

The stable water isotopes and snow accumulation from Weddell Sea sector imprint the large-scale atmospheric circulation variability

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40 left graph. On the right: Relative hourly frequency of 850 hPa wind direction and speed derived from ERA5 datasets for both HSD (top right graph) and all days (bottom right graph). The adopted threshold for blowing snow and snowdrift is shown in the wind speed graph (thin grey line).

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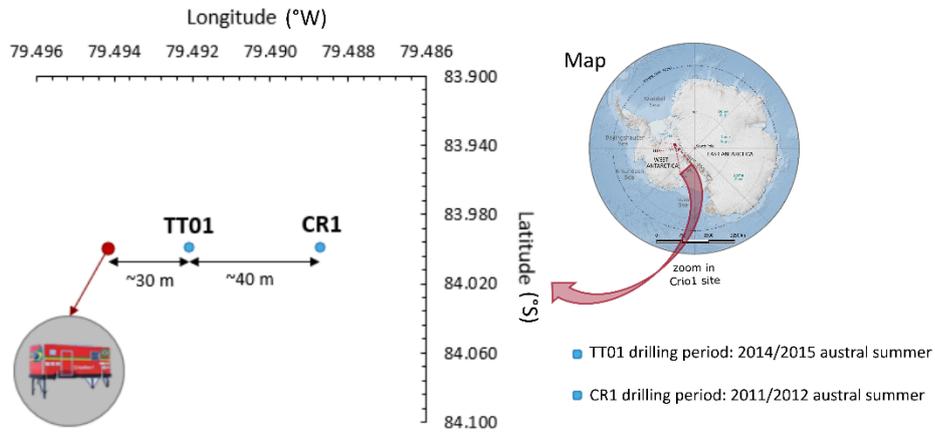


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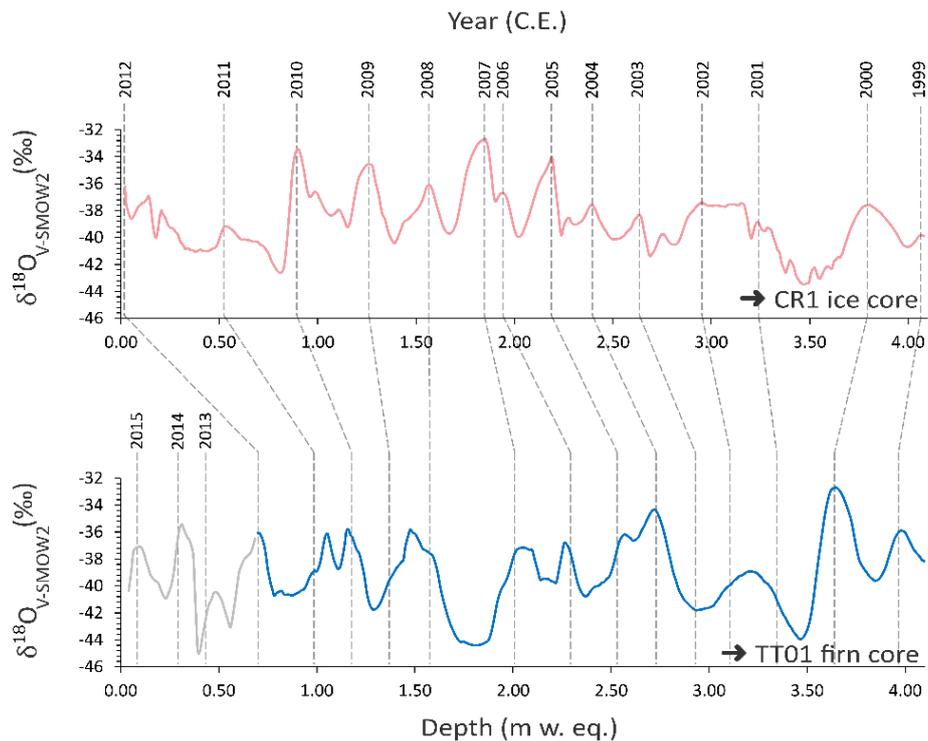


