

Supplementary Material
The Extraordinary March 2022 East Antarctic “Heat” Wave. Part I:
Observations and Meteorological Drivers
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2. Data and methods

Reanalysis			Model			Station		
Name	Resolution	Purpose	Name	Resolution	Purpose	Name	Location	Purpose
ERA5	.25° at daily, 1 hourly	Synoptics; Precip; Firn core model	MAR	35 km; regional model with 24 vertical atmospheric levels (3hourly)	Rain, snow estimates; Antarctic PBL and snow interactions	AWS	Figure 1	Near surface (1.8m) temperature, 4m wind; used in extreme event analysis
MERRA2	.5°x.6 at (1 hourly)	Total precip over grounded ice and ice shelves; grid used for SNOWPACK; Wille ARDT	PWRF (Driven by ERA5)	20 km/4 km regional model with 71 vertical levels (1 hourly)	High resolutions simulation; liquid water, sfc energy balance	Vostok	Figure 1	Historical temperature records
NOAA OLR	2.5° at (temporal resolution)	Tropical deep convection	SNOWPACK	Vertical layers: .5-2 cm near the surface; 1 m near bottom of firn column	Firn	Dumont d'Urville	Figure 1	AR evolution via radiosonde data; Micro Rain Radar
			IPSL_CM6	2.5°x1.267° at daily	Climate simulations	Concordia	Fig 1	Radiosonde profiles ps, t, q, v; Isotopes; Cosmic rays, neutron spectra (thermal region up to GeV energy range)
			Firn core model	1 cm	Simulates signal from isotopic composition of snow	Dome C	Fig 1	Isotope proxy for precip composition; vapor monitoring to be paired with Firn core model

Table S1: Summary of the various reanalysis, models, and station instrumentation utilized in this study.

