 1.85 | 17.76 | 1.19 | 0.99 | 1.44 | 17.16 | 0.78 | 0.99 |

* Dissmissed in the study. see Table S2

**Table S8.** Same as Table S6 but for ASR.

| Surface pressure (hPa) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| ERA5 | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -20.65 | 20.67 | 0.86 | 1 | -19.81 | 19.81 | 0.45 | 1 |
| KPC_U | 10.24 | 10.28 | 0.89 | 1 | 9.32 | 9.34 | 0.5 | 1 |
| SCO_L* | -85.12 | 85.17 | 2.69 | 0.97 | -82 | 82.01 | 1.26 | 0.98 |
| SCO_U | -39.21 | 39.23 | 1.23 | 0.99 | -38.03 | 38.04 | 0.67 | 0.99 |
| TAS_A* | 48.51 | 48.65 | 3.65 | 0.97 | 47.81 | 47.82 | 0.7 | 1 |
| QAS_U | 6.58 | 6.77 | 1.56 | 0.99 | 6.52 | 6.56 | 0.68 | 0.99 |
| QAS_A* | 17.47 | 17.85 | 3.67 | 0.95 | 17.99 | 18.45 | 4.06 | 0.84 |
| NUK_U | 2.47 | 2.57 | 0.7 | 1 | 2.21 | 2.28 | 0.58 | 1 |
| NUK_N | 9.28 | 9.29 | 0.6 | 1 | 8.73 | 8.73 | 0.38 | 1 |
| KAN_L | 9.16 | 9.19 | 0.68 | 1 | 8.6 | 8.61 | 0.42 | 1 |
| KAN_M | -3.44 | 3.47 | 0.43 | 1 | -3.54 | 3.55 | 0.23 | 1 |
| KAN_U | 0.77 | 0.86 | 0.39 | 1 | 0.68 | 0.77 | 0.35 | 1 |
| UPE_U | 6.43 | 6.64 | 1.65 | 0.99 | 5.81 | 5.99 | 1.46 | 0.98 |
| THU_L | 34.1 | 34.15 | 1.83 | 0.98 | 32.54 | 32.55 | 1 | 0.99 |
| THU_U | 55.66 | 55.7 | 2.34 | 0.98 | 53 | 53.01 | 0.91 | 0.99 |
| NUK_L | -33.18 | 33.22 | 1.64 | 0.99 | -32.26 | 32.28 | 1.18 | 0.98 |
| QAS_L | -15.65 | 15.71 | 1.39 | 0.99 | -15.41 | 15.47 | 1.27 | 0.98 |
| QAS_M | -13.24 | 13.25 | 0.57 | 1 | -12.82 | 12.82 | 0.26 | 1 |
| TAS_L* | -25.68 | 26.97 | 8.24 | 0.85 | -24.49 | 26.39 | 9.84 | 0.47 |
| TAS_U | 11.59 | 11.62 | 0.81 | 1 | 10.94 | 10.95 | 0.5 | 1 |
| UPE_L | -42.54 | 42.57 | 1.71 | 0.99 | -40.97 | 40.99 | 1.06 | 0.99 |
| All aws | -6.13 | 23.76 | 1.65 | 0.98 | -6.3 | 23.13 | 1.18 | 0.97 |
| 17 aws | -1.83 | 18.45 | 1.17 | 0.99 | -1.96 | 18.03 | 0.74 | 0.99 |

* Dissmissed in the study. see Table S2

**Table S9.** Same as Table S6 but for ERA5.

| Surface pressure (hPa) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| EI | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -28.17 | 28.2 | 1.13 | 0.99 | -26.95 | 26.95 | 0.58 | 1 |
| KPC_U | 7.87 | 7.91 | 0.81 | 1 | 7.25 | 7.27 | 0.53 | 1 |
| *SCO_L | -83.6 | 83.64 | 2.69 | 0.97 | -80.39 | 80.4 | 1.22 | 0.99 |
| SCO_U | -38.61 | 38.64 | 1.26 | 0.99 | -37.32 | 37.33 | 0.62 | 1 |
| *TAS_A | -7.48 | 8.3 | 3.59 | 0.97 | -7.46 | 7.48 | 0.53 | 1 |
| QAS_U | -25.55 | 25.61 | 1.7 | 0.99 | -25.02 | 25.03 | 0.81 | 0.99 |
| *QAS_A | -15.89 | 16.31 | 3.68 | 0.95 | -14.7 | 15.26 | 4.1 | 0.84 |
| NUK_U | -2.28 | 2.4 | 0.76 | 1 | -2.38 | 2.46 | 0.62 | 1 |
| NUK_N | -4.09 | 4.13 | 0.58 | 1 | -4.14 | 4.17 | 0.46 | 1 |
| KAN_L | -18.44 | 18.46 | 0.88 | 1 | -17.76 | 17.77 | 0.5 | 1 |
| KAN_M | 1.27 | 1.35 | 0.47 | 1 | 1.09 | 1.13 | 0.29 | 1 |
| KAN_U | 3.47 | 3.51 | 0.46 | 1 | 3.38 | 3.4 | 0.36 | 1 |
| UPE_U | 4.47 | 4.76 | 1.62 | 0.99 | 3.93 | 4.19 | 1.43 | 0.98 |
| THU_L | 22.23 | 22.28 | 1.51 | 0.99 | 21.16 | 21.18 | 0.96 | 0.99 |
| THU_U | 45.93 | 45.97 | 2.02 | 0.98 | 43.67 | 43.68 | 0.84 | 0.99 |
| NUK_L | -61.01 | 61.05 | 2.3 | 0.98 | -59.27 | 59.28 | 1.32 | 0.98 |
| QAS_L | -87.14 | 87.17 | 2.56 | 0.98 | -85.47 | 85.49 | 1.7 | 0.97 |
| QAS_M | -50.84 | 50.87 | 1.54 | 0.99 | -49.38 | 49.39 | 0.58 | 1 |
| *TAS_L | -82.93 | 83.35 | 8.4 | 0.84 | -80.86 | 81.44 | 9.7 | 0.48 |
| TAS_U | -45.31 | 45.32 | 1.24 | 1 | -45 | 45.01 | 0.79 | 0.99 |
| UPE_L | -53.8 | 53.84 | 2.08 | 0.98 | -51.78 | 51.79 | 1.15 | 0.99 |
| All AWS | -25.15 | 33.61 | 1.82 | 0.98 | -24.33 | 32.71 | 1.24 | 0.97 |
| 17 selected AWS | -19.09 | 28.92 | 1.36 | 0.99 | -18.26 | 27.96 | 0.83 | 0.99 |

* Dissmissed in the study. see Table S2

**Table S10.** Same as Table S6 but for ERA-Interim.

11

| T2M (°C) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| MAR$_{E5}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -0.76 | 2.93 | 2.83 | 0.97 | -0.97 | 1.79 | 1.50 | 0.91 |
| KPC_U | 0.41 | 2.56 | 2.53 | 0.98 | -0.46 | 1.27 | 1.18 | 0.94 |
| SCO_U | -1.38 | 2.63 | 2.24 | 0.97 | -0.67 | 1.80 | 1.67 | 0.89 |
| QAS_U | 0.62 | 2.20 | 2.11 | 0.96 | 0.55 | 0.95 | 0.77 | 0.83 |
| QAS_A | 0.08 | 1.64 | 1.64 | 0.98 | -0.36 | 0.86 | 0.78 | 0.89 |
| NUK_U | 0.21 | 1.76 | 1.74 | 0.98 | 1.51 | 1.86 | 1.10 | 0.89 |
| NUK_N | 0.71 | 2.25 | 2.13 | 0.98 | 2.91 | 3.41 | 1.78 | 0.83 |
| KAN_L | 0.32 | 2.12 | 2.10 | 0.98 | 1.65 | 1.87 | 0.88 | 0.89 |
| KAN_M | 0.33 | 2.22 | 2.20 | 0.98 | 0.01 | 1.02 | 1.02 | 0.92 |
| KAN_U | 0.93 | 2.66 | 2.49 | 0.97 | 0.01 | 1.45 | 1.45 | 0.91 |
| UPE_U | 0.05 | 2.01 | 2.01 | 0.98 | -0.44 | 0.90 | 0.79 | 0.96 |
| THU_L | -1.84 | 3.02 | 2.40 | 0.98 | -0.95 | 1.39 | 1.01 | 0.94 |
| THU_U | -1.11 | 2.37 | 2.09 | 0.98 | -0.64 | 1.18 | 0.99 | 0.94 |
| QAS_L | -0.49 | 2.10 | 2.04 | 0.97 | 1.84 | 2.32 | 1.40 | 0.76 |
| QAS_M | 0.29 | 1.40 | 1.37 | 0.98 | 1.07 | 1.22 | 0.58 | 0.88 |
| TAS_U | 1.16 | 2.28 | 1.97 | 0.95 | 2.55 | 2.89 | 1.37 | 0.79 |
| UPE_L | 0.61 | 2.80 | 2.73 | 0.97 | 2.12 | 2.59 | 1.50 | 0.82 |
| NUK_L* | -1.86 | 3.21 | 2.61 | 0.97 | 0.68 | 1.90 | 1.78 | 0.70 |
| TAS_A | 0.45 | 2.13 | 2.08 | 0.95 | 0.70 | 1.15 | 0.91 | 0.84 |
| SCO_L* | -4.55 | 5.43 | 2.96 | 0.95 | -3.67 | 4.23 | 2.11 | 0.71 |
| TAS_L | 0.41 | 2.55 | 2.51 | 0.93 | 3.07 | 3.56 | 1.82 | 0.59 |
| All AWS | -0.38 | 2.63 | 2.32 | 0.97 | 0.32 | 1.91 | 1.30 | 0.85 |
| 19 selected AWS | 0.06 | 2.37 | 2.24 | 0.97 | 9.16 | 1.73 | 1.20 | 0.87 |

* Dissmissed in the study. see Table S2

**Table S11.** Annual and summer near-surface temperature (T2M, °C) mean bias (MB). RMSE. centered RMSE (RMSEc) and correlation (r) between daily observations at PROMICE AWS and MAR$_{E5}$ over 2010 – 2016.

