

Supplementary material

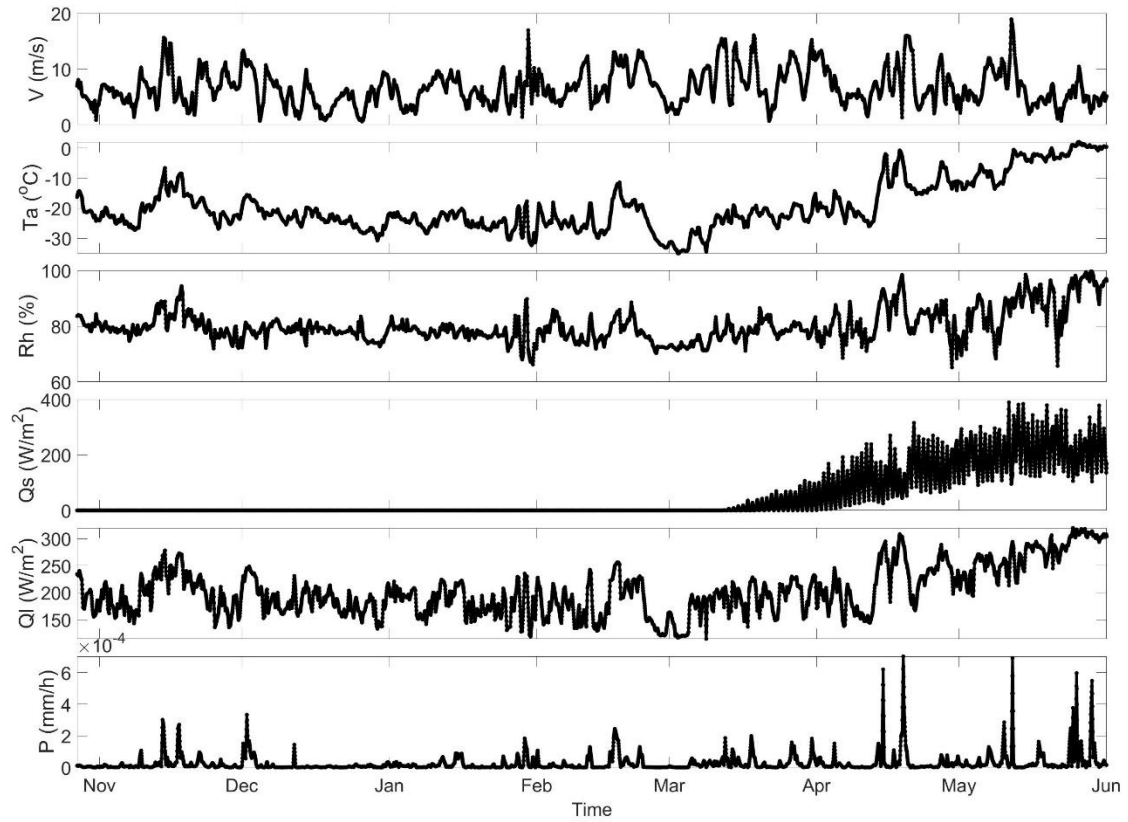


Figure S1: Time series of wind speed (V_a), air temperature (T_a), relative humidity (R_h), precipitation (P), as well as shortwave (Q_s) and longwave (Q_l) radiative fluxes from ERA5 reanalysis products. These data are used as weather forcing for HIGHTSI.

