

APPENDIX A - [SUPPLEMENTARY FIGURES AND TABLES]

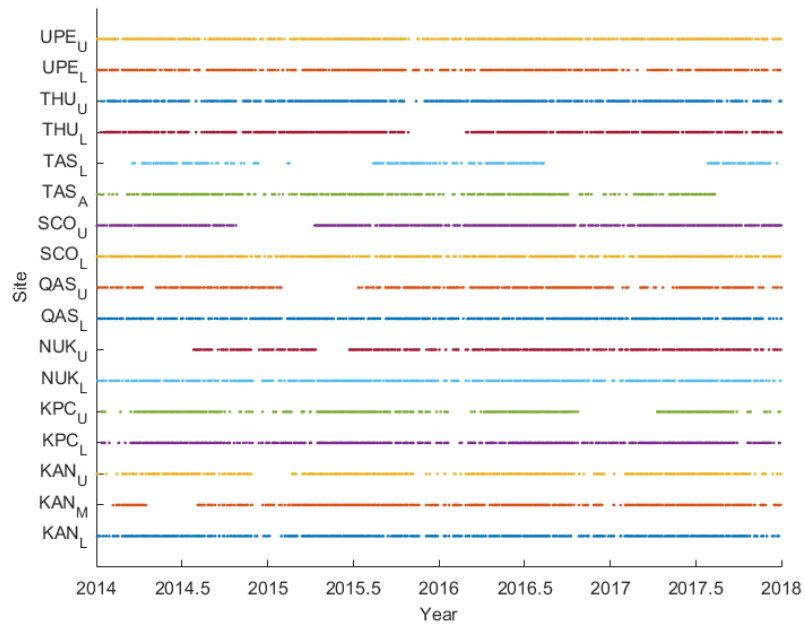


Fig. 8: Instances when both PROMICE skin temperature and MODIS LST were available for comparison at each of the 17 AWS sites over the 4 years of analysis (2014-2017).

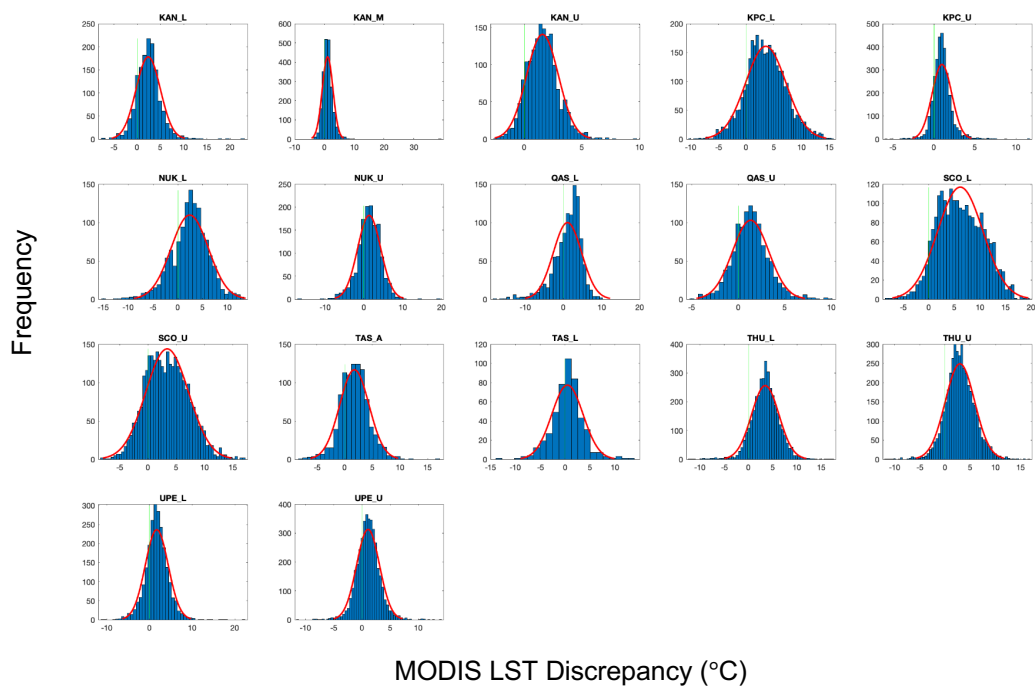


Fig. 9. Histogram of temperature bias by AWS site during the Below Freezing period. Zero is indicated by a green horizontal line.

