An Antarctic assessment of surface and mid-tropospheric pressure and temperature in the latest generation of global atmospheric re-analysis datasets

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Re-analysis datasets are a very important source of atmospheric data over Antarctica due to the sparsely distributed network of observation stations. Five re-analysis datasets have been released recently, but as yet have not been comprehensively assessed at high southern latitudes. They are: 20th Century Reanalysis V2 (20CV2), NCEP Climate Forecast System Reanalysis (CFSR), ERA-INTERIM (ERAINT), Japanese 25-year Reanalysis (JRA25) and NASA Modern Era Retrospective-Analysis for Research and Applications (MERRA). The accuracy of these re-analyses in reproducing observed climatological mean sea-level pressure (MSLP), 500 hPa geopotential height (H500), surface air temperature (SAT) and 500 hPa temperature (T500) is assessed for the period 1979 through 2008. The re-analyses were compared with available in-situ data from surface weather stations and radiosondes. For near-coastal locations CFSR, ERAINT and MERRA are all of similar accuracy for all four variables. JRA-25 is less accurate for the surface variables, which is possibly due to its lower horizontal resolution. 20CV2 is clearly the least accurate in all variables since it is poorly constrained by the sparse network of observations stations over Antarctica. All the re-analyses consistently give cold biases along the coastline of East Antarctica in both summer and winter, which is associated smoothed orography. Over the interior of Antarctica ERAINT is clearly the most accurate in terms of summer SAT. The other re-analyses show large positive SAT biases in summer (approximately 10oC). The accuracy of CFSR, ERAINT and MERRA is broadly similar to that of ERA-40, which is generally close to the observational instrumental error. One exception is that these newer re-analysis generally show smaller SAT biases in regions of steep orography, which is presumably a consequence of their higher horizontal resolution.