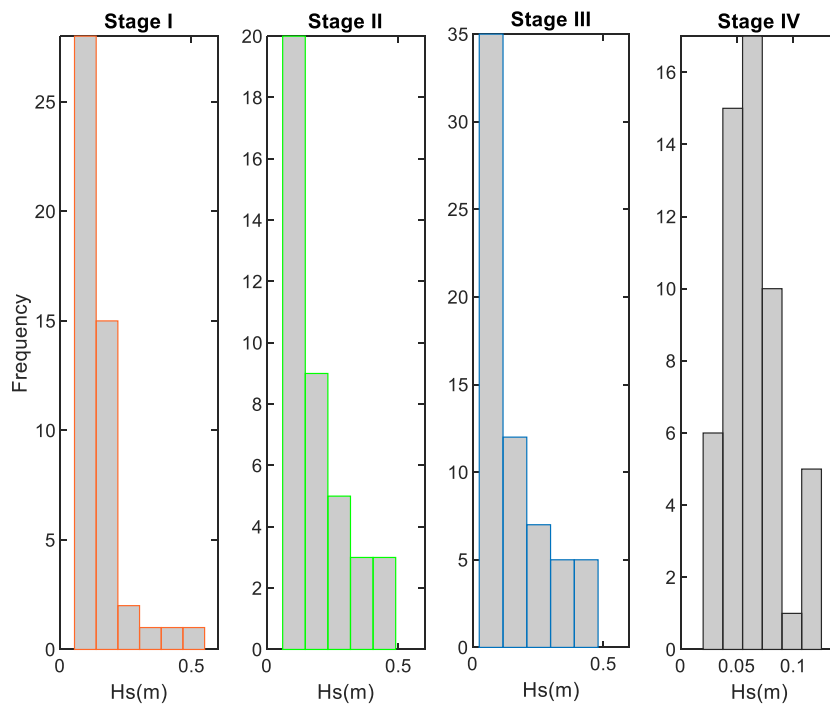


Figure S2: Frequency distribution of snow depth samples observed during each stage. In each stage, the number of samples are 49, 40, 64 and 56, respectively.

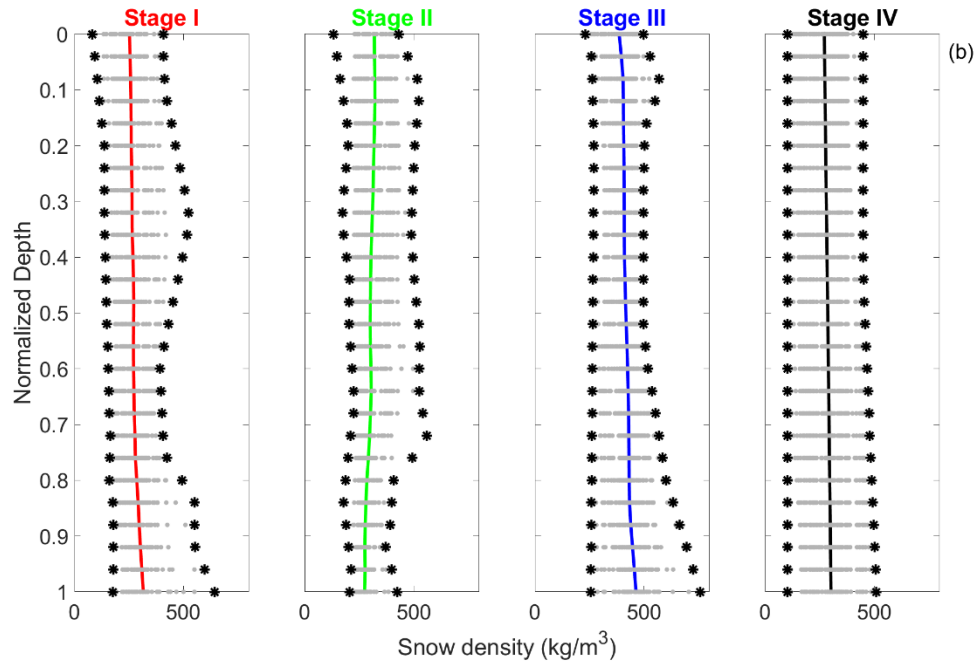


Figure S3: The spatial standard deviation of snow density across the sample sites (represented by horizontal bars) is shown at normalized interpolated vertical levels. The vertical lines represent the normalized mean snow density.

Table S1: Snow and ice physical parameters used for HIGHTSI model experiments.

Parameter	Value	Source
V_a, T_a, R_h	Time series	ERA5
$Q_s, Q_l, Prec$	Time series	ERA5
Oceanic heat flux (F_w)	2 W m ⁻²	(Lei et al., 2022)
Freezing point (T_f)	-1.8 °C	Literature
Sea ice density (ρ_i)	910 kg m ⁻³	Literature
Snow density* (ρ_o)	320 kg m ⁻³	(Wagner et al., 2022)
Snow density (ρ_s)	Difference density schemes and observation time series	
Sea ice salinity (s_i)	MOSAIC observation	(Angelopoulos et al 2022)
Heat capacity of ice (c_i)	2093 J kg ⁻¹ K ⁻¹	Literature
Latent heat of freezing (L_i)	0.33×10^6 J kg ⁻¹	Literature
Initial ice temperature	Linear interpolation between T_a and T_b	

*This snow density is used to convert SWE to snow accumulation.

References

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