



Comparisons of Google Loon observations and reanalyses

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Observations of the southern hemisphere lower stratosphere made by long duration super pressure balloons launched in 2014 as part of Google [X] Project Loon are used to assess the quality of the NCEP Climate Forecast System version 2 analysis, the ECMWF ERA-Interim reanalysis, the NASA Modern Era Retrospective-Analysis for Research and Applications (MERRA), and the recently released MERRA version 2. Using balloon GPS data the wind speeds are derived and compared with the interpolated reanalyses datasets. Each reanalysis is found to accurately describe the winds, with net zonal (meridional) biases of up to 0.37 (0.07) m/s and latitude dependent standard deviations ranging between 2.5 and 3.5 m/s . The balloon flights are also used to examine the quality of trajectories derived from reanalyses winds. We find that MERRA-2 produces the most accurate trajectories, with a mean (median) 5 day balloon–reanalysis trajectory separation of 621 (324) km , showing significant improvements over version 1 and slightly outperforming ERA-Interim. An attempted is made to characterize the observed errors in the reanalyses and provide a method for generating an ensemble of possible trajectories which could be used to estimate the expected trajectory accuracy. A side result of this work is that initial analysis suggests the contribution to the separation that results from the observed high frequency variability in wind speeds, which is often attributed to gravity waves, does not have a significant effect on the accuracy of the resulting trajectories.