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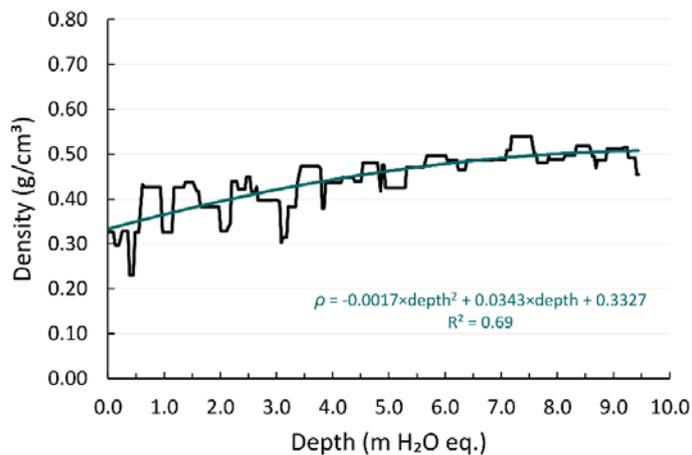


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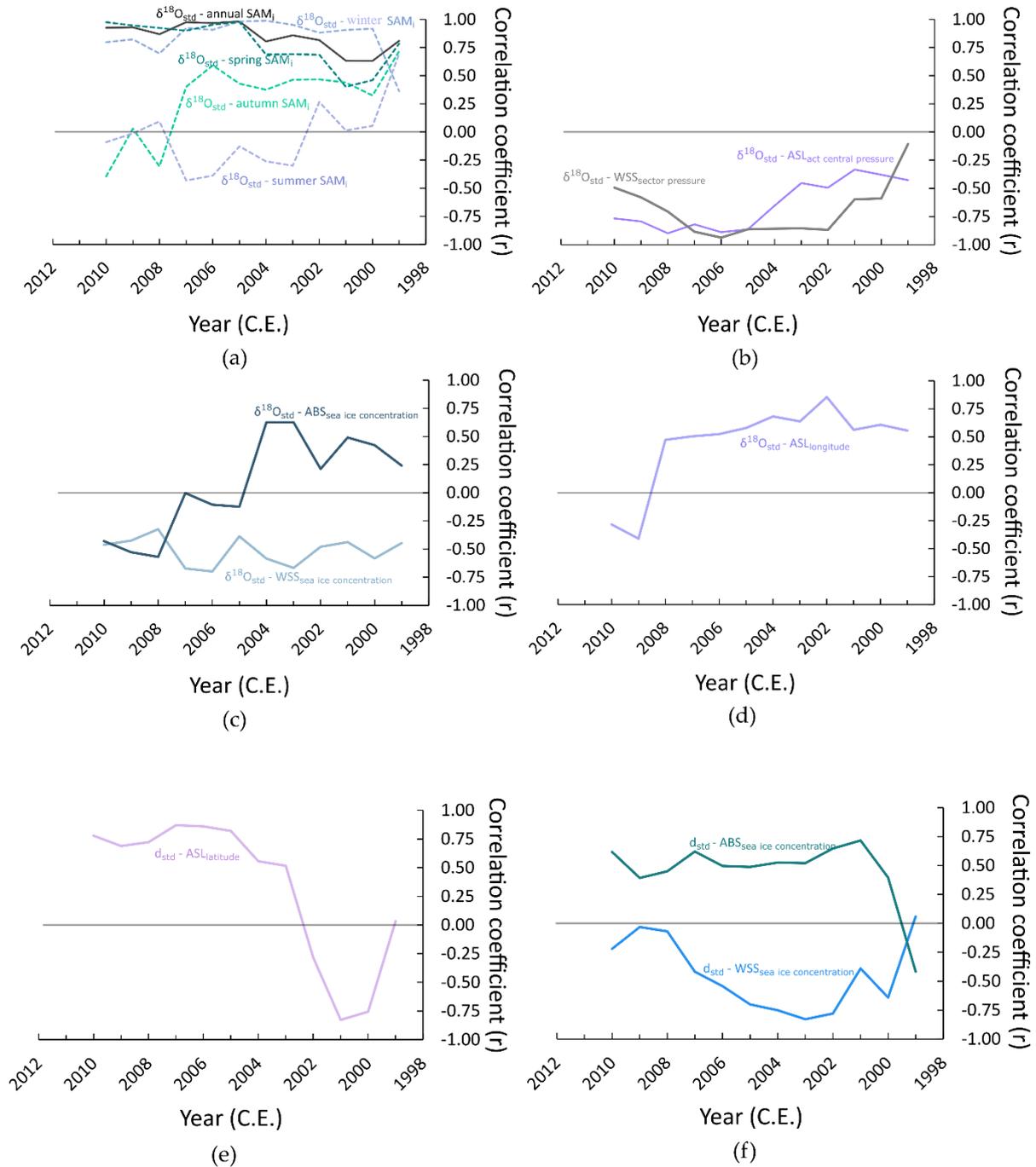