| T2M (°C) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| MAR$_{EI}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -0.54 | 2.69 | 2.64 | 0.97 | -0.51 | 1.55 | 1.46 | 0.92 |
| KPC_U | 0.70 | 2.43 | 2.32 | 0.98 | -0.04 | 1.10 | 1.10 | 0.94 |
| SCO_U | -1.37 | 2.62 | 2.24 | 0.98 | -0.44 | 1.68 | 1.62 | 0.88 |
| QAS_U | 0.69 | 2.22 | 2.11 | 0.96 | 0.67 | 1.02 | 0.77 | 0.83 |
| QAS_A | 0.10 | 1.65 | 1.65 | 0.97 | -0.28 | 0.81 | 0.76 | 0.89 |
| NUK_U | 0.29 | 1.81 | 1.79 | 0.98 | 1.66 | 1.99 | 1.09 | 0.89 |
| NUK_N | 0.88 | 2.36 | 2.18 | 0.98 | 3.23 | 3.65 | 1.70 | 0.83 |
| KAN_L | 0.39 | 2.12 | 2.08 | 0.98 | 1.74 | 1.95 | 0.89 | 0.89 |
| KAN_M | 0.33 | 2.13 | 2.11 | 0.98 | 0.10 | 0.98 | 0.97 | 0.93 |
| KAN_U | 0.94 | 2.65 | 2.48 | 0.97 | 0.15 | 1.46 | 1.45 | 0.91 |
| UPE_U | -0.13 | 2.01 | 2.01 | 0.98 | -0.34 | 0.89 | 0.82 | 0.95 |
| THU_L | -1.76 | 3.16 | 2.62 | 0.98 | 0.01 | 1.16 | 1.16 | 0.93 |
| THU_U | -0.94 | 2.47 | 2.28 | 0.98 | 0.23 | 1.06 | 1.04 | 0.94 |
| QAS_L | -0.40 | 2.15 | 2.11 | 0.97 | 1.94 | 2.4 | 1.41 | 0.75 |
| QAS_M | 0.35 | 1.41 | 1.36 | 0.98 | 1.13 | 1.27 | 0.58 | 0.86 |
| TAS_U | 1.26 | 2.41 | 2.06 | 0.95 | 2.95 | 3.24 | 1.34 | 0.79 |
| UPE_L | 0.33 | 2.87 | 2.85 | 0.97 | 2.15 | 2.65 | 1.55 | 0.81 |
| NUK_L* | -1.74 | 3.21 | 2.70 | 0.97 | 0.86 | 2.00 | 1.81 | 0.68 |
| TAS_A | 0.45 | 2.20 | 2.15 | 0.94 | 0.83 | 1.23 | 0.91 | 0.84 |
| SCO_L* | -4.55 | 5.40 | 2.92 | 0.95 | -3.43 | 4.00 | 2.06 | 0.71 |
| TAS_L | 0.49 | 2.67 | 2.62 | 0.93 | 3.35 | 3.78 | 1.73 | 0.63 |
| All AWS | -0.33 | 2.64 | 2.33 | 0.97 | 0.58 | 1.91 | 1.29 | 0.85 |
| 19 selected AWS | 0.11 | 2.38 | 2.26 | 0.97 | 0.88 | 1.74 | 1.19 | 0.87 |

* Dissmissed in the study. see Table S2

**Table S12.** Same as Table S11 but for MAR$_{EI}$.

| T2M (°C) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| ASR | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -2.73 | 3.91 | 2.8 | 0.97 | -2.06 | 2.66 | 1.69 | 0.87 |
| KPC_U | -0.28 | 1.96 | 1.94 | 0.99 | -0.78 | 1.35 | 1.10 | 0.94 |
| SCO_U | -3.68 | 4.16 | 1.94 | 0.98 | -3.54 | 3.75 | 1.22 | 0.89 |
| QAS_U | 2.34 | 3.11 | 2.05 | 0.96 | 1.80 | 2.08 | 1.05 | 0.80 |
| QAS_A | 1.64 | 2.10 | 1.30 | 0.99 | 0.59 | 0.86 | 0.62 | 0.94 |
| NUK_U | -0.22 | 1.72 | 1.71 | 0.99 | 0.73 | 1.27 | 1.04 | 0.92 |
| NUK_N | 0.95 | 2.21 | 1.99 | 0.99 | 3.32 | 3.50 | 1.08 | 0.94 |
| KAN_L | 0.49 | 1.95 | 1.89 | 0.99 | 2.09 | 2.22 | 0.75 | 0.95 |
| KAN_M | -0.52 | 2.11 | 2.05 | 0.98 | -0.70 | 1.49 | 1.32 | 0.89 |
| KAN_U | -1.29 | 2.64 | 2.3 | 0.98 | -1.62 | 2.27 | 1.59 | 0.89 |
| UPE_U | -0.23 | 1.83 | 1.82 | 0.98 | -0.16 | 0.95 | 0.94 | 0.95 |
| THU_L | -1.78 | 3.05 | 2.48 | 0.98 | -0.77 | 1.75 | 1.57 | 0.81 |
| THU_U | -0.49 | 2.40 | 2.35 | 0.98 | -0.19 | 1.77 | 1.76 | 0.80 |
| QAS_L | 0.15 | 1.70 | 1.69 | 0.98 | 2.12 | 2.30 | 0.89 | 0.89 |
| QAS_M | 1.47 | 1.85 | 1.13 | 0.99 | 1.79 | 1.93 | 0.73 | 0.92 |
| TAS_U | 1.46 | 1.93 | 1.27 | 0.98 | 1.37 | 1.64 | 0.90 | 0.85 |
| UPE_L | -1.48 | 3.37 | 3.03 | 0.96 | -0.55 | 1.44 | 1.33 | 0.89 |
| NUK_L* | -1.55 | 3.42 | 3.05 | 0.97 | 1.44 | 2.15 | 1.59 | 0.76 |
| TAS_A | 1.38 | 2.22 | 1.74 | 0.96 | 0.71 | 1.03 | 0.75 | 0.89 |
| SCO_L* | -5.36 | 6.04 | 2.77 | 0.96 | -4.96 | 5.26 | 1.75 | 0.71 |
| TAS_L | 0.14 | 1.42 | 1.42 | 0.97 | 1.00 | 1.41 | 1.00 | 0.76 |
| All AWS | -0.81 | 2.75 | 2.15 | 0.98 | -0.22 | 2.14 | 1.25 | 0.86 |
| 19 selected AWS | -0.39 | 2.44 | 2.03 | 0.98 | 0.04 | 1.89 | 1.18 | 0.88 |

* Dissmissed in the study. see Table S2

**Table S13.** Same as Table S11 but for ASR.

| T2M (°C) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| E5 | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_U | 1.61 | 2.72 | 2.19 | 0.98 | 0.24 | 1.35 | 1.33 | 0.92 |
| SCO_U | -6.4 | 6.97 | 2.78 | 0.96 | -5.04 | 5.37 | 1.86 | 0.80 |
| QAS_U | 2.09 | 3.14 | 2.35 | 0.95 | 1.31 | 1.82 | 1.26 | 0.79 |
| QAS_A | 2.83 | 3.51 | 2.07 | 0.98 | 0.37 | 0.74 | 0.64 | 0.92 |
| NUK_U | 0.09 | 2.14 | 2.13 | 0.97 | -1.37 | 2.26 | 1.79 | 0.77 |
| NUK_N | 1.58 | 2.56 | 2.02 | 0.98 | 3.8 | 4.10 | 1.52 | 0.89 |
| KAN_L | 1.63 | 2.96 | 2.47 | 0.98 | 4.43 | 4.64 | 1.39 | 0.91 |
| KAN_M | 1.44 | 2.94 | 2.56 | 0.98 | -1.22 | 1.88 | 1.43 | 0.86 |
| KAN_U | 1.41 | 3.14 | 2.81 | 0.98 | -1.69 | 2.40 | 1.71 | 0.86 |
| UPE_U | 0.27 | 1.77 | 1.75 | 0.99 | -0.54 | 1.33 | 1.21 | 0.91 |
| THU_L | -2.66 | 5.51 | 4.83 | 0.97 | 2.32 | 3.00 | 1.89 | 0.86 |
| THU_U | -0.74 | 4.52 | 4.46 | 0.97 | 3.01 | 3.49 | 1.77 | 0.87 |
| QAS_L | -0.06 | 1.75 | 1.75 | 0.98 | 1.83 | 2.13 | 1.10 | 0.89 |
| QAS_M | 0.37 | 2.02 | 1.99 | 0.96 | 0.03 | 1.16 | 1.16 | 0.87 |
| TAS_U | 1.19 | 1.77 | 1.30 | 0.98 | 1.14 | 1.60 | 1.12 | 0.75 |
| UPE_L | -1.89 | 3.10 | 2.46 | 0.97 | -1.21 | 1.8 | 1.32 | 0.89 |
| NUK_L* | -2.26 | 3.02 | 2.01 | 0.97 | -2.04 | 2.76 | 1.87 | 0.65 |
| TAS_A | 2.98 | 3.71 | 2.21 | 0.95 | 1.59 | 1.95 | 1.13 | 0.74 |
| SCO_L* | -7.96 | 8.59 | 3.21 | 0.95 | -5.64 | 6.10 | 2.31 | 0.65 |
| TAS_L | -0.58 | 1.59 | 1.48 | 0.97 | 0.41 | 1.18 | 1.10 | 0.72 |
| All AWS | -0.69 | 3.44 | 2.43 | 0.97 | -0.31 | 2.77 | 1.51 | 0.83 |
| 19 selected AWS | 0.01 | 3.05 | 2.39 | 0.97 | 0.25 | 2.5 | 1.42 | 0.85 |

