Impacts of Atmospheric Dynamics on Sea-Ice and Snow Thickness at a Coastal Site in East Antarctica

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Supplementary Material

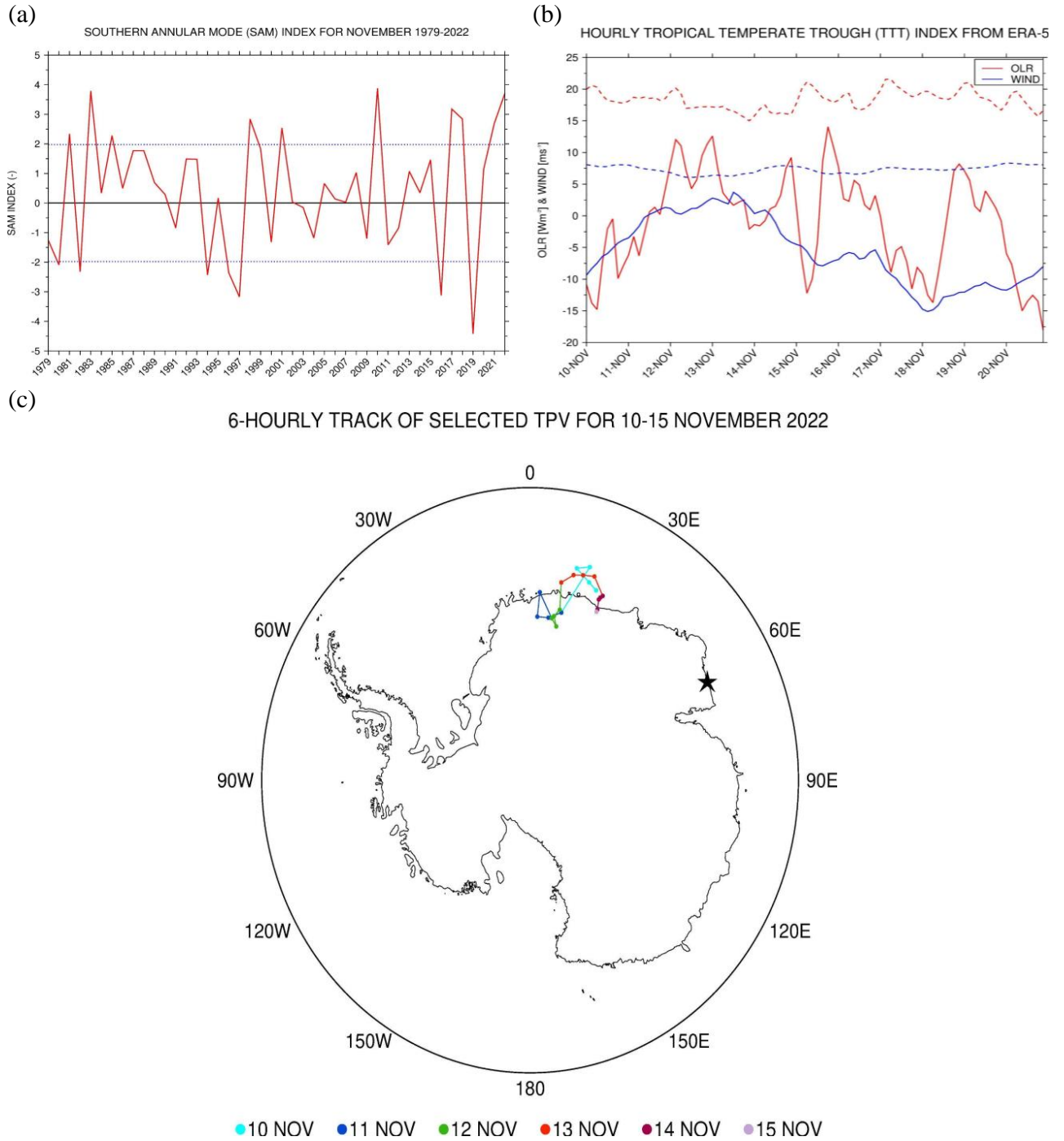



Figure S1: Atmospheric State during November 2022: (a) Southern Annular Mode (SAM) index for the November months of 1979 to 2022 from Marshall (2003). The blue dashed lines give one standard deviation, extracted for the 1979-2021 climatological period. (b) 3-hourly OLR (red; $W\,m^{-2}$) and wind (blue; $m\,s^{-1}$) tropical temperate trough (TTT) indices, equations (8a)-(8b), for 10-20 November 2022. The dashed lines give the respective 1979-2021 3-hourly standard deviation. (c) 6-hourly positions of the TPV discussed in the text as given by the TPVTrack v1.0 software.