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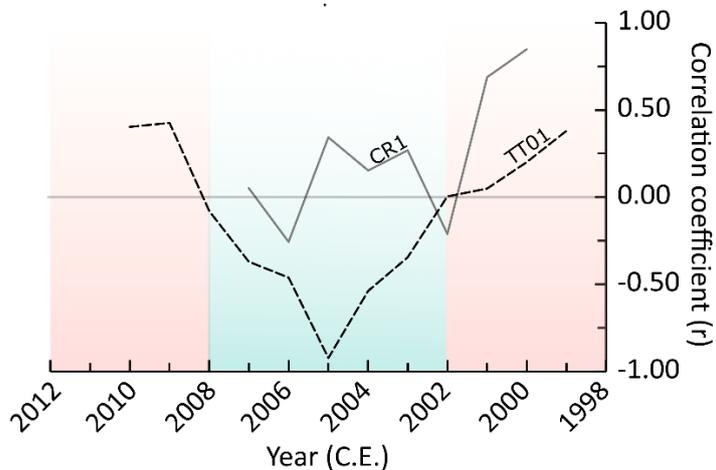


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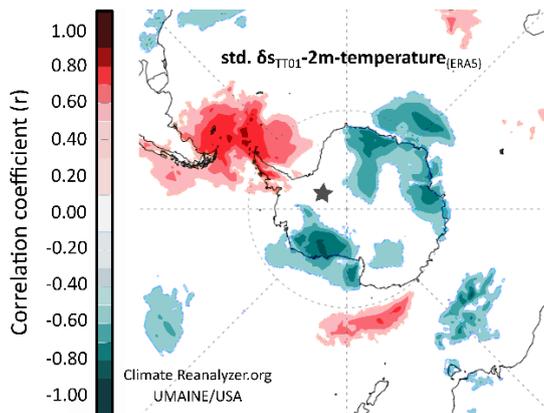


Figure S6. Spatial correlation map of annually averaged ERA5 near-surface (2 m) air temperatures with standardized (std.) mean annual $\delta^{18}\text{O}_{\text{TT01}}$. The map was produced at Climate Reanalyzer.org. Only statistically significant correlations ($\alpha = 0.05$) are displayed. Grey star indicates the Criosfera 1 site.

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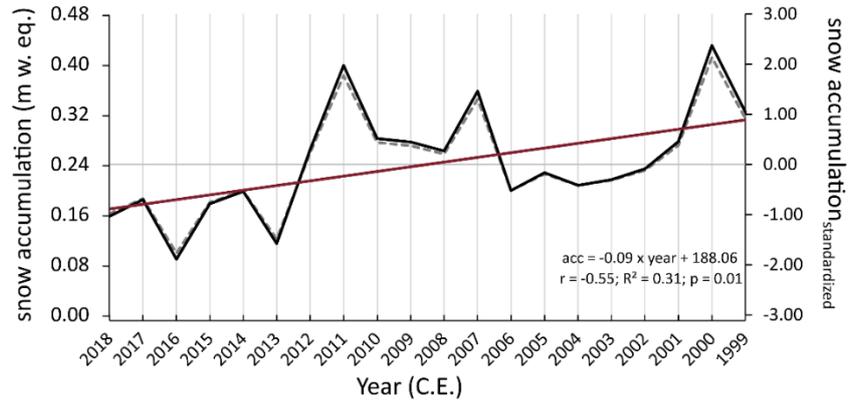


Figure S7. Composite record of annual snow accumulation in Criosfera 1 site from 1999 to 2018.

