

Supplementary material for:

Effects of meteorology and soil moisture on the spatio-temporal evolution of the depth hoar layer in the polar desert snowpack

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Table S1. Detailed information on snowpits dug in 2019 at Ward Hunt Island and Resolute Bay

Site	Snowpit	Date	Substrate
WHI_1	#1	2019-06-04	dry; gravels; no vegetation
WHI_1	#2	2019-06-10	humid; organic crust; vegetation
WHI_1	#3	2019-06-11	humid; organic crust; vegetation
WHI_1	#4	2019-06-11	dry; gravels; no vegetation
WHI_1	#5	2019-06-04	dry; gravels; no vegetation
WHI_1	#6	2019-06-10	dry; gravels; no vegetation
WHI_1	#7	2019-06-10	humid; organic crust; vegetation
WHI_1	#8	2019-06-11	humid; organic crust; vegetation
WHI_2	#1	2019-06-05	dry; gravels; sparse vegetation
WHI_3	#1	2019-06-05	dry; gravels; sparse vegetation
WHI_3	#2	2019-06-05	dry; gravels; sparse vegetation
WHI_4	#1	2019-06-08	dry; gravels; sparse vegetation
WHI_4	#2	2019-06-08	dry; gravels; sparse vegetation
WHI_5	#1	2019-06-07	humid; organic crust; vegetation
WHI_6	#1	2019-06-08	humid; organic crust; vegetation
WHI_7	#1	2019-06-09	dry; gravels; no vegetation
WHI_8	#1	2019-06-12	dry; gravels; no vegetation
WHI_9	#1	2019-06-12	humid; organic crust; vegetation
RB_1	#1	2019-05-28	dry; gravel; no vegetation
RB_1	#2	2019-05-28	dry; gravel; no vegetation
RB_2	#1	2019-05-28	humid; thin moss layer
RB_3	#1	2019-05-31	dry; gravel and fine mix; no vegetation
RB_4	#1	2019-05-28	dry; gravel; sparse vegetation
RB_5	#1	2019-05-28	humid; thin moss layer
RB_6	#1	2019-05-31	humid; grass and moss
RB_6	#2	2019-05-31	humid; grass and moss
RB_7	#1	2019-05-29	dry; gravel; no vegetation
RB_8	#1	2019-05-29	humid; grass and moss
RB_8	#2	2019-05-29	humid; grass and moss
RB_8	#3	2019-05-29	humid; grass and moss
RB_8	#4	2019-05-29	humid; grass and moss
RB_9	#1	2019-05-30	dry; gravel; sparse vegetation
RB_9	#2	2019-05-30	dry; gravel; sparse vegetation
RB_10	#1	2019-05-30	dry; gravel; sparse vegetation

Table S2. Summary table of the end-of-winter snow heights (SH, cm) measured in early June 2019 and of thermal conditions in the early snow season (30 days after the snow onset) between dry and humid monitoring sites at Ward Hunt Island. The thermal conditions include the duration of zero-curtain period (ZC period), the thermal offset between the air and the soil near-surface temperatures, and the calculated temperature gradient into the snowpack.

	Sensor ID	SH (cm)	ZC period (d)	Offset (°C)	Grad T (K m ⁻¹)
Humid sites	LT2	25.0	27.0	6.5	21.1
	LT4	22.0	29.0	6.4	20.6
	LT5	31.0	32.0	6.6	21.4
	Site 5 ¹	46.0	20.5	6.7	22.4
	AVG	31.0	27.1	6.6	21.4
	STD	10.7	4.9	0.1	0.7
Dry sites	LT1	35.0	9.0	3.2	7.7
	LT3	20.0	3.0	2.5	6.8
	LT6	17.0	11.0	2.1	1.1
	LT7	18.0	8.0	1.1	10.4
	SILA	35.0	8.0	2.1	6.8
	AVG	25.0	7.8	2.2	6.6
STD	9.2	2.9	0.8	3.4	

¹ for the WT site, the average between the water track and inter-track was used.