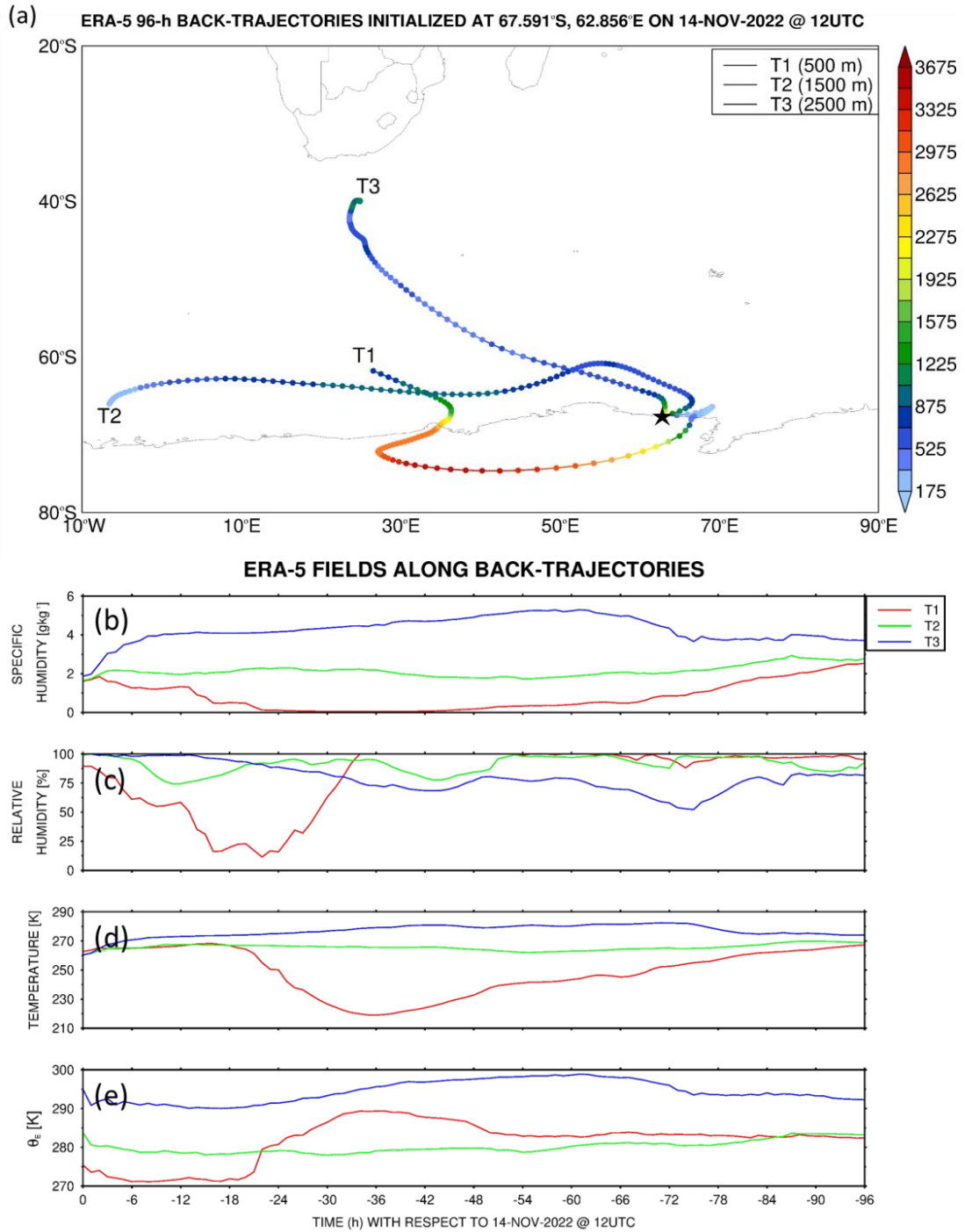



Figure S2: Back-Trajectories: (a) 96-h back-trajectories initialized at 12 UTC on 14 November 2022 at 67.591ºS and 62.856ºE and at 500 m (T1), 1500 m (T2) and 2500 m (T3) above sea-level. They are obtained using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT; Stein et al., 2015) model forced with 0.25º × 0.25º hourly ERA-5 reanalysis data. The colour of the dots gives the altitude as the parcel is advected back in time. (b)-(e) give the hourly specific humidity (g kg^{-1}), relative humidity (%), temperature (K) and equivalent potential temperature (θ_E; K), respectively, along each of the trajectories. The horizontal axis shows the time in hours backwards from 14 November 2022 at 12 UTC.