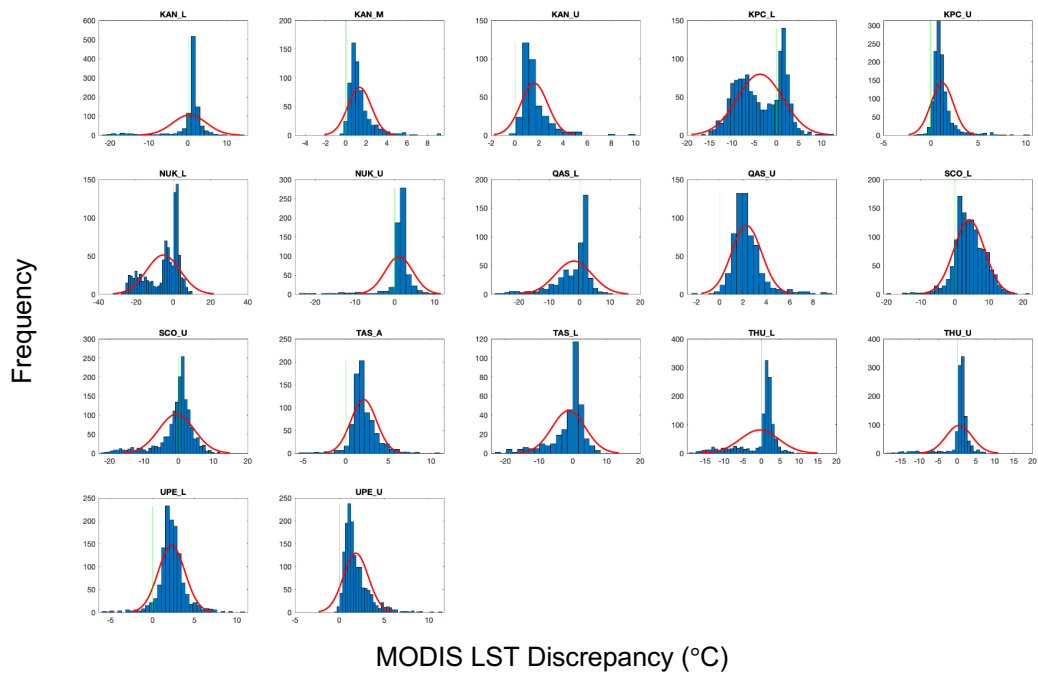


Fig. 10. Histogram of the magnitudes of MODIS difference calculated as PROMICE unclipped Above Freezing period temperature minus MODIS LST at all 17 sites for years 2014-2017. Zero is indicated by a green horizontal line.

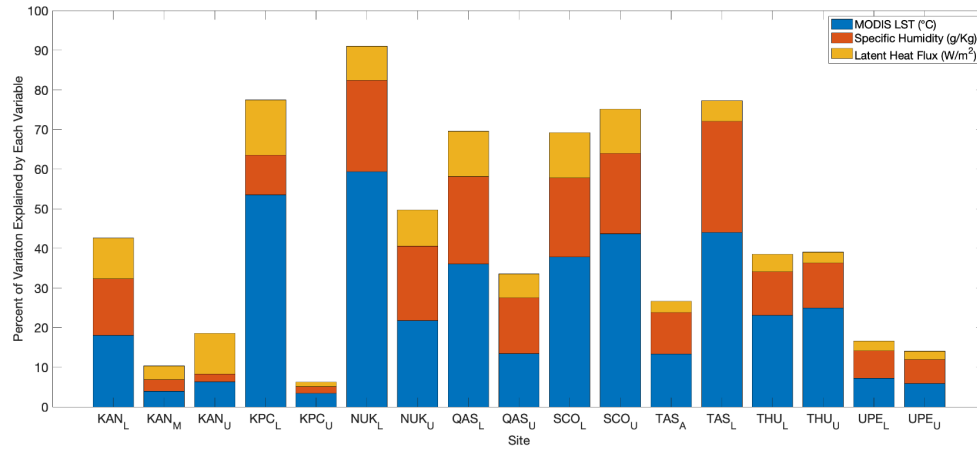


Fig. 11. Percentage of variance in the MODIS/PROMICE difference explained by temperature, specific humidity, and latent heat, in our ANOVA test for all 17 sites for all the data. The temperature measurement used is MODIS LST.