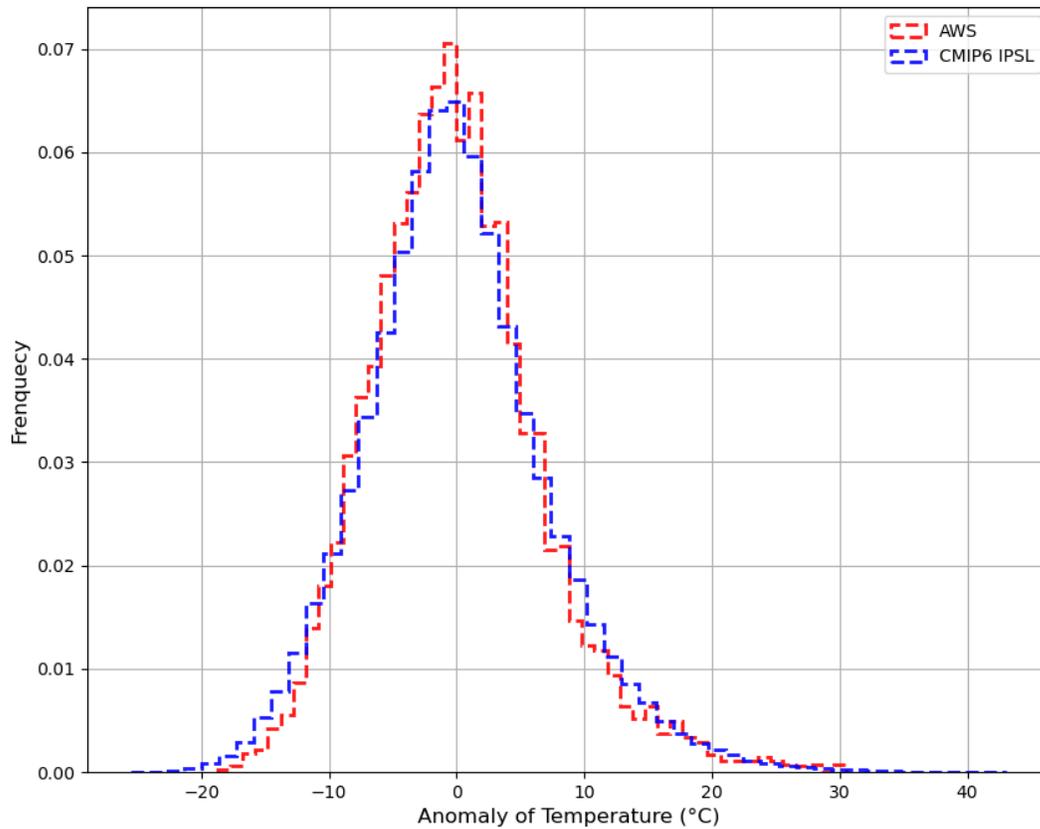


Fig. S1: Probability distribution functions (PDFs) of the temperature anomalies with respect to monthly means for the IPSL-CM6 model (blue line) and for the AWS temperature measurements (red line) at Dome C.