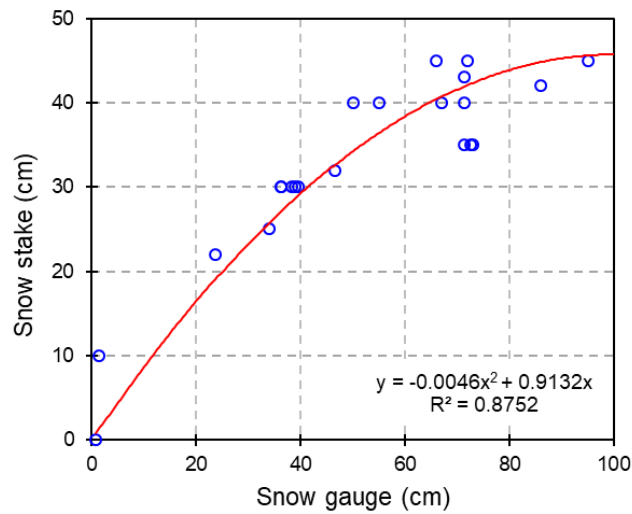


Fig. S1. Comparison between the snow height measurements recorded by the snow gauge SR50 at the SILA station and the daily snow height read on the snow stake installed in the field of view of the automatic camera (see Fig. 3). The equation was used to correct the snow gauge measurements which overestimated the snow height due to its position in a slight depression making it unrepresentative of typical snow height in the polar desert.

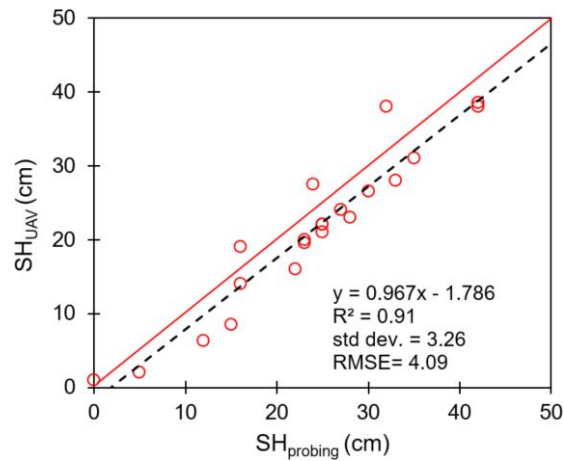


Fig. S2. Scatter plot of the snow heights derived by UAV surveys (SH_{UAV}) versus the manual measurements ($SH_{probing}$) made over Site 1. The dashed black line is the linear regression line and the red line is the 1:1 line. Std dev. = Standard deviation; RMSE=Root mean square error.