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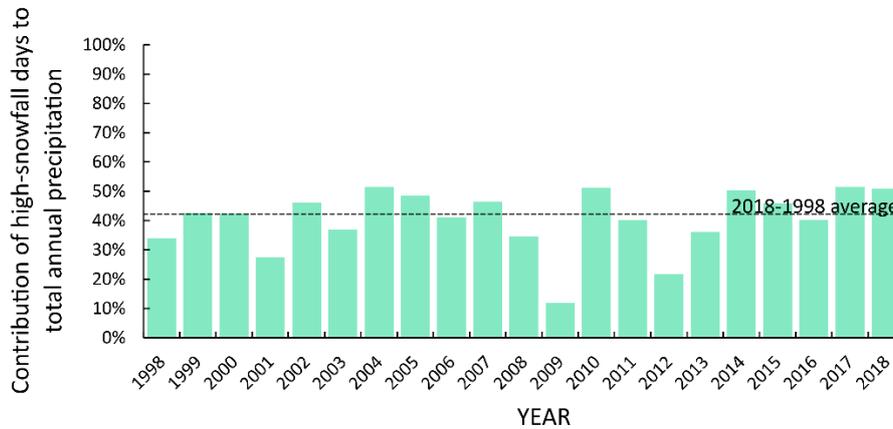


Figure S8. Interannual variability of the contribution of HSDs to total annual precipitation from 1998 to 2018 (in percentage).

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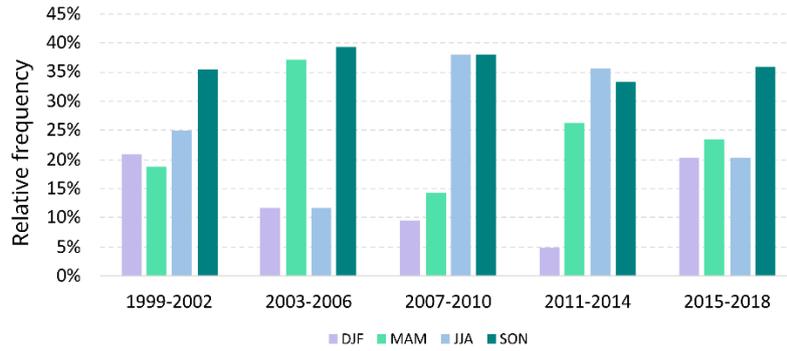


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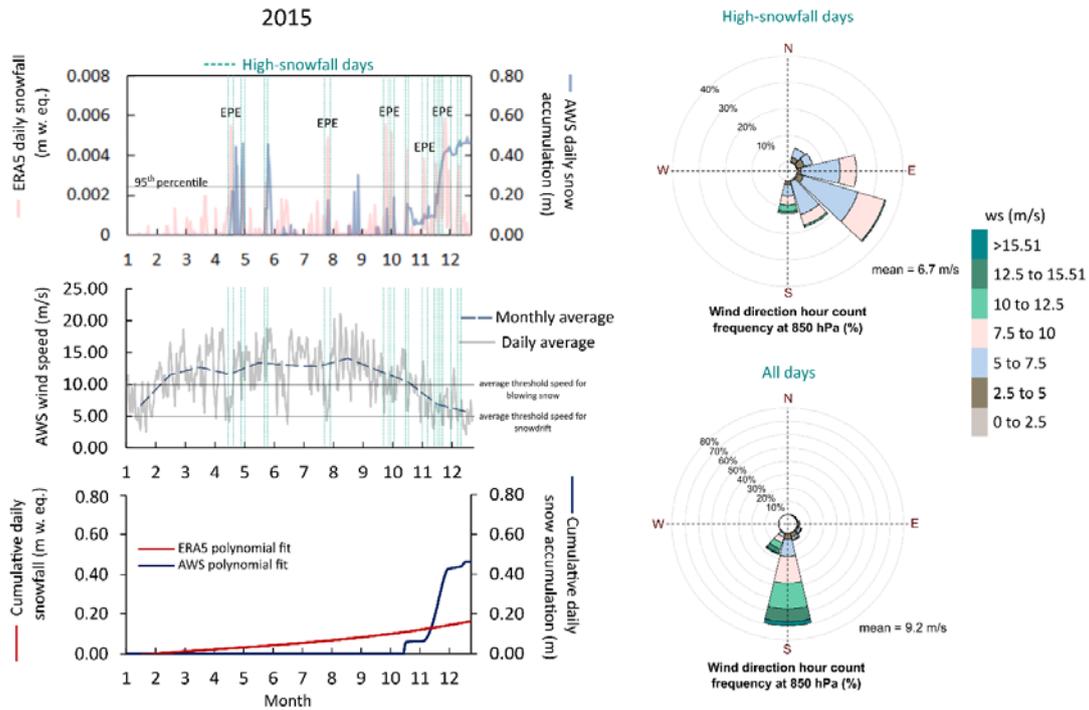