3. Meteorological drivers

b. Inland moisture advection

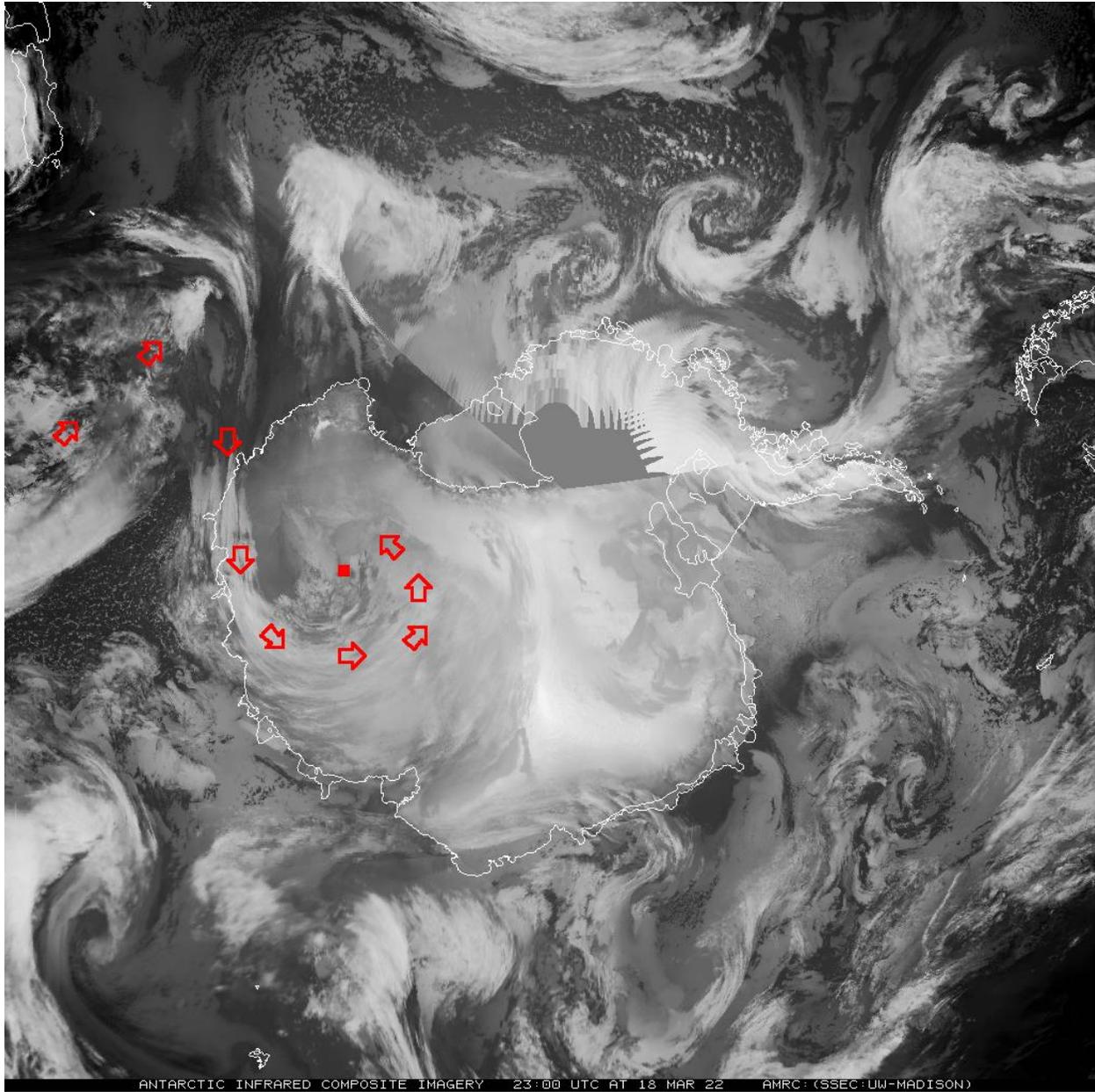


Fig. S2: The state of the cloud mass associated with the ending phase of the atmospheric river is depicted here in this 23 UTC 18 March 2022 infrared (~11.0 micron) composite satellite image. The flow of the clouds is highlighted with the red arrows.