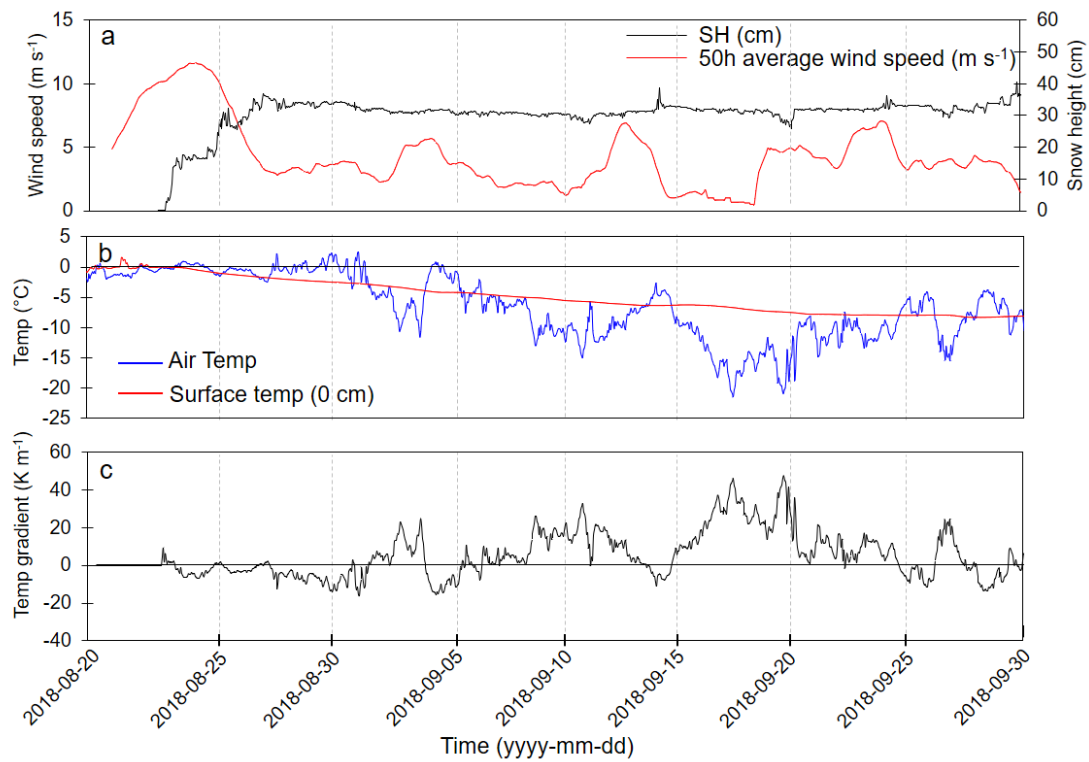


Fig. S3. Environmental variables monitored at the SILA station at Ward Hunt Island during the cold season 2018/19 between August 20 and September 30. a) Snow height measurements by the snow gauge and normalized with the readings of the snow stakes visible on the time-lapse photos and hourly maximum wind speed averaged over 50 h; b) Hourly temperature records at the soil surface (0 cm) and of the air; c) Hourly temperature gradient calculated from Eqn (1).

