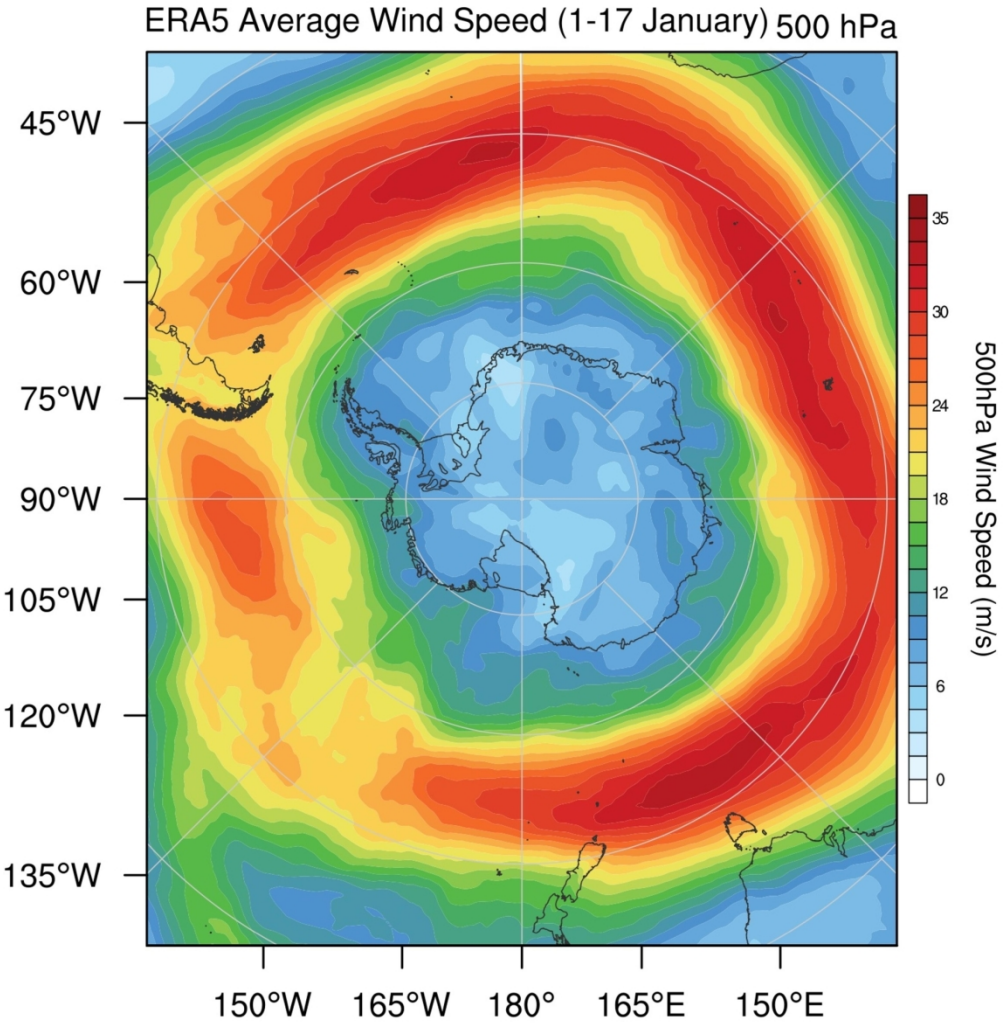

Figure S1. Average wind speed at 500 hPa from ERA5 global reanalysis data.