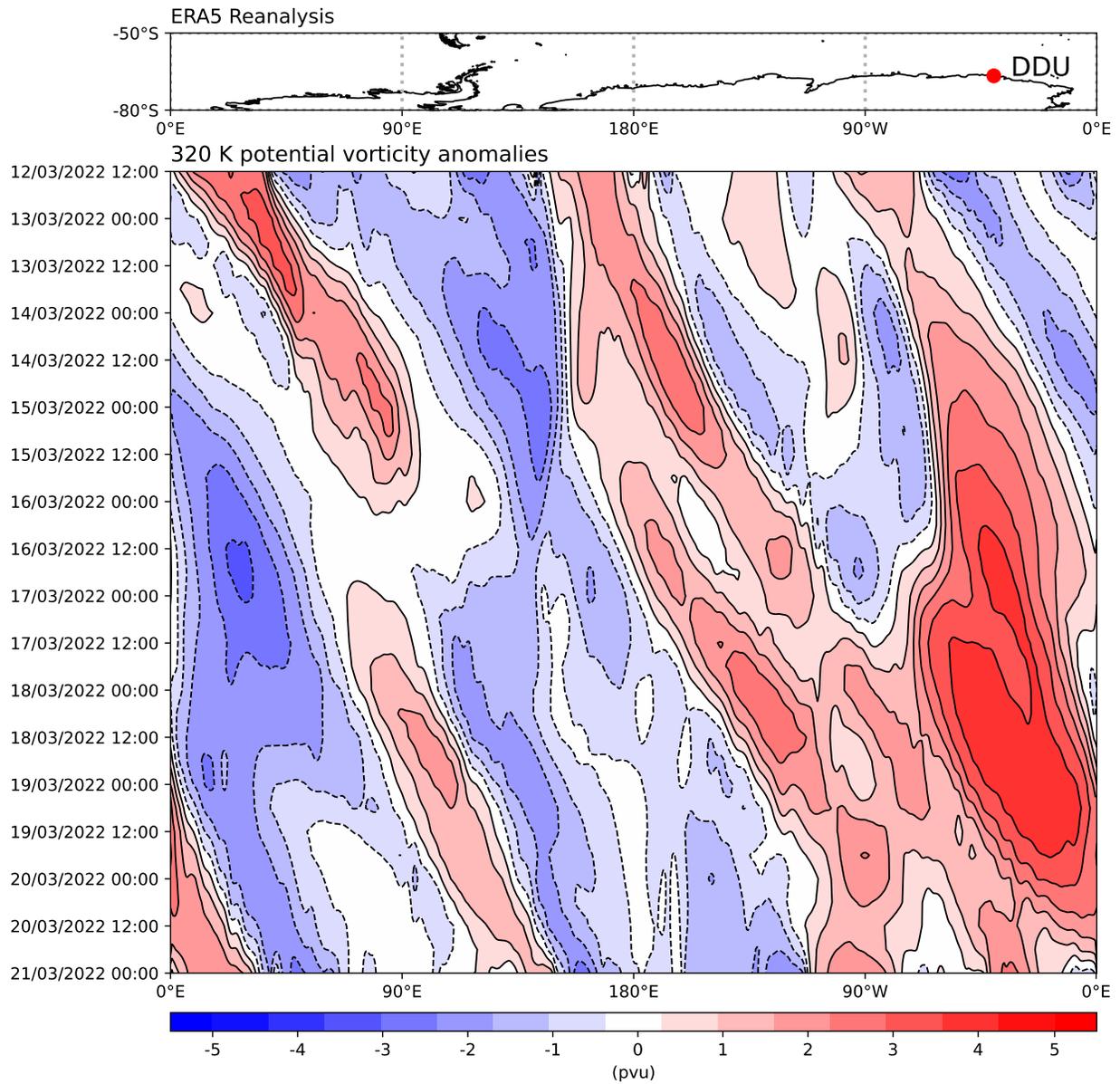


Fig. S3: Hovmöller diagram (time vs longitude) of the 300 hPa potential vorticity anomalies starting from March 12 - 19. 6-hourly potential vorticity data is averaged between 50° S - 80° S and is provided by ERA-5 reanalysis. DDU - Dumont-d'Urville on the coast of Adélie Land, East Antarctica.