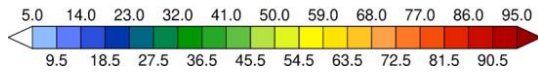
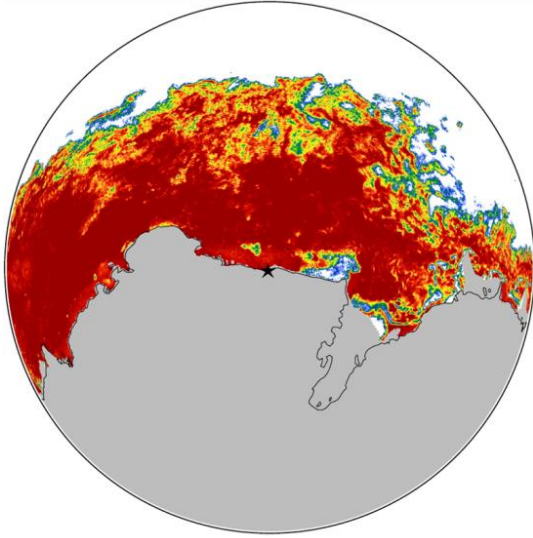
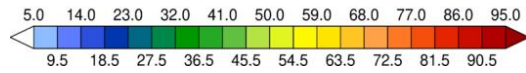
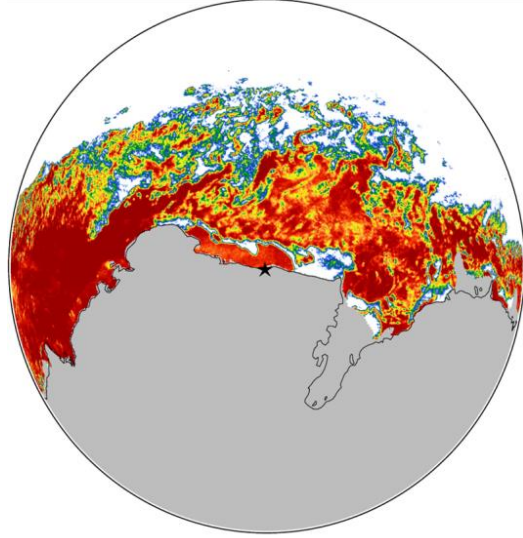
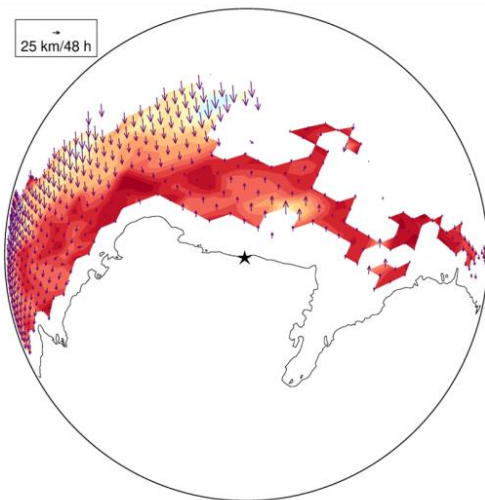
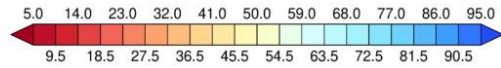
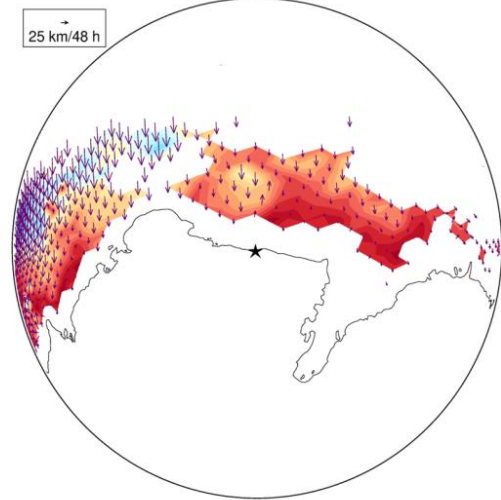



Figure S3: Effects of Atmospheric River on Sea-Ice: Sea-ice extent (SIE; %) at 3.125 km resolution around the Mawson Station (star) on (a) 14 and (b) 17 November 2022. Grey shading indicates land regions. Sea-ice velocity (km) from a 62.5 km dataset from (c) 11 to 13 and (b) 14 to 16 November 2022. Regions for which there is no data and/or sea-ice are shaded in white.

