

Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04912, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04912
EGU General Assembly 2008
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Consistency of the upper-air temperature climate record observed by satellites, radiosondes and reanalyses in the southern hemisphere

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This study aims to examine the variability in upper-air temperature in the Southern hemisphere and the consistency of the various datasets available. The work performed was also motivated by the wish to determine whether these datasets can be used to observe coupling between various layers of the atmosphere, particularly stratosphere/troposphere coupling. The upper-air datasets used in this analysis are the brightness temperature data derived from the Microwave Sounding Unit/ Advanced Microwave Sounding Unit (MSU/AMSU) observations produced by the University of Alabama Huntsville (UAH) and the Remote Sensing Systems (RRS) groups. These records span the period from 1978 to the present. The radiosonde climate records utilised in this study are the HadAT2 and RATPAC archives. These datasets, use subsets of the global radiosonde network and span the period 1958 to the present. The NCEP/NCAR reanalyses temperature series are also examined. To determine whether the various datasets display consistent patterns the temperature trends derived from each dataset over the whole Southern hemisphere and at various specific locations associated with the launch sites of radiosondes, particularly those in Antarctica, are compared.

Initial analysis shows that comparison of the MSU/AMSU temperature trends at the four broad altitude ranges, defined by the satellites weighting functions, for the RSS and UAH datasets in general show good agreement over the majority of the Southern hemisphere. This is perhaps to be expected given the fact that only biases associated

with differences in the processing procedures used on the individual datasets, often termed structural uncertainties, can be anticipated to change the trends. However, at the regional scale significantly more variability is observed.

Comparison between the different radiosonde datasets shows slightly poorer, but nevertheless good correlation. Comparison of the trend from the measurements at 100hPa at each radiosonde station with the patterns from the MSU/AMSU Lower Stratosphere retrievals show broad agreement. Comparison of the trend from the measurements at 500hPa at each radiosonde station with the patterns from the MSU/AMSU Middle Troposphere retrievals also show good consistency, in particular the same annular structure is observed. However, little agreement between radiosonde and MSU/AMSU trends are observed over New Zealand and the majority of Antarctica. To further examine the potential inconsistency over the Antarctic, data from the SCAR READER dataset is also examined. The signal associated with the Southern Annular Mode is also determined in each dataset and used to examine how consistent this mode of variability is within the various datasets.