* Dissmissed in the study. see Table S2

**Table S14.** Same as Table S11 but for ERA5.

| T2M (°C) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| EI | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -3.44 | 4.48 | 2.88 | 0.98 | -2.09 | 2.49 | 1.36 | 0.88 |
| KPC_U | 1.27 | 2.55 | 2.21 | 0.98 | 0.75 | 1.47 | 1.27 | 0.91 |
| SCO_U | -5.58 | 6.43 | 3.18 | 0.97 | -3.01 | 3.61 | 2.00 | 0.82 |
| QAS_U | -1.20 | 3.84 | 3.64 | 0.94 | 0.77 | 1.57 | 1.37 | 0.72 |
| QAS_A | -0.88 | 2.69 | 2.54 | 0.96 | -0.92 | 1.24 | 0.83 | 0.90 |
| NUK_U | 0.04 | 2.36 | 2.36 | 0.97 | 1.38 | 1.81 | 1.17 | 0.84 |
| NUK_N | 0.37 | 2.38 | 2.36 | 0.98 | 2.21 | 2.49 | 1.13 | 0.82 |
| KAN_L | -0.6 | 2.56 | 2.48 | 0.98 | 1.17 | 1.63 | 1.14 | 0.88 |
| KAN_M | 1.71 | 2.64 | 2.01 | 0.98 | 1.30 | 1.76 | 1.19 | 0.88 |
| KAN_U | 2.11 | 2.99 | 2.11 | 0.98 | 0.70 | 1.67 | 1.52 | 0.89 |
| UPE_U | -0.32 | 2.75 | 2.73 | 0.97 | 0.97 | 1.60 | 1.28 | 0.92 |
| THU_L | -0.54 | 3.77 | 3.73 | 0.96 | 1.2 | 1.91 | 1.48 | 0.84 |
| THU_U | 1.09 | 3.48 | 3.31 | 0.96 | 2.07 | 2.59 | 1.55 | 0.87 |
| QAS_L | -4.89 | 6.04 | 3.54 | 0.96 | -1.36 | 2.04 | 1.52 | 0.67 |
| QAS_M | -4.23 | 5.38 | 3.31 | 0.97 | -1.49 | 1.72 | 0.84 | 0.92 |
| TAS_U | -3.49 | 4.55 | 2.91 | 0.96 | -0.61 | 1.63 | 1.51 | 0.66 |
| UPE_L | -2.57 | 3.83 | 2.84 | 0.96 | -1.05 | 1.67 | 1.30 | 0.89 |
| NUK_L* | -3.53 | 4.54 | 2.85 | 0.97 | -1.29 | 2.07 | 1.62 | 0.67 |
| TAS_A | -1.45 | 3.06 | 2.69 | 0.94 | -0.49 | 1.55 | 1.47 | 0.70 |
| SCO_L* | -6.23 | 7.00 | 3.19 | 0.96 | -3.38 | 4.05 | 2.24 | 0.77 |
| TAS_L | -5.44 | 6.48 | 3.51 | 0.95 | -1.38 | 1.99 | 1.44 | 0.62 |
| All AWS | -1.73 | 4.00 | 2.84 | 0.97 | -0.15 | 2.09 | 1.46 | 0.82 |
| 19 selected AWS | -1.24 | 3.72 | 2.81 | 0.97 | 0.19 | 1.93 | 1.38 | 0.83 |

* Dissmissed in the study. see Table S2

**Table S15.** Same as Table S11 but for ERA-Interim.

| W10M (ms$^{-1}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| MAR$_{E5}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | 0.40 | 1.94 | 1.90 | 0.73 | -0.59 | 1.50 | 1.38 | 0.70 |
| KPC_U | 0.96 | 1.61 | 1.29 | 0.83 | 0.39 | 1.12 | 1.05 | 0.79 |
| SCO_L* | 1.70 | 2.32 | 1.57 | 0.54 | 1.15 | 1.67 | 1.21 | 0.53 |
| SCO_U | -0.34 | 1.64 | 1.61 | 0.45 | -0.22 | 1.25 | 1.23 | 0.41 |
| TAS_A | 1.98 | 3.26 | 2.60 | 0.83 | 1.74 | 2.31 | 1.52 | 0.78 |
| QAS_U | 2.23 | 3.00 | 2.01 | 0.85 | 1.84 | 2.29 | 1.36 | 0.71 |
| QAS_A | 1.31 | 2.64 | 2.29 | 0.76 | 0.71 | 1.42 | 1.22 | 0.73 |
| NUK_U | 1.49 | 2.34 | 1.81 | 0.84 | 1.24 | 1.75 | 1.23 | 0.73 |
| NUK_N | 1.29 | 1.92 | 1.42 | 0.88 | 0.87 | 1.28 | 0.94 | 0.83 |
| KAN_L | 1.88 | 2.29 | 1.31 | 0.85 | 2.20 | 2.45 | 1.07 | 0.79 |
| KAN_M | 0.79 | 1.58 | 1.37 | 0.9 | 1.04 | 1.52 | 1.11 | 0.78 |
| KAN_U | 0.31 | 1.36 | 1.32 | 0.93 | -0.05 | 0.96 | 0.96 | 0.89 |
| UPE_U | 1.33 | 2.38 | 1.98 | 0.8 | 1.59 | 2.32 | 1.69 | 0.72 |
| THU_L | 1.89 | 2.99 | 2.32 | 0.79 | 1.48 | 2.52 | 2.04 | 0.85 |
| THU_U | 1.38 | 2.57 | 2.17 | 0.79 | 0.93 | 2.06 | 1.83 | 0.87 |
| NUK_L* | 2.69 | 3.40 | 2.08 | 0.77 | 1.71 | 2.18 | 1.35 | 0.64 |
| QAS_L | 1.84 | 2.73 | 2.02 | 0.83 | 0.72 | 1.53 | 1.35 | 0.68 |
| QAS_M | 1.18 | 1.9 | 1.49 | 0.92 | 0.34 | 0.77 | 0.69 | 0.75 |
| TAS_L | 1.94 | 3.53 | 2.95 | 0.79 | 0.50 | 1.74 | 1.67 | 0.56 |
| TAS_U | 1.94 | 3.31 | 2.68 | 0.81 | 1.20 | 1.99 | 1.58 | 0.68 |
| UPE_L | 1.62 | 2.58 | 2.00 | 0.74 | 1.48 | 2.08 | 1.46 | 0.77 |
| All AWS | 1.40 | 2.40 | 1.86 | 0.78 | 1.01 | 1.80 | 1.35 | 0.72 |
| 19 selected AWS | 1.31 | 2.34 | 1.86 | 0.80 | 0.96 | 1.79 | 1.36 | 0.74 |

* Dissmissed in the study. see Table S2

**Table S16.** Annual and summer 10-m wind speed (W10M) mean bias (MB). RMSE. centered RMSE (RMSEc) and correlation (r) between daily observations at PROMICE AWS and MAR$_{E5}$ over 2010 – 2016.

| UV2 (ms$^{-1}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| MAR$_{E5}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -1.04 | 2.11 | 1.83 | 0.75 | -1.73 | 2.24 | 1.42 | 0.69 |
| KPC_U | -0.41 | 1.32 | 1.25 | 0.83 | -0.67 | 1.24 | 1.04 | 0.78 |
| SCO_L* | 0.40 | 1.62 | 1.57 | 0.5 | 0.11 | 1.25 | 1.24 | 0.50 |
| SCO_U | -1.58 | 2.23 | 1.58 | 0.42 | -1.3 | 1.78 | 1.22 | 0.41 |
| TAS_A | 0.25 | 2.64 | 2.63 | 0.82 | 0.38 | 1.60 | 1.55 | 0.76 |
| QAS_U | 0.41 | 2.01 | 1.96 | 0.83 | 0.38 | 1.38 | 1.32 | 0.70 |
| QAS_A | -0.47 | 2.25 | 2.20 | 0.75 | -0.67 | 1.38 | 1.21 | 0.73 |
| NUK_U | -0.02 | 1.74 | 1.74 | 0.84 | -0.11 | 1.23 | 1.23 | 0.72 |
| NUK_N | -0.18 | 1.41 | 1.4 | 0.87 | -0.33 | 1.05 | 1.00 | 0.8 |
| KAN_L | 0.55 | 1.46 | 1.35 | 0.83 | 1.05 | 1.51 | 1.08 | 0.77 |
| KAN_M | -0.53 | 1.51 | 1.42 | 0.89 | 0 | 1.11 | 1.11 | 0.77 |
| KAN_U | -0.98 | 1.67 | 1.35 | 0.92 | -1.02 | 1.43 | 1.01 | 0.88 |
| UPE_U | -0.04 | 1.91 | 1.91 | 0.8 | 0.39 | 1.66 | 1.61 | 0.72 |
| THU_L | 0.38 | 2.38 | 2.35 | 0.78 | 0.13 | 2.17 | 2.16 | 0.83 |
| THU_U | -0.08 | 2.21 | 2.21 | 0.78 | -0.37 | 1.99 | 1.95 | 0.85 |
| NUK_L* | 1.20 | 2.30 | 1.96 | 0.76 | 0.34 | 1.36 | 1.31 | 0.64 |
| QAS_L | 0.04 | 1.98 | 1.98 | 0.81 | -0.79 | 1.56 | 1.34 | 0.67 |
| QAS_M | -0.61 | 1.67 | 1.55 | 0.89 | -1.04 | 1.19 | 0.59 | 0.79 |
| TAS_L | 0.37 | 3.01 | 2.99 | 0.76 | -0.69 | 1.80 | 1.66 | 0.52 |
| TAS_U | 0.31 | 2.74 | 2.72 | 0.78 | -0.10 | 1.55 | 1.55 | 0.66 |
| UPE_L | 0.32 | 1.97 | 1.94 | 0.73 | 0.36 | 1.47 | 1.43 | 0.76 |
| All AWS | -0.06 | 1.96 | 1.84 | 0.77 | -0.20 | 1.53 | 1.36 | 0.71 |
| 19 selected AWS | -0.16 | 1.96 | 1.85 | 0.79 | -0.25 | 1.56 | 1.37 | 0.74 |