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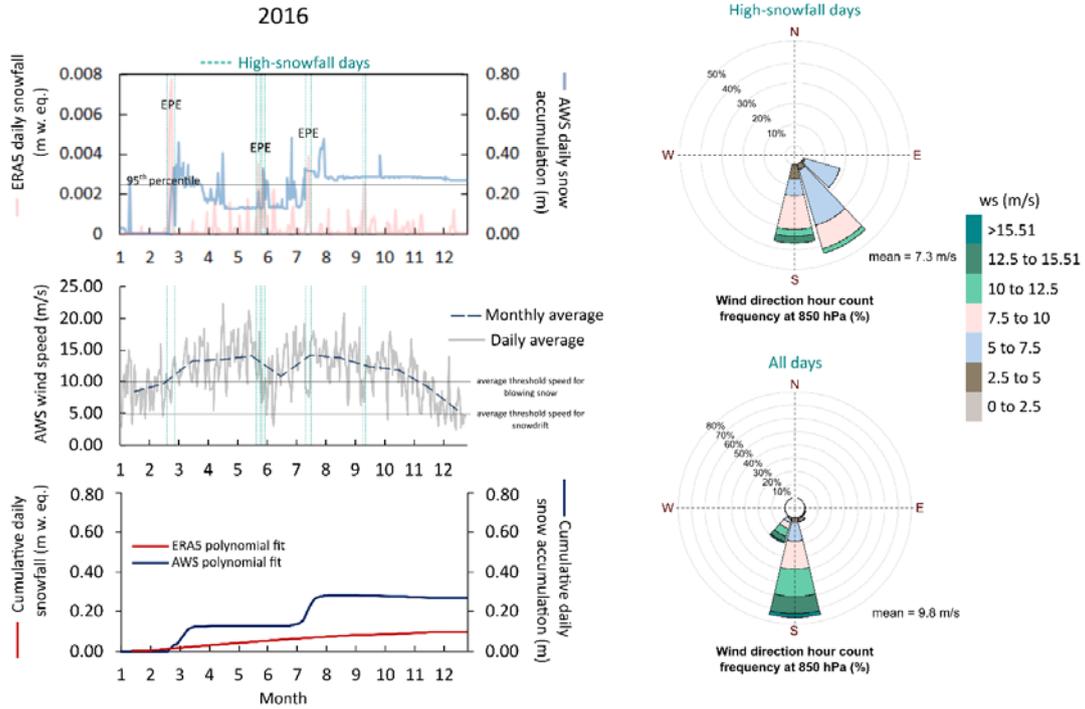


