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Long term trends in winds in the mesosphere and lower thermosphere over Rothera (67°S, 68°W) from radar observations and WACCM-X

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The Mesosphere and Lower Thermosphere (MLT), at 80-100 km altitude, is critical in the coupling of the middle and upper atmosphere and determining momentum and energy transfer between these two regions. However, despite its importance, General Circulation Models (GCMs) have only recently been extended to the MLT region and remain poorly constrained.

We use a long term meteor radar dataset from Rothera on the Antarctic Peninsula to test the eXtended Whole Atmosphere Community Climate Model (WACCM-X). This radar has been running continuously since 2005, resulting in a uniquely long, consistent measure of the winds in the MLT that we can use to investigate long term variability. We find that although some characteristic features are represented well in WACCM-X, the model exhibits considerable biases. In particular, the observations show a ~10m/s eastward wind in Antarctic winter whereas the model predicts winds of the same magnitude but opposite direction. We propose that this difference is due to the lack of secondary gravity wave modelling in WACCM-X.

We also find interannual variability in both the observations and the model. In order to understand these differences, we further investigate the role of external climate processes in driving the winds in this region. Using a linear regression method, we quantify how the (observed and modelled) winds in the Antarctic MLT respond to Solar activity, the El Nino Southern Oscillation (ENSO), the Quasi-Biennial Oscillation (QBO) and the Southern Annular Mode (SAM). For some indices we find good agreement between the observations and model results while for others we see important differences.