* Dissmissed in the study. see Table S2

**Table S17.** Same as Table S16 but for AWS height wind speed (UV2).

| W10M (ms$^{-1}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| MAR$_{EI}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | 0.54 | 1.92 | 1.84 | 0.75 | -0.44 | 1.46 | 1.39 | 0.70 |
| KPC_U | 1.09 | 1.69 | 1.28 | 0.84 | 0.56 | 1.19 | 1.05 | 0.79 |
| SCO_L* | 1.77 | 2.39 | 1.60 | 0.54 | 1.23 | 1.72 | 1.21 | 0.53 |
| SCO_U | -0.33 | 1.63 | 1.60 | 0.47 | -0.2 | 1.21 | 1.19 | 0.45 |
| TAS_A | 2.02 | 3.24 | 2.53 | 0.84 | 1.92 | 2.45 | 1.52 | 0.79 |
| QAS_U | 2.32 | 3.12 | 2.09 | 0.84 | 2.00 | 2.44 | 1.40 | 0.7 |
| QAS_A | 1.43 | 2.75 | 2.34 | 0.75 | 0.89 | 1.57 | 1.29 | 0.72 |
| NUK_U | 1.55 | 2.41 | 1.84 | 0.83 | 1.37 | 1.90 | 1.32 | 0.7 |
| NUK_N | 1.32 | 1.91 | 1.38 | 0.88 | 0.94 | 1.33 | 0.95 | 0.81 |
| KAN_L | 1.85 | 2.28 | 1.33 | 0.85 | 2.21 | 2.45 | 1.06 | 0.79 |
| KAN_M | 0.74 | 1.60 | 1.42 | 0.89 | 1.02 | 1.53 | 1.14 | 0.76 |
| KAN_U | 0.19 | 1.33 | 1.31 | 0.92 | -0.14 | 0.93 | 0.92 | 0.9 |
| UPE_U | 1.23 | 2.26 | 1.89 | 0.81 | 1.56 | 2.19 | 1.54 | 0.76 |
| THU_L | 0.93 | 2.4 | 2.21 | 0.81 | 0.41 | 1.83 | 1.78 | 0.89 |
| THU_U | 0.36 | 2.07 | 2.04 | 0.81 | -0.11 | 1.68 | 1.67 | 0.89 |
| NUK_L* | 2.75 | 3.46 | 2.11 | 0.76 | 1.81 | 2.25 | 1.33 | 0.66 |
| QAS_L | 1.88 | 2.80 | 2.08 | 0.82 | 0.78 | 1.57 | 1.37 | 0.67 |
| QAS_M | 1.28 | 1.99 | 1.53 | 0.92 | 0.49 | 0.90 | 0.75 | 0.71 |
| TAS_L | 1.90 | 3.44 | 2.87 | 0.8 | 0.54 | 1.77 | 1.68 | 0.56 |
| TAS_U | 1.95 | 3.24 | 2.59 | 0.82 | 1.26 | 2.02 | 1.58 | 0.68 |
| UPE_L | 1.50 | 2.47 | 1.96 | 0.74 | 1.42 | 1.98 | 1.38 | 0.78 |
| All AWS | 1.32 | 2.35 | 1.84 | 0.79 | 0.96 | 1.77 | 1.32 | 0.73 |
| 19 selected AWS | 1.31 | 2.34 | 1.86 | 0.80 | 0.96 | 1.79 | 1.36 | 0.74 |

* Dissmissed in the study. see Table S2

**Table S18.** Same as Table S16 but for MAR$_{EI}$.

| UV2 (ms$^{-1}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| MAR$_{EI}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -0.90 | 1.99 | 1.77 | 0.77 | -1.57 | 2.12 | 1.42 | 0.69 |
| KPC_U | -0.27 | 1.28 | 1.25 | 0.84 | -0.5 | 1.15 | 1.04 | 0.79 |
| SCO_L* | 0.48 | 1.67 | 1.6 | 0.51 | 0.20 | 1.26 | 1.24 | 0.5 |
| SCO_U | -1.56 | 2.21 | 1.57 | 0.44 | -1.25 | 1.71 | 1.17 | 0.45 |
| TAS_A | 0.28 | 2.59 | 2.58 | 0.83 | 0.54 | 1.65 | 1.56 | 0.76 |
| QAS_U | 0.52 | 2.09 | 2.02 | 0.83 | 0.53 | 1.45 | 1.34 | 0.69 |
| QAS_A | -0.36 | 2.3 | 2.27 | 0.73 | -0.49 | 1.36 | 1.27 | 0.71 |
| NUK_U | 0.04 | 1.79 | 1.79 | 0.83 | -0.01 | 1.31 | 1.31 | 0.69 |
| NUK_N | -0.14 | 1.39 | 1.38 | 0.87 | -0.28 | 1.08 | 1.04 | 0.78 |
| KAN_L | 0.52 | 1.46 | 1.37 | 0.83 | 1.05 | 1.50 | 1.07 | 0.77 |
| KAN_M | -0.58 | 1.57 | 1.46 | 0.88 | -0.03 | 1.16 | 1.16 | 0.75 |
| KAN_U | -1.10 | 1.74 | 1.35 | 0.92 | -1.11 | 1.49 | 0.99 | 0.88 |
| UPE_U | -0.15 | 1.83 | 1.82 | 0.81 | 0.34 | 1.50 | 1.46 | 0.76 |
| THU_L | -0.59 | 2.28 | 2.2 | 0.81 | -0.94 | 2.09 | 1.87 | 0.88 |
| THU_U | -1.10 | 2.33 | 2.05 | 0.81 | -1.44 | 2.26 | 1.74 | 0.89 |
| NUK_L* | 1.26 | 2.36 | 1.99 | 0.76 | 0.43 | 1.36 | 1.29 | 0.66 |
| QAS_L | 0.11 | 2.03 | 2.03 | 0.80 | -0.71 | 1.51 | 1.34 | 0.67 |
| QAS_M | -0.51 | 1.67 | 1.59 | 0.89 | -0.88 | 1.14 | 0.71 | 0.72 |
| TAS_L | 0.34 | 2.95 | 2.93 | 0.77 | -0.70 | 1.84 | 1.70 | 0.51 |
| TAS_U | 0.30 | 2.66 | 2.65 | 0.80 | -0.05 | 1.55 | 1.55 | 0.66 |
| UPE_L | 0.21 | 1.91 | 1.90 | 0.74 | 0.32 | 1.38 | 1.34 | 0.78 |
| All AWS | -0.13 | 1.96 | 1.82 | 0.78 | -0.26 | 1.53 | 1.32 | 0.72 |
| 19 selected AWS | -0.16 | 1.96 | 1.85 | 0.79 | -0.25 | 1.56 | 1.37 | 0.73 |

* Dissmissed in the study. see Table S2

**Table S19.** Same as Table S17 but for MAR$_{EI}$.

| W10M ($ms^{-1}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| ASR | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | 0.05 | 1.87 | 1.87 | 0.78 | -1.34 | 2.04 | 1.54 | 0.70 |
| KPC_U | 1.86 | 2.39 | 1.51 | 0.84 | 0.96 | 1.53 | 1.19 | 0.81 |
| SCO_L* | 2.73 | 3.40 | 2.02 | 0.54 | 2.18 | 2.6 | 1.41 | 0.58 |
| SCO_U | 1.45 | 2.37 | 1.87 | 0.56 | 1.45 | 2.04 | 1.43 | 0.53 |
| TAS_A | 2.10 | 3.23 | 2.44 | 0.86 | 3.09 | 3.48 | 1.61 | 0.74 |
| QAS_U | 2.22 | 3.04 | 2.07 | 0.8 | 2.35 | 2.72 | 1.38 | 0.68 |
| QAS_A | 1.67 | 2.87 | 2.33 | 0.73 | 1.65 | 2.12 | 1.34 | 0.67 |
| NUK_U | 2.79 | 3.57 | 2.23 | 0.84 | 2.07 | 2.48 | 1.38 | 0.75 |
| NUK_N | 1.36 | 2.2 | 1.73 | 0.88 | 0.56 | 1.12 | 0.97 | 0.84 |
| KAN_L | 1.65 | 2.22 | 1.49 | 0.82 | 1.93 | 2.30 | 1.25 | 0.76 |
| KAN_M | 1.98 | 2.59 | 1.67 | 0.88 | 1.96 | 2.40 | 1.38 | 0.76 |
| KAN_U | 0.84 | 1.62 | 1.39 | 0.93 | 0.29 | 1.13 | 1.09 | 0.89 |
| UPE_U | 2.51 | 3.06 | 1.76 | 0.89 | 2.43 | 2.82 | 1.44 | 0.85 |
| THU_L | -1.38 | 2.76 | 2.39 | 0.77 | -2.02 | 2.83 | 1.98 | 0.86 |
| THU_U | -1.45 | 2.79 | 2.39 | 0.74 | -2.16 | 3.01 | 2.09 | 0.83 |
| NUK_L* | 2.79 | 3.69 | 2.41 | 0.78 | 1.31 | 2.00 | 1.51 | 0.57 |
| QAS_L | 1.25 | 2.22 | 1.83 | 0.82 | 0.63 | 1.39 | 1.24 | 0.73 |
| QAS_M | 0.50 | 1.90 | 1.83 | 0.82 | 1.48 | 1.65 | 0.73 | 0.68 |
| TAS_L | 1.82 | 3.01 | 2.40 | 0.86 | 1.46 | 1.97 | 1.32 | 0.76 |
| TAS_U | 1.99 | 3.00 | 2.24 | 0.87 | 2.48 | 2.86 | 1.43 | 0.74 |
| UPE_L | 3.36 | 4.18 | 2.49 | 0.72 | 2.61 | 3.06 | 1.59 | 0.76 |
| All AWS | 1.66 | 2.8 | 1.98 | 0.79 | 1.20 | 2.28 | 1.43 | 0.74 |
| 19 selected AWS | 1.52 | 2.70 | 1.95 | 0.81 | 1.13 | 2.28 | 1.42 | 0.76 |