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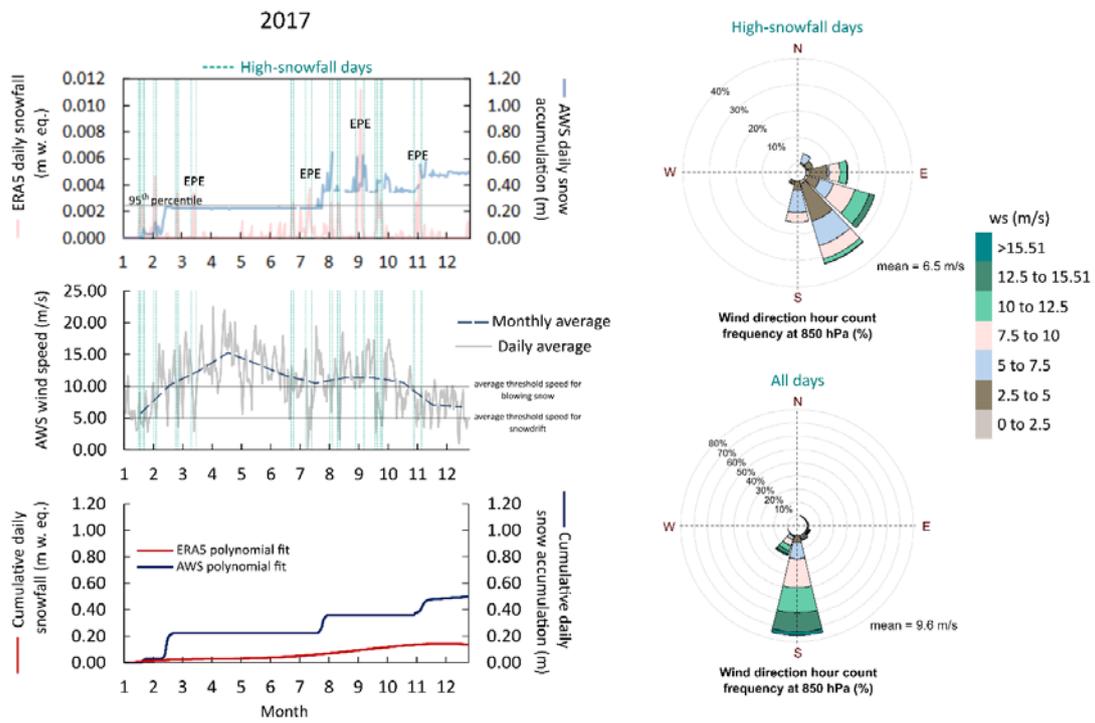
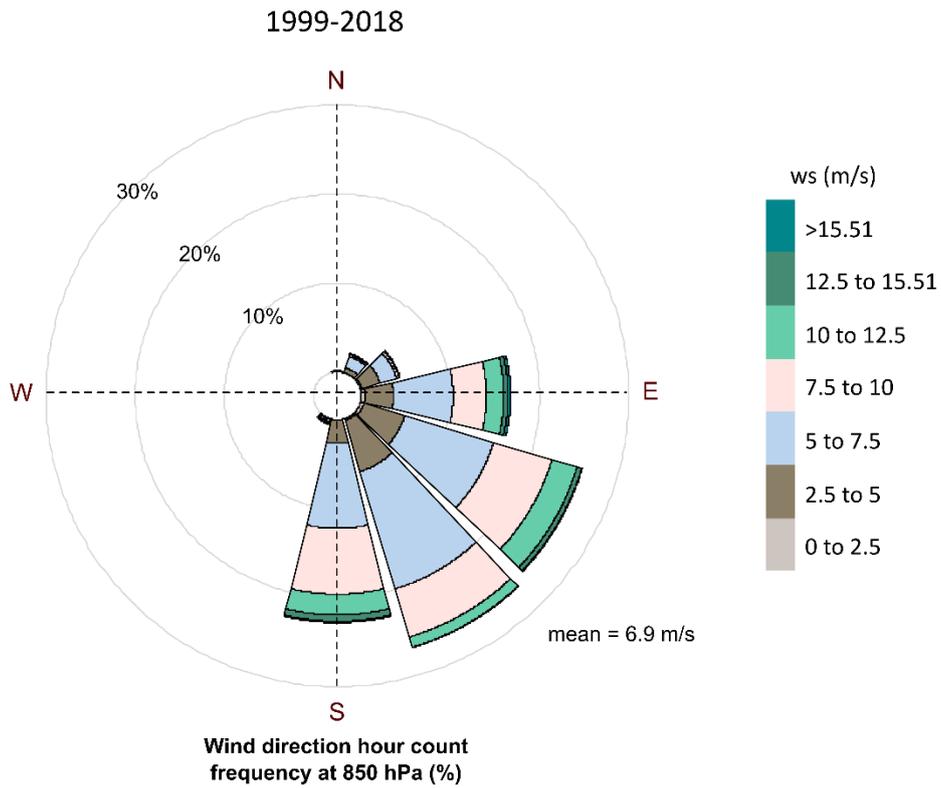


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Figure S13. Wind direction and speed during EPEs at the Criosfera 1 site. Wind 850 hPa from 1999 to 2018 provide by ERA5 datasets.