c. Clouds, radiation, and surface energy balance

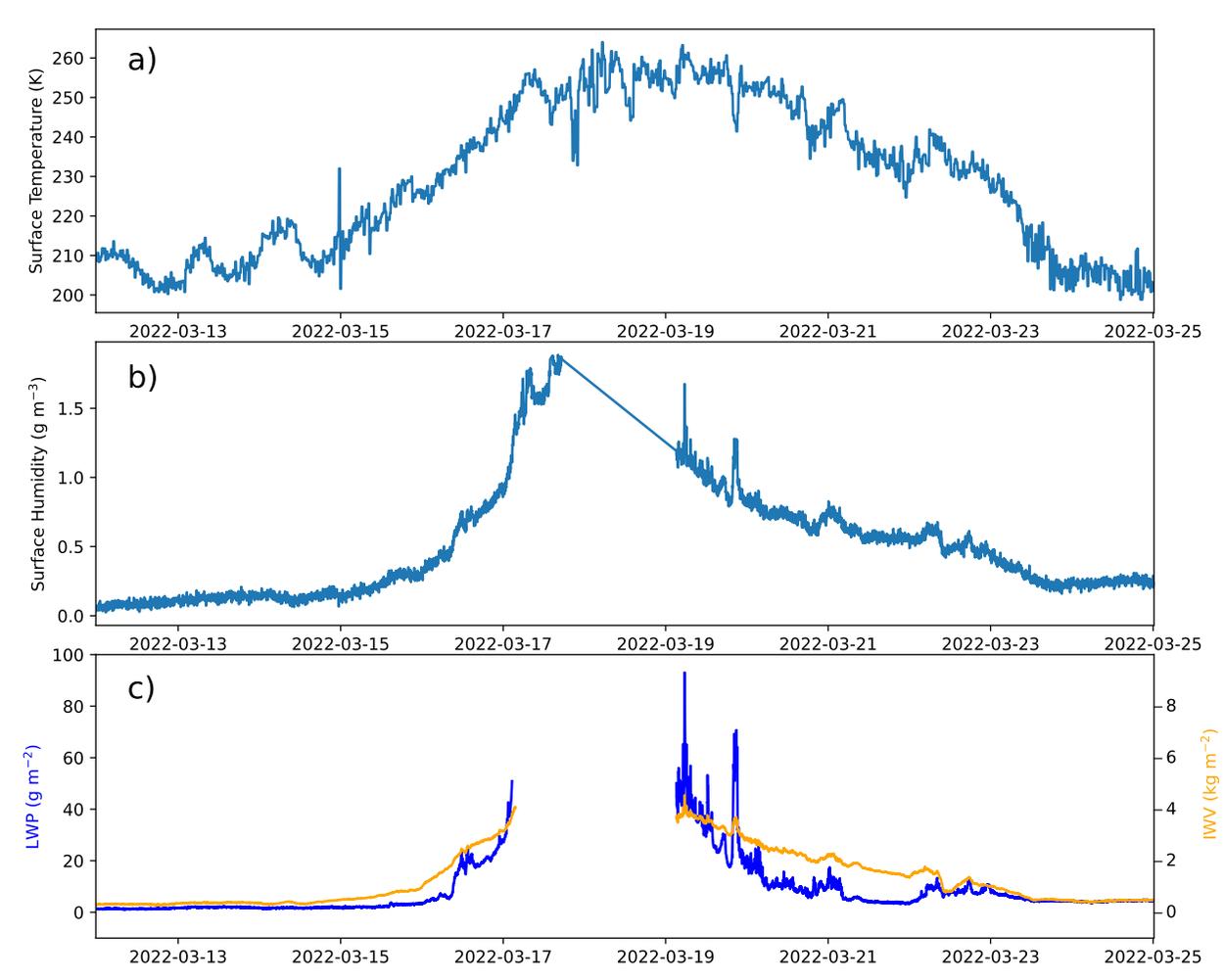


Fig. S4: (a) Surface temperature, (b) surface humidity, and (c) liquid water path (LWP) and integrated water vapor (IWV) measured by the HAMSTRAD instrument operating on the surface at Dome C. The gap in the data is due to snow accumulation on the instrument, which was removed on 2022/03/19 at 03:10 UTC.