* Dissmissed in the study. see Table S2

**Table S20.** Same as Table S17 but for ASR.

| W10M (ms$^{-1}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| E5 | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -2.26 | 2.71 | 1.49 | 0.85 | -2.70 | 2.92 | 1.10 | 0.83 |
| KPC_U | 0.45 | 1.18 | 1.08 | 0.90 | 0.30 | 1.07 | 1.02 | 0.88 |
| SCO_L* | -2.22 | 2.51 | 1.19 | 0.59 | -2.02 | 2.32 | 1.14 | 0.65 |
| SCO_U | -3.43 | 3.66 | 1.30 | 0.65 | -2.78 | 2.96 | 1.03 | 0.61 |
| TAS_A | -2.31 | 3.36 | 2.44 | 0.88 | -1.27 | 1.96 | 1.49 | 0.80 |
| QAS_U | -0.82 | 1.72 | 1.51 | 0.87 | -0.49 | 1.23 | 1.13 | 0.77 |
| QAS_A | -1.48 | 2.39 | 1.88 | 0.76 | -1.24 | 1.90 | 1.44 | 0.55 |
| NUK_U | -0.65 | 1.62 | 1.49 | 0.86 | 0.17 | 0.99 | 0.98 | 0.79 |
| NUK_N | -1.88 | 2.17 | 1.10 | 0.92 | -1.76 | 1.95 | 0.84 | 0.82 |
| KAN_L | -0.97 | 1.41 | 1.03 | 0.90 | -0.80 | 1.21 | 0.91 | 0.85 |
| KAN_M | 0.84 | 1.70 | 1.48 | 0.90 | 1.99 | 2.37 | 1.29 | 0.8 |
| KAN_U | 0.53 | 1.31 | 1.2 | 0.95 | 0.71 | 1.23 | 1.00 | 0.91 |
| UPE_U | -0.50 | 1.35 | 1.26 | 0.91 | -0.14 | 1.02 | 1.01 | 0.88 |
| THU_L | -3.14 | 4.08 | 2.6 | 0.80 | -3.71 | 4.32 | 2.21 | 0.92 |
| THU_U | -3.33 | 4.10 | 2.39 | 0.79 | -3.86 | 4.37 | 2.04 | 0.91 |
| NUK_L* | -0.44 | 1.30 | 1.22 | 0.81 | -0.34 | 1.09 | 1.03 | 0.68 |
| QAS_L | -1.15 | 2.10 | 1.76 | 0.78 | -1.38 | 1.97 | 1.40 | 0.54 |
| QAS_M | -1.87 | 2.47 | 1.61 | 0.87 | -1.55 | 1.75 | 0.81 | 0.64 |
| TAS_L | -0.71 | 2.26 | 2.14 | 0.90 | -0.81 | 1.20 | 0.88 | 0.79 |
| TAS_U | -1.37 | 2.49 | 2.08 | 0.91 | -0.81 | 1.25 | 0.96 | 0.81 |
| UPE_L | 0.21 | 1.82 | 1.81 | 0.75 | -0.4 | 1.26 | 1.20 | 0.77 |
| All AWS | -1.08 | 2.15 | 1.55 | 0.83 | -0.95 | 1.89 | 1.19 | 0.78 |
| 19 selected AWS | -1.04 | 2.18 | 1.60 | 0.85 | -0.92 | 1.91 | 1.20 | 0.80 |

* Dissmissed in the study. see Table S2

**Table S21.** Same as Table S17 but for ERA5.

| W10M (ms$^{-1}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| EI | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -2.7 | 3.35 | 1.99 | 0.72 | -3.17 | 3.41 | 1.27 | 0.77 |
| KPC_U | 0.28 | 1.27 | 1.23 | 0.85 | -0.18 | 0.98 | 0.97 | 0.86 |
| SCO_L* | -1.56 | 1.88 | 1.04 | 0.65 | -1.60 | 1.89 | 1.01 | 0.69 |
| SCO_U | -2.39 | 2.64 | 1.11 | 0.67 | -2.09 | 2.28 | 0.91 | 0.63 |
| TAS_A | -1.68 | 3.24 | 2.77 | 0.86 | -0.33 | 1.56 | 1.52 | 0.77 |
| QAS_U | -0.4 | 2.27 | 2.24 | 0.75 | -0.08 | 1.41 | 1.41 | 0.70 |
| QAS_A | -1.03 | 2.82 | 2.63 | 0.59 | -0.87 | 1.79 | 1.56 | 0.55 |
| NUK_U | -1.2 | 2.10 | 1.72 | 0.81 | -1.37 | 1.83 | 1.21 | 0.67 |
| NUK_N | -1.6 | 2.13 | 1.4 | 0.85 | -1.75 | 2.03 | 1.03 | 0.73 |
| KAN_L | -0.56 | 1.41 | 1.29 | 0.84 | -1.13 | 1.42 | 0.85 | 0.8 |
| KAN_M | -0.38 | 1.41 | 1.36 | 0.90 | 0.11 | 1.21 | 1.21 | 0.78 |
| KAN_U | 0.24 | 1.48 | 1.47 | 0.92 | 0.32 | 1.17 | 1.13 | 0.88 |
| UPE_U | -2.21 | 3.00 | 2.03 | 0.79 | -1.67 | 2.29 | 1.57 | 0.61 |
| THU_L | -2.71 | 3.60 | 2.37 | 0.82 | -2.99 | 3.75 | 2.26 | 0.88 |
| THU_U | -2.86 | 3.56 | 2.12 | 0.83 | -3.11 | 3.7 | 2.02 | 0.89 |
| NUK_L* | 0.15 | 1.78 | 1.77 | 0.68 | -0.88 | 1.74 | 1.50 | 0.41 |
| QAS_L | -0.46 | 2.13 | 2.08 | 0.74 | -0.67 | 1.65 | 1.51 | 0.61 |
| QAS_M | -1.83 | 2.95 | 2.31 | 0.71 | -0.88 | 1.54 | 1.27 | 0.6 |
| TAS_L | -0.03 | 2.76 | 2.76 | 0.82 | 0.18 | 1.19 | 1.17 | 0.65 |
| TAS_U | -0.73 | 2.75 | 2.65 | 0.84 | 0.13 | 1.16 | 1.15 | 0.72 |
| UPE_L | -0.31 | 2.16 | 2.14 | 0.59 | -0.53 | 1.69 | 1.61 | 0.52 |
| All AWS | -1.03 | 2.28 | 1.82 | 0.78 | -1.06 | 1.88 | 1.33 | 0.71 |
| 19 selected AWS | -1.06 | 2.33 | 1.87 | 0.79 | -1.04 | 1.89 | 1.34 | 0.73 |

* Dissmissed in the study. see Table S2

**Table S22.** Same as Table S17 but for ERA-Interim.

| LWD (Wm$^{-2}$) | Annually | | | | Summer | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MAR$_{E5}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -12.82 | 26.84 | 23.58 | 0.87 | -23.63 | 29.57 | 17.79 | 0.73 |
| KPC_U | -8.98 | 25.41 | 23.77 | 0.85 | -13.7 | 23.86 | 19.54 | 0.73 |
| SCO_L* | -25.49 | 34.51 | 23.27 | 0.87 | -40.6 | 44.79 | 18.9 | 0.75 |
| SCO_U | -7.57 | 23.02 | 21.74 | 0.88 | -19.66 | 27.37 | 19.04 | 0.76 |
| TAS_A | -4.62 | 25.65 | 25.23 | 0.77 | -9.91 | 19.66 | 16.98 | 0.81 |
| QAS_U* | -10.41 | 30.48 | 28.65 | 0.81 | -10.50 | 22.25 | 19.61 | 0.79 |
| QAS_A | -10.78 | 26.26 | 23.94 | 0.87 | -11.24 | 20.00 | 16.54 | 0.85 |
| NUK_U* | -7.20 | 26.10 | 25.08 | 0.86 | -13.51 | 27.45 | 23.9 | 0.73 |
| NUK_N | -10.68 | 24.44 | 21.99 | 0.9 | -15.39 | 22.96 | 17.03 | 0.84 |
| KAN_L | -10.48 | 25.14 | 22.85 | 0.88 | -13.98 | 21.76 | 16.67 | 0.80 |
| KAN_M | -5.68 | 24.09 | 23.41 | 0.87 | -10.31 | 22.35 | 19.83 | 0.80 |
| KAN_U | -5.08 | 23.37 | 22.81 | 0.86 | -10.08 | 23.49 | 21.21 | 0.81 |
| UPE_U | -2.56 | 25.32 | 25.19 | 0.87 | -9.05 | 23.92 | 22.15 | 0.77 |
| THU_L | -18.33 | 30.68 | 24.6 | 0.88 | -20.83 | 26.99 | 17.16 | 0.80 |
| THU_U | -15.15 | 29.39 | 25.18 | 0.88 | -11.89 | 20.05 | 16.14 | 0.85 |
| NUK_L | -20.31 | 31.55 | 24.14 | 0.87 | -24.24 | 30.11 | 17.85 | 0.81 |
| QAS_L | -12.62 | 22.49 | 18.62 | 0.92 | -15.86 | 22.93 | 16.56 | 0.82 |
| QAS_M | -10.58 | 17.66 | 14.14 | 0.96 | -13.15 | 17.44 | 11.46 | 0.93 |
| TAS_L | -10.31 | 26.99 | 24.94 | 0.78 | -14.02 | 22.33 | 17.38 | 0.77 |
| TAS_U* | -9.49 | 28.31 | 26.67 | 0.77 | -16.33 | 28.75 | 23.66 | 0.63 |
| UPE_L | -15.62 | 31.00 | 26.78 | 0.85 | -17.35 | 27.25 | 21.01 | 0.71 |
| All AWS | -11.28 | 27.06 | 24.05 | 0.86 | -16.43 | 25.84 | 19.17 | 0.77 |
| 17 selected AWS | -10.58 | 26.20 | 23.54 | 0.87 | -15.12 | 24.33 | 18.61 | 0.79 |

\* Dissmissed in the study. see Table S2

**Table S23.** Annual and summer long wave downward radiation fluxes (LWD) mean bias (MB). RMSE. centered RMSE (RMSEc) and correlation (r) between daily observations at PROMICE AWS and MAR$_{E5}$ over 2010 – 2016.

