

Response to reviews

Review n°2 by Jonathan Wille

Dear Jonathan Wille,

Thank you very much for your careful review of our manuscript. Please find herebelow our responses to your comments:

There are quite a few papers that assess boundary layer climatology at one or a couple radiosonde sites at coastal stations around Antarctica, but never a full utilization and comparison. This paper offers the first comprehensive low troposphere climatology of the Antarctic coastal regions along with an in-depth analysis of reanalyses and Polar-WRF. The comparison between ERA-Interim and ERA40 provides a helpful guide for all future research on Antarctic atmospheric science when transitioning to the higher resolution ERA40. The analysis of the AMPS Polar-WRF deserves a separate paper given the extensiveness of the model assessment. This paper alluded to weaknesses in the Polar-WRF that have been noticed in various locations around Antarctica, but this paper demonstrates that the boundary layer issues in regard to the depth and strength of the katabatic flow are an Antarctic-wide problem. This will provide a useful tool for Antarctic weather forecasters who adjust their aviation forecast according to known Polar-WRF biases. In addition, the analysis of the observed and simulate boundary layer provides good insight to those who would like to examine the coastal boundary layer in long-term climate simulations.

I made some specific comments about details I found compelling Section 2.1 A very well detailed section with an in-depth explanation of station geography and a diligent description of the quality control processes.

Section 2.4. I appreciate the explanation for choosing relative humidity.

Section 3.2.1 I noticed Polar-WRF overestimated the katabatic winds at the Alexander Tall Tower so it's very interesting to see this trend continue across Antarctica. Also the difference in reanalysis performance from not assimilating the Princess Elizabeth data is intriguing.

Section 4.1 I expected the radiosondes from Halley and Neumayer to be representative of a larger footprint than like McMurdo, but it is really impressive and surprising to see just how homogenous the coastal Antarctic climate really is.

The manuscript is clearly organized, and the reader should have no problem finding the specific information they are interested in (i.e. Observed climatology, Polar-WRF performance). The figures are easy to read while the methodology is sound. I find the paper is nearly ready for publication after some technical corrections are made in regard to grammar.

Thanks a lot for these encouraging comments and for supporting the publication (after corrections) of our paper.

Major Points

1. I would like to see more of an explanation for the motivation of this research in the introduction and some comments about the applicability of the results to climate research and weather forecasting in the conclusion. The literature review is extensive, but the introduction could benefit from a couple sentences stating what knowledge gaps are to be filled and who could benefit from this research. And the conclusion summarizes the main results of the research well, but could use again a couple sentences describing future direction and how your results could benefit the scientific and weather forecast community.

Thank you for raising this point.

As we document here a 8-year climatology and as we evaluate the statistics in reanalyses and Polar simulations over this 8-year period, we think that our results could primarily benefit the climate modelers community.

That's why we have added the following sentence in the introduction?:

'Nonetheless, little is known about the spatial and temporal variability of the fine vertical structure of the temperature, humidity and wind over the coastal margins of Antarctica. Moreover, although the lower-tropospheric dynamics in this region is critical for the global climate, its representation by state-of-the-art climate models and atmospheric reanalyses has not been studied hitherto.'

and the following one in the conclusion:

'Overall, the 8-year radiosoundings-based climatology and the thorough evaluation of reanalyses presented in this article may be relevant for future climate models evaluation in this extremely important region of the Earth where intense air mass exchanges between polar and mid-latitudes occur and where atmosphere-ocean interactions control globally-relevant processes such as sea ice and bottom water formation.'

2. Figure 2 appears to be rotated in the wrong direction. Please discuss with the editor for a solution.

Thank you for noticing this. The figure has been rotated.

Minor Points

1. I don't mean to self-advertise, but I recommend referring to the boundary layer case studies using SUMO UAV measurements compared against Polar-WRF. I examined

the performance of the Polar-WRF up to 800 m next to the Alexander Tall Tower! Which is near the Ross Sea. The Polar-WRF wind speed and relative humidity at radiosonde sites affected by the katabatic wind were similar to what I noticed in this study. Wille, J.D., D.H. Bromwich, J.J. Cassano, M.A. Nigro, M.E. Mateling, and M.A. Lazzara, 2017: Evaluation of the AMPS Boundary Layer Simulations on the Ross Ice Shelf, Antarctica, with Unmanned Aircraft Observations. J. Appl. Meteor. Climatol., 56, 2239–2258, <https://doi.org/10.1175/JAMC-D-16-0339.1>.

Thanks a lot for this pertinent reference. It has been added in the Introduction in the following paragraph:

‘A significant body of literature has focused on the near-surface atmosphere in Antarctica (Parish and Bromwich, 2007; Nicolas and Bromwich, 2014; Bracegirdle and Marshall, 2012) and its representation in meteorological reanalyses and models. In particular Wille et al. (2017) have highlighted an excessive wind speed and a dry bias in the boundary-layer over the Ross ice shelf in the Antarctic Mesoscale Prediction System (AMPS, <http://www2.mmm.ucar.edu/rt/amps>) which is based on simulations with the polar version of the Weather Research Forecast model (Polar WRF). Sanz Rodrigo et al. (2013) have further stressed that the near surface wind speed in escarpment areas are strongly underestimated in ERA40 and ERA-Interim reanalyses and to a lesser extent in model simulations with RACMO. The simulations with the EC-Earth global climate model in Bintanja et al. (2014) and in the LMDZ general circulation model in Vignon et al. (2018) concur with these conclusions, especially at low horizontal resolutions due to the coarse representation of terrain slopes.’

2. Please change “Mc Murdo” to “McMurdo” throughout the manuscript.

This has been corrected throughout the manuscript and in the figures.

3. Please find the attached document that contains my corrections for grammar and sentence structure.

Thank you very much for all your grammatical corrections and suggestions to improve the text. All your comments and corrections were taken into accounts.

We thank you again for your review that significantly improved the quality of our manuscript,

The authors of “*On the fine scale vertical structure of the low troposphere over the coastal margins of East Antarctica*”