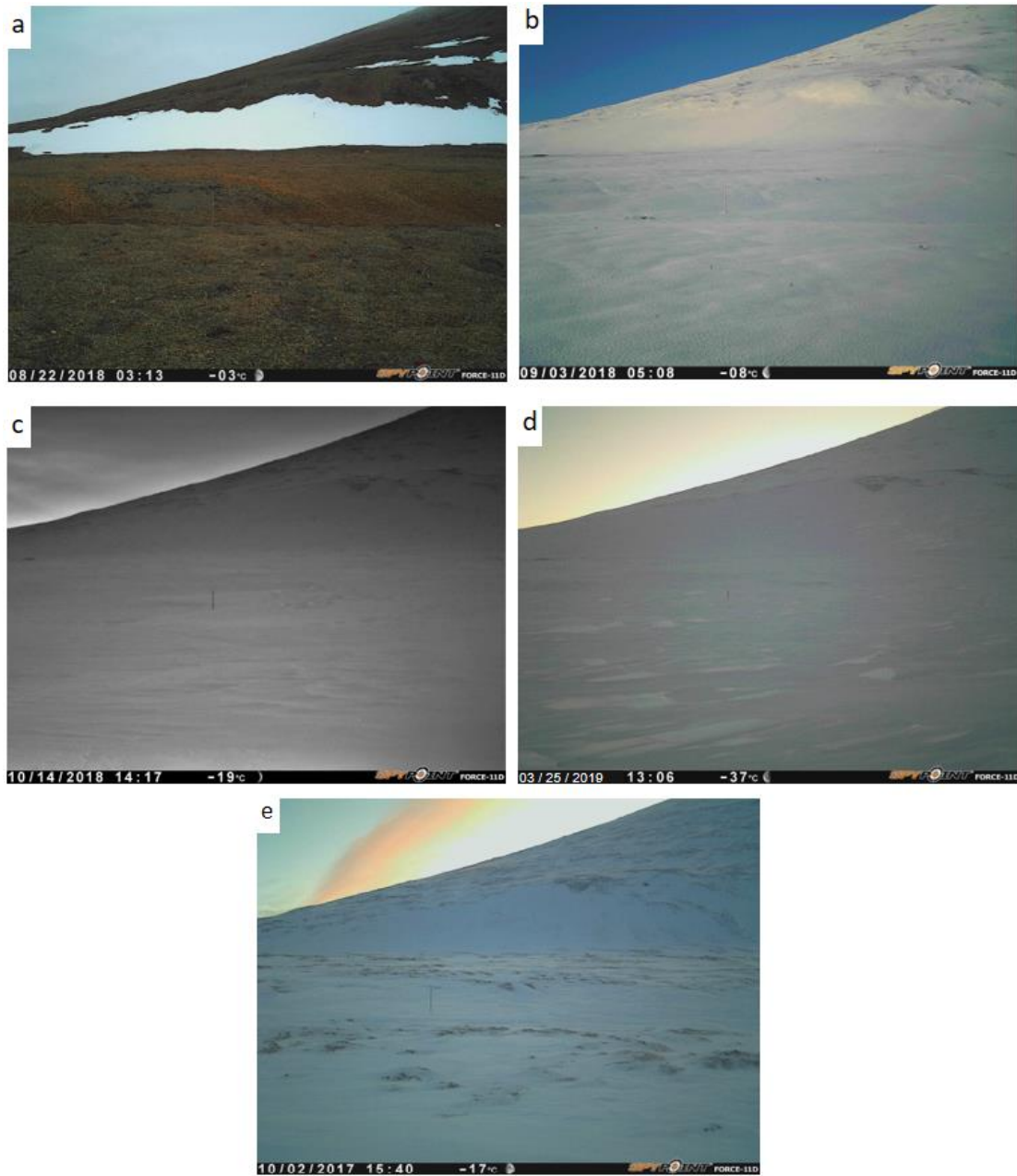


Fig. S4. Photograph of the ice patch IP1 and its downslope margin (Site 1) at Ward Hunt Island taken on 22 August (a), the day before the first snowstorms, on 3 September (b) showing the continuous snow cover, on 14 October (c), on 25 March 2019 (d) and on 2 October 2017 (e).