| LWD ($Wm^{-2}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| $MAR_{EI}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -12.12 | 25.84 | 22.83 | 0.88 | -20.59 | 27.00 | 17.46 | 0.75 |
| KPC_U | -7.93 | 24.55 | 23.23 | 0.86 | -10.79 | 21.55 | 18.66 | 0.77 |
| SCO_L* | -25.33 | 34.13 | 22.88 | 0.87 | -38.2 | 42.76 | 19.23 | 0.76 |
| SCO_U | -7.03 | 22.76 | 21.65 | 0.89 | -17.02 | 25.36 | 18.80 | 0.78 |
| TAS_A | -5.74 | 26.26 | 25.63 | 0.77 | -10.26 | 20.59 | 17.85 | 0.79 |
| QAS_U* | -11.36 | 30.93 | 28.77 | 0.81 | -11.00 | 23.00 | 20.20 | 0.78 |
| QAS_A | -12.32 | 27.6 | 24.7 | 0.86 | -14.29 | 22.73 | 17.68 | 0.83 |
| NUK_U* | -7.78 | 26.31 | 25.14 | 0.86 | -13.93 | 27.64 | 23.87 | 0.73 |
| NUK_N | -11.01 | 24.4 | 21.77 | 0.9 | -15.43 | 22.86 | 16.87 | 0.84 |
| KAN_L | -10.36 | 24.28 | 21.96 | 0.89 | -14.09 | 21.86 | 16.72 | 0.8 |
| KAN_M | -6.34 | 23.68 | 22.82 | 0.88 | -10.85 | 21.83 | 18.94 | 0.82 |
| KAN_U | -5.66 | 23.12 | 22.41 | 0.87 | -10.73 | 22.79 | 20.10 | 0.83 |
| UPE_U | -5.14 | 24.62 | 24.08 | 0.88 | -10.78 | 23.02 | 20.34 | 0.80 |
| THU_L | -20.74 | 31.59 | 23.82 | 0.89 | -21.93 | 28.1 | 17.57 | 0.78 |
| THU_U | -17.95 | 30.5 | 24.66 | 0.88 | -13.77 | 21.36 | 16.33 | 0.84 |
| NUK_L | -20.31 | 31.39 | 23.93 | 0.87 | -24.06 | 29.79 | 17.56 | 0.82 |
| QAS_L | -13.33 | 23.13 | 18.9 | 0.92 | -16.18 | 23.49 | 17.02 | 0.81 |
| QAS_M | -10.95 | 18.73 | 15.19 | 0.95 | -11.61 | 22.74 | 19.55 | 0.76 |
| TAS_L | -10.56 | 26.63 | 24.45 | 0.79 | -12.92 | 21.5 | 17.19 | 0.78 |
| TAS_U* | -9.88 | 28.21 | 26.42 | 0.78 | -15.43 | 28.54 | 24.01 | 0.62 |
| UPE_L | -18.15 | 31.53 | 25.78 | 0.86 | -19.07 | 27.57 | 19.91 | 0.74 |
| All AWS | -11.98 | 27.00 | 23.66 | 0.86 | -16.28 | 25.45 | 18.93 | 0.78 |
| 17 selected AWS | -11.35 | 26.11 | 23.08 | 0.87 | -15.11 | 23.93 | 18.22 | 0.80 |

* Dissmissed in the study. see Table S2

**Table S24.** Same as Table S23 but for $MAR_{EI}$.

| LWD ($Wm^{-2}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| ASR | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -22.63 | 27.96 | 16.42 | 0.94 | -24.56 | 28.87 | 15.18 | 0.79 |
| KPC_U | -16.81 | 24.6 | 17.96 | 0.92 | -13.15 | 19.94 | 14.99 | 0.83 |
| SCO_L* | -36.05 | 39.69 | 16.59 | 0.93 | -45.81 | 47.86 | 13.87 | 0.83 |
| SCO_U | -22.17 | 26.61 | 14.71 | 0.95 | -29.24 | 32.56 | 14.33 | 0.84 |
| TAS_A | -8.58 | 22.86 | 21.19 | 0.85 | -13.42 | 19.55 | 14.21 | 0.86 |
| QAS_U* | -9.64 | 28.07 | 26.36 | 0.85 | -6.63 | 18.56 | 17.34 | 0.84 |
| QAS_A | -11.63 | 23.82 | 20.79 | 0.91 | -8.53 | 14.55 | 11.8 | 0.92 |
| NUK_U* | -14.37 | 26.68 | 22.48 | 0.90 | -14.90 | 26.54 | 21.96 | 0.76 |
| NUK_N | -14.72 | 22.07 | 16.44 | 0.95 | -8.90 | 16.34 | 13.71 | 0.9 |
| KAN_L | -13.73 | 22.63 | 18.00 | 0.94 | -5.68 | 14.19 | 13.00 | 0.88 |
| KAN_M | -12.82 | 22.97 | 19.06 | 0.93 | -5.34 | 16.8 | 15.92 | 0.88 |
| KAN_U | -15.06 | 25.18 | 20.19 | 0.92 | -5.67 | 18.27 | 17.37 | 0.87 |
| UPE_U | -10.15 | 21.51 | 18.96 | 0.93 | -10.29 | 19.00 | 15.97 | 0.87 |
| THU_L | -18.74 | 27.55 | 20.19 | 0.93 | -11.60 | 19.88 | 16.15 | 0.84 |
| THU_U | -16.51 | 28.29 | 22.97 | 0.92 | -4.02 | 16.05 | 15.54 | 0.86 |
| NUK_L | -23.94 | 32.34 | 21.74 | 0.91 | -18.46 | 24.15 | 15.56 | 0.86 |
| QAS_L | -12.03 | 19.37 | 15.18 | 0.95 | -9.92 | 16.93 | 13.71 | 0.89 |
| QAS_M | -8.02 | 14.58 | 12.17 | 0.97 | -4.05 | 12.26 | 11.58 | 0.92 |
| TAS_L | -14.15 | 24.94 | 20.54 | 0.86 | -13.64 | 20.6 | 15.44 | 0.82 |
| TAS_U* | -12.41 | 25.57 | 22.36 | 0.85 | -15.00 | 25.58 | 20.71 | 0.71 |
| UPE_L | -26.15 | 34.24 | 22.11 | 0.90 | -22.88 | 28.51 | 17.01 | 0.82 |
| All AWS | -17.06 | 26.59 | 19.6 | 0.91 | -14.81 | 22.78 | 15.83 | 0.84 |
| 17 selected AWS | -16.55 | 25.48 | 18.98 | 0.92 | -12.91 | 20.69 | 15.22 | 0.86 |

* Dissmissed in the study. see Table S2

**Table S25.** Same as Table S23 but for ASR.

| LWD ($Wm^{-2}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| E5 | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -18.25 | 23.45 | 14.74 | 0.95 | -23.23 | 27.09 | 13.95 | 0.83 |
| KPC_U | -13.18 | 20.87 | 16.18 | 0.93 | -12.84 | 18.33 | 13.09 | 0.87 |
| SCO_L* | -42.86 | 45.77 | 16.06 | 0.94 | -56.54 | 58.23 | 13.94 | 0.82 |
| SCO_U | -27.09 | 30.63 | 14.31 | 0.95 | -37.94 | 40.37 | 13.81 | 0.85 |
| TAS_A | -2.46 | 17.73 | 17.56 | 0.90 | -1.43 | 13.45 | 13.38 | 0.88 |
| QAS_U* | -15.36 | 29.15 | 24.78 | 0.87 | -9.18 | 18.76 | 16.35 | 0.86 |
| QAS_A | -12.79 | 23.02 | 19.14 | 0.92 | -6.07 | 10.35 | 8.38 | 0.96 |
| NUK_U* | -16.4 | 25.15 | 19.07 | 0.92 | -16.64 | 26.89 | 21.12 | 0.80 |
| NUK_N | -14.97 | 19.99 | 13.24 | 0.97 | -5.55 | 14.08 | 12.94 | 0.92 |
| KAN_L | -6.36 | 18.03 | 16.87 | 0.95 | 7.94 | 14.83 | 12.53 | 0.9 |
| KAN_M | -11.71 | 18.04 | 13.72 | 0.95 | -9.49 | 15.41 | 12.14 | 0.93 |
| KAN_U | -14.18 | 20.45 | 14.73 | 0.94 | -14.12 | 19.25 | 13.09 | 0.93 |
| UPE_U | -11.18 | 19.28 | 15.7 | 0.95 | -5.61 | 15.62 | 14.58 | 0.89 |
| THU_L | -13.98 | 22.58 | 17.73 | 0.94 | -7.12 | 15.38 | 13.64 | 0.89 |
| THU_U | -11.65 | 23.16 | 20.02 | 0.93 | -0.89 | 12.7 | 12.67 | 0.91 |
| NUK_L | -27.32 | 32.72 | 18.01 | 0.93 | -22.48 | 27.21 | 15.32 | 0.89 |
| QAS_L | -13.99 | 19.42 | 13.46 | 0.96 | -3.83 | 13.69 | 13.15 | 0.89 |
| QAS_M | -15.66 | 18.35 | 9.57 | 0.98 | -7.64 | 13.19 | 10.75 | 0.93 |
| TAS_L | -15.8 | 23.85 | 17.87 | 0.9 | -11.17 | 17.12 | 12.97 | 0.89 |
| TAS_U* | -13.02 | 24.55 | 20.81 | 0.87 | -10.7 | 23.21 | 20.6 | 0.73 |
| UPE_L | -27.58 | 33.53 | 19.07 | 0.93 | -17.48 | 23.56 | 15.8 | 0.84 |
| All AWS | -17.20 | 24.99 | 17.04 | 0.93 | -14.22 | 22.35 | 14.38 | 0.87 |
| 17 selected AWS | -15.58 | 23.02 | 16.18 | 0.94 | -11.23 | 19.41 | 13.50 | 0.89 |