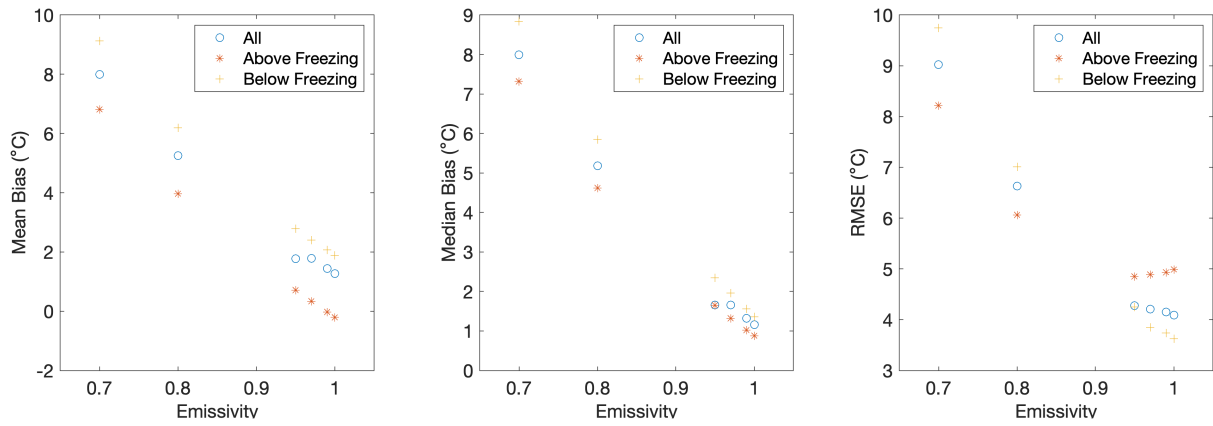


Fig. 12. The mean, median, and RMSE of the MODIS LST bias (where positive values indicate a cold bias) when compared to PROMICE skin temperatures calculated using surface emissivities of 0.7, 0.8, 0.95, 0.97, 0.99, and 1.

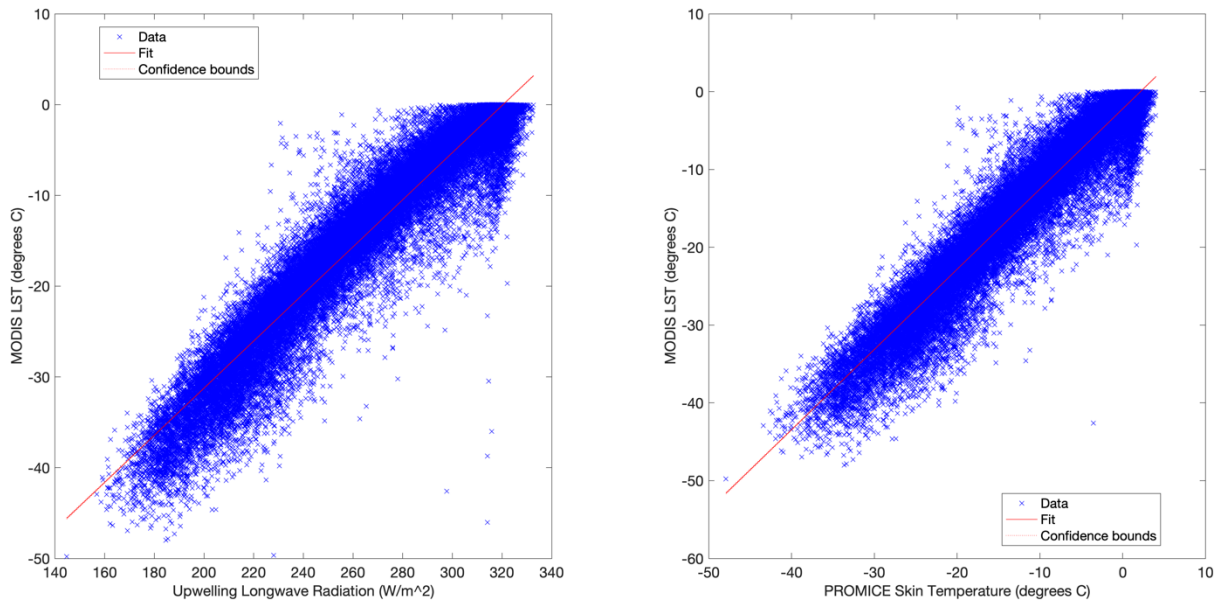


Fig 13. Comparison of MODIS LST to Upwelling Longwave Radiation (left) and PROMICE Skin Temperature (right) at 17 sites for the years 2014-2017. MODIS LST $> 0^{\circ}\text{C}$ have been set to 0°C (clipped). A linear fit has an R^2 value of 0.93 for the MODIS LST and PROMICE skin temperature comparison, and an R^2 value of 0.92 for the MODIS LST and longwave radiation comparison. The spread of the data in both 1:1 plots indicates that there is not more error introduced in the conversion to skin temperature, but the variability is inherent in the longwave radiation measurements themselves.

Table 4. Multiple linear regression and ANOVA analysis showing the minimum, maximum, and average (of the 17 sites) percentage of variance in the MODIS/PROMICE difference during the below freezing period explained by each explanatory variable (temperature, specific humidity, and latent heat) and the total multiple linear regression model.