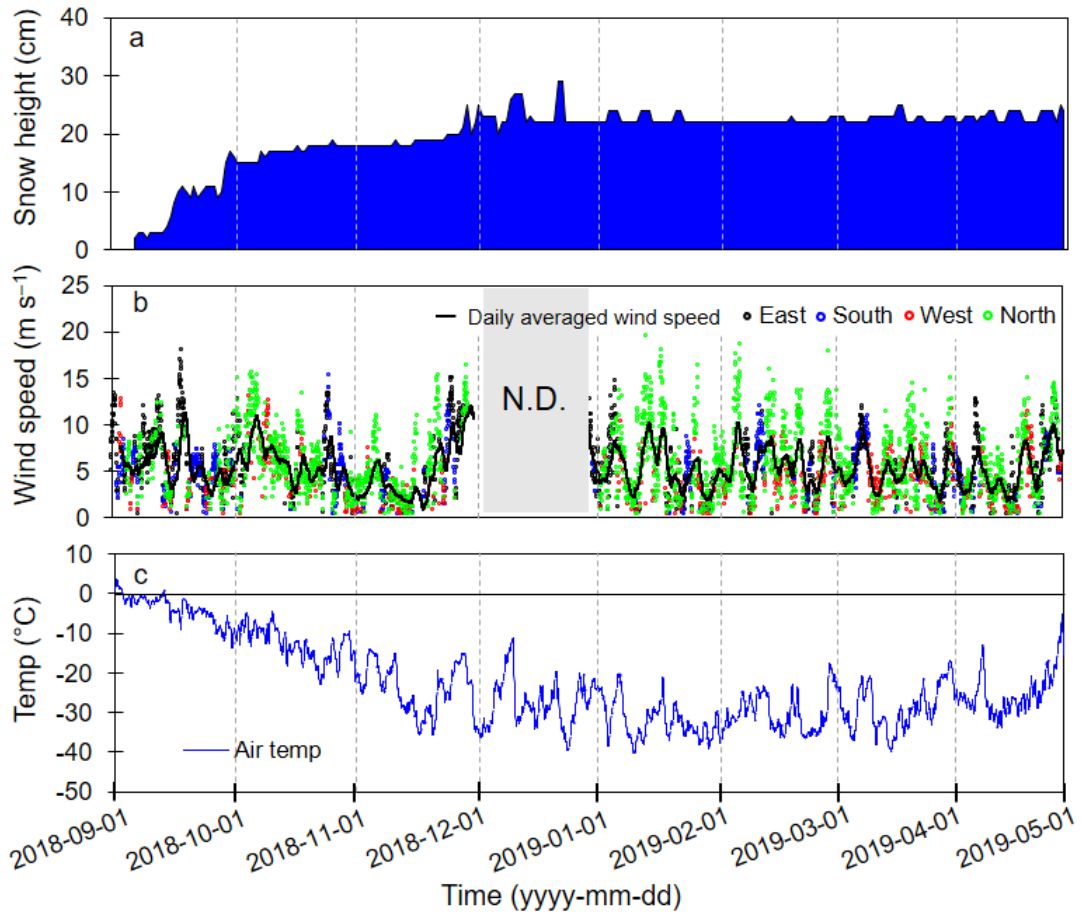


Fig. S5. Environmental monitoring at Resolute Bay during the cold season 2018/19. a) Snow height measured at the snow gauge; b) Hourly maximum wind speed according to their direction (North/East/South/West); c) Hourly air temperature (Environment Canada, 2020).

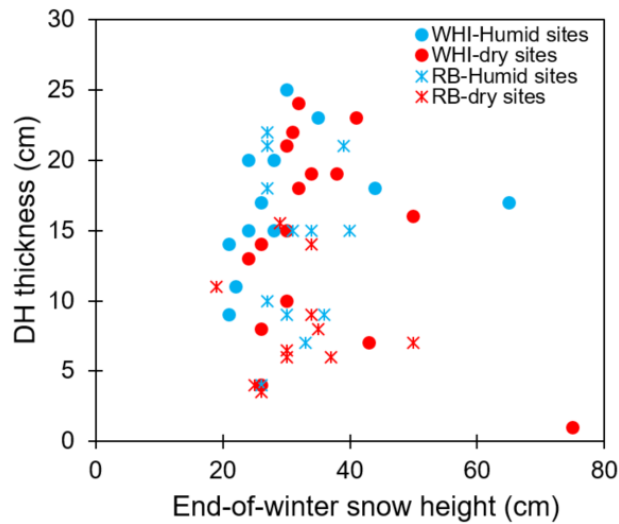


Fig. S6. Relationship between the end-of-winter snow height and the depth hoar thickness measured at snowpits dug at Ward Hunt Island and Resolute Bay.