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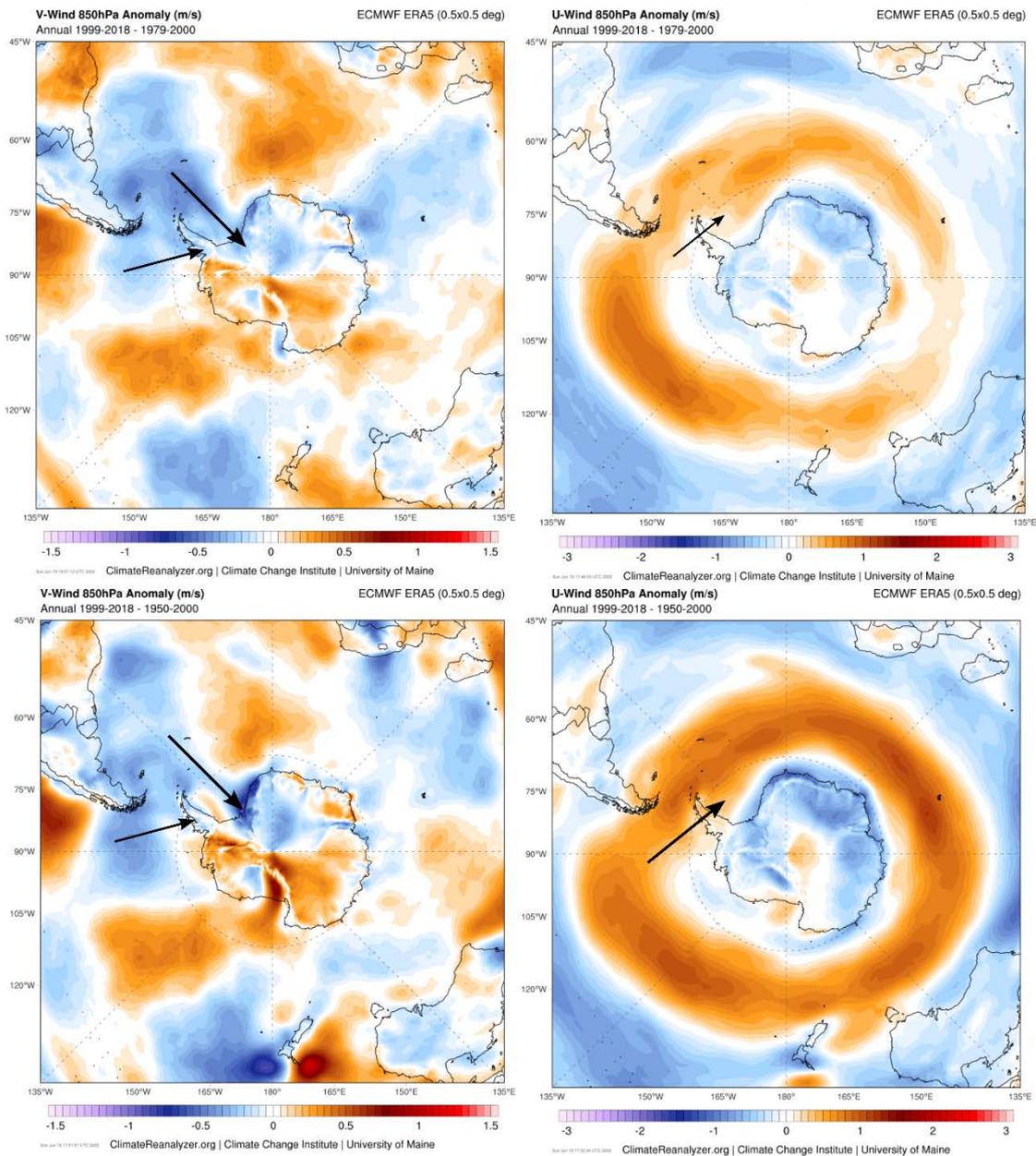


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Data source: Climate Reanalyzer.org

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Equation S1. Equation to compute the annual snowfall weighted (a_{sw}) mean temperature at 900 hPa (T_{900}).

$$a_{sw} \text{ mean } T_{900} = \frac{\sum P_{day} \times T_{day}}{P_{annual}}$$

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where P_{day} is the daily precipitation, T_{day} is daily mean temperature and P_{annual} is the annual total precipitation. To calculate the annual HSD weighted (a_{HSD}) mean temperature at 900 hPa (T_{900}) the same equation was used, but only days with high snowfall rate was considered.