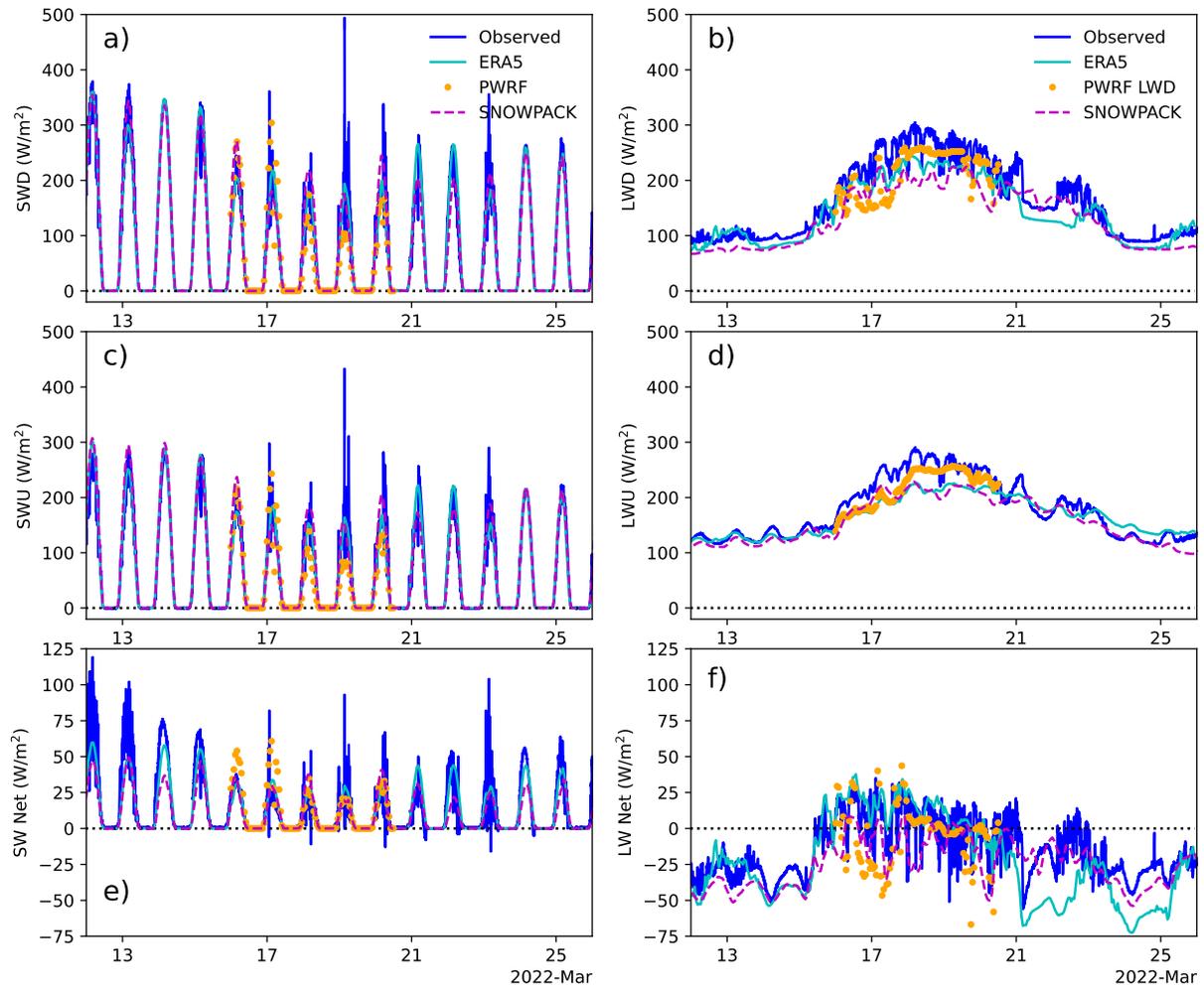


Fig. S5: Broadband downwelling radiance at the surface at Dome C based on surface observations (Dome C), as well as from the closest geographical data points from Polar WRF (PWRF), ERA5, and SNOWPACK. Panels show shortwave downwelling, upwelling, and net (SWD, SWU, and SW Net, respectively, from top to bottom in left panels a, c, and e) and longwave downwelling, upwelling and net (LWD, LWU, and LW Net, respectively, from top to bottom in right panels b, d, and f).