MODIS LST			Specific Humidity			Latent Heat			Total		
Max %	Min %	Ave %	Max %	Min %	Ave %	Max %	Min %	Ave %	Max %	Min %	Ave %
48.26	4.09	25.24	25.25	1.17	13.34	16.41	1.63	6.78	70.92	7.74	44.59

Table 5. Mean bias, standard error, median bias, root mean square error, and standard deviation of the MODIS LST data for the Above Freezing period, the Below Freezing period, and the entire year calculated with PROMICE Emissivity set to 1.00, 0.99, 0.97, 0.95, 0.80, and 0.70. The number of observations for each case is also reported.

Time Period	PROMICE Emissivity	Mean Bias (°C)	Standard Error of the Mean (°C)	Median Bias (°C)	Standard Deviation (°C)	RMSE (°C)	Number of Observations
Above Freezing		-0.211	0.00	0.88	4.98	4.99	14388
All	1	1.27	0.01	1.16	3.88	4.09	53070
Below Freezing		1.89	0.01	1.36	3.10	3.63	38682
Above Freezing		-0.029	0.00	1.02	4.93	5	15014
All	0.99	1.44	0.01	1.32	3.89	4	53070
Below Freezing		2.07	0.01	1.56	3.11	4	38056
Above Freezing		0.336	0.00	1.32	4.85	5	16045
All	0.97	1.78	0.01	1.66	3.90	4	53070
Below Freezing		2.40	0.01	1.96	3.21	4	37025
Above Freezing		0.711	0.01	1.65	4.80	5	16918
All	0.95	1.776	0.01	1.66	3.90	4	53070
Below Freezing		2.789	0.01	2.35	3.21	4	36152
Above Freezing		3.968	0.03	4.62	4.58	6	22400
All	0.8	5.25	0.02	5.18	4.04	7	53070
Below Freezing		6.19	0.04	5.85	3.28	7	30670
Above Freezing		6.819	0.04	7.32	4.58	8	26208
All	0.7	7.99	0.03	7.99	4.19	9	53070
Below Freezing		9.13	0.06	8.84	3.40	10	26862

Table 6. Sensitivity study of the effect of distance cutoff on the resulting difference between MODIS LST and PROMICE skin temperature showing the effect of the distance cutoff at 10km, 5 km, 2.5km, and 1km. All data reported are not clipped (i.e. temperatures calculated above 0°C are left as is). Note that this shows data from 2014, 2016, and 2017.

Period	Distance Cutoff (km)	Mean Bias (°C)	Standard		Standard Deviation (°C)	RMSE (°C)	Number of Observations
			Deviation of the Mean (°C)	Median Bias (°C)			
All	10	1.74	0.0091	1.65	3.92	4.29	36850
	5	1.69	0.0096	1.59	3.94	4.29	31189
	2.5	1.57	0.0122	1.49	4.01	4.31	16572
	1	1.55	0.0290	1.53	4.29	4.56	2849
Below Freezing	10	2.38	0.0150	1.95	3.18	3.97	25291
	5	2.36	0.0160	1.90	3.15	3.93	21808
	2.5	2.29	0.0212	1.81	3.11	3.87	11728
	1	2.40	0.0542	1.91	3.26	4.05	1966
Above Freezing	10	0.33	0.0031	1.32	4.91	4.92	11559
	5	0.14	0.0015	1.24	5.02	5.02	9381
	2.5	-0.18	-0.0026	1.13	5.22	5.23	4844
	1	-0.36	-0.0121	1.12	5.52	5.52	883

Table 7. Maximum tilt of the AWS for each PROMICE site in each calendar year. The values reported in the table are all expressed in degrees and are absolute values of the reported angle. The tilt can represent a tilt in the north/south direction or the east/west direction.

Site	Maximum Tilt Angle (°)			
	2014	2015	2016	2017
KAN_L'	15.2	14.3	15.3	14.1
KAN_M'	10.6	8.4	7.9	7.5
KAN_U'	4.7	4.8	5.8	9.3
KPC_L'	8.8	8.1	6.6	3.7
KPC_U'	5.1	2.8	5.0	5.2
NUK_L'	10.4	9.6	15.4	13.8
NUK_U'	25.1	23.5	25.0	25.0
QAS_L'	7.3	4.1	7.4	8.7
QAS_U'	10.4	26.4	25.8	26.0
SCO_L'	10.7	8.5	9.5	11.4
SCO_U'	4.0	10.1	10.3	8.7
TAS_A'	13.7	14.5	15.1	26.2
TAS_L'	13.9	19.9	16.3	26.3
THU_L'	10.5	12.0	11.3	11.3
THU_U'	4.6	9.4	12.8	12.5
UPE_L'	10.3	7.2	7.8	18.8
UPE_U'	5.7	6.2	6.7	4.8