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Table S1. Validation of ERA5 surface data (temperature and wind velocity) at the Criosfera 1 site.

Scale	Parameter		Slope	p-value	r	R ²
	AWS	ERA 5				
Hourly	Surface temperature	2m temperature	0.80	<0.001	0.99	0.97
Daily	Surface temperature	2m temperature	0.81	<0.001	0.99	0.98
Daily	Surface temperature	Temperature at 900 hPa	0.72	<0.001	0.97	0.95
Monthly	Surface wind velocity	10 m wind velocity	1.44	<0.001	0.96	0.93

	TT01 $\delta^{18}\text{O}$	TT01 d	CR1 $\delta^{18}\text{O}$	CR1 d	Composite record $\delta^{18}\text{O}$	Composite record d	Annual $T_{(900\text{hPa})}$	a_{sw} mean $T_{(900\text{hPa})}$	a_{HSD} mean $T_{(900\text{hPa})}$	ABSS sea ice (concentration)	WSS sea ice (concentration)	SAM index	SOI index	ASL act. central pressure	ASL longitude	ASL latitude	Weddell sector pressure
TT01 $\delta^{18}\text{O}$	1	0.37	-0.06	-0.10	0.75	0.22	0.20	-0.17	-0.29	0.06	-0.54	0.78	0.12	-0.62	0.54	-0.04	-0.72
TT01 d		1	0.10	0.48	0.36	0.92	0.10	-0.13	-0.11	0.41	-0.49	0.19	0.20	0.14	0.09	0.52	-0.08
CR1 $\delta^{18}\text{O}$			1	-0.10	0.61	0.02	0.31	0.22	0.15	-0.24	-0.21	-0.08	-0.34	-0.05	0.38	0.11	-0.23
CR1 d				1	-0.15	0.79	-0.15	0.22	0.34	0.62	-0.04	-0.35	0.16	0.62	-0.43	-0.08	0.54
Composite record $\delta^{18}\text{O}$					1	0.19	0.36	0.01	-0.13	-0.11	-0.57	0.57	-0.13	-0.52	0.67	0.04	-0.72
Composite record d						1	0.00	0.01	0.07	0.57	-0.36	-0.02	0.21	0.38	-0.13	0.33	0.18
Annual $T_{(900\text{hPa})}$							1	0.58	0.49	0.24	-0.70	0.30	-0.21	-0.33	0.29	0.13	-0.45
a_{sw} mean $T_{(900\text{hPa})}$								1	0.97	0.20	-0.49	-0.04	-0.26	-0.03	-0.08	-0.26	0.01
a_{HSD} mean $T_{(900\text{hPa})}$									1	0.25	-0.37	-0.17	-0.21	0.08	-0.15	-0.31	0.12
ABSS sea ice (concentration)										1	-0.19	-0.15	0.08	0.46	-0.08	0.34	0.28
WSS sea ice (concentration)											1	-0.50	0.13	0.35	-0.19	-0.18	0.43
SAM index												1	0.48	-0.80	0.59	0.10	-0.76
SOI index													1	-0.05	0.10	0.24	0.01
ASL act. central pressure														1	-0.60	0.26	0.84
ASL longitude															1	0.14	-0.84
ASL latitude																1	0.06
Weddell sector pressure																	1

180 **Table S2.** Correlation matrix table showing the relationships between isotopic time series of TT01, CR1, composite record and the climatic parameters. Correlations on the annual scale (from 2000 to 2012) among the standardized average of $\delta^{18}\text{O}$ and d-excess, the temperature at 900hPa, snowfall weighted mean temperature at 900hPa, HDS weighted mean temperature at 900hPa, ABSS and WSS average sea ice concentration, SAM [Marshall, 2003], SOI [NOAA] and ASL indices [Hosking et al., 2016], and mean sea level pressure in the WSS are presented in the matrix. Statistically significant correlations ($p < 0.05$; $\alpha = 0.05$) are marked in bold. The climatic time series were detrended, excluding the SAM and SOI time series.