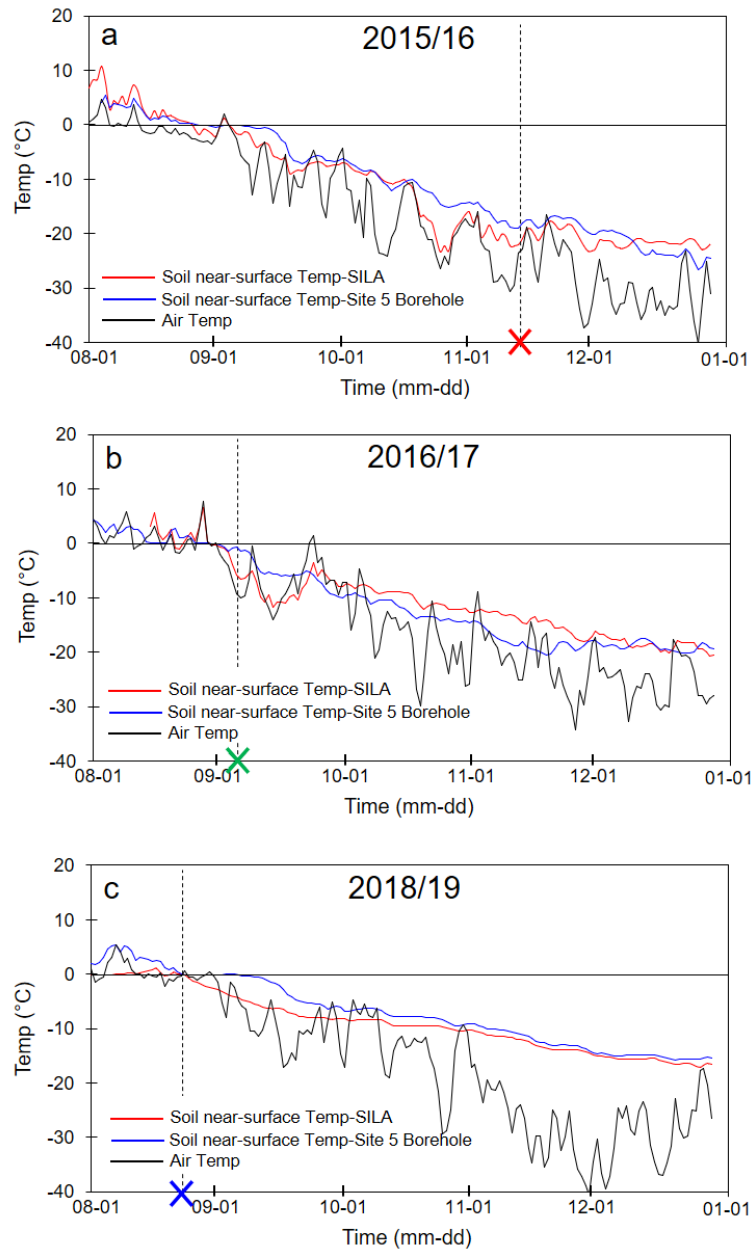


Fig S7. Hourly evolution of the near-surface soil temperature at SILA and at Site 5 along with the air temperature also recorded at SILA for the first half of the snow season 2015/16 (a), 2016/17 (b) and 2018/19 (c). The crosses marked the snow onset date for each year.

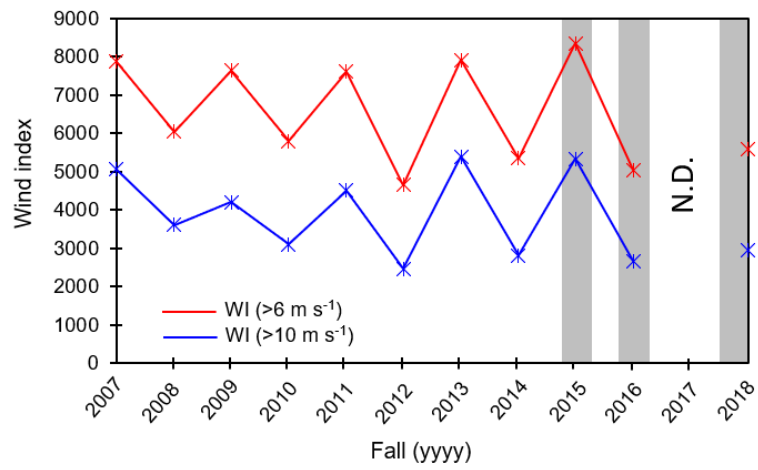


Fig. S8. Early snow season (Sept/Oct/Nov) wind indices for wind speed over 6 and 10 m s⁻¹ (i.e. sum of hourly wind speed values >6 m s⁻¹ and >10 m s⁻¹) calculated from fall 2007 to fall 2018. The shaded bars indicate falls 2015, 2016 and 2018 detailed in our study. No data in 2017.