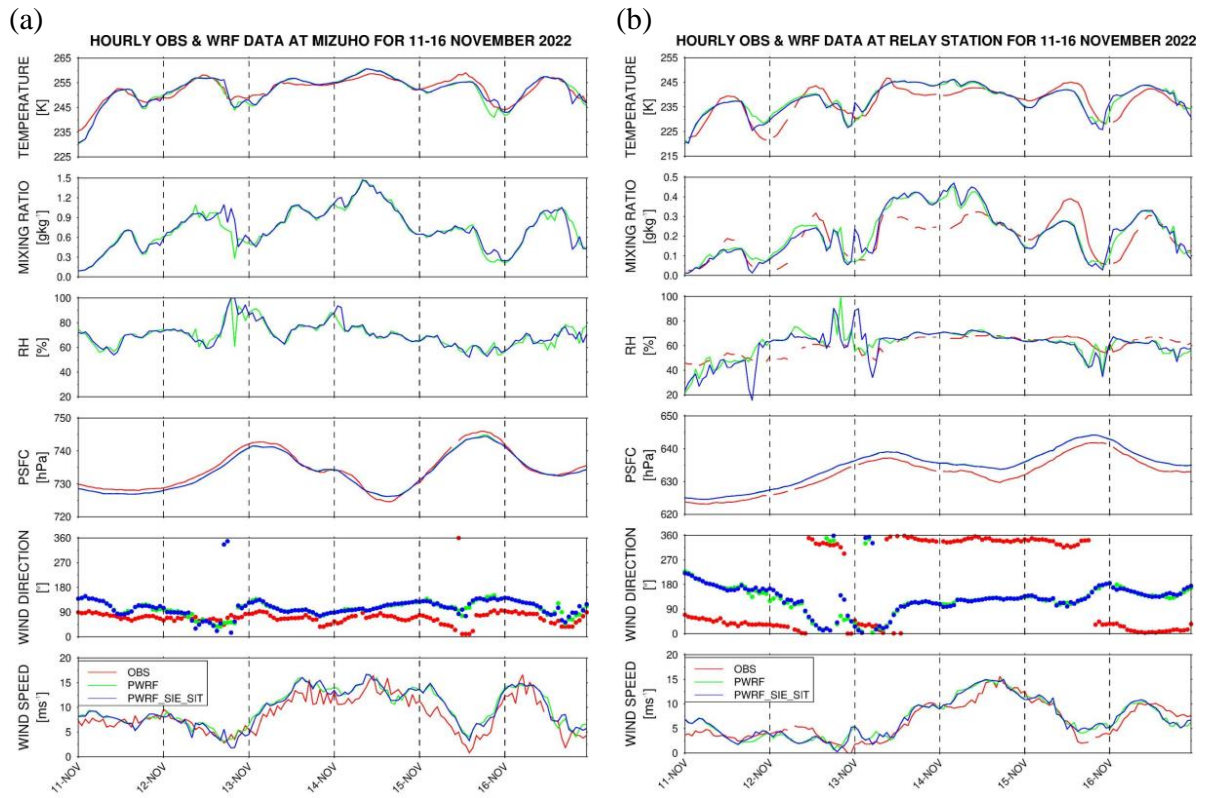
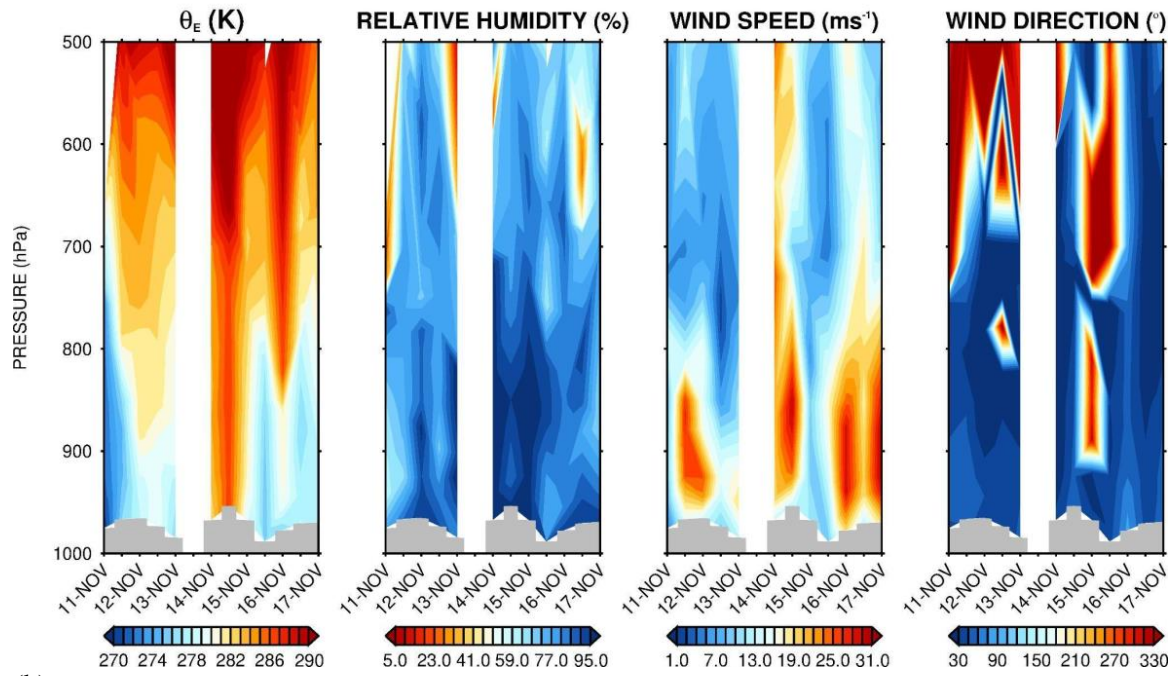