165x177mm (300 x 300 DPI)

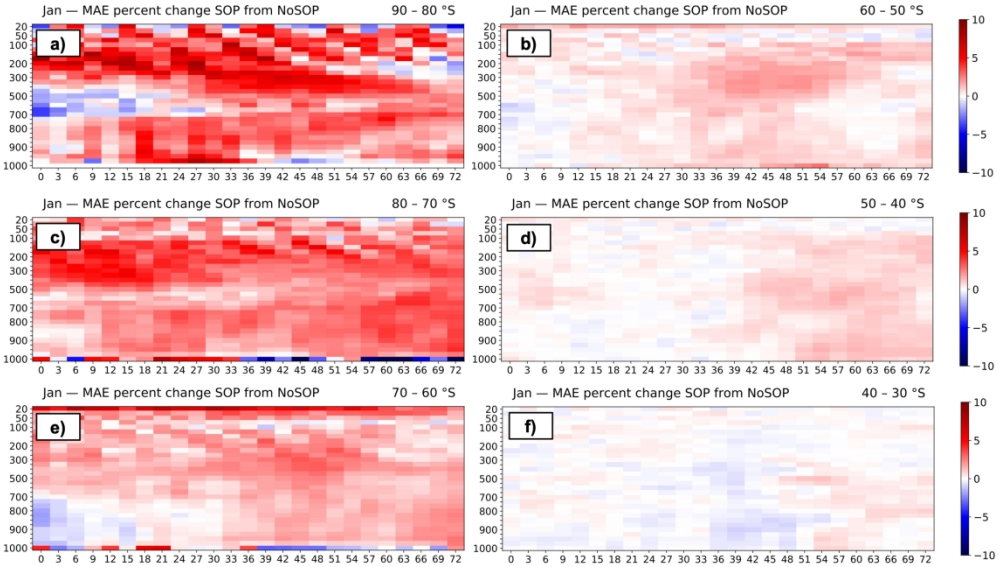

Figure S2. Percent change of Mean Absolute Error (MAE) between SOP and NoSOP for wind speed over all grid points every 10 degrees in latitude from 90º to 30ºS from 1 to 17 January 2019. ERA5 reanalysis data is used as a reference for MAE calculation. Red (positive value) shows the SOP has better forecast results. The pressure levels below the ice sheet surface are omitted.

279x159mm (300 x 300 DPI)