* Dissmissed in the study. see Table S2

**Table S26.** Same as Table S23 but for ERA5.

| LWD (Wm$^{-2}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| EI | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -13.89 | 21.08 | 15.86 | 0.94 | -23.02 | 26.58 | 13.29 | 0.87 |
| KPC_U | -7.30 | 18.46 | 16.96 | 0.92 | -11.32 | 17.65 | 13.54 | 0.87 |
| SCO_L* | -53.42 | 55.69 | 15.73 | 0.95 | -50.93 | 53.8 | 17.34 | 0.85 |
| SCO_U | -37.11 | 39.66 | 14.00 | 0.96 | -35.79 | 39.02 | 15.55 | 0.86 |
| TAS_A | -21.87 | 29.28 | 19.47 | 0.89 | -21.79 | 24.57 | 11.36 | 0.92 |
| QAS_U* | -26.96 | 40.13 | 29.73 | 0.84 | -17.27 | 24.6 | 17.52 | 0.83 |
| QAS_A | -25.16 | 36.4 | 26.30 | 0.88 | -14.31 | 20.55 | 14.75 | 0.88 |
| NUK_U* | -8.25 | 22.57 | 21.01 | 0.90 | -16.31 | 27.17 | 21.74 | 0.75 |
| NUK_N | -10.65 | 17.34 | 13.69 | 0.96 | -12.24 | 18.56 | 13.95 | 0.88 |
| KAN_L | -16.09 | 24.27 | 18.17 | 0.94 | -10.39 | 17.98 | 14.68 | 0.88 |
| KAN_M | -10.5 | 19.33 | 16.22 | 0.95 | -7.84 | 16.4 | 14.4 | 0.90 |
| KAN_U | -11.73 | 21.27 | 17.75 | 0.93 | -8.9 | 18.93 | 16.71 | 0.89 |
| UPE_U | -9.82 | 21.21 | 18.8 | 0.94 | -1.23 | 15.36 | 15.31 | 0.89 |
| THU_L | -23.87 | 38.1 | 29.69 | 0.89 | -4.41 | 17.46 | 16.89 | 0.79 |
| THU_U | -20.01 | 38.19 | 32.53 | 0.87 | 3.16 | 17.68 | 17.4 | 0.8 |
| NUK_L | -23.72 | 30.73 | 19.54 | 0.91 | -30.82 | 34.58 | 15.69 | 0.84 |
| QAS_L | -31.03 | 35.14 | 16.48 | 0.95 | -26.65 | 30.42 | 14.67 | 0.87 |
| QAS_M | -28.92 | 32.83 | 15.54 | 0.96 | -25.19 | 28.33 | 12.97 | 0.91 |
| TAS_L | -34.91 | 40.22 | 19.97 | 0.88 | -31.96 | 35.04 | 14.36 | 0.86 |
| TAS_U* | -32.24 | 39.09 | 22.11 | 0.87 | -30.55 | 36.11 | 19.25 | 0.77 |
| UPE_L | -26.41 | 33.97 | 21.36 | 0.92 | -17.22 | 23.76 | 16.38 | 0.84 |
| All AWS | -22.16 | 30.90 | 19.88 | 0.92 | -18.57 | 26.10 | 15.90 | 0.85 |
| 17 selected AWS | -19.6 | 28.28 | 19.26 | 0.92 | -15.58 | 23.39 | 15.11 | 0.86 |

* Dissmissed in the study. see Table S2

**Table S27.** Same as Table S23 but for ERA-Interim.

| SWD (Wm$^{-2}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| MAR$_{E5}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -3.27 | 30.54 | 30.36 | 0.97 | 2.26 | 48.18 | 48.13 | 0.89 |
| KPC_U | -11.5 | 28.3 | 25.86 | 0.98 | -14.83 | 38.59 | 35.63 | 0.93 |
| SCO_L* | 8.35 | 31.27 | 30.13 | 0.97 | 27.16 | 52.61 | 45.06 | 0.87 |
| SCO_U | -2.28 | 28.57 | 28.48 | 0.98 | 10.29 | 43.41 | 42.18 | 0.89 |
| TAS_A | -8.94 | 36.08 | 34.96 | 0.96 | -12.56 | 40.15 | 38.14 | 0.89 |
| QAS_U* | 18.43 | 82.13 | 80.04 | 0.79 | 15.28 | 100.55 | 99.39 | 0.53 |
| QAS_A | -1.85 | 37.63 | 37.58 | 0.95 | -17.33 | 44.57 | 41.06 | 0.89 |
| NUK_U* | 3.73 | 69.2 | 69.1 | 0.83 | 22.81 | 102.58 | 100.02 | 0.57 |
| NUK_N | -3.46 | 30.15 | 29.95 | 0.97 | 3.44 | 45.28 | 45.15 | 0.88 |
| KAN_L | -14.09 | 35.87 | 32.99 | 0.96 | -8.88 | 45.69 | 44.82 | 0.85 |
| KAN_M | -10.74 | 30.84 | 28.91 | 0.97 | -7.05 | 40.77 | 40.15 | 0.89 |
| KAN_U | -20.36 | 36.79 | 30.64 | 0.98 | -22.97 | 45.45 | 39.22 | 0.86 |
| UPE_U | -11.66 | 33.23 | 31.12 | 0.97 | -16.85 | 51.71 | 48.89 | 0.87 |
| THU_L | -4.32 | 28.61 | 28.28 | 0.97 | 4.77 | 43.52 | 43.26 | 0.90 |
| THU_U | -5.16 | 25.92 | 25.40 | 0.98 | -4.62 | 38.47 | 38.19 | 0.92 |
| NUK_L* | 10.08 | 52.62 | 51.65 | 0.90 | 14 | 62.61 | 61.03 | 0.8 |
| QAS_L | 1.88 | 35.36 | 35.31 | 0.95 | 16.99 | 54.57 | 51.86 | 0.85 |
| QAS_M | -2.21 | 24.14 | 24.04 | 0.95 | 23.56 | 46.29 | 39.84 | 0.79 |
| TAS_L | -5.40 | 40.41 | 40.05 | 0.95 | 0.7 | 50.91 | 50.91 | 0.84 |
| TAS_U* | 4.73 | 72.2 | 72.04 | 0.81 | 25.76 | 113.4 | 110.44 | 0.39 |
| UPE_L | -6.88 | 36.73 | 36.08 | 0.95 | -2.3 | 54.83 | 54.78 | 0.83 |
| All AWS | -3.17 | 40.47 | 39.12 | 0.94 | 2.43 | 56.35 | 54.26 | 0.81 |
| 16 selected AWS | -7.95 | 32.8 | 31.30 | 0.97 | -4.42 | 46.07 | 44.41 | 0.88 |

* Dissmissed in the study. see Table S2

**Table S28.** Annual and summer short wave downward radiation fluxes (SWD) mean bias (MB). RMSE. centered RMSE (RMSEc) and correlation (r) between daily observations at PROMICE AWS and MAR$_{E5}$ over 2010 – 2016.

| SWD (Wm$^{-2}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| MAR$_{EI}$ | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -3.85 | 29.26 | 29 | 0.98 | -0.61 | 45.95 | 45.95 | 0.9 |
| KPC_U | -12.48 | 28.52 | 25.64 | 0.99 | -17.94 | 38.88 | 34.49 | 0.93 |
| SCO_L* | 7.67 | 30.42 | 29.44 | 0.97 | 24.58 | 50.27 | 43.85 | 0.88 |
| SCO_U | -3.32 | 28.09 | 27.89 | 0.98 | 7.17 | 41.38 | 40.75 | 0.90 |
| TAS_A | -8.17 | 36.5 | 35.57 | 0.96 | -12.08 | 42.47 | 40.72 | 0.87 |
| QAS_U* | 18.79 | 82.88 | 80.72 | 0.78 | 15.41 | 101.77 | 100.6 | 0.52 |
| QAS_A | -0.42 | 37.86 | 37.85 | 0.95 | -12.51 | 44.75 | 42.96 | 0.87 |
| NUK_U* | 4.49 | 69.84 | 69.7 | 0.83 | 24.91 | 103.14 | 100.09 | 0.57 |
| NUK_N | -2.94 | 30.61 | 30.47 | 0.97 | 3.86 | 46.56 | 46.4 | 0.87 |
| KAN_L | -13.73 | 36.25 | 33.54 | 0.96 | -7.33 | 46.8 | 46.22 | 0.84 |
| KAN_M | -10.17 | 30.79 | 29.06 | 0.97 | -6.05 | 41.05 | 40.6 | 0.88 |
| KAN_U | -19.69 | 35.75 | 29.84 | 0.98 | -22.08 | 43.75 | 37.77 | 0.88 |
| UPE_U | -9.59 | 30.62 | 29.08 | 0.97 | -11.84 | 46.17 | 44.63 | 0.89 |
| THU_L | -1.85 | 30.31 | 30.25 | 0.97 | 10.01 | 48.11 | 47.05 | 0.88 |
| THU_U | -2.23 | 25.75 | 25.65 | 0.98 | 2.5 | 39.2 | 39.12 | 0.91 |
| NUK_L* | 10.43 | 53.20 | 52.17 | 0.90 | 15.74 | 63.29 | 61.3 | 0.79 |
| QAS_L | 2.38 | 36.88 | 36.81 | 0.95 | 17.82 | 57.99 | 55.19 | 0.83 |
| QAS_M | -2.89 | 23.43 | 23.26 | 0.95 | 20.51 | 48.35 | 43.79 | 0.75 |
| TAS_L | -5.14 | 40.02 | 39.69 | 0.95 | 0.01 | 51.1 | 51.1 | 0.84 |
| TAS_U* | 5.60 | 72.09 | 71.87 | 0.82 | 26.45 | 113.52 | 110.4 | 0.4 |
| UPE_L | -4.67 | 35.18 | 34.87 | 0.96 | 3.25 | 51.27 | 51.17 | 0.85 |
| All AWS | -2.54 | 40.31 | 39.06 | 0.94 | 3.57 | 56.11 | 54.10 | 0.82 |
| 16 selected AWS | -7.18 | 32.52 | 31.15 | 0.97 | -2.98 | 45.74 | 44.18 | 0.88 |

