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Temperature trend estimates in the troposphere over Antarctica by use of analysis of the GPS radio occultation data

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Analyses of the Antarctic climate change during recent decades have demonstrated a positive continent-wide average near-surface temperature trend. Strong warming of the Antarctic Peninsula in contrast to slight cooling of the Antarctic continental interior in the last five decades has been emphasised [Turner et al. 2005]. Recently, it has been reported that significant warming of the Antarctic ice-sheet surface extends well beyond the Antarctic Peninsular to cover most of West Antarctica with a warming rate exceeding 0.1°C per decade over the past 50 years, and is strongest in winter and spring [Steig et al. 2009]. Assessments of atmospheric temperature trends have also found significant warming of the Antarctic winter troposphere. Analysing data from nine Antarctic radiosonde stations, it has been shown that regional midtropospheric temperatures have increased at a statistically significant rate of 0.5 to 0.7°C per decade over the past three decades – a major warming of the Antarctic winter troposphere that is larger than any previously identified regional tropospheric warming on Earth [Turner et al. 2006].

Analysis of climate change over the Polar Regions is particularly challenging due to the scarcity of observations from a small number of sparsely located weather stations. Obviously, data obtained by various satellite remote sensing techniques are invaluable in order to obtain spatially-complete distributions of near-surface and atmospheric temperature trends in high latitudes. For example, using the climate quality records of satellite Microwave Sounding Unit (MSU) observations, it has been shown that significant tropospheric warming prevails during Antarctic winters and springs, with the largest winter tropospheric warming of about 0.6°C per decade for 1979-2005 between 120°W and 180°W [Johanson and Fu 2007].

Recently, a new atmospheric observation technique, GPS radio occultation (RO), has been developed for acquiring the Earth's atmospheric characteristics. Latest research results have demonstrated the great potential of the new technique to global climate monitoring and numerical weather prediction. With the newly launched six FORMOSAT-3 LEO satellites in 2006, thousands of high–quality, globally-distributed daily vertical profiles of refractivity, temperature and moisture have been obtained [Liou et al. 2007]. It is anticipated that GPS RO technique will play an important role in meteorological studies because of the significantly increased amount of atmospheric observations and improved data processing methodology. In this study, we use GPS RO data and collocated radiosonde data from three Australian weather observation stations (Casey, Davis and Mawson) to evaluate impacts of different collocation criteria (specifically, 100, 200 and 300 km spatial buffers and 1, 2 and 3 hour temporal buffers). Spatial and temporal variations in troposhperic temperatures over Antarctica are also investigated using the GPS RO data. Detailed analysis of refractivity and temperature profiles is presented and seasonal temperature variations in the troposphere are discussed.

References

Johanson, C. M., and Q. Fu, 2007: Antarctic atmospheric temperature trend patterns from satellite observations. Geophys. Res. Lett. 34, L12703, doi:10.1029/2006GL029108.

Liou, Y.-A., A. G. Pavelyev, S. F. Liu, A. A. Pavelyev, N. Yen, C. Y. Huang, and C. J. Fong, 2007: FORMOSAT-3 GPS radio occultation mission: preliminary results. IEEE Trans. Geosci. Remote Sensing, 45(10), doi:10.1109/TGRS.2007.903365.

Steig, E. J., D. P. Schneider, S.D. Rutherford, M. M. Mann, J. C. Comiso, and D. T. Shindell, 2009: Warming of the Antarctic ice-sheet surface since the 1957 International Geophysical Year. Nature 457, 22 January 2009, doi: 10.1038/nature07669.

Turner, J., S.R. Colwell, G.J. Marshall, T.A. Lachlan-Cope, A.M. Carleton, P.D. Jones, V. Lagun, P.A. Reid, and S. Iagovkina, 2005: Antarctic climate change during the last 50 years. Int. J. Climatol. 25, 279-294.

Turner, J., T. A. Lachlan-Cope, S. Colwell, G. J. Marshall, and W. M. Connolley, 2006: Significant Warming of the Antarctic Winter Troposphere, Science 311, 1914, doi: 10.1126/science.1121652.