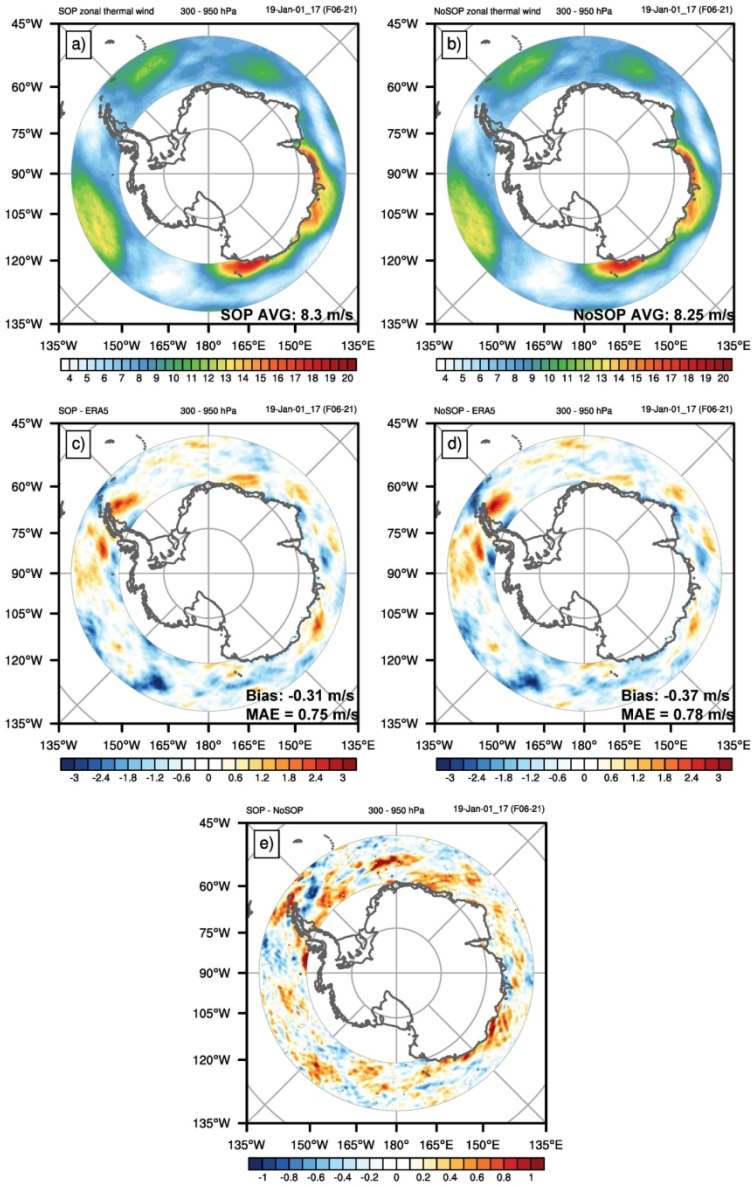

Figure S3. Zonal component of the thermal wind calculated based on meridional temperature gradient between 300 hPa and 950 hPa (300, 400, 500, 600, 700, 750, 800, 850, 900, 950 hPa) from a) SOP and b) NoSOP; c) difference between SOP and ERA5, d) difference between NoSOP and ERA5, and e) difference between SOP and NoSOP between 0600UTC 1 January and 2100UTC 17 January. For SOP and NoSOP outputs, 3 hourly forecasts from hours 06 and 27 are used.

125x190mm (300 x 300 DPI)