* Dissmissed in the study. see Table S2

**Table S29.** Same as Table S28 but for MAR$_{EI}$.

| SWD (Wm$^{-2}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| ASR | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | 8.37 | 30.92 | 29.76 | 0.98 | 28.34 | 54.93 | 47.06 | 0.89 |
| KPC_U | 0.41 | 19.33 | 19.33 | 0.99 | 8.21 | 32.14 | 31.07 | 0.95 |
| SCO_L* | 24.16 | 43.28 | 35.91 | 0.97 | 56.49 | 73.35 | 46.78 | 0.85 |
| SCO_U | 15.56 | 35.48 | 31.89 | 0.98 | 43.26 | 62.62 | 45.28 | 0.86 |
| TAS_A | 9.96 | 33.74 | 32.24 | 0.97 | 23.58 | 46.25 | 39.78 | 0.88 |
| QAS_U* | 36.63 | 89.50 | 81.66 | 0.79 | 50.99 | 109.18 | 96.54 | 0.53 |
| QAS_A | 11.76 | 39.54 | 37.74 | 0.95 | 16.83 | 42.76 | 39.31 | 0.89 |
| NUK_U* | 24.27 | 78.2 | 74.34 | 0.83 | 63.55 | 120.6 | 102.50 | 0.53 |
| NUK_N | 6.50 | 27.55 | 26.77 | 0.98 | 15.43 | 43.24 | 40.40 | 0.90 |
| KAN_L | -1.50 | 30.34 | 30.3 | 0.97 | 10.13 | 44.03 | 42.85 | 0.87 |
| KAN_M | 4.28 | 24.96 | 24.59 | 0.98 | 15.93 | 41.34 | 38.14 | 0.90 |
| KAN_U | -3.64 | 22.6 | 22.3 | 0.99 | -0.93 | 31.9 | 31.88 | 0.91 |
| UPE_U | 5.71 | 25.17 | 24.51 | 0.98 | 21.35 | 44.95 | 39.55 | 0.91 |
| THU_L | 4.69 | 29.34 | 28.96 | 0.97 | 24.34 | 49.87 | 43.53 | 0.90 |
| THU_U | 6.86 | 26.03 | 25.1 | 0.98 | 20.95 | 42.89 | 37.43 | 0.92 |
| NUK_L* | 21.71 | 57.4 | 53.14 | 0.90 | 33.61 | 69.51 | 60.84 | 0.79 |
| QAS_L | 15.18 | 39.10 | 36.03 | 0.96 | 41.65 | 64.87 | 49.73 | 0.86 |
| QAS_M | 2.93 | 27.06 | 26.9 | 0.94 | 37.02 | 54.72 | 40.30 | 0.79 |
| TAS_L | 17.35 | 48.29 | 45.06 | 0.94 | 41.8 | 72.35 | 59.05 | 0.78 |
| TAS_U* | 25.96 | 77.9 | 73.45 | 0.83 | 65.27 | 124.15 | 105.61 | 0.42 |
| UPE_L | 10.75 | 36.1 | 34.47 | 0.97 | 34.36 | 58.46 | 47.29 | 0.87 |
| All AWS | 12.28 | 40.84 | 38.39 | 0.94 | 31.10 | 61.83 | 52.27 | 0.82 |
| 16 selected AWS | 6.80 | 30.31 | 29.09 | 0.97 | 22.87 | 48.69 | 41.88 | 0.89 |

* Dissmissed in the study. see Table S2

**Table S30.** Same as Table S28 but for ASR.

| SWD (Wm$^{-2}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| E5 | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | 4.03 | 25.39 | 25.07 | 0.98 | 15.16 | 44.11 | 41.42 | 0.92 |
| KPC_U | -4.15 | 17.90 | 17.41 | 0.99 | -4.28 | 28.25 | 27.92 | 0.96 |
| SCO_L* | 22.78 | 39.57 | 32.36 | 0.98 | 53.75 | 67.80 | 41.33 | 0.89 |
| SCO_U | 13.47 | 30.98 | 27.90 | 0.98 | 38.52 | 55.30 | 39.67 | 0.90 |
| TAS_A | -3.09 | 30.28 | 30.12 | 0.97 | -9.24 | 34.19 | 32.92 | 0.92 |
| QAS_U* | 28.26 | 83.84 | 78.93 | 0.79 | 28.35 | 100.19 | 96.10 | 0.54 |
| QAS_A | 4.22 | 35.82 | 35.57 | 0.95 | -13.05 | 34.85 | 32.31 | 0.93 |
| NUK_U* | 18.15 | 71.43 | 69.09 | 0.84 | 47.39 | 109.16 | 98.34 | 0.57 |
| NUK_N | -9.54 | 26.48 | 24.70 | 0.98 | -25.9 | 43.44 | 34.87 | 0.93 |
| KAN_L | -21.61 | 38.5 | 31.86 | 0.97 | -39.79 | 57.22 | 41.12 | 0.88 |
| KAN_M | 0.78 | 22.16 | 22.15 | 0.98 | 9.27 | 34.33 | 33.05 | 0.93 |
| KAN_U | -9.86 | 22.72 | 20.47 | 0.99 | -12.7 | 30.38 | 27.6 | 0.93 |
| UPE_U | -0.88 | 22.27 | 22.25 | 0.99 | -1.95 | 38.40 | 38.35 | 0.92 |
| THU_L | -10.6 | 27.03 | 24.86 | 0.98 | -18.60 | 41.60 | 37.21 | 0.93 |
| THU_U | -9.48 | 27.1 | 25.39 | 0.98 | -22.48 | 43.87 | 37.68 | 0.92 |
| NUK_L* | 18.84 | 51.92 | 48.39 | 0.91 | 26.26 | 59.94 | 53.88 | 0.83 |
| QAS_L | 1.13 | 27.4 | 27.38 | 0.97 | -1.63 | 43.45 | 43.42 | 0.90 |
| QAS_M | 1.40 | 17.49 | 17.43 | 0.97 | 17.95 | 33.88 | 28.74 | 0.91 |
| TAS_L | 4.53 | 34.33 | 34.03 | 0.96 | 14.07 | 45.02 | 42.76 | 0.89 |
| TAS_U* | 13.96 | 70.44 | 69.04 | 0.83 | 37.04 | 109.9 | 103.47 | 0.46 |
| UPE_L | 2.04 | 27.48 | 27.40 | 0.97 | 4.65 | 43.02 | 42.76 | 0.89 |
| All AWS | 3.56 | 36.86 | 34.73 | 0.95 | 7.83 | 54.01 | 47.71 | 0.85 |
| 16 selected AWS | -2.98 | 26.98 | 25.59 | 0.98 | -3.68 | 41.53 | 37.1 | 0.91 |

* Dissmissed in the study. see Table S2

**Table S31.** Same as Table S28 but for ERA5.

| SWD (Wm$^{-2}$) | Annually | | | | Summer | | | |
|---|---|---|---|---|---|---|---|---|
| EI | MB | RMSE | RMSEc | r | MB | RMSE | RMSEc | r |
| KPC_L | -0.99 | 23.26 | 23.24 | 0.99 | 7.26 | 35.22 | 34.46 | 0.94 |
| KPC_U | -8.39 | 23.20 | 21.63 | 0.99 | -10.4 | 33.82 | 32.18 | 0.95 |
| SCO_L* | 17.19 | 34.37 | 29.76 | 0.98 | 45.01 | 58.52 | 37.40 | 0.91 |
| SCO_U | 7.80 | 27.91 | 26.79 | 0.98 | 30.74 | 47.71 | 36.48 | 0.92 |
| TAS_A | -3.70 | 30.47 | 30.25 | 0.97 | 1.38 | 31.82 | 31.79 | 0.93 |
| QAS_U* | 19.14 | 81.29 | 79.00 | 0.79 | 20.33 | 98.24 | 96.11 | 0.55 |
| QAS_A | -4.75 | 37.01 | 36.70 | 0.95 | -16.85 | 41.48 | 37.91 | 0.91 |
| NUK_U* | 3.76 | 69.27 | 69.16 | 0.83 | 18.31 | 103.97 | 102.35 | 0.54 |
| NUK_N | -4.75 | 25.79 | 25.35 | 0.98 | -2.45 | 39.31 | 39.24 | 0.91 |
| KAN_L | -12.55 | 30.8 | 28.12 | 0.97 | -9.16 | 40.07 | 39.01 | 0.90 |
| KAN_M | -6.16 | 27.39 | 26.69 | 0.98 | 2.19 | 38.14 | 38.08 | 0.9 |
| KAN_U | -12.45 | 28.6 | 25.75 | 0.98 | -9.23 | 37.08 | 35.91 | 0.91 |
| UPE_U | -9.92 | 26.67 | 24.75 | 0.98 | -14.68 | 38.95 | 36.08 | 0.93 |
| THU_L | -16.33 | 33.07 | 28.75 | 0.97 | -28.52 | 50.01 | 41.08 | 0.91 |
| THU_U | -16.14 | 34.54 | 30.53 | 0.97 | -35.56 | 55.51 | 42.63 | 0.9 0 |
| NUK_L* | 10.19 | 51.54 | 50.52 | 0.9 | 10.24 | 59.55 | 58.66 | 0.80 |
| QAS_L | 6.93 | 33.48 | 32.75 | 0.96 | 29.16 | 52.8 | 44.02 | 0.90 |
| QAS_M | -4.24 | 21.82 | 21.4 | 0.96 | 24.1 | 40.03 | 31.96 | 0.90 |
| TAS_L | 5.72 | 36.83 | 36.38 | 0.96 | 26.23 | 51.41 | 44.22 | 0.88 |
| TAS_U* | 13.70 | 73.72 | 72.43 | 0.83 | 47.06 | 116.75 | 106.84 | 0.46 |
| UPE_L | -4.44 | 28.05 | 27.69 | 0.97 | -1.41 | 39.63 | 39.61 | 0.92 |
| All AWS | -0.41 | 38.02 | 36.36 | 0.95 | 6.50 | 53.91 | 48.91 | 0.85 |
| 16 selected AWS | -5.55 | 29.21 | 27.67 | 0.98 | -1.40 | 42.34 | 38.22 | 0.91 |

* Dissmissed in the study. see Table S2

**Table S32.** Same as Table S28 but for ERA-Interim.