Figure S4: Evaluation of PolarWRF against inland Antarctica station observations: Hourly air temperature (K), water vapour mixing ratio (g kg^{-1}), relative humidity (RH; %), sea-level pressure (SLP; hPa) and horizontal wind direction (⁰) and speed (m s^{-1}) from observations (red), for the control (green) PWRF simulation and for the PWRF simulation with updated SIE and SIT (blue) for 11-16 November 2022 at the (a) Mizuho and (b) Relay stations in East Antarctica (Fig. 1b). Humidity measurements are not available at the Mizuho Station for this period.

(a)

SOUNDING PROFILES AT SYOWA STATION FROM 11/11/22 TO 16/11/22

(b) **WRF PROFILES AT SYOWA STATION FROM 11/11/22 TO 16/11/22**

(c)

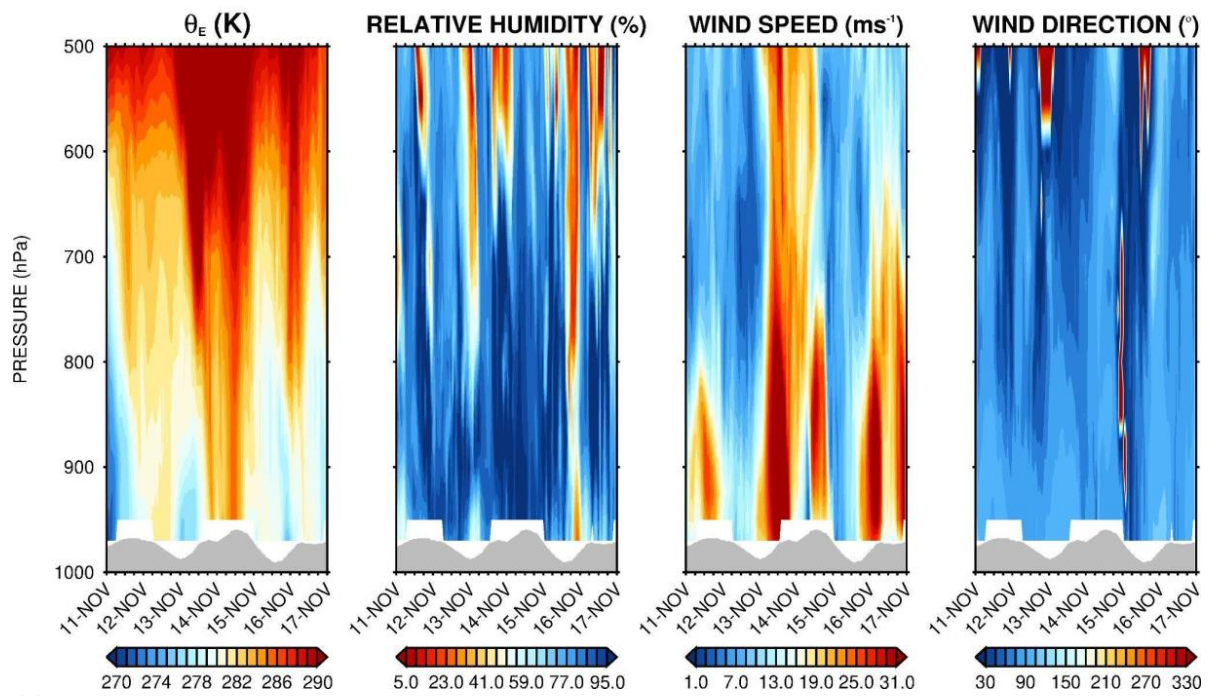
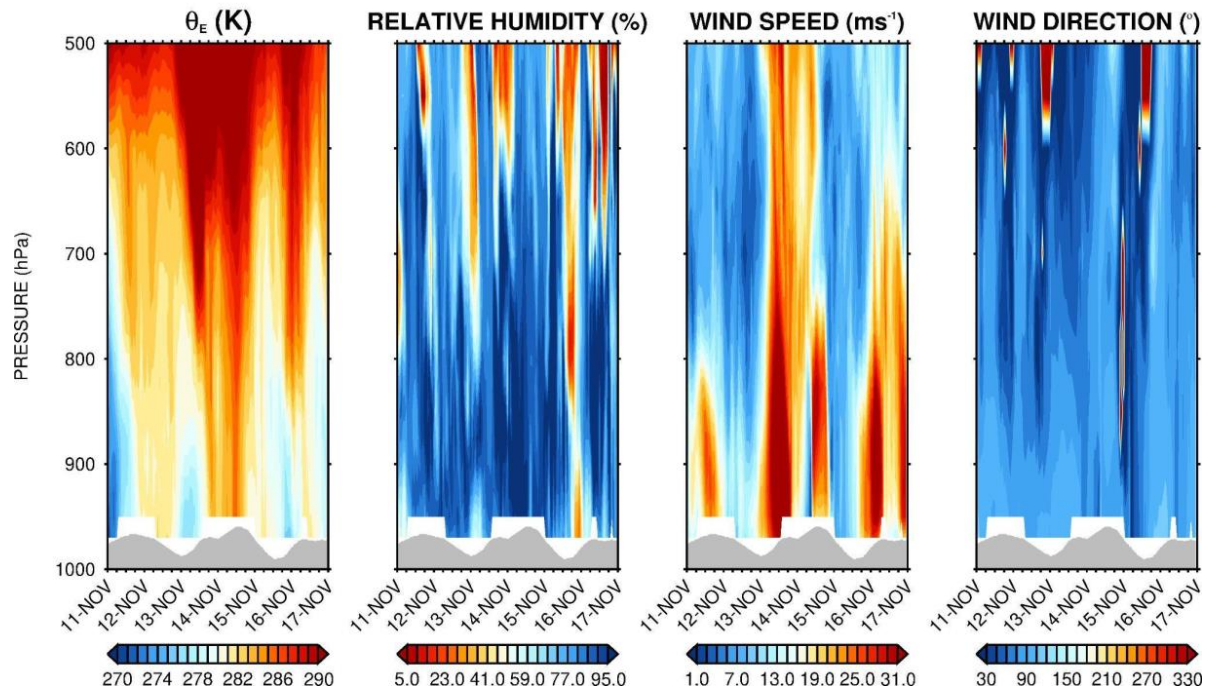



Figure S5: Evaluation of PolarWRF profiles against sounding observations: (a) Equivalent potential temperature (K), relative humidity (%), and horizontal wind speed (m s⁻¹) and direction (º) vertical profiles at the Syowa weather station every 12 h for 11-16 November 2022 from 1000 and 500 hPa. (b)-(c) are as (a) but for the hourly profiles from the control and updated SIE and SIT PWRF simulations, respectively. Grey shading denotes regions below topography, while white regions indicate missing data.