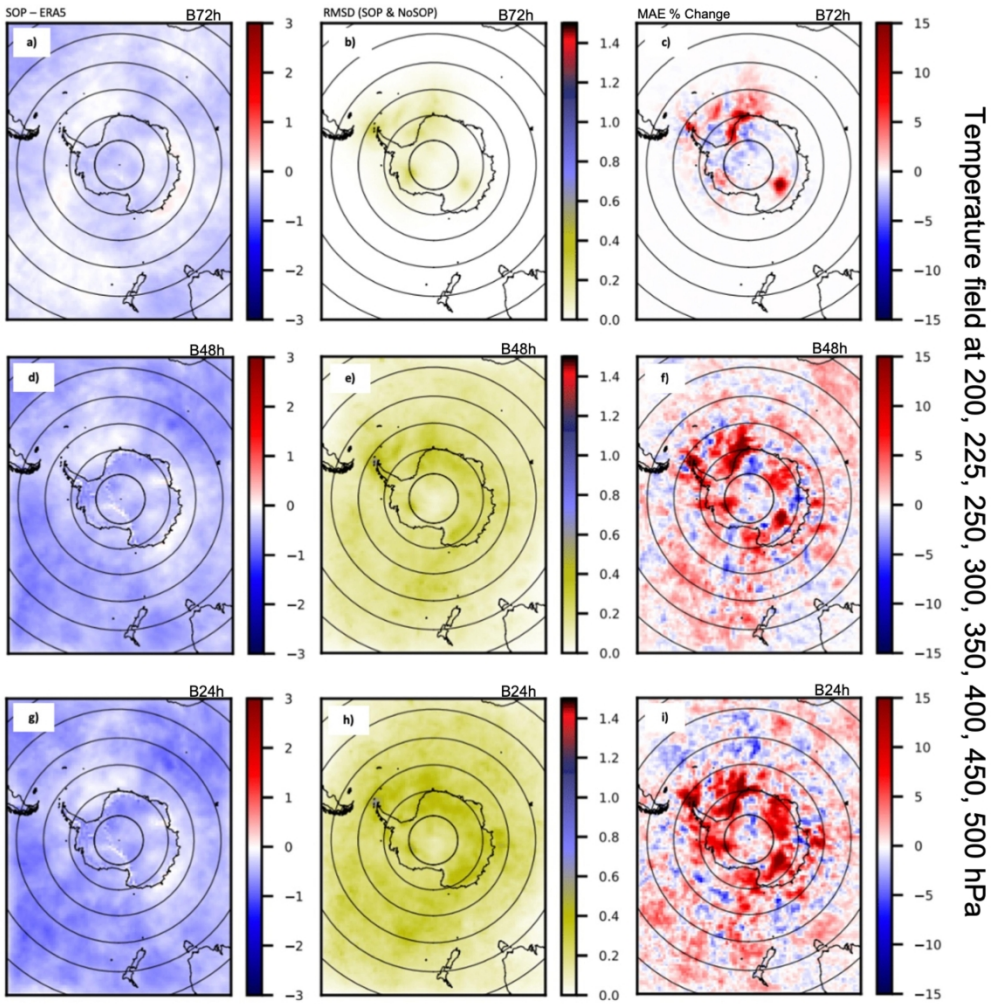

Figure S4. Temperature comparison among SOP, NoSOP and ERA5 vertically averaged for pressure levels from 500 to 200 hPa during the cycling simulation, 72h, 48h and 24h before the forecast starts (1-17 January 2019). a), d), and g) are temperature difference plots between SOP and ERA5 at the 3 different analysis times (NoSOP–ERA5 plots are similar); b), e), and h) are root of the mean square difference between SOP and NoSOP at the 3 different analysis times; c), f), and i) temperature mean absolute error (MAE) difference (ERA5 is used as the reference) between NoSOP and SOP at the 3 different analysis times.

215x217mm (300 x 300 DPI)