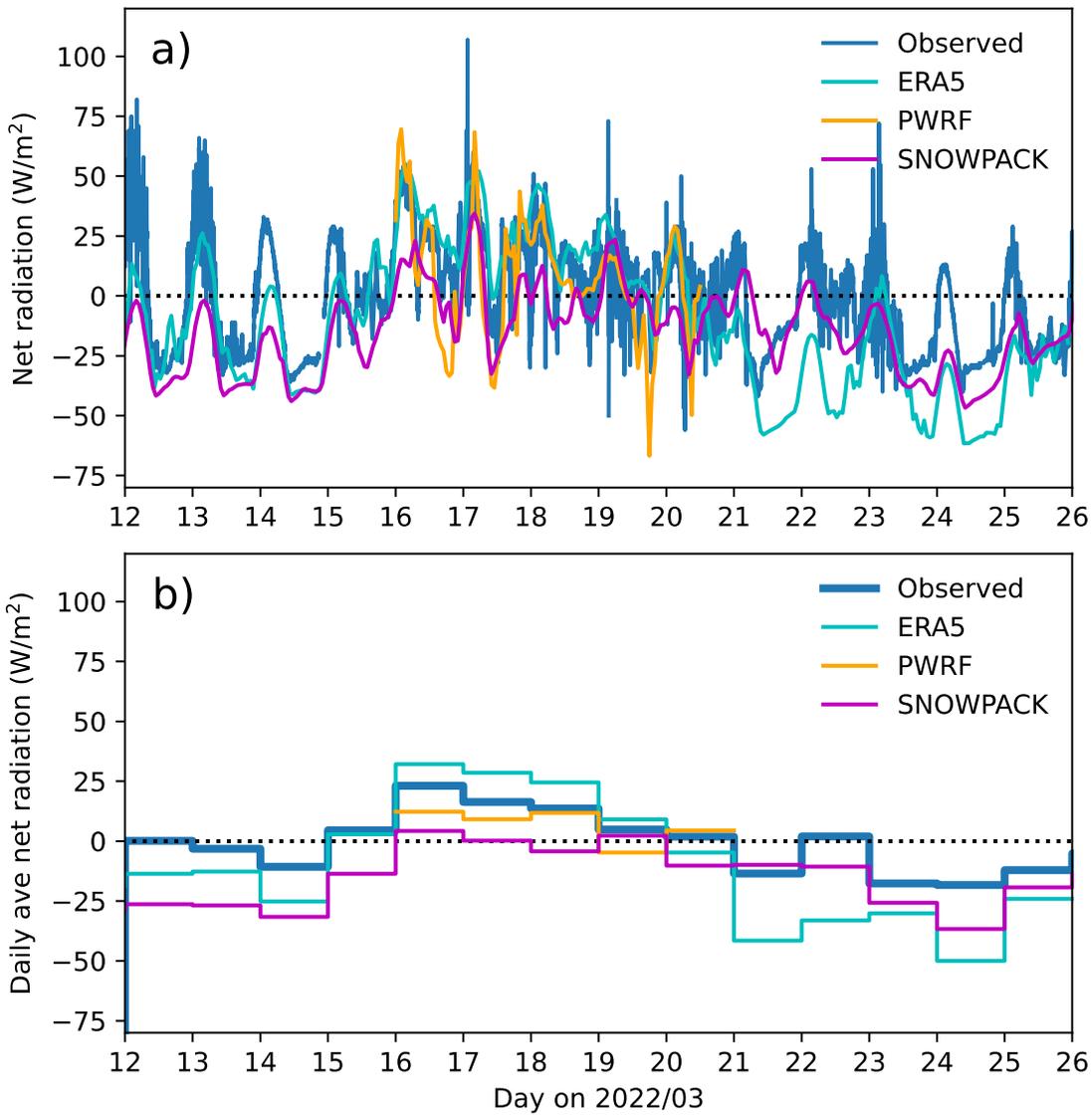


Fig. S6: (a) Broadband net radiative fluxes at the surface at Dome C (downward shortwave - upward shortwave + downward longwave - upward longwave) for surface observations (Observed), as well as from the closest geographical data points from Polar WRF (PWRP), ERA5, and SNOWPACK. (b) Daily averages.

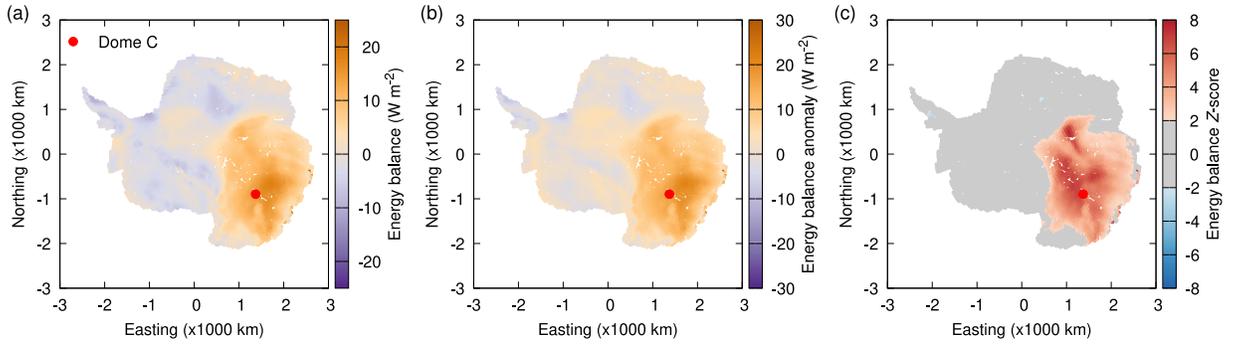


Fig. S7: (a) SNOWPACK calculated average total surface energy balance over the period March 14-19, 2022, (b) deviation of the 2022 period from the March 14-19 1980-2021 climatology and (c) Z-score of the 2022 anomaly. A positive energy balance denotes a downward directed total energy flux at the surface. Easting and northing are in the EPSG 3031 coordinate system (Antarctic polar stereographic projection).