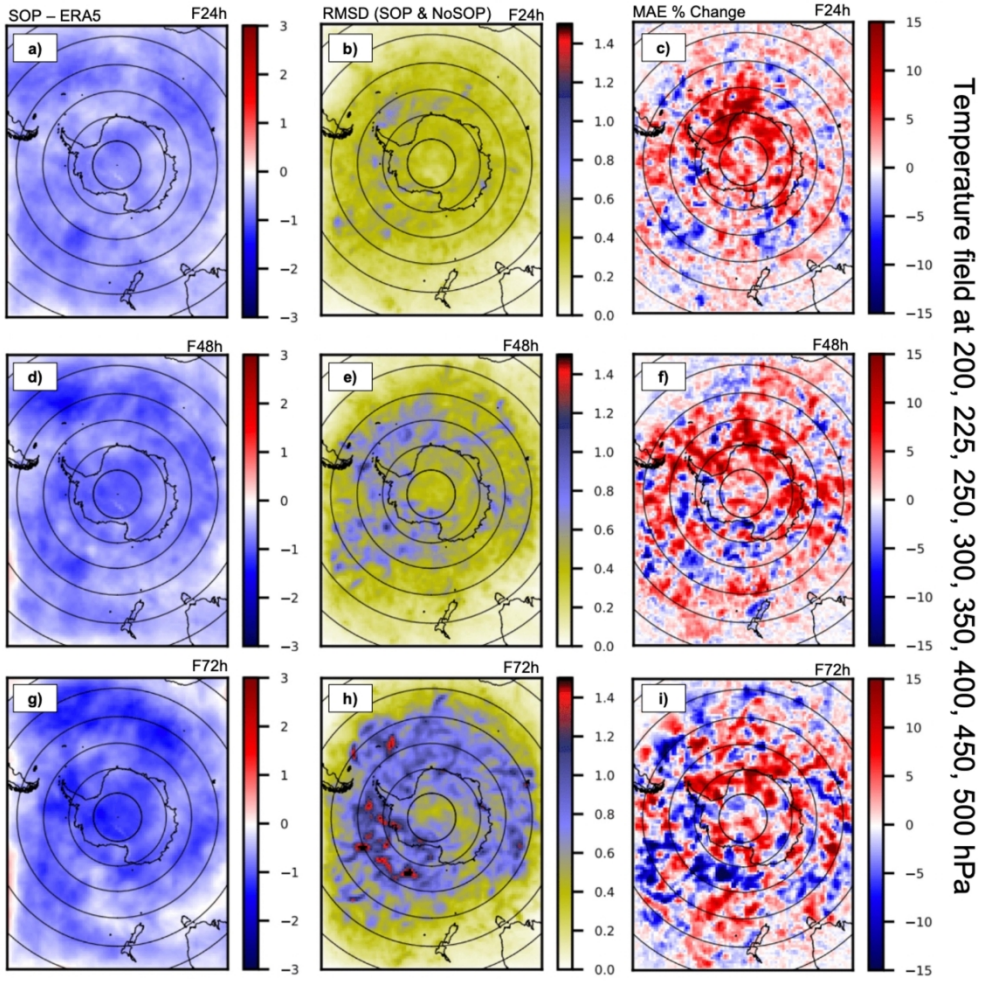

Figure S5. Temperature comparison among SOP, NoSOP and ERA5 vertically averaged for pressure levels from 500 to 200 hPa during the forecast period, at forecast hour 24, 48 and 72 (1-17 January 2019). a), d), and g) are temperature difference plots between SOP and ERA5 at 3 different forecast times; b), e), and h) are the root mean square of the difference between SOP and NoSOP at 3 different forecast times; c), f), and i) temperature mean absolute error (MAE) difference (ERA5 is used as benchmark) between NoSOP and SOP at 3 different forecast times.

219x215mm (300 x 300 DPI)

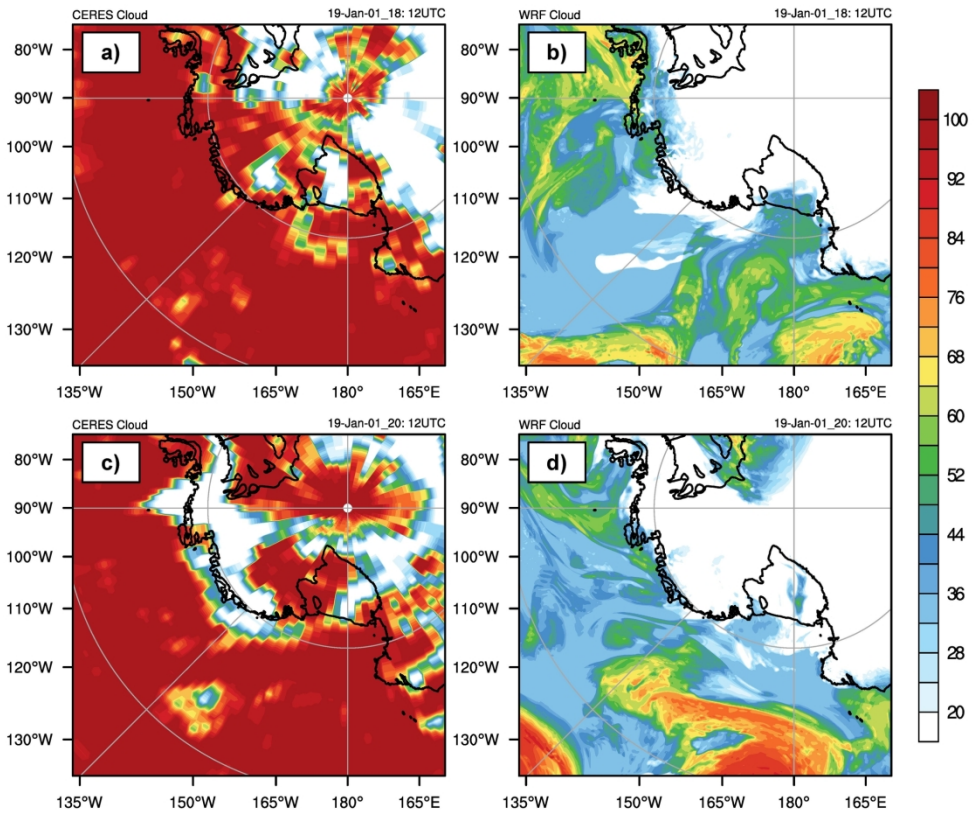

Figure S6. Total cloud cover from CERES data and SOP forecast at 1200UTC 18 January and at 1200UTC 20 January 2019.

192x158mm